

Performance of Ad Hoc Networks using Omni-Directional Antennas with Interference Alignment

S.Vandana, T.Madhavi



Abstract: *The performance of Wireless ad hoc networks (WANET) using Omni-directional antenna node is improved by lightening the negative impact of interference. This article uses the concept of interference alignment to subsidise the interference effect and to increase the performance of networks nodes. The interference alignment produces synchronization among numerous transmitters with the common interference, so that it aligns at the receivers using easy interference cancellation techniques. The performance metrics throughput, packet loss and delay are improved by using the interference alignment in WANET with nodes using Omni - directional antenna.*

Key Words: *Omni - directional antenna, interference alignment, WANET.*

I. INTRODUCTION

Interference is a key destruction to successful communication of data in WANETs. Interference is created in any medium if numerous waves are combined together with the phase differences between the different waves remains constant over a period of time. In cellular systems, interference is produced once dissimilar ground stations distribute the equal carrier frequency because of frequency reuse. Interference alignment is an innovatory wireless communication approach to condense the interference effect. Ever since the interference alignment inception, researchers explored numerous ways to yield better performance. The role of maintaining channel state information at the transmitter, and the realistic behaviour of interference alignment in large networks make the use of it, more obvious. Interference alignment is linear precoding technique in which user data streams are separated in different transmit directions and effort to align time, frequency, or space interfering signals. The major initiative is to use the linear precoding and make the consumer synchronize their transmissions, so that the interference signal is positioned at each receiver in a condensed dimensional subspace. Our areas of interest include interference alignment performance in measured channels and examination of interference alignment with the existence of channel estimation error. Firstly the recent works in the field of interference are seen followed by the ways to reduce it. We also see the current trends in improving the performance of different types of antenna.

Revised Manuscript Received on December 30, 2019.

* Correspondence Author

S.Vandana*, Assistant Professor, Electronics and Instrumentation Department, VNR Vignana Jyothi Institute of Engineering and Technology, Hyderabad. Email: vandanasini@gmail.com

Dr.T.Madhavi, Professor, Electronics and Communication Department, GITAM Institute of Technology, Visakhapatnam. Email: m_tatineni@yahoo.com.

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](http://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

In the counterpart, we introduce the interference alignment while transferring the data to intended receivers using Omni-directional antenna improving the performance metrics Zheng in his paper introduces a basic interference pattern in a novel way which is in contrary to conventional methods. A secure platform in which interference is used effectively to block impending unauthorised users is referred [1].

Zhao reviewed iterative interference alignment and power control scheme to provide better frame error rate and bit error rate. He also proved that interference alignment will increase the throughput taking the reduction in bandwidth required for feedback[2].

Mohapatra in his work, investigated the possible ways for safe transmission of data over the two user Interference channel. His findings showed that a restricted rate of safe connection in a two user Interference channel between the transmitters will significantly increase the attainable rate for safe transmission[3]. Campolo in his study modelled adjacent channel interference to comprehend the undesirable situations on concurrent connections in Intelligent transport systems. The simulation result evidently showed that a little more delay and considerably small reliability will be observed during ACI modelling [4].

Shokri developed a novel structure to quantify and contrast the correctness in wireless interference models. A recent metric to measure the correctness of interference model is designed. This recent move formulates the potential to measure the correctness of different interference models [5].

In directional antennas the throughput capability in arbitrary system and the transport capability in random networks is studied [6]. It was found that random directional system can extent exclusive of lobe antenna gain. Further, it was noticed that the number of beams has to be increased substantially as the number of nodes enhance.

The throughput capacity of a WANET is significantly improved and transmission delay is condensed by utilising directional antennas in Wireless ad hoc networks which is produced by multi- hop communications. The enhancement in throughput of a directional antenna, mainly leads to the decrease in interference and focus the signals in a particular direction[7]. Zhou in his paper, used the concept of shadowing and beamforming and an analytical model is proposed to examine the consequences. Nodes capable of multiple antennas are designed with random and center-directed beamforming schemes [8]. Sundaresan showed random heterogeneous networks endow with considerable performance in MANETs. In this context, an first-cut MAC routing protocol with increased network performance is proposed for random heterogeneous smart antenna networks [9].

The radio interference in Ad hoc wireless networks can be decreased by utilising a directional antenna .The throughput capacity of different antenna modes is studied by Su Yi [10]. In WANETs, the directional antennas is used during the harmonization of transmission power and antenna directivity will be able to obtain the benefit of reducing interference and multi hop relay burden. The radio interference is reduced by the use of directional antenna in the perspective of WANETs .

. In WANETs, the capability to afford an essential break through and a sophisticated inspection of this capability concentrating on utilizing the longer range and also reducing interference of a Beamforming antenna is examined [11].A number of extensions to a existing system was considered and also the impact of extension obtained through simulation is studied.

Wang proposed an iris antenna model to provide better accuracy even in complex conditions. This analytical framework was evaluated through wide range of simulations and shown that the network connectivity is truthful and iris antenna model presents an enhanced estimation to rational directional antennas [12].

Ramanathan explained the advancement of a real-life using switched directional antennas in ad hoc network test-bed using directional antennas. UDAAN is an cooperative suite of modular network- and medium access control (MAC)-layer mechanisms for adaptive control of steered or switched antenna systems in an ad hoc network which produced a very considerable development in throughput over Omni-directional communications[13].

Dai proposed a new broadcast protocol known as DSP(directional self-pruning) using directional antennas in ad hoc networks. DSP is a non-trivial simplification of an accessible localized deterministic broadcast protocol using Omni-directional antennas. It was shown in DSP that estimated quantity of onward nodes is within a steady factor of the smallest value and the transmission cost was reduced by 30%–65% using DSP[14].

Islam proposed a suburban adhoc network with wireless links in which nodes are immobile. This paper investigated the routing performances using three antenna schemes and emphasized the interference reduction capability of directional antennas .The affect of using Omni-directional antennas on routing performance using overlapping frequency channels surrounded by each other's transmission ranges is also discussed[15].

Dong, in his paper communicate in mobile ad-hoc network through wireless links using directional antennas considering a collection of UAVs. Maximizing the throughput and minimizing the end-to-end delay is the design goal. In this aspect, a new MAC protocol for a network of UAVs including directional antennas is proposed and the results show enhancement in performance with end-to-end delay and throughput also[16].

The main objective of our work is to propose a method integrating the Omni directional antenna with interference alignment .Since conventional techniques are lacking in introducing the alignment, a routing method is proposed and compare with traditional algorithm the performance metrics.

II. METHODOLOGY

The existing work is selected such that the data transmission from source to destination has to be done securely through Routing in any network; it be wired or wireless. Routing is the method of selecting the path for transfer of information from a source to a destination. Data transmission between transmitter and receiver should be inside the communication range of the antenna. If direct transmission is chosen there will not be any intermediate nodes existing in between the transmitter and receiver for sharing of data.

The compound multiple access channel is utilized by the relay-eavesdropper channel, where transmitter/relay to receiver is considered as the initial mac and transmitter/relay to hearer is selected as the afterward. R1 is the codeword rate of the transmitter, and R2 is the codeword rate of the relay. If the relay doesn't broadcast, the right secrecy rate is zero for the input distribution since $R1(A) < R1(B)$. Further, if the transmitter and the relay synchronize their communications, an equivocation rate (R_e) is achieved which is strictly greater than zero. A positive perfect secrecy rate can still be preserved in the non existence of relay by working at point A. By moving to the operating point B, it is probable to get a higher secrecy rate. It is a multi relay transmission which gives more secure connection but not viable when eavesdropper attacks.

Interference alignment permits some synchronization among transmitter and receiver client pairs. With interference alignment, it is probable to propose the transmit approach such that each receiver will have the interference alignment. With a sum rate perception, from K user pairs, an interference alignment approach achieves an order of $K/2$ interference free links in sum throughput. Essentially the system capacity is successfully shared equally by each user. The net sum capability will amplify the number of active user pairs in contrasting to conventional interference channel. Viewing that coordination among users this result has particular significance in cellular and ad hoc networks, which help to prevail the restrictive effects of interference produced by synchronized transmission.

The performance of different WANET routing protocols was measured by a number of quantitative metrics. RFC2501 illustrates metrics that can be used for evaluation. To analyze whether interference alignment has improved the performance, three performance metrics Throughput, Delay and Packet loss are evaluated.

III. RESULTS AND ANALYSIS

The performance of the Omni- directional antenna was measured with the help of network simulator NS2. The topology comprises of 35 nodes in a 500m × 500m grid. The communication range used is 100 m. The number of nodes considered is 35. Throughput, measuring the packet loss at the receiver and average delay are the primary metrics of interest. The transmitter and receiver are chosen at random. AODV is utilized as the routing protocol. Every transmitter produces traffic at an extremely high rate to stay back-logged for the complete simulation duration. The simulations are run for 60 s with variable step size.

Throughput is the proportion of the total amount of data that is transmitted from the source to destination to the time taken for the last packet of the data to reach the receiver.

It measures of effectiveness of a routing protocol. Based on the simulation results, shown in Fig2. The throughput value of existing method gradually increases in the beginning but does not maintain its value when the time increases. The throughput value of proposed method increases at lower pause time and falls as the time increases and maintain its value as the time increases. Hence, the introduction of interference alignment in Omni-antennas shows better performance with respect to throughput

Packet loss measures the loss rate of the data from transmitter to receiver it characterizes both the exactness

and accuracy of ad hoc routing protocols. The packet loss of existing method is less when compared to other protocols but from the simulation result in Fig3. it was clear that the proposed method has less packet loss when compared with existing method.

The Average delay is a measure of how long it takes for packet to reach from transmitter to receiver and represents the reliability of the routing protocol .Even though the AODV does not have lower average delay, the proposed method shows a lower average delay throughout the simulation as shown in Fig4

Delay(Sec)			Through Put(bps)			Packet Loss		
Time(Sec)	Delay22.tr	Delay02.tr	Time(Sec)	Out22.tr	Out 02.tr	Time(Sec)	Lost22.tr	Lost02.tr
0	0	0	0	0.0	0.0	0	0	0
5	0.06	0	5	89376.0	0	5	0	0
10	0.06	0.02	10	89376.0	170240.0	10	0	0
15	0.05	2.19	15	89376.0	8512.0	15	0	56
20	0.05	0.05	20	76608.0	72352.0	20	0	42
25	0.05	0.09	25	85120.0	38304.0	25	0	0
30	0.05	0.26	30	89376.0	29792.0	30	0	0
35	0.05	0.14	35	80864.0	34048.0	35	0	0
40	0.05	0	40	80864.0	0.0	40	0	0
45	0.05	0.04	45	76608.0	106400.0	45	0	0
50	0.05	0.04	50	80864.0	89376.0	50	0	0
55	0.05	0.05	55	80864.0	80864.0	55	0	0
59.5	0.05	0	59.5	0.0	0.0	59.5	0	0

Fig1: The Simulation values of Delay, Through put and Packet loss in NS2 trace files.

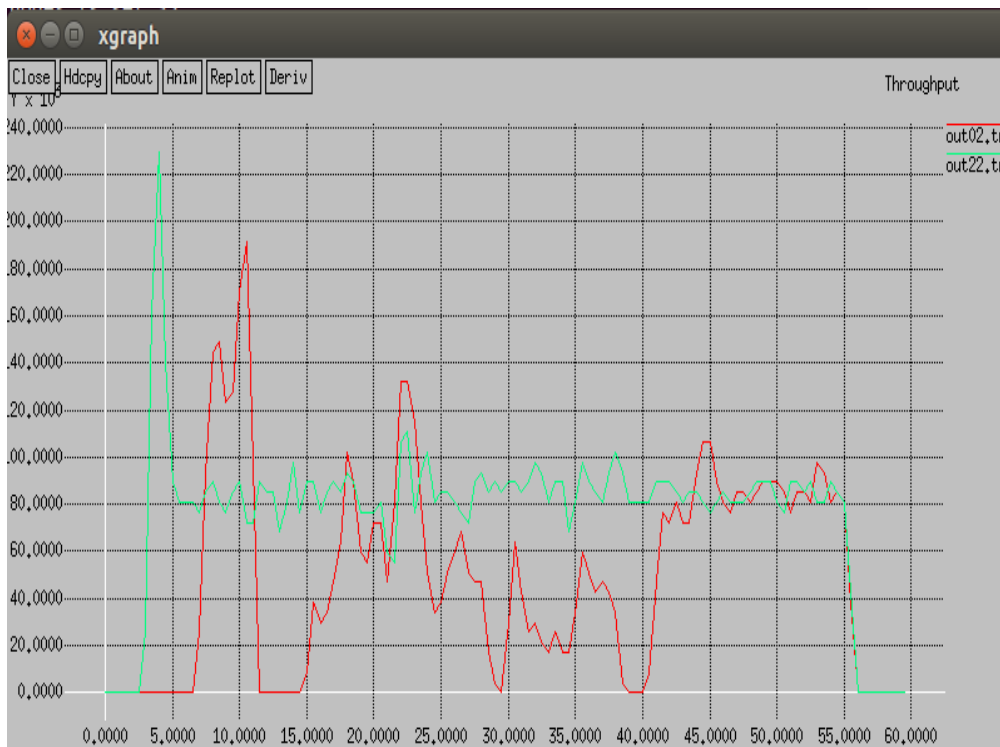


Fig2. Throughput comparison between Existing Method with Proposed method

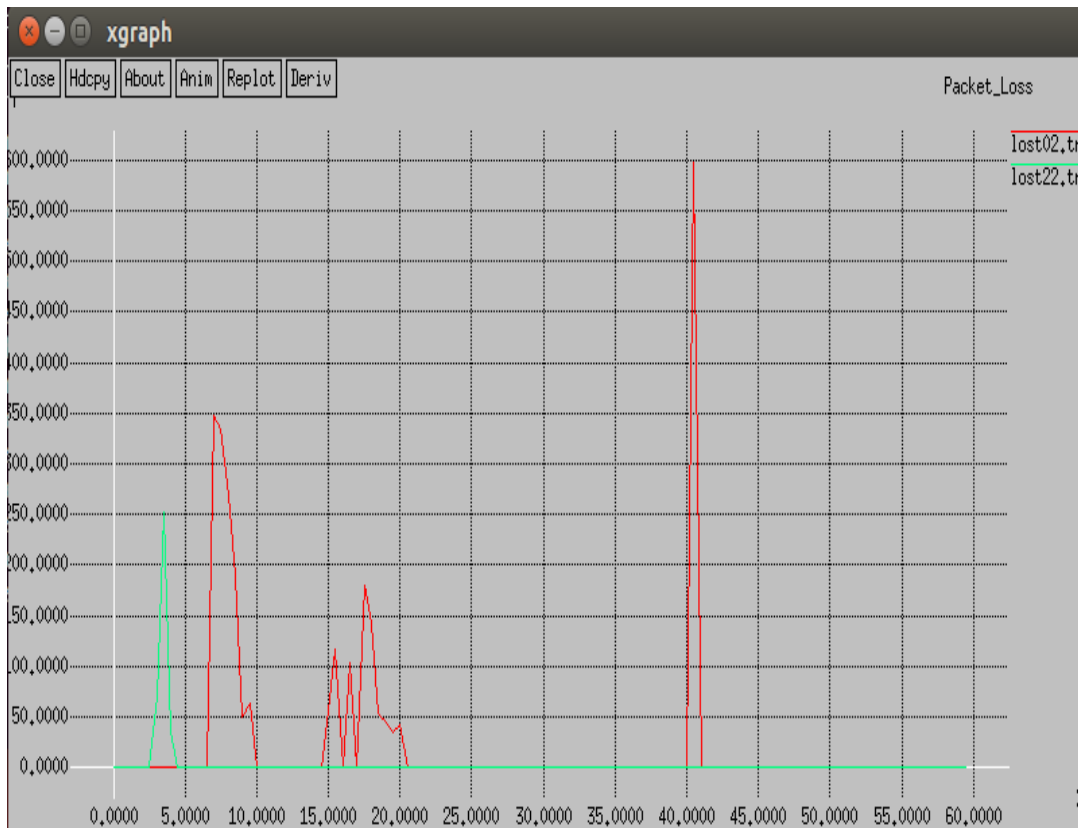


Fig3.PacketLoss comparison between Existing Method with Proposed method.

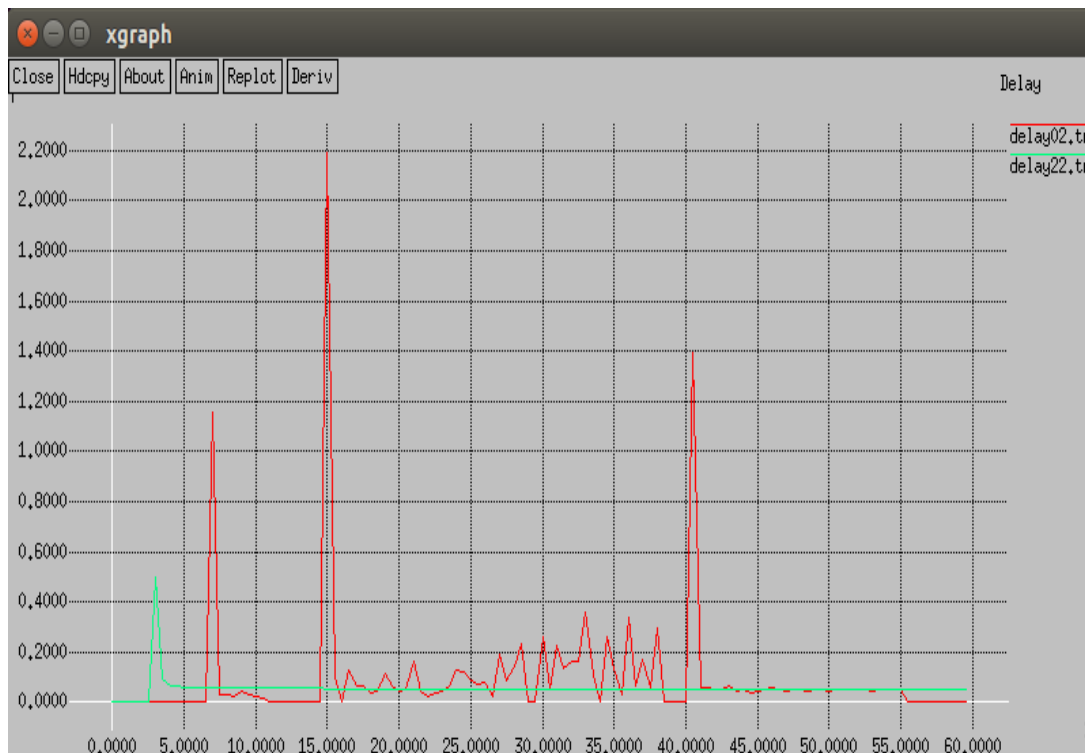


Fig4:.Delay comparison between Existing Method with Proposed method

IV. CONCLUSION

This comparison has given a method to alleviate the negative impact of interference on signals at intended receivers with the introduction of interference alignment. Additionally performance of WANETs by considering nodes with Omni-directional antennas with parameters throughput, packet loss and average delay are evaluated through the simulations. Different studies show that there

won't be any protocol which will depicts better result in all the aspects. Hence proposed method improves the performance in terms of packet loss and average delay effectively

REFERENCES

1. G. Zheng, I. Krikidis, C. Masouros, and S. Timotheou, "Rethinking the Role of Interference in Wireless Networks," pp. 1–14.
2. N. Zhao, F. R. Yu, S. Member, M. Jin, Q. Yan, and V. C. M. Leung, "Interference Alignment and its Applications: A Survey , Research Issues and Challenges," no. c, pp. 1–27, 2016.
3. P. Mohapatra, C. R. Murthy, and S. Member, "On the Capacity of the Two-User Symmetric Interference Channel With Transmitter Cooperation and Secrecy Constraints," pp. 1–26, 2016.
4. C. Campolo, C. Sommer, F. Dressler, and A. Molinaro, "On the Impact of Adjacent Channel Interference in Multi-Channel VANETs," 2016.
5. H. Shokri-ghadikolaie, C. Fischione, and E. Modiano, "On the Accuracy of Interference Models in Wireless Communications."
6. P. Li, C. Zhang, and Y. Fang, "The capacity of wireless ad hoc networks using directional antennas," IEEE Trans. Mob. Comput., vol. 10, no. 10, pp. 1374–1387, 2011.
7. H. N. Dai and Q. Zhao, "On the delay reduction of wireless ad hoc networks with directional antennas," Eurasip J. Wirel. Commun. Netw., vol. 2015, no. 1, 2015.
8. X. Zhou, S. Durrani, and H. M. Jones, "Connectivity analysis of wireless ad hoc networks with beamforming," IEEE Trans. Veh. Technol., vol. 58, no. 9, pp. 5247–5257, 2009.
9. K. Sundaresan and R. Sivakumar, "Ad hoc networks with heterogeneous smart antennas: Performance analysis and protocols," Wirel. Commun. Mob. Comput., vol. 6, no. 7, pp. 893–916, 2006.
10. S. Yi, Y. Pei, and S. Kalyanaraman, "On the capacity improvement of ad hoc wireless networks using directional antennas," Proc. Int. Symp. Mob. Ad Hoc Netw. Comput., pp. 108–116, 2003.
11. R. Ramanathan, "On the performance of ad hoc networks with beamforming antennas," Proc. 2001 ACM Int. Symp. Mob. Ad Hoc Netw. Comput. MobiHoc 2001, pp. 95–105, 2001.
12. Q. Wang, H. N. Dai, Z. Zheng, M. Imran, and A. V. Vasilakos, "On connectivity of wireless sensor networks with directional antennas," Sensors (Switzerland), vol. 17, no. 1, pp. 1–22, 2017.
13. R. Ramanathan, J. Redi, C. Santivanez, D. Wiggins, and S. Polit, "Ad hoc networking with directional antennas: A complete system solution," 2004 IEEE Wirel. Commun. Netw. Conf. WCNC 2004, vol. 1, no. 3, pp. 375–380, 2004.
14. F. Dai and J. Wu, "Efficient broadcasting in ad hoc networks using directional antennas," Lect. Notes Comput. Sci., vol. 3462, pp. 499–510, 2005.
15. M. M. Islam, R. Pose, and C. Kopp, "Multiple directional antennas in suburban ad-hoc networks," Int. Conf. Inf. Technol. Coding Comput. ITCC, vol. 2, pp. 385–389, 2004.
16. A. I. Alshbatat and L. Dong, "Performance Analysis of Mobile Ad Hoc Unmanned Aerial Vehicle Communication Networks with Directional Antennas," Int. J. Aerosp. Eng., vol. 2010, pp. 1–14, 2010.
17. W. C. Ao and K. C. Chen, "Broadcast transmission capacity of heterogeneous wireless ad hoc networks with secrecy outage constraints," GLOBECOM - IEEE Glob. Telecommun. Conf., pp. 0–4, 2011.
18. M.-H. Guo, H.-T. Liaw, D.-J. Deng, and H.-C. Chao, "Cluster-based secure communication mechanism in wireless ad hoc networks," IET Inf. Secur., vol. 4, no. 4, p. 352, 2010.
19. Y. Xu, J. Liu, Y. Shen, X. Jiang, and T. Taleb, "Security/QoS-aware route selection in multi-hop wireless ad hoc networks," 2016 IEEE Int. Conf. Commun., pp. 1–6, 2016.
20. W. Yajun et al., "An Anti-Eavesdrop Transmissionscheduling scheme based on maximizing secrecy outage probability in Wireless ad hoc Networks.China Communications.Jan 2016

Adhoc Networks and Embedded Systems. She is a life time member in ISOI and she had publications in various International Journals.



Dr.T.Madhavi did her Bachelors degree in Electronics and Communication Engineering . She has 20 years of teaching experience and presently working as an Professor in Electronics and Communication Department in GITAM Institute of Engineering And Technology at Vishakapatnam.

Her areas of research include Wireless Adhoc Networks and Embedded Systems. She had publications in various national and International Journals

AUTHOR'S PROFILE



S.Vandana did her Bachelors degree in Electronics and Instrumentation Engineering from Sir C.R.Reddy Engineering College, Eluru and obtained her Masters degree in Embedded Systems from Sri Vasavi Engineering College, Tadepalligudem. She has 10 years of teaching experience and presently

working as an Assistant Professor in Electronics and Instrumentation Department in VNR VIGNANA JYOTHI Institute of Engineering And Technology at Hyderabad. Her areas of research include Wireless