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Evaluation of QoS Metrics in Ad-Hoc Wireless Sensor Networks using Zigbee

K. Mor[1*], S. Kumar[2]

[1*]ECE Department, University Institute of Engineering and Technology, Rohtak, India
[2]ECE Department, University Institute of Engineering and Technology, Rohtak, India

Corresponding Author: morkirti7@gmail.com

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Abstract— Ad-hoc wireless sensor Networks (AWSN) has become a worldwide thought for the investigators and researchers for last few years. Ad-hoc networks are acts as decentralized type networks therefore it is used for a large number of applications like sensing, computing and processing techniques. In this paper we have used Zigbee application to make wireless connection with other devices. However some issues are associated with usage of ZigBee based Ad-hoc Wireless Sensor Networks including reduction in lifetime of nodes and Quality of services. Sensor nodes works on battery power and it is limited for each node; hence Zigbee based data routing and transferring to the base station are very important. In this paper, design network model has been evaluated by using various parametric factors including average End to End Delay, Throughput, Jitter and Total Packets Received with the help of AODV and DSR Routing Protocols. Latest version of Qualnet simulator has been used in this paper for simulation.

Keywords— Dynamic Manet on Demand (DYMO), Quality of services (QOS), Route Request (RREQ), Route Reply (RREP) packet.

I. INTRODUCTION

A wireless sensor network consists of multiple numbers of nodes which are used for sensing various parameters like temperature, speed, humidity etc. Two categories in which wireless networks have been categorized are (i) Infrastructure wireless networks (ii) Infrastructure-less wireless networks. Infrastructure wireless networks use an access point for transferring data hence it is a wired network. On the other hand, Infrastructure-less wireless networks also called Ad-hoc networks being a wireless service does not require any access points. The network devices are connected directly with each other. Contribution of each node in routing is to ascend the data to other nodes. They are also called peer to peer networks. On the basis of network connectivity the determination of nodes is dynamically made. The main problem with Ad-hoc networks is energy consumption as the nodes are working on limited battery resources which are insufficient in real life applications [1]. This paper focuses on comparison of performance of Routing protocols- AODV and DSR to select the optimal path to reach at the destination node. It also enhances the lifetime of AWSN with respect to energy efficiency by comparing routing properties of AODV and DSR protocol. In this paper the various technological aspects which are associated with Routing Protocols and their literature Review are described in Section 2 and section 3 respectively.

II. AODV and DSR

AODV and DSR Routing protocols are used for Ad-hoc wireless sensor networks. Different mechanisms are used in these protocols due to which results varies in performance level. This paper compares DSR and AODV on the basis of various parametric factors aforementioned [2].

AODV: This protocol was developed in 1991 by Nokia Research Centre, the University of California, Santa Barbara and the University of Cincinnati. AODV routes only on demand basis. It works with both types of routings- unicast and multicast. It does not require a sequence of paths to reach the destination but uses a circulated approach and keeps following the neighboring nodes [3]. It also uses path discovery and path protection mechanism like DSR.

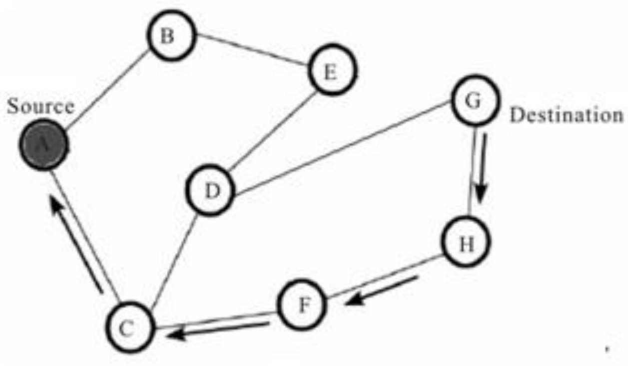


Figure1 Routing in AODV Protocol

The AODV develops a path using two routers one for route request and one for route reply which is shown in Fig 1. Routing path is being maintained by the router when it is used and if not maintained properly then there are possible chances of getting expired. AODV uses:

a) Route Request (RREQ) packet: broadcast to find the route.

b) Route Reply (RREP) packet: To Setup forward path.

c) Route Error (RERR): To Find Sending Packet is active or not.

DSR: DSR is demand-driven Protocol in which path is made on demand of device or computer. Though both AODV and DSR are Reactive routing Protocols however the only difference is that DSR depends on Source Routing. In source routing, all kinds of data are maintained at the mobile nodes. The DSR computes the routes and also updates them. Source routing is a technique in which the packet identifies the entire sequence of sender nodes through which the packet has to pass [4]. Packet sender lists the route in the packet header so that packets can be broadcasted to the next node, which can be identified at the address of the destination host. Routing process of DSR is described in Fig 2.

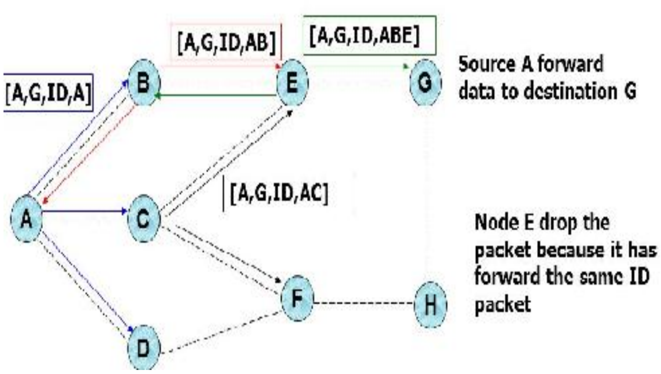


Figure 2 Routing in DSR

III. Related work

In [5], the authors compared two models on the basis of Grid and Star topology on Qualnet v6.1 simulator. In this paper total energy consumption is better for grid network and QOS is better for cluster networks. In [6], the authors describe Ad-hoc routing protocols on the basis of (i) Table driven, (ii) on demand (iii) Hybrid. It has been found that DSR perform better in terms of traffic load and throughput, whereas AODV and DYMO performs better in terms of end to end delay and average jitter.

In [7], the authors discussed four protocols AODV, DYMO, OLSR and IERP on the basis of mobility model using Qualnet 5.0.2 Simulator. It has been concluded that by using this model IERP gives best performance and OLSR gives worst in terms of Average Jitter, Throughput, End to End delay, Signals received with errors.

In [8] this paper, the authors described the wireless sensor nodes, QOS and its routing protocols. Routing protocols are classified into three categories which are flat, hierarchical and location based. Authors concluded that how to increase the life time of WSN.In this paper [9] author have described the applications of WSN for providing security in military, hospitals and weather departments. WSN as two motes (nodes) (i) Crossbow “MICAz” mote (ii) Berkeley’s “MICA2” mote. For enhancing security levels in WSN, the authors used two cryptographic schemes using schemes (i.) Asymmetric Key (ii.) Symmetric Key. After simulations the authors concluded that symmetric key schemes are better than asymmetric key schemes in providing greater degree of security while improving end to end delay. In this paper [10] author have described about the quality of service parameters for WSN based on IEEE 802.15.4 star topology .The main aim was to improve QOS by efficient use of network resources .The major constraints and parameters that limits the QOS support in WSNs are (i) Severe resource constraints (ii) Data redundancy (iii) scalability (iv) network dynamics packet criticality. The authors used AODV, DSR, DYMO routing protocols for evaluation of different traffic loads and concluded that DRS protocol outperforms AODV and DYMO.

In [11], the authors have described (i) Energy-Efficient PEGASIS-Based protocol (EEPB) (ii) PEGASIS with double cluster head (PDCH) protocol for evaluation of QOS in WSN. After performance evaluation, authors concluded that PDCH provides better performance than EEPB protocol. PDCH protocol provided optimum energy consumption, minimizing network overhead, increasing the network lifetime and load balance.

IV. COMPARITIVE STUDY OF AD-HOC ROUTING PROTOCOLS

Proactive Protocol [12]: Each node maintains one or more routing tables and their information is updated by nodes. If any changes takes place in the network than each node sends a broadcast message to the network.

Reactive protocol [13]: Here each node participates in network only on demand of network, hence it is also called demand based routing protocols. Examples are AODV and DSR.

Hybrid Protocols [14]: When Proactive and Reactive protocols are combined to makes group they form hybrid protocols. It minimizes the overhead of control message in proactive and decrease the latency problem in reactive routing protocols.

Table.1 Comparison of Ad-hoc Routing Protocols [15]

Comparison of Adhoc routing protocols Performance Constraints	Proactive	Reactive	Hybrid
Category	Table Driven types	On-Demand types	Hybrid types
Protocol Type	Link State protocol	Distance Vector protocol	Link Reversal protocol
Route maintained through	Routing Table	Routing Table	Routing Table
Loop Freedom	It has	It has	It has
Route Mechanism	Works on smooth level	Works on smooth level	Works on smooth level
Multiple Route	Don't	Don't	Do
Multitask Capability	It has	It has	It has not
Frequency of update transmission	Periodically and as needed	Periodically	Periodically and

V. Proposed design and simulation work

The protocol performance is analyzed using the Qualnet simulator version 7.3.1. In this paper we have used 25 nodes network within 1500m*1500m Area. The designed model scenario is shown at figure 6.

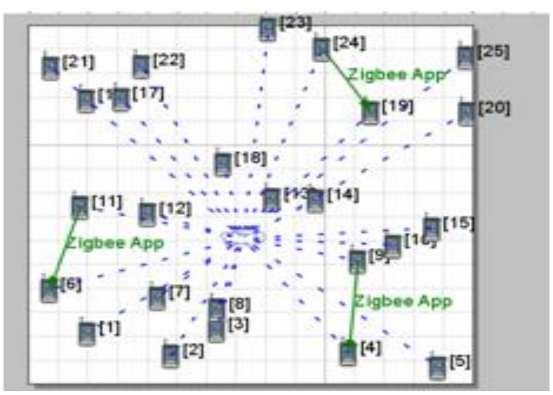


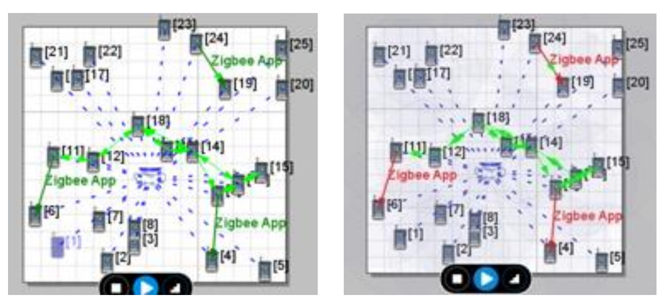
Figure 3 Scenario of 25 nodes network using Zigbee

The Routing Protocols which have been used are AODV and DSR. For traffic loads various Zigbee Applications are used at different nodes (6, 11),(4,9)(19,24). The modulation scheme which has been used is O-QPSK with linear battery model. The simulation parameters for the scenario in figure 6 are given at Table 2.

Table.2 Simulation Parameters

Parameter name	Parameter value
No. of nodes	25
Area	1500m*1500m
Routing protocol	AODV, DSR
Topology	Uniform
Physical and MAC layer	IEEE 802.15.4
Modulation Scheme	O-QPSK
Device Type	FFD
Radio type	802.15.4 radio
Application	Zigbee(6,11),(4,9)(19,24)
Battery Model	Linear
Items to send	500
Item size	64 bytes
Channel Frequency	2.4 GHz
End time	510
Antenna model	Omni directional

Performance evaluation of AODV and DSR is simulated below in Figure 4. In this scenario analysis we have used Zigbee applications with full function devices using 64 bytes Item size. In this model we have used Omni-directional Antenna with 2.4 GHz channel frequency.



(a.) AODV **(b.) DSR**

Figure 4 Scenario analysis of AODV and DSR

VI. RESULTS

The performance of two Routing Protocols – AODV and DSR is interpreted by using Qualnet Simulator. Their performance evaluation is carried out using four parameters which are End to End Delay, Throughput, Average jitter and

Total Received Packets. These parameters along with the obtained values are explained in a graphical manner.

Jitter: It is defined as the variation between the estimated entrance time and definite entrance time of the packet. The main causes of jitter in a network are delays and overcrowding. It causes a discontinuity in the synchronized accent stream. A jitter barrier is implemented which temporarily collects incoming packets to decrease the interrupt variation. The presentation of the average jitter (s) is different at different times of pause.

End to End delay: Time taken by a packet to reach from its source to destination is described in this Metrics including all possible delays due to buffering

1) path discovery latency,
2) queuing at the interface queue,
3) retransmission delays at the MAC
4) propagation and transfer times of data packets

$$delay = \frac{arrive\ time - send\ time}{no.of\ connection}$$

Comparison of Average jitter and Average End-to-End Delay for AODV and DSR is shown in figure 5 (a).

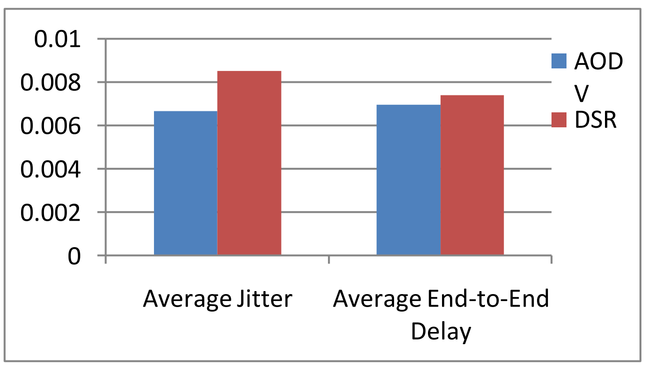


Figure 5 (a) Comparison of average jitter and Average End-to-End Delay for AODV and DSR

From the graphical results, DSR provides more jitter than AODV. The values of jitter obtained with DSR and AODV are 0.00853629 sec & 0.00667032 sec. Jitter length for DSR is greater hence its performance is poor as compared to AODV. The average end to end delay for AODV and DSR is 0.00697958 sec & 0.00740721 sec hence on the basis of end to end delay AODV gives better results than DSR.

Total Packets Received: It is defined as total number of successful received packets divided by total packets sent by the sender. The performance of AODV has the Greater Packet Delivery ratio as compared to DSR.

$$Total\ packets\ received = \frac{total\ no\ of\ packets\ received}{total\ no\ of\ packets\ send}$$

Throughput: Throughput is defined as the amount of data transmitted to destination from destination node per unit time. It is calculated in bits per second. Throughput of AODV is greater than DSR from above observation.

$$Throughput = \frac{no.of\ bytes\ received}{time\ of\ transmission}$$

The Comparison of Total Packets Received and Throughput for AODV and DSR is shown in figure 5 (b).

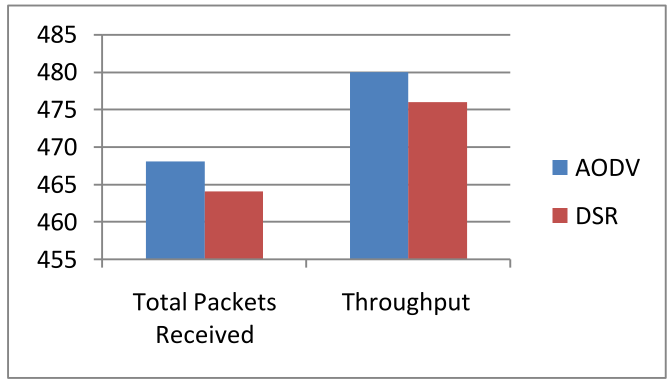


Fig.5 (b) Comparison of Total Packets Received and Throughput for AODV and DSR

From the graphical results, Total packets received for DSR and AODV is 464 and 468 packets respectively. The efficiency of AODV is much better than DSR hence it performs well. Total Throughput for DSR and AODV is 476 bits/sec and 480 bits/sec respectively. Throughput efficiency of AODV is better than DSR

Table.3. Result of various parameters

Routing Protocol	Average jitter(seconds)	End to End Delay(seconds)	Throughput (bits per seconds)	Total packets Received
AODV	0.00667	0.00697	480	468
DSR	0.00853	0.00740	476	464

In table 3, we have discussed results of various parameters like Throughput, Total Packets Received, Jitter and End to End delay.

VII. CONCLUSION

This paper provides comparative analysis of QOS metrics in ad-hoc wireless sensor networks using Zigbee. The performance evaluation of 25 nodes wireless sensor network is carried out on the basis of various parameters like End to End delay, Throughput, Average Jitter and Total received packets. From simulation results it is concluded that average jitter for DSR is 21.80 % greater than that of AODV. Whereas in terms of End to End delay AODV performs 5.67 % better than DSR. On the basis of Throughput and Total packets received AODV is better than DSR with 0.83 and 0.85 % respectively. On the basis aforementioned mathematical results, it can be concluded that AODV routing protocol is better than DSR and hence to enhance QoS in AWSN using Zigbee Application AODV can be preferred to DSR.

REFERNCES

[1]. M. Chandane, SG Bhirud, SV Bonde, "*Performance Analysis of IEEE 802.15.4*" International Journal of Computer Applications, Vol. 40, No.5, pp 23-29, 2012.

[2]. V Saxenal, D Rastogi, R Kumar, "*Challenge in Route Discovery Process of Dynamically Arranged Multitier Protocol in Wireless Network*" 5th International Conference on System Modeling & Advancement in Research Trends. , IEEE Conference ID: 39669, pp 183-185, 2016.

[3]. MK Singh, SN Thakur, "*Comparison of DSDV, DSR and ZRP Routing Protocols in MANETs. International Journal of Computer Applications*" ISSN 0975 – 8887, Volume 108 – No. 13, pp 10-12, 2014.

[4]. JJD Gifty JJD, K Sumathi, "ZigBee Wireless Sensor Network Simulation with Various Topologies" Online International Conference on Green Engineering and Technologies (IC-GET), 978-1-5090-4556-3/16/$31.00 ©2016 IEEE, 2016.

[5]. P. Charan, T. Usmani, R. Paulus, S.H. Saeed, "*Performance Evaluation of AODV Protocol for Energy Consumption and QoS in IEEE 802.15.4 Based Wireless Sensor Network Using QualNet Simulator" Wireless Sensor Network*, 8, http://dx.doi.org/10.4236/wsn.2016.88014, pp 166-175, 2016.

[6]. A. Narmada, P.S. Rao, "*Comparison of Routing Protocols for Zigbee WPANs Performance*" International journal of computer science issues (IJCSI), vol 8, ISSN: 1694-0814, pp. 394-402, 2011.

[7]. A. Goyal, S. Vijay, D.K. Jhariya, "*Simulation and Performance Analysis of Routing Protocols in Wireless Sensor Network using Qualnet*" International Journal of Computer Applications (0975 – 8887) vol 52-NO 2; pp. 47-50, 2011.

[8]. Ishita Chakraborty, Prodipto Das, "*Data Fusion in Wireless Sensor Network-A Survey*", International Journal of Scientific Research in Network Security and Communication, Vol.5, Issue.6, pp.9-15, 2017.

[9]. G. Singh, S. K. Dhanda, "*Performance Analysis of Security Schemes in Wireless Sensor Network*" International Journal of Advanced Research in Computer and Communication Engineering, ISSN: 2278-1021, Vol. 2, No 8, pp. 3217-3223, 2013.

[10]. D. Verma, A. kaur, "*Performance comparison of QoS based routing protocols MBRR, REAR and SPEED for wireless sensor networks*" International Journal of Research in Engineering and Technology (IJRET), Volume: 02, Issue: 09, ISSN: 2319-1163, pp. 272-278, 2013.

[11]. S. K. Kurmi, N.K. Saluja, S. Patel, "*Performance Analysis of Quality of Service Evaluation in IEEE 802.15.4 Wireless Sensor Networks*" International Journal of Engineering Sciences & Research Technology, ISSN: 2277-9655, pp 3516-3522, 2013.

[12]. S. Vhatkar, J. Rana, M. Atique, "*Performance Evaluation and QoS Analysis of EEPB and PDCH Routing Protocols in Wireless Sensor Networks*" IOSR Journal of Computer Engineering (IOSR-JCE), e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 17, Issue 5, Ver. IV (Sep. – Oct. 2015), PP 101-109, 2015.

[13]. S. Muthuramalingam, V.V. Ananth, M.S. Kumar, "*AN ENERGY-CONSERVING TOPOLOGY MAINTENANCE ALGORITHM IN MANETS*" 3rd International Conference on Eco-friendly Computing and Communication Systems, 2014.

[14]. S.K. Guha, P.Y. Nabhiraj, T.K. Bhaumik, C. Mallik, "Design and implementation of an IEEE 802.15.4 / Zigbee based Star Network for data Acquisition and Monitoring. Proceedings of PCaPAC2012, Kolkata, India, ISBN 978-3-95450-124-3, pp 160-162 , 2012.

[15]. B. Fan, "*Analysis on the Security Architecture of ZigBee Based on IEEE 802.15.4"* IEEE 13th International Symposium on Autonomous Decentralized Systems, DOI 10.1109/ISADS.2017.23, pp 241-246, 2017.

Authors Profile

Mrs. Kirti pursed Bachelor of Technology from N.C. Institute of Technology, Kurukshetra University in year 2016 and currently pursuing Master of Technology from University Institute of Engineering &Technology (UIET), MDU and Rohtak, India.

Col (Dr.) Suresh Kumar has served in Corps of Signals (Indian Army) After taking PMR, joined as teaching faculty in UIET, MDU Rohtak, in Department of ECE in October 2008.He did his B.Tech from CME Pune and MCTE Mhow in 1999 from JNU New Delhi in Electronics and Communication Engineering. He did his PhD. In ECE in 2011 on the title "CONTROL SPILL OVER OF TRANSMITTED POWER IN CDMA CELLULAR COMMUNICATION NETWORKS IN BORDER AREAS FOR DEFENCE FORCES". His area of specialization is wireless and Optical communication. He has guided 06 PhD. Thesis(04 awarded and 02 pursuing) and 24 M Tech students dissertations. He has published 85 papers in International Journals and international/national conf proceedings in India and abroad.