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Simulation and Performance Analysis of Routing Protocols in Wireless Sensor Network using QualNet

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ABSTRACT

A sensor network is a system that consists of thousands of very small stations called sensor nodes. The communication among nodes is done in a wireless fashion, and thus, the name of wireless sensor networks. Wireless sensor networks (WSN) have generated tremendous interest among researchers in recent years because of their potential usage in wide variety of applications [1]. In mobile sensor network (MSN), nodes are free to move with wireless links without any infrastructure.This paper investigates & undertakes simulation based study of Adhoc Routing Protocols in wireless sensor Network. In this paper comparison of four Routing Protocols AODV, DYMO, OLSR & IERP is done by using random waypoint mobility model and changing the nodes mobility using QualNet 5.0.2 Simulator. The metrics used for performance evaluation are Average Jitter, Throughput, End-to End delay, Signals received with errors, Average Queue Length, Packets to Application Layer, Total packets Received at the Receiver end.

General Terms

Wireless sensor network, Mobility, QualNet Simulator, Routing Protocols

Keywords

Wireless sensor network (802.15.4), Mobility, AODV, IERP, DYMO, OLSR, QualNet Simulator.

1. INTRODUCTION

Wireless Sensor Network (WSN)[11] consists of thousands of autonomous low cost tiny, multifunctional sensor nodes, each of which can monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, humidity, lighting and pollutants through wireless medium. A sensor network normally constitutes a wireless ad-hoc network, such that each sensor supports a multi-hop routing algorithm and nodes function as forwarders, relaying data packets to a base station, immediate neighbours, and then throughout the network. This way, routers gain knowledge of the topology of the network. Routing in Sensor Network is very challenging[12][13]due to their characteristics such as dynamically changing network topology, resource-poor devices, multi-hop nature and power constraints which makes the data transmission very computational. Keeping in view such complexities, a number of routing protocols have been developed[14] but it is not easy to decide which one wins. Though [2], [3] & [4] illustrates the performance of the protocols. This paper throws light on comparative results of AODV, DYMO, IERP & OLSR protocols of Wireless Sensor networks using QualNet Simulator [5] in CBR traffic. The results draw some general conclusion by considering MAC & Physical layer Model metrics which can be helpful for future research work.

The rest of the paper is organized as follows. Section second describes the random Waypoint Mobility Model .Section third gives the system description. Section four describes the results of all the protocols in Wireless sensor networks. Finally, we conclude our paper in section five.

2. RANDOM WAYPOIINT MOBILITY MODEL

Mobility models are used for simulation purposes when new network protocols are evaluated. The Random waypoint model was first proposed by Johnson and Maltz[6]. It is a random mobility model used to describe the movement of mobile users, and how their location changes with time. It is one of the most popular mobility model to evaluate Mobile ad hoc network (MANET) routing protocols, because of its simplicity and wide availability. Using this model, the mobile nodes move randomly and freely without any restriction i.e. the destination, speed and direction are all chosen randomly and independently of all other nodes.

3. SYSTEM DESCRIPTION

We develop a scenario using QualNet 5.0.2; a software that provides scalable simulations of Wireless Networks to analyze the performance of different routing protocols in wireless sensor network with CBR application.CBR[15][16] is the data traffic that keeps bit rate same throughout the process. In this scenario there are 20 nodes placed within 600*600 m^2 area. Node 1 is a Full Function device and acts as a Pan Coordinator & rest of the nodes are Reduced function device. CBR application is used between source nodes 1 & destination nodes 3 & 9 respectively. Random waypoint mobility is used as a Node movement model. Simulation is done by varying the Mobility of nodes and the results are analyzed using different protocols.

The network described above is studied by varying the routing protocols Adhoc on Demand Distance Vector (AODV)[7][17]Inter–Zone Routing Protocol(IERP)[8][18], Dynamic MANET On Demand (DYMO)[9][17], Optimized Link State Routing(OLSR)[10][19] with variation in mobility of nodes and then comparing the results of the respective protocols in terms of Throughput, Average end to end delay, Average jitter, Signals received with errors, Average Queue Length, Packets to Application Layer, Total packets Received at the Receiver end.

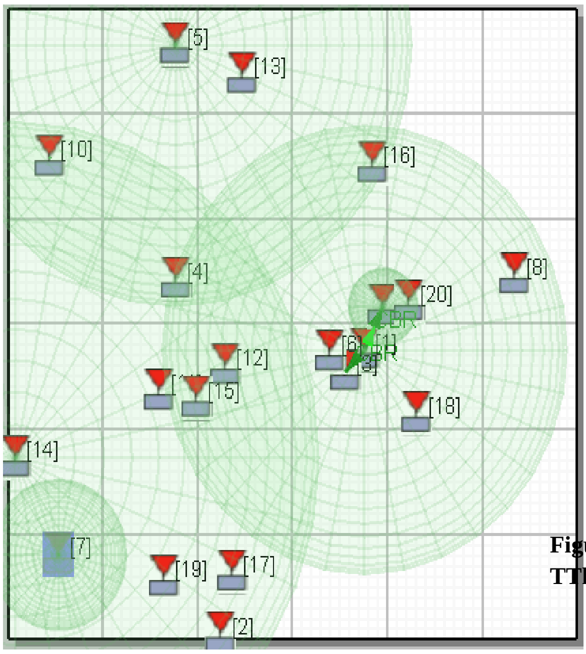

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Figure 1: Animation view of Wireless sensor network (20 nodes)

TABLE 1 shows the parameters used for the simulation

Parameters	Values
Simulator	QualNet
Protocols studied	AODV,DYMO,OLSR & IERP
Number of nodes	20 nodes
Simulation time	600 s
Simulation area	600*600 sq m
Node movement model	Random waypoint mobility
Traffic types	2 CBR sources
Mobility of nodes	Min speed=1m/s ,Max speed=5m/s,10m/s,15m/s & 20m/s

4. RESULTS AND DISCUSSIONS

4.1. Throughput

Throughput is the average rate of successful message delivery over a communication channel. Throughput is usually measured in bits per second (bits/sec), and sometimes in data packets per second or data packets per time slot. High throughput is always desirable in a communication system.

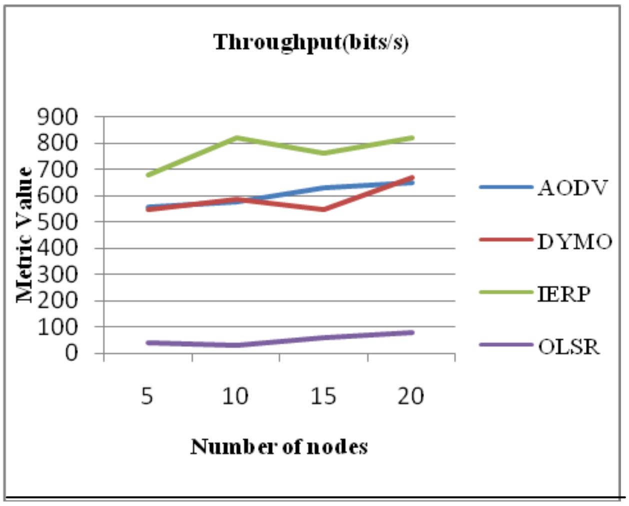

Figure 2: Graph of comparison of client and server Throughput

The above Figure shows that throughput increases with increase in node mobility and is maximum in case of IERP & minimum for OLSR as lot of control overhead is associated due to their proactive nature.

4.2. Average Jitter

Jitter is the variation in delay by different data packets that reached the destination and can seriously affect the quality of audio/video and thus an unwanted parameter.

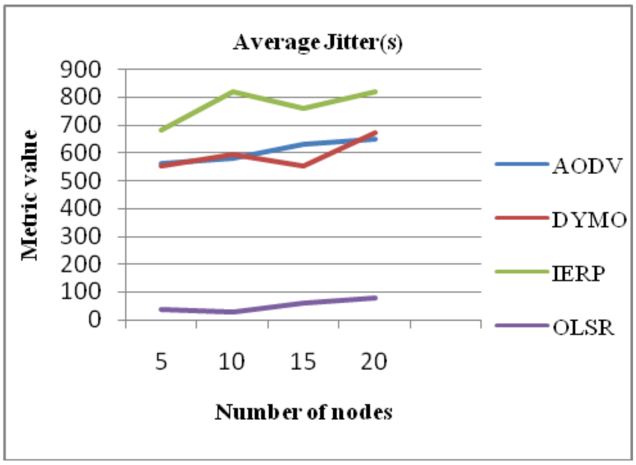

Figure 3: Graph for Average Jitter

Figure shows that Jitter decreases with increase in node mobility and is high for IERP and is lowest for OLSR with less node mobility but increases with increase in node mobility and intermediate for AODV & DYMO.

4.3. Average End to End Delay

End-to-end delay refers to the time taken for a packet to be transmitted across a network from source to destination. A data packet may take longer time to reach to the destination due to queuing and different routing paths.

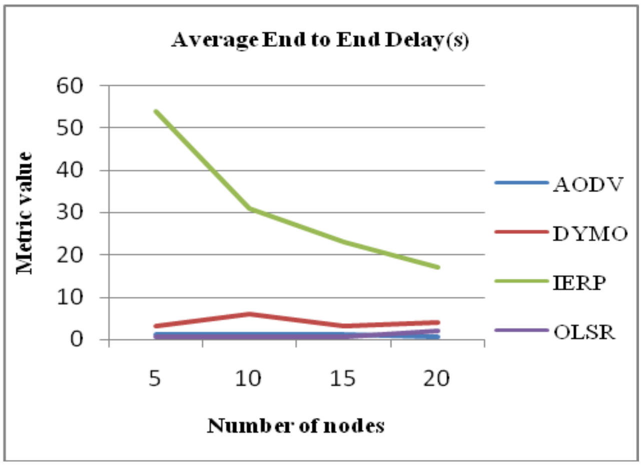

Figure 4: Graph for Average End to End Delay

Figure shows that OLSR & AODV performed better than DYMO & IERP. IERP has highest delay while OLSR has lowest delay due to regular update of routing table.

4.4. Signal Received but with errors

It shows the number of incoming signals the radio failed to receive.

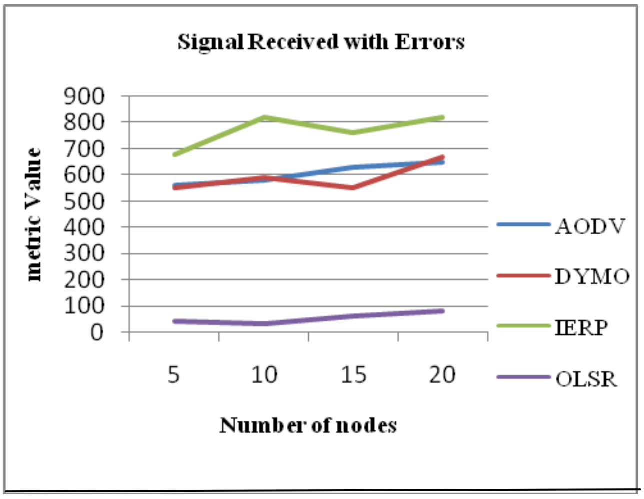

Figure 5: Graph for Signals Received with errors

Figure shows the signals received at the destination with errors and is highest for AODV followed by DYMO.OLSR shows the best results.

4.5. Average Queue Length

It is FIFO Queue Size (bytes) in MAC layers. The length of Queue depends on congestion and route discovery.

Figure shows that AODV & OLSR builds small queues, DYMO and IERP gives the worst results with increase in node mobility.

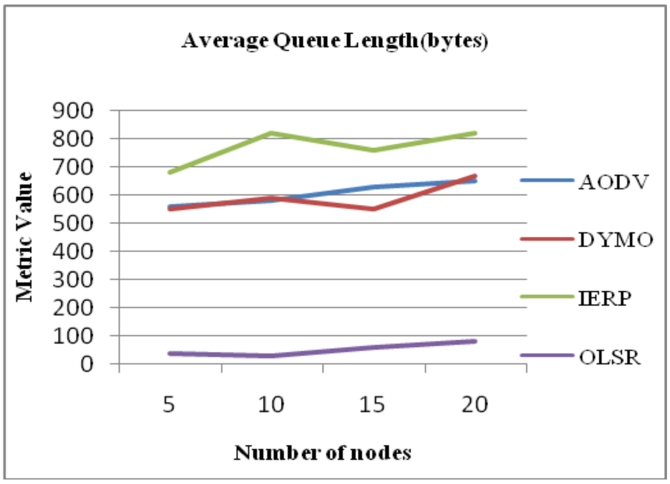

Figure 6: Graph for Average Queue Length

4.6. Packets to Application layer

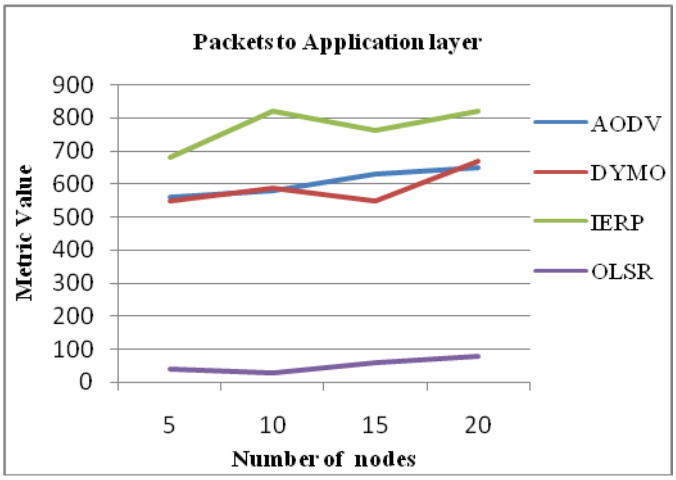

Figure 7: Graph for Packets to Application Layer

Small number of packets send to application layer are same for AODV & DYMO, while bulk of packets are send in OLSR

4.7. Total Packets Received

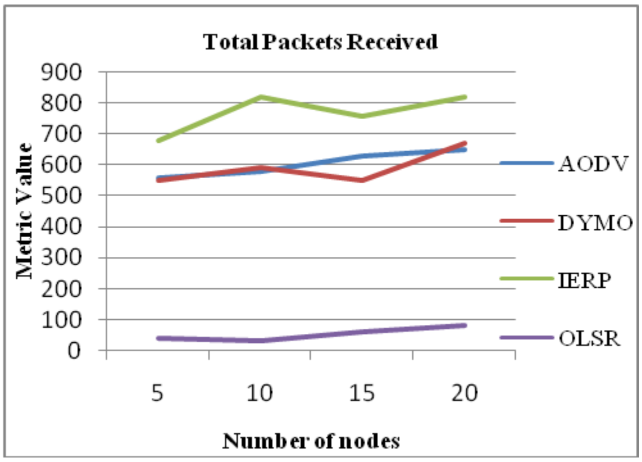

Figure 8: Graph for Total Packets Received

Figure shows that number of packets received increases with increase in node mobility & highest number of packets are received in IERP which is higher than AODV & DYMO & minimum in OLSR.

5. CONCLUSION

From the above results, we obtain some conclusion that in Random waypoint mobility model with CBR traffic IERP gives maximum throughput followed by DYMO & AODV, OLSR gives the worst results in terms of Throughput as it always needs to keep update of whole networks information. Jitter & end to end delay is lowest for OLSR & highest for IERP as convergence time of OLSR for routing table calculation will be less and route will be available soon. But AODV and DYMO shows similar nature as when route breaks occurs both setups routes on-demand. Less error is obtained in signals received for OLSR & maximum for AODV. AODV & OLSR has least Queue length. Highest numbers of packets are received in IERP & minimum in OLSR.

6. REFERENCES

[1] N. Bisht, R. Mishra, R.Dhillon,"Mobility Based Performance Analysis of Wireless Sensor Networks", International Journal of Computer, Electronics & Electrical Engineering (ISSN: 2249 -9997) Volume 2– Issue 2 ,pp 15-20.

[2] M. Amin , M.Abrar & Zahid Ullah Khan, "Comparison of OLSR & DYMO Routing Protocols on the Basis of Different Performance Metrics in Mobile Ad-Hoc Networks", American Journal of Scientific Research ISSN 1450-223X Issue 37, pp.34- 57, 2011

[3] B. Ahmed, Md. K. Ben Islam, J. Rahman, "Simulation, Analysis and Performance Comparison among different Routing Protocols for Wireless Sensor Network", Computer Engineering and Intelligent Systems ISSN 2222-1719 (Paper) ISSN 2222-2863 Vol 2, No.4, pp.61-71, 2011

[4] L. Viennot, P. Jacquet, and T.H. Clausen, "Analyzing Control Traffic Overhead versus Mobility and Data Traffic Activity in Mobile Ad-Hoc Network Protocols", Wireless Networks, Vol. 10, Issue 4, pp. 447-455, July 2004

[5] QualNet Simulator

[6] J. Heidemann and N. Bulusu et al., "Effects of detail in Wireless network Simulation", In Proceedings of the SCS Multiconference on Distributed simulation",pp 3-11, January 2001.

[7] C. Perkins, E. Royer, and S.Das "Ad hoc on demand Distance vector (AODV) routing". IETF RFC No.3561, July 2003

[8] Haas, Zygmunt J., Pearlman, Marc R., Samar, P.Interzone Routing Protocol (IERP), June 2001, IETF Internet Draft, draft- ietf-manet-ierp-01.txt

[9] Ian D. Chakeres and Charles E. Perkins. Dynamic MANET on demand (DYMO) routing protocol. Internet-Draft Version 06, IETF, October 2006.

[10] A. Laouti, P. Muhlethaler, A. Najid and E. Plakoo: "Simulation results of the OLSR routing protocol for Wireless network", INRIA Rocquencourt, Project Hypercom 2002.

[11] Gowrishankar. S, T.G. Basavaraju, Subir Kumar Sarkar," Issues in Wireless Sensor Networks", In proceedings of The 2008 International Conference of Computer Science and Engineering, (ICCSE 2008)

[12] Meenakshi Tripathi, M.S.Gaur. VijayLaxmi,"Analysis of effects of Mobility and Active Route Timeout between Sensor Nodes in Wireless Sensor Networks", Special Issue of International Journal of Computer Applications (0975 – 8887) on Wireless Communication and Mobile Networks, No.5. Jan.2012,pp.22-25.

[13] Jinglun Shi, Zhilong Shan, and Xuxun Liu, "A Two-Level Routing Scheme forWireless Sensor Network", International Journal of Distributed Sensor Networks Volume 2012, Article ID 601389, 6 pages, May 2012

[14] W.R.Heinzelman, A.Chandrakasan, and H. alakrishnan,"Energy-efficient communication protocol for wireless microsensor networks," in Proceedings of the The 33rd Annual Hawaii International Conference on System Siences (HICSS-33'00), pp. 223, January 2000.

[15] Dinesh Singh, Ashish K. Maurya, Anil K. Sarje ,"Comparative Performance Analysis of LANMAR,LAR1, DYMO and ZRP Routing Protocols in MANET using Random Waypoint Mobility Model" PP 62-66, 2011 IEEE

[16] Sree Ranga Raju , Dr. Jitendranath Mungara ," ZRP versus AODV and DSR : A Comprehensive Study on ZRP Performance" International Journal of Computer Applications (0975 – 8887) Volume 1 – No. 12,pp 35-40, 2010.

[17] Parma Nand, Dr. S. C. Sharma," Routing Load Analysis of Broadcast based Reactive Routing Protocols AODV, DSR and DYMO for MANET" International journal of grid and distributed computing vol.4, No.1, PP 81-92, March 2011

[18] Shaily Mittal, Prabhjot Kaur," PERFORMANCE COMPARISION OF AODV, DSR and ZRP ROUTING PROTOCOLS IN MANET'S," International conference on Advances in Computing, Control, and Telecommunication Technologies , IEEE computer society .pp 165-168,2009

[19] Alexander Klein," Performance Comparison and Evaluation of AODV, OLSR, and SBR in Mobile Ad-Hoc Networks" PP 571-575, 2008 IEEE