Volume 4, Issue 1, January 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Performance Evaluation of AODV and DSDV Routing Protocols in Wireless Sensor Network Using Different Network Parameters

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Abstract- In the recent past, wireless sensor networks have been introduced to use in many applications. To design the networks, the factors needed to be considered are the coverage area, mobility, power consumption, communication capabilities etc. The challenging goal of our work is to create a simulator to support the wireless sensor network simulation. The network simulator (NS-2) which supports both wire and wireless networks is implemented to be used with the wireless sensor network. Deployment of sensor networks are increasing either manually or randomly to monitor physical environments in different applications such as military, agriculture, medical transport, industry etc. The most important in monitoring application like critical condition is the sensing of information during emergency state from the physical environment where the network of sensors is deployed. In order to respond within a fraction of seconds in case of critical conditions like explosions, fire and leaking of toxic gases, there must be a system which should be fast enough. A big challenge to sensor networks is a fast, reliable and fault tolerant channel during emergency conditions to sink (base station) that receives the events. The main focus of this paper is to discuss and evaluate the performance of different routing protocols (Destination Sequenced Distance Vector Routing Protocol (DSDV), Ad-hoc On-Demand Distance Vector Routing Protocol (AODV)) using different parameters in terrain area which is (1000m x 1000m) in wireless sensor network for monitoring of critical conditions with the help of parameters (Packet Delivery Fraction (PDF), Normalized Routing Load (NRL), Average end-to-end Delay and Average Throughput).

Keywords: - AODV Protocol, DSDV Protocol, NS-2, Wireless Sensor Network, PDF, NRL.

I. INTRODUCTION

Wireless Sensor Networks are designed by many small nodes with sensing and wireless communication capabilities [1, 8]. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue. The focus, however, has been given to the routing protocols which might differ depending on the application and network architecture. In this paper, this dissertation presents a survey of the state-of-the-art routing techniques in WSNs. This paper first outline the design challenges for routing protocols in WSNs followed by a comprehensive survey of different routing techniques. There are many research papers on routing protocols in wireless sensor network and all are used for evaluating performance of different parameters in different scenario. Researchers specify the difference between routing protocols and its performance for different parameters and which one is best for the case of Wireless Sensor Network. In comparison of AODV, DSDV and DSR the Average Throughput, Packet Delivery Fraction and Normalized Routing Load in DSR are optimal. While in comparison of DSDV and AODV routing protocols, AODV performed better than DSDV in terms of bandwidth as AODV do not contain routing tables so it has less overhead and consume less bandwidth while DSDV consumes more bandwidth [28, 3].

II. RELATED WORK

Wireless ad hoc network is a collection of autonomous mobile nodes that communicate with each other over wireless links. Such networks are expected to play increasingly important role in future organizations, University, Civilian and Military settings, being useful for providing communication support where no fixed infrastructure exists or the deployment of a fixed infrastructure is not economically profitable and movement of communicating parties is possible. To accomplish this, a number of ad-hoc routing protocols have been proposed and implemented, which include dynamic source routing (DSR), Destination sequenced Distance Vector (DSDV), ad hoc on-demand distance vector (AODV) routing. In previous work, Investigators considered 300 m x 300 m, 300 m x 500 m and 500 m x 500 m terrain areas and illustrate the performance of the Average End-to-End delay of routing protocol. Our simulation results using ns2 shows that DSR is best in case of both average end-to-end delay and packet delivery fraction over DSDV and AODV.

III. PROPOSED SOLUTION

Wireless sensor networks are characterized by a dynamic topology triggered by the nodes mobility. Thus, the wireless multi-hops connection and the channel do not have deterministic behavior such as: Interference or multiple paths. Moreover, invisibility of nodes makes the wireless channel difficult to detect. This wireless network's behavior should be scrutinized. This paper discuss and evaluate the performance of different routing protocols based on varying the speed (node speed) and keeping the pause time constant in terrain area which is (1000 m. x 1000 m.) using DSDV and AODV routing protocols and monitoring of critical conditions with the help of important parameters like Average Throughput, Packet Delivery Fraction, Average end-to-end Delay and Normalized Routing Load.

IV. IMPLEMENTATION & RESULTS

The purpose of this experimental study was to measure the ability of the routing protocols to react to the network topology change while continuing to successfully deliver data packets to their destinations. To measure this ability, different scenarios are generated by varying the pause time and Maximum speed in the network that also over different terrain areas. Simulations are run by considering DSDV and AODV routing protocol. In order to get realistic performance, the results are averaged for a number of scenarios. Investigators were not attempting to measure the protocol performance on a particular workload taken from real life, but rather to measure the protocol, performance under different range of conditions.

Performance Metrics:
This project had considered several metrics in analyzing the performance of routing protocols. These metrics are as follows.
(a) Packet Delivery Fraction*:* The packet delivery fraction is defined as the ratio of number of data packets received at the destinations over the number of data packets sent by the sources. In other words, fraction of successfully received packets, which survive while finding their destination, is called as packet delivery ratio [23].
(B) Average Throughput: The throughput metric measures how well the network can constantly provide data to the sink. Throughput is the number of packet arriving at the sink per ms. Throughput refers to the amount of data (in bits) transferred successfully from one node to another in a specified amount of time. The objective is to calculate the maximum throughput of IEEE 802.11 technologies in the medium access control (MAC) layer for different parameters such as packet size. The maximum throughput in higher layers i.e. application layer, will be lower due to additional overhead at each layer. Overhead due to protocol headers and checksums are not included in the calculation of throughput as it is defined in this paper [20].
(C) Normalized Routing Load: The normalized routing load is defined as the fraction of all routing control packets sent by all nodes over the number of received data packets at the destination nodes. In other words, it is the ratio between the total numbers of routing packets sent over the network to the total number of data packets received [23].
(D) End-To-End Delay: The average time taken to route the packet from source to destination.

TABLE 4.1
Simulation Parameter

Parameters	**Values**
Transmitter range	250m
Bandwidth	2 Mbps
Simulation time	750 s
Number of nodes	15
Max Speed	20, 40, 60, 80, 100 m/s
Pause time	10 s
Environment size	1000 m. x 1000 m.
Traffic type	Constant Bit Rate
Packet rate	4 packets/seconds
Packet size	512 bytes data
MAC type	IEEE 802.11b Large Preamble
Antenna type	Omni-Antenna
Radio propagation method	Two Ray Ground

Calculate the following factors according to the table 4.1:

Packet Delivery Fraction:-

TABLE 4.2
Evaluating Parameters: Packet Delivery Fraction

Node Speed → Topology ↓	20	40	60	80	100
1000 m. x 1000 m. (AODV)	98.29	96.36	98.04	96.62	97.88
1000 m. x 1000 m. (DSDV)	96.32	87.54	92.03	88.24	87.83

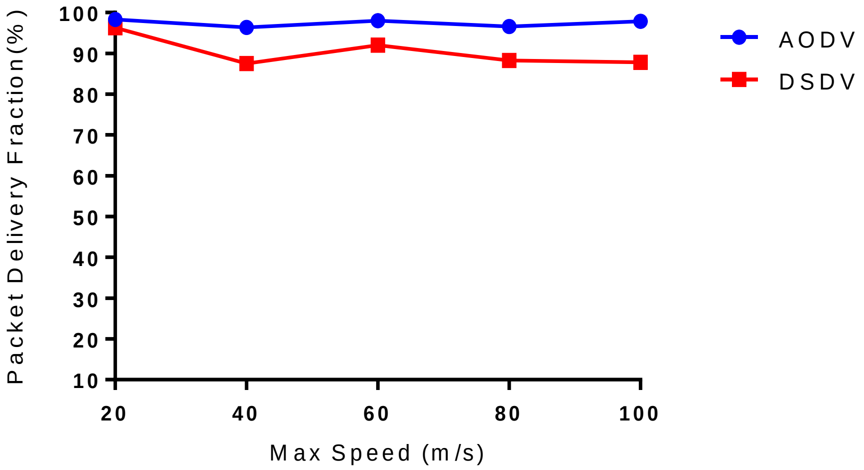

Figure 4.1 Node Speed versus packet delivery fraction when terrain area is 1000 m. x 1000 m.

Using the DSDV and AODV routing Protocol with 15 nodes, pause time 10 s, varying node speed (20-100 m/s by interval of 20 m/s) and 1000 m. x 1000 m. terrain area, this dissertation examine that Packet Delivery Fraction in 1000 m. x 1000 m. of AODV is more optimal than 1000 m. x 1000 m. of DSDV. So if this dissertation implements wireless sensors in small terrain area with keeping the pause time constant, the Packet Delivery Fraction is always low in DSDV on varying node speed.

Average Throughput:-

TABLE 4.3
Evaluating Parameters: Average Throughput (kbps)

Node Speed → Topology ↓	20	40	60	80	100
1000 m. x 1000 m. (AODV)	194.18	181.96	240.66	137.41	234.96
1000 m. x 1000 m. (DSDV)	188.42	176.50	232.43	135.75	228.50

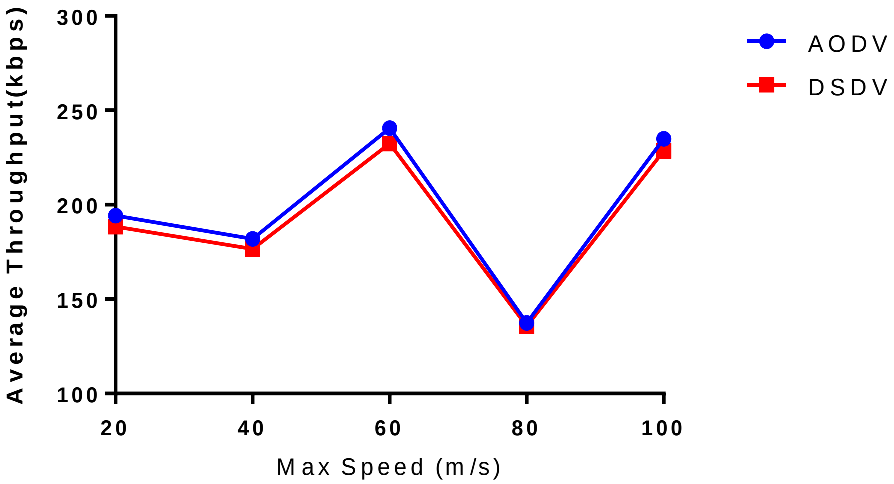

Figure 4.2 Node Speed versus Average Throughput (kbps) when terrain area is 1000 m. x 1000 m.

Using the DSDV and AODV routing Protocol with 15 nodes, pause time 10 s, varying node speed (20-100 m/s by interval of 20 m/s) and 1000 m. x 1000 m. terrain area, this dissertation examine that Average Throughput in 1000 m. x 1000 m. of DSDV is more optimal than 1000 m. x 1000 m. of AODV. So if this dissertation implements wireless sensors in small terrain area with keeping the pause time constant, the Average Throughput is always greater than in DSDV on varying node speed.

Normalized Routing Load:-

TABLE 4.4
Evaluating Parameters: Normalized Routing Load

Node Speed → Topology ↓	20	40	60	80	100
1000 m. x 1000 m. (AODV)	0.042	0.064	0.057	0.049	0.048
1000 m. x 1000 m. (DSDV)	0.036	0.039	0.042	0.041	0.042

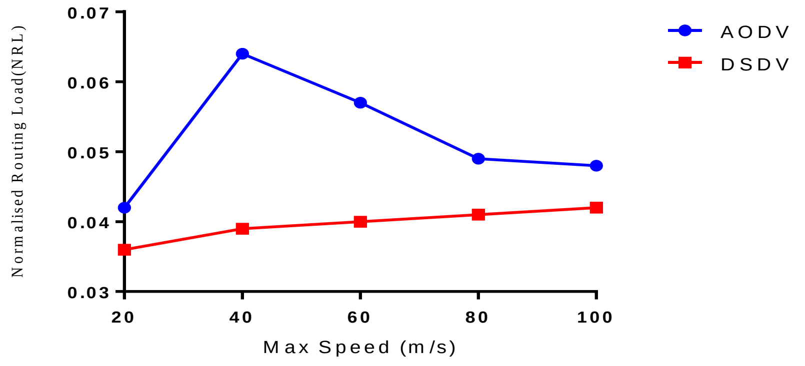

Figure 4.3 Node Speed versus Normalized Routing Load when terrain area is 1000 m. x 1000 m.

Using the DSDV and AODV routing Protocol with 15 nodes, pause time 10 s, varying node speed (20-100 m/s by interval of 20 m/s) and 1000 m. x 1000 m. terrain area, this dissertation examine that Normalized Routing Load in 1000 m. x 1000 m. of AODV is more optimal than 1000 m. x 1000 m. of DSDV on varying node speed.

Average (e-e) Delay:-

TABLE 4.5
Evaluating Parameters: Average end-to-end Delay

Node Speed → Topology ↓	20	40	60	80	100
1000 m. x 1000 m. (AODV)	178.02	163.007	144.022	224.84	201.195
1000 m. x 1000 m. (DSDV)	146.08	144.50	142.50	176.82	174.50

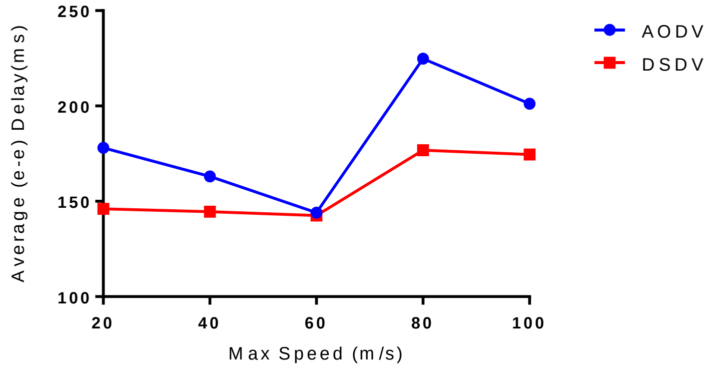

Figure 4.4 Node Speed versus Average end-to-end Delay when terrain area is 1000 m. x 1000 m.

Using the DSDV and AODV routing Protocol with 15 nodes, pause time 10 s, varying node speed (20-100 m/s by interval of 20 m/s) and 1000 m. x 1000 m. terrain area, this dissertation examine that Average end-to-end Delay in 1000 m. x 1000 m. of DSDV is more optimal than 1000 m. x 1000 m. of AODV on varying node speed.

V. CONCLUSION

The results are analyzed and discussed in a particular area having networks of 15 mobile nodes on varying node speed (20-100 m/s with interval of 20 m/s.) For finding performance of routing protocols in different metrics like packet delivery fraction, normalized routing load, average e-e delay, and average throughput in (1000 m. x 1000 m.) terrain area.

Our study provides an optimal result which is fully based on simulation and analysis. Every case explains evaluation of parameter with the help of table and generated graph. Each case represents a special issue for metric and Terrain area (which is (1000 m. x 1000 m.). If we are Using the DSDV and AODV routing Protocol with 15 nodes, pause time 10 s, varying node speed (20-100 m/s by interval of 20 m/s) in terrain area (1000 m. x 1000 m) than overall result say that packet delivery fraction and normalized routing load in 1000 m. x 1000 m. of AODV is more optimal than 1000 m. x 1000 m. of DSDV. The Packet Delivery Fraction is always low in DSDV on varying node speed. The Average Throughput and Normalized Routing Load are greater in AODV on varying node speed. The Average end-to-end delay is always low in DSDV on varying node speed. So, according to the results the performance of AODV routing protocol is much better than DSDV routing protocol in wireless sensor network. For some specific applications, the implementation of a new routing protocol is needed. The information concerning the implementation of a new protocol can be found in [23]. Furthermore, one of the challenging works is to make a new sensor network simulator which supports the simulation in the high level application. This new simulator should also be possible to apply for other applications in easy ways of implementations.

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