Performance Optimization of WSN Using Multiple Sinks

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Abstract- As the name indicates, wireless sensor network is very useful our day to day life. The term mobile technology is happening in recent years. And thus this is challenging job for industry to develop an efficient network which suits in today's technology. The users are main factor in this technology, without users the network is incomplete or rather incomplete technology without users. The main aim behind this paper is to simulate and analyse performance in a multi sink environment with static infrastructure and mobile sources. We modified traditional aodv protocol and developed a new protocol called as MSAODV. To improve performance parameters for static sink infrastructure as well as for dynamic sink infrastructure this protocol is useful. Will compare results of MSAODV protocol with the traditional AODV protocol, and note down performance of MSAODV which will be greater than AODV.

The paper is divided into 5 sections. First one is introduction, second one is related work, third one is system model, and fourth one is results and observations, final one is conclusion and future scope.

Index Terms **- Remote user, Mobile communication, Mobile users, Wireless sensor networks, multiple sink.**

I.INTRODUCTION

Wireless mobile technology has more demand in today's culture. Mobile network has more popular now days because of its availability and ease of use.

To overcome the limitations of single sink AODV protocol, there is need to develop a new protocol called as MSAODV. The new modified protocol (MSAODV) is a routing protocol for mobile ad hoc networks and other wireless ad hoc networks. MSAODV is, as the name indicates, a multiple sink ad hoc on demand distance vector. This protocol uses more than one sink for data gathering. By using more number of sinks in the network, the route request is divided and packets are distributed through sharing queries.

The resolve functions for routing table management doing a great work for MSAODV protocol. Basically this function check for hop count, on the basis of hop count sink movement changes from static to dynamic. It will check if the hop count is greater than two than it will do a route request, add the packets to the queue and sending packets to default sink node. If this condition fails, again it will ask for rout request, add the packets to the queue and sending packets to nearest sink. In this way, MSAODV protocol distributes packets to different sinks which results in less congestion of packets near to sink node. That helps to improve packet delivery ratio of network. The node nearer to sink consumes more energy, due to that such nodes die at an early stage but in MSAODV protocol, by using multiple sink less energy consumption nearer to sink node that ultimately increases node life. This helps to improve overall energy consumption of network.

II.RELATED WORK

While referring the paper [1], author introduce a novel communication model that solves the disconnection problem of both static and mobile users, due to of data gathering tree in the mobile sink model and the dynamic sink model, and the hotspot problem and data delivery with both low delivery ratio and high latency of the single static sink, named the multiple static sinks based communication model, and propose a novel protocol for supporting the mobile users based on the multiple static sinks model.

The paper [2], deals with the effect of a non uniform traffic pattern consisting of a single hot spot of higher access rate superimposed on a background of uniform traffic. Due to hot spot traffic, memory access is decreases. They call this problem as tree saturation. The technique [2], understands this problem arises due to lock or synchronization contention.

The study of data collection capacity [3], has concentrated on large-scale random networks. The author of the paper gives idea of data collection technique, and how it is useful to collect sensing data from all sensor nodes. The paper [3], aim to understand the theoretical limits of data collection in a TDMA-based sensor network in terms of possible and achievable maximum capacity. This paper [3], first derive the upper and lower bounds for data collection capacity in arbitrary networks under protocol interference and disk graph models. They show that a simple BFS tree based method can lead to order-optimal performance for any arbitrary sensor networks. Also they study the capacity bounds of data collection under a general graph model, where two nearby nodes may be unable to communicate due to barriers or path fading, and discuss performance implications.

Data can be collected from sensor nodes through multi hop technique. Generally, each sensor has the task to monitor and

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measure ambient conditions and disseminate the collected data toward a base station, or sink, for data post-analysis and processing. The paper [6] proposed data dissemination protocol to allow the dissemination of the collected data toward a static sink. Recently, mobile sinks were shown to be more energy-effective than static ones. In the article [6], existing data dissemination protocols supporting mobile sinks are summarized. In addition, sink mobility is analyzed, as well as its impact on energy consumption and the network lifetime.

The paper [10] uses technique called as foot-print chain, to adapt the strategy for supporting mobile sink groups. In the paper [10], they propose a novel strategy for data dissemination decoupled with any member sink of a mobile sink group. In order to independently deal with a mobile sink group, the strategy is composed of three mechanisms: representative location update, distributed data collection, and per-group foot-print chaining.

This paper [8] deals with new term called as, jumping sensors. They are mobile sensors that provide relocation capabilities and a temporary increase in elevation can be utilized for improving communication. The paper [8] provides a comprehensive multidimensional analysis for jumping sensors. It studies the main factors that impact the Received Signal Strength (RSS) in sensor communication, and performs a comparative analysis between theoretical and experimental results.

The paper [7], proposes distributed energy-efficient deployment algorithms for mobile sensors and intelligent devices that form an Ambient Intelligent network. The term cluster structure is used by this paper. These algorithms [7] employ a synergistic combination of cluster structuring and a peer-to-peer deployment scheme. An energy-efficient deployment algorithm based on Voronoi diagrams is also proposed here. Performance of papers algorithms is evaluated in terms of coverage, uniformity, and time and distance travelled until the algorithm converges. According to author those algorithms are shown to exhibit excellent performance.

In the paper [11], gives results for aodv protocol for multiple sink. But the results are varying from scenario to scenario. Some scenario it will give better, in some little bit vary. Individual node wise energy is also calculated. The paper compares single sink results with the multiple sink results by using same protocol AODV. The results are evaluated with the help of some parameters like delay, data delivery ratio, energy consumption. Here the base stations are static. Dynamic stations can be used for better results.

III.SYSTEM MODEL

The system model of my communication protocol is as follows. It is observed that from fig.1 number of nodes is taken to simulate with the help of speed. To decide the topology of network, network size is taken as parameter. Multiple sink is act as a gateway between users and sensor field.

During the simulation process, queries of mobile users as well as mobile user’s record are stored in mobile user management table. This helps to recognize the information of mobile users in the network.

After simulation process will get the parameters output, with the help of trace n analysis process will plot the graph against energy consumption, packet delivery ratio, delay, throughput by using xgraph. Simulation can be done by using ns2 simulation tool.

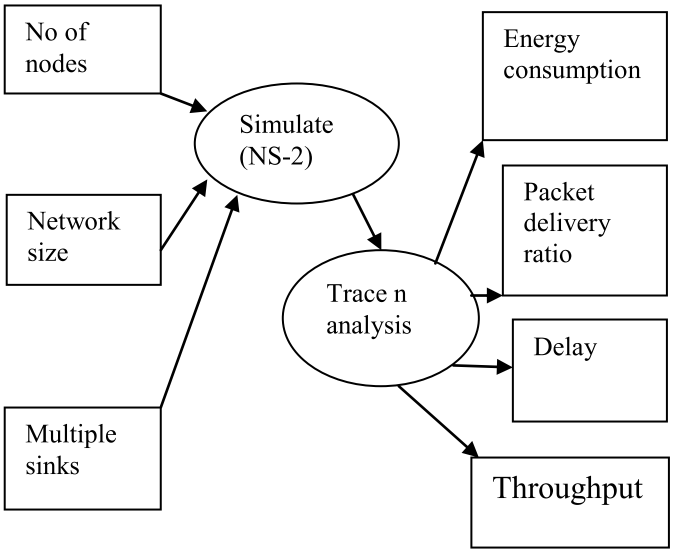

Fig.1 Block diagram of MSAODV model

IV.RESULTS AND OBSERVATIONS

In result analysis section we compared performance of both protocols (AODV and MSAODV) with respect to their parameters. We use four metrics to evaluate the performance of AODV and MSAODV protocol, say Packet delivery ratio, throughput, delay, and energy consumption. We have used Network Simulator (NS-2.34) on fedora 13 system to collect results. We have created following wireless networking scenarios and have recorded the values for above mentioned parameters.

Scenario 1:-Wireless Topology with Random Node movement

Simulation Time: 100 s Node Movement: Dynamic

Source Node: 1(Movable) Number of Sink Node: 1(AODV), 2(MSAODV)

MAC Type: 802.11 Application Traffic: UDP

Here performance is calculated on basis of number of technical stuffs.

A.Packet Delivery Ratio

Packet delivery ratio is nothing but the number of successfully received data packets at a user to the total number of data packets generated by every sensor node.

Table 1 Number of Nodes Vs PDR

Number of Nodes	**Packet delivery ratio for AODV and MSAODV**	
	AODV	**MSAODV**
50	99.6669	99.9167
70	99.8335	99.8335
90	94.7544	99.9167
110	96.1699	100
130	24.1465	58.368
150	58.368	96.1699

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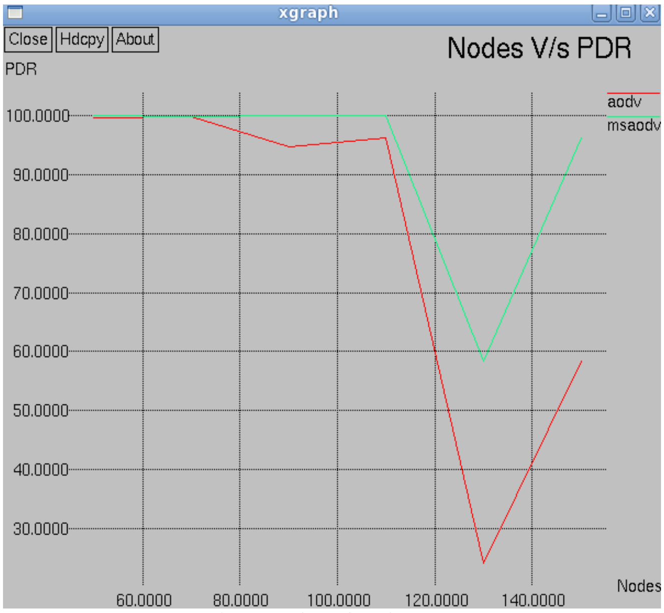

Fig.2 Number of Nodes Vs PDR

Here, PDR is slightly increased in case of MSAODV protocol as compared with AODV in case of 50 no of nodes. PDR is constant in case of 70 no of nodes in both the protocols. PDR is much greater than AODV in case of 90 no of nodes. PDR is 100 percent as compared with AODV in case of 110 no of nodes. The overall PDR of MSAODV protocol is 14 percent more than AODV protocol.

B.Throughput

Throughput refers to how much data can be transferred from one location to another in a given amount of time. Thus, higher throughput value refers to better performance of the MSAODV. From graph it can be observed that throughput is slightly increased in case of MSAODV protocol as compared with AODV in case of 50 no of nodes. Throughput is constant in case of 70 no of nodes in both the protocols. Throughput is much greater than AODV in case of 90 no of nodes. The overall throughput of MSAODV protocol is near about 11 percent more than AODV protocol.

Table 2 Number of Nodes Vs Throughput

Number of Nodes	Throughput for AODV and MSAODV	
	AODV	MSAODV
50	82992	83200
70	83130.7	83130.7
90	78901.3	83200
110	80080	83269.3
130	20106.7	48602.7
150	48602.7	80080

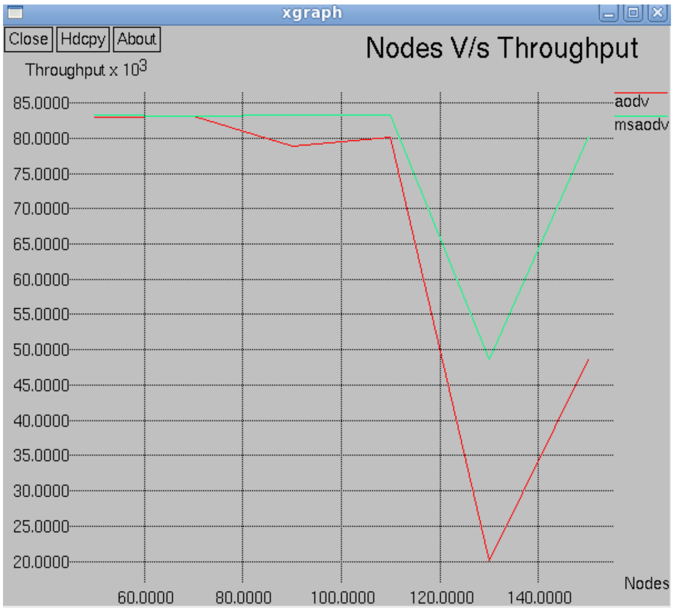

Fig.3 Number of Nodes Vs Throughput

C. Delay

Delay is nothing but the average time between the time a sensor node transmits a data packet and the time a user receives the data packet. Due to multiple base station nodes, delivery of data packets is carried out with short hops. So due to short hop count the data packets can transmit in low time period to the respective node. Less delay in data transmission by using multiple sink model.

From graph it can be observed that delay is slightly less in case of MSAODV protocol as compared with AODV in case of 50 no of nodes. Due to short hope count delay is much lesser than AODV in case of MSAODV. As the number of node increases delay of MSAODV protocol improves as compared with AODV protocol. The overall delay of MSAODV protocol is near about 0.11 percent improves than AODV protocol.

Table 3 Number of Nodes Vs Delay

Number of Nodes	Delay for AODV and MSAODV	
	AODV	MSAODV
50	0.0529844	0.00921018
70	0.0118455	0.00760953
90	0.157506	0.00847554
110	0.127074	0.00574759
130	0.471044	0.178745
150	0.202024	0.110822

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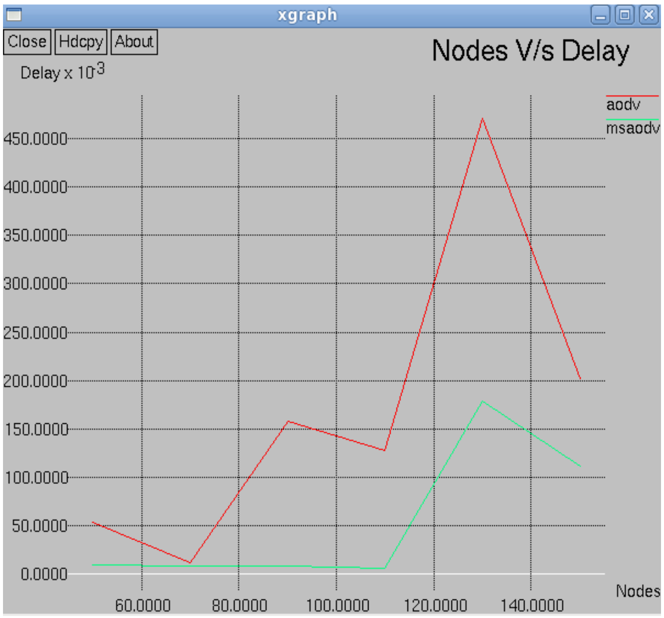

Fig.4 Number of Nodes Vs Delay

D.Energy Consumption

Energy consumption is nothing but how much energy the network consumes. From graph we observed that energy consumption is less in case of MSAODV protocol as compared with AODV in case of 50 no of nodes. Due to short hope count the packet transfer rate is good, so energy consumption of the network is decreases in case of MSAODV. The overall Energy consumption of MSAODV protocol is 13 percent less than AODV protocol.

Table 4 Number of Nodes Vs Energy consumption

Number of Nodes	**Energy Consumption for AODV and MSAODV**	
	AODV	**MSAODV**
50	26.788	9.61505
70	30.6189	21.6491
90	43.5047	14.353
110	2.26696	0.688965
130	22.2236	3.74328
150	4.80574	1.63832

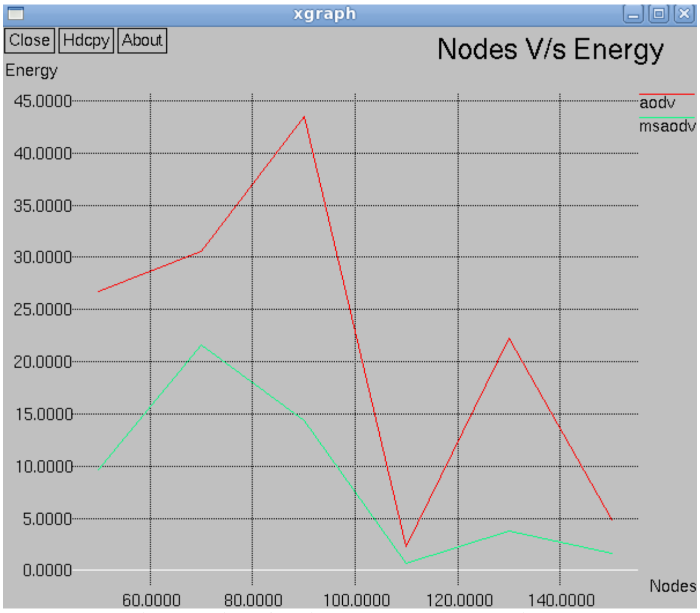

Fig.5 Number of Nodes Vs Energy Consumption

Scenario 2:- Wireless Grid Topology (Fixed)
Simulation Time: 100 sNode Movement: Static
Source Node: 1(Movable) Number of Sink Node: 1(AODV), 2(MSAODV)
MAC Type: 802.11Application Traffic: UDP

Here also performance is calculated on basis of same number of technical stuffs as stated in scenario 1.

A. Packet Delivery Ratio

Packet delivery ratio is nothing but the number of successfully received data packets at a user to the total number of data packets generated by every sensor node.

From the graph we observed that, PDR is 100 percent in case of both the protocols. Only for the case of 49 no of nodes PDR is less than 100 in case of AODV, but in MSAODV it will be 100 percent.

Table 5 Number of Nodes Vs PDR

Number of Nodes	**Packet delivery ratio for AODV and MSAODV**	
	AODV	**MSAODV**
16	100	100
25	100	100
36	100	100
49	96.2531	100

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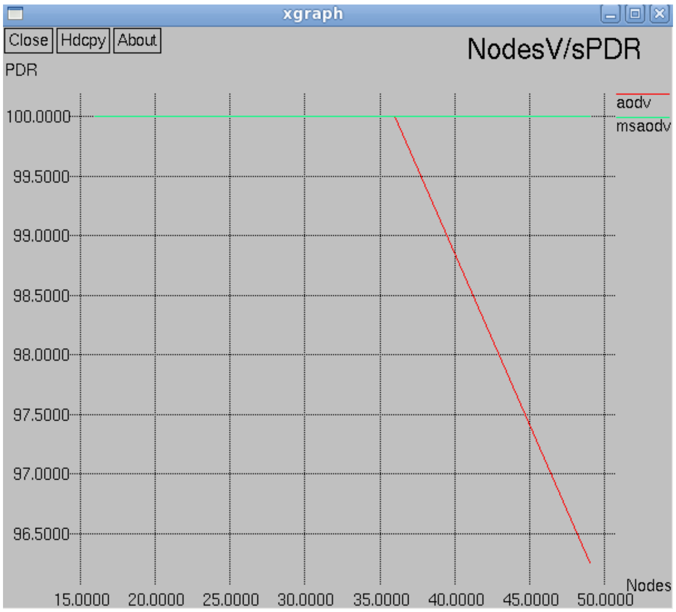

Fig.6 Number of Nodes Vs PDR

B.Throughput

Table 6 Number of Nodes Vs Throughput

Number of Nodes	Throughput for AODV and MSAODV	
	AODV	**MSAODV**
16	83269.3	83269.3
25	83269.3	83269.3
36	83269.3	83269.3
49	80149.3	83269.3

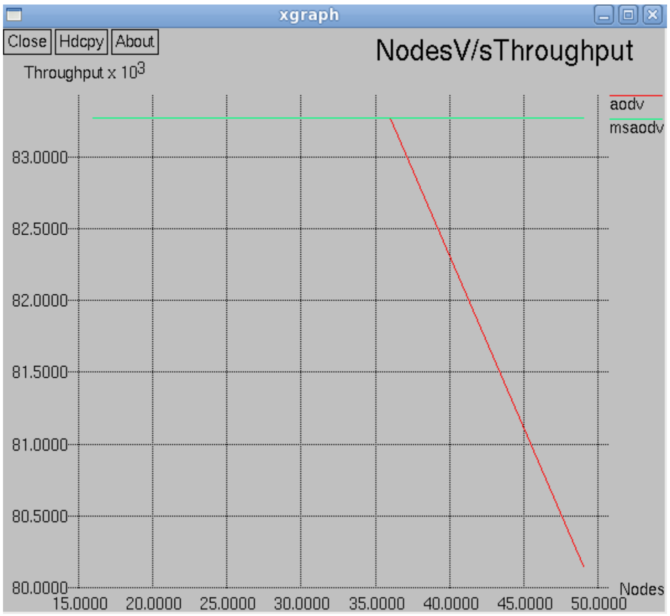

Fig.7 Number of Nodes Vs Throughput

Throughput is constant in case of both the protocols. Only for the case of 49 no of nodes throughput is more than AODV in case of MSAODV.

C.Delay

Table 7 Number of Nodes Vs Delay

Number of Nodes	Delay for AODV and MSAODV	
	AODV	**MSAODV**
16	0.0057175	0.00571795
25	0.00572713	0.00572622
36	0.0495118	0.00572744
49	0.112584	0.0393262

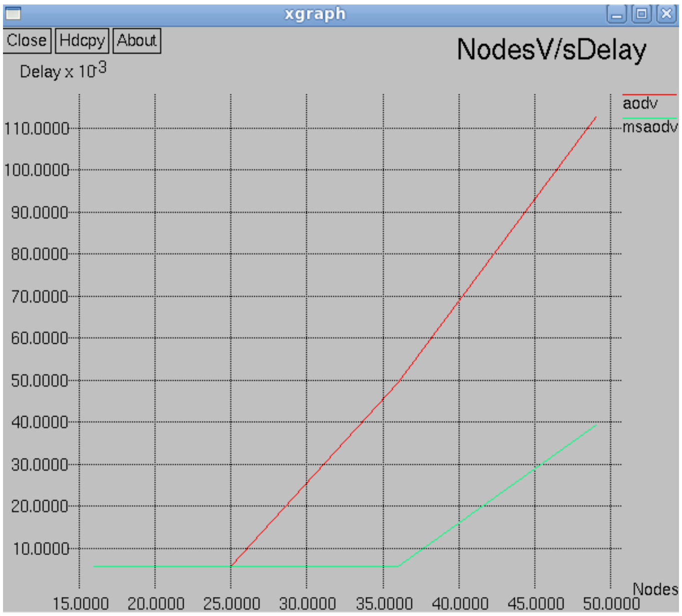

Fig.8 Number of Nodes Vs Delay

As the number of node increases delay improves in case of MSAODV. The overall delay of the network is 0.029 percent improves in case of MSAODV.

D.Energy Consumption

As the number of node increases energy consumption of MSAODV protocol decreases. Due to less energy consumption life of MSAODV protocol network is better than AODV protocol network.

Table 8 Number of Nodes Vs Energy Consumption

Number of Nodes	Energy Consumption for AODV and MSAODV	
	AODV	**MSAODV**
16	0.543276	0.543713
25	0.552358	0.550224
36	1.57753	0.568436
49	0.824485	0.687271

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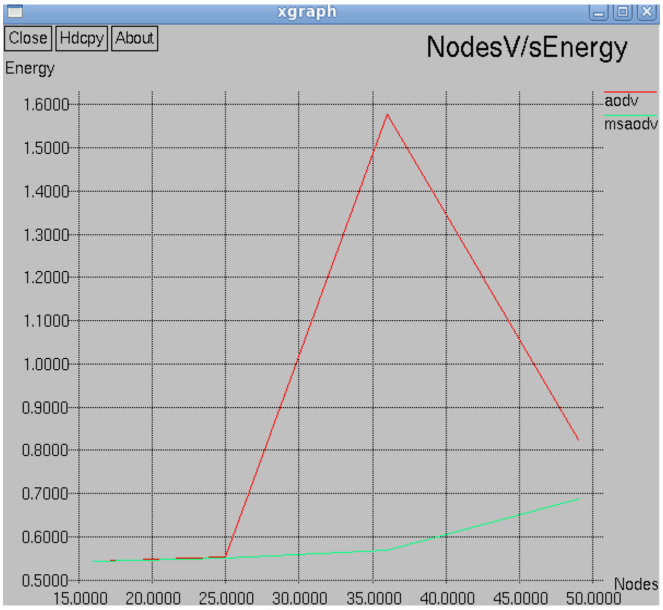

Fig.9 Number of Nodes Vs Energy Consumption

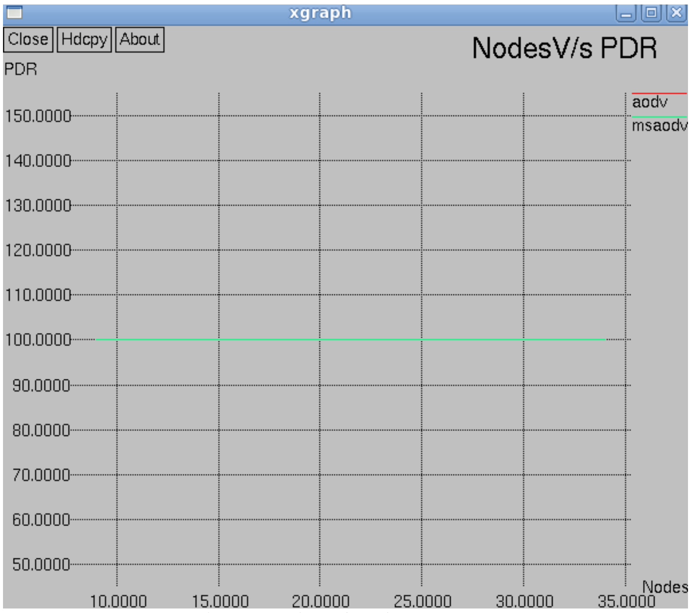

Fig.10 Number of Nodes Vs PDR

Scenario 3:- Wireless Ring Topology (Fixed)
Simulation Time: 100 sNode Movement: Static Source Node: 1(Movable)Number of Sink Node: 1(AODV), 2(MSAODV)
MAC Type: 802.11Application Traffic: UDP

Here also same parameters are used to calculate performance of protocols.

A. Packet Delivery Ratio

Packet delivery ratio is nothing but the number of successfully received data packets at a user to the total number of data packets generated by every sensor node.

From the graph, we observed that PDR is 100 percent in case of both the protocols.

Table 9 Number of Nodes Vs PDR

Number of Nodes	PDR for AODV and MSAODV	
	AODV	MSAODV
9	100	100
17	100	100
26	100	100
34	100	100

B. Throughput

Table 10 Number of Nodes Vs Throughput

Number of Nodes	Throughput for AODV and MSAODV	
	AODV	MSAODV
9	83269.3	83269.3
17	83269.3	83269.3
26	83269.3	83269.3
34	83269.3	83269.3

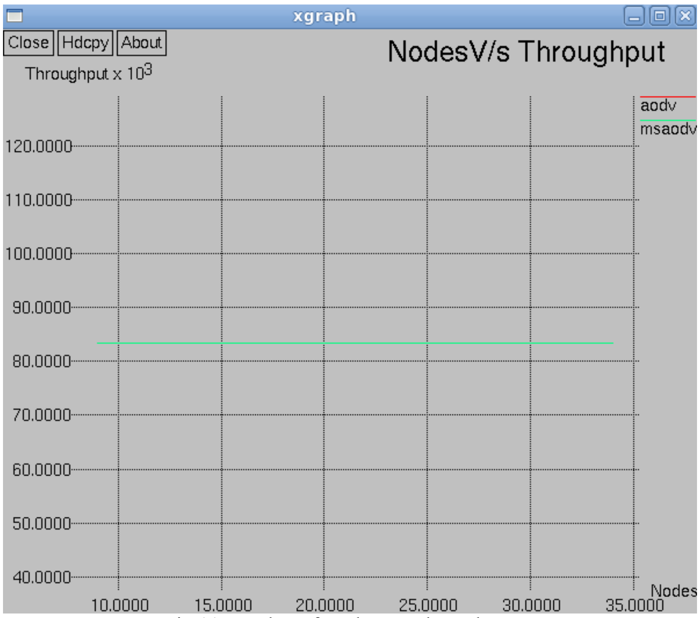

Fig.11 Number of Nodes Vs Throughput

Throughput is constant for both AODV and MSAODV protocol.

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C.Delay

Table 11 Number of Nodes Vs Delay

Number of Nodes	Delay for AODV and MSAODV	
	AODV	MSAODV
9	0.00571328	0.00571256
17	0.00571904	0.00571839
26	0.0057	0.0057
34	0.0057	0.0057

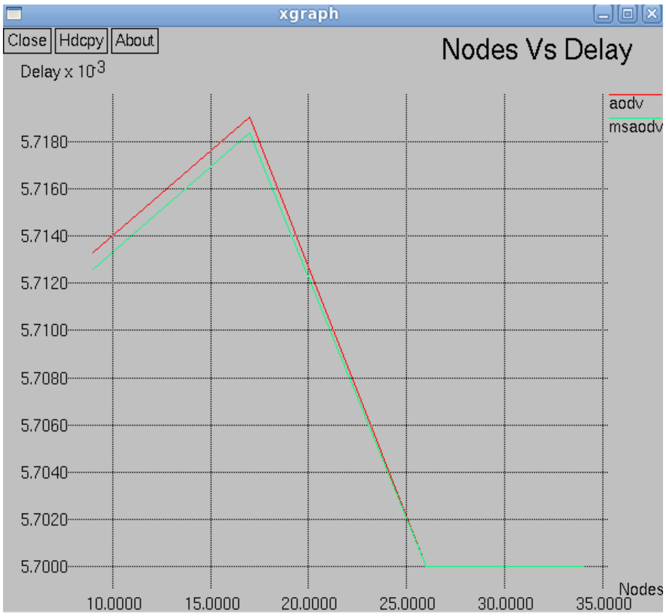

Fig.12 Number of Nodes Vs Delay

In this graph, delay will be slightly less in case of MSAODV.

D.Energy Consumption

In case of 9 and 17 no of nodes, energy consumption of network is constant for both protocols. As the number of nodes increases energy consumption of network decreases for MSAODV protocol as compared with AODV.

Table 12 Number of Nodes Vs Energy Consumption

Number of Nodes	Energy Consumption for AODV and MSAODV	
	AODV	MSAODV
9	0.53909	0.53909
17	0.279661	0.279661
26	0.559959	0.556004
34	0.560074	0.558065

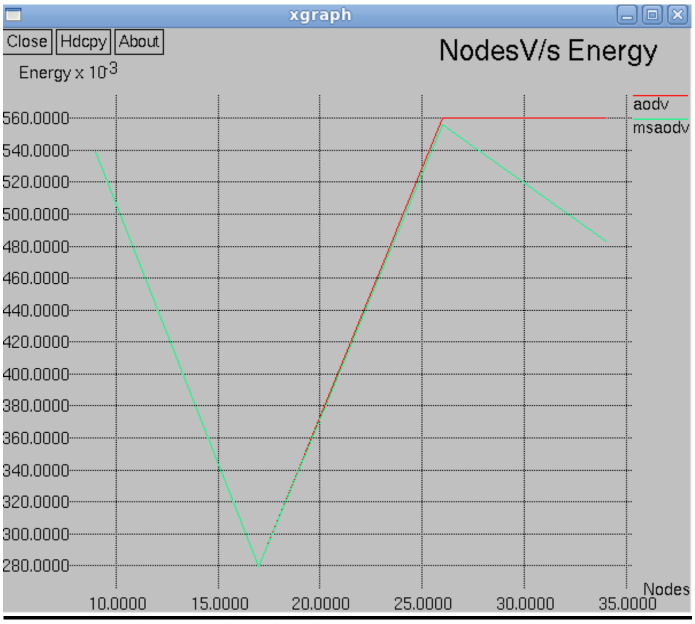

Fig.13 Number of Nodes Vs Energy Consumption

V.CONCLUSION AND FUTURE SCOPE

For random topology MSAODV protocol gives best performance in all results. MSAODV protocol can be applicable for both static as well as dynamic sink. Every time it will give better results for random topology (dynamic sink), grid topology (static sink), and ring topology (static sink). MSAODV protocol helps to reduce hot spot problem up to some extent, it improves life of node which is nearer to sink, and hence reduces energy consumption of overall network that helps to improve network lifetime. Due to use of multiple sinks, packets are distributed and which results in less congestion of packets near the sink node.

The MSAODV protocol provides high packet delivery ratio through distributed data gathering and low delay through packet delivery with short hops.

To test load balancing of the different sink is the future scope of the MSAODV protocol.

REFERENCES

[1] Euisin Lee, Soochang Park, Fucai Yu, and Sang-Ha Kim, “Communication Model and Protocol based on Multiple Static Sinks for Supporting Mobile Users in Wireless Sensor Networks”, IEEE Transactions on Consumer Electronics, Vol.56, pp.1652-1660, 2010.

[2] GREGORY F. PFISTER, V. ALAN NORTON, ““Hot Spot" Contention and Combining in Multistage Interconnection Networks”, IEEE TRANSACTIONS ON COMPUTERS, Vol.c-34, pp.943-948, 1985.

[3] Siyuan Chen, Minsu Huang, Shaojie Tang, Yu Wang, “Capacity of Data Collection in Arbitrary Wireless Sensor Networks”, IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS, Vol.23, pp.52-60, 2012.

[4] E.Oyman and C. Erso, “Multiple Sink Network Design Problem in Large Scale Wireless Sensor Networks,” in Proc, IEEE ICC, Jun. 2004.

[5] H. Kim, T. Abdelzaher, and W. Kwon, “Minimum-Energy Asynchronous Dissemination to Mobile Sinks in Wireless Sensor Networks,” in Proc. ACM SenSys, Nov. 2003.

[6] ELYES BEN HAMIDA AND GUILLAUME CHELIUS, “STRATEGIES FOR DATA DISSEMINATION TO MOBILE SINKS IN WIRELESS SENSOR NETWORKS”, IEEE Wireless communications, pp. 31-37, 2008.

[7] Nojeong Heo and Pramod K. Varshney, “Energy-Efficient Deployment of Intelligent Mobile Sensor Networks”, IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS-PART A: SYSTEMS AND HUMANS, Vol. 35, pp.78-92, 2005.

[8] Fernando J. Cintrón, Kanthakumar Pongaliur, Matt W. Mutka, Li Xiao, Jianguo Zhao, and Ning Xi, “Leveraging Height in a Jumping Sensor

ISSN: 2278 – 1323

Network to Extend Network Coverage", IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS, Vol.11, pp.1840-1849, 2012.

[9] Mark A. Perillo, Zhao Cheng, and Wendi Beth Heinzelman., "An analysis of strategies for mitigating the sensor network hot spot problem", In MobiQuitous, pp.474-478, 2005.

[10] Soochang Park, Euisin Lee, Min-Sook Jin, and Sang-Ha Kim, "Novel Strategy for Data Dissemination to Mobile Sink Groups in Wireless Sensor Networks", IEEE COMMUNICATIONS LETTERS, Vol.14, pp.202-204, 2010.

[11] Amol Bhadange, Sudipta Giri, "Multiple sink model which support different parameters in wireless sensor field", Vol. 3, Issue 5, pp.12666-12670, 2014.

[12] I. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "A Survey on Sensor Networks," *IEEE Communication Magazine*, Aug. 2002.

[13] X. Wu and G. Chen, "Dual-Sink: Using Mobile and Static Sinks for Lifetime Improvement in Wireless Sensor Networks," in *Proc. IEEE ICCCN*, Aug.2007.

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