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PERFORMANCE EVALUATION OF WIRELESS SENSOR NETWORK USING ED-TDMA WITH AODV AND DSR

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Abstract- *Wireless Sensor Networks(WSN) consists of a large number of sensor nodes deployed over an area to monitor physical conditions, such as temperature, pressure, humidity etc. and to cooperatively pass their data through the network to a main location.The WSN is built of nodes. The number of nodes may vary from a few to several hundreds, where each node is connected to one or several sensors. In this paper we put forward Event Driven-Time Division Multiple Access (ED-TDMA) with the two Reactive Routing Protocols: Ad hoc On-Demand Distance Vector Routing(AODV) and Dynamic Source Routing(DSR) for the two models, where in one model, sensor nodes are static and in the other model, the sensor nodes are considered to be mobile. The simulation work is carried out in Network Simulator-ns2 environment considering six parameters to observe the overall network behaviour and energy consumption for the various topologies in both the models stated aboved. The comparision results show that the AODV outperforms DSR in most cases and the energy consumption is higher for high density deployment under heavy traffic.*

Keywords*- Wireless Sensor Network, Event Driven-Time Division Multiple Access, Ad hoc On-Demand Distance Vector Routing and Dynamic Source Routing.*

I. INTRODUCTION

A Wireless Sensor Network (WSN) consists of consists of nodes with sensing, computing and wireless communication capabilities [7]. The nodes consists sensors for monitoring various parameters such as humidity, temperature, motion, pressure and pass their gathered information cooperatively through the network to a main location. The sensing circuit senses the environment and converts the signals into electrical signals which are then transmitted to the Base Station [6]. The sensor nodes are energy constrained due to the limited source of energy and die when they have no power. The sensors can work until the energy stored in them are completely utilised. Thus to maximize their lifetime, efficient networking and power management is important for any WSN.
The different characteristics of WSN are listed below [5]:

i) Ability to cope with node failure.

ii) It consists of one or more number of base stations and a large number of sensor nodes where sensors observe the real world.

iii) Multi hop communication is used.

iv) The sensors have a limited power supply and do not necessarily need to be active all the time.

v) The nodes in WSN are generally deployed randomly and are left unattended.

vi) The wireless sensor network have no fixed infrastructure.

II. PROTOCOLS USED

ED-TDMA is an energy efficient protocol for event-driven application in WSN. It improves the channel utilisation by changing the length of TDMA frames according to the number of source nodes. It operation is divided into rounds. It consists of set-up phase and the steady phase. It the set-up phase time synchronisation takes place while the steady phase begin with the resevation phase where n- minislots are created and n is equal to the number of source nodes then comes the schedule phase where the schedule packets are broadcasted by the cluster head.
The localisation technique is used is Time of Arrival where the distance between the sender and receiver of a signal can be determined using the measured signal propogation time and the known signal velocity.

Dynamic Source Routing is a reactive protocol as Ad-hoc On-demand Distance Vector protocol. Difference between Ad- hoc On-demand Distance Vector and Dynamic Source Routing is that Ad-hoc On-demand Distance Vector only stores address of next node to the destination but Dynamic Source Routing stores complete path from source to destination including all the intermediate nodes. Source of the packet discovers the route through which to forward the packets. Sender carries in data packet header the complete ordered list of nodes through which the packet must pass.

III. RELATED WORKS

G. Pottie, W. Kaiser[1] This paper provided a detailed survey on the issues on which WSN have been categorized or classified and also explored the issues that are actually challenges that must be considered while selecting or designing an algorithm for routing purpose in WSN. The study clearly brought forth important finding that were very useful and presented enough valuable contents related to wireless sensor network protocol design issues and existing classification.

Anastasi, Giuseppe, Marco Conti, Mario Di Francesco, and Andrea Passarella [3]This paper reported on the effects of low-power listening, a physical layer optimization, in combination with the MAC protocols. The comparison was based on extensive simulation driven by driven by traffic that varies from over time and location: sensor nodes are inactive unless they observe some physical event or send status updates to the sink node providing the connection to the weird world. The key issue that needed to be addressed is the efficient operation of the radio link to foster collaboration between individual resource scarce sensor nodes on the one hand and to minimize the energy consumption on the other. They had compared the three approaches for saving energy in sensor network: low power listening at the physical layer and MAC protocols operating at medium access layer. These three approaches have in common that they introduce duty cycle to mitigate idle listening, the dominant cause of energy consumption in typical sensor network scenarios.

Ye, Wei, John Heidemann, and Deborah Estrin [2]Proposed S-MAC an energy efficiency protocol designed for wireless sensor networks. S-MAC uses three novel techniques to reduce energy consumption and support self-configuration. To reduce energy consumption in listening to an idle channel the nodes periodically sleep. S-MAC sets the radio to sleep during transmission of the other nodes. S-MAC applies message passing to reduce contention latency for sensor-network applications that require store-and-forward processing as data move through the network. Another important property of the protocol is that it has the ability to make trade-offs between energy and latency according to traffic conditions.

Haigang Gong, Ming Liu, Lingfei Yu, Xiaomin Wang [4] They proposed to deploy multiple, mobile base stations to prolong the lifetime of the sensor network. Their method made use of an integer linear program to determine new location for base station and flow-based routing protocol to ensure energy efficient routing during each round. They proposed four evaluation metrics and compared their solution using these metrics.

GinniTonk, S.S. Tyagi [11]

In this paper, they evaluate the performance of Mobile Ad-Hoc Network Routing Protocols Dynamic Source Routing (DSR), Ad-Hoc On Demand Distance Vector (AODV) and Destination-Sequenced Distance Vector (DSDV) under different performance metrics

IV. SIMULATION SETUP

The simulations were carried out with NS-2 simulator. In order to understand on the various efficiency parameters, especially, Network Lifetime, Average End-End Delay, Energy Consumption Packet Delivery Ratio and Throughput of the ad-hoc routing protocols, we are scenarios of static and mbile models with each 25, 50and 75 nodes for Ad-hoc On-demand Distance Vector, and Dynamic Source Routing protocols.

The following metrics were employed for the purpose of performance analysis of protocols:

Throughput: It is the number of packets/bytes received by source per unit time. It is an important metric for analysing network protocols and is measured in kbps.

Packet Delivery Ratio : It is the ratio of actual packet delivered to total packets sent. The following table shows the values of the various parameters used during simulation of these protocols. It is measured in percentage.

Average End to End Delay- It is taken as the average time from the begining of the packet transmission at a sourcs node until until packet delivery to the destination. It is measured in milli seconds

Normalised Routing Load- It is the number of routing packets transmitted perdata packet delivered at the destination. It is expressed in percentage.

Energy Consumption- It is the total amount of energy required for communication and its unit is taken in milli joules.

Network Lifetime- It is the time at which the first node of the network dies. It was measured in seconds.

Table 1: Values for Simulation Parameters

Parameters	Values
Routing Protocols	AODV, DSR
No of Nodes	25, 50, 75
Models	Static, Mobile
Simulation Period	300 sec
MAC type	ED-TDMA
Initial Energy	10 Joule
Connection Type	CBR
Simulation Area	500m X 500m

V. PERFORMANCE METRICS AND RESULTS

The following tables show the results obtained under different simulations performed.

Table 2: Average throughput(kbps) for static model

NODES	DSR	AODV
25	42.65	47.39
50	41.8	43.57
75	39.11	34.63

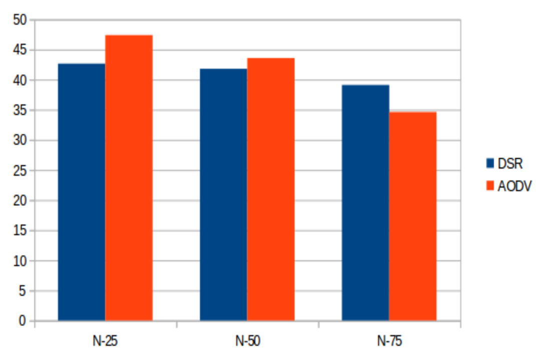

Fig 1: Average throughput(kbps) for static model.

Table 3: Average throughput(kbps) for mobility model.

NODE	DSR	AODV
25	48.65	50.12
50	46.16	39.05
75	43.02	47.39

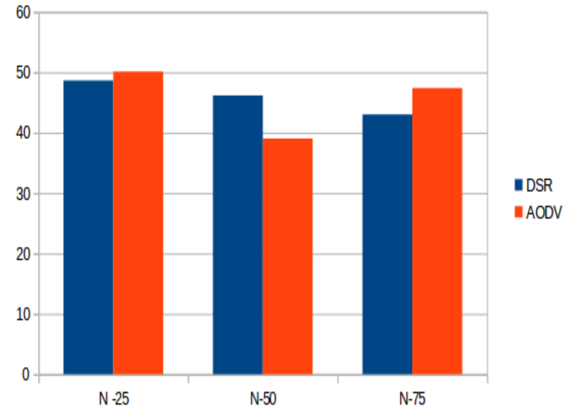

Fig 2: Average throughput(kbps) for mobility model.

Table 4: Average end-to-end delay(ms) for static model.

NODES	DSR	AODV
25	1500	700
50	1650	570
75	1100	1350

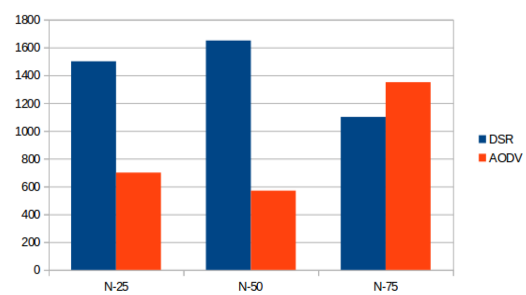

Fig 3: Average end-to-end delay(ms) for static model.

Table 5: Average end-to-end delay(ms) for mobility model.

NODES	DSR	AODV
25	1000	460
50	1200	300
75	850	960

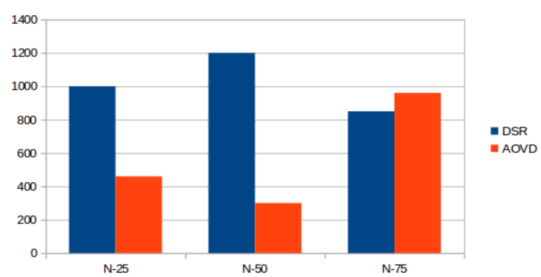

Fig 4: Average end-to-end delay(ms) for mobility model.

Table 6: Packet Delivery Ratio(percentage) for static model.

NODES	DSR	AODV
25	76	80.96
50	70.56	74.32
75	67.03	70.58

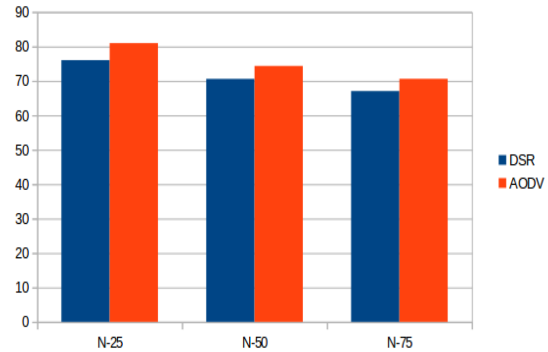

Fig 5: Packet Delivery Ratio(percentage) for static model.

Table 7: Packet Delivery Ratio(percentage) for mobility model.

NODES	DSR	AODV
25	79.4	82.05
50	71.3	77.03
75	74.28	76.70

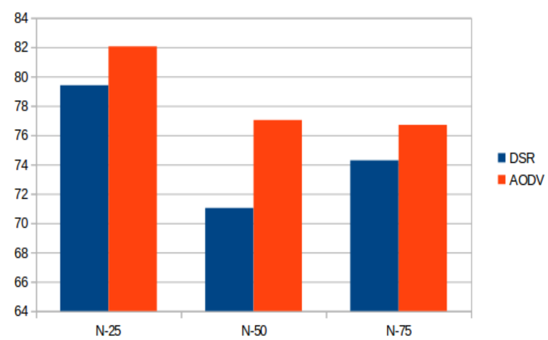

Fig 6: Packet Delivery Ratio(percentage) for mobility model.

Table 8: Normalised Routing Load (percentage) for static model

NODES	DSR	AODV
25	5	9
50	7	8
75	11	6

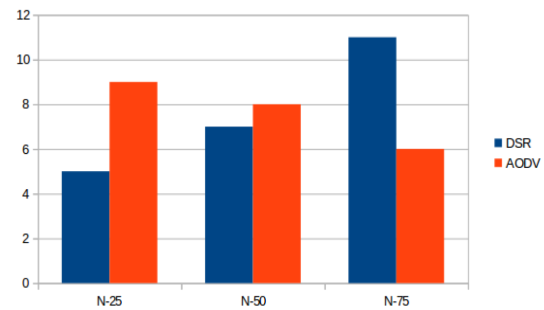

Fig 7: Normalised Routing Load (percentage) for static model

Table 9: Normalised Routing Load (percentage) for mobility model

NODES	DSR	AODV
25	2	9
50	3	8
75	8	6

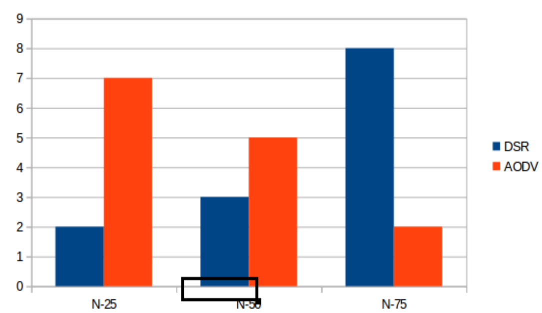

Fig 8: Normalised Routing Load (percentage) for mobility model

Table 10: Network Lifetime(seconds) for the static model

NODES	DSR	AODV
25	262	249
50	212	227
75	173	177

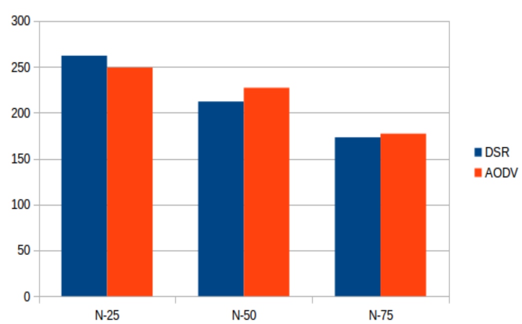

Fig 9: Network Lifetime(seconds) for the static model

Table 11: Network Lifetime(seconds) for the mobility model

NODES	DSR	AODV
25	270	281
50	237	253
75	195	186

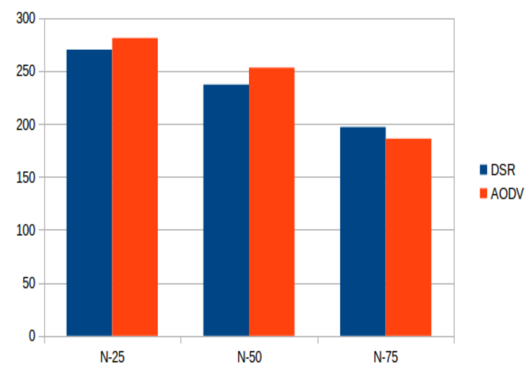

Fig 10: Network Lifetime(seconds) for the mobility model

Table 12: Energy Consumption(Joules) for the static model

NODES	DSR	AODV
25	2.648	2.88
50	3.507	3.615
75	4.881	5.667

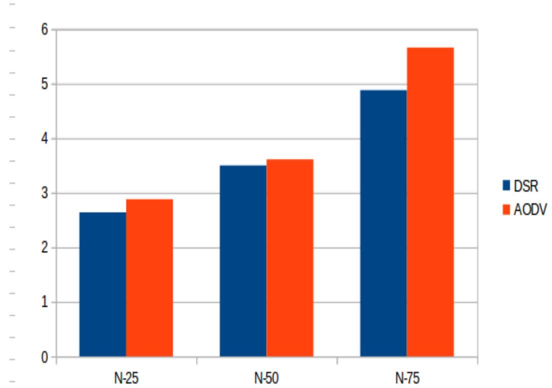

Fig 11: Energy Consumption(Joules) for the static model

Table 13: Energy Consumption(Joules) for the mobility model

NODES	DSR	AODV
25	2.75	3
50	3.53	3.74
75	5.68	6.57

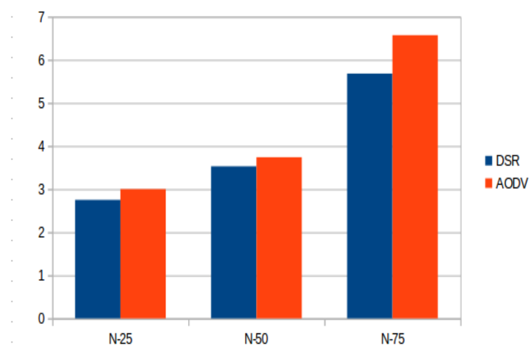

Fig 12: Energy Consumption(Joules) for the mobility model

VI. CONCLUSION

We have evaluated the overall network behaivour and the energy consumption for communication for static and mobile wireless sensor networks for the protocols-AODV and DSR using ED-TDMA.The network performance was measured using Average throughput(kbps), Average end-to-end delay(ms), packet delivery ratio(percentage), Network lifetime (seconds), Normalised routing load(percentage), Energy consumption(joules).

From the evaluation results we conclude that AODV outperforms DSR in most cases and the energy consumption increased for high density deployment under high traffic for both static and mobility WSN.

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