Volume 5, Issue 6, June 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Performance Analysis of Various Routing Protocols for Dynamic Wireless Sensor Network

Simmy, Deepak Kedia
Department of ECE, GJUS&T, Hisar,
Haryana, India

Abstract— In Wireless Sensor Networks, Routing protocols are used to determine the route of data packet transmission from source to destination. These routing protocols differ from each other in many aspects. A comparison of AODV and DYMO routing protocol for mobile sensor nodes is presented in this paper in terms of various parameters i.e. throughput, end to end delay, packet delivery ratio and energy consumption. Also three energy models Generic, Mica-mote and MICAz have also been considered for detailed comparative analysis.

Keywords— AODV, DYMO, Energy consumption, Mica-mote, MICAz, Generic

I. INTRODUCTION

Wireless Sensor Network consists of small sensor nodes that do the task of sensing environment temperature, humidity, air pressure, sound etc. In sensor network, sensor nodes send data to the other node in the network either directly (source and destination nodes are close to each other) or via hop (source and destination are far apart to communicate directly).

In ad hoc networks, nodes are not familiar to the topology of the network. Instead, they have to discover it i.e. a new node announces its presence and listens for announcements broadcasted by its neighbours. Each node learns about its other nearby nodes and how to reach them. Ad hoc network routing protocols can be used to discover the route. Routing protocols can be classified in many ways. One of the classifications of routing protocol is presented here: Proactive (Table driven) routing, Reactive (on-demand) routing and Hybrid (both proactive and reactive) routing [1].

In proactive routing protocol every source maintains the network topology information by exchanging the routing information periodically. Examples of proactive routing protocol are: OLSR, DSDV, STAR, WRP etc. In proactive routing protocol large amount of data is used in maintenance and if failure occurs then restructuring process is slow. In reactive routing protocol route is discovered when needed, that is why known as on-demand routing protocol. Examples of reactive routing protocol are: DSR, AODV, DYMO etc. The disadvantages of reactive routing protocol includes large delay in route discovery and flooding of route request packets leads to network clogging. Hybrid routing protocol uses the advantages of both proactive and reactive routing protocols. Here, initially routing is done using proactively possible routes and then for additionally activated nodes reactive protocol is used. Example of hybrid routing protocol is ZRP (uses IARP as proactive and IERP as reactive protocol) [2].

Reactive routing protocol is used mostly. And, in this paper AODV and DYMO routing protocols are compared for dynamic network, in terms of throughput, end to end delay, packet delivery ratio and energy consumed by the network, with respect to pause time of the mobile nodes.

II. ROUTING PROTOCOLS.

A. AODV

The Ad hoc On-demand Distance Vector (AODV) [3] routing protocol falls under reactive routing protocol, which means whenever a node wants to transmit some data to another node, at that time it start searching for the route. If they do not want to send any data they would not go for any route searching. So, when they need they search for the route. In order to discover a route, first the source will transmit the route request packet, destination receiving the route request packet will reply by sending route reply packet. AODV maintain all the routes in the form of table. When any entry is made in the table, timer is also associated with the table, that timer specifies at what time that entry should be removed from the table. Route discovery in AODV is explained below.

Route discovery— when a node wants to transmit some data to another node and having no route to the destination node, it will start route discovery mechanism by broadcasting route request (RREQ) packet. RREQ packet consists of source address, source sequence number, broadcast id, destination address, destination sequence number and hop count. If intermediate nodes receiving RREQ packet, have route to the destination node with higher sequence number then they will send the route reply (RREP) packet otherwise rebroadcast the RREQ packet. Before rebroadcasting, intermediate node will update the hop count and create an entry to back track the source in their routing table. And rebroadcasted packet will be received by other intermediate nodes in the network until it reaches the destination. As RREQ reaches the destination, a back track to reach the source from the destination node is established. Now, destination will create a route reply packet that travels from destination node to the source node creating an entry of forward path to reach destination in the routing table of intermediate nodes. So, as RREP reaches the source node, route will be established between source and destination. If link between any two nodes fail due to any reason, route error message (RERR) is flooded into the network and new route is discovered.

B. DYMO

Dynamic Mobile On-demand (DYMO) routing protocol is successor of AODV routing protocol. In DYMO, route creation mechanism is same as the DSR (Dynamic Source Routing) routing protocol and route maintenance mechanism is similar to AODV routing protocol [4].

Route Discovery— In DYMO [5] routing protocol, to discover the route from source to destination, source node broadcasts the route request (RREQ) packet to its neighbours, which on receiving RREQ packet stores the backward route to the source in its routing table and rebroadcast the RREQ packet after attaching its address to RREQ packet, which is called path accumulation function. Same thing is done by other intermediate nodes in the network, until RREQ packet reaches the destination. On receiving RREQ packet, destination reply to source node by transmitting route reply (RREP) packet. On receiving RREP packet each intermediate node attach its address to RREP packet before transmitting it, similar to RREQ packet. When source node receives the RREP packet, route is established between source node and destination node. Route maintenance is similar to the AODV routing protocol.

III. SIMULATION SCENARIO

We have used QUALNET Developer 5.2 simulator for the simulation of wireless sensor network. We have designed a scenario with 10 sensor nodes randomly placed in the area of 1500x1500 m^2 as shown in figure 1. Here, all the nodes are source node except one node which acts as a sink node; we have assigned that node as PAN coordinator. From the remaining 9 nodes, 3 nodes are coordinators that relay data to the sink node and remaining 6 nodes are Reduced Function Device (RFD). CBR (Constant Bit Rate) is used as traffic source [6].

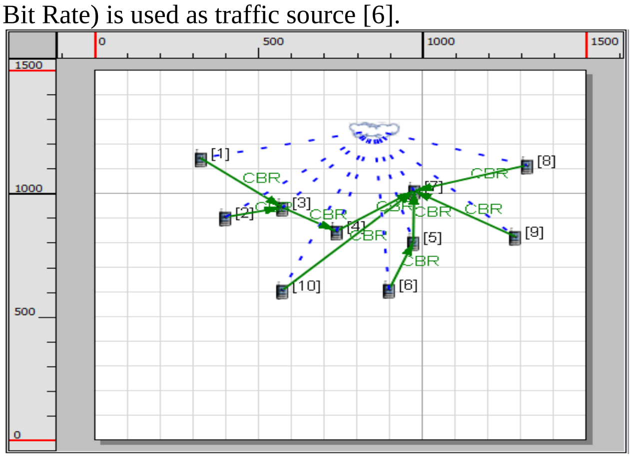

Fig. 1 Simulation scenario

The network designed in this paper is dynamic, i.e. all the nodes in the network are mobile. Mobility model used is Random Waypoint Mobility model, in which node selects a random destination and move in the direction of that destination in straight line. After reaching the destination, node stays there for a time period equal to the pause time and then repeats the same for entire simulation.

TABLE I SIMULATION PARAMETERS

Terrain Size	1500x1500 m^2
Simulation time	300 sec
Transmission Power	0dBm
Radio type	IEEE 802.15.4
MAC protocol	IEEE 802.15.4
Energy models	Generic, Mica-mote, MICAz
Routing protocols	AODV, DYMO
Mobility	Random Waypoint
Min. Speed	0m/s
Max. Speed	20m/s
Pause Times	30, 60, 90, 120, 150 sec

IV. SIMULATION RESULTS

The network used in our scenario consists of mobile nodes and we have analysed the effect of variation of pause time on the performance of AODV and DYMO routing protocol. The parameters used for performance measurement are: Throughput, end to end delay, packet delivery ratio and energy consumption.

A. Throughput

Throughput is defined as the ratio of total amount of data successfully received by the receiver to the total transmission time. Throughput is measured in bits/sec.

The throughput results of AODV and DYMO routing protocol are shown in figure 2. As shown in the graph, throughput of DYMO routing protocol is greater than AODV routing protocol. The reason behind this is that the path accumulation function in DYMO decreases routing overhead and hence, its throughput is higher than AODV.

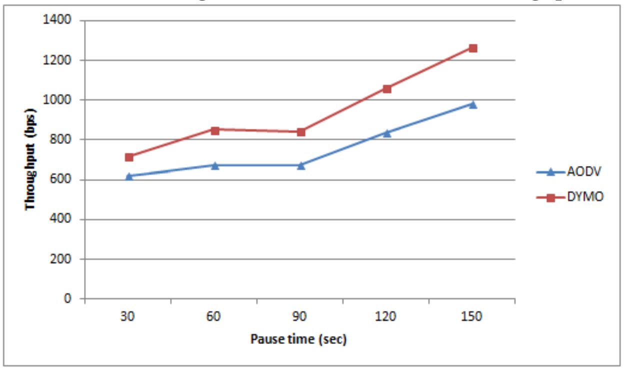

Fig. 2 Throughput vs. Pause time

The graph also shows that with increase in pause time, throughput of the network increases. This is because of decrease in link breakage with increase in pause time [7].

B. End to End Delay

It is the average time taken by packets to reach from source node to the destination node. Figure 3 shows delay performance of AODV and DYMO routing protocol.

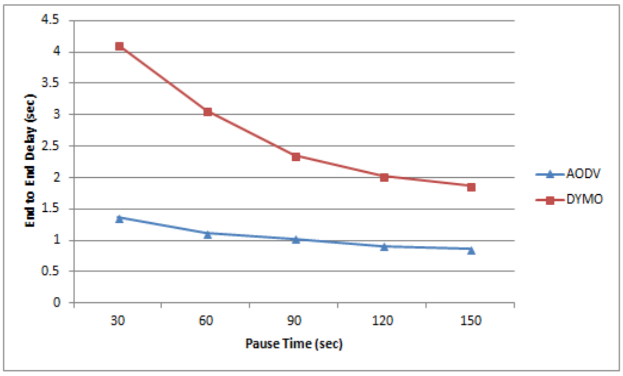

Fig. 3 End to End Delay vs. Pause time

In AODV, routing table of intermediate nodes stores the address of the next hop of forward and reverse path made by RREP and RREQ packets respectively. While in DYMO routing protocol, RREQ and RREP packets carry the addresses of intermediate nodes. So, end to end delay is less in case of AODV than DYMO routing protocol.

Figure 3 also shows that, delay decreases with increase in pause time. This is because for increased pause time, nodes behave as static nodes that lead to less number of hops for data transmission and hence, decrease in end to end delay.

C. Packet Delivery Ratio

It is defined as the ratio of total number of successfully received packets to the total transmitted packets. Packet Delivery ratio of AODV and DYMO routing protocol is shown in figure 4. The figure shows that DYMO performs better than AODV routing protocol. Because DYMO uses path accumulation function, which reduces the route request packets and increase the reception of data packet.

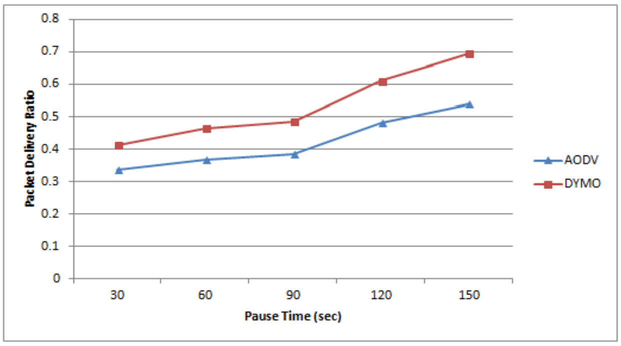

Fig. 4 Packet Delivery ratio vs. Pause time

Also with increase in pause time, packet delivery ratio increases. The reason for this is same as that for increase in throughput with pause time; that is with increase in pause time, link breakage probability decreases, so packet delivery ratio increases.

D. Energy Consumed

It is the total energy consumed in the network i.e. the sum of energies consumed in transmit, receive and idle mode.

$$E_{Total} = E_{Rx} + E_{Tx} + E_{idle} \quad \text{......................... (1)}$$

In this paper, we have analysed three energy models named Generic, Mica-mote and MICAz. Here, energy consumption for the three models is plotted against Pause time. Figure 5, 6 and 7 show graphs of energy consumption of Generic, Mica-mote and MICAz energy models respectively. We observed from the graphs that for dynamic network, DYMO consumes less energy than AODV in all the energy models [6].

It is also observed that energy consumed in the network decreases with increase in pause time.

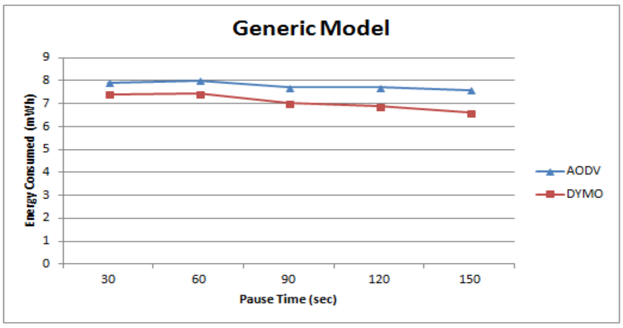

Fig. 5 Energy Consumption in Generic Energy Model vs. Pause Time

The comparative analysis of three energy models show that among all the three energy models, energy consumed using Generic model is highest. And lowest energy is consumed using MICAz model. To summarise,

$$E_{Total\_Generic} > E_{Total\_mica-mote} > E_{Total\_MICAz} \quad \text{......................... (2)}$$

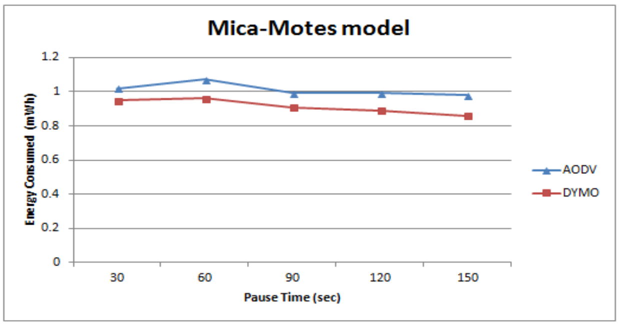

Fig. 6 Energy consumption in Mica-mote Energy model vs. Pause Time

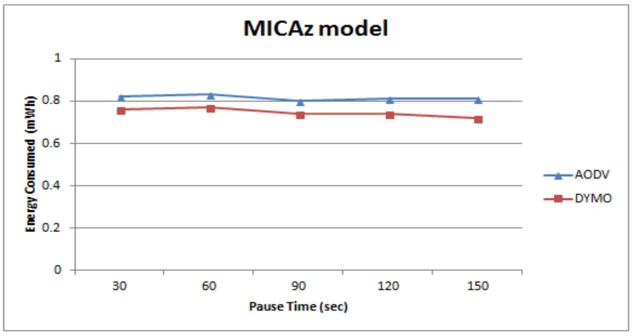

Fig. 7 Energy Consumption in MICAz Energy model vs. Pause Time

During simulation, we have also observed that in MICAz model, energy consumed in transmission and reception is greater than the energy consumed in transmission and reception in Mica-mote model [8], [9] i.e.

$$(E_{Tx} + E_{Rx})_{MICAz} > (E_{Tx} + E_{Rx})_{Mica-mote} \quad \text{......................... (3)}$$

V. CONCLUSION

In this paper, we have analysed the performance of AODV and DYMO routing protocols. The parameters used to analyse the performance are Throughput, End to End Delay and Packet Delivery Ratio. We have analysed all the parameters by varying the pause time. We have concluded that for dynamic network, DYMO performs better than

AODV routing protocol. Therefore, DYMO protocol is better than AODV routing protocol for dynamic sensor network. Also, the energy consumed by the network is analysed for AODV and DYMO routing protocol using three energy models viz. Generic, Mica-mote and MICAz. And we have concluded that DYMO consumes less energy as compared to AODV in all the three energy models.

REFERENCES

[1] Ashish K. Maurya, Dinesh Singh, Ajeet Kumar and Ritesh Maurya (2014), *"Random Waypoint Mobility Model based Performance Estimation of On-Demand Routing Protocols in MANET for CBR Applications"*, IEEE International Conference on Computing for Sustainable Global Development (INDIACom), India, pp. 835-839, March 5-7, 2014.

[2] Md. Arafatur Rahman, Farhat Anwar, Jannatul Naeem and Md. Sharif Minhazul Abedin (2010) *"A Simulation Based Performance Comparison of Routing Protocol on Mobile Ad-hoc Network (Proactive, Reactive and Hybrid)"*, IEEE International Conference on Computer and Communication Engineering (ICCCE), Malaysia, pp. 1-5, May 11-13, 2010.

[3] C. Perkins, E. Belding-Royer and S. Das (2003), *"Ad hoc On-Demand Distance Vector (AODV) Routing"*, IETF, July 2003.

[4] Waseem M. Arain and Sayeed Ghani (2010), "*Impact of offered load on performance of routing protocols in Mobile Ad Hoc Networks"*, IEEE UKSim Fourth European Modelling Symposium on Computer Modelling and Simulation, Italy, pp. 438-443, Nov. 17-19, 2010.

[5] I. Chakeres and C. Perkins (2008), *"Dynamic MANET On-demand (DYMO) Routing"*, IETF MANET, Internet-Draft, Dec. 5, 2008, draft-ietf-manet-dymo-16.

[6] Sarah Asheer and Sanjeet Kumar (2014), *"Performance of Wireless Sensor network Under Various Energy Models, Routing Protocols and Node Mobility Conditions"*, IEEE International Conference on Advanced Communication Control and Computing Technologies (ICACCCT), India, pp. 813-817, May 08-10, 2014.

[7] G R K Sai Teja and P. Samundiswary (2014), *"Performance analysis of DYMO protocol for IEEE 802.15.4 based WSNs with mobile nodes"*, IEEE International Conference on Computer Communication and Informatics (ICCCI), India, January 03-05, 2014.

[8] *"MICAz datasheet*", URL: http://www.memsic.com

[9] *"Mica2 mote datasheet*", URL: http://www.eol.ucar.edu/isf/facilities/isa/internal/CrossBow/DataSheets/mica2.pdf.

