Performance Analysis of Routing Protocol for IEEE 802.15.4 WSN

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Abstract— **Wireless sensor network is a type of wireless network basically it consist of small autonomous device with wireless networking, In wireless sensor network minimizing energy consumption is one of the most critical issue because sensor node in wireless sensor network constraint means battery power ,storage and communication capability. In this paper the energy consumption for wireless sensor network node is analyzed and compare with AODV Further, the performance metrics such as delivery ratio and delay are determined and analyzed for various simulation times and number of nodes. This energy aware ad hoc on demand routing protocol for IEEE 802.15.4 enabled WSN is simulated by using ns-2.35 for different number of nodes and simulation time.**

Keywords— **WSN, AODV, EAODV**

I. INTRODUCTION

Recent advances in electronics and wireless communication technologies have enabled the development of large-scale wireless sensor networks that consist of many low-power, low-cost, and small-size sensor nodes. Sensor networks hold the promise of facilitating large-scale and real-time data processing in complex environments.

Some of the application areas are health, military, and home. In military, for example, the rapid deployment, self-organization, and fault tolerance characteristics of sensor networks make them a very promising technique for military command, control, communications, computing, and targeting systems. In health, sensor nodes can also be deployed to monitor patients and assist disabled patients, and etc. The area of interest for the project is the survey of different routing protocols that have been developed for minimum energy consumption and find their capabilities and deficiencies and suggest the most efficient among them. The sensor's low cost has made wireless sensor networks more viable and has contributed to their increasing popularity as potential low-cost solutions to a variety of real life challenges

II. AODV

AODV [4] is a reactive routing protocol that determines routes on-demand. It is based on the distance vector technology. The hosts only know the next hop to every destination. When a source host wants to send packets to the destination and cannot get the routes from its routing table, it will broadcast a Route Request (RREQ). The receivers may establish the routes back to the source host through the paths that they get the RREQ. If the receiver has an active route to the destination, it will be uncast a Route Reply (RREP) back to the source. Otherwise, the RREQ will be re-broadcast further. If a reply is sent, all hosts along that path may record the route to the destination through this packet. Because there may exist multiple exclusive paths between two hosts, a mobile host can receive the same RREQ more than once. To prevent the same request from being broadcast repeatedly, every request is uniquely identified by a Host ID, Broadcast ID couple. Every host keeps a record for the RREQs that have been processed. The mobile hosts send out the Route Error (RERR) packets to their neighbors to report broken paths and activate the route re-discovery procedure.

To avoid routing loop and identify the freshness of the route, destination sequence number is introduced. The sequence number of a mobile host can only be updated by itself in monotonically increasing mode. A larger sequence number denotes a fresher route. The sequence number is carried in both RREQ and RREP. The sequence number in RREP must be larger than or equal to the one carried in corresponding RREQ to avoid the source host to adopt a stale path. When more than one path represented by different RREPs is available, the one with the largest destination sequence number is used. If several paths have the same sequence number, the shortest one is chosen. AODV's desirable features are its low byte overhead in relatively static networks and loop free routing using the destination sequence numbers. However, the lifetime of network is reduced by using the same nodes (having shortest route) repeatedly for transferring the data from source to destination nodes.

III. EAODV

Sequence no	Next pointer	Previous pointer	Hop counter	job requirement template

Frame format of Message fields of EAODV

To identify each node distinctly, a unique node identification number (node id) is used. Each message contains the following field given in figure 1.

DESTINATION IP ADDRESS
RREQ ID
DESTINATION SEQUENCE NUMBER
MINIMAL RESIDUAL ENERGY (ADDED)
ORIGINATOR SEQUENCE NUMBER
ORIGINATOR IP ADDRESS

Figure:1. A RREQ message format for EAODV

Previous Pointer: The pointer points to the previous node in the route from source to Destination. Previous pointer at a source node where the message has generated holds a null value.

Next pointer: pointing to the next node in the route from source to destination.

Sequence no: It gives a unique sequence number to messages for a particular job Requirement template.

Hop Counter: It counts the number of traveled nodes.

Job Requirement Template: This template contains the minimum part of the job Requirement template which is required to be matched

The proposed protocol performs a route discovery process similar to the AODV protocol. The difference is to determine an optimum route by considering the network lifetime performance; that is, considering residual energy of nodes on the path and hop count. In order to implement such functions, a new field, called Min-RE (Minimum Residual Energy) field, is added to the RREQ message as shown in Figure 1.2 the Min-RE field is set as a default value of -1 when a source node broadcasts a new RREQ message for a route discovery process.

To find a route to a destination node, a source node floods a RREQ packet to the network. When neighbor nodes receive the RREQ packet, they update the Min-RE value and rebroadcast the packet to the next nodes until the packet arrives at a destination node. If the intermediate node receives a RREQ message, it increases the hop count by one and replaces the value of the Min-RE field with the minimum energy value of the route. In other words, Min-RE is the energy value of the node if Min-RE is greater than its own energy value; otherwise Min-RE is unchanged. Although intermediate nodes have route information to the destination node, they keep forwarding the RREQ message to the destination because it has no information about residual energy of the other nodes on the route. If the destination node finally receives the first RREQ message, it triggers the data collection timer and receives all RREQ messages forwarded through other routes until time expires. After the destination node completes route information collection, it determines an optimum route and then sends a RREP message to the source node by uncasing. If the source node receives the RREP message, a route is established and data transfer gets started. Such route processes are

Performed periodically, though node topology does not change to maintain node energy consumption balanced. That is, the periodic route discovery will exclude the nodes having low residual energy from the routing path and greatly reduce network partition.

IV. RESULT AND DISCUSSION

AODV and EAODV protocol are simulated by using network simulator (ns-2) [13] of version 2.35, by varying the no of nodes from 100 to 250 and simulation time from 100 s to 400s. Then the performance parameters such as delivery ratio and delay are determined and analyzed for AODV and EAODV protocol by varying simulation time and coverage area. The simulation parameters used for simulation is given in table 1.

Simulation Parameter	Value
IEEE Standard	802.15.4
Channel type	Wireless channel
Traffic mode	CBR
Simulation time	100 (s) to 400 (s)
No of mobile node	100 to 250
Routing protocol	AODV
Simulation platform	NS-2.35

Table1. Simulation Parameters

A. *Delivery ratio analysis*

EAODV outperforms AODV by achieving higher delivery ratio for different simulation time with 100 nodes as illustrated by the figure 3. As the simulation time increases the delivery ratio decreases because the packet loss will be increased due to the increase in the link failure.. The higher delivery ratio achieved by EAODV is due to the selection of route involving the nodes with less energy level and shortest route for transmission of data from source to destination node.

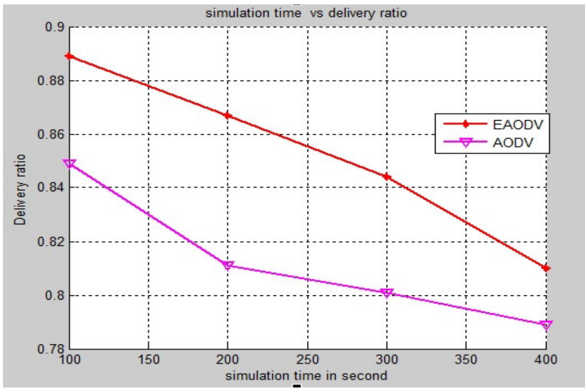

Figure.1Delivery Ratio with respect to simulation time

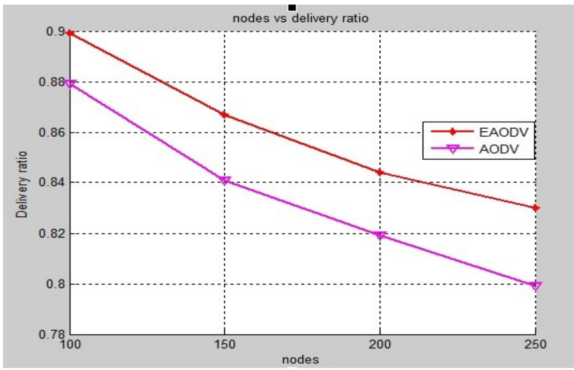

Figure.2 Delivery Ratio with respect to nodes

It is depicted through the figure 4 that EAODV provides higher delivery ratio of approximately 3% than that of AODV for different coverage area with consideration of 100 nodes. The improvement in delivery ratio is due to the fact that EAODV selects neighbor node having minimum energy level as well as shortest path. The reduced delivery ratio for increased coverage area is due to more random nature of nodes which increases packet loss.

B. Delay analysis

It is verified through simulation results shown in figure 5 that delay of EAODV protocol is higher than that of AODV protocol. EAODV has higher delay than that of AODV protocol depicted in Figure 1.5. The increment in delay is due to the fact that EAODV selects intermediate nodes based upon their energy levels in addition to the shortest route which will increase the path length.

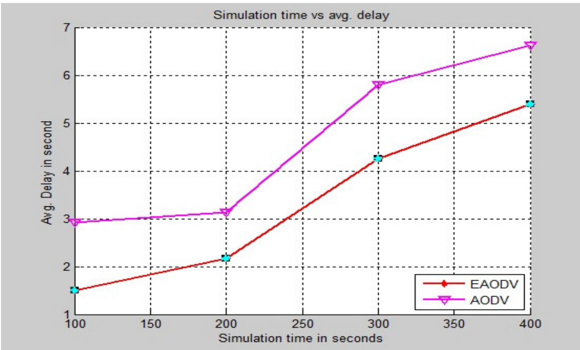

Figure.3 Average delay with respect to simulation time

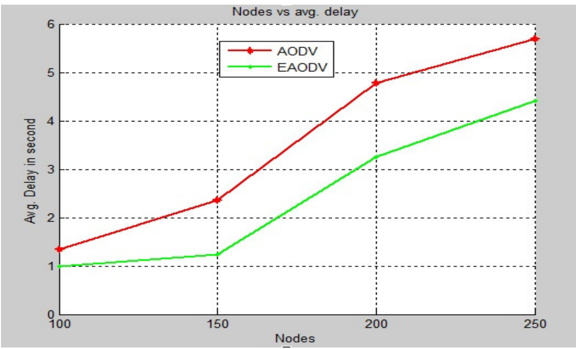

Figure.4 Average delay with respect to nodes

The end to end delay of EAODV is higher than the AODV demonstrated in figure 6. The higher delay attained by EAODV for larger coverage area is due to the more number of hops taken by path involving the nodes based upon their energy levels in addition to the shortest route to transfer the packets from source to target node.

V. CONCLUSION

Wireless Sensor Networks have emerged as an important new area in wireless technology. The key challenge in sensor networks is to maximize the lifetime of sensor nodes due to the fact that it is not feasible to replace the batteries of thousands of sensor nodes. Therefore, computational operations of nodes and communication protocols must be made as energy efficient as possible. Hence, energy efficient routing protocol is required for sensor networks.

EAODV protocol is developed for IEEE 8012.15.4 enabled WSN by using ns-2.35. The performance parameters such as delivery ratio and delay of EAODV are determined and also compared with AODV protocol by varying the simulation time from 100s to 400s considering 100 coverage area for different no of nodes from 100 to 250. The results show that an improvement of approx 3% in delivery ratio is achieved by using the EAODV protocol than the standard AODV. This is mainly due to the successful transmission of packets from source to destination by considering path having minimum energy level nodes and shortest route. However, the delay of EAODV protocol is higher than that of AODV. The work can be extended by implementing the capability aware structure in the existing AODV protocol to improve the network performance of sensor network. The performance parameters such as delivery ratio and delay can be further analyzed by varying CBR packet size, pause time and speed of nodes.

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