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ENERGY EFFICIENT MULTIPATH ROUTING PROTOCOL FOR MOBILE SENSOR NETWORK

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Abstract: - The paper investigates the usefulness of multi-path routing to achieve lifetime improvements by load balancing and exploiting cross-layer information in mobile sensor networks. Performance gains in the order of delivery ratio and delay could be achieved by altering path update rules of existing on-demand routing schemes. Problems encountered with concurrent traffic along interfering paths have been identified as a direct consequence of special MAC protocol properties.
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Keywords: WSN, AODV, AOMDV, EAOMDV

I. INTRODUCTION

Sensor networks are dense wireless networks of small, low-cost sensors, which collect and disseminate environmental data. Wireless sensor networks facilitate monitoring and controlling of physical environments from remote locations with better accuracy. They have applications in a variety of fields such as environmental monitoring, military purposes and gathering sensing information in inhospitable locations. Sensor nodes have various energy and computational constraints because of their inexpensive nature and adhoc method of deployment. Considerable research has been focused at overcoming these deficiencies through more energy efficient routing, localization algorithms and system design. Our survey attempts to provide an overview of these issues as well as the solutions proposed in recent research literature

A. AODV

There are two types of routing protocols which are reactive and proactive. In reactive routing protocols the routes are created only when source wants to send data to destination whereas proactive routing protocols are table driven. Being a reactive routing protocol AODV uses traditional routing tables, one entry per destination and sequence numbers are used to determine whether routing information is up-to-date and to prevent routing loops.

The maintenance of time-based states is an important feature of AODV which means that a routing entry which is not recently used is expired. The neighbors are notified in case of route breakage. The discovery of the route from source to destination is based on query and reply cycles and intermediate nodes store the route information in the form of route table entries along the route. Control messages used for the discovery and breakage of route are as follows:

Route Request Message (RREQ)

Route Reply Message (RREP)

Route Error Message (RERR)
HELLO

II. AOMDV Protocol

An extension to AODV is Ad-hoc on-demand Multipath Distance Vector (AOMDV) routing protocol which is for computing multiple loop-free and link disjoint paths. For each destination, along with the respective hop counts it contains a list of the routing entries of the next-hops. Same sequence number is allocated to all next hops. This helps for keeping track of a route. A node maintains the assigned hop count, which is the maximum hop count for all the paths at each node. Loop freedom is assured for a node by accepting another path to destination if it has a less number of hop counts than the assigned for that destination. AOMDV allows intermediate nodes to reply to RREQs, while still selecting disjoint paths. During route discovery, its message overhead is high, due to increased flooding. Since it is a multipath routing protocol, the destination replies to the multiple RREQs those results are in longer overhead [7]. In this paper, all these three routing protocols are compared for proposed network model using NS-2.

A. Benefits of Multi-Path Routing

Standard routing protocols in ad hoc wireless networks, such as AODV [3] and DSR [4] are mainly intended to

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discover one single route from a source to a destination. During the route discovery process, these cost. Multi-path routing protocols aim to find multiple routes. Multiple routes can be useful to compensate for the dynamic and unpredictable nature of ad hoc networks, also in energy and bandwidth constrained sensor networks. Multi-path routing has been investigated in the Internet, in metropolitan and local networks, in wireless mobile ad hoc networks, as well as in wireless sensor networks. In [6] goals, problems and recent suggestions for multi-path routing protocols in wireless ad hoc networks have been discussed. Discovering and maintaining multiple paths causes certain overhead, but yields several advantages, namely load balancing, fault tolerance, bandwidth aggregation, and reduced delay [2].

Reduced Delay: In wireless networks running single path on-demand routing protocols, route failures trigger the path discovery process to find new routes causing route discovery delay. Delay can be reduced in multi-path routing, as backup routes can be identified immediately. Furthermore, discovering several paths and observing Quality-of-Service (QoS) characteristics of both paths permits to switch the load to another route whenever the service parameters of another route promise better quality. In wireless sensor networks, the focus of multi-path routing is often on load-balancing or fault tolerance, rather than on the aggregation of bandwidth. Often, the goal of multi-path routing protocols is to maximize the time the network is operable and fulfils its observation task.

Bandwidth Aggregation: By splitting data to the same destination into multiple streams, each stream is routed through a different path. The effective bandwidth can be aggregated. This strategy is especially beneficial when a node has multiple low bandwidth links but requires higher bandwidth than each individual link can provide.

Load Balancing: Multi-path routing can avoid congestion and improve performance. When certain nodes and links become over-utilized and cause congestion, multi-path routing can spread traffic over alternate paths to balance the load over those paths. In wireless sensor networks, the main focus of multi-path routing is typically on the load balancing issue. As nodes are constraint to a limited amount of energy, and traffic is expected to be low, the main concern is to keep the network operable for a maximum amount of time. In sensor networks, one has to deal with traffic generated by many leaf nodes attempting to deliver data to one or a few sinks. Usual on-demand routing schemes tend to utilize always the same set of nodes to forward packets, whereas many other nodes remain unused. It has been observed that in such cases nodes that have to forward traffic from large sub-trees suffer much earlier from energy depletion, whereas other nodes have only slightly been used. When nodes collaborate in sensing and data forwarding and packets are not always routed on the same routes, but the load is balanced over multiple routes, network lifetime can be increased significantly.

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
Routing protocol	AODV
Area(m^2)	100 *100 M^2
Simulation platform	ns-2.35

B. Overview

This paper investigates the usefulness of multi-path routing in wireless sensor networks. After discussing related work in Section 2, we propose in Section 3 a multi-path routing protocol for wireless sensor networks based on the AODV multi-path extensions called AOMDV. The protocol has been evaluated by simulations as discussed in Section 4. Section 5 concludes the paper.

III. PROPOSED NETWORK MODEL AND PARAMETERS

A. EAOMDV

The E-AOMDV is an energy aware ad-hoc reactive routing protocol based on AOMDV [13]. E-AOMDV is developed by appending energy model in the existing AOMDV protocol. The goal behind the developed protocol is to provide efficient recovery from "route failure" in a network. To achieve this, at the time of route discovery, it computes the energy level of the mobile nodes involved to route the packets from source to destination to avoid the route failure. It also calculates the received power to predict pre-emptively before the route failure. In mobile sensor networks, route failure may occurs due to less received power, mobility, congestion and node failures [14].E-AOMDV protocol reduces the route failures by considering the above mentioned problem and enhances the network performance.

It is inferred through the Figure 4.3 that EAOMDV provides higher delivery ratio than that of AOMDV, AODV routing protocols in varying simulation time. Further, it is observed that as the simulation time increases, the delivery ratio decreases. The higher delivery ratio offered by E-AOMDV is due to the reduced route failure which in turn decreases the packet loss. Hence the delivery ratio of E-AOMDV is higher than that of AOMDV.

IV. RESULT AND SIMULATION PARAMETERS

AODV and EAODV protocol is simulated by using network simulator (ns-2) of version 2.35, by varying the no of nodes and simulation time from 100 s to 400s. Then the performance parameters such as delivery ratio and delay are determined and analyzed for AOMDV and EAOMDV

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protocol by varying simulation time and no of nodes. The simulation parameters used for simulation is given in table

A. DELIVERY RATIO ANALYSIS

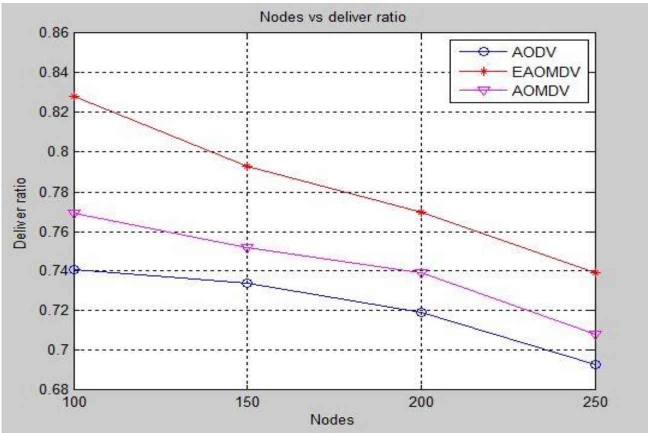

Figure 4.1 Delivery Ratio with respect to nodes

It is depicted through the figure 4.1 that EAOMDV provides higher delivery ratio than that of AOMDV and AODV for different no of nodes with consideration of simulation time as 100s. The improvement in delivery ratio is due to the fact that EAOMDV selects neighbour node having minimum energy level as well as shortest path. The reduced delivery ratio for increased no of nodes is due to more random nature of nodes which increases packet loss.

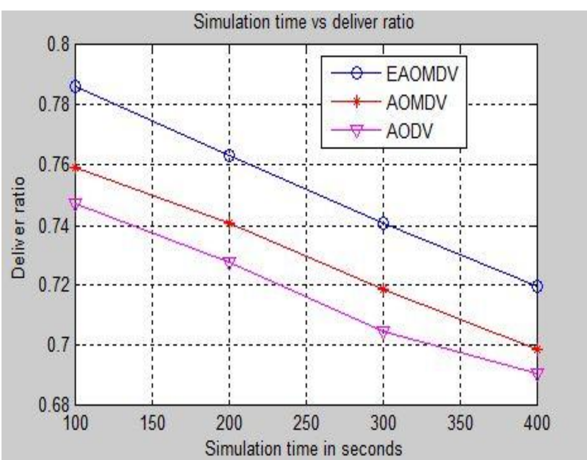

Figure 4.2 Delivery Ratio with respect to simulation time

Delivery ratio of E-AOMDV is higher than that of AOMDV. It is inferred through the Figure 4.2 that EAOMDV provides higher delivery ratio than that of AOMDV, AODV routing protocols in varying simulation time. Further, it is observed that as the simulation time increases, the delivery ratio decreases. The higher delivery ratio offered by E-AOMDV is due to the reduced route failure which in turn decreases the packet loss. Hence the rough depicted figure we have seen the comparison between AODV, AOMDV and EAOMDV in delivery ratio with respect to simulation time. EAOMDV provides better result, Delivery ratio of EAOMDV is much higher than that of AODV and AOMDV, through above figure comparison of AODV, AOMDV and EAOMDV delivery ratio with respect to simulation time. Delivery ratio of EAOMDV is good as compared to AODV and AOMDV, It means EAOMDV gives more life for wireless sensor nodes, performance parameters are delivery ratio and delay calculated, finally EAOMDV provide better performance

B. DELAY ANALYSIS

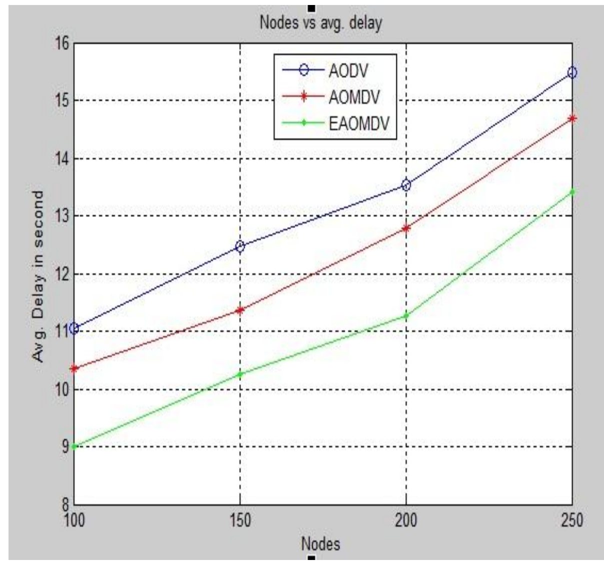

Figure 4.3 Average delay with respect to nodes

The end to end delay of EAOMDV is less than that of AOMDV and AODV as depicted in Figure 4.3. EAOMDV outperforms AOMDV and AODV. The reason is that EAOMDV chooses the path with the less route discovery process (ie less no. of hops) from source to target node. Hence, average delay of EAOMDV is reduced.

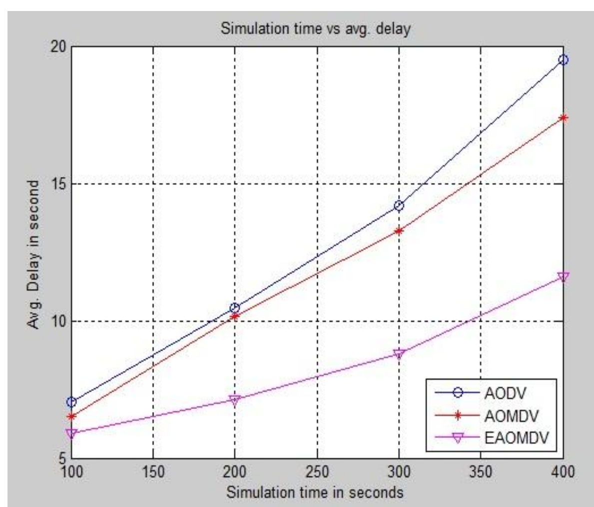

Figure4.4. Average delay with respect to simulation time

It is observed through the figure 4.4 that EAOMDV shows less delay than the AOMDV and AODV protocol as the simulation time is varied from 100 s to 400 s. it is due to the fact that EAOMDV would choose the alternate path from the available backup routes which has shortest route and minimal residual energy without involving route discovery process.

V. CONCLUSION

EAOMDV 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 EAOMDV are determined and compared with AOMDV protocol by varying the simulation time from 100s to 400s considering coverage area 100 m2 nodes for different no of nodes. The results show that an improvement in delivery ratio is achieved by using the EAOMDV protocol than the standard AOMDV. 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 AOMDV protocol is higher than that of EAOMDV.

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