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Performance Analysis of Deterministic Energy-Efficient Clustering Protocol for WSN

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Abstract:
Recently, special types of routing protocols are designed for sensor networks. Almost all of these routing protocols have considered the energy efficiency as the ultimate objective in order to maximize the lifetime of the whole network. The different types of routing protocols available in WSN are data centric, hierarchical, and location–based and on demand routing protocols. Low-Energy Adaptive Clustering Hierarchy (LEACH) protocol is one of the best hierarchical clustering protocols with probabilistic model to manage the energy consumption of WSN. However, LEACH uses global information without considering the local information i.e. the residual energy of each node for CH election process. Hence, Deterministic Energy-efficient Clustering protocol (DEC), a deterministic model is developed by using clustering scheme to manage and organize the WSN with mobile scenario. This protocol promises a better election of cluster-heads based on residual energy information and it is more energy efficient than LEACH protocols. Ad hoc on demand Distance Vector (AODV) is another routing protocol used in sensor network to support mobility. AODV is also on demand routing protocol. However, AODV do not provide multipath loop free and has link disjoint path. Hence, Ad hoc On-demand Multipath Distance Vector (AOMDV) is developed for WSN to guarantee loop freedom and disjointness of alternate paths. Frequent route discovery and route failure is occurred in AOMDV protocols due to the involvement of repeated mobile nodes without checking the energy levels of those nodes for packet transmission. To reduce the route failures occurred by the usage of nodes with reduced energy, energy aware ad hoc on-demand multipath distance vector routing protocol (E-AOMDV) is developed
by incorporating energy aware concept in AOMDV protocol to increase the network performance. In this paper, the performance analysis namely residual energy of DEC protocol is examined for various packet length and nodes. Delivery ratio analysis of EAOMDV protocol is also done in this paper for various simulation times and nodes. The simulation results shows that DEC has better performance than LEACH and also E-AOMDV has better performance than AOMDV.

I. INTRODUCTION:

Wireless Sensor Networks (WSN) is a new class of networking technology that is progressively becoming popular today. Huge strides taken in sensing technology, low-power microcontrollers and communication radio have also spurred the mass production of moderately economical sensor nodes. Such large scale sensor networks far outweigh the usage of conventional networks in circumstances like terrain, climate and other environmental constraints which delay the deployment and setting up of steady networks. Because of the tremendous scale at which such nodes can be deployed, they are extremely robust in terms of individual node failures which make them all the more promising in such extreme situations. A sensor is a hardware device that produces a assessable response signal to a variation in a physical condition such as temperature, pressure and humidity. The continual analog signal sensed by the sensors is digitized by an analog to digital converter and sent to the embedded processor for further processing.

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Because a sensor node is a micro electronic device powered by a limited power source, the attached sensors should also be slight in magnitude and consume extremely low energy. Therefore, computational operations of nodes and communication protocols must be made as energy efficient as conceivable. Hence it is required to develop energy efficient routing protocols to improve the performance of the network. In this paper an attempt has been made to implement DEC by varying packet length and nodes and the implementation of E-AOMDV protocol is also tried by varying simulation time and nodes to determine and analyze the network performance. This paper is divided into four sections: Section II reviews some of the relevant studies on existing routing models. In Section III, the proposed routing protocol is presented. Section IV discusses about the performance parameters of the DEC and EAOMDV obtained through the simulation and compared with the existing protocols. Finally, Section V concludes with the summary of the work and highlight future directions

II.EXISTING ROUTING PROTOCOLS:

A. LEACH:

LEACH is an example for hierarchical routing protocol. This protocol uses clustering schemes to cooperate among the sensors in the network. This has been proven to considerably improve the performance of WSN. The process of the clustering process initiates with a setup phase when all nodes use the indicator function for selection as Cluster Heads (CHs). The chosen CHs broadcast advertisement message (ADV) by means of the non-persistent Carrier Sense Multiple Access (CSMA) protocol. This message comprises the CH's ID and a header that shows it as an announcement message. The non -elected nodes termed Cluster Members (CMs) define their cluster by choosing the CH with the least communication cost based on the acknowledged signal strength of the advertisement message. The CMs send join-request to their elected CH using CSMA MAC protocol. This message comprises the Cluster Member-ID (CM-ID), Cluster Head-ID (CHID) and the header that indicates the message as a request.

The CHs set up a TDMA for their intra-cluster communication, which finishes the setup phase. The steady-state phase begins when sensed data are directed from CMs to CHs and from CHs to BS. The inter-cluster communication [6] is attained using the Direct Sequencing Spread Spectrum (DSSS).

B. AOMDV:

AODV is quite simple, efficient, and effective routing protocol for sensor networks which is not having fixed topology. On demand routing defines that it builds routes between nodes only on demands when needed by source nodes. The AODV routing protocol maintains routes only when or as long as they needed. It uses sequence numbers to maintain the freshness of routes. It is self-starting, loop-free, and scales to large numbers of mobile nodes. The on demand route discovery and route maintenance phases of AODV come from Dynamic Source (DSR) routing and hop-by hop routing. Usage of node sequence numbers from Destination-Sequenced Distance Vector (DSDV) routing make the algorithm cope up with topology and routing information. Maintaining the routes on-demand makes AODV a very useful and desired algorithm for sensor network.

AOMDV protocol is an extension to the AODV protocol to compute multiple loop free disjoint of paths. The AOMDV considered only disjoint nodes in all the paths. For route discovery, route request packets are propagated throughout the network thereby establishing multiple paths at destination node and at the source nodes. Multiples Loop-Free paths are achieved using the advertised hop count method at particular node. This advertised hop count is required to be maintained at each node in the route table entry per destination. The route entry table also contains a list of next hop at each node along with the corresponding hop counts. Each node maintains an advertised hop count for the destination. Advertised hop count is the "maximum hop count for all the paths". Route advertisements of the destination are sent using this hop count.

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An alternate path to the destination is accepted by a node if the hop count is less than the other hop count for the destination.

III. DEC AND E-AOMDV ROUTING PROTOCOLS:

A.DEC:

This protocol determines CH election based on the Residual Energy (RE) of each node. In simple term, the goal is to endorse DEC algorithm to look analogous to an ideal solution.The major benefit of DEC model is that the suspicions in the cluster-head elections have been reduced. Since node's energy can be determined earlier, the CH selection process is rationalized to only use the residual energy (RE) of each node. In DEC, at round m, the BS elects Nopt cluster-heads for the system. The BS can only take part in the determination of CHs if and only if m= 1.

The designated CHs broadcast their role by means of CSMA MAC just as in LEACH. However, in DEC disparate in LEACH, the join-request message will comprise CM-ID, CHID, CM-RE (Cluster Member - Residual Energy) and the legend that indicates it as a request. This way the RE evidence of CMs is known by their corresponding CHs, thus confined and it can be exploited for CH rotation in the successive rounds. After the setup phase tops, the steady phase initiates, but before the end of this phase, the current CHs checks the piggy-backed CM-RE's information acknowledged to decide whether they will persist as CHs or renounce their roles by choosing any node in their clusters with the utmost RE as the new CHs.

After this verdict is made for the new CHs and all the data from the present round is linked to the BS, the present round (r=m) ends (a perfect synchronization is implicit, just as in LEACH). The next round r=m+1begins; but since the new CH's are already chosen in the prior round, they broadcast their role in the fresh round, CMs join their group as already explained above. The steady phase activates again. This process carried in each round until the last node expires.

With this process, the battery life of WSNs is considerably improved.

B. E-AOMDV:

The E-AOMDV is an energy aware ad-hoc reactive routing protocol based on AOMDV. E-AOMDV is developed by appending energy model in the existing AOMDV protocol. The goal behind the developed protocol is to provide efficient route 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 . E-AOMDV protocol reduces the route failures by considering the above mentioned problem and enhances the network performance.

IV. RESULTS:

The wireless sensor network model using DEC (Deterministic Energy -efficient Clustering Protocol) and LEACH (Low-energy adaptive clustering hierarchy) protocol is simulated by using MATLAB. The performance parameter namely residual energy of DEC and LEACH models are determined by varying nodes and packet length. The parameters used for simulation of DEC and LEACH protocol are given in the table I. AOMDV and E-AOMDV protocol are simulated by varying the simulation time from 100 s to 400s using network simulator (ns-2) of version 2.35. Then the performance parameters of E-AOMDV protocol are determined and compared with AOMDV. The parameter used for simulation is given in the table II.

TABLE II: SIMULATION PARAMETERS of AOMDV, E-AOMDV PROTOCOLS

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Simulation Parameters	Values
Routing protocol	AOMDV,E-AOMDV
No of nodes	100,150,200,250
Simulation time	100 to 400 (s)
Traffic mode	CBR, FTP

A. Residual Energy Vs Nodes:

The simulation process is carried out to calculate residual energy of DEC and LEACH protocol for various nodes (100,150,200,250,300). It is verified through the simulation result shown in figure 1, that the residual energy of DEC protocol is higher than LEACH protocol by varying the nodes. The reason is due to the nodes involved for data transmission is less in DEC which uses the deterministic clustering approach. Hence residual energy increases. Therefore, as nodes increase residual energy increases.

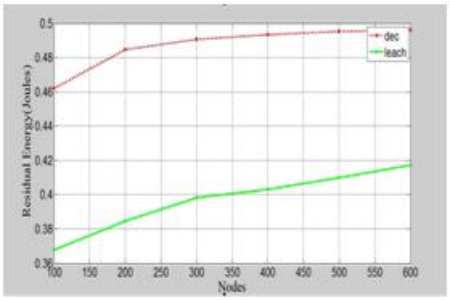
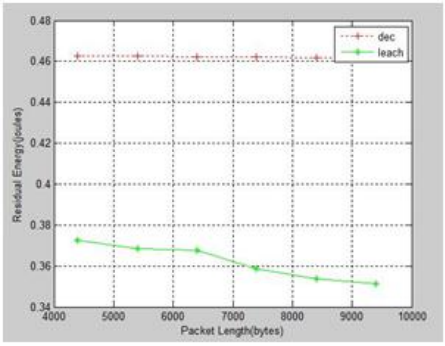


Figure1. Residual Energy of DEC and LEACH protocol for various nodes

B. Residual Energy Vs Packet Length:

The simulation process is carried out to determine residual energy of DEC protocol for various packet lengths(4400, 5400, 6400, 7400, 8400, and 9400).



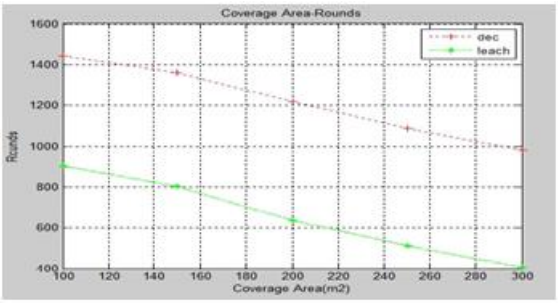


Figure2. Residual energy of DEC and LEACH protocol for various packet lengths.

C. Delivery ratio Vs Simulation Time:

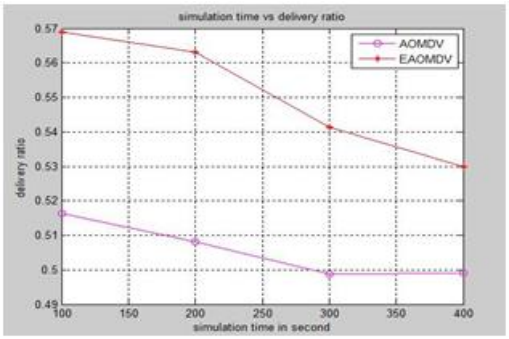


Figure.3. Delivery ratio of EAOMDV and AOMDV with Respect to simulation time.

It is inferred through the Figure 3 that EAOMDV provides higher delivery ratio than that of AOMDV 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.

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D. Delivery ratio Vs Nodes:

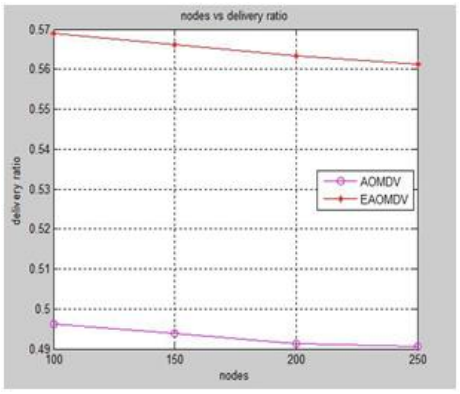

Figure.4. Delivery ratio of EAOMDV and AOMDV with Respect to Nodes.

It is depicted through the Figure 4 that EAOMDV provides higher delivery ratio than that of AOMDV for different nodes. The improvement in delivery ratio is due to the fact that EAOMDV selects neighbor node having minimum energy level as well as shortest path. The reduced delivery ratio for increased nodes is due to more random nature of nodes which increases packet loss.

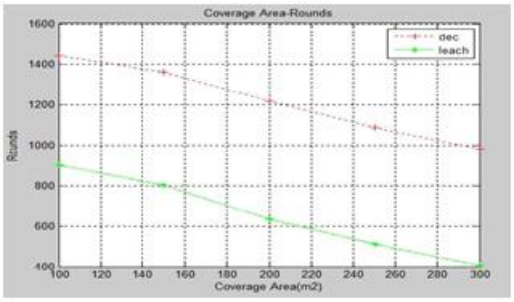

Fig 4.1 Coverage Area with respect to No of Rounds (PL=6400)

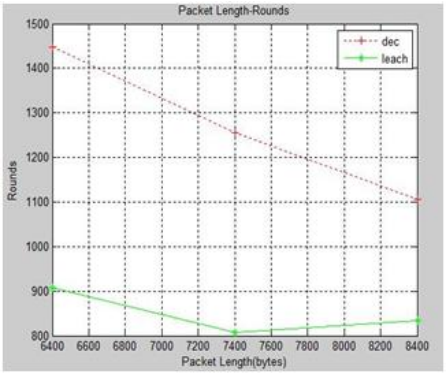

Fig 4.2 Coverage Area with respect to No of Rounds (PL=8400)

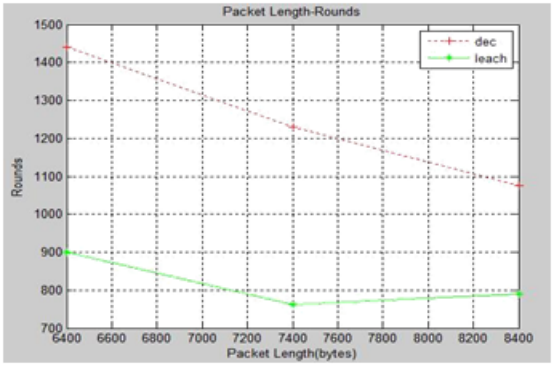

Fig 4.3 Packet Length with respect to No of Rounds (N=100)

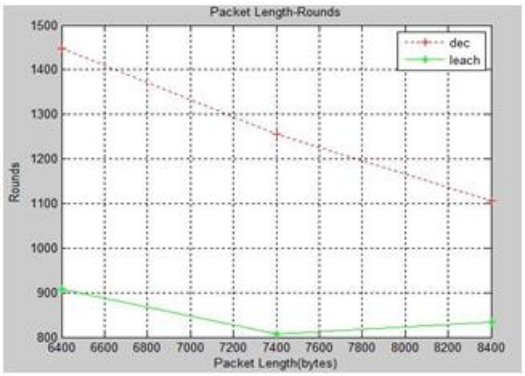

Fig 4.4 Packet Length with respect to No of Rounds (N=200)

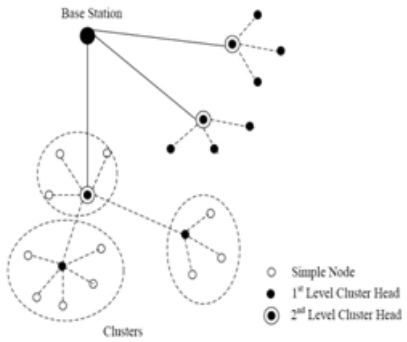

Fig: ster based Hierarchical model

V. CONCLUSION:

LEACH is a probabilistic-based model used to manage energy consumption in WSN without considering residual energy of each node during cluster-head election process. DEC outperforms the probabilistic-based models by guaranteeing that a fixed number of cluster-heads are elected per round. DEC determines CH election based on the residual energy of each node.

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DEC proves to be more robust and more stable than the probabilistic-based models. LEACH and DEC are simulated by using MATLAB. The performance parameters of LEACH and DEC protocols (Nodes Vs Residual Energy; Packet Length Vs Residual Energy) are determined and analyzed. From the simulation results, it is observed that DEC protocol outperforms LEACH protocol in terms of residual energy. Hence it increases the life time of sensor network. E-AOMDV and AOMDV are simulated by using ns2. E-AOMDV can overcome link or route failure problem than that of AOMDV protocol because E-AOMDV considers the energy levels of the nodes used to route the packets in order to reduce link failure and route discovery process. As a result, battery life of nodes increases which in turn increases network lifetime. Further, the work can be extended by incorporating security mechanisms in DEC protocol and E-AOMDV protocol to improve the performance of sensor networks in hostile environment.

REFERENES:

[1]Aderohunmu F.A., Deng J.D., Purvis M.K., "A deterministic energy-efficient clustering protocol for wireless sensor networks" , Proceedings of Seventh IEEE International Conference on Intelligent Sensors, 2000.

Sensor Networks and Information Processing, pp.341 - 346, 2011.

[2]F. A. Aderohunmu, J. D. Deng, and M. K. Purvis. "Enhancing Clustering in Wireless Sensor Networks with Energy Heterogeneity". International Journal of Business Data Communications and Networking- (Accepted, to appear in the forthcoming issue, 2011).

[3]F. Comeau, "Optimal Clustering in Wireless Sensor Networks Employing Different Propagation Models And Data Aggregation Techniques", Ph.D. Thesis, Dalhousie University, Halifax, Nova Scotia, 2008.

[4]M. Haase and D. Timmermann, "Low energy adaptive clustering hierarchy with deterministic cluster-head selection", Proceedings of IEEE Conference on Mobile and Wireless Communications Networks (MWCN), pp.368–372, 2002.

[5]W. R. Heinzelman, A. Chandrakasan, and H. Balakrishnan. "Energy efficient communication protocol for wireless micro sensor networks", Proceedings of 33rd Hawaii International Conference on System Sciences, Vol. 8, pp.8020,USA