Performance Evaluation of Energy Efficient POLY Protocol

Shimrose S.Mulla[1] Prof.Dr.S.V.Sankpal[2]
[1]Student [2]Professor
[1,2]Department of Electronics & Telecommunication Engineering
[1,2]D.Y.Patil College of Engineering & Technology, Kolhapur

Abstract— this paper consists of Performance Evaluation of Proposed protocol.The CDS technique Proven to be very useful for different types WSN Applications. The CDS protocols provide a descent amount of Efficiency & Reliability. We are trying proving that how proposed Protocol performs better than the existing Protocols. This paper explains how poly works & gives the simulation results which we have used further to compare the performances with existing CDS Based TC protocols. While for comparison some performance metrics are defined which are also explained?

Key words: Wireless sensor networks, CDS Concept Topology control, Network reliability, Energy efficiency

I. INTRODUCTION

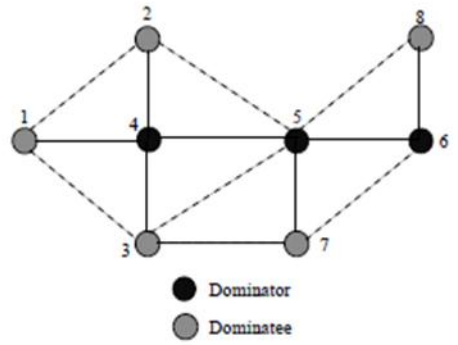
Mission Critical WSN applications consist of Homeland security, forest Fire detection etc. The CDS based Topology Control Protocols are used for these applications. These applications require the network topology to provide a certain level of reliability. This reliability [7] should however be achieved while keeping in mind the fundamental energy consumption constraint of a WSN. In this context, the Connected Dominating Set (CDS) is proven the most popular method for energy efficient topology control (TC) in WSNs.TC consists of two phases: topology construction and topology maintenance. In the topology construction phase, a desired topological Property is established in the network while maintaining connectivity. Once the topology is constructed, topology maintenance phase starts in which nodes switch their roles to cater for topological changes.

CDS size is a critical parameter which controls the compromise between reliability and energy efficiency. For instance, for small CDSs, fewer nodes handle the load of the network traffic and consequently deplete their batteries quickly. The positive side of a small CDS is that more nodes can go into sleep mode. While both energy efficiency and reliability are equally important for mission-critical WSNs, existing CDS-based routing protocols cannot simultaneously cater both metrics.

This paper Explains how poly [8] Works better than the existing CDS protocols by considering two metrics Message overhead & Energy overhead. Concept of Connected Dominating Set (CDS) based topology construction protocols for the generation of energy-efficient topology in WSN is very important .Which is briefly explained below:

II. CDS CONCEPT

Wireless sensor networks (WSNs), consist of small nodes with sensing, computation, and wireless communications capabilities, are now widely used in many applications, including environment and habitat monitoring, trace control, and etc. Routing in WSNs is very challenging due to the inherent characteristics that distinguish these networks from other wireless networks like mobile ad hoc networks or cellular networks. Hierarchical or cluster-based methods, originally proposed in wire line networks, are well-known techniques with special advantages related to scalability and efficient communication. As such, the concept of hierarchical routing is also utilized to perform energy-efficient routing in WSNs.



As shown in above figure, when a source node wants to deliver a packet to another destination node, it first forwards this packet to its dominator. And along this CDS, the packet will be derived to dominator neighbor of destination. Finally, this dominator neighbor forwards the packet to the destination node. The graph-theoretic Connected Dominating Set (CDS) principle has emerged as the most popular method for energy-efficient topology control (TC) in WSNs.

III. CDS BASED TC PROTOCOLS

The CDS based Topology control protocols ware A3, and CDS Rule K.

A. CDS-Rule K Protocol:

CDS-Rule K, proposed in [3], uses marking and pruning rules to exchange the neighbor's lists among a set of nodes. A node remains marked if there is at least one pair of unconnected neighbors and unmark itself if it determines that

All of its neighbors are covered with higher priority. The node's higher priority is indicated by its level in the tree. In CDS-based TC schemes, some nodes are a part of the virtual backbone which is responsible for relaying packets in the WSN. Non-CDS nodes conserve energy by turning off their transceivers. CDS size is a critical parameter which controls the compromise between reliability and energy efficiency. For instance, for small CDSs, fewer nodes handle the bulk of the network traffic and consequently deplete their batteries quickly [5]. The positive side of a small CDS is that more nodes can go to sleep mode. While both of these metrics energy efficiency and reliability – are equally important for mission-critical WSNs, existing CDS-based routing protocols cannot simultaneously cater both metrics [6].

B. A3 Protocol:

The authors of [1] have proposed a topology construction protocol that produces an approximate solution to form a suboptimal CDS.A3 selects active nodes which are at the farthest distance from the parent based on the signal strength and remaining energy. This allows fewer nodes to be selected in the CDS tree which in turn leads to an overhead of long distance communication. One known strategy to save energy in WSNs is that of Topology Control (TC). TC consists of two separate components: the topology construction mechanism, which finds a reduced topology while preserving important network properties, such as network connectivity and coverage, and the topology maintenance mechanism, which changes the reduced topology when it can't provide the requested service any longer. It is expected that these two mechanisms will work in a iterative manner until the network energy is depleted, and together will increase the network lifetime compared with a continuously run WSN without topology control.

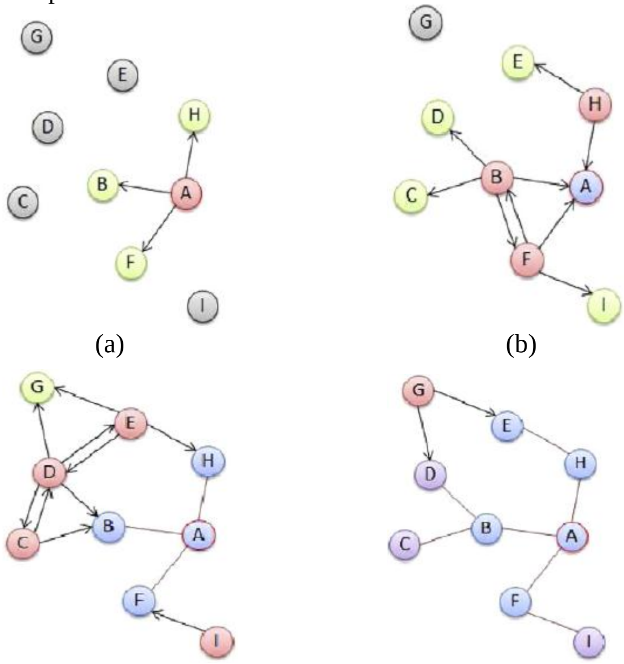
IV. THE PROPOSED PROTOCOL: POLY PROTOCOL

This work, proposes a semi distributed graph-theoretic topology control protocol for wireless sensor networks. The protocol creates the network as a connected graph and finds the number of polygons present in the network. Poly adaptively finds a polygenic backbone to turn-off the unnecessary nodes while keeping the network connected and covered.

Due to our main focus on mission-critical applications, two Fundamental design constraints that we impose on a topology construction protocol are: (1) its resultant topology should provide a desired level of packet delivery reliability, and (2) its energy efficiency should be comparable to or less than existing CDS-based topology construction protocols. To satisfy these constraints, the new protocol arranges the nodes in such a way that they form a closed path among a set of nodes. The closed path provides a reliable and energy efficient topology because:

(1) The sink node gets polygenic redundancy with its neighbors which allows the nodes to use an alternative path in case of random link failures, and
(2) It forms an active node set – nodes comprising a polygon allowing leaf nodes to enter into the dormant/ sleep mode. An additional advantage of polygenic is that the topology construction protocol does not need the position or orientation information of the nodes.

In this work it is showed that, formation of a polygon in the network provides a reliable and energy efficient topology. Following figure shows the topology formation in poly protocol. Where the area is assumed of 300 by 500m.In which the node are deployed in H-V and H-V-D Randomly to create the topology. Efficiency. For instance, for small CDSs, fewer nodes handle the load of the network. The positive side of a small CDS is that more nodes can go to sleep mode. While both of these metrics-Energy efficiency and reliability – are equally important for Mission-critical WSNs, existing CDS-based routing protocols cannot simultaneously cater both metrics. The Proposed protocol is explained as follows:



(a) (b) (c) (d)

Fig. 1:

As shown in the above figure 9 nodes are deployed randomly and one initial node is defined which is called as a sink node. In fig A, Sink node a, broadcasts hello message received by nodes B, F and H - and they wait to receive Hello message in response from its children. Nodes B, F and H recognize sender node A as their parent. Now consider fig B, H and F further broadcast hello message with parent ID set to A. Covered nodes, B and F, also recognizes one another as neighbors. When a node recognizes its children, it waits for Finish discovery message. Therefore, A is now waiting for Finish message from B, F and H. In C it is shown that. Next level nodes again broadcast the Hello message after changing the parent IDs to their respective parent. Let's say G chooses E as its parent. Moreover, C, D and E recognize their neighbors through hello message exchange. in Fig C, G broadcasts hello message. Timeout for hello message from children expires at C, D and I in which these nodes do not receive any hello message with their own IDs as parent ID. Therefore, these nodes consider them as leaf nodes.

In fig 2 e, G broadcasts hello message. Timeout for Hello message from children expires at C, D and I in which these nodes do not receive any hello message with their own IDs as parent ID. Therefore, these nodes consider them as leaf nodes. We can see in f that Node B extends the message paths with its own ID and send it to its parent node. In this way, all message paths, in the form of branches, reaches the sink node. Message paths sent by B are shown in the figure 2 f.

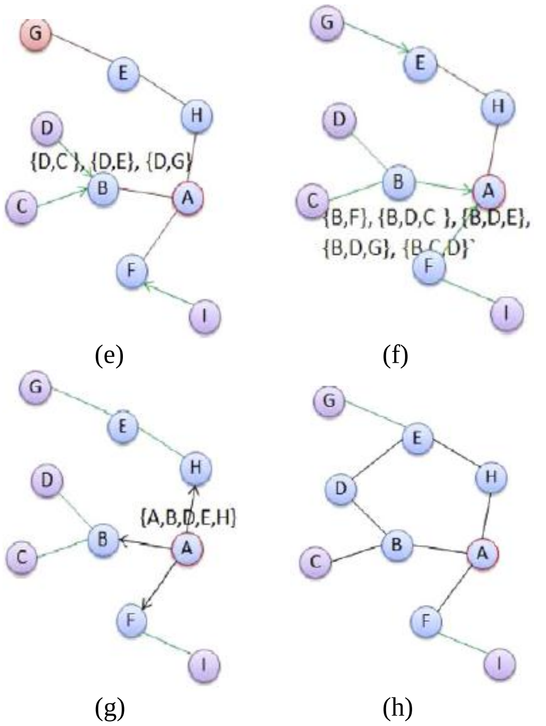


Fig. 2:

Node B extends the message paths with its own ID and sends it to its parent node. In this way, all message paths, in the form of branches, reaches the sink node. Message paths sent by B are shown in the figure. (E) After receiving finish Discovery message from all children, sink node adds it own ID to message paths and figures out a polygon. In F Sink node then broadcasts the create topology message for the chosen polygon. Nodes in the polygon set turn them as active nodes. Final is topology of polygon with redundant paths (h).

V. SIMULATION RESULT

The Grid topology consists of both H-V and H-V-D topology. While creating grid topology the no of nodes assumed in H-V grid topology is less than H-V-D grid topology. In fig: 3, shows message overhead and fig 4 Energy overhead. We can observe that Message and Energy overhead of CDS Rule-k increases due to two phase topology creation. While A3 has low message overhead because it use three way hand shake mechanism. The proposed protocol Poly has low energy overhead despite the fact that its message overhead is greater than A3.

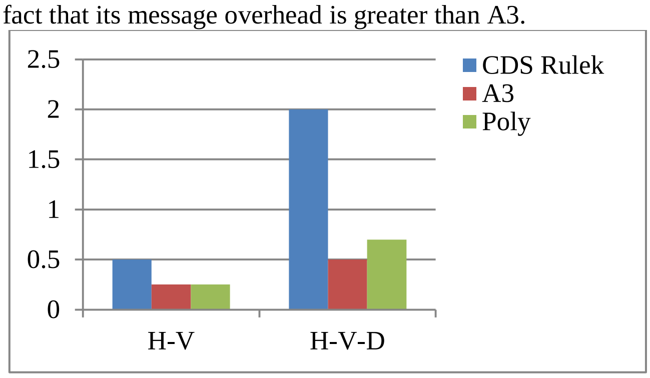


Fig. 3: Message Overhead

These protocols also show message, energy overhead of the protocol. As the network size grows no of messages exchanged increases exponentially. The increase in Node density automatically increases the no of messages shared within the node. This no of messages that CDS Rule-k have are higher than Poly protocol. An increasing node density leads to higher energy consumption due to an increase in the number of received packets. However, Poly still has lower energy consumption due to its rebroadcast Strategy for topology discovery. A3 protocol has fewer messages overhead when compared with other two protocols. The energy overhead remains constant for A3 and Poly protocols because both protocols do not use a two-phase strategy like CDS-Rule K.

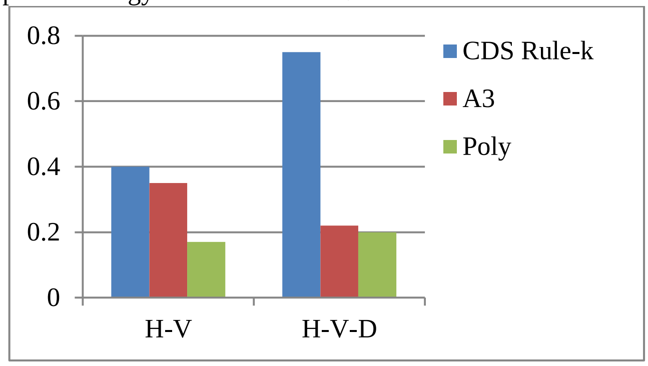


Fig. 4: Energy Overhead

Following are the Performance metrics shows that how the proposed protocol performs better in terms of Message overhead and Energy Overhead. These performance metrics are explained along with the Simulation results.

A. Message Overhead:

Message overhead is defined as the total number of packets --sent or received – generated in the whole network during an experiment.. Higher Message overhead consumes higher energy. The new Protocol tries to minimize this overhead. As shown in fig 3 the of CDS rule k is high on comparing with poly and A3.Here A3 has low message overhead because it uses three way handshake mechanism. In this case also Poly performs better. It is an important parameter which is directly affects the Energy consumed by the Network.

B. Energy Overhead:

Energy overhead is defined as the fraction of the network energy expended during construction of the topology. While maintaining the topology this metric is very important. The fig: 4 show the simulation results that we have obtained. It shows that Cds rule –k has higher energy overhead on comparing with poly and A3.And it happens because of two phase topology creation. While the other factor, node density also affects on energy consumption. As we see in H-V Grid no of node is less than that of in H-V-D Grid topology. So that Poly has less energy overhead in H-V Grid but it also performs better in H-V-D Grid as well.

VI. CONCLUSION

In this paper we propose an energy efficient POLY Protocol. This creates Polygons in the Network to form a topology. Where nodes are randomly deployed, the performance of Poly is observed in H-V & H-V-D Grid environment. We had considered Message overhead and Energy overhead as metrics for Performance evaluation. And Matlab is used as simulation tool. The simulation results shows poly performs better in terms of selected metrics providing greater efficiency and reliability.

REFERENCES

[1] P.M. Wightman and M.A. Labrador, "A3: A Topology Construction Algorithm for Wireless Sensor Network", in Proceedings IEEE Globecom, 2008
[2] Z. Yuanyuan, X. Jia, and H. Yanxiang,"Energy efficient distributed connected dominating sets construction in wireless sensor networks", in Proceedings of the ACM International Conference on Communications and Mobile Computing, pp. 797-802, 2006.
[3] J. Wu, M. Cardei, F. Dai, S. Yang,Extended dominating set and its applications in ad hoc networks using cooperative communication,IEEE Transactions on Parallel and Distributed Systems 17 (8) (2006) 851–864.
[4] V. Rodoplu, T.H. Meng, Minimum energy mobile wireless networks, IEEE Journal Selected Areas in Communications 17 (8) (1999) 1333–1344.
[5] M. Gerla, J.T. Tsai, Multicluster mobile multimedia radio network, ACM Wireless Networks 1 (3) (1995) 255–265.
[6] F. L. Levis, "Wireless sensor networks" Associate Director for Research Head, Advanced Controls, Sensors, and MEMS Group Automation and Robotics Research Institute The University of Texas at Arlington 7300 Jack Newell Blvd. S Ft. Worth, Texas 76118-7115.
[7] Muhammad Adeel Mahmood and Winston Seah, "Reliability in Wireless Sensor Networks: Survey and Challenges Ahead, School of Engineering and Computer Science, Victoria University of Wellington, Wellington, New Zealand.