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Fault Tolerant Middleware Multicast Routing In Wireless Sensor Network

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Abstract: Wireless sensor node is a composition of many small sensor nodes. Each sensor node has a potential to sense and forward the data to the other nodes and a gateway (to send information globally on internet) which is commonly known as sink. For sensor nodes, the factors that need to be worked upon are limited energy and memory. If data by all sensor nodes is sent separately to the base station then energy consumption rate increases highly which reduces survival time of the node? So to improve the network lifetime and also to minimum consumption of energy to survive the node in network the middleware multicast routing algorithm is proposed. In Proposed approach by using a clustering based middleware multicast technique allows any cluster head to be a multicast source with an unlimited number of subscribers for optimized group communication in WSN's. And also ensures that, the sensor nodes do not deprecate rapidly in energy levels.

Keywords: WSN, Node Energy, Euclidian distance, Cluster, Routing, Middleware, Multicasting.

I. INTRODUCTION

A Wireless sensor network (WSN) embodies large number of sensor nodes and is usually self-organized wireless ad hoc network. These sensor nodes are randomly dispersed over the interested area. Data is generated by sensor nodes based on its sensing mechanisms observation and the sensed data is transmitted to the base station (sink). The role of a base station is collection of the all data which is received from the different sensors, to analyse them and ultimately make decisions. Sensor nodes could be deployed in military, home, industry, and science applications. For example, transportation, warfare, disaster recovery, health care, security, industrial and building automation, and even space exploration. One of the key areas in wireless sensor networks is phenomena monitoring among a large variety of applications and in such network. Deployment of the sensor nodes can be either random or deterministic, mobile or stationary, homogeneous or heterogeneous which depends on the application.

Multicast protocols can offer several benefits. The use of a set of point-to-point channels to support a virtual multicast environment results in a complex and inefficient process, mainly in wide area networks. When a source needs to transmit a message to n receivers using point-to-point channels, it is necessary to transmit the same message n times. In the case of IPTV, where the number of receivers is extremely high, this is not only technologically impossible but also the required resources are prohibitive.

Sensor networks offer a powerful combination of distributed sensing, computing and communication. They lend themselves to countless applications and, at the same time, offer numerous challenges due to their peculiarities, primarily the stringent energy constraints to which sensing nodes are typically subjected. Energy efficiency is crucial because of the scale and application environments in which sensors are deployed. The network topology of WSN affects the network connectivity and organization, hence affecting various performance metrics such as communication, network scalability, reliability, data latency, energy efficiency and network life time. Therefore, current research depicts customized domain-specific WSN topologies for efficient utilization of their constrained resources.

The emergence of applications with inherent multicast requirements led to the development of native multicast protocols. In the case of IP networks, multicast support was typically based on the Internet Group Management Protocol (IGMP) [Fenner1997] to announce hosts interested in receiving multicast information, and on Protocol-Independent Multicast – Sparse Mode (PIM-SM) [Estrin1998], Multicast Border Gateway Protocol (MBGP) [Bates2000] and Multicast Source Discovery Protocol (MSDP) [Fenner2003] to route multicast messages between core routers. With the increasing demand for multicast support, new protocols were proposed. The most promising protocol is the Source-Specific Multicast (SSM) protocol [Bhattacharya2003]. According to this protocol, when a host decides to join a multicast group it is necessary to specify not only the IP multicast address, as usual, but also the source address or a list of source addresses that the node joining the multicast sessions accepts to receive information from. This source identification significantly reduces the routing complexity. However, as shown in [SaSilva2005], SSM has several limitations when applied to mobile environments. Recent advances in wireless communications, electronics and miniaturization supported the development of a new generation of multi functional, low-cost sensor nodes. These new sensor nodes, with control components and communication functionality, are at the base of the development of Wireless Sensor Networks (WSNs).

A variety of networking based approaches to energy efficiency are possible. One of the well-known approaches is to apply clustering techniques to effectively establish an ordered connection of sensor nodes whilst improving the overall network lifetime. The proposed system has an improved clustering based middleware multicast approach that allows any cluster head to be a multicast source with an unlimited number of subscribers, to optimize group communication in WSNs whilst ensuring sensor nodes do not deprecate rapidly in energy levels.

II. SURVEY OF LITERATURE

A literature review containing a Middleware and multicast routing techniques for wireless sensor network

Anker, Tal, et all shows Clustering is an important mechanism in large multi-hop wireless sensor networks for obtaining scalability, reducing energy consumption and achieving better network performance. Most of the research in this area has focused on energy efficient solutions, but has not thoroughly analyzed the network performance, e.g. in terms of data collection rate and time. The main objective of is to provide a useful fully distributed inference algorithm for clustering, based on belief propagation. The algorithm selects cluster heads, based on a unique set of global and local parameters, which finally achieves, under the energy constraints, improved network performance. Evaluation of the algorithm implementation shows an increase in throughput in more than 40% compared to HEED scheme. This advantage is expressed in terms of network reliability, data collection quality and transmission cost.

Jeongcheol Lee, Euisin Lee, Soochang Park et all proposed Destination-initiated Geographic Multicasting Protocol which consists of three phases: first, a source collects the position information of all destination nodes; second, the source constructs a multicast tree through the position information; third, the source forwards data down the multicast tree. However, if a multicast group contains many mobile destinations, the SGM approach may cause a great deal of delivery of position registration and update messages to the source, thus lead to significant energy consumption of the sensor nodes in the vicinity of the source. In addition, high data delivery latency is another problem since the data delivery is triggered after the source obtains the position of all destinations and constructs a geographic multicast tree. Moreover, since each destination asynchronously updates one's new position to the source, the source node in the SGM approach is difficult to find an opportune time for reconstructing the multicast tree.

Adeyemi Abel Ajibesin, Gregory M. Wajiga et all proposed Energy-Efficient for Multicast Networks in that check the energy efficiency of network. Energy efficiency in wired and wireless multicast networks. Two major multicasting algorithms are analyzed using energy-efficiency as metric MIP and RLNC algorithm. The performance of these algorithms is evaluated and optimized using combined methods: simulation and Data Envelopment Analysis (DEA) method. These approaches are combinations of methods from different disciplines. The first method has been considered for measuring network effectiveness through simulations, while the second method is based on data envelopment analysis for measuring network relative efficiency. the DEA method, which is a non-parametric technique that is based on linear programming. The technique has been used in the Operations Research (OR) and economics communities to study the relative efficiency of systems with multiple inputs and outputs. Two types of DMUs are assumed for multicast networks. First, the network size is varied. and second the multicast group is varied. It is found that RLNC algorithm show better energy efficiency performance than MIP algorithm for all DMUs that are considered.

Many-to-many multicast can be widely used in computer and communication networks supporting various continuous multi-media applications. Wei Ding assumes each user is a source and a receiver as well as a terminal in many-to-many multicasting. Under this assumption a many-too many multicast tree appears as a terminal Steiner tree (TeST). Wei Ding uses a heuristic idea of under a fixed TeST topology to compute a good many-to-many multicast tree. Based on this novel idea two basic problems are proposed, the minimum cost/delay many-to-many multicast tree under a fixed TeST topology problem (MCMP/MDMP). Further both of them are distributed into two types, the centralized and decentralized. The former employs a node with a bootstrap as a server to receive one terminal's data then copy and branch them to all other terminals using multicasting, resulting in a centralized multicast tree, essentially a rooted TeST (at the server node). The latter conducts every terminal to send its data directly to all others using multicasting, resulting in a decentralized multicast tree, essentially an unrooted TeST.

Mauve, Martin, et al present Position-Based Multicast (PBM), a multicast rout ing algorithm for mobile ad-hoc networks which does neither require the maintenance of a distribution structure (e.g., a tree or a mesh) nor resorts to flooding of data packets. Instead forwarding node uses information about the positions of the destinations and its own neighbours to determine the next hops that the packet should be forwarded to and is thus very well suited for highly dynamic networks. PBM is a generalization of existing position-based unicast routing protocols such as face2 or GPSR. In order to extend position-based routing to multicast two key problems have to be solved. First, at certain nodes a multicast packet has to be split into multiple copies in order to reach all destinations, the challenge being to decide when such a copy should be created. Second, the recovery strategy used to escape from a local optimum needs to be adapted to take multiple destinations into account. The key contributions of this work are solutions for both problems.

III. Proposed System

Sensor nodes are deployed randomly in network with a two dimensional field with the following assumptions:

- Each node is identified with a unique ID;
- Nodes can transmit at various power levels depending on the distance of the receivers;
- Nodes are not mobile that is they remain stationary;
- Nodes are equally distributed in the field;

The BS is having no energy constraints and is located away from the sensing field. A node is considered with enhanced computation and communication capabilities. The BS is stationary. The employed radio model uses both the free space and the multicasting model and also it assumes error-free communication links. The configuration parameters are those summarized in Table 1.

Table 1. Configuration Parameters

Parameters	Values
Network grid	400x400
BS/Sink	(36,41)
Eelec	50nJ/bit
Ea	0.0013pJ/bit/m4
Data packet size	3000bits
Competition radius	90m

The transmission energy ETx spent to send a packet can be calculated by using the following formula:

ETx = (Eelec x k) + (Ea x k x dn)

where, k is the length of the message, d is the transmission distance between the transmitter and the receiver, Eelec is the electronic energy, Ea is the transmitter amplifier and d is the path loss component.

The amount of energy ERx spent to receive a k-bit size message can calculated as follows:

ERx = (Eelec x k)

A. *Algorithmic strategies*

Middleware multicast routing algorithm:

1. Get input no of nodes n.
2. Clustering of nodes with respect to their distance from server by using energy efficient clustering algorithm.
3. Calculate cluster head for each cluster.
4. Add s to source nodes (cluster heads).
5. For each n in source nodes.
6. Compare energy of all cluster heads in set of cluster heads.
7. Select a cluster head ch with max energy in each ch group and assign it as middleware.
8. Repeat process till all the ch have middleware

Middleware multicast routing Algorithm:

Input: Graph G = (V, E), n is the number of nodes, s is the source node and d1,. . . ,dk is the set of k destinations.

Output: The multicast time of graph m(G), which is given by max(m(di)), where i =1 to k.

1. Add s to Source Nodes
2. For each n in Source Nodes
3. Select an uninformed ch
4. Add ch to ch group
5. compare energy of all ch
6. if ch has max energy in ch group then
7. assign ch as middleware
8. If d1,. . . ,dk have been informed then
9. Goto step 13

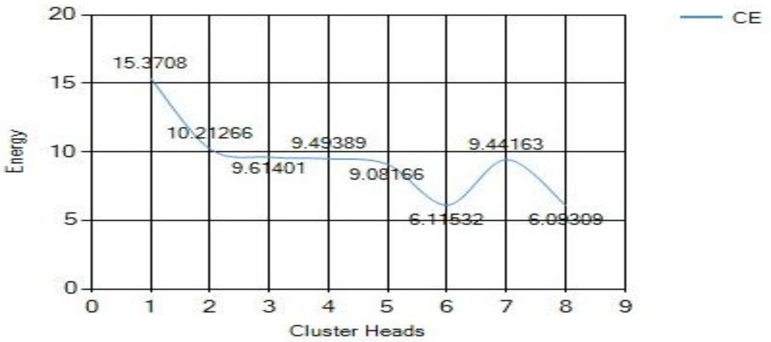
10. else
11. Copy InformedNodes to SourceNodes
12. Goto step 2 untill all the ch have middleware
13. Update multicast time

Unequal Clustering Algorithm

Energy efficient unequal clustering algorithm for WSN consists of different stages:

1. Initialization: Initialization stage is nothing but deployment of sensor nodes in a fixed size grid and assignment of initial energy to the sensor nodes in the heterogeneous environment.
2. Cluster Head Selection: Cluster heads are selected among the deployed nodes as in UHEED. It is commonly believed in the research community that clustering is an effective solution for achieving scalability, energy conservation and reliability.
3. Re-clustering: When any of node among the cluster deplete its energy completely, re-clustering is performed as per step 1. There is no need to perform clustering when CH depletes its energy. This saves the energy required for clustering when each time CH depletes its energy.

B. Results



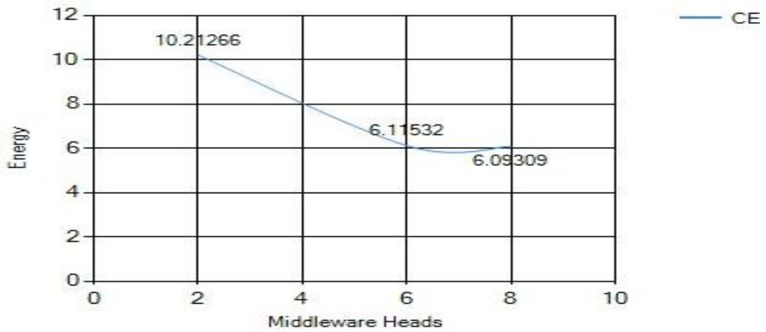


Fig1.Comparision of Energy consumption by ES & Middleware (PS)

Results are calculated for energy consumption parameter and time required to multicast the data compare to existing system. Energy consumption is calculated for each multicast route which is generated for data sending. So, the results of fig 1 shows that comparision of energy consumption to multicast data is less for proposed algorithm as compared to existing system. Therefore increasing the energy efficiency and hence the network lifetime. Also the time required to multicast the data is less for praposed system compare to existing system as shown in fig3.

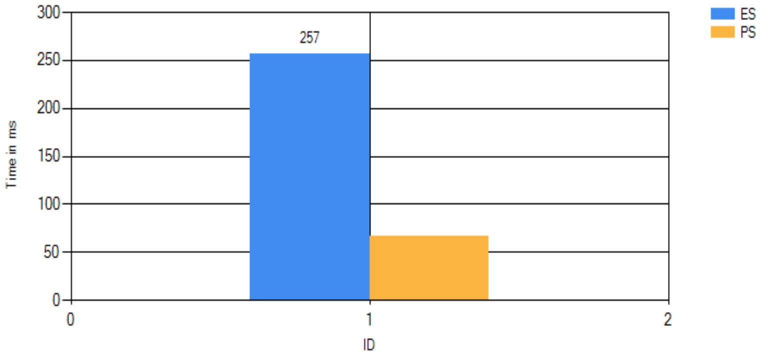


Fig2. Time required to multicast data

IV. Conclusion

A middleware multicast routing algorithm is proposed for multicast the data to unlimited no of subscriber at the same time in WSN which improves existing systems. The proposed scheme can significantly reduce energy consumption and the time required to multicast data is less also increases the lifetime of the network compared to the existing schemes.

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