AN ENERGY EFFICIENT AND RELIABLE TWO TIER ROUTING PROTOCOL FOR TOPOLOGY CONTROL IN WIRELESS SENSOR NETWORKS

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ABSTRACT

Wireless Sensor Networks (WSNs) is used in many applications for precise monitoring. The key issue in WSNs is energy conservation is the most important strategies to save energy and to prolong the lifetime of the WSNs are topology control. A reliable energy-efficient topology control protocol in wireless sensor networks is proposed, it is one of the most important techniques utilized to reduce energy consumption in wireless sensor networks, considers the residual energy and number of neighbors of each node for cluster formation, and well-balanced a loss of energy of the network. Topology control is an efficiency method that can extend the network lifetime in a wireless sensor network. Cluster heads selection and selected cluster head maintains connectivity and network coverage with respect to time in this approach. Balancing energy consumption and prolonging network lifetime are open challenges in Wireless Sensor Networks. This not only balances the energy consumption of each node and provides prolonged the network life time but also provides global reliability for the whole network.

Keywords: Clustering, Topology Control, Wireless Sensor Network.

I. INTRODUCTION

A WSN consists of spatially distributed autonomous sensor nodes to cooperatively monitor physical or environmental conditions such as temperature, sound, vibration, motion, pressure, or pollutants at different locations. A WSN may consist of hundreds or even thousands of nodes. Source node transmits their data to destination nodes through intermediate nodes. This destination node is connected to a central gateway, also known as a base station. Central gateway provides a connection to the wired world where the data can be collected, processed, and analyzed.

Achieving maximum lifetime in WSNs by optimally using the energy within sensor nodes has been the subject of significant researches in the last recent years. A wireless sensor network (WSN) mainly considered as a number of tiny, low-powered, energy-constrained sensor nodes with sensing, data processing and wireless communication components. Sensor nodes in WSNs are small battery powered devices with limited energy resources, and their batteries cannot be recharged once the sensor nodes are deployed. Therefore, minimizing energy consumption is an important issue in the design of WSNs protocol. Clustering is a most effective solution in reducing energy consumption, prolonging the lifetime of the networks and network scalability [1].

Transmit power adjustment of node in multihop and access control with cross layer optimization, this is a Power control technique [*2*, *3*] that reduces interference and improve throughput. Topology control by tuning transmission powers is discussed in [*4*, *5*, and 6]. Among several challenging issues, in most current designs, nodes are deployed using random and uniform distributions as they are the popular schemes because of simplicity. However, node deployment schemes have a good impact on system functionality as well as on lifetime.

Data funneling and aggregation [8] may address the problem to some extent, but cannot eliminate the problem either. The main objective of our work is to provide a long-term continuous connectivity. They attempt to address the problem by designing a power-aware topology management scheme. Major attention is given to the connectivity of the network as purposes of sensing coverage. Note that without a valid data path, an active node has the same role as a dead one. The sensing area covered by unconnected nodes is still inaccessible. Most of the application only one tiered or two tiered sensor network is used. Two tiered scenario different compared to muti-hop scenario, thus energy consumption also will be different. Two tiered architecture of sensor network itself is a solution to energy loss problem in wireless sensor network. A node is selected as cluster head again and again then it energy will reduce by destroying. Many of the researcher have tier two to balance energy consumption in two tier sensor network.

II. LITERATURE SURVEY

Heinzelman W.B, Chandrakasan, A.P Balakrishnan H, Proposed the application specific protocol architecture for wireless Microsensor networks, IEEE Transition on Wireless Communication 2002[1]. Robust wireless communication protocols that are energy efficient and provide low latency, develop and analyze low-energy adaptive clustering hierarchy (LEACH), it is a protocol architecture for Microsensor networks that combines the ideas of energy-efficient cluster-based routing and media access together with application-specific data aggregation to achieve good performance in terms of system lifetime, latency, and application-perceived quality. The LEACH includes a distributed cluster formation technique that enables self-organization of large numbers of nodes, algorithms for adapting clusters and rotating cluster head positions to evenly distribute the energy load among all the nodes, and techniques to enable distributed signal processing to save communication resources.

Zhi Chen, Shaoqian Li proposed the Energy-Efficient Access Control Algorithm with Cross-Layer Optimization in Wireless Sensor Networks(WSN)[3], Access control algorithm designed to minimize WSN node energy consumption. This algorithm incorporates the power control of physical layer, the transmitting probability of medium access control (MAC) layer, and the automatic repeat request (ARQ) of link layer, Based on slotted ALOHA protocol. Access control algorithm, a cross-layer optimization is preformed to minimizing the energy consuming per bit. The cross-layer algorithm results in a significant energy savings relative to layered design subject to the same throughput per node, and the energy saving is extraordinary in the low throughput. A new cross-layer access control (CLAC) algorithm that accounts for power control of physical layer, access control of MAC layer, and ARQ behavior of link layer

Ram Ramanathan, Regina Rosales-Hain proposed the topology control of multihop wireless networks using transmit power adjustment [5]. *Multihop wireless network* is a packet may have to traverse multiple consecutive wireless links in order to reach its destination. The *topology* of a multihop wireless network is the set of communication links between node pairs used explicitly or implicitly by a routing mechanism. The topology depends on 'uncontrollable" factors such as node mobility, weather, interference, noise, as well as on "controllable" parameters such as transmit power and antenna direction. Consider the problem of adjusting the trans-mit powers of nodes in a multihop wireless network (also called an ad hoc network) to create a desired topology, formulate it as a constrained optimization problem with two constraints - connectivity and biconnectivity, and one op-timization objective - maximum power used. They present two centralized algorithms for use in static networks, and prove their optimality. For mobile networks, presents the two distributed heuristics that adaptively adjust node transmit powers in response to topological changes and attempt to maintain a connected topology using minimum power.

III. A TWO-TIERED WIRELESS SENSOR NETWORK.

A two-tiered Wireless Sensor Network (WSN) where nodes are divided into clusters and nodes forward data to base stations through cluster heads is considered. To maximize the network lifetime, two tier energy efficient approaches are investigated. Topology of two-tiered WSN as depicted in Figure 1. It consists of a number of clusters and multiple mobile base stations. Each cluster is composed of a set of Sensing Nodes and one Cluster Head. Sensing Nodes are small, low cost and densely deployed in each cluster. They are responsible of sensing raw data and then forwarding to the corresponding Cluster Head.

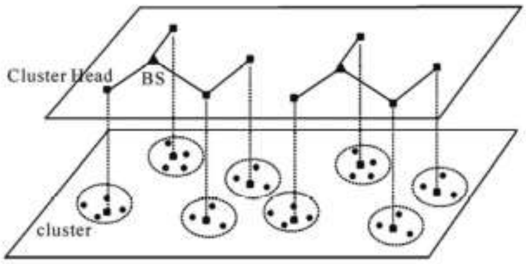

Fig1. Two - tiered wireless sensor network.

Consider the cluster formation is based on neighborhood. Hence, direct transmissions can be used inside each cluster. However, Sensing Nodes do not communicate with other Sensing Nodes in the same or other clusters. Cluster Heads, on the other hand, have much more responsibilities. First, they manage their clusters (send queries, instruct some nodes to be in idle or sleep status…) and gather data from their cluster members. Second, they perform aggregation of this data to eliminate redundancy and minimize the number of transmissions and thus save energy. The aggregated data at each Cluster Head represents a local view of its cluster. Third, they transmit the composite bit-stream towards the nearest base station. Each base station can then generate a comprehensive global view of the entire network coverage by combining the different local view data received from the different Cluster Heads.

Cluster heads from different regions send their collected data to the gateway. The cluster head of tier 2 can send the data to the cluster head of another network which can further send the data to the gateway. The biggest advantage e of this topology is that it divides the whole network into a number of small zones within which routing of signals can be done locally. The cluster heads can be designed to be more powerful in terms of computation/communication. In addition to it, the nodes can also be connected through a wire, which increases the transmission speed as well as reliability of network

Cluster-head selection mechanisms consider cluster heads cooperate with each other to forward their data to the base station, the cluster heads closer to the base station are burdened with heavy relay traffic and tend to die early leaving areas of the network uncovered and causing network Partitions, This mechanism developed that considers residual energy, number of neighbors, and centrality of each node and uses production rules for cluster-head selection. Reasoning mechanism is used to develop reliable multi-hop routing algorithm among cluster heads, the pre-processed data is forwarded to the back-end via a gateway, optionally multi-hopping over routers. The sinks perform local, rule-based reasoning,

IV. EXISTING SYSTEM

A3 algorithm [7] assumes no prior knowledge about the position or orientation of the wireless sensor nodes. However, nodes can determine how distance of a node is from another node, based on signal strength when it is received. This information is enough to select a close-to-optimal Connected Dominating Set (CDS) tree, based more area of communication coverage. The A3 is executed in three phases: Neighborhood Discovery, Children Selection and Second Opportunity

A. Neighborhood Discovery

The CDS building process is started by a pre-defined node that might be the sink node just after the nodes are deployed. The sink node starts the protocol by sending an initial *Hello* Message. It allows the neighbors of the starting node to know its 'parent' node. If the node not have been covered by another node receives the *Hello* message, it sets state as covered, adopts the sender as its 'parent' node and replies with a *Parent Recognition* Message. This message also includes a selection metric that is based on the signal strength of the received *Hello* Message. If another node has already covered to the receiver, it ignores the *Hello* Message.

B. Children Selection

The parent node sets a timeout to receive answers from its neighbors. Each metric is stored in a list of candidates. Once this timeout expires, the parent node sorts the list in decreasing order according to the selection metric. The parent node then broadcasts a *Children Recognition* Message that includes the complete sorted list to all its candidates. During the timeout, nodes wait for *Sleeping* Messages from their brothers. If a node receives a *Sleeping* Message during the timeout period, it turns off. This is because the recipient of the *Sleeping* Message understands that one of its brothers is more appropriate to become a part of the CDS tree. Based on this scheme, the best node according to the chosen metric sends a *Sleeping* Message thereby blocking any other node in its range. Therefore, only other candidate nodes outside its area of coverage have the opportunity to start their own generation process.

C. Second Opportunity

Although this methodology works very well, there are some cases where a node is sent to sleep to avoid bottleneck. In order to avoid this situation, every node sets a timer once it receives the *Sleeping* Message to send a *Hello* Message and starts its own building process.

D. Advantages

- A3 is very scalable, as it only needs local information and operates in a completely distributed manner;
- A3 does not need location information; no GPS or any localization mechanism is necessary.
- A3 requires no synchronization scheme thanks to the ordered sequence of the tree creation.
- A3 is simple, and presents low computational complexity, and
- A3 is very Energy-efficient.

E. Disadvantages

- This algorithm in a complete topology control solution where the CDS tree will have to be changed many times
- Doesn't determine an approximation ratio to the optimal solution, as a performance metric of the algorithm.

V. PROPOSED SYSTEM

A reliable energy-efficient topology control protocol in wireless sensor networks is proposed. This approach considers the residual energy it means that remaining energy of each node and number of neighbors of each node for cluster formation in network, and well-balanced a loss of energy of the network. This proposed system not only balances the energy load of each node but also provides global reliability for the whole network. To maximize the network life time optimal cluster head selection is important. CHs require more energy than all other nodes because they perform processing, sensing, communication and aggregation. In case, the cluster head dies in earlier, then the entire network becomes useless; since the CH cannot communicate with Base Station. To obtain optimal cluster head, CH should be elected based on the residual energy of each and every node. Therefore energy efficiency is maximized & prolonged network lifetime.

A. Cluster head selection

CHs are selected from the deployed nodes based on the criteria such as residual energy, connectivity, communication cost and mobility. All nodes are located in a two tier dimension and it has to reach communication coverage. Each and every node starts in an unvisited state. The sink is main step of the process and it has a large amount of energy. As the cluster heads change after time $t=T+\beta$, to connect between the cluster heads use an approximation of (CDS)connected dominating set algorithm to form a reliable multihop connection and converge among the cluster heads.(β= the time interval between two CH selection run). So that then there is no packet loss at the Data Link Layer, It is main advantage of this approach.

As per the cluster head selection chance A_i, can get the time t_i of the m^{th} node broadcasting the cluster declaring message CH as $t_i = A_i \times T$, where T is predefined as the maximum time cluster head is competing. If a sensor node does not receive the message CH before time t expires, it will broadcast message CH to its neighbor nodes. If the n^{th} node receives some CH message before the time t_j expires, the n^{th} node will not compete for cluster head selection and will construct a cluster head candidate table containing the sender of the CH messages. Then, the n^{th} node selects the node with the maximum chance as its cluster head. If there are multiple nodes having the same maximum chance, the node having more energy is selected as the cluster head. Finally, the node transmits the JOIN message to the cluster head.

B. Cluster heads connection

Immediately when the clusters are formed further there is a need to connect the cluster heads to aggregate data and forward it to the base station through a multihop path. As the cluster heads change after time T, they use an approximate connected dominating set algorithm to form a reliable multi-hop connection among the cluster heads.

C. Advantages

- Really significant in terms of better coverage and efficiency in terms data handling.
- In the proposed scheme energy is spent insidiously to build topology compared to the A3 algorithm.
- Energy efficient, and has prolonged network life.
- No pocket loss at the data link layer.
- Nodes have a perfect communication coverage disk.

D. Disadvantages

- The sensing area coverage in the proposed system is initially less.
- The proposed system is not time efficient.

VI. CONCLUSION

Cluster-head selection mechanism is selects the cluster head of network this mechanism aggregates the date from each cluster node, considers the residual energy, number of neighbors, and cluster head connection mechanism is develop reliable multi-hop routing among cluster heads and network coverage. The reliable energy efficient two tiers routing protocol that provides to balances the energy load of each node and there is no pocket loss in network this provides global reliability for the whole network.

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