



An Efficient Routing Protocols for Canvassing Energy In Wireless Sensor Networks

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Abstract: - This paper presents a review of well-known routing protocols. Due to limited energy of sensor nodes in Wireless sensor networks, It is important to design a routing protocols. Routing protocol increases network lifetime. This paper discuss various existing routing protocol techniques.

Keywords— routing in wireless sensor networks, flat routing protocol, location-based routing protocol

I. INTRODUCTION

Wireless sensor networks[14] is widely considered as one of the most important technologies. In Wireless sensor network, sensor nodes are used for gathering data and transmitting to sink but sensor nodes has limited energy and communication ability. So, it is important to design a routing protocol for WSNs[13] so that sensing data can be transmitted efficiently. It balances the energy consumption and increases the network lifetime and guarantees high QoS of WSN[8]. Routing protocols are used for finding and keeping the routes in the network. Various categories of routing protocols are Flat protocols, Hierarchical protocol, Location based protocols which is used for balance the energy consumption and increases the network lifetime

II. ROUTING PROTOCOLS IN WSN

In WSNs [4] depending on network structure routing is divided into three categories i.e. flat based routing, hierarchical routing and location based routing. All nodes in a flat routing protocol are assigned equal roles or functionality and the nodes collaborate to perform the sensing tasks. The sink sends queries to certain regions within the WSN and awaits data from the sensors located in that region. SPIN and directed diffusion are examples of flat routing protocols.

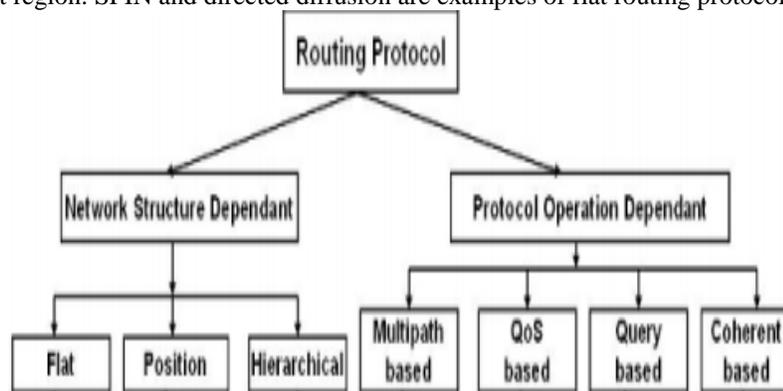


Figure 1 Routing Techniques In WSN [5]

Location or position information of sensor nodes is essential to calculate the distance between neighboring nodes. If the location of sensor nodes are known then data transmission only occurs on that region to reduce the number of transmissions. GAF and GEAR are examples of location-based energy-efficient routing protocols. In hierarchical routing protocols[11], clusters are created and a head node is assigned to each cluster. The head nodes are the leaders of their groups having responsibilities like collection and aggregation the data from their respective clusters and transmitting the aggregated data to the Base Station. This data aggregation in the head nodes greatly reduces energy consumption in the network (CH) and the CH transmits the data to the global Base station or sink. This reduces the transmission range of normal nodes to conserve energy. Figure 1 shows the various routing techniques in WSNs.

III. FLAT ROUTING TECHNIQUES

The first technique of routing protocols[7] is flat routing protocols. In flat networks[4], each node typically plays the same role and sensor nodes collaborate together to perform the sensing task. This consideration has led to data centric routing, where the sink sends queries to certain regions and waits for data from the sensors located in the selected regions. Since data is being requested through queries, attribute-based naming is necessary to specify the properties of data. Two most commonly used flat routing protocols are:-

- SPIN(Sensor Protocols For Information Via Negotiation)
- Directed Diffusion

3.1 SENSOR PROTOCOLS FOR INFORMATION VIA NEGOTIATION:-

The SPIN[5] family of protocols are used to efficiently disseminate information in a wireless sensor network. Conventional data dissemination approaches like flooding and gossiping waste valuable communication and energy resources sending redundant information throughout the network. In addition, these protocols are not resource-aware or resource-adaptive. SPIN[10] solves these shortcomings of conventional approaches using data negotiation and resource-adaptive algorithms. Nodes running SPIN assign a high-level name to their data, called meta-data, and perform meta-data negotiations before any data is transmitted. This assures that there is no redundant data sent throughout the network. In addition, SPIN has access to the current energy level of the node and adapts the protocol it is running based on how much energy is remaining. Simulation results show that SPIN is more energy-efficient than flooding or gossiping while distributing data at the same rate or faster than either of these protocols.

3.2 DIRECTED DIFFUSION:-

Directed diffusion is a data-centric (DC)[5] and application- aware paradigm in the sense that all data generated by sensor nodes is named by attribute-value pairs. The main idea of the DC paradigm is to combine the data coming from different sources route (in-network aggregation) by eliminating redundancy, minimizing the number of transmissions; thus saving network energy and prolonging its lifetime. All sensor nodes in a directed diffusion-based network are application-aware, which enables diffusion to achieve energy savings by selecting empirically good paths and by caching and processing data in the network. Caching can increase the efficiency, robustness and scalability of coordination between sensor nodes which is the essence of the data diffusion paradigm.

IV. HIERARCHICAL PROTOCOL

In hierarchical routing protocols[12], clusters are created and a head node is assigned to each cluster. the head nodes are the leaders of their groups having responsibilities like collection and aggregation the data from their respective clusters and transmitting the aggregated data to the sink. this data aggregation in the head nodes greatly reduces energy consumption in the network by minimizing the total data to be sent to sink. the less the energy consumption, the more the network life time. The main idea of developing cluster-based routing protocols[is to reduce the network traffic toward the sink. Commonly used hierarchical protocols are

- i. **LEACH Protocol**
- ii. **Energy Efficient Clustering Scheme**
- iii. **Power-Efficient Gathering In Sensor Systems**

4.1 LEACH PROTOCOL

Low energy adaptive clustering hierarchical protocol is self organizing clustering protocol. The protocol is divided into two phases:-

- i. **Setup phase**
- ii. **Steady-state phase**

The protocol is divided into a setup phase when the clusters are organized themselves, in steady-state phase data are transferred from the nodes to the cluster head and on to the sink [5]. In the setup phase, each node choose a random number between 0 and 1, if this number is less than a certain threshold $T(n)$, the node will act as the cluster head. The non cluster head node chooses the cluster head with greater signal strength and join the cluster, and after the formation of cluster and cluster head node, cluster head node receives data from all of the cluster members and transmits data to the sink.

During the setup phase, a predetermined fraction of nodes, p , elect themselves as CHs as follows. A sensor node chooses a random number, r , between 0 and 1. If this random number is less than a threshold value, $T(n)$, the node becomes a cluster-head for the current round. The threshold value is calculated based on an equation that incorporates the desired percentage to become a cluster-head, the current round, and the set of nodes that have not been selected as a cluster-head in the last $(1/P)$ rounds, denoted by G . It is given by:

$$T(n) = p / 1 - p(r \bmod (1/p)) \text{ if } n \in G \text{ [4]}$$

where G is the set of nodes that are involved in the CH election. These working of LEACH shown in Figure 2.

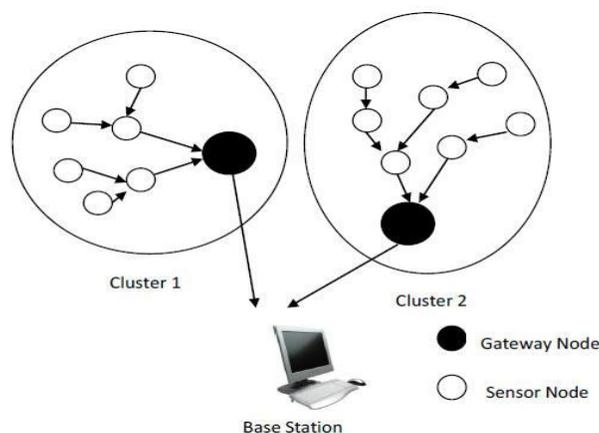


Figure 2 Working of LEACH [4]

During the steady state phase, the sensor nodes can begin sensing and transmitting data to the cluster-heads. The cluster-head node, after receiving all the data, aggregates it before sending it to the base-station. After a certain time, the network goes back into the setup phase again and enters another round of selecting new CH.

4.2 ENERGY EFFICIENT CLUSTERING SCHEME:-

An Energy Efficient Clustering Scheme (EECS)[6] is a clustering algorithm in which cluster head candidates compete for the ability to elevate to cluster head for a given round. This competition involves candidates broadcasting their residual energy to neighboring candidates. If a given node does not find a node with more residual energy, it becomes a cluster head. Cluster formation is different than that of LEACH. LEACH forms clusters based on the minimum distance of nodes to their corresponding cluster head. EECS extends this algorithm by dynamic sizing of clusters based on cluster distance from the base station. EECS is a LEACH-like clustering scheme, where the network is partitioned into a set of clusters with one cluster head in each cluster. Communication between cluster head and Sink is single-hop or direct. In the network deployment phase, the Sink broadcasts a “hello” message to all the nodes at a certain power level. By this way each node can compute the approximate distance to the sink based on the received signal strength. It helps nodes to select the proper power level to communicate with the sink.

4.3 POWER-EFFICIENT GATHERING IN SENSOR INFORMATION SYSTEMS (PEGASIS):-

It is an improvement of the LEACH protocol. Rather than forming multiple clusters, PEGASIS [7] forms chains from sensor nodes so that each node transmits and receives from a neighbor and only one node is selected from that chain to transmit to the base station (sink). Gathered data moves from node to node, aggregated and eventually sent to the base station

V. LOCATION BASED PROTOCOL:-

In Location based or position based routing[5] protocol sensor nodes are addressed by means of their locations. Location information for sensor nodes is required for sensor networks by most of the routing protocols to calculate the distance between two particular nodes so that energy consumption can be estimated.

- i. **Geographic Adaptive Fidelity(GAF)**
- ii. **Geographic and Energy Aware Routing (GEAR)**

5.1 GEOGRAPHIC ADAPTIVE FIDELITY(GAF):-

Geographic Adaptive Fidelity or GAF[1] is an energy- aware location-based routing algorithm designed primarily for mobile ad hoc networks, but is used in sensor networks as well. This protocol aims at optimizing the performance of wireless sensor networks by identifying equivalent nodes with respect to forwarding packets. In GAF[3] protocol, each node uses location information based on GPS to associate itself with a “virtual grid” so that the entire area is divided into several square grids, and the node with the highest residual energy within each grid becomes the master of the grid. Two nodes are considered to be equivalent when they maintain the same set of neighbor nodes and so they can belong to the same communication routes. Source and destination in the application are excluded from this characterization.

Nodes use their GPS-indicated location to associate itself with a point in the virtual grid. Inside each zone, nodes collaborate with each other to play different roles. For example, nodes will elect one sensor node to stay awake for a certain period of time and then they go to sleep. This node is responsible for monitoring and reporting data to the sink on behalf of the nodes

in the zone and is known as the master node. Other nodes in the same grid can be regarded as redundant with respect to forwarding packets, and thus they can be safely put to sleep without sacrificing the “routing fidelity” or routing efficiency.

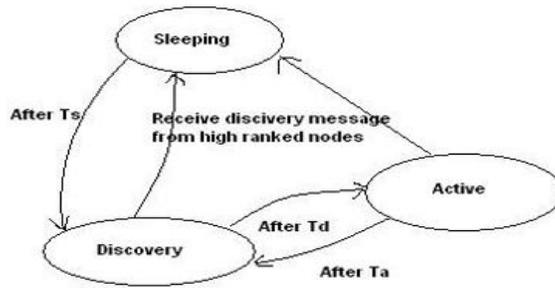


Figure 3 State Transition In Gaf Protocol [1]

There are three states defined in GAF as shown in Figure 3, These states are discovery, for determining the neighbors in the grid, active reflecting participation in routing and sleep when the radio is turned off. In order to handle the mobility, each node in the grid estimates its leaving time of grid and sends this to its neighbors. The sleeping neighbors adjust their sleeping time accordingly in order to keep the routing fidelity. Before the leaving time of the active node expires, sleeping nodes wake up and one of them becomes active.

5.2 GEOGRAPHIC AND ENERGY AWARE ROUTING (GEAR) :-

It is Energy-efficient routing protocol used for routing queries to target regions in a sensor field, sensors are aware of their residual energy as well as the locations and residual energy of each of their neighbors. It uses energy aware and geographically-informed neighbor selection heuristics to route a packet towards the destination region. The key idea is to restrict the number of interests in directed diffusion by only considering a certain region rather than sending the interests to the whole network. By doing this, GEAR can conserve more energy than directed diffusion.

In GEAR[2], each node keeps an estimated cost and a learning cost of reaching the destination through its neighbors. The estimated cost is a combination of residual energy and distance to destination. The learned cost is a refinement of the estimated cost that accounts for routing around holes in the network. A hole occurs when a node does not have any closer neighbor to the target region than itself. If there are no holes, the estimated cost is equal to the learned cost. The learned cost is propagated one hop back every time a packet reaches the destination so that route setup for next packet will be adjusted. Figure 4 shows the Recursive Geographic Forwarding In GEAR. The process of forwarding a packet to all the nodes in the target region consists of two phases:

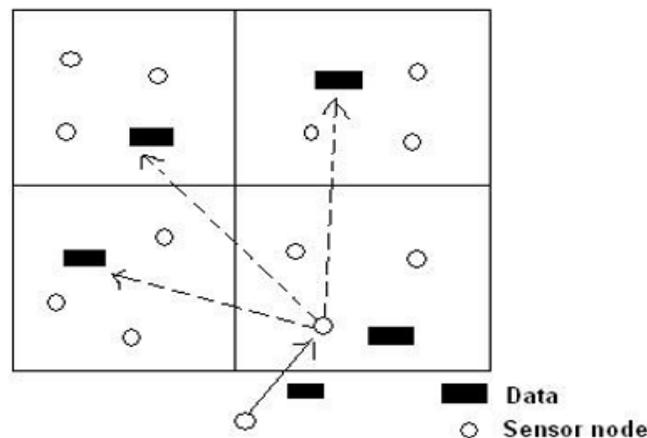


Figure 4 Recursive Geographic Forwarding In GEAR [1]

➤ **Forwarding packets towards target region:-**

Upon receiving a packet, a node checks its neighbors to see if there is one neighbor, which is closer to the target region than itself. If there is more than one, the nearest neighbor to the target region is selected as the next hop. If they are all further than the node itself, this means there is a hole.

In this case, one of the neighbors is picked to forward the packet based on the learning cost function.

➤ **Forwarding packets within target region:-**

If the packet has reached the region, it can be diffused in that region by either recursive geographic forwarding or restricted flooding. Restricted flooding is good when the sensors are not densely deployed. In high- density networks, recursive geographic flooding is more energy efficient than restricted flooding. In that case, the region is divided into four sub regions and four copies of the packet are created. This splitting and forwarding process continues until the regions with only one node are left.

VI. CONCLUSION AND FUTURE SCOPE

In this paper, survey of routing techniques in wireless sensor networks is done. The routing techniques are classified into three categories: flat, hierarchical, and location based routing protocols. Different protocols belong to these categories are analysed in depth and their methods are studied. These protocols improve the working of WSN by increasing its life and network efficiency to a certain extent.

In future data aggregation can be implemented in WSNs for efficient transmission of data to the sink which will further prolong network lifetime by saving the energy that is dissipated during data transmission. Also the inter and intra cluster routing cost can be reduced by aggregation of the data.

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REFERENCES

- [1] Roychowdhury, Sinchan and Chiranjib "Geographic adaptive fidelity and geographic energy aware routing in ad hoc routing." *International Conference*. Vol. 1. 2010.
- [2] Xu, Ya, John Heidemann, and Deborah Estrin. "Geography-informed energy conservation for ad hoc routing." *Proceedings of the 7th annual international conference on Mobile computing and networking*. ACM, 2001.
- [3] Frey, Hannes, Stefan Rührup, and Ivan Stojmenović. "Routing in wireless sensor networks." *Guide to Wireless Sensor Networks*. Springer London, 2009. 81-111.
- [4] García Villalba, Luis Javier, et al. "Routing protocols in wireless sensor networks." *Sensors* 9.11 (2009): 8399-8421.
- [5] Akkaya, Kemal, and Mohamed Younis. "A survey on routing protocols for wireless sensor networks." *Ad hoc networks* 3.3 (2005): 325-349.
- [6] Heinzelman, Wendi Rabiner, Anantha Chandrakasan, and Hari Balakrishnan. "Energy-efficient communication protocol for wireless microsensor networks." *System Sciences, 2000. Proceedings of the 33rd Annual Hawaii International Conference on*. IEEE, 2000.
- [7] Biradar, Rajashree V., et al. "Classification and comparison of routing protocols in wireless sensor networks." *Special Issue on Ubiquitous Computing Security Systems, UbiCC Journal* 4 (2009): 704-711.
- [8] Schurgers, Curt, and Mani B. Srivastava. "Energy efficient routing in wireless sensor networks." *Military Communications Conference, 2001. MILCOM 2001. Communications for Network-Centric Operations: Creating the Information Force*. IEEE. Vol. 1. IEEE, 2001.
- [9] Heinzelman, Wendi B., Anantha P. Chandrakasan, and Hari Balakrishnan. "An application-specific protocol architecture for wireless microsensor networks." *Wireless Communications, IEEE Transactions on* 1.4 (2002): 660-670.
- [10] Perrig, Adrian, et al. "SPINS: Security protocols for sensor networks." *Wireless networks* 8.5 (2002): 521-534.
- [11] Shen, Bo, Shi-Yong Zhang, and Yi-Ping Zhong. "Cluster-based routing protocols for wireless sensor networks." *Ruan Jian Xue Bao (Journal of Software)* 17.7 (2006): 1588-1600.
- [12] Bandyopadhyay, Seema, and Edward J. Coyle. "An energy efficient hierarchical clustering algorithm for wireless sensor networks." *INFOCOM 2003. Twenty-Second Annual Joint Conference of the IEEE Computer and Communications*. IEEE Societies. Vol. 3. IEEE, 2003.
- [13] Chen, Benjie, et al. "Span: An energy-efficient coordination algorithm for topology maintenance in ad hoc wireless networks." *Wireless networks* 8.5 (2002): 481-494.
- [14] Xu, Ya, et al. "Topology control protocols to conserve energy in wireless ad hoc networks." (2003).