Wireless Sensor Networks Protocol: A Review

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Abstract **- The use of wireless sensor networks has increased tremendously. For the collection and detection of information, battery operated wireless sensor nodes are used for the areas where there is such a small zone that it is not possible to change or recharge batteries manually. The information is collected and then passed by these sensing nodes to the network towards the sink for further activities. We require considering its consumption of energy as a central point of concern for a superior working and a more extended lifetime for a sensing node within the network. This paper, presents a critical review of the WSN protocols**

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1. INTRODUCTION

Battery is the only source of life in WSNs for the nodes. In the process of communication with other nodes or sensing activities a lot of energy is consumed in processing the data and in the transmission of the collected data to the sink. In a majority of cases (e.g. surveillance applications), it is not desirable to change the batteries that are depleted or drained of energy. A number of researchers are hence attempting to discover power-aware protocols for wireless sensor networks with a specific end goal to overcome such energy efficiency issues as those mentioned above.

Each protocol that are constructed and implemented in WSNs should be provided with some real-time support as they are implemented in the zones where data is sensed, processed and transmitted on the basis of an event that prompts to a quick action. If a protocol is reliable and fast in its responses to the changes prevailing in the network, only then, it is said to have real-time support. It should give redundant data to the sink or base station using the data that is gathered among all the sensing nodes in the network. While transmitting the data from the sensing nodes to the sink, the delay should be short that will result in a fast response.

2. DETAILED STUDY OF ROUTING PROTOCOLS

Routing protocols are classified into a number of categories. Some of them are operation-based routing protocols and structure-based routing protocols. All these Sub layers such as multipath-based routing, location-based, flat, query-based and negotiation-based falls under the categories like location-based routing, hierarchical based routing, network flow and data-centric routing – quality-of service based routing protocols.

2.1 LEACH *Low Energy Adaptive Clustering Hierarchical*

The present enthusiasm in wireless sensor networks has prompted the development of numerous application oriented protocols among them LEACH is the most widely used and aspiring protocol [1]. It can be explained as a blend of a multi-hop routing and cluster-based architecture. The word cluster-based can be described with the help of the fact that sensors that uses the functions of LEACH protocol are depend on cluster members and cluster heads. For inter-cluster communication, Multi-hop routing is used along with cluster heads and base stations. It is clearly shown by the simulation results [1] that less energy is consumed by multi-hop routing in comparison to the direct transmission.

It is already been mentioned that wireless sensors, sense the data, collect them and after this send it to the base station from a remote area by making use of the radio transmission plan as a medium of communication.

While sending the collected data by the sensors to the base station, a number of problems take place like data aggregation and data collision. LEACH is very effectively worked to decrease the data aggregation problems by making use of a local data fusion which carries out a compression of the data measure which is done by the cluster head prior to sending it to the base station. A self-organized network is formed by all sensors. This is accomplished by sharing a cluster head role at least once. The major responsibility for sending the data to the base station is of Cluster head. It attempts to create the balance of energy dissipation within the network and improves the life time of the network by enhancing the life time of the sensors [2].

In the LEACH protocol, the operations accomplished are classified into two stages, the setup phase and the steady-state phase.

Set-up Phase

In this phase, a group of some cluster regions is formed by all the sensors within a network. This is done by communicating with each other by the means of short messages. At a certain stage, one sensor acts as a cluster head in the network and transfers short messages to the various left over sensors within the network. The sensors decide to be part of those regions or groups that are framed by the cluster heads, relying upon the messages signal strength that is sent by the cluster heads. Sensors those who are interested in joining a specific cluster head or region reacts in turn to the cluster heads by giving a response signal showing their acknowledgment to join. In this way the set-up phase finishes [1].

The optimal number of cluster members could be decided by cluster head that could be handled or needed. Before entering the steady-state phase, some parameters are taken into consideration, like the network topology and the relative expenses of computation against the communication. A TDMA Schedule is used with each member of the cluster group to transfer messages

to the cluster head, and after this to the cluster head towards the base station. Two sensor phases of a in a LEACH protocol is illustrated in figure 2 : each sensor turns as cluster members to the cluster heads and in the second phase cluster heads carries out the data transmission to the sink in a multi-hop frame. A direct transmission scheme is also demonstrated underneath

Leach lessens the dissipated communication energy. This energy is dissipated by the cluster members and the cluster heads up to 8 times in the case of comparison with direct transmission and least transmission energy routing [1]. It has not much latency because of the fact each cluster members send the sensed data to the closest cluster head. Thereafter cluster heads examines that the data is arrived to the sink whether through inter cluster head transmissions. The scalability of Leach is high because nodes can conveniently deal with the changes such as deployments of new node in the network and they can begin the process as cluster members by making use of the signals transferred by cluster heads. With the formation of clusters, it becomes more energy conservative as the responsibility of transferring data is of only cluster heads and each node adhere randomised rotation in order to create cluster head. It does not consist of quality of service feature due to limited resource such as limited processing which is performed with quite low memory buffer size. Apart from these, it also has an erratic traffic pattern because in the network all nodes continue to change the regions of cluster.

2.2 PEGASIS: *Power-Efficient GAthering in Sensor Information Systems*

The chain development in PEGASIS prompts a great latency because whole data needs to go via the chain to arrive the base station; in the case the most distant or the first node of the chain has crucial data which has must be passed quickly, then it will require going through the whole chain [3]. It can conveniently include the latest conveyed nodes in the chain due to the fact that it is an unfixed transmitting path. In the event that it discovers a new node that conserves energy in a great deal then it includes it at the time of the chain formation. PEGASIS consist of high awareness of energy as development of chain structure to arrive the base station which is capable of conserving quite more energy than that of cluster formation in LEACH. An overhead of low measure is noticed on the network because there is no existence of any other nodes that are used in transmit except those that create the chain and it is the responsibility of just one node which is closer to the sink or the destination to transmit.

Due to the delay in the transmission of data and neither having processing capabilities, quality of service factor is low. Each node fuses certain data with the data packet at the time of forwarding to other nodes in the chain. Network instability such as a link failure or node failure or power failure can result in loss of data.

2.3 SPIN: *Sensor Protocols for Information via Negotiation*

SPIN has average latency factor because its goal is to observe that all make sure that all the interested nodes in the network get the needed data [4-5]. SPIN has a moderate scalability as at any point when a new node gets into it transfers request or signals for data sharing and each one of those nodes which are not high in energy doesn't give any response for any action in order to save energy, moderate energy awareness could be noticed in SPIN due to the reason that the nodes that are interested just participate in data sharing and the one with low energy reserves discontinue to response to the messages sent by neighboring nodes.

It consists of quite low data overhead on the network because only some nodes participate in transmission. It maintains its quality of service factor to a low level due to the reason that there is availability of redundant data in the network; each one of the nodes gives the similar data. Due to this, memory is wasted and being not an end to end transmission numerous nodes interfere during transmitting the data to the sink or base station.

2.4 GEAR: *Geographic and Energy Aware Routing protocol*

GEAR has average efficiency of energy because the nodes just adhere to the minimum cost ways that are evaluated, until another way is discovered that is quite more least way as compared to the earlier one, this demonstrates that even after using the least cost paths it is not able to conserve more energy [6]. It does not consist of a low latency because the time consumed by a node in the process of transmission from the source nodes to the destination region and from that point to the destination node in the region. A moderate overhead is observed at the time of transmission; in the event the nodes discover drained nodes in the network they discontinue the transmission of data until another least cost way is discovered. The service quality is not high because it comprises some network instabilities such as power failure, link failure or topology changes can result in lowering down the rate of data transmission. A number of bandwidth is gone useless in discovering the destination region and afterward the destination node utilizing various types of algorithms.

2.5 GAF: *Geographic Adaptive Fidelity*

Latency is average as in the event of a source nodes want to transfer the data to the neighbour grid, each node in that particular grid notice that just one and only one of them stay active to carry on the forwarding system and the left over nodes remains inactive [7]. It has a great scalability, a number of nodes can be in the network and they partition themselves into grids. In the case of more than one node, one goes to sleep in order to conserve energy. This result to get high energy awareness because each node changes it state. Due to the fact that intermediate nodes are not in active state, a very small number of nodes participate in transmission provides low overhead of data in the network. It has very low As far as quality of service factor is concerned, it is low because of the unpredictable traffic pattern, non end to end transmission prevails.

2.6 MECN: *Minimum Energy Communication Network*

The scalability is low because if new nodes included in the sparse graph it doesn't take them into consideration despite the fact that they are the closest nodes to the base station [8]. This likewise prompts to low latency because all nodes needs to compute the sparse graph for its closest neighbours each time it consist of the data to transmit. A great measure of energy is wasted in the

construction of this sparse graph each time a node begins transmission. Despite the fact that it is not a significant amount of energy it makes MECN an average energy aware protocol. We get a low quality of service factor due to the network hazards such as power failure, link failure, and limited bandwidth.

2.7 SAR: *Sequential Assignment Routing*
It does not contain high latency factor because nodes in a continuous way adhere to a routing table which demonstrates a minimum cost way to the sink from the node, and there is for certain one path lies to the destination, QoS is more in the event of comparison with other traditional protocols [9]. It does not contain any resource restriction such as restricted bandwidth, power of transmission and memory buffers. It has a limited factor of scale because it needs to build routing table for the latest imploded nodes which is expensive. It has error full tolerance and simple node recovery in the case of failure of node. The use of power is quite low and least compared on the grounds that it develops tree structure with just those nodes which are energy saved and equipped with QoS metric, the one which don't qualify are overlooked from framing the roots in the tree.

2.8 SPEED: *Stateless Protocol for End- to-End Delay*
It is considered as one of the finest routing protocols, it contain low latency as each node are straightforwardly associated hence no deferral in transmission of data among nodes, regardless of the possibility that there is a failure of node by making use of backpressure rerouting another way is discovered to continue the data transmission procedure [10]. It observes the most ideal ways with minimum expense which makes it to be an energy conservative protocol. It, in a continuous way, has low overhead as it balances the network in such a manner that there is no existence of network congestions, with a great quality of service factors such as, no data redundancy, no resource limitations such as restricted processing, size of memory buffer and regardless of the fact that link failure there back up for data transmission.

2.9 SEP: *Stable Election Protocol*
We examine the effect of nodes heterogeneity, in terms of their energy, in wireless sensor networks that are progressively clustered. We make the assumption that a measure of the population of sensor nodes is furnished with extra energy assets - this is a heterogeneity source which may come about from the beginning setting or as the operation of the system develops [11,12]. We demonstrate that the attitude of these kinds of sensor networks turns out to be quite unstable once the initial node dies, particularly in the vicinity of node heterogeneity. Typical clustering protocols consider that each node is furnished with the same measure of energy and consequently, they cannot get full benefit of node heterogeneity.

Main Idea
SEP, a heterogeneous-aware protocol is proposed to delay the time interim prior to the first node death (it is referred as stability period), which is important for numerous applications where the response from the sensor network must consist of the reliability. SEP depends on weighted election probabilities of all nodes to turn out to be cluster head as per the left over energy in each node.

3. COMPARISON OF ROUTING PROTOCOLS
The detailed examination of routing protocols made it simple to estimate each protocol generally relying upon the components that are already explained above in this thesis. Estimation is performed on each protocol as per their operation by making use of the sensor nodes in the network. Table-I illustrates the operability of protocols in respect to Mobility, Latency, Scalability, and Awareness of Energy. Each protocol is likewise provided a paragraph underneath to motivate the table entries.

Table 2.1 Comparison of Various Protocols

Characteristics	Latency	Scalability	Connectivity Adaptation	Energy Awareness
Protocols				Low Moderate High
LEECH	Low when the network is small	High	Cluster head leads the transmission	High uses clustering technique to save energy
PEGASIS	High if network density is high	High	Single node of the chain is responsible in transmission	High it forms chain using nodes to reach the base station
SPIN	Moderate if the network is large	Moderate	Data shared with interested nodes, to reach sink	Moderate, the nodes which have energy resources only take part in transmission
GEAR	Moderate, checks for drained nodes	Moderate	Calculate the least cost paths to reach sink	Moderate, same path used until new path is calculated
GAF	Moderate, uses limited nodes	High	One node from the grid is used remaining go to sleep state	High, Node use sleep, discovery, awake states
MECN	Moderate, few edges in the relay region	Low	Relay nodes are used to reach the sink	Moderate, constructs spares graph for every transmission
SAR	Low, Multi path exists	Moderate	Tree is designed from sink to nodes	High, calculates the best path and does not deplete all the nodes in network

SPEED	Low, always tries to reduce congestion	Moderate	Paths are built using least cost algorithms	High, always uses multiple paths to transmit data

4. CONCLUSIONS

In this paper various protocols have been studied, with their pros and cons. The protocols are compared in terms of energy awareness, delay, scalability and connectivity adaption. It is found that under various quality measures different protocols performs better in comparison to others.

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