

# A Survey on Routing Protocol for Wireless Sensor Network

**Sitender Kumar**  
Research Fellow  
Dept. of Computer Science  
Lovely Professional University  
Jalandhar, Punjab

**Arvind Kumar**  
Asth. Professor  
Dept. of Computer Science  
Lovely Professional University  
Jalandhar, Punjab

**Rohit kumar vishwkarma**  
Research Fellow  
Dept. of Computer Science  
Lovely Professional University  
Jalandhar, Punjab

*Abstract*— This paper gives the survey on routing protocol for wireless sensor networks. In recent years, many approaches and techniques have been proposed for consuming the energy efficiency of the Wireless Sensor Network. In order to gather information more efficiently, Wireless Sensor Network is partitioned into clusters. Clustering is an important mechanism in large Wireless Sensor Network for obtaining scalability, reducing energy consumption and activity for better network performance. Those methods are proposed already for Wireless Sensor Network is not without problem. Routing protocols for wireless sensor networks are responsible for maintaining the routes in the network and have to ensure reliable multi-hop communication. In this paper, We gives a survey on routing protocols for Wireless Sensor Networks and compare their relative strengths and limitations.

*Index Terms*— Clustering, Energy Efficiency, Routing, Wireless Sensor Network.

## I. Introduction

Due to recent technological advances, the manufacturing of small and low cost sensors became technically and economically feasible. A Wireless Sensor Network (WSN) contains hundreds or thousands of these sensor nodes. These sensors have the ability to communicate either among each other or directly to an external base-station (BS). A greater number of sensors allows for sensing over larger geographical regions with greater accuracy. The main

component of these sensor nodes are microcontroller, transceiver, external memory and power source. Basically, each sensor node comprises sensing, processing, transmission, mobilizer, position finding system, and power units (some of these components are optional like the mobilizer). Sensor nodes are usually scattered in a sensor field, which is an area where the sensor nodes are deployed. Sensor nodes coordinate among themselves to produce high-quality information about the physical environment. Each sensor node bases its decisions on its mission, the information it currently has, and its knowledge of its computing, communication, and energy resources. Each of these scattered sensor nodes has the capability to collect and route data either to other sensors or back to an external base station. A base-station may be a fixed node or a mobile node capable of connecting the sensor network to an existing communications infrastructure or to the Internet where a user can have access to the reported data. Wireless Sensor Network the multifunctional sensor node to accomplish certain sensing task in an intelligent manner. These nodes have contain all things which is need for transmission like transmission of energy. WSN mainly used in military application, earthquake monitoring. 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. Routing is a technique that is required for sending the data between sensor node and the base station for communication. Different routing protocol is proposed for Wireless Sensor Network.

In WSN there is the routing protocol that minimizes the used energy, extending subsequently the life of the WSN. Energy awareness is an essential in routing protocol design issue. Depending on the network structure, routing in WSN can be divided into:

1. Flat routing
2. Hierarchical routing
3. location-based routing

Depending on the protocol operation, routing in WSNs can be divided into:

1. Multipath-based routing
2. Query-based routing
3. Negotiation-based routing
4. QoS-based routing
5. Coherent-based routing

But here I can focus on Hierarchical routing protocol and compare the few of protocol which are already exist for routing in WSN.

## II. Routing designing issues in WSN

**Node deployment:** Node deployment in WSN that affect the performance of routing protocol. The deployment can be either deterministic or randomized. In deterministic the nodes are manually placed and data routed through the pre-defined paths. In randomized the nodes are scattered randomly creating an infrastructure like ad-hoc network. Therefore, it is most likely that a route will consist of multiple wireless hops.

**Energy consumption:** In WSN this is the great issue because the nodes have limited power for

communication if they lose their energy they cannot be rechargeable. Sensor node lifetime shows a strong dependence on the battery lifetime.

**Fault Tolerance:** Some sensor nodes may fail or be blocked due to lack of power, physical damage, or environmental interference. The failure of sensor nodes should not affect the overall task of the sensor network. If many nodes fail, MAC and routing protocols must accommodate formation of new links and routes to the data collection base stations.

**Scalability:** The number of sensor nodes deployed in the sensing area may be in the order of hundreds or thousands, or more. That routing protocol is used for huge network which is scalable for any upcoming event in that environment.

**Connectivity:** In a WSN each node is completely connected to the other nodes. If any node is failure due to some reason like power supply etc. so that the network topology is being shrinking and all network is destroyed. So that the connectivity is a main issue while generate the routing protocol for WSN.

**Data Aggregation:** It means collection of data from different source so that the same packets are received more than one time. In data aggregation we try to reduce the number of transmission so that less battery power is used and lifetime of the network is prolonged.

**Quality of Service:** In some applications the data should be delivered on regular time interval if it is not delivered on time that it is useless so the QoS is the main issue in WSN.

## III. Related work

S. Kaur *et al* [1] have proposed Improvement in energy efficiency of Wireless Sensor Network. In this scheme WSN the energy efficiency is the greatest topic for the research purpose. Clustering in the wireless sensor network is very important to increase

the lifetime of the network .There are several numbers of protocol which is based on it but here the LEACH protocol is used for clustering .In LEACH each node has to equal probability of select as the cluster head .In each round the cluster head is change because every node has equal probability for selecting as a cluster head .In this paper the focus is on the approach how could the number of cluster head are limited in the network if there are limited number of cluster head in the network than the lifetime of the network is increased and decrease the energy dissipation per node.

H.Gao *et al* [2] have proposed A Hybrid Relative Distance Based Cluster Scheme for Energy Efficiency in Wireless Sensor Networks. In this scheme energy efficiency is of great importance for wireless sensor network. A popular way for saving the energy of the node is construct the cluster of the networks for data collecting and transmitting. This paper studies the distributed cluster algorithm to improve the energy efficiency .We observe that the cluster head has to lie within the range of transmission of the base station and the distance between the cluster head and sink node for energy consumption. Author have proposed the HRDCS scheme which is based on the distance between CH and BS and the energy consumption at the time of cluster head selection.

C. Guo *et al* [3] have proposed the Analysis and Optimization of Energy Efficient Cluster Forming for Wireless Sensor Networks. In this scheme Wireless Sensor Network should operate without protection for the long time before the replacement of battery; therefore characteristics such as self-organization and energy efficiency are of at most importance to the WSN. In the WSN we have meet with all these requirement by dividing the WSN network into

clusters, where each the cluster managed by a cluster head. In this paper we provide the analysis of energy consumption in a clustered network and gain of energy with different number of nodes in the network. This analysis is generally proposed for minimize the energy consumption at the time of cluster head selection by the less cluster head selection. This provides the lifetime of the network is prolonged and easy to maintain the network.

Y. Jin *et al* [4] have proposed A Distributed Energy-efficient Re-clustering Solution for Wireless Sensor Networks. In this scheme Clustering algorithm is mostly used in WSN for the energy consumption at the time of selection of CH .So that the re-clustering algorithm is used to generate the different cluster head are selected and cluster are recognized .Hence, the question of how the network perform that re-clustering algorithm .In this paper a distributed re-clustering algorithm solution is provide for consume the energy of the network .The proposed algorithm calculates the energy required to recognize the cluster .This is the first work which is going on re-clustering algorithm in a WSN.

C. Wang *et al* [5] have proposed An improved LEACH protocol for application specific WSN. In this scheme how the energy of the network is improved the lifetime of network and cost. LEACH is a clustering-based protocol with best performance, which consumes the energy and balanced the network. In this paper LEACH protocol is improved in which the steady phase of that protocol is improved. The proposal protocol focuses on saving the energy and cost induced due to the redundant node and balanced the energy consumption by converting the large cluster into smaller. The simulation result of that protocol is compared with LEACH. The proposal scheme improves the partition

of cluster and decrease energy consumption. In this improvement each node that becomes the CH will create a TDMA schedule for the sensor node within the cluster. That allows the radio component of each non- CH node to be turned off all time when the transmission is not there. In this scheme the two proposals are there:

- ❖ Twin nodes
- ❖ Sub cluster head assignment

The conception Sub cluster head is provided, which is used to confine the size of cluster.

P. Patil *et al* [6] have proposed A HEED protocol for energy efficiency for Wireless Sensor Network. In this scheme HEED protocol is proposed on the basis of remaining energy of each sensor node is the first parameter for election of cluster-heads. There are four primary goals of HEED. These are listed below:

- Prolonging the lifetime of the wireless sensor network by evenly distributing energy consumption.
- Selecting cluster-heads in a constant number of rounds.
- Minimization of control overhead.
- Formation of well-distributed cluster-heads and compact clusters.

If the two sensor node having same remaining energy at the time of cluster-head election, than node degree or average distance to neighbours parameters are used to determine the cluster-head. HEED protocol is implemented in TinyOS, which is an operating system developed for Berkeley motes. Experimentations that are employed for evaluating HEED protocol show that clustering and data aggregation at least double the lifetime of the wireless sensor network.

In HEED protocol the position of the clusters is unaware but it has an important role for the

communication. If the cluster is very closer to the base station than the nodes directly communicate with the base station and the traffic is more around the cluster than the lifetime and the battery is discharge quickly and the cluster head is dies. If the cluster head is dies than the energy is wasted that is used for select the cluster head.

A. Manjeshwar *et al* [7] have proposed TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks. In this scheme TEEN: A routing protocol for enhanced efficiency in WSN. In which the classification is based on the routing that are as proactive and reactive networks In this scheme a TEEN (Threshold Sensitive Energy Efficient Sensor Network) protocol that is implemented for reactive network. In which the overall performance of protocol is depending for a simple temperature sensing applications. TEEN is basically depending on two parameters:

- ❖ Hard threshold: This is the value for the sensed attribute. It is the predefined value for attribute after senses that value the node switch on its transmission and report to its cluster head.
- ❖ Soft threshold: This is the small change on value of sensed attribute after the node release to switch on transmitter and transmit the information.

The first transmit of the node is based on the hard threshold value. In next transmission the node can transmit data only when both the conditions are true:

- i) Current value of the sensed attribute > the hard threshold value
- ii) The current value of sensed attribute is different from sensed value that have sensed already by sensor node.

**Table no. 1 Comparison between the different routing protocol**

Routing Protocol	Classification	Power Usage	Data Aggregation	Cluster Stability	Mobility Support	Query based	QoS
LEACH	Hierarchical	High	Yes	Moderate	Nil	No	No
HEED	Hierarchical	High	Yes	Good	Nil	No	No
TEEN	Hierarchical	High	Yes	Good	Nil	No	No
HRDCS	Hierarchical	High	Yes	Moderate	Nil	No	No
DD	Flat/Data-centric/Des-initiated	Limited	Yes	No	Nil	Yes	No

**Table no. 2 Strengths and limitations of the different routing protocol**

Protocol	Strengths	Limitations
LEACH	<ul style="list-style-type: none"> <li>Cluster head election is done periodically</li> <li>Cluster head rotated randomized manner</li> </ul>	<ul style="list-style-type: none"> <li>It doesn't give guarantee good CH is distributed.</li> <li>Cost of the formation CH is expensive.</li> <li>Random selection of CH in the vicinities they have low node density.</li> </ul>
HEED	<ul style="list-style-type: none"> <li>Remaining energy of node used is used for select the cluster head.</li> <li>Minimized the control overhead.</li> <li>Formation of well-distributed cluster head.</li> <li>Selecting cluster head in a constant number of iteration.</li> </ul>	<ul style="list-style-type: none"> <li>Energy consumption during the data transmission for far away CH is significant especially in large network.</li> <li>The position of the clusters is unaware in HEED protocol.</li> </ul>
HRDCS	<ul style="list-style-type: none"> <li>The network keeps working for long time with this scheme HRDCS.</li> </ul>	<ul style="list-style-type: none"> <li>To solve the problem of energy of the node that is not sufficient for the selection of CH.</li> <li>If any node have more energy as the network will stop.</li> </ul>
TEEN	<ul style="list-style-type: none"> <li>Data reaches to the user without any delay</li> <li>Message transmission consumes</li> </ul>	<ul style="list-style-type: none"> <li>If the threshold value not reached then the node will never communicate and user will not get data from the network.</li> </ul>

	<p>much more energy than data sensing</p> <ul style="list-style-type: none"> <li>• A smaller value of soft threshold value gives accurate picture of network</li> </ul>	<ul style="list-style-type: none"> <li>• It is not good for applications where the periodically data is needed.</li> </ul>
--	---	--

#### IV. Conclusion and open issues

Routing in sensor networks is a new area of research, with a limited, but rapidly growing set of research. In this paper, comprehensive Survey of routing techniques in wireless sensor networks which have been presented in the literature. They have the common objective of trying to extend the lifetime of the sensor network. Overall, the routing techniques are classified based on the network structure into three categories: Flat, hierarchical, and location based routing protocols. But here only the hierarchical based routing protocol is being discussed. I highlight the strengths and weakness (Table no. 2) and make comparisons (Table no. 1) between them each of routing protocol based on hierarchical network.

#### V. REFERENCES

- [1] S. Kaur, D. Prashar and R. Rani, "Improvement in energy efficiency of Wireless Sensor Network", in International Journal of Computer & Technology, vol. 2 no.2 , 2012
- [2] H. Gao, H. Li and Y. Cheng "A Hybrid Relative Distance Based Cluster Scheme for Energy Efficiency in Wireless Sensor Networks", in IEEE Globecom, 2010.
- [3] C. Guo, R. Hekmat and Przemyslaw, "Analysis and Optimization of Energy Efficient Cluster Forming for Wireless Sensor Networks", in IEEE Publication, 2007.
- [4] Y. Jin, D. Wei, A. Gluhak and K. Moessner, "A Distributed Energy-efficient Re-clustering Solution for Wireless Sensor Networks", in IEEE Globecom, 2011.
- [5] C. Wang, J. Liu, J. Kuang, A.S. Malik, H. Xiang, "An Improved LEACH Protocol for Application Specific Wireless Sensor Network".
- [6] P. Patil, U. Kulkarni and N.H. Ayachit, "Some issues in clustering algorithm for Wireless Sensor Network", IJCA Special Issues on "2<sup>nd</sup> National Conference-Computing, Communication and Sensor Network".CCSN,2011.
- [7] Arati Manjeshwar and Dharma P. Agrawal."TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks".
- [8] Shio Kumar Singh, M P Singh, D K Singh, "A Survey of Energy-Efficient Hierarchical Cluster-Based Routing in Wireless Sensor Networks", International Journal. of Advanced Networking and Applications , ,Vol. 02, Issue. 02, pp. 570-580, 2010
- [9] K. Akkaya and M. Younis, "A Survey of Routing Protocols in Wireless Sensor Networks," in the Elsevier Ad Hoc Network Journal, Vol. 3/3 ,pp. 325-349, 2005.