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A Comparative Study on Variants of LEACH Routing Protocol in Wireless Sensor Networks

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Abstract: ***A WSN is a network formed by large number of sensor nodes which are randomly deployed in a region. There is an issue of limited source of power in a node and in fact battery of node cannot be replaced. Wireless sensor network consists of sensor nodes which are powered by battery; to communicate with each other for environment monitoring because the energy efficiency is foremost issue in the wireless sensor networks. Therefore, some routing techniques have been developed to maximize network lifetime and to also attain the maximum reliability as well as scalability. In this paper, we present a comparative survey of descendant of LEACH hierarchical routing protocol. The objective of this paper is to compare some features of LEACH protocol variants and provide brief detail of some LEACH improved versions.***
Keywords: Wireless Sensor Network (WSN), Hierarchical routing, LEACH, CH selection, Network lifetime

I. INTRODUCTION

A Wireless Sensor Network (WSN) consists of a large number of tiny nodes with sensing, computation, and wireless communications capabilities. The sensors are used to process the data and transmit them to the base station. Besides, sensor nodes are equipped with a radio transceiver or other wireless communications device, a small microcontroller and an energy source. Since in most WSN applications the energy source is a battery and energy play an important role in such applications because sensor nodes are generally constrained with limited energy. Therefore, preserving the consumed energy of each node is a significant area and it is also essential to be considered when developing a routing protocol for WSN. In general, routing in WSNs can be divided into flat, hierarchical, and location-based routing depending on the network structure. Hierarchical routing is also recognized as cluster-based routing because in this routing sensor nodes are grouped together and form the clusters. In each cluster, a higher energy node is assigned as a head-node and known as cluster-head (CH). The CH acts as the leader of their own cluster having the responsibilities like collection and aggregation the data from their respective clusters and transmitting the aggregated data to the Base station (BS). The most well-known hierarchical routing protocols in WSN are LEACH, PEGASIS, TEEN, HEED etc. Among these all, LEACH is the simplest routing protocol in WSN whose main objective is to distribute the energy load equally among all sensor nodes in the network and increase network life time.

1) Wireless sensor network can be useful in any case where it would be difficult or unsafe for human to manually collect the data that the sensors would collect.
2) In WSN, one can configure additional sensor nodes to communicate on the same network and deploy them into expanded area. There is no need to change or modify existing sensors to add new ones to your network.
3) The signal relay capability makes it possible for user to collect data that would be inaccessible using WSN.
4) WSN can develop hardware and data assets.

A. LEACH

LEACH stands for Low-Energy Adaptive Clustering Hierarchy and it was one of the first cluster-based hierarchical protocols. The sensor nodes are combined together to make a local cluster and from those sensor nodes one sensor node acts as a cluster-node. A randomize rotation technique of CH is used by this protocol whose main aim is to distribute the energy load equally among all sensors in the network which ultimately gives result of a longer life to the node's battery. The most important role of cluster-head is to collect data and then combine those collected data and sent to the base station. The Operation of LEACH is divided into two phases and these phases are further divided in some sub-phases. The sub phases are such as set-up phase and a steady-state phase. In this type of hierarchal protocol, most of the nodes communicate to cluster head (CH). It consists of two phases:

1) The Setup Phase: In this phase, clusters are ordered and then cluster head has been selected. The task of CH is to cumulate, wrapping and forward the data to the base station i.e. sink.
2) The Steady Phase: In this stage, the data is communicated to the base station i.e. sink and the duration for this phase is longer as compare to setup phase. In steady-state phase nodes transmit their data to their respective CHs, and after that the CHs transmit the "compressed" data of the whole cluster to base station.

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B. Advantages of LEACH Protocol

1) Any node that served as a cluster head in certain round cannot be selected as cluster head again.
2) Energy saving due to aggregation by cluster heads.
3) Increase the lifetime of the network.
4) In this protocol, the cluster head communicate directly with sink.
5) The efficient transmission is there by using TDMA.

C. Disadvantages of LEACH Protocol

1) LEACH assumes all nodes can transmit with enough power to reach the base station if it is necessary.
2) In this protocol, need to do time synchronization and nodes uses single hop communication.
3) LEACH is not best suited for large- scale networks that interns require single hop communication with sink.
4) This process requires high range of transmission power in the network.
5) It depends on cluster heads rather than cluster members of the cluster for communicating to the sink. Due to this it incurs robustness issues like failure of the cluster heads.

The work is organized as follows. Section 2 describes the details about the descendants of LEACH routing protocols. Section 3 presents comparison of LEACH protocols and its descendants. Finally conclude the survey in section 4.

II. DESCENDANTS OF LEACH ROUTING PROTOCOL

In this section, we're going to dive into the details of the descendants of LEACH protocols.

A. LEACH-E (Energy Low Energy Adaptive Clustering Hierarchy)

In LEACH-E protocol, initially all nodes have same energy and same probability of becoming the cluster head. LEACH-E enhance lifetime of network by balancing energy load among all nodes in the network.

B. LEACH-C (Centralized Low Energy Adaptive Clustering Hierarchy)

Centralized low energy adaptive clustering hierarchy has steady-state which is same as the LEACH protocol but it may vary in the set-up phase. The cluster head nodes are chosen by base station and each node sending information about the current location and also the energy level to the base station and the base station uses this global knowledge via GPS to produce better clusters which requires the less transmission energy.

The base station will choose only those nodes to become cluster head nodes which have enough energy level. Advantage of this protocol over basic LEACH is the deterministic approach of choosing number of cluster head nodes in each round which is predetermined at the time of deployment. LEACH-C causes better distribution of cluster head nodes in the network. But LEACH-C requires current location information of all nodes using GPS which is not robust.

C. LEACH-F (Fixed number of cluster Low Energy Adaptive Clustering Hierarchy)

Fixed number of cluster low energy adaptive clustering hierarchy protocol also uses the centralized approach for cluster formation. Once the cluster formation process is done, then there is no re-clustering phase in next round. The steady-state is same as classical LEACH.

The overhead of re-clustering in basic LEACH is removed by LEAC-F protocol as once the fixed number of clusters is formed; they are maintained throughout the network. But this protocol provides no flexibility of adding or removing the nodes once clusters are formed and nodes cannot adjust their behaviour on node dying.

D. LEACH-B (Balanced Low Energy Adaptive Clustering Hierarchy)

LEACH-B uses decentralized approach of cluster formation in which each sensor node only knows about its own position and position of final destination and has no information about the location of all the sensor nodes. LEACH-B works in three stages: Cluster head selection, Cluster formation and data transmission with multiple accesses. By analysing the energy lost in the path between final receiver and itself, each of the sensor nodes chooses its cluster head. LEACH-B has better energy efficiency than basic LEACH protocol.

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E. I-LEACH (Improved Low Energy Adaptive Clustering Hierarchy)

Detection of Twin nodes (These kinds of node obviously would sense the same information so it is necessary to keep one among the two twin nodes in sleep mode, until the first node runs out of energy.) and assignment of Sub-Cluster Head (SCH) nodes are the two functions served by Improved-LEACH protocol. Randomly deployment of nodes results in high probability of two nodes located very close to each other called Twin nodes. It is necessary to keep one node sleep until the energy of another node depletes. Therefore I-LEACH has uniform distribution of cluster head so that it doesn't run out of energy when longer distance transmission takes place. This protocol uses threshold approach for managing number of cluster members for each cluster head in the network at a time

F. V-LEACH (Vice Cluster Head Low Energy Adaptive Clustering Hierarchy)

V-LEACH is a new version of LEACH Protocol which aims to reduce energy consumption within the wireless network. The main concept behind V-LEACH is that besides having a CH in the cluster, there is a vice-CH that takes the role of the CH when the CH dies. By doing this, cluster nodes data will always reach the BS; no need to elect a new CH each time the CH dies which will extend the overall network life time. In classical LEACH protocol, the cluster head node consumed more energy as compared to normal nodes in sending aggregated data to the base station (located far away). Therefore, the cluster head node dies early and the whole cluster will become useless, results data loss.

G. TL-LEACH (Two-Level LEACH)

In original LEACH protocol, the Cluster Head (CH) collects and aggregates data from sensors within its own cluster and sends the information to the Base Station (BS) directly. Most of the time the Cluster Head (CH) can be located far away from the Base Station (BS), so it consumes most of its energy in sending information and then it will die faster in comparison of other nodes. Therefore, a next version of LEACH called Two-level Leach was evolved. In this leach protocol; Cluster Head (CH) collects data from other cluster members as original LEACH, but rather than relays data to the Base Station directly. The two-level structure i.e. TL-LEACH reduces the number of nodes which is used to transmit to the base station, and then effectively reduces the total energy consumption.

III. COMPARISON BETWEEN LEACH PROTOCOL AND ITS DESCENDANTS

A brief comparison among LEACH protocol and its improved versions are shown in Table I. All these protocols have better performance than classical LEACH protocol.

TABLE I

Routing Protocols	Abbreviation	Scalability	Advantages	Disadvantage	Cluster head selection	Transmission between the CH and BS
LEACH	Low-Energy Adaptive Clustering Hierarchy	Limited	Load distribution in network	CH are not uniformly	Threshold value	Single hop
LEACH-E	Energy LEACH	Very Good	Improves CH selection	CH is always in active	Residual energy	Single hop
LEACH-C	Centralized LEACH	Good	Achieves more rounds in n/w	it is not robust. requires location information for all sensors in the network	Base Station select cluster heads	Single hop
LEACH-F	Fixed number of cluster LEACH	Limited	Delay is small	do not allow new nodes to be added to the network	Number of Clusters and total number nodes (CH and non-CH) are fixed	Single-hop
LEACH-B	BALANCED LEACH	Good	Network lifetime increase	Overhead increase	LEACH-B Choose its CH by Calculating the Energy need for the Path Between itself and Destination.	Single hop
I-LEACH	Improved LEACH	Very Good	Equally divide field	Periodically updates	Detection of Twin nodes (one among the two twin nodes in sleep mode, until the first node would run out of energy) and Assignment of Sub-CH (SCH) nodes in addition to CH.	Single-hop
V-LEACH	Vice Cluster Head LEACH	Very Good	Introduce vice CH	Extra processing for vice CH	Vice-CH is selected in addition to CH in each cluster, but in LEACH only CH node is selected.	Single-hop
TL-LEACH	Two Level LEACH	Very Good	Increase energy efficiency	Two CH are used	CH sends the Data to bs through a Ch that lies between the Ch and bs.	Multihop

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IV. CONCLUSIONS

In this paper, the most important issue is energy efficiency in designing cluster-based routing protocols for wireless sensor network, because sensor nodes have limited energy during data broadcast and reception. So, routing protocols used in Wireless Sensor Network should be energy efficient to increase not only the individual node lifetime, but also extend the lifetime of the whole of the wireless sensor networks. There are several routing protocols but, in this paper, we have described about the LEACH protocol because this protocol gives the best performance in terms of energy and network lifetime. LEACH can overcome the problem of Wireless Sensor Network. LEACH has many advantages but along with advantages some disadvantages are also present. To overcome these disadvantages many descendants of LEACH protocol are introduced like TL-LEACH, E-LEACH, LEACH-C, V-LEACH, LEACH-B, Fixed-LEACH, and I-LEACH etc. are explained in this paper.

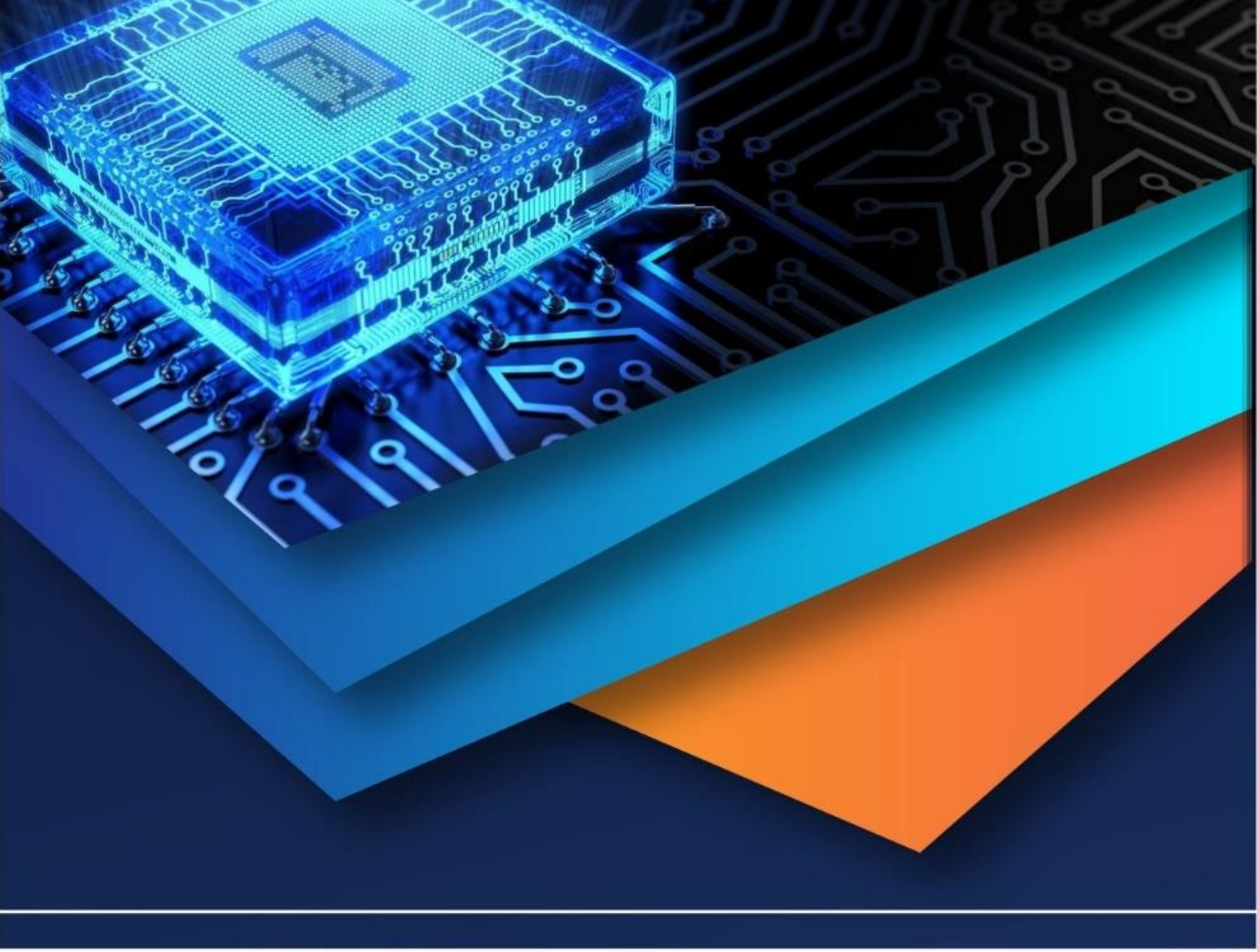
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REFERENCES

[1] Ankit Pare et.al, “LEACH: ANALYSIS OF WIRELESS SENSOR NETWORK PROTOCOL” IJAICT Volume 1, Issue 11, March 2015.
[2] Heena Dhawan et.al, “A Comparative Study on LEACH Routing Protocol and its Variants in Wireless Sensor Networks: A Survey” International Journal of Computer Applications (0975 – 8887) Volume 95– No.8, June 2014.
[3] J. Gnanambigai et.al, “Leach and Its Descendant Protocols: A Survey” International Journal of Communication and Computer Technologies Volume 01 – No.3, Issue: 02 September 2012.
[4] Rajendra Prasad Mahapatra et.al,” Descendant of LEACH Based Routing Protocols in Wireless Sensor Networks” 3rd International Conference on Recent Trends in Computing 2015 (ICRTC-2015).
[5] Ravneet Kaur et.al, “Comparative Analysis of Leach and Its Descendant Protocols in Wireless Sensor Network” International Journal of P2P Network Trends and Technology- Volume3Issue1- 2013.
[6] Gaganpreet Kaur et.al, “LEACH AND its Descendants: A Review” An International Journal of COMPUTER & IT.
[7] Divya Prabha et.al, “A Survey on LEACH and its Descendant Protocols in Wireless Sensor Network” International Conference on Communication, Computing & Systems (ICCCS–2014).
[8] G Devika et.al, “A Pragmatic Study of LEACH and its Descendant Routing Protocols in WSN” International Journal of Computational Intelligence and Informatics, Vol. 4: No. 4, March 2015.
[9] Alakesh Braman et.al, “A Comparative Study on Advances in LEACH Routing Protocol for Wireless Sensor Networks: A survey” International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 2, February 2014.
[10] Amandeep Kaur et.al, “LEACH and Extended LEACH Protocols in Wireless Sensor Network-A Survey” International Journal of Computer Applications (0975 – 8887) Volume 116 –No. 10, April 2015.
[11] Subodh Ku. Gond et.al, “Energy Efficient Deployment Techniques for Wireless Sensor Networks” Volume 2, Issue 7 ISSN: 2277 128X International Journal of Advanced Research in Computer Science and Software Engineering.
[12] Sunil Kumar et.al,” Study of Wireless Sensor Networks its Routing Challenges and Available Sensor Nodes” International Journal of Engineering Research & Technology.
[13] Suraj Sharma, “On Energy Efficient Routing Protocols for Wireless Sensor Networks” Phd dissertation 2016.
[14] Tim Nieberg et.al, “Collaborative Algorithms for Communication in Wireless Sensor Networks”.
[15] T. V. padmavathy et.al, “Extending the Network Lifetime of Wireless Sensor Networks Using Residual Energy Extraction—Hybrid Scheduling Algorithm” Int. J. Communications, Network and System Sciences, 3, 98-106.
[16] Uroš M. Pešović et.al, “Single-hop vs. Multi-hop – Energy efficiency analysis in wireless sensor networks” Telecommunication forum TELFOR 2010 Srbija, Beograd.
[17] Wendi Rabiner Heinzelman et.al, “Energy-Efficient Communication Protocol for Wireless Microsensor Networks”, Proceedings of the 33rd Hawaii International Conference on System Sciences – 2000.
[18] Wendi B. Heinzelman, “An Application-Specific Protocol Architecture for Wireless Microsensor Networks” IEEE transections on wireless sensor network, VOL. 1, NO. 4, OCTOBER 2002.
[19] Yi Zhu et.al, “Parallel LEACH Algorithm for Wireless Sensor Networks”.
[20] Yousif Mohsin Hasn et.al, “Energy Efficient Routing Protocols for Wireless Sensor Networks” IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278-2834, p- ISSN: 2278-8735.Volume 11, Issue 2, Ver. I.

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