Comprehensive Analysis of Energy Aware Clustering and Routing Protocols Used In WSN

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ABSTRACT

The evaluation and up gradation of wireless sensor Network (WSN) requires transfer of data from source to destination. Nodes within wireless network are sensors having limited energy associated with them. Nodes collaborating together form clusters. Data transmission takes place from distinct clusters towards base station. Energy of sensors needs to be preserved in order to enhance lifetime of network. This paper presents various techniques used to enhance lifetime of network. Lifetime of network ensures degradation in terms of packet drop ratio. Comparative analysis of techniques is also presented to determine approach that can be used for future enhancements.

KEYWORDS: WSN, Clusters, Lifetime, Packet drop ratio

INTRODUCTION

Wireless sensor network consist of spatially distributed devices used to maintain physical or environmental conditions. Nodes used within WSN could be of distinct configuration. These nodes form heterogeneous environment. [2], [3] Heterogeneous environment requires protocols in order to establish communication among distinctly configured nodes. IEEE 802.11 standards established for Wi-Fi connectivity is commonly used protocol for transmission within WSN. Nodes following common protocols form clusters.

Clustering in WSN is formed so that minimum energy is consumed during transmission of data. Formed clusters consist of large number of nodes which may have same or distinct configuration. The nodes within the clusters if belongs to same configuration then homogeneous clusters are formed. In case nodes are of distinct configuration then heterogeneous clusters are formed. In [5] Nodes selection from clusters is critical that leads to selection of cluster head.

Cluster head from particular cluster is node having maximum energy. In [6] All the nodes from a distinct clusters transfer the data towards selected cluster head from their cluster. Data then is transmitted from one cluster head to another cluster head until destination node i.e. base station is reached. Packet drop ratio is considerably reduced as maximum energy node is selected for transmission of information. [7] As energy decays, sensors unable to hold the packet and hence packet is dropped. As more and more packets arrive at the sensor having minimum energy, packets are dropped. This enhances packet drop ratio considerably. Within clustered environment techniques were researched over to enhance performance in terms of

packet drop ratio during degradation of sensor energy. This paper presents comprehensive analysis of techniques used to enhance lifetime and decrease packet drop ratio.

Highlights of this paper is listed as under

- Energy efficient protocols in WSN for enhancing lifetime of networks are discussed.
- Techniques used to minimize packet drop ratio are identified.
- Cluster head formation techniques are discussed in detail.
- Comparative analysis of various protocols is presented for determining best possible protocols out of available protocols.

ENERGY EFFICIENT CLUSTERING TECHNIQUES IN WSN

Large number of protocols researched over a decade to enhance lifetime associated with the network. This section discusses various protocols falls under energy efficient category

LEACH

In [4], [8] Low Energy Adaptive Clustering hierarchical protocol is used to enhance energy efficiency associated with transfer process. Time division multiple access protocol is integrated within LEACH. Cluster head selection is a problem within LEACH. In fact cluster head selection does not take place and data is transmitted from transmitter towards random selection of node selected as head. Aggregation is performed at cluster head and when threshold value is reached, packets are transmitted forward. In case cluster head energy dissipated completed, all the packets aggregated at node will be lost.

DEEC

This convention is headway related with LEACH. [9], [10] Cluster head choice is mind boggling if there should be an occurrence of DEEC. Most extreme vitality hubs are chosen among accessible hubs. The hub with the most elevated likelihood of preserving vitality is chosen as bunch head. A disseminated multilevel grouping calculation for heterogeneous remote sensor systems is DEEC.

In DEEC, every one of the hubs must have the thought regarding all out vitality and lifetime of the system. Normal vitality of the system is utilized as the reference vitality.

SEP

In [10] SEP concentrate the effect of heterogeneity of Clusters, as far as their vitality, in remote sensor arranges that are progressively bunched. [11], [12] SEP is advancement associate with DEEC. Energy is conserved and lifetime of network is improved considerably by the use of this protocol.

EDEEC

In [13]–[15] Remote Sensor Networks (WSNs) contains no matter how you look at it subjective sending of imperativeness obliged sensor centre points. Improved conveyed

vitality productive grouping convention is progression of DEEC that save vitality and decrease bundle drop proportion impressively. Promote upgrade in DEEC can be made to improve execution DEEC by lessening separation between hubs in which information is being transmitted. The present world needs a few innovations to satisfy their standard work. [16]WSN is that innovation which satisfies the normal work of the general public. Remote sensor arrange faculties the physical world whether it is temperature, weight, moistness and some other condition exercises. WSN is utilized as a part of a domain where the wires or link are impractical to reach. It is anything but difficult to introduce contrasted and alternate links arrange. Presently, these days WSN are utilizing for the most part for the information exchange reason. [17]Sensor hubs in the remote system exchange the information parcels from source to goal. Remote sensor organize incorporates sensors hubs and a base station (sink) and there are such huge numbers of sensors which make a system. Sensor hubs can discuss specifically with the base station. This is the real issue of the sensor arrange. [18]There are more issues of the system yet vitality utilization and enhance the lifetime of the system. Taking these issues in worry, there is one strategy which is especially valuable to determine these issues called grouping. Bunching, the system in which substantial system district is partitioned into littler one. In each bunch, there is a group head which gathers the information from all the system hubs and afterward transmits that information to the base station. The group head is chosen based on most extreme vitality of the hub. The hub which has most noteworthy vitality is chosen for bunch head. Fundamentally just bunch head is in charge of the correspondence in the system. Group head needs more vitality for the information collection and transmitting the information. Next section describes background analysis or literature survey to determine best possible protocol for future enhancement.

RELATED WORK

Techniques have been devised for improvement of performance in WSN. The WSN performance is critically analyzed using this paper. The worth of study is proved using this literature survey. [19] Proposed distance and energy aware LEACH. In case cluster head go down, every packet aggregated at source could be lost. In [20] proposed EAP for conserving energy during transmission of data from source to destination. Inter cluster coverage was introduced in this approach. Data gathered at particular cluster was according to probability distribution factor that reduces energy consumption and enhances lifetime of network. [8] discussed energy efficiency achieved through LEACH protocol. Time division MAC was integrated to achieve energy efficiency and lifetime within the WSN. M. Prajapat et al. [21] proposed a mechanism to analyze energy dissipation through Multi-Chain PEGASIS. This protocol constructs a chain of routing path. In other words time and space complexity was enhanced using PEGASIS. Future modifications required in order to enhance performance of examined system. In [22], proposed LEACH, a hierarchical protocol for achieving energy efficiency within WSN. Adaptive cluster head selection allows performance enhancement however aggregation mechanism used within WSN has merits and demerits associated with it. Energy conservation was achieved with the risk of enhancement of packet drop ration in case of cluster head failure. R. Kumar et al. [23] Proposed energy efficient DEEC protocol. DEEC protocol uses probability distribution function to determine cluster head out of number of nodes available within WSN. DEEC performance decreases by the application of aggregation mechanism leading to increase in packet drop ratio. In [13] proposed enhancement in DEEC protocol to achieve more energy efficiency. Lifetime of network significantly improved by the application of E-DEEC. As packets moved from one node to another, energy associated with nodes will be analyzed. Node having highest energy will be selected as cluster head. Packet being received by node having highest energy. Lifetime of

network was considerably enhanced but packet drop ratio increases hence requires improvement. In [9] proposed a sleep awake protocol for WSN data transmission. Node being idle was set to sleep and energy conservation was achieved. The problem of topology breakage occurred as node was made to sleep. In order to wake the node sufficient amount of energy was required to be dispensed with. In [15] discussed a super energy aware protocol by accomplishing modifications to the existing DEEC protocol. Modified mechanism of electing cluster head was proposed. Node selected as cluster head was evaluated against several criteria's before electing it as cluster head. Complexity in terms of cluster head was extremely high. M. A. Jan et al. [24] proposed a priority based application specific congestion control algorithm. Packets can be initiated through any node and hence traffic could be a problem. Packets from distinct nodes were maintained within queue. As congestion becomes high, en-queue operation takes place. As traffic becomes moderate de- queue operation takes place. In [25] advised gateway based energy routing protocol (M-GEAR) for WSN. Depending on their location in the sensing area, they divided the nodes into four zones. In this protocol, they placed the base station out of the sensing zone and placed a gateway at the middle of the sensing area. They compared the performance of proposed protocol with LEACH. Analysis results show that their assigned protocol perform greatly basis on the consumption of energy and lifespan of the network. In [26] said that in the upcoming time, WSNs require a great need of spreading the nodes and also enhance its applications in all fields because in the future most of the devices will be connected to each and everything. So spreading of these nodes is the greatest challenge, keeping this in mind a new protocol is given called TDEEC used for the heterogeneous network. TDEEC protocols use three levels of heterogeneity.

COMPARISON OF ENERGY AWARE SCHEMES WITHIN WSN

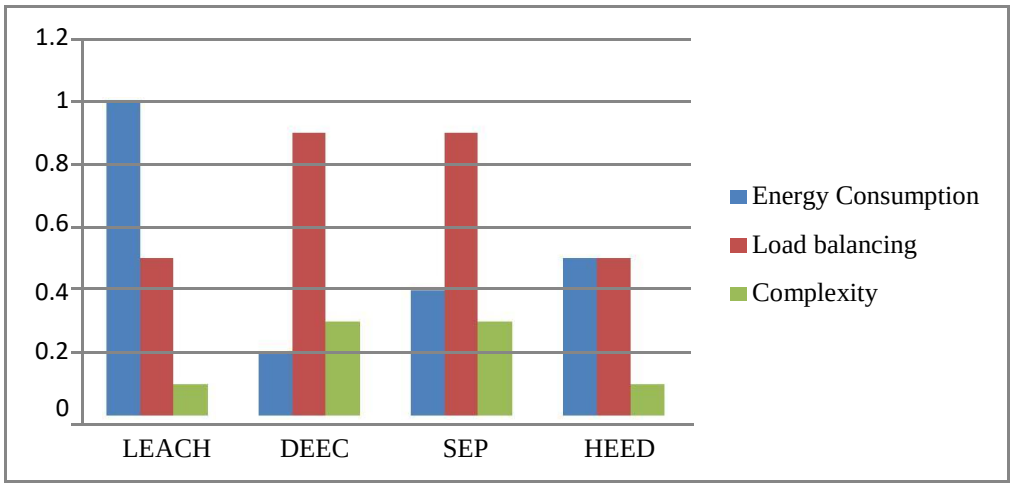
Comparison of energy aware schemes presented in this section provides clear and concise view of optimal technique within WSN during data transmission.

Protocol	**Merits**	**Demerits**	**Parameter**			**Remarks**
			Energy Efficiency	Load Balancing	Algorithm Complexity	
LEACH	• No priority is assigned on any node so any node can become a cluster head • Collision of data packet is resolved using this protocol	• Large scale network cannot use this protocol • Probability based cluster head selection causes unequal load on cluster head	Very low	Medium	Low	Earliest protocol associated with clustering
HEED	• Fully distributed routing scheme • Requires only local communication • Uniform cluster head selection policy is employed • Energy efficiency improves by the application of HEED	• Overhead in terms of cost is high • High energy is consumed in selection of cluster head	Medium	Medium	Low	Better connectivity of cluster heads
UCS	• Unequal size clusters are formed	• Only homogeneous networks can	Very low	Bad	Medium	Commonly used protocol in unequal cluster sized

	• Nodes in cluster can be variable	be used in this protocol • Large range network cannot be employed through this protocol				environment
EECS	• Balanced network is created EECS • Size of the cluster depends upon the network being employed	• Overhead in terms of cost is high • Only single hop communication is used hence parallelism is not supported	Medium	Medium	Very high	Energy efficient protocol used commonly at media access control layer within data link layer
CCM	• Energy and power consumption is limited as compared other protocols used in WSN	• Cluster head selection through chain head is poor	Very low	Medium	Medium	Mixture of flat, hierarchical and location based routing is combined
LEACH-VF	• Area coverage is good, in other words if area to be covered is large this protocol can succeed • Nodes considered are movable hence structure is dynamic in nature	• More energy is consumed in cluster head selection mechanism • Load balancing degree is poor in this protocol	Medium	Medium	Medium	Area independence is achieved

Table-1 Comparison of Techniques of Clustering used within WSN

From comparison table it is concluded that techniques associated with clustering algorithm within WSN requires considerable improvement in terms of energy conservation and packet drop ratio. Distance handling among WSN is critical for this purpose.



(a) Comparison in terms of plots is as under

CONCLUSION AND FUTURE SCOPE

This paper present comprehensive survey of techniques used within WSN to achieve increase in lifetime of sensor within WSN. Enhancement in lifetime involves mechanism such as sleep and wake up protocol but has demerits associated with it. From analysis of existing techniques it is identified that there exist a trade-off between energy and packet drop ratio. In future this tradeoff between energy and packet drop ratio is to be eliminated by considering distance between nodes before selection of cluster head. Use of priority queue can also be merged within existing approach for enhancing performance of WSN.

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