An Exploration of Various Routing Protocols for WSN

ArpitTyagi[1], Dr. P. K. Singh [2]
[1]*M.Tech (Electronics & Communication Engineering),* [2]*Professor & Head Department of Electronics & Communication Engineering*
[12]*RadhaGovind Group of Institutions, Meerut*

Abstract- Network is an interconnection between computers using wired or wireless medium. In wireless, major difficulty faced by the system is transmission of data from one system (node) to another system (node) as compared to wired. In recent years many researchers are working towards data transmission in two major areas of wireless network: one is Wireless Ad-Hoc Network and another is Wireless Sensor Network (WSN). Another and the main problem of WSN is Network lifetime (i.e. how long sensor nodes can survive on battery which are embedded in them). So to overcome these two problems researchers have proposed many protocols and they succeeded upto some extent. Wireless sensor networks are expected to find wide applicability and increasing deployment in the near future. In this paper, we propose a formal classification of sensor networks, based on their mode of functioning, as proactive and reactive networks. Reactive networks, as opposed to passive data collecting proactive networks, respond immediately to changes in the relevant parameters of interest. We also introduce a new energy efficient protocol, TEEN (Threshold sensitive Energy Efficient sensor Network protocol) for reactive networks. In this paper Threshold-sensitive Energy Efficient Network (TEEN) protocol discussed and implemented and then graph is drawn with respect Number of dead nodes Vs. Number of rounds, where in every round, head nodes are getting change after some interval of time.

Keywords- Wireless Sensor Network, Wireless Ad-Hoc Network, TEEN, Energy Efficient Protocol

I. INTRODUCTION

Wireless Sensor network (WSN) is widely considered as one of the most important technologies for the twenty-first century. In the past decades, it has received tremendous attention from both academia and industry all over the world. A WSN typically consists of a large number of low-cost, low power, and multifunctional wireless sensor nodes, with sensing, wireless communications and computation capabilities. These sensor nodes communicate over short distance via a wireless medium and collaborate to accomplish a common task, for example, environment monitoring, military surveillance, and industrial process control [1]. In many WSN applications, the deployment of sensor nodes is performed in an ad hoc fashion without careful planning and engineering. Once deployed, the sensor nodes must be able to autonomously organize themselves into a wireless communication network. Wireless Sensor networks have emerged as a promising tool for monitoring (and possibly actuating) the physical world, utilizing self-organizing networks of battery-powered wireless sensors that can sense, process and communicate. The requirements and limitations of sensor networks make their architecture and protocols both challenging and divergent from the needs of traditional Internet architecture. A sensor network [1][2] is a network of many tiny disposable low power devices, called nodes, which are spatially distributed in order to perform an application oriented global task.

a. Clustering in WSN

In terms of energy consumption, traditional routing protocols for WSN may not be very optimal. Clustering provides scalability; better network lifetime and it reduce energy consumption. As shown in figure 1 Cluster consists of a group of sensor nodes and also known as clump. There is a special node which leads or manages a cluster is called as cluster head and it also responsible for coordination and data transmission in cluster as it act as local coordinator or sink for that cluster. Cluster head aggregates the data and send it to the base station. Clustering provides a load balancing among the nodes and improves the network lifetime. Clustering reduces routing overhead and network appears small in size and more stable. Clusters have ability to use different power levels in inter-cluster and intra cluster communication which reduce the interference and collision in network

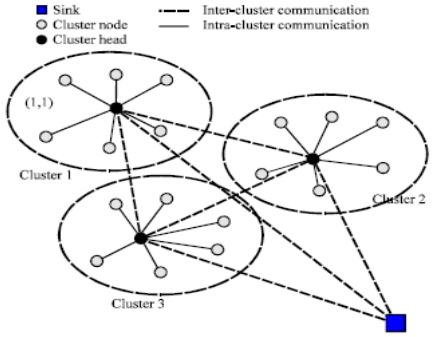

Fig.1: Clustering of Sensor Nodes

II. CLASSIFICATION OF ROUTING PROTOCOLS

A routing protocol specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes on networks. Routing algorithms determine the specific choice of route. The topology of the WSNs can be simply star network to an advanced multi hop wireless mesh network. The way how to effectively route the

collected data among nodes is very important as well very challenging in WSNs because of many constraints of sensor nodes and several discriminated characteristics of WSN that distinguish them from contemporary communication and wireless ad hoc networks. Routing in WSN is very different from conventional routing in fixed network in various ways: In WSNs there is no infrastructure, it is unfeasible to build global addressing and routing algorithms exactly as for conventional IP-based protocols for the deployment of steep number of energy and processing capacity constrained sensor nodes.

A. Routing protocols can classify based on whether they are reactive or proactive. Depending on how the source finds a route to the destination, routing protocols can be classified into three categories, namely, proactive, reactive, and hybrid protocols. A proactive protocol sets up routing paths and states before there is a demand for routing traffic. Paths are maintained even there is no traffic flow at that time. In reactive routing protocol, routing actions are triggered when there is data to be sent and disseminated to other nodes. Here paths are setup on demand when queries are initiated.

- In proactive protocols, all routes are computed before they are actually needed
- In reactive protocols, routes are computed only when they are needed
- Hybrid protocols are combination of the above two ideas

B. Depending upon the network structure, routing in WSNs can be classified as

(a) Flat based routing

(b) Hierarchical based routing and

(c) Location based routing. In flat-based routing, all the nodes in the topology are having same functionality or role. In hierarchical-based routing, nodes are assigned different roles or functionalities according to the hierarchy. In location-based routing, routing path for the data is decided according to the Sensor nodes position in the field.

C. Routing protocols are also classified based on whether they are destination-initiated (Dst-initiated) or source initiated (Source-initiated). A source-initiated protocol sets up the routing paths upon the demand of the source node, and starting from the source node. Here source advertises the data when available and initiates the data delivery. A destination initiated protocol, on the other hand, initiates path setup from a destination node.

D. Depending on the protocol operation, routing protocols can be classified into multipath based, query-based, negotiation-based, QOS based, or coherent based routing.

- In multipath-based routing, multiple paths are used to enhance network performance.
- In negotiation-based routing, high-level data descriptors are used in order to eliminate redundant data transmission through negotiation. Communication
- In QOS-based routing, a balance between energy consumption and data quality is maintained.
- In coherent-base routing, the data is aggregated with minimum processing before forwarding. Here energy efficiency is achieved by path optimality.

III. APPLICATIONS OF WNS SENSORS

- Military Applications
- Environment Monitoring
- Agricultural Applications
- Support for logistics
- Human Centric Applications

IV. ROUTING CHALLENGES AND DESIGN ISSUES

Consultant on the application, the implementation of the steering convention is firmly linked to a structural model, so different design and planning objectives are the purpose of the sensor system.

a. Network dynamics

The maximum system structure is that sensor hubs are stationery, because many gadgets use versatile sensors. You may need to help the recipient or group head portable. Yet life, data transmission, and so on. Steering security is an important development factor. Routing messages from mobile nodes or more are difficult. Therefore, detection events can be dynamic or steady depending on the application.

b. Node deployment

This application is subordinate and can affect the guidance of convention procession. Deciding or configuring itself. In the decisive organization, the sensors are physically arrived and the information is instructed correctly. On the other hand, in the advertising system, the sensor nodes are divided into a basically basic structure.

c. Energy Considerations

During the establishment of the infrastructure, the process of making the way is more influenced by energy considerations. Multi jump steering is expected to be lesser than direct transmission, because the power of radio transfer is according to the separation square within obstacles or more. However, multi-stop routing can introduce the head of the head of the main administration in the control of the above land and media. Works well for all nodes directly.

V. BACKGROUND

As mentioned above TEEN is data centric, event driven and energy efficient protocol but there are some drawbacks in this scheme. The summery of this drawback is as follows:

Yousaf*et al.* (2019) introduced, Resources in sensor networks are scarce, especially in terms of energy, which is required to make nodes alive. Enhancing the energy efficiency by applying different techniques is the main research topic in WSN. The biggest advantage of WSN is that they can be deployed in harsh environment like in seismic regions, volcanic eruption, forest and battle field etc. They also play a vital role in monitoring areas, precise agriculture and medical field. To increase the lifetime of network several protocols have been defined. In this paper, comparisons of different protocols of LEACH have been made to judge performance of these protocols. The protocols LEACH, LEACH-C, MH-LEACH, TL-LEACH, E-LEACH, TB-LEACH, W-LEACH and LEACH-VH have been studied and compared in terms of their energy efficiency. In all the protocols of LEACH cluster head selection mechanism have been discussed in a different way due to which energy is saved. The simulation results of these protocols are observed on MATLAB. All these protocols are implemented on stationary source and sink and implemented on homogenous as well as on heterogeneous network. In future more energy can be saved by applying different strategies in the existing protocols.

Jaradat*et al.* (2019) proposed a simulation model which can be used to evaluate the performance of LEACH protocol in realistic noise-prone WSN environment. In this model, the noise-level is represented by the probability of reception (p_{r}) of packets. When p_{r} is one the network environment is considered noise-free and all packets sent are received and when p_{r} is less than one the environment is considered noise-prone. The noise effect is specified by generating a uniform random number $U; if U is less than p_{r} the packet is delivered successfully to the receiving node, otherwise, packets are dropped. The proposed simulation model was implemented utilizing Python programming language. The effect of various noise levels on the performance of homogeneous LEACH algorithm was investigated for different network metrics. An energy model incorporating noise was derived analytically.

Rahmadhani*et al.* (2018) showed Low Energy Adaptive Clustering Hierarchy (LEACH) is one of clustering routing protocols on Wireless Senosor Network (WSN). LEACH algorithm is divided to setup phase and steady state phase. In a busy network, LEACH Routing has a high packet loss. To solve the problem they need Delay Tolerant Network (DTN). DTN is an advanced architecture that allows communication in extreme conditions like a busy network. In this research, LEACH-WSN changes to optimize the network by adding DTN to LEACH-WSN over DTN. The LEACH-WSN modification by providing a bundle layer to keep the data temporarily. Simulation is performed to test the performance of LEACH-WSNover DTN based on changes in the number of node and buffer capacity. In changing the number of node, LEACH-WSN over DTN can improve performance by decreasing packet loss value by 50% of LEACH-WSN packet loss. In changing of the buffer capacity, LEACH-WSNover DTN also improves performance on PDR values that increase by 1.8% of LEACH-WSN. In the test of energy consumption in two scenarios, LEACH-WSN and LEACH-WSNover DTN have no significant differences but when check the lifetime of node which depends on energy consumption, LEACH-WSNoverDTN has early death node. The effect of LEACH-WSNoverDTN is significant when the number of nodes increases or busy network.

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Jiang (2018) introduced, wireless sensor networks (WSN) technology has become a research hotspot for information gathering in the Internet of Things. In view of the limited energy of WSN and the large amount of data transmission, it is essentially important to optimize LEACH protocol for network data transmission of WSN. This paper uses ant colony algorithm (AC) and particle swarm algorithm (PSO) to optimize the LEACH protocol most commonly used in WSN routing protocol, in order to reduce the energy consumption of WSN data transmission and optimize the data transmission routing. In the clustering process of LEACH protocol, the cluster heads are randomly chosen without considering the energy consumption caused by factors such as location and data analysis, resulting in that the selected cluster heads are not the optimal one.

Therefore, PSO is used to optimize LEACH protocol so as to get the most global optimal communication representative-cluster head. In the data transmission phase of LEACH protocol, a single-hop route is easy to cause a cluster head to consume all the energy too earlier, thus the network cycle is shortened. In order to solve this problem, the inter-cluster communication route is established with the help of the AC, turning the single-hop route to multi-hop route algorithm. Considering that the AC algorithm is prone to fall into a local optimal solution, PSO is used to interfere with the updated pheromone to get rid of the local optimal solution thus accelerating its acquisition of the global optimal communication path under the LEACH protocol. The simulation results show the performance of artificial intelligence (AI) of LEACH routing protocol is enhanced and its imbalance between the data transmission and network energy consumption is well solved through jointly integrated innovation method of AI algorithm.

Sharma and Mittal, (2018) showed Wireless sensor network (WSN) communication has gathered a lot of attention of research scholars due to its various features such as high wireless data transmission. A large number of techniques have been developed till now in order to achieve an energy efficient network. The clustering and cluster head selection is the major and difficult task to perform in a network. LEACH serves as a basic for rest of the energy efficient clustering protocols. This study considers the LEACH-Mobile Fuzzy (LEACH-MF) as base for developing the proposed work. Fuzzy Inference System (FIS) with LEACH along with threshold based data transmission concept is developed in this work. The major objective of this work is to utilize the allotted energy to sensor nodes in an effective way. The proposed model is parted in two forms i.e. Modified Parameter-LEACH-MF (MP-LEACH-MF) and Limited Communication-LEACH-MF (LC-LEACH-MF). LC-LEACH-MF is a reactive protocol whereas the former one is periodic. In order to assure the performance efficiency of the proposed work, the parameters such as Packet Delivery Ratio (PDR), Last Node Dead (LND), Half Node Dead (HND), First Node Dead (FND), Energy Consumption of the network are evaluated and along with this a comparison analysis has been done with traditional LEACH, LEACH-Mobile (LEACH-M), LEACH-MF. After analyzing the obtained results it is concluded that the LC-LEACH-MF outnumbers the rest of the traditional energy efficient clustering techniques.

Chit and Zar (2018) proposed, Wireless Sensor Networks (WSNs) contains small battery powered devices (sensors), and it is very difficult to replace them. Thus, designing and creation of energy efficient routing protocols becomes the active research field in WSNs. The famous protocol called LEACH (Low Energy Adaptive Clustering Hierarchy) proves energy efficiency by using clustering method. In clustering, there are two main phase: heads of clusters choosing phase and clusters making phase. Among them, cluster heads (CHs) selection is the most important. LEACH suffers from early dead nodes problem because it chooses cluster heads (CHs) without considering the remaining energy of each node and remoteness to base station (BS). Therefore, this paper proposes the lifetime improvement of wireless sensor network (WSN) using residual energy and distance to base station (BS) parameters on LEACH protocol and the proposed protocol is termed as RED_LEACH. To prolong the network life in WSNs, RED_LEACH uses two parameters: remaining energy in each node and remoteness to base station in heads of clusters selection and its results is compared with the results of original LEACH in terms of sum of energy of nodes against round and the number of dead nodes against round.

Juwaied and Jackowska-Strumitto, (2018) demonstrate in Wireless Sensor Network (WSN) the energy consumed by each sensor is an important parameter, which affects the lifetime of the network. Therefore, different routing protocols have been developed to extend the lifetime of WSN by efficient use of energy of the sensors, what can also limit the energy used by the whole Internet of Thing (IoT) network. Nowadays, SEP (Stable Election Protocol) and LEACH (Low-energy adaptive clustering hierarchy) are the best known hierarchical routing protocols for maintaining power consumption in WSN. In SEP and also in LEACH, some nodes work as Cluster Heads (CH), which combine the records of their cluster members and transmit it to the sink. In this paper, They propose a modified Stable Election Protocol with a new algorithm for choosing cluster heads from normal nodes and advanced nodes. In each cluster, the node which is in the center of the cluster area is chosen as a cluster head. In our previous work [5] this algorithm was implemented for LEACH protocol. Finally, the results obtained for modified SEP and modified LEACH protocols have been compared.

Saini and Bhatia (2018) described the conventional assurance gadgets can't have the capacity to ensure complex power framework arrangement due to numerous blame current circles will sustain the blame point. Transfers in light of independent choices can't give dependable and revise activity at the point when utilized on a perplexing dispersion framework. This research paper includes information about Routing Techniques like Hierarchical formed routing with its protocols like LEACH, TEEN, SEP and EAMMH. This Proposes new assurance theory utilizing remote innovation. Information sharing among transfers to acquire dependable and exact choice are presented. Wireless Token Ring Protocol (WTRP) as a remote Local Area Network (LAN) tradition charged by the IEEE 802.4 Token Bus Protocol is used for data sharing. WTRP is upgraded adequacy by diminishing the quantity of retransmissions as a result of chances. WTRP plan and tradition are defined to affirm action. MATLAB recreation program is used to mirror the data

exchange tradition among moves in a ring for a predefined measure of time.

Adhisa and Wibisono (2018) showed, Low-Energy Adaptive Clustering Hierarch (LEACH) is one of the most prominent cluster-based routing algorithm for wireless sensor networks (WSN). LEACH applies round where clusters of sensor nodes are formed with a single node that acts as a cluster head (CH) for each cluster. However there are existing problems related to multiple CH appearances and stray node problems where sensor nodes do not receive any CH advertisement messages due to limited radio coverage from the elected CH nodes. To deal with multiple CH appearance problems, this paper evaluate two parameters used to select best CH node, they are the remaining CH energy and distance between the CH node to sink node. The results of the experiment show that by using energy factor as CH-choosing decision factor results in an overall longer network lifetime, more packets sent and received by the sink and overall better packet delivery ratio (PDR), but the network latency is considerably longer than by using CH distance to sink as a decision parameter to select the best CH node in multiple CH appearances.

Priyanga*et al.* (2018) introduced, Wireless Sensor Networks are the efficient technology to build the monitoring system which consists of spatially distributed sensor nodes which are inherently resource constrained. WSN are the typical part of IoT–A network of physical objects or 'things' that can interact with each other to share information via 'internet'. WSN – Assisted IoT has numerous constraints which it makes difficult to directly employ the conventional routing protocols. Energy is one of the biggest constraint for a WSN-assisted IoT. Communication between sensor nodes consumes most of available power much more than that of the sensing and computation. Therefore, they require efficient energy management techniques to prolong the lifetime of the network. In this paper, They propose a energy aware multiuser& multi-hop hierarchical –based routing protocol (EAMMH-RP) includes multi-hop communication in which evenly distribute the energy load among all sensor nodes in cluster formation ,a new series of algorithms for adapting & rotating clusters and a new mechanism to reduce the energy consumption for long-distance communication. Multi-hop in which it uses relay nodes for transmitting the information to the base station(BS).Our simulation results shows that EAMMH-RP performs much better than EECRP using MATLAB and in addition EAMMH-RP is well suitable for the networks that requires along lifetime.

Mukherjee *et al.* (2017)in this paper, Wireless Sensor Network (WSN) plays a very important role within the future wireless communication domain due to its intelligence, low cost and small size. With the wireless interfaces, these will communicate with one another just in case of cooperative communication in single or multiple hops. Multiple nodes are required for co-operative communication where the Stable Enable Protocol (SEP) and SEP - Vector Quantization (SEP-V) is used for cluster and active cluster head (CH) formation. Further Dijkstra Algorithm is used to find the shortest path between the active cluster heads (CHs) and high energy utilization respectively. The main issue of inter-cluster communication is carried out in earlier work using SEP and SEP-V protocols. The proposed work illustrates the SEP-Vector Quantization Dijkstra (SEP-VD) protocol, for shortest path active cluster head (CH) communication on a Cooperative communication network. From the applications point of view, SEP-VD determines the lowest energy path. SEP-V provides the intra-cluster communication between the cluster head and nodes. Using Dijkstra's Algorithm, the minimum distance is calculated connecting the active cluster heads which creates the shortest path resulting in energy efficient technique. Further the spectral distortion of the proposed technique has been analyzed for practical implementation.

VI. CONCLUSIONS

The wireless sensor network is an active research area constantly due to their promising development and wide area of applications. The main concerns in WSNs are energy and network life time and there are many protocols introduce to overcome these concerns. TEEN is energy efficient protocol which also prolong the network life time. But there is drawback of this protocol that if threshold is not reached then there will be no communication and user will not come to know about dead nodes of network or all the nodes are dead in network. And I have proposed the solution in which node will send their energy status to the base station to overcome the problem of user not knowing about dead node of network and can be aware of network life time.

VII. REFERENCES

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