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Energy Efficient Cluster based Hierarchical Routing Protocols in Wireless Sensor Network – a Survey

Abstract

Nowadays the wireless sensor networks have developed into popular domain owing to their extensive variety of applications. Many aspects are decisive the survivability and lifetime of the wireless sensor networks. Energy consumption is one of the biggest restraints of the wireless sensor node and these limitations joint with a characteristic operation of greatest number of nodes that have added several tasks to the design management of wireless sensor networks. The existing systems say that, one of the ways, the energy can be saved efficiently is only by clustering and cluster head election, by using many techniques. Provision of energy to the sensor nodes remains the primary deterrent in the development of sensor nodes as per the typical remote environment monitoring. This survey highlights the way of power saving and energy optimization techniques in wireless sensor networks, enhances the available methods to save energy. In this paper, a detailed study of the resources used, protocols modified and medium access control changes of the energy optimization techniques are provided so as to promote power saving in wireless sensor networks.

Keywords: *Wireless Sensor Networks; Energy Efficient; Network Lifetime; Optimization Techniques; Cluster; Cluster-Head.*

1. INTRODUCTION

A network of small embedded devices referred as the Wireless Sensor Network (WSN) can be called as sensors, which follows an ad–hoc configuration by communicating wirelessly. To provide the sensed information and thereby to measure physical parameters from the environment, sensors are located intentionally in a physical medium and are able to act together [1]. The network topology can alter constantly by the use of a broadcast communication. Due to this, nodes be supposed to be autonomous and they will be unnoticed normally. This sort of device has partial power, low computational capabilities and low memory. In WSNs, features of scalability [2], communication strategy for connection and the partial energy to supply the device [3] are to be studied.

In WSN, advances in research and development was primarily provoked by military applications such as threats in surveillance in the battlefield, which can restore single high-cost sensor resources with many arrays of distributed sensors. Also, various fields are applicable like, building automation, home control and medical applications. The technology of WSN has been used widely in a number of applications [4] of hospitals and medical centres which includes the pre-hospital, in-hospital patient monitoring, rehabilitation and disaster response. In environmental monitoring applications such as marine fish farms, fire detection in the forest and in rural areas, WSNs can be detected.

Sensor nodes are typically battery powered and they are naturally unattended because of their exploitation in dangerous, hostile or remote environments. The design of electronic transceiver circuits and the network protocols uses a number of power saving techniques [5]. The steps towards reduced power consumption are the design of a sound electronic, right component selection and also by applying appropriate design techniques to each case. Idle mode consumption is one of the major causes of energy loss in the WSN node, when the node is not transmitting/receiving any information but listening and waiting for information from other nodes. Due to packet collision [6], there occurs an energy loss, as all packets involved in the collision are to be discarded and to be retransmitted. A third cause of loss of energy is the packet reception is not addressed to the node. Different strategies that relate, the power saving techniques are studied, but the entire network is looking into a way to, improve the energy consumption and save power in WSNs. This paper presents a survey of the various power saving and energy optimization techniques for WSNs and ad-hoc networks, and we will tackle this problem from several perspectives in order to provide a complete view.

2. WSN CLUSTERING CONCEPTS

2.1 Clustering

In this review, we have discussed about the cluster definition, the design goals of clustering algorithms, advantages, challenges, and various algorithms and issues occur at various levels like hardware level, software level, Medium Access Control level and etc., Attention will be given to design of clustering, mobility aware clustering, energy efficient clustering, load balancing clustering and combined metrics based clustering. How can be a network looks like with a various number of nodes. Each node is defined as single normal nodes and the grouped in a particular pale, and a leader will be elected for each group node. The group leader is the cluster head of the particular cluster. The leader will do data gathering and data aggregation.

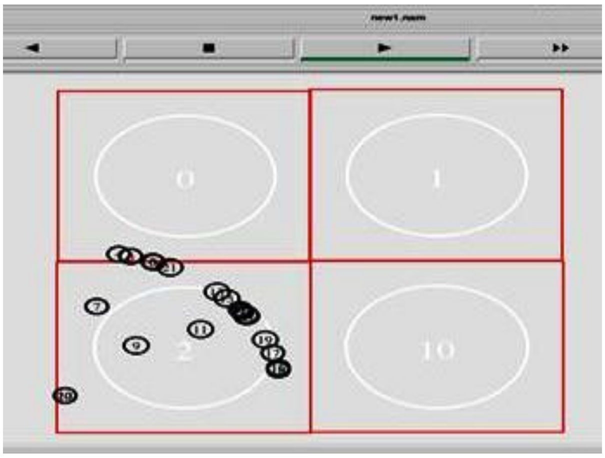

Fig.1a: Intial assembly of Nodes

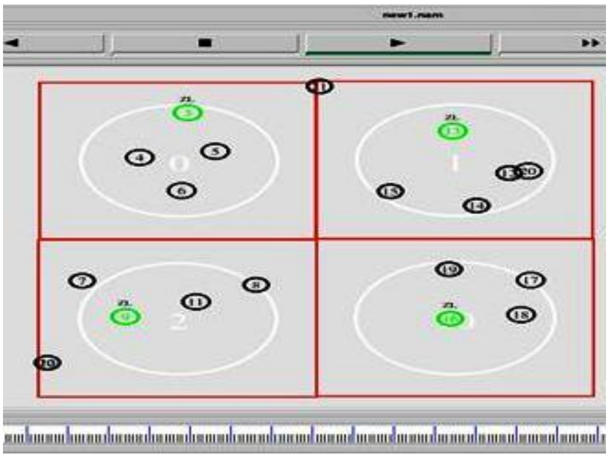

Fig.1b: Nodes Clustered by Characteristics

In mobile ad hoc network references, clustering can be defined as a notional arrangement of the active nodes into different groups. These virtual collections of nodes are grouped together regarding their relative transmission range proximity to each other that allows them to establish a bidirectional link. The diameter size of the clusters determines the control architectures as single-hop clustering and multi-hop clustering. In single-hop clustering every member node is never more than 1-hop from a central coordinator - the cluster head. Thus, all the member nodes remain at most two hops space left between each other within a logical cluster. In multi-hop clustering, the limitation co- restriction of an immediate proximity to member nodes from the head is removed, allowing them to be present in serial k-hop distance to form a cluster. A typical mobile ad hoc network is illustrated in Fig.1a with flat and cluster structure. The small circles in the Fig.1a represent the individual wireless nodes in the network and the lines joining the circles show the sequential single hops of the wireless link between the wireless nodes. Single node is identified with an Identification number, each node bearing equal responsibility in its function as a router for forwarding packets to every other node in a flat architecture Mobile Ad hoc Network (MANET).

2.2 Cluster Head Nodes

There should be an essential support to control functions such as channel access, routing, calculation of the routes for long-distance messages, bandwidth allocation, forwarding inter-cluster packets, power control and virtual-circuit support, for operating the cluster very efficiently. This support or backbone takes the form of connected cluster heads, in a managerial role and it is connected either directly or via entry nodes. Another function of cluster heads is internal node communication, to forward inter cluster messages. Packet sending, takes place by an ordinary node which must be 'superior' to its cluster head. Should the receiver share the same cluster location, cluster head will direct the packet to it. However, should the receiver be in a different cluster location, cluster head will route it to another cluster head (directly) connected to the receiver and the new cluster head then directs it to the final destination (Chen et. al., 2003).

2.3 Cluster Gateway Nodes

Two cluster heads remain within the given transmission range as the node 22 in Fig.1b it is called as the ordinary gateway for two corresponding clusters and a node having one cluster head as an immediate neighbor in addition to which it can reach a second cluster head in two hops as node 21 is a distributed gateway that is linked to another distributed gateway for other cluster. Both of the distributed gateways provide the path for the inter-cluster communication (Purtoosiet et al., 2004).

2.4 Ordinary Nodes (Cluster Member)

As the name represents, it does not carry out any other operation ahead of a normal node. They are members of an exclusive cluster independent of neighbors residing in a different cluster.

2.5 Need of Cluster Designing

Beyond the typical challenges such as limited energy, limited capabilities, network lifetime, some additional important considerations in the design process of clustering algorithms are to be noted for WSNs named as Cluster formation: The Cluster Head (CH) selection and cluster formation procedures should generate the best possible clusters. However, they should also preserve the number of exchanging messages low and the total time complexity should (if possible) remain constant and independent for the growth of the network. This yields a very challenging trade-off. When designing clustering and routing protocols for WSNs, application robustness must be of high priority and the designed protocols should be able to adapt to a many application requirements. As in traditional networks, the security of data is naturally of equal importance in WSNs too. The ability of a WSN clustering scheme to preserve secure communication is ever more important when considering these networks for military applications. Slotted transmission systems such as Time Division Multiple Access (TDMA) enter nodes to regular time sleep intervals to reduce energy used. Such schemes require corresponding synchronization mechanisms and the effectiveness of this mechanism must be considered. Because this process makes energy optimization possible, it remains a fundamental design challenge in many sensor network schemes nowadays. However, its effective implementation in many applications is not a straight forward procedure and has to be further optimized according to specific application requirements.

2.6 Cost Effective

In the ad-hoc network topology designing clustering one of a specific task known as a vivacious element, but there are often important message and processing tasks required that request resource to augment the creation and easing of grouping topology that incur costs beyond data transmission or processing tasks. Message stresses increase with the network size and as it grows better so the quantity of bandwidth spent with it is more. The payment for scalability from grouping is at the expense of the quantity of obtainable bandwidth for the broadcast of data.

2.7 Load Balancing

All the cluster Heads outperform the data gathering and aggregation or it so called intragroup management processes, even node distribution between the group nodes is often needed in order for the CHs to have a balanced the load so that expected performance goals are not compromised. Load balancing is a particular issue for MANETs and the establishment of equal sized clusters offers energy savings and thus prolongs the network lifetime rather than employing a subset of high rate CHs that could expire too early. Even node distribution can also influence data delay.

2.8 Clustering Formation

Sensor nodes are normally applied one-off the power by limited capacity. Computing, communicating, and storage is very limited by the node's capacity, the main purpose is to maximize the network lifetime is by preserving the energy by the requirements of WSN protocol. An energy-efficient communication protocol Low-Energy Adaptive Clustering Hierarchy (LEACH), have been introduced by the employees of hierarchical clustering is done, which is based in order to receive by the base station. The base station sometimes it changes both the cluster membership and CH towards to conserve energy. The CH collects and combined the information's from the sensors, during by its own cluster and it passes on in order to the BS. As a result of rotating the cluster-head by chance, the energy is utilized and it is expected to be uniformly spread [7]. On the other hand, LEACH probably chooses moreover the various cluster heads by the time or by chance it selects the cluster heads by distant which is gone from the base station, exclusive of by considering the nodes' of the remaining energy. As a result, a number of cluster heads are drained of their energy early on, so the lifespan of WSN is reduced.

During each one round by the arrangement of the cluster, the network desires to track two steps to select the cluster head as well as to transfer to combine the data. (i) Set-up Phase, which has been subdivided once more to the announcement, Cluster Set-Up & Schedule Creation phase. (ii) Steady-State Phase, it provides the data transmission by using the TDMA. The determination of cluster head node inside the LEACH has some deficiency such as, a number of very big clusters, as well as very small clusters this may exist in the network by same time. Difficult cluster head selection at the same time as the nodes have unusual energy. The cluster member nodes reduce its energy even though the cluster head is deceased. The algorithm does not obtain to hook on the explanation of the location of nodes. It ignores the residual energy, and the geographic location also other information, which may be easily guided the cluster head node and it would stop working quickly.

2.8.1. Clustering Parameters

1. **Number of clusters (cluster count):** During the probabilistic and randomized clustering algorithms, the CH determination and formation procedure could lead naturally towards the unpredictable number of clusters. Here is some published approach, however, the set of CHs are programmed and therefore the numbers of clusters are

preset. The number of clusters is usually important for the parameter which has to regard the efficiency of the total routing protocol.

2. **Intra cluster communication:** Early clustering approaches the communication by Connecting the sensor and it's designated the CH which unsaid to be direct (one-hop communication). However, multi-hop intra cluster communication is often (now a-days) required, i.e., when the quantity of CH is surrounded by the range of the communication of sensor nodes are limited or quantity of sensor nodes are large.

3. **Nodes and CH mobility:** Suppose if the stationary sensor nodes and stationary CHs are normally led to stable clusters were facilitated to the intra cluster and the inter cluster network management. On the opposing, if the CHs or the nodes are unspecified to be movable, the cluster membership for each node should dynamically change; forcing clusters to evolve over time and probably need to be continually maintained.

4. **Nodes types and roles:** Several proposed network models of (i.e., heterogeneous environments) the CHs are unspecified to be prepared by significant more by computation and communication resources than others. Most common network models (i.e., homogeneous environments) of all nodes have the same capability and a detachment of deployed sensors which is designated as CHs.

5. **Cluster formation methodology:** In more recent approaches, when CHs are just regular sensors nodes and time efficiency is a primary design criterion, clustering is being performed in a distributed manner without coordination. In few earlier approach a centralized (or hybrid) approach is followed one or more coordinator nodes are used to partition the whole network off-line and control the cluster membership.

6. **Cluster-head selection:** The head nodes of the clusters (CHs) inside by some proposed algorithms (mainly for heterogeneous environments) can be pre-assigned. Most of the cases though (i.e., in homogeneous environments), the CHs were selected from the deployed by the set of nodes either in the probabilistic or entirely by random way or which is based on other extra specific criteria (residual energy, connectivity etc.).

7. **Overlapping:** Some protocols also give high importance to the concept of node by overlapping, surrounded by different clusters (either for better routing efficiency or more rapidly of the cluster formation protocol execution or intended for extra reasons). Most of the identified protocols, however, they are still trying to have a minimum overlap by merely or they do not support overlapped at all.

2.9 Real-time Operation

Data lifespan is another consideration that may, or may not, is pertinent to a particular application. For some, receipt of data has only been adequate for analysis and delay is not a significant issue whereas it is absolutely imperative that military tracking or emergency services applications receive real-time data (Chlamtac et al., 2003). In tailoring a clustering algorithm, delay created by the clustering scheme itself and the time is compulsory for the recovery cluster mechanisms it must also be taken to hook on consideration for the particular application.

2.10 Advantages of Clustering Structure

The cluster MANET with a many figure of mobile terminal and it ensures the efficient of the performance. The cluster structure offers a certain amount of profit, some of which are mentioned below:

2.10.1 Data Aggregation

A characteristic wireless sensor network is a large number of sensor nodes, it collects an application on specific information from the environment, plus this information is transferred to the central base station anywhere it is processed and it is analysed, and used by the applications. In these resource forced networks, the general approach is equally process the data which is generated by different sensor nodes while it's being forwarded towards the base station. Such spread in-network processing of data is generally known as the data aggregation and it involves by combining the data which belongs to the same phenomenon. The main purpose of data aggregation is to enlarge the network lifetime by dropping the supply consumption of sensor nodes (like battery energy and bandwidth). Whereas, by increasing network lifetime, the data aggregation protocols may degrade the vital to value the service of metrics in wireless sensor networks, such as by the data accuracy and latency, fault-tolerance, and security. As a result, the aim of an efficient data aggregation protocol naturally be challenging to the task because the protocol designer must be a tradeoff between the energy efficiency, latency, data accuracy, fault-tolerance, and security. This arranges to achieve this trade off the data aggregation system are tightly coupled with how the packets are routed through the network. For this reason, the architecture of the sensor network it plays a vital role in the performance of special the data aggregation protocols. There are some protocols which allow the routing and aggregation of data packets by at once. These protocols are categorized into two parts: tree-based data aggregations and cluster-based data aggregation protocols. Previous works are on data aggregation are focused on by improving the existing of the routing algorithms to make the data aggregation to be potential. As a result, many of the data aggregation protocols are based on the shortest path of tree structure which has been proposed. To decrease the latency to tree-based data aggregation, current work on data aggregation tends to group the sensor nodes into the clusters, so the data's are aggregated in every group to improve the efficiency.

2.10.2 Efficiency and Stability

The quality of a cluster structure is important that it causes a MANET to seem lesser and more stable in the facet of each mobile terminal. Hence, now this method, mobile node switches after it is attached cluster, only mobile nodes exist in the matching clusters are necessary to change their data structures (Mai et al., 2009; El-Bazzal et al., 2006).

2.10.3 Communication Coordination

In this section, we focus on two communication coordination mechanisms, Information Coordination (IC) and Communication Coordination (CC). When using IC, whether or not a node transmits depends on the fraction of neighboring nodes that are not having the message. By deciding to transmit a message only when some minimum number of the node's neighbors do not already possess the message, the number of redundant transmissions can be reduced. When employing CC, the nodes which are transmitting a certain number data to its neighbors are not already received from any other transmitter node in the network. This reduces the number of collisions that may occur. IC improves efficiency, whereas CC reduces collisions. We study the performance of a WSN using IC and/or CC under variations in topology and when nodes die due to energy constraints (battery depletion). There are four broadcast protocols to gauge the individual and joint benefits of IC and CC. These protocols are the combinations of either using or not using IC and CC.

2.10.4 Routing Efficiency

We also compare the routing efficiency with the average number of hops and optimal hops. Optimal hops are calculated by network simulator 2 during the simulation. The plot shows that the average number of hops and optimal hops depending on the cut off time. Ad-Hoc On-Demand Distance Vector- Node Caching (AODV –NC) delivers packets with the smallest number of hops while AODV uses the largest number of hops. On the other hand, AODV uses the lowest optimal hops among the rest of the protocols. The other plot shows the ratio of average hops to optimal hops in that AODV and Ad-Hoc On-Demand Distance Vector- With Load Balancing (AODV-WLB) show a higher ratio than other protocols while AODV-NC shows the lowest ratio. It means that AODV-NC protocols finds a shorter path than AODV. The plot shows the distribution of delivering data packets per hops. In this plot, AODV-NC tends to send packets with a smaller number of hops than AODV. AODV uses a larger number of hops compared to other protocols.

2.10.5 Spatial Reuse of Resources

A cluster increases the system capacity; that the information is saved once on the cluster head, which make easy to spatial reuse of resources. Two clusters can share a same data or frequency set if they are not adjacent clusters, make easy with the non-over lapping multi-cluster structure. Also, they can be improved synchronization by a cluster head of its transmission with the help of a specialized mobile node residing in it. This functionality is modified in the existing system where the resources can store the resources, which are used for re-transmission to avoid the collision.

1. LITERATURE SURVEY

3.1 Energy Consumption in Medium Access Control (MAC)

In [9], this paper, present an Energy Optimization Approach based on Cross-Layer for Wireless Sensor Networks named as EOA, which consider the combined optimal design of the physical, routing layer, and MAC. EOA is about the computation of optimal routing, transmission power, and duty-cycle program that optimize the WSNs energy-efficiency.

In [12], Efficiency of Energy is a major challenge in sensor networks and the radio consumes the overall energy of the node. There are severe resources constraints in WSN and conservation of energy is very essential. This presents a reduction of energy consumption in wireless sensor networks. This paper also introduces an adaptive radio low-power sleep mode, based on present traffic condition in the network. It provides an analytical model to carry out a relative study of different MAC protocols (BMAC, TMAC, SMAC, and DMAC) suitable for reduction of energy consumption in wireless environment. The energy tradeoffs of different MAC protocols were exposed by this technique. Energy model is introduced, which includes energy components for radio transmission, listening, switching, sleeping, and the reception for determining the optimal sleep mode and MAC protocol to use for giving traffic scenarios.

The main sources of energy waste are inactive listening, retransmission resulting from collision, unnecessarily high transmission power and sub-optimal operation of the available resource. There is an important approaches to address different aspects of energy waste correspondingly to these problems, To alleviate, this energy utilization of idle listening, duty cycling mechanisms have been introduced [13] in sensor network MAC protocol. Various MAC protocols such as, S-MAC, SCP-MAC and so on explaining about MAC in detail. In [14], to reduce the unnecessary transmission of energy consumption, some approaches to control the transmission power and decrease the interference among nodes to maintain the network connectivity. The Largest amount of energy is saved by Power aware routing protocols by selecting the correct route according to the available energy of nodes. To minimize the energy consumption, a WSN is required to reduce the energy consumed in all states (i.e., transmission, reception, idle). This enhances a WSN to effectively apply all the above approaches.

3.2 Energy Consumption in Hardware

With a CH as the coordinator in each cluster, clustering schemes organize the network in a hierarchical way. Redundant nodes can be put into a sleep mode, and the multi-hop forwarding between CHs can avoid long-range, over-the-air transmissions. One general simplification in the sensor network analysis is the use of average distance to calculate energy consumption [15]. This largely underestimates the distance distribution between sensor nodes, and the error will become larger due to this upper linear path loss exponent [18]. In the case of energy, reduced in the hardware part, the energy can be recharged or replaced by a cheap and best hardware spare where the cost should be adoptable comparatively with recharge or replacement should be handled. The number of hardware devices can be an autonomous based on the monitoring, communication and computation, energy supply due to save the energy. The system designer can be motivated in challenging careful designs, separate devices and integrate it. The number of resources can also reduce in numbers in terms of process and energy reducing.

In a WSN with collection of sensor nodes predefined with low cost, minimum power and limited network life time etc., are presented. All the nodes are placed in a region based manner and do data gathering from nature. In this paper, we simulate the static clustering based routing schemes Energy Efficient Protocol with Static Clustering (EEPSC) and Extended Energy Efficient Protocol with Static Clustering (EEEPSC) [19]. Our experimental results display that EEEPSC raise the network lifetime of a wireless sensor network.

3.3 Protocol Based Energy Consumption

3.3.1 A Cluster Based Energy Efficient Routing Protocol (CBERP)

CBERP [22] proposed clustering and cluster head election same like LEACH protocol C. In addition the header selection mechanism is utilizing a maximum number of nodes to decrease the overhead. After the CH election the chaining will be formed among CH and the data transmission is happening shown in Fig.2.

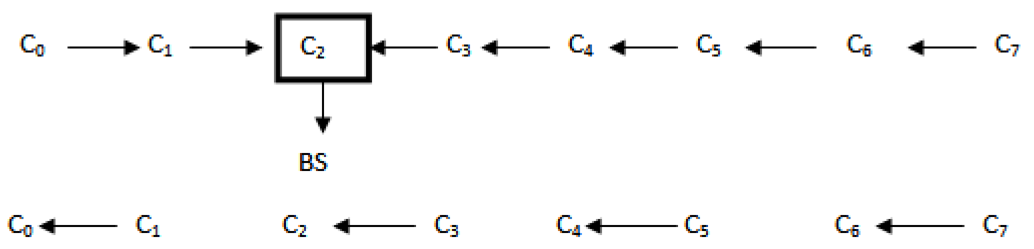

Fig.2: CBERP

3.3.2 Linear Chain Model

A narrow bind associates all the sensor nodes within the network. Data is transmitted from one limit of the end slave to the other close. Each host attaches its own data to the accept data to configure a larger bundle and emit it to the next host. When the data finally deceive the end of the bind, the same process begins from that end back to the origin host. To preserve power, each node alleges the same gauge of the leader. Thus, all nodes transmit the same numeral of bits except for the termination nodes, since the termination nodes only transmit their own data. It is beneficial to share the power use among nodes to anticipate nodes from being foolishly overused. Using this project, nodes expire randomly. When an adjacent expires, a host merely skips the death like host and transmits data to the next active adjacent in the bind.

One model of the narrow-bind scheme is demonstrated in Fig.2. If each set subsist of a 40-byte header and 20-byte data, host C0 throw complete 60 bytes (head + d0) to host C1.After accept this set, host C1 detain the same gauge of the header, attaches its understanding data (d1),and forwards 80 bytes to host C2. The procedure persists until the communication deceives the other termination of the bind, which is C4 in this event. Once host C4 accept data, it has instruction from all other nodes. Now host C4 only throw its own 60 bytes set (head + d4) to host C3.Then the same process perseveres along this invert direction until data transmission termination at host C0. Eventually every host has the instruction of the whole condition. In the broadcasting procedure, termination nodes C0 and C4 throw 60 bytes. Other nodes, C1, C2 and C3, throw 200 bytes each shown in Fig.3.

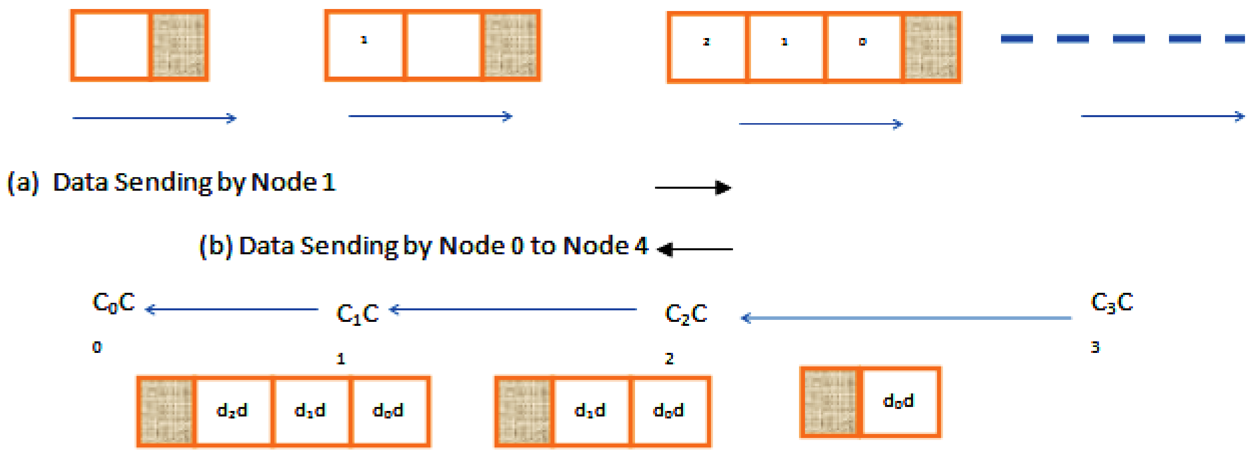

Fig.3: Linear Chain Model

3.3.3 Energy Aware Routing

To surge the period of the network, shah et. al. recommends that to use set of sub finest paths rarely. These paths are preferred by means of a possibility we're gathering is done, which it depends on the energy consumption of path respectively. The method which is concerned by the main metric is network survivability. Whenever the minimum energy path is used entirely, that could drain the energy nodes on its path. In its place, a unique various paths are used with an assured possibility, so that the entire network lifetime rises.

The protocol consists of three phases. This protocol undertakes each single node which is addressable through a class –based lecturing, which embraces the location and its type.

1] Setup Phase: limited overflowing ensures that creation of routing table and finding their routes. However by doing this, each node is calculated to the total energy cost. For example, if the request is given from the node *N i to* node *N j, N j and* to calculate the cost of the path follow:

$$C\ N_j N_I = Cost(N_i) + Metric\left(N_j, N_i\right)$$

Here, the energy metric is used to capture the transmission & reception costs along with the remaining energy of the nodes. Paths which are most expensive are rejected. Familiarity to the destination, the node selection is ended. The node allocates to the each of its neighbors routing (forwarding) table (FT) corresponding to the designed Paths. This probability inversely proportional to cost, that is:

$$P_{N_j,N_i} = \frac{1/C_{N_j,N_i}}{\sum_{k\in FT_j} 1/C_{N_j,N_k}}$$

N then estimates the average cost for accomplishment to the endpoint using the adjacent in the forwarding fable (j FT) using the formula:

$$Cost(N_j) = \sum_{i\in FT_j} P_{N_j,N_i} C_{N_j,N_i}$$

This average cost for j N is set in the cost pitch of the appeal and forwarded.

2] Data Communication Phase: Each node on the packet is randomly taking a node from its forwarding table and it is using the probabilities.

3] Route Maintenance Phase: occasionally limited overflowing is performed to keep all the paths alive.

The defined method is similar to the Directed Diffusion in the way of potential paths from data bases to the sink which are exposed. In Directed Diffusion, the data which is sent through the multiple paths and individual of them is being secure to send the higher rates. By other hand, Shah et al. select a particular path casually from the various options in order to save the energy. Consequently, when compared to Directed Diffusion, [23] it offers a complete improvement of 21.5% energy saving and a 44% rise in network lifetime. Still, such particular path usage delays the ability of improving from a node or path failure as different to Directed Diffusion. In addition, the method requires the gathering of location information and background up the addressing mechanism for nodes, which confuse the route setup which is related to the Directed Diffusion.

3.3.4 Rumor Routing

Rumor routing is additional variation of Directed Diffusion and it is mainly proposed for contexts by which geographic routing principles are not valid. Normally, Directed Diffusion overflows the request to the full network, when there are no geographic principle to drawn-out the tasks. Though, in some circumstances there is only a little amount of data is demanded from the nodes and by consequently the use of flooding is avoidable [24]. An alternate method is to flood the occasions if there are a number of events are slight and number of requests is large. Rumor routing is concerning event flooding and query flooding. The knowledge's are able to route the queries and to the nodes which have witnessed an individual event somewhat flooding the full network to recover the information about the occurring of events. In order to flood the events through the network, the rumor are routing algorithm to employ long-lived packets, called agents. When an event is identified by a node, such events are added to its local table and generates the agent. The agents travel in the network in order to spread the information about the local actions to the distant nodes. When the node generates a request for an event, the nodes are able to find the route, so they can react to the query by referring its own event table. Therefore, the cost of flooding the entire network is dodged. Rumor routing keeps the only one path, between the source and destination as different to Directed Diffusion whereas the data can be sent through various paths at low rates. Imitation results have shown that the rumor routing completes the significant energy saving over by event flooding and it can also handle its node's failure to. But, rumor routing executes well only when the number of events are small. For a big number of events, the costs of by preserving the agents and the event-tables of the each node may not be repaid if there is not enough awareness on those events from the drop. Additional issue is to deal with its tuning the above is done, by adjusting the parameters which are used by the algorithm such as the time-to-live for requests and the agents.

3.3.5 Gradient-Based Routing

Schurgers have recommended a slightly improved version of Directed Diffusion, is called Gradient-based routing (GBR). The awareness is to keep the number of steps when the interest is spread over the network. Later, each node can be discovered a minimum number of steps to the drop, where called as the node height. The difference between a node's height and its neighbor is considered to be the gradient on that connection. A packet is sent on a link by the largest gradient [25]. The authors aim at by using some of the auxiliary techniques such as data combination and traffic diffusion along with GBR in sequence to balance the traffic evenly over the network. No des-acting as the relay for multiple paths it can create a data merging object in order to combine the data. The three different types of data spreading techniques have been presented.

4 HIERARCHICAL PROTOCOLS

In a communication network, scalability in sensor network is one the major attributes. The overload gateway can cause a single-tier network to increase in mass sensor network. Such overload might reason, for latency in inadequate communication and tracking of actions. In addition, the single-gateway structure is not accessible for a large set of sensors covering an area because the sensors are not capable of long-haul communication. To enter the system to manage with additional load and to be able to cover a large area without service degrading, networking clustering has been followed in various routing approaches.

The Hierarchical routing protocol is called tree-structure routing protocol. The goal of tree-structured routing is to efficiently maintain the energy consumption of sensor nodes by connecting them in multi-hop communication within a specific cluster and by performing data fusion and aggregation in order to reduce the number of transmitting messages to the base station. Cluster arrangement is normally based on the sensors, energy and sensor's nearness to the cluster head [25]. In hierarchical routing approaches Low-Energy Adaptive Clustering Hierarchy **(**LEACH) is first approached in sensor networks. The LEACH proposed idea has been an inspiration for many trees-structured routing protocols, while some protocols have been developed independently. We explore tree-structure, routing protocols in this section.

4.1 LEACH

LEACH [26] is one of the main hierarchical routing protocols for sensor networks. The clusters form of the sensor nodes built on the received signal strength and use local group heads as routers to the base station. Because the transmission will only be done by such group heads rather than all sensor nodes and save energy. Sensor nodes, optimal number of group heads is estimated to be 5% of the total number of nodes.

All data processing such as data aggregation and fusion are local to the cluster. Cluster heads modify irregular in order to balance the energy dissipation of nodes. This result is made by the selecting node a random number between 0 and 1. For current round the node becomes a group head if the number is less than the following threshold:

$$T(n) = \begin{cases} \dfrac{p}{1 - p * (r \bmod \frac{1}{p})} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases}$$

Where p is the desired percentage of group heads (e.g. 0.05), r is = the current round, and G is the set of nodes that have not been group heads in the last 1/p rounds.

4.2 Threshold sensitive Energy Efficient sensor Network protocol (TEEN) and Adaptive Threshold sensitive Energy Efficient sensor Network protocol (APTEEN)

TEEN [27] is a tree-structure protocol designed to be reactive to unexpected changes in the sensed characteristics such as temperature. Reaction is primary for time-critical applications, in which the network functioned in an immediate mode. TEEN follow a hierarchical method along with the use of a data-centric mechanism. The sensor network structure is based on a hierarchical grouping where nearer nodes form groups and this process goes on the next level until base station is reached.

The model is pictured in Fig.4**,** which is redrawn from [27]. After the groups are formed, the cluster head transfers two thresholds to the nodes. These are soft and hard thresholds for sensed characteristic. Hard threshold is the lowest possible value of an attribute to activate a sensor node to change on its transmitter and transmit to the group head. Thus, the hard threshold permits the nodes to transfer only when the sensed characteristic is in the range of interest, thus decreasing the amount of transmissions importantly. Once a node senses a value at or without the hard threshold, it transmits data only when the values of that characteristic changes by an amount greater than or equal to the soft threshold. As a result, soft threshold will further decrease the number of transmissions if there is little or no change in the value of sensed characteristic. One can modify both soft and hard threshold values in method to control the packet transmissions. However, TEEN is not useful for applications where seasonal reports are required since the user may not get any data at all if the thresholds are not reached.

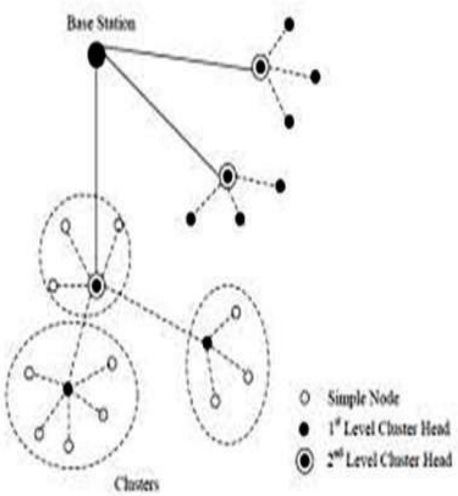

Fig.4: TEEN and APTEEN

The TEEN can be extended to APTEEN is design at both capturing seasonal data collections and return to time-critical events. APTEEN structure is same as in TEEN. When the base station creates the group, the group heads transmit the threshold values, the attributes, and the transmission list to all nodes. Cluster heads also execute data aggregation in order to save energy consumption. APTEEN supports three dissimilar query types: historical, to analyze ended data values; one-time, to take a picture of the network view; and stable to monitor an event for time duration.

5. CONCLUSION

This paper provides an effective presentation about the clustering based energy efficiency in WSN, with overall energy consumption way by techniques, protocols and by clustering mechanisms. In this paper, it focused on the important aspects of the sensor networks, like how energy can be saved by clustering, maximizing the life of the node and the network by clustering, and by chain models. Then looked at some of the main processes in the design related problems, hardware issues based on energy optimization, etc., and finally the layer based modification for making energy efficiency in the protocol like MAC, PHY and NETWORK layer configurations.

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