ENERGY EFFICIENT ROUTING TECHNIQUES IN WIRELESS SENSOR NETWORK

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1. INTRODUCTION

Sensor Networks (WSNs) consist of small nodes with sensing, computation, and wireless communications capabilities. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue. Here we concentrate on routing protocols which might differ depending on the application and network architecture. In this module we comprehend the routing technique for energy efficiency. This paper surveys recent routing protocols for sensor networks and presents different approaches to conserve the energy.

2. ENERGY CONSIDERATIONS CONTEMPALTION AND CONTENTION

During the creation of an infrastructure, the process of setting up the routes is greatly influenced by energy considerations. Since the transmission power of a wireless radio is proportional to distance squared or even higher order in the presence of obstacles, multihop routing will consume less energy than direct communication. However, multi-hop routing introduces significant overhead for topology management and medium access control. Direct routing would perform well enough if all the nodes were very close to the sink [14]. Most of the time sensors are scattered randomly over an area of interest and multi-hop routing becomes unavoidable.

3. ENERGY EFFICIENT PROTOCOL

The study regarding WSN protocols is been surveyed on broadly classified into two types, first is based on network structure, this includes flat networks routing, hierarchical networks routing, location based routing. Second is with respect to protocol operation which includes coherent based routing, query based routing, QOS based routing , multipath based routing and negotiable based.

3.1 Sensor Protocols for Information via Negotiation (SPIN):

Among the Data Centric Routing mechanism SPIN is the early work,[25] . Heinzelman et.al. in [3] and [7] proposed a group of adaptive protocols known as Sensor Protocols for Information via Negotiation (SPIN) scatter the all information to each and every node assuming that all nodes are Base station through advertisement mechanism which is key feature of SPIN. Hence this makes easy to retrieve the required information from any node instantaneously, here the data will be same in the nearby nodes so it's essential to distribute data only to those nodes which do not possess. The protocols of SPIN family use data negotiation and resource-adaptive algorithms. Nodes working on SPIN algorithms assign a high-level name to completely describe their collected data (called meta-data) and then perform a meta-data negotiations before those data is transmitted, making sure that there is no redundant data transmission in the network. Even this SPIN overcome the problem of flooding such as passing of redundant data, sensing area overlapping and resource blindness in-turn accounting for good energy conservation. The meta-data has no standard format, instead it'll adopt as per the application i.e. application framing. But three types of message types defined in SPIN, they are ADV message which is to advertise the particular meta-data from that node, DATA message which carry the actual meta-data, REQ message to request the particular data. Fig 1 summaries the SPIN protocol [25]
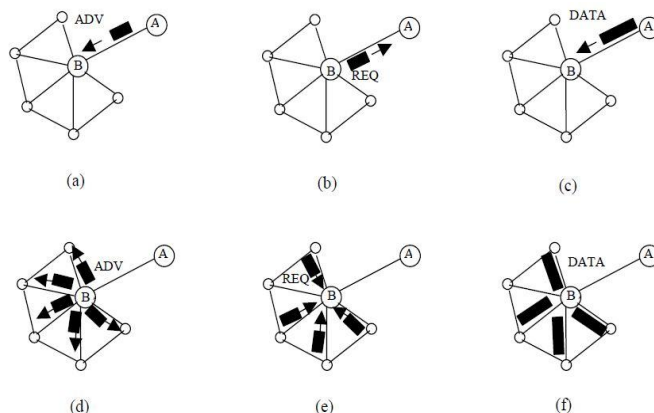

Fig. 1: SPIN Protocol. Node A starts by advertising its data to node B (a). Node B responds by sending a request to node A (b). After receiving the requested data (c) node B then sends out advertisements to its neighbors (d) who in turn send requests back to B (e-f).

The advantage of SPIN protocol the nodes need to just one hop neighbor. SPIN protocol yield a factor of 3.5 less than flooding with regard to energy dissipation and negotiation of meta-data almost reduces the redundant data by half. In same time the assurance of data delivery is not possible through advertisement mechanism. Therefore, in applications such as intrusion detection where reliable delivery of data packets required in regular intervals SPIN protocol is not a good choice.

3.2 Directed Diffusion

In order to get rid of unnecessary operation of routing in network layer ,a scheme was introduced known as Direct Diffusion which in turn save energy[19]. This was a milestone in research of Data-centric (DC) routing. Here all data generated by the sensor nodes in a network is named by attribute-value pairs. The DC paradigms main ideology is to combine the incoming data from different sources enroute (aggregation in-networking) by elimination of redundancy, minimizing the trail of transmissions, hence saving network energy and increasing its lifetime. In this routing mechanism sensors measure events and audit the information in neighborhood. The base station requests for the data by broadcasting interests. Interest describes a task required to be done by the network. This interest is passed on through the network hop-by-hop, and is broadcast so on by each node to their neighboring sensors and can be cached for future use. Interest is defined by using attribute-value pairs such as objects name, interval, duration, geographical area, etc. The in-network data aggregation can also be done by the nodes; this is modeled as a minimum Steiner tree problem [23]. A gradient is setup by sensor nodes towards those sensor nodes from which it receives the interest, gradient specifies direction and attribute values. Until gradients are setup between BS from the source the process continues. The gradient strength may not be the same towards different neighbors therefore resulting in different rate of information flow. Loops are not checked, at this stage but it's deleted at a later stage. Figure 2 depicts an example of directed diffusion operation.

When interests occupy gradients, paths for the information flow are formed from available multiple paths and as to prevent further flooding the best paths are top up according to a local rule. The data is combined on the way in order to reduce communication costs. The intent of this is to find a good aggregation tree which communicates the data from source nodes to the BS. The BS repeatedly revives and re-transmits the interest when it starts to receive data from the source(s). As interests are not reliably transmitted this is done throughout the network.
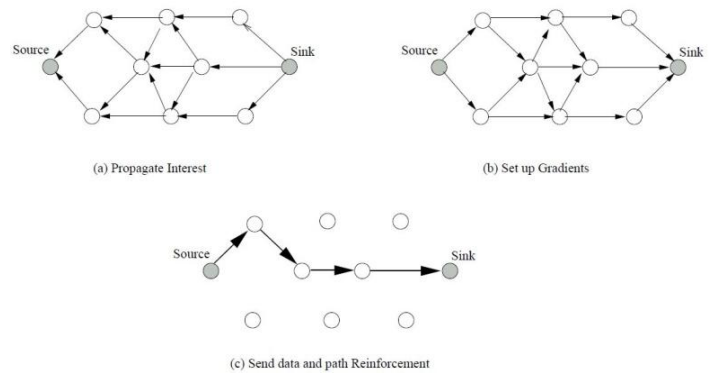

Figure 2. An example of interest diffusion in sensor network ((a) sending interests, (b) building gradients, and (c) data dissemination).

3.3 RUMOUR ROUTING

One of the variations of directed diffusion is Rumor routing [14]. Its mainly intended for contexts in which geographic routing criteria is not applicable. The query is spread throughout the network if the geographical criterion is not specified in the Directed Diffusion, suppose if requested data is of minimal amount, flooding is not required. Hence we use a different approach, where the event is flooded if number of events is small and number of queries is large. Rumor routing is allying query flooding and event flooding. Instead of flooding the queries to the entire network in order to reclaim the information, the queries are routed to those nodes that have noticed the particular event. Long lived packets named agents are employed in rumor routing in order to flood events in the network. The task of circulating information to distant nodes about local events in network is done by agents. To avoid flooding of whole network, the nodes that perceive the route can authenticate to the query generated by the nodes for an event by mentioning in its event table. Unlike Directed Diffusion routing where the data can be forwarded in low rate through multiple path, Rumor routing will establish dedicated path between destination and source.

The simulation results showed significant result in rumor routing with respect to saving energy over event flooding and also can manage nodes failure. But the drawback over rumor routing is that it can't perform well if events are not small. In case of large number events, cost of event-tables and maintaining in each node may not compromised if there is no good heed on those events form sink. Adjusting the overhead by regulating parameters used in algorithm such as time to live (TTL) for agents and queries is a another issue.

3.4 Minimum cost forwarding algorithm

Minimum cost forwarding protocol intend in finding minimum cost path for vast sensor network, this will be simple and scalable [28]. Though this protocol is not flow based, in this section the resource on nodes is updated after each flow and data flow is kept over minimum cost path. The cost foundation includes effect of delay, energy consumption and throughput from nodes to the sink. This comprises two phases, i.e. setup phase and broadcast of data to neighbor.

First is setup phrase where the cost value for all nodes is predetermined, which is initiated from sink and diffuses through network. The cost of each node will be adjusted by adding cost of link and also by adding the cost of node it has received the message, but this type of cost adjustment is not done by flooding. The number of message exchanged is limited through back-off based algorithm. The arrival cost is minimized by delaying the forward of message to the present timing. Therefore only one message is used at each node to find the minimum cost by this algorithm. Scalability is ensured here because there is no need to keep the states of next nodes once the cost fields are set.

In second phase the data is broadcasted to their neighbors. On the reception of broadcast message, the cost of the packet will be added up with its transmission cost. This in turn checks the remaining cost in the packet. The packet is dropped if the cost of that packet isn't sufficient, instead that packet will be forwarded to its neighbors. Addresses and forwarding paths are not required in this protocol. The cost value for each node in flooding was same for simulation results obtained for this proposed model. With minimum amount of advertising messages optimal forwarding is accomplished here. Hence in flooding the average number of advertising messages can be reduced by a factor of 50 by using this algorithms based on back off with proper adjustment of back off timer.

3.5 Gradient based routing

Another variant of directed diffusion, was proposed by Schurgers et al. [15] called Gradient-Based Routing (GBR). The number of hops will be counted in this method when the interest is diffused through the entire network. As such, parameter known as height of the node can be calculate which is the minimum count of hops needed to reach the BS. The packet with large gradient value is sent through the link and gradient on the link is the difference between nodes height and that of its neighbor respectively. Some auxiliary techniques such as traffic spreading and data aggregation is used by the author in order to divide the traffic over the network uniformly. In case if node acts as relay node for multipath, that relay node may combine data according to a certain function.

Three different data dissemination techniques have presented in GBR.

(1) Stochastic Scheme: when same gradient is associated with two or more next hops, the node chooses one among them in random.

(2) Energy-based scheme: when energy drops below a specific threshold after increasing its height, so that sending data to that node are discouraged.

(3) Stream-based scheme: where new streams will not be routed through those nodes which are already a path of other streams.

Traffic is evenly distributed throughout the network by this data spreading scheme, hence this increases lifetime of network because of load balancing on sensor nodes. GBR Simulation results showed GBR is more efficient by this directed diffusion with regards of total communication energy.

3.6 Constrained anisotropic diffusion routing (CADR) and Information-driven sensor querying (IDSQ):

Two routing methods was proposed [16] namely Constrained anisotropic diffusion routing (CADR) and Information-driven sensor querying (IDSQ). The main idea here is to query the sensors and forward the data in order to maximize the efficiency and minimize the bandwidth and latency. Certain criteria will be considered while diffusing the queries to those sensors which can get data. By activating those sensors that are close to a précised event and by adjusting route dynamically we will achieve this. The main difference between from directed diffusion and this method is consideration of the communication cost and the consideration of information gain. On basis of cost gradient/ local information and end-user requirements each node estimates the information/cost objective and routes data in CADR. Information utility measure model was done by Estimation theory. Advantage of using IDSQ it that the querying node can determine which node is able to provide the most useful information with the added asset of balancing the energy cost. On the other hand IDSQ will not specifically define how data and the queries are routed between sensors and the base stations. Hence IDSQ is can be used as substitute for optimization procedure. These approaches simulation results showed that they are more energy-efficient than directed diffusion in which queries are diffused in an isotropic way and reaching its nearest neighbors first.

3.7 COUGAR

COUGAR is another data-centric protocol [13] here the network is viewed as a huge distributed database system. The abstraction of query processing is done by

declarative queries from the network layer functions like selection of relevant sensors and so on. To obtain more energy savings, COUGAR utilizes in-network data aggregation method. The notion is supported by an additional query layer that's between network and application layers. COUGAR includes architecture for sensor database system in which sensor nodes select a leader node to perform aggregation and pass on that data to the base station. The base station will be generating a query plan, which list outs the necessary information regarding the data flow and in-network computation for the incoming query and send it to the précised nodes. For data query COUGAR provided network-layer independent methods. The query plan will also describe how to select a leader for the query. When the generated data is large, this architecture will provide in-network computation ability which renders good energy efficiency in these situations. In spite of this COUGAR have some complications, at first an extra overhead is added with include of query layer on each sensor node. Next the synchronization is needed among the nodes to deliver data to the leader node and have successful in-network data consumption. Also the leader nodes must be handled and maintained to avoid it from attaining failure.

3.8 ACQUIRE:

Active Query forwarding In sensor networks (ACQUIRE) is a technique proposed for querying sensor networks by Sadagopan et a [41]. The network is viewed as a distributed database in ACQUIRE similar to COUGAR where complex queries can be further divided into several sub queries. The ACQUIRE function is described as follows; the base station node transmits a query, which is then forwarded by each node which will receive this query. Using its pre-cached information, nodes will forward it to another sensor node this is how each node tries to respond to the query partially during this process. Suppose the pre-cached details are not updated, the nodes will gather information from its neighbors within parameter d, look-ahead. Suppose if network diameter is equal to d, ACQUIRE mechanism acts similar to flooding. The query has to traverse long if the d value is small. To find an optimal value of the parameter d for a grid of sensors ,a mathematical modeling is used in which each node comprising 4 immediate neighbors is considered. However, there is no validation of results through simulation. To select the next node for forwarding the query, ACQUIRE either picks it randomly or the selection is based on maximum potential of query satisfaction. Remember that selection of next node is done on basis of information gain (CADR and IDSQ) or else a query is forwarded to a node,

which has details of the path to the searched event (rumor routing).

3.9 ENERGY AWARE ROUTING:

A set of sub-optimal paths utilization can be made in order to increase the network lifetime, this method has been proposed by Shah et al. [29]. This maintains a set of paths instead of maintaining or having one optimal path at great rates as in directed diffusion. Paths are chosen and maintained by certain probability. This probability will be governed by how low the consumption of energy in that path is achieved. The energy of any single path will not diminish quickly by having paths chosen at separate times. Network persistence is main metric of this protocol. As the energy dissipated equal among majority of nodes the longer network life can be achieved here. This protocol assumes that through a class-based addressing in each nodes which includes types of the nodes and it's the location. By means of localized flooding connection is started in this protocol, and this discovers all the routes between source-destination pairs and its cost hence building up route table. The high-cost paths will be neglected and a forward table is made by picking the neighboring nodes in the same way corresponding to their cost. This forwarding tables are used to send data to the destination with the probability which is inversely proportional to the node cost, to keep the paths in the network localized flooding is performed. This protocol provides an overall enhancement of 21.5% energy saving and enhancement of 44% network lifetime improvement. However, in this approach its needed to gather the location information and positioning up the addressing mechanism to those nodes, this will mess up route setup when compared to the directed diffusion.

3.10 ROUTING PROTOCOL WITH RANDOM WALKS:

The main idea in this protocol is to achieve load balancing in steady sense and also making use of multi-path routing [49] in WSN's having large scale networks with restricted mobility of nodes. Also these nodes have identifiers but no information about location is needed.

Though topology may be irregular, nodes will be arranged such that each nodes fall precisely on one crossing point of regular grid. The location details or lattice coordinates is obtained by evaluating between nodes using the distributed asynchronous to find a route between source and destination through the bellman-ford algorithm. An intermediate node will be selecting another successive node closer to the destination according to a calculated probability. Some sort of load balancing can be pertained

in the network by frugal altering this probability. As we maintain little state information this routing algorithm is made simple. But here different routes are picked at different times for the same source/destination nodes pair. But the main review about this protocol is that topology of this network may not be empirical.

3.11 Hierarchical Routing

Hierarchical routing carryout energy efficient routing in WSNs. Scalability is one of the major designs aspects of sensor networks. Initially this hierarchical/cluster based routing was proposed for wire lined networks and this rendered the advantages like scalability and effective communication. Higher energy nodes can be used to process and pass the information where as low energy nodes can be acquainted to perform the sensing the accessibility of the target. This means that the creation of the clusters and assignment of the special task to this cluster heads can abruptly hand out to overall system scalability, lifespan and energy competence. The hierarchical routing is dual layered routing where one layer picks cluster heads and other layer for routing. Also energy consumption is reduced by this routing protocol within clusters by fusion and data aggregation, so that the number of transmitted messages to the base station is reduced.

3.12 LEACH PROTOCOL:

Low Energy Adaptive Clustering Hierarchy (LEACH) was initiated by Heinzelman,et.al. for sensor networks which are hierarchical clustering algorithm [1], this includes distributed cluster information. In order to distribute the load uniformly among the sensor nodes, LEACH selects cluster head (CH) haphazardly among the sensor nodes. In order to minimize the transmission of data, a compressed and aggregated packet is sent to the base station by the cluster head arriving from a respective cluster. In applications which need constant surveillance of sensor networks LEACH is more précised because data aggregation is done periodical and consolidated. Sometimes a user may not necessarily need the data instantaneously so data transmission on periodic basis isn't necessary because it drains minimal energy of the sensor nodes. To reduce inter-cluster and intra-cluster collusion this protocol uses CDMA/TDMA. Later the indiscriminate means of Cluster head is performed so that the uniform energy dissipation is performed in the sensor network. The simulation models disclose that only 5% of the nodes are sufficient to act as cluster head according to the author.

The data processing such as data collection and fusion are local to the clusters, the CH change haphazardly over time to balance the nodes dissipation. The cluster head will

be chosen for that particular round if the random number used for making the decision is less than the following threshold, this can take value between 0 to1. The threshold value is calculated by the equation in order to become a cluster head, this includes the nodes which are not selected as the cluster head in past (1/p) rounds which is represented by G and the current round, this is given by:

$$T(n) = \frac{p}{1-p(r \bmod (1/p))} \quad if\ n\ \epsilon\ G$$

Where G is the nodes which are involved in the cluster head selection and this new CH will broadcast an advertisement message to the rest of the nodes in the network that it's the new cluster heads. All these non-cluster head nodes, after the reception of this advertisement decide the cluster on to which they want to belong to. This decision is based on the signal strength of the advertisement. The node dies haphazardly and hence dynamic clustering increases the lifetime of that system. LEACH attain factor of 7 reducing with regards to the energy dissipation compared to the direct communication and a factor of 4-8 when emulated to minimum transmission energy routing protocol. LEACH does not require global knowledge of the network and it's completely distributed, but is a single-hop routing where every node can transmit directly to the sink and cluster head. Therefore this is not applicable to networks which are established in vast regions. This ideology of dynamic clustering which intern reduce the gain in energy consumption caused by extra overheads such as head changes ,advertisements and so on.

3.13 Power-Efficient Gathering in Sensor Information Systems (PEGASIS):

LEACH protocol was improvised in [17] and this was known as PEGASIS, which is a optimal chain based protocol. Here the nodes will communicate the data to their nearest neighboring nodes and this happens unceasing till the base station in turn extending the lifetime of the network. When the communication to the base station completes by all the nodes, a new round will start and goes on. The PEGASIS has two main objectives, firstly a collaborative technique is used to increase the lifetime of each node and in turn this increases the lifetime of the network. Secondly the bandwidth usage in communication is reduced by allowing the local coordination between those nodes which are close together. PEGASIS restrict cluster pattern instead this uses only one node continuous to transmit to the BS preference of using multiple nodes unlike LEACH protocol.

The signal strength of a neighboring node will be measured and in order to ensure that only those node can be heard and hence locating the closest neighbor. The aggregated form of data is transmitted to the base station by cluster of nodes which in turn known as chain, this chain consists of those nodes that are nearest to each other and form a course to the base station. Simulation results depicts that the lifetime of the network that uses PEGASIS is increased twice when compared to those networks using LEACH protocol. This swing of operation is achieved by elimination of overhead incurred by dynamic cluster formation in LEACH and by reduced count of transmission and reception through data aggregation. Dynamic topology adjustment is done in PEGASIS because the sensor nodes need to know the energy status of their neighboring nodes to select the route for data, for highly utilized network this adjustment may introduce significant overhead but here the clustering overhead is avoided here. Sensor nodes uses multihop communication in order to reach base station, in PEGASIS it assumes that communication can happen directly to the base station by each sensor nodes. For distant nodes on the chain this protocol may introduce extensive delay. In PEGASIS we assume that all sensor nodes will have same energy level and will likely die at the same instance of time, PEGASIS assumes that all the nodes will have a complete database about the location of all the nodes in that network. But the method through which the location is obtained is not summarized. Also the single leader can become a bottleneck. Thought we assume that the sensors are fixed or immobile in PEGASIS in most of the scenarios, some sensors will affect the functionality of the protocol as it'll be allowed to move. With the objective of reducing the delay occurred during the data transmission of the packet to the base station, an extension of PEGASIS was introduced known as Hierarchical – PEGASIS [21]. The process that integrates spatial transmission and signal coding is used to avoid the collusion during the simultaneous data transmission, later only successively separated nodes were allowed to transmit the data at the same time. A chain of nodes is constructed to form a hierarchy like tree in the chain based protocol with CDMA capable nodes; the data is transmitted to those nodes which are in the upper level of the hierarchy hence ensuring data is transmitted parallel and hence reducing the delay considerably. This method has showed the result better by a factor of approximately 60 than the regular PEGASIS scheme.

3.14 Threshold-sensitive Energy Efficient Protocols (TEEN and APTEEN):

TEEN (Threshold-sensitive Energy Efficient sensor Network protocol) and APTEEN (Adaptive Periodic Threshold -sensitive Energy Efficient sensor Network protocol) are two hierarchical based routing protocols proposed in [8] and [9], respectively. These protocols were proposed for those applications which are responsive to time critical and sudden changes in sensed attributes such as temperature. In this time-critical application the network is operated in reactive mode to have a better responsiveness, also the sensor nodes sense the medium constantly but transmission will be less often. In TEEN a data centric mechanism along with data-centric mechanism is used, here a CH will send its member nodes a hard threshold which is the sensed attribute and a small change in the sensed attribute which in turn triggers the node to transmit by turning it on is said as soft threshold. Therefore the hard threshold tries to reduce the count of transmissions by assisting the nodes to transmit only when the nodes sense the attributes in the précised range figure 2(a). More accurate view of network is given by soft network in case where there is no change or little change in sensed attribute, the unnecessary transmission is reduced by soft threshold hence reduce the expense of energy consumption. So by this the user can govern the transaction between data accuracy and energy consumption. Suppose if the cluster head are to change, new value for the previous parameters are broadcasted. This is main disadvantage in this scheme because if the nodes do not receive threshold value then the nodes will never communicate and making the user unavailable about data from that network.
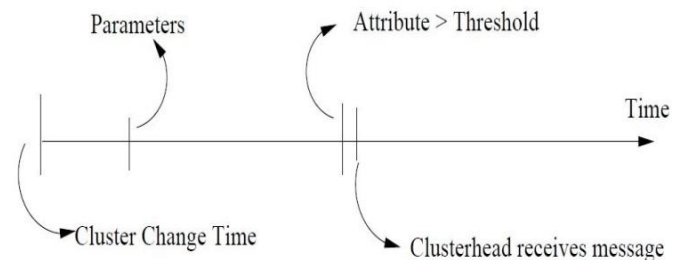

Figure 2(a) operation of TEEN

The environmental changes are sensed continuously from these nodes, when the hard threshold value reached by parameters, then the transmitter is switched on and the sensed data is sent by the transmitter. This sensed data is stored in the internal variable known as Sensed Value (SV). The data transmission happens only in this cluster period if the following conditions are valid: (1) The current sensed value must be greater than the hard threshold (2) The current sensed attribute value and the SV will vary by an amount equal to or greater than the soft threshold. The main feature of TEEN is that its adaptability to time critical applications, sensing the data consumes less energy than transmission so here we the consumption of energy is less compared to proactive networks.

APTEEN is a form of TEEN protocol but here the user can change the threshold value and periodicity according to the application, the following parameters will be broadcasted by the cluster head in this scheme as shown in figure 2(b):

1. Count Time (CT): the maximum time interval between two successive reports transmitted by the nodes.
2. Thresholds: this parameter constitutes Hard Threshold (HT) and Soft Threshold (ST).
3. Attributes (A): the set of physical parameter that the users interested in getting from the nodes.
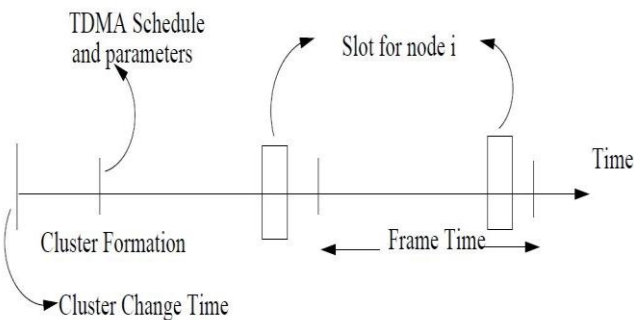4. Schedule: the time slot assigned to each node by TDMA scheduling.

Figure 2 (b) operation of APTEEN

The operation of this scheme is similar to TEEN, where environment is sensed continuously by sensor nodes and those nodes sensing values beyond or equal to the Hard Threshold can transmit. Once this node senses the above HT the data is transmitted only when the attribute changes by an amount equal to or greater than the Soft Threshold. The data will be re-transmitted if the node fails to send the data in time period equal to count time. To implement hybrid network the APTEEN uses modified TDMA schedule and hence here each node in the cluster will be given a slot for transmission. The main feature of APTEEN is it consist both reactive and proactive policies, making user to change the threshold value and the count time (CT) to have more flexible, but additional complexity is needed to do this. Simulation results depicts that both TEEN and APTEEN has greater potential than LEACH, but the APTEEN performance is intermediate between TEEN and LEACH with regards to energy dissipation and lifetime of network. The common disadvantage of these two approaches is overhead and complexity in forming the cluster at multiple levels.

3.15 Minimum Energy Communication Network (MECN) and Small Minimum Energy Communication Network (SMECN):

For applications which are not mobile MECN is more appropriate. For low power GPS wireless networks,

MECN are deployed and used to maintain minimum energy network [39] this includes a master node present in minimum network topology. In case of sensor network, Master-site is assumed to be information sink in MECN.

A relay region is identified for every node this constitutes those nodes in the surrounding which is more energy efficient compared to direct transmission. The node pair (i, r) relay region is depicted in figure 3, redrawn from [39]. By considering union of the entire relay region the combination of node i is then created that node i can reach. Here MECN trace the sub-networks with less number of nodes and also which utilizes less transmission power between two nodes. In this way without considering the nodes of the entire network a minimum power path is found by localized search for each node considering each node in the relay region. MECN has two phase:

1.) Through local computation an enclosure graph is made on two dimensional plane which consists all the enclosures of each transmit node in the graph. This sparse graph has globally perfect link in terms of energy consumption.
2.) Using distributed Belmann-Ford algorithm with the power consumption as parameter and optimal link on the enclosure graph is found. GPS is used to find the coordinates in case of mobility
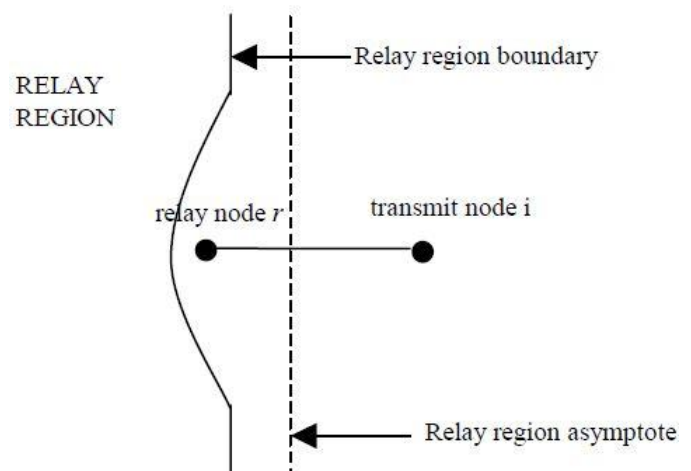

Figure 3 MECN relay region of transmit-relay node pair (i, r)

The advantage of MECN is, in case of node failure it can adopt itself or deploy new sensors and self reconfigure. First phase of the algorithm is executed between two consecutive wakeups of the nodes, and then a minimum cost link is updated by considering or newly joining nodes.

Extension of MECN is small minimum energy communication network (SMECN) [40], in SMECN possible obstacles between nodes pair is considered. Though in MECN we assume every node can transmit to all other nodes, in fact practically this is not possible always but we still consider it as fully connected. The sub-

network that constructed by MECN is miniaturized by SMECN for smaller energy relay in circular region if the broadcast are able to reach all the nodes around the broadcaster. These results in the reduction in transmission with regard to hop count, SMECN simulation results shows that it uses less energy compared to MECN and the link maintenance cost is less. But this introduces overhead in this algorithm while finding sub-network with smaller edge numbers.

3.16 Self Organizing Protocol (SOP):

A self organizing protocol and an application taxonomy was explained by Subramanian.et al. [12] which is used to build architecture aligned to support heterogeneous sensors which can be either stationary or mobile. Furthermore some sensors acts as routers which analyze the environment and forward the data to those particular set of nodes. These router nodes acts as backbone for the communication and are stationary. The most robust base station will receive the data forwarded to the routers, each sensing node must be able to sway a router so that it can be a part of network. The sensing nodes are identified through router nodes address connected to it, so it requires addressing scheme for each sensors for this routing architecture. This routing architecture is hierarchical in which a cluster of nodes are formed and when necessary they are merged. An approach similar to virtual grid is used known as Local Markov Loops (LML) algorithm does fault tolerance through broadcasting.

The functioning of this scheme is initiated with assignment of individual addresses to every node in routing architecture so this method is more suitable to those applications where communication to individual node is needed. In spite of this an extra care has to be taken to maintain routing table along with act of balancing the routing hierarchy. In organizational phase of algorithm SOP is not an on demand protocol introducing an extra overhead, but the energy consumed to broadcast message in this is very less compared to SPIN protocol. As there are many cuts in this hierarchy this is an issue which increases the expense of operation in turn increasing the probability of reorganizing phase.

3.17 Virtual Grid Architecture routing (VGA):

By means of data aggregation and in-line network an energy efficient routing scheme has been introduced in [31] to maximize the lifetime of the network. An approach has been reasonably proposed and explained in [24] to arrange the nodes in fixed topology because in many applications the nodes are extremely low mobile and not stationary. Without using GPS a technique is given in [21] to build clusters that are not mobile, equal, and symmetric and no overlapping with this shape. A clusterhead is selected in each zone which acts optimally. The data aggregation is done in two levels termed as local and global method. The local aggregation is performed by group of clusterheads also termed as local aggregators (LAs); to perform global aggregation a subset of these LAs is used. But the main problem in selection of global aggregation points optimally, called Master Aggregators.

4. PROPOSED MODEL

For fully connected ad hoc network, usage of medium access control(MAC) scheme will ensure performance of the wireless network protocol is enhanced, for example in cases where smartphones are used as a nodes this method is applicable. We can attain low packet transmission delay and high throughput by usage of radio interface in sleep state periodically to reduce the energy consumption and also mechanism to reduces the transmission collusion. For low packet transmission delay the proposed MAC scheme will serve the realtime traffics in saving energy. Significantly high throughput and lower packet transmission delay can be achieved by implementation of this model and hence the performance of the proposed MAC scheme is more efficient than existing.

5. CONCLUSION

Routing in sensors is an emerging area this is rapidly growing as a new area of research in recent years with the ambiguous availability of resources also introducing many challenges when compared to wired networks data routing. In this paper a comprehensive survey is presented for routing techniques in WSN, and main objective of the survey is focused on extension of sensor node lifetime without compromising the data delivery. Many routing techniques are explained and its energy efficiency is been explained here by highlighting the design methodology and comparing the energy and communication overhead savings in routing paradigm accompanied with its advantage and disadvantage of individual protocols. The proposed model overcomes the disadvantage of traditional MAC scheme and provide a better energy efficient protocol.

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