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A SURVEY OF ROUTING MAC TECHNIQUES FOR WIRELESS SENSOR NETWORKS ROUTING PROTOCOL

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Abstract-

A Wireless Sensor Network (WSN) contains a random number of sensors distributed in the environment to monitor physical conditions. In the following, a survey of MAC routing mechanisms in WSN is presented and discussed. One of the most important issues in WSN is the issue of energy efficiency of the routing protocols. The importance of this issue stems from the fact that the nodes have usually a life time and this life time can be extended by saving more energy by using efficient routing techniques.

In the following, we present a survey of the MAC routing mechanisms in WSN. Firstly, an outline of the architecture challenges for routing protocols in WSN is given according to the system tradeoffs between the power and communication overhead savings in different routing techniques. Secondly, advantages and disadvantages for each routing protocol are presented and discussed.

In this survey, we will concentrate only on some protocols like Data Centric, Hierarchal and other related energy saving protocols. In addition, we will discuss some of the surveyed protocols results, comparisons and conclusions.

Keywords: WSN, MAC, Routing Protocols, Low Energy, Energy Efficiency.

Introduction

WSN is one of the most important technologies, in the world, that has different applications including military, water quality, medical systems, pollution and many others.

WSN consists a large number of nodes distributed randomly or uniformly in a sensor field. Each node contains processors, low-power radios and battery. Typically, these nodes coordinate to perform a common task. Like in all shared-medium networks, medium access control (MAC) is an important technique that enables the successful operation of the network. One primary task of the MAC protocol is to avoid collisions so that two nodes will not send data at the same time. There are many MAC protocols that have been developed for WSN.

The Medium Access Control (MAC) layer provides mechanisms that allow sensor nodes to enter into a shared communication medium. Various routing techniques have been proposed for WSNs in the last decade. They usually differ in the main problem they attempt to solve. Examples of MAC protocols are numerous such as the Spare Topology and Energy Management (STEM)[10], Sensor Medium Access Control (S-MAC)[12], Carrier Sense Multiple Access (CSMA), Power Aware Multi-access with Signaling (PAMS)[6], Mediation Device (MD)[2][5], Distributed Mediation device (DMD)[7][16], Modified Distributed Mediation Device (MDMD)[17], Time Reservation using Adaptive Control for Energy Efficiency (TRACE) Protocol [9] and Packet Reservation Multiple Access (PRMA) protocol [8].

Medium access control is a broad research area in the domain of low power wireless sensor networks. A sensor node remains in the active mode (on-mode) throughout the period during

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which it acts as cluster head. Researchers typically elect the original LEACH to propose new protocols because of its simplicity and being very basic. In our literature review, we will present some background material necessary for Wireless Sensor Network Routing protocols and in particular, protocols such as Data Centric (Flooding, Gossiping, Spin, DD), HIERARCHICAL and other related Works (MD, Fair Efficient Location-based Gossiping, Efficient and Secure Routing Protocol for Wireless Sensor Network through Optimal Power Control and Optimal Handoff-Based Recovery Mechanism).

One of the main objectives of the design of WSN is to prolong the lifetime of the network by the reduction of its energy consumption.

1- Articles Selection in this manuscript.

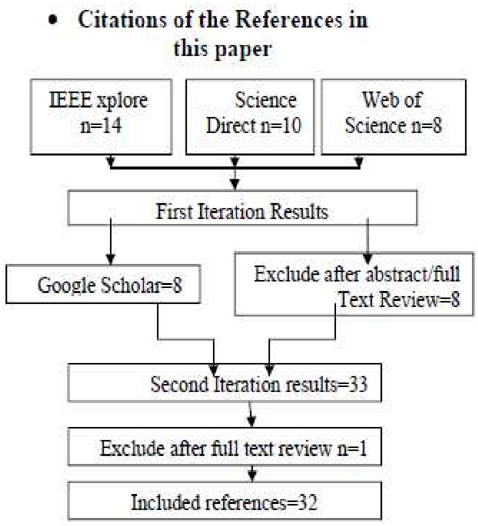

Figure.1 Article Selection In This Paper

2.1 Background of Sensor Network Routing Protocols

In the network routing protocols, the sensors are divided into two types; sensor and sink nodes. Sensor nodes are small, wireless, battery powered, bandwidth constrained, sensing data, aggregating data, relying with no global address scheme as opposed to sink nodes which are more powerful and are usually gateway to wired networks. In addition, the sink node is collecting data and processing it. The goal of sensor and sink nodes is to disseminate data from sensor nodes to the base station node in energy-awareness manner and hence, to improve the lifetime of the WSNs. The sensor routing protocols are divided into many types namely: Data-centric, Hierarchal, Location Based and Quality of Service based Protocols.

2.2.1 Data-Centric protocols

The Data-Centric protocol introduces complexity to query data from a specific set of nodes. The collected data, is aggregated in some nodes from the deployed region, is redundant which results in decreasing the amount of transmitted data and thus, decreasing the transmission power.

2.2.1.1 Flooding [24]:

Flooding is an old routing mechanism in which the sensor broadcasts the gathered data to all its neighbors until the destination node is reached. This protocol will produce implosion, overlap, and blindness problems but it is a simple routing and does not require routing maintenance.

2.2.1.2 Gossiping [24]:

gossiping protocol is also an old mechanism but unlike the Flooding its sensors send the gathered data to a randomly selected neighbor until the specified data gathered is delivered to the destination. This protocol leads to appreciable delay in delivering the data to destination.

2.2.1.3 Sensor Protocol for Information via Negotiation (SPIN) [25]:

In this protocol, there are three types of messages namely: ADV (Advertisement Messages), REQ (Request Messages) and data. The source node broadcasts an ADV message to its neighbors, the interested neighbors nodes send REQ message to source node, and then the source node sends the data to interested nodes. An advantage of this protocol is that it solves the classic problems while the topological changes are localized. However, the main disadvantage of this protocol is that there is no guarantee on the delivery data.

2.2.1.4 Directed Diffusion (DD) [18]:

In this protocol, the sink node broadcasts messages named "interest messages" with larger update interval to other nodes. The sensor nodes then store the "interest messages" and cache them in their memories. Every node then sends back data to the sink by the "gradients messages ". After Sink node

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receives data from other nodes by the "gradient messages" it sends the same "interest messages" but with a smaller update interval and so on. Some of the advantages for this protocol are that it uses on demand route technique and each node does aggregation and caching thus good energy efficiency and low delay. However, a main disadvantage is that it has extra overheads for data matching and queries.

Mediation Device (MD) Protocol [2]:

In the MD protocol, there is an MD node that acts as a mediator between nodes. The MD node allows each node in a WSN to go into sleep mode periodically and to wake up only for short times to receive data from neighbor nodes and it uses shortest messages beacons to save energy and hence, there is no global time reference [2]. Each node has its own sleeping schedule, and it is not concerned with its neighbors sleep schedules.
If a node has data to transmit to another node, then this node transmits a short query beacon message to the MD node to inform it that it has packets to send. This short query beacon message contains the address of the destination and indicates the node's willingness to accept packets from other nodes. The MD node transmits a wakeup signal to the destination node. The receiving node stays awake for some short time period following the query beacon to open up a window for incoming packets. If no packets are received during this window then the node goes back into sleep mode. If a packet is received then an ACK is sent to the source node and the destination node goes back to sleep. It can be noticed that using an MD device saves energy in that a destination node need not be awake all the time awaiting destination query beacons.
Using the MD protocol has some advantages. First, it does not require any time synchronization between nodes. Only the MD has to be aware of the activity periods of nodes; when they sleep and when they wake up. Second, the MD protocol shifts the energy burden to the MD. Other nodes can be in sleep mode most of the time. The only control energy spent is for the short periodic beacons.

Table 1. Summary Of The LEACH And MD Protocols.

Protocol	Number of required channels	Idle listening avoidance	Collision avoidance
LEACH	1	TDMA	TDMA
MD	1	Periodic sleep	No

2.2.2 Hierarchical Protocol

Hierarchical protocol will form a cluster that contains sensor nodes and cluster heads which communicate with each others. The cluster head aggregates and relays data to the sink node. The Hierarchical protocols have been proposed to meet the energy efficiency and scalability requirement of the wireless sensor networks .

2.2.2.1 Low Energy Adaptive Clustering Hierarchy (LEACH) [4];

LEACH is a clustering-based protocol that compressed the data before transmission to the sink so as to reduce communication and save energy. The LEACH operation is divided into rounds. Each round begins by organizing clusters. Initially, in an advertisement phase, each node needs to decide whether to become a cluster head for the current round based on the suggested percentage of nodes that can become cluster heads for the network and the number of times the node has acted as a cluster head. That is, the decision of a node to become a cluster head depends on the probability . The node decides by choosing a random number between 0 and 1. If this random number is less than threshold T(n), the node become a CH for this round.

$$T(n) = \begin{cases} \frac{P}{1 - P * (r \bmod \frac{1}{P})} & \text{If } n \in G \\ 0 & \text{Otherwise} \end{cases}$$

P = desired percentage of nodes that can become cluster heads.
r = current round.
G = set of nodes that have not been cluster heads in the last 1/P rounds.

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Each node elected as cluster head broadcasts an advertisement message to the rest of the nodes. During this cluster head advertisement phase, the non-cluster head nodes decide which cluster head to join based on the signal strengths of the advertisement messages received. The source of the advertisement with the highest signal strength is chosen as cluster head.

In the cluster set-up Phase that follows, each node informs its cluster head that it will be a member of its cluster. Upon receiving all the join messages from its members, a cluster head creates a TDMA schedule for the allowed transmission times of the members based on the total number of members in the cluster.

Each node starts data transmission to its cluster head based on the TDMA schedule. The radio of a cluster member node can be turned OFF until its allocated transmission time comes, reducing energy dissipation. The cluster head nodes must keep their receiver ON so as to receive the data. This is the main drawback of this protocol. The cluster head may consume much energy while not transmitting or receiving. Once all of the data is received, the cluster head compresses it before forwarding it to the sink.

In order to minimize the radio interference between nearby clusters, each cluster head chooses a Code Division Multiple Access (CDMA) code randomly and it informs its cluster members to transmit using this code. The radio signals of neighboring cluster heads will be filtered out to avoid corruption of the transmission. Some of the advantages of the LEACH protocol are; localized coordination to enable scalability in dynamic networks, incorporating data fusion into the routing protocol in order to reduce the amount of information transmitted to the sink, distributing energy dissipation evenly throughout the sensors, with the goal of increasing the system lifetime of the network. An issue in LEACH is how to decide the percentage of cluster heads for a network. The topology, density and number of nodes of a network could be different from one network to another. Moreover, there are no suggestions about when the re-election of cluster heads needs to be invoked. The cluster heads farther away from the sink will use higher power and deplete their energy more quickly than the nearby ones. As noted earlier, another disadvantage of LEACH is that the radio transceiver of the cluster head is always on to receive data, which can consume much energy.

2.2.2.2 Time Controlled Clustering Algorithm (TCCA) Protocol [15]:

In TCCA, the cluster head selection is based on sensor residual energy and a random probability. If this probability is less than a variable threshold, the sensor node becomes a cluster head. The threshold value depends on the sensor residual energy as a fraction of the maximum sensor energy. Cluster heads send advertisement messages to other nodes to become its members. These advertisement messages contain the cluster head ID, initial TTL, residual energy and timestamp. The timestamp and TTL are used to provide the cluster head with the ability to produce multi-hop clusters in an effective way that has the same performance as that of the one-hop clusters. When a sensor node receives an advertisement message, it will forward it to other neighbors based on the TTL value that is based on the current energy of the cluster head. Cluster heads use the timestamp to approximate the relative distance of its neighbors. Sensors inform the cluster head that they are joining it by sending a join requesting message that contain sensor ID, cluster head ID, the original timestamp from the advertisement message and the remaining TTL value. The cluster head will produce a time schedule for its sensors considering their relative distances so as to avoid collision.

2.2.2.3 M-LEACH protocol [14]:

M-LEACH (Multi-hop LEACH) is similar to LEACH, but the difference is that a cluster head in M-LEACH can communicate with the sink via other cluster heads when the distance between the cluster head and the sink is high. Transmitting a message over a long distance consumes much energy. To reduce energy, M-LEACH chooses an optimal path between a cluster head and the sink. In contrast, a LEACH cluster head always transmits data directly to the sink, regardless of the distance between them.

2.2.2.4 LEACH-C protocol [15]:

LEACH-C (LEACH Centralized) utilizes the sink for cluster formation. During the setup phase of LEACH-C, the sink receives information regarding the location and energy level of each node in the network. Using this information, the sink finds a predetermined number of cluster heads and configures the

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network into clusters. The cluster groupings are chosen to minimize the energy required for non-cluster-head nodes to transmit their data to their cluster heads. Other operations of LEACH-C are identical to those of LEACH.

2.2.2.5 TL-LEACH protocol [13]:

This Two-Level variant of LEACH (TL-LEACH) adds an additional level in the organization of clusters. Nodes first send data to their secondary cluster head, which sends data to a primary cluster head. Primary cluster heads send the aggregated data to the sink. Through mathematical models, it was shown that TL-LEACH outperforms the original single-level LEACH protocol significantly.

2.2.2.6 VLEACH protocol (Vice Cluster Head LEACH)[16]

VLEACH protocol proposed cluster contains components as CH, vice-CH, member nodes.

Member nodes get the data from the environment and broadcast it to the CH.

Cluster head will send the data that it received from the cluster member nodes to the sink. Vice-CH is the node that will become a cluster head of the cluster only when cluster head dies.

In the original LEACH Protocol, the cluster will become insufficient because there's no suggestion or mechanism to how to choose the cluster head again in the next round and moreover, if CH dies before the round finishes or before other nodes die, the Cluster will be useless so VLEACH eliminate this problem from the Original LEACH.

The drawback of this VLEACH protocol is that they didn't suggest any mechanism to choose Vice-CH when the Cluster head will die.

2.2.2.6 Power-Efficient Gathering in Sensor Information Systems (PEGASIS) [19]:

In this protocol, it is assumed that all nodes have location information about all other nodes and sensor nodes are immobile. The protocol constructs chains of nodes using a greedy algorithm. Each node gathers data from close neighbors and aggregates it with its own data, then it transmits the aggregated data it to another close neighbor. Finally, the aggregated data from neighbors is sent it to the sink by any node in the chain (see figure1 below). Since the head node is single which is aggregated the data from its all neighbors and sends it to the sink it will cause a bottleneck. PEGASIS outperforms LEACH by eliminating the overhead of dynamic cluster formation, by minimizing the total sum of transmission distances and by limiting the number of transmissions. All the nodes in the chain will take turns for transmitting to the sink then the sink broadcast information of the chain to sensor nodes. The chain construction is started at the farthest node from the sink. This operation is continued until all nodes are on the chain. This achieved about 100-300% improvement over LEACH over a range of percentages of nodes dying out in different network sizes.

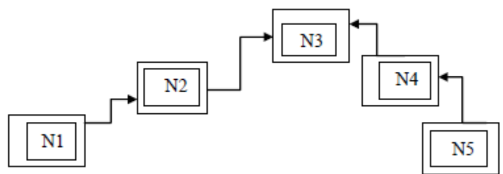

Figure1. PEGASIS protocol.

2.2.2.7 Hierarchical-PEGASIS [20]:

Hierarchical-PEGASIS adds new modification of PEGASIS that proposes two solutions to avoid collisions of simultaneous transmissions. The first solution can produce CDMA codes between nodes. The other solution is allowing simultaneous transmission only for spatially separated nodes. For example node N: 0,2,4,6 forward its obtained data to N:1,3,5, and 7. N7 sends the aggregated data to N3. Node N3 is then responsible for sending the gathered data to the sink (see Figure 2 below). For this network, Hierarchical-PEGASIS takes 3 unit times but PEGASIS takes unit times to gathered data.

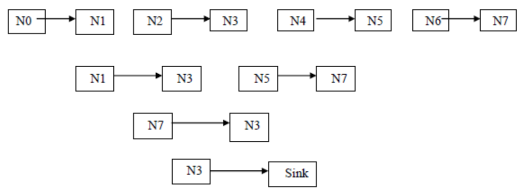

Figure2. Hierarchical-PEGASIS protocol.

Figure2. Hierarchical-PEGASIS Protocol.

2.2.2.8 Threshold sensitive Energy Efficient sensor Network (TEEN) [21]:

TEEN is a modified version of LEACH, where each node has two thresholds: a hard threshold (HT) and a soft threshold (ST) that are got by the cluster head. The hard threshold is the absolute value for the sensed attribute which the node must transmit to the cluster head. The

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soft threshold is a small change in the value of the sensed attribute that triggers the node to switch on its transmitter. The decision as to whether to report the data or not is based on the values of the hard threshold and the soft threshold. The data is reported only when the sensed value exceeds the hard threshold and when the sensed value's change is bigger than soft threshold .This protocol has some drawbacks. One of them is that each node turns on its transmitter all the time and cannot allocate the time slot, which will consume much energy. Another drawback is that this protocol cannot distinguish a node which does not sense a big change from a dead or failed node. In addition, collisions occur in the cluster. Also, small values of the soft threshold will increase energy consumption. However in TEEN, in Figure3 there are three levels of nodes and a sink for gathering the data from the environment and forwarding it to the first level cluster head. Each first level cluster head aggregates the data gathered from the simple nodes in its cluster, then it forwards the data to the second level cluster heads. A second level cluster head can directly forward the data gathered from its cluster to the sink.

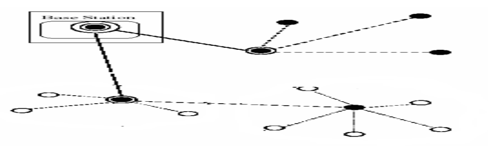

Figure3. TEEN Protocol.

2.1.10 Adaptive Periodic Threshold Sensitive Energy Efficient Sensor Network (APTEEN)[22]:

The APTEEN protocol was proposed to address the drawbacks of the TEEN. APTEEN is similar to the TEEN, but the difference is that it adds an extra attribute to the packet sent by the cluster head to its node members. This attribute not only includes the thresholds but also includes the maximum interval between two packets. This new modification makes protocol usable even by time driven networks. It is easy for the sink to know that the node is dead or has failed to send data.

2.1.3.2 Efficient and Secure Routing Protocol for Wireless Sensor Network through Optimal Power Control and Optimal Handoff-Based Recovery Mechanism [27]

Modified triple umpiring system (MTUS) incorporates signal to noise ratio (SNR) with optimal handoff-based self-recovery features for show an efficient and secure routing for WSN also handoff-based self-recovery can significantly reduce the power usage.

Modified triple umpiring system (MTUS) contains two fields: node ID and status. If status bit is "1" then the protocol does not allow the node to participate in any network activity and if the status bit is "0" then the protocol allows the node to participate in any network activity.

Each node appends its own address on these route discovery messages to enable path accumulation during the route discovery cycle. It updates the route to the source node. Also it checks for intermediate nodes accumulated in the path. They propose to differentiate between the "good" and "bad" neighbors by the signal to noise ratio (SNR) value which is measured whenever a packet that contains a TUS message is received.

MTUS with Optimal Handoff-Based Self-Recovery Feature that the Self-recovery MTUS can repair broken route without considering the distance between the broken node and the destination node. Because the intermediate nodes are usually nearer than the source node to the destination, the intermediate nodes on the data flow are more suitable than the source to broadcast RREQ to repair or find a route to destination.

2.1.3.3 Energy Efficient Routing in Wireless Sensor Networks Through Balanced Clustering [28]

A new energy efficient routing protocol, named ECHERP, with main difference with previous protocols is that this one uses a more efficient mechanism to select a node as the cluster head that will maximize the network lifetime. In fact, the protocol selects the node with the higher residual energy in the cluster as the cluster head for the next round by using Gaussian elimination algorithm. The algorithm calculates the aggregate of nodes that can be chosen as cluster heads in order to extend the network lifetime.

The cluster formation using data collected from the Base Station (BS) to form the

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member nodes. The cluster head (CH) selection is done by Base Station (BS) Using Gaussian elimination that computes the appropriate number of rounds that the nodes can be cluster heads and sends this information to the nodes.
Cluster head advertises joining messages to nodes then the nodes will join the cluster head which has a highest signal advertisement message. Base Station (BS) creates the TDMA schedule and sends it to the member cluster nodes that allows each node to transmit data in their time slot, then the cluster head aggregates the data and transmits the compressed data to the upper level cluster heads until the data reaches the base station.
The performance and energy saving of this protocol is better than LEACH, PEGASIS and BCDCP protocols experimentally. This protocol computes the energy consumed using Gaussian elimination algorithm in order to minimize the overall network energy consumption at every single round.

2.1.3.4 An Optimized Energy Efficient Routing Algorithm for Wireless Sensor Network [29].

The Novel energy efficient shortest path routing algorithm combines two types of protocols; the MAC and the routing protocols of WSN. In addition, it also includes the concept of ACO for getting the shortest path between sender and receiver.
The energy consumption is reduced and distance is also optimized so the proposed routing algorithm is cost effective and the nodes radio will be "ON".
Finding sender, receiver is chosen on basis of shortest distance out of the nodes whose radios are 'ON'. The final receiver radio of all other nodes will be "OFF" when it receives transmitted data so there's no wasted energy.

2.1.3.4 A Novel Energy Efficient Routing Protocol in Wireless Sensor Networks (Fair Efficient Location-based Gossiping) [30].

The Novel Fair Efficient Location-based Gossiping protocol will modify the Gossiping protocol and there extensions. This proposed protocol can decrease the energy consumption and also increase the network lifetime by selecting a node with a maximum residual energy and lower distance to the sink. In addition, this proposed protocol used GPS to find the base station.
When neighbor nodes send messages and packets between each others, they compare between two neighbor nodes then select the nodes that had the most residual energy and ignore the maximum hop count of the two nodes. If two nodes have the same residual energy we take the node that has a lower hop count to the sink. The packet will move through these selected neighbors until it reaches the sink.
Each node produces a *gradient* (showing the number of hops to the sink). This proposed protocol handles the problems of Gossiping and its extensions and reducing the message overheads and consequently, will reduce the energy consumed by the nodes that have sent the data to the base station by sending an acknowledgment message.

TDTCGE[31]

This proposed protocol used a two Dimensional techniques (Computes the Center of Gravity for each Grid and Computes the energy Center) that help to select the optimal node as a Cluster head by which node is the nearest to one of these Centers. this proposed protocol solves the problems of the distance and how much farther cluster head from the Base station but not solve the idle listening problem . The results of this protocol approved that this protocol improved the life time and the energy consumption.

CRCWSN [32]

In this algorithm, a new two techniques of selecting cluster head (CH) has been initially used by genetic algorithm and re-clustering technique
algorithm. In this protocol, considering distance and energy parameters, this proposed protocol have created a target function having more optimum and highest conditions, as opposed to previous techniques. In addition, the combination of chromosomes and timing of generation repeats has been done by a new technique having more efficiency and more life time with decreasing generation repeats compared to previous similar techniques.

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TABLE I. ROUTING SCHEMES COMPARISON

(Schema, year)	Method, Technique, Approach	Brief Description	Striength & Weaknesses
(TDTCGE,2013)	Two Techniques	Calculate Center of Gravity and Energy Center	*Improvement life time by Solving the Distance *(idle Listening, less management)
(LEACH,2002)	TDMA Schedule	Elect CH by using (TH) and using TDMA Schedule for Collect Data	*low Consumption but not enough , Distributed protocol *(idle Lestining, Bad TH, not applicable for large Regions, Extra overhead)
LEACH-C	Centralized CH Approach	the BS obtains data as per the location and has a universal Knowledge & energy level of every node in the network. On the second stage it will find a recent number of C.H and the after that it will be organizes the network into the clusters. It has been completed in respect to curtail the energy	* The energy for data transmission is less than LEACH * Overhead,
PEGASIS	aggregator Approach	The nodes Aggregates data between each others in same level without CH	*The transmitting distance for most of the node is reduced. *There is no consideration of the base station's location about the energy of nodes when one of the nodes is selected as the head node
TEEN	Thresh Hold Approach	the data will transmits between these 3 sensed Thresh holds	*It works well in the conditions like sudden changes in the sensed attributes such as temperature. *A lot of energy consumption and overhead in case of large network , Long Delay.
APTEEN	Thresholds Approach	The Data will transmit between 4 Sensed thresh holds	*Low energy consumption Than TEEN. *Very Long delay.
Mediation Device (MD)	Management device	Work as mediator to schedule the active time and sleep time between	*solve Idle listening by periodic sleep beacons *saving energy low

3. RESULTS & DISCUSSIONS

We will discuss results of the related routing protocols that are compared with the original LEACH and we will concentrate on expected improvements carried by our proposed protocol. In LEACH paper [5], they compared the life time of the Direct-Transmission, MTE and Static Clustering protocols with Original LEACH protocol. It has been show in [5] that LEACH protocol has more life time than doubles of the other protocols (Direct-Transmission, MTE and Static Clustering protocol). When these protocols consume 0.5J/node, the first node died in LEACH protocol after 932 Round and the last node died after 1312 Round but in other protocols the first node and last node died earlier than the LEACH protocol, so the LEACH protocols outperform these other protocols.

In The VLEACH paper[16], the number of messages sent by the V-LEACH protocol to the sink is less than the messages sent by the original LEACH to the sink. Thus, if messages sent by the VLEACH are less then this means the network energy remaining using V-LEACH is more than the Original of LEACH.

In The TDTCGE paper [31], the simulation results show that algorithm can maintain a more lifetime in the network than Original LEACH that guarantee balanced energy consumption distribution among nodes in a sensor network because uniform clustering and nearest distance structure of nodes are balanced between all the active associate nodes of the network so energy dissipation is always balanced then the lifetime is increased as compared to the Original LEACH protocol.

active associate nodes of the network so energy dissipation is always balanced then, the lifetime is increased as compared to the Original LEACH protocol.

In the paper of LEACH-C [15], LEACH-C simulation results show that the LEACH-C delivers 40% more data for each unit energy than LEACH because the BS has information of the location and energy of all the nodes in the network, so it can produce better clusters that require less energy for data transmission that achieve a more lifetime than LEACH, MTE and static clustering. Our improved protocol will outperform Original LEACH in

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lifetime, energy dispassion and also in the number of recieved messages.

Research Parameters:

Parameter Values that will be used in the research are;
Network size = 100*100 m
Ee= 50nJ/bit % Eelec=Etx=Erx % Eelec is the energy to transmit one bit of a message
Fs= 10pj/bit/m2 / // amplification coefficient of free-space signal
mp= 0.0013pj/bit/m4 % multi-path fading signal amplification coefficient
Nodes number= 100 //number of nodes in the network
Grids number =9 //network divided into 9 Grides
D=87m //Distance
L= 1000 //Length

Research Questions

In WSN, the routing protocols have many issues and problems facing researchers and consequently, needs to be solved. Among those are the issues of how to save more energy and how to improve the life time for the network. Moreover, how to Select CH and how to form Clusters, how to minimize the energy dissipation and how to improve an efficient mechanism with respect to saving energy.

4. CONCLUSIONS

Routing protocols in sensor networks is a new area of research, with a limited, but rapidly growing set of research results. This survey will illustrate the routing protocols with their effects on their energy consuming and saving.
This paper presents several routing protocols for wireless sensor networks. It has very good energy conserving properties compared with IEEE 802.11. The protocol has been implemented on our test bed nodes, which demonstrates its effectiveness. Future work includes system scaling studies and parameter analysis. More tests will be done on larger test beds with different number of nodes and system complexity.
From other researches results, we can draw many conclusions. One of these conclusions is how can these protocols minimize the overall network energy consumption and in the same time save energy at every single round and hence, resulting in maximizing the lifetime for the overall network.
This paper presents a new MAC protocol for wireless sensor networks. It has very good energy conserving properties compared with IEEE 802.11. Another interesting property of our proposed protocol is that it has the ability to make trade-offs between energy and latency according to traffic conditions. The protocol has been implemented on our test bed nodes, which demonstrates its effectiveness. Future work includes system scaling and parameter analysis. More tests will be done on larger test beds with different number of nodes and system complexity.
We also discussed in this paper results of the related works and compare them with LEACH protocol which is the most basic but also most important protocol in clustering routing protocol.
All the new routing protocols are using new techniques as (TDTCGE and CRCWSN) that maximizes the lifetime and reduces the energy consumption by an efficient mathematical mechanism which will prolong the life time approximately 3 times than that of the basic LEACH Protocol.

5. FUTURE WORK

The CH is an important node in the TDTCGE protocol because it consumes more energy. We will maximize the lifetime of the TDTCGE protocol by mixing two protocols: TDTCGE Protocol and MD Protocol . In addition, we will add a new mechanism and mathematical model to this improved protocol. The problem of the newest TDTCGE protocol is that the cluster head is always on and we want to minimize the idle listening on the radio. One can notice from the survey that routing protocols have many limitations. Therefore, the cluster head in WSN always has many limitations. One of these limitations is that it consumes more energy when the radio is on or when the distance is far from the base station .

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