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A SURVEY ON WIRELESS SENSOR NETWORK PROTOCOLS

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ABSTRACT:

Recent advances in wireless sensor networks have led to many new protocols specifically designed for sensor networks where energy awareness is an essential consideration. Most of the attention, however, has been given to the routing protocols since they might differ depending on the application and network architecture. This paper surveys recent routing protocols for sensor networks and presents a classification for the various approaches pursued. The three main categories explored in this paper are data-centric, hierarchical and location-based. Each routing protocol is described and discussed under the appropriate category.

Keywords- wireless sensor networks, routing protocols, network structure, Hierarchical routing, data centric routing

INTRODUCTION:

[1] A Wireless sensor network (WSN) consists of hundreds to thousands of low-power multi-functional sensor nodes, operating in an unattended environment, and having sensing, computation and communication capabilities. The basic components of a node are a sensor unit, (ADC) Analog to digital converter, a CPU (Central processing unit), a power unit and a communication unit. Sensor nodes are micro-electro-mechanical systems (MEMS) that produce a measurable response to a change in some physical condition like temperature and pressure. Sensor nodes sense or measure physical data of the area to be monitored. The continual analog signal sensed by the sensors is digitized by an analog-to-digital converter and sent to controllers for further processing.

Each sensor node has a certain area of coverage for which it can reliably and accurately report the particular quantity that it is observing. Several sources of power consumption (a) Signal sampling and conversion of physical signals to electrical ones (b) signal conditioning (c) analog-to-digital conversion.A routing protocol is a protocol that specifies how routers communicate with each other disseminating information that enables them to select routes between any two nodes on the network. There are mainly two types of routing process: static routing and dynamic routing

Classification of protocols:

Mode of functioning	Example	Participation style of nodes	Example	Network structure	Example
Pro-active	LEACH	Direct Communication	SPIN	Hierarchical	Leach, TEEN, APTEEN
Reactive	TEEN	Flat	Rumor Routing	Data Centric	SPIN
Hybrid	APTEEN	Clustering	TEEN	Location Based	GEAR

CLASSIFICATION ACCORDING TO ROUTING PROTOCOLS:

Classification of protocols

Hierarchical Routing

ROLE:

Hierarchical routing is used to perform energy efficient routing, i.e., higher energy nodes can be used to perform the sensing in the area of interest

ADVANTAGES:

- More Scalability
- Data Aggregation/Fusion
- Less Load
- Less Energy
- More Robustness

DISADVANTAGES:

- Not query based
- Time consumption is high

Examples:

SPIN

DD,RR, CADR

COUGAR, ACQUIRE, EAR

Data Centric Routing

ROLE:

Data centric protocols are query based and they depend on the naming of the desired data, thus it eliminates much redundant transmissions

ADVANTAGES:

- Energy savings
- Less transmission
- Limited power usage
- Limited scalability

DISADVANTAGES:

- Complex queries used

Examples:

PEGASIS

HEED

TEEN

APTEEN

Location Based Routing

ROLE:

Location based routing protocols need some location information of the sensor nodes. Location information can be obtained from GPS (GLOBAL POSITIONING SYSTEM)

ADVANTAGES:

- Location accuracy
- Increases network life time
- Good scalability

DISADVANTAGES:

- No data aggregation
- Not query based

Examples:

GEAR

Geographic Adaptive Fidelity (GAF)

MECN and SMECN

Hierarchical protocols

[1][2]Hierarchical routing (examples: LEACH, TEEN, APTEEN) is used to perform energy efficient routing, i.e., higher energy nodes can be used to process and send the information; low energy nodes are used to perform the sensing in the area of interest. Similar to other communication networks, scalability is one of the major design attributes of sensor networks. A single-tier network can cause the gateway to overload with the increase in sensors density. Such overload might cause latency in communication and inadequate tracking of events. In addition, the single-gateway architecture is not scalable for a larger set of sensors covering a wider area of interest since the sensors are typically not capable of long-hau communication. To allow the system to cope with additional load and to be able to cover a large area of interest without degrading the service, networking clustering has been pursued in some routing approaches

[1][2]**LEACH: Low-Energy Adaptive Clustering Hierarchy (LEACH**) is one of the most popular hierarchical routing algorithms for sensor networks. The idea is to form clusters of the sensor nodes based on the received signal strength and use local cluster heads as routers to the sink .This will save energy since the transmissions will only be done by such cluster heads rather than all sensor nodes. Optimal number of cluster heads is estimated to be 5% of the total number of nodes. All the data processing such as data fusion and aggregation are local to the cluster. Cluster heads change randomly over time in order to balance the energy dissipation of nodes. This decision is made by the node choosing a random number between 0 and 1

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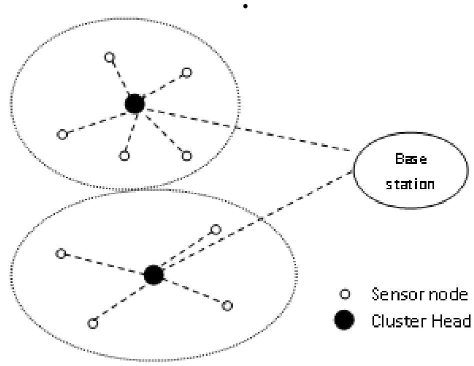


Clustering in LEACH Protocol

. The node becomes a cluster head for the current round if the number is less than the following threshold:
T(n)={p/1-p*(r mod 1/p) if n is a element of G otherwise

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

TEEN and APTEEN: [8][9]Threshold sensitive Energy Efficient sensor Network protocol (TEEN) is a hierarchical protocol designed to be responsive to sudden changes in the sensed attributes such as temperature. Responsiveness is important for time-critical applications, in which the network operated in a reactive mode. TEEN pursues a hierarchical approach along with the use of a data-centric mechanism. The sensor network architecture is based on a
Hierarchical grouping where closer nodes form clusters and this process goes on the second level until base station (sink) is reached.

After the clusters are formed, the cluster head broadcasts two thresholds to the nodes. These are hard and soft thresholds for sensed attributes. Hard threshold is the minimum possible value of an attribute to trigger a sensor node to switch on its transmitter and transmit to the cluster head. Thus, the hard threshold allows the nodes to transmit only when the sensed attribute is in the range of interest, thus reducing the number of transmissions significantly. Once a node

senses a value at or beyond the hard threshold, it transmits data only when the value of that attribute changes by an amount equal to or greater than the soft threshold. As a consequence, soft threshold will further reduce the number of transmissions if there is little or no change in the value of sensed attribute. One can adjust both hard and soft threshold values in order to
control the number of packet transmissions. However, TEEN is not good for applications where periodic reports are needed since the user may not get any data at all if the thresholds are not reached.

[5]The **Adaptive Threshold sensitive Energy Efficient sensor Network** protocol (APTEEN) is an extension to TEEN and aims at both capturing periodic data collections and reacting to time-critical events. The architecture is same as in TEEN. When the base station forms the clusters, the cluster heads broadcast the attributes, the threshold values, and the transmissionschedule to all nodes. Cluster heads also perform data aggregation in order to save energy. APTEEN supports three different query types: historical, to analyze past data values; one-time, to take a snapshot view of the network; and persistent to monitor an event for a period of time. Simulation of TEEN and APTEEN has shown them to outperform LEACH. The experiments have demonstrated that APTEEN's performance is between

LEACH and TEEN in terms of energy dissipation and network lifetime. TEEN gives the best performance since it decreases the number of transmissions. **The main drawbacks of the two approaches are the overhead and complexity of forming clusters in multiple levels, implementing threshold-based functions and dealing with attribute-based naming of queries.**

PEGASIS

[5]PEGASIS (Power-Efficient GAthering in Sensor Information Systems) is a greedy chain-based power efficient algorithm. Also, PEGASIS is based on LEACH (the scenario and the radio model in PEGASIS are the same as in
LEACH). The key features of PEGASIS are

1) The BS is fixed at a far distance from the sensor nodes.
2) The sensor nodes are homogeneous and energy constrained with uniform energy.
3) No mobility of sensor nodes.

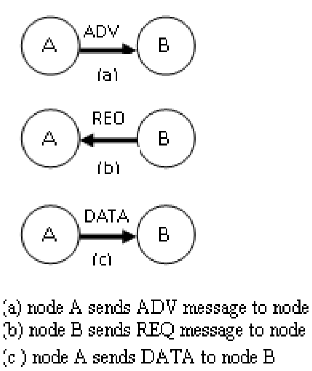
PEGASIS is based on two ideas; Chaining and Data Fusion.
In PEGASIS, each node can take turn of being a leader of the chain, where the chain can be constructed using greedy algorithms that are deployed by the sensor nodes. PEGASIS assumes that sensor nodes have a global knowledge of
the network, nodes are stationary (no movement of sensor nodes), and nodes have location information about all other nodes. PEGASIS performs data fusion except the end nodes in the chain. PEGASIS outperforms LEACH by eliminating
the overhead of dynamic cluster formation, minimizing the sum of distances that non leader-nodes must transmit, limiting the number of transmissions and receives among all nodes, and using only one transmission to the BS per round. PEGASIS has the same problems that LEACH suffers from. Also, PEGASIS does not scale, can not be applied to sensor network where global knowledge of the network is not easy to get.

Data centric Protocols:

Data Centric protocols are query based and they depend on the naming of the desired data, thus it eliminates much redundant transmissions. The BS sends queries to a certain area for information and waits for reply from the nodes of that particular region. SPIN was the first data centric protocol.

SPIN

[5]SPIN (Sensor Protocols for Information via Negotiation) is a family of adaptive protocols for WSNs. Their design goal is to avoid the drawbacks of flooding protocols mentioned above by utilizing data negotiation and resource adaptive algorithms. SPIN is designed based on two basic ideas; (1) to operate efficiently and to conserve energy by sending meta-data (i.e., sending data about sensor data instead of sending the whole data that sensor nodes already have or need to obtain), and (2) nodes in a network must be aware of changes in their own energy resources and adapt to these changes to extend the operating lifetime of the system.
SPIN has three types of messages, namely, ADV, REQ, and DATA.
ADV: when a node has data to send, it advertises via broadcasting this message containing meta-data (i.e., descriptor) to all nodes in the network.
REQ: an interested node sends this message when it wishes to receive some data.
DATA: Data message contains the actual sensor data along with meta-data header.
SPIN is based on data-centric routing where the sensor nodes send ADV message via broadcasting for the data they have and wait for REQ messages from interested sinks or nodes. The semantics of SPIN's meta-data format is application dependent and not supported by SPIN. In another words; SPIN uses application specific meta-data to name the sensed data. Although, SPIN has some advantages, such as (1) solving the problems associated with classic flooding protocols, and (2) Topological changes are localized; it has its own drawbacks like; (1) scalability, SPIN is not scalable, (2) if the sink is interested in too many events, this could make the sensor nodes around it deplete their energy, and (3) SPIN's data advertisement technique cannot guarantee the delivery of data if the interested nodes are far away from the source node and the nodes in between are not interested in that data.
SPIN-1 starts when a node has new data to share. This node sends out an ADV message containing a descriptor (i.e., meta-data) about the data it has to its neighbor nodes. An interested neighbor in that data sends out a REQ message to the broadcasting node, which then in turns sends out the actual data along with the meta-data. In SPIN-2, which is simply SPIN-1 with a low-energy threshold, if a node has new data to share or received an ADV message, it will not take part in the protocol if it does not have enough energy.



Data Transmission in SPIN.

4. Directed Diffusion

[5]Directed diffusion is another data dissemination and aggregation protocol. It is a data-centric and application aware routing protocol for WSNs. It aims at naming all data generated by sensor nodes by attribute-value pairs. Directed diffusion consists of several elements; first of all, naming; where task descriptors, sent out by the sink,

are named by assigning attribute-value pairs. Secondly, interests and gradients; the named task description constitutes an interest that contains timestamp field and several gradient fields. Each node stores the interest in its interest cache. As the interests propagate throughout the network, the gradients
from the source back to the sink are set up. Thirdly, data propagation, when the source has data for the interest, it sends out the data to the interest (i.e., sink) along the interest's gradient path. Fourthly, after the interest (sink) starts receiving low rate data events, it reinforce one particular neighbor to draw down higher quality (higher data rate) events. This feature of directed diffusion is achieved by data-driven local rules. Directed diffusion assists in saving sensors' energy by selecting good paths by caching and processing data in-network since each node has the ability for performing data aggregation and caching. On the
other hand; Directed diffusion has its limitations such as; implementing data aggregation requires deployment of synchronization techniques which is not realizable in WSNs. Also, the overhead in data aggregation involves recording information. These two drawbacks may contribute to the cost of sensor node, which is not desired.

Rumor routing

[7]Rumor routing is another variation of Directed Diffusion and is mainly intended for contexts in which geographic routing criteria are not applicable. Generally Directed Diffusion floods the query to the entire network when there is no geographic criterion to diffuse tasks. However, in some cases there is only a little amount of data requested from the nodes and thus the use of flooding is unnecessary. An alternative approach is to flood the events if number of events is small and number of queries is large. Rumor routing is between event flooding and query flooding. The idea is to route the queries to the nodes that have observed a particular event rather than flooding the entire network to retrieve information about the occurring events. In order to flood events through the network, the rumor routing algorithm employs long lived packets, called agents. When a node detects an event, it adds such event to its local table and generates an agent. Agents travel the network in order to propagate information about local
events to distant nodes. When a node generates a query for an event, the nodes that know the route, can respond to the query by referring its event table. Hence, the cost of flooding the whole network is avoided. Rumor routing maintains only one path between source and destination as opposed to Directed Diffusion where data can be sent through multiple paths at low rates. Simulation results have shown that rumor routing achieves significant energy saving over event flooding and can also handle node's failure. However, rumor routing performs well only when the number of events is small. For large number of events, the cost of maintaining agents and event-tables in each node may not be amortized if there is not enough interest on those events from the sink. Another issue to deal with is tuning the overhead through adjusting parameters used in the algorithm such as time-to-live for queries and agents.

Location based protocols:

[1][7]Location based routing protocols need some location information for the sensor nodes. Location information can be obtained from GPS (Global Positioning System) signals, received radio signal strength, etc. GEAR is an example of a location based routing protocol

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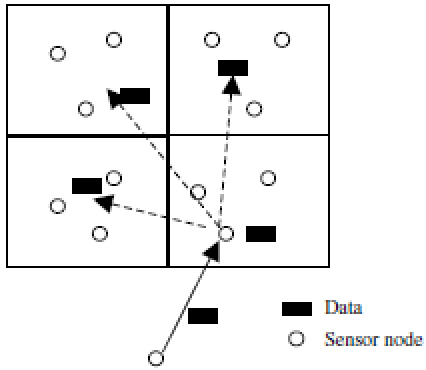
Geographic and Energy-Aware Routing (GEAR)



Geographic Forwarding in GEAR

[6][13]Location based routing protocols for sensor network need location information of all the sensor nodes to calculate the distance between any two nodes. GEAR is a location based routing protocol which uses GIS (Geographical Information System) to find the location of sensor nodes in the network. According to this protocol, each node store two types of cost of reaching the destination:

Estimated cost and learning cost. The estimated cost is a combination of residual energy and distance to destination. The learned cost is a modified estimated cost and it accounts the routing around holes in the network. When a node does not have any closure neighbors towards the target region, a hole occurs. In case where no holes exit, the estimated cost is equal to the learned cost. The GEAR protocol only considers a certain region rather than sending the interests to the whole network as happens in Directed Diffusion and thus restricting the number of interests. There are two phases in this protocol:

Phase-I: In this phase, packets are forwarded towards the target region. After receiving a packet, a node searches for a neighbor which is closer to the target region then itself. The neighbor is then selected as the next hop. If there are more than one suitable node then there exists a hole and in this case one node is picked to forward the packet based on the learning cost function.

Phase-II: in this phase, the packets are forwarded within the region. If the packet reaches the region, it is diffused in that region by either recursive geographic forwarding or restricted flooding. If the sensors are not densely deployed, then restricted flooding is used and if the node density is high, then geographic flooding is used. In geographic flooding, the region is divided into four sub regions and four copies of the packet are created. This process continues until the regions with only one node are left.

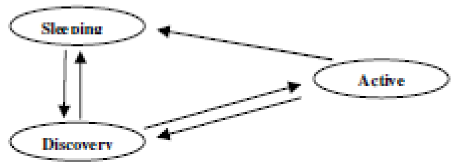
Geographic Adaptive Fidelity (GAF)

[16][14]GAF is an energy efficient location-based routing protocol. This protocol was initially conceived for mobile ad hoc networks, but it can also be applied to sensor networks. GAF can be implemented both for non-mobile and mobile nodes. Although GAF is a location based protocol, it may also be implemented as a hierarchical protocol where the clusters are based on geographic location. Initially the area of interest is split into some fixed zones forming a virtual grid for the covered area. Nodes in each zone have different functionalities and each node uses its GPS-indicated location to associate itself with a point in the grid. Nodes which are positioned at the same point on the grid are considered equivalent in terms of the cost of packet routing. Such equivalence is exploited in keeping Some nodes located in a particular grid area in a sleeping state in order to save energy. Thus GAF can increase the network lifetime as the number of nodes increases. GAF conserves energy by turning off unnecessary nodes in the network without affecting the level of routing fidelity. GAF defines three.

states: discovery, active, sleep.

The **'discovery'** state is used for determining the neighbors in the grid; the 'active' state participates in routing process and at the time of 'sleep' state, the radio is turned off.

In order to handle the mobility, each node in the grid estimates it's leaving time of grid and sends this to its neighbors. The sleeping neighbors adjust their sleeping time accordingly in order to keep the routing fidelity. Before the leaving time of the active node expires, sleeping nodes wake up and one of them becomes active.



State Transition Diagram of GAF

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PERFORMANCE ANALYSIS OF PROPOSED PROTOCOL ADPTV.TH

[6]ADAPTIVE THRESHOLD is a variable threshold in which value of threshold get changed after predefined round. ADAPTIVE THRESHOLD is variance of past sensed values. Constant soft threshold is the draw back of protocol TEEN and APTEEN because it gives the limited results. In ADAPTIVE THRESHOLD the soft threshold is not constant but varying with the sensed values. The sensed values are as per the count time, and the variations are taken by averaging (as per eq.4) these sensed values and then taking variance (as per eq.5)of these sensed values. These variations work as a soft threshold.
Avg. = sum of all sensed values/total sensed values ……………………….(4)
Variance = Square root of (sum of (sensed value – avg.)2)/count …………(5

Because of the variations in soft threshold, user gets a complete picture of the network at least one time in a count time. The node will be active at least one time as the soft threshold is the variance of all those sensed values and the node become active if it is in the range of the soft threshold. In this way the drawback of TEEN and APTEEN will overcome. The similar data that means the sensed value with little or no changes will not be transmitted to the CH so node is in sleep, there is no transmission. So the life time of nodes will increase and get better energy efficiency.

The network includes some of the initial simulation parameters and the initialization of the sensor network. So it is necessary to generate the locations of the nodes in the L * L m2 of the region. Random 100- node topology for a 100 * 100 m2. region, base station is located at (50, 50). The simulation parameters used in the experiment is shown below:

Number of sensor nodes (N) - 100
Network area (MxM) - 100 x 100 m
Location of base station (x,y) - (50,50),
Eelec (transmission & reception energy per bit) - 50 nJ/bit
Eamp (amplification energy at transmitter per bit) -0.0013pJ/bit/m4
Eda (data aggregation energy per bit) - 0.5J
K (number of bits in a packet) - 4000bits Constant for free space energy - 10pJ/bits m2

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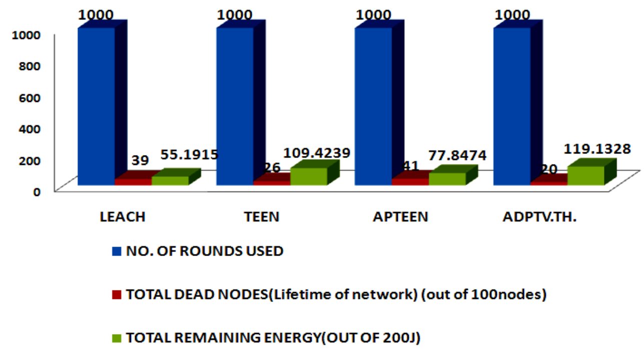
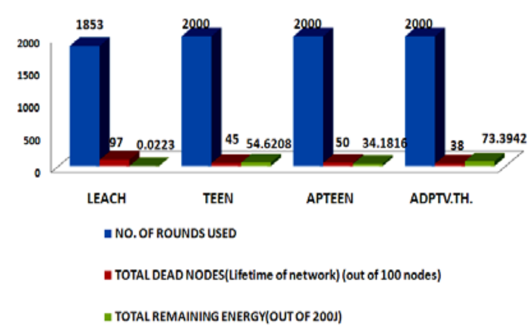


Protocols	No. of rounds used	Total dead nodes (out of 100 node	Total remaining energy (out of 200J)
LEACH	1000	39	55.1915
TEEN	1000	26	55.1915
APTEEN	1000	41	77.8474
ADPTV.TH	1000	20	119.1328

COMPARISON FOR 1000 ROUNDS

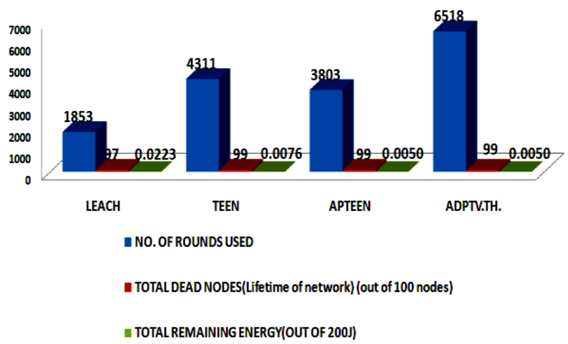
After 2000 rounds all the nodes become dead in normal LEACH, it runs up to 1853 rounds only and after completion of 1853 rounds remaining energy is also almost zero. APTEEN has 50 dead nodes and 34 J remaining energy. TEEN has 45 dead nodes and 54 J remaining energy. ADAPTIVE THRESHOLD has 38 dead nodes and J remaining energy after 2000 rounds which is the best result again.

Protocols	No. of rounds used	Total dead nodes (out of 100 node)	Total remaining energy (out of 200J)
LEACH	1853	97	0.0223
TEEN	2000	45	54.6208
APTEEN	2000	50	34.1816
ADPTV.TH	2000	38	73.3942



COMPARISON FOR 2000 ROUNDS

Table - III: Performance comparison of protocols for maximum rounds



Protocols	No. of rounds used	Total dead nodes (out of 100 node)	Total remaining energy (out of 200J)
LEACH	1853	97	0.0223
TEEN	4311	99	0.0076
APTEEN	3803	99	0.0050
ADPTV.TH	6518	99	0.0050

COMPARISON FOR MAXIMUM ROUNDS

Each protocol runs up to different rounds so the maximum rounds covered by each protocol are as follow:

LEACH - 1853
APTEEN - 3803
TEEN - 4311
AD.TH.- 6518
All the nodes become dead and energy get zero after completion of 1853 rounds in LEACH, 3803 rounds in APTEEN, 4311 rounds in TEEN and 6518 rounds in ADAPTIVE THRESHOLD. So ADAPTIVE THRESHOLD gives the best results compare to LEACH, TEEN and APTEEN.

RESULTS:

[6]The proposed protocol is presented using the proper node scheduling (ACTIVE and SLEEP) in the individual clustering of the whole network. Clustering is according to the condition given by TEEN, APTEEN and ADAPTIVE THRESHOLD, transmission energy consumption will decrease and network lifetime will be increased. APTEEN works better than LEACH.TEEN gives better results than APTEEN and LEACH both. And the most improved results are achieved by ADAPTIVE THRESHOLD. IN ADAPTIVE THRESHOLD algorithm, threshold is changed based on previously sensed data. So sensor will try to adapt the environment changes by varying the threshold. So the conclusion is that ADAPTIVE THRESHOLD gives better results, improved energy efficiency of nodes and better network lifetime compared to normal LEACH, TEEN and APTEEN

CLASSIFICATION OF PROTOCOLS:

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PROTOCOLS	ROLE AND FUNCTIONALITY	ADVANTAGES	DISADVANTAGES
LEACH (Low-energy adaptive clustering hierarchy)	[3]In order to reduce power consumption in a network, Leach was the first energy-efficient hierarchical clustering algorithm for WSNs.It supports only single hop communication as it transmits data directly to base station. It uses the cluster based topology to increase the life time of network. LEACH is basically based on an aggregation technique that aggregates the useful data and forwards it to sink. The redundant data is removed with use of efficient aggregation technique and with the clustering approach routing and data dissemination are made more scalable and robust. Various improvement has been done to make LEACH more efficient.	• High Scalability • very Good Life Time • Highly Energy Efficient • Very less latency involved • Throughput is very high	LEACH assumes all nodes to be homogeneous which is practically not usual as heterogeneity in energy is the most common case. Single Hop Communication Leads to hot spot problem.
TEEN (Threshold sensitive energy efficient sensor network)	[1][3]TEEN is a clustering communication protocol. When clusters are formed, the CH broadcasts two thresholds to the sensor nodes namely (i) Hard threshold (*HT*), and (ii) soft threshold (*ST*). Hard threshold gives the minimum value of an attribute after which sensor should turn on its transmitter to give information about sensed data to its CH. So transmission of data is made dependent on location of sensed attribute. When value is greater than Hard threshold, it will allow the node to transmit but it has to further check that if there is change in sensed attribute beyond the value of soft threshold. So in this way number of transmission are reduced.	Adjustment can be made in the value of hard and soft threshold values in order to control the number of packet transmissions. Suitable for time critical application	It is not suitable for applications where periodic reports are required.
APTEEN (Adaptive threshold TEEN)	[1][3]Adaptive Threshold sensitive Energy Efficient sensor Network protocol(APTEEN) performs both capturing periodic data collections and also reacting to the time-critical events .After the formation of cluster, CH broadcast the attributes, the threshold values, and the transmission schedule to all nodes and it also perform data	APTEEN guarantee lower energy dissipation and a larger number of sensor alive. The performance of APTEEN is between LEACH and TEEN in terms of energy dissipation	Complexity is involved in forming clusters in multiple levels and also in implementation of threshold based function.

	aggregation. Three types of query are supported by APTEEN: **Historical**, which analyze past data values; **One-time**, which take a snapshot view of the network and **Persistent** which monitor an event for a period of time.	and network lifetime.	
PEGASIS (Power efficient Gathering Sensor Information System)	[3]Power-Efficient Gathering in Sensor Information Systems (PEGASIS) are an improved algorithm of the LEACH protocol. Unlike LEACH it avoids cluster Formation and selection of one node is done to transmit data to sink rather than doing it by multiple nodes. So a chain is formed and only one node performs the task of transmission to the sink. PEGASIS uses a greedy approach and incase if there is any node failure than it bypass that node. So in each round node selection is done randomly thus reducing the per round energy consumption compared to LEACH	Increase Life Time of network twice as compare to LEACH Decreases the number of transmission and reception by using data aggregation. Clustering overhead is avoided. Avoids so much clustering, Increases lifetime twice	It needs dynamical Topology adjustment which causes significant Overhead. It assumes every node to be of same energy which is not practically possible. Delay involved is concerning issue here.
SPIN (Sensor protocols for Information via negotiation)	[5][7]SPIN is a data centric protocol that use data negotiation and resource adaptive algorithms	Topological changes are localized since each node only needs to know the single-hop neighbors' Energy savings than flooding Meta-data negotiation halves the redundant data	**SPIN**s data advertisement mechanism cannot guarantee the delivery of data
DD (Directed Diffusion)	[8]Directed diffusion is a data centric and application aware protocol in which data generated by sensors nodes is named by attribute value pairs. It consists of four elements (a) Interests (b) Data messages (c) Gradients (d) Reinforcement (e)	Save energy by selecting optimal paths by caching and processing data in the network	**(a)**Time synchronization technique that is not very easy to achieve in WSNs (b) overhead involved in recording information thus increasing the cost of a sensor node
RR (Rumor Routing)	[9]Rumor routing is a kind of	This RR protocol	This routing performs magnificently only when

	directed diffusion and is used for applications where geographic routing is not feasible It combines both query flooding and event flooding protocols in a random way	maintains one path between source and destination	numbers of events are small.
GAF(Geographic Adaptive Fidelity)	[18][16]GAF is an energy efficient location-based routing protocol. This protocol was initially conceived for mobile and ad hoc networks	GAF performs well as a normal ad hoc routing protocol in terms of latency and packet loss Increases the lifetime of the network by saving energy	GAF conserves energy by turning off unnecessary nodes in the network without affecting the level of routing fidelity
GEAR *(Geographic and Energy-Aware Routing)*	[16]GEAR is a location based routing protocol which uses GIS (Geographical Information System) to find the location of sensor nodes in the network.	The GEAR protocol only considers a certain region rather than sending the interests to the whole network	GEAR reduces the energy consumption It is not scalable and does not support data diffusion. GEAR not only reduces energy consumption for the route setup, but also performs better than GPSR in terms of packet delivery.

Thus the existing protocols have been classified and the advantages and disadvantages of these protocols have been briefly given above

Conclusion:

Routing in sensor networks is a new area of research. Since sensor networks are designed for specific applications, designing efficient routing protocols for sensor network is very important. In our work we have presented the comparative study of the eight routing protocols and their brief classification. Some of the sample evaluation is also study with the references cited below[6]

Future Enhancement:

Researchers may also extend this work with implementation of each protocol with simulators and emulators.

References:

1. Holgerkarl and Andreas willig**"Protocols and architectures for wireless sensor networks",** wiley publications

2.Kemal Akkayaand **Mohamed Younis “A Survey on Routing Protocols for Wireless Sensor Networks”** Department of Computer Science and Electrical Engineering University of Maryland, Baltimore County.2 Nov 2010.

3.**SandeepVerma,Richa Mehta, DivyaSharma,Kanika SharmaWireless Sensor Network and Hierarchical Routing Protocols: A Review”** ***International Journal of Computer Trends and Technology (IJCTT) – volume 4 Issue 8– August 2013***

4.**Debnath Bhattacharyya, Tai-hoon Kim , and Subhajit Pal “A Comparative Study of Wireless Sensor Networks and Their Routing Protocols”**

5.Yazeed Al-Obaisat, Robin Braun “On Wireless Sensor Networks: Architectures, Protocols, Applications, and Management” Institute of Information and Communication Technologies University of Technology, Sydney

6**. Bhakti Parmar and JayeshMunjani** “**Analysis and Improvement of Routing Protocol LEACH using TEEN, APTEEN and Adaptive Threshold in WSN”**International Journal of Computer Applications (0975 – 8887) Volume 95– No.22, June 2014

7.**Ms. ParulTyagi and** Ms**. Surbhi Jain “**Comparative Study of Routing Protocols in Wireless Sensor Network” International Journal of Advanced Research in Computer Science and Software Engineering Volume 2, Issue 9, September 2012

8. Manjeswar, A.; Agrawal, D.P. TEEN: A protocol for enhanced efficiency in wireless sensor networks. In *Proceedings of 1st International Workshop on Parallel and Distributed Computing Issues in Wireless Networks and Mobile Computing*, San Francisco, CA, USA, 2001; p. 189.

9. Manjeswar, A.; Agrawal, D.P. APTEEN: A hybrid protocol for efficient routing and comprehensive information retrieval in wireless sensor networks. In *Proceedings of 2nd International Workshop on Parallel and Distributed Computing Issues in Wireless Networks and Mobile Computing*, Fort Lauderdale, FL, USA, April 15–19, 2002; pp. 195-202

10. Rahul, C.; Rabaey, J. “Energy aware routing for low energy *ad hoc* sensor networks”. In *Proceedings of IEEE Wireless Communications and Networking Conference (WCNC)*, Orlando, FL, USA, March, 2002; pp. 350-355.

11. Shio Kumar Singh, M p Singh and DK Singh “Routing Protocols in Wireless Sensor Networks-A Survey” International Journal of Computer Science &Engineering Survey(IJCSES)Vol.1,No.2,November2010.

12. Mar. 2002. [25] **A. Manjeshwar and D. P. Agrawal**, .TEEN**: A Protocol for Enhanced Efficiency in Wireless Sensor Networks.**,in the Proceedings of the 1st International Workshop on Parallel and Distributed Computing Issues in Wireless Networks and Mobile Computing, San Francisco, CA, April 2001.

13**. W. Lou, “An Efficient N-to-1Multipath Routing Protocol in Wireless Sensor Networks”**. Proceedings of IEEE MASS’05, Washington DC, pp. 1-8, Nov. 2005.

14. **A.A. Ahmed, H. Shi, Y. Shang**, "**A Survey on Network Protocols for Wireless Sensor Networks**," In Proc. of International Conference on Information Technology: Research and Education (ITRE’03), pp. 301 - 305, 11-13 Aug. 2003

15 **.R. Min, et al., "Low Power Wireless Sensor Networks",** in the Proceedings of International Conference on VLSI Design, Bangalore, India, January 2001.

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