Review on Variants of Routing protocols and Leach protocols in Wireless Sensor Network

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***Abstract-* WSN's are collection of sensor nodes. Power of these sensor nodes is limited and also increase the lifetime of these sensor nodes. WSN's have limited battery power, limited memory and have limited computational power. It consists various parameters like atmospheric pressure, temperature, humidity and heat all are measure or sense by the sensor networks. Today's WSN's is an emerging field for research. Wireless sensor networks have usage of sensor networks in different areas like military area, health applications, home application, disaster management, sensing environment etc. Routing protocols are the most challenging issue and it increases the lifetime of battery. Hierarchical routing protocol is one of most energy efficient routing protocol. Routing algorithms are divided into different types: direct transmission, hop-to-hop. In wireless sensor networks, two paths are single path routing and multipath routing protocols are used for transfer the data or nodes from source to sink. Leach is the one of most energy efficient routing protocol and increases the lifetime of network. All communication in a network is performed by sensor nodes so the effect of energy depletion occurs which decreases the network lifetime. So to optimize networks lifetime there is a need of highly energy efficient routing protocols. LEACH protocols are energy efficient protocol. The main motive or objective of this paper is to study the various variants of the ROUTING protocols and LEACH protocols which are studied to maximize the lifetime of network and efficient consumption of energy.**

***Index terms*-Leach protocols, Multipath routing, Routing protocols, Single path routing, and Wireless sensor network.**

I Introduction

Wireless sensor network consisting huge number of sensor nodes that are wirelessly connected to each other. It is helpful for exchange the data between one or more sensor nodes. Wireless sensor network consist the BS and sensor nodes. The combinations of these sensor nodes are called motes. Each motes of wireless sensor network are capable for forwarding the data to the other motes or devices. A mote is a node but a node is always not a mote. Various parameters like atmospheric pressure, heat, humidity and temperature are measures or sense by the sensor nodes. In WSN's, sensor nodes send the collected data from source to sink with the help of single path routing or multi path routing protocol.
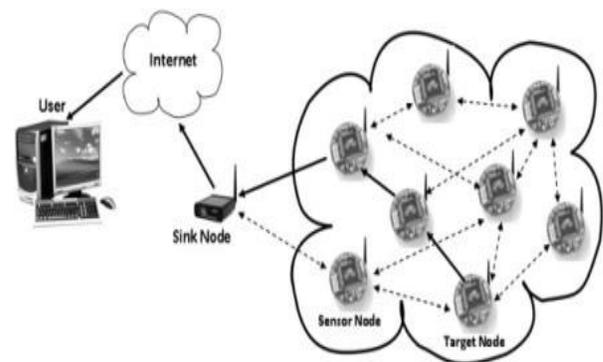

Figure1.1 WSN's

In multi path routing, sensor nodes collect data from other nodes and send to the BS. Range of these nodes is very small so data cannot send directly to base station. In this situation, multipath routing protocols are used for transmitting the data from source to BS. Unicast, broadcast and multicast these three different techniques are used for forwarding the packets. There is only one sender or one receiver that is helpful for sending one packet to another at a time. In Broadcasts communication packets are sending from one host to all hosts. It sends information everyone at once. There is only one sender but the information is send to all the connected receivers or in multicast, multiple packets are send from one to another. In

2013, Zuo Chen, Kai Chen [3] proposed an improved multi-hop routing protocol for large-scale for WSN's based on merging adjacent clusters are used for designing routing protocols. The lifetime of wireless sensor networks are extended by the Leach protocols and all nodes are directly communicates with the sink node. LEACH MM is a new protocol that reduces the consumption of energy. This protocol selects that node whose remaining energy is more as compare to the average of the full energy. Leach protocols are not suitable for the large scale of wireless sensor network and LEACH-MM choose the multi layer clusters based on the distance. LEACH-MF or LEACH protocols are better than the LEACH-MM because it sends the data packets to sink through multi-hop and sensor nodes may long life. In 2003, B. Deb, S. Bhatnagar and B. Nath [1] proposed ReInForM: reliable information forwarding using multiple paths in sensor networks is a protocol. The replica of each packet is delivered from source to destination by using multiple paths in ReInForM protocol. A Source decides to send the multiple packets to destination by using the multiple paths. In ReInFoRM protocol, the packets are delivers at suitable transmission cost. In 2012, El-Saadawy, Eman Shaaban [4] proposed enhancing S-LEACH security for WSN's is a version of leach protocols. Leach is a cluster based routing protocol for WSN's and use the TDMA/CDMA MAC to reduce the inter-cluster and intra-cluster collision. S-Leach protocol is one of the first modified version of leach protocol. Leach protocol is protected by attacks with the help of S-Leach. In 2013, Abdulsalam, Hanady M., Bader A. Ali [7] proposed W-leach based dynamic adaptive data aggregation algorithm for wireless sensor networks consist two different phases called setup phase and steady state phase. This new data aggregation technique is used on both uniform and non uniform state. Aim of data aggregation technique is reduce the size or amount of transfer data to WSN's. W-leach protocol is based on algorithm of C-leach protocol. Lifetime of network is increase in W-leach protocol and also save the energy of sensors. In 2006 Michele Garetto [9] proposed An Analytical Model for WSN's with Sleeping Nodes. Performance of system is evaluated in term of network capacity, consumption of energy and the data delivery delay. Nodes are sends their data to sink with the help of multi hop transmissions. Sensor node is optional between the sleep mode and active mode. Data is not transmits or receive by sensor nodes because sensor nodes consume low power. Sensor nodes are far away from the sink but the range for the transmission of data is limited so the multi-hop communication are prefer for sending data from source to sink. Active and Sleep state is characterized by the sensor. The node are transmits or receive data in active state but sleep state cannot take part in an activity so the nodes

exits the sleep state. The network performance is evaluate by an analytical model and can be easily modified. In 2013 Nutan Sindhwani [5] proposed V LEACH: an energy- efficient communication protocol for WSN's that present new version of Leach protocol called V-Leach. Energy consumption by the V-LEACH is less as compare to leach protocol and increases the lifetime of sensor networks. V LEACH protocol consist clusters and base station. In figure 2.1 Cluster head (CH) is receive data from the nodes of cluster and send to the BS.
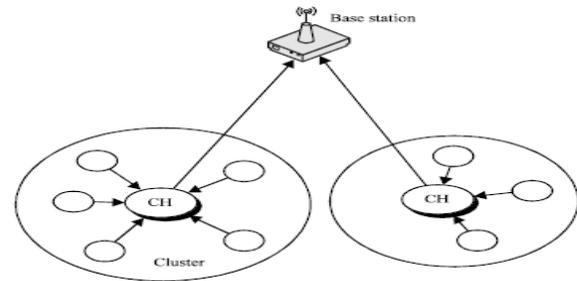
Figure1.2 V-LEACH

The cluster becomes useless after CH is die. Thus the BS will not received data collected by the cluster nodes. When the cluster head is die, then it is replaced by the vice cluster head but the Vice Cluster Head dies, in this case it does not provide for that and start reducing the energy very fast and finally the network dies completely. The number of dead nodes is less as compare to the alive nodes in V Leach. Life time of V Leach is more as compared to the original version of Leach protocol. In 2002 Wei Ye, John Heidemann [6] proposed an energy efficient MAC protocol for Wireless Sensor Networks. WSN's are used to manage the computing and sensing devices. Sensing devices are co-operation with other application such as environmental control. For wireless sensor network a new MAC protocol is designed called S-MAC (Sensor-Media Access Control) protocol. S-MAC protocol is helpful to reduce the energy wastage. Different techniques are used by the S-MAC for reduce the consumption of energy. S-MAC protocol are used for reduce the wastage of energy. A MAC protocols are present, that conserving energy with 802.11. Protocols are implemented on test beds nodes that show its effectiveness. More tests are done with different number of nodes on large test beds. In 2011 Yuhong Zhang [10] proposed An Energy-Based Stochastic Model for Wireless Sensor Networks, every sensor node consisting the active state and sleep state. These sensor nodes are continuously receives and transmit the data in an active state but in sleep state the nodes cannot interact with the others. Senor node changes its state from active to sleep for the consumption of energy. The generating rate increases when the

sensor consumes more energy. Sensor model is investigated then the steady-state probability (time independent) is derived. Steady-state probability is time independent. In 2008, Min Chen, Yong Yuan, Victor C.M. Leung [14] proposed REER: reliable and energy-efficient routing protocols in dense WSN's are based on the geographic routing. Sensory data is deliver by the sink node is large problem and this problem is hold by the deployment of sensors that allow us to choose an intermediate node for REER. Reference nodes (RNs) are select between the sources and sink in energy-efficient routing protocol. The REER protocol is the concept of Reference Nodes which means the source and sink node is close to the ideal locations, both protocols are based on the geographic routing. Multiple CNs (cooperative nodes) are selected for Reference Nodes to relay data packets successfully. Each data is broadcasts once at a hop. Multiple cooperative nodes consists each hop for broadcast the messages. Cooperative nodes are selected before the delivery of data in REER and unselected nodes are in sleeping mood to save energy.

1.2 Components of WSN's

WSN consist the sensor nodes and base station (BS). Sensor nodes are deployed in particular sensing area and have limited resources but base stations have unlimited resources. The Sensor unit, processing unit and Transceiver unit (Transmitter/Receiver) all units are receive powered by the power unit, which is usually composed by battery. Components of WSNs as shown below
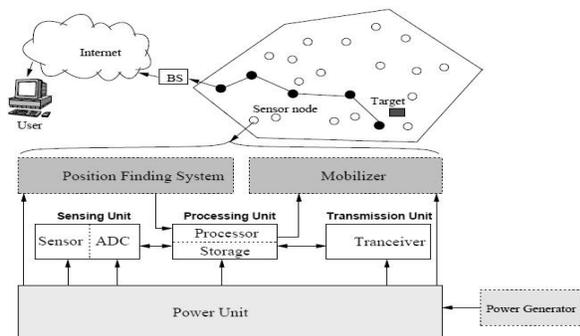

Figure1.3. Components of WSN's

1.2.1 **Power Unit**: Wireless sensor node consist four different units. Each unit of sensor node consumes energy through the power unit because it is fundamental part of sensor nodes. Power unit sends power or data to sensing unit (sensor, ADC), processing unit (processor, storage) and transmission unit (transmitter/receiver) as shown in figure 1.2.

1.2.2 **Sensing unit:** Sensor nodes are deployed in sensing unit. ADCs (analog-to-digital converters) and Sensors are two subunits.

1.2.3 **Sensor nodes:** Sensor nodes are important part of wireless sensor network. Sensor nodes are the brain of the wireless sensor networks. It is used to detect any incident that occurs in particular sensing field. Sensor nodes have a responsibility to collect data and complete routing.

1.2.4 **ADC:** Analog-to-digital-converter means convert analog to digital format and that data measured by the sensors so that it can be stored and processed.

1.2.5 **Processing Unit**: Collected data in the memory are stored in the processor until it is forwarded to the next node. Processing unit consist the processor and storage.

1.2.6 **Transmission Unit:** Transmitter is a radio device that used to send the other nodes or sink.

1.2.7 **Transceiver unit:** Communication between two wireless sensor nodes are perform by the transceiver unit. This unit consist transmitter and receiver. Receiver is helpful for receiving data from neighboring nodes or sink and the data is transmitted from nodes to sink in transmitter.
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1.3 WSN's Challenges

In the following, we summarize some challenges associated with Wireless Sensor Networks.

1.3.1 **Scalability:** Sensing area consist the huge amount of sensor nodes. The routing schemes are capable to working with the large amount of sensor nodes. These sensor nodes are scalable enough to respond to any query.

1.3.2 **Coverage and Connectivity:** The range and accuracy of the sensor nodes is limited. It can cover only the limited area of a particular field with the help of sensor nodes. Sensor nodes are strongly connected to establish the link between coverage area and connectivity. So, coverage area and connectivity are an important challenge of wireless sensor networks.

1.3.3 **DataAggregation/Convergecast:** Transmission of similar messages is reduced and multiple messages are fused together in data aggregation. Data fusion technique used by the many sensor nodes to send the same packet. All multiple packets or messages are handled by the collector nodes and

Convergecasting is data collection from all sensor nodes or set of sensors in the network towards the base station (many to one communication). Route construction plays a main role during the convergecasting.

1.3.4 Fault tolerance: Due to lack of power sensor nodes may fail or block. Nodes are performed on two or more links, if one node is failed the other can take over and forming the new links and adjusting the transmitting and receiving power used for relaying messages.

1.3.5 Deployment of nodes: Deployment of nodes are in uniform or randomized manner. Nodes are kept at fixed location or paths in uniform manner whereas in random deployment, the nodes are expanded in particular area. The routing can take place by using the single and multi-hop manner.

1.3.6 Energy consideration: Sensor nodes are uses small amount of energy for transmitting or computation the information in wireless environment. Their energy consumption decides the number of rounds they are going to complete. Thus the life time of sensor nodes totally depend upon the battery. In multi-hop wireless sensor networks, nodes plays dual role such as sender and router. Energy used in network either be homogeneous or heterogeneous.

1.3.7 Product Cost: Cost of the single node must be low.

1.4 Types of WSN's

Wireless sensor network are facing the different types of attacks, challenges and constraints. Various tasks such as widespread, security, health and surveillance both are used by the sensor network. There are five different ways of WSN's: terrestrial, underground, underwater, multimedia and mobile wireless sensor network. So, the WSN's are deployed on land, underground and underwater.

1.4.1 Underground WSN's: This sensor network consist that device which work under the surface of ground like road, subway, tunnels and mines.

1.4.2 Terrestrial WSN's: Two different networks are used in terrestrial WSN's called the structured and unstructured network. In terrestrial network, sensor nodes are deployed in a given area. Ad-

hoc is an unstructured network and preplanned is a structure network.

1.4.3 Underwater WSN's: Underwater WSN's is more expensive than the terrestrial network and has limited bandwidth. It consist sensor nodes and vehicles under water.

1.4.4 Multi-media WSN's: Multi-media wireless sensor network consist the low cost sensor nodes. In it, multimedia WSN's must possess the high throughput and energy efficient characterstics.

1.4.5 Mobile WSN's: In mobile WSN's, two different sensing modes are used: local sensing and remote sensing. The capacity of channel in mobile WSN's is more as compared to other networks. Mobile WSN's are applicable for tracking a device and searching.

II Protocol Stack

Wireless sensor networks consists five different layers. These are application layer, transport layer, network layer, data link layer and physical layer. All these layers follow the OSI model. Task management planes, Connection management planes and Power management planes are three different cross layers planes. Communication can take place between source and the base station by using five different layers. The stack performs the routing technique by estimating the best path. Protocol stack of wireless sensor networks represents in below figure
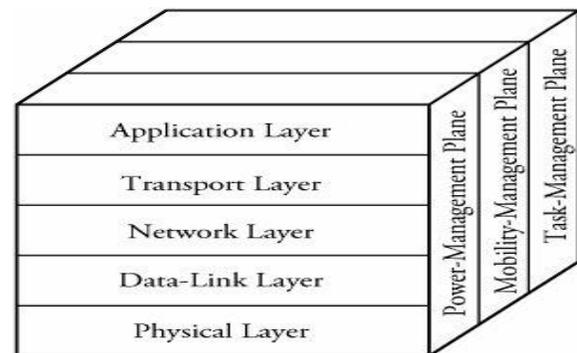
Figure 2: Protocol stack of WSNs

2.1 Application layer: A Protocol stack of wireless sensor networks start with application layer and forward the data to the next down layer. This layer is responsible for showing all the data in human readable format. The three different planes in protocol stack of WSNs, two of them task manager plane and mobility manager plane both are responsible for checking the mobile

nodes. These mobile nodes have responsibility for forwarding and receiving data from source node to sink.

2.2 Transport layer: Transport layer deliver the entire messages and maintaining the flow of data when accessed through internet.

2.3 Network layer: The packets are individually sent from source to the destination node and also responsible for maintain the flow of data when accessed through network.

2.4 Data-link layer: The data-link layer supports node to node connection and structure is moving from one node to the next node. The network layers also use the data link layer to transmit or receive data from physical layer. Flow error and flow control techniques are used to recover the data at this layer.

2.5 Physical layer: The physical layer are generating the signal modulation, detection, encryption of data, transmission and receiving of signals and bits are moving from the one node to next node.

III Routing Protocols

Routing protocols are responsible for sending the data between sensor nodes and the BS. All major protocols are proposed in WSN's. Routing algorithms are designed for wireless sensor networks.

3.1 Data-centric protocols: Data-centric protocols deals with queries. Base Station send queries to get information about a certain area and wait for reply from the nodes. So the sensor node collects particular data for that area and transmits to BS and reduces the number of transmissions. SPIN is a Data-centric protocol whose scalability is small.

3.2 Hierarchical protocols: To use energy efficiently, hierarchical routing is preferred over other routings. It consist the high energy node and low energy node. The lower energy nodes perform sensing in required area and higher energy nodes are helpful for send the data. It increases the lifetime, energy efficiency and system scalability.

3.3 Location-based protocols: Location-based protocol has uses to get position information sending data. Two techniques are used to find the position, one is to find the coordinate of neighboring node and other is to acquire the GPS (Global Positioning System) signals.

IV Routing for WSN's

Many protocols are proposed for routing of packet in wireless sensor networks. Transmission of data between source and sink is either performed by single path routing and multipath routing. Routing protocols are classified into different paths.

4.1 Single-path routing
4.2 Multipath routing

4.1 Single path routing in WSN's
Routing protocols are performs an end to end deliver of packets that is based on the topology or position addressing. If the addressing is the host based is called topological addressing and if a unique identification is chosen that addressing is called position addressing. In single path routing, transmission of data is PERFORMED between source and sink through the shortest path. The single path routing protocol is sent only one packet at any time for wireless sensor networks. The resource used by the single path is less than the resources used by the multi-path routing protocols.

4.2 Multipath Routing in WSN's
WSN's is collection of sensor nodes. Multipath routing protocol discovers a path that contains several components for constructing the multi-paths between source and destination. At any time multiple packets are periodical sent in Multi-path routing. The network reliability can be increased and paths are increased. It has widely used due to its fault tolerant and reliable nature. It is helpful to enhance the network performance. The classification of multi path routing in WSN's as in shown below figure:
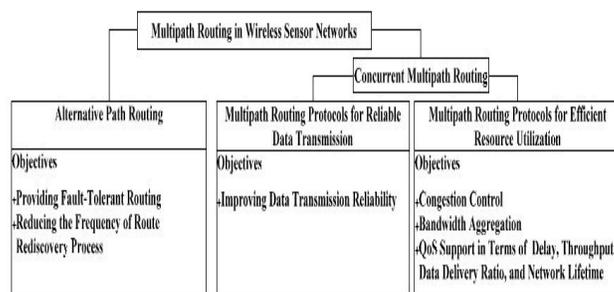

Figure4 Multipath routing in WSN's

V Leach protocols

LEACH (Low Energy Adaptive Clustering Hierarchy) protocol is first hierarchical routing protocol. It consist the cluster and base station (BS). Cluster consist the number of nodes and these cluster nodes are called CH (cluster head). In each cluster one node is considered as cluster head and all

remaining nodes are members of the cluster. CH is responsible for send data to base station. Leach protocol is self adaptive or self organization V-Leach, Leach-C, TL-Leach, C-Leach, A-Leach, MM-LEACH, B-Leach and S-leach all are types of leach protocol. Every protocol has its own life time and scalability.
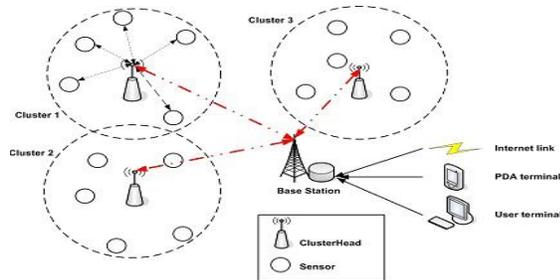

Figure5.1 Cluster sensor network

V.1 Variants of Leach protocols

TL-LEACH: TL-LEACH called two levels-low energy adaptive clustering hierarchy protocols. In leach protocol, CHs receive data from the nodes of cluster and broadcast this collected data to base station. But sometime CHs are very far away from the base station so in this position it uses more power for sending the data to base station. TL-leach new version of leach protocol is introduced. Two levels leach protocol works between two cluster heads and a base station. CHs of TL-Leach protocol collect data from the member of cluster and transmit this collected data to another CHs that is lies between cluster head and base station. Consumption of energy or number of nodes for transmitting the data to base station is reduces.

V-LEACH: Vice-Cluster Head leach is a new version of leach protocol. Energy consumption by the V LEACH is less as compare to leach protocol and increases the lifetime of sensor networks. V LEACH protocol consist clusters and base station. Cluster head receive data from the nodes of cluster and send to the BS. The cluster and nodes of cluster becomes useless after CH is die. Thus the BS will not received data collected by the cluster nodes. When the cluster head is die, then it is replaced by the vice cluster head but the Vice Cluster Head dies, in this case it does not provide for that and start reducing the energy very fast and finally the network dies completely. The number of dead nodes is less as compare to alive nodes in V Leach. Life time of V Leach is more as compared to the original version of Leach protocol.

C-LEACH: Centralized leach protocol consist the setup phase or study state. Setup phase is similar to the leach protocol but study state phase and C-Leach both are different from the original leach protocol. BS collects information about the location of data and level of energy from each node by using centralized clustering algorithm. This algorithm plays a main role for selection of cluster heads. In set up phase of Leach protocol, current location of all nodes and their energy level sent to base station. GPS method is used by the C-leach protocol to find the location of the nodes. The average of the node energy is calculate by the BS .When the energy of nodes is more than the calculated energy then the current node cannot be selected from the cluster head.

A-LEACH: TDMA/CDMA techniques are used for saving energy in Advanced-leach protocol. In leach protocol, cluster head receive energy from the nodes of cluster and then directly send it to the BS. A-LEACH protocol is helpful for decreasing the failure chances of sensor nodes, increasing the time interval and energy saving protocol. This protocol works as synchronized clock in which one device is connected with another using different standard of wireless communication.

MM-LEACH: Lifetime of wireless sensor network is extended by the Leach protocols and all nodes are directly communicates with the sink node. LEACH-MM is a new protocol version of leach protocol that reduces the consumption of energy. MM-Leach select that nodes whose remaining energy is more as compare to the average of full energy. Leach protocols are not suitable for the large scale of WSN's and LEACH-MM choose the multi layer clusters based on the distance. So, LEACH-MM protocol is better as compared to LEACH-MF and LEACH protocol because it sends the data packets to sink through multi-hop and sensor nodes may long life.

B-LEACH: Efficiency of Balanced leach protocol is better as compared to leach protocol and also improves the performance of leach protocol. Each sensor node in B-leach is known only about its own position. Multiple techniques are used for sending data in b-leach. In a cluster, each sensor node selects that node as a cluster head in which the energy loss between that node and the sensor node is less.

VI. Conclusion

We have studied the different routing protocols and leach protocols. There are many routing or leach protocols but we selected some protocols because it gives better performance as compared to another. Routing protocols are introduced like data-centric protocol, location based protocol and hierarchical protocol or leach protocols like TL-Leach, V-Leach,

C-Leach, A-Leach, MM-Leach and B-Leach. These leach protocols provides better result as compared to original leach protocol and improve the performance of wireless network. Two routing protocols are used in wireless sensor network first is single path routing or other one multipath routing protocols. Multipath is better as compare to single path because we send multiple packets at a time by using multi path protocols. Different type of leach protocol provides highest performance with the help of clustering algorithms. In future, the average consumption of energy will increases and easy for transmitting the data between the channels.

ACKNOWELEDGEMENT

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