IQ-LEACH Protocol for energy minimization using Probabilistic model for Wireless Sensor Network

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ABSTRACT
The proper utilization of energy is major issue in wireless sensor network. The process of path discovery and data transmission acquired more energy and the life of network is expiring. For the improvement of life of wireless sensor network used energy based routing protocol is used. The proposed method made in two factor one is measurement of power during formation of cluster head and in second phase used the process of data aggregation with sensor node. The deployment model of sensor node is distributed in different section. The distribution of these sensor node in random fashion according to mobility model of senor network. Our empirical evaluation of result shows that the modified protocol M-Q-LEACH is very efficient in compression of LEACH and Q-LEACH. The process reduces the consumption of energy about 45%.

Keyword: - WSN, LEACH, SPIN, EAR, Q-LEACH.

INTRODUCTION
WSN is a popular and have capability to high penetrate with several applications areas. It consists of small nodes having limited sensing, computation, and wireless communications capabilities. A typical WSN usually consists of a large number of sensors, which are distributed over a given area and generate local observations, together with a fusion center (FC), where messages from sensors are decoded to reach a global decision. When the sensors and the FC are connected by wireless links, energy efficiency is one of the key issues for designing high performance WSNs. Wireless Sensor Networks are grossly employed in applications like environmental monitoring (for pollution and species monitoring), physiological monitoring, medical diagnosis (for computer aided detection of brain tumor, cardiovascular disorders & breast cancer renewable energy generation etc. . To optimize the usage of WSNs for various applicative trends, energy consumption forms the major cause of concern due to the energy consumed during transmission of data. This is so, because WSNs are mostly used in such areas where human approach is nearly impossible; and non-rechargeable batteries of sensor nodes cannot be recharged which leading to network failure.

The usual topology of wireless sensor networks involves having many network nodes dispersed throughout a specific physical area. There is usually no specific architecture or hierarchy in place and therefore, the wireless sensor networks are considered to be ad hoc networks. An ad hoc wireless sensor network may operate in a standalone fashion, or it may be connected to other networks, such as the larger Internet through a base station. Base stations are usually more complex than mere network nodes and usually have an unlimited power supply. Regarding the limited power supply of wireless sensor nodes, spatial reuse of wireless bandwidth, and the nature of radio communication cost which is a function of the distance transmitted squared, it is ideal to send information in several smaller hops rather than one transmission over a long communication distance. Wireless Sensor Networks (WSN) is one of emerged technology that is being rapidly adopted due to their flexibility and use in a various environments. Networks protocols in WSN have to achieve fault tolerance whenever individual node is failed and energy consumption [5] as to be reduced. Moreover the routing protocols in WSN should have capability to perform local collaboration to reduce the bandwidth requirements, since the channel bandwidth is shared among all the sensor nodes in the network. WSN's are one of best technology for monitoring critical situations and remote fields which far away from the human perspective. Network lifetime can be defined as the time elapsed until the first node (or the last node) in the network depletes its energy (dies). For example, in a military field where sensors are monitoring chemical activity, the lifetime of a sensor is critical for maximum field coverage.

Sensor networks may consist of different types of sensors such as thermal, infrared, acoustic, magnetic, visual and seismic, to monitor a wide variety of conditions such as temperature, lighting conditions, noise levels, vehicle movement, presence or absence of objects and soil movement. The range of use of sensor nodes vary from event detection to continuous sensing to local control of actuators. Wireless sensor networks are usually deployed in inaccessible or remote locations and are often unattended. Despite the numerous applications of wireless sensor networks, these networks have several limitations such as limited energy supply, limited bandwidth of the wireless link and limited processing power. The ability to execute data communications while trying to prolong the lifetime of the network and also prevent connectivity degradation is a difficult task.

II SENSOR PROTOCOLS FOR INFORMATION VIA NEGOTIATION (SPIN)

SPIN is a family of adaptive protocols that disseminate the information at each node to every node in the network assuming that all nodes in the network are potential base stations. These nodes use the assumption that nodes in close proximity of each other have similar data and as such, only data that other nodes do not posses need to be distributed. Nodes assign a high level name to describe their data completely (called meta-data) and perform metadata negotiation before any data is transmitted. This ensures that no redundant data are sent throughout the network. The semantics of the meta-data format is application specific and not specified in SPIN. The SPIN family of protocols is based on two basic ideas. First, to operate efficiently and conserve energy, sensor applications need to communicate with each other about the data that they already have and the data they still need to obtain. Exchanging data about the sensor data requires less energy than exchanging all the sensor data. Secondly, nodes in the network monitor and adapt to the changes in their own energy sources to extend the operating life of the network.

DIRECTED DIFFUSION

A data aggregation model for a wireless sensor network called directed diffusion. The main idea of this model is to dispose of unnecessary network operations through combining the data coming from different sources en route, eliminating redundancy, minimizing the number of transmissions, thereby saving energy and prolonging the network lifespan. Directed diffusion is a data-centric and application aware model in the sense that all data generated by sensor nodes is named by attribute-value pairs such as name of objects, interval, duration, geographic location etc. Each node receiving the interest can cache the interest for later in-network data aggregation. The interests in the caches are compared with the received data with the values of the interest. This enables diffusion to achieve energy savings later by selecting empirically good paths. As the interest propagates through intermediate nodes in the network, gradients are set up to draw data satisfying the query toward the requesting node (e.g., NE). Each sensor node that receives the interest establishes a gradient toward the sensor node from which it received the interest. This process continues until gradients are built from the source back to the base station.

ENERGY AWARE ROUTING (EAR)

Energy aware routing is a variant of directed diffusion and is intended to increase the lifetime of the network. It differs from directed diffusion in that it maintains a set of sub-optimal paths instead of maintaining or enforcing one optimal path at a higher rate. These paths are maintained and chosen by a certain probability. The value of this probability is determined by how low an energy consumption each path can achieve. Always using the minimum energy path all the time will deplete the energy of the nodes on that path. Hence, by having multiple paths that are chosen at different times, the energy of any single path will not be depleted quickly. This can achieve longer network lifetime as energy is dissipated equally among the nodes. The protocol assumes that each node is addressable through class-based addressing that includes locations and types of the nodes. The protocol initiates a connection through localized flooding, which is used to discover all routes between source and destination pairs and their costs, building routing tables. High cost paths are discarded and a forwarding table is built by choosing neighboring nodes in a manner proportional to their cost. Node selection is done according to the closeness to the destination and each node assigns a probability to each of its neighbors in the forwarding table which corresponds to the formed paths. Each node randomly selects a neighbor node from its forwarding table to send data to the destination with the probability inversely proportional to the node cost. Route maintenance is achieved through periodic localized flooding to keep the paths alive.

III LEACH (LOW-ENERGY ADAPTIVE CLUSTERING HIERARCHY)

LEACH [10] is a cluster-based wireless sensor networking protocol. LEACH adapts the clustering concept to distribute the energy among the sensor nodes in the network. LEACH improves the energy-efficiency of wireless sensor networking beyond the normal clustering architecture. As a result, we can extend the life time of our network, and this is the very important issue that is considered in the wireless sensor networking field. In LEACH protocol, wireless sensor networking nodes divide themselves to be many local clusters. In each local cluster, there is one node that acts as the base station (or we can call it “cluster-head”). Hence, every node in that local cluster will send the data to the cluster-head in each local cluster. The important technique that makes LEACH be different from the normal cluster architecture (the drain the nodes battery very quickly) is that LEACH uses the randomize technique to select the cluster-head depending on the energy left of the node. After cluster-head is selected with some probability, the cluster-heads in each local cluster will broadcast their status to the sensor nodes in their local range by using CSMA MAC protocol. Each sensor node will choose a cluster-head that is closest to itself to join that cluster because each sensor node will try to spend the minimum communication energy with it cluster head. After the clustering phase is set up, each cluster-head will make a schedule for the nodes in its cluster. In paper LEACH, TDMA is used. For more efficiency, each sensor node could turn-off waiting for their allocated transmission. Cluster-heads will collect the data from the nodes in its cluster, and compresses that data before transmits the data to the base station. By following this protocol, the base station will get the data from all sensor nodes that we are interested, and ready for the end-user to access the data.

IV PROPOSED METHOD

In this section discuss the improved protocol of Q-LEACH protocol. The Q-LEACH protocol not measures the prior knowledge of cluster head selection during transmission of data for base station. The selection of cluster head process done by using EM estimation technique. The EM technique estimates the energy level and consumption level during transmission and selection of cluster node in individual cluster group. The process of individual group of node for selecting the cluster head depends on minimum energy

required for the formation process. Now process of that reduces the energy consumption and increase the life time of the network. In each area of cluster head selection using the grouping of node using estimation of maximum entropy for the generation of information during selection of cluster head and data aggregation for the transmission of data form sensor node to base station. The working algorithm discuss in two phase in first phase discus the estimation technique of energy and second phase discuss the process of data aggregation of algorithm.

➢ The process of energy estimation and relation of network estimation function

The selection of cluster head node and network relation define in four quadrature in such a manner is U,Z,V,W. the process of distribution an collection of node information derive the equation such as

$$EM(U,Z,V,W) = \sum_{l=1}^{k}\sum_{i=1}^{n}\sum_{t=1}^{T}\sum_{j\in Gi}^{1} uiwtvjd(xij,zij) + n\sum_{j=1}^{m} vjlog(vj) + \lambda\sum_{t=1}^{T} wtlog(wt) \ldots\ldots(1)$$

Subject to the level of energy function realized in the selection area

$$\begin{cases} \sum_{i=1}^{k} ui.l = 1, ui,l \in (0,1), 1 \le i \le n \\ \sum_{t=1}^{T} wt = 1, 0 \le wt \le 1, \quad \ldots\ldots(2) \\ \sum_{j\in Gi} vj = 1, 0 \le vj \le 1, 1 \le t \le T, \end{cases}$$

Where

U is a area of cluster and I,J is the location of node.

Z={Z1,Z2,…….,Zk} is a set of optimal set of sensor node whose energy function is minimum.

W={W1,W2,……..Wt} are T weight for T cluster head of minimum energy.

V={v1,v2,……vm} are sensor power level.

d(xij,zlj) measure the power level of two different cluster head.

$d(xij ,zlj)=(xij-zlj)^2$…….(3)

if the selected node is minimum power consumption then sensor node select form the random fashion

d(xij,zlj)={0 (xi.j=zl.j)……..(4)

1 (xi.j=/zl.j)

➢ Node Association in M-Q-LEACH

area = (V, E) ←assigned sensor node //initialize network

NP_area ← EM (U,V,W,X) //estimated sensor node value

for h ∈ N P_area do

h.nn ← selection_group (NP_area - {h})

h.sc ← Compute-SC (h, h.nn) //energy coefficient

V←V ∪ {h} //add these nodes

V←V ∪ {h.nn}

if h.sc < th_{sc} then //relatively closer to the cluster head

E←E ∪ {(h,h.nn)} //add this into cluester head

endif

end for

1. count ← list_area (U,V,W,X) //find all bidirectional area of network

// selection phase

for each group of node (g1,g2) ∈ G(U,V,W,X) do

μ_1←mean-energy (g1), μ_2←mean-energy (g2)

if $\frac{\mu_1+\mu_2}{2*selection\_energy(g1,g2)} > 1$ then g1←select(g1, g2)

end for

// Now assign the cluster head

NP_area ← EM (U,V,W,X)

for x ∈ Emin do

h ← selectof (x)

N_type ← N_type ∪ {(x, h.area)}

end for

V EXPERIMENTAL RESULT AND ANALYSIS

The proposed model of M-Q-LEACH written in C++ script language and scenario of network generated by TCL (tool command language), both C++ and TCL command provided by NS-2.35 simulator. NS-2.35 well knows research software of wireless network. The evaluation of performance of our proposed methodology in two parameter throughput of network and packet dropping of network.

Simulation Parameters

Table 1 lists the simulation parameters, their values and description of these parameters used in the simulation.

Parameter	Value	Description
Environment size	100 * 100 ms	Area of simulation
Base sation location (x,y)	50,170	
Node types	Mobile node	Relative load due to traffic.
Node speed	30m/s,40m/s,50m/s	Mobility time of node
Packet type	TCP/UDP	Application load
Packet size	500 bytes	load
Base node node	2	
Simulation time	200	Total time
Receiver node	one	Single destination

Table 1: Simulation Parameters.

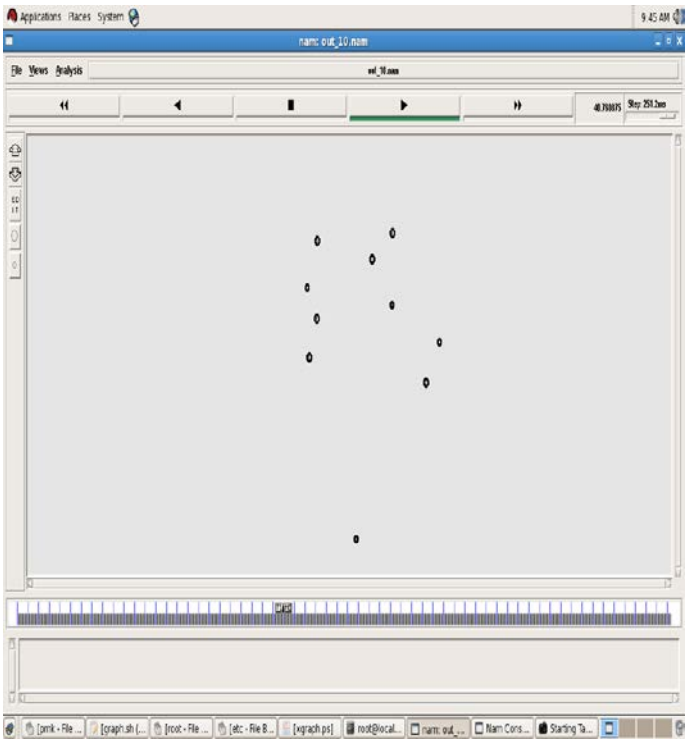

Figure 1: shows that simulation scenario of 10 node for the performance evaluation of LEACH, Q-LEACH and M-Q-LEACH

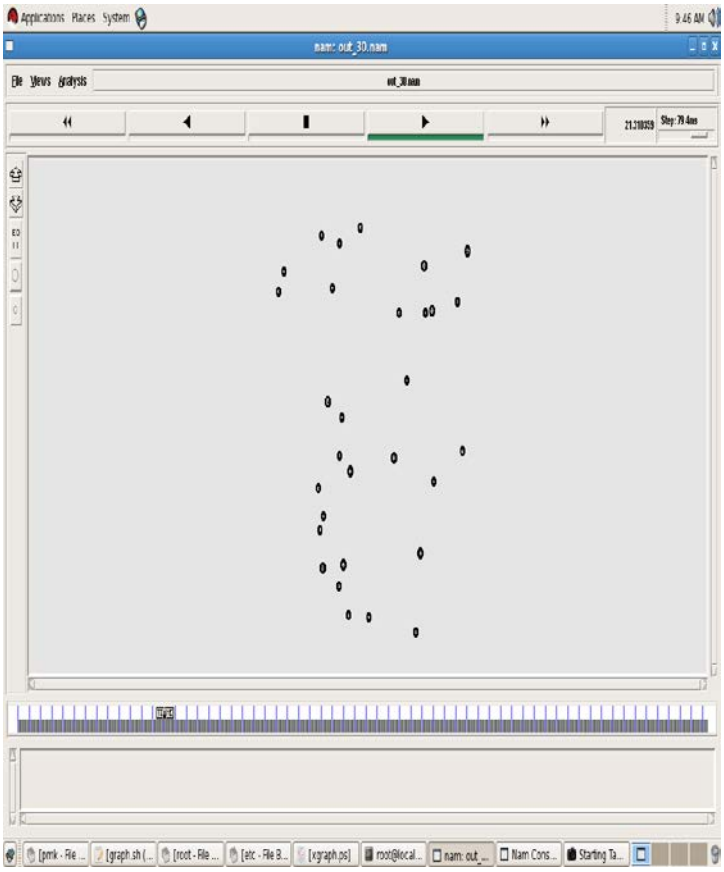

Figure 2: shows that simulation scenario of 30 node for the performance evaluation of LEACH, Q-LEACH and M-Q-LEACH

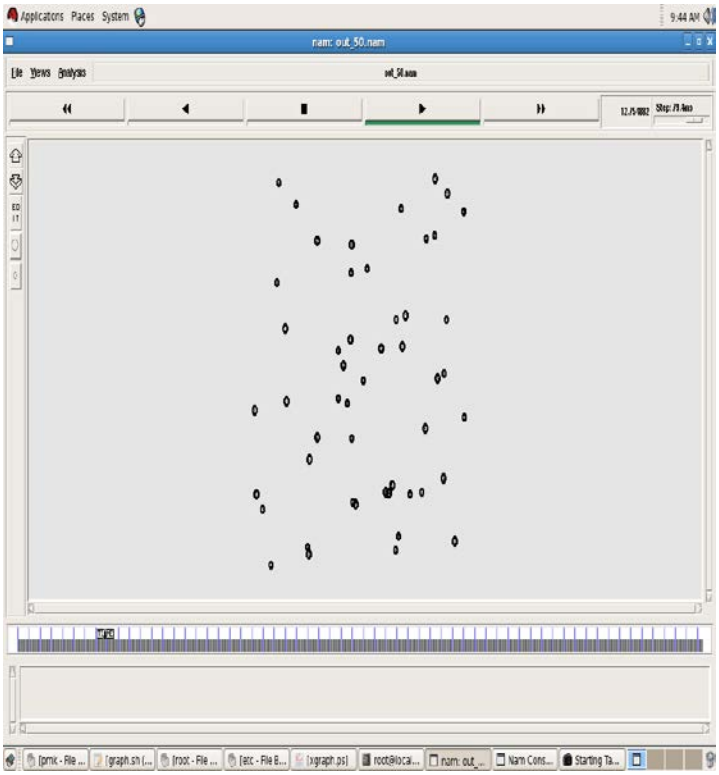

Figure 3: shows that simulation scenario of 50 node for the performance evaluation of LEACH, Q-LEACH and M-Q-LEACH

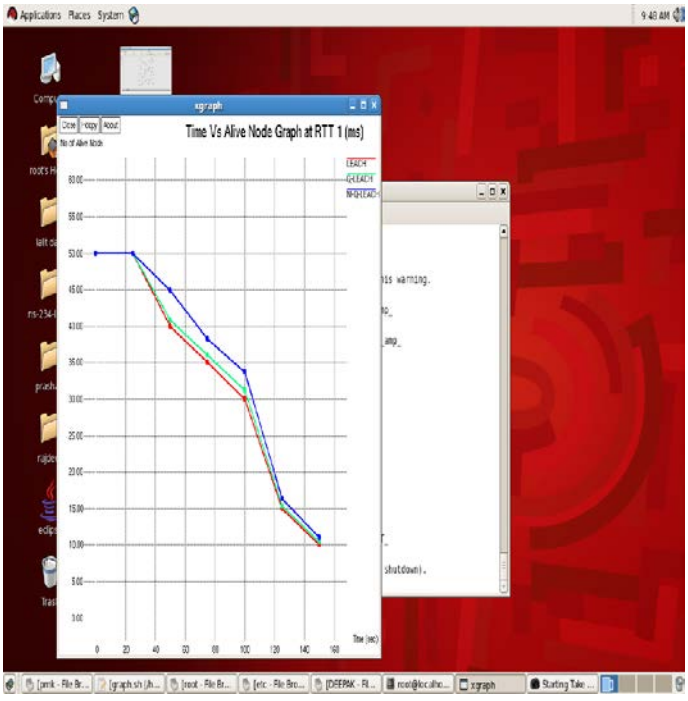

Figure 4: shows that simulation result of time with number of node alive. The LEACH protocol consumed more time in compression of Q-leach protocol and in case of M-Q-LEACH the node alive time period is increases almost 30% in compression of pervious protocol for this used round trip time is 1.

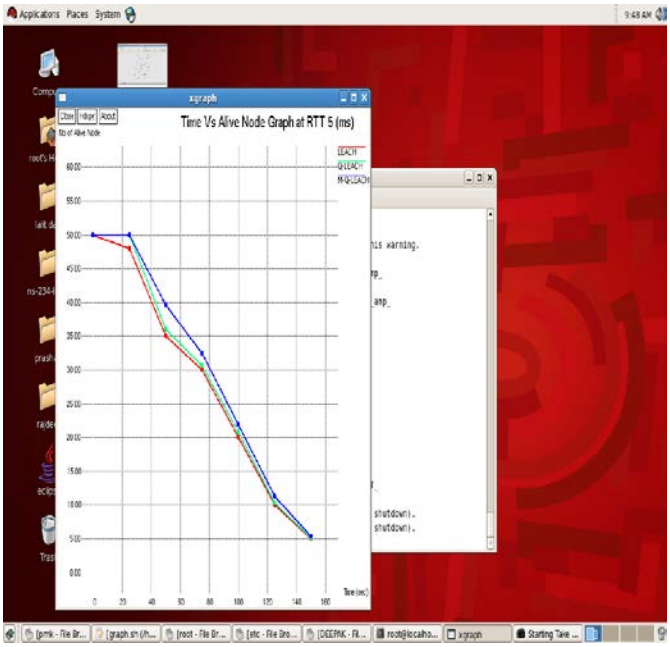

Figure 5: shows that simulation result of time with number of node alive. The LEACH protocol consumed more time in compression of Q-leach protocol and in case of M-Q-LEACH the node alive time period is increases almost 32% in compression of pervious protocol for this used round trip time is 5.

VI CONCLUSION AND FUTURE WORK

This paper provides minimization of energy for wireless sensor network in concern of power consumption and life time of network. The proposed models give a better energy utilization factor for wireless sensor network. The proposed model M-Q-LEACH implies in two section one is base node and another node as sensor. The sensors end request for communication for next node in installed location of BS.
Now exploding of this works and optimized the process of reference node allocation and reduces the capacity of memory for the expanding of power allocation.

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