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Performance Evaluation of Energy Efficient Routing Protocols in WSN

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Abstract

There has been ample amount of importance in developing and deploying wireless sensor networks. The Wireless Sensor Networks have been a collection of a large number of nodes, and they have to execute the router function too. The overall lifetime of a Wireless Sensor Network is depending on the enduring energy level of its nodes. Energy consumption of these sensor nodes is important aspect as the power supply of the node is provided by restricted batteries, which frontier the lifetime of the connection in addition to whole networks. The energy handling of network sensor node is severe subject for long lifetime of the network. As the nodes acting like routers, the choice of routing algorithm would be a solution in the energy consumption control. In this survey paper we have analyse of various research effort related to Energy Efficient Routing in Wireless Sensor Networks in order to plan an energy efficient path routing protocol for WSNs.

I. INTRODUCTION

There are various routing protocols in sensor networks that exploit the available resources at sensor nodes more efficient way. These protocols are usuallyattempt to find out the path with minimum energy for optimizing the energy usage at the nodes. Repeatedly using least energy paths may not be perfect from the network lifetime viewpoint and for long-term connection. Network availability is a metric that is more useful for recovering the enhanced energy based routing protocol. The protocol should confirm that, the connection is preserved as far as possible in a network, and the energy level of the whole network would be in an almost equal range. This is a condition which is different to the energy efficiency routing protocols which will find the best paths from the source to the destination and then decrease the nodes energy along that path.

A. Wireless Sensor Network

A wireless sensor network consists of distributed independent sensors those jointly watch the physical and environmental situations such as sound, temperature, vibration, motion, pressure or pollutants. In sensor networks are the surroundings is required to be distantly monitored, the data from the individual sensor nodes is sent to a base station, through the end-user nodes can access data.

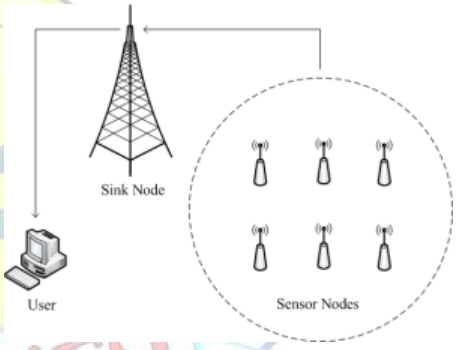

Figure 1: Wireless Sensor Network

Characteristics of Wireless Sensor Networks:

- Ease Of Use
- Large Scale Deployment
- Power Consumption

B. Energy based Routing in WSN

Wireless Sensor Node are planned for watch an environment. The main goal of a WSN is to gather data from a certain domain, forward it to the sink node. Assuring the direct communication between a sensor and the sink may drain the nodes' power very quickly, as of higher energy requirement in transferring messages. So, it is sometimes required that the nodes are work together to ensure communication of distant nodes with the sink. In this way, messages are propagated through intermediate nodes by establishing a route to the sink.

C. Routing Protocols

There are some issues in the design of routing protocols for WSNs because of several limitation in the network. WSNs practice from the limitations of several network resources for example, energy, bandwidth, computation power and storage. The design challenges in sensor

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networks involve the following key aspects:

Energy

The sensor nodes are battery powered, so limited energy capacity, energy is a big challenge for the network designers in hostile environments. For example, in a battlefield, it is about impossible to access the sensors and recharge their batteries. Another challenge that is faced during the design of routing protocols is to manage the locations of the sensors. The majority of the protocols assume that the sensors either are equipped with GPS receivers or use some localization technique to learn about their positions.

Hardware Resources

The processing and storage capacities of sensors are also limited as the energy capacity. Thus, they can only perform limited computational functionality. These constraints give rise to many challenges in network protocol design for WSN, which must consider not only the energy efficiency of sensor nodes, but also the processing power and storage capacities.

Random Node Deployment

Sensor node deployment in WSNs is application dependent and affects the performance of the routing protocol. Sensor nodes could be scattered randomly in a specified area or dropped massively over a remote or hostile region in most of the applications. When the resultant distribution of nodes is un-uniform, optimal clustering helps in connectivity and enabling energy efficient network operation.

Data Aggregation

Sensor nodes may generate significant redundant data. Similar packets from multiple sensors can be aggregated to reduce number of transmissions. Data aggregation methods are used to achieve energy efficiency and to optimize data transfer in the routing protocols.

Diverse application requirements

WSNs have a wide range of applications each having different requirements. No network protocol can meet all the requirements of every application. Hence, routing protocols should guarantee data delivery and its accuracy to provide the sink with the required knowledge about the physical and environmental condition on time.

Scalability

Routing protocols should be capable of scaling with the network size. Also, sensors need not necessarily have the same capabilities in terms of energy, processing and communication. Consequently, communication links between sensors may not be symmetric (i.e. a pair of sensors may not be able to have communication in both directions). This should be taken care of in the design of routing protocols.

II. LITERATURE SURVEY

Ahmad, A., Latif, K. Javaid N. Khan investigated on Cluster based routing method is most popular routing method in WSNs. Due to varying need of WSN application efficient energy use in routing protocols is at rest a potential field of research. In this research authors introduced new energy efficient cluster oriented routing method. This method is used to overcome the basic difficulty of coverage hole and energy hole. In their method they have controlled these problems by introducing density controlled uniform distribution of nodes and fixed optimum number of Cluster Heads in each round. At the last authors had verified their methodology by simulation results in MATLAB.

Beiranvand, Z., Patooghy, A., Fazeli, M., [2] worked on large amount of energy on nodes of a WSN is consumed owing to the inner-network communications. An energy efficient routing algorithm is proposed which saves a important part of inner-network communications energy. The proposed routing method selects the sensor nodes with higher residual energy, extra neighbors, and lower distance from the Base Station as Cluster Head nodes. When, it manages sensor nodes suitably and constructs clusters this way to maximize WSN lifetime and reduce average energy dissipation per every sensor node. To approximation the proposed routing method, the proposed routing method has been compared with the previous proposed algorithms for example LEACH, DBS, and LEACH-C algorithms. Results of the simulation show that the proposed routing scheme has been improved the WSN act at least 65%, reduce the energy consumption of the WSN up to 62%, & improve the effectively delivered packet ratio at least 56% as compared to the previous routing scheme.

Lohan, P. and Chauhan, R., [3] presented the Geography-Informed Sleep Scheduling and Chaining Based Routing (GSSC) algorithm in wireless sensor network. As sensor nodes are energy constraint, the network lifetime by utilizing the energy of nodes very efficiently. GSSC saves energy by finding out equivalent nodes from routing perspective by using their geographical information the nodes, it sense almost same information and then turning off unnecessary nodes to remove data redundancy. To reduce the energy consumption of communication in network they use chaining based routing scheme to route the sensed data from active nodes to the base station. This chaining has been based data routing can reduce energy consumption of data transmission with the help of multi-hop routing concept. Our simulation results (using MATLAB) show that in comparison of very famous routing protocols like LEACH and PEGASIS, that algorithm has achieved significant increment in network lifetime.

Fareed, M.S., Javaid, N. and Ahmed [4] worked on the advent and development in the field of Wireless Sensor Networks in recent years has seen the growth of extremely small and low-cost sensors that possess sensing, the signal processing and the wireless communication capabilities. The sensors can be expended at a much lower cost and are capable of detecting conditions such as temperature, sound, security or any other system. Authors have compared six different protocols of different scenarios which are presenting their own schemes of energy minimizing, the clustering and route selection in order to have more effective communication. This work is to have an insight that which

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of the under consideration protocols suit well in which application and can be a guide-line for the design of a more robust and efficient protocol. MATLAB simulation results are performed. Sathian, D., Baskaran, R. and Dhavachelvan [5] worked for Energy-constrained WSN has attained considerable research concentration now days and requires robust and energy efficient routing protocols for communication in fading environments to minimize the energy consumption. To moderate the fading effects in the wireless channels, MIMO method is utilized for energy efficient communication system and to route the data in WSN. The cluster head nodes can cooperate the transmit data cooperatively before selecting the cooperative sending and receiving groups in each cluster. The theory has been used to elect healthier cluster heads having enough residual energy and high faith level. The theory has been used to select the cooperative nodes for MIMO communication. The outcome show that the CH-CTEEM routing algorithm provides more than 50% increase in residual energy as compared to TEEM.

III. SYSTEM DESIGN

Task is to study and compare various routing algorithms used in Wireless Sensor Networks, clubbed with some placement algorithms such that they can address the following problem: Given a remote rectangular field, the task is establish a sensor network, having its base station at centre, with some sensor node placement and following a certain routing protocol, such that it can monitor fixed or randomly generated targets and report the targets to the base station, consuming less power & maintenance and without compromising with the performance.

The objective of this project is to develop a new clustering algorithm for WSN, improving on the existing LEACH Algorithm and its variations to outperform:

- The network life time
- Consumption of energy in the network
- Number of data received at the BS.

A. *Method #1: A-LEACH*

Ring Routing is a hierarchical routing protocol for large scale WSNs organized outside with static sensor nodes and a mobile sink. Ring Routing protocol first construct a virtual ring structure that allows the fresh sink position to be easily delivered to the ring and sink nodes to obtain the sink position from the ring with minimal overhead whenever needed.
The ring structure can be easily changed. The ring no des are able to change roles with regular nodes by a dire ct and well-organized mechanism, thus modifying the hotspot difficult.
Benefits of A-LEACH:

- Dynamic changing of ring structure will provide the efficient accuracy.
- Moderate cost for implementing mobile sink.
- Most secure and efficient communication.

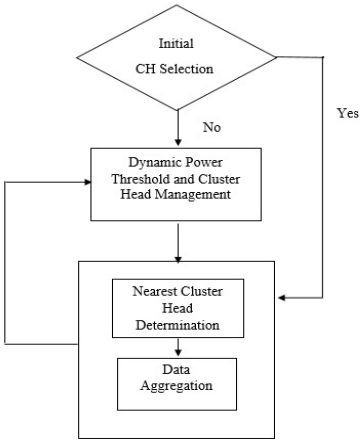

Figure 2: A-LEACH Methodology

Load Finder

I. Multipath Routing Algorithm for wireless sensor network finds the node disjoint routing path similar to mazing search.
II. It reduces the energy consumption and congestion.
III. It introduces Multi path selection strategy to balance the load in the network.
IV. The bandwidth is utilized efficiently for transmitting packets.

B. *Method #2: Mobile Crowdsensing (MCS)*

This paper proposes a novel Mobile CrowdSensing(MCS) framework, which intends to reduce energy consumption of individual user as well as all participants in data transfer caused by task assignment and data collection of MCS tasks, considering the user privacy issue, minimal number of task assignment requirement and sensing area coverage constraint.

The mobile crowd sensing system includes the following components: a huge number of mobile participants who are willing to perform sensing tasks assigned to them, a set of crowd sensing applications who are continuously generating crowd sensing tasks and looking for sensing data from assigned participants, and the proposed participant recruitment component which dynamically decides particular participants for each sensing task. Figure 3 illustrates the overall framework. In this paper, we assume that the task assignment can be sent to each selected participant via cellular service at any time, while the sensing data collected by selected participants will be piggybacked to the mobile crowd sensing system as in. Therefore, we will only focus on the participant selection process.

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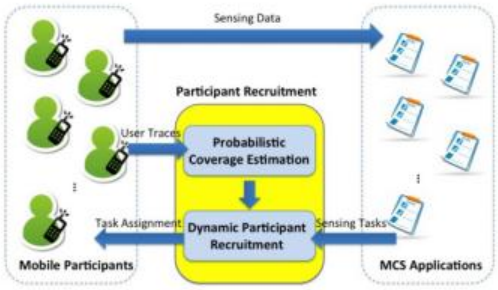

Figure 3: Mobile Crowdsensing

In this survey, we focus on a new dynamic recruitment problem for heterogeneous mobile crowd sensing tasks, with a goal to minimizing the sensing cost while satisfying certain level of coverage. Unlike other existing works, the sensing tasks in our proposed scenario can have different starting time and life time.

C. *Method #3: Load Balancing System*

Clustering and Load Balancing in Hybrid Sensor Network with mobile Cluster Node, has proposed an algorithm that consider the problem of positioning mobile cluster heads and balancing traffic load in hybrid sensor network which consists of static and mobile nodes. It is stated that the location of the cluster head can affect network lifetime significantly. Network load can be balanced and lifetime can be prolonged by moving cluster head to better location.
A Load Balanced Clustering Algorithm for Heterogeneous Wireless Sensor Networks, has Proposed the load balanced group clustering to balance the battery power in wireless sensor network by implementing dynamic route calculation according to the condition of energy distribution in the network. It make use of heterogeneous energy to realize load balance.

Fuzzy Based Approach for Load Balanced Distributing database on Sensor Networks has proposed fuzzy based approach for load balanced distributing database on sensor network that prolong the network lifetime. In this algorithm vertical partitioning algorithm for distributing database on sensors is used. In this approach, first clusters are formed and then distribute partitions on clusters.

Figure 4: Load Balancing System

IV. PERFORMANCE EVALUATION

Ring Routing has the best performance in all cases. LBDD performs better than Mobile CrowdSensing and LBS for sink speed.

A. *Packet Delivery Ratio*

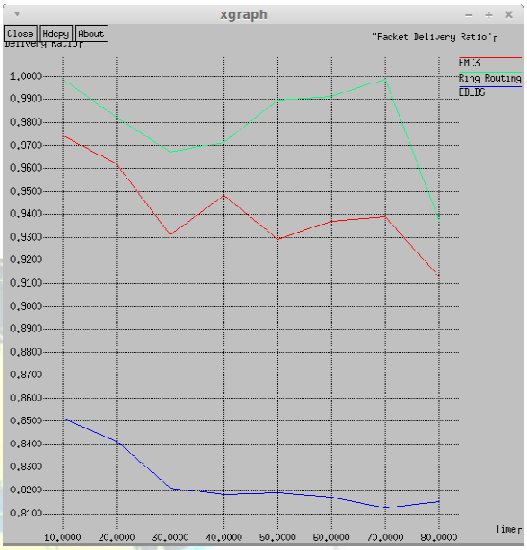

Figure 5: PDR Graph
PDR = Rec_Data / Sen_Data

B. *Communication Overhead*

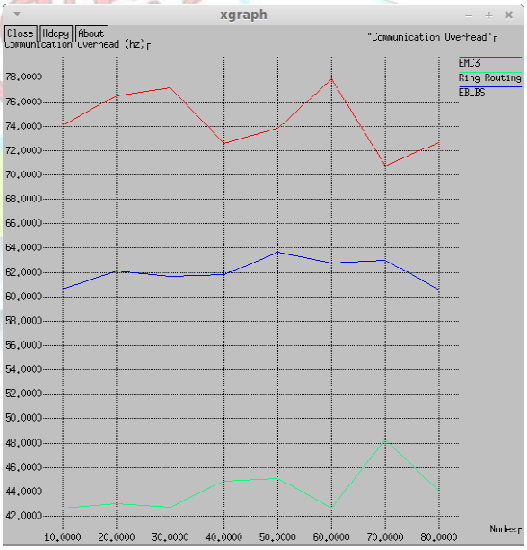

Figure 6: Communication overhead graph

: Effect on communication overhead with increase node count.

$$C(p)-C_r(p)=1-h(p)-\frac{1}{2}h^{(3)}\left(\frac{1}{2}-p(1-p),\frac{1}{2}-p(1-p)\right)+\frac{1}{2}h^{(3)}(p^2,(1-p)^2).$$

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C. Data Delay

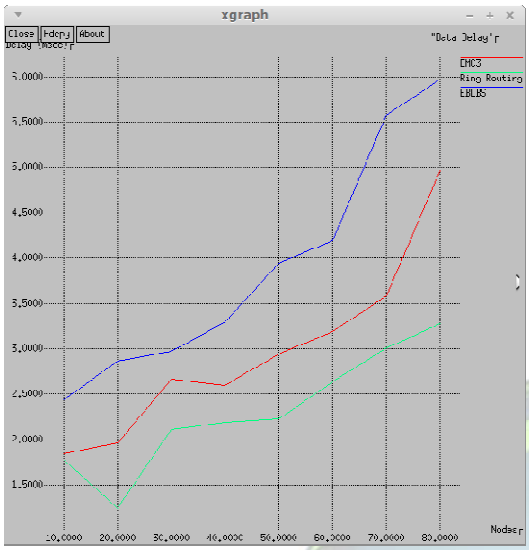

Figure 7: Data delay graph

D. Average Energy Consumption

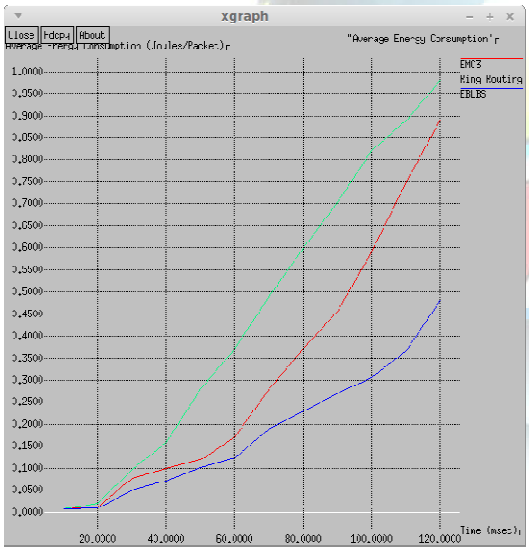

Figure 8: Energy Consumption graph

V. CONCLUSION

In this survey work we analyzed the sensors nodes in WSNs have got only limited sources of energy and computing. The main limitation of these networks is the amount of energy consumption. The lifetime of a Wireless Sensor Network depends on its node's energy level. In most of sensor networks there is no way to recharge node's battery because of its unattended nature; therefore efficient use of the available energy sources of the node is vital. The routing protocol must consider the link quality and the possible interference and the noise level of the link before selecting a next hop node for communication.

Wireless Sensor Networks, which may be spread over a vast geographical area, have their applications in many fields. There is a need of approaches which can manage these WSNs in a better way possible.

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