Review of Lifetime Maximizing Approaches for Wireless Sensor Network

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***Abstract*— The field of wireless sensor networks is booming field nowadays. It combines sensing, processing, and communication into a single tiny device. This technology can be seen everywhere in this world within few years. Using this knowledge many applications are imaginable like home automation, health monitoring, traffic, security monitoring and many more. The main purpose of sensor nodes is to detect event and inform to sink node. This transmission of data must consume minimum amount of energy to maximize lifetime of WSN. Minimum consumption of battery increases lifetime of network. In this paper we discuss the different approaches to maximize the life of WSN.**

Index Terms: Backbone, Clustering, Energy Efficiency, MNMU, Sleep scheduling, Wireless Sensor Networks (WSNs)

I. INTRODUCTION

A. Wireless Sensor Network

A Wireless Sensor Network is a collection of sensor nodes which are organized in network as co-operative manner. Each sensor node has processing capacity (Microcontroller, CPU), memory (flash, data memory), transceiver (antenna), power (battery, solar cells). These nodes are deployed to monitor physical or environmental conditions, like temperature, moisture, sound, etc.

Basically sensor network research is initially motivated from military applications such as battlefield surveillance and enemy tracking. But today there are different applications in civil area also like habitat monitoring, environmental condition monitoring such as temperature, moisture, health monitoring, irrigation and many more. To measure properties of the environment different mechanical, thermal, biological, chemical and magnetic sensors may be attached to the sensor node. Since the sensor nodes have limited memory and are typically deployed in area which is difficult to access, a radio is implemented for wireless communication to transfer the data to a base station. Battery is the only power source in a sensor node. Secondary power supply may gain power from the environment such as solar panels may be added to the node depending on the appropriateness of the application or environment where the sensor will be deployed.[1]

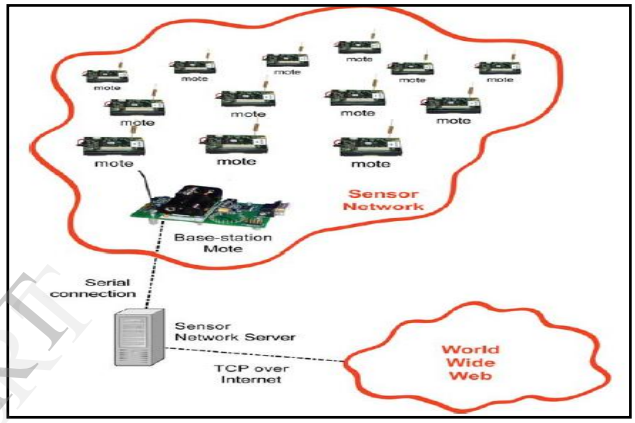

Fig.1 Basic WSN Architecture

There are two types of WSNs: structured and unstructured. In an unstructured WSN there is a dense collection of sensor nodes. Sensor nodes may be deployed in an ad hoc manner into the field. Then network can be left unattended to perform monitoring and reporting functions. In an unstructured WSN, network maintenance such as managing connectivity and detecting failures is difficult since there are so many nodes.

In a structured WSN, all or some of the sensor nodes are deployed in a pre-planned manner. The advantage of a structured network is that fewer nodes can be deployed with lower network maintenance and management cost. [1]

There are some important characteristics common to all WSNs independent of the application they were developed for. The important ones to consider are:

- Each network has at least one base-station node, which must be connected to a server which is connected to the Internet.
- Each node is able to transmit and receive messages through radio frequency.
- Messages are passed to the base-station node using the multi-hopping communication method: packets are (re)routed through various (intermediate) nodes in order to reach the base-station node. This also

requires that all nodes have its unique identification code within the network.

- Generally the sensor nodes can be at any location, so networks can be queried according to geographical region rather than specifying a particular node.
- Each network is extendable and flexible. With the exception of the base-station node, any node can be added or removed from the network. Normally networks are composed of a large number of sensor nodes that are densely deployed either inside the area being monitored, or very close to it;
- Sensor nodes work cooperatively, using their computing power to carry out simple computations, and then transmit only the required data.[2]

B. *Need for maximizing lifetime of WSN*

Battery is the sole source of energy in WSN. It is impractical to replace or recharge a battery in the node as nodes are deployed at various location. In such conditions it is necessary to use power efficiently. For this purpose different techniques are used.

Efficient routing algorithms and scheduling techniques are proposed for maximizing life of WSN. These techniques extends life of WSN which results in more reliability, availability, QoS, etc.

C. *Research scope in increasing lifetime of WSN*

Many researchers proposed various techniques to prolong life of nodes. Sometimes efficient use of energy is achieved by compromising quality, reliability concerns. Mainly delay is compromised to achieve efficiency in energy consumption.

To balance the network quality improving factors, like delay, power consumption, reliability, QoS more research has to be done in this area. There is a need of more work in various techniques of scheduling and routing which will focus on these quality improving factors.

D. *Challenges in Wireless Sensor Network*

- *Power:* Power is always been a challenge for WSNs designs. One of the ways to maximize the network lifetime is to design the energy efficient algorithms and hardware that uses power efficiently.
- *Hardware Cost:* One of the main challenges is to produce low cost and tiny sensor nodes. Low cost of sensor nodes can be achieved by recent and future progress in the fields of MEMS.
- *Security:* Security is one of the major challenges in WSNs. Most of the attacks that are performed on WSN are insertion of false information by compromised nodes within the networks. Development of security schemes for WSN also faces challenges related to constrained environment.
- *System Architecture:* Researches in the field of WSN is going on around the world but still there is no unified system and network architecture, on the top of that different application can be built.
- *Real World Protocols:* Protocols need to be developed for real world problems considering the theoretical concepts and synthesizing novel solutions into a complete system wide protocol for real world application.
- *Analytical and Practical Results:* Till date very few analytical results exists for WSNs. All new applications only get confidence when it is tested & analyzed practically and results are compared with existing schemes.

II. REVIEW OF DIFFERENT APPROACHES FOR MAXIMIZING LIFETIME OF WSN

In [3] Sangeetha S, Ramalakshmi K have proposed an approach, to reduce the energy consumption in the network, it is using clustering technique. In this, the clustering operation includes two phases: Clustering Formation Phase and Clustering Eligibility Phase. In this technique group of nodes are called cluster.

Every cluster, checks neighbor's energy and choose high energy node, and announce it as a cluster head (CH). Receiving node verifies cluster head energy with its own energy. If it is less than it, convert it as a member. All the nodes in each cluster are supposed to convey the information to their respective cluster heads (CH) (see fig.2). Cluster head node is responsible for collecting the information, then it processes data and sends to the BS.

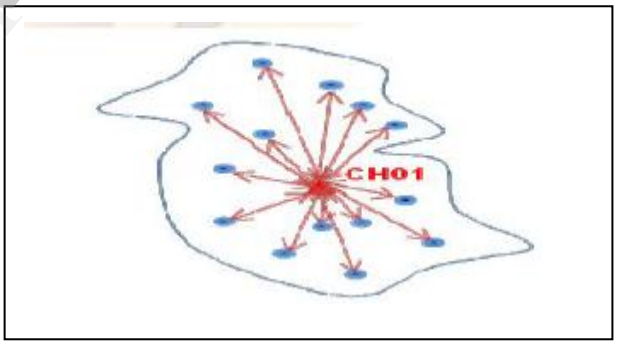

Fig. 2 Data communication between nodes and its cluster head

Therefore, the cluster head minimizes the number of active nodes, due to this it reduces the energy consumption in every node in the WSN. Specifically, some nodes are active whereas the others enter sleep state so as to save the energy. Clustering technique presents an original algorithm for each node can self scheduled to decide which ones have to switch to the sleep state. Cluster head nodes may be redundant for some rounds of operation. The residual energy at every node in the decision of turning off redundant nodes. Hence, the node with low residual energy has greater priority over its neighbors to enter sleep state. Significant energy savings can be achieved by sleep scheduling nodes activities in high-density WSNs. Clustering technique is one of the approach to minimize the number of active nodes in order to maximize the network lifetime, reduce the energy consumption, provide full coverage and saving the tremendous energy. The main

benefits of proposed scheme are that the energy consumption is reduced and better network lifetime can be carried out.

In [4] Hafiz Bilal Khalil, Syed Jawad, Hussain Zaidi, have proposed an approach which runs shortest path routing algorithm or link state routing to find the shortest path for each node in the wireless sensor network. Calculate all the possible shortest paths for each node. Then find the MNMU (Most Nearest Most Used) node (Fig.3). In above network model we assumed that sensed information is equally probable for all the nodes. Then we calculate the shortest path for the nodes A, B and C. Then we find out the nodes which are most nearest to the gateway node. In above network model there are only two nodes X and Y which are closer to the gateway node. Then for selection we give the preference to the node which is most used in shortest paths. In above model Y is node which is most used in all shortest paths. If nodes A, B and C transmit their data the entire time node Y will be included in their path. Then every node keeps its routes information towards the node Y for future communications.

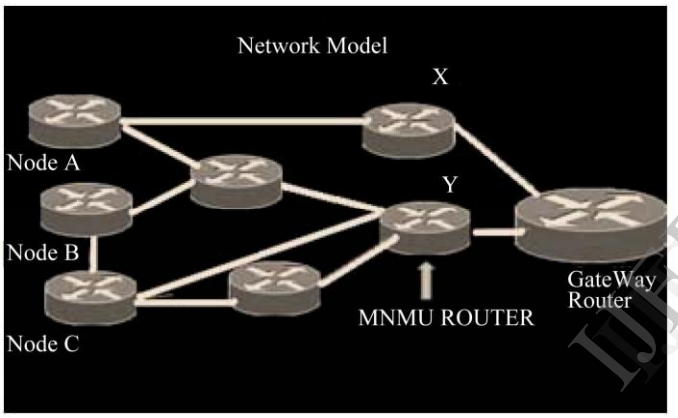

Fig 3. Location of selected MNMU node

In [5] Sasikala V, C. Chandrasekar have proposed an approach which states that an energy conservation is a key issue in the design of systems based on WSN. Clustering routing protocols have been developed in order to reduce the network traffic toward the sink and therefore increases the network lifetime. An alternative of clustering is to build chains instead of clusters (fig. 4). In this context, they propose a routing protocol for Wireless Sensor Networks (WSN). It is based on constructing multiple chains in the direction of the sink. The first node of each chain sends data to the closest node in the same chain. This latter collects, aggregates and transmits data to the next closest node. This process repeats until reaching the last node, which aggregates and transmits data directly to the sink. An improvement of this approach is proposed. It works as follows: In addition to forming multiple chains as previously, it constructs a main chain (fig. 5), which includes leader node of each chain. Since, initially all main chain nodes have the same amount of power, the nearest node to the sink aggregates data from others then transmits it to the sink. In the next transmission, main chain node having the higher residual energy performs this task. Compared with the first approach, simulation results show that improvement approach consumes less energy and effectively extends the network lifetime.

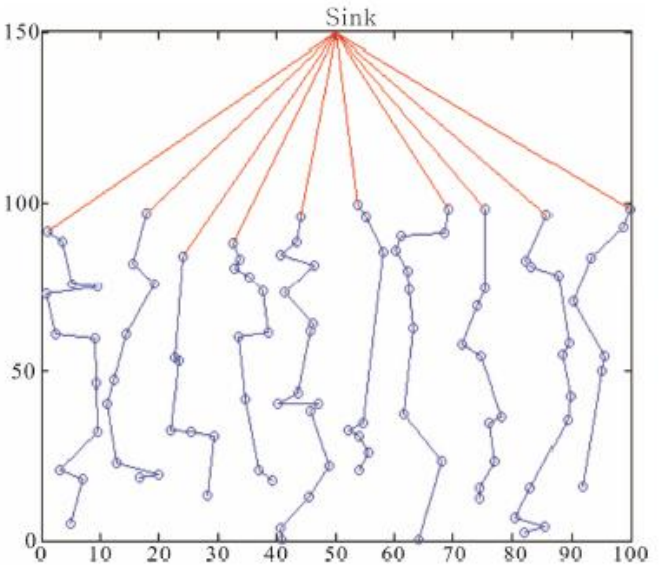

Fig. 4. Formation chains and ending transmission.

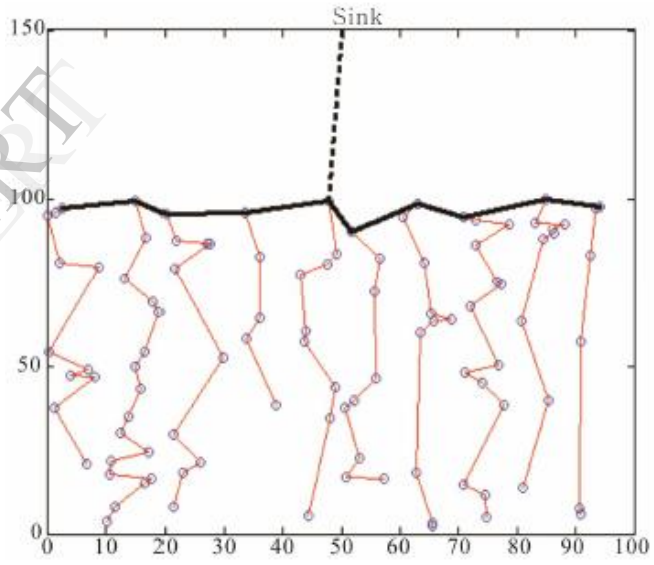

Fig. 5. Formation of Main chain

In [6] Ms. Neeraj, Ms. Monika, Gaurav, have proposed an algorithm to minimize delay in WSN for prolonging lifetime of WSN which is a combination of Bellman Ford algorithm and Multi hop routing. This deals with the minimum energy consumption.

In [7][8] Yaxiong Zhao and Jie Wu proposed virtual backbone scheduling (VBS), a combination of backbone scheduling and duty cycling method with redundancy for maximization of WSN lifetime. Design of two centralized algorithm and distributed implementation of VBS is given by them.

III. DISCUSSION AND REMARKS

Many researchers have worked or working on energy saving issue in WSN. Many of them introduced many techniques to achieve energy efficiency based on different approaches like clustering, chain based routing, sleep/wake-up scheduling, etc. Some of these techniques achieve energy efficiency by compromising with other quality factors like delay, reliability concerns.

IV. CONCLUSION AND FUTURE SCOPE

This paper gives review of various techniques to prolong the lifetime of the WSN. It focuses mainly on minimization of energy consumption and maximizing lifetime of WSN. Every approach discussed here has its own merits and demerits. But it will definitely help in further research in energy efficiency of WSN.

REFFERENCES

[1] *"ODBC Interface for Remote Sensor Network"* , COMP6720 eScience Project IV Research Plan Report, Jun Ma, University ID: u2581445, Supervised by: Dr Ken Taylor (CSIRO)

[2] Wireless sensor network survey, Jennifer Yick, Biswanath Mukherjee, Dipak Ghosal Department of Computer Science, University of California, Davis, CA 95616, United States

[3] " Clustering Approach For Maximizing The Lifetime Of Wireless Sensor Networks" Sangeetha S, (Department of Computer Science and Engineering, Karunya University, Coimbatore-641114, India), Ramalakshmi K(Department of Computer Science and Engineering, Assistant Professor, Karunya University, Coimbatore)

[4] MNMU-RA: Most Nearest Most Used Routing Algorithm for Greening the Wireless Sensor Networks, Hafiz Bilal Khalil, Syed Jawad Hussain Zaidi, School of Electrical Engineering & Computer Sciences, National University of Sciences and Technology, Islamabad, Pakistan.

[5] Cluster based Sleep/Wakeup Scheduling Technique for WSN Sasikala V Professor, DRBCCC Hindu College, Chennai, Tamil Nadu C. Chandrasekar, Ph.D, Associate Professor, Dept. of Computer Science, Periyar University, Salem – 636 011, Tamil Nadu, India.

[6] Ms. Neeraj, Ms. Monika, Gaurav, B.M.I.E.T, SONEPAT, "*Minimizing Delay and Maximizing Lifetime for WSN*", *Neeraj et al. / IJEA Vol. 2 Issue 7 ISSN: 2320-0804*

[7] Yaxiong Zhao, Jie Wu, *Fellow, IEEE*, Feng Li, *Member, IEEE*, and Sanglu Lu, *Member, IEEE, "*On Maximizing the Lifetime of Wireless Sensor Networks Using Virtual Backbone Scheduling*",* Transaction on parallel and distributed processing 2012.

[8] Shalini C. R, Nirmala. S, Dept. Of CSE AMC Engg. College, Bangalore, India, "*Virtual Backbone Scheduling For Balancing Energy Efficiency In Wireless Sensor Networks*", International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 7, July - 2013