Maximizing the Lifetime of Wireless Sensor Networks Using ERPMT

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***Abstract* — A sensor mote is a small node with the capabilities such as sensing computation, wireless communication. By networking large numbers of sensor nodes, it is possible to obtain data about physical and environmental phenomena. These networks work for very long duration from several months to years. In these applications, sensor nodes use batteries as the sole power source. Therefore, energy efficiency becomes critical issue. In this paper, I present a novel sleep-scheduling technique called Virtual Backbone Scheduling (VBS) in combination with Remote differential Compression (RDC) Algorithm and ERPMT (Efficient Routing Power Management Technique) method. VBS forms a multiple overlapped backbones which work alternatively to prolong the network lifetime. The rotation of multiple backbones makes sure that the energy consumption of all sensor nodes is equal and balanced. The RDC algorithm is used to compress the transmitting data along the backbone. ERPMT method is used to divide the node energy into two ratios one is self-generated data by node and other for the data obtained from other working sensor nodes which fully utilizes the energy and achieves a longer network lifetime compared to the existing techniques. The scheduling problem of VBS is formulated as the Approximation algorithm based on the Schedule Transition Graph (STG) is used to estimate the problem of maximum Lifetime Backbone Scheduling. Basically the comparison is made in between the power consumption of network with and without using the energy efficient routing power management method. The result can be shown by using NS2 simulator The performance is evaluated by considering the QoS parameters like data rate, packet loss ratio, throughput, delay, energy.**

***Keywords*— Virtual Backbone Scheduling (VBS), Schedule Transition Graph (STG), Efficient power management technic (ERPMT), Connection Dominating Set(CDS), Remote Differential Compression (RDC) Algorithm.**

I. INTRODUCTION

The WSN is built of "nodes" from a several hundreds to thousands, where each node is connected to other sensors. Each such sensor network node has typically several parts such as a radio transceiver with an internal antenna or connection to an external antenna, an analog to digital converter, an electronic circuit for interfacing with the sensors and an energy source, usually a battery. WSN has ability to monitor a wide variety of ambient conditions temperature, pressure,luminosity, Liquid level, Water Flow, Mechanical Stress level on attached objects.A sensor node might vary in size from smallest as grain of dust to largest as a metal box. The cost of sensor nodes is similarly variable, ranging from a few to thousands of dollars. Size and cost constraints of nodes result in corresponding constraints on resources such as energy, computational speed and communicational bandwidth. The Wireless Sensor Networks (WSNs), an efficient technology for various applications that involve long-term and low cost monitoring, such as battlefield reconnaissance, building inspection, security surveillance, etc. An Architecture of Wireless Sensor Network is given in fig.1. Several Sensor nodes are located spatially in particular area for monitoring the conditions regarding the appropriate target. One node collects the data and processes it and forwards it to next node. The gathering and propagation of data depends on the user. According to user request the data is collected and propagate from node to node to reach the user through the Base Station (BS). In most WSNs, the battery consumption of each node is equally important in order to calculate the network life time. Thus the only energy supply on which network resides has to consume properly and efficiently in order to provide larger life to the sensor network.

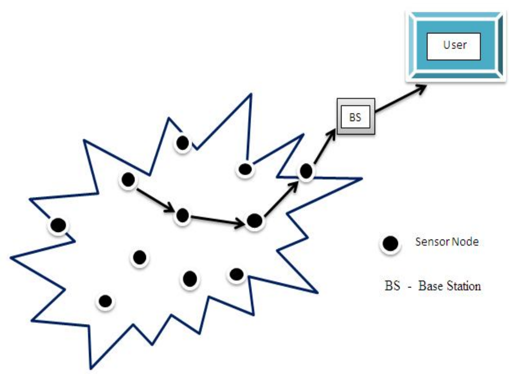

Fig.1 Architecture of wireless Sensor Network

Thus, power consumption becomes a critical issue in WSNs. Among the functional components of a sensor node, the radio consumes a major proportion of energy. Various techniques are proposed to minimize its energy consumption. The nodes which are idle consume same amount of energy as that of active node. Thus it is essential to save the energy at each node level. This paper focuses on Virtual Backbone Scheduling (VBS), which turns off the radio of the sensor nodes which are idle to save energy. Sensor nodes in a WSN turn on their radio to forward messages, which forms a backbone, the rest of the sensor nodes turn off their radio to save energy. VBS is implemented in combination with RDC Algorithm and ERPMT method to improve the performance of AODV Algorithm.

II. Literature Survey

The wireless sensor networks are new families of wireless networks which consist of many sensor nodes. These nodes are generally stationary and self-organized into a network. They perform certain task as sensing and sending the information to a control center or base station, where the end-user can retrieve the data[1]. One of the most popular hierarchical routing algorithms for sensor networks is low energy efficient Clustering (LEACH)[2]. The basic idea is to form clusters of the nodes based on the received signal strength and make use of local cluster heads as routers to the sink. since the transmissions will only be done by such cluster heads thus energy will be saved. As LEACH uses single-hop routing in which each node can transmit directly to the cluster-head and the sink. Therefore, it is not suitable for large sensor network. In Power Efficient Gathering in Sensors Information Systems (PEGASIS) [8] sensors form chains to transmit the data along the nodes and receives data from a nearby neighbour. Excessive delay is being introduce due to use of this technique for distant node on the chain due to which single leader can become a bottleneck, which result in decreases of network lifetime WSNs. Currently, a well-studied and widely-used power saving and energy efficient technique is used [4] for maximizing network life time. A limitation of existing duty cycling approaches is that it does not consider the redundancy in WSN as the sensor's cycles are identical. A detail survey on power saving techniques for multi-hop wireless networks is studied in [5]. It is impossible by a single backbone to prolong the network lifetime. An initiative idea is to construct multiple disjointed CDSs and let them work alternatively[6]. A combined VBS and ERPMT method to increase the lifetime of backbone-scheduling[7].

III. Improving Performance of Wireless Sensor Network

Many techniques are studied and implemented in order to improve the performance of wireless Sensor Networks. The main focus is on designing power efficient routing techniques and algorithm with directly effect on the performance of the sensor network. In this paper we are presenting a novel technique which improve the performance of AODV i.e. Ad-hoc On Demand Distance vector routing. This routing algorithm basically use in large area network in order to communicate between the nodes and base station. It is reactive kind of protocol that means a route is provided only when it is required. The rout creation and route maintenance is done by using different messages. Such as whenever a route is required from source to destination a Source sends a Rout Request message to all other node. The node having path to destination after receiving RREQ send backs the Route Reply (RREP) message. The nodes keep receiving other messages by continuously listening to Hello message. If any kind of link failure occurs during transmission then it is handled by Route Error. The ideology basically focuses on improvising the energy consumption by each node. In networks the nodes which are not participating in any transmission or processing are called as idle node. These kinds of nodes consume same energy as the other active nodes. Thus in order to save the energy we have to manage the energy consumption of idle node. For this purpose we are using ERPMT method along with Virtual Backbone Scheduling Algorithm and Remote Differential Compression.

A. *Virtual Backbone Scheduling Algorithm*

It is a fine grained sleep-scheduling technique in which the nodes which does not participate in any kind of propagation or data transmission turns of their radios. This is achieved by creating a Backbone for particular nodes that participate in the data transmission. The nodes which are not in the backbone are considered to be in idle state and they turn off their radios in order to save the energy. The radios of the nodes consume large portion of the energy. Thus we can minimize the energy use here by saving the energy of idle nodes while nodes which are in backbone perform the transmission of data and consume energy equally. Connected Dominating set Algorithm is used for construction of virtual backbone in the network.

1) Connected Dominating Sets (CDS): A Connected Dominating Set (CDS) has been recommended to construct virtual backbone for a WSN to reduce routing overhead. Having such a CDS improves routing by restricting the main routing tasks to the dominators only. The nodes which are in a CDS are called dominators, the others are called dominates. Fault tolerance and routing flexibility are essential for routing since nodes in WSNs are prone to failures and nodes may turn on and off frequently. Thus, it is important to maintain a certain degree of redundancy in a CDS.

2) *Schedule Transition Graph:* Schedule Transition Graph (STG) is to model the MLBS problem and energy distribution. Each state contains a backbone and the corresponding energy levels. An initial state is connected with all the states in the first round as a starting point. Uni-directed backbone transition edges connect one state to another. The nodes in the backbone of the starting states consume fixed amounts of energy after each transition. No transition is allowed after any sensor is consumes it full energy. A path in STG represents a schedule in the network. The MLBS problem of a network is nothing but to find the longest path, to find the longest path in the network. The maximum number of rounds in a STG can be calculated by dividing the sum of the initial energy of all nodes by the minimum energy consumed in each round. Every Backbone node consumes a fixed amount of energy. The search starts from the initial state and after a backbone transition. Each state keeps the largest energy levels of each node recorded at each step. A path terminates when associated energy level becomes zero path is terminated. When all the paths are terminated the longest path can be obtained.

B. *Remote Differential Compression (RDC) Algorithm*

Remote Differential Compression Algorithm is a compression technique which compresses the packets to be transmitted from different nodes to base station. The packets or data here are divided into certain proportions of chunks. Chunks are the point from which the whole data is divided into equal parts and transmitted in compressed form. The data is stored in the form of file that's why the files are in turns divided into chunks. RDC FilterMax Algorithm is used for converting files into chunks. The different chunks are identified by using Chunk Signature. The difference in the received data can be regenerated from the source nodes using chunk files. As we compress the data their might be some kind of redundancy in the data which can be terminated with the use of chunk signatures.

C. Efficient Routing Power Management Technique(ERPMT)

ERPMT manages the battery life at the node level. The energy of the node is divided into two parts, one is for transmitting the data collected from other nodes and second part is to transmit the self-generated data. The energy ratio which is used to transfer the data from other nodes forwards the data into compressed form. For this purpose we are implementing Remote Differential Compression algorithm. It is totally approximation based technique. The simulation result clearly shows us that the power consumption is reduced in the network implementing the ERPMT method. The different results are generated with respective different parameters such as packet loss, delay and throughput. As the power consumption is reduced in the network using ERPMT method the performance of that network is increases. Node life is increased in the network thus the coverage of the network is also improves. As there are more alive nodes more area can be monitored easily and for long duration.

III. PERFOMANCE EVALUATION

The simulation result shows the comparison between the wireless sensors Network implemented using ERPMT method in combination Virtual Backbone Scheduling and Remote Differential Compression Algorithm and without using ERPMT Method. The fig.2 shows the nodes creation in the network. Fig.3 shows the data transmission without using ERPMT method, whereas fig.3 shows the data transmission using the ERPMT Method.

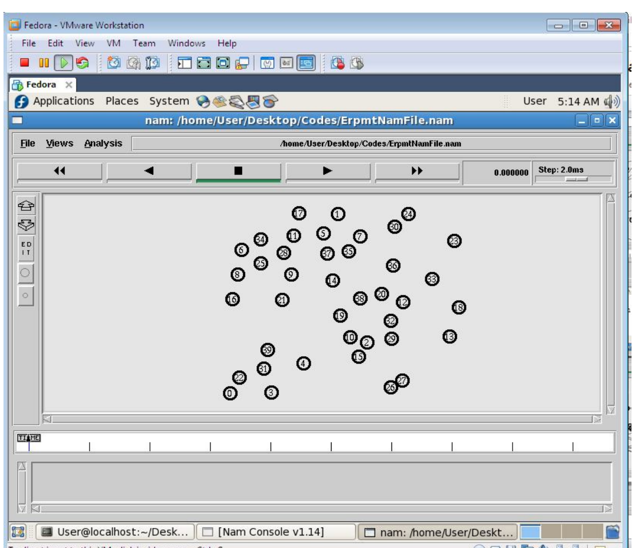

Fig.2 Node Creation in Wireless Sensor network

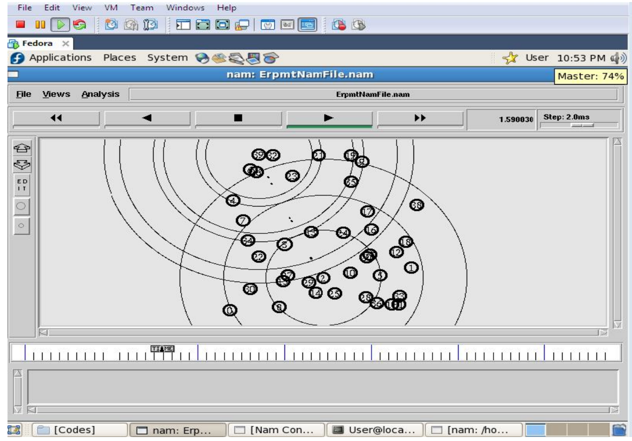

Fig.3 Data Transmission in WSN without using ERPMT method

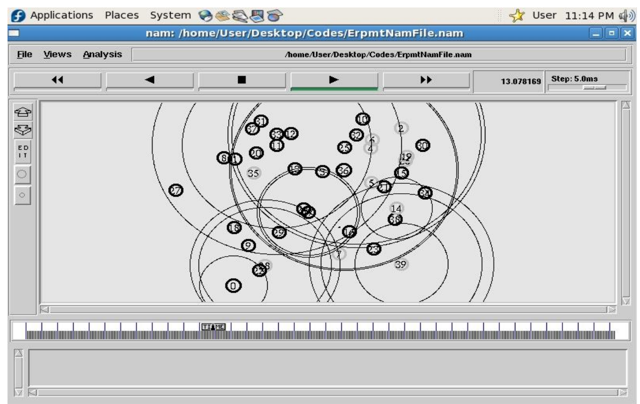

Fig. 4 Data Transmission in WSN using ERPMT Method

The graph in Fig. 5 shows the comparison between the delays occurring during the data transmission. From the graph it is clear that the delay of the network ERPMT method is reduced as compared to the network not using ERMPT method.

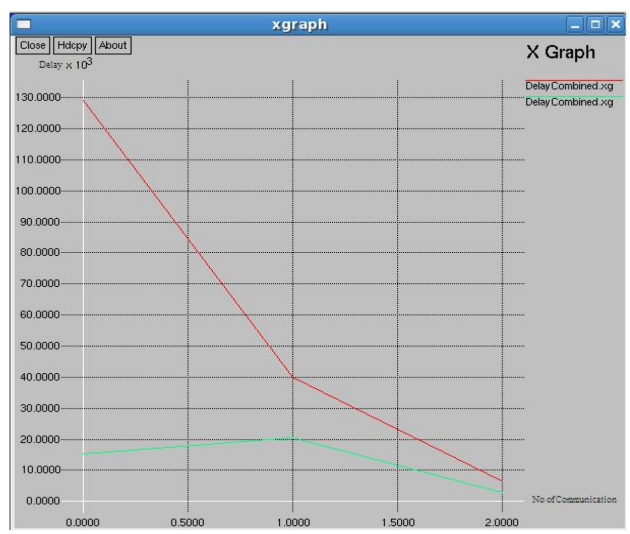

Fig.5 Delay Occurred in the Network

Fig.6 shows the graph of throughput of the communication, we can see that the Green line (with algorithm) has higher throughput than the red line (without algorithm).

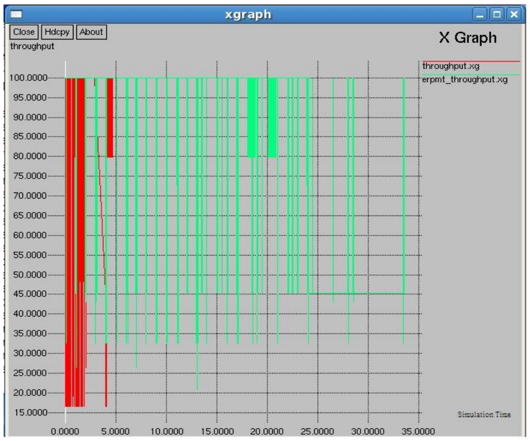

Fig. 6 Throughput of Communication

The fig.7 shows the energy consumption of the network with and without using the algorithm. As shown in fig.7 the energy consumption of network using ERPMT in combination with RDC and virtual Backbone scheduling is less than that of network without using Algorithm.

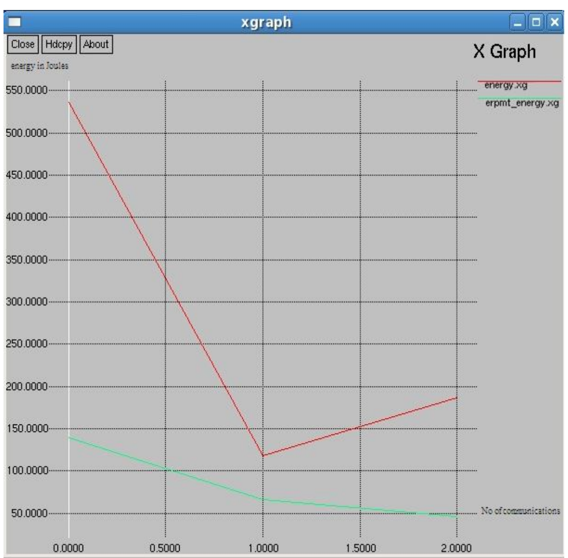

Fig.7 Energy Consumption of the Network

IV. CONCLUSIONS

WSNs require energy-efficient and power aware communication to be able to work for a long period of time without human intervention. We present Energy Efficient Power Management (ERPMT) in combination with Virtual Backbone Scheduling (VBS) Algorithm and Remote Differential Compression algorithm (RDC) method to increase the lifetime of wireless sensor networks. Ii is clear from the simulation result the energy consumption of network only using AODV is greater as compared with the proposed system. The Energy Efficient, Power Aware Routing significantly increased packet delivery ratio, decreasing end- to-end delays for the data packets, lower network load, supporting reliability and decreasing power consumption resulting in the increased coverage.

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