Energy Efficient and Reliable Data Centric Routing Protocol Technique to Improve Performance of Wireless Sensor Network System

Anuj Gupta
Assistant Professor
Department of Electronics & Communication Engineering
APIIT SD Panipat, India

Abstract— Wireless sensor networks is composed of thousands of nodes that are deployed in large geographical area and these sensor nodes are small, wireless and battery powered. Wireless Sensor Network have wide range of applications but they are conquered with many challenging issues and complications that need to be addressed. The energy consumption of the nodes and the extension of the Network lifetime are the main challenges and the most significant features of the routing protocol in order to make it suitable, effective and energy efficient. As the sensor nodes are battery powered in this paper we propose an energy efficient routing power management technique which uses the concept of Time to Live TTL, 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 backbone 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 Quality of services QoS parameters like Energy Consumption, throughput, delay.

Key words: Virtual Backbone Scheduling (VBS), Schedule Transition Graph (STG), Energy Efficient Power Management Technique (EERPMT), Time to Live (TTL), Reliability, Remote, Differential Compression (RDC) Algorithm

I. INTRODUCTION

A. Wireless Sensor Network

Wireless Sensor Networks (WSN) brought a dramatic variation in bringing advancement in wireless communication, information technologies, electronics field and providing opportunities for effective usage of resources in critical environments. WSNs are basically the collection of wireless nodes having limited energy capabilities, are deployed randomly over a dynamically changing atmosphere, may be mobile or stationary that can sense the environment and communicate the information gathered from the monitored field through wireless links; the data is forwarded, possibly via multiple hops relaying, to a sink that can use it locally, or is connected to other networks (e.g., the Internet) through a gateway [1]. The concept of wireless sensor networks is based on a simple equation: Sensing + CPU + Radio = thousands of potential applications. This sensing technology deploys tiny, autonomous and compact devices called sensor nodes or motes in a remote area to detect phenomena, collect and process data and transmit sensed information to users [2]. WSNs provide a new class of computer systems and expand the ability of individuals to remotely interact with the physical world. In a broad sense, WSNs will transform the way we manage our homes, factories, and environment. The sensor node consists of basic four components sensing unit, processing unit, transceiver and power unit shown in Fig.1.

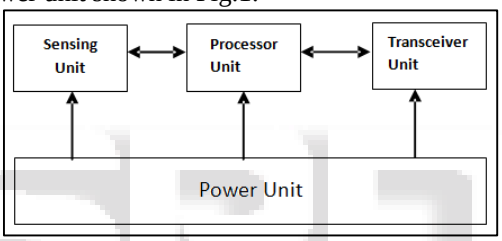

Fig. 1: Components of Wireless Sensor Network

B. Architecture of Wireless Sensor Network

A sensor network is composed of a large number of sensor nodes, which are densely deployed in a terrain under monitoring. These sensors have the ability to communicate either among each other or directly to an external base-station. 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).

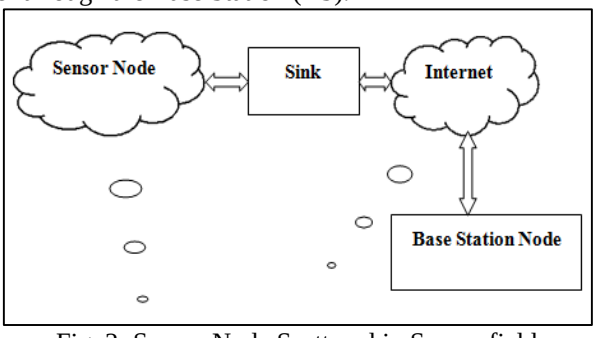

Fig. 2: Sensor Node Scattered in Sensor field

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. A greater number of

sensors allows for sensing over larger geographical regions with greater accuracy. Each sensor node comprises sensing, processing, transmission and power units. Sensor nodes are usually scattered in a sensor field, which is an area where the sensor nodes are deployed. Sensor nodes coordinate among themselves to produce high-quality information about the physical environment which is shown in Fig.2.

So 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 for larger Terrain.

II. 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. 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.

A. Connected Dominating Sets

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 nodes may turn on and off frequently. Thus, it is important to maintain a certain degree of redundancy in a CDS.

B. 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.

C. Remote Differential Compression

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 Filter Max 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.

D. 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. PERFORMANCE 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. 3 shows the nodes creation in the network. Fig.4 shows the path selection on the basis of threshold energy with the node, fig.5 shows the data transmission using the ERPMT Method.

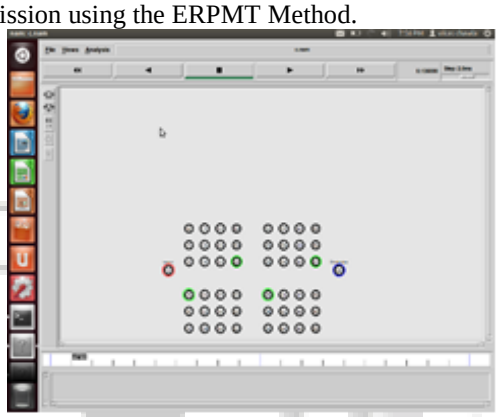

Fig. 3: Node creation in Wireless Sensor

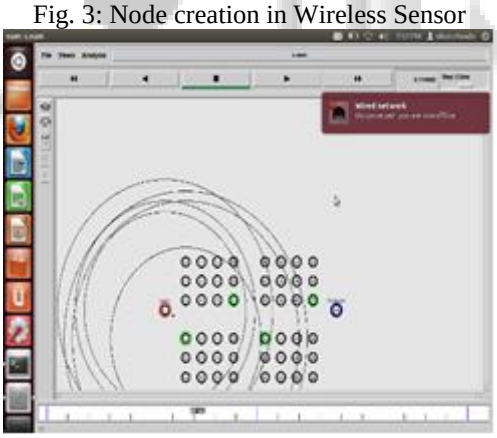

Fig. 4: Path Selection for data transmission

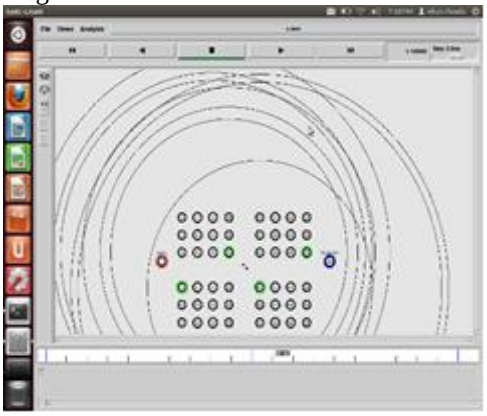

Fig. 5: Data Transmission in WSN with ERPMT

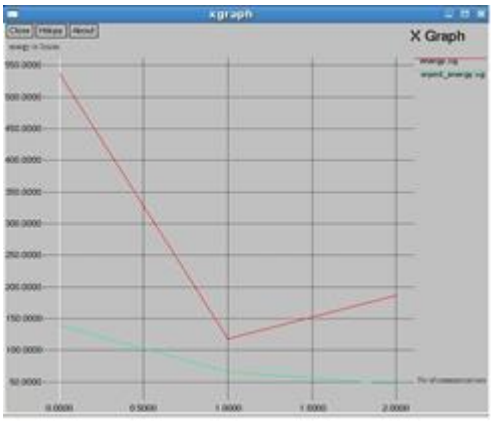

Fig. 6: End to End Delay In Data Transmission

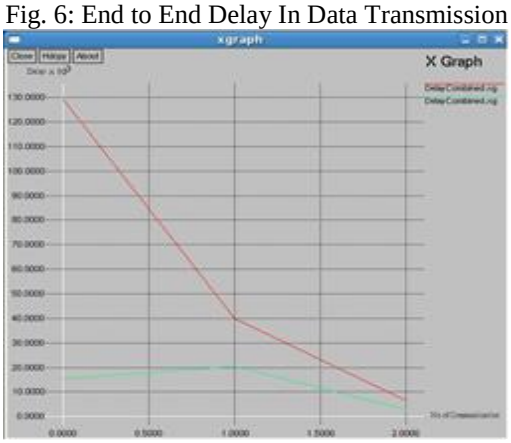

Fig. 7: Throughput of Network

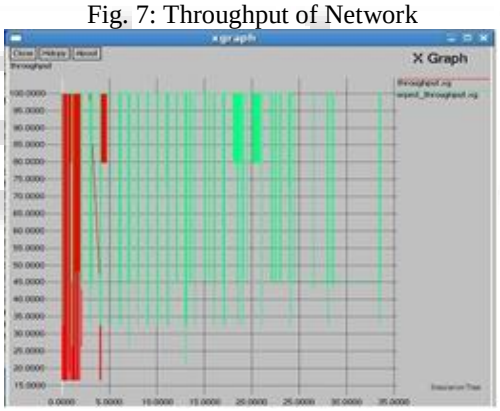

Fig. 8: Energy Consumption in Transmission

The graph in Fig.6 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. The fig.7 shows the energy consumption of the network with and without using the algorithm. As shown in fig.8 the energy consumption of network using ERPMT in combination with RDC and virtual Backbone scheduling is less than that of network without using Algorithm.

IV. CONCLUSIONS

Fig.7 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).

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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