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# *Energy Efficiency in Wireless Sensor Network Using Green TBS Approach*

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***Abstract*—Typically in the wireless sensor network, sensor nodes assigned for task execution. The scheduling of the individual task in wireless sensor network has typically a strong influence on the achievable performance. The Number of routing challenges and design issues like node placement and energy consumption can affect the routing process in wireless sensor networks. Therefore this new approach for energy efficiency is introduced. The concept of power adaptation with sleep and wake-up is merged in this green task based sensing method. This will overcome the challenges like nodes availability, synchronization process, and overall network efficiency and also will help to avoid the detailing in classical routing technique. In network simulator ns2, with reference of variations in total no. of nodes the performance of this method is evaluated. And the results are obtained on the basis of performance measurement parameters such as Event delivery ratio (EDR), time delay, residual energy (average) and control overhead. The obtained results are justified on the basis satisfactory performance of the considered system against the energy efficiency constraint.**

***Keywords—energy efficiency, green task based sensing, wireless sensor network analysis***

## I. Introduction

A Wireless Sensor Networks (WSNs) are composed of hundreds or thousands of sensor nodes which have many different types of sensors. These sensors are gathering information of considered parameters and send data to sink which will performs assigned job. Routing protocol has limitation in terms of storage space, computing power, and energy. Therefore task scheduling is an important aspect in WSNs. The cooperative behavior in between sensor nodes by transferring data among closest nodes can be favorable to task scheduling in the view of energy optimization and continuation of satisfactory performance [1].

Traffic control and resource control methods are used in order to control and avoid the congestion. This method do not control data rate of sources but the path through which data flows. There are many other techniques based on route selection. In [3] the source based routing trees, sink base tree creation and source based tree creation techniques are used. But in the source based tree creation the issues such as location awareness and higher level connection availability is incorporated. [4] Hierarchical Tree based Energy efficient and Congestion aware Routing Protocol (HTECRP) tries to manage the congestion using the routing trees and nodes neighbors average queue length as a parameter to manage the congestion. In wireless, multi hop sensor network, choosing transmission power levels has an important impact on energy efficiency and network lifetime. Two algorithms for dynamically adjusting transmission power level on a per-node basis are proposed. Network lifetime, convergence speed as well as resulting network connectivity are used as figures of merit for these two algorithms. The network lifetime metrics of these two local algorithms are also benchmarked against power control algorithms using global information. It improves the network lifetime and also the energy efficiency in the network.

Therefore in order to avoid the issues and challenges that are occur in the classical routing protocol, the gTBS approach is proposed. In this approach, task based routing scheme that not only consider energy efficiency but also reduces delay. This system is unique as it avoids the details which are required in the routing table of classical routing protocols.

## II. Proposed System Description

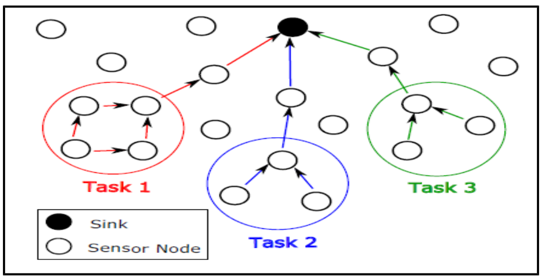
The propose gTBS, a task based routing system, which improves energy efficiency by minimizing the delay. This system composed of power adaptation and sleep - wake-up techniques but this combination has the challenges in the nodes availability and synchronization process. The gradient node is selected as a closest node to sink. The transmission of gradient is achieved by adapted power level so that each node will consider the task that is intended by its gradient only.

In this work, the route is selected by sensing task therefore in the network no other node is activated. Only the intended node and gradient will be activated during the task period, other network is inactive but ready to receive the other task. The work is simulated by using the Network Simulator 2 (NS2) software and four parameters are considered such as event delivery ratio (EDR), delay, average residual energy and control overhead by varying the number of nodes to justify the results.

### *A. Task based WSN*

In the gTBS system as shown in the fig. 1, the wireless sensor network is configured in which the node 0 is base-

Fig. 1. Task Based WSN Topology



station. Base-station node broadcast the Id packet in the assignment phase to sensor nodes. When the ID assignment request is broadcasted by the sink, the first node that forwards this request to the given node is its gradient.

After the gradient ID is assigned for all sensor nodes the base-station node send the task request to sensor node. Each node only considers a task received from its gradient [1]. Only the intended and gradient node is active and the rest of the network is in inactive or sleep state. After completion of the task the sensor node send the data to sink via gradient node.

### *B. Flow Chart*

Fig. 2 shows the operational flowchart of program algorithm. In the system, the sensing is covered in the form of tasks which is initiated by the sink and then this task is broadcasted over the rest of the network. It is assume that the nodes are randomly distributed but with a fixed location. It also assume that, sink node is having ID=0. Each node is having unique ID and also order.

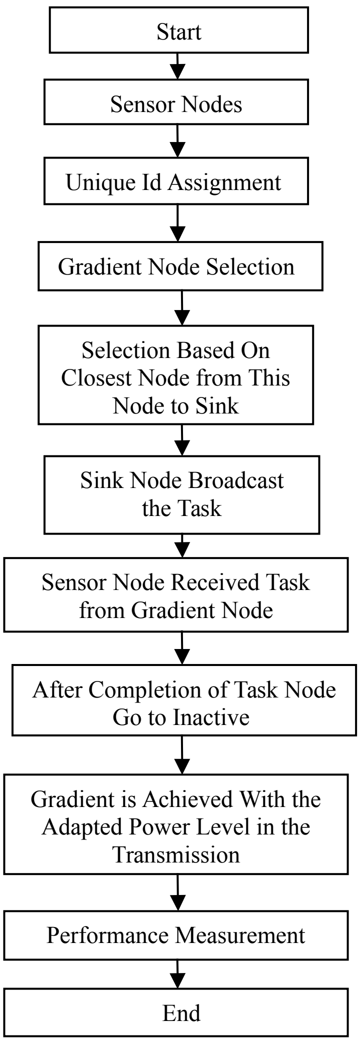



Fig. 2. Operational flowchart of proposed system

Order is defined as the minimum number of hops to reach to the sink node.

Therefore sink is having ID = 0 and order = 0 and the nodes which are at line of sight (LOS) with the sink has order 1 and likewise order goes on increasing. The gradient of a node is the node through which the ID assignment was forwarded from the sink for the first time. Hence gradient based transmission saves the energy for both initializations as well as throughout the network operation. This approach reduces the number of nodes through which data flows and hence overall network activity also reduces results into reduced energy consumption. After receiving ID, order and gradient of a node, sink broadcast the task. The sensor node receives the task from the gradient node and only the nodes which are in that task and gradient is active and the rest of all the network nodes are inactive but ready to receive the next task. After completion of the task, the node goes to the inactive state. In gTBS gradient is achieved with the adopted power level in the transmission. In this system, the sleep and wake-up technique is applied which is based on the task sensing scheme. [1].

## III. System and Parameter Considerations

Table 1 show the system parameter specifications which are considered while simulating the proposed method. Sink node, sensor node and gradient node are main components of said system. In this study, number of nodes varied according to 50, 60, 70, 80, 90, and 100. The initial energy for the each node is set as 10 J. The nodes are deployed in the area of 800 m x 800 m. Basic introduction of evaluation parameters are explained as follows.

TABLE I. System Parameters Description

| Sr. No. | Parameter | Description |
|---|---|---|
| 1 | Simulator | NS2 |
| 2 | No. of Nodes | 50 – 100 |
| 3 | Area | 800 m x 800 m |
| 4 | Communication Range | 250 m |
| 5 | Interface type | Phy / Wireless Phy |
| 6 | MAC type | IEEE 802.11 |
| 7 | Queue Type | Drop tail / Priority queue. |
| 8 | Queue Length | 50 Packets |
| 9 | Antenna Type | Omni Antenna |
| 10 | Propagation Type | Two Ray Ground |
| 11 | Routing Protocol | AODV |
| 12 | Transport Agent | UDP |
| 13 | Application Agent | CBR |
| 14 | Initial Energy | 10 J |

***Event delivery ratio*** can be justified as function of received data packets with respect to total no. of nodes used for analysis. It also defined as,

$$Event\ Delivery\ Ratio = \frac{Received\ Packets}{Sensing\ Request\ X\ Intended\ Nodes} \quad (1)$$

Fig. 3 shows the result for EDR with respect to varying the number of nodes from 50 nodes to 100 nodes.

***Delay*** is the time elapsed between transmitted task signal and received task signal at corresponding node.

$$Delay = Receiving\ time - Sending\ time\ of\ Packet \quad (2)$$

Fig. 4 shows the result for delay with respect to varying the number of nodes from 50 nodes to 100 nodes. As we increases number of nodes, delay for the system also increase.

***Residual energy*** can be stated as difference between Initial energy and consumed energy. Fig. 5 shows the result for average residual energy with respect to varying the number of nodes from 50 nodes to 100 nodes. The average residual energy is measured in terms of Joule. As we increases number of nodes, energy consumption of network will increases which results into decrease in the average residual energy of nodes.

***Control overhead*** is used as measure of total no. of control packets in the network. Fig. 6 shows the result for control overhead with respect to varying the number of nodes from 50 nodes to 100 nodes. As we increases number of nodes, control over-head will also increases.

## IV. Simulation Results

### *A. Event Delivery Ratio*

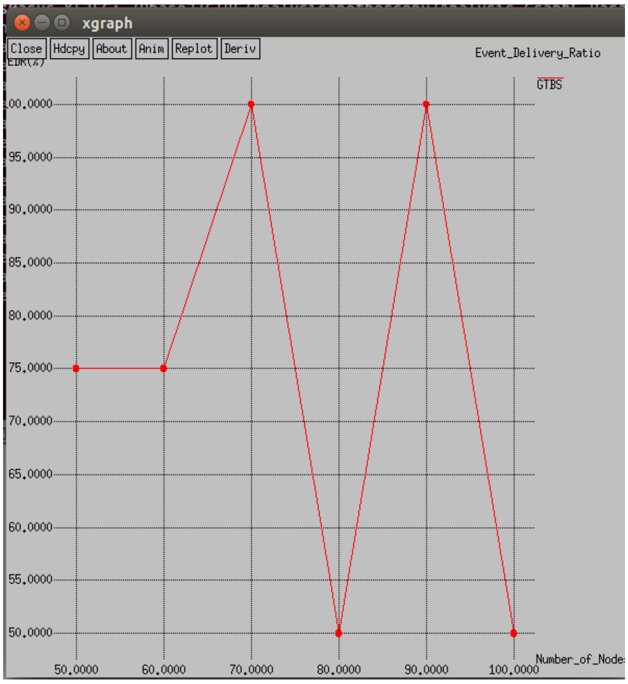
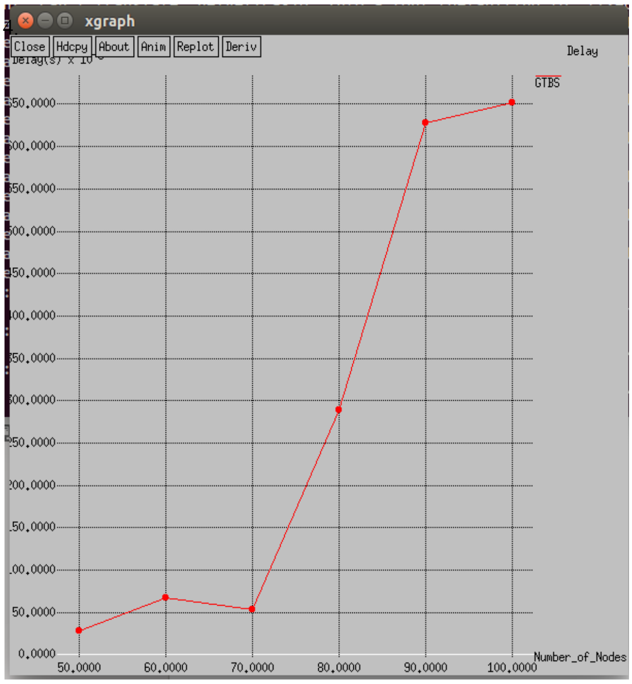



Fig. 3. *E D R vs. No. of Node*

### *B. Delay*

Fig. 4




*Delay vs. No of Node*

### *C. Average Residual Energy*

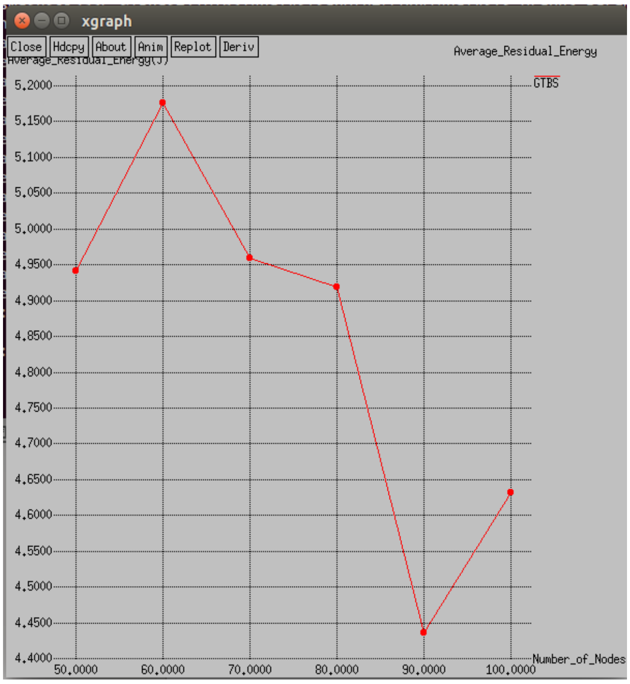



Fig. 5. *Average Residual Energy vs. No of Node*

### *D. Control Overhead*

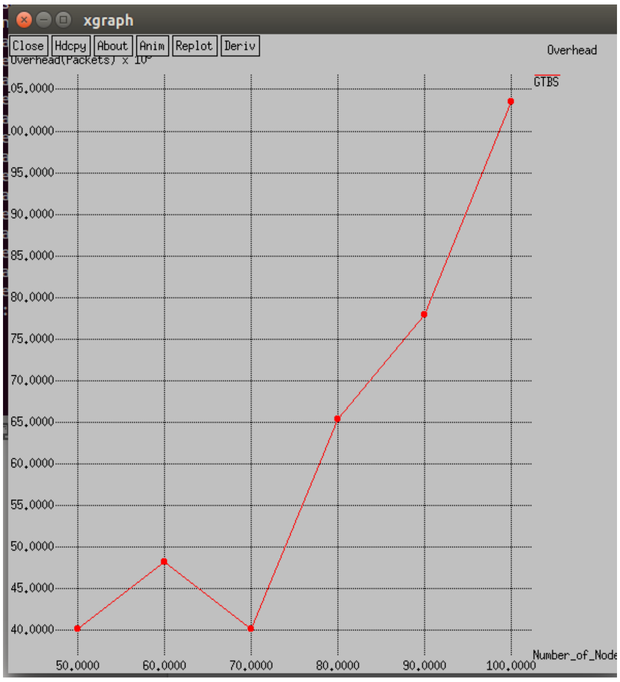



Fig. 6. *Overhead vs. No of Node*

Above graphs are based on the simulation results exectued in Network simulator (2). The obtained values are mentioned in table 2.

TABLE II. SIMULATION RESULT

| **No. of nodes** / **Parameter** | **50** | **60** | **70** | **80** | **90** | **100** |
|---|---|---|---|---|---|---|
| EDR (%) | 75 | 75 | 100 | 50 | 100 | 50 |
| Delay (sec) | 0.028 | 0.067 | 0.053 | 0.289 | 0.628 | 0.652 |
| Avg. Residual Energy (J) | 4.942 | 5.176 | 4.959 | 4.919 | 4.436 | 4.632 |
| Control Overhead (packets) | 40152 | 48225 | 40152 | 65387 | 77915 | 103550 |

## V. CONCLUSION

This system allows the green task based routing in wireless sensor networks. It uses the combination of both power adaptation and sleep and wake-up techniques in order to get energy efficient wireless sensor networks. In gTBS, gradient selection is based on closest node to the sink but this will drain the energy of corresponding node. To overcome such issue we use the weighted routing scheme in which gradient is selected on the basis of two parameters i.e., closeness to the sink as well as residual energy of the node and appropriate weight is assigned which is termed as EgTBS. The EDR for both the system is same for 80 nodes but it will increase as the number of nodes will increased. In EgTBS delay is reduced as compared to the gTBS and it will increases as the number of nodes increases.

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