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Improved Energy Efficiency and Reduced Delay Using Self Knowledge with SCHP in Wireless Sensor Networks

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Abstract: ***Tiny sensor nodes that can sense their vicinity and communicate among themselves constitute the wireless sensor networks. These sensor nodes run on battery and are usually deployed in harsh environments. So energy efficiency is always a design issue for wireless sensor networks. Recently many energy efficient techniques were developed for routing. These techniques increased the network lifetime but compromised the delay metric. In some applications of wireless sensor networks like environment monitoring, intrusion detection etc delay is not tolerable at all. In this paper, self knowledge technique is implemented along with SCHP(sub cluster head protocol) to reduce the delay incurred due to link stability problem in SCHP. With self knowledge each node has information about its neighbors. The sender sends data according to the receiving capacity of the receiver which gives better link stability. Simulation results show that SCHP with self knowledge has lower delay and energy spent than SCHP and other network structure algorithms like top-down approach and bottom up approach.***

Keywords: Wireless sensor networks; top-down; bottom up; delay; SCHP; energy efficiency; self knowledge.

I. INTRODUCTION

Wireless sensor networks popularly known as WSN is combination of three words. Sensors are tiny devices that sense physical quantities and convert them into electrical signals. The word network signifies that these sensors can communicate among themselves. Wireless denotes that the communication takes place through a wireless medium. Thus wireless sensor network comprises of hundreds of sensor nodes that can sense their vicinity and communicate either among themselves or to the external base station(also known as sink) [8]. Some unique advantages of WSN include adaptability, battery powered sensor nodes, self configurable, comprehensive sensing range, application specific and fault tolerance. Nowadays wireless sensor networks has wide areas of applications ranging from environment monitoring, health, home, space exploration to chemical processing, disaster relief and other commercial areas. As the sensor nodes are battery powered and it is not always possible to recharge or replace the batteries so energy efficiency or network lifetime is one of the most important design issues of wireless sensor networks. In the recent past many algorithms have been developed to provide the energy efficiency but these algorithms somehow compromised the delay factor. In this paper we proposed a technique which provides the energy efficient path for delay constrained wireless sensor networks.

In this technique the sender keeps knowledge of all the parameters like delay, threshold, packet size, energy of its one hop neighbors and transfers the packet according to the receiver's capacity. This helps in maintaining the link stability by avoiding congestion in the link. The time and energy which earlier was consumed in reestablishing the link due to less stability of the link

is now can be utilized for productive packet transfer. In this way we can say that this technique is both energy efficient and delay constrained. Rest of the paper is organized as follows. Section II includes related research work. Section III gives the proposed technique. Section IV lists the simulation parameters. Section V shows the results of simulations and finally section VI concludes the paper and signifies the future scope.

II. Related Work

In [1] authors presented the heuristic solution for obtaining energy efficient path for delay constrained data in wireless sensor networks. It employs topology control for sensor networks using 802.11 like channel access schemes. To model the access delay caused by MAC layer they proposed a routing framework and network architecture.

A delay aware network structure was proposed in [2] by Chi-Tsun et. al to minimize delays in the data collection process of wireless sensor networks. There are two network formation algorithms to construct this network structure can in a centralized or decentralized approach. First is Top-Down approach and the other is bottom-up. In top-down approach the whole process is executed by the base station(which is assumed to have all the coordinates of sensor nodes). The sensor nodes are instructed to establish the essential data links by the base station at the end of process. Bottom-Up approach is more scalable as compared to Top-Down approach. The basic operation of this approach is joining the same size clusters together. It is implemented both in centralized or decentralized manner. In SCHP each SCH(sub cluster head) broadcasts an invite to its neighbors by sending invitation packets (IVP) within a calculated distance. The level and identity of sender SCH are the contents of IVP. The receiver SCH uses the signal strength of received IVP to estimate the distances from neighboring SCHs. A SCH also keeps the count of IVPs received. If this number of IVPs exceeds a certain predefined threshold value or a maximum duration has been reached, a SCH will send a request to his nearest neighbor called as connection request. If both SCHs are found to be the nearest neighbor of each other, a connection will be formed between two SCHs.

In [9] authors proposed EDAL, an energy efficient delay aware lifetime balancing protocol for data collection in wireless sensor network, which is inspired by recent techniques developed for open vehicle routing problems with time deadlines (OVRP-TD) in operational research. To evaluate EDAL, authors implemented both the centralized heuristic (C-EDAL) and the distributed heuristic (D-EDAL). Simulation results proved that compared to baseline protocols, EDAL achieves a significant increase on network lifetime without violating the packet delay constraints.

In [10] author has assumed that a single source sends event reporting packets to the sink. With anycast packet forwarding scheme the node is allowed to send the packet to its first neighboring node which wakes up among the set of candidate nodes. Simulation results showed that the anycast packet forwarding scheme can reduce the event reporting delay and prolong the lifetime of the network employing asynchronous sleep-wake scheduling.

III. Proposed Techniques

Our proposed technique uses clustering procedure is same as that of SCHP. In addition we implement self knowledge technique to make SCHP more energy efficient and delay resistant. In Self knowledge technique sender keeps the information regarding its one hop neighbors. All important parameters like delay, threshold, packet size, energy are considered before sending data to the next node. A minimum criterion is set for all the parameters, among all the neighboring nodes the nodes satisfying this minimum criteria are considered for the candidates of relay node. Among these nodes the node with lowest delay and maximum energy is chosen as relay node. If this node dies after sometime then the next eligible candidate is chosen as relay node and attempt is made to reconfigure the dead node.

This technique provides a better link stability than simple SCHP by avoiding congestion in the link because the sender sends the data according to the receiving capacity of the receiver. So the time and energy wasted in reestablishing the link that can be lost due to congestion is saved that accounts in increasing the lifetime and reducing the delay.

IV. SIMULATIONS

In this section the proposed technique is compared with Top-Down approach, Bottom-Up approach and SCH. First of all a base file is created for wireless sensor networks and transfer of packets.

Topology of wireless sensor networks with more number of nodes is deployed in the network, transmission of packets between the nodes by using TOP-DOWN APPROACH by creating a base station or a central hub to control it, BOTTOM UP APPROACH by Forming clusters, SCH technique by forming clusters and base station communication is done between cluster head and base station, Average energy spent, end to end delay is calculated and the output is shown using graphs.

TABLE 1
Simulation Parameters

Einitial	90
Number of nodes	51
Quelength	200
MAC type	Mac/802_11
Network interface type	Phy/WirelessPhy
X	500
Y	500
routing protocol	SCHP

V. RESULTS

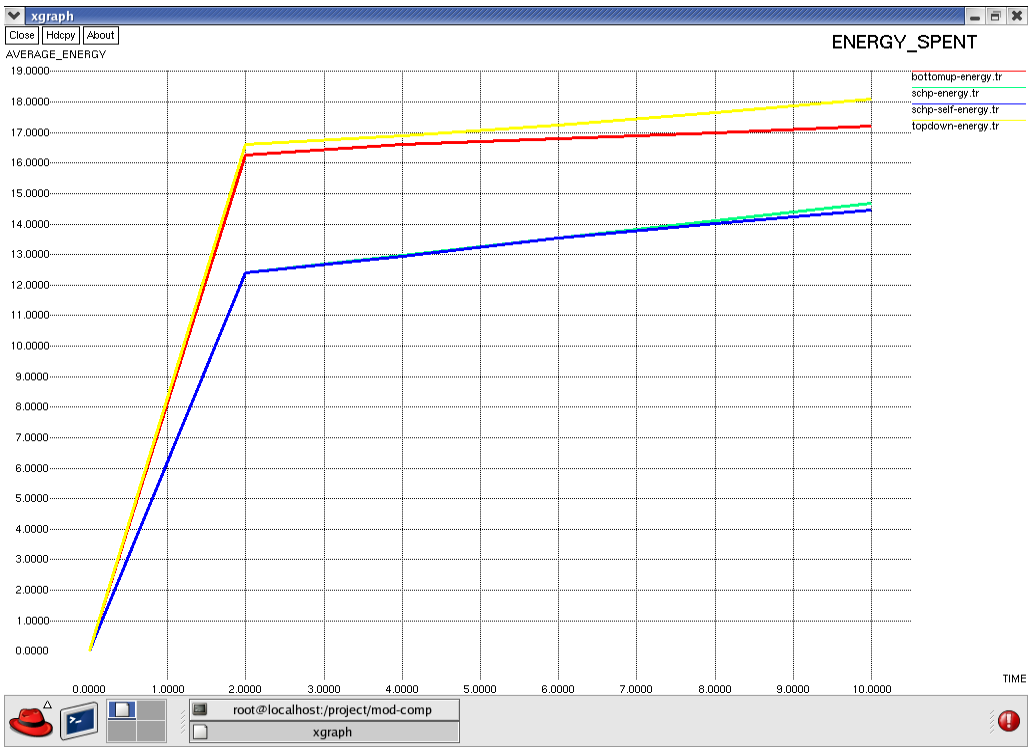

Fig 1. Average energy spent results of topdown, bottomup, schp and schp using self knowledge. Schp-self results overlapped with the schp in the starting but as the time progress schp-self gives better results than all other techniques used in the simulation.

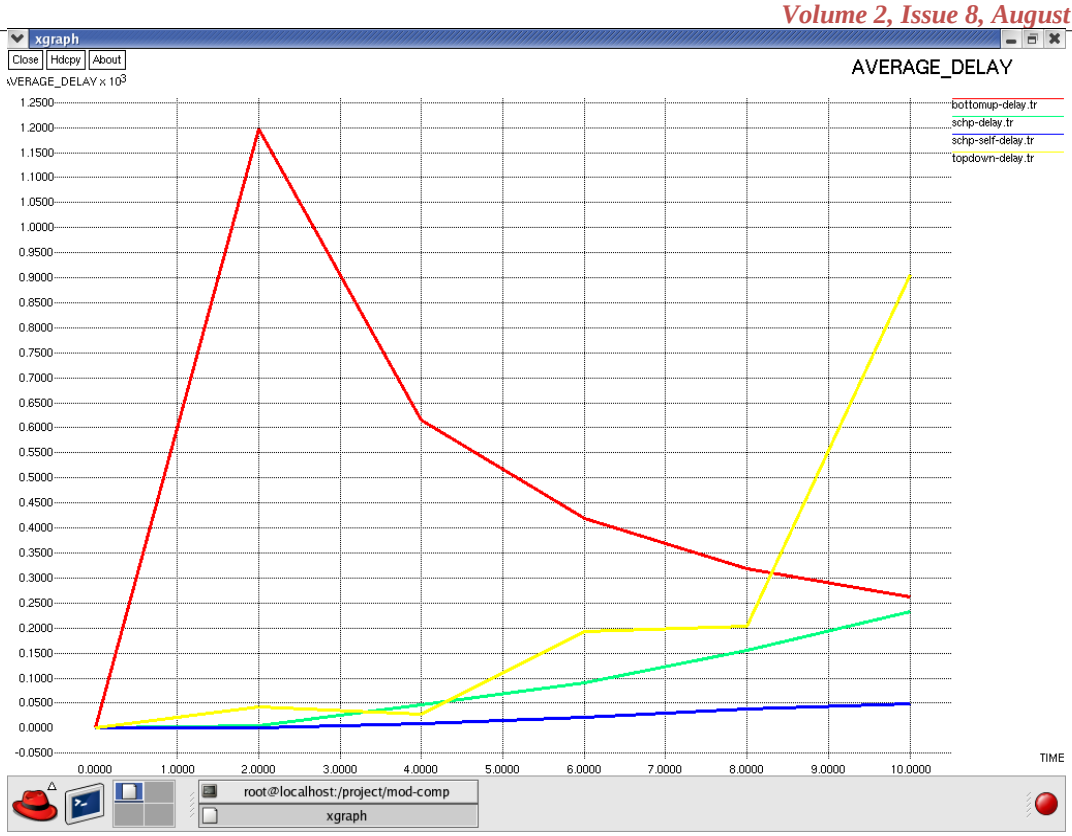

Fig 2. Average delay results of topdown, bottomup, schp and schp using self knowledge. Clearly schp-self gives minimum delay as compared to top-down, bottom up and schp.

VI. Conclusion and Future Scope

In this paper, self knowledge technique is implemented along the SCHP (sub cluster head protocol) to reduce the delay occurring for transfer of data. The performance of proposed technique is compared with top down approach, bottom up approach and schp. SCHP-self is found to be most efficient in minimizing the delay by providing the link stability. The proposed technique also gives better result in terms of average energy spent as compared to other techniques which helps in improving the network lifetime. In the future efforts can be made to make the technique more efficient in terms of throughput and packet delivery ratio.

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Agam Gupta has completed his B.Tech degree in Information and Technology from Rayat Institute of Engineering and Information Technology, Railmajra, Punjab. He is currently pursuing her M.Tech CSE (Networking System) from Punjab Technical University Main Campus Jalandhar. He has qualified GATE exam thrice. He is working as a faculty for GATE COMPUTER SCIENCE at GATE NETWORKS institute in Chandigarh.

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