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Development of Virtual Backbone Scheduling Technique to Improve Lifetime of WSN

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Abstract: ***Now a day, Wireless Sensor Networks (WSN) is class of latest networking technology and it is becoming more popular. There are various research areas in the field of WSN like security, deployment, data aggregation, designing less power consuming devices, etc. Sensor nodes are the battery powered and it is not that much easy to recharge batteries of nodes. As we know that sensing, computing and transmission these are the main tasks of sensor nodes out of which for transmitting, the sensors require more energy. So to improve performance of the network in terms of network lifetime, it is necessary to minimize early depletion of sensor nodes. In this paper, we present new virtual backbone scheduling algorithm called energy and event based VBS to maximize the lifetime of a network by efficient energy utilization.***

Keywords: Wireless Sensor Networks, Connected Dominated Sets, Virtual Backbone, Sleep scheduling, Energy and event based scheduling

1. Introduction

WSN is formed by number of sensor nodes, where each node is connected to other sensors. All deployed sensors may be variation in size and Cost. Size and cost of sensors are resulting in corresponding resources such as energy, computational speed and communications bandwidth. In most WSNs, the battery consumption of each node is also important in order to find out the network lifetime. Thus, power consumption becomes a critical issue in WSNs.

To improve the QoS of the WSN it is necessary to reduce energy consumption of the nodes. Backbone construction is one of the important methods for reducing energy consumption. When numbers of backbones are formed, reduce the problem of overloading and early defusing of sensor nodes because the total available load gets distributed over the backbones. Backbone is subset of original graph G (V, E) [1]. Virtual backbone helps to improve network performance in terms of QoS sensing [1]. Virtual backbones are constructed using Connected Dominating Sets (CDS) [2] algorithms.

2. Related work

Like Ad –Hoc network WSN has no any fixed infrastructure. To improve the routing performance virtual backbones are formed using CDS algorithms. Nodes present in the CDS has more computational and communication load which results in faster energy reduction. So proper load balancing is important in CDS to avoid early reduction of energy. To avoid this need of rotation for selection of nodes present in CDS [2]. W. Ye, J. Heidemann et al. proposed concept of S-MAC[3] protocol which mainly avoids collision using following three things: (i) Periodic sleep and listen: If no any data is sensed for longer time the sensor nodes become idle for longer time. To avoid this periodic sleep and active method is used, i.e. nodes are in idle mode for certain time amount, it then wakes up to check is anyone wants to send data to it. Fig. 1 shows the diagrammatic representation of periodic sleep and listen schedule.

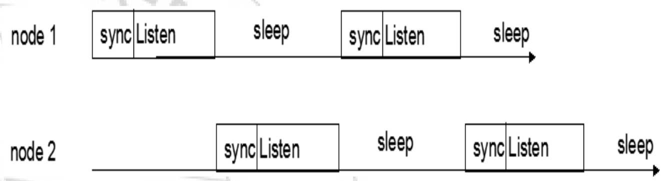

Figure 1: Representation of listen and sleep schedule [6]

(ii) Message passing: The major drawback of long message transmission is that though there is a minor error, and then also need to resend it completely instead of that particular erroneous packet. To avoid this concept of message fragmentation is used .In which complete message gets fragmented into small parts and transmits them in burst, so whenever a sender sends fragment it waits for ACK.If it fails to receive an ACK.If will retransmit current fragment immediately.

(iii) Collision and overhearing avoidance: Collision is mainly occurring when multiple senders want to send data at the same time. When collision occurs, there are the chances of data loss. MAC protocol is mainly designed to avoid collisions.

Four basic states of sensor nodes as sleep, idle, receive and transmit. In sleep mode or state radios of sensor node turn off, which helps to prevent extra power consumption. In idle mode, nodes neither receive nor send any data. Energy consumption is mainly done during sensing and communication. Yaxiong Zhao et al. [1] proposed a Virtual Backbone Scheduling (VBS) concept in which radios of the sensor nodes dynamically turns off to save energy. To find out the optimal schedule Maximum Lifetime of Backbone Scheduling (MLBS) problem is considered. MLBS problem mainly consist of two constraints: (i) connectivity (ii) energy. Two centralized algorithms Schedule Transition Graph (STG) and Virtual Schedule Graph (VSG) are designed to find out the MLBS problem. In STG model and structure are considered separately and in VSG model and structure are together. To maintain the complexity of the network Iterative Local Replacement (ILR) is used. New CDS has to form with replacement of nodes and ILR helps to find out that replacement nodes. Before actual starting of node replacement some threshold value is declared which helps to stop the replacement when energy becomes low. To find out the replacement node rule1, rule2 and rule k consider along with Marking Process [5].

3. Proposed work

For better performance of WSN it is important to maintain QoS with improving the network lifetime of WSN. In existing STG algorithm [1] creates static virtual backbones. But we know that in STG, if any node becomes dead or fail, then that backbone become invalid. So, though there are some nodes are alive then also network becomes dead. Our main aim is to provide better network lifetime with maintaining QoS in terms of energy and connectivity too. Our problem is to find out the optimal schedule that maximizes the network lifetime. To find out the optimal schedules backbones are created in such way that each node has sufficient energy for its working.

3.1 Contribution

In proposing algorithm we create backbones dynamically. For creation of backbones we consider the residual energy of all the sensor nodes. We alternatively schedule sleep and active mode of the sensor nodes based on their residual energy levels. All the available nodes get sorted by their residual energy and nodes those are with higher residual energy levels considered first and will active for certain time duration. Fig. 2 shows the idea of the backbone rotation.

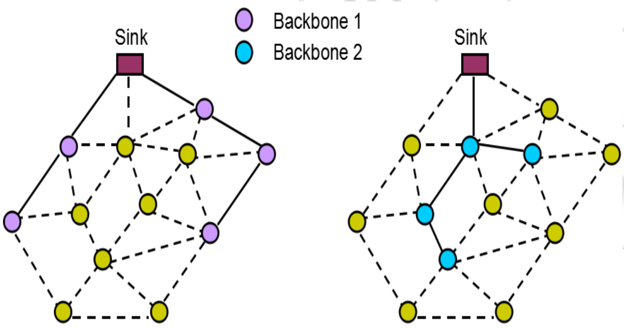

Figure 2: Idea of backbone rotation

3.2 System Architecture

For the system implementation, we consider some assumptions like sink is centrally located and it is an infinite source of energy. Sensor nodes are randomly placed in the field and immobile thereafter. In process of data transmission and receive, equal amount of energy utilized. Initially all nodes are with equal energy value. And we validate our results using simulation process.

Fig.3 shows the system architecture of the proposed system. Initially, all the nodes are deployed in the networks and backbones are formed by considering declaring conditions. Objects are the moving entities. When the object enters into sensor radios that particular sensor and its respective shortest links gets active and data receive and transmission is done.

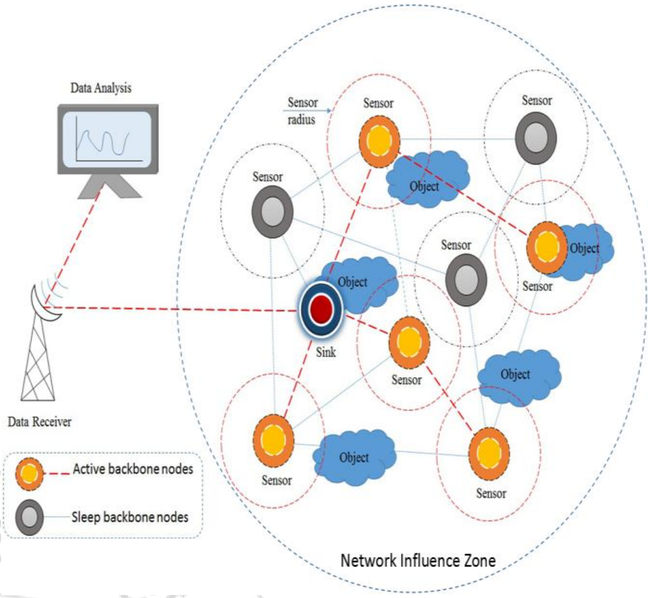

Figure 3: System architecture for proposed system

3.3 Flow of the system

Fig.4 describes the different activities which are performed during the simulation process. As we work on the residual energy of the sensor nodes, it is necessary to keep a record of all the remaining energy. If any node gets fail, then alternative node is getting selected. Nodes those are satisfied the initial condition that only considered for replacement. Once the nodes get selected active and sleep mode scheduled by sorting their energy levels. Nodes those are with more energy are considered first.

We calculate the network lifetime in terms of rounds. |V| is the total number of nodes, E is the initial energy. We construct the backbones by using a CDS algorithm so minimum energy consumption by each backbone is n*ε. C is the total number of rounds which is calculated by [1]

$$C=\frac{|V|E}{n*\varepsilon} \quad (1)$$

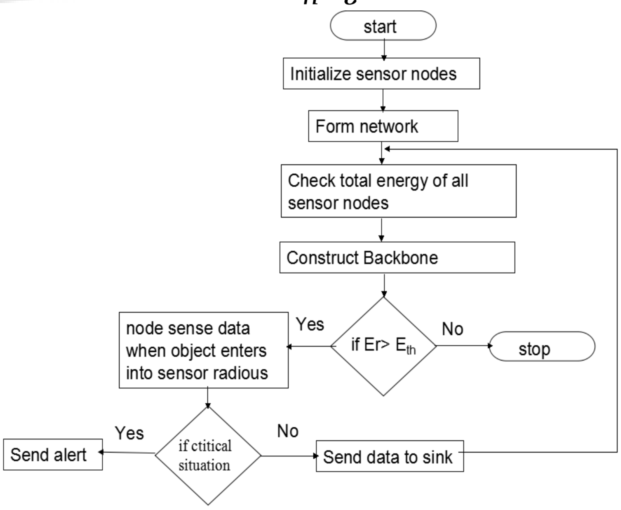

Figure 4: Activity flow of the proposed system

4. Conclusion

In the field of WSN energy efficiency is a critical issue. To improve the performance of the network it is necessary to minimize energy consumption of the sensor nodes. With the proposed system we can improve the QoS of the system with constraints of energy and network lifetime. For developing the proposed algorithm VBS method is used. Along with new technique and VBS, combines virtual backbone and sleep scheduling, which achieves longer lifetimes for WSNs over existing methods.

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