Enhancing Lifetime and Reducing Synchronization Error using Mobility in WSN

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Abstract - *The vitality of the sensor hubs in the Wireless Sensor Networks (WSNs) is a restricted part and causes the variance in the lifetime of the system. Likewise, the throughput and delay of the system rely upon to what extent the system supports for example energy utilization of the system. One approach to build the plausibility of system is the presentation of heterogeneous hubs in regards to vitality, and the other is to synchronize the neighborhood clock of the part hub with the worldwide clock of the bunch head and the sink in the system. Prior, a typical WSN was made out of static sensor hubs and a static sink set inside the watched locale. In such an arrangement, the significant vitality customer is the correspondence module of every hub. In practice, multi-hop is required for sending information from sources to sink hubs. Thus, the vitality utilization relies upon the correspondence separation. So in this paper Sink mobility is presented alongside the hub heterogeneity based synchronization plot so as to diminish the vitality utilization of the system and subsequently expanding the lifetime of the system when contrasted with the current Node Heterogeneity aware Energy Efficient Synchronization Algorithm.*

Key Words: **heterogeneity, plausibility, static sink,mobile sink.**

1. INTRODUCTION

In heterogeneous wireless sensor networks (HWSN), the property of heterogeneity can be of many types. Here, either some of the nodes may have uneven initial energy levels called Energy heterogeneity or may have the ability to communicate to the farthest node called Link heterogeneity or may have the differences in processing capabilities called Computational heterogeneity [1]. A network can become a heterogeneous one when it performs tasks for prolonged duration, because of which their energy gets depleted. Whether it may be from the initial stage or it can be from prolonged operation, heterogeneity can be a problem or an opportunity to perform challenging tasks. For instance if a node has more memory or processing capability then it's best for data aggregation, if node is equipped with a radio which can communicate farther distances are used for communication over large distances [2]. These tasks must be perfectly coordinated in the network between nodes and as time passes it should be reevaluated to assign new tasks to the nodes in the network to benefit more from this abnormality.

Time and clock synchronization are two substantial services for the collective and organized operations in WSNs. Time synchronization in the WSN is mainly contrived by low-cost clocks, frequent topological changes, error sources during communication, node failures, static sink and the resource constraint attribute of the nodes. For instance, network protocols such as time division multiple access (TDMA) surely demands synchronization among sensor nodes. The unsynchronized clocks in the network take more time to send the packet to sink and hence consume more amount of energy. Due to static sink the distance between nodes and sink is more which results in more energy consumption in data transmission. The nodes used in the formation of the network are supplied with limited amount of energy, and cannot sustain for a long time. Also, some part of node energy is utilized in the synchronization of activities of the nodes. To increase the lifetime and solve the problem, some percentage of the nodes with varying energy is added to the network and sink is also made movable in order to reduce average energy consumption. The energy consumption of the synchronization algorithm is minimized by matching the global clock of the sink and the local clock of the node.

Perhaps, we can get the best result if we introduce heterogeneity which helps increase stability, lifetime, and energy efficiency by taking best aspects of the above protocols. The paper focuses on a hybrid approach to minimize the energy consumption with increased throughput, hence bandwidth utilization and reduced delay with the controlled mobility of the sink.

2. RELATED WORK

This section explores the idea how one can use TDMA technique for scheduling and synchronization technique to improve the QoS. [2] Considers the spanning tree mechanism to improve the energy consumption as compared with TPSN. It shows the reduced sync errors. [3] Defines a time synchronization protocol based on spanning tree. A spanning tree formed by the nodes and is divided into multiple sub-trees. The sub-tree synchronization process helps to match the clock time within the level. It minimizes the clock adjustment time and hence reduce the delay in the network.

In [4] Clustered Time Synchronization algorithm and energy model is presented, that reduces the energy consumption beside accuracy while synchronizing the WSNs. Reference Broadcast Synchronization Protocol [5] (RBS)uses the synchronization between the two receivers by the intermediate node within the listening range of the sender and receiver. The intermediate node sends the message for recording the time hence saves the energy in clock updates. The major disadvantage of the protocol is that the energy is wasted to synchronize the reference sender.[6] Proposes the distributed clustering data aggregation algorithm with consideration of mobile and heterogeneous nodes into the clusters. The mobility of node often changes the structures and accordingly consumes more energy. In [8] Author considers the network with heterogeneous nodes in respect to energy with a mobile sink. It shows enhancement in throughput and network lifetime. Due to the mobility of sink control overheads are increased and drains some part of node energy. [9] Consider hybrid synchronization scheme for WSN used to evaluate the vibrations with minimum sync errors. Authors used the partial offset time synchronization of TPSN and clock adjustment for decreased energy consumption of K nodes.

[9] Proposes the hybrid scheme to make sure the sync accuracy with minimum energy. It considers partial scheme to calculate the time offset of few child nodes. In [10] time synchronization of node and network is done at the time of cluster tree formation. It reduces the energy consumption and relative time drifts used in data collection from the tree. [11] Proposes the cycle-based sync scheduling in the delay-sensitive applications to achieve low packet delay and high throughput in the communication of packets from intra to inter-cluster communication. It rearranges the transmission order by upgrading the cycle length. It has a limitation of overhead with increased network size and synchronization error. [12] Proposes TDMA based slot allocation for transferring the accumulated packets from CH to sink with reduced energy consumption even though the mobility of node restructures the cluster and increases the energy consumption. The TDMA scheduling requires the proper synchronization for reduced packet collisions. [13] Proposes the bandwidth efficient hybrid synchronization algorithm [BESDA] which uses the combination of scheduling and synchronization algorithm to enhance the throughput. [14] Mobility–aware Hybrid synchronization (MHS)consider the random mobility of node to improve the throughput and delay, but the mobility of nodes causes the energy consumption in aggregating the packets from nodes to CH and CH to sink.

3. PROPOSED MODEL

The paper proposes the cluster- based Time Synchronization for WSN. It uses the spanning tree mechanism for synchronizing the slots as well as clocks of the heterogeneous nodes with the global clock of the network (Sink).Sink is mobile here, and the route for sink is determined after the CH selection according to average residual energy concept. The clusters in the network are used to form the spanning tree with 'V' set of CH connected with 'E' wireless links T (V, E) as shown in Fig.1.

The network T (V, E) is divided into many sub-trees of clusters T1, T2, T3,…, Tn. The sink is placed at the root of the tree. The network has sub-tree of clusters (inter-cluster) with one CH and a number of nodes within the cluster. Also, a spanning tree of all nodes in the cluster is made and then divided into sub-levels (intra-cluster). Each sub-tree is a set of nodes including CH and several child nodes. The frequency of each clock is approximately fixed and maintains the time stamp which is synchronized with the global clock of the network during synchronization process. The algorithm used in synchronization process is also given. We are using controlled mobility of sink in our new algorithm in order to minimize the energy consumption.

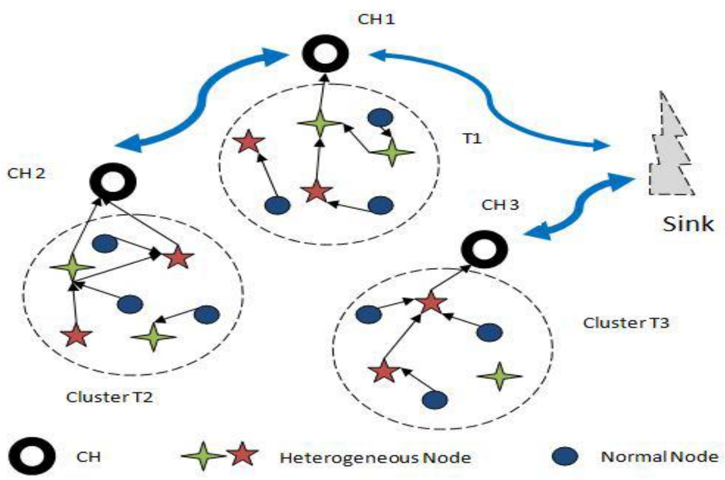

Fig 1: Network Model

The formation of algorithm progress as:

A. Structure the cluster tree and perform level by level total.

B. Synchronize the exercises of the hub to decrease energy utilization by diminishing errors and delay.

C. Timetable the exercises of the hubs as indicated by free slots.

D. Diminish the errors because of clock skew thus the vitality utilization and delay.

E. Zone of WSN is partitioned into 8 sections and average residual energy of each part is determined and Sink course is characterized on the premise of average leftover energy determined.

Algorithm used for synchronizing the nodes

1) Head clock drift and offset is broadcast.

2) Member's clock drift and offset is calculated.

3) Node time is calculated by the given formula:

4) Node_time=current time*drift+offset ;

5) Difference between head and member's clock drift i.e., deldrift is calculated.

6) In the same manner deloffset is calculated

7) Two clocks are synchronized by adding the difference value of drift and offset to the member clock.

3.1 Sink Mobility Process:

We are utilizing controlled mobility of sink so as to limit the energy utilization as looked at in past NHES model. Controlled mobility alludes to plans where sink portability is controlled or guided dependent on a parameter of intrigue, for example, remaining vitality of the hubs, or on a predefined target work, or on predefined recognizable occasions., Here the sink attempts to remain away from the hubs with high residual energy and attempts to be in the region of those hubs that have less leftover energy. This makes a difference adjusting the energy scattering from the hubs, and henceforth decreases E-avg (normal vitality of model). To play out this sort of approach we partition the region of the remote sensor organizes in 8 sections (45 degree each).

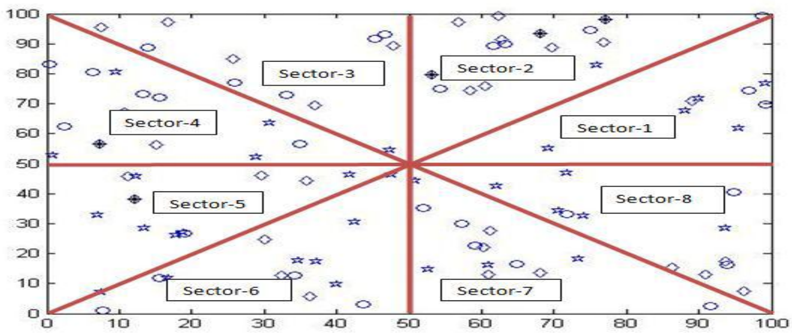

Fig 2: Area of WSN is divided into 8 sectors to define the route for sink

4. RESULT AND DISCUSSION

4.1 Average Energy Consumption

This graph is showing the comparison between base NHES algorithm and the newly developed NHES with Mobile sink (NHESMS) algorithm. The graph is representing average energy consumption is reduced by adding sink mobility in the network.

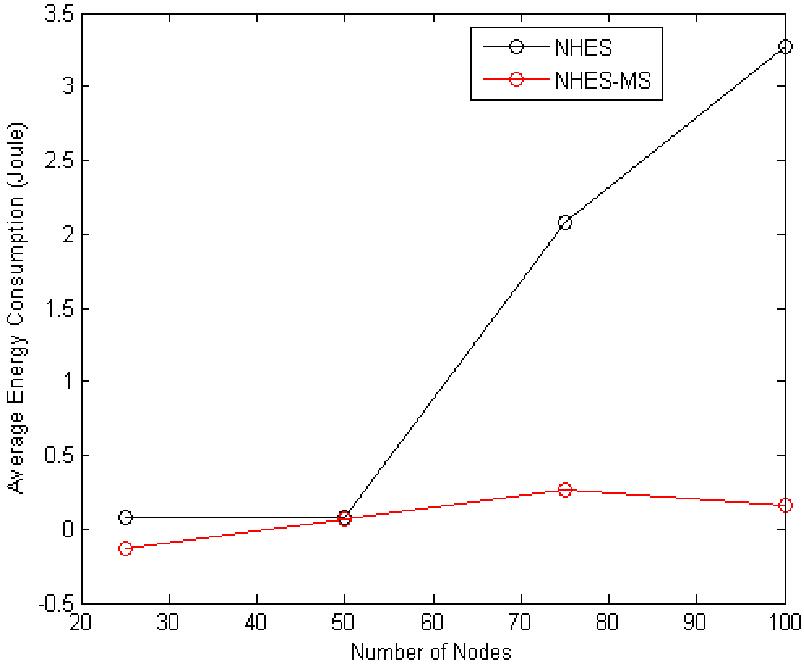

Fig 3: Average Energy Consumption

4.2 Synchronization Error:

This graph is representing the reduced synchronization error in the new mobile sink NHES algorithm.

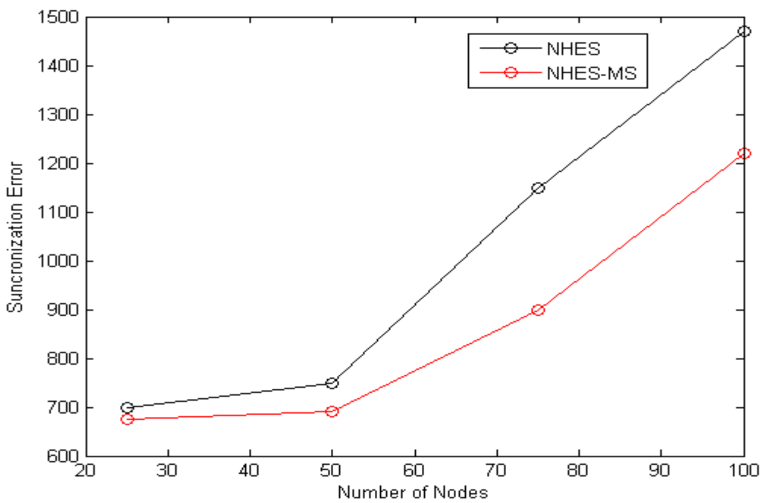

Fig 4: Synchronization Error

5. CONCLUSION

The proposed synchronization calculation with spreading over tree component and sink versatility shows improvement in vitality utilization and deferral as contrasted and existing NHES model. The expansion of heterogeneous nodes in the system alongside the synchronization of local and global clock assists with continuing the system for quite a while. The clock synchronization decreases the clock floats and consequently errors which bring about an expansion of the throughput, and lessens the delay. With the presentation of controlled hub heterogeneity, the exhibition of the synchronized calculation is improved. Additionally, the pair-wise synchronization lessens the probability of retransmission of bundles and lessens the postponement. This Sink portability based NHES algorithm(NHES-MS) can be made progressively proficient on the off chance that we perform information gathering method utilizing PSO.

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