6. Methodology of Proposed WSN Setup

In this section, we propose an alternate theoretical WSN setup, which utilizes best practices from some of the energy efficient mechanisms discussed earlier, in hopes of producing an overall WSN implementation which maximizes its limited energy resources, and thereby survives for a longer time.

The following are the aspects from the aforementioned energy efficient mechanisms we intend to use to form our proposed structure:

- The overall structure for the mobile sinks or base stations will employ the Radial Propagation Structure, as it provides maximum coverage of the entire area of the WSN due to the mobility pattern of the mobile sinks
- The principle of forming the entire WSN into multiple clusters or groups, with each cluster having its own cluster head, will be used. The cluster head here will be the node that receives data from other nodes in the same group.
- The TRAMA protocol will be utilized to create time slots for WSN activity, and also to measure and recognize if nodes are ready to transmit data or not.

In our proposed implementation of the WSN, we intend to use the Radial Propagation Structure for the movement of the base station or mobile sink throughout the network. This is mainly because this pattern of double mobile sinks covers the maximum area in shortest time, of the entire network. However, there is some minor energy expending disadvantages of the radial structure. In this structure, it is said that nodes will mostly be idle, but they will always be calculating the shortest distance (Euclidean Distance) between themselves and the mobile sink, in order to find the right moment to activate and transmit data. This leads to a small lack of energy efficiency, as the nodes always need to be calculating even when not in use, the calculation thereby, using up some minor energy in the process. This is something we try to avoid in our proposed structure. At the same time, this structure assumes that the WSN is continuous in nature, thereby remaining active even at times when the nodes might not have any data to transmit.

The proposed implementation will employ clustering or grouping of the WSN into various clusters, each with its own assigned cluster head. This cluster head is calculated based on the calculation that the node in a group is the shortest distance from all other nodes. This makes it easier and much quicker for other nodes within the group, to transfer their data to the cluster head. This setup will also have the advantage that the other nodes in a group can transfer their data to the cluster head only when needed, and as such, the WSN doesn't need to be one of a continuous nature. When the mobile sinks move along a circular path in the network to collect data, only the cluster heads will transfer the data to the base stations, based on shortest distance calculation. Apart from the time taken to transfer data to the cluster head in each group, the other nodes will always be in idle state. This ensures that the nodes in each group are in idle state for most of the time thereby preserving energy. At the same time, the cluster head only transfers data to the mobile sink based on shortest distance, which also helps in energy efficiency.

Lastly, because of the continuous nature of the previous radial structure of the WSN, the dual mobile sinks had to always move in circular direction whether the other nodes had any data to transfer or not. This leads to some wastage of energy as the mobile sinks would have to take round trips through the network and make the cluster heads calculate shortest distance even when there might be no data to transfer. This is where the application and time slot management of TRAMA protocol comes in. The TRAMA protocol here would first be able to create time slots at regular intervals. At the start of each of these time slots, this protocol will also be able to determine, whether any cluster head nodes in the network have any data transmission activity pending. The mobile sink will be released on its usual circular route to receive data from head nodes, only if the TRAMA protocol confirms that there are indeed cluster heads which await data transmission in the time slot. On the other hand, if the protocol finds out that there are no transmissions pending at any given time slot period, the WSN will cancel the circular propagation operation of the mobile sink for that time period, thereby saving more energy.

The above proposed structure of the WSN shifts from the usual continuous network as described in previous energy efficient mechanisms, and shifts to a more event driven network, where controlled events based on node groups, are driven based on time slots and the need to transmit information. This helps the proposed WSN to do minimal work, only when necessary, thereby saving much needed energy.

A diagrammatic approximation of the above proposed WSN structure is given below in Figure 4.

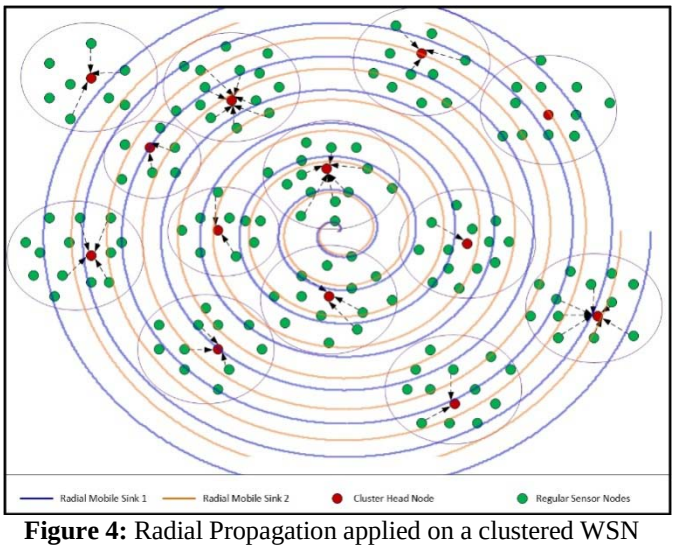

Figure 4: Radial Propagation applied on a clustered WSN (proposed)

7. Conclusion and Future Work

This paper presented a detailed review on the structure and nature of wireless sensor networks, their applications and inherent problems associated with WSNs. The paper also discussed some of the promising solutions suggested for

energy efficiency in WSNs, followed by discussion of a theoretical proposed solution that might further help the energy resource issues in WSNs.

With all the different applications as discussed in section 3 of this paper, it is easy to imagine how important a part the WSNs play in our daily lives now and for the coming years. The applications of WSNs can only be fully realized if the critical problems associated with WSNs could be solved. The various applications mentioned in the form of environment and terrain monitoring, military and healthcare can only succeed if the WSN stays alive and working and is not brought down by things such as low energy or lack of resources. This is the main problem which this article tries to provide solutions to, so that future and current applications of WSN last longer and are more reliable, scalable and sustainable.

Future work in this field would include an alternate proposed theory for energy efficiency in WSNs, where the radial propagation structure of mobile sinks might be dropped in favor of mobile sinks which could just directly go to the cluster heads and get data. However, this would mean additional concerns such as the head nodes having GPS sensors for positioning information, which are also detrimental to battery life and hence life of the network. Future work in this area could also include applying or developing mathematical models and simulations to prove the performance measures for the proposed theoretical structure in WSNs in this paper.

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