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Centralized and Energy Saver Hierarchical Routing Protocol for Wireless Sensor Network

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Abstract: *The main issue in WSN is energy limited characteristic of the sensor node. So the problem is to have the routing protocol in such the manner that it should be energy efficient in order to increase the life span of the whole WSN. Based on the network structure adopted, the routing architecture is classified as Data centric architecture, hierarchical routing architecture, and location based routing architecture. Hierarchical routing can be centralized or non- centralized. In non centralized hierarchical routing, the sensor nodes self configures for the cluster head on the basis of selecting a random number. They don't consider the case of residual energy. But in centralized routing the base station is responsible to create cluster. To design a new protocol with named Centralized and Energy Saver Hierarchical Routing Protocol (CESH). In CESH, initially the base station request to all nodes to send their neighbor list and residual energy. After having the information about the whole network, the base station performs computation to form the better cluster in such a way that there is less energy consumption. In CESH, the election of cluster heads is not randomized but is based on the residual energy of the cluster nodes and the logical structure of the whole network. So the life span of the whole network is increased. In hierarchical routing architecture, sensor nodes self configures them for the formation of cluster heads. In this paper, we will design a routing protocol with named Centralized and Energy Saver Hierarchical Routing Protocol -CESH. This protocol is base station assisted i.e. this protocol utilizes a high-energy base station to set up clusters and routing paths, perform randomized rotation of cluster heads, and carry out other energy-intensive tasks. So, in terms of power it will be highly power efficient. It is centralized since in this protocol, rather than self-configuration, base station is used (that is centralized located in the sensor field). Lastly, the new protocol CESH will be compared with LEACH-C.*

1. INTRODUCTION

Wireless sensor networks are an emerging technology for monitoring physical world. The energy constraint of Wireless sensor networks makes energy saving and Prolonging the network lifetime become the most important goals of various routing protocols. Clustering is a key technique used to extend the lifetime of a sensor network by reducing energy consumption. Also Putting few heterogeneous nodes in wireless sensor network is an effective way to increase the network lifetime and stability. The energy saving schemes for homogeneous wireless sensor networks do not perform efficiently when applied to heterogeneous wireless sensor networks. Thus, Energy efficient clustering protocols should be designed for the characteristic of heterogeneous wireless sensor networks [1].

In wireless sensor network, one of the main constraints is limited battery power which plays a great influence on the lifetime and the quality of the network. Several routing protocols have been designed for wireless sensor networks to satisfy energy utilization and efficiency requirement. Efficiency, scalability and lifetime of wireless sensor network can be enhanced using hierarchical routing. Here, sensors are organized themselves into clusters and each cluster has a cluster head [2].The main role of cluster head is to provide data communication between sensor nodes and the base station efficiently [3].

Another way to prolong the lifetime of wireless sensor network is to insert a percentage of heterogeneous nodes. Heterogeneous wireless sensor network consists of sensor nodes with different ability, such as different computing power and sensing range. Heterogeneous wireless sensor networks are very much useful in real deployments because they are more close to real life situations [4-7].

Routing in WSNs is very challenging due to the inherent characteristics that distinguish these networks from other wireless networks like mobile ad hoc networks. A sensor node in general serves a unique need in an application where ad-hoc nodes are found to

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be more generic. Some examples of the ad-hoc device could include a PDA, laptop PC or a cellular phone. As mentioned in [8][9], the key distinguishable differences are:

Network Size: The sizes of the wireless sensor network can ran into thousands, perhaps in future even into millions, e.g. (small dust). On the other hand, ad-hoc network usually consist of smaller number of nodes. One aspect that could also be included in this area is the problem of localization. If the sensor network is deployed over a large geographical area there may exist a need to know the location of that node, else the sensed information may be useless. The two predominate means of determining location is via either GPS or triangulation. Methods using triangulation are better suited for WSNs, as they don't require another power consuming module attached to the sensor node. The transceivers in most provide information that will allow triangulation to certain accuracy. GPS modules in most cases provide for more accurate positioning but consume large amount of power [9].

Node Density: Some applications in WSN area only require a small number of nodes covering a specific area, but the idea is that there would be some form of redundancy where the ratio of nodes per square meter is larger than that of traditional ad-hoc network. A node in ad-hoc network is usually much larger than a sensor node of a WSN and thus power source and transmission equipment can be greater. This fact alone allows for some sensor nodes to be placed in an overlapping pattern so as to maintain network integrity should be neighbor node die.

Node proneness to failure: the energy that is available to an ad-hoc node is usually replenishable via recharging or swapping out the batteries. This is not always the case or even an available option with the sensor node. Unless some form of power scavenging is performed, a sensor node is left with the energy reserves that it was given at the start. Power is not the only reason for a possible failure, as mentioned previously; the sensor nodes are smaller in size. This makes them more prone to hazardous environmental conditions when placed randomly and without fore thought, i.e. dropping from an aircraft. Their size would even alone them to be stepped upon after deployment. If a node is placed in a location on purpose and out of harms reach, the only failure should be due to power or equipment [8].

Frequency of topology changes: Due to a node failure, movement or some environmental factors, a sensor network can have many changes to its topology. Routes appearing and disappearing places the most pressure on the network layer and the routing algorithms. A topology change will usually result in some transmissions, and ad mentioned these transmissions are the main use of the available energy given to a node. Ad-hoc nodes usually join the network and for the most part can communicate with the gateway or final destination, e.g. sink node, directly. The failure rate is lower and ad-hoc nodes are not usually affected by environmental hazards to the extent that sensor nodes may be.

Communication paradigm employed: communication between wirelesses nodes are broadcast and are received by all nodes within reception range. Ad-hoc networks usually use point to point communication as they are in direct contact with their sink node. An ad-hoc node also has a more intelligent and powerful routing protocol. A wireless node does not always know the path to the destination, and makes use of broadcasts to send and receive. Another distinct differentiator is that a WSN usually has one destination for communication, the sink, whereas an ad-hoc network may have many destinations for a single transmission[8].

Resource limitations of nodes: the two main limitations for a sensor node include the available bandwidth and the afore mentioned energy reserves. The available bandwidth of an ad-hoc network is usually greater (11 Mbps) than that of a sensor node (250kbps). All the components are smaller and /or more limited than their counterparts on ad-hoc nodes. Some of these components include; memory, processor, transceiver, and batteries. A sensor node could operate using a 4 MHz microcontroller and an ad-hoc node could make use of the latest Intel CPU [9].

Node identification: with the possibility of thousands of nodes, an addressing scheme becomes very important. For possible and effective communication of data, each node would require a unique address. Due to sheer number of nodes, it is not possible to have a global addressing scheme and it would be difficult to enforce. Ad-hoc nodes in contrast generally make use of IP addresses which have well defined criteria for their selection and implementation.
Each of these previously mentioned differences add to the woes of designing and implementing the protocols

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and algorithms for a WSN environment however they must be considered [8,9].

2. PROPOSED METHODOLOGY

Step 1: Initially, base station deploys the nodes in Network area with constant energy E.

Step 2: Base Station sends a START message to all the nodes in the sensor field, to acquire information about their routing table.

Step 2: After receiving the "START" message, each node broadcasts the hello message "HELLO". Each node receiving hello message "HELLO" sends "REPLY" message containing its ID. When a node gets reply, it will note down the ID of the node from where the reply has been acknowledged. In this way each node will have their individual routing table.

Step 3: After receiving the information about their neighbors the nodes, for which the base station is within their range, sends a STATUS message to the base station. This STATUS includes ID, routing table, and Energy of the node. Base station sends an acknowledge (ACK) to all sending nodes.

Step 4: After acquiring acknowledge ACK, the nodes declare itself as parent node and broadcast to all its neighboring nodes.

Step5: The node receiving the parent node's message will check their status whether it is parent node or not, if it is not a parent node then it will become a child node of the parent, from where it has received the parent node message first.

Step6: Parent nodes send the STATUS to its grand-parent or direct to Base Station.

Step7: The nodes which are directly sending the STATUS to Base Station, becomes the Cluster Head for the current round. Steps 5-7are repeated until single node is alive.

Step8: For second round the nodes directly communication with Base Station and having max. Energy becomes the Cluster Head.

Step 9: Cluster Head will receive data from nodes that comes in its cluster area.

Step 10: After collecting data, Cluster Head sends the aggregated data to the Base Station.

Steps 9-10 are repeated until system is alive.

Each node, during its allocated transmission time, sends to the cluster head quantitative data concerning the sensed events. Each cluster head receives the data from its cluster nodes. The base station collects all the messages transmitted to it.

3. IMPLEMENTATION and RESULT

To access the performance of CESH, we simulated CESH using OMNET++ and compared its performance with other centralized based clustering routing protocol LEACH-C. Performance is measured by quantities matrices of average energy dissipation, system lifetime and number of nodes that are alive. Throughout the simulations we consider network node configuration with 100 nodes where, each node is assigned an initial energy of 2J.

For the experiments described in this paper [10], the communication energy parameters are set as:
E=50nJ/bit, e_{fs}=10pJ/bit/m^2, and e_{mp}=0.0013pJ/ bit/ m^4. The energy for data aggregation (E_{DA}) is set as 5nJ /bit/ signal. The electronics energy E, depends on factors such as the digital coding, modulation, filtering, and spreading of the signal, whereas the amplifier energy $e_{fs}d^2$, or $e_{mp}d^4$, depends on the distance to the receiver and the acceptable bit-error rate.

Average Energy Dissipation: Figure 1 shows the average energy dissipation of the protocols under study over the number of rounds of operation. This plot clearly shows that CESH has a much more desirable energy expenditure curve than that of LEACH-C. On average, CESH exhibits a reduction in energy consumption of 40 and 30 percent in LEACH-C. This is because all the cluster heads in LEACH-C transmit data directly to the distant base station, which in turn causes significant energy losses in the cluster head nodes. CESH alleviate this problem by having only one cluster head node forward the data to the base station. This in turn increases the communication energy cost for those LEACH-C nodes that have far neighbours.

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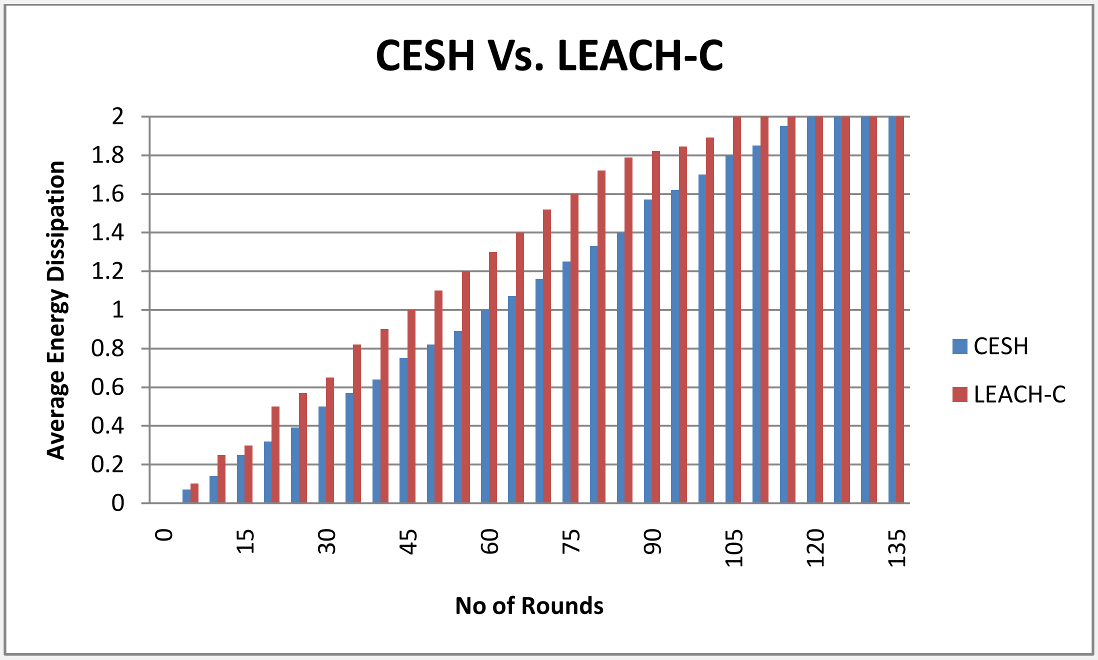

Figure 1: A Comparison of CESH's Avg. energy dissipation with other centralized clustering based LEACH-C routing protocol

System Lifetime: The improvement gained through CESH is further exemplified by the system lifetime graph in Figure 2. This plot shows the number of nodes that remain alive over the number of rounds of activity for the 100 m × 100 m network scenario. With CESH, 82% of the nodes remain alive for 60 rounds, while the corresponding numbers for LEACH-C is 40%, respectively. And With this, 45% of the nodes alive for 105 rounds while the corresponding numbers for LEACH-C is 0 node alive i.e. all the nodes are dead for LEACH-C after 105 rounds.

Furthermore, if system lifetime is defined as the number of rounds for which 75 percent of the nodes remain alive; CESH exceeds the system lifetime of LEACH-C and outperforms that of LEACH-C by 30 percent.

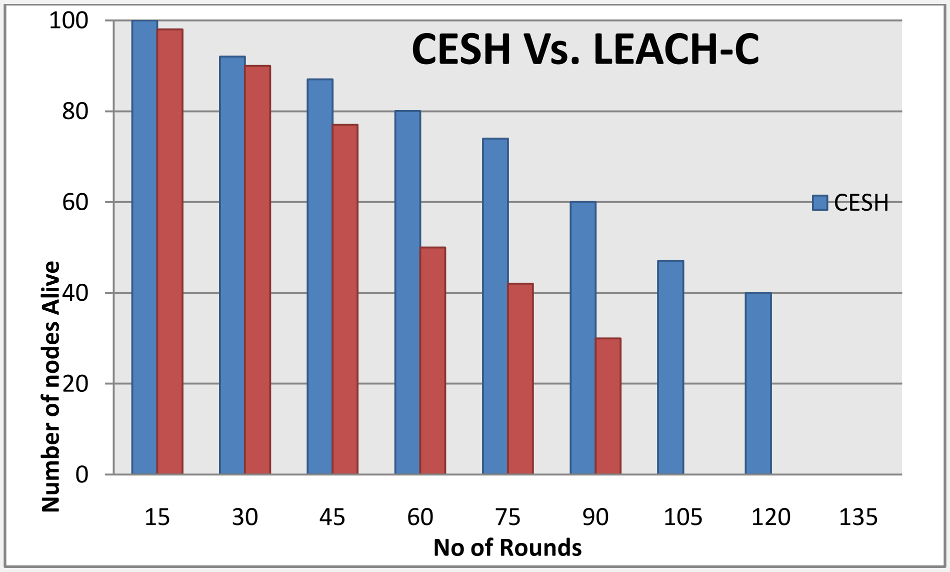

Figure 2: Comparison of CESH's System lifetime with other centralized clustering based LEACH-C routing protocol

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4. CONCLUSION

CESH is compared with already developed routing protocol Low Energy Adaptive Clustering Hierarchy-Centralized (LEACH-C). A comparison between two is done on the basis of energy dissipation with time and the system lifetime of network. System lifetime is basically for how long the system works. CESH exceeds the system lifetime of LEACH-C and outperforms that of LEACH-C by 30 percent. CESH has a much more desirable energy expenditure curve than that of LEACH-C. On average, CESH exhibits a reduction in energy consumption of 40 and 30 percent in LEACH-C.

REFERENCES

[1] Razieh Sheikhpour, Sam Jabbehdari, Ahmad Khadem-Zadeh, "Comparison of Energy Efficient Clustering Protocols in Heterogeneous Wireless Sensor Networks" International Journal of Advanced Science and Technology Vol. 36, November, 2011.

[2] Md. Golam Rashed, M. Hasnat Kabir and S. E. Ullah, "WEP: An energy efficient protocol for cluster based heterogeneous wireless sensor network," International Journal of Distributed and Parallel Systems (IJDPS) Vol.2, No.2, March 2011, pp. 54-60.

[3] P. Saini and A. K. Sharma, " Energy Efficient Scheme for Clustering Protocol Prolonging the Lifetime of Heterogeneous Wireless Sensor Networks," International Journal of Computer Applications (0975 – 8887)Vol. 6– No.2, September 2010, pp.30-36.

[4] D. Kumar, T. C. Aseri and R. B. Patel, "Distributed Cluster Head Election (DCHE) Scheme for Improving Lifetime of Heterogeneous Sensor Networks," Tamkang Journal of Science and Engineering, Vol. 13, No. 3, 2010, pp. 337-348.

[5] V. Katiyar, N. Chand, S. Soni, "A Survey on Clustering lgorithms for Heterogeneous Wireless Sensor Networks" Int. J. Advanced Networking and Applications Vol. 02, Issue: 04, pp. 745-754, 2011.

[6] D. Kumar, T. C. Aseri and R. B. Patel, "EEHC: Energy efficient heterogeneous clustered scheme for wireless sensor networks," Computer Communications, Vol. 32, 2009, pp. 662–667.

[7] A. A. Abbasi and M. Younis, "A survey on clustering algorithms for wireless sensor networks," Computer Communications 30, 2007, pp. 2826-2841.

[8] C. Leuschner, "The Design of a Simple Energy Efficient Routing Protocol to Improve Wireless Sensor Network Lifetime," Master's thesis, Electrical, Electronic and Computer Engineering, University of retoria, April 2005. [Online]. Available: http://upetd.up.ac.za/thesis/available/etd-01242006-091709/unrestricted/00dissertation.pdf.

[9] I. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless Sensor Networks: A Survey," Computer Networks (Elsevier), vol. 38, pp. 393–422, 2002.

[10] W. B. Heinzelman, A. P. Chandrakasan, and H. Balakrishnan, "An Application-Specific Protocol Architecture for Wireless Microsensor Networks," IEEE Trans. Wireless Commun., vol. 1, no. 4, Oct. 2002, pp. 660–70.