Enhanced Balanced Cluster Lifetime Prolonging Protocol for Wireless Sensor Network

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ABSTRACT
In enhanced balanced cluster lifetime prolonging protocol we investigate that how balance cluster approach work in heterogeneous environment by applying same network structure in heterogeneous environment. Dividing network in four equal static balanced cluster so that all the clusters have almost equal number of nodes. This will help in even load distribution of network and this will increase the network lifetime and energy of the network. Simulation-based evaluations are performed to compare the performance of EBCLPP against BCLPP balanced cluster lifetime prolonging protocol and EDDEEC Enhanced Developed Distributed Energy-Efficient Clustering for Heterogeneous Wireless Sensor .Our experiment results show that EBCLPP outperforms BCLPP and EDDEEC in terms of network lifetime and power consumption minimization.
In heterogeneous wireless sensor network optimization of energy is the main issue. In previous scheme the clusters where formed dynamically and the cluster head selection was based on the probability. Formation of clusters dynamically lead to loss of energy in every round which affected the network lifetime and energy of every node. We investigate that how balance cluster approach work for heterogeneous wireless sensor network in this scheme we are forming the balance cluster in the start of network operation in order to reduce the overhead of cluster formation after every round. We divide sensor nodes in four cluster and all the cluster have almost equal number of nodes. And by doing so the cluster does not even get unbalanced as nodes in all the clusters are almost same. Cluster head selection is mapped to homogenous network that is done by finding the weight of nodes in the cluster and so the node having highest energy will become cluster head for the round. In this case all the nodes whether they are super nodes or normal nodes all the nodes get the chance to become the cluster head. This will increase the number of nodes alive over time and also the average energy per node.

Keywords
Cluster head, Heterogeneity, Energy-Efficiency, Network Lifetime, and Wireless Sensor Network.

1. INTRODUCTION
A wireless sensor network is a collection of sensor nodes interconnected by wireless communication channels. Each sensor node is a small device that can collect data from its surrounding area, carry out simple computations, and communicate with other sensors or with the base stations (BS). Such networks have been realized due to recent advances in micro electromechanical systems and are expected to be widely used for applications such as environment monitoring, home security, and earthquake warning [1].

The advent of efficient short range radio communication and advances in miniaturization of computing devices have given rise to strong interest in wireless sensor networks [2], [3]. A wireless sensor network (WSN) consists of hundreds or thousands of MEMS-based sensor nodes with the station either directly (single hop) or via other nodes (multi hop) around it in a cooperative manner. Such as network typically suffers from a number of unavoidable problems, such as resource-constrained nodes, random node deployment sometimes in an unattended open field etc. In some critical applications e.g. medical instrument monitoring it is very difficult to replace/recharge battery. Therefore, the network as a whole must minimize the energy usage in order to enable untethered and unattended operation for an extended period of time.

Many works are so far reported towards minimization of energy usage. One of the ways to minimize such energy usage is employment of clustering. Clustering is defined [4] as the grouping of similar objects or the process of finding a natural association among some specific objects or data. It is used in WSN to transmit processed data to base station minimizing the number of nodes that take part in long distance communication leading to lowering of total energy consumption of the system.

In this present work, we investigate that how balance cluster approach work in heterogeneous environment by applying same network structure in heterogeneous environment. Dividing network in four equal static balanced cluster so that all the clusters have almost equal number of nodes. This will help in even load distribution of network and this will increase the network lifetime and energy of the network. The rest of the paper is organized as follows. Section 2 describes the proposed scheme along with the equivalent algorithm. Performance evaluation and simulation results are obtained in section 3. The entire work is concluded in section 4.

2. PROPOSED SCHEME
The proposed protocol for heterogeneous wireless sensor network is based on to increasing the network life time and to make sure that there are more number of nodes alive in the network for longer period of time. It is an energy efficient protocol based on clustering scheme where first the network is divided into clusters and all the clusters have all most equal number of sensor nodes.

2.1 Proposed Algorithm

Setup Phase

- Arrange Xi in ascending order. Arrange Yi in ascending order.
- Now short Xi and Yi to get half no. of nodes and plot them on X, Y axis.
- Now this becomes center coordinate.
- Nodes greater then both coordinate are put in one cluster.
- Nodes smaller then both coordinate are put in one cluster.
- Nodes smaller then Xi and greater then Yi are put in one cluster.
- Nodes smaller then Yi and greater then Xi are put in one cluster.
- Now all clusters have same no. of nodes.
- Random selection of temporary-cluster-heads to start with.
- Preparation of TDMA-schedule.

Responsible Node Selection Phase

1. BEGIN /* setup phase (tasks are performed by base station)*/
2. For i← 1 to m_i /* m_i → Number of nodes of $Cluster_i$ */
3. For every node m_i

   $W_i = R_{energy}\, m_i / I_{energy} m_i$

   /* R_{energy}→ Residual Energy
   I_{energy} → Initial Energy
4. If $R_{energy}\, m_s > R_{energy}\, m_A$ /*M_s→ Supernode, M_A → Advanced Node */
5. CH= max(M_s)
6. Else
7. CH= max (M_A)
8. Else
9. CH_i= [ ] /* for current round */
10. TCH_i= [ ] /* for next round */
11. End

    /* Setup phase finished */

Steady-State Phase

- Data is transmitted to base station by CH.

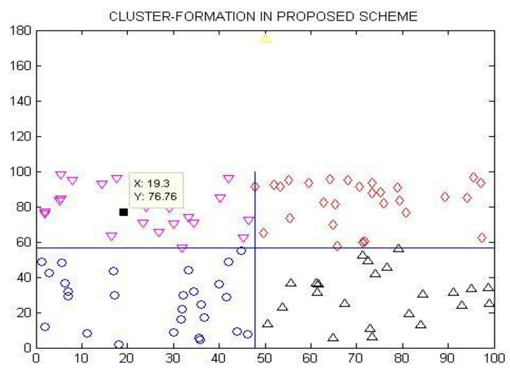

Figure 1. Cluster formation in EBCLPP

3. PERFORMANCE EVALUATION

3.1 Quantitative Analysis

3.1.1 Simulation Environment:

We consider a network containing 20 normal nodes having E_0 energy, 32 advanced nodes having 2.0 times greater energy as compare to normal nodes and 48 super nodes containing 3.5 times greater energy as compare to normal nodes. The parameters use for the simulation are given following:

• m = 0.8

• m_0 = 0.6

• a = 2.0

• b = 3.5

Table 1 represents various parameters and their values used in simulation.

TABLE 1. PARAMETERS AND CORRESPONDING VALUES USED IN SIMULATION

Parameter	Parameter's Name
Network Area	100m X 100m
Base Station's Position	(50m, 175m)
Initial Energy for Nodes	2 Joule
Number of Deployed Nodes	100
Size of Data Message	4000 bits
Energy Consumed in Data Aggregation(E_{DA})	5nJ/bit/signal
Energy Consumed by Transceiver's Circuitry(E_{elec})	50nJ/bit
Energy Expenditure in Transmit-Amplification in free-space model(e_{fs})	10pJ/bit/m^2
Energy Expenditure Transmit-Amplification in multipath fading model(E_{mp})	0.0013pJ/bit/m^4

3.1.2 Simulation Metric:

The performance of the scheme is evaluated considering network lifetime as a parameter which is defined as the time until the last node dies in the network. Network lifetime is measured using following yard-stick.

- Number of nodes alive in the network.
- Average energy per node.

3.1.3 Result and Discussion:

A set of experiments is conducted to compare the performance of present scheme EBCLPP with EDDEEC [5] and BCLPP [9].

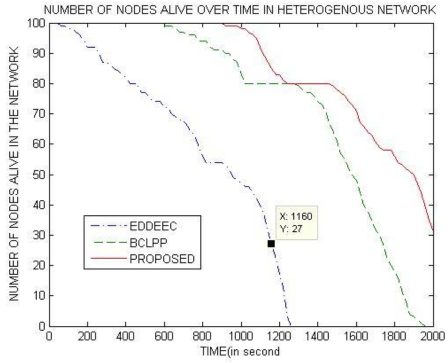

Figure 2.(a) Comparison of proposed scheme with BCLPP and EDDEEC in terms of number of nodes alive in the network

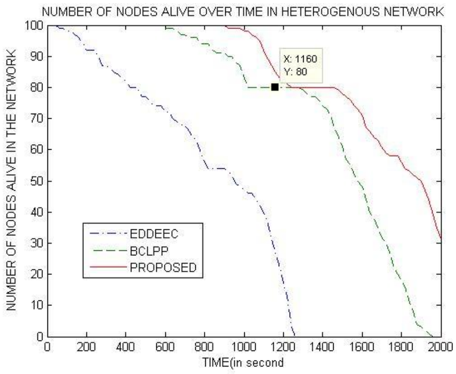

Figure 2. (b) Comparison of proposed scheme with BCLPP and EDDEEC in terms of number of nodes alive in the network

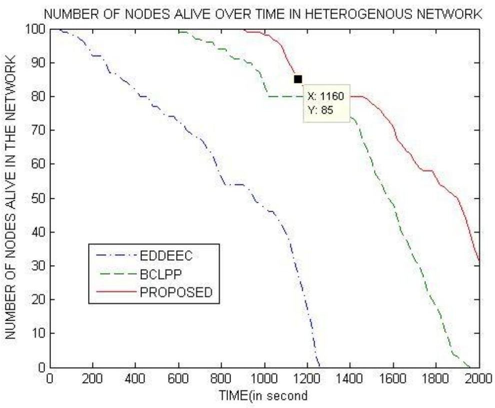

Figure 2. (c) Comparison of proposed scheme with BCLPP and EDDEEC in terms of number of nodes alive in the network

Fig .2 (a) shows that at 1160 seconds, only 27 nodes are still alive in EDDEEC and in fig.2(b), at the same time there are 80 nodes are alive in BCLPP whereas in fig.2(c), in the proposed scheme EBCLPP, there are 85 nodes are live at the same time

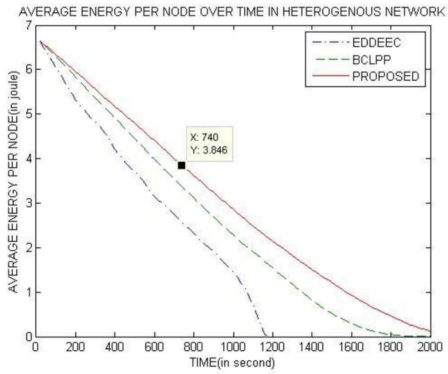

Figure 3. (a) Comparison of proposed scheme with BCLPP and EDDEEC in terms of average energy per node

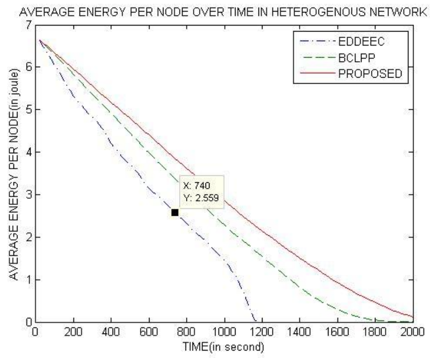

Figure 3. (b) Comparison of proposed scheme with BCLPP and EDDEEC in terms of average energy per node

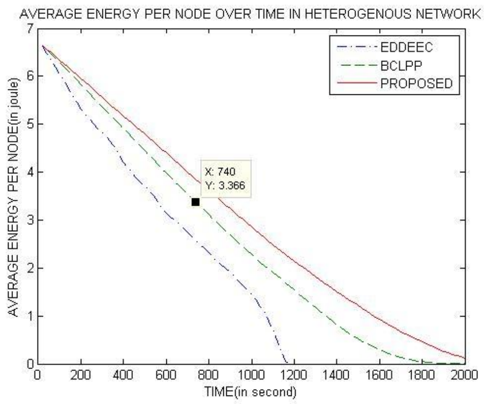

Figure 3. (c) Comparison of proposed scheme with BCLPP and EDDEEC in terms of average energy per node

In fig 3(a), after 740 seconds, the average energy per node(in joule) is 2.559 in EDDEEC, in fig 3(b) at the same time the average energy per node is 3.366 joule in BCLPP but in fig 3(c), it shows that, after same time the average energy of per node is 3.864 in proposed scheme.

4. CONCLUSION

With the results of simulation, we can conclude that in the case of EDDEEC and BCLPP, the sensor nodes died earlier as they lose their energy while giving data to the CH. This reduced the network life time and even the energy per node was decreased. And in case of EDDEEC and BCLPP the clusters were not balanced as nodes in cluster were not equal. Energy dissipated in the node to cluster head was high in EDDEEC. As the simulation time increases, nodes in the network continuously lose its energy and after a fix simulation time network collapse.

And from the result we can see that in the proposed algorithm the number of nodes in cluster were almost equal and due to this the energy dissipated was less and node died less in comparison to that of EDDEEC and BCLPP.

5. FUTURE WORK

- Energy heterogeneity can be enhanced further more.
- To investigate the proposed scheme with
    - Event driven application.

6. REFERENCES

[1] F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach (Morgan Kaufmann Series in Networking)." San Mateo, CA: Morgan Kaufmann, 2004.

[2] F. Akyildiz, Weilian Su, Yogesh Sankarasubramaniam, and Erdal Cayirci, "A Survey on Sensor Networks", IEEE Communication Magazine 40(8) 2002, pp. 393-422.

[3] J. N. Al-Karaki and A. E. Kamal, "Routing Techniques in Wireless Sensor Networks: A Survey", IEEE Wireless Communication Vol.11, No.6, Dec.2004, pp. 6-28.

[4] Soheil Ghiasi, Ankur Srivastava, Xiaojian Yang, and Majid Sarrafzadeh, "Optimal Energy Aware Clustering in Sensor Networks", SENSORS Journal, Vol. 2, No. 7, 2002, pp. 258-269.

[5] N.Javed, T.N.Qureshi,A.H.Khan, A.Iqbal, E.Akhtar, M.Ishfaq, "Enhanced Developed Distributed Energy-Efficient Clustering for Heterogeneous WSN." Procedia Computer Science 19 (2013), 914-919.

[6] Brown, L. D., Hua, H., and Gao, C. 2003. A widget framework for augmented interaction in SCAPE.

[7] Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "A survey on sensor networks", IEEE Communication Magazine, Aug. 2002.

[8] Wei Yen, Ching-Wei Chen and Cheng-hsiang Yang, "Single Gossiping with Directional Flooding Routing Protocol in Wireless Sensor Networks", in Proceedings IEEE, 2008.

[9] Nidhi Rawat, Anshika Garg and Pooja Khulbe, "Balanced Cluster Lifetime Prolonging Protocol for WSN." IJCA (0975-8887), Volume 100- No. 19, Aug 2014.