A Deterministic & Dynamic Energy- Efficient Clustering Protocol for Wireless Sensor Networks

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ABSTRACT
Wireless Sensor Networks have been used for various purposes in different spaces from the field of industry to our home surroundings because of their capacity to powerfully screen remote areas such as agriculture farm lands, health care system etc [1]. DEC (Deterministic Energy Efficient Clustering) protocol is fast, dispersive, organizing toward oneself and much productive as far as continuity than other of the current protocols. Here presents the Improved DEC (I-DEC) protocol which shows a better performance in comparison to other protocols like original DEC, LEACH, E-SEP with respect to stability or in terms of energy. Through an experiment it was noticed that in I-DEC protocol the network life time has been increased by 132 rounds in comparison to the original DEC protocol. This analysis shows that the approach used in this research, provides an ideal solution for balanced energy consumption in wireless sensor networks.

Keywords
Wireless sensor networks, cluster head, rounds, energy-efficient, protocol.

1. INTRODUCTION
A Wireless sensor network (WSN) is consists of low-size and low complex devices referred as sensor nodes and these nodes are scattered in the field to monitor certain conditions like temperature, humidity etc. at different locations [1], [2]. In WSN, Sensor nodes are electrical devices that may sense the surroundings and gather the knowledge from the surroundings and send the collected information to base station. The sensor nodes are energy constrained devices and the batteries of these nodes cannot be charged [3], [4] so it is very important to design an algorithm which organizes sensors in cluster to reduce the energy and improve the network lifetime.

Therefore, designing energy aware algorithms becomes an important factor for extending the life time of sensor nodes which is necesarry to improve the life time of the network [5], [6]. Low Energy Adaptive Clustering Hierarchy (LEACH) is one of the mostly used probabilistic cluster-based routing protocols for wireless sensor network [7], [8]. In the LEACH protocol the selection of cluster head is randomly on basis of probability of each node in the cluster. Main limitations of LEACH protocol is the uncertainties in the election process of cluster head which affects the network life time. Hybrid Energy- Efficient Distributed (HEED) Clustering protocol is an extension of LEACH protocol. In HEED protocol the residual energy of each node is used as primary parameter while other topology features like node degree, distances to neighbors are also used as secondary parameter to attain power balancing in the network. But they cannot guarantee optimal elected set of cluster heads which is drawback of this protocol [9]. Stable Election protocol (SEP) [10], [11] is also a further

modification to the LEACH protocol that uses two types of node and two level hierarchies are considered. It is based upon weighted electron probabilities of every node which are not dynamic; it shows that the nodes that are far away from the power full nodes will die first i.e. main limitation of SEP protocol.

Wireless sensor network [12] is based on the management of the battery life of each sensor node because sensor nodes are non rechargeable electrical devices. To obtain the better utilization of the energy in wireless sensor network Deterministic Energy-Efficient Clustering (DEC) protocol comes to under the existence [13]. DEC protocol is dynamic and a purely deterministic model that utilizes clustering to organize WSN. In DEC protocol residual energy of each node is used in the cluster for election process of cluster head which provides efficient cluster head [13], [14]. So this protocol is more energy efficient than other protocols like LEACH, SEP. The uncertainties in the cluster-head elections have been minimized in DEC which is main drawback LEACH protocol [14].

In this paper, deterministic & dynamic energy-efficient clustering protocol is present which is an Improved DEC (I-DEC) protocol that provides a better selection of cluster-heads is demonstrated because this protocol uses the sensor node's residual energy completely as the selection process as in DEC protocol. Simulation results shows that I-DEC protocol gives better manage energy consumption and improve the network life-time in number of rounds in comparisons to original DEC protocol.

2. DETERMINISTIC & DYNAMIC ENERGY- EFFICIENT CLUSTERING PROTOCOL
Deterministic & Dynamic Energy-Efficient Clustering protocol i.e. Improved DEC (I-DEC) defined that it can gives a better lifetime in comparison to original DEC protocol and also ensures the node with the highest residual energy will get elected as the cluster head as in original DEC protocol. So in I-DEC protocol a fixed number of cluster heads per round can be chosen which provides a more ideal solution for energy consumption in WSNs.

I-DEC shows better results which makes this protocol is more desirable because in I-DEC the cluster head is selected on the basic of residual energy of each node and each round is independent to their subsequent round. I-DEC ensures that every node has a chance to become the cluster head if its residual energy is higher than other nodes and every cluster head has enough energy to do its work, until at least the end of the network lifetime. So with the help of I-DEC the battery

life of wireless sensor network is significantly optimized I-DEC is by all accounts like a perfect arrangement i.e. similar to ideal solution as shown in figure (1) [14].

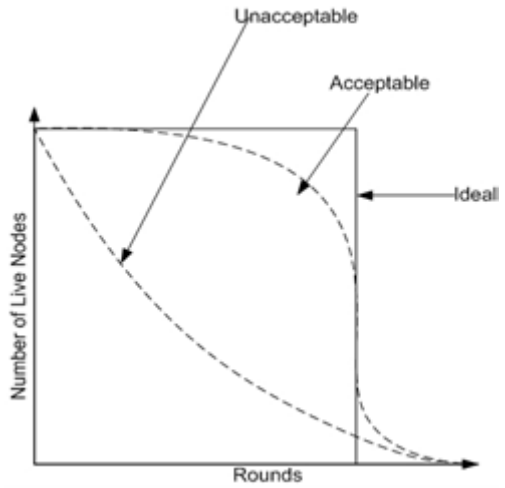

Fig 1: Behavior of node energy consumption in comparison to Rounds [14].

3. SIMULATION PARAMETERS

The initial parameters used to implement the I-DEC protocol are mentioned in Table 1.

Table 1. Initial parameters [14]

Parameter	Value
$x_m \times y_m$	100m x 100m
N	100
K	6000
P_{opt}	0.1
E_o	0.5 J
E_{elec}	50nJ/bit
E_{DA}	5nJ/bit/message
ϵ_{fs}	10pJ/bit/m^2
ϵ_{mp}	0.0013pJ/bit/m^4

In I-DEC protocol five types of nodes: Normal nodes, Intermediate nodes, Advance nodes, Super nodes and Ultra Super nodes are used in the field. All nodes have different energy and energy of each node varies from 0.5 joule to 2.25 joule [14]. These nodes are shown in table 2 along with their configurations.

Table 2. Types of nodes

Types of nodes	Representation of Node	%age
Normal Node		70%
Intermediate Node		9%
Advance Node		8%
Super Node		7%
Ultra Super Node		6%

4. RESULTS AND COMPARISONS

Table3 shows comparison of various existing protocols like LEACH, E-SEP and DEC with the proposed I-DEC Protocol. It shows that in I-DEC protocol network life-time is increased in terms of rounds in comparison to other protocols.

Table 3. Network life time of I-DEC protocol with comparison to existing protocols

PROTOCOL	First Node Dead(Rounds)	Last Node Dead(Rounds)
LEACH[14]	995	4585
E-SEP[14]	1450	3751
DEC[14]	1839	2350
Proposed I-DEC	**1979**	**2482**

Figure (2) shows the performance of alive nodes vs. no. of rounds in I-DEC protocol with the existing protocols i.e. LEACH, E-SEP & DEC. In an I-DEC protocol first node is dead at 1979 which is more in comparison to other protocols. So, I-DEC protocol is more stable and survives more number of nodes i.e. last node dead at 2482 in comparison to original DEC protocol, LEACH & E-SEP.

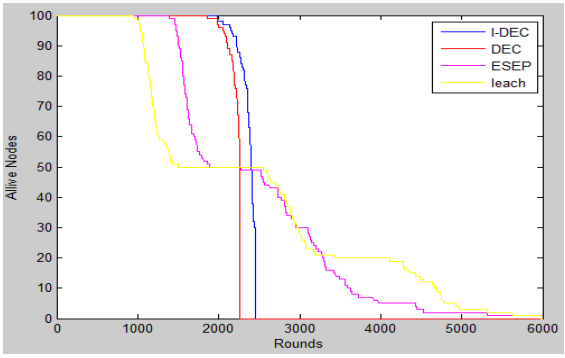

Fig 2: Alive nodes vs. no. of rounds

When I- DEC protocol is compared with original DEC protocol in term of energy it also shows I-DEC protocol is more energy efficient than original DEC protocol. Figure (3)

shows the total energy vs. rounds of I-DEC protocol with comparison to original DEC protocol.

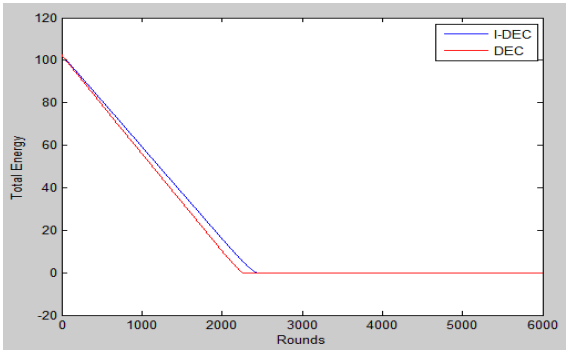

Fig 3: Total energy vs. no. of rounds

Figure (4) shows the Dead nodes with respect to number of rounds and here again the I-DEC perform better than other protocols.

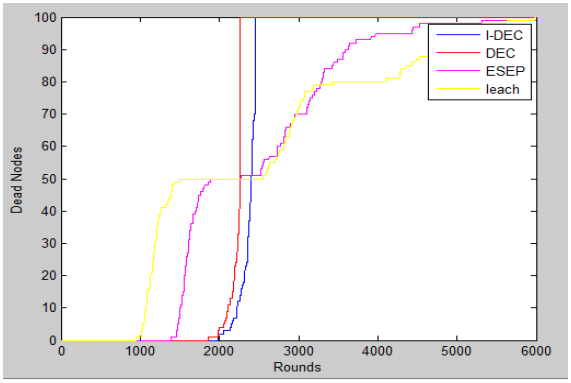

Fig 4: Dead nodes vs. no. of rounds

5. CONCLUSION AND FUTURE SCOPE

In this paper an I-DEC protocol presents which beats the probabilistic-based models by ensuring that a fixed number of cluster heads are chosen every round like in original DEC protocol. After every round cluster heads are chosen according to their remaining energies inside every group to pick the suitable cluster heads. The attributes of I-DEC is extremely attractive because it is near to a perfect arrangement. I-DEC also provides the better lifetime of wireless sensor networks when contrasted with original DEC, LEACH, E-SEP. It has been experimentally verified that the I-DEC improves by 132 rounds in comparison to the original DEC protocol, Further it was also noticed that in terms of stability I-DEC provides more stability in comparison with existing protocols. It is estimated that by the coming years more than 10 billion wireless sensors will be deployed for various applications as environmental monitoring, agricultural farm lands, health care monitoring, medical monitoring etc. These networks connect the physical world and the digital world together that provide us with a richer understanding of our environment and with the ability to more accurately control our surroundings.

6. REFERENCES

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