Initial Energy Value Effects on the Performance of Some Heterogeneous Protocols Levels in Wireless Sensor Network

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Abstract

This paper presents the simulating of 2-level heterogeneous network model for Wireless Sensor Networks (WSNs) to enhance the network life-time, dead nodes number and packet to base station with different value of initial energy which is characterized by a single parameter. The heterogeneous network model also helps to select cluster heads and different nodes sends to base station with different initial values. The network lifetime, number of dead nodes and number of packet send to base station have been computed by implementing Low Energy Adaptive Clustering Hierarchy (LEACH) and Distributed energy-efficient clustering (DEEC) protocols for our network. Low Energy Adaptive Clustering Hierarchy (LEACH) and Distributed energy-efficient clustering (DEEC) protocols have been implemented for the existing 1-level and 2-level heterogeneous network models it is denoted as LEACH-level1, LEACH-level2, DEEC-level1 and DEEC-level2, respectively. The network lifetime and the rate of packet to Base station increased with increasing initial energy on the other side dead nodes number decreased with increasing initial energy. Different values and new results are presented in our article it is recommends adequate initial energy use to increase the network lifetime of WSN.

Keywords: *2-level heterogeneous, LEACH, DEEC, alive nodes, dead nodes, packet to BS, WSN.*

1. Introduction

Sensors capturing and revealing real-world phenomena and converting these into a form that can be processed, stored, and acted upon. Integrated into numerous devices, machines, and environments, sensors provide a tremendous societal benefit could be said that it links the physical with the digital world. Sensors could be help to avoid catastrophic infrastructure failures, conserve precious natural resources, increase productivity, enhance security, and enable new applications such as context-aware systems and smart home technologies. The phenomenal advances wireless communications further contribute to the widespread use of distributed sensor systems. For example, the huge developments in semiconductor technologies evolution and continue to produce microprocessors by increasing processing capacities, while at the same time shrinking in size. The reducing of computing and sensing technologies enables the development of tiny, low-power, and inexpensive sensors, actuators, and controllers. Further, embedded computing systems "i.e., systems that typically interact closely with the physical world" continue to find application in an increasing number of areas. While multi deferent systems still dominate the market, there is an increasing focus on systems to monitor and protect people infrastructure (such as bridges and tunnels), the national grid and networks, and pipeline infrastructure. Networks of thousands of sensor nodes are already being used to monitor large geographic areas for modeling and forecasting environmental pollution and flooding, collecting structural health information on bridges

using vibration sensors, and controlling usage of water, fertilizers, and pesticides to improve crop health and quantity[1].

Increasing the number of sensor nodes does increase the network energy, but the cost is quite high because deploying an extra sensor incurs the cost of the sensor, which is ten times more than the cost of the batteries. Therefore, it is more appropriate and economical to increase the network lifetime by deploying some sensors with high battery. The sensor networks with such characteristics, i.e., sensor node with different energy levels are termed as heterogeneous wireless sensor networks [2].

In this paper, the 2-level heterogeneous network model for WSNs have been presented to prolonging the network lifetime. the heterogeneous network model also helps to select cluster heads and their respective cluster members by using weighted election probability and threshold function.

The rest of the paper is organized as follows. Section 2 background and clustering routing protocols. Section 3 discusses simulation and in Section 4, conclusion are presented and finally in Section 5, the paper is references.

2. Background on clustering routing protocols

Cluster techniques is used in wireless sensor network to make a balance in the network. layered protocols is an example of cluster where the network is consisting of several clusters of sensor nodes. leader node of cluster called cluster head [3].

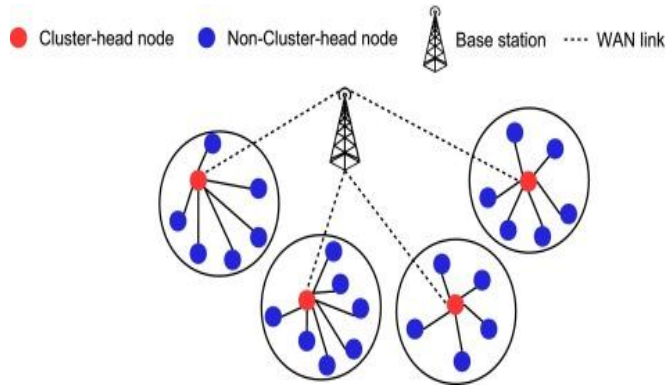

Fig 1. Clusters in wireless sensor network

In two steps the cluster process can be make as for example first cluster heads are chosen and then clusters are formed. Selection-Number of cluster to be chosen depending upon the application it can be either fixed in priori or dynamically. Selection of cluster head can take place in two ways distributed and centralized. In centralized approach a central authority chooses the cluster head based on certain parameters which distributed of each node is independent to take the decision of becoming the cluster head. Clusters formation is chosen cluster heads then broadcast invite packets to all the nodes that comes in their range. this is necessary for all the nodes to turn on their receivers during this stage. Nodes which signal received join the cluster head. In case it receives signal from the cluster heads those it compares the strength of signal to estimate the distance from cluster head, the nearest cluster head is selected cluster head. From this scenario clusters are formed [4].

2.1 Low Energy Adaptive Clustering Hierarchy (LEACH)

LEACH [5] is the most popular algorithms for WSNs. clusters formed based on the received signal strength and the CH nodes is used as routers to the base-station. data fusion and aggregation and other data processing are local to the cluster. It pledges that every node evenly become CH, it does not take into account battery level and the Inter-relationship among nodes. LEACH is a distributed algorithm but cluster count (cluster head) is not fixed in each round per epoch. Due to distributed algorithm each node is capable to select itself as a cluster head by choosing random number. There is possibility that each node chooses the same number for cluster head selection, due to randomness property of random number generator. So cluster head count is varying in each round.

2.9 Distributed energy-efficient clustering (DEEC)

Distributed energy-efficient clustering (DEEC) [6] protocol is also based on LEACH protocol and classified as heterogeneous WSN. The network is divided into clusters where each cluster head is chosen by a probability of ratio between residual energy of each node and average energy of the network. DEEC is better than LEACH, SEP because it has longer lifetime. DEEC protocol assumes that a WSN with two types of nodes of different initial energy levels is a two-level heterogeneous network, and the one with three types of nodes of different initial energy levels is a three-level heterogeneous network [6]. In DEEC, nodes probability of a CH is based on the ratio between the residual energy of the node and the average energy of the whole network. So that the nodes which exceeds in initial energy and residual energy is more likely to be elected as a CH.

Model describes a wireless sensor network that consists of three types of sensor nodes based on their energy levels. The nodes having more energy are supposed to be costly other than having less energy. Because of the costly, the nodes having maximum energy are assumed to be less in numbers. The nodes having a low energy level are the tinny ones and hence they can be deployed amply. The low energy node or node far away from base station becomes cluster-head, cluster-head dies quickly. 2-levels find solution of this problem by dividing task of collection sum aggregation of data from nodes within cluster and transformation of collected data to base station into secondary and primary cluster-head respectively. Secondary cluster-head is responsible for collecting and aggregating data collection from member nodes and then forwarding to primary cluster-head, primary cluster-head is responsible for transmitting and receiving data from secondary cluster- head station. Initial energy changes exceed the performance of protocols and levels of network.

3. Simulation and Results

in this section, the performance of LEACH-level1, LEACH-level2, DEEC-level1 and DEEC-level2 protocols have been discussed and compared with deferent initial energy values. In the simulations, random deployment of 300 sensor nodes in a square field of dimension 300 M x 300 M has been considered. the protocols have been simulated using matlab 2016a and the parameters are listed in the table 1. Also the medium network with 200 nodes number have been used to test the performance of these protocols. The parameters that have been used to test the comparison are Packet-to-BS, Dead nodes and Alive nodes in the network.

Table 1. list of simulation parameters

S. No.	Parameters	Values
1	Network Area	300*300
2	Number of Nodes	200
3	Cluster head probability p	0.01
	Initial energy	0.3,0.5,1,2
4	transmitter energy	50*0.000000001
5	receiver energy	50*0.000000001
6	Aggregation Energy	5*0.000000001
7	amplification energy	0.0013*0.000000000001
8	Number of Rounds	5000

A. First simulation run with initial energy 0.3

In our simulation, the random deployment of 200 sensor nodes in a square field of dimension 300 M x 300 M and 5000 rounds number with intial energy 0.3 j is used.

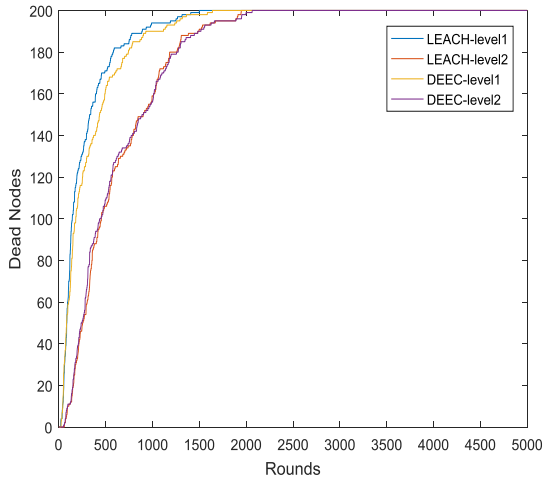

Fig 2. number of dead nodes with 0.3

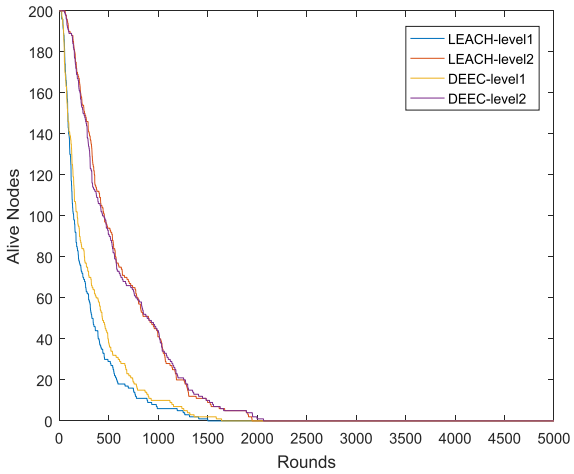

Fig 3. alive nodes number with 0.3

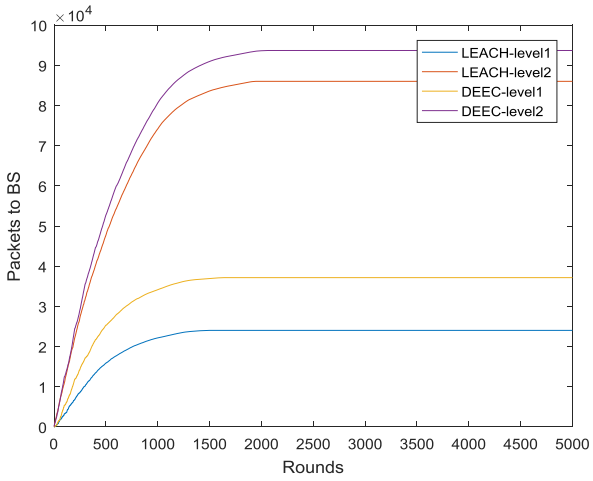

Fig 4. packet to base station with 0.3

First simulation with 0.3 initial energy it has been observed that in fig 2 the dead nodes number of LEACH and DEEC level1 increased other than level2 the maximum reach in level1 when simulation reach 2000 rounds. But in level2 the maximum reach when simulation reach 1500 rounds. This lead us that the dead nodes number decreased in level2 other than level1. The fig 3 shows that the alive nodes number of LEACH and DEEC in level1 decreased until 2000 rounds of simulation but the alive nodes in level2 decreased until the simulation reach 1500 rounds. Means that the network life time decreased in level2 other than level1 heterogeneous protocols. Fig 4 depicts that the packet to base station increased and reach the maximum of level2 in 1500 rounds number of simulation. But in level1 it is still exceeds until 2000 number of simulation rounds

B. Second simulation run with initial energy 0.5

In our simulation, the random deployment of 200 sensor nodes in a square field of dimension 300 M x 300 M and 5000 rounds number with intial energy 0.5 j is considered.

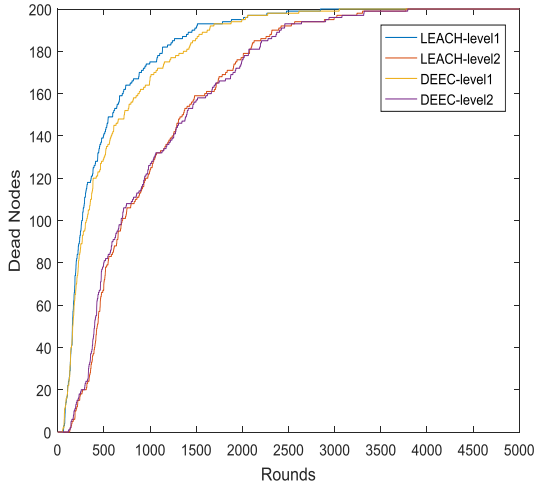

Fig 5. number of dead nodes with 0.5

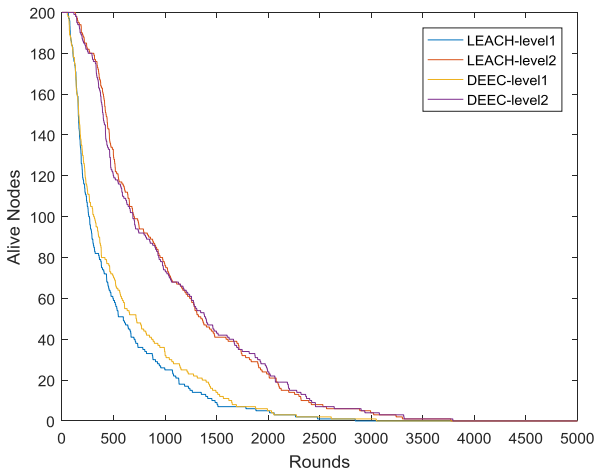

Fig 6. number of allive nodes with 0.5

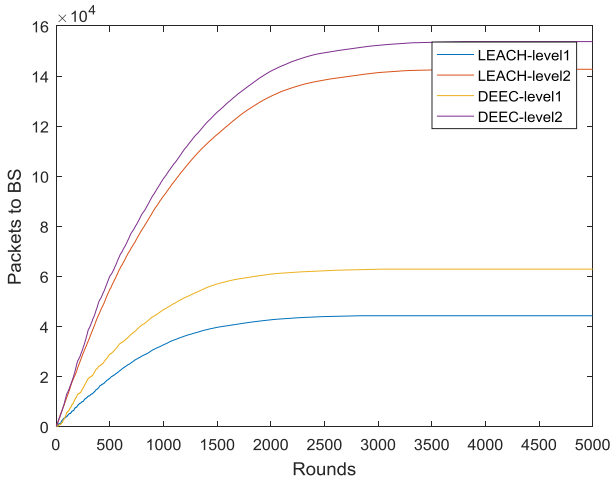

Fig7. Packet to base station with 0.5

Second simulation with exceeds initial energy to 0.5 in fig 5 shows that the dead nodes number of LEACH and DEEC level1 increased other than level2 the maximum reach in level1 when simulation reach 3000 rounds. But in level2 the maximum reach when simulation reach 2500 rounds. This lead us that the dead nodes number decreased in level2 heterogeneous protocols other than level1. Fig 6 depicts that the alive nodes number of LEACH and DEEC in level1 decreased until 3500 rounds of simulation but the alive nodes in level2 decreased until the simulation reach 2700 rounds. Means that the network lifetime decreased in level2 other than level1 heterogeneous protocols. But increased with increasing initial energy. Fig 7 depicts that the packet to base station increased and reach the maximum of level2 in 2500 rounds number of simulation. But in level1 it is still exceeds until 3500 number of simulation rounds. It reaches the maximum in level2 quickly other than level1.

C. Third simulation with initial energy 1

In our simulation, random deployment of 200 sensor nodes in a square field of dimension 300 M x 300 M and 5000 rounds number with intial energy 1 j has been considered.

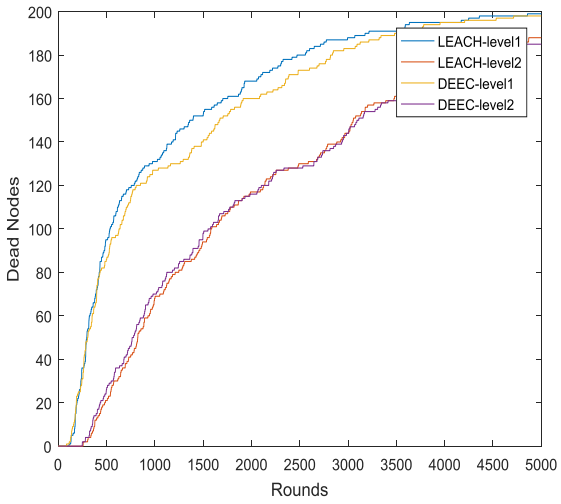

Fig 8. number of dead nodes with 1

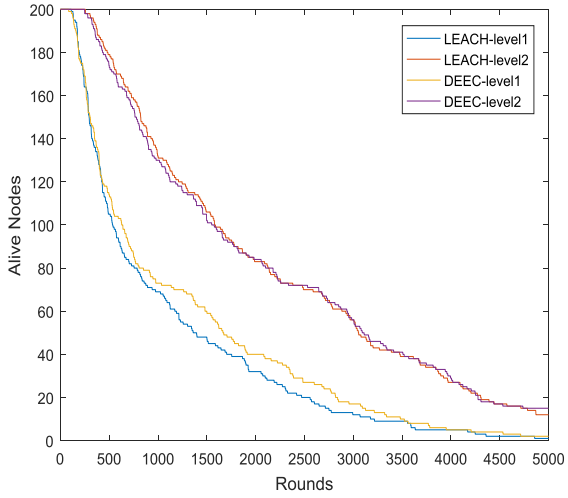

Fig 9. number of allive nodes with 1

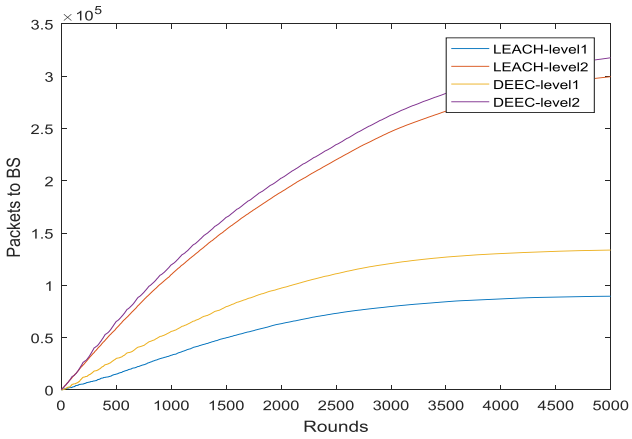

Fig 10. Packet to base station with 1

Third simulation with exceeds initial energy to 1 it has been observed that in fig 8 the dead nodes number of LEACH and DEEC level1 increased other than level2 the maximum reach in level1 exceeds of number of round simulation and about 18% of nodes does not consider dead until 5000 rounds. But in level2 the maximum reach when simulation reach 5000 rounds. This lead us that the dead nodes number decreased in level2 heterogeneous protocols other than level1. Also fig 9 shows that the alive nodes number of LEACH and DEEC in level1 decreased and about 18 nodes still in the transmission range motion until 5000 rounds of simulation but the alive nodes in level2 decreased until the simulation reach 5000 rounds. Means that the network lifetime decreased in level2 other than level1 heterogeneous protocols. But increased with increasing initial energy. Fig 10 depicts that the packet to base station increased and reach the maximum of level2 in 5000 rounds number of simulation. But in level1 it is still exceeds until 5000 number of simulation rounds is still also nodes and packets to send approximately 18 nodes. It reaches the maximum in level2 quickly other than level1.

D. Fourth simulation with initial energy 2

In our simulation, random deployment of 200 sensor nodes in a square field of dimension 300 M x 300 M and 5000 rounds number with intial energy 2 j.

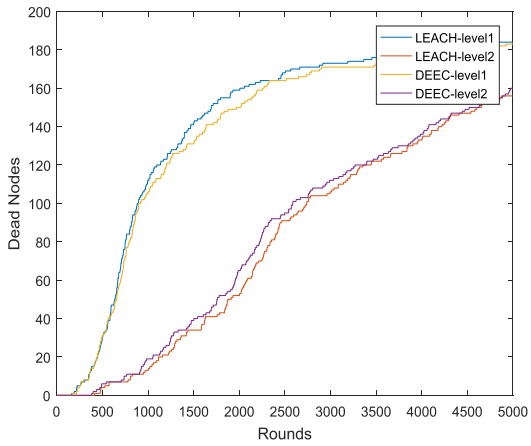

Fig 11. number of dead nodes with 2

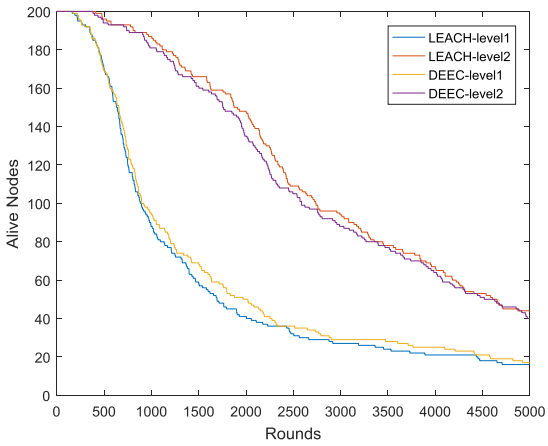

Fig 12. number of allive nodes with 2

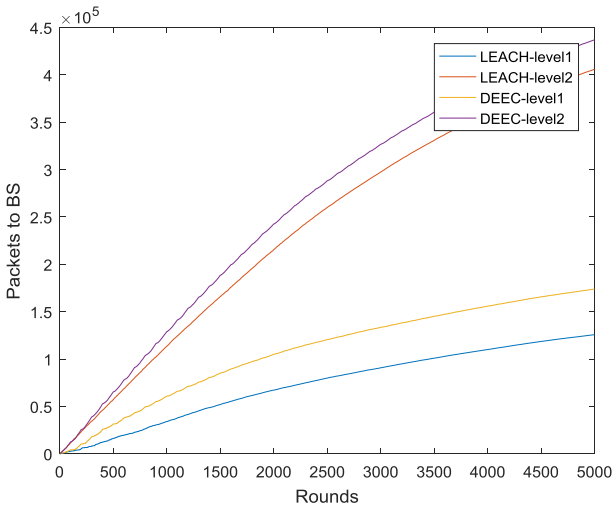

Fig 13. Packet to base station with 2

Forth simulation with exceeds initial energy to 2 it has been observed that in fig 11 the dead nodes number of LEACH and DEEC level1 increased other than level2 the maximum reach in level1 exceeds of number of round simulation and about 41 nodes still work in the network until 5000 rounds. But in level2 the maximum reach when simulation reach 5000 rounds and about 18 nodes still in the network. This lead us that the dead nodes number decreased in level2 heterogeneous protocols other than level1. Again fig 12 depicts that the alive nodes number of LEACH and DEEC in level1 decreased and about 39 nodes still in the transmission range motion until 5000 rounds of simulation but the alive nodes in level2 decreased until the simulation reach 5000 rounds about 18 nodes still in the network. Means that the network lifetime decreased in level2 other than level1 heterogeneous protocols. But increased with increasing initial energy. Fig 13 depicts that the packet to base station increased and reach the maximum of level2 in 5000 rounds number of simulation and about 45 nodes number still for LEACH and 55 nodes of DEEC also till sends packet. But in level1 it is still exceeds until 5000 number of simulation rounds is still also nodes and packets to send approximately 5 nodes of LEACH and 8 nodes of DEEC. It reaches the maximum in level2 quickly other than level1.

4. Conclusion

In this paper, the LEACH and DEEC level1 and level2 heterogeneous network protocols have been simulated. The model is characterized by a single parameter and can describe level1 and level2 energy heterogeneity in a network. The energy heterogeneity helps increasing the network energy and utilizing the network energy efficiently increases the network lifetime [7]. Network lifetime extended and increased with increasing initial energy of these protocols. The other side dead node number decreased with increasing initial energy. The performance of some of the protocols have been computed by using the heterogeneous networks and compared with deferent values of initial energy. The protocols perform much better than high level protocols by taking equal amount of energy.

That the changes of initial energy have been clear effects on the performance of heterogeneous protocols. Moreover, initial energy parameters will increase the performance of the network quality. It will be affected in all applications that use the WSNs. It is expected

to work in fields such as industry, rubout or battle tracking. The modeling of these protocols seems to suggest that the initial energy has clear effects on the network lifetime and packets send to base station. it must be taken into consideration during the process design. future of design and process these classification of protocols must take in consideration the initial energy parameter because these protocols will be efficient for applications that are time critical by nature.

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