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SELF ORGANIZING PROTOCOL FOR HIGH-PRIORITY COVERED AREA

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ABSTRACT

Network life is the Parameter which varies with the application. Researches are done to improve the network life but very less which are concentrated on particular region of network (Priority area), this paper is concentrate on that part. Here an algorithm SOPHCA (Self Organizing Protocol for High-Priority Covered Area) is proposed which explains how to improve the life of priority area. This algorithm can be explained in one line that "If any priority Node dies, a non-priority Node will replace it". To test and verify this algorithm some simulation are done on NS2 simulator and results are analysed. Results are compared with network without this algorithm, and comparative results shows that the algorithm can improve the life of priority network up to considerable level. This paper explains SOPHCA and discussed how it improves the life of priority network.

KEYWORDS: 1) Sensor Network, 2) Node Energy, 3) Priority Area Life, 4) Priority Area, 5) SOPHCA, 6) Node Replacement 7) NS2 and 8) Mobility

INTRODUCTION

The wireless sensor networks [1] are suffering from the various issues. Many things are coming every day to improve the performance and many more yet to come. The mobility is the biggest advantage [2] [3] of wireless sensor network and sometimes it is the biggest problem [4] also, either directly or indirectly. Because of the mobility, designer has to face the issues like topology change; path and link breaks, coverage problem and energy drain [5]. In this paper the main concentration is on *energy issues* [6]. In many applications, sensor Node is mobile device and it does not have any power supply available continuously. Because of this, the life of sensor Node strictly depends on the energy level of it which directly affects the life of whole network. Thus proper utilization of this resource it must. Here in this paper based on the remaining energy level of Node the mobility is utilized in favour of network life time.

SOPHCA

Imagine small part of sensor network with 5 Nodes, Node D is the destination point and here the Node D is in the direct range of Node 2 only, as shown in Figure 1. So if Node 1, Node 3 and Node 4 want to send the data to Node D, everyone has to follow the path through Node 2 only. In this scenario Node 2 will have extra stress and will lose extra energy compare to other Nodes. But if we observe that the Node 2 is the key Node of network also, if it dies, the whole network fails. Assume that at a time instant Node 2 have lost its energy completely, but Node 3 and Node 1 are left with more than 80% energy level, but it is waste now as Node 2 is dead no data can be reported. But there is one option with which the life of network can be increased. Now when the Node 2 dies the Node 3 replace Node 2's position as shown in the Figure 2. From Figure 2 it is observed that though some part of network is getting dark but overall network survives for some more time. This how the neighbour's energy can be utilized and gives dying network a new life. This is what happening in SOPHCA (Self Organizing Protocol for High-Priority Covered Area).

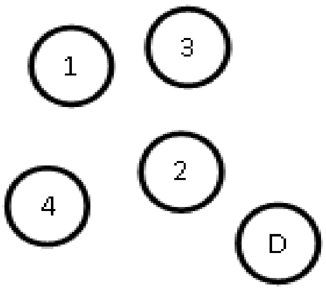

Figure 1: Sensor Network Example Where 1, 2, 3, 4 are Source and D is Destination

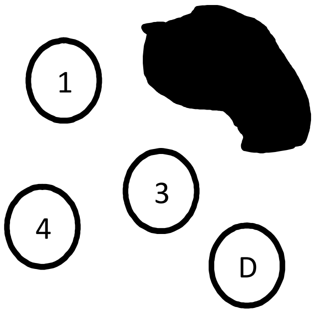

Figure 2: Node 3 Replaces Node 2

This paper discusses SOPHCA in detailed. First we see algorithm for working of SOPHCA. This algorithm is tested on "Network Simulator 2" also known as ns 2. For more information on ns 2 refer [7] [8]. The simulation is done for different scenarios and results are compared with "without SOPHCA" network. First this algorithm is described in detailed. Simulation conditions and used parameters are discussed in simulation section.

ALGORITHM FOR SOPHCA

The algorithm of SOPHCA is not so complex. It gets activated at dying priority Node and ends with the replacement of not priority Node. The steps are following.

Input: Dying priority Node$_i$.

Output: non-priority Node$_k$ Replaces priority Node$_i$.

1) if Energy_prio_Node$_i$<= 10 %

2) if Net_life> 5%

3) Node$_i$-> "help";

4) if Energy_non-prio_Node$_j$=> 50

5) Reply"Energy_non-prio_Node$_j$";

6) End if;

7) short "Max energy Node from reply"

```
8)                 {Node_k};
9)                 Replace Node_i with Node_k;
10)                Remove Node_i from prio_Node;
11)                Remove Node_k from non-prio_Node;
12)                Add Node_k to prio_Node;
13)        End if;
14)        End if;
```

This algorithm comes in picture if any Node from priority area reaches to energy level 10% or lesser we can see this at line 1 of algorithm. As the *priority Node* detects its energy level 10% or lesser it will send **“Help”** message to neighbour in non-priority area, as mentioned in line 3. Now the question is “what is there inside this Help message?” **“Help”** is help in real meaning also. In real life the most cases “help” is used for calling someone toward them only. Here also it doses the same. This message is transmitted to one hop non-priority neighbours only. It does not directly send the non-priority Node towards the dying Node, but it is just call for energy level of non-priority neighbours.

Now non-priority neighbour receives the **“Help”** message. As it receives the **“Help”** message first it will check for its own energy level. If the energy level is more than 50%, the non-priority Node will reply, see the lines 4, 5 and 6. This condition makes the non-priority Node eligible for replacing the priority Node. This step is for avoiding conflict between non-priority Nodes. Means not more than one non-priority Node should replace dying priority Node.

As the dying priority Node gets reply from the non-priority Nodes, the next step gets executed. The next step is “shorting out”, searching the Node with the highest energy level. As shown in line 7 & 8. The Node which has the highest energy level is extracted from the list of Nodes which have replied. This will give the most eligible non-priority Node$_k$ which can replace dying priority Node$_i$. This part of algorithm is main part as the whole algorithm is based on only two things one *priority area* and the second *energy level*, based on the energy level of the Nodes all decision are taken, so it plays key role here. Here one more question comes in to picture “what happens if no non-priority Nodes replies?” then the ***“Help 2”***[**] can be sent. While receiving **“Help 2”** the non-priority Nodes which has energy level 30% or more can also reply, the **“Help 2”** will be repeated 3 time with the interval of 10 sec if no reply from non-priority Node. In case, if any Node with energy more than 50% couldn’t reply at first attempt, due to reasons like *collision* [9], can do so at second time.

Now the algorithm has come to its final stage, *Node replacement*, which is going to increases the priority area’s life. In this stage, as shown in lines 9, 10, 11 & 12 the priority Node$_i$ will be replaced by the non-priority Node$_k$ (which is the highest energy holding non-priority neighbour). As part of this, the Node$_k$ will start moving towards the Node$_i$. This is due to the mobility, which is feature of wireless sensor network; here in this case the mobility is advantageous. For letting any wireless sensor to be mobile, *robotic equipment* [10]-[12] is required attached to wireless sensor Node. This is how the Node$_i$ will be replaced by Node$_k$. But this is not over; some more important changes are required in topology, to prevent conflict on Node$_k$. Node$_i$ must be removed from the list of priority Node, Node$_k$ must be removed from the non-priority list and Node$_k$ must be added to the priority list. Here actually Nodes are not priority but the location at which they are located is prior.

SIMULATION AND RESULT ANALYSIS

Simulation is done on *NS2 simulator*. The topology set is *greedy* 10x10. Here **100 Nodes** are set in greed of 10x10 equally. Each sensor Node is controlled mobile. The parameters set to each mobile Node are as shown in TABLE 1. The range of each Node is 250 m. There are 8 Nodes in the range of any (not applicable for Nodes at boundary) are as shown in Figure 3. The greedy Nodes are numbered from 0 to 99 (**total 100 Nodes**). In this network *Node- 65, 66, 67, 75, 76, 77, 85, 86 and 87 are priority Nodes*, and rest are non-priority Nodes. These priority Nodes are situated at priority network (priority area).

*****Help 2*** *is not implemented in SOPHCA while simulation but it can be a solution for no reply.*

Table 1: Parameter for Node Configuration

Parameters	
Channel	Wireless Channel
network interface type	Wireless Physical
radio-propagation model	Two Ray Ground model
MAC type	802_11
interface queue type	Drop Tail-Priority Queue
link layer type	Default link layer (LL)
max packet in queue	50
number of mobile Nodes	100
routing protocol	AODV
Energy Model	
Rx Power	1.0
Tx Power	5.0
Sleep mode Power	0.001
Transition Power	0.002
Transition Time	0.005

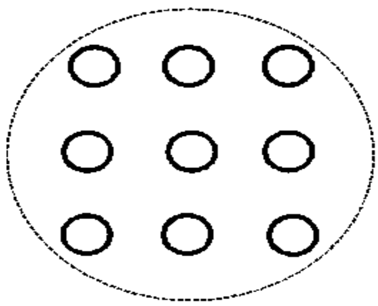

Figure 3: Range of the Nodes

In first simulation the Nodes are not mobile, they remain at the same location and data traffic is generated, to simulate a sensor network. The total 180 seconds of network simulation is done. If the data traffic is more at priority area so the Nodes at priority will die soon compare to non-priority area Nodes.

The results of this scenario are shown in Figure 4. As we can see, the Node no. 65, 66, 67 (*other priority Nodes carries more than 10% throughout the simulation so their energy level is neither mentioned nor discussed*) are going to die after simulation time of *80 second, 60 seconds and 145 seconds* respectively, the same is shown in Figure 4. If any Node in priority area dies the priority network fails, it means **the priority network fails after 60 second of simulation**. In this simulation three priority Nodes dies during the simulation, it affects lot to whole network as total priority Nodes are 9 only so we can say 33.33% priority network dies before simulation gets over.

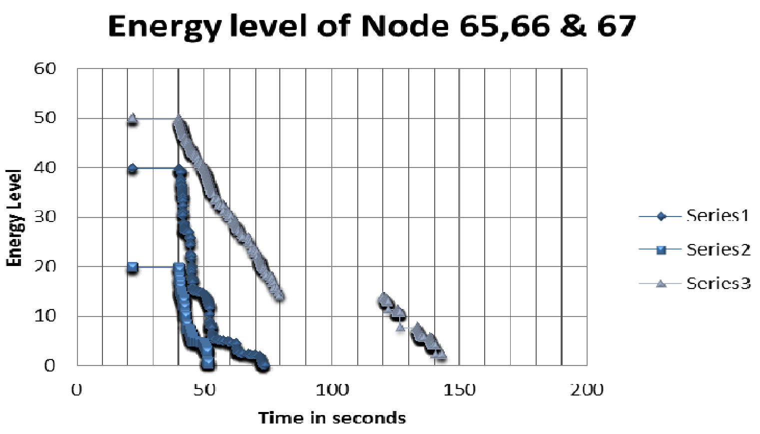

Figure 4: Energy Level of Node 65, 66 & 67. Series 1 is for Node 66, Series 2 is for Node 65 and Series 3 is for Node 67

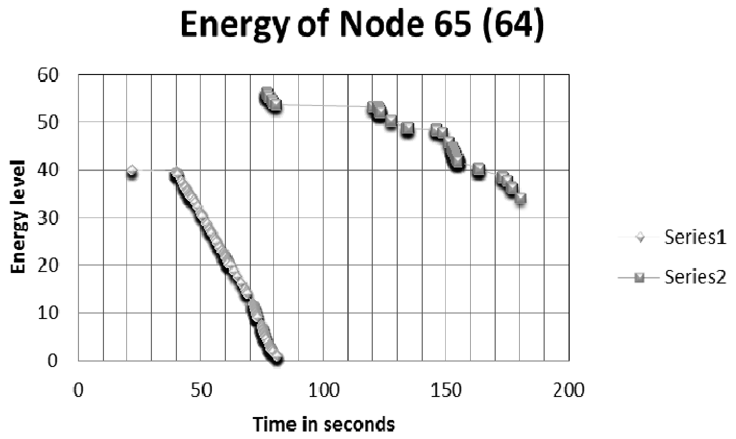

Figure 5: Energy of Node 65 (64). Series 1 is for Node 65 and Series 2 is for Node 64

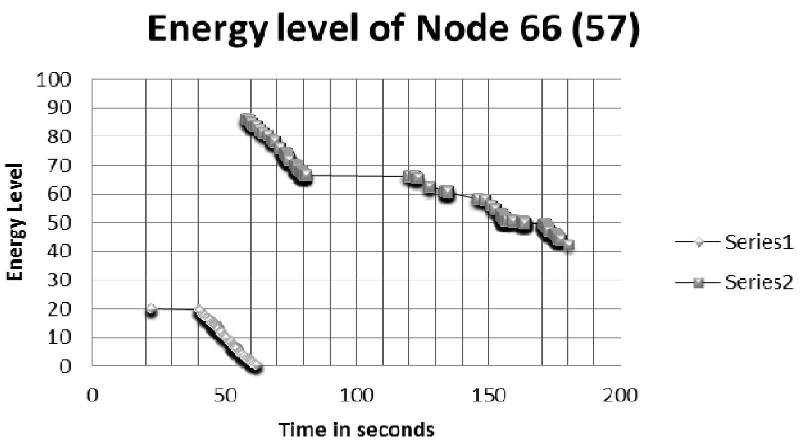

Figure 6: Energy of Node 66 (57). Series 1 is for Node 66 and Series 2 is for Node 57

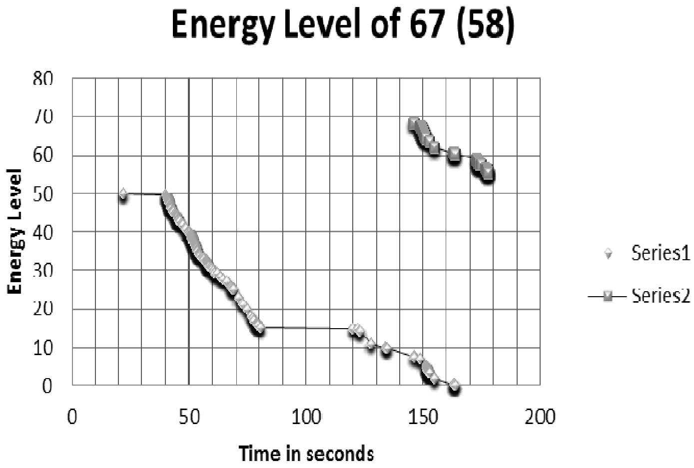

Figure 7: Energy Level of Node 67 (58). Series 1 is for Node 67 and Series 2 is for Node 58

This situation can be avoided with the help of SOPHCA. Without changing any parameter, any traffic pattern or altering energy level of any Node. All conditions are same as previous scenario just SOPHCA algorithm is added to network and batter results are generated, in the favour of priority network. If the non-priority Node replaces the priority Node, then the effective energy will be of non-priority Node (*ultimately non-priority Node becomes priority Node only after replacement, thus the energy of that priority location will be of replacing Node*). These results are shown in Figure 5, Figure 6 and Figure 7. In Figure 5 Node 64 replaces Node 65, in Figure 6 Node 57 replaced Node 66 and in Figure 7 Node 58 replaces Node 67. In this way the whole priority network last till the end of simulation, which shows 100% priority network is active till the end.

CONCLUSIONS

The main target of paper is to improve or increase the life of priority area. The SOPHCA is designed for that only. This paper shows the importance of priority area, and how it becomes the reason for failure of network. Three Nodes of priority area become dry (dead) but with the help of SOPHCA this condition were prevented. The heuristic SOPHCA is claiming its effectiveness, based on the results shown in this paper. It has improved the life of priority area. From the above discussion a conclusion can be made that, if the network have priority region (area) within it, if controlled mobility is an option, a simple algorithm SOPHCA can improve the life of priority area up to considerable level.

Even though it has some issues 1) *it invites the network separation*, 2) *The Node must be mounted on controlled mobile system,* which is again limits *speed* and *range,* and if this system fails the SOPHCA becomes helpless. To overcome the network separation issue some algorithm should be merged or develop. Mobility system is the member of hardware robotics. The research is on its full fledge to improve it. The simulations are done in ideal environment; this algorithm is needed to be tested in harsh environment to calibrate its effectiveness.

REFERENCES

1. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci. “A survey on sensor networks,” Communications magazine, IEEE 40, no. 8 pp. 102-114, 2002.
2. B. Liu, P. Brass, O. Dousse, P. Nain, and D. Towsley. “Mobility improves coverage of sensor networks,” In *Proc.* of the 6th ACM international symposium on Mobile ad hoc networking and computing, 2005, pp. 300-308.

3. M. Grossglauser, and T. David "Mobility increases the capacity of ad-hoc wireless networks," in *Proc.* INFOCOM 2001, Twentieth Annual Joint Conference of the IEEE Computer and Communications Societies. IEEE. Vol. 3, IEEE, 2001.
4. F. Akyildiz, and X. Wang. "A survey on wireless mesh networks," Communications Magazine, IEEE Vol. 43 Issue 9, pp. S23-S30, 2005.
5. C. S. R. Murthy, and B. S. Manoj. *Ad hoc wireless networks: Architectures and protocols,* Pearson education, 2004.
6. G. Anastasi, M. Conti, M. Di Francesco, & A. Passarella, "Energy conservation in wireless sensor networks: A survey." Ad Hoc Networks, Vol. 7, Issue 3, pp. 537-568, 2009.
7. T. Issariyakul, E. Hossain, "Introduction to Network Simulator NS2", Springer Science-Business Media, LLC, 2009.
8. E. Altman and T. Jimenez; "NS simulator for beginners", Lecture notes, University de Los Andes, Merida, Venezuela and ESSI, Sophia-Antipolis, France, Dec. 4, 2003.
9. M. Joa-Ng, and L. I-Tai. "Spread spectrum medium access protocol with collision avoidance in mobile ad-hoc wireless network," in *Proc.* INFOCOM'9, Eighteenth Annual Joint Conference of the IEEE Computer and Communications Societies, IEEE. Vol. 2. IEEE, 1999.
10. S. Bergbreiter, K. S. J. Pister," CotsBots: An off-the-shelf platform for distributed robotics," in *Proc.* of the IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS 2003.
11. K. Dantu, et al. "Robomote: enabling mobility in sensor networks," in *Proc.* of the 4th international symposium on Information processing in sensor networks. IEEE Press, 2005.
12. IEEE Spectrum, (2014) IEEE Spectrum [Online]. Available: http://spectrum.ieee.org/automaton/robotics/robotics-hardware/iros-2013-robot-cars-get-hypermaneuverable-with-actuated-tails.
13. R. Rajaraman. "Topology control and routing in ad hoc networks: A survey." ACM SIGACT News Vol. 33, Issue 2, pp. 60-73, June 2002.