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Increased Network Life Time Algorithm in Wireless Sensor Networks

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Abstract— Wireless sensor devices are generally battery operated devices which have limited battery power. Once deployment is done, it is not possible to replace the battery and energy harvesting is not practically feasible in most of the cases. Optimal use of energy and maximized network life time are the primary challenges in wireless sensor networks. Initially for optimal use of battery, shortest path is chosen to put forward the network traffic from source to destination but it has been seen that some nodes are overused as a result network life time is less. Increased Network Life Time algorithm selects the shortest path from source to destination, and calculates the power consumptions of all nodes. The nodes whose power consumption is less are used as the intermediate nodes to forward network traffic from source to destination, as a result of which, less power consumed nodes are utilized. If a node is directly connected to the destination then it may not use intermediate nodes to forward its traffic. While choosing the path in future, our approach always gives chance to the less used node to be utilized more. This approach selects different paths instead of a particular path to forward the network traffic as a result the variance of power consumption of all nodes is less and network life time is more.

Keywords— Increased Network Life Time Algorithm, variance.

I. INTRODUCTION

Wireless sensor devices consist of low power embedded processor, limited memory, low data rate radio transceiver, low data rate sensor, global positioning system and battery. These are generally battery operated and the lifetime of the battery is finite. Once deployment is done, it is not possible to change the battery in hostile environments. Energy harvesting is not practically feasible in most of the cases. So optimal use of battery is a challenge in Wireless sensor networks. Generally more energy is spent while transmitting data, so there is need for efficient routing protocol which optimally use of battery as well as the increase the network life time of all nodes. Shortest path routing generally consumes less battery but always forwards the traffic in same route from source to destination as a result of which only some nodes are overused. Many nodes in the network with higher battery capacity are used less. There should be an approach to use these nodes whose residual energy is more.

II. RELATED WORK

Ratul et al. [1] has explained about coalition in power aware routing as a result, groups involved in coalition get benefitted over without coalition routing. They have proposed a fair coalition algorithm which gives equal benefit to every group involved in coalition. K. Das and M. Panda [2] have explained about Maximize Network Life Time approach which excludes the overused node to route packet as the result the network life time increases. The research carried out by Omid Namvar Gharehshiran and Vikram Krishnamurthy [3] have explain about the formulation of the sleep time allocation problem in a deployed WSN to localize targets as a non-convex cooperative game and a concept of core is used to solve the problem. The research carried out by Zhi Sun, Rong Yu and Shun liang Mei [4] have explained about the A Robust Power-aware Routing Algorithm for Wireless Sensor Networks. They have used power aware geographic routing algorithms for reducing the routing energy consumption and increase the network lifetime.The research carried out by Hongbin Chen, Chi K. Tse & Jiuchao Feng [5] has explained about the problem of source extraction in bandwidth-constrained wireless sensor networks. They have analysed the impact of topology on the performance and energy efficiency. The fast fixed-point algorithm with pre whitening is used for the simplicity and fast convergence of the received quantized data. Hence the results show that the sensor networks can achieve performance close to the benchmarking case. Farruh Ishmanov and Sung Won Kim [6] have proposed Distributed Clustering with Load Balancing (DCLB) algorithm and balanced inter-cluster communication for energy efficient communication. Xiaoxia Huang et al. [7] proposed Robust Cooperative Routing Protocol in Mobile Wireless Sensor Networks. They present a distributed robust routing protocol in which nodes work cooperatively to enhance the robustness of routing against path breakage.

III. POWER CONSUMPTION AND NETWORK MODELS

A. Power Model

Power consumption of a node Pc is in the form of $Pc = K1+K*r*d^{\alpha}$.Where, K1 is the idle power consumption which is the power consumption of a node when it is neither transmitting nor receiving data, in our experiment we have assumed K1=0 W/Sec and K=1µWatt/M bit*m^4. So the power consumption is of the form $Pc = 0 + r\, d^{\alpha}$ where, $2 \leq \alpha \leq 6$ and r is the rate of transmission [9][10][11].

B. Network Model

Our network G(V,E) consists of vertices V and edges E of the graph G . We have assumed every node has a finite range of transmission and every node should obey flow balance condition to transmit data which is the sum of rate of incoming traffic and rate of originating traffic, equal to rate of outgoing traffic [6].In our approach we have considered that every node has a limited range to transmit data beyond which error free transition is not possible. Using shortest path routing, a source node can find the next node to the destination and forward the traffic to the next node. In our simulation we have chosen the value of α=4, so the power consumption is of the form: $Pc = r\, d^4$.

The experimental environment is similar to that employed in Ratul et al. [1].There is one destination to which all nodes forward the traffic. Each node generates 1 Mbps of traffic. A simple network model with 25 nodes uniformly distributed in a square of side 4 meter is given in Fig. 1.

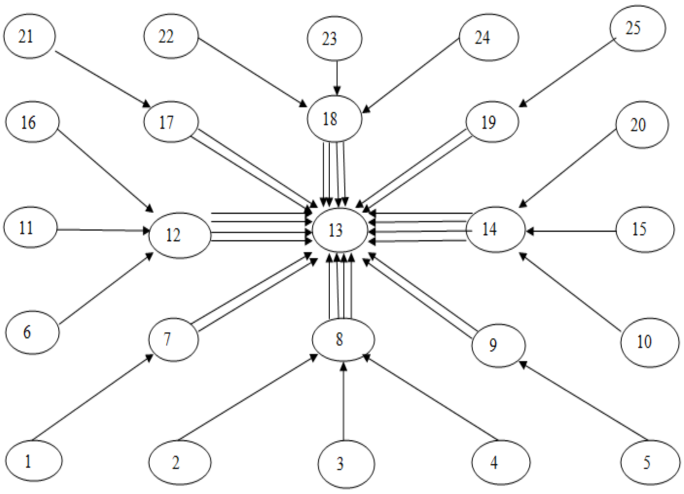

Figure 1: Nodes are distributed uniformly and all node sends traffic to node 13.

For the 1st node the power consumption = $0+1\mu W/Mbit*m^4* 1\ Mbps* (\sqrt{2})^4\ m^4= 4\ \mu W/Sec$ .Similarly the power consumption of other nodes is given in Table I.

TABLE I
POWER CONSUMPTION OF NODES USING MINIMUM TOTAL TRANSMISSION POWER ROUTING.

Node No.	**Power Spent**	**Node No.**	**Power Spent**	**Node No.**	**Power Spent**
1	4 µ W/Sec	9	8 µ W/Sec	18	4 µ W/Sec
2	4 µ W/Sec	10	4 µ W/Sec	19	8 µ W/Sec
3	1µ W/Sec	11	1 µ W/Sec	20	4 µ W/Sec
4	4 µ W/Sec	12	4 µ W/Sec	21	4 µ W/Sec
5	4 µ W/Sec	14	4 µ W/Sec	22	4 µ W/Sec
6	4 µ W/Sec	15	1 µ W/Sec	23	1µ W/Sec
7	8µ W/Sec	16	4 µ W/Sec	24	4 µ W/Sec
8	4µ W/Sec	17	8 µ W/Sec	25	4 µ W/Sec

In Fig. 1 node 3, node 11, node 15 and node 23 consume less power which is 1 µ W/Sec so they have more residual energy. The variance of power consumption of all nodes is equal to 4.1 using Minimum Total Transmission power Routing.

IV. INCREASED NETWORK LIFE TIME ALGORITHM

Algorithm

1. In G(V,E) for all vЄV Run Shortest Path Routing Algorithm to find the shortest route from source to the destination.
2. Calculate Pi = the power consumption of each node by $d^{\alpha} * r$
3. Find Min(Pi)
4. Using the nodes whose power consumption is Min(Pi) as the intermediate nodes, forward network traffic from source to destination if the node is not directly connected to the destination.
5. Calculate Pj = the power consumption of each node by $d^{\alpha} * r$, Find Px = Averge (Pi, Pj), Calculate Min (Px).
6. Using the nodes whose power consumption is Min(Px), forward network traffic from source to destination if the node is not directly connected to the destination.

7. Calculate Pk = the power consumption of each Node by $d^{\alpha} * r$, Find Py = Averge(Pi, Pj, Pk), Calculate Min(Py).
8. Use the nodes whose power consumption is Min(Py) as the intermediate nodes, and forward network traffic from source to destination if nodes are not directly connected to the destination .

Nodes with more residual energy can be used as intermediate mode to forward traffic in Increased Network Lifetime Algorithm. The network traffic flow diagram using node 3, node 11, node 15 and node 23 as intermediate mode is given in Figure 2.

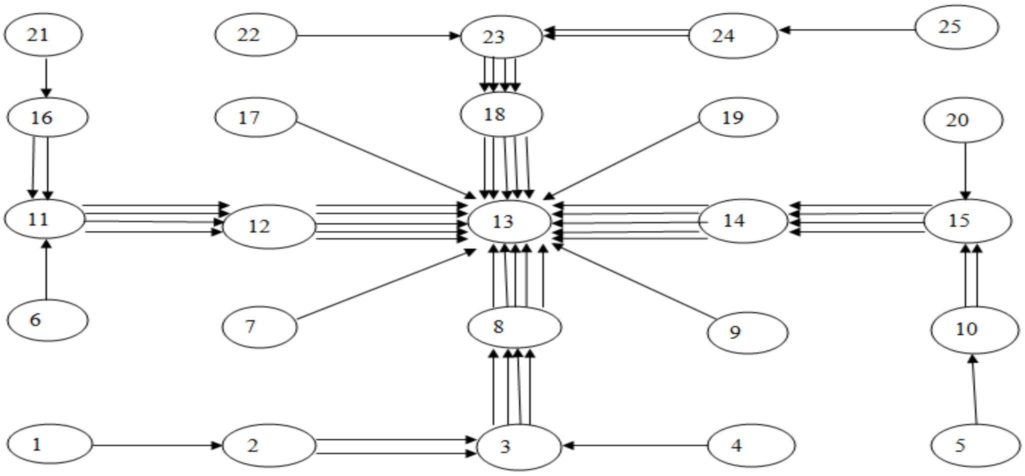

Figure 2: Using node 3, node 11, node 15 and node 23 as intermediate modes to forward traffic.

For the 1st node the power consumption = 0+1µW/Mbit*m^4* 1 Mbps* $(1)^4$ m^4= 1 µ W/Sec .Similarly the power consumption of other nodes is given in Table II.

TABLE II
POWER CONSUMPTION OF NODES USING INCREASED NETWORK LIFE TIME ALGORITHM.

Node No.	**Power Spent**	**Node No.**	**Power Spent**	**Node No.**	**Power Spent**
1	1 µ W/Sec	9	4 µ W/Sec	18	5 µ W/Sec
2	2 µ W/Sec	10	2 µ W/Sec	19	4 µ W/Sec
3	4µ W/Sec	11	4 µ W/Sec	20	1 µ W/Sec
4	1 µ W/Sec	12	5 µ W/Sec	21	1 µ W/Sec
5	1 µ W/Sec	14	5 µ W/Sec	22	1 µ W/Sec
6	1 µ W/Sec	15	4 µ W/Sec	23	4µ W/Sec
7	4µ W/Sec	16	2 µ W/Sec	24	2 µ W/Sec
8	5µ W/Sec	17	4 µ W/Sec	25	1 µ W/Sec

The average power consumption is of Table I and Table II is given in table III.

TABLE III
AVERAGE POWER CONSUMPTION OF NODES USING INCREASED NETWORK LIFE TIME ALGORITHM.

Node No.	**Power Spent**	**Node No.**	**Power Spent**	**Node No.**	**Power Spent**
1	2.5 µ W/Sec	9	6 µ W/Sec	18	4.5 µ W/Sec
2	3 µ W/Sec	10	3 µ W/Sec	19	6 µ W/Sec
3	2.5 µ W/Sec	11	2.5 µ W/Sec	20	2.5 µ W/Sec
4	2.5 µ W/Sec	12	4.5 µ W/Sec	21	2.5 µ W/Sec
5	2.5 µ W/Sec	14	4.5 µ W/Sec	22	2.5 µ W/Sec
6	2.5 µ W/Sec	15	2.5 µ W/Sec	23	2.5 µ W/Sec
7	6 µ W/Sec	16	3 µ W/Sec	24	3 µ W/Sec
8	4.5 W/Sec	17	6 µ W/Sec	25	2.5 µ W/Sec

The variance of power consumption after the algorithm runs two times is equal to 2.26 which is less compare to 4.1 which was calculated earlier.

V. CONCLUSION

Variance of power consumption of all nodes is less in Increased Network Life Time algorithm as compared to Minimum Total Transmission Power Routing. The network life time of Increased Network Life Time (INLT) algorithm is more compare to Minimum Total Transmission Power routing as INLT uses nodes whose residual energy is more as the intermediate node to forward its traffic. In the future we can carry out the simulation for the nodes in the range 100 to 200.

REFERENCES

[1] Ratul K. Guha, Carl A. Gunter and Saswati Sarkar,"Fair Coalitions for Power-Aware Routing in Wireless Networks," *IEEE transactions on Mobile Computing*, 2007.
[2] K. Das and M. Panda, "A novel approach to maximize network life time by reducing the variance of power consumption among Nodes in wireless sensor network," *International Journal of Advanced Computational Engineering and Networking, October* 2013.
[3] Omid Namvar Gharehshiran and Vikram Krishnamurthy,"Dynamic Coalition Formation for Efficient Sleep Time Allocation in Wireless Sensor Networks Using Cooperative Game Theory," *Signal Processing IEEE Transactions*, 2010.
[4] Zhi Sun, Rong Yu and Shunliang Mei," A Robust Power-aware Routing Algorithm for Wireless Sensor Networks," *Military Communications Conference MILCOM IEEE*, 2006.
[5] Hongbin Chen, Chi K. Tse and Jiuchao Feng, "Impact of Topology on Performance and Energy Efficiency in Wireless Sensor Network for Source Extraction," *IEEE Transactions on Parallel and Distributed Systems* ,2009.
[6] Farruh Ishmanov and Sung Won Kim, "Distributed Clustering Algorithm with Load Balancing in Wireless Sensor Network," *IEEE Computer Science and Information Engineering WRI World Congress*, 2009.
[7] Xiaoxia Huang, Hongqiang Zhai and Yuguang Fang,"Robust Cooperative Routing Protocol in Mobile Wireless Sensor Networks," *IEEE Transactions on Wireless Communications*, 2008.
[8] S. Sarkar and M. Adamou, "A Framework for Optimal Battery Management for Wireless Nodes," *Proc. IEEE INFOCOM*, 2002.
[9] E. Jung and N.H. Vaidya, "An Energy Efficient MAC Protocol for Wireless LANs," *Proc. IEEE INFOCOM*, 2002.
[10] Zhang Jin-rong, Wang Yue, Wang Dong and Han Jing, "A clustering and routing algorithm with combination weight for energy Consumption balance of WSNs," *International Conference on Multimedia Information Networking and Security IEEE* ,2009.
[11] C.-K. Toh, "Maximum Battery Life Routing to Support Ubiquitous Mobile Computing in Wireless Ad Hoc Networks," *IEEE Communications Magazine*, 2001.
[12] Bhaskar Krishnamachari, Networking Wireless Sensors, *Cambridge University Press*, 2006.