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Research Article

Performance analysis of Energy consumption in WSN with Four GW using Zone Clustering routing protocol

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Abstract

Wireless Sensor Network (WSN) is widely used for monitoring and gathering data in an autonomous fashion. Since sensors are small and power constrained devices, it is the most important to minimize the energy consumption. We propose energy efficient zone routing protocol with multi-gateway for enhancing life time performance of wireless sensor networks. In this paper, two types of sensor nodes, i.e., advanced and normal nodes are used. Advance nodes are having more energy than normal nodes. The advanced nodes are selected as cluster head based on its energy and node degree in the network. Normal nodes are used for sensing and data forwarding. Using multi-gateway we have reduced communication cost among sensor nodes used for transmitting and receiving the messages for cluster head selection. Simulation results show that by selecting the optimum position of cluster head on the basis of density, the consumption of energy for communication is minimized. It also increases the overall lifetime compared with the existing schemes. In this paper we are observing the energy consumption in WSN with four GW using zone clustering routing protocol.

Keywords: *Wireless sensor network, zone clustering, energy consumption.*

1. Introduction

A WSN consists of spatially distributed sensors, and one or more sink nodes (also called base stations). Sensors monitor, in real-time, physical conditions, such as temperature, vibration, or motion, and produce sensory data. A sensor node could behave both as data originator and data router. A sink, on the other hand, collects data from sensors. For example, in an event monitoring application, sensors are required to send data to the sink(s) when they detect the occurrence of events of interest. The sink may communicate with the end-user via direct connections, the Internet, satellite, or any type of wireless links. Figure 1.6 depicts a typical WSN architecture. Note that there may be multiple sinks and multiple end-users. As a fundamental issue in WSNs, deployment is a research topic that has attracted much attention in recent years. Recent technological advances have enabled the inexpensive mass production of sensor nodes, which, despite their relatively small size, have particularly advanced sensing, processing and communication capabilities. A WSN consists of spatially distributed sensor nodes, which are interconnected without the use of any wires [1, 2].

In a WSN, sensor nodes sense the environment and use their communication components in order to transmit the sensed data over wireless channels to other nodes and to a designated sink point, referred to as the Base Station (BS). BS collects the data transmitted to it in order to act either as a supervisory control processor or as an access point for a human interface or even as a gateway to other networks [3, 4]. Through the collaborative use of a large number of sensor nodes, a WSN is able to perform concurrent data acquisition of existing conditions at various points of interest located over wide areas. Nowadays, WSNs, due to the numerous benefits that their utilization offers, support an ever-growing variety of applications, including agriculture, traffic control, environment and habitat monitoring, object tracking, fire detection, surveillance and reconnaissance, home automation, biomedical applications, inventory control, machine failure diagnosis and energy management.

However, despite the advantages that the utilization of a WSN offers, their use is severely limited by the energy constraints posed by the sensors. The energy expenditure of the sensor nodes occurs during the wireless communication, the environment sensing and the data processing. Therefore, most of the routing protocols in WSNs aim mainly at the attainment of power conservation. Since most of the routing protocols developed for wired networks pursue the

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attainment of high Quality of Service (QOS), they are practically improper for application in WSNs. For these reasons, many protocols have been proposed for data routing in sensor networks. Most of the protocols use clusters in order to provide energy efficiency and to extend the network lifetime. Each cluster first elects a node as the cluster head (CH), and then, the nodes in every cluster send their data to their own cluster head. The cluster head sends its data to the base station. This data transfer can be performed in two alternative ways. Either directly, in the case in which the cluster head is located close to the base station, or via intermediate cluster heads. In this paper, a novel energy efficient zone clustering routing protocol with multi-gateway is proposed. Multi-gateway contrary to other existing cluster-based protocols that select a random node or the node with the higher energy at a particular time instance as the new cluster head, considers the current and the estimated future residual energy of the nodes, along with the number of rounds that can be cluster heads, in order to maximize the network lifetime. The focus of this thesis is the deployment of tactical WSNs. Tactical WSNs are remotely deployed in potentially hostile areas with gateway nodes located on the outskirts of these areas. A key challenge in the deployment of tactical WSNs is the limited battery power of each sensor node. This has a significant impact on the service life of the network. In order to improve the lifespan of the network, load balancing techniques using efficient routing mechanisms to achieve energy efficiency must be employed such that traffic is distributed between sensor nodes and gateway(s). In order to solve the load balancing problem, it is important to first understand the layout of a networking system. Modern day networks abstract all the processes that take place between any two nodes and represent them in the form of layers.

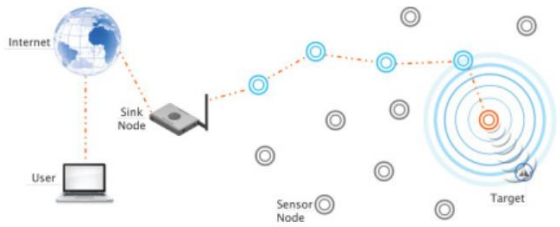

Fig.1 Architecture of Wireless sensor network.

The general network layering construct is shown in Figure 1.1 and contains the following five layers labeled one through five, respectively: physical, medium access control (MAC), network, transport, and application layers. Generally, layers of one node only rely on information from the layer immediately above or below it, and the information from Layer i of Node X is only accessed from the same layer i of node Y (logical links). In this thesis, we exploit the opportunity to explore a cross-layer solution for the load balancing problem. A cross-layering method does not restrict a layer from utilizing information only from the layer directly above or below it. Specifically, for load balancing and energy efficiency [2].

The protocols in place at each layer have a dramatic impact on the service life of the network and the coverage area. As node battery levels are depleted, they begin to die-out. Thus, various design techniques are needed at each layer to achieve load balancing energy efficiency node across the network.

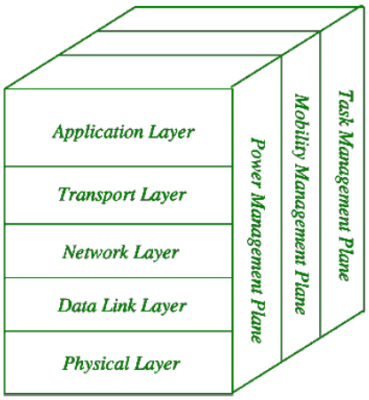

Fig.2: WSN cross layer model

In our scenario we are using cross layer approach to improve performance of energy life time of WSN by securing data transmission, avoiding extra transmission and interference data continuity of large information and losses of packet. For this scenario we are using cross layer approach for improvement of result. In physical link layer we are using multi-gateway that performs as a bridge between base station and WSN. Advantage of using multi-gateways is that cluster head directly communicate to gateways instead of base station. Because transmission energy increases with increases covering distance. In data link layer we are using two multiple access technique first is TDMA and second is CDMA. Here TDMA technique is used for information exchange between outside world (base station) to gateway while for securing and avoiding of interference, CDMA access technique used for communication between WSN node and gateway.

2. Simulation parameter & proposed model

In this paper, MATLAB simulator tool are used to evaluate and improve the performance of load balancing with energy efficient node. This concept provides two options at the each layer first of all each node sends their information to the cluster head then cluster-head communicate to the base station by gateway directly. The zone clustering case chooses the CH for each zone randomly if the highest energy node is chosen to be the CH; individual node energy depletion rates are minimized with the battery levels in any Zone depleting at a uniform rate. In this scenario we electing the highest energy node to be the CH during each round in each zone require additional processing by the gateway to perform CH election. Our simulations perform this aspect automatically with the

assumption that it is normally performed by the gateway. One possible implementation of this strategy in practice is that the aggregated packet sent to the gateway includes updated node energies for each node in the zone in the packet header. The gateway, being unconstrained by energy, can then estimate the amount of energy consumed by the CH to transmit the aggregated packet. The gateway can then decide which node in each zone should be assigned the CH for the next round and broadcast this information back to the WSN. In our case, since each node is within communication range of the gateway, every node in every zone will know who its CH is for the next round.

Table.1 Simulation parameter

Energy model	zone clustering routing protocol with two gateways
Radio type	802.11n
Traffic model	Data aggregators
Energy Data aggregation (EDA)	10n/j
Packet size (bits)	6000,8000 bits
Multiple access technique	TDMA and CDMA
Physical link	Two Gateways
Initial CH energy (Joules, J)	1.0
Initial node energy (Joules, J)	0.8
Energy to Transmit(ET_X) (nJ/bit)	50
Energy to Receive(ER_X) (nJ/bit)	50
Free space propagation (pJ/bit/m2)	10 to 100
Probability of being a CH (LEACH)	.08
No of nodes	5000
Number of Zones (Zone clustering)	5

E-Zone cluster routing algorithm for a multi-gateway scenario splits the field into five zones elects a CH in each zone to receive packet (in this we are going to analyze the energy consumption performance of WSN on these packet size) all L =6000, 8000 bit packets from supported nodes according to the node that contains the highest energy, and then aggregates the packet and transmission to the closest gateway.

3. E-Zone routing protocol with four gateway for 6000 packet size

Figure 3.0 (a & b) show energy consumption performance of WSN with 2000 packet size. From figure it can be state that transmission round of 50% and 80 % node ded become at 3197 and 3376.

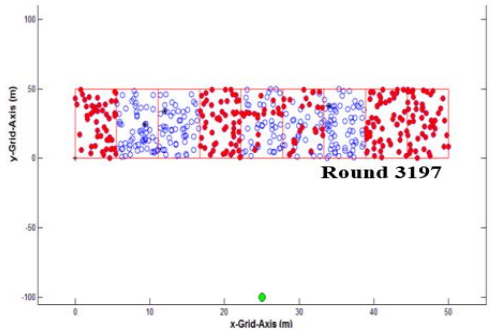

Fig 3.0 (a) 50% node dead at transmission round 3197 with 6000 packet size

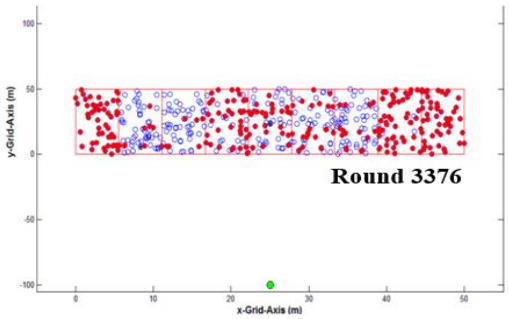

Fig 3. (b) 80% node dead at transmission round 3376 with 6000 packet size

4. E-Zone routing protocol with multi-gateway for 8000 packet size

Figure 4.0 (a & b) show energy consumption performance of WSN with 8000 packet size. From figure it can be state that transmission round of 50 and 80 % node dead become at 2234 and 2386.

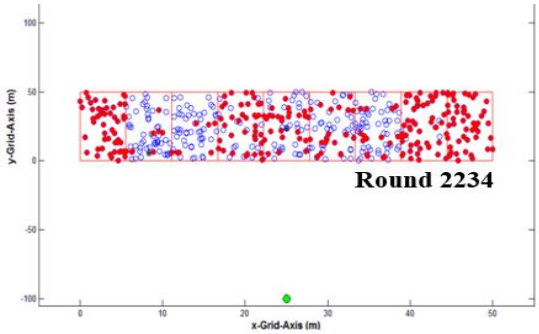

Fig 4. (a) 50% node dead at transmission round 2234 with 8000 packet size

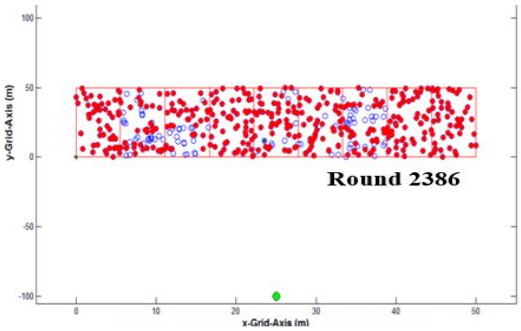

Fig 4. (b) 80% node dead at transmission round 2386 with 8000 packet size.

Conclusion

In this paper we have proposed energy efficient cluster head selection protocol with 4 gateways. It is a zone cluster based routing protocol that considers energy of nodes to extend the network lifetime. We have compared the performance of proposed protocol with different packet size like 6000, 8000 bits. After results it can be concluded that life time performance of WSN network with 6000 bits packet size is most efficient and better than 8000 packet size

References

[1] I. Akyildiz, W. Su, Y. Sankarasubramaniam and E. Cayirci, "Wireless Sensor Networks: A Survey," Computer Networks, vol. 38, no. 4, pp. 393–422, 2002.

[2] W. Ye, J. Heidemann and D. Estrin, "An energy-efficient MAC protocol for wireless sensor networks," Proceedsing of IEEE International Conference on Computer Communications (INFOCOM), New York, 2012, pp. 1567–1576.

[3]S. K. Singh, M. P. Singh and D. K. Singh, "Energy efficient homogenous clustering algorithm for wireles sensor networks," International Journal of Wireless Mobile Networks, vol. 2, no. 3, pp. 49–61, 2010.

[4] J. Hao and H. Mouftah, "Routing protocols for duty cycled wireless sensor networks: A survey," IEEE Communications Magazine, vol. 50, no. 12, pp. 116– 123, 2012.

[5] C. Cirstea, "Energy efficient routing protocols for wireless sensor networks: A survey," Proceedings of IEEE 17th International Symposium on Design and Technology in Electronic Packaging (SIITME), Timiºoara, Romania, 2011, pp. 277–282

[6] Pradna Gajbhiye, Anjali Mahajan, "A Survey of Architecture and Node deployment in WirelessSensor Network" First International Conference on Applications of Digital Information and WebTechnologies, ICADIWT 2008. Page(s): 426 – 430,4-6 Aug. 2008