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Energy Efficiency Techniques for Wireless Sensor Networks: A Review

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ABSTRACT: A sensor network is a static ad hoc network which consists of hundreds of sensor nodes that can be deployed on the fly operation being not attended So the main design issue for a sensor network must be conservation of the energy available at each sensor node. The wide utilization of Wireless Sensor Networks (WSNs) is obstructed by the severely limited energy constraints of the individual sensor nodes. This is the reason why a large part of the research in WSNs focuses on the development of energy efficient routing protocols. We can deploy multiple, mobile base stations to prolong the lifetime of the sensor network. Though lots of research has been done on energy efficiency of WSN but still there is a requirement to save the energy of nodes and to save the messages that are being discarded.

KEYWORDS: WSN; Energy efficiency, PEGASIS; LEACH;

I. INTRODUCTION

In recent times, wireless sensor networks (WSN) have become progressively more attractive and have found their way into huge variety of applications because of their low cost, self-organizing behaviour, and sensing ability in hard environments. A WSN is a collection of nodes organized to form a network. Routing is an important technology in WSNs. The energy efficiency in the WSN is one of the very important Performance Indicators. In this paper, a survey on different routing schemes for WSNs has been done. This describes an introduction to sensor network, PEGASIS, and Ant colony algorithm: A sensor network is one of the major rising technologies that required the data transmission at high rate with higher reliability ratio. These kinds of networks require interest for the architectural definitions and algorithmic enhancements. While explaining this kind of network, the main concern is needed while selecting the sensors based on the type of surface, the type of link, control centre, control parameters etc. These networks requires the regular supervision on network because of regular changes are possible due to the sensors are having floating movements and relatively needs to analyse the energy definitions, requirement, consumption etc. It also needs to analyse based on type of communication, type of channel etc.

Sensor networks [1] are one of major wide spread networks that are effective in recent years because of the involvement of the network in terms of electronics, communication and information technology in the single network. A sensor network is composed with vast number of tiny sensors. Each sensor node is defined with specific parameters in terms of energy. With each communication over the network some energy is consumed. The type of energy in the network can be of different types such as solar, electronic energy etc. This kind of network requires the effectiveness of each kind of operation in terms of energy. More the energy will be wasted, lesser the network life will be. A network is the network of connected sensors defined in terms of radio frequency, range specification etc. Each device available these days having some sensor incorporated in it such as laptops, mobiles etc. Because of this it is the challenging advance area that requires feasibility in terms of memory, power consumption, memory management, security etc. The economic and the technological factors are also required to be analyzed. The complexities of this kind of network also increase with the inclusion of heterogeneity, environment, and solar energy parameters etc. The challenging area in wsn includes the data oriented work, protocol modification, security enhancement, os improvement

Node Specifications

These kinds of networks basically having two types of nodes called sensor node and the master node.

- **Sensor Nodes:** These are the basic information of node that transfers the information over the network in the form of signals. These work as the transmitters and defined with some energy constrains. These nodes transfer

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data to the master nodes.

- **Master Nodes:** Also node as head node or the collectors that work as the controller node. These nodes work as the gateway that collect data from the nodes and connect the sensor network with outer environment such as with internet etc. These nodes are capable to issue some command to sensor nodes

The sensor nodes are inter-connected to the master node in a hierarchical system. The number of hops that is needed for a sensor node to transfer data with the master node determines the level of the node.

The frequency band is spitted into sub-bands; all these sub-bands are appointed to a cluster or group of nodes. A cluster of nodes is provided in the same geographical area. The neighbor-hood clusters are appointed distinct frequency bands to assure low interference. Each group of nodes communicates with the master node through first level node.

II. PROTOCOL AND TECHNIQUES STUDIED

PEGASIS

PEGASIS [15] (Power-efficient Gathering in Sensor Information Systems) is a greedy chain-based power efficient algorithm. Also, PEGASIS is based on LEACH. The key features of PEGASIS are

- The Base Station is fixed at long distances from the sensor nodes.
- The sensor nodes are alike and energy constrained with consistent energy.
- No mobility of sensor nodes.

PEGASIS is based on two ideas; chaining, and data fusion. In PEGASIS, each node can take turn of being a leader of the chain, where the chain can be constructed using greedy algorithms that are deployed by the sensor nodes. PEGASIS assumes that sensor nodes have a global knowledge of the network, nodes are stationary (no movement of sensor nodes), and nodes have location information about all other nodes. PEGASIS performs data fusion except the end nodes in the chain. PEGASIS outperforms LEACH by removing the overhead of cluster formation, decreases the sum of distances that non leader-node must transmit, less the number of transmissions and receives all nodes, and use only one transmission to the BS per round. PEGASIS has the same problems that LEACH suffers from. Also, PEGASIS does not scale, cannot be applied to sensor network where global knowledge of the network is not easy to get. Power-efficient Gathering in Sensor Information Systems (PEGASIS) [6] is an enhancement of the LEACH protocol. Rather than designing multiple clusters, PEGASIS makes chains of sensor nodes so that every node transmits and receives from a neighbour-hood and only one node is picked up from that chain to transmit to the base station. Collected data transfer from node to node, aggregated and eventually sent to the base station. The chain designing is achieved in a greedy way. Node c0 transmit its data to node c1. Node c1 combine node c0 data with its own and then passes it to the leader. After node c2 passes the token to the node c4, node c4transfer its data to node c3. Node c3 combines node c4's data with its own and then passes to the leader. Node c2 waits to receive data from both neighbour-hood and then attached its data with its neighbour-hood data. Finally, node c2 pass one message to the base station.

LEACH

Low Energy Adaptive Clustering Hierarchy (LEACH),[19] a hierarchical protocol in which most nodes transmit to cluster heads, is presented. The Setup Phase:

1. In this phase, the clusters are organized and the cluster heads are selected. In every round, a stochastic algorithm is used by each node to check whether it will become a cluster head. If a node can be a cluster head once, it can't become a cluster head again for *P* rounds, where *P* is the percentage of these cluster heads.
2. The Steady Phase: In this phase, the data is transmitting to the base station. The duration of this phase is much longer than the duration of the above phase in order to reduce overhead.

LEACH is a protocol that uses to reduce energy consumption in a wireless sensor network. However, LEACH uses Single-hop routing in which every sensor node sends information directly to the cluster-head or the Sink. Therefore, it is not recommended for networks that are delivered in large areas.

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Ant Colony algorithm

Ant colony algorithm [12] originates from the actual behavior of ants which communicate with each other by pheromone. Pheromone is a chemical substance released by ants and in turnaffecting their moving decisions. Initially, no pheromone is laid on the branches and ants have no bit of information about the length of branches. However, once a shorter one is found, it will receive pheromone at a higher rate. The more quantities ants leave pheromone on the path, the larger probability they visit this path next time. Thus, there will be a positive feedback in the group of ants.

Particle Swarm Optimization (PSO)

The PSO algorithm [18] is a computing approach, developed after the social behavior of a group of birds. The context of PSO, a swarm indicates to a number of possible solutions to the optimization problem, where every possible solution is referred to a particle. The main aim of the PSO is to check out the particle location that provides the best evaluation of fitness function. In the initialization of PSO, every particle has provided initial parameters irregularly and is 'flown' through the multi-dimensional search space area. During each generation, particle uses the information about its old best individual position and global best optimum location to maximizing the probability of moving towards a optimum solution space that will result in a better fitness.

III .RELATED WORK

Wang Linping[17] performed the wok on energy efficiency in the WSN as one of the very important Performance Indicators. This proposed a new algorithm-PDCH, on the bases of PEGASIS to make every notes load balance and extent the network lifetime. Protocol PEGASIS is based on the chain structure, every chain have only one cluster head, it is in charge with every note's receiving and sending messages who belong to this chain, the cluster head consumes large energy and the times of every round increasing.

Wenjing Guo[12] performed a work on routing protocol for the applications of wireless sensor network (WSN). It is a protocol based on the PEGASIS protocol but using an improved ant colony algorithm rather than the greedy algorithm to construct he chain. Compared with the original PEGASIS, this one, PEG-ant, can achieve a global optimization. It forms a chain that makes the path more even-distributed and the total square of transmission distance much less. Moreover, in the constructing process, the energy factor has been taken into account, which brings about a balance of energy consumption between nodes. In each round of transmission, according to the current energy of each node, a leader is selected to directly communicate with the base station (BS). Simulation results have show that the proposed protocol significantly prolongs the network lifetime.

Olaf Landsiedel[11] performed a work on low power, low delay opportunistic routing meets duty cycling. In this paper author introduced ORW, a practical opportunistic routing scheme for wireless sensor networks. In a duty cycled setting, packets are addressed to sets of potential receivers and forwarded by the neighbour that wakes up first and successfully receives the packet. This reduces delay and energy consumption by utilizing all neighbours as potential forwarders.

Xufei Mao[14] performed a work on energy-efficient opportunistic routing in wireless sensor networks. In this paper, author focused on selecting and prioritizing forwarder list to minimize energy consumption by all nodes. Author studied both cases where the transmission power of each node is fixed or dynamically adjustable. Author presented an energy-efficient opportunistic routing strategy, denoted as EEOR.

Eric Rozner[5] performed a work on model-driven optimization of opportunistic routing. Author developed a model-driven optimization framework to jointly optimize opportunistic routes and rate limits for both unicast and multicast traffic. A distinctive feature of presented framework is that the performance derived from optimization can be achieved in a real IEEE 802.11 network. Presented framework consists of three key components: (i) a model for capturing the interference among IEEE 802.11 broadcast transmissions, (ii) a novel algorithm for accurately optimizing

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different performance objectives, and (iii) effective techniques for mapping the resulting solutions to practical routing configurations.

Junwhan Kim [8] performed a work on opportunistic real time routing in multihop wireless sensor networks. This paper proposed a new routing protocol called opportunistic real time routing (or ORTR) that guaranteed delivery of data under time constraints with efficient power consumption. Author compared existing routing protocols against ORTR through a set of simulation experiments. Presented simulation results illustrate that ORTR provides guaranteed real-time service with optimal transmission power without degrading the energy balance.

Che-Jung Hsu [4] performed a work on economy: a duplicate free opportunistic routing. This paper proposes ECONOMY, an opportunistic routing (OR) protocol that is free from duplicate transmission. OR utilizes overheard packets and takes multiple routes into consideration concurrently. It had been shown that OR outperformed traditional routing by close to 100% in term of throughput; however, duplicate transmissions may occur as relays cannot hear one another, and it consequently degrades the performance of OR. ECONOMY used token passing along a path that relays can hear one another to eliminate duplicate transmission.

IV. CONCLUSION

In this paper, we have tried to systematically study the unified theoretical framework, configurations and routing schemes for the data-centric paradigm in sensor networks. The energy efficient protocol for WSNs and some algorithms have been discussed. In this paper, we have discussed two protocols named as PEGASIS and LEACH and their utilization for network. By knowing this, we can understand the operation of various energy efficiency algorithms and it is usable for those who want to implement new energy efficiency algorithm. For the achievement of energy efficient routing, we can use artificial intelligent algorithms and some new techniques for the betterment for route optimization and by using a rigorous approach we can optimize energy utilization that leads to a significant increase in network lifetime by computing optimal solutions.

REFERENCES

[1] Adrian Perrig," SPINS: security protocols for sensor networks", mobile computing and networking ,2001.
[2] Amir Darehshoorzadeh," candidate selection algorithms in opportunistic routing", PM^{2}HW^{2}N'10, October 20–21, 2010
[3] AmrAljarhi," rethinking opportunistic routing using space syntax", chants'11, September 23, 2011.
[4] Che-Jung Hsu," Economy: a duplicate free opportunistic routing", mobility , 2-4,sept 2011.
[5] Eric Rozner," model-driven optimization of opportunistic routing", sigmetrics'11, June 7–11, 2011.
[6] Fan Wu," incentive-compatible opportunistic routing for wireless networks", mobicom'08, September 14–19, 2008, San Francisco, California, USA2008.
[7] Hamed Shah-Hosseini, "The intelligent water drops algorithm:a nature-inspired swarm-based optimizationalgorithm" international. journal. bio-inspired computation, vol. 1, Nos. 1/2, 2009.
[8] Junwhan Kim," opportunistic realtimerouting in multihop wireless sensor networks", sac'09 March 812, 2009.
[9] Kemal Akkaya , Mohamed Younis, "a survey on routing protocols for wireless sensor networks",nov2009.
[10] Libo Song," evaluating opportunistic routing protocols with large realistic contact traces", CHANTS'07, September 14,2007
[11] Olaf Landsiedel," low power, low delay:opportunistic routing meets duty cycling", IPSN'12, April 16–20, 2012
[12] WenjingGuo, Wei Zhang, Gang Lu "PEGASIS protocol in wireless sensor network based on an improved ant colony algorithm",East China Normal University 2010.
[13] Wenliang Du," an efficient scheme for authenticating public keys in sensor networks", mobihoc'05, May 25–27, 2005.
[14] Xufei Mao," Energy-Efficient opportunistic routing in wireless sensor networks", IEEE transactions on parallel and distributed systems, vol. 22, p.no.11, November 2011 1045-9219/11@ 2011 IEEE,2001.
[15] Yazeed Al-Obaisat, Robin Braun, "on wireless sensor networks: architectures, protocols, applications, and management"
[16] Zhongliang Zhao,"performance evaluation of opportunistic routing protocols: a framework-based approach using OMNeT++", LANC'12, October 4-5, 2012
[17]Wang Linping, Cai Zhen,"Improved algorithm of PEGASIS protocol introducing double clusterheads in wireless sensor network",vol 10,pno148-151, IEEE,2011.
[18] N. M. Abdul Latiff, C. C. Tsimenidis, B. S. Sharif" Energy-aware clustering for wireless sensor networks using particle swarm optimization", 1-4244-1144-0/07, IEEE,2007.
[19] Stefanos A. Nikolidakis" Energy Efficient Routing in Wireless Sensor Networks Through Balanced Clustering",vol 6,pno 29-42,IEEE,2011.

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