A Survey on Energy Efficiency in WSN

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ABSTRACT

Wireless Sensor Networks have an extensive range of applications but they are conquered with many challenging problems and complications that need to be addressed. The energy consumption of the nodes and the extension of the network lifetime are the core challenges and the most significant features of the routing protocol in order to make it suitable, effective and efficient for WSNs. As the sensor nodes are basically battery powered devices, so the top concern is always to how to reduce the energy utilization to extend its lifetime. In the past few years WSNs has gained a considerable amount of attention from both the research community and the real users. The researchers also proposed many different energy efficient routing protocols to achieve the desired network operations. In this paper there is an attempt to give a wide comparison of the routing protocols in WSNs focusing on the hierarchical or clustering based routing protocols. Moreover, extracting the strengths and weaknesses of each protocol, providing a comparison among them, including some metrics like scalability, mobility, power usage, robustness etc. to make it understandable and simple to select the most suitable one as per the requirement of the network.

Keywords: - *Energy Efficiency, WSN, Security, Load balancing, Graph theory, Greedy algorithm*

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1. INTRODUCTION:

Wireless Sensor Networks (WSNs) brought a dramatic variation in bringing advancement in technologies and also providing opportunities for effective usage of resources in critical environments [2]. WSNs are basically the collection of wireless nodes having limited energy capabilities, are deployed randomly over a dynamically changing atmosphere, may be mobile or stationary, for observing physical phenomena like humidity, temperature, health monitoring, vibrations, seismic events etc. [4][5]. Selecting a routing strategy is the core issue for gathering and delivering the efficient packets of useful information to the specified destination. So the routing strategy should guarantee the least energy consumption resulting in maximizing the network's lifetime [6].

The WSNs may be used in the variety of everyday life activities or services. For example its common use is for monitoring like in Military to detect enemy intrusion or monitoring the air pollution or to be used for forest fire detection to control when a fire has started. In addition, an important area of use is the healthcare sector. Moreover, the use of WSNs on agriculture may benefit the industry frees the farmer from the maintenance and wiring in a difficult environment [5].

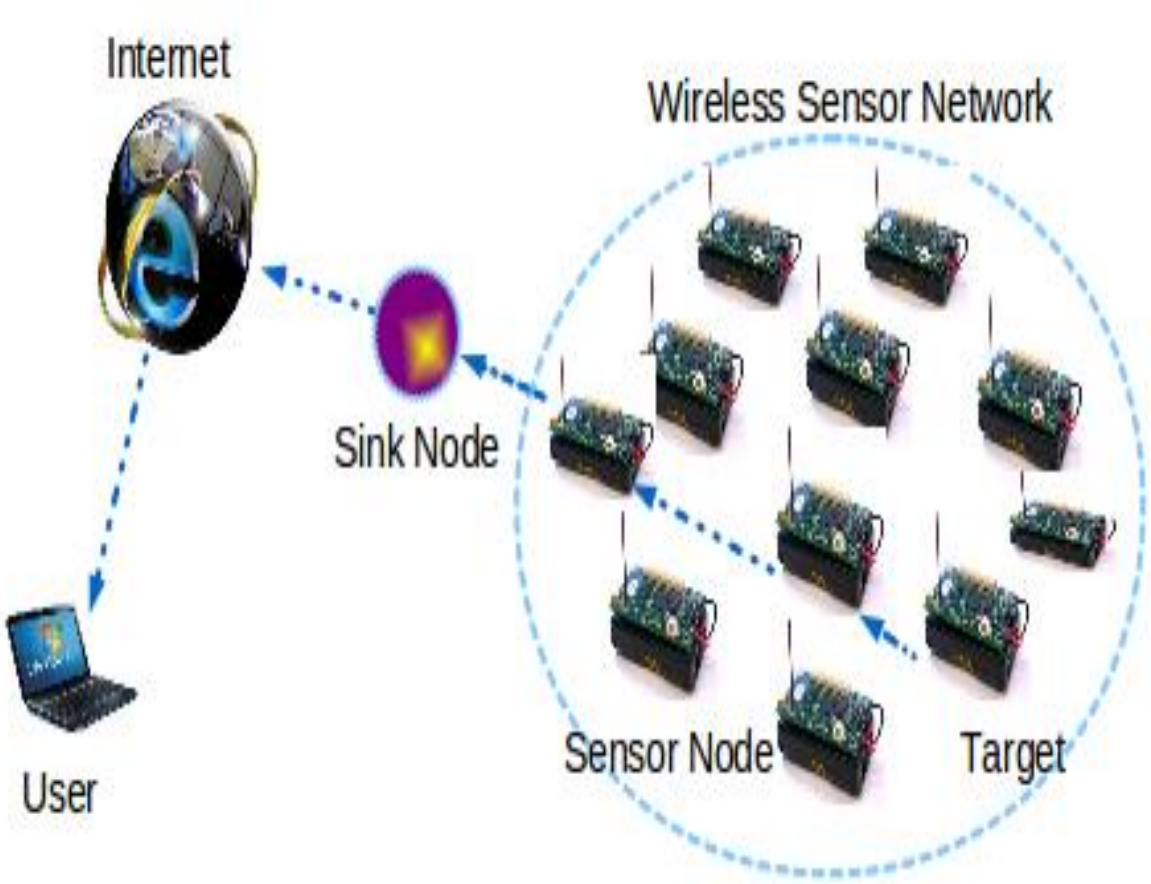

Fig: Wireless Sensor Network

A sensor node is typically an ultra-small limited power device that consists of four basic components. First is the sensing part for data acquisition, then the control system for the local data processing and memory operations (storage), then a communication subsystem for transmission and reception of data from other linked devices and finally a power source that supplies the required energy for performing the desired tasks [1][3]. This power source usually comprises of a battery with limited energy so if a critical node stops working then it's a big and serious protocol failure. The main thing is that it could be impossible to recharge the battery because the nodes are deployed and spread randomly in a hostile environment or any other area of interest such as unapproachable areas or the disaster locations for getting the required information. So to fulfill the scenario requirements the sensor nodes should have enough and prolonged life time, even in some cases up to several months or years can be required. So the question arises that "how to elongate the lifetime of the node for such a long duration" [2][3].

It is also possible to use the energy from the external environment e.g. using the solar cells as a power source [7]. But usually a non- continuous behavior is usually observed from the external power sources so some energy buffer is also needed. Whatever is the situation; energy is a serious resource and should be used very carefully. So what clear from it is that energy is a main issue for the systems grounded on WSNs.

2. LITERATURE REVIEW:

2.1 Achieving Energy Efficiency through Load Balancing :A Comparison through Formal Verification of two WSN Routing Protocols

- In [8] This paper introduces Robust Formally Analyzed Protocol for Wireless Sensor Networks Deployment with Load Balancing (RAEED-LB). This protocol takes the decision of selecting the next node on the basis of load balancing. The performance of RAEED-LB and RAEED is compared through formal verification. The formal verification results show that RAEED-LB achieves network lifetime gain in the range of 10% to 35% over RAEED.

2.2 Enhancing Routing Energy Efficiency of Wireless Sensor Networks

- In [9] This paper is intended to introduce energy efficient routing protocol, known as Position Responsive Routing Protocol (PRRP) to enhance energy efficiency of WSN. Position responsive routing protocol differs in several ways than other existing routing techniques. Position response routing protocol approach allows fair distribution of gateway\cluster head selection, maximum possible distance minimization among nodes and gateways\cluster heads to utilize less energy. Position responsive routing protocol shows significant improvement of 45% in energy efficiency of wireless sensor network life time as a whole by increasing battery life of individual nodes. Furthermore PRRP shows drastic increases for data throughput and provide better solution to routing energy hole due to it fair distributed approach of gateway selection.

2.3 Preliminary Framework of Topology Control Algorithm in WSN to Achieve Node's Energy Efficiency

- In [10] The objective of this paper is to propose fundamental modeling of topology control algorithm to conserve individual WSN node's energy, and at the same time preserving the graph connectivity. The proposed topology control algorithm consists of three phases: 1. Identifying connecting nodes at maximum transmission, 2. pairing nodes with shortest algorithm /minimum energy level, 3. Calculating/setting minimum power transmission per-node for energy conservation. The algorithm works-out locally and dispenses full graph connectivity, and theoretically would be able to reduce WSN control overhead.

2.4 Energy efficiency in WSN : IEEE 802.15.4

- In [11] Wireless connection suffer from some weaknesses chiefly fault detection and energy efficiency which stay again the main problems in (WSN).Both was under the scope of research communities and industry engineers. We are interested to the IEEE 802.15.4 standard with beacon enabled mode. IEEE802.15.4 is a protocol designed to Physical (PHY) layer and Medium Access Control (MAC) for WSN. We intervene in the Super fame Duration (SD) which present the main private characteristic of the MAC frame in IEEE 802.15.4 in order to minimize the energy consumption when the energy level in a battery reach a critical level.

2.5 An Energy-Efficient Balancing Scheme in Wireless Sensor Networks

- In [12] This paper propose a user-oriented load balancing scheme for an energy-efficient load balancing in wireless networks which is based on allocate load on wireless sensor nodes proportionally to each of the agent's capacity and user-oriented approach. This proposed scheme is combined dynamic provisioning algorithm based on greedy graph and user oriented load balancing scheme for maintain of the performance and stability of distributed system in wireless sensor networks. We address the key functions for our proposed scheme and simulate the efficiency of our proposed scheme using mathematical analyze.

3. COMPARATIVE TABLE:

Table -1: Comparative Table

Paper Title	Methods/Techniques	Advantages	Disadvantages
Achieving Energy Efficiency through Load Balancing: A Comparison through Formal Verification of two WSN Routing Protocols	Load Balancing, Formal verification	Using formal verification for protocol designers is to test extreme cases And to quickly verify the proof of concept.	The use of greater network size is not possible in formal verification
Enhancing Routing Energy Efficiency of Wireless Sensor Networks	PRRP(Position Response Routing Protocol)	Improve and increasing overall energy efficiency and life time.	More energy drain due to longer distance.
Preliminary Framework of Topology Control Algorithm in WSN to Achieve Node's Energy Efficiency	Graph Theory	Reduce the amount of power propagates by individual node during transmissions and same time guarantee no loss of connectivity.	Lifetime of N/W measured in hours, so it may cause the connectivity lost.
Energy efficiency in WSN: IEEE 802.15.4	IEEE 802.15.4, Beacon interval, super frame Duration	We could set the life period of the node at the first use then change periodically the SD in order to get the lifetime set at the beginning.	Possibility of energy fault in network .
An Energy-Efficient Balancing Scheme in Wireless Sensor Networks	Greedy algorithm, User Oriented algorithm.	Maintain the performance and stability of distributed system in WSNs.	Not use for large networks.

4. CONCLUSION:

WSNs have greatly prolonged playing a key role for the data efficient selection and delivery. The energy efficiency is a very most important issue for the networks particularly for WSNs which are described by "limited battery capabilities". Due to complexity in WSNs operations, what is required is the use of energy-efficient routing

techniques and protocols, which will assure the network connectivity and routing of information with less required energy.

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