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A SURVEY ON MINIMIZING DELAY AND MAXIMIZING LIFETIME IN WIRELESS SENSOR NETWORKS

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Abstract: - The field of wireless sensor networks is booming field nowadays. It combines sensing, processing, and communication into a single tiny device. This technology can be seen everywhere in this world within few years. Using this knowledge many applications are imaginable like home automation, health monitoring, traffic, security monitoring and many more. The main purpose of sensor nodes is to detect event and inform to sink node. This transmission of data must consume minimum amount of energy to maximize lifetime of WSN. But it requires extra delays because a transmitting node needs to wait for its next hop relay node to wakeup. To reduce these delays, in this paper we discuss the different approaches to maximize the life of WSN.

KEYWORDS: Delay, Energy Efficiency, Sleep scheduling, Network lifetime, Wireless Sensor Networks (WSNs)

I. INTRODUCTION

A Wireless Sensor Network

A Wireless Sensor Network is a collection of sensor nodes which are organized in network as co-operative manner. Each sensor node has processing capacity (Microcontroller, CPU), memory (flash, data memory), transceiver (antenna), power (battery, solar cells). These nodes are deployed to monitor physical or environmental conditions, like temperature, moisture, sound, etc. Basically sensor network research is initially motivated from military applications such as battlefield surveillance and enemy tracking. But today there are different applications in civil area also like habitat monitoring, environmental condition monitoring such as temperature, moisture, health monitoring, irrigation and many more. To measure properties of the environment different mechanical, thermal, biological, chemical and magnetic sensors may be attached to the sensor node. Since the sensor nodes have limited memory and are typically deployed in area which is difficult to access, a radio is implemented for wireless communication to transfer the data to a base station. Battery is the only power source in a sensor node. Secondary power supply may gain power from the environment such as solar panels may be added to the node depending on the appropriateness of the application or environment where the sensor will be deployed. [9]

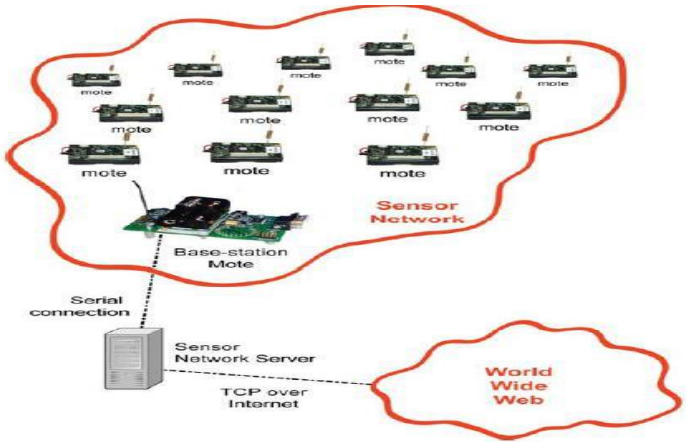

Fig.1 Basic WSN Architecture

There are two types of WSNs: structured and unstructured. In an unstructured WSN there is a dense collection of sensor nodes. Sensor nodes may be deployed in an ad hoc manner into the field. Then network can be left unattended to perform monitoring and reporting functions. In an unstructured WSN, network maintenance such as managing connectivity and detecting failures is difficult since there are so many nodes. In a structured WSN, all or some of the sensor nodes are deployed in a pre-planned manner. The advantage of a structured network is that fewer nodes can be deployed with lower network maintenance and management cost. [9] There are some important characteristics common to all WSNs independent of the application they were developed for. The important ones to consider are:

- Each network has at least one base-station node, which must be connected to a server which is connected to the Internet.
- Each node is able to transmit and receive messages through radio frequency.
- Messages are passed to the base-station node using the multi-hopping communication method: packets are through various (intermediate) nodes in order to reach the base-station node. This also enquires that all nodes have its unique identification code within the network.
- Generally the sensor nodes can be at any location, so networks can be queried according to geographical region rather than specifying a particular node.
- Each network is extendable and flexible. With the exception of the base-station node, any node can be added or removed from the network. Normally networks are composed of a large number of sensor nodes that are densely deployed either inside the area being monitored, or very close to it;
- Sensor nodes work cooperatively, using their computing power to carry out simple computations, and then transmit only the required data.[7]

B. Need for maximizing lifetime of WSN

Battery is the sole source of energy in WSN. It is impractical to replace or recharge a battery in the node as nodes are deployed at various locations. In such conditions it is necessary to use power efficiently. For this purpose different techniques are used. Efficient routing algorithms and scheduling techniques are proposed for maximizing life of WSN. These techniques extend life of WSN which results in more reliability, availability, QoS, etc.

C. Research scope in increasing lifetime of WSN

Many researchers proposed various techniques to prolong life of nodes. Sometimes efficient use of energy is achieved by compromising quality, reliability concerns. Mainly delay is compromised to achieve efficiency in energy consumption. To balance the network quality improving factors, like delay, power consumption, reliability, QoS more research has to be done in this area. There is a need of more work in various techniques of scheduling and routing which will focus on these quality improving factors.

D. Challenges in Wireless Sensor Network

- *Power:* Power is always been a challenge for WSNs designs. One of the ways to maximize the network lifetime is to design the energy efficient algorithms and hardware that uses power efficiently.
- *Hardware Cost:* One of the main challenges is to produce low cost and tiny sensor nodes. Low cost of sensor nodes can be achieved by recent and future progress in the fields of MEMS.
- *Security:* Security is one of the major challenges in WSNs. Most of the attacks that are performed on WSN are insertion of false information by compromised nodes within the networks. Development of security schemes for WSN also faces challenges related to constrained environment.
- *System Architecture:* Researches in the field of WSN is going on around the world but still there is no unified system and network architecture, on the top of that different application can be built.
- *Real World Protocols:* Protocols need to be developed for real world problems considering the theoretical concepts and synthesizing novel solutions into a complete system wide protocol for real world application.
- *Analytical and Practical Results:* Till date very few analytical results exists for WSNs. All new applications only get confidence when it is tested & analyzed practically and results are compared with existing schemes.

II Review of different approaches of minimizing delay and maximizing lifetime in WSN

In this work done by Joohwan Kim, Xiaojun Lin, and Ness B. Shroff proposed asynchronous sleep-wake scheduling, where nodes do not synchronize their clocks with other nodes and thus wake up independently asynchronous sleep-wake scheduling is simpler to implement, and it does not consume energy required for synchronizing sleep-wake schedules across the network. However, because nodes do not know the wake-up schedules of other nodes, asynchronous sleep-wake scheduling could result in large one-hop delays. The end-to-end delay as the delay from the time when a source node detects an event and generates the event reporting packet (or packets) to the time the first packet is received at the sink. For applications that use a single packet to carry the event information, the above definition captures the actual delay for reporting the event information. For applications that use multiple packets, if the nodes that relayed the first packet stay awake for a while, the delay to relay subsequent packets will be much smaller than that experienced by the first packet.

In this work done by Priyanka M.Lokhande, A.P.Thakare proposed asynchronous sleep wake scheduling where each node wakes up independent of its neighboring nodes in order to save energy. Technique assumes that the sensor network employs asynchronous sleep–wake scheduling to improve energy efficiency. Poisson process of sleep–wake scheduling is that, due to its memory less property which uses a time-invariant optimal policy to maximize the network lifetime. To reduce the delays any cast-based packet forwarding schemes is used.

In this work done by Kemal Akkaya, Mohamed Younis and Moustafa Youssef proposed in order to conserve energy; many of the routing protocols proposed for wireless sensor networks reduce the number of transmitted packets by pursuing in-network data aggregation. Almost all of the aggregation schemes presented in the literature strive to save sensor's energy while considering unconstrained data traffic. However, aggregation extends the queuing delay at the relay nodes and can thus complicate the handling of latency-constrained data. An algorithm for achieving maximal possible energy saving through data aggregation while meeting the desired level of timeliness. A Weighted Fair Queuing based mechanism for packet scheduling is employed at each node in order to perform service differentiation and ensure bounded delay for constrained traffic.

In this work done by Arul Xavier V. M, Angelin Jeyaseeli D, proposed sleep scheduling, sender nodes should wait until receiver nodes are active and ready to receive the message. Sleep scheduling should increase the network life time but it could cause transmission delay. Whenever the network scale increases, the broadcasting delays also increase. So, delay efficient sleep scheduling methods are needs to be designed to provide low broadcasting delay from any node in the WSN. Most of sleep scheduling methods in focus to minimize the energy consumption. To minimize the broadcasting delay in WSN, the time wasted for waiting during the broadcasting needs to be minimized. So there is a need for balance both energy consumption and broadcasting delay in wireless sensor network. The destination node wakes up immediately when the source nodes obtain the broadcasting packets. Here, the broadcasting delay is reduced. Problem of minimizing communication delay while providing energy efficient periodic sleep cycles for nodes in wireless sensor networks. The objective is to reduce the delay given the duty cycling requirement. The Code Division Multiple Access (CDMA) scheme also offers collision free access to the medium. For the single wake up schedule case, where each sensor can wake up at exactly one of the k slots, it provided by graph-theoretic problem formulations for arbitrary all-to-all as well as weighted communication patterns. Using this technique, they proposed algorithms with provable guarantees on tree, grid and arbitrary graphs.

CONCULSION

This paper gives review of various techniques to minimize delay and prolong the lifetime of the WSN. Hence for developing real life applications that have minimizing delay and maximizing lifetime researches and engineers should pay attention to all these techniques and should develop new algorithms which solve current issues in these techniques. It can improve the network performance.

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