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SYSTEM SUPPORT FOR THE IN SITU TESTING OF WIRELESS SENSOR NETWORKS VIA PROGRAMMABLE VIRTUAL ONBOARD SENSORS

[1]K. Anbumathi, Asst. Professor, Bharathiyar Arts And Science College For Women, Deviyakurichi, Thalaivasal, Salem.

[2]S. Maheshwari M.Phil Scholar, Bharathiyar Arts And Science College For Women, Deviyakurichi, Thalaivasal, Salem.

Abstract:

A wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices us- ing sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants, at different locations. Wireless sensor networks gather data from places where it is difficult for humans to reach and once they are deployed, they work on their own and serve the data for which they are deployed. When the environment changes, sensor network should change too. This paper is an attempt to de- vise an efficient, robust and stable solution for the problem of remote reprogramming of wireless sensor networks and trying to address some of the problems associated with attempts taken by other researchers such as Network Reprogramming, Sensor reconfiguration and Supporting Tools.

KeyWords: Wireless Sensor Network, Wireless Sensor, Network.

1. INTRODUCTION

Wireless sensor networks gather data from places where it is difficult for humans to reach and once they are deployed, they work on their own and serve the data for which they are deployed. When the environment changes, sensor network should change too. For an example , it is meaningless, if the sensor network is collecting data of rainfall in the months of January-March in India. However, the same network could be utilized to gather temperature data for the same period. Or at least we should stop retrieving data of rainfall. And also, the aggregation function ought to be changed from ”Send the data continuously”, to ”Send the data if it rains”. Since bug fixes and regular code updatesIt is not feasible to collect each and every sensor node which is deployed and reconfigure it for our needs. Hence a set of protocols, applications and operating system support are needed to reconfigure wireless sensor networks remotely. The ability to add new functionality or replace an existing functionality with a new one in order to change the sensor behavior totally, without having to physically reach each individual node, is an important service even at the limited scale at which current sensor networks are deployed. TinyOS supports single-hop over-the-air reprogramming, but the need to reconfigure or reprogram sensors in a multihop network will become particularly critical as sensor a network grows and moves toward larger deployment sizes. Hence, this paper reports an attempt to develop suitable protocols and techniques to achieve reconfigurability of sensor networks with minimal human intervention. Network Reprogramming includes many subtopics open for research. We consider the problem as a whole and then divide it into different sub-problems. We then try to solve each of them and merge the solutions into one solution to the big problem. As explained in subsequent sections, since none of above studied algorithms sufficed our pur- pose, we had to devise a new algorithm. Hence our second priority would be to design an al- gorithm for code dissemination which would be most suitable for remote reprogramming of wireless sensor network when nodes are at a distance of more than single hop from the base station, which is disseminating the code. Design a scheme which would be resilient to losing some packets during the process since nodes may operate in noisy conditions, have very simple radios, or cannot afford expensive transmission schemes.

2. LITERATURE REVIEW

A completely different mechanism for implementation of reprogramming has been used in [Dunkels et al. (2006)]. It uses runtime dynamic linking for reprogramming wireless sensor net- works. This approach uses standard ELF object file format of Contiki [Dunkels (2004)] operating systems for sensor networks since it supports loadable modules. They have ported Java virtual ma- chine from lejOS [Dunkels (2004). A Unix diff-like approach for code distribution has been taken in [Reijers (2003)]. They have devised an algorithm for edit script generation. The edit script is generated by comparing the old code with the new one. The difference between the codes, that is the edit script, is sent to the node to be reprogrammed. At the receiver side, the patch is applied to the currently running code to generate the new version. The algorithm is further optimized by using mechanisms like Address shifts, Padding, Address Patching and Patch List generation. Optimization by making proper choices for opcode selection is also used for this approach.

TinyOS 2.0 also supports In-Network Reprogramming of wireless sensor networks. This sup- port is available mainly for telos and micaZ platforms. It implements the Deluge algorithm [Hui (2004)] for code dissemination and for remote reprogramming of wireless sensor networks. Multi- hop reprogramming is supported with the use of Deluge. We, in our literature, analyze Deluge for the problems faced by it when it is scaled to highly dense networks and try to solve these problems with our approach. TinyOS 1.0 [Jeong (2003)] already supports Network Reprogramming for the Mica-2 motes. But the support is for single-hop reprogramming only. It uses a NACK based broadcasting protocol for code dissemination. The Base station breaks the code to be transmitted into small units known as capsules. It then transmits these code capsules to all nodes within its broadcast range. After the entire code image has been transmitted.

3. RELATED WORK

A wireless sensor network (WSN) comprises of sensor nodes, which monitor the terrain where they are deployed and gather the physical environmental parameters which they communicate to the base station [1]. The sensor nodes are densely deployed in regions where they monitor many physical phenomena such as vibration, movement of objects, temperature, humidity, pressure, radiations, noise levels, and light conditions. The sensor nodes self-organize to form an Ad-hoc network after the deployment. The sensor nodes are resource constraint as these are equipped with batteries with limited power, tiny microprocessors/microcontrollers, low power transceivers, and sensors for gathering information about the deployed environment. When a single sensor node is limited in its capabilities, the composition of large number of nodes offers technological capabilities. In wireless sensor networks, individual sensor nodes are inherently unreliable and have very limited capabilities to ensure real-time guarantees. The target is to provide more reliable services with reduced end-to-end delays, and lower energy consumption in the underlying sensor network. These systems are implemented as safety critical systems such as in aerospace and defence. Performance of such systems cannot be compensated over any other feature of the system. A certain amount of latency is allowed for soft-real time solutions. In such cases the transferred data is not critical and the system used may use the soft real time solutions for directing the information to the sink.

These systems are known as non-safety critical systems where the system deals with non critical data and use soft real time solutions for data transfer. The applications of wireless sensor networks spread in different domains viz. military, emergency situation management, physical world, medical and health, industry, home network and automotive. Most of the sensor network applications need real time communication and the need for deadline aware real time communication is becoming eminent in these applications. These applications have different dead line requirements also. Some of the challenges for real time communication are random deployment, dynamic network topology, traffic characteristics, resource constraints, and transient congestion.

4. ANALYSIS

We have presented a real time routing protocol, RRDTE in which detects time critical events in WSN. But the bandwidth allocation is not addressed in this protocol. In , we propose a scheduling algorithm for sensor networks based on the packet service ratio which helps in congestion control and flow control. But this also does not address the bandwidth partitioning based on the priority of the packets. M.Caccamo et propose an implicit prioritized access protocol, for deterministic real time communication which demands prior topological information and synchronization.

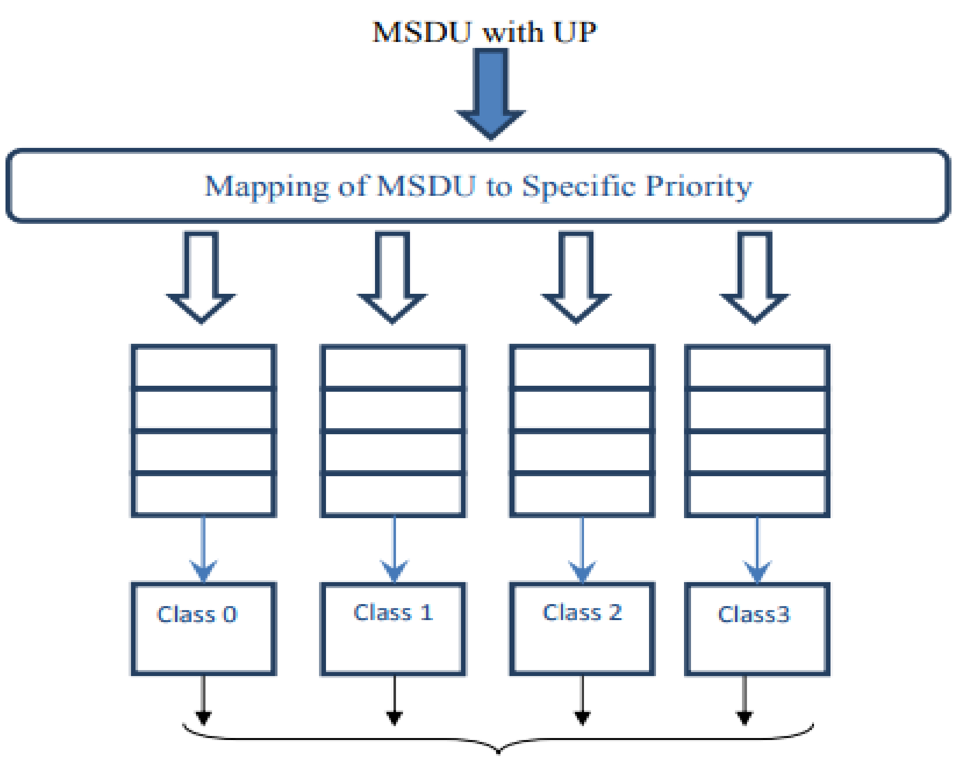

Fig.1.System Analysis

However, this is not suitable in non-deterministic environments. In I-EDF nodes are organized in hexagonal cells. Each cell will have a unique frequency in intra- cellular communication. The six directions of the hexagon are numbered and the communication slots alternate with a given direction in inter-cellular communication. The rigid cell-based organization of the topology has a limitation in real environment where there is random deployment of sensor nodes. Sensor nodes share the available resources such as transmission bandwidth, buffer storage and the processing capability. The delay and loss performance can be quantified as explained in this subsection.

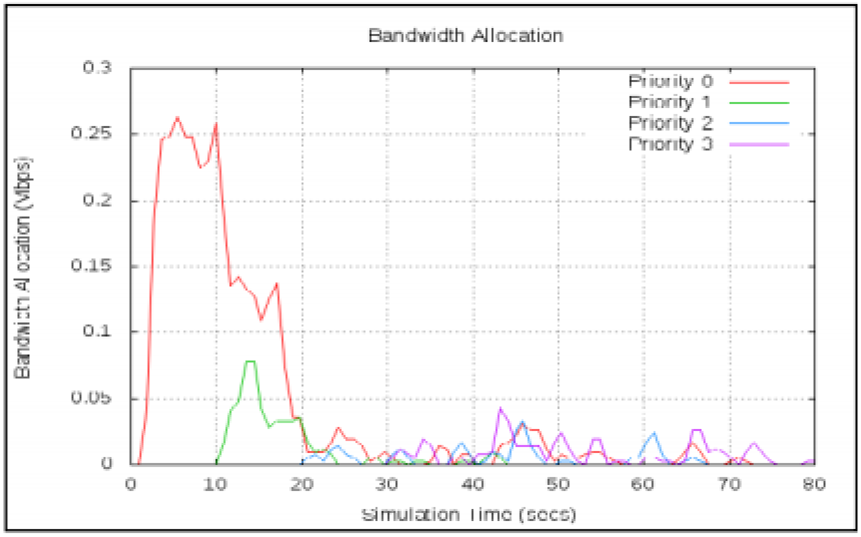

Fig.2.Output Analysis

When a packet or connection request arrives at a node, the node may be in a blocking state because of the unavailability of the resources. The data packets arrive at a node in a random manner; the time that they spend in the node is also random. Due to lack of resources, the packets may get blocked or lost. Throughput of the system is the long-term departure rate from the system. The average arrival rate is given by the inverse of the average inter arrival time. we are comparing the end-to end delay of packet delivery in our method with the end-to end delay incurred in transmission of data packets with the AODV [20] protocol for priority 0, the critical data. AODV is an on-demand routing protocol which is widely used for wireless networks. This protocol has less routing and computational overheads, simplicity.

CONCLUSION

This paper details the priority based data delivery to the sink node from the sensor nodes. In this work, we consider the bandwidth allocation based on the priority of the data for the applications where sensor nodes are deployed in Ad-hoc manner to detect critical events. The data generated in WSN has different priority levels. WSNs are application specific and several applications of WSN are designed for vital event monitoring and to ensure timeliness and reliability for the measured environmental values direction of this work could be an enhancement to support load balancing. We have considered a static base station and nodes in this work. Studies may be further extended for scenarios considering the mobility of the sink, the sensor nodes or both.

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