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A Survey of Dynamic Multilevel Packet Scheduling in Wireless Sensor Network

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Abstract- wireless sensor network is becoming a very popular area that starts having many applications in different fields. Packet scheduling is one of the most important functions of the nodes in the wireless sensor networks. The scheduling of packets according to the priorities whether real time or non real time is of vital importance to decrease end to end transmission delay of data and waiting time of sensors in the network. Multilevel packet scheduling schema consists of multiple queue to hold packets according to its priority. Dynamic packet scheduling provides low end to end delay.

Keywords— wireless sensor network, different packet scheduling, deadline, end to end delay

I. INTRODUCTION

Wireless sensor network consist of number of tiny sensor nodes deployed over a geographical area. Most existing wireless sensor network operating systems use first come first serve schedulers that process data packets in the order of their arrival time. Real time data packets need to be sent with minimum delay to the corresponding base station. It is proposed to be place in first priority queue. Sensor energy consumption and data transmission delay reduced due to routing protocols and data transmission. Packet scheduling at sensor nodes is highly important since it ensures delivery of different types of data packets based on their priority and fairness with a minimum latency.

Extensive research for scheduling the sleep wake times of sensor nodes has been conducted, only a few studies exist on the packet scheduling of sensor nodes that schedule the processing of data packets available at a sensor node and also reduce energy consumptions. Sensed data have to reach the base station within a specific time period or before the expiration of a deadline. Scheduling different types of packet, at sensor nodes with resource constraints in wireless sensor networks is of vital importance to reduce sensors energy consumptions and end to end data transmission delay.

II. RELATED WORK

In sleep scheduling the sensors and/or the radios of sensor nodes are modelled to sleep so as to conserve energy. Previous works discussed about several distributed algorithms to perform sensor and radio sleep scheduling in wireless sensor networks.

In [4], have defined ASLEEP for efficient energy consumption in wireless sensor networks targeted to periodic data acquisition. This helps to reduce latency also when nodes are sleeping for most of the time and favours data aggregation. ASLEEP is able to adapt to variations in the message generation rate, network topology, external conditions, and so on. An Adaptive Staggered sLEEp Protocol (ASLEEP) which automatically adjusts the activity of sensor nodes, benefiting both low-power consumption and low message latency. This protocol is targeted to data collection applications (e.g., monitoring applications), in which sensor nodes have to periodically report to a base station. This scheme provides two main advantages. Initially this schema is not tied to any particular medium access control (MAC) protocol, so that it can be used with various sensor platforms. Next, it is able to adapt the sleep/wakeup periods of each single node to the actual operating condition, resulting in a better utilization of the energy resources and, results in a longer network lifetime.

Yang,bo sun [8]proposed a randomized scheduling algorithm, in which finite number of subsets of sensors work alternatively. In this paper, first the randomized scheduling algorithm has checked via both analysis and simulations according to network coverage intensity, delay in detection, and probability of detection. Then asymptotic coverage and other properties are discussed. Finally, analyse a problem of maximizing network lifetime under Quality of Service constraints. In other words, at any time, only one set of sensor nodes are working, and the rest of sensor nodes sleep. k-set randomized scheduling algorithm comes at a very trivial cost since it requires only loose time synchronization. In addition to the coverage intensity, delay in detection and probability of detection are also very important measures. For example, since only one set of sensors are turned on, there is a chance that an intrusion event, in particular, a transient intrusion event, may not be detected. A too large detection delay may be disastrous. The duration that the simulations run affects the results. The locations of sensors and intrusions derived from uniform distributions. Three types of events present in this schema are intrusion, detection, and intrusion departure events. Randomly generated events are intrusion events. if the associated intrusion event is detected by at least one sensor node then detection event is occurred. Whenever the lifetime of the intrusion event expires departure event is generated. Sufficient redundancy is required for the scheduling algorithm to maintain connectivity and network coverage, which is achieved by these parameters.

Feng Liu, Chi *et al* in [6] discussed about joint routing and sleep scheduling.The separate design of routing and sleep scheduling results a serious problem in the real implementation of WSNs, for no component can be optimally adjusted before the other one is fixed. In addition, it would not be surprising that the network lifetime thus achieved is suboptimal compared with that when routing and sleep scheduling are jointly optimized. This paper discussed Endeavour's to jointly optimize energy-efficient routing and sleep scheduling to maximize overall network lifetime. In particular, it creates the integrated design of route selection, traffic load allocation, and sleep scheduling into a constrained optimization problem. In this paper, discussed about network life time maximization of wireless sensor networks through joint routing and sleep scheduling. Optimal joint routing and sleep scheduling is known to be a complex problem due to its non-convexity. It deal with this problem transform it into a special form of SP (Signomial Program **)** **t**hat only has inequality constraints. The problem is then solved through an IGP (iterative Geometric Programming) algorithm, where the non-convex problem is approximated by a standard GP in each iteration. The IGP algorithm drastically outperforms the performance of optimal iterative separate routing and sleep scheduling method over a large range of traffic rates. Compared with the traditional design joint routing and sleep scheduling maximize the network lifetime. Design good distributed algorithms with limited complexity and control overhead based on the existing work of distributed algorithms for routing and GP problems is one of the interesting future work.

In [2], focused on critical event monitoring in wireless sensor networks (WSNs), where only a small number of packets need to be transmitted most of the time. An alarm message should be broadcasted to the entire network if critical event occurred. Some sleep scheduling methods are always employed in WSNs to extend the network lifetime, follow-on in significant broadcasting delay, especially in large scale WSNs. It proposed a novel sleep scheduling method to reduce the delay of alarm broadcasting from any sensor node in WSNs. Specifically, two determined traffic paths are designed for the transmission of alarm message, and wake-up pattern based on level by level offset according to the paths. If a critical event occurred, an alarm is quickly transmitted along one of the traffic paths to a center node, and then it is immediately broadcasted by the center node along another path without collision. Therefore, its energy consumption is ultra low and broadcasting delay is independent of the density of nodes. Exactly, the upper bound of the broadcasting delay is only 3D +2L, where D is the maximum hop of nodes to the center node, L is the length of sleeping duty cycle, and the unit is the size of time slot. The broadcasting delay and the energy consumption of the proposed scheme is much lower than that of existing methods. In [3], proposed Virtual Backbone Scheduling (VBS), a novel algorithm that explains a fine-grained sleep scheduling. It schedules multiple overlapped backbones so that the network energy consumption is evenly distributed among all sensor nodes. So the energy of all of the sensor nodes in the network is fully utilized, which in turn extends the network lifetime.VBS is a combined backbone-scheduling and duty-cycling method. Upon state-of-the-art techniques VBS improves by taking advantage of the redundancy in WSNs. This paper discussed two centralized approximation algorithms with different complexities and performances are presented. Additionally, it tells ILR design, an efficient distributed implementation of VBS.

Switching off and on of sleep mode is also an energy consuming process. Therefore the node to should not sleep very frequently. There are different ways to model this. Paper [5] tells about that. One way is to charge a switching cost whenever turn on the node. In this paper adopt a different model. It require that the sleep period of the node has to be an integer multiple of some constant N in time slots instead of charging the node for switching. Author tells that, By adjusting the value of N we can also prevent the node from switching too frequently. Here suppose that even while asleep, the node accurately learns its current queue size at each time t. Based on the current backlog information a node can make the sleeping decision, as well as the current time slot. A good sleep policy has two objectives. First, to minimize the packet queuing delay and the second is to conserve energy in order to continue operating for an extended amount of time. This assesses costs to backlogged packets and energy consumed during the slots in which the node remains awake. It described the optimal policy for all states except the boundary state for the finite horizon average expected cost problem. The existence of a "shutdown" period at the end of the time horizon in which the queue stops serving packets is the most significant difference from the infinite horizon, regardless of the queue size

C. Lu et al., in RAP [9] suggest Velocity Monotonic Scheduling (VMS) policy suitable for packet scheduling in sensor networks. It is based on a different concept of packet requested velocity. It is expected that each packet meets its end-to-end deadline if it can move toward the destination at its requested velocity, which reflects its local urgency. RAP is a new real time communication architecture for large-scale sensor networks. RAP provides convenient, high-level event services for distributed micro-sensing applications. A scalable and light-weight network stack supported novel location addressed communication models. VMS policy is particularly proper for communication scheduling in sensor networks in which a physical space contain a large number of wireless devices to perform real-time monitoring and control.

K. Mizanian et al. proposed RACE algorithm in [7], a real time scheduling policy for large scale wireless sensor networks. Support a soft real-time communication service through the path with minimum delay is the main goal of RACE algorithm. Thus the end-to-end delay in the sensor network becomes comparative to congestion of nodes between source and destination. To find the path with minimum traffic load between source and destination is the role of bellman ford algorithm. Weight of algorithm is the sum of propagation delay, queuing delay and contention delay. Earliest Deadline First (EDF) scheduling algorithm is used in each node to send the packet with earliest deadline before other packets.

III. SCHEDULING ALORITHMS

Priority and fairness are the main limitations of existing scheduling algorithms. In pre-emptive priority scheduling the continuous arrival of real time data places the other type of data and the data packets from lower level nodes to starvation which restricts the fairness. The real time emergency data have to suffer long waiting time in non-pre-emptive scheduling because of other tasks execution. In this type of scheduling there is no preference to the priority of the data packets which is not suitable for large scale sensor network dynamic applications and in multilevel queue scheduling and the nodes at the lowest levels have a single ready queue consisting of both real time data and the data that is not real time , but they should be processed (executed) depending on their priorities ,if it is not the case, the real time data packets which are emergency experience long routing algorithm exist in three types flat routing ,hierarchical routing and location based routing protocols.

RAP [9] is a real time scheduling in large scale sensor networks. It proposes new packet scheduling policy called velocity monotonic scheduling. Rap significally reduce the end to end deadline miss ratio. Static velocity monotonic (SVM) and dynamic velocity monotonic (DVM) achieved lower miss ratio than the protocols using FCFS. But it only concentrates on real time packets so non real time should wait for a long time.

ETRI [11] is a dynamic packet scheduling for wireless sensor network. It provides different versions to reduce energy consumption, improve information quality and performance of sensor network. This use two tier buffer model and ETRI scheduling algorithms. Each time only one version can be used. So it need more space time.

Packetized dynamic batch co-scheduling algorithm [14] is developed to schedule incoming packets among multiple processors. It achieve load balancing in the presence of variable length packets, also ensures the minimal out of order departure of scheduled packets.

PSA[12] is an algorithm that schedule packets in the network layer and application layer in order to reduce network congestion in the data link layer. it reduce the packet collision and increase the throughput. The packet scheduling algorithm is to schedule packet in network layer and higher to reduce packet congestion in MAC layer and to reduce the packet collision and end-to-end delay; better packet delivery ratio is a by product. A greedy technique is used in this algorithm that is simple and easily implemented in a sensor node. Average delay is more than other algorithms is the limitation of PSA.

Real Time Scheduling (RTS) [13] algorithm deals with all the contributing components of the end-to-end travelling delay of data packets in sensor network to achieve better power management and stable routes when case of failure occurs. RTS delays packets at intermediate hops for a duration that is a function of their deadline. To avoid hot spotting, network allows delaying packet while maintaining deadline-faithfulness.

Table 1: Priority Selection And Delay In Different Scheduling Algorithms

Scheduling algorithms	Less end to end delay	Real time and non real time priority
RAP	✗	✓
ETRI	✓	✗
RACE	✗	✓
PSA	✗	✗
RTS	✗	✓

IV. CONCLUSIONS

Wireless Sensor Networks is increasingly used for real time applications and it is an important area in networking research. This stress techniques to send the sensed data to base station as soon as possible. Scheduling is used for processing the data packets in a wireless sensor network according to their importance and urgency. Diverse packet scheduling techniques for wireless sensor networks were discussed. Active packet scheduling algorithms are static and does not provide fair least amount of delay dynamic packet scheduling algorithm provide a mechanism which provide minimum end to end delay but it does not check the time limit of packets..

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