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Abstract

Real time and non-real-time data packets are the two types of scheduling packets which is used at sensor nodes with resource constraints in WSN of importance to reduce sensors energy and end-to-end delays. Existing First Come First Served, starvation of high priority real-time data packets due to the transmission of a large data packet in non-preemptive priority scheduling, starvation of non-real-time data packets due to the probable continuous arrival of real-time data in preemptive priority scheduling, and improper allocation of data packets to queues in multilevel queue algorithms. A Dynamic Multilevel Priority has priority queues in the zone-based topology, except the last level. Real-time packets are placed high priority queue and non-real-time packets are placed into two other queues based on a certain threshold, leaf nodes are real-time and non-real-time data packets since they do not receive data from other nodes and thus, reduce end-to-end delay.

1. Introduction

Wireless sensor networks usually contain thousands of sensors which are randomly and densely deployed. Each sensor has a light weight and a low cost with three technologies of sensing, on-board processing and transmission. Sensor nodes have limited battery power which leads to limited coverage and communication range. Most of the applications in wireless sensor networks involve primarily data aggregation in which sensor node periodically produced data and transmitting to the sink node through the aggregated node where continuous queries are posed and processed.

1.1 Issues

First, save energy in battery powered sensor and second, fast and efficient query response are essential to network performance and maintenance. In sensor node, both sensor element and processing element consume constant and low power. Energy used by the transceiver is variable and very high in comparison to sensing and processing energy. The power consumed in the transmission depends upon the network topology, MAC layer protocol, routing algorithms, data fusion and cache memory in sensor node, wireless sensor network, during the data aggregation any node listen the channel every time even if data is not placed on the channel that is called ideal listening as nodes do not know when data will come from its child nodes. Time Division Multiple Access scheduling removes the idle listening because every node has a fixed time slot for transmitting and receiving. Every node after receiving or transmitting data goes in sleep mode or processing the data and this technique saves battery power. It has wide range of application such as traffic analysis, environmental monitoring, industrial process monitoring, and tactical systems. Large-scale wireless sensor networks are expected to play increasingly important role in future civilian and military application.

1.2 Reasons For Energy Waste

In wireless sensor network, if network has limited number of non overlapping channels than a different channel is not assigned to every node on the data aggregation tree. Hence data aggregation introduces data retransmission which is caused by co-channel interference from neighboring sensor nodes and extra battery power is required for retransmission of data.

One of the major sources of energy waste is idle listening. An ideal listening occurs when a node listen an ideal channel in order to receive possible traffic. The reason for energy waste is overhearing. Overhearing occurs when a node receives packets which are going to other destination. The another reason of energy wastage is transmitted when redundant data packet or redundant data to the destination.
2. Packet scheduling

Packet scheduling refers to the decision process used to select which packets should be serviced or dropped. Dropping of packets will be based on network characteristics like bandwidth, packet arrival rate, deadline of packet and packet size. Scheduling will be done in scheduler. A scheduler will find it difficult to handle all the packets coming in if the packet rate is high, if the bandwidth is too low or the packet size is large. So the scheduler will select certain packets based on various algorithms. Some of these algorithms have been selected for this survey. It’s not possible for every packet to reach at destination some may be dropped along the way due to the effect of network characteristics mentioned previously. It is an efficient method to enhance the system performance.

Packet scheduling is mainly applied to guarantee quality of service, improve transmission rate in wireless networks. Each input packet is associated to a flow. Flow is a logical unit which represents a sequence of input packets. In practice, packets associated to the same flows often share the same or similar quality of service requirement. There should be a classifier in the server to map each input packets to appropriate flows. The Quality of Service requirement of a flow is usually characterized by a set of parameters. In practice, the parameters may include tolerant delay or tolerant jitter of each packet, or data rate requirement such as the minimum required throughput. The choice of Quality of Service parameters might defer flow by flow, according to the specific requirement of different services.

3. Related work

The rapid proliferation of wireless sensor networks has stimulated enormous research efforts that aim to maximize the lifetime of battery-powered sensor nodes and, by extension, the overall network lifetime. Most work in this field can be divided into two equally important threads, namely

a) energy efficient routing that balances traffic load across the network according to energy-related metrics
b) sleep scheduling that reduces energy cost due to idle listening by providing periodic sleep cycles for sensor nodes.

Kim realized small devices which have been enabled wireless communication among sensors. Wireless sensor network is used for monitoring such as environment, earthquake and disaster. In sensor network, real-time end-to-end data communication is very important. If using traditional First Come First Served scheduler, which needs a lot of time to send if a packet generated from leaf nodes which is the nodes in end of the network. To reduce the amount of exceeded deadline packet, intermediate node need to change delivery order among packets in its ready queue. In propose Multi-Level-Queue scheduler scheme which use different number of queue according to location of node in the network.

Nasser have proposed data packets based on their priority and fairness with a minimum latency. Wireless Sensor Network operating systems use First Come First Serve schedulers that process data packets in the order of their arrival time and, thus, require a lot of time to be delivered to a relevant base station. Emergency data should not deliver to Base S with the shortest possible end-to-end delay. Data packets have to wait for completing the transmissions of other non-real-time data packets and preemptive priority scheduling, lower-priority data packets can be placed into starvation for continuous arrival of higher-priority data.

Any lower-priority task waits for a long period of time for the continuous arrival of higher-priority tasks, fairness defines a constraint that allows the lower-priority tasks to get processed after a certain waiting time. Nodes that are located at the lowest level and one level upper to the lowest level can be allocated timeslots. A real-time priority scheduler is statically used and cannot be changed during the operation of WSN applications.

3.1 Drawback

A real-time priority scheduler is statically used and cannot be changed during the operation of WSN applications. The process are neither dynamic nor suitable for large scale applications since these schedulers are pre-determined path. High processing overhead and long end to end data transmission delay. Due to their FCFS concept, starvation of high priority real-time packets due to the transmission of a large data packet in non preemptive priority scheduling. Starvation of non-real-time data packets due to the probable continuous arrival of real-time data in preemptive priority scheduling, and improper allocation of data packets to queues in multilevel queue scheduling algorithms.

4. Proposed system
4.1 Real-Time Packet Scheduling Technique

Packets at sensor nodes should be scheduled based on their types and priority time data packets are considered as the highest priority packets among all data packets in the ready queue. Hence, they are
processed with the highest priority and delivered to the BS with a minimum possible end-to-end delay. Each node has two or more queues. Data packets are placed into the different queues according to their priorities and types. Thus, scheduling has two phases:

a) Allocating tasks among different queues,
b) Scheduling packets in each queue.

The number of queues at a node depends on the level of the node in the network. For instance, a node at the lowest level or a leaf node has a minimum number of queues whereas a node at the upper levels has more queues to reduce end-to-end data transmission delay and balance network energy consumptions. Data enter the ready queue according to priority but this scheduling also has a high starvation rate. The multi-FIFO queue is divided into a maximum of three queues, depending on the location of the node in the network. If the lowest level is, nodes that are located at level have only one queue but there are two queues for nodes at level. Each queue has its priority set to high, mid, or low. When a node receives a packet, the node decides the packet’s priority according to the hop count of the packet and accordingly sends it to the relevant queue.

4.1 Tdma scheme

Task or packet scheduling at each nodal level is performed using a TDMA scheme with variable-length timeslots. Data are transmitted from the lowest level nodes to BS through the nodes of intermediate levels. Queue sizes differ based on the application requirements. Since preemptive priority scheduling incurs overhead due to the context storage and switching in resource constraint sensor networks, the size of the ready queue for preemptive priority schedulers is expected to be smaller than that of the preemptable priority schedulers. The idea behind this is that the highest-priority real-time/emergency tasks rarely occur.

4.2 First come first served

Packet scheduling schemes can be classified based on the deadline of arrival of data packets to the base station. The data packet are arrive in the arranging in their hop count, it define least value as highest priority. Most existing WSN applications use First Come First Served schedulers that process data in the order of their arrival times at the ready queue. In FCFS, data that arrive late at the intermediate nodes of the network from the distant leaf nodes require a lot of time to be delivered to base station but data from nearby neighboring nodes take less time to be processed at the intermediate nodes. In FCFS, many data packets arrive late and thus, experience long waiting times.

4.2.1 Earliest Deadline First

Whenever a number of data packets are available at the ready queue and each packet has a deadline within which it should be sent to BS, the data packet which has the earliest deadline is sent first. This algorithm is considered to be efficient in terms of average packet waiting time and end-to-end delay. Large-scale sensor networks, whereby they use a priority-based scheduler. Data, that have travelled the longest distance from the source node to BS and have the shortest deadline, are prioritized. If the deadline of a particular task expires, the relevant data packets are dropped at an intermediate node.

4.3 Pre-emptive priority scheduling

The sake of energy efficiency and balance in energy consumption among sensor nodes, we envision using a zone-based routing protocol. In a zone-based routing protocol, each zone is identified by a zone head and nodes follow a hierarchical structure, based on the number of hops they are distant from the base station. For instance, nodes in zones that are one hop and two hops away from the BS are considered to be at level 1 and level 2, respectively, they described between nodes and denoted their Queue.

Each zone is also divided into a number of small squares in such a way that if a sensor node exists in square Si, it covers all neighboring squares. Due to the Fairness, Metric ensures that tasks of different priorities get carried out with a minimum waiting time at the ready queue based on the priority of tasks. It defines a constraint that allows the lower-priority tasks to get processed after a certain waiting time. Priority of an real-time and emergency data should have the highest priority. The priority of non-real-time data packets is assigned based on the sensed location and the size of the data.

4.3 Non-preemptive priority scheduling

Data packets of nodes at different levels are processed using the Time-Division Multiplexing Access scheme. For instance, nodes that are located at the lowest level and the second lowest level can be allocated timeslots 1 and 2, respectively. Three-level of queues, that is, the maximum number of levels in the ready queue of a node is three: priority 1, priority
2, and priority 3 queues. Real-time data packets go to pr1, the highest priority queue, and are processed using FCFS.

Non-real time data packets that are sensed at a local node go to pr3, the lowest priority queue. The possible reasons for choosing maximum three queues are to process:

a) real-time pr1 tasks with the highest priority to achieve the overall goal of WSNs,
b) non-real-time pr2 tasks to achieve the minimum average task waiting time and also to balance the end-to-end delay by giving higher priority to remote data packets,
c) non-real-time pr3 tasks with lower priority to achieve fairness by preempting pr2 tasks if pr3 tasks wait a number of consecutive timeslots.

4.4 Dmp task scheduling

Real Time Priority 1 Queue Data A residing at level l_k is sensing a real-time, emergency event, example, fire detection. This node transmits the emergency priority 1 data to BS through l_{k-1} intermediate levels. To consider the following scenario whereby every time a real-time data packet reaches a neighboring active node, y at an upper level, a non-real-time lower priority data is being processed at that node.

Non-Real Time Priority 2 Queue Data Tasks at pr2 queue can be preempted by real-time ones. Taking the first consider the scenario when a real-time task is sensed at nodes and is forwarded to BS through relay nodes. It should be observed that tasks are available at the pr2 queue at. Since one real-time task is available at the pr2 queue of, real-time tasks will be processed and transmitted first during the timeslot of nodes.

Non-Real Time Priority 3 Queue Data In the best case, when no task is available at the pr1 and pr2 queues, the end-to-end delay of the pr3 tasks will be almost equal to that of the pr1 queue tasks in Equation 1 although it can differ slightly based on the size of the pr1 queue task. Let t_k denote the length of a timeslot of nodes at level l_k. The transmission time or delay to place pr3 data from a node into the wireless medium is equal to data_{pr3}/s_{pr3}.

Average Waiting Time The average waiting time of tasks at different workloads. Let us assume that pr1 represents the processing time of the j-th pr1 task at a node x, where, 1 ≤ i ≤ 3 and 1 ≤ j ≤ n_i. The average waiting time for real-time, pr1 tasks at node x is

\[
\text{Avg Waiting Time Pr1}(t) = \frac{\sum_{j=1}^{n_1} \sum_{m=1}^{m_1} P_{r1} m(t)}{n_1}
\]

5. Result

The performance of the proposed DMP packet scheduling scheme, comparing it against the FCFS, and Multilevel Queue scheduling schemes. The comparison is made in terms of average packet waiting time, and end-to-end data transmission delay. To use randomly connected Unit Disk Graphs on a surface of 100 meter × 100 meter as a basis of our simulations.

5.1 End-to-end zone

Figure 5.1 End to end of dmp scheduling

The DMP task scheduling has the level of finding out their end to end delay and to calculate the average waiting time. But compared the Multilevel and FCFS are increasing overhead due to package dropped.

5.2 Delay

The end-to-end data transmission delay of real time tasks over a number of zones and levels and the outperforms existing Multilevel and FCFS scheduler are higher data transmission delays. Proposed
Dynamic Multilevel Processing tasks scheduling gives highest priority to preempt the processing of non-real time tasks, so they become lower delays occur.

![Figure 5.2 Delay of Dmp scheduling](image)

**6. Conclusion**

Dynamic Multilevel Priority packet scheduling scheme for Wireless Sensor Networks. The scheme uses three-level of priority queues to schedule data packets based on their types and priorities. Ensuring minimum end-to-end data transmission for the highest priority data while exhibiting acceptable fairness towards lowest-priority data. Experimental results show that the proposed DMP packet scheduling scheme has better performance than the existing FCFS and Multilevel Queue Scheduler in terms of the average task waiting time and end-to-end delay.

**7. References**