Abstract: A network consisting of distributed autonomous sensors to cooperatively monitor physical or environmental conditions such as sound, temperature, pressure, pollutants and etc. is called as a wireless sensor network (WSN). The origin of wireless sensor networks was motivated by defense applications i.e. battlefield surveillance. However, WSNs are now used in many commercial and civilian application areas, including home automation, traffic control, environment, healthcare applications and habitat monitoring. Priority based scheduling of packets can guarantee quality of service and improve rate of transmission in wireless sensor networks. Reduction of sensors energy consumptions and end-to-end data transmission delays at sensor nodes is of vital importance in Wireless Sensor Networks (WSN).

Keywords—Wireless sensor network; packet scheduling; priority scheduling; Transmission delay; real-time; non-real-time; data waiting time; FCFS.

I. INTRODUCTION

A network consisting of distributed autonomous sensors to cooperatively monitor physical or environmental conditions such as sound, temperature, pressure, pollutants and etc. is called as a wireless sensor network (WSN). The origin of wireless sensor networks was motivated by defense applications i.e. battlefield surveillance. However, WSNs are now used in many commercial and civilian application areas, including home automation, traffic control, environment, healthcare applications and habitat monitoring.

Most of the present packet scheduling schemes of the wireless sensor network use First Come First Served (FCFS), pre emptive priority and non pre emptive priority scheduling algorithms. The above algorithms have long end-to-end data transmission delay and high processing overhead. In FCFS, the data packet which is enter the node first will go out first from the node, and the packet which will enter last will leave at last. But in FCFS packet scheduling, real time data packets coming to the node have to wait for a long time period.

In non pre emptive priority scheduling algorithm there is deprivation of real time data packets because once the processor enters the running state. So there is deprivation of real time data packets as it will not allow remove until it is completed. In pre emptive scheduling, deprivation of non-real time data packets, due to continuous arrival of real time data. Therefore, the data packets are to be scheduled in multilevel queues, but these are not suitable for dynamic inputs, and hence a scheme is designed for dynamically change in the inputs i.e., Dynamic Multilevel Priority (DMP) packet scheduling scheme.

In DMP packet scheduling scheme each node will have three levels of priority queues. Highest priority queue accommodates the real time data packets, which can preempt the data packets in the other queues. Based on threshold of estimated processing time, non-real time data packets are placed in the remaining two queues. The leaf node with two queues, for non-real time data packet since they do not receive data from other nodes and another one for real time data packet and thus reduces end to end delay. This scheme reduces the average delay time and end to end delay of data packets.

II. ASSUMPTIONS AND TERMINOLOGIES

The following assumptions are made in the design and implementation of DMP packet scheduling scheme

- Data traffic comprises only real-time or non-real-time data, e.g., real-time health data sensed by body sensors and non-real-time data by temperature sensors.
- All data packets are of same size
- Sensors are synchronized to time.
- For real time data, aggregation is not performed at intermediate nodes.
- Nodes are located at different levels based on the number of hop counts from Base Station.
- TDMA scheme is used to allocate timeslots to nodes at different levels.
- The ready queue at each node has maximum three levels or sections for real-time data (prt1) non-real-time local data (prt2) and non-real-time remote data (prt3).
- Data queue length is variable.
- A multichannel MAC protocol is required to send multiple packets simultaneously with DMP scheduling scheme.

The Zone Routing Protocol (ZRP) can be classified as a hybrid reactive/proactive routing protocol and it aims to address the problems of both approaches. Thus ZRP reduces the control overhead for longer routes that would be necessary if using proactive routing protocols throughout the entire route, while eliminating the delays for routing within a zone that would be caused by the route-discovery processes of reactive routing protocols.
Intra-zone Routing Protocol (IARP) is a limited scope proactive routing protocol used to improve the performance of existing globally reactive routing protocols. With each node monitoring changes in its surrounding r-hop neighbourhood (routing zone), global route discoveries to local destinations can be avoided. When a global route search is needed, the IARP’s routing zones can be used to efficiently guide route queries outwards (via border casting) rather than blindly relaying queries from neighbour to neighbour.

![Fig-1: ZRP architecture](image)

In order to know about a node’s direct neighbours and possible link failures, IARP depends on a neighbour Discovery Protocol (NDP) provided by the MAC layer. IERP is a family of reactive routing protocols like DSR or AODV that offer enhanced route discovery and route maintenance services based on local connectivity monitored by IARP.

### III. DMP PACKET SCHEDULING SCHEME AND WORKING PRINCIPLE

In non-pre-emptive packet scheduling schemes real-time data packets have to wait for completing the transmissions of other non-real-time data packets. On the other hand, in preemptive priority scheduling, lower-priority data packets can be placed into deprivation for continuous arrival of higher priority data. In the multilevel queue scheduling algorithm, each node at the lowest level has a single task queue considering that it has only local data to process. However, local data can also be real-time or non-real-time and should be thus processed according to their priorities. Otherwise, emergency real-time data traffic may experience long queuing delays till they could be processed. Thus, we propose a Dynamic Multilevel Priority (DMP) packet scheduling scheme that ensures a trade-off between priority and fairness.

![Fig-2: DMP packet scheduling scheme](image)

Among many network design problems, such as data aggregation and routing protocols, that reduce data transmission delay and sensor energy consumption, packet scheduling at sensor nodes is highly important since it ensures delivery of different types of data packets based on their priority with a minimum latency. A Dynamic Multilevel Priority (DMP) packet scheduling scheme is a technique in which sensor nodes are virtually organized into a hierarchical structure. The hierarchical level of the nodes that have the same hop distance from the base station will be at same level and we consider the network is then divide it into zones. Zone head is used for routing data to the destination i.e. to the base station. Data is transmitted with the help of zone head. Other member nodes are not used for routing. They only transmit data to their zone head within the zone through Intra-zone routing and outside the zone through inter-zone routing.

The proposed DMP packet scheduling scheme assumes that nodes are virtually organized in the following a hierarchical structure. Nodes that are at the same hop distance from the base station (BS) are considered to be located at the same level as shown in figure 2. Data packets are processed using the Time-Division Multiplexing Access (TDMA) scheme. For instance, if the nodes that are located at the lowest level and the second lowest level can be allocated timeslots 1 and 2, respectively the we consider three-level of queues, that is, the maximum number of levels in the ready queue of a node is three: priority 1 (prt1), priority 2 (prt2), and priority 3 (prt3) queues. Real-time data packets go to prt1, the highest priority queue, and are processed using FCFS. Non-real-time data packets that arrive from sensor nodes at lower levels go to prt2, the second highest priority queue. Finally, non-real-time data packets that are sensed at a local node go to prt3, the lowest priority queue as shown in below figure 3.2. The possible reasons for choosing maximum three queues are to process (i) real-time prt1 tasks with the highest priority to achieve the overall goal of WSNs, (ii) non-real-time prt2 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, (iii) non-real-time prt3 tasks with lower priority to achieve fairness by pre-empting prt2 tasks if prt3 tasks wait a number of consecutive timeslots.

Methodology of the proposed system requires the following parameters

#### A. Network Initialization

In the network design, the number of nodes ‘n’ is deployed randomly in the networks. The node which is in the centre of the network is chosen as the base station. And the communication range of the node is set to the area of 200m, where the nodes are divided into number of zones with a zone head.
B. Packet Types
Classification of Packets is based on priority levels and scheduling of packets at sensor nodes is highly recommended, since it ensures delivery of different types of data packets based on their priority and fairness with a minimum delay. If the data sensed for real-time applications have higher priority than data sensed for non-real-time applications, then the processing of data packets is available at a sensor node and also it reduces energy consumptions.

C. Task Scheduling
Task scheduling is done for priority queue packet scheduling. High priority real time data packets are scheduled using FCFS. At other two low priorities, data packets are processed using SJF.

D. Performance Evaluation
Performance evaluation is providing positive results on minimum average waiting time and reduction in end-to-end delay while transmission. Comparison of results obtained from DMPPS and FCFS will provide performance evaluation.

IV. RESULTS AND ANALYSIS
The proposed model is implemented using the Network Simulator-2 (NS-2) language. It is used to evaluate the performance of proposed DMP packet scheduling scheme and comparing it with Multilevel Queue scheduling schemes and FCFS. The comparison is made in terms of aggregate packet delay time, and end-to-end data transmission delay. The number of simulated zones varies from 3 to 12 zones. Nodes are distributed uniformly and ready queue of each node can hold a maximum of 40 tasks. Each task has a type ID that identifies its type. For example, type 0 is considered to be a real-time task. Based on the processing time of the task, data packets are placed into the ready queue and each packet has a hop count number that is assigned randomly. The packet with the highest hop count number is placed into the highest-priority queue. Simulation is done for both levels in the network until data from a node in each zone or level reach base station and a specific number of zones. Simulation results are presented for all types of data traffic.

In the DMP packet scheduling approach, the priority of data packets other than real-time is defined by source of a data packet. The priority of non-real-time data packet will be more if it is sensed at remote node rather than the current sending node. Moreover, if no real-time tasks are available, prt3 tasks can preempt prt2 tasks if they are in deprivation for a long time. The memory is also dynamically allocated to three queues and the size of the highest-priority queue is usually smaller than the two other queues since prt1 real-time tasks do not occur frequently compared to non-real-time tasks. As the memory capacity of a sensor node is limited, this also balances memory usages. In addition, tasks are mostly non-real-time and are processed in the prt2 and prt3 queues. Non-real-time tasks that a node x receives from the lower level nodes are known as non-real time remote tasks and processed with higher priority (prt2) than the non-real-time local tasks. Thus, non-real-time remote tasks incur less average waiting time. In addition, the average waiting time will not be affected for real-time tasks that are processed using FCFS scheduling, since these real-time tasks occur infrequently with a short processing time.

The figure-4 shows the comparison between the real time packet delays of DMP packet scheduling scheme with Multilevel Queue scheduling schemes and FCFS.
The figure-5 shows the comparison between the non-real time packet delays of DMP packet scheduling scheme with Multilevel Queue scheduling schemes and FCFS.

V. CONCLUSION

Dynamic Multilevel Priority (DMP) packet scheduling scheme for Wireless Sensor Networks (WSNs) is discussed in this paper, which is the combination of proactive and reactive routing protocols and have advantages of both type of protocols. The ZRP protocol is suitable for large networks and is not an independent protocol but rather a routing framework. It is especially well adapted to large networks and diverse mobility patterns and also we propose a. The scheme uses three-level of priority queues to schedule data packets based on their types and priorities. It ensures 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.

REFERENCES


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