ISSN (online): 2349-6010

# A Novel and Efficient Packet Scheduling Scheme for Wireless Sensor Network

**E.Indumathi**
*PG Student*
*Department of Computer Engineering*
*Govt. College of Engineering, Tirunelveli, Tamilnadu, India*

**J.Antony Jeyanna**
*PG Student*
*Department of Computer Engineering*
*Govt. College of Engineering, Tirunelveli, Tamilnadu, India*

**Dr.D.Shalini Punithavathani**
*Principal*
*Department of Computer Engineering*
*Govt. college of Engineering, Tirunelveli, Tamilnadu, India*

## Abstract

Scheduling different types of packets, such as real time and non-real time data packet at sensor nodes with resource constraints in wireless sensor network, to reduce the sensor energy consumption and end- to-end data transmission delay. Most of the existing system based on the FCFS (First Come First Serve), non-preemptive priority and preemptive priority concepts. This algorithm incurs a large processing overhead and more energy consumption. It does not support dynamic packet scheduling scheme. In this paper, a Dynamic Multilevel Priority packet scheduling scheme proposed. In this scheme, it should maintain the virtual hierarchy the zone based topology of WSN, has three levels of priority queues. Real time packets are placed in to the highest priority queue. Non-real time packets are placed into two other queues based on a certain threshold of their estimated processing time. Leaf nodes have two queues for real-time and non-real time data packets since they do not receive data from other nodes and thus, reduce end-to-end delay. According to the priority of packet node will route the packet to the destination. The result of this paper is reduce average data waiting time and end to end delay.
**Keywords: Wireless sensor networks, FCFS, priority packet scheduling, pre-emptive, non-preemptive, real-time packets, non-real-time packets, Dynamic Multilevel priority (DMP)**

## I. 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 [1].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. But data aggregations in WSN have two main 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.

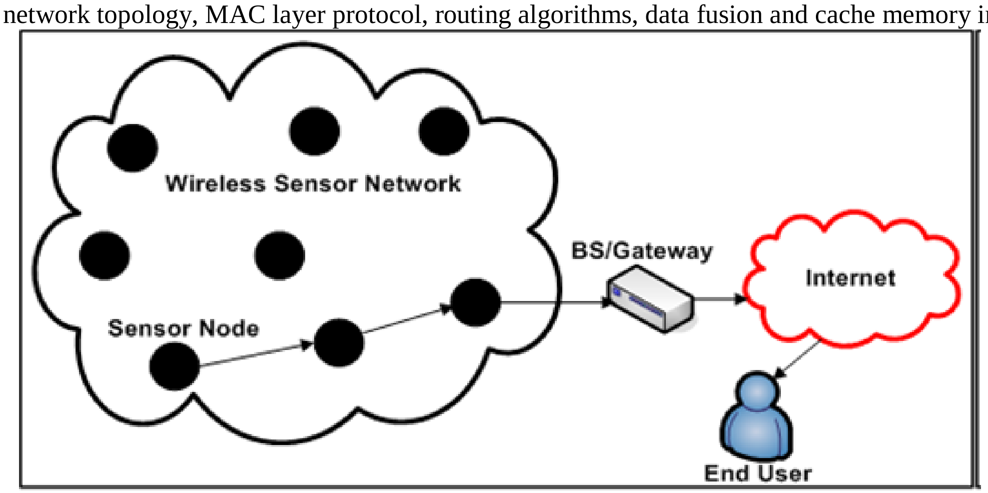

Fig. 1: Wireless Sensor Network

Among many network design issues, such as routing protocols and data aggregation, that reduce sensor energy consumption[3-7] and data transmission delay, packet scheduling (interchangeably use as task 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. For instance, data sensed for real-time applications have higher priority than data sensed for non-real- time applications. Though extensive research for scheduling the sleep-wake times of sensor nodes has been conducted [8-14]only a few studies exist in the literature on the packet scheduling[17-22] of sensor nodes that schedule the processing of data packets available at a sensor node and also reduces energy consumptions. Indeed, most existing Wireless Sensor Network (WSN) operating systems use First Come First Serve (FCFS) 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 (BS). However, to be meaningful, sensed data have to reach the BS within a specific time period or before the expiration of a deadline. Additionally, real-time emergency data should be delivered to BS with the shortest possible end-to-end delay. Hence, intermediate nodes require changing the delivery order of data packets in their ready queue based on their importance (e.g., real or non-real time) and delivery deadline. Further- more, most existing packet scheduling algorithms of WSN are neither dynamic nor suitable for large scale applications since these schedulers are predetermined and static, and cannot be changed in response to a change in the application requirements or environments. For example, in many real- time applications, a real-time priority scheduler is statically used and cannot be changed during the operation of WSN applications.

Application of WSN covers, Environmental Monitoring, Structural Health Monitoring, Energy Monitoring, Machine Condition Monitoring, Transportation, Industrial Monitoring, Distributed Temperature Monitoring. Some of the challenges faced by the wireless networks are energy issues, self-management, de-centralized management, design constraints, security constraints.

## II. RELATED WORK

### A. Deadline:

1) *First Come First Serve (FCFS):*

Most presented wireless sensors networks applications uses First Come First Serve (FCFS) schedulers [23] that process data in the order of their arrival times at the ready queue. Basically, there is a single queue of ready processes. Relative significance of jobs calculated only by arrival time (poor choice). The execution of the FCFS policy is simply managed with a First in First out (FIFO) queue. When the process is ready it enters the ready queue, its Process Control Block is linked on to the tail of the queue.
Earliest Deadline First (EDF):

It is a dynamic algorithm for scheduling used in real time operating system to place processes in priority queue. 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 Base Station, the priority queue will check for the process with the nearest deadline and the data packet which has the earliest deadline is sent first.

### B. Priority:

1) *Non Pre-emptive Scheduling:*

In non-pre-emptive priority packet scheduling, when a packet p1 starts execution, task p1 carries on even if a higher priority packet p2 than the currently running packet p1 arrives at the ready queue. Thus p2 has to wait in the ready queue until the execution of p1 is complete.

2) *Pre-emptive Scheduling:*

In this pre-emptive priority packet scheduling, higher priority packets are processed first and then it will pre-empt lower priority packets by saving the context of lower priority packets if they are already running.

### C. Level of Queues:

1) *Single Level Queue:*

Each sensor node has a single ready queue. All types of data packets enter the ready queue and are scheduled based on different criteria: type, priority, size, etc. Single queue scheduling has a high starvation rate.
Multi-level Queue:

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: (i) allocating tasks among different queues, (ii) scheduling packets in each queue. The number of queues at a node depends on the level of the node in the network.

### D. Types of scheduling:

1) *Priority Based Scheduling:*

Assign each process a priority. Schedule the highest priority process at first. All processes within same priority are FCFS. Priority may be determined by user or by some default mechanism.

 

2) *Shortest Job First Scheduling:*

Shortest job next (SJN), also known as Shortest Job First (SJF) or Shortest Process Next (SPN), is a scheduling policy that selects the waiting process with the smallest execution time to execute next.SJN is a non-preemptive algorithm.

### *E. Packet Type:*

1) *Real-time packet scheduling:*

Real time data packets are given highest priority among all the data packets in the ready queue, so higher priority packets are processed first and then it has to be delivered to the base station (BS) with minimized end-to-end delay.

2) *Non-real-time packet scheduling:*

The non-real time data packets will have lower priority and so they can be delivered to the base station with little delay if there are no real time packets in the ready queue then the data packets uses FCFS or Shortest Job First in order to deliver it to the base station.

## III. PROPOSED WORK

### *A. Dynamic Multilevel Priority (DMP):*

DMP packet scheduling scheme for WSNs in which sensor nodes are virtually organized into a hierarchical structure. Nodes that have the same hop distance from the BS are considered to be located at the same hierarchical level. Data packets sensed by nodes at different levels are processed using a TDMA scheme. For instance, nodes that are located at the lowest level and one level upper to the lowest level can be allocated timeslots 1 and 2, respectively. Each node maintains three levels of priority queues. This is because we classify data packets as (i) real-time (priority 1), (ii) non-real-time remote data packet that are received from lower level nodes (priority2), and (iii) non-real-time local data packets that are sensed at the node itself (priority 3). Non-real-time data traffic with the same priority are processed using the shortest job first (SJF) scheduler scheme since it is very efficient in terms of average task waiting time.

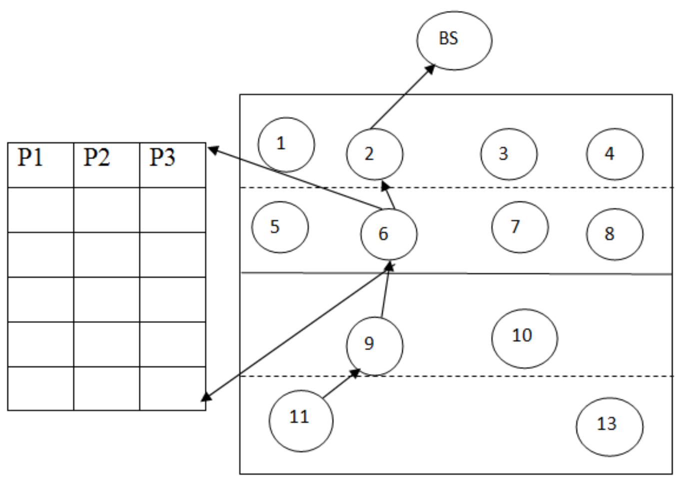


Fig. 2: Dynamic Multi-Level Priority Queue

### *B. Routing Protocol:*

For 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 (ZH) and nodes follow a hierarchical structure, based on the number of hops they are distant from the base station (BS). 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.

### *C. 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. Thus, nodes at the intermediate and upper levels have more tasks and processing requirements compared to lower-level nodes.

### *D. Fairness:*

This 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. For instance, if 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.

 

### *E. Priority:*

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 (i.e., remote or local) and the size of the data. The data packets that are received by node *x* from the lower level nodes are given higher priority than the data packets sensed at the node *x* itself.

## IV. BLOCK DIAGRAM

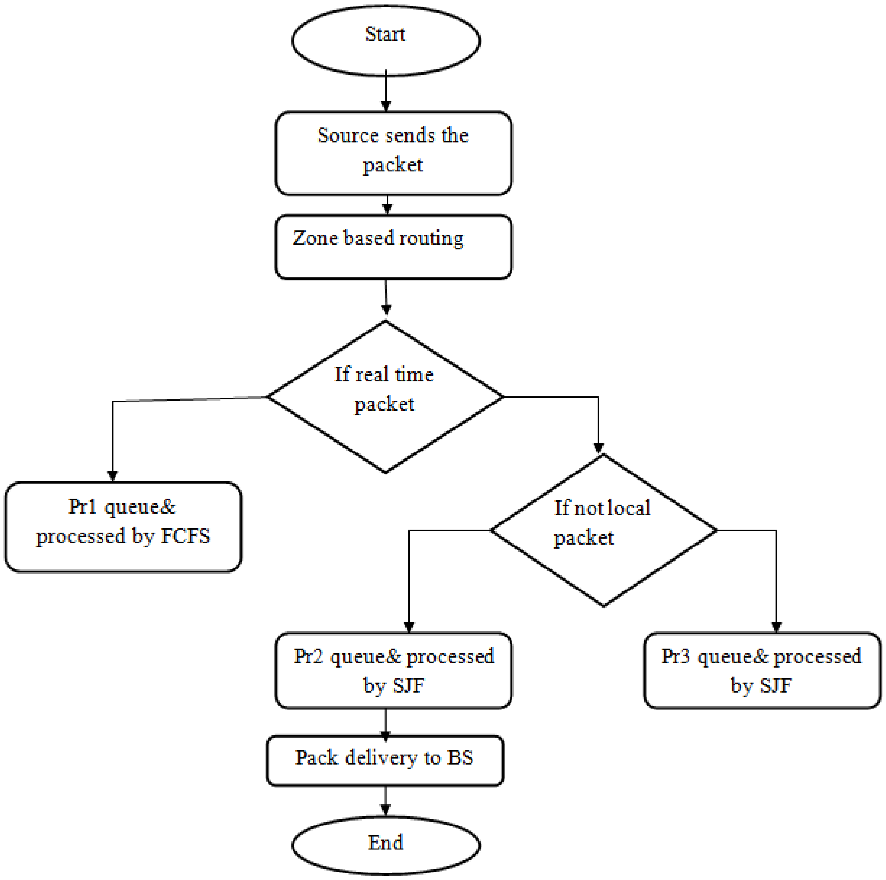


Fig. 3: Flow Graph for DMP

The idea behind this is that the highest-priority real-time/emergency tasks rarely occur. They are thus placed in the preemptive priority task queue (pr1 queue) and can preempt the currently running tasks. Since these processes are small in number, the number of preemptions will be a few. On the other hand, non-real time packets that arrive from the sensor nodes at lower level are placed in the preempt able priority queue (pr2queue).The processing of these data packets can be preempted by the highest priority real-time tasks and also after a certain time period if tasks at the lower priority pr3 queue do not get processed due to the continuous arrival of higher priority data packets. Real-time packets are usually processed in FCFS fashion. Each packet has an ID, which consists of two parts, namely level ID and node ID. When two equal priority packets arrive at the ready queue at the same time, the data packet which is generated at the lower level will have higher priority. This phenomenon reduces the end-to-end delay of the lower level tasks to reach the BS. For two tasks of the same level, the smaller task (i.e., in terms of data size) will have higher priority

## V. PERFORMANCE ANALYSIS

Graph is an essential part of display a result, so we plot a graph to show a various result comparison with packets, throughput, energy efficient, end-to-end delay Comparison among the FCFS, Multilevel queue, DMP and reduce the average waiting time in the ready queue.

 

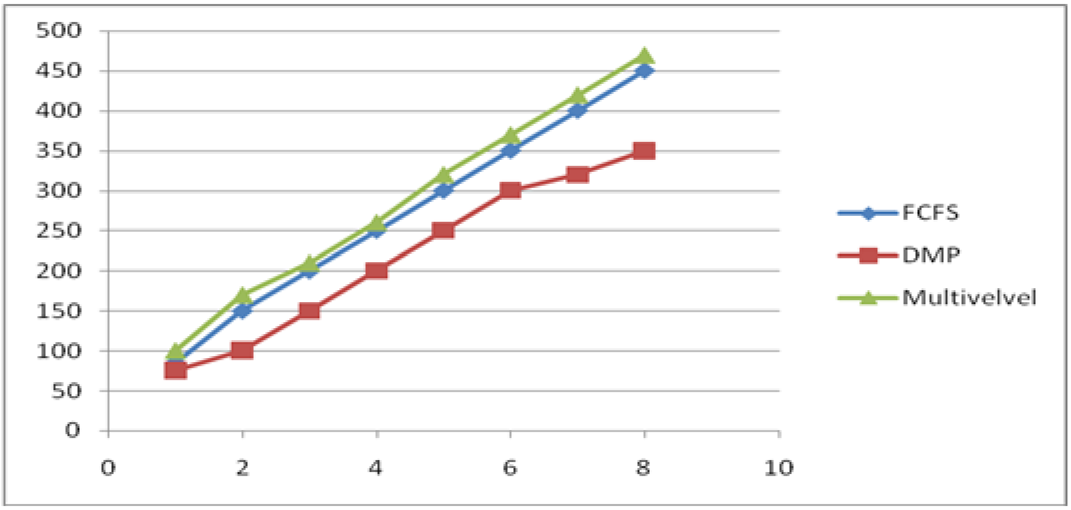

Fig. 4: Comparison Graph Of Dmp

### A. *End-to-End Delay:*

End-to-end delay refers to the time taken for a packet to be transmitted across a network from source to destination. It also includes the delay caused by route discovery process and the queue in data packet transmission. Only the data packets that successfully delivered to destinations that counted.

### B. *Average Waiting Time:*

The time the process remains in the ready queue.

$$\text{Average waiting TimePr1 (t)} = \frac{\sum_{j1=1}^{n1-1} \sum_{m=1}^{j1} \text{pr1,m(t)}}{\text{n1}}$$

For real-time tasks, i = 1,Assuming that real time and emergency tasks rarely occur and require a very short time to get processed, pr1(t) < t(k). Hence, all tasks,1 ≤ j1 ≤ n1, in the pr1 queue complete processing and tasks in the pr2 and *pr3* queues are processed for the remaining,t2(k) = t(k) − pr1(t), period of time.

$$\text{Average waiting Time Pr2 (t)} \geq \frac{\sum_{j2=1}^{n2-1} \sum_{m=1}^{j2} \text{pr2,m(t)}}{n2}$$

The first pr1 task has no waiting time and waiting time for the j-th pr1 task is equal to m=1 pr1,m(t). Now, pr2 tasks be sorted according to the ascending order of the processing time, pr2j2 (t), of pr2 tasks at the ready queue so that we have pr21(t) ≤ pr22(t) ≤ . . . pr2n(t). If pr2 tasks are not preempted by pr1 tasks and can be completed within the t2(k) time.

## VI. EXPERIMENTAL RESULTS

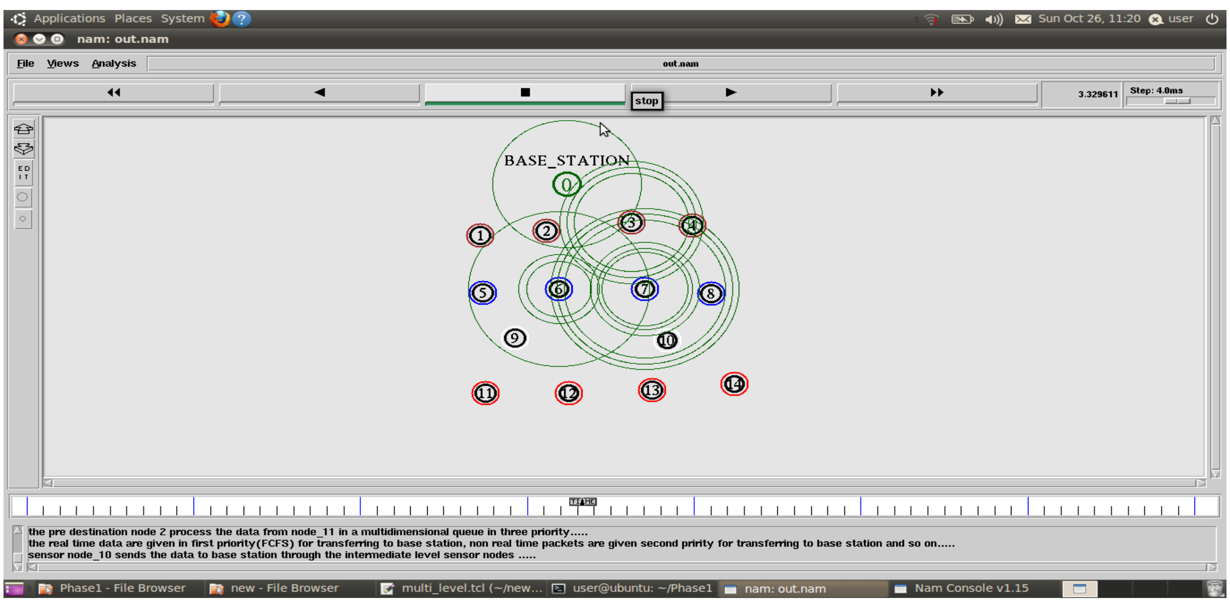

Fig. 5: Performance Result

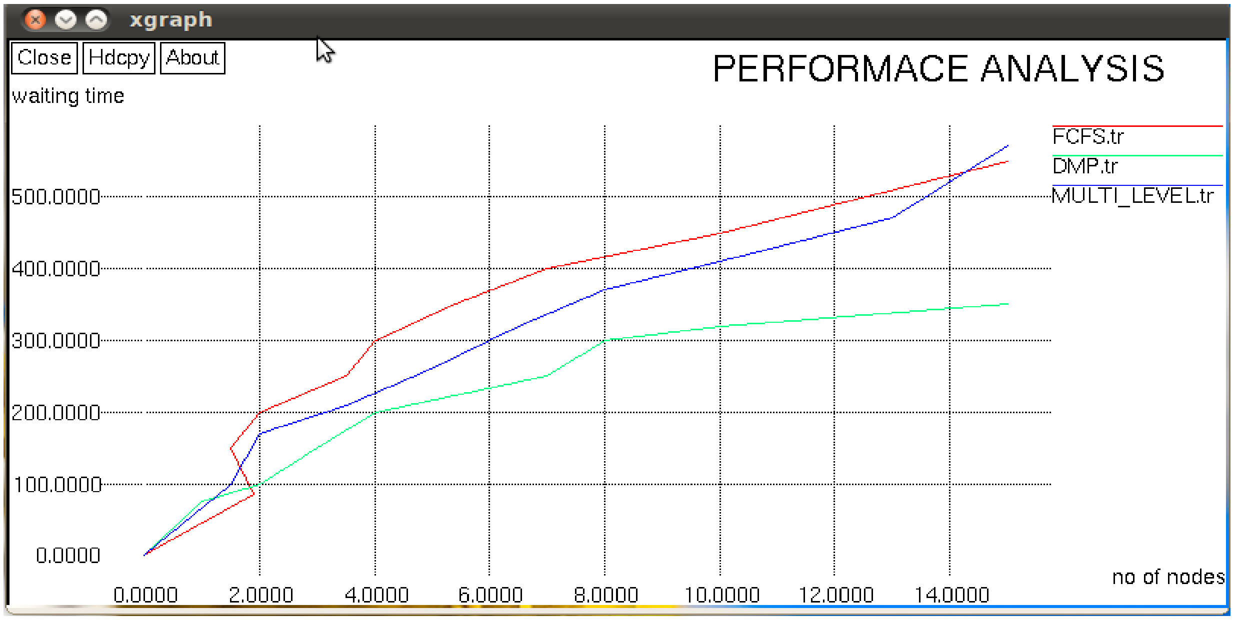


Fig. 6: Performance Analysis

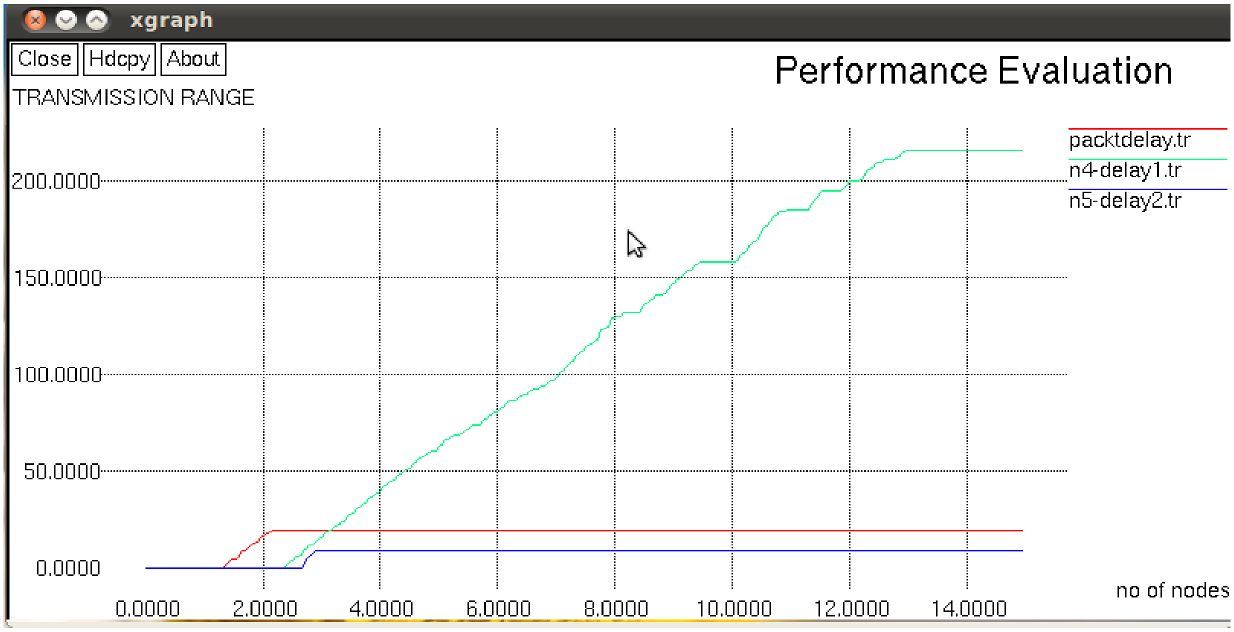


Fig. 7: Performance Evaluation

## VII. CONCLUSION

Dynamic Multilevel Priority (DMP) packet scheduling scheme for Wireless Sensor Networks (WSNs). 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. As enhancements to the proposed DMP scheme, we envision assigning task priority based on task deadline instead of the shortest task processing time. To reduce processing overhead and save bandwidth, we could also consider removing tasks with expired deadlines from the medium.

## REFERENCES

[1] G. Anastasi, M. Conti, and M. Di Francesco, "Extending the lifetime of wireless sensor networks through adaptive sleep," IEEE , vol. 5, no. 3, pp. 351–365, 2009.

[2] G. Bergmann, M. Molnar, L. Gonczy, and B. Cousin, "Optimal period length for the CQS sensor network scheduling algorithm," in Proc. 2010 International conf pp. 192–199.1458 IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS, VOL. 12, NO. 4, APRIL 2013

[3] E. Bulut and I. Korpeoglu, "DSSP: a dynamic sleep scheduling protocol for prolonging the lifetime of wireless sensor networks," in Proc. 2007 International Conf., vol. 2, pp. 725–730.
[4] S. Chachra and M. Marefat, "Distributed algorithms for sleep scheduling in wireless sensor networks," in Proc. 2006 IEEE International Conf. Robot. Autom., pp. 3101–3107.
[5] P. Guo, T. Jiang, Q. Zhang, and K. Zhang, "Sleep scheduling for critical event monitoring in wireless sensor networks," IEEE Trans. Parallel Distrib. Syst., vol. 23, no. 2, pp. 345–352, Feb. 2012.
[6] F. Liu, C. Tsui, and Y. J. Zhang, "Joint routing and sleep scheduling for lifetime maximization of wireless sensor networks," IEEE Trans. Wireless Commun., vol. 9, no. 7, pp. 2258–2267, July 2010.
[7] J. Liu, N. Gu, and S. He, "An energy-aware coverage based node scheduling scheme for wireless sensor networks," in Proc. 2008 International Conf. Young Comput. Scientists, pp. 462–468.
[8] O. Khader, A. Willig, and A. Wolisz, "Distributed wakeup scheduling scheme for supporting periodic traffic in wsns," in Proc. 2009 European Wireless Conf., pp. 287–292.
[9] B. Nazir and H. Hasbullah, "Dynamic sleep scheduling for minimizing delay in wireless sensor network," in Proc. 2011 Saudi International Electron., Communications Photon. Conf., pp. 1–5.
[10] D. Shuman and M. Liu, "Optimal sleep scheduling for a wireless sensor network node," in *Proc.* 2006 Asilomar Conf. Signals, Syst. Comput., pp. 1337–1341.
[11] S. Paul, S. Nandi, and I. Singh, "A dynamic balanced-energy sleep scheduling scheme in heterogeneous wireless sensor network," in Pro*c. 2008* IEEE International Conf. Netw., pp. 1–6, 2008.
[12] A. R. Swain, R. C. Hansdah, and V. K. Chouhan, "An energy aware routing protocol with sleep scheduling for wireless sensor networks," in. Proc. 2010 IEEE International Conf. Adv. Inf. Netw Appl., pp. 933–940.
[13] Y. H. Wang, Y. L. Wu, and K. F. Huang, "A power saving sleep scheduling based on transmission power control for wireless sensor networks," in Proc. 2011 International Conf. Ubi-Media Comput., pp.19–24.
[14] Y. Wang, D. Wang, W. Fu, and D. P. Agrawal, "Hops-based sleep scheduling algorithm for enhancing lifetime of wireless sensor networks," in Proc. 2006 IEEE International Conf. Mobile Adhoc Sensor Syst., pp. 709–714.
[15] Y. Xiao, H. Chen, K. Wu, B. Sun, Y. Zhang, X. Sun, and C. Liu, "Coverage and detection of a randomized scheduling algorithm in wireless sensor networks*,"* IEEE Trans. Comput., vol. 59, no. 4, pp.507–521, Apr. 2010.
[16] X. Xu, Y. H. Hu, J. Bi, and W. Liu, "Adaptive nodes scheduling approach for clustered sensor networks," in Proc. 2009 IEEE Symp. Comput. Commun., pp. 34–39.
[17] Y. Zhao, J. Wu, F. Li, and S. Lu, "VBS: maximum lifetime sleep scheduling for wireless sensor networks using virtual backbones," in Proc. 2010 IEEE INFOCOM, pp. 1–5.
[18] B. Zeng, Y. Dong, and D. Lu, "Cooperation-based scheduling algorithm in wireless multimedia sensor networks," in Proc. 2011 International Conf. Wireless Commun., Netw. Mobile Comput., pp. 1–4.
[19] N. Edalat, W. Xiao, C. Tham, E. Keikha, and L. Ong, "A price-based adaptive task allocation for wireless sensor network," in Proc. 2009 IEEE International Conf. Mobile Adhoc Sensor Syst., pp. 888–893.
[20] H. Momeni, M. Sharifi, and S. Sedighian, "A new approach to task allocation in wireless sensor actor networks," in Proc. 2009 International Conf. Computational Intelligence, Commun. Syst. Netw., pp. 73–78.
[21] F. Tirkawi and S. Fischer, "Adaptive tasks balancing in wireless sensor networks," in Proc. 2008 International Conf. Inf. Commun. Technol.: From Theory Appl., pp. 1–6.
[22] X. Yu, X. Xiaosong, and W. Wenyong, "Priority-based low-power task scheduling for wireless sensor network," in Proc. 2009 International Symp. Autonomous Decentralized Syst., pp. 1–5.
[23] W. Stallings, Operating Systems, 2nd edition. Prentice Hall,1995.
[24] Y. Zhao, Q. Wang, W. Wang, D. Jiang, and Y. Liu, "Research on the priority-based soft real-time task scheduling in TinyOS," in Proc. 2009 International Conf. Inf. Technol. Comput. Sci., vol. 1, pp. 562–565.
[25] E. M. Lee, A. Kashif, D. H. Lee, I. T. Kim, and M. S. Park, "Location based multi-queue scheduler in wireless sensor network," in Proc. 2010 International Conf. Advanced Commun. Technol., vol. 1, pp. 551–555.