© 2017 IJSRSET | Volume 3 | Issue 2 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Cluster based Earliest Deadline First Scheduling approach for Wireless Sensor Networks

Dr. M. Senthil Kumaran

Department of Computer Science and Engineering, SCSVMV University, Kanchipuram, Tamil Nadu, India

ABSTRACT

The advancement of cluster based technique with real time scheduling algorithm earliest deadline first improves the success ratio of earliest deadline scheduling during the overload condition of sensor nodes. This proposal is mainly applicable to group the sensors data with closest deadline for the purpose of data processing. After forming the cluster, the sensor nodes use shortest job first scheduling algorithm for scheduling the data to various nodes. Cluster based EDF scheduling technique is used for transmission and the simulation results shows that the degree of parallelization increases the success ratio compared to EDF scheduling.

Keywords: Cluster, Data packets, Deadline, Earliest Deadline First, Scheduling, Task

I. INTRODUCTION

Energy expenditure is an important issue in wireless sensor networks due to the short span battery life. Reliable content delivery over a wireless channel is a major source of energy expenditure. The increasing wireless transmission rate results in a rapid increase of the energy consumption of wireless devices. This approach follows the cluster based earliest deadline scheduling algorithm in which nodes selectively transmit data streams of different data sizes at different transmission rates so that the system reward can be maximized under given time and energy constraints [1]. Scheduling strategy operates on an extremely fast time scale compared to the user dynamics, making it to natural to analyze the user level performance in continuous rather than discrete time, and assume that the users are served simultaneously rather than in a time-slotted fashion [2]. In dynamic scheduling [3],[4], when new data packets arrive, the scheduler dynamically determines the feasibility of scheduling these new data packets without jeopardizing the guarantees that have been provided for the previously scheduled data packets. When dealing with dynamic scheduling, it becomes necessary to be aware of several anomalies, called Richard's anomalies, so that they can be avoided. Changing the priority list, increasing the number of processors, reducing the computation times, or weakening the precedence constraints can increase the schedule length [5].

Most existing work focuses on the minimization of the total energy consumption under the timing constraints and scheduling algorithms. To minimize the transmission energy, we vary packet transmission times and power levels to find the optimal schedule for transmitting the packets within the given amount of time. The observation that leads to this approach is that transmission energy can be lowered by reducing transmission power and transmitting a packet over a longer period of time.

II. METHODS AND MATERIAL

1. Literature Review

Numerous solutions have been proposed for energy efficient problem in wireless sensor networks were largely targeted at communication channels over a single-transmitter-single receiver model; [7],[8],[9],[10]. Zhang and chanson targeted both throughput and value (reward) maximization in an Additive White Gaussian Noise (AWGN) channel [1],[12]. Authors in [11], [12] considered time and energy constraints, they assumed all packets in the system share the same deadline. Power Consumption in packet transmission can be reduced significantly by transmitting packets at a lower bit rate.

Most existing studies on energy-efficient packet transmission focused on minimizing the energy expenditure subject to a time constraint. Many protocols have been developed for wireless sensor networks. S-MAC is one among the protocol is used for energy efficiency. The main goal of the S-MAC protocol is to reduce energy waste caused by idle listening, collisions, overhearing and control overhead. The protocol includes four major components such as periodic listen and sleep, collision avoidance, overhearing avoidance, and message passing. Periodic listen and sleep is designed to reduce energy consumption during the long idle time when no sensing events happen, by turning off the radio periodically [6]. The Power Control Multiple Access allows different nodes to have different transmission power levels. PCMA uses two channels, one channel for "busy tones", and the other for all other packets. PCMA use busy tones, instead of RTS-CTS, to overcome the hidden terminal problem. The power level at which the busy tone is transmitted by a node is equal to the maximum additional noise the node can tolerate. Any node wishing to transmit a packet first waits for a fixed duration and senses the channel for busy tones from other nodes. The signal strength of busy tones received by a node is utilized to determine the highest power level at which this node may transmit without interfering with other on-going transmissions. The time constraint can be in terms of average response time [9], [8], [13] and a single deadline [14], [10], [12] to all packets. Many applications require the guaranteed arrival of sensor data to access point within a specific deadline. Self-Organizing Medium Access Control for sensor networks achieves power conservation based on TDMA-FDMA combination. Each node schedules different time slots for communication with its known neighbors by generating transmission/reception schedules during the connection phase [6]. DPA and Delay Fair Scheduling share the same delay priority criterion, which is based on the Time-Dependent Priority to differentiate connections. It provides at each scheduling period a guaranteed rate per traffic flow and thus is able to offer a deterministic delay bound to each session when the transmission is constantly reliable.

2. Data Model

Many sensing tasks require a sensor network system to process data cooperatively and to combine information from multiple sources. In traditional centralized sensing and signal processing systems, raw data collected by sensors are relayed to the edges of a network where the data is processed. If every sensor has some data that it needs to send to another node in a network, then a well known wireless capacity per node throughput scales as $1/\sqrt{N}$, in other words, it goes to zero as the number of nodes N in a wireless sensor network increases. Sensor networks contain a large quantity of nodes that collect measurements before sending them to the applications. If all nodes forwarded their measurements, the volume of data received by the applications would increase exponentially, rendering data processing a tedious task.

In this proposed data model, a single-transmitter-multiple-receiver model [14], [12] in which a wireless transmitter communicates with multiple receivers as shown in Fig. 3.1. In this model transmitter can only communicate with one receiver at a time and has an energy budget in each transmit cycle. Each receiver will receive data from the transmitter periodically. Every transmitter-receiver pair has a maximal amount of data to be transmitted in each time period. The receivers are located with different distances from the transmitter. The data to different receivers can be transmitted at different transmission rates. Fig. 3.1 shows the resource peer node locations and resource sharing between the transmitter to the receivers.

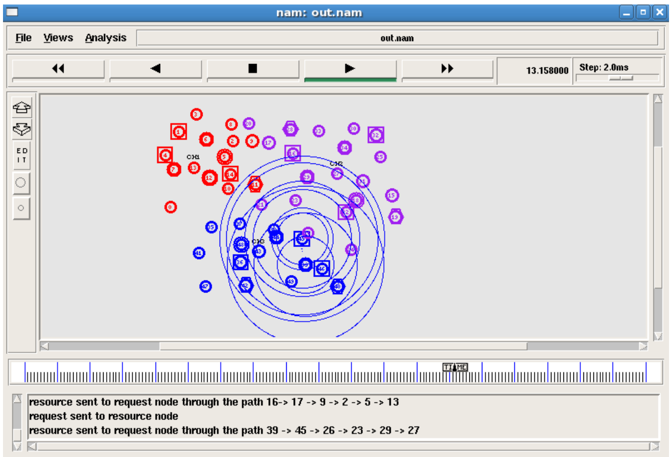

Figure 1. Resource Sharing between transmitter and receivers

III. RESULTS AND DISCUSSION

Cluster based Earliest Deadline Scheduling

Terminology

Dynamic scheduling algorithm has complete knowledge about the currently active set of tasks but not about any new tasks that may arrive while scheduling the current state. Tasks are aperiodic, and it is represented by a tuple τi {Si,Ci,Di,Ai,Ri,Pi,}each task τ_i is characterized by its size of data to be transmitted (Si), worst-case computation time (C_i), deadline (D_i), arrival time (A_i), ready time (R_i), and Power (Pi). Each task might need some resources for its execution. It is assumed that for each data stream i, there are several discrete levels of sizes of data to be transmitted, $\{s^1_i, s^2_i, \ldots s^k_i\}$.
In general, the data stored in the transmit buffer can be either generated by local host or forwarded from other nodes. Different data may have different priorities to the corresponding receiver and data size. There are two types of accesses to a resource: shared and exclusive. Resource conflict exists between two tasks τi and τj if both require the same resource and one of the accesses is exclusive. The following definitions are necessary to describe the scheduling algorithms. The transmitter has a set of discrete levels of transmission rates. The set of available transmission rates of a transmitter as speed = $\{a_1,a_2,\ldots a_n\}$in which the available rates are indexed in an ascending order.

Definition 1: Earliest Available Time (EAT_k^s, EAT_k^e) : is the earliest time when resource R_k becomes available for shared usage [4].

Definition 2: Let P be the set of nodes and R_i be the set of resources requested by task T_i. The earliest start time of a task T_i, denoted as $EST(T_i)$, is the earliest time when its execution can be started, stated as

$EST(T_i)=\max(r_i,\min_{j \in P}(\text{avail time}(j)),\max_{kj \in Ri}(EAT_k^u))$,
Where avail time(j) denotes the earliest time at which the processor P_j becomes available for executing a task and the third term denotes the maximum among the earliest available times of the resources requested by task Ti, in which u=s for shared mode and u=e for exclusive mode.

Earliest Deadline First Scheduling is a type of real time scheduling algorithm which finds the shortest deadline of various sensory data. Whenever a scheduling is needed for data processing the queue maintained in a sensor nodes search the data with the shortest deadline by using the formulae $EST(T_i)=\max(r_i, \min_{j \in P}(\text{avail time}(j)), \max_{kj \in Ri}(EAT_k^u))$. Once the data were found then the algorithm searches the closest deadline values and form the group by using a clustering technique called ant colony optimization.

IV. CONCLUSION

4.1 Simulation parameters

MIN_C minimum computation time of tasks, taken as 30
MAX_C maximum computation time of tasks, taken as 60
R laxity parameter denotes the tightness of the deadline, 0.009

Use P probability that a task uses a resource,taken as 0.6
Share P probability that a task uses a resource in shared mode, taken as 0.5

K size of feasibility check window taken as 7
W weightage given to EST(Ti) for H calculation, as 1
Num-btrk number of backtracks permitted in search as 10
Num-proc number of processors considered for simulation, as 10

The metric used was schedulability of task sets called the success ratio defined as the ratio of the number of task sets found schedulable to the number of task sets considered for scheduling. The computation time C_j^1 of a task T_i is chosen randomly between MIN_C and MAX_C. The deadline of a task T_i is randomly chosen in the range from SC to (1+R) * SC, where SC is the shortest completion time of the task set generated in the previous step. Figures 4.1represents the success ratio by varying Laxity parameter and Fig. 4.2 represents the number of nodes vs message overhead. Fig. 4.1 shows the effect on success ratio of the laxity parameter which helps in investigating the sensitivity of task parallelization with respect to earliest deadline first and cluster based earliest deadline first scheduling algorithms and it shows the success ratio of variation. Fig. 4.2 shows the effect on message overhead with respect to number of nodes and the result shows less performance compared to the existing mechanism because of clustering the closely related deadline data.

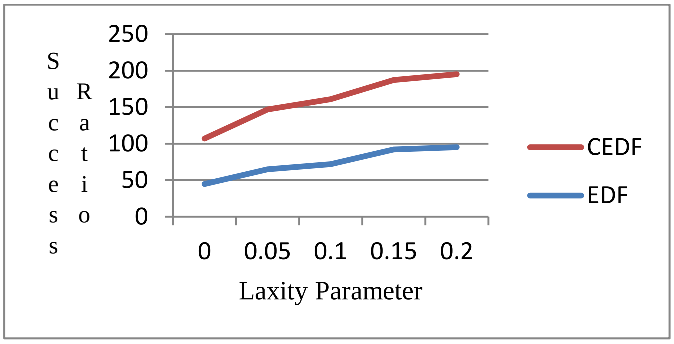

Figure 1. Effect of Laxity Parameter

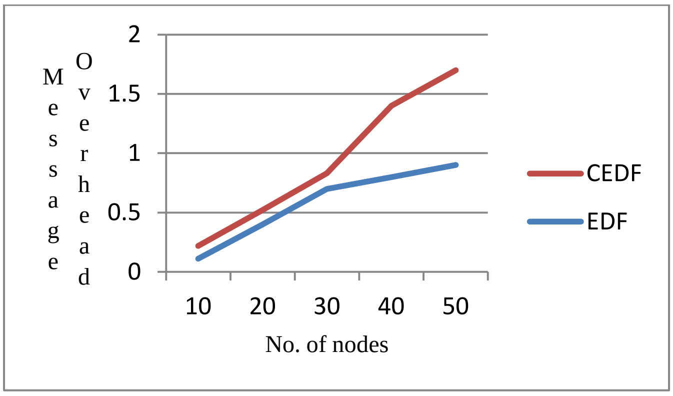

Figure 2. Effect of Message Overhead

V. REFERENCES

[1]. Jiayu Gong, Xiliang Zhong, and Cheng-Zhong Xu, "Maximizing Rewards in Wireless Networks with Energy and Timing Constraints for Periodic Data Streams", IEEE Trans. on Mobile Computing, vol 9, no. 8, pp.1187-1200, August 2010.

[2]. Sem Borst," User-Level performance of Channel-Aware Scheduling Algorithms in Wireless Data Networks", IEEE/ACM Trans. on Networking, vol 13, no. 3, pp. 636-647, June 2005.

[3]. G. Manimaran and C. Siva Ram Murthy, "An efficient dynamic scheduling algorithm for multi-processor real-time systems", IEEE Trans. on Parallel and Distributed Systems, vol. 9, no. 3, pp. 312-319, Mar 1998.

[4]. K. Ramamritham, J.A. Stankovic, and P.F. Shiah, " Efficient scheduling algorithms for real-time multiprocessor systems", IEEE Trans. on Parallel and Distributed Systems, vol. 1, no. 2, pp. 184-194, Apr 1990.

[5]. R. Graham, "Bounds on the performance of scheduling algorithms", In Computer and Job Scheduling Theory (E.G. Coffman, ed.) John Wiley and Sons, pp. 165-227, 1976.

[6]. A. Bhapnagar, and T.G. Robertezi, " Layer Net: A new self organizing network protocol", Proc. IEEE Military Comm. Conf. (MILCOM) vol 2, pp. 845-849, Oct 1990.

[7]. B. Collins and R.L. Cruz, "Transmission Policies for Time Varying Channels with Average Delay Constraints", Proc. Allerton Conf. Comm., Control, and Computing, 1999.

[8]. R.A. Berry and R.G. Gallager, "Communication over Fading Channels with Delay Constraints", IEEE Trans. on Information Theory, vol 48, no. 5, pp. 1135-1149, May 2002.

[9]. E. Uysal-Biyikoglu, B. Prabakar, and A.E. Gamal, "Energy Efficient Packet Transmission over a Wireless Link", IEEE/ACM Trans. Networking, vol 10, no. 4, pp. 487-499, Aug 2002.

[10]. A. Fu, E. Modiano, and J.N. Tsitsiklis, " Optimal Energy Allocation for Delay-Constrained Data Transmission over a Time-Varying Channel", Proc. IEEE INFOCOM, 2003.

[11]. F. Zhang and S.T. Chanson, "Improving Communication Energy Efficiency in Wireless Networks Powered by Renewable Energy Sources", IEEE Trans. Vehicular Technology, vol. 54, no. 6, pp. 2125-2136, Nov. 2005.

[12]. D. Rajan, A. Sabharwal, and B. Aazhang, "Delay-Bounded Packet Scheduling of Bursty Traffic over Wireless Channels", IEEE Trans. Information Theory, vol. 50, no. 1, pp. 125-144, Jan 2004.

[13]. A. E. Gamal, C. Nair, B. Prabhakar, E. Uysai-Biyikoglu, and S. Zahedi, "Energy-Efficient Scheduling of Packet Transmissions over Wireless Networks", Proc. IEEE Infocom, 2002.

[14]. M. Senthil Kumaran and R. Rangarajan, "An Adaptive Power Resourceful and Energy Conscious Protocol for Multi channel Medium Access Control layer in Wireless sensor Networks", International Journal of Computer and Network Security, vol. 2, no. 7, pp. 32-36, July 2010.