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Preemptive EDF And Round Robin Scheduling Schemes For Real Time Wireless Networks

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Abstract: *The existing scheduling schemes were by means of the First Come First Serve(FCFS) scheduling for scheduling the real time tasks. Derived from the (Dynamic Multilevel Priority) DMP scheduling scheme [1] the real time tasks which scheduled by FCFS which proceed deadlock. To conquer this problem this paper proposes to schedule the real time task by means of preemptive (Earliest Deadline First) EDF. This will prevail over the deadlock. In addition to that the non-real time tasks will also be scheduled using the round robin scheduling. So that it will be scheduled in a circular fashion which in turn will reduce the delay and overhead in so doing increasing the throughput and packet delivery ratio. Consequently the overall performance will be improved.*
Keywords: *deadlock, end-to-end delay, overhead, priority, round robin, scheduling, task*

I. Introduction

In the DMP packet scheduling scheme, the packets will be classified into three levels of priority queue based on the processing time. The priority level1 (Pr1) will be containing the real time packets which will be scheduled using FCFS. The priority levels Pr2 and Pr3 will be containing the non-real-time packets which will be scheduled using Shortest Job First algorithm [1]. Based on the zone based routing protocol; the nodes will be classified as zones. The level will be based on the hop count from the base station. The highest hop count will be put into the highest priority level. Based on the priority level the shortest and emergency packets will be scheduled first within the allocated timeslots variable generated using TDMA. The packets are scheduled simultaneously using multichannel MAC protocols to send multiple packets simultaneously.

In the above mentioned DMP packet scheduling scheme, there occurs the problem of starvation or deadlock in the pr1 queue because the packets arrived later which may be an emergency packet will wait for a long time. To overcome this condition, the proposed scheduling scheme is using the preemptive and circular conditions.

According to the proposed scheduling scheme, the task will be identified as real time and non-real time task and put into the queues. Based on the queues Pr1 tasks will be scheduled by preemptive EDF[2] and pr2 and pr3 task uses round robin scheduling[3] to schedule the tasks. In the preemptive EDF based scheduling the processing time is calculated for each and every task. If the completion time of each and every task falls before the deadline then that task is allowed to process. Otherwise the demand bound analysis for the task which falls after the deadline is calculated for the dropped task.[4]

Round-robin (RR) is one of the algorithms which employed in circular fashion.[4] It uses the time slice named quatum. Based on the quantum it assigns it will proceed to process in all queues evenly. So that no process will wait in the queue for a long time. So that the deadlock which may occur because of the use of FCFS will be removed when introducing the round robin scheduling scheme instead of FCFS.

In preemptive EDF, the shortest packets which are having shortest processing time will be scheduled first later the other in their increasing order of processing time. In addition to, if a packet which is an urgent one which is waiting in the queue for a long time because of their increased processing time. Then the execution will be preempted by allowing the above mentioned to process. After processing the normal process interrupted will be allowed to process. This is the scheduling scheme which is used in preemptive EDF than EDF. Therefore the packets or the tasks which is dropped in EDF will also be processed. In turn the packet dropping ratio, end-to-end delay will be reduced increasing the packet delivery ration and overall performance when compared to the existing packet scheduling schemes.

II. Related Works

As proposed[5] Scheduling Algorithm 1 and Scheduling Algorithm 2, the processor time of quanta based on round robin are measured using chunks of blocks. Round-robin is one of the algorithms employed process and network in computing.[4] As the term is generally used, time slices are assigned to each process in equal portions and in circular order, handling all processes without priority (also known as cyclic executive).

Round-robin scheduling is simple, easy to implement, and starvation-free. Round-robin scheduling can also be applied to other scheduling problems, such as data packet scheduling in computer networks. And the blocks will be measured and scheduled in equal sized blocks which will be done using the greatest common divisor. So that the utilization of the tasks will be carried out and it seems to be high when compared to the other scheduling schemes of real-time tasks.

In EDF the utilization of all tasks which meets the deadline will be calculated based on SJF (Shortest Job First). Shortest-Job-First (SJF) is a non-preemptive restraint in which waiting job (or process) with the smallest assessed run-time-to-completion is run next. In other words, when CPU is offered, it is allotted to the process that has smallest next CPU burst. Based on that condition it will be scheduled in a multiprocessor discipline. EDF is Earliest Deadline First scheduling in which the task with earliest deadline will be scheduled first later on the other. In this scheduling if the process which is scheduled does not meet its deadline then that process will be rejected. Preemption in EDF scheduling is also available. Based on this scheduling if any important task arrives when other task is in execution, then that task will be preempted and the task which is prioritized will be scheduled first later on the other task.

So that the task which will be failing to meet its deadline based on the calculation of the deadline based on SRT (Shortest Remaining Time) will be dropped. The SRT is the preemptive complement of SJF and valuable in time-sharing environment. In SRT scheduling, the process with the smallest predictable run-time to completion is run next, containing new arrivals. In SJF scheme, once a job begins executing, it run to completion. All other task which meets the deadline in a multiprocessor environment will continue to process. [6]

The global Limited Preemptive Earliest Deadline First (g-LP-EDF) scheduling[7] is proposed in which the feasibility analysis is carried over in real-time tasks in which it tells that the preemptive condition in real time tasks will be proved by using a feasibility analysis. In addition to it provides to prove the feasibility analysis in non-preemptive tasks also. This in result provides a feasibility in preemptive tasks which in turn improves the performance of the tasks.

Deadlock is a situation which arises when there occurs four conditions. They are (1) Mutual exclusion: Mutual exclusion is only one process share the resource for a long time when other process is waiting for the same resource.(2) Hold and wait or resource holding: Hold and wait condition arises if a process and using one resource and again it is waiting for other resource.(3) No preemption: No preemption is if a resource is voluntarily released from a process which is holding that resource. (4) Circular wait: Circular wait condition arises if a process waiting for other resource which is again waiting for resource in first process. These four conditions are known as the Coffman conditions.

If deadlock is occurred it can is detected and it is prevented. Detecting a deadlock that has previously happened is simply likely since the resources that each process has locked and/or presently demanded are recognized to the resource scheduler of the operating system. Deadlock prevention is done by preventing one of the four Coffman conditions from occurring. They are mutual exclusion, hold and wait, no preemption and circular Wait. Deadlock can be avoided by knowing the details about resources currently available, resources currently allocated to each process and resources that will be required and released by these processes in the future. Based on the details the deadlock can be avoided.

Load-aware weighted round robin (LAWRR) [8] is proposed for 802.16 networks in the downlink direction to improve efficiency based on (Weighted Round Robin) WRR scheduling scheme. This algorithm will schedule the task according to the static weight and the characteristics of each and every task. Based on that the task will be scheduled. By doing so the packet dropping ratio, delay will be analyzed and it was found low which may be caused by the burst input traffic and thus in turn it will improve the overall performance of the system.

In DMP scheduling scheme [1], the scheduling is done in a multilevel packet scheduling scheme in which it chooses three priority levels. In which it will schedule the packets using FCFS and preemptive scheduling based on the shortest processing time of the packets. But the pr1 queue is suffering from deadline and so that the delay and average waiting time of the packets may be increased which will affect the overall performance of the scheduling scheme.

III. CW-DMP Scheduling Architecture

In the existing scheduling schemes, the packets were scheduled in three priority queue pr1, pr2, pr3 respectively. In this scheme, pr1 is scheduled using round robin scheduling, pr2 comprises non-real time task with remote data and pr3 holds non-real time task with remote data. The remedy for this problematic is ended by put forward by a novel CW-DMP task scheduling scheme, the starvation occurred in previous scheme is eliminated by including circular wait scheduling.

The overall architecture of the process in shown in Fig. 1, where the tasks which are entering are first subjected to the task identification module. Here the type of the task was identified and put into the node level according to the task. Then from the queue level it is directed to the priority decision module. Here according to the priorities the tasks were put into the priority level Pr1, Pr2 and Pr3accordingly.

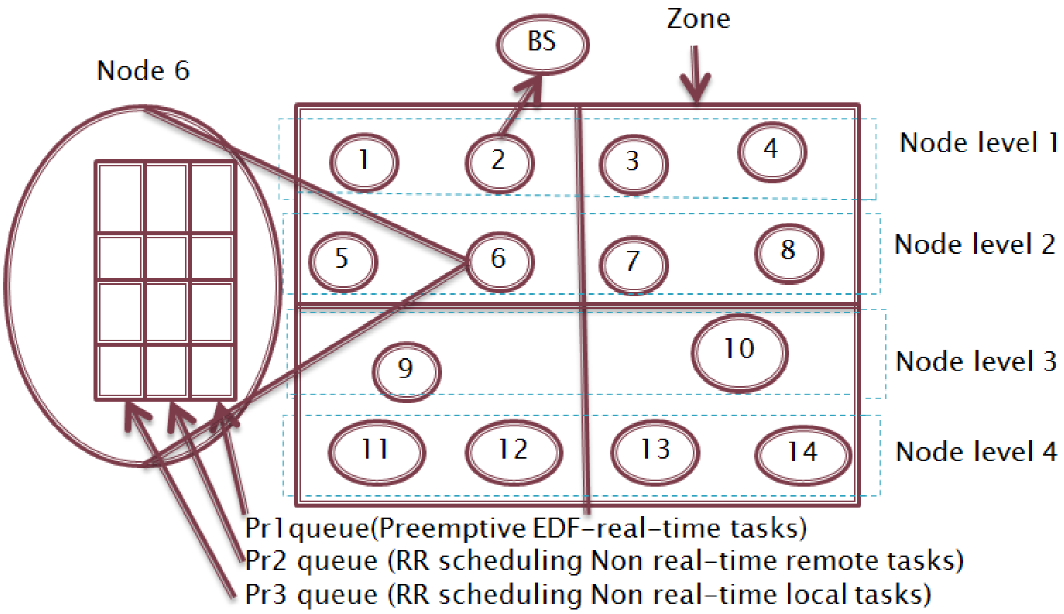

Fig.1 CW-DMP Architecture

IV. CW-DMP Scheduling Scheme

In the existing scheduling schemes, the tasks were scheduled in three priority queue pr1, pr2, pr3 respectively. In this scheme, pr1 is scheduled using round-robin, pr2 covers non-real time task with remote data and pr3 comprises is non-real time task with remote data. The remedy for this problem is done by recommending an innovative Circular Wait - Dynamic Multilevel Priority task scheduling scheme, the starvation occurred in the scheme is eliminated by including the same.

This scheme is using zone-based routing protocol. Now in a zone- based routing protocol, every zone is acknowledged 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, correspondingly. Every zone is also alienated into a number of small squares in such a way that if a sensor node exists in square S1, it covers all neighboring squares. Thus, this protocol reduces the probability of having any sensing hole in the network even if the neighboring squares of a node do not have any sensor node.

In this section, the performance of the proposed CW-DMP task scheduling scheme in terms of end-to-end delay of different types of traffic at the ready queues of active nodes is analyzed. Formulation is done the average end-to-end delay of transmitting different priority packets to the base station (BS).

V. CW-DMP Scheduling algorithm

In Circular Wait the Precedence Factor (PF) is calculated by the formula:

$$PF = [P \times PR_i][B \times BR_i]$$

Where P=Priority, PR_i=Priority Ratio, B=Burst Time, BR_i= Burst Ratio

The Priority Ratio is given by,

$$PR_i = P/P_t$$

Where P is the priority and P_t is the total processes

The Burst Time Ratio is given by,

$$BR_i = BT_i/BT_t$$

Where BT_i is the Burst time of processes and BT_t is the total burst time of process.

The CW-DMP algorithm is explained in the form as below:

do
begin
while *Type*(*task*) = *real* − *time* then
put *task* into *pr*1 queue
else if *Type*(*task*) = non *real* – *time* & *remote* then

put *task* into *pr*2 queue
else
put *task* into *pr*3 queue
end if
For pr1 queue
Assume
Input: Task (Ti), Completion time(Ci), Deadline (Di)

Output: Utilization(U),Domino effect(U')Demand Function(dfi), Demand Bound Function(dbf)
Initialize U≤1
For (T_N =1 to n)

$$U = \sum_{i=1}^{N} \frac{C_i}{T_i} \leq 1$$
Equation 1

If U≤1 schedule the task
ElseIf U'>1

Calculate $U' = \sum_{i=1}^{N} \frac{C_i}{D_i}$ (Equation 2) schedule the task
For preemption levels:
Calculate $\Pi_i > \Pi_j$
If yes then preempt task
For Pr2 and Pr3 tasks:

Assume
Input: Process (Pn), Burst Time(BTi), Priority (P), Ready Queue(RQ)
Output: Context Switch(CS), Average Waiting Time(AWT), Average Turn Around Time (ATAT)
Initialize RQ=0, CS=0, AWT=0, ATAT = 0, Quantum Time (QT) = 0, n= Number of Processes

Do
Begin
Initialize PRi=0; BRi=0; RBTi=0; PFi=0;
If i=1 to n
Calculate $PR_i = P_i / P_t$; Equation 3

$BR_i = BT_i / BT_i$; Equation 4

$RBT_i = BT_i$; Equation 5

$PF_i = (P_i \times PR_i) + (BT_i \times BT_i)$; Equation 6

RQ is filled according to PF

If(RQ!=NULL)
Calculate $QT = \sum_1^n \frac{RBT_i}{n}$ Equation 7
If(RBTi≤QT)
Pi completed and removed from RQ
Else If
$RBT_i = BT_i - QT$ Equation 8
Process added to tail of RQ;
End if
End if
Calculate AWT, ATAT & CS;

VI. Simulation Results

The projected scheme can be compared with the results of two schemes: ITF, DMP and EDMP which uses DMP scheme. The packets are scheduled according to the priority [11]-[13]. As a result, the overhead and the delay get reduced. The surface for the basis of the simulation is 100 x100m. The number of nodes is 50. The zones used vary from 4 to 12[14]. The base station is positioned at 55m x 101m. The transmission speed is 250 Kbps. The propagation speed is 250 Kbps. Figures 3 and 4 are the graph generated based on the delay and overhead. In this proposed scheme, the tasks were scheduled according to the priority and the preemption is included in the EDF also. As a result, the overhead and the delay get reduced. The decrease in overhead and end-to-end delay thus the packet delivery ratio, throughput and overall performance gets improved.

TABLE I. SIMULATION PARAMETERS AND THEIR VALUES

Parameters	Values
Network Size	100m x 100m
Number of nodes	Maximum 200
Number of zones	4 to 12
Base station position	55m x 101m
Transmission energy consumptions	50 *nJoule/bit*
Energy consumption in free space or air	0.01 $nJoule/bit/m^2$
Initial node energy	2 *Joule*
Transmission speed	250 *Kbps*
Propogation speed	198 x 10^6 *meter/sec*

As a result, the overhead and the delay get reduced. The surface for the basis of the simulation is 100 x100m. The number of nodes is 50. The zones used vary from 4 to 12[9]. The base station is positioned at 55m x 101m. The transmission speed is 250 Kbps. The propagation speed is 250 Kbps. Figures 3 and 4 are the graph generated based on the delay and overhead. Thus the delay which occurred in FCFS gets minimized when the CW-DMP scheme is applied. This is achieved because the real time task anticipates the non- real time task if it arrives. After the completion of the real time task it will go back to the pr2 and pr3 task unless the starvation appears.

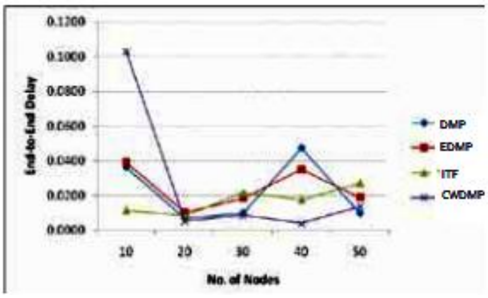

Fig.2 End-to-end delay vs Number of nodes

Figure 2, 3and 4 illustrates the ρ -values for the end-to-end delay in DMP and other schedulers are 0.0137. But the DMP and CW-DMP ρ -values is 0.0091. Thus it validates 95% confidence level.

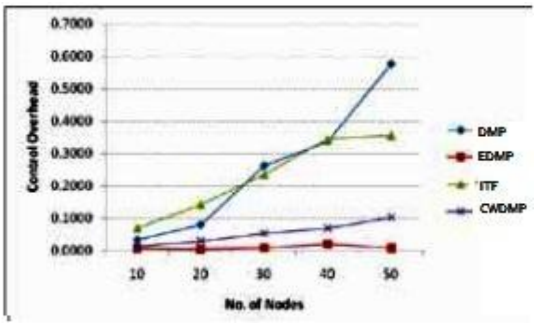

Fig.3 Overhead vs Number of nodes

In figure 2 and 3 the end-to-end delay and overhead is low when compared to the DMP, ITF and EDMP schemes[15]. This in turn icreases the Throughput and thus the overall performance is increased.

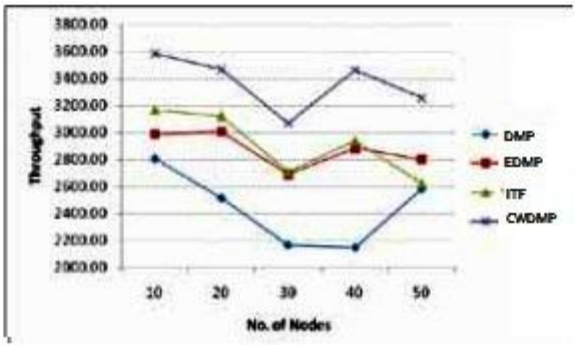

Fig.4 Throughput vs Number of nodes

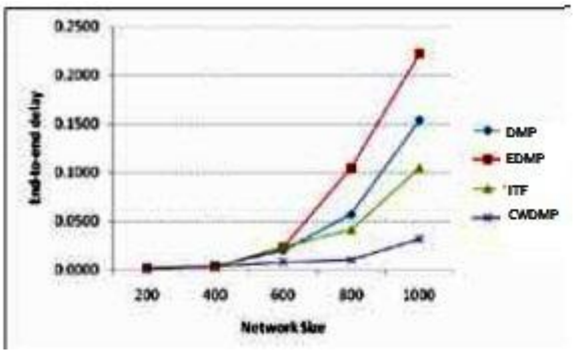

Fig.5 End-to-end delay vs Network size

Figure 5 and 6 illustrates the ρ -values for the task in DMP and other schedulers are 0.01156. But the DMP and CW-DMP ρ -values is 0.00034. Thus it validates 95% confidence level.

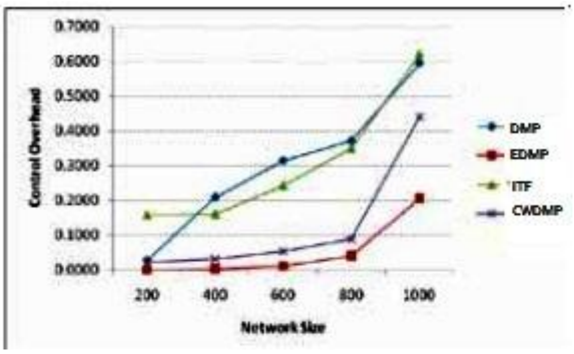

Fig.6 Overhead vs Network size

When the delay and overhead is compared with the other scheduling schemes DMP,EDMP and ITF against the network size it tells that it is low and the figure 7 will have an increased throughput when compared to the previous scheduling schemes which will improve the overall performance of the tasks.

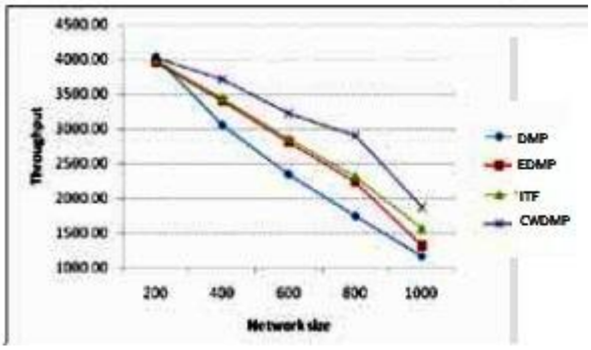

Fig.7 Throughput vs Network size

VII. Conclusion

In CW-DMP[10] , the real time task is subjected to Circular Wait. After completion of the tasks which are before the task deadline the pr2 tasks were scheduled using Earliest Deadline First. After the completion of the task the pr3 tasks were scheduled and processed using preemptive First Come First Serve. If pr1 task arrives when processing both pr2 and pr3, the tasks will be preempted and pr1 task will be processed using circular wait. In all pr1, pr2 and pr3 tasks if the processing time exceeds the task deadline then the task will be dropped. In future the dropping of task which is based on the task deadline can be minimized by upgrading the task. So that the overall performance can be increased.

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