Earth Quake Data Scheduling Using Starvation Free Scheduling Scheme

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Abstract

The emergence of sensor nodes leads to the need for scheduling of packets in real time. This will lead to efficient packet delivery with less delay and less power consumption. In the existing multilevel scheduling schemes, First Come First Serve Scheduling (FCFS) is commonly used to schedule the real-time packets. FCFS leads to starvation. Hence, Starvation Free Dynamic Multilevel Packet (SF-DMP) scheduling scheme is applied. Using this an earthquake data is scheduled which is taken from the dataset. Furthermore, the performance is high due to the emergent data from the earthquake dataset will be send fast to any system assigned there by an alert can be sent.

Keywords: Scheduling, Priority, Earth quake, Scheme, Level, Starvation.

1. Introduction

It is critical to use packet scheduling at sensor nodes synonymously with task scheduling in order to deliver various types of data packets based on their priority and impartiality with the least amount of latency, among other network design problems, such as routing protocols and data aggregation, in order to reduce sensor energy consumption and data transmission delay. Sensitive data, such as that for real-time applications, is given precedence over less critical data. Many studies on sensor node sleep-wake time scheduling have been done; however, the literature on sensor node packet scheduling, which schedules processing of available data packets and also cuts energy use, is scant.

According to current Wireless Sensor Network (WSN) operating systems, data packets are processed in the order in which they arrive, which means that they take a long time to arrive at a base station (BS). Data must arrive to the BS in a specified time frame or before a deadline to be considered significant. In addition, the minimum end-to-end latency feasible should be used to provide real-time emergency data to BS. As a result, intermediary nodes need to reorder their ready queue based on the relevance of the data packets in their queue (e.g., real or non-real time).

Due to their present and static nature, most existing WSN packet scheduling algorithms aren't dynamic or appropriate for large-scale applications. They also can't be altered in response to changes in application needs or conditions. For example, a real-time priority scheduler is statically utilised in many real-time applications and cannot be altered while WSN apps are running.

2. Existing Work

In the existing Dynamic Multilevel Packet (DMP) Nasser et al., [2013] scheduled using FCFS. The amount of real time packets arriving is high in priority. As the previous scheme uses FCFS for the same purpose, it suffers from starvation due to the real time packets waiting more which is emergent may arrive later than the other packets. This leads to starvation. Previously, the priority is assigned based on hop count of the nodes as of the base station. So, the nodes with the highest hop count are given the preference. Due to this assignment, the emergent packet which is located in the nearest hop count will be waiting for a long time to be scheduled which will lead to starvation. To remedy this problem the algorithm was introduced.

Lipika [2015] introduces a novel round robin scheduling method for real time. Nayak et al., [2012] and Negi introduced the dynamic time quantum mechanism. Rajput and Gupta [2012] introduce a priority based round robin scheme. Varma [2013] suggest relative performance analysis is considered and found.

Iraji et al., [2015] suggested the dynamic weighted harmonic round robin. Behera et al., [2011] suggested re-adjusted round robin scheduling algorithm. Mostafa et al., [2010] given a new time quantum measurement for the round robin mechanism. In Mohanty et al., [2011]; Leung and Merrill [1980] the performance evaluation is suggested. Baital and Chakrabarti [2016] suggest about the preemptive scheduling. In Kinsy and Devadas [2014], Salamy et al., [2013] and Khurma et al., [2018] dynamic scheduling in tasks were done.

Datta [2015] gives an efficient algorithm through dynamic time slice. In Saeidi and Baktash [2012], Farooq et al., [2017] the time quantum based scheduling is carried out. In Chochiang et al., [2019] Weighted Priority Scheduling is done. Dave et al., [2017] suggests the modified round robin scheme. In Ayeni et al., [2017], Derahman et al.,[2016], Elmougy et al., [2017] and Fataniya and Patel [2018] dynamic time quantum is used for carrying out the round robin scheduling.

Marosits et al., [2001] suggests about the round robin scheme and based on which the quality of service is maintained. Yuan and Duan [2005] suggest a round robin scheduler. Arif et al., [2016] implemented an alternating median based round robin scheduling algorithm.

Chahar and Raheja [2013] suggested that the ready queue is categorized into two queues based on the CPU bound and input output bound. By scheduling based on the above categories the starvation which occurred previously has removed.

Madhumathi and Kalaiyarasi [2018] suggest a remedy for the resource allocation issue. They usedx the Shortest Job First (SJF) scheduling. This leads to the starvation. This shortcoming is reduced by combining both the SJF and multilevel queue scheduling.

Thombare et al., [2016] suggest that the multilevel feedback queue for small task is analogous to round robin scheduling. By implementing the concept of dynamic time quantum in round robin, the starvation occurred has removed. It will further improve the performance.

Biswas et al., [2017] suggest that multilevel queue scheduling s proving the parallelizing of the subtasks. By implementing the resource utilization is shared fairly.
K and Gupta [2014] suggest that by using the Multilevel Feedback Queue (MFQ) each and every ready queue used different scheduling techniques. As a result, the performance is high compared to the previous schemes.
Scheduling is required for arranging the nodes and to send the packets earlier. By introducing the scheduling, the power consumption issue which arises will be reduced. Many researchers have proposed algorithms for scheduling in wireless sensor networks. I have referenced a lot of papers in scheduling and I have quoted some of it here.

3. Proposed System

In the scheduling scheme the overall architecture comprises of the four steps as in figure 3.1:

- Zone Classification
- Node Level Classification
- Priority Level Classification
- Scheduling Phase

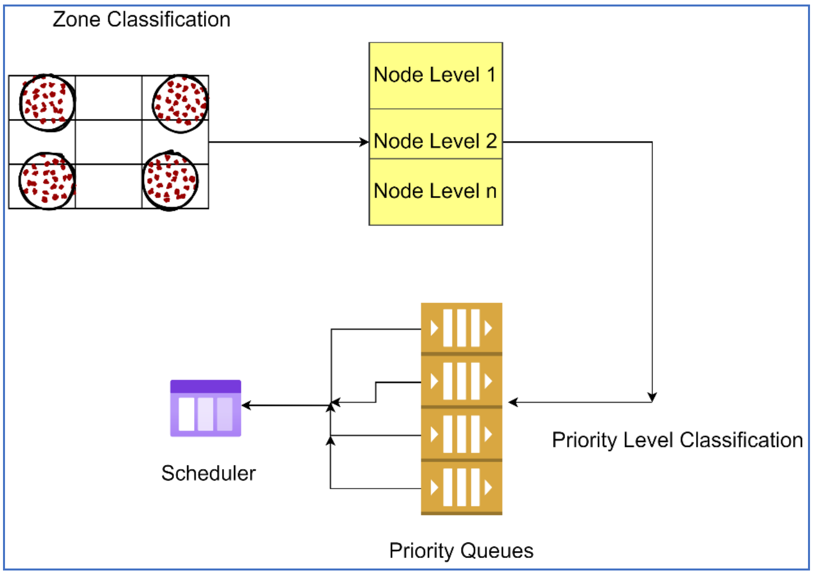

Figure 3.1; Overall Architecture

The nodes are categorized as node levels based on the position in the zones as in Figure 3.2. In SF-DMP scheduling scheme depicted in figure 3.2 the packets were first classified as four zones and in each and every zone the task was identified in the task identification zone.

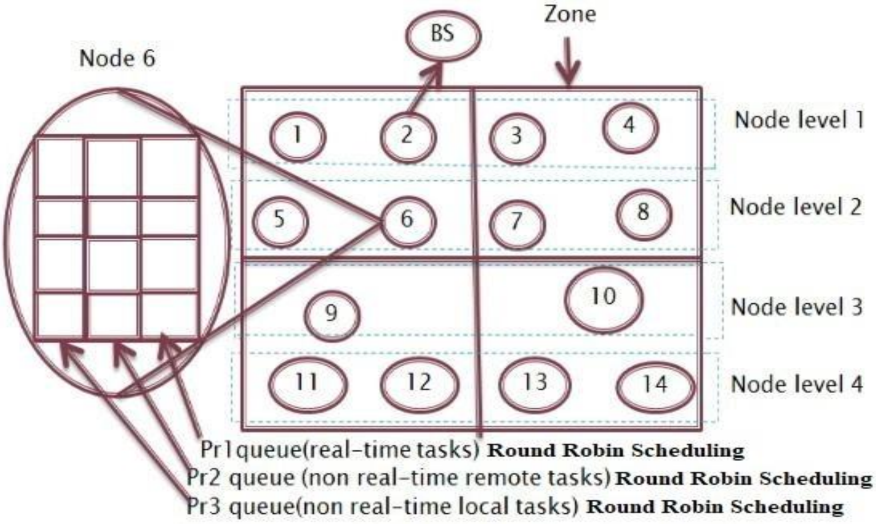

Figure 3.2; SF-DMP Scheduling Scheme

Then it is fed into the queues in which the tasks were using minheap or maxheap technique and based on the order it will choose either maxheap or minheap and is placed in the queue. After that in the scheduling phase based on the priority levels the scheduling is done. The sum of the burst times of task is equal to the time quantum is calculated. The modulo value is generated as burst time modulo time slice. Founded on this scheme the priority level 1 packets which contains the real time urgent task were scheduled using round robin scheduling. The Pr2 packets which contains the real time task were scheduled using round robin scheduling. Pr3 task is scheduled using round robin scheduling.

Algorithm 1 SF-DMP Algorithm

1: Procedure SF-DMP ALGORITHM
Do
begin
while task arrives
if Type_of_task = real_time then
place task in Pr1 queue
else if Type_of_task = non_real_time and remote then place task in Pr2 queue
else
place the task in Pr3 queue
end if
if(maxheap==1)
if (right ≤ N and Arr[right] >Arr[longest])
if (left ≤ n and Arr[left] >Arr[i]) Longest = left;
else
Longest = j Longest = right; if (longest! =j)
Swap (Arr[i], Arr[longest]); Max_heapify (Arr, longest, N);
for (int j= N/2); j ≥1; j–);
Max_heapify(Arr,j);
if(minheap==1)

if (left ≥ n and Arr[left] <Arr[j]) Small= left;
else
Small =j
if (right ≥ N and Arr[right] <Arr[small])
small = left;
if (small! =j)
Swap (Arr[j], Arr[small]);
1: end procedure
2: procedure SF-DMP ALGORITHM Min_heapify (Arr, small, N);
for (int j= N/2); j ≥1; j–);
Min_heapify (Arr,j); for Pr1 task:
I/P : Process (Pn), Burst Time (BTi), Highest Burst Time (HBT), priority(Pi), Ready Queue(RQ) ;
O/P: Context Switch (CS), Average Waiting Time(Awt), Average Turnaround Time(Atat).
Initialize Ready Queue,CS,Awt, Atat, Quantum Time (QT) as 0 Let n=number of processes;
for (j=1to n) Priority ratio (PRj)= 0; Burst ratio (BRj)= 0 Remaning Burst Time (RBTj)= 0; Precedence Factor (PFj)=0; Median=0;
for (j=1 to n)
RBTj = BTj
for (j=1 to n) PFj = (Pj x PRj) + (BTj x BRj)
If n is odd then:
median= Total number o f processes
If n is even then:
median= Total number o f processes+1 QT=ceil (sqrt(median*HBT)) Modulo Burst Time= BTj%QT
End while

2: end procedure
The flowchart of SF-DMP scheduling scheme is given in Figure 3.4.

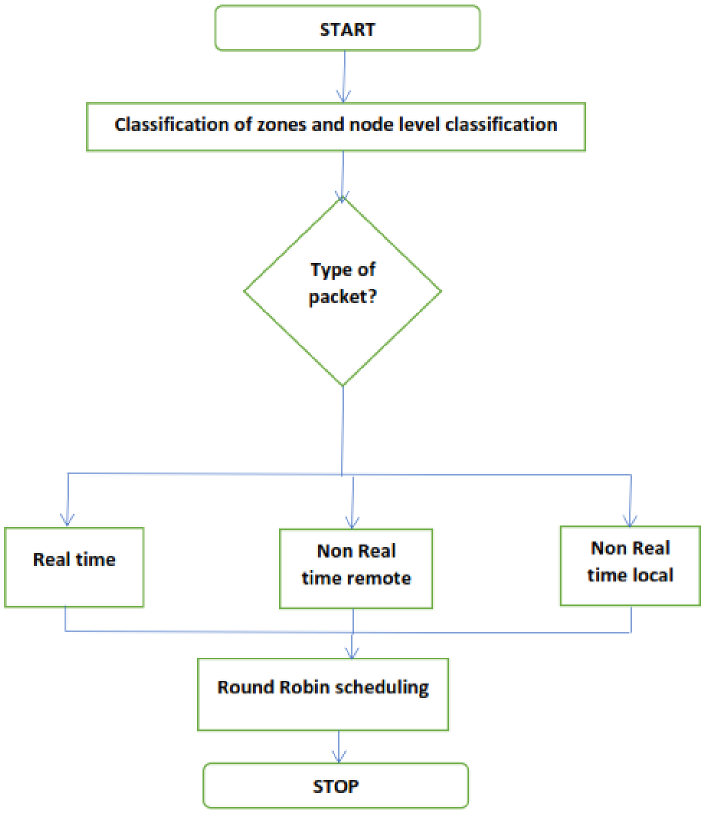

Figure 3.4; Flowchart of SF-DMP Scheduling Scheme

The C programming language is used for simulation. From USGS science for a changing world which contains the spreadsheet format about the earth quake real time notifications feeds and services, the parameters like magnitude and time were taken from the dataset.

From USGS science for a changing world which contains the spreadsheet format about the earth quake real time notifications feeds and services, the parameters like magnitude and time were taken from the dataset. It was observed that if the magnitude increases more than 2.5 MW, it will lead to earthquake. So, the values more than 2.5 mw is taken as real time data (Pr1) in CW-DMP, ITF, IPS and SF-DMP scheduling scheme. For pr2 queue, the magnitude ranging between 1mw and 2.5mw will be considered. In Pr3, the value which is below 1mw is taken. But in EDMP the pr1 contains real-time urgent data. So, the values above 3mw which causes major disaster will be considered as real-time urgent data and placed in Pr1 queue. Pr2 contains the real time data which is ranging between 2.5 mw and 3 mw. For pr3 queue, the magnitude ranging between 1mw and 2.5mw will be considered. In Pr4, the value which is below 1mw is taken.

Table 4.1. Simulation Parameters and their Values

Parameter Values
Network Size-100m x 100m
Number of nodes (Maximum 200)
Number of zones-4
Number of tasks-10000
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
Propagation speed -198 x 10^6 meter/sec
Task priority levels -3
Time Quantum – 5
Zone height - 20

4. Results and Discussion

The C programming language is used for simulation. From USGS science for a changing world which contains the spreadsheet format about the earth quake real time notifications feeds and services, the parameters like magnitude and time were taken from the dataset.

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Transmission speed - 250 Kbps
Propagation speed -198 x 10^6 meter/sec
Task priority levels -3
Time Quantum – 5
Zone height - 20

4.1. Case Study of DMP

In DMP the pr1 contains real-time urgent data. So the values above 3mw which causes major disaster will be considered as real-time urgent data and placed in Pr1 queue. Pr2 contains the real time data which is ranging between 2.5 mw and 3 mw. For pr3 queue, the magnitude ranging below 2.5mw will be considered. The snapshot of Pr1,Pr2 and Pr3 are shown in Figure 4.1, Figure 4.2 and Figure 4.3 respectively.

Processes	Burst time	Waiting time	Turn around time
1	2.590000	0.000000	2.590000
2	2.600000	2.590000	5.190000
3	4.300000	5.190000	9.490000
4	4.900000	9.490000	14.389999
5	3.300000	14.389999	17.689999
6	3.140000	17.689999	20.829998
7	5.900000	20.829998	26.729998

Average waiting time = 26.729998
Average turn around time = 26.729996

Figure 4.1; Pr1 Snapshot of DMP

29	1.270000	42.470005	43.740005
30	1.960000	43.740005	45.700005
31	1.470000	45.700005	47.170006
32	1.550000	47.170006	48.720005
33	1.900000	48.720005	50.620007
34	1.680000	50.620007	52.300007
35	1.410000	52.300007	53.710007
36	1.400000	53.710007	55.110008
37	1.160000	55.110008	56.270008
38	1.090000	56.270008	57.360008
39	1.520000	57.360008	58.880009
40	1.960000	58.880009	60.840008
41	1.900000	60.840008	62.740009
42	1.810000	62.740009	64.550011
43	1.510000	64.550011	66.060013
44	1.060000	66.060013	67.120010
45	2.400000	67.120010	69.520012
46	2.020000	69.520012	71.540009
47	1.990000	71.540009	73.530006
48	1.800000	73.530006	75.330009
49	1.500000	75.330009	76.830009
50	1.070000	76.830009	77.900009
51	1.020000	77.900009	78.920006
52	2.230000	78.920006	81.150009
53	1.290000	81.150009	82.440010
54	1.910000	82.440010	84.350014
55	1.070000	84.350014	85.420013
56	1.420000	85.420013	86.840012
57	2.210000	86.840012	89.050011
58	1.240000	89.050011	90.290009

Average waiting time = 90.290009
Average turn around time = 90.289978

Figure 4.2; Pr2 Snapshot of DMP

Processes	Burst time	Waiting time	Turn around time
1	0.880000	0.000000	0.880000
2	0.560000	0.880000	1.440000
3	0.660000	1.440000	2.100000
4	0.980000	2.100000	3.080000
5	0.950000	3.080000	4.030000
6	0.780000	4.030000	4.810000
7	0.540000	4.810000	5.350000
8	0.990000	5.350000	6.340000
9	0.760000	6.340000	7.100000
10	0.680000	7.100000	7.780000
11	0.570000	7.780000	8.350000
12	0.950000	8.350000	9.300000
13	0.560000	9.300000	9.860001
14	0.510000	9.860001	10.370001
15	0.860000	10.370001	11.230000
16	0.820000	11.230000	12.050000
17	0.680000	12.050000	12.730000
18	0.530000	12.730000	13.260000
19	0.960000	13.260000	14.220000
20	0.750000	14.220000	14.970000
21	0.960000	14.970000	15.930000
22	0.750000	15.930000	16.680000
23	0.660000	16.680000	17.340000
24	0.920000	17.340000	18.260000
25	0.890000	18.260000	19.150000
26	0.630000	19.150000	19.779999
27	0.930000	19.779999	20.709999
28	0.540000	20.709999	21.250000
29	0.700000	21.250000	21.950001
30	0.860000	21.950001	22.810001
31	0.880000	22.810001	23.690001
32	0.780000	23.690001	24.470001
33	0.780000	24.470001	25.250002
34	0.510000	25.250002	25.760002
35	0.590000	25.760002	26.350002

Average waiting time = 26.350002
Average turn around time = 26.349991

Figure 4.3; Pr3 Snapshot of DMP

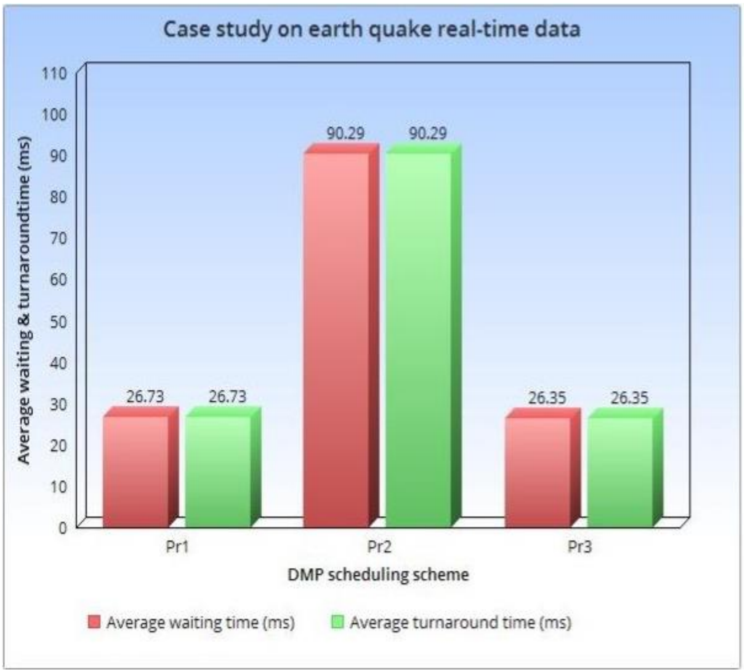


Figure 4.4; Case Study of DMP

Table 4.2. Case Study of DMP

Case study of DMP Scheduling scheme		
Priority Level	**Average Waiting Time (ms)**	**Average Turnaround Time (ms)**
Pr1	26.73	26.73
Pr2	90.29	90.29
Pr3	26.35	26.35

The case study of DMP is tabulated in Table 4.2 and the graph is plotted in Figure 4.4.

4.2. Case Study of EDMP

```
Processes   Burst time   Waiting time   Turn around time
1       4.300000        0.000000        4.300000
2       4.900000        4.300000        9.200001
3       3.300000        9.200001        12.500001
4       3.140000        12.500001       15.640001
5       5.900000        15.640001       21.540001
Average waiting time = 8.328001
Average turn around time = 12.636001
```

Figure 4.5; Pr1 Snapshot of EDMP

In EDMP the pr1 contains real-time urgent data. So, the values above 3mw which causes major disaster will be considered as real-time urgent data and placed in Pr1 queue. Pr2 contains the real time data which is ranging between 2.5 mw and 3 mw. For pr3 queue, the magnitude ranging between 1mw and 2.5mw will be considered. In Pr4, the value which is below 1mw is taken. The snapshot of Pr1, Pr2, Pr3 and Pr4 are shown in Figure 4.5, Figure 4.6, Figure 4.7 and Figure 4.8 respectively.

```
Processes   Burst time   Waiting time   Turn around time
1       2.590000        0.000000        2.590000
2       2.600000        2.590000        5.190000
Average waiting time = 1.295000
Average turn around time = 3.890000
```

Figure 4.6; Pr2 Snapshot of EDMP

29	1.270000	42.470005	43.740005
30	1.960000	43.740005	45.700005
31	1.470000	45.700005	47.170006
32	1.550000	47.170006	48.720005
33	1.900000	48.720005	50.620007
34	1.680000	50.620007	52.300007
35	1.410000	52.300007	53.710007
36	1.400000	53.710007	55.110008
37	1.160000	55.110008	56.270008
38	1.090000	56.270008	57.360008
39	1.520000	57.360008	58.880009
40	1.960000	58.880009	60.840008
41	1.900000	60.840008	62.740009
42	1.810000	62.740009	64.550011
43	1.510000	64.550011	66.060013
44	1.060000	66.060013	67.120010
45	2.400000	67.120010	69.520012
46	2.020000	69.520012	71.540009
47	1.990000	71.540009	73.530006
48	1.800000	73.530006	75.330009
49	1.500000	75.330009	76.830009
50	1.070000	76.830009	77.900009
51	1.020000	77.900009	78.920006
52	2.230000	78.920006	81.150009
53	1.290000	81.150009	82.440010
54	1.910000	82.440010	84.350014
55	1.070000	84.350014	85.420013
56	1.420000	85.420013	86.840012
57	2.210000	86.840012	89.050011
58	1.240000	89.050011	90.290009

Average waiting time = 90.290009
Average turn around time = 90.289978

Figure 4.7; Pr3 Snapshot of EDMP

Processes	Burst time	Waiting time	Turn around time
1	0.880000	0.000000	0.880000
2	0.560000	0.880000	1.440000
3	0.660000	1.440000	2.100000
4	0.980000	2.100000	3.080000
5	0.950000	3.080000	4.030000
6	0.780000	4.030000	4.810000
7	0.540000	4.810000	5.350000
8	0.990000	5.350000	6.340000
9	0.760000	6.340000	7.100000
10	0.680000	7.100000	7.780000
11	0.570000	7.780000	8.350000
12	0.950000	8.350000	9.300000
13	0.560000	9.300000	9.860001
14	0.510000	9.860001	10.370001
15	0.860000	10.370001	11.230000
16	0.820000	11.230000	12.050000
17	0.680000	12.050000	12.730000
18	0.530000	12.730000	13.260000
19	0.960000	13.260000	14.220000
20	0.750000	14.220000	14.970000
21	0.960000	14.970000	15.930000
22	0.750000	15.930000	16.680000
23	0.660000	16.680000	17.340000
24	0.920000	17.340000	18.260000
25	0.890000	18.260000	19.150000
26	0.630000	19.150000	19.779999
27	0.930000	19.779999	20.709999
28	0.540000	20.709999	21.250000
29	0.700000	21.250000	21.950001
30	0.860000	21.950001	22.810001
31	0.880000	22.810001	23.690001
32	0.780000	23.690001	24.470001
33	0.780000	24.470001	25.250002
34	0.510000	25.250002	25.760002
35	0.590000	25.760002	26.350002

Average waiting time = 26.350002
Average turn around time = 26.349991

Figure 4.8; Pr4 Snapshot of EDMP

The case study of EDMP is tabulated in Table 3.3.

Table 4.3; Case study of EDMP

Case study of EDMP Scheduling scheme		
Priority Level	**Average Waiting Time (ms)**	**Average Turnaround** Time **(ms)**
Pr1	8.32	12.64
Pr2	1.29	3.89
Pr3	90.29	90.29
Pr4	26.35	26.35

Based on the tabulation above, the graph for the average waiting time and average turnaround time for EDMP is plotted in Figure 4.9.

From the table above the pr1 and pr2 packets were take the mean and considered as the real time packets. Thus it is compared as three priority queues as like the other scheduling schemes and compared accordingly.

Figure 4.9: Case Study of EDMP

4.3. Case Study of CW-DMP

In CW-DMP, the values more than 2.5 mw is taken as real time data (Pr1). For pr2 queue, the magnitude ranging between 1mw and 2.5mw will be considered. In Pr3, the value which is below 1mw is taken. Based on the magnitude the waiting time and turnaround time for the three priority levels were computed and the snapshot is given in Figure 4.10, 4.11 and 4.12 respectively.

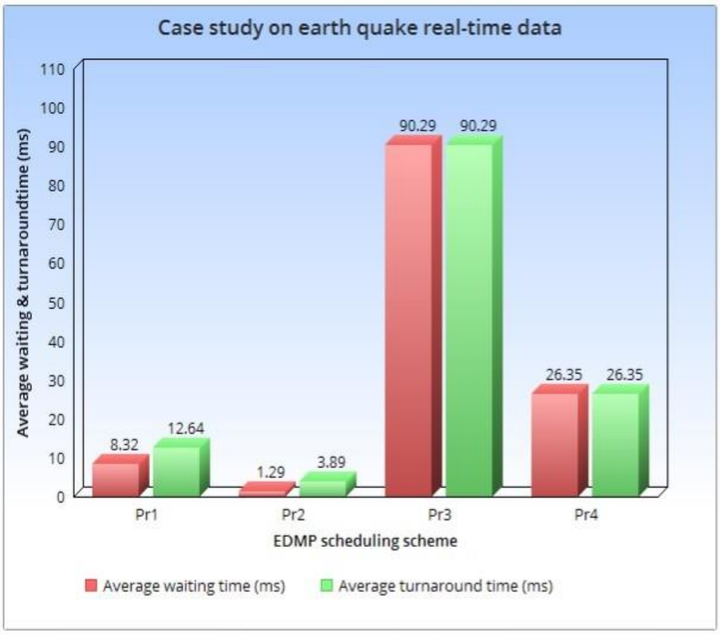


Figure 4.10; Pr1 Snapshot of CW-DMP

Processes	Burst time	Waiting time	Turn around time
1	2.59	0	2.59
2	2.6	2.59	5.19
6	3.14	5.19	8.33
5	3.3	8.33	11.63
3	4.3	11.63	15.93
4	4.9	15.93	20.83
7	5.9	20.83	26.73

Average waiting time = 9.21429
Average turn around time = 13.0329

Figure 4.11; Pr2 Snapshot of CW-DMP

25	1.27	26.73	28
26	1.27	27.73	29
27	1.95	28.05	30
28	1.04	29.96	31
29	1.27	30.73	32
30	1.96	31.04	33
31	1.47	32.53	34
32	1.55	33.45	35
33	1.9	34.1	36
34	1.68	35.32	37
35	1.41	36.59	38
36	1.4	37.6	39
37	1.16	38.84	40
38	1.09	39.91	41
39	1.52	40.48	42
40	1.96	41.04	43
41	1.9	42.1	44
42	1.81	43.19	45
43	1.51	44.49	46
44	1.06	45.94	47
45	2.4	62.6	65
46	2.02	62.98	65
47	1.99	50.01	52
48	1.8	51.2	53
49	1.5	52.5	54
50	1.07	53.93	55
51	1.02	54.98	56
52	2.23	62.77	65
53	1.29	57.71	59
54	1.91	58.09	60
55	1.07	59.93	61
56	1.42	60.58	62
57	2.21	62.79	65
58	1.24	63.76	65

Average waiting time = 34.9088
Average turn around time = 36.4655

Figure 4.12; Pr3 Snapshot of CW-DMP

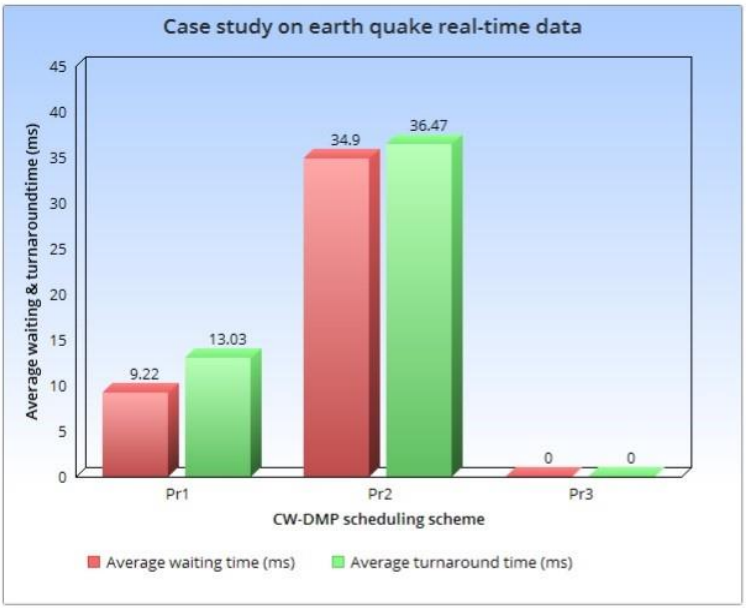


Figure 4.13; Case Study of CW-DMP

The case study of CW-DMP is tabulated in Table 3.4 and the graph is plotted in Figure 4.13.

Table 4.4. Case Study of CW-DMP

Case study of CW-DMP Scheduling scheme		
Priority Level	**Average Waiting Time (ms)**	**Average Turnaround Time (ms)**
Pr1	9.22	13.03
Pr2	34.9	36.47
Pr3	0	0

4.4. Case Study of ITF

In ITF, the values more than 2.5 mw is taken as real time data (Pr1). For pr2 queue,

Processes	Burst time	Waiting time	Turn around time
1	2.59	0	2.59
2	2.6	2.59	5.19
6	3.14	5.19	8.33
5	3.3	8.33	11.63
3	4.3	11.63	15.93
4	4.9	15.93	20.83
7	5.9	20.83	26.73

Average waiting time = 9.21429
Average turn around time = 13.0329

Figure 4.14; Pr1 Snapshot of ITF

The magnitude ranging between 1mw and 2.5mw will be considered. In Pr3, the value which is below 1mw is taken.

22	1.4	27.04	28.44
35	1.41	28.44	29.85
56	1.42	29.85	31.27
19	1.45	31.27	32.72
15	1.45	32.72	34.17
31	1.47	34.17	35.64
49	1.5	35.64	37.14
43	1.51	37.14	38.65
39	1.52	38.65	40.17
32	1.55	40.17	41.72
23	1.6	41.72	43.32
34	1.68	43.32	45
12	1.7	45	46.7
20	1.74	46.7	48.44
16	1.74	48.44	50.18
48	1.8	50.18	51.98
42	1.81	51.98	53.79
2	1.84	53.79	55.63
4	1.88	55.63	57.51
33	1.9	57.51	59.41
41	1.9	59.41	61.31
5	1.9	61.31	63.21
8	1.91	63.21	65.12
54	1.91	65.12	67.03
27	1.95	67.03	68.98
40	1.96	68.98	70.94
30	1.96	70.94	72.9
47	1.99	72.9	74.89
46	2.02	74.89	76.91
7	2.05	76.91	78.96
10	2.13	78.96	81.09
57	2.21	81.09	83.3
52	2.23	83.3	85.53
1	2.36	85.53	87.89
45	2.4	87.89	90.29

Average waiting time = 38.0271
Average turn around time = 39.5838

Figure 4.15; Pr2 Snapshot of ITF

Processes	Burst time	Waiting time	Turn around time
1	0.880000	0.000000	0.880000
2	0.560000	0.880000	1.440000
3	0.660000	1.440000	2.100000
4	0.980000	2.100000	3.080000
5	0.950000	3.080000	4.030000
6	0.780000	4.030000	4.810000
7	0.540000	4.810000	5.350000
8	0.990000	5.350000	6.340000
9	0.760000	6.340000	7.100000
10	0.680000	7.100000	7.780000
11	0.570000	7.780000	8.350000
12	0.950000	8.350000	9.300000
13	0.560000	9.300000	9.860001
14	0.510000	9.860001	10.370001
15	0.860000	10.370001	11.230000
16	0.820000	11.230000	12.050000
17	0.680000	12.050000	12.730000
18	0.530000	12.730000	13.260000
19	0.960000	13.260000	14.220000
20	0.750000	14.220000	14.970000
21	0.960000	14.970000	15.930000
22	0.750000	15.930000	16.680000
23	0.660000	16.680000	17.340000
24	0.920000	17.340000	18.260000
25	0.890000	18.260000	19.150000
26	0.630000	19.150000	19.779999
27	0.930000	19.779999	20.709999
28	0.540000	20.709999	21.250000
29	0.700000	21.250000	21.950001
30	0.860000	21.950001	22.810001
31	0.880000	22.810001	23.690001
32	0.780000	23.690001	24.470001
33	0.780000	24.470001	25.250002
34	0.510000	25.250002	25.760002
35	0.590000	25.760002	26.350002

Average waiting time = 26.350002
Average turn around time = 26.349991

Figure 4.16; Pr3 Snapshot of ITF

Based on the above Figure 4.14, Figure 4.15 and Figure 4.16 the following Table 4.5 is tabulated.

Table 4.5; Case Study of ITF

Case study of ITF Scheduling scheme		
Priority Level	**Average Waiting Time (ms)**	**Average Turnaround Time (ms)**
Pr1	9.22	13.03
Pr2	38.02	39.59
Pr3	26.35	26.35

Based on the values calculated from the above table 5.36 the graph is plotted in the Figure 4.17.

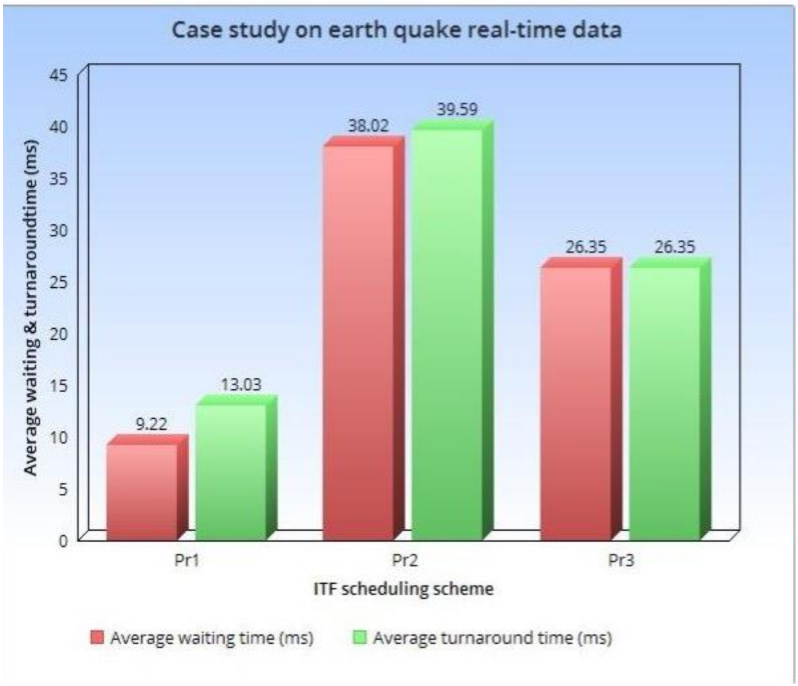


Figure 4.17; Case Study of ITF

4.5. Case Study of IPS

In IPS, the values more than 2.5 mw is taken as real time data (Pr1). For pr2 queue, the magnitude ranging between 1mw and 2.5mw will be considered. In Pr3, the value which is below 1mw is taken. The snapshot of Pr1, Pr2 and Pr3 is given in figure 4.18, figure 4.19 and figure 4.20 respectively.

Processes	Burst time	Waiting time	Turn around time
1	2.59	11.41	14
2	2.6	11.4	14
3	4.3	17.7	22
4	4.9	17.1	22
5	3.3	15.7	19
6	3.14	16.86	20
7	5.9	17.1	23

Average waiting time = 15.3243
Average turn around time = 19.1429

Figure 4.18; Pr1 Snapshot of IPS

22	1.4	27.04	28.44
35	1.41	28.44	29.85
56	1.42	29.85	31.27
19	1.45	31.27	32.72
15	1.45	32.72	34.17
31	1.47	34.17	35.64
49	1.5	35.64	37.14
43	1.51	37.14	38.65
39	1.52	38.65	40.17
32	1.55	40.17	41.72
23	1.6	41.72	43.32
34	1.68	43.32	45
12	1.7	45	46.7
20	1.74	46.7	48.44
16	1.74	48.44	50.18
48	1.8	50.18	51.98
42	1.81	51.98	53.79
2	1.84	53.79	55.63
4	1.88	55.63	57.51
33	1.9	57.51	59.41
41	1.9	59.41	61.31
5	1.9	61.31	63.21
8	1.91	63.21	65.12
54	1.91	65.12	67.03
27	1.95	67.03	68.98
40	1.96	68.98	70.94
30	1.96	70.94	72.9
47	1.99	72.9	74.89
46	2.02	74.89	76.91
7	2.05	76.91	78.96
10	2.13	78.96	81.09
57	2.21	81.09	83.3
52	2.23	83.3	85.53
1	2.36	85.53	87.89
45	2.4	87.89	90.29

Average waiting time = 38.0271
Average turn around time = 39.5838

Figure 4.19; Pr2 Snapshot of IPS

Processes	Burst time	Waiting time	Turn around time
34	0.51	0	0.51
14	0.51	0.51	1.02
18	0.53	1.02	1.55
28	0.54	1.55	2.09
7	0.54	2.09	2.63
2	0.56	2.63	3.19
13	0.56	3.19	3.75
11	0.57	3.75	4.32
35	0.59	4.32	4.91
26	0.63	4.91	5.54
3	0.66	5.54	6.2
23	0.66	6.2	6.86
10	0.68	6.86	7.54
17	0.68	7.54	8.22
29	0.7	8.22	8.92
22	0.75	8.92	9.67
20	0.75	9.67	10.42
9	0.76	10.42	11.18
33	0.78	11.18	11.96
32	0.78	11.96	12.74
6	0.78	12.74	13.52
16	0.82	13.52	14.34
15	0.86	14.34	15.2
30	0.86	15.2	16.06
1	0.88	16.06	16.94
31	0.88	16.94	17.82
25	0.89	17.82	18.71
24	0.92	18.71	19.63
27	0.93	19.63	20.56
12	0.95	20.56	21.51
5	0.95	21.51	22.46
21	0.96	22.46	23.42
19	0.96	23.42	24.38
4	0.98	24.38	25.36
8	0.99	25.36	26.35

Average waiting time = 11.2323
Average turn around time = 11.9851

Figure 4.20; Pr3 Snapshot of IPS

4.6. Case Study of SF-DMP

In SF-DMP, the values more than 2.5 mw is taken as real time data (Pr1). For pr2 queue, the magnitude ranging between 1mw and 2.5mw will be considered. In Pr3, the value which is below 1mw is taken. The snapshot of Pr1, Pr2 and Pr3 is given in Figure 4. 22, Figure 4. 23 and Figure 4.24 respectively.

Processes	Burst time	Waiting time	Turn around time
1	2.59	-0.59	2
2	2.6	1.4	4
3	4.3	3.7	8
4	4.9	7.1	12
5	3.3	11.7	15
6	3.14	14.86	18
7	5.9	17.1	23

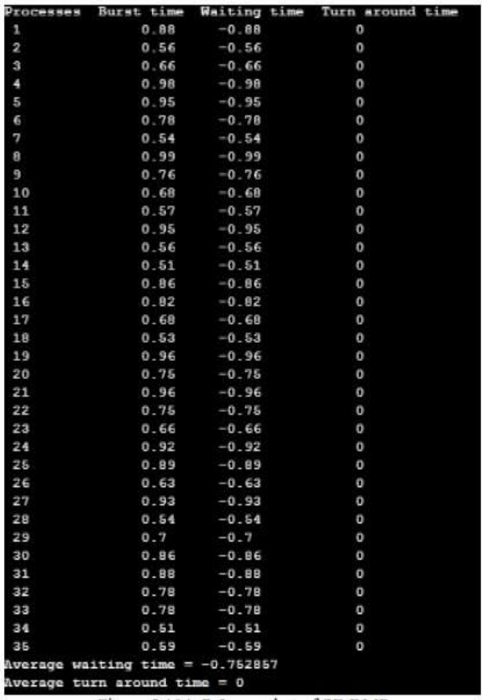
Average waiting time = 7.89571
Average turn around time = 11.7143

Figure 4.22; Pr1 Snapshot of SF-DMP

26	1.27	27.73	29
27	1.95	28.05	30
28	1.04	29.96	31
29	1.27	30.73	32
30	1.96	31.04	33
31	1.47	32.53	34
32	1.55	33.45	35
33	1.9	34.1	36
34	1.68	35.32	37
35	1.41	36.59	38
36	1.4	37.6	39
37	1.16	38.84	40
38	1.09	39.91	41
39	1.52	40.48	42
40	1.96	41.04	43
41	1.9	42.1	44
42	1.81	43.19	45
43	1.51	44.49	46
44	1.06	45.94	47
45	2.4	46.6	49
46	2.02	48.98	51
47	1.99	50.01	52
48	1.8	51.2	53
49	1.5	52.5	54
50	1.07	53.93	55
51	1.02	54.98	56
52	2.23	55.77	58
53	1.29	57.71	59
54	1.91	58.09	60
55	1.07	59.93	61
56	1.42	60.58	62
57	2.21	61.79	64
58	1.24	63.76	65

Average waiting time = 31.3053
Average turn around time = 32.8621

Figure 4.23; Pr2 Snapshot of SF-DMP



Processes	Burst time	Waiting time	Turn around time
1	0.88	-0.88	0
2	0.56	-0.56	0
3	0.66	-0.66	0
4	0.98	-0.98	0
5	0.95	-0.95	0
6	0.78	-0.78	0
7	0.54	-0.54	0
8	0.99	-0.99	0
9	0.76	-0.76	0
10	0.68	-0.68	0
11	0.57	-0.57	0
12	0.95	-0.95	0
13	0.56	-0.56	0
14	0.51	-0.51	0
15	0.86	-0.86	0
16	0.82	-0.82	0
17	0.68	-0.68	0
18	0.53	-0.53	0
19	0.96	-0.96	0
20	0.75	-0.75	0
21	0.96	-0.96	0
22	0.75	-0.75	0
23	0.66	-0.66	0
24	0.92	-0.92	0
25	0.89	-0.89	0
26	0.63	-0.63	0
27	0.93	-0.93	0
28	0.64	-0.64	0
29	0.7	-0.7	0
30	0.86	-0.86	0
31	0.88	-0.88	0
32	0.78	-0.78	0
33	0.78	-0.78	0
34	0.51	-0.51	0
35	0.59	-0.59	0

Average waiting time = -0.752857
Average turn around time = 0

Figure 4.24; Pr3 Snapshot of SF-DMP

Based on the data from the above snapshot the following Table 4.7 is tabulated and the graph is plotted in Figure 4.25.

Table 4.7. Case Study of SF-DMP

Case study of ITF Scheduling Scheme		
Priority Level	**Average Waiting Time (ms)**	**Average Turnaround Time (ms)**
Pr1	7.89	11.72
Pr2	31.3	32.86
Pr3	0	0

As the burst time ranges 0 to 1ms, the waiting time and there by the turnaround time also falls the same. According to different applications the value varies. But compared to all other schemes - the value diminishes in SF-DMP.

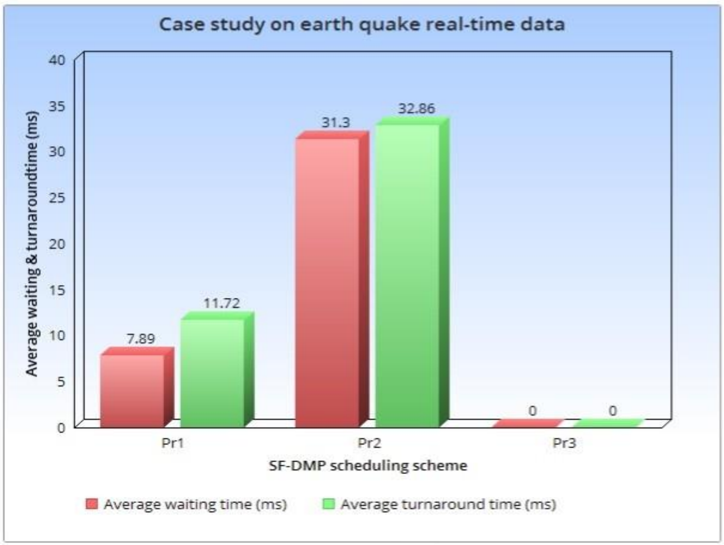


Figure 4.25; Case Study of SF-DMP

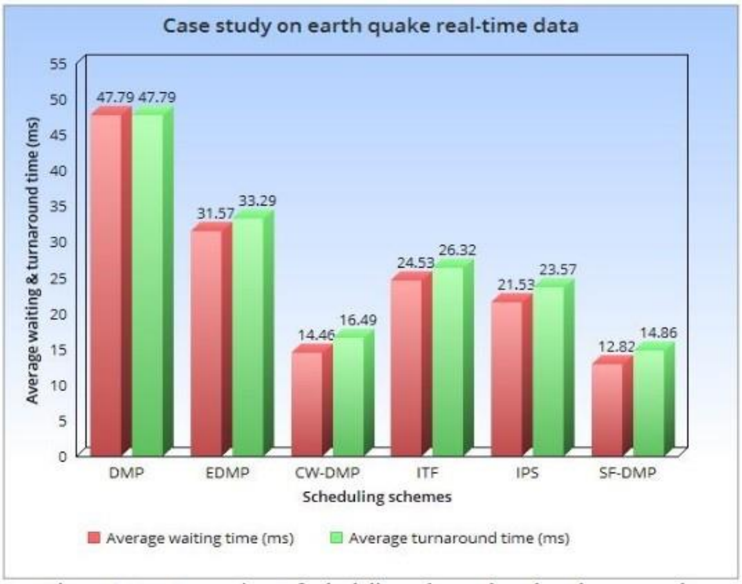


Figure 4.26; Comparison of Scheduling Schemes Based on the Case Study

Based on the case study from the real time earth quake data the average waiting time and turnaround time were calculated as follows in Table 4.8 and the graph is plotted in Figure 4.26.

CW-DMP and SF-DMP values are nearby due to the use of round robin scheduling and the value reached 0 ms in both the cases.

Table 4.8. Average Waiting Time and Turnaround Time of Earthquake Real Time Data

Scheduling Schemes	Average Waiting Time (ms)	Average Turnaround Time (ms)
DMP	47.79	47.79
EDMP	31.57	33.29
CW-DMP	14.46	16.49
ITF	24.53	26.32
IPS	21.53	23.57

SF-DMP	12.82	14.86

4.7. Case Study of SF-DMP

In SF-DMP, the values more than 2.5 mw is taken as real time data (Pr1). For pr2 queue, the magnitude ranging between 1mw and 2.5mw will be considered. In Pr3, the value which is below 1mw is taken. Based on the data from the above Table 4.9 is tabulated and the graph is plotted in Figure 4.27.

Table 4.9. Case Study of SF-DMP

Case study of SF-DMP Scheduling Scheme		
Priority Level	**Average Waiting Time (ms)**	**Average Turnaround Time (ms)**
Pr1	7.89	11.72
Pr2	31.3	32.86
Pr3	0	0

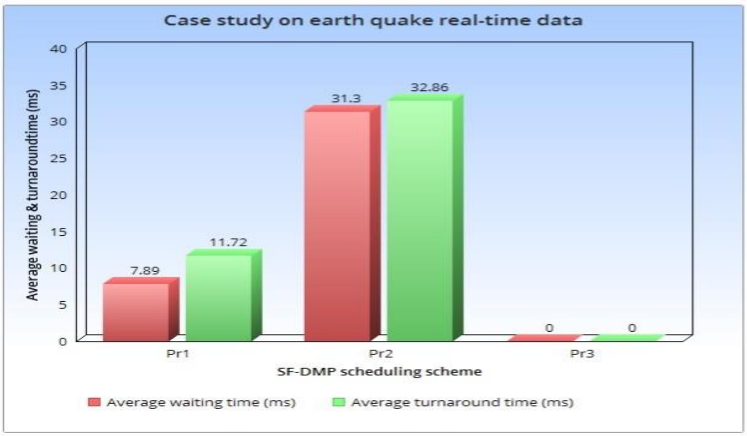


Figure 4.27; Case Study of SF-DMP

As the burst time ranges 0 to 1ms, the waiting time and there by the turnaround time also falls the same. According to different applications the value varies. But compared to all other schemes - the value diminishes in SF-DMP.

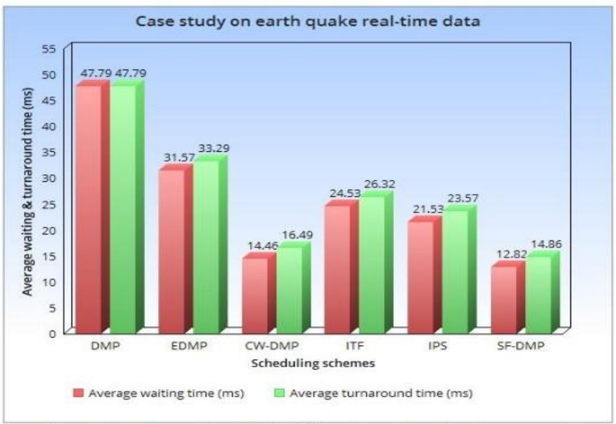


Figure 4.28; Comparison of Scheduling Schemes Based on the Case Study

Based on the case study from the real time earth quake data the average waiting time and turnaround time were calculated as follows in Table 4.9 and the graph is plotted in Figure 4.28. CW-DMP and SF-DMP values are nearby due to the use of round robin scheduling and the value reached 0 ms in both the cases. The below table shows the graphical representation of the case Study of SF-DMP.

Table 4.10; Average Waiting Time and Turnaround Time of Earthquake Real Time Data

Scheduling Schemes	Average Waiting Time (ms)	Average Turnaround Time (ms)
DMP	47.79	47.79
EDMP	31.57	33.29
CW-DMP	14.46	16.49
ITF	24.53	26.32
IPS	21.53	23.57
SF-DMP	12.82	14.86

5. Conclusions

When compared with the previous scheme based on the case study of the earthquake data, the waiting time of EDMP decreases by 16.22ms, CWDMP decreases by 33.23ms, ITF decreases by 23.26ms and IPS decreases by 26.26ms, SF-DMP the waiting time decreases by 37.97ms. Thus, the starvation is mitigated in the proposed scheme. SF-DMP outperforms by reducing its average waiting time by 5.2ms than IPS packet scheduling scheme. In the comparison made on non-real time of the average waiting time among the scheduling schemes, SF-DMP outperforms by reducing its average waiting time by 46.8ms than DMP and EDMP, 11.7ms than CW-DMP, 6.86ms than ITF and IPS packet scheduling scheme. When compared with the previous scheme based on the case study of the earthquake data, the waiting time of EDMP decreases by 16.22ms, CWDMP decreases by 33.23ms, ITF decreases by 23.26ms and IPS decreases by 26.26ms. Based on the case study, the average waiting time and turnaround time of SF-DMP reduced than all the other proposed scheduling schemes. Thus, it outperforms among the proposed scheduling schemes.

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