

EDF Scheduler verification report

- **System Tasks:**

Task No.	Task	Periodicity	Deadline	WCET	Priority
1	Button 1 Monitor	50	50	5.2us	2
2	Button 2 Monitor	50	50	5.2us	2
3	Periodic Transmitter	100	100	2.616667us	1
4	Uart Receiver	20	20	72.5us	3
5	Load 1 Simulation	10	10	5ms	4
6	Load 2 Simulation	100	100	15ms	1

- **Calculate the system hyper-period using analytical method**

$$H = LCM(P_1, P_2, \dots) = LCM(50, 50, 100, 20, 10, 100) = 100ms$$

- **Calculate the CPU load**

$$U = \frac{\text{Busy Time}}{\text{Busy Time} + \text{Idle Time}} = \frac{\sum(WCET * \frac{H}{P})}{H} = \sum_{i=1}^n \frac{WCET_i}{P_i}$$
$$U = \left(\frac{5.2us}{50ms} + \frac{5.2us}{50ms} + \frac{2.616667us}{100ms} + \frac{72.5us}{20ms} + \frac{5ms}{10ms} + \frac{15ms}{100ms} \right) * 100\%$$
$$U = 65.385\%$$

- **Check system Schedulability using URM**

$$U = \sum_{i=1}^n \frac{WCET_i}{P_i} \leq n \left(2^{\frac{1}{n}} - 1 \right)$$

$$LHS = U = 65.385\%$$

$$RHS = n \left(2^{\frac{1}{n}} - 1 \right) = 6 * \left(2^{\frac{1}{6}} - 1 \right) = 0.73477 = 73.477\%$$

$$LHS \leq RHS$$

So, System is Schedulable

- **Check system Schedulability using Time Demand Analysis**

As we assume Rate-Monotonic Scheduler for the analysis so it's required to give the higher priority for the task with higher periodicity

$$W_i(t) = e_i + \sum_{k=1}^{i-1} \left[\frac{t}{P_k} \right] e_k$$

Where,

$W_i(t)$: worst response time

e_i : Execution Time of the current Task

t : Time Instance

P_k : the periodicity of the tasks with higher priority than the current task

1. Load 1 Simulation: Task5(P = 10, D = 10, E=5, Priority = 4)

Time instance for Task5 = 0, 10, 20, 30,

$$W_5(10) = 5 + 0 = 5ms \leq 10ms$$

So, Task5 is schedulable

2. Uart Receiver: Task4(P = 20, D = 20, E = 72.5us, Priority = 3)

Time instance for Task4 = 20, 40, 60, 80,

$$W_4(20) = 72.5us + \frac{20}{10} * 5 = 10.0725ms \leq 20ms$$

So, Task4 is schedulable

3. Button 1 Monitor: Task1(P = 50, D = 50, E = 5.2us, Priority = 2)

Time instance for Task1 = 50, 100, ...

Because all Task5 and Task4 will execute at 100 also

$$W_1(50) = 5.2us + \frac{50}{10} * 5 + \frac{50}{20} * 72.5us = 25.2227ms \leq 50ms$$

So, Task1 is schedulable

4. Button 2 Monitor: Task2(P = 50, D = 50, E = 5.2us, Priority = 2)

Time instance for Task2 = 50

$$\begin{aligned} W_2(50) &= 5.2us + \frac{50}{10} * 5 + \frac{50}{20} * 72.5us + \frac{50}{50} * 5.2us \\ &= 25.2279ms \leq 50ms \end{aligned}$$

So, Task2 is schedulable

5. Periodic Transmitter: Task3(P = 100, D = 100, E = 2.6167us, Priority = 1)
Time instance for Task3= 100

$$W_3(100) = 2.6167us + \frac{100}{10} * 5 + \frac{100}{20} * 72.5us + \frac{100}{50} * 5.2us + \frac{100}{50} * 5.2us = 53.648ms \leq 100ms$$

So, Task3 is schedulable

6. Load 2 Simulation: Task6(P = 100, D = 100, E = 15, Priority = 1)

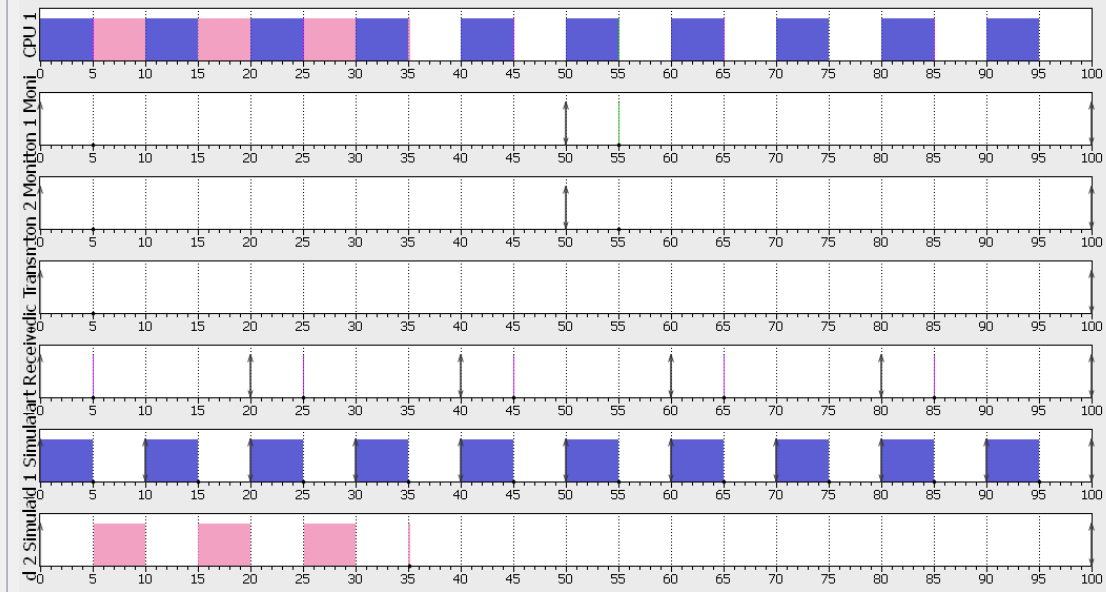
$$W_6(100) = 15 + \frac{100}{10} * 5 + \frac{100}{20} * 72.5us + \frac{100}{50} * 5.2us + \frac{100}{50} * 5.2us + \frac{100}{100} * 2.6167us = 68.648ms \leq 100ms$$

So, Task6 is schedulable

So, System is schedulable (feasible)

- **calculate and plot the execution time from the actual implemented tasks, tick and idle task using GPIOs and the logic analyzer**

By measuring the HIGH Period in every bit, we can calculate the worst case execution time (WCET) of Task



- Calculate the CPU usage time using timer 1 and trace macros

WCET is an array of 6 elements

where,

WCET[0]	is the Worst-Case Execution Time of Task 1 “Button 1 Monitor”
WCET[1]	is the Worst-Case Execution Time of Task 2 “Button 2 Monitor”
WCET[2]	is the Worst-Case Execution Time of Task 3 “Periodic Transmitter”
WCET[3]	is the Worst-Case Execution Time of Task 4 “Uart Receiver”
WCET[4]	is the Worst-Case Execution Time of Task 5 “Load 1 Simulation”
WCET[5]	is the Worst-Case Execution Time of Task 6 “Load 2 Simulation”

Watch 1		
Name	Value	Type
xLastWakeTime	<not in scope>	uint
Task_WCET[0]	0x00000000	uint
Task_WCET[1]	0x00000000	uint
Task_WCET[2]	0x00000000	uint
Task_WCET[3]	0	uint
Task_WCET[4]	5	uint
Task_WCET[5]	15	uint
CPU_Load	0.649999976	float
<Enter expression>		

As we noticed WCET[0] : WCET[3] is equal to zero because the WCET is less than 1ms.

Thanks & Regards.

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