

EDF Scheduler for FreeRTOS

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Verifying the system implementation

1. Using analytical methods:

Task name	Execution time	X number of times to come within the hyperperiod	Total execution time within the hyperperiod
Button_1_Monitor	0.0075 ms	2	0.015 ms
Button_2_Monitor	0.0075 ms	2	0.015 ms
Periodic_Transmitter	0.2 ms	1	0.2 ms
Uart_Receiver	0.3 ms	5	1.3 ms
Load_1_Simulation	5 ms	10	50 ms
Load_2_Simulation	12 ms	1	12 ms

➤ **Hyperperiod** = 100 ms

➤ **Cpu load** = $((0.015 + 0.015 + 0.2 + 1.3 + 50 + 12) / 100) * 100$
= 63.73 ms

➤ **Schedulability using URM method**

$$\sum_{k=1}^n \frac{C_k}{T_k} \leq U_{RM} = n(2^{1/n} - 1)$$

$$0.6373 < 0.7347 = (6 * (2^{(1/6)} - 1))$$

Schedulable 🤖

➤ **Schedulability using time demand analysis method**

$$w_i(t) = e_i + \sum_{k=1}^{i-1} \left\lceil \frac{t}{p_k} \right\rceil e_k \quad \text{for } 0 < t \leq p_i$$

Task name	Calculation	Result	Schedulability
Arranged from the lowest period to highest			
Load_1_Simulation	$W_{10} = 5 + 0 = 5$	$5 < 10$	Schedulable
Uart_Receive	$W_{20} = 0.3 + (20/10)*5 = 10.3$	$10.3 < 20$	Schedulable
Button_1_Monitor	$W_{50} = 0.0075 + (50/10)*5 + (50/20)*0.3 = 25.75$	$25.75 < 50$	Schedulable
Button_2_Monitor	$W_{50} = 0.0075 + (50/10)*5 + (50/20)*0.3 + (50/50)*0.0075 = 25.765$	$25.765 < 50$	Schedulable
Periodic_Transmitter	$W_{100} = 0.2 + (100/10)*5 + (100/20)*0.3 + (100/50)*0.0075 + (100/50)*0.0075 = 51.73$	$51.73 < 100$	Schedulable
Load_1_Simulation	$W_{100} = 12 + (100/10)*5 + (100/20)*0.3 + (100/50)*0.0075 + (100/50)*0.0075 + (100/100)*0.2 = 63.73$	$63.73 < 100$	Schedulable

Schedulable 🤖

AS expected, the results indicate a successful implementation.

2. Using Simso offline simulator:

General Scheduler Processors Tasks										
id	Name	Task type	Abort on miss	Act. Date (ms)	Period (ms)	List of Act. dates (ms)	Deadline (ms)	WCET (ms)	Followed by	Priority
1	Button 1	Periodic	<input type="checkbox"/> No	0.0	50.0	-	50.0	0.0075	▼ 1	
2	Button 2	Periodic	<input type="checkbox"/> No	0.0	50.0	-	50.0	0.0075	▼ 1	
3	Transmitter	Periodic	<input type="checkbox"/> No	0.0	100.0	-	100.0	0.2	▼ 1	
4	Receiver	Periodic	<input type="checkbox"/> No	0.0	20.0	-	20.0	0.3	▼ 1	
5	Load 1	Periodic	<input type="checkbox"/> No	0.0	10.0	-	10.0	5.0	▼ 1	
6	Load 2	Periodic	<input type="checkbox"/> No	0.0	100.0	-	100.0	12.0	▼ 1	

SimSo: Real-Time Scheduling Simulator - [Results]

File View Help

Gantt Results

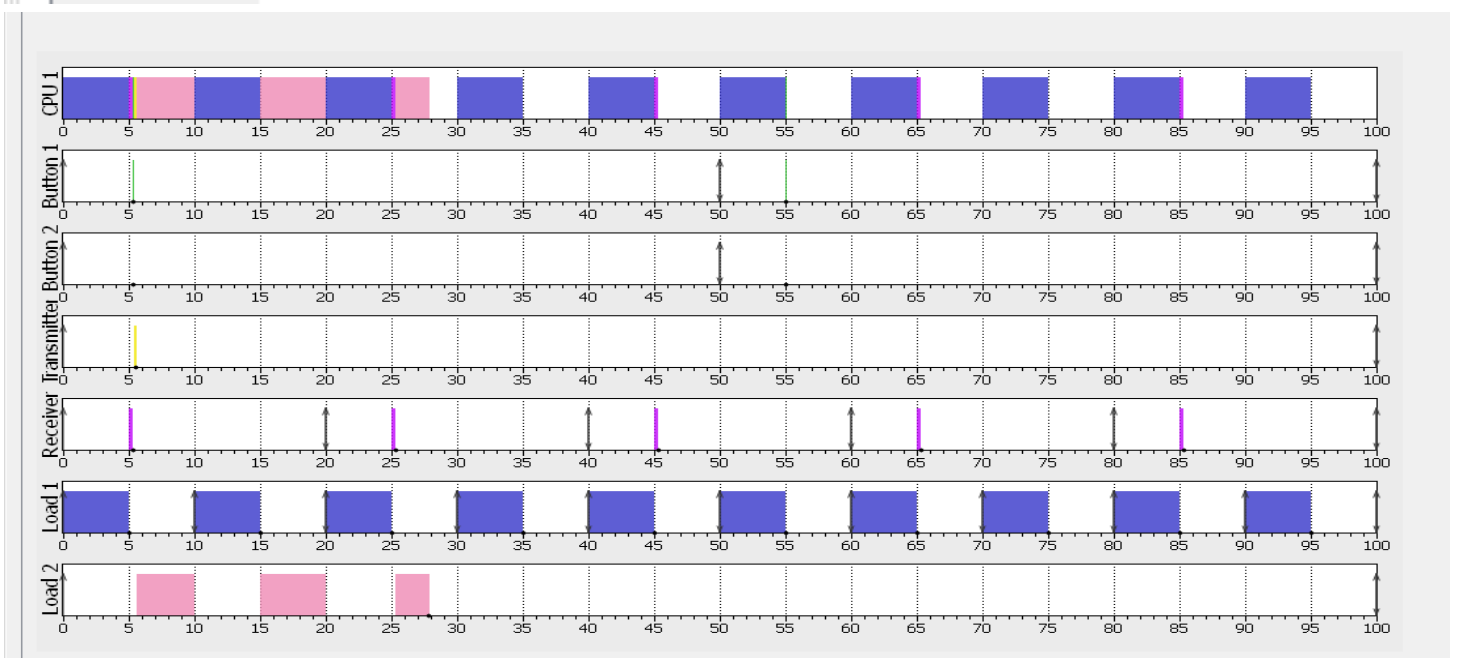
* Unsaved

General Logs Tasks Scheduler Processors

Observation Window:

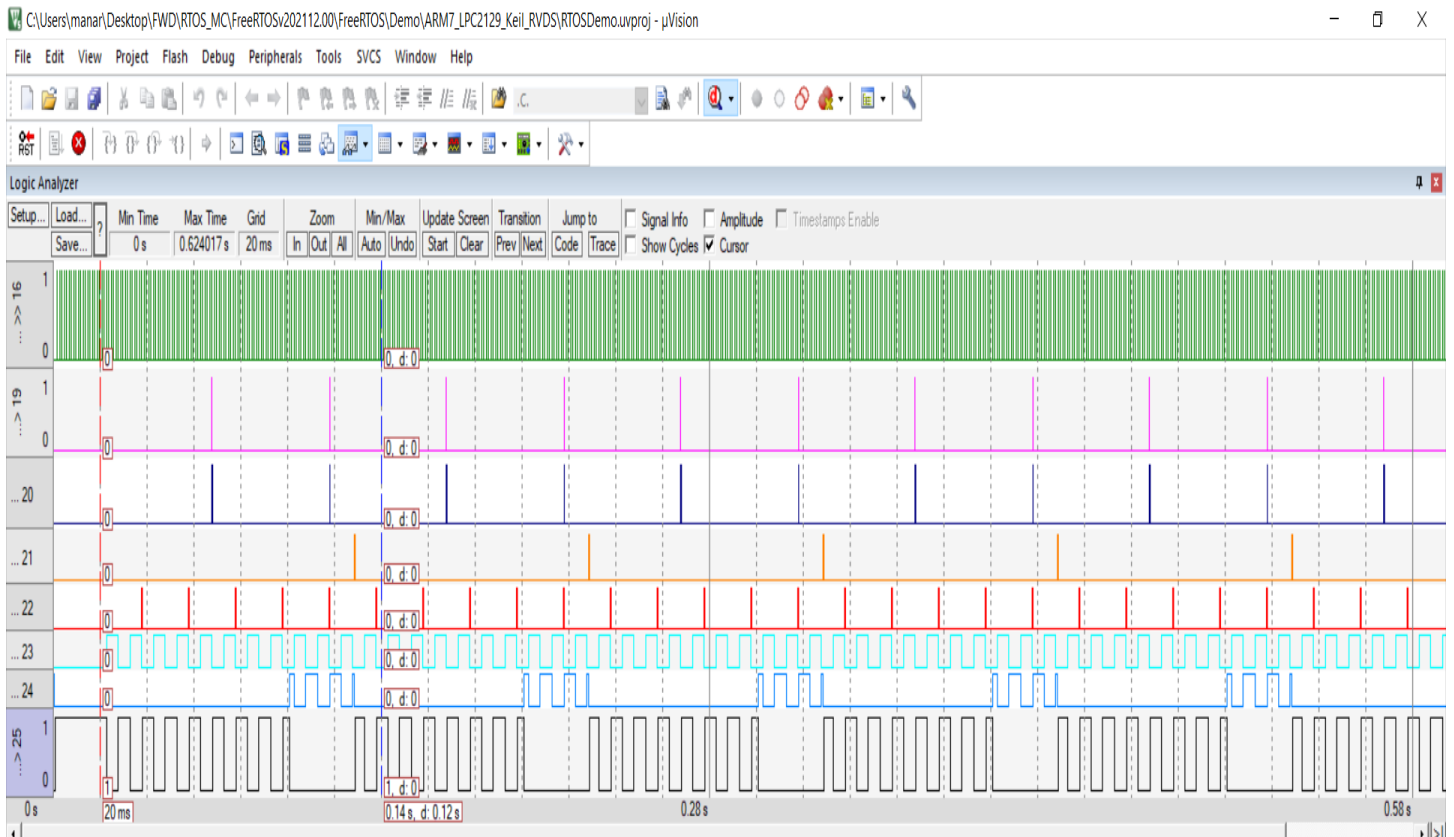
from 0.00 to 100.00 ms

	Total load	Payload	System load
CPU 1	0.6373	0.6373	0.0000
Average	0.6373	0.6373	0.0000



Schedulable 🤔

3. Using Keil simulator in run-time



Tick

Button_1_Simulator (task 1)

Button_2_Simulator (task 2)

Periodic_Transmitter (task 3)

Uart_Receiver (task 4)

Load_1_Simulation (task 5)

Load_2_Simulation (task 6)

Idle_Task

Schedulable



Watch 1		
Name	Value	Type
task_1_in_time	0x004EB836	int
task_1_out_time	0x004EB838	int
task_1_total_time	0x00000B9F	int
task_2_in_time	0x004EB838	int
task_2_out_time	0x004EB839	int
task_2_total_time	0x00000BCA	int
task_3_in_time	0x004EAF0A	int
task_3_out_time	0x004EAF17	int
task_3_total_time	0x00002F40	int
task_4_in_time	0x004EBA8C	int
task_4_out_time	0x004EBA9A	int
task_4_total_time		int
task_5_in_time	0x004EB706	int
task_5_out_time	0x004EB836	int
task_5_total_time	0x0027CD4C	int
task_6_in_time	0x004EAD9	int
task_6_out_time	0x004EAF09	int
task_6_total_time	0x0009BBF3	int
system_time	0x004EB95D	int
cpu_load	64	int
<Enter expression>		

- Stats summary of all tasks.

The screenshot displays two windows from a development environment. The top window, titled 'Watch 1', contains a table with three columns: 'Name', 'Value', and 'Type'. It lists two variables: 'system_time' with a hexadecimal value '0x001C5A8E' and 'cpu_load' with a decimal value '64'. The bottom window, titled 'UART #2', shows a serial terminal output. It contains two identical blocks of task statistics, each preceded by the text 'Implemented EDF Scheduler successfully'. Each block lists tasks and their CPU usage percentages: Periodi (4378, <1%), IDLE (636124, 34%), Print S (11651, <1%), Load 1 (938374, 50%), Uart Re (22212, 1%), Button1 (961, <1%), Button2 (990, <1%), and Load 2 (231832, 12%). The first block's statistics are for time 4378, and the second block's are for time 4393. The bottom status bar indicates the target is stopped, the simulation is running, and the time is 31.00176750 seconds.

Name	Value	Type
system_time	0x001C5A8E	int
cpu_load	64	int
<Enter expression>		

```
Periodi 4378          <1%
IDLE    636124        34%
Print S 11651         <1%
Load 1  938374        50%
Uart Re 22212         1%
Button1 961           <1%
Button2 990           <1%
Load 2  231832        12%

Implemented EDF Scheduler successfully

Periodi 4393          <1%
IDLE    638189        34%
Print S 11689         <1%
Load 1  941420        50%
Uart Re 22283         1%
Button1 965           <1%
Button2 992           <1%
Load 2  232585        12%

Implemented EDF Scheduler successfully
```

ne Agent: Target Stopped Simulation t1: 31.00176750 sec L:536 C:7 CAP NUM SCRL OVR R/M

AT THE END, ALL THE RESULTS INDICATE A SUCCESSFUL IMPLEMENTATION.