

egFWD Embedded Systems Advanced Track

# EDF Scheduler Implementation In FreeRTOS

Project Report

Eng. Omar Alaa  
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- **System summary:**

- **Number of tasks(N):** 6
- **Hyper-period:** 100ms
- **System tick period:** 10ms

Task Name	Periodicity(ms) P	Deadline(ms) D	Execution Time(us) C
Button 1 monitor	50	50	20
Button 2 monitor	50	50	20
Periodic transmitter	100	100	20
UART Receiver	20	20	24
Load 1 simulation	10	10	5000
Load 2 simulation	100	100	12000

➤ **Max CPU load scenario:**

Button 1&2 always toggling, hence task 1&2 always sending respective strings to consumer task.

➤ CPU load calculation:

$$\frac{((20 \times 2) + (20 \times 2) + (20 \times 1) + (24 \times 5) + (5000 \times 10) + (12000 \times 1))}{100000} \times 100 = 62.2\%$$

➤ Checking system schedulability using URM analysis:

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

$$U = \frac{20}{50000} + \frac{20}{50000} + \frac{20}{100000} + \frac{24}{20000} + \frac{5000}{10000} + \frac{12000}{100000} = 0.622$$

$$6 \left( 2^{\frac{1}{6}} - 1 \right) = 0.734$$

$$0.622 \leq 0.734$$

**The system is schedulable.**

➤ **Checking system schedulability using Time Demand analysis:**

$$w_i(t) = e_i + \sum_{k=1}^{i-1} \left( \frac{t}{P_k} \right) e_k \quad , for \ 0 < t \leq P_k$$

- Tasks are prioritized by their periodicity.
- Time is in microseconds.

**1. Load\_1\_Simulation:**

$$W(10000) = 5000$$

$W(10000) < 10000$ , The task is schedulable.

**2. UART\_Receiver:**

$$W(20000) = 24 + (20000/10000)*5000 = 15024$$

$W(20000) < 20000$ , The task is schedulable.

**3. Button\_1\_Monitor:**

$$W(50000) = 20 + (50000/20000)*24 + (50000/10000)*5000 = 30092$$

$W(50000) < 50000$ , The task is schedulable.

**4. Button\_2\_Monitor:**

$$W(50000) = 20 + (50000/50000)*20 + (50000/20000)*24 + (50000/10000)*5000 = 30132$$

$W(50000) < 50000$ , The task is schedulable.

**5. Periodic\_Transmitter:**

$$W(100000) = 20 + (100000/50000)*20 + (100000/50000)*20 + (100000/20000)*24 + (100000/10000)*5000 = 55284$$

$W(100000) < 100000$ , The task is schedulable.

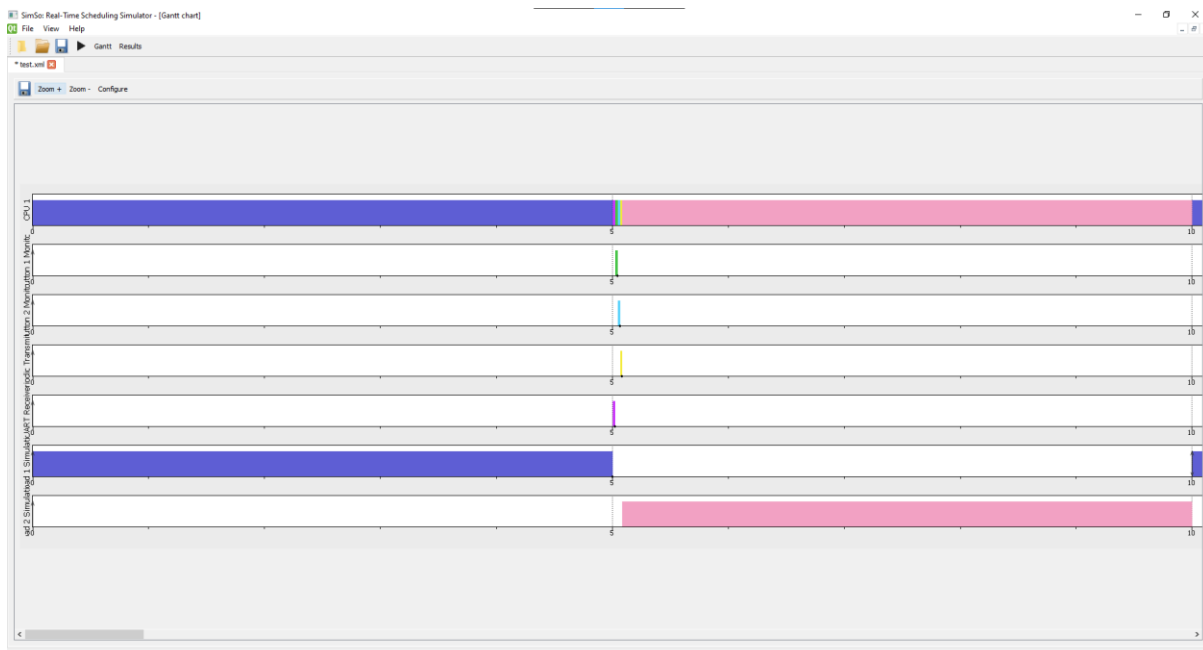
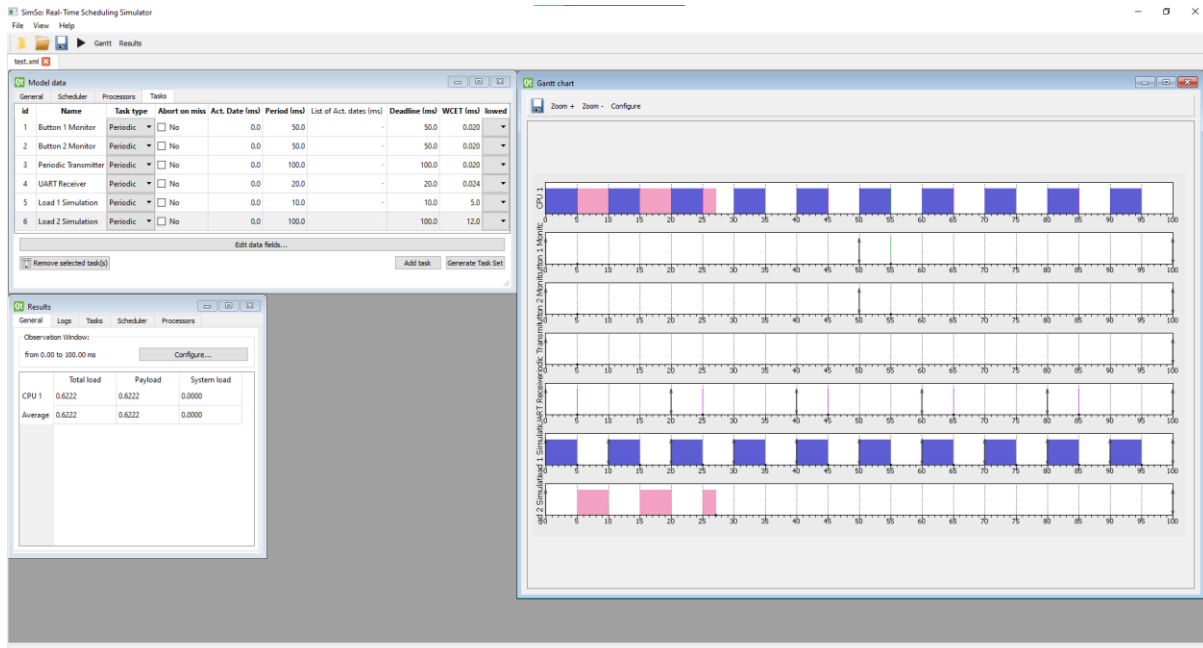
**6. Load\_2\_Simulation:**

$$W(100000) = 12000 + (100000/100000)*20 + (100000/50000)*20 + (100000/50000)*20 + (100000/20000)*24 + (100000/10000)*5000 = 67304$$

$W(100000) < 100000$ , The task is schedulable.

**The system is schedulable.**

- System simulation on SIMSO:

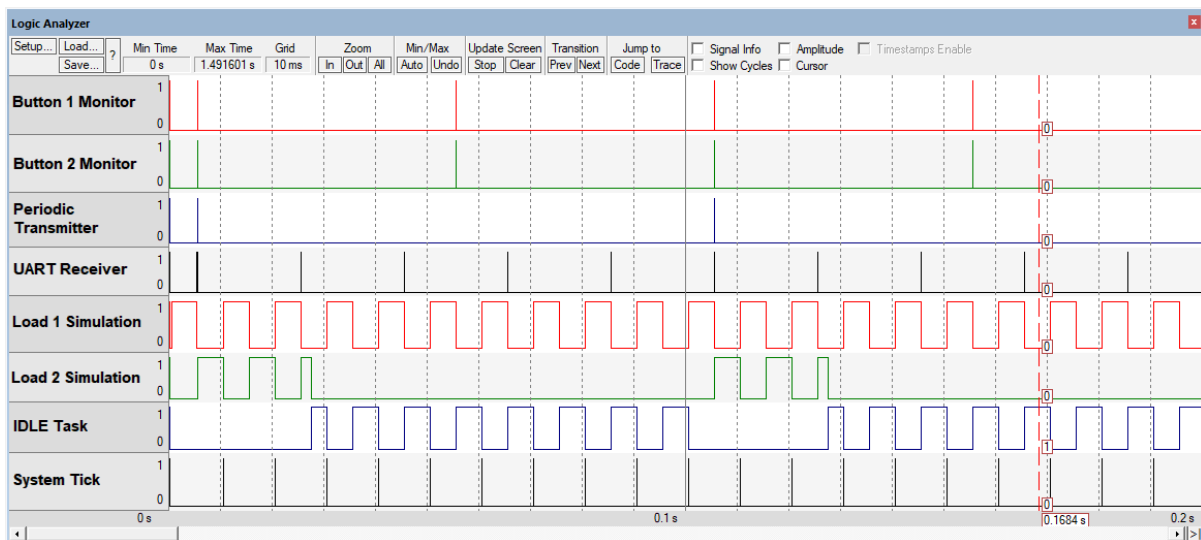


- System simulation on KEIL:

- CPU usage:

Watch 1		
Name	Value	Type
CPU_Load	62	ushort
<Enter expression>		

- Logic analyser:



- System runtime stats using FreeRTOS run-time stats function:

UART #2		
IDLE	22893	38%
Load_2_Simulation	7242	12%
UART_Receiver	61	<1%
Button_1_Monitor	22	<1%
Button_2_Monitor	26	<1%
PeriodicTransmitter	16	<1%
Load_1_Simulation	29998	49%
Periodic Check		
Periodic Check		

- **Final comments:**

**Looking at the simulation results, we can note the following:**

- At each hyper-period, the tasks are executing in the expected order according to their deadlines.
- Load 2 gets pre-empted each time Load 1 is unblocked since Load 1 has the earliest deadline.
- The Idle task only executes when no other task is in the ready state, and gets pre-empted as soon as a task is available.
- All the tasks are able to meet their deadlines, which indicates that the system is schedulable.

**This indicates a successful implementation of the EDF scheduler.**