
RTOS

Scheduling Analysis

By:

Alaa Hisham

Date:

10.7.2023



Table of Contents

Table of Contents..... 1

Overview..... 1

Scheduling Analysis..... 1

 Rate Monotonic Utilization Bound (URM)..... 1

 Time Demand Analysis..... 3

 Task 1..... 3

 Task 2..... 3

 Task 3..... 3

 Hyper Period..... 3

SimSo System Model..... 4

Overview

A scheduling analysis of the following task set using rate-monotonic scheduler:

- T1 {P: 5, E: 2.5, D: 5}
- T2 {P: 15, E: 4.5, D: 15}
- T3 {P: 20, E: 3.5, D: 20}

Scheduling Analysis

Rate Monotonic Utilization Bound (URM)

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

Where 'C' is the Execution Time, 'P' is the Periodicity and 'n' is the number of tasks.

$$U = \frac{2.5}{5} + \frac{4.5}{15} + \frac{3.5}{20} = 0.975$$

$$URM = 3 \times (2^{\frac{1}{3}} - 1) = 0.779$$

$$U > URM$$

∴ The system needs further testing.

Time Demand Analysis

$$W_i(t) = E_i + \sum_{k=1}^{i-1} \left(\frac{t}{P_k}\right) E_k \quad \text{for } 0 < t \leq p_i$$

Where:

- W: Worst response time
- E: execution time
- P: periodicity
- t : time instance

Task 1

(highest priority)

$$\text{Time Provided } (T_p) = \text{Task deadline} = 5 \text{ ms}$$

$$\text{Time Needed } (T_n) = W(5) = 2.5 + 0 = 2.5 \text{ ms}$$

$$T_p > T_n \rightarrow \text{Task 1 is schedulable}$$

Task 2

$$\text{Time Provided } (T_p) = \text{Task deadline} = 15 \text{ ms}$$

$$\text{Time Needed } (T_n) = W(15) = 4.5 + \left(\frac{15}{5}\right) \times 2.5 = 12 \text{ ms}$$

$$T_p > T_n \rightarrow \text{Task 2 is schedulable}$$

Task 3

$$\text{Time Provided } (T_p) = \text{Task deadline} = 20 \text{ ms}$$

$$\text{Time Needed } (T_n) = W(20) = 3.5 + \left(\frac{20}{5}\right) \times 2.5 + \left(\frac{20}{15}\right) \times 4.5 = 22.5 \text{ ms}$$

(by rounding $\left(\frac{20}{15}\right)$ up to 2)

$$T_p < T_n \rightarrow \text{Task 3 is not schedulable}$$

T_3 is not schedulable \rightarrow System is not schedulable

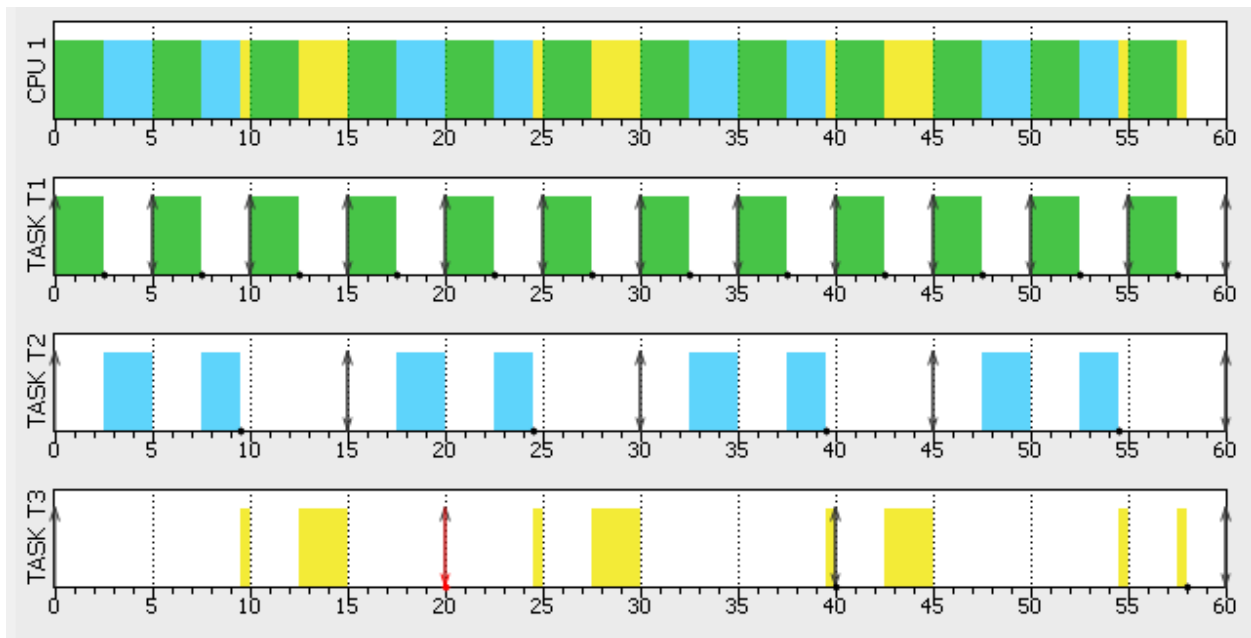
Hyper Period

$Hyper\ period = LCM(All\ task\ periodicities) = LCM(5, 15, 20) = 60\ ms$

SimSo System Model

General		Scheduler	Processors	Tasks							
id	Name	Task type	Abort on miss	Act. Date (ms)	Period (ms)	ct. da	Deadline (ms)	WCET (ms)	Followed by	priority	
1	TASK T1	Periodic	<input checked="" type="checkbox"/> Yes	0	5.0	-	5.0	2.5		0	
2	TASK T2	Periodic	<input checked="" type="checkbox"/> Yes	0	15	-	15	4.5		0	
3	TASK T3	Periodic	<input checked="" type="checkbox"/> Yes	0	20	-	20	3.5		0	

Results



From the SimSo results, we can see that task 3 will miss its deadline at some point which matches the results manually calculated above.

	Total load	Payload	System load
CPU 1	0.9667	0.9667	0.0000
Average	0.9667	0.9667	0.0000