

## Rate monotonic: Design analysis and simulation

### Tasks:

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

### Rate monotonic utilization bound:

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

Assuming zero context switching time,

$$U = (2.5/5) + (4.5/15) + (3.5/20) = 0.975$$

$$U_{rm} = 3 * (2^{1/3} - 1) = 0.779$$

Since  $U > U_{rm}$ , Tasks are guaranteed not schedulable. Also system is guaranteed not schedulable with other fixed priority schedulers.

### Time demand analysis:

Assuming zero context switching time and by checking the system at critical instant (Hyperperiod) with the equation:

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

By ordering tasks from the highest priority to the lowest priority:  $T1 > T2 > T3$

$$\text{LCM}(5, 15, 20) = 60$$

By checking the system at 60ms or 0ms (Hyperperiod):

At  $W(5)$  :  $2.5 + 0 = 2.5$ ,  $2.5 < 5$  (the deadline) so, Task1 is schedulable

At  $W(15)$  :  $4.5 + 15/5 * 2.5 = 12$ ,  $12 < 15$  (the deadline) so, Task2 is schedulable

At  $W(20)$  :  $3.5 + 20/5 * 2.5 + 20/15 * 4.5 = 22.5$ ,  $22.5 > 20$  (the deadline) so, Task1 is NOT schedulable

**Time demand analysis predict that task3 is not schedulable**

## Tasks simulation:

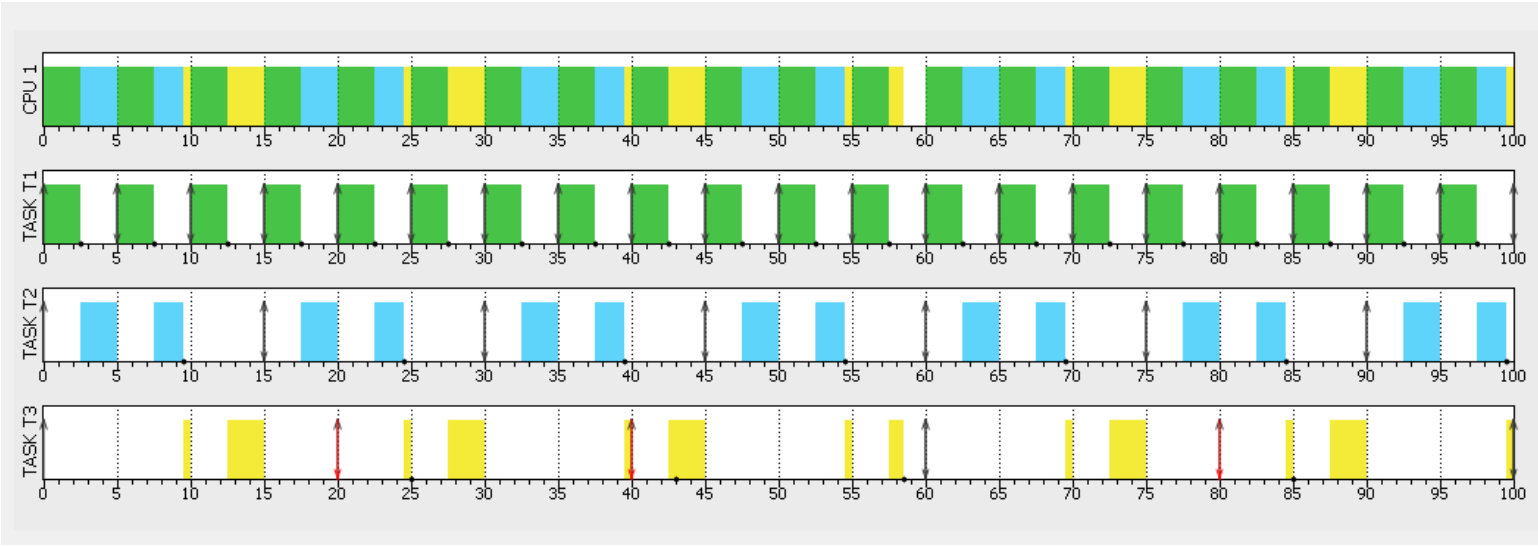
Simso scheduler options:

General	Scheduler	Processors	Tasks
Scheduler		simso.schedulers.RM	
Scheduler Path			
Overhead schedule (cycles)		0	
Overhead on activate (cycles)		0	
Overhead on terminate (cycles)		0	

Simso tasks configurations:

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	
1	TASK T1	Periodic	<input type="checkbox"/> No	0	5.0	-	5.0	2.5	▼ 0	
2	TASK T2	Periodic	<input type="checkbox"/> No	0	15.0	-	15.0	4.5	▼ 0	
3	TASK T3	Periodic	<input type="checkbox"/> No	0	20.0	-	20.0	3.5	▼ 0	

Simso tasks simulation:



**Simulation shows task3 misses it's deadline. Observation is in accordance with time demand and rate monotonic utilization bound analysis**