RTOS concepts

Scheduling (step-by-step investigation),
ITs in a RTOS,
Timer (step-by-step investigation),
Oscilloscope as task monitor

NASZÁLY Gábor
Ver.: 2013a

Scheduling (step-by-step)

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- restore registers

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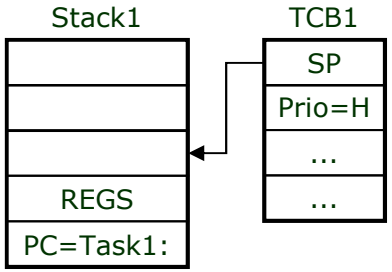

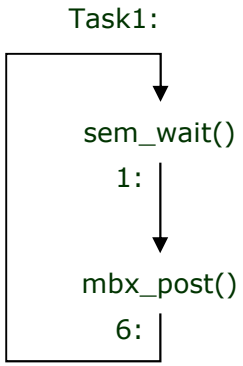

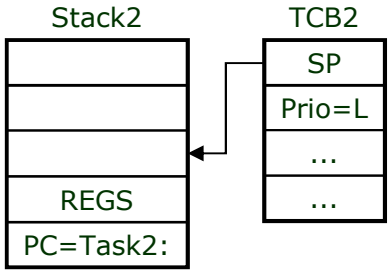

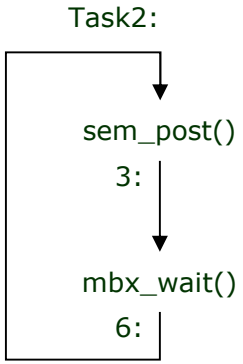

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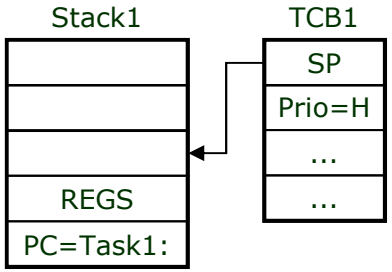

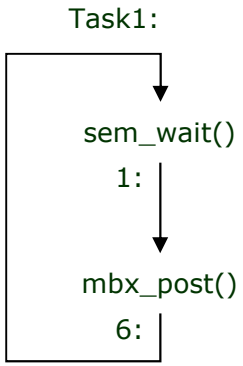

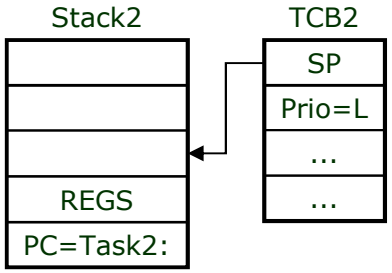

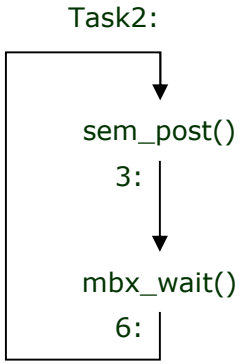

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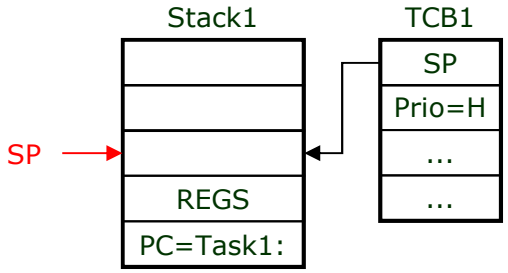

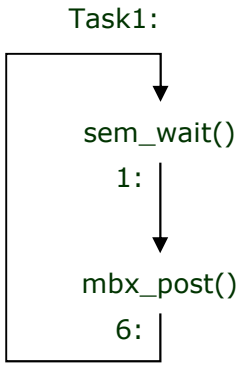

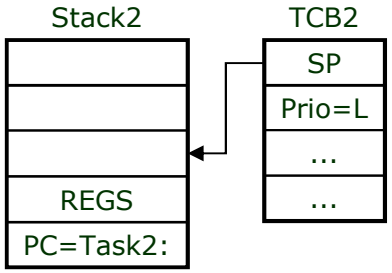

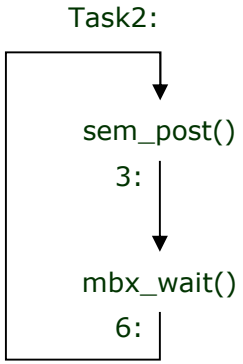

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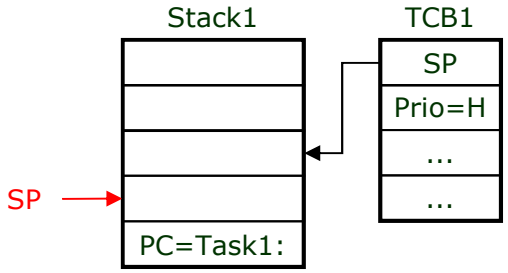

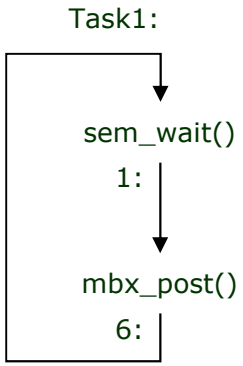

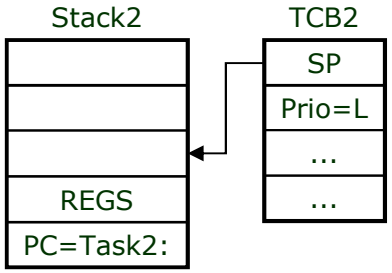

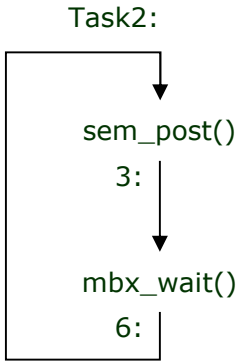

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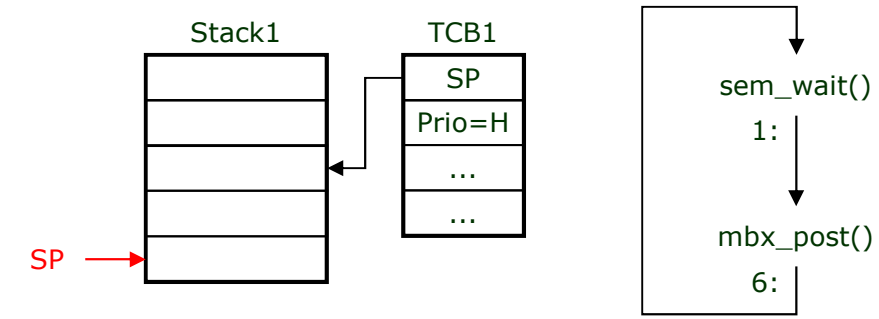

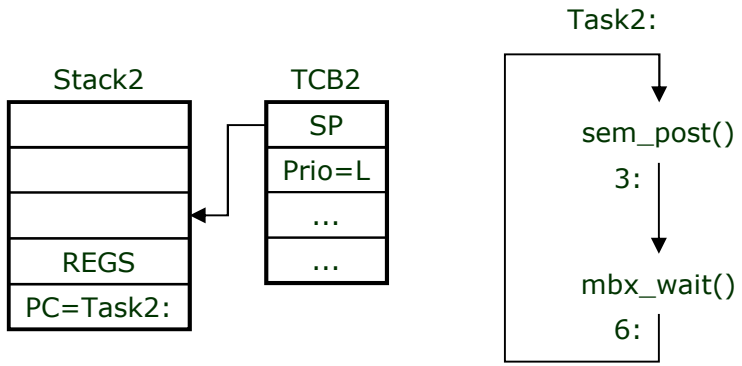

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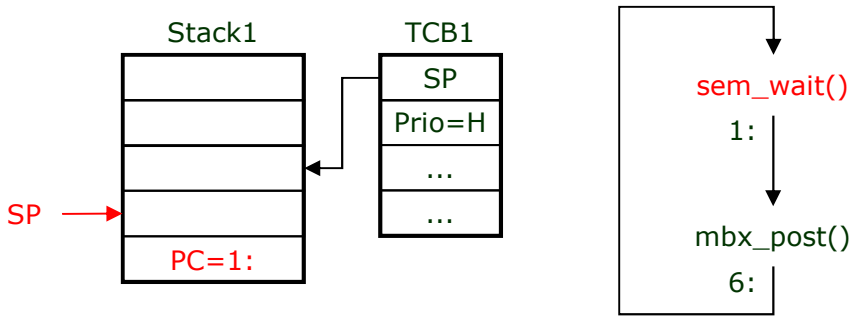

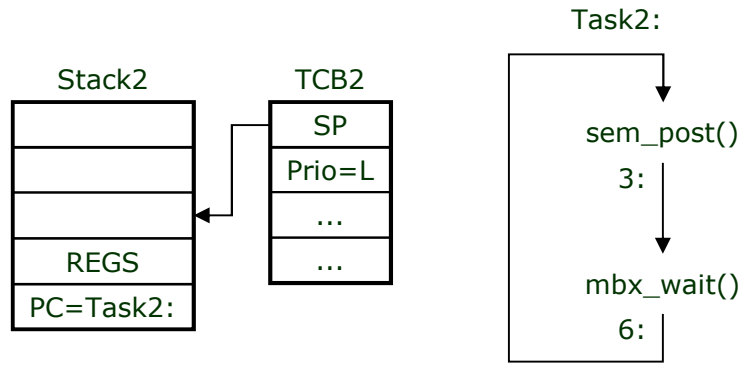

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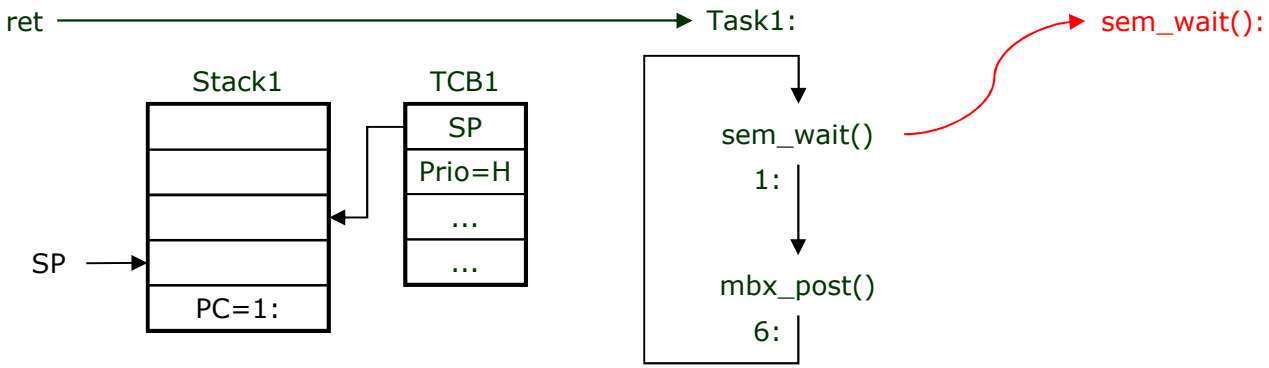

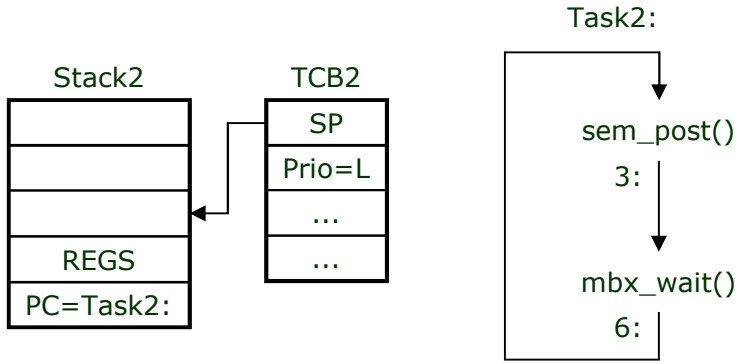

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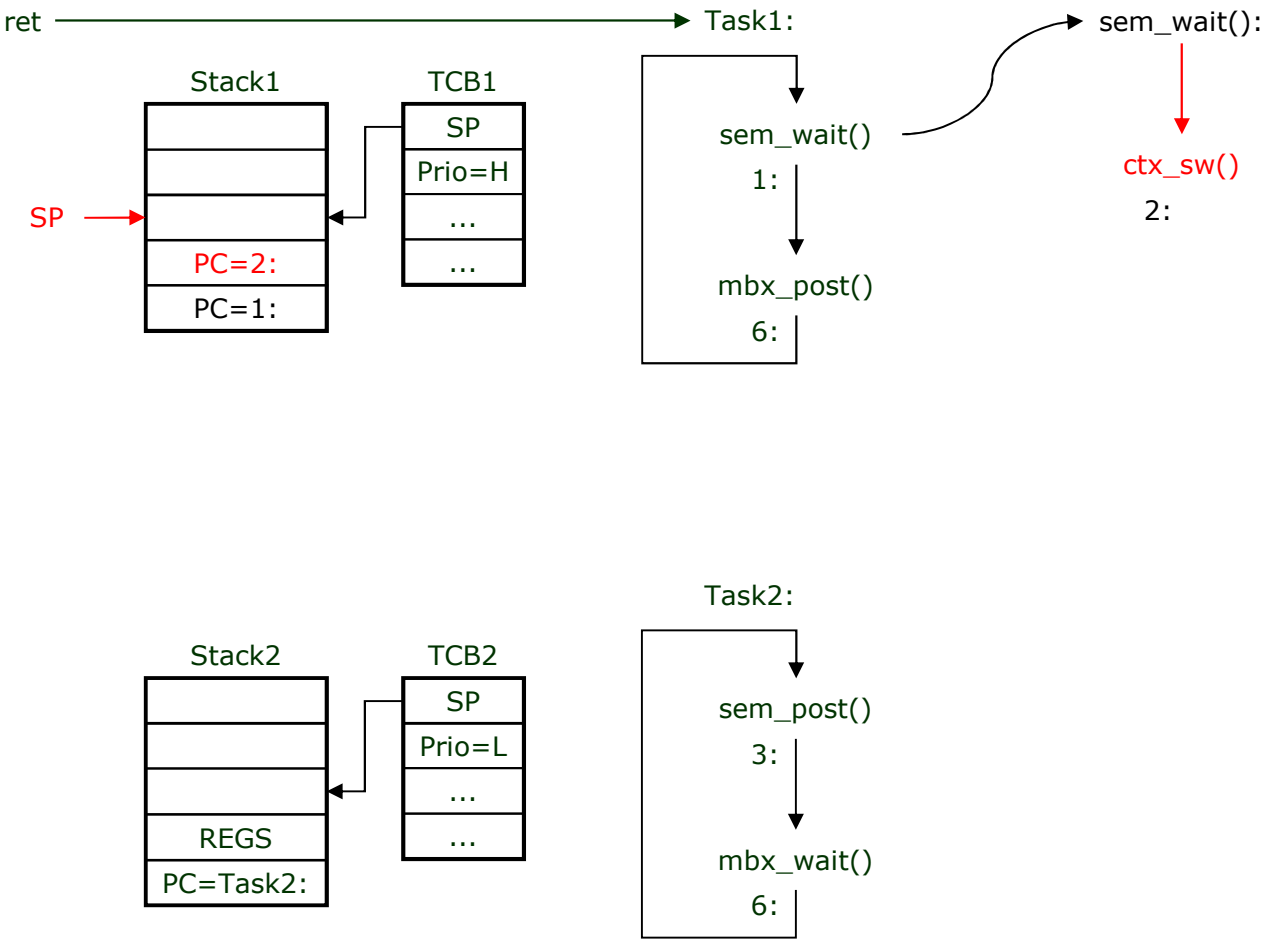

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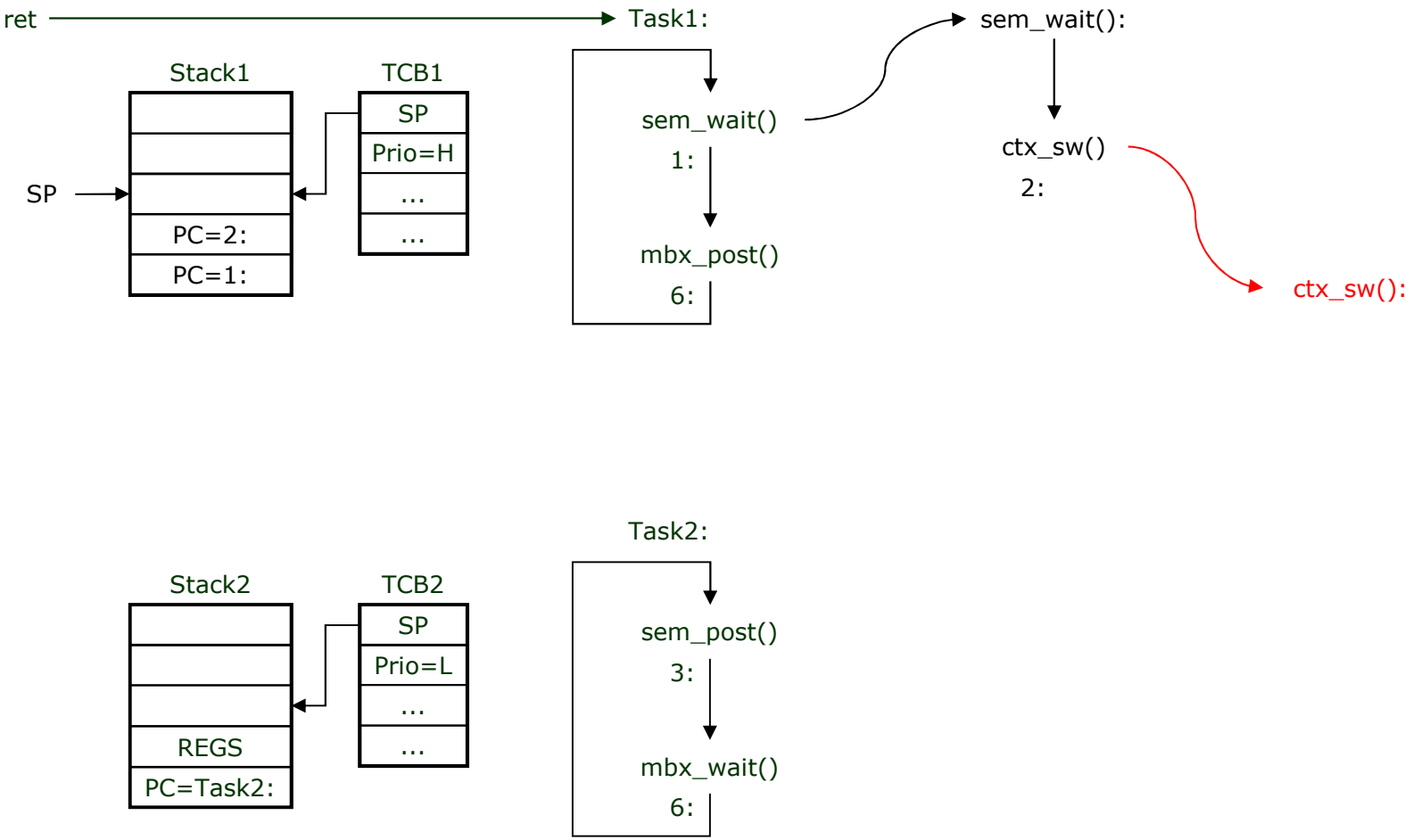

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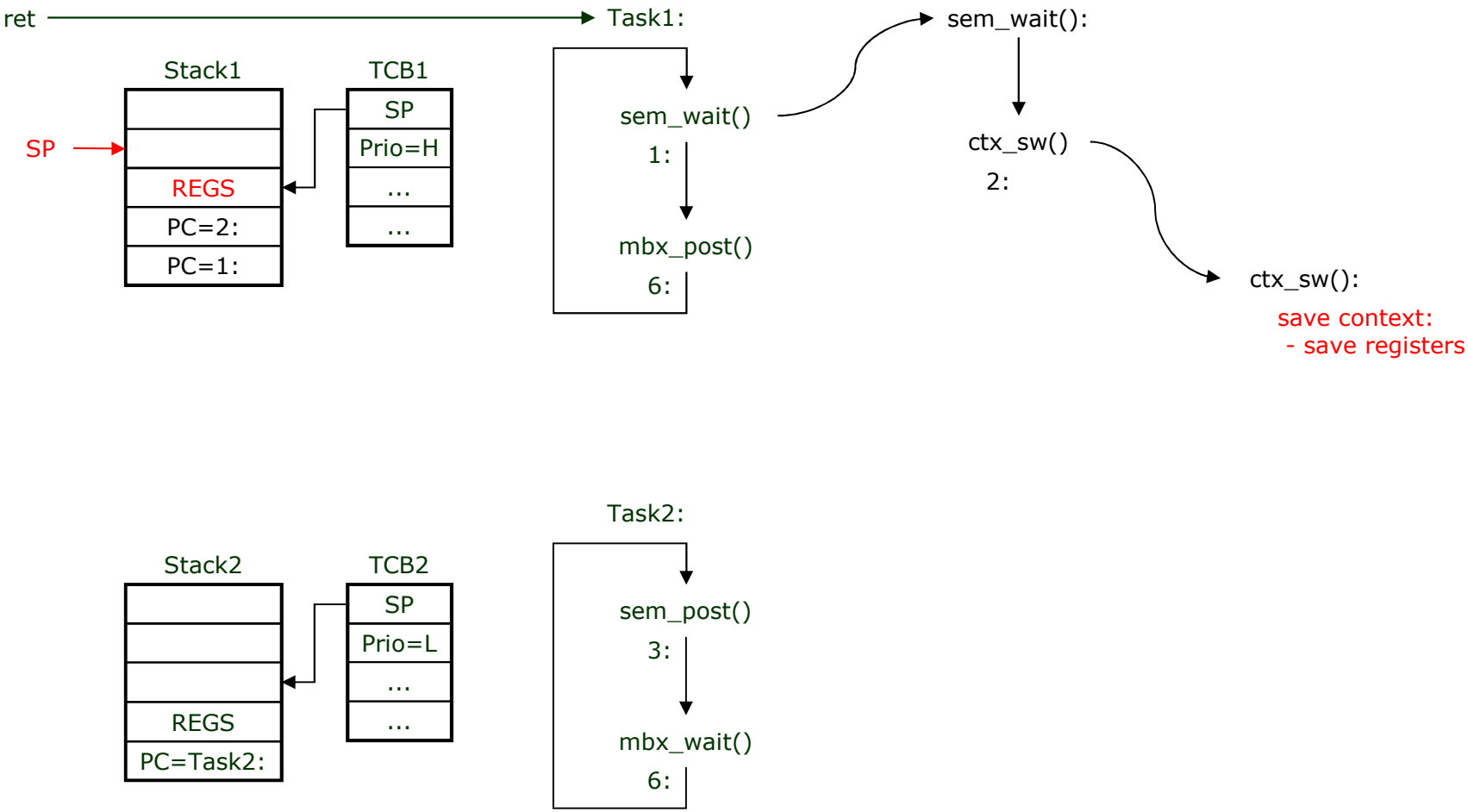

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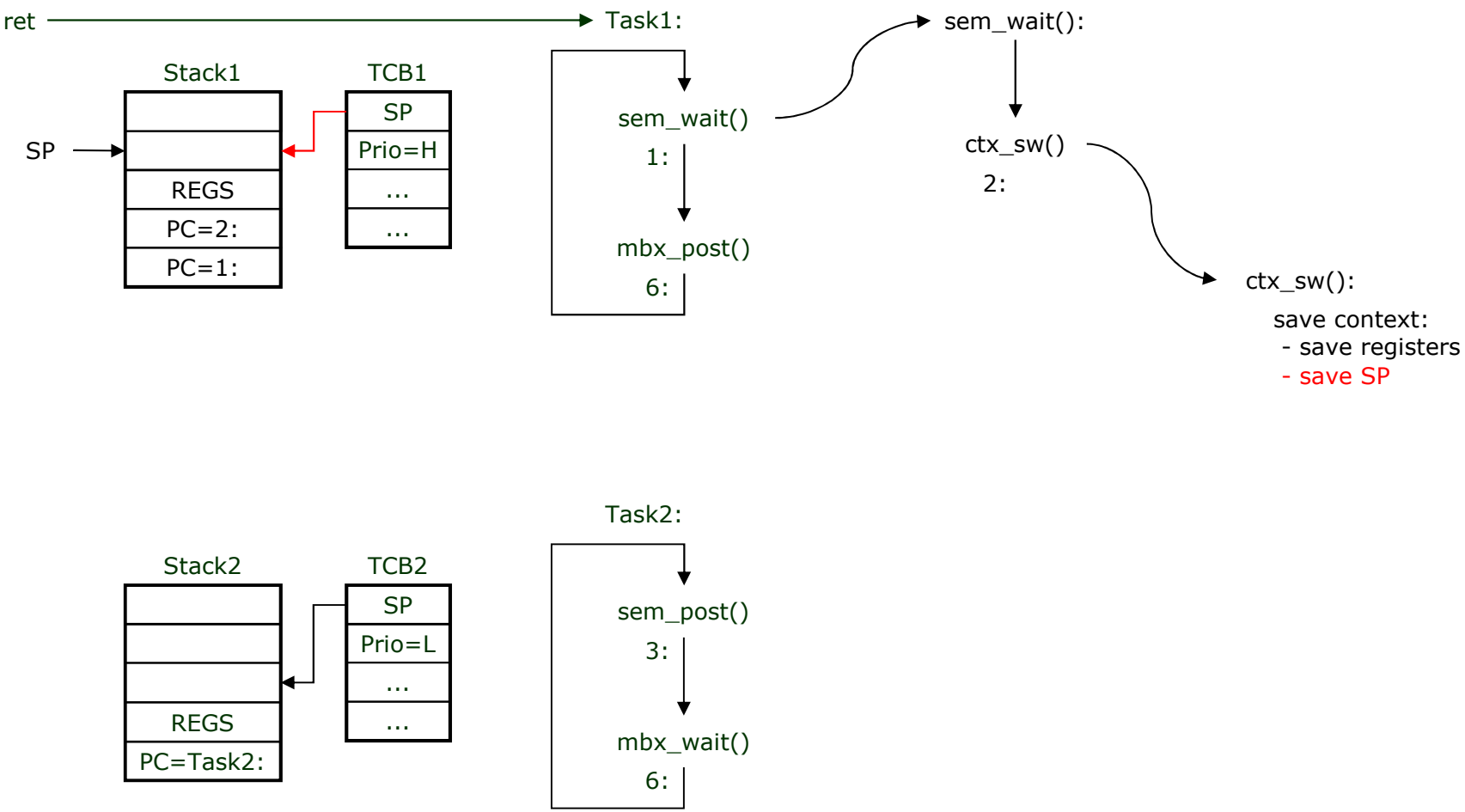

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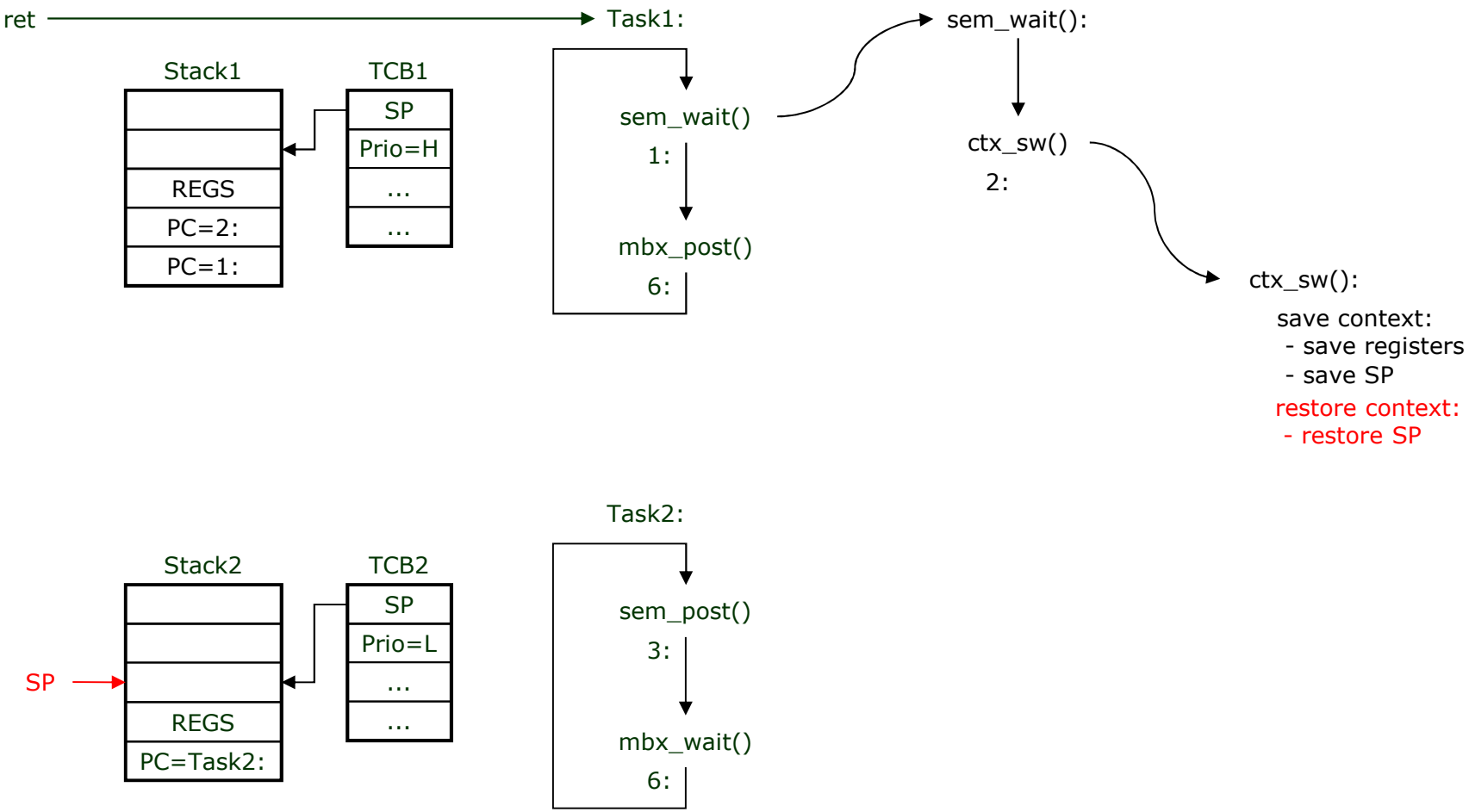

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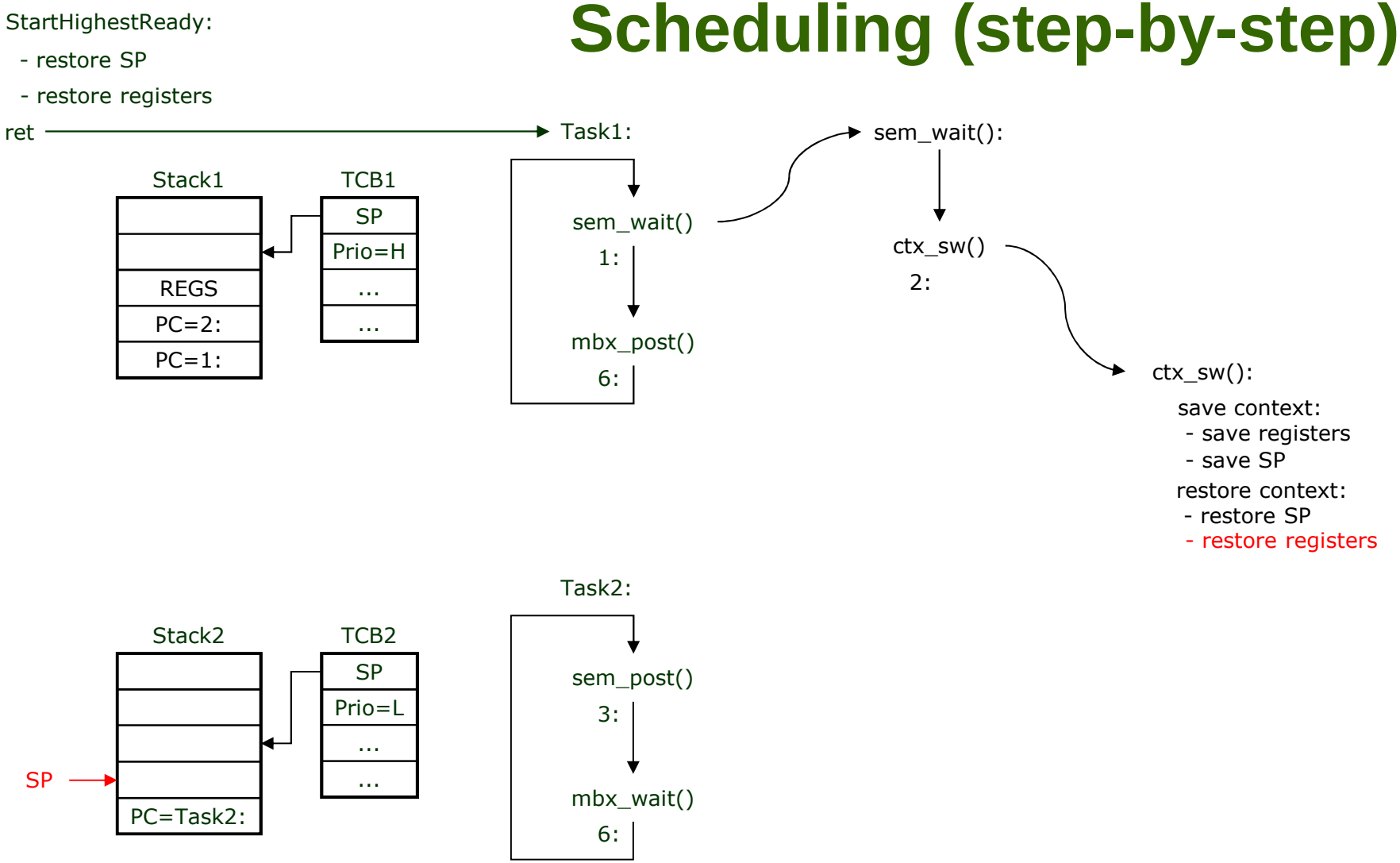

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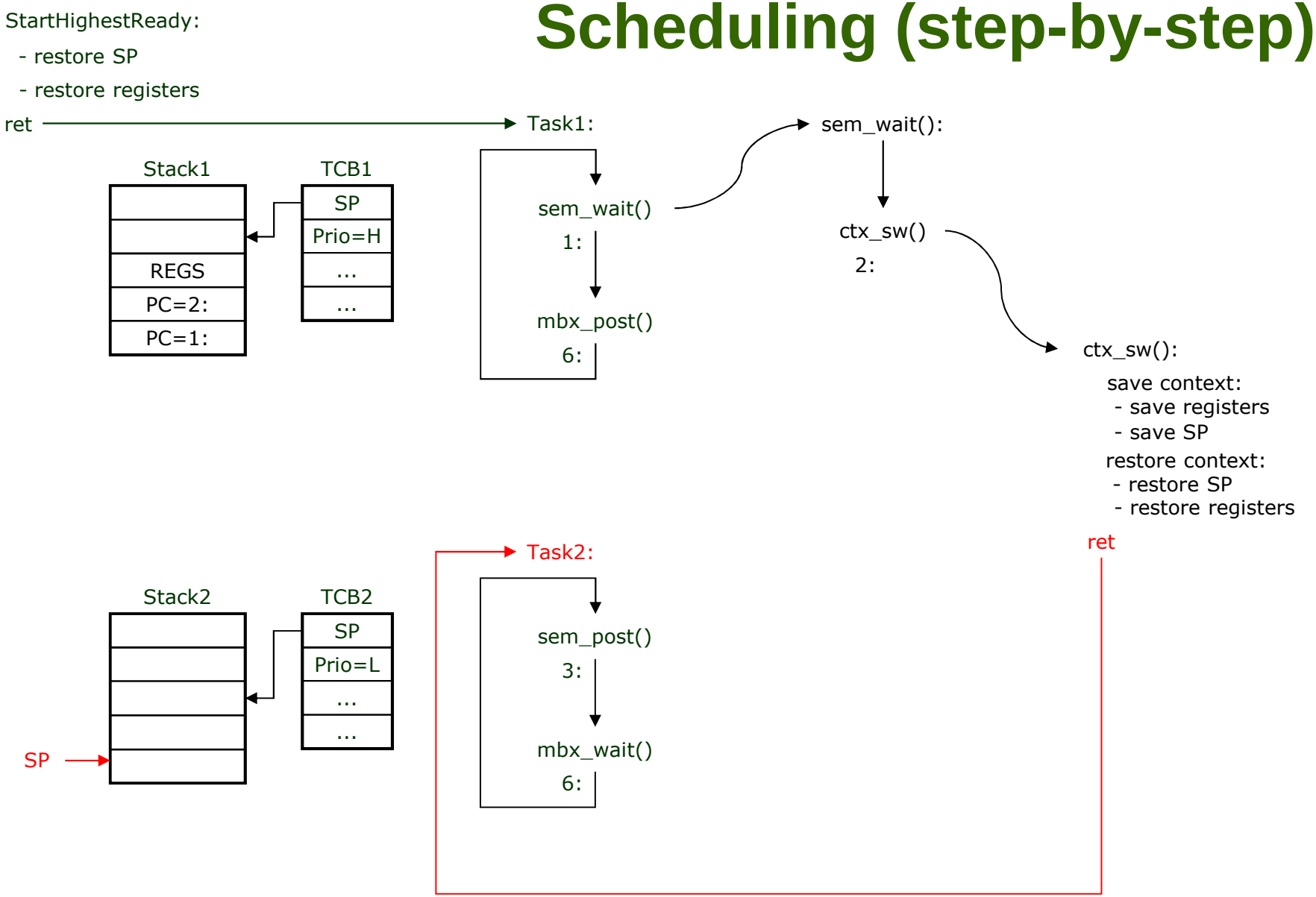

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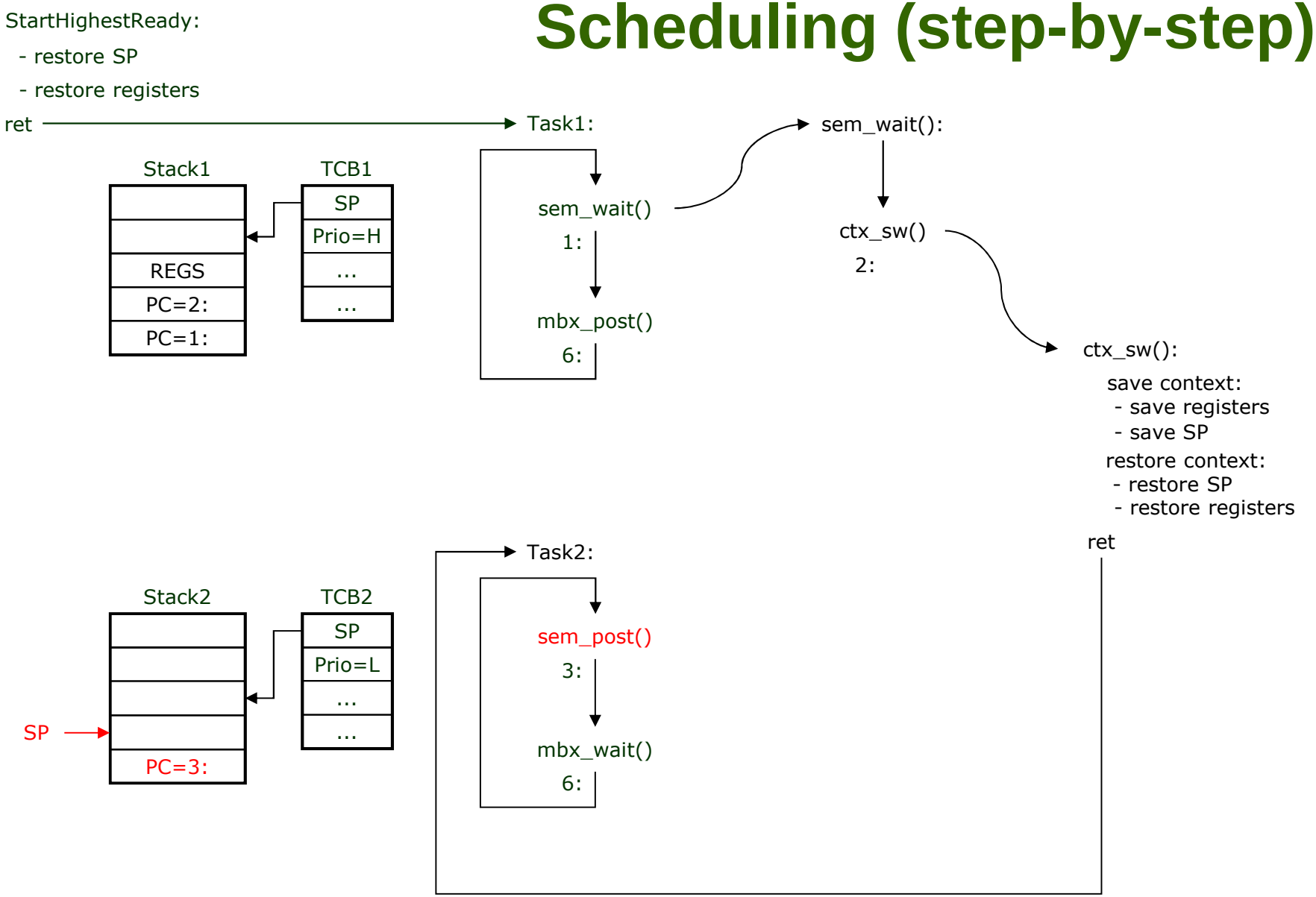

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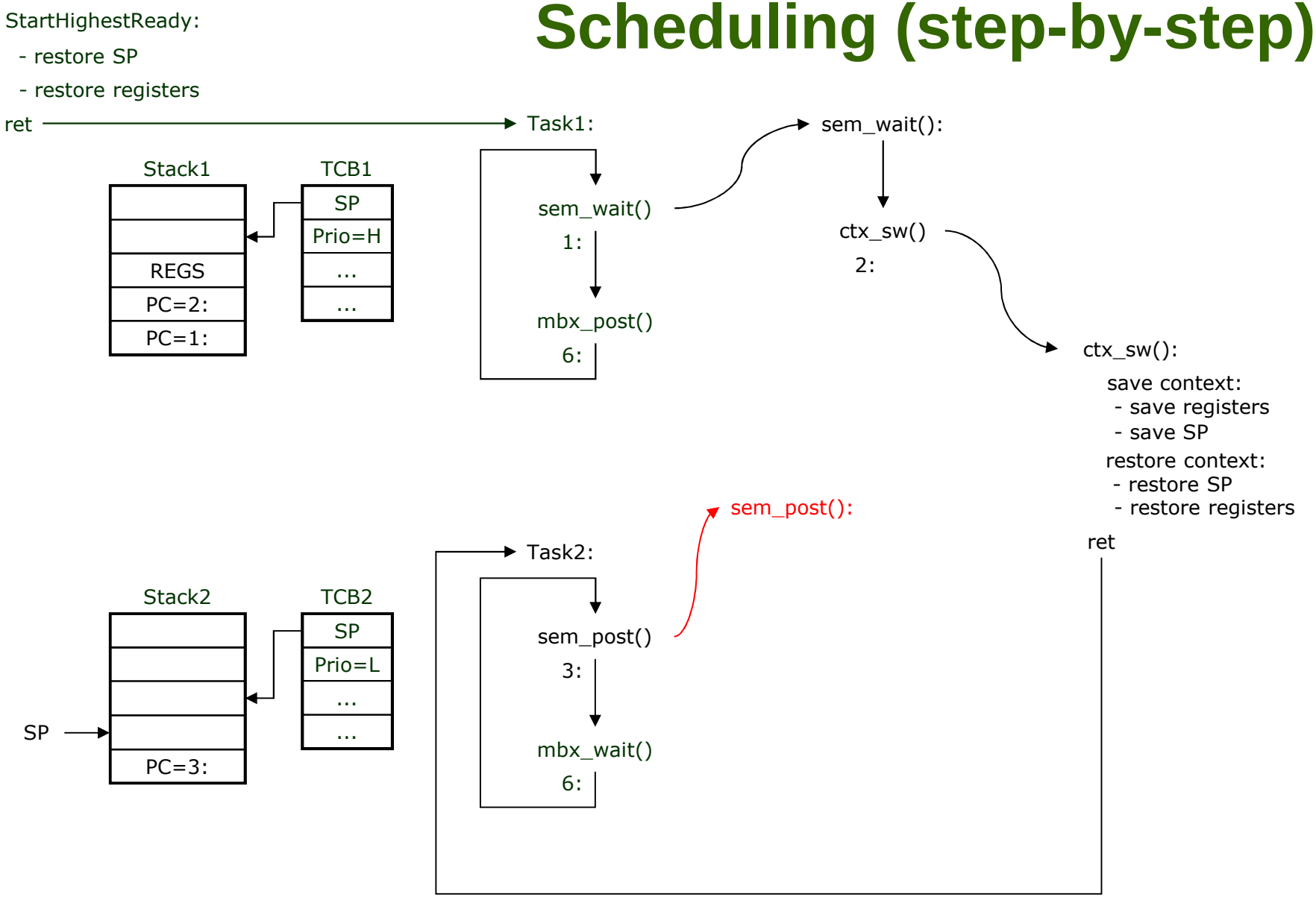

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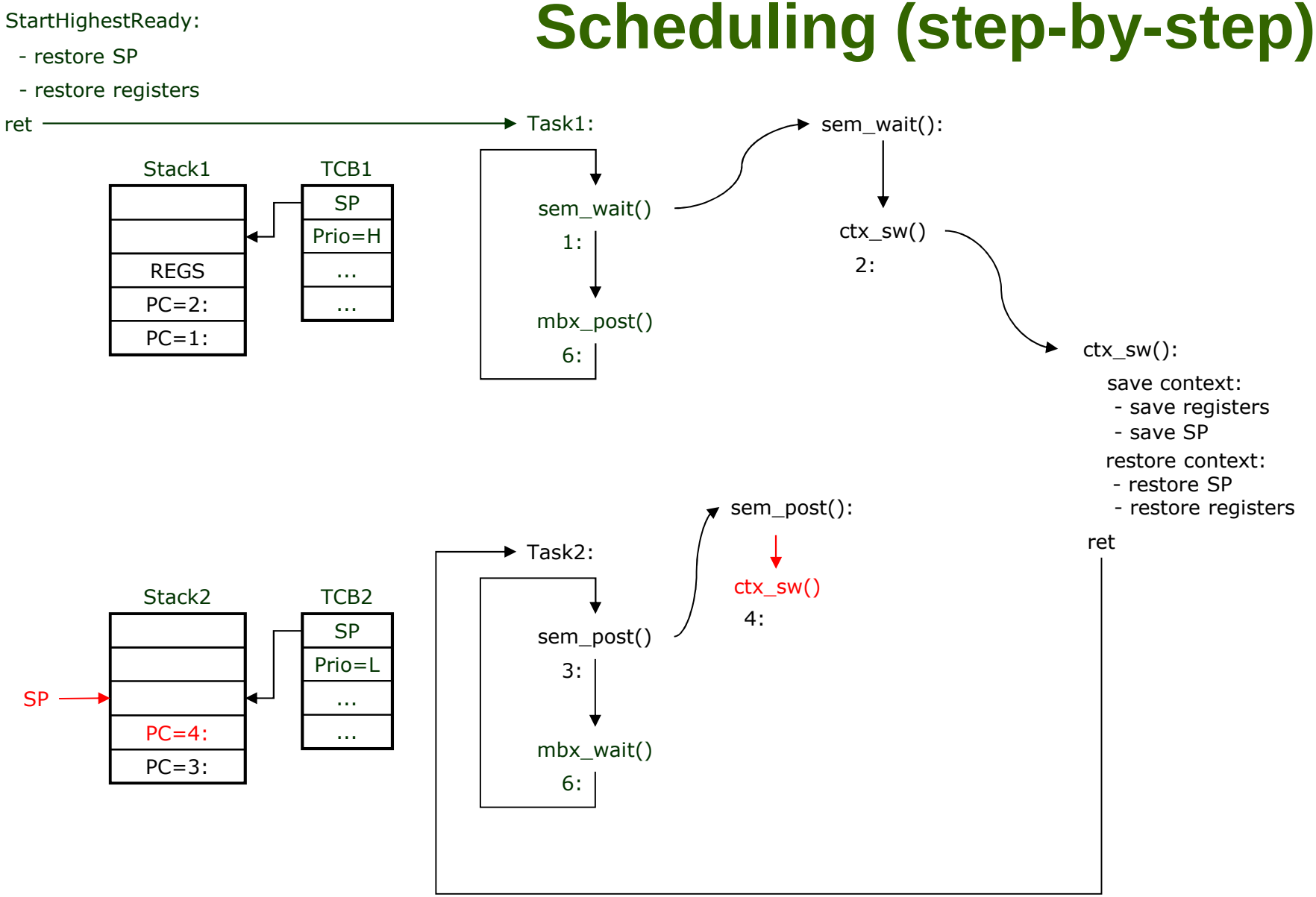

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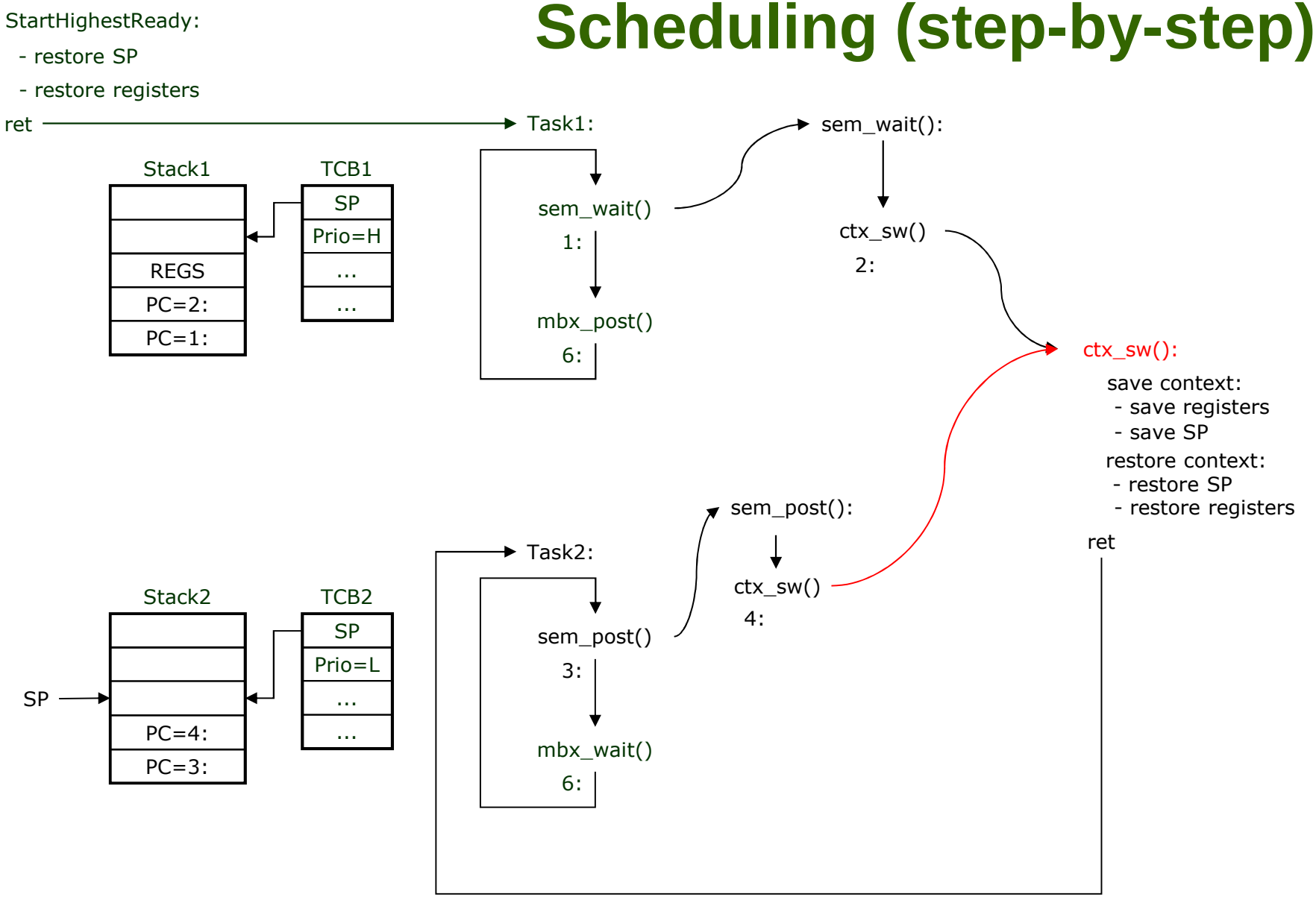

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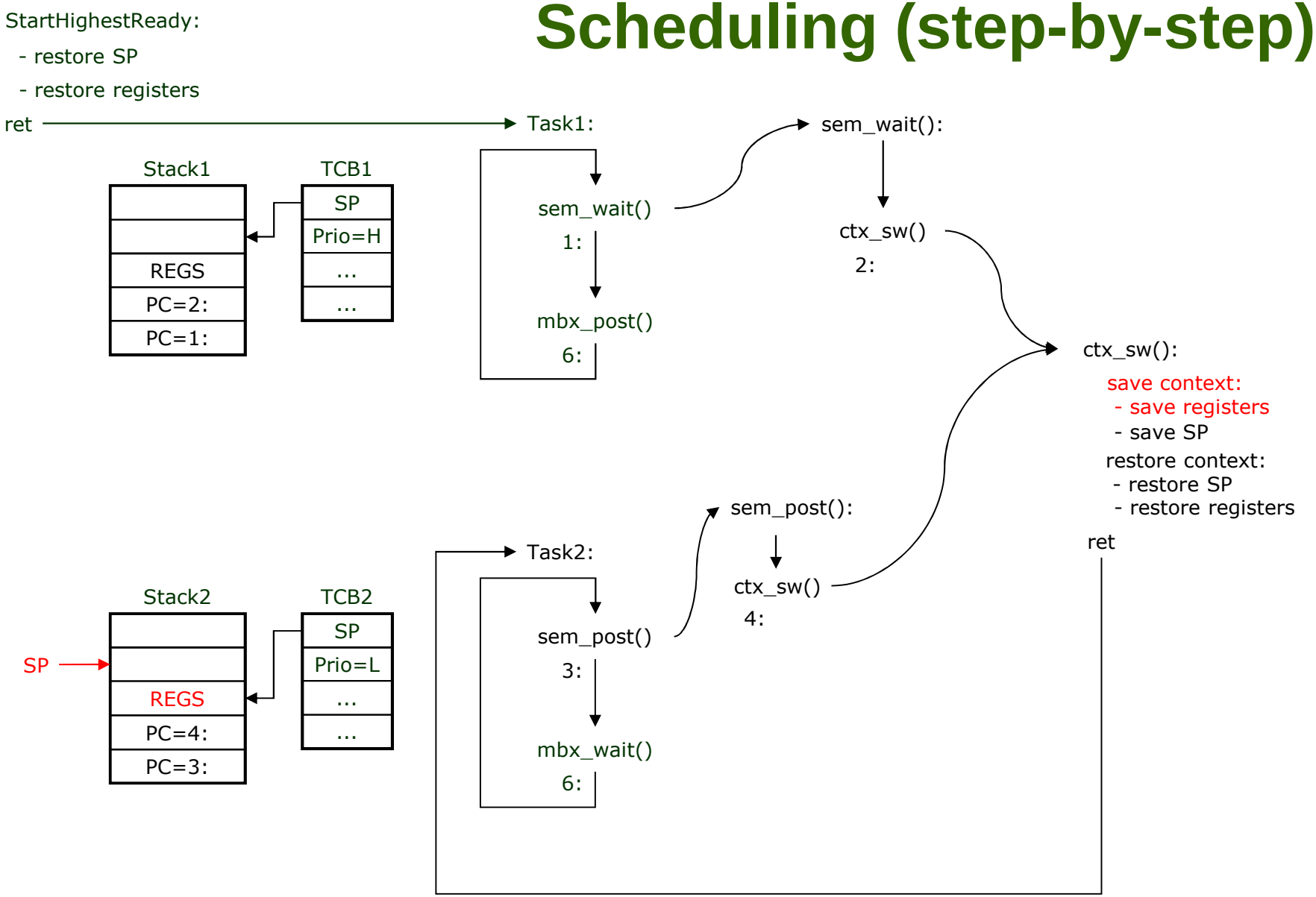

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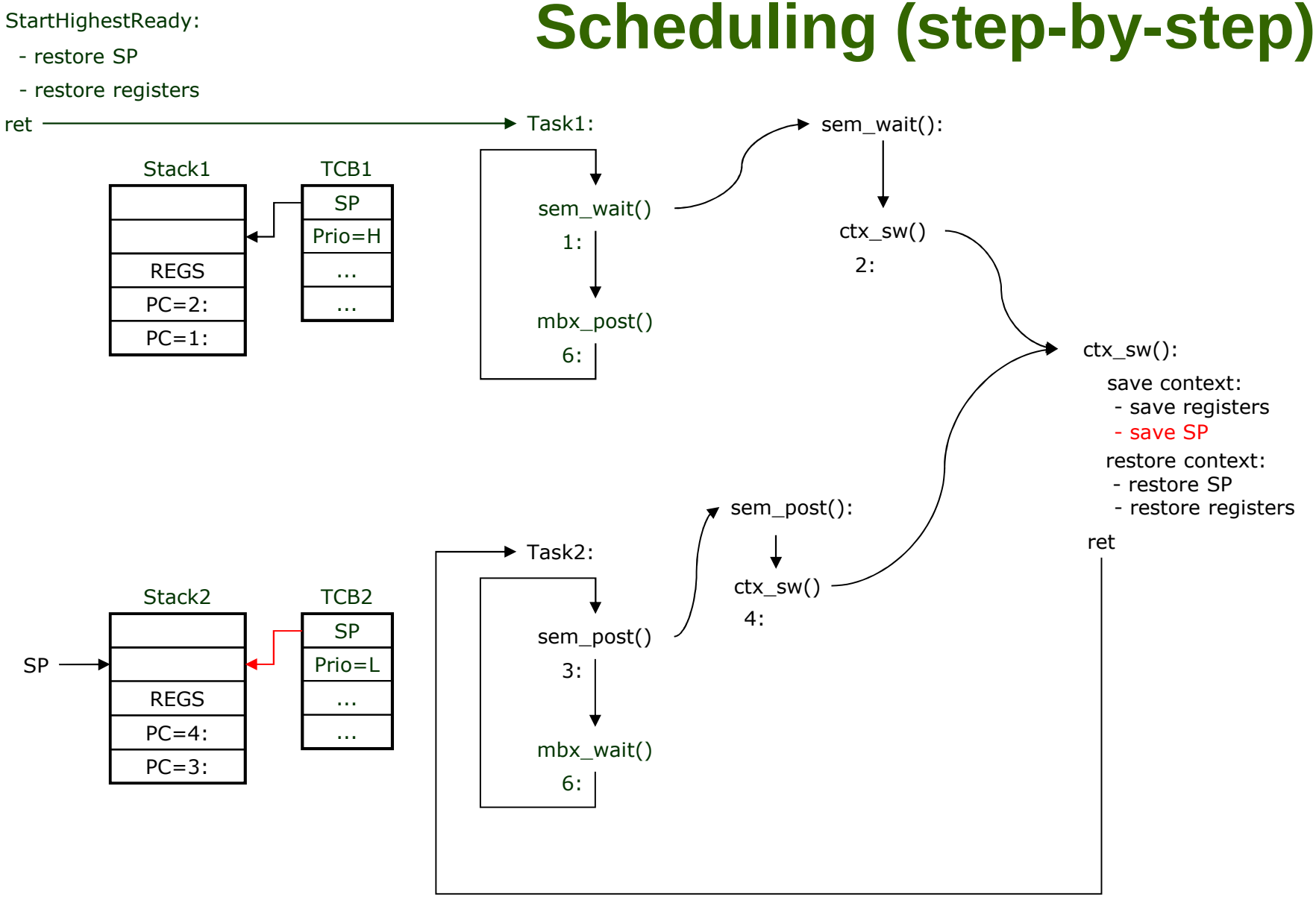

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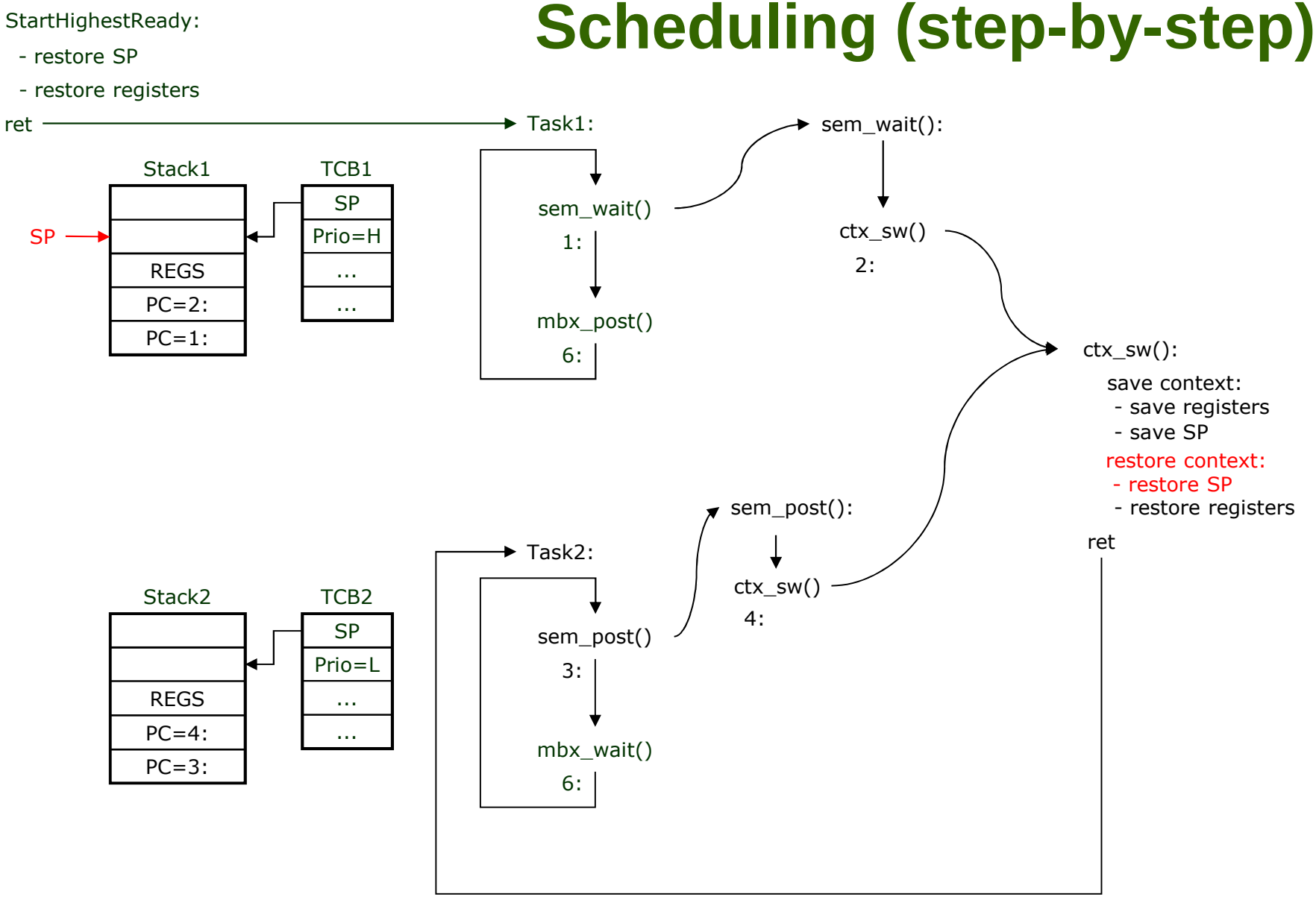

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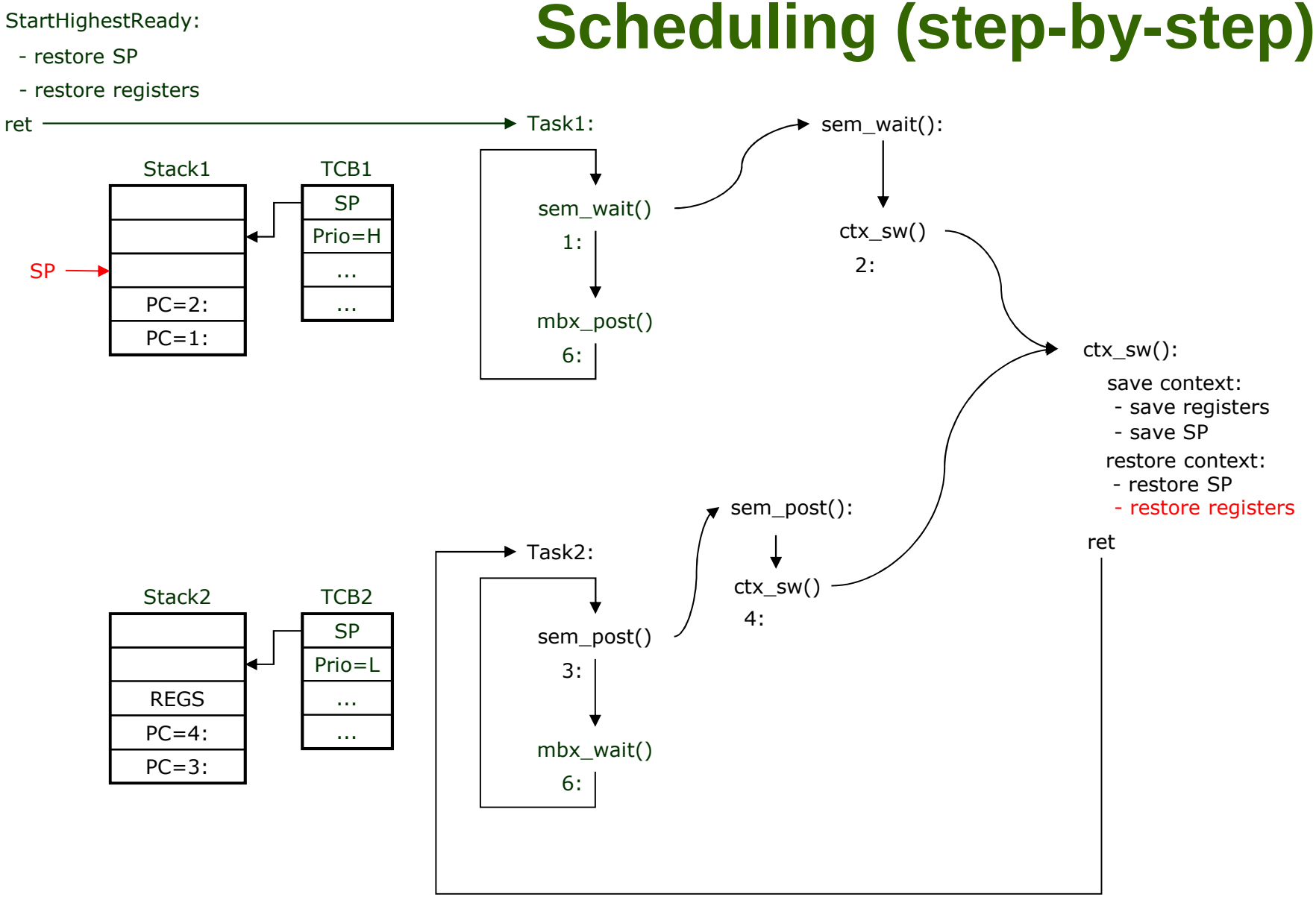

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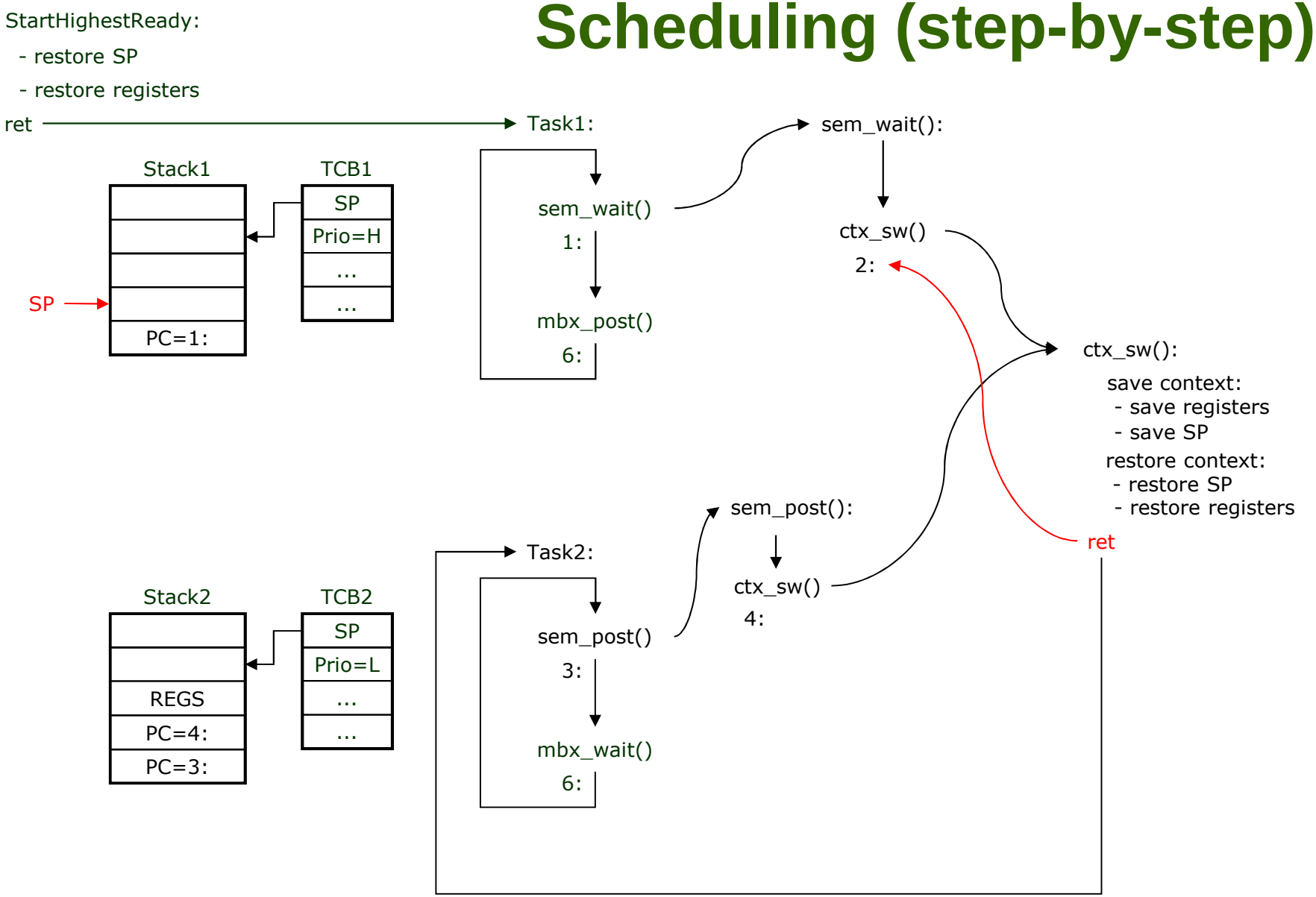

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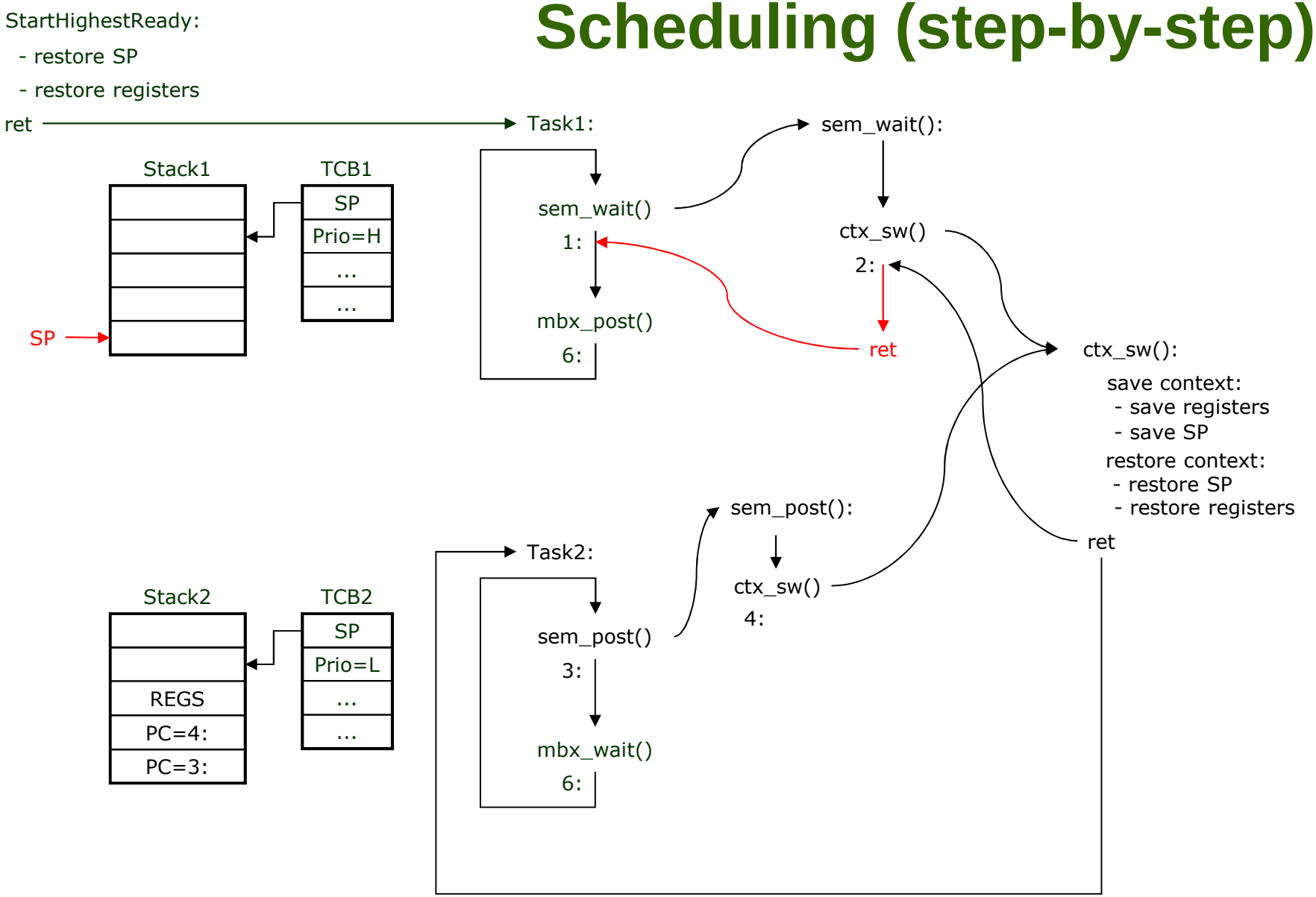
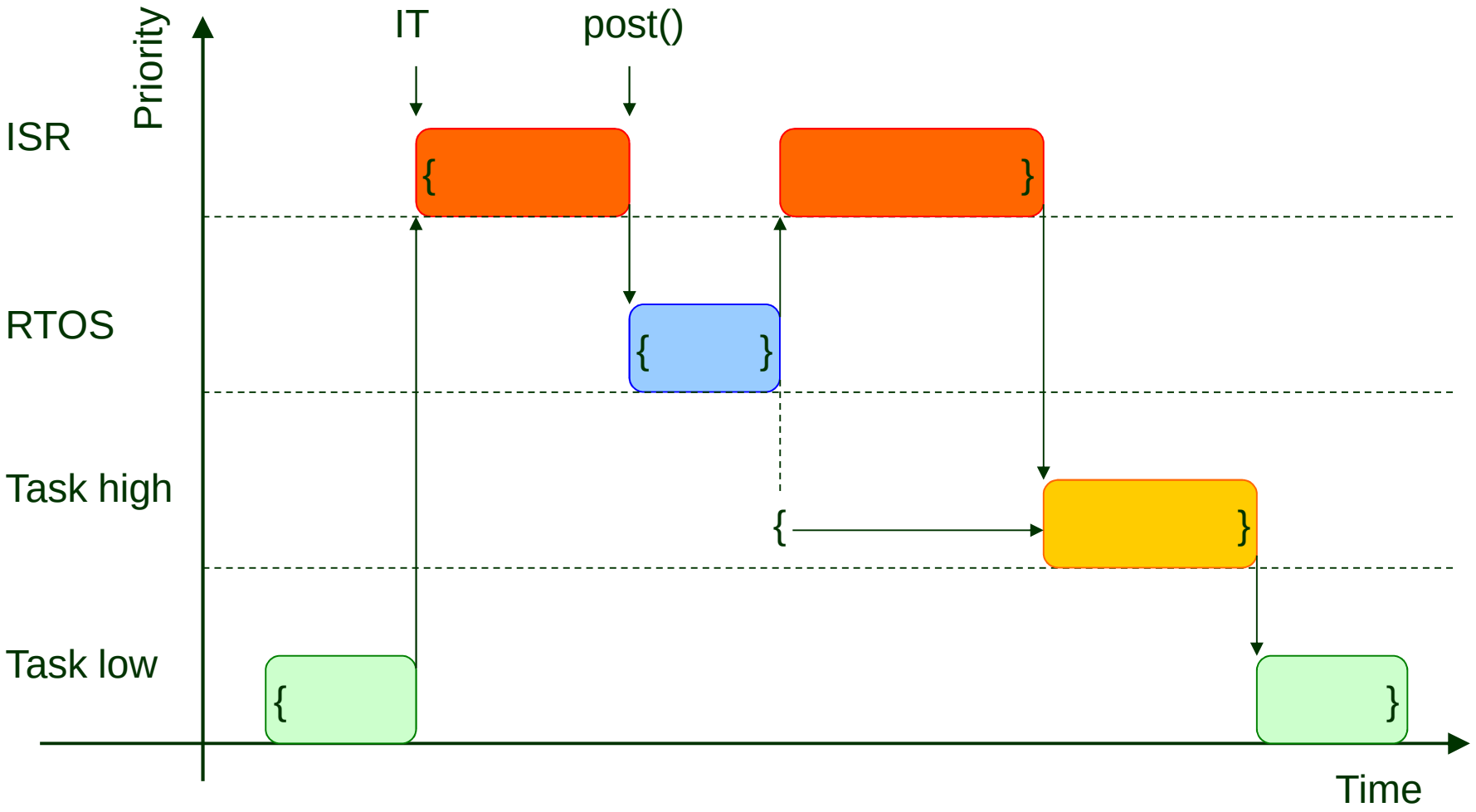


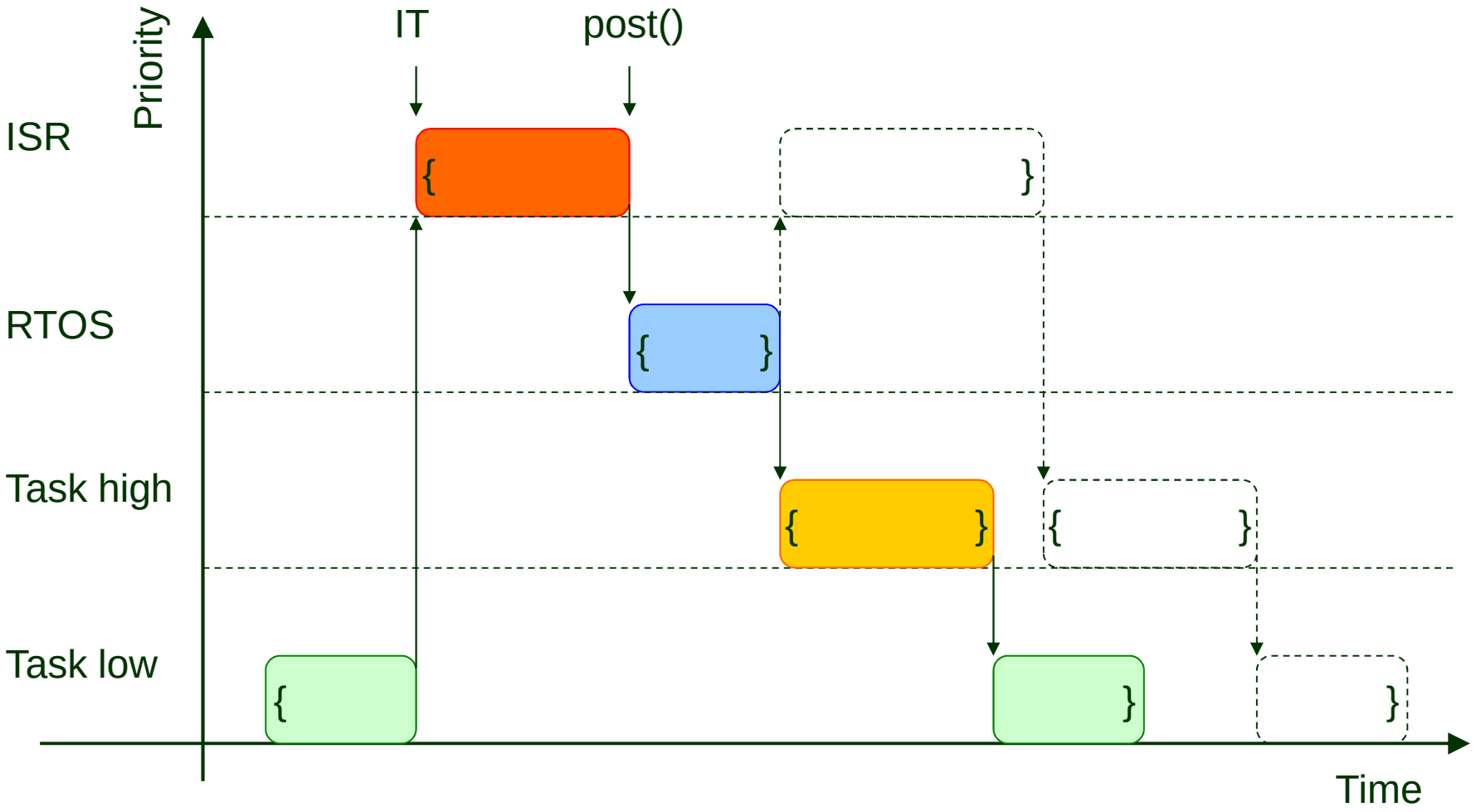
Interrupts in a RTOS environment

What we want…



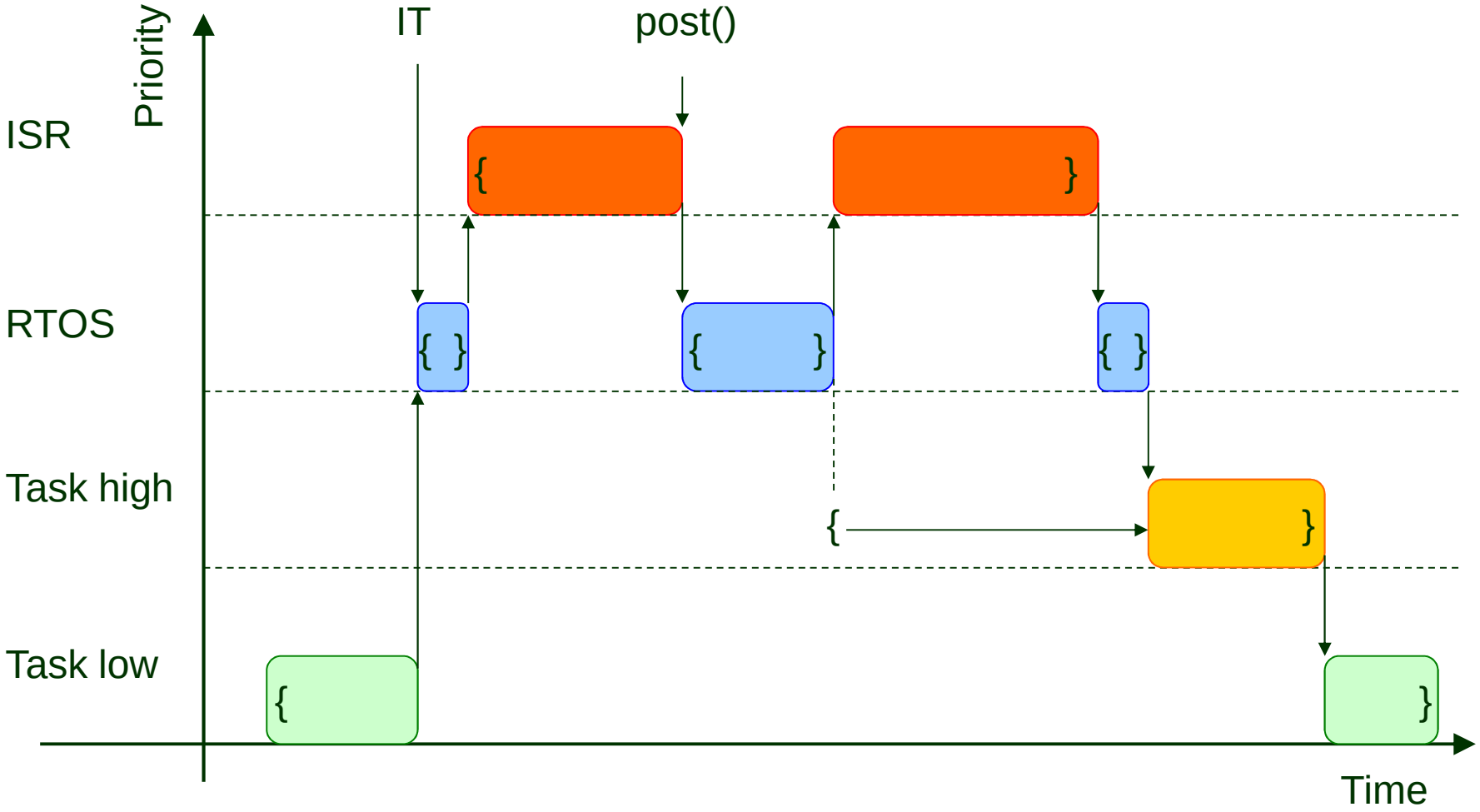
Interrupts in a RTOS environment

What would happen…



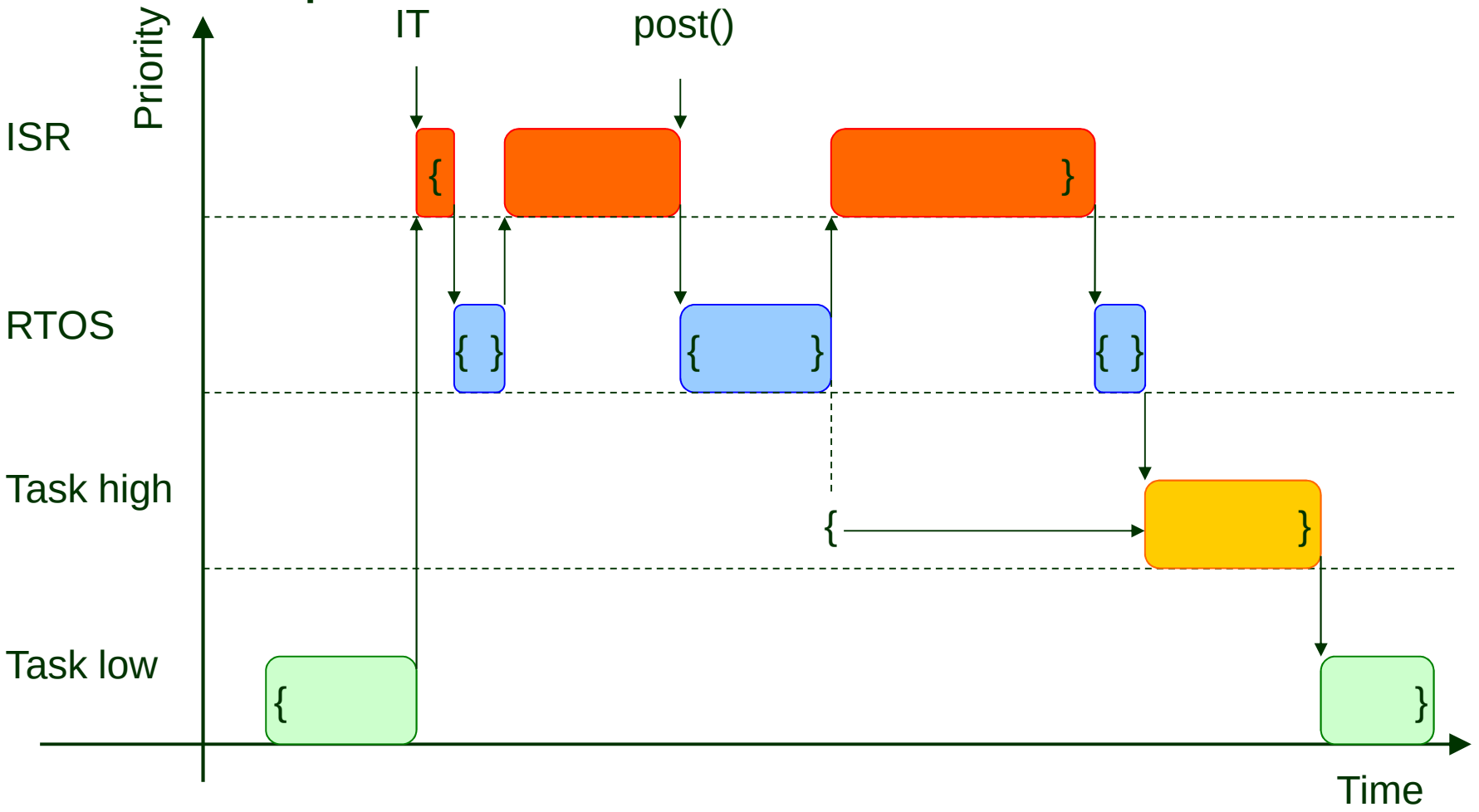
Interrupts in a RTOS environment

One solution is to let the OS catch the interrupts and then it calls our ISR.



Interrupts in a RTOS environment

An other solution is that we catch the interrupts but we tell the OS (as soon as possible) that we are in interrupt code. And also tell when we leave interrupt code.



Timer

- Usage:
  - Time-slicing
  - Delay the execution of a task
  - OS calls with timeout
  - Call a function after a given time
  - Call a function periodically
  - Measure the flow of time

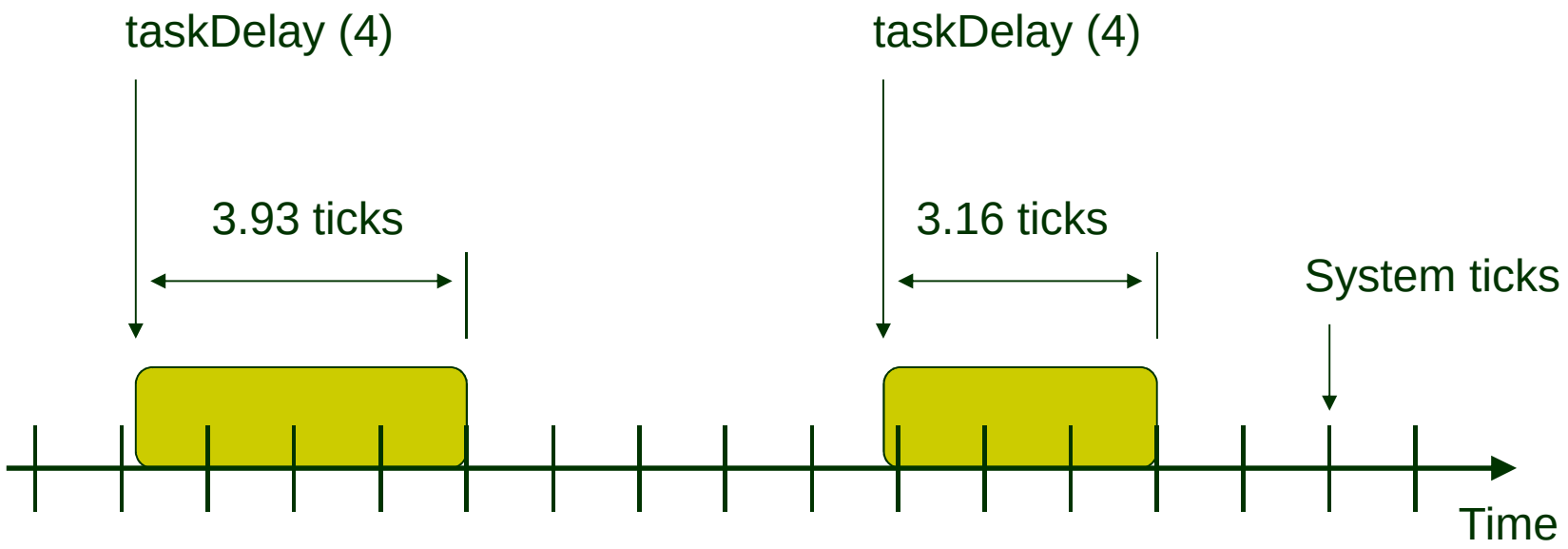
Timer

- For these purposes the OS configures a hardware timer (**heartbeat timer**) to make periodic interrupts (**system ticks**)
- How large a system tick should be?
  - If it is smaller, we get better accuracy
  - If it is larger, we get less overhead
  - In practice: 10ms…100ms

Timer

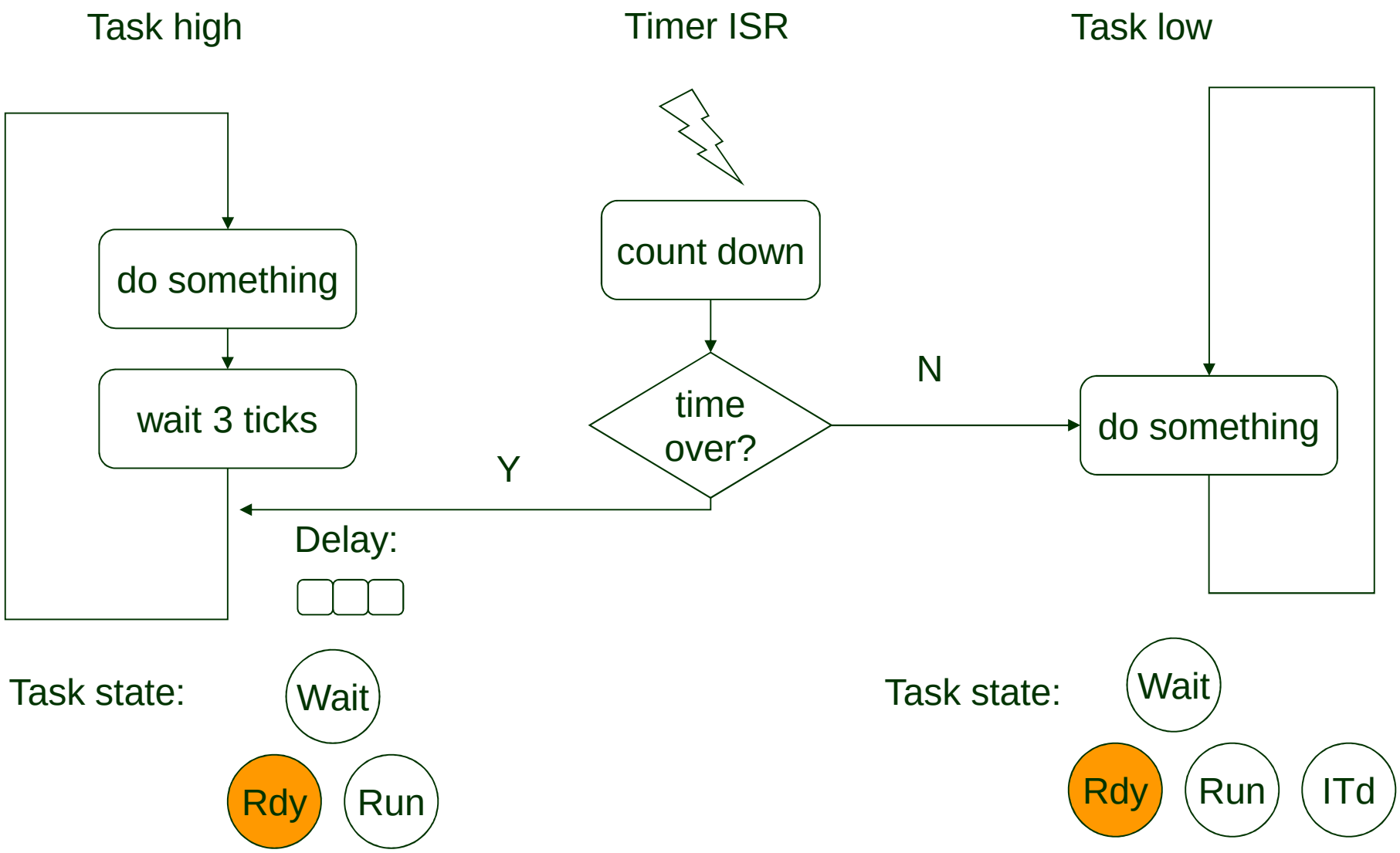
- The ISR (Interrupt Service Routine) for the heartbeat timer contains OS code
- Thus the OS gets the chance to run at every system tick
- So (if needed) rescheduling can be done at every system tick → **preemption**

Timer

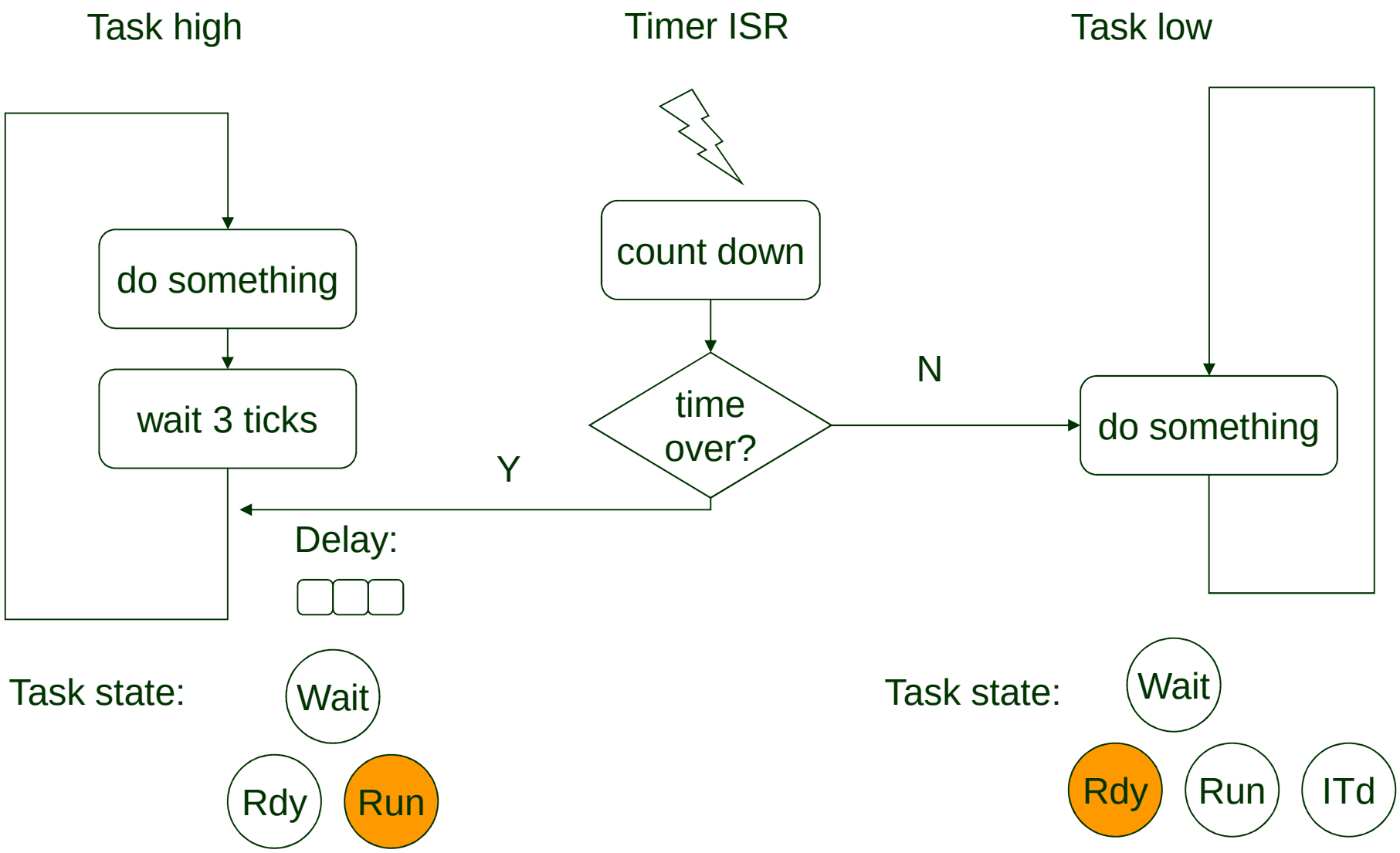


- Accuracy: 1 system tick
- For a minimum **n** tick delay we need to set **n+1**

Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

Timer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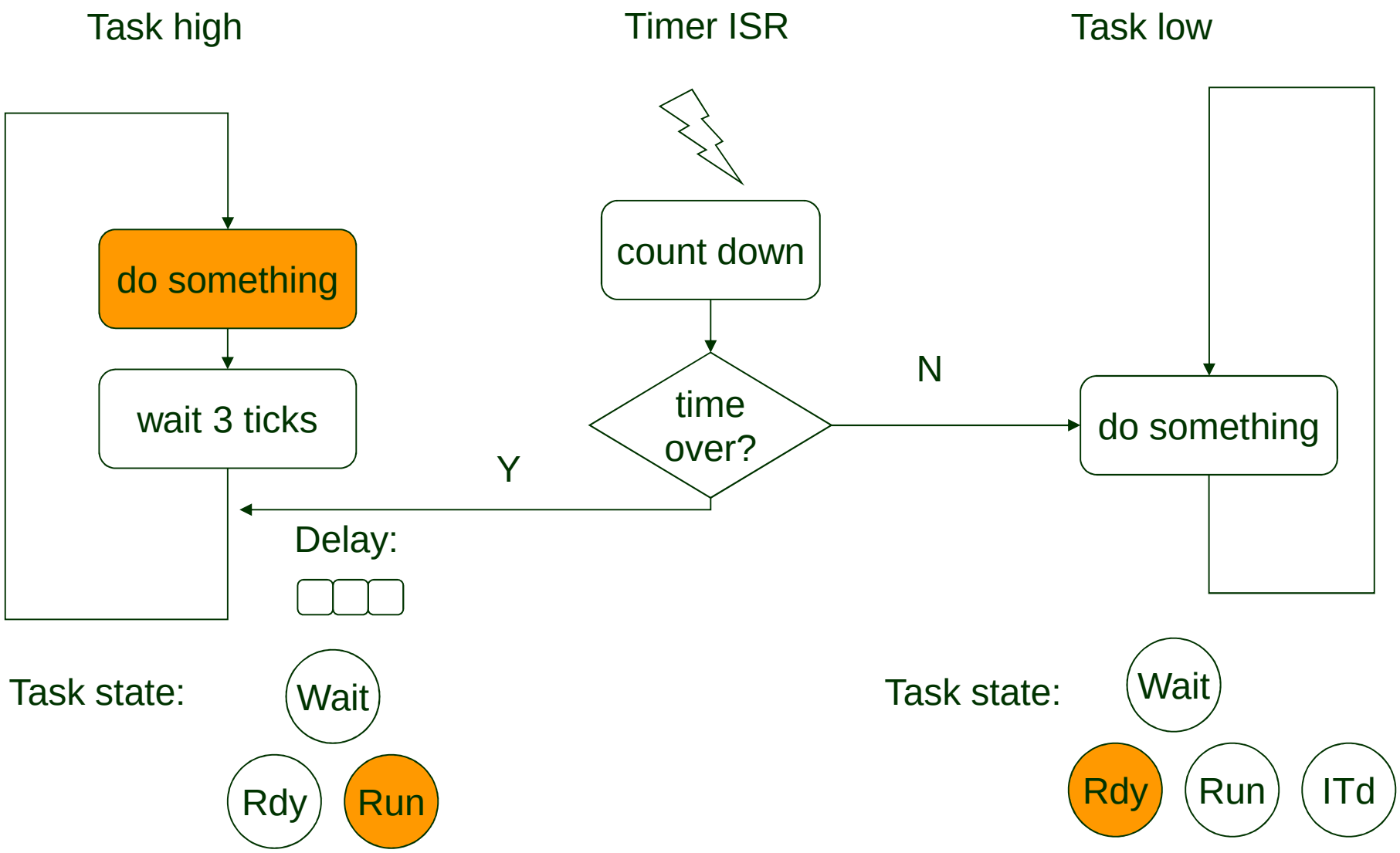
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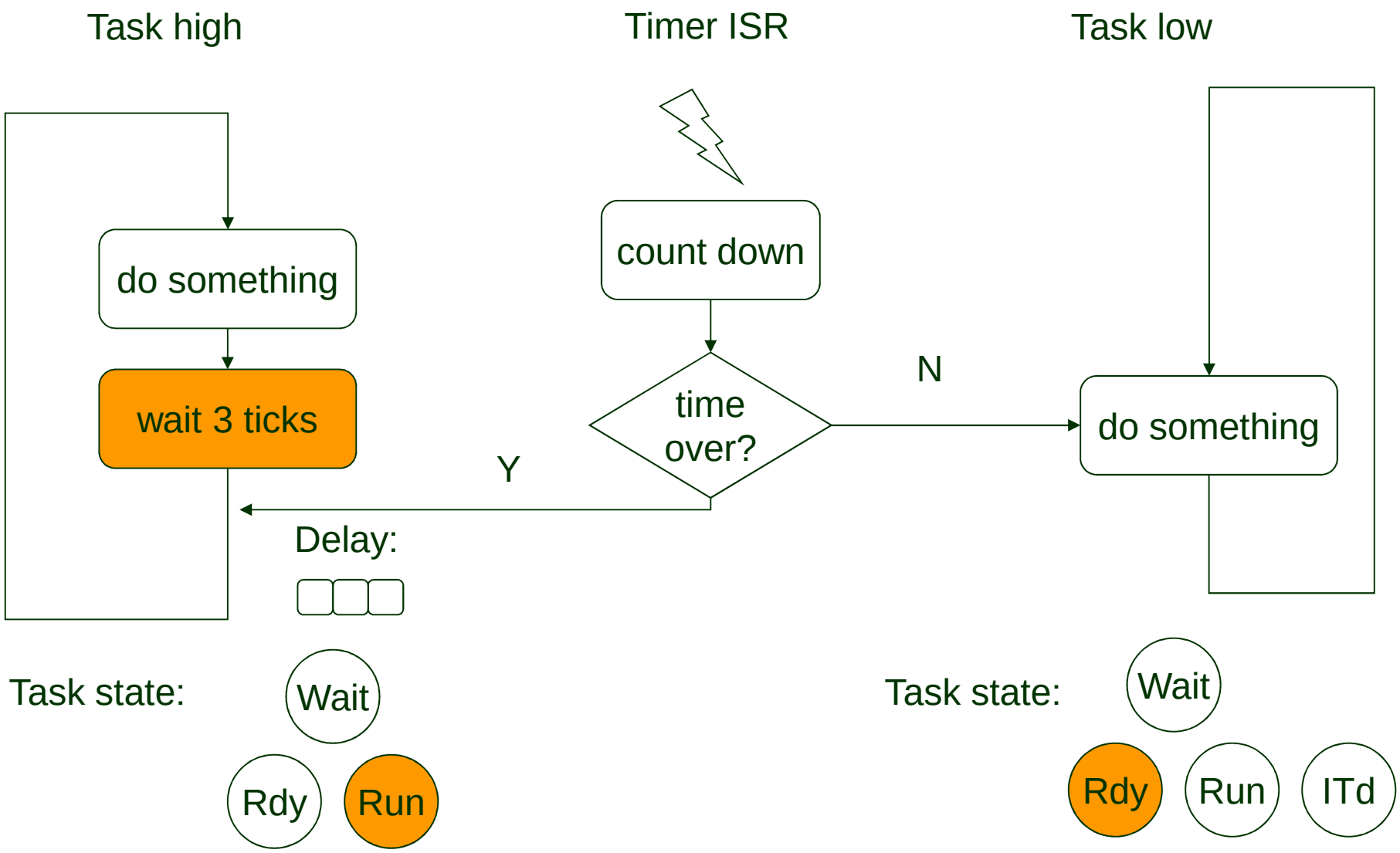
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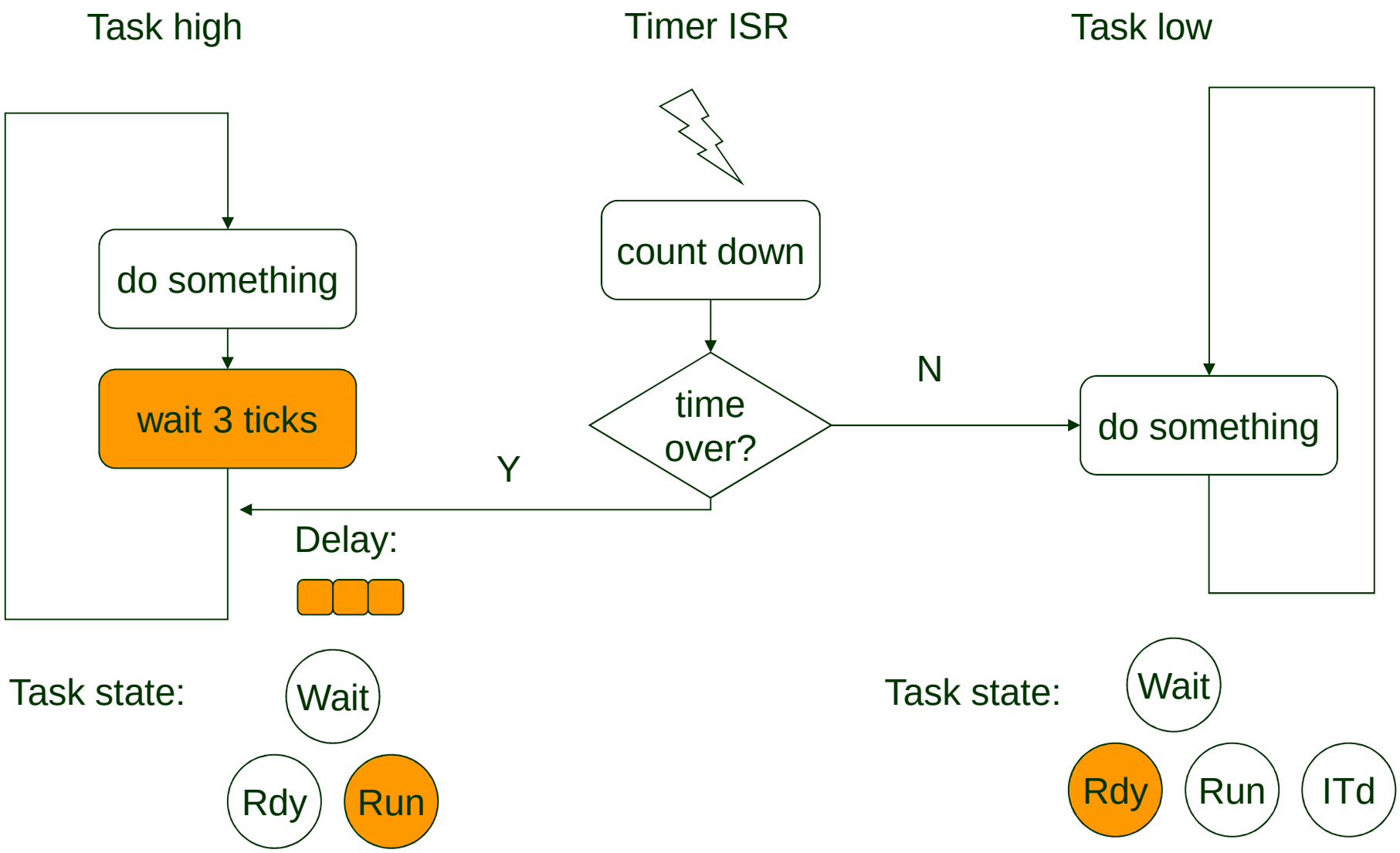
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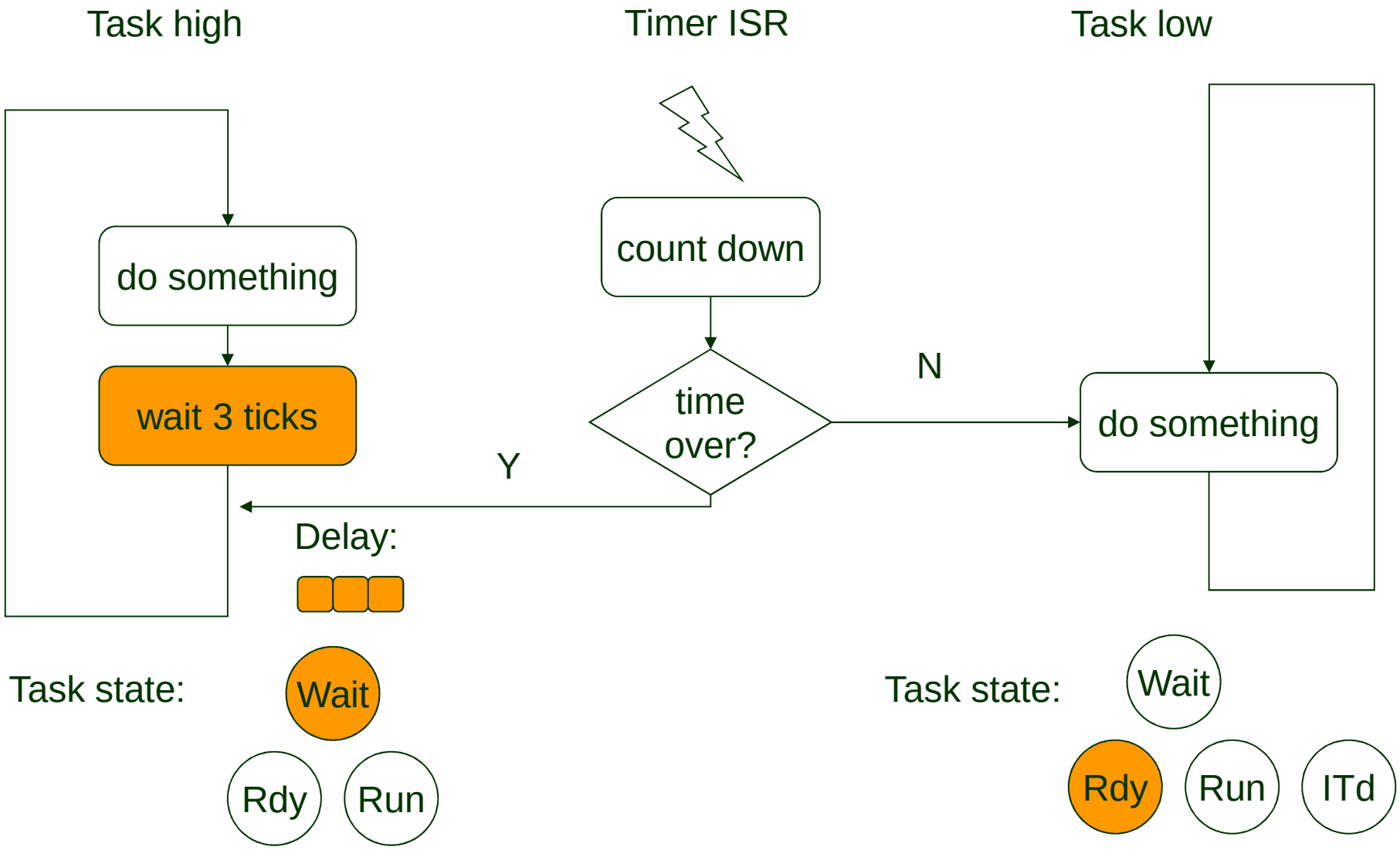
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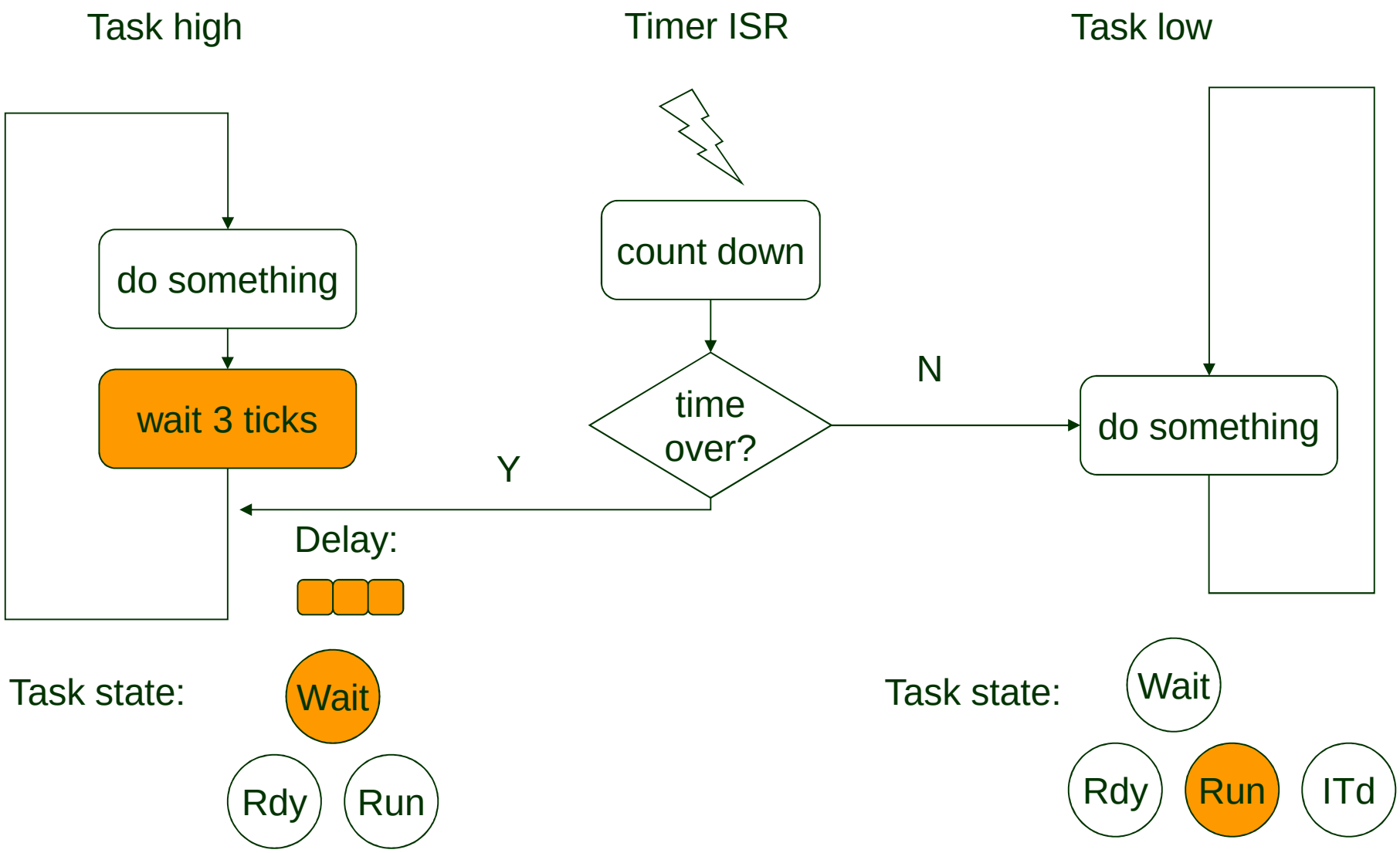
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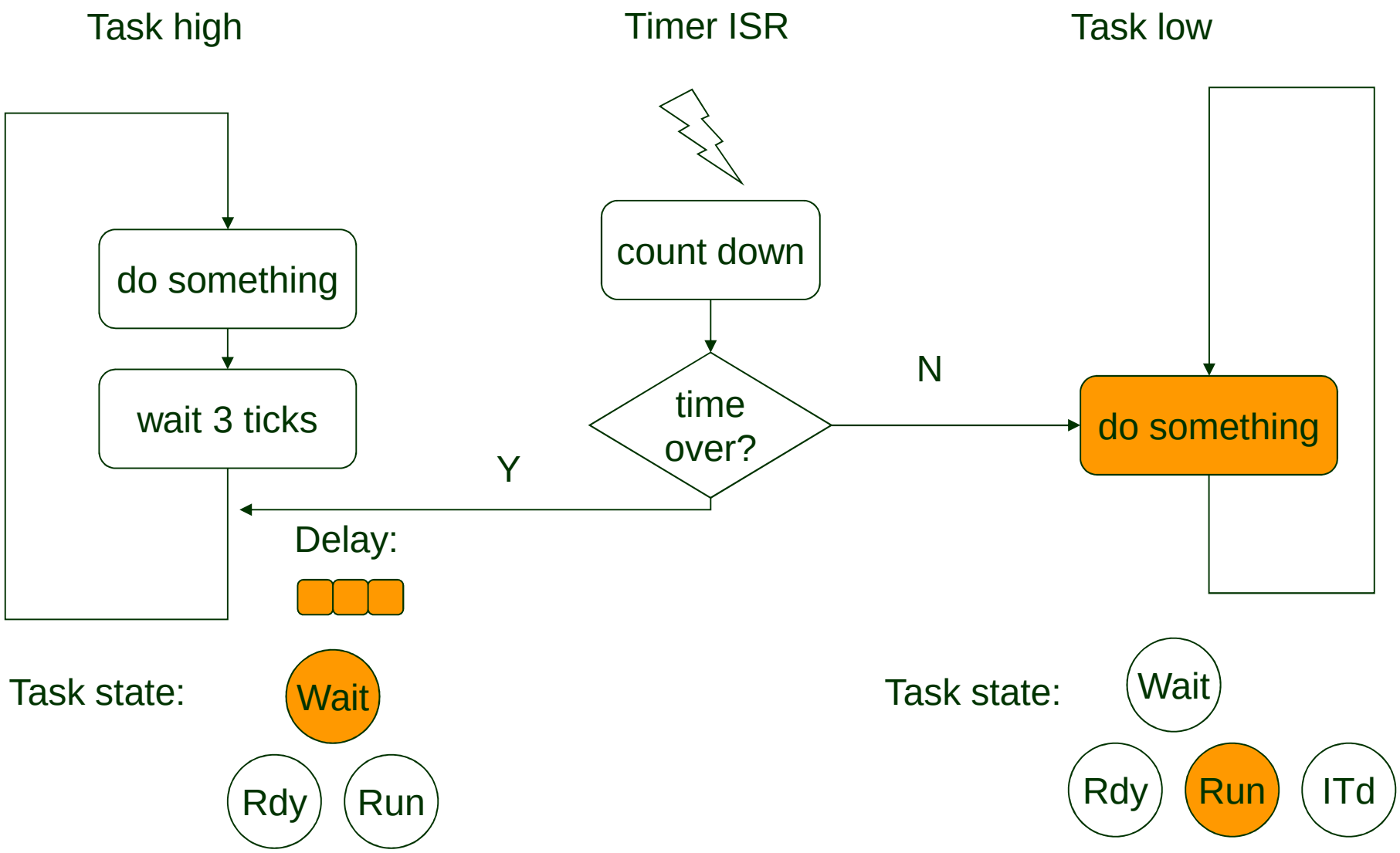
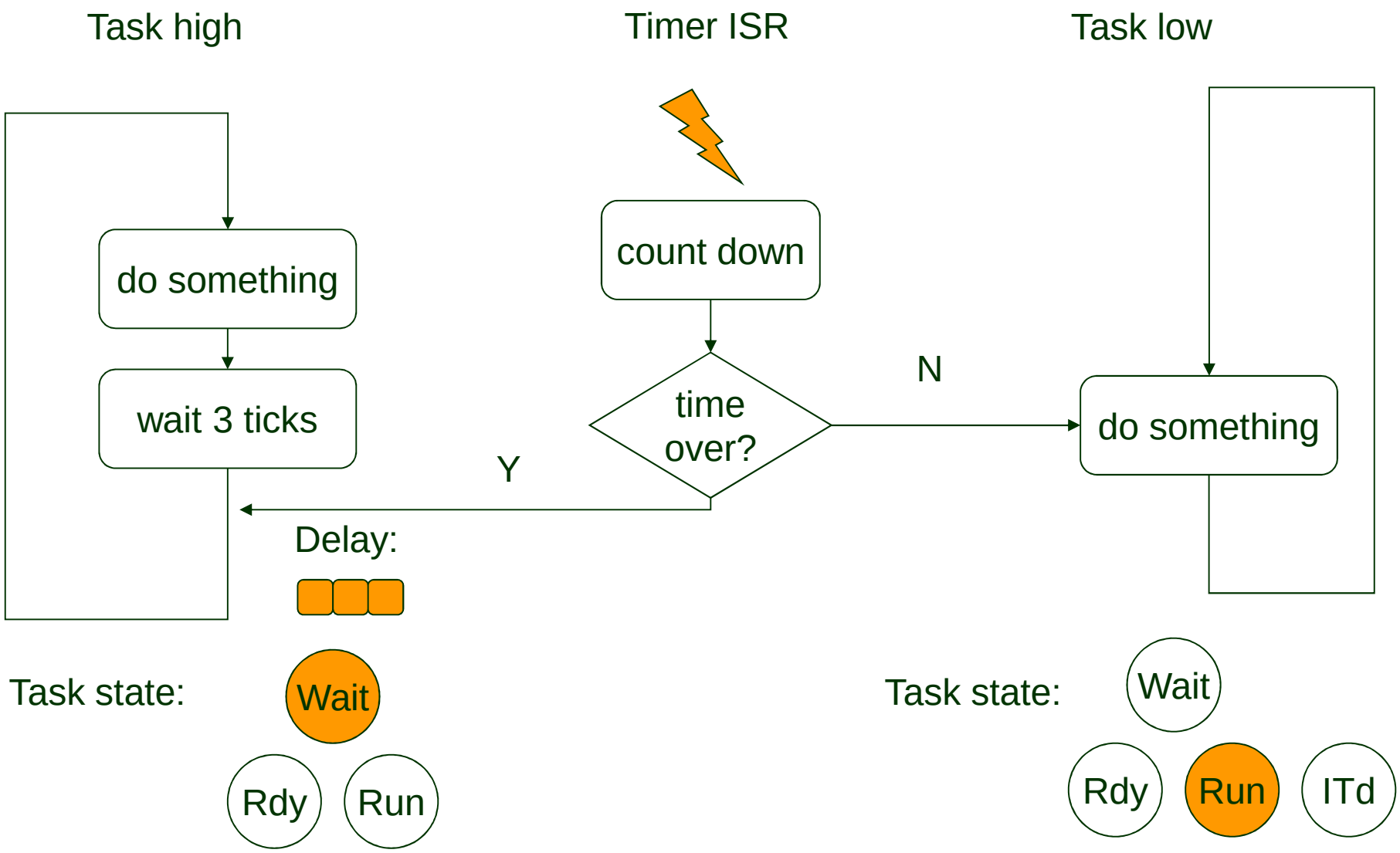
ITd

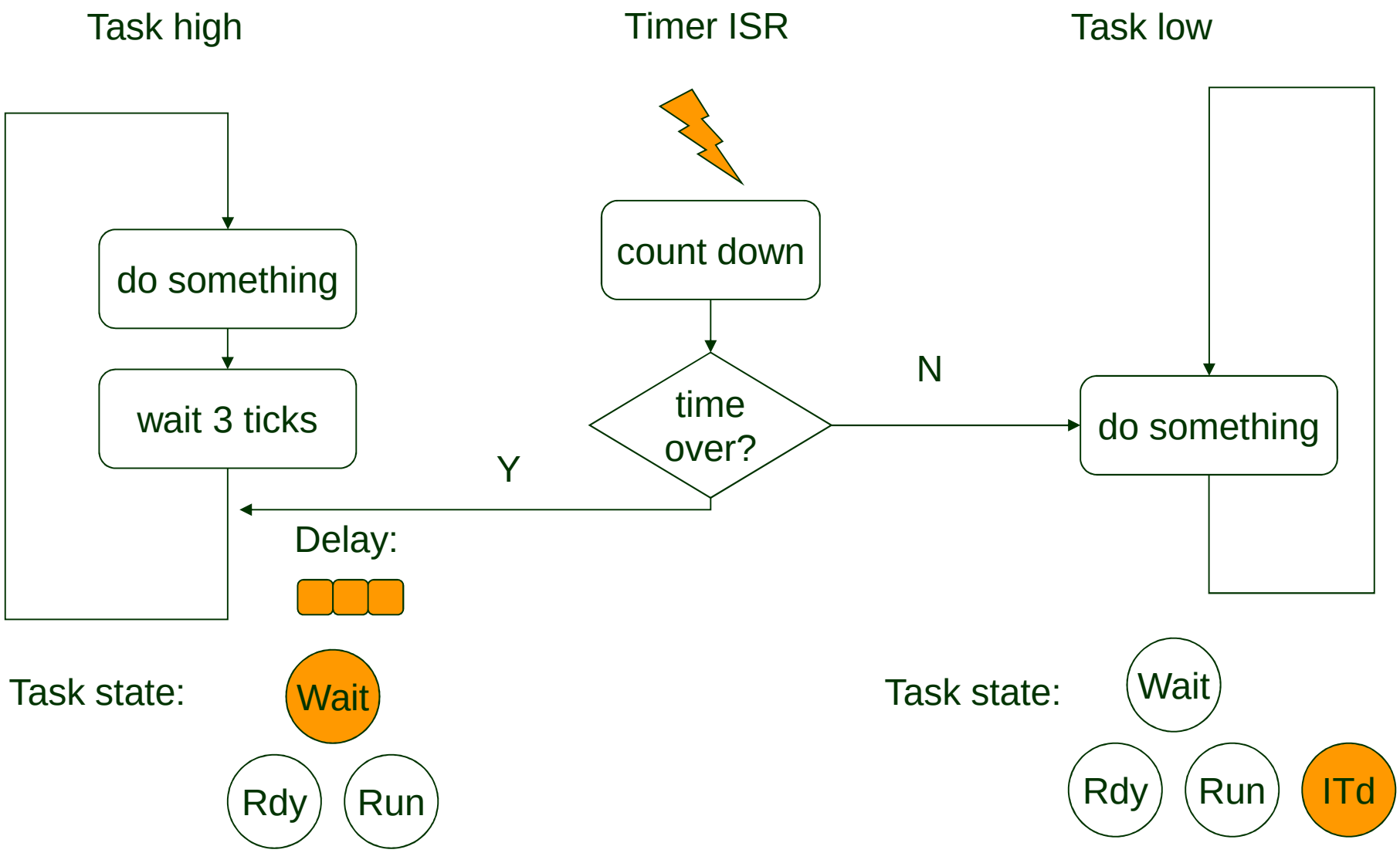
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

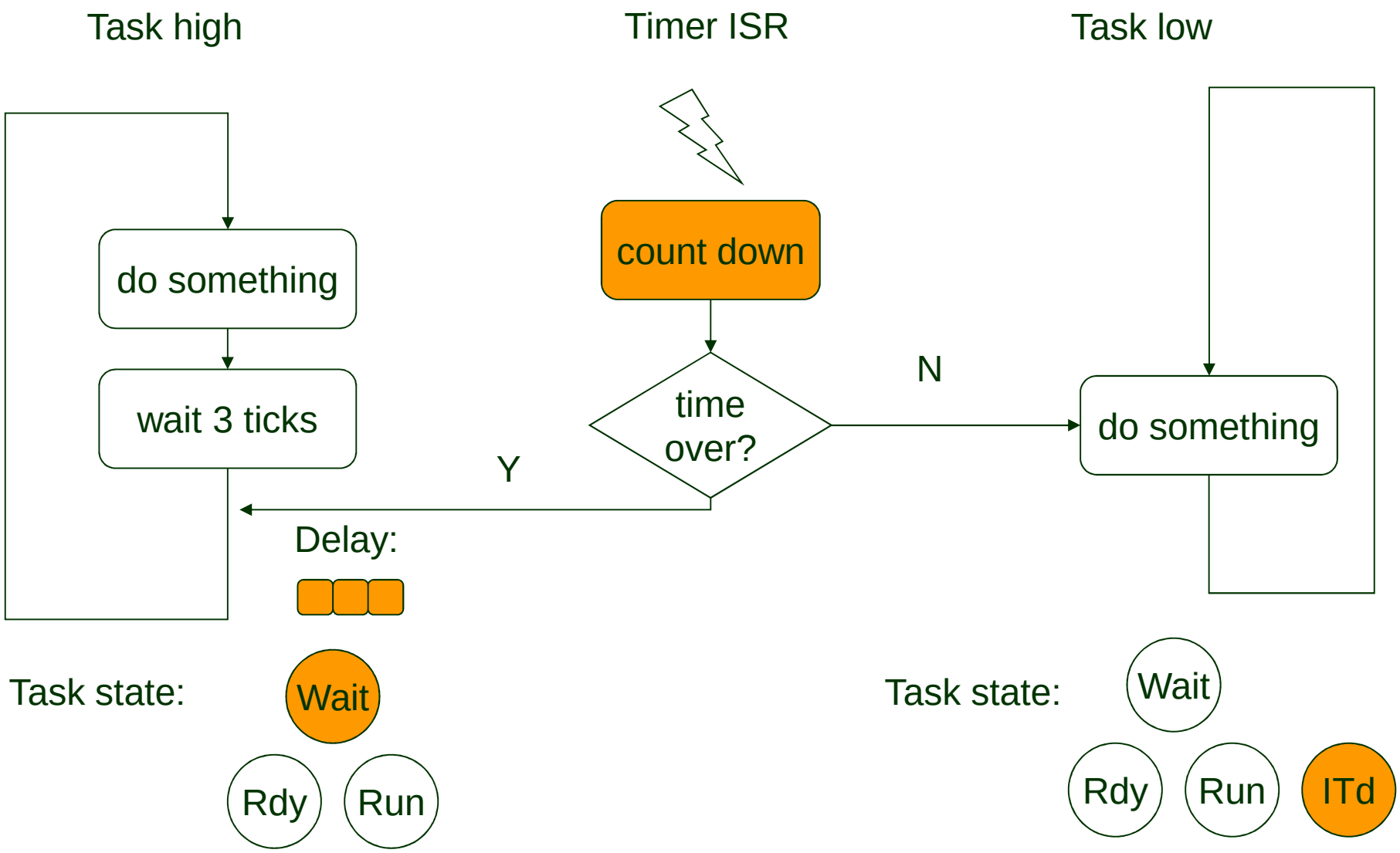
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

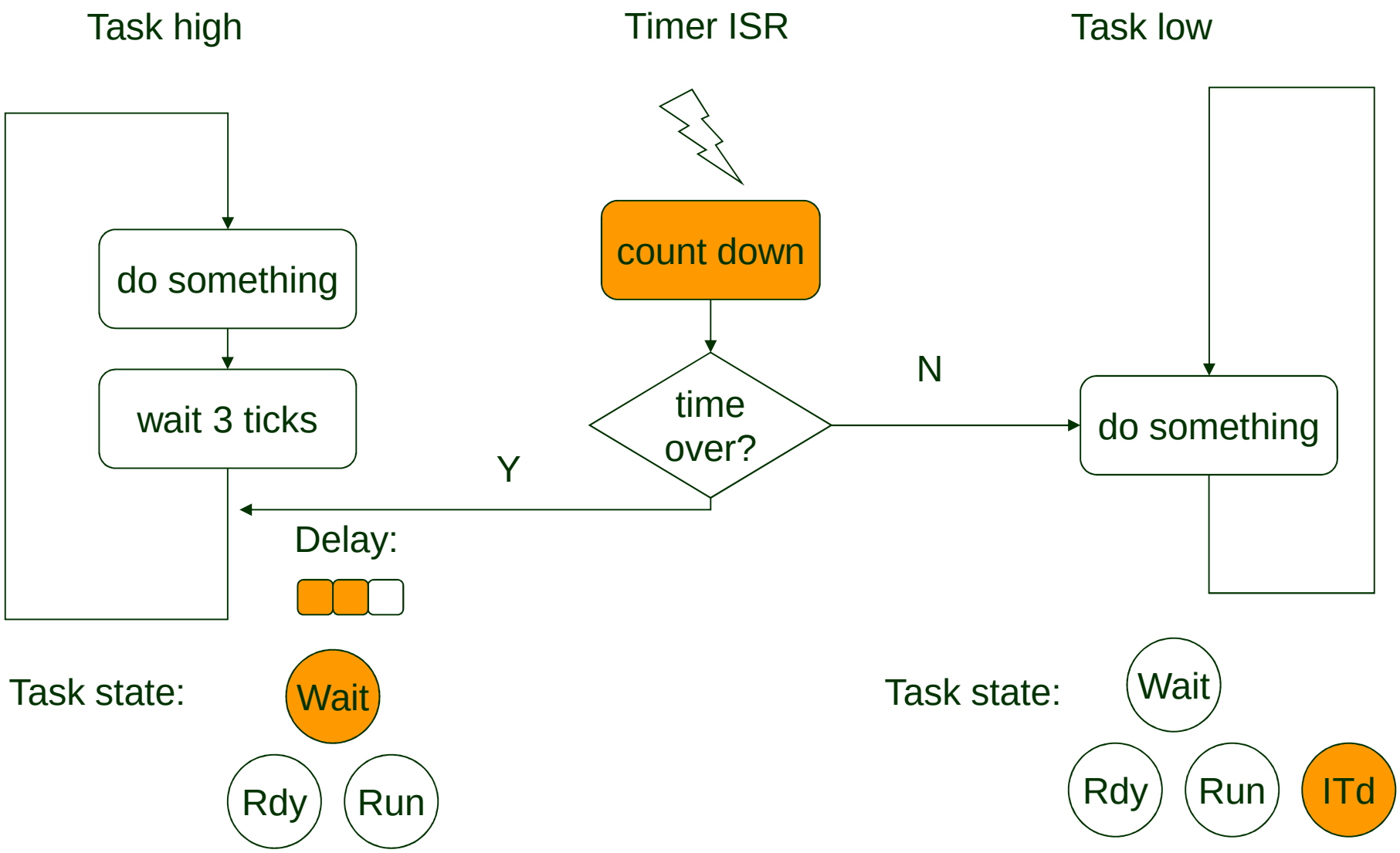
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

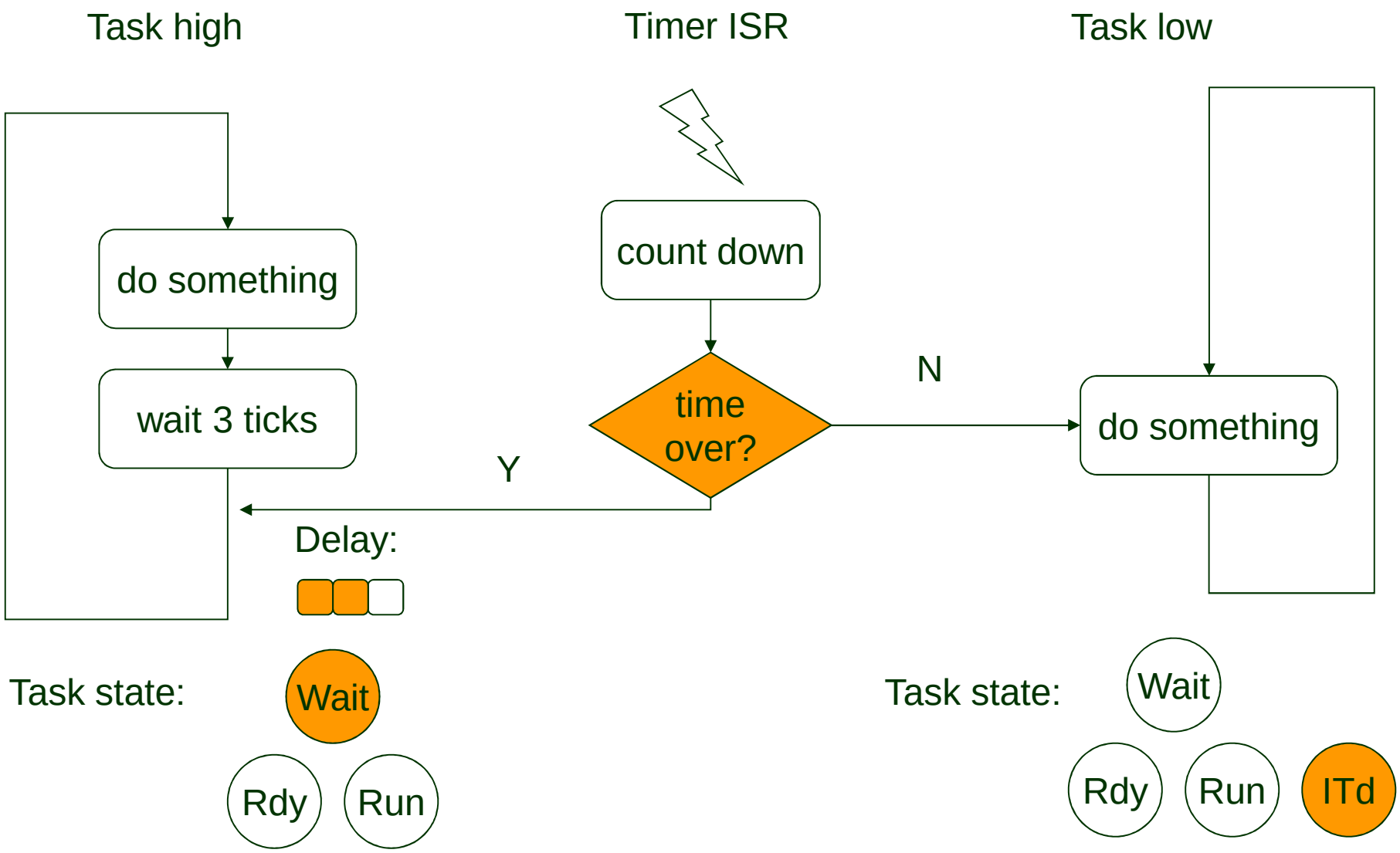
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

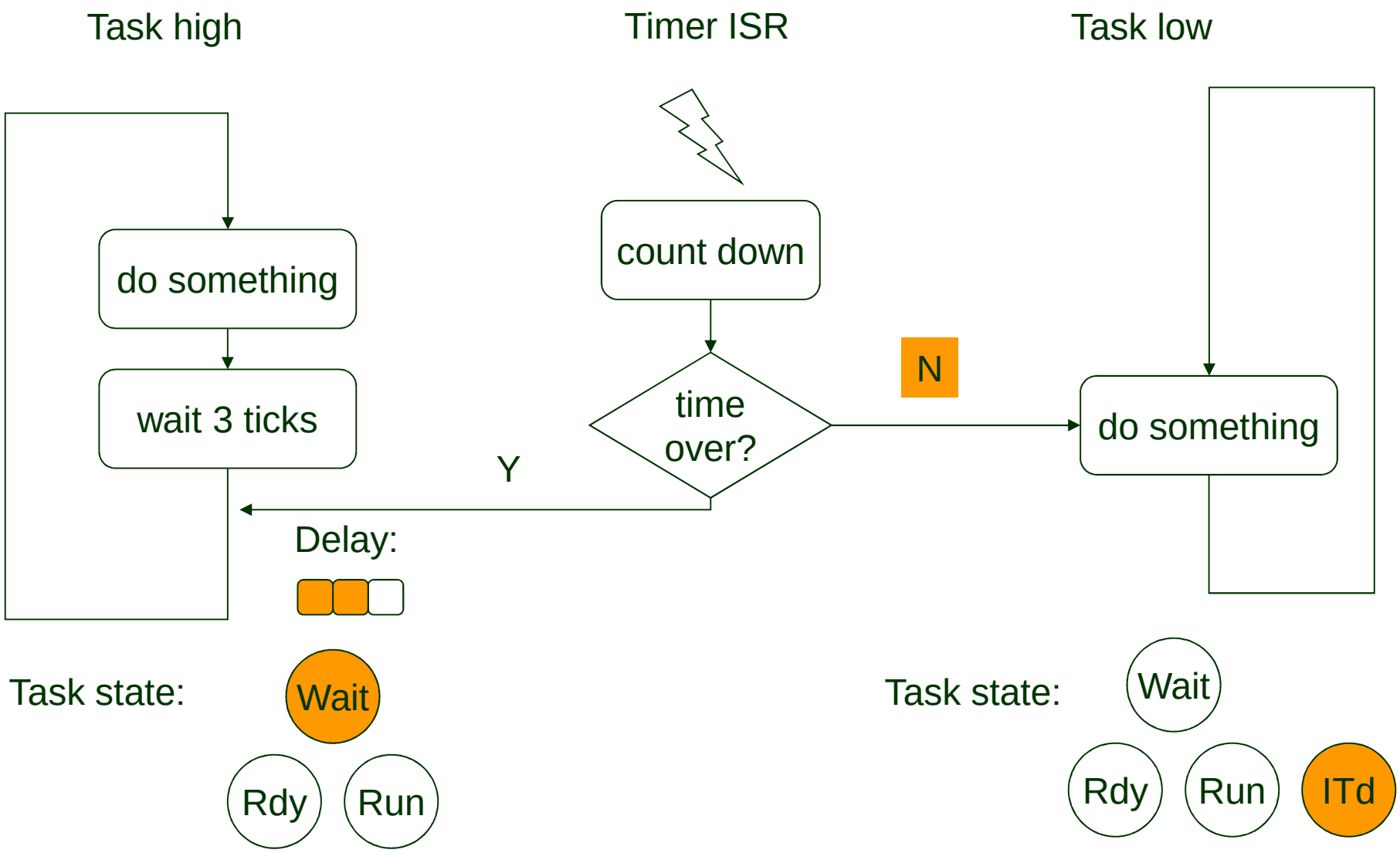
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

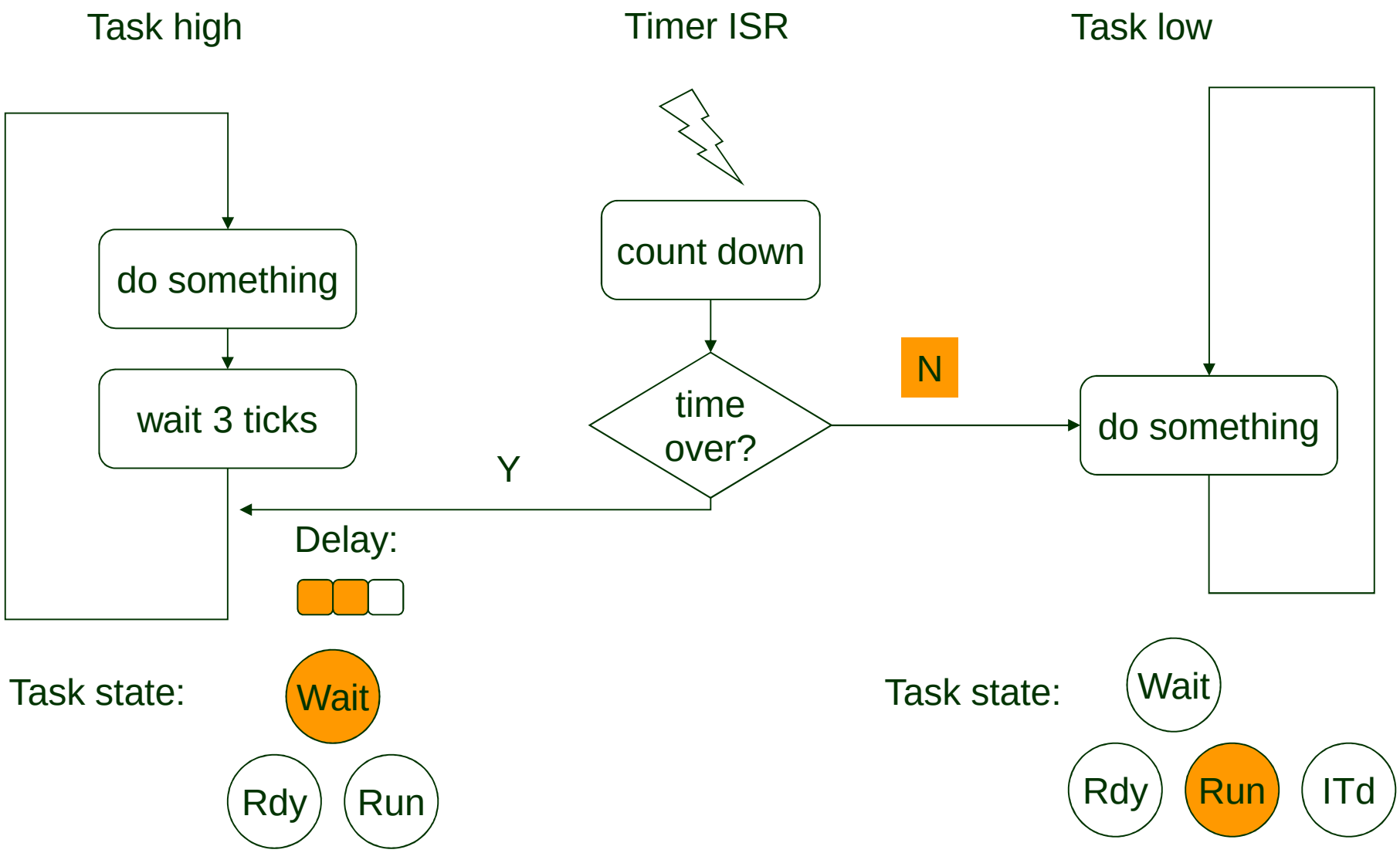
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

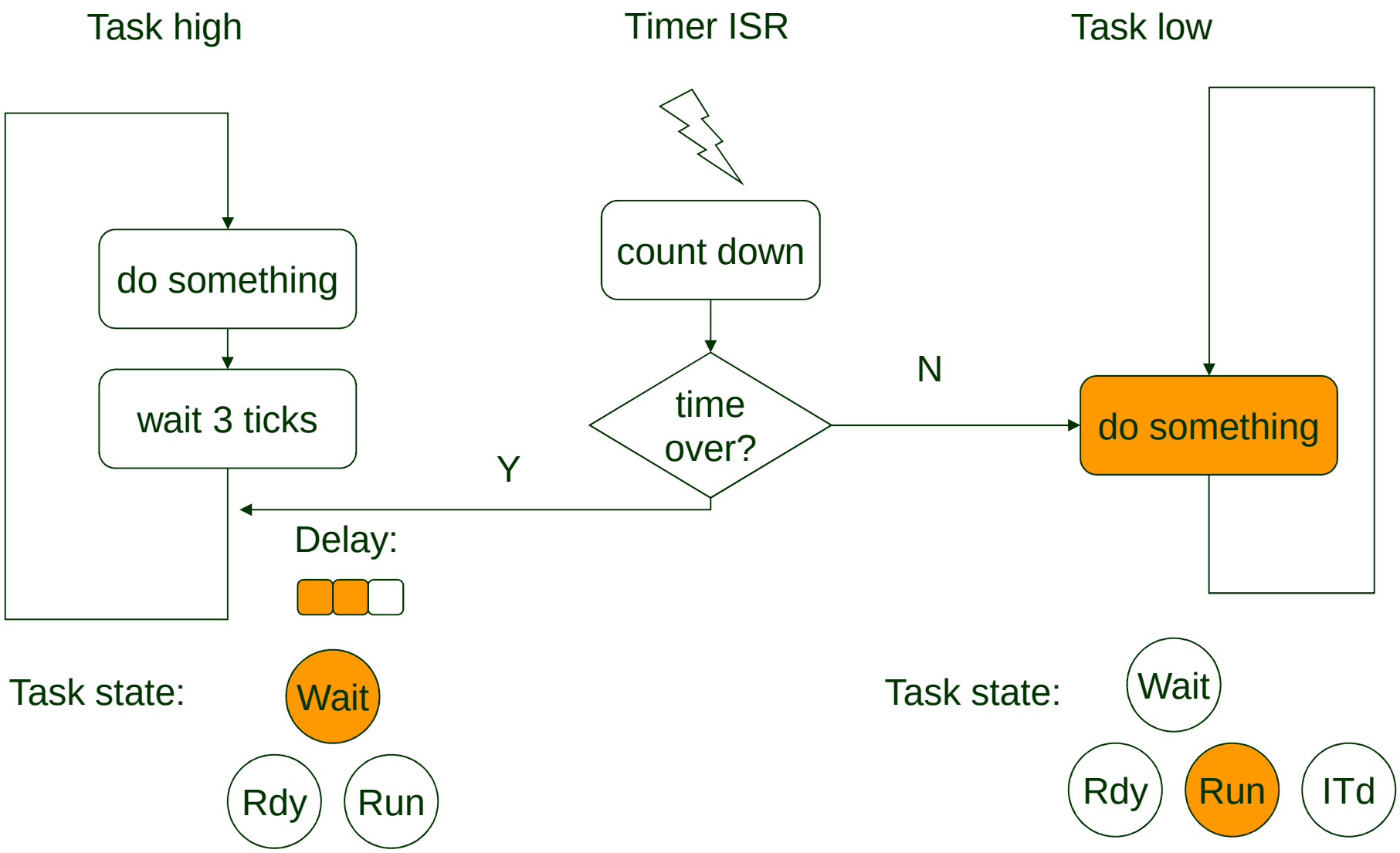
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

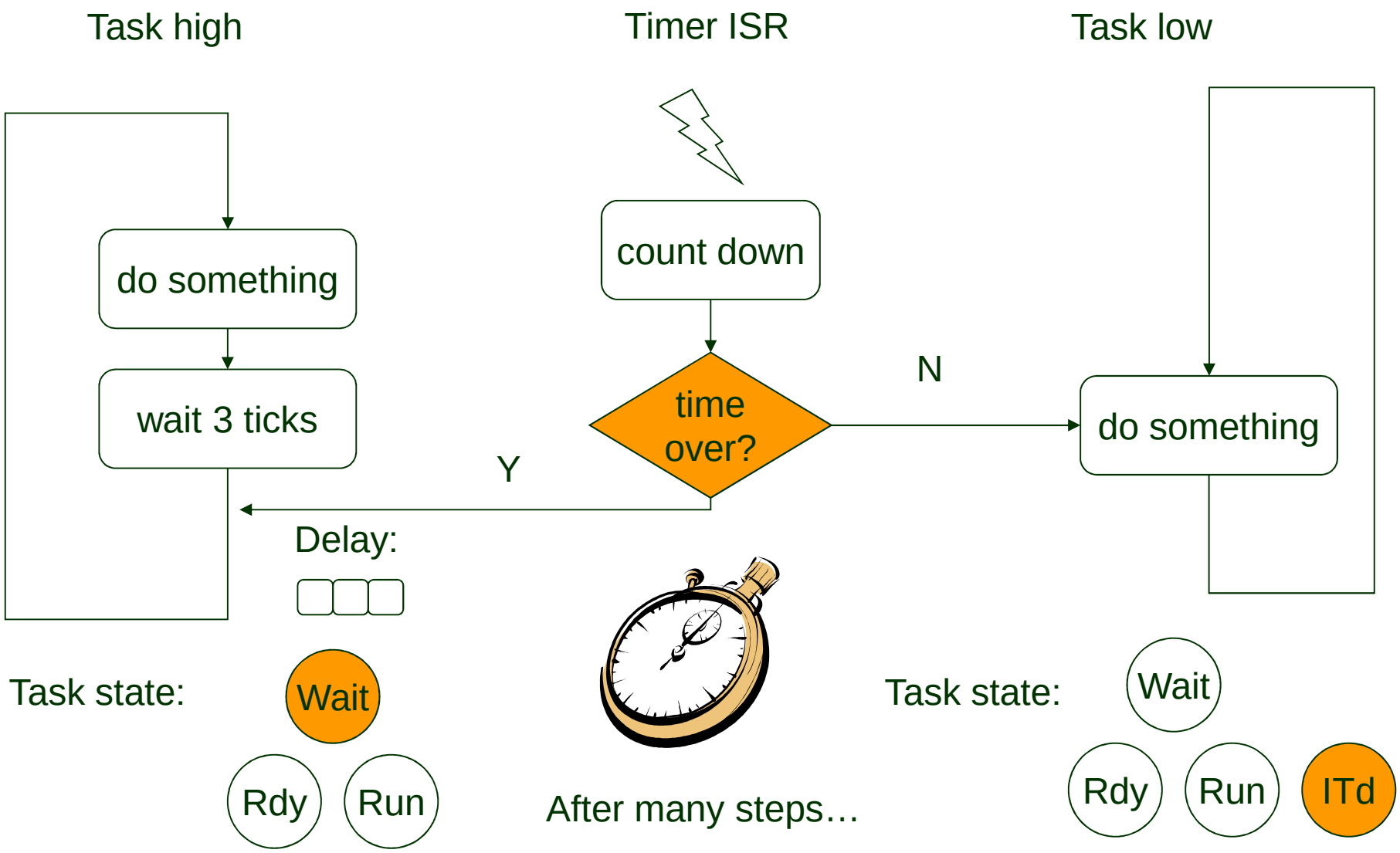
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

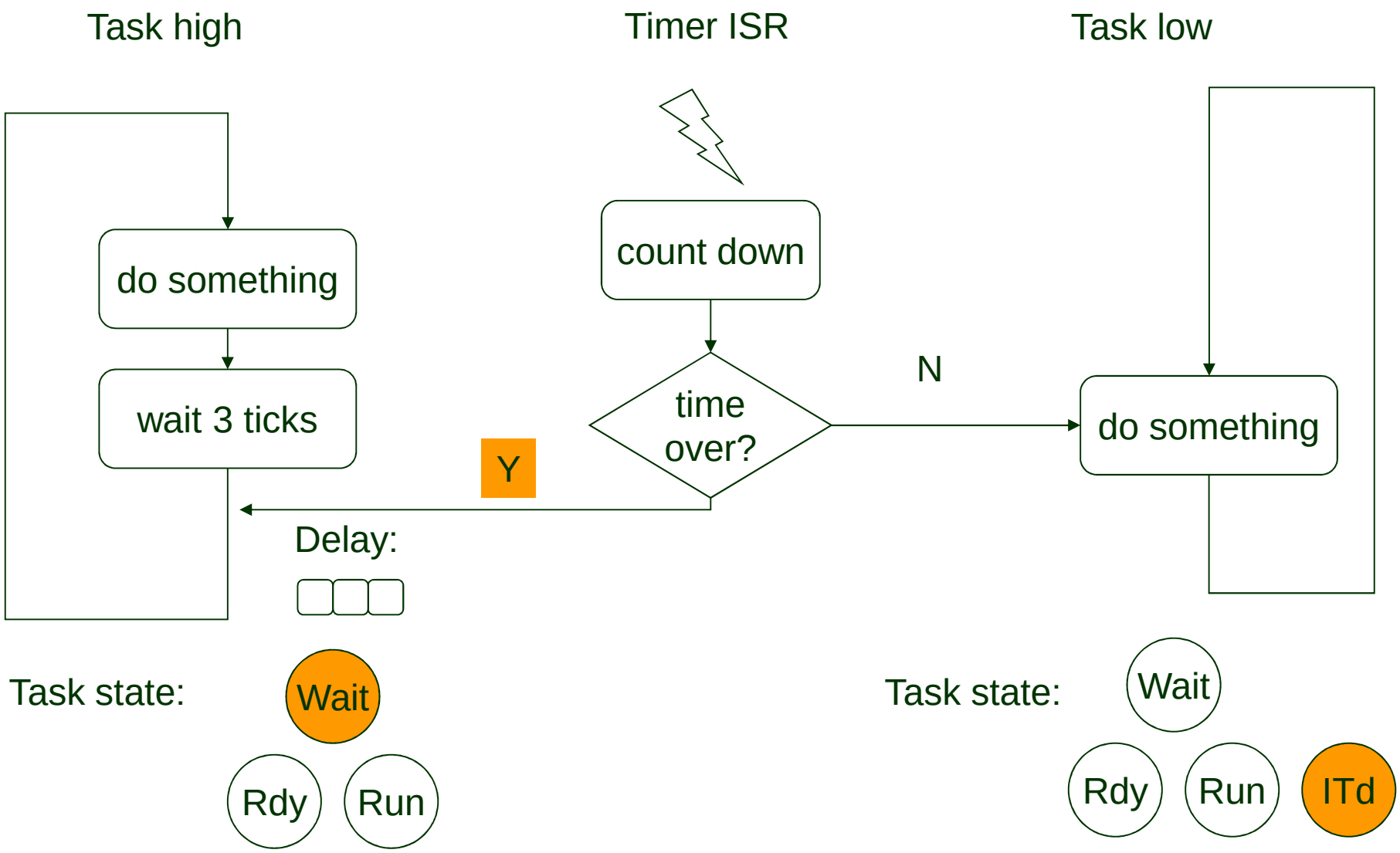
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

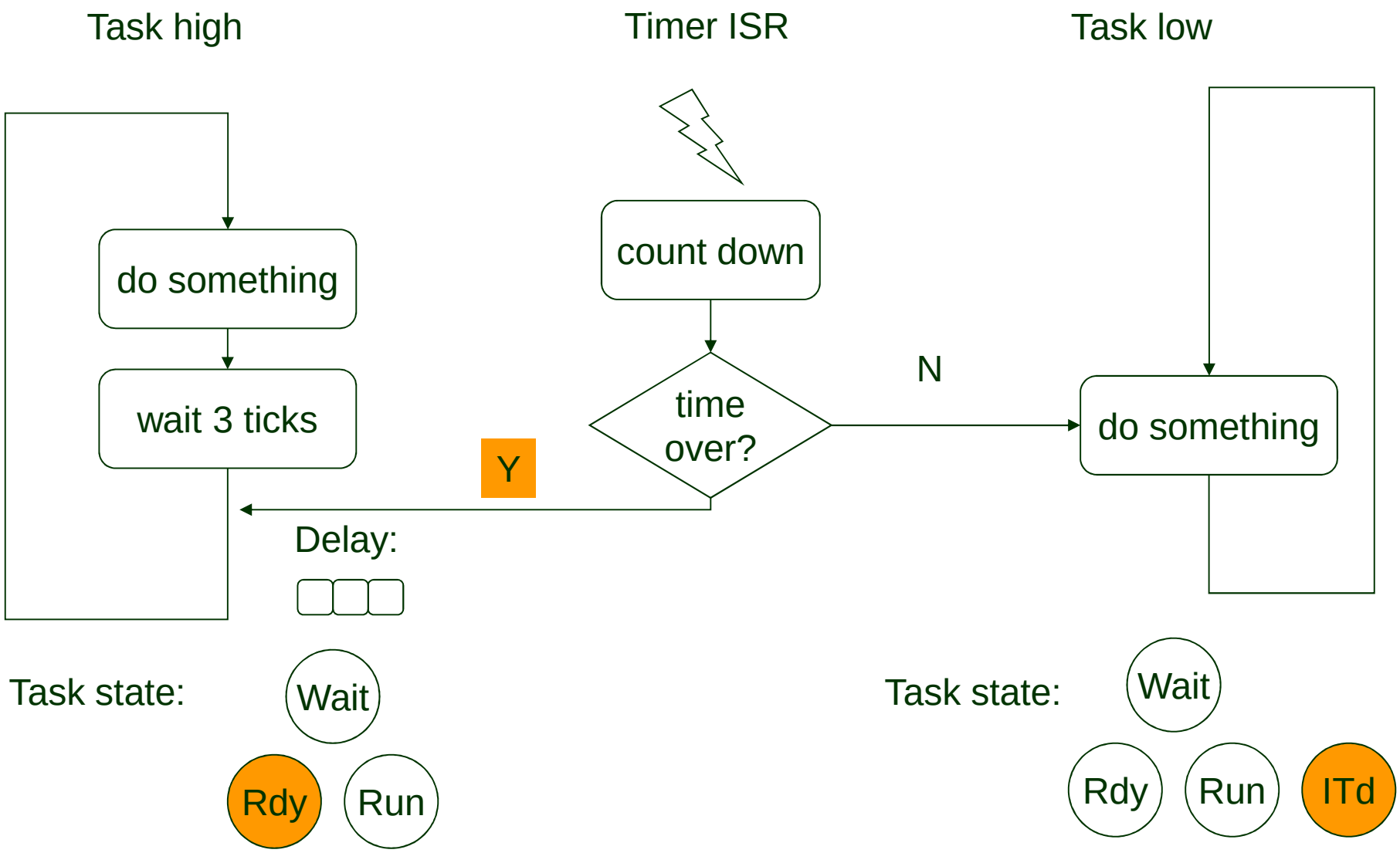
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
After many steps…
Task state:
Wait
Rdy
Run
ITd

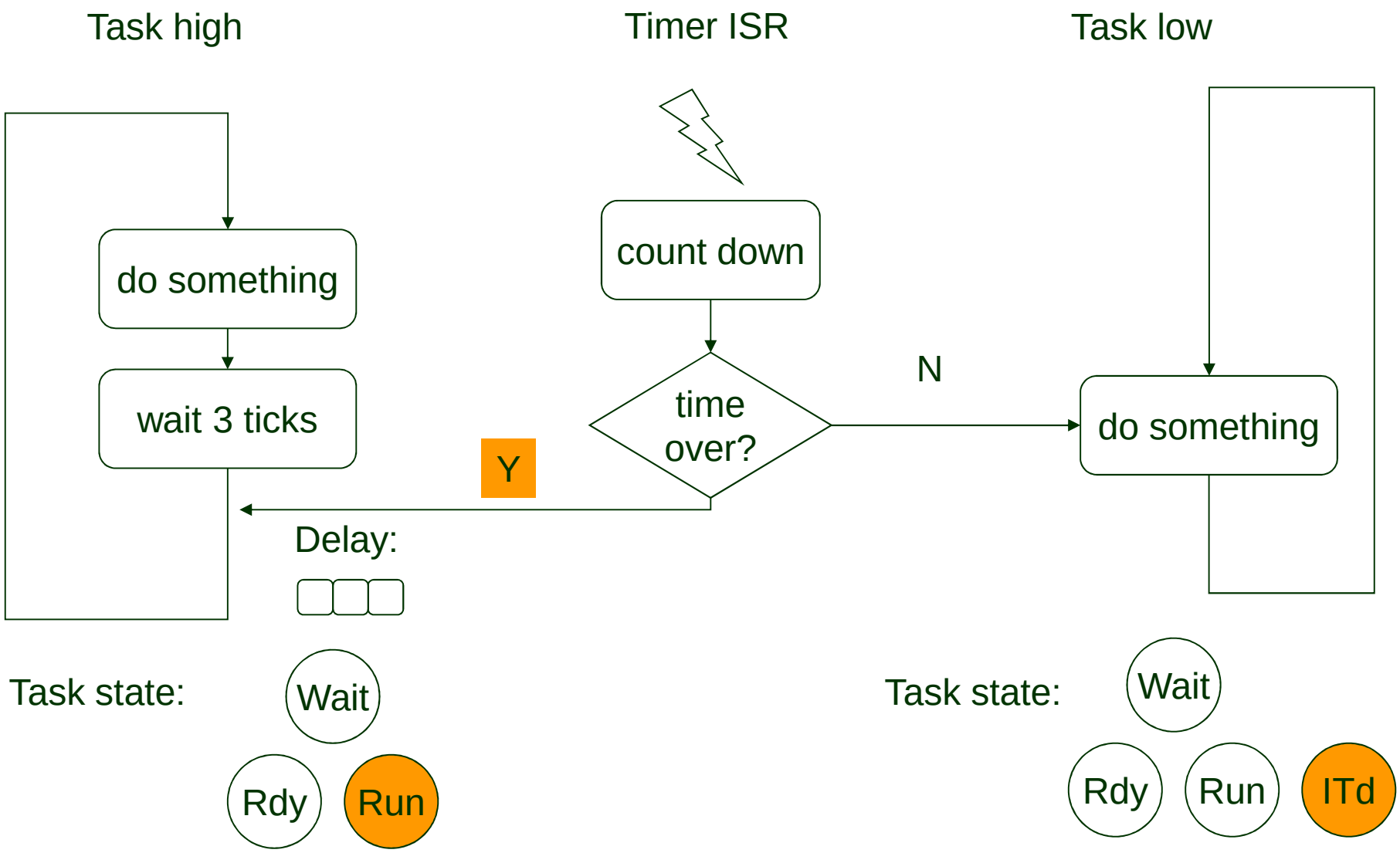
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

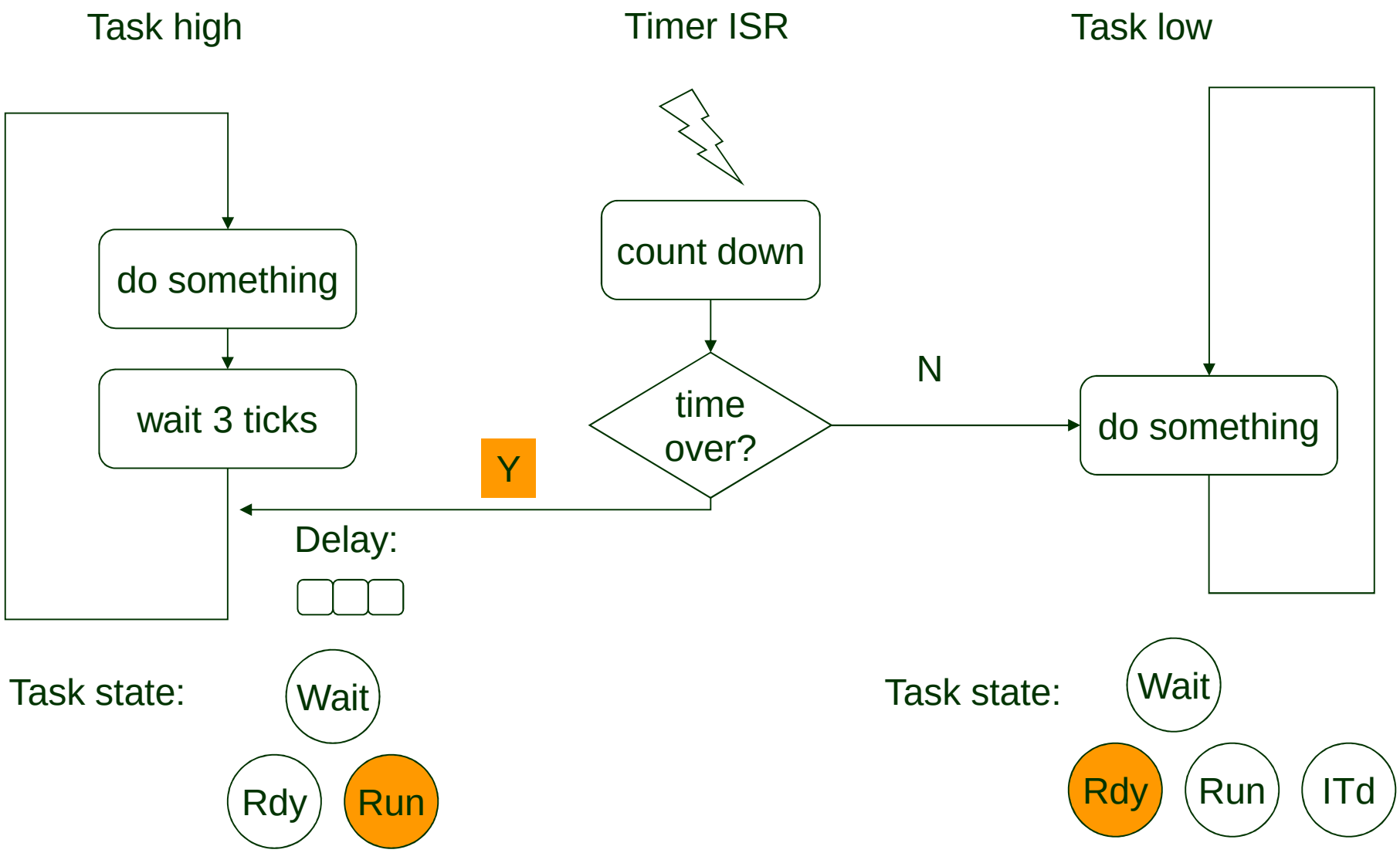
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

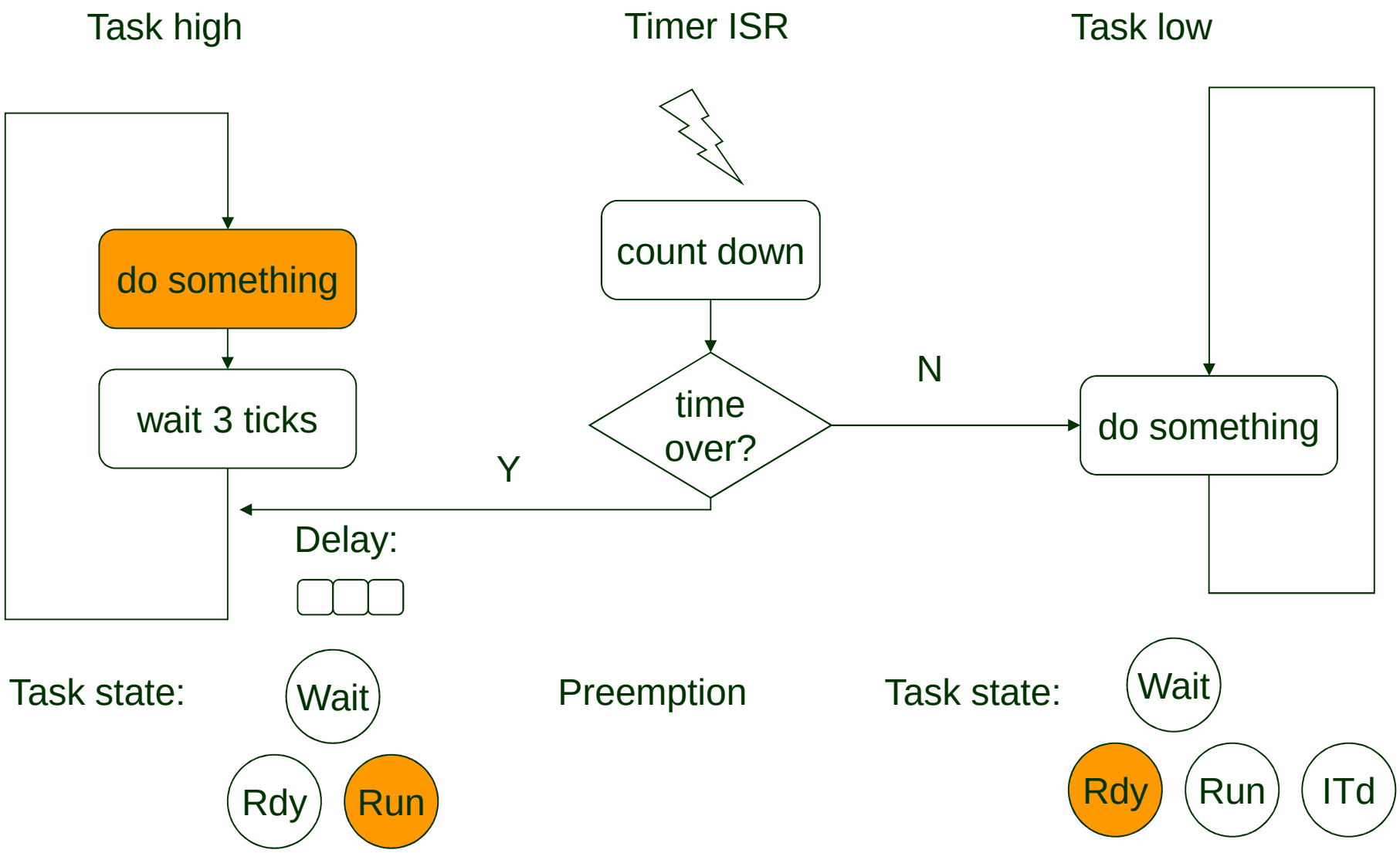
Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Task state:
Wait
Rdy
Run
ITd

Timer


Task high
Timer ISR
Task low
do something
wait 3 ticks
count down
time over?
N
Y
do something
Delay:
Task state:
Wait
Rdy
Run
Preemption
Task state:
Wait
Rdy
Run
ITd

Using oscilloscope for SW debugging ☺