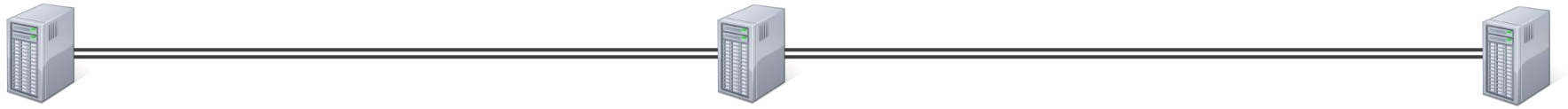
Process Scheduling

(Operating System)



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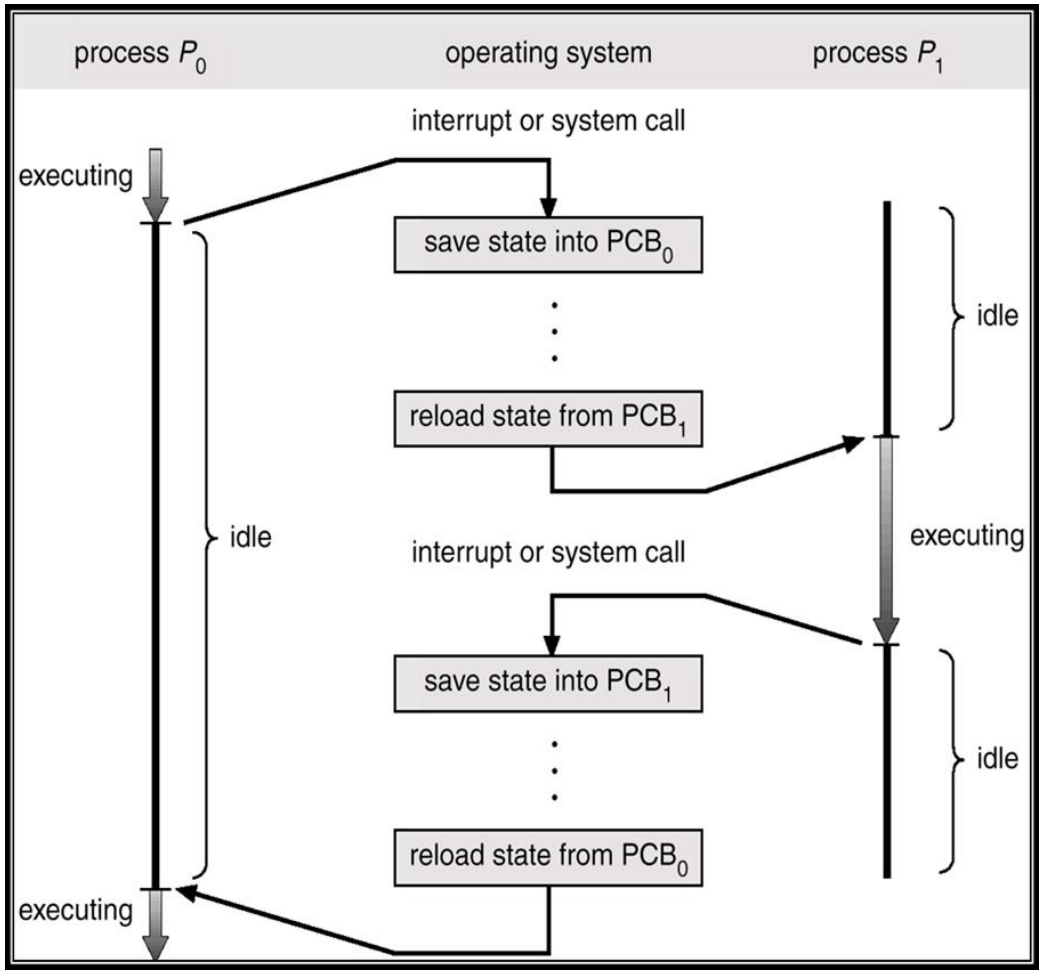
- **Dispatcher & swap**
- **Preemptive and non-preemptive Scheduling**
- **Scheduling Algorithms**
  - FCFS
  - SJF & SRTF
  - RR

CPU Switch



1	5000	27	12004
2	5001	28	12005
3	5002	----------Timeout	
4	5003	29	100
5	5004	30	101
6	5005	31	102
----------Timeout		32	103
7	100	33	104
8	101	34	105
9	102	35	5006
10	103	36	5007
11	104	37	5008
12	105	38	5009
13	8000	39	5010
14	8001	40	5011
15	8002	----------Timeout	
16	8003	41	100
----------I/O Request		42	101
17	100	43	102
18	101	44	103
19	102	45	104
20	103	46	105
21	104	47	12006
22	105	48	12007
23	12000	49	12008
24	12001	50	12009
25	12002	51	12010
26	12003	52	12011
		----------Timeout	

Dispatcher

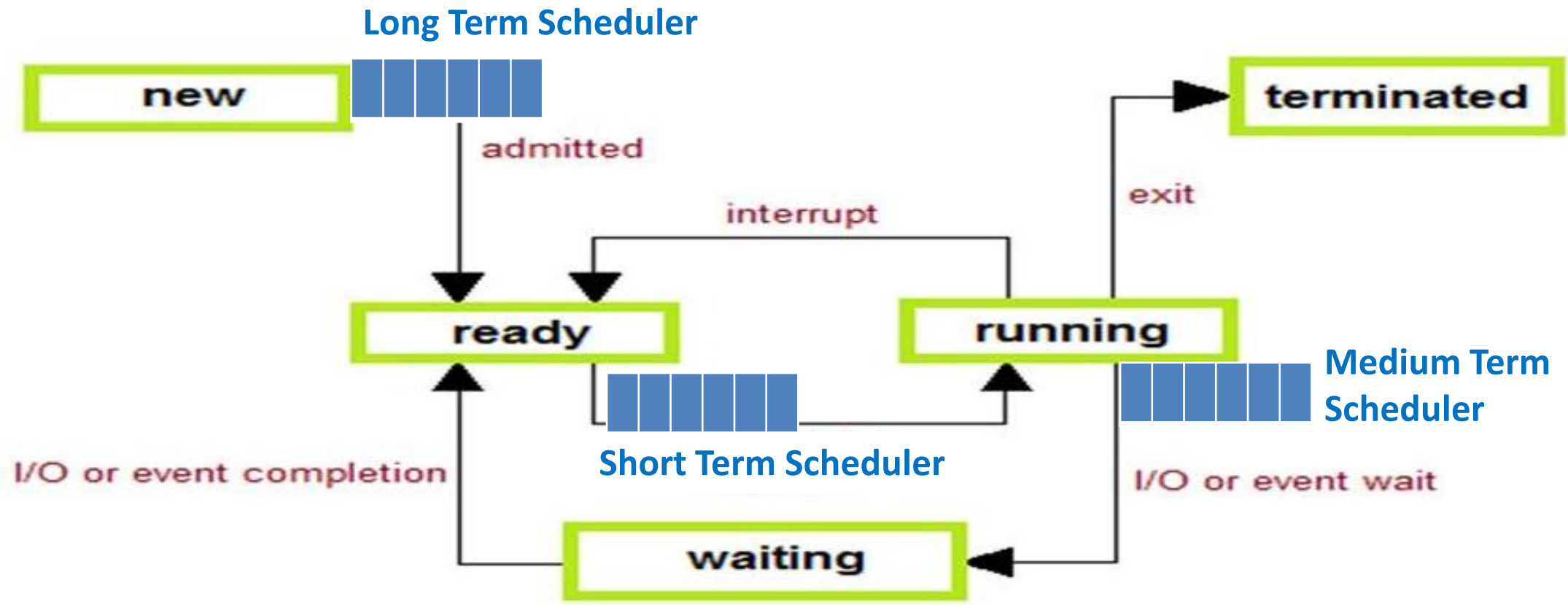
- **Module which gives control of CPU to the process selected by short term scheduler**
  - Switch context
  - Switching to user mode
  - Jump to exact location in the program to restart the process

- **Dispatch latency**
  - Time taken by dispatcher to stop on process and start execution of the other process

1	5000
2	5001
3	5002
4	5003
5	5004
6	5005
----------	Timeout
7	100
8	101
9	102
10	103
11	104
12	105
13	8000
14	8001
15	8002
16	8003
----------	I/O Request
17	100
18	101
19	102
20	103
21	104
22	105
23	12000
24	12001
25	12002
26	12003
27	12004
28	12005
----------	Timeout
29	100
30	101
31	102
32	103
33	104
34	105
35	5006
36	5007
37	5008
38	5009
39	5010
40	5011
----------	Timeout
41	100
42	101
43	102
44	103
45	104
46	105
47	12006
48	12007
49	12008
50	12009
51	12010
52	12011
----------	Timeout

Scheduler

- **Long term (Job Scheduler)**
  - selects which processes should be brought into the ready queue
  - Degree of multiprogramming
  - I/o bound or CPU bound
- **Medium term (swapping scheduler)**
  - Swapping is necessary to improve the process mix. Swap-in and swap-out of processes.
- **Short term (CPU scheduler)**
  - selects which process should be executed next and allocates CPU


Long Term Scheduler
new
admitted
terminated
exit
interrupt
ready
running
Medium Term Scheduler
Short Term Scheduler
I/O or event completion
I/O or event wait
waiting

- **Non-preemptive scheduling**
  - when a process terminates or
  - when an explicit system request causes a wait state

- **Preemptive scheduling**
  - An interrupt occurs
  - When new processes become ready with higher priority

Acronyms

- **CPU utilization –** keep the CPU as busy as possible
- **Throughput –** # of processes, complete their execution per time unit
- **Turnaround time –** amount of time taken between submission of program to execute and return of the output.
- **Waiting time –** amount of time a process waits in the ready queue
- **Response time –** amount of time it takes from when a request was submitted until the first response is produced, not output (for time-sharing environment)
- **Arrival Time -** time when a process enters into the ready state and is ready for its execution

Algorithms

- **First-come, First-Served (FCFS)**
  - Complete the jobs in order of arrival
- **Shortest Job First (SJF)**
  - Complete the job with shortest next CPU requirement (e.g., burst)
  - Provably optimal w.r.t. average waiting time
- **Priority**
  - Processes have a priority number
  - Allocate CPU to process with highest priority
- **Round-Robin (RR)**
  - time quantum or time slice based
  - For now, assume a FIFO queue of processes

FCFS

- **Draw Gantt chart and compute average wait time**

Process	Burst time
P1	7
P2	3
P3	4
P4	6

0 7 10 14 20

Process	Burst time	Waiting Time
P1	7	0
P2	3	7
P3	4	10
P4	6	14
	Average	7.75

SJF

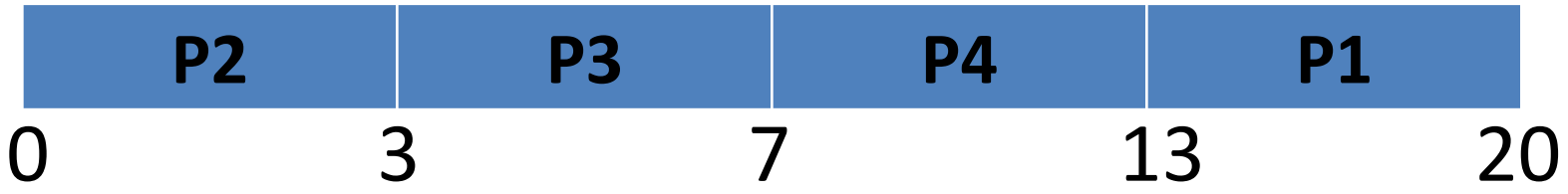
- **Non pre-emptive**
  - once CPU given to the process it cannot be preempted until completes its CPU burst

- **Pre-emptive**
  - if a new process arrives with CPU burst length less than remaining time of current executing process, preempt. This scheme is known as the Shortest-Remaining-Time-First (SRTF)

SJF

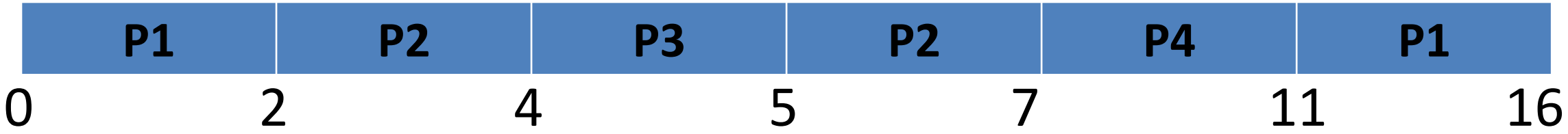
Process	Burst time	Waiting Time
P1	7	13
P2	3	0
P3	4	3
P4	6	7
		Avg: 5.75

Process	Arrival Time	Burst time
P1	0.0	7
P2	2.0	4
P3	4.0	1
P4	5.0	4



SRTF

Process	Arrival Time	Burst time	Waiting Time
P1	0.0	7	9
P2	2.0	4	1
P3	4.0	1	0
P4	5.0	4	2
			Avg : 3

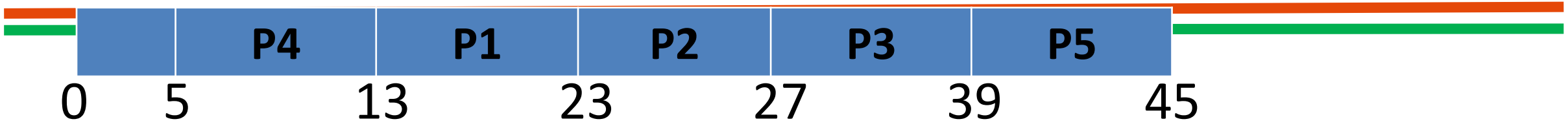


Scheduling with Priority

- **Calculate TAT and waiting time**
  - Turnaround time = Process finish time – Arrival time
  - Waiting time = Turnaround time – CPU Burst time

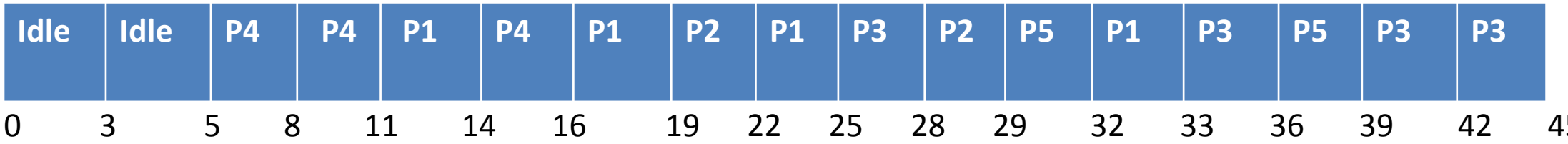
Process	Arrival Time	Burst time	Priority
P1	10	10	2
P2	15	4	1
P3	20	12	4
P4	5	8	3
P5	25	6	5

Priority



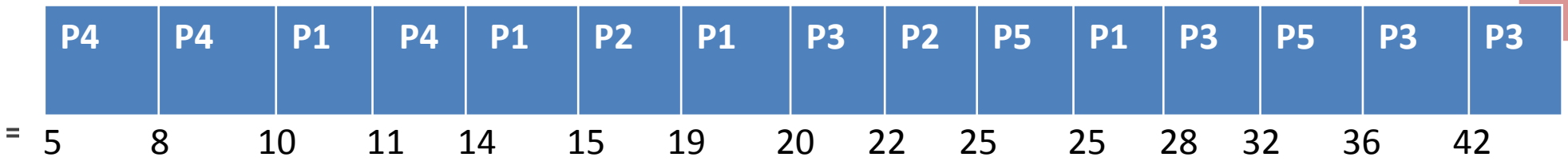
Process	Arrival Time	Burst time	Priority	Finish Time	Turnaround time	Waiting time
P1	10	10	2	23	13	3
P2	15	4	1	27	12	8
P3	20	12	4	39	19	7
P4	5	8	3	13	8	0
P5	25	6	5	45	20	14

- **Average Turnaround time : 14.4 and average waiting time is 6.4**



Process	Arrival Time	Burst time	Finish Time	Turnaround time	Waiting time
P1	10	10	33	23	13
P2	15	4	29	14	10
P3	20	12	45	25	13
P4	5	8	16	11	3
P5	25	6	39	14	8
				Avg: 87/5 =17.4	Avg: 47/5 =9.4

Request Queue



Thank You