Scheduling Algorithm and Analysis

Aperiodic Server

(Module 36)

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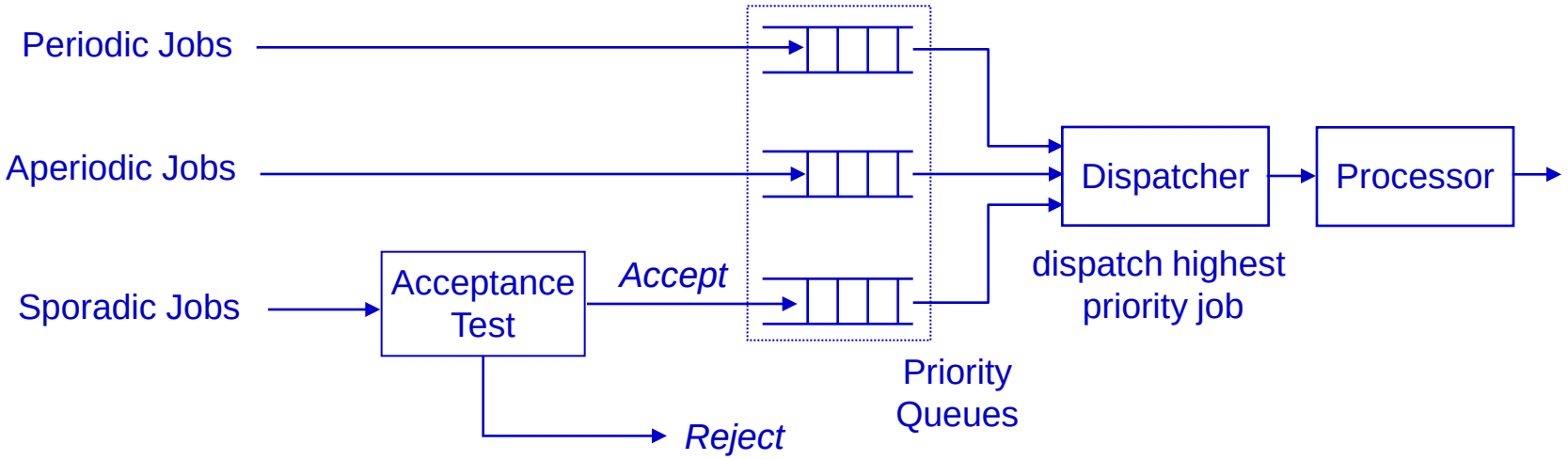
Scheduling Aperiodic/Sporadic Tasks

- **Assumptions:**
  - Preemptive, priority-driven algorithms
  - Jobs independent of one another with arbitrary interrelease times
- **Periodic Jobs**
  - parameters and priority driven algorithm given
  - on their own, periodic jobs meet all deadlines
- **Aperiodic Jobs**
  - parameters not necessarily known on release
- **Sporadic**
  - Parameters known on release
  - variable execution time
  - arbitrary deadline

Scheduling Architecture for Aperiodic Tasks

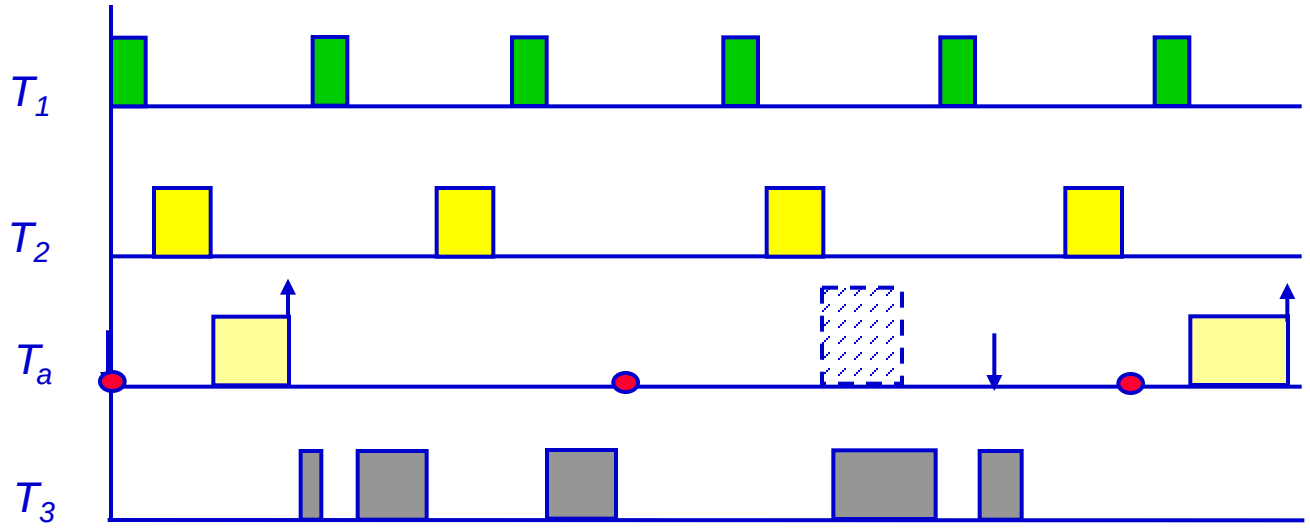
- **Aperiodic, Sporadic scheduling algorithms:**
  - all periodic tasks meet their deadlines
  - Sporadic jobs: on arrival, undergo acceptance test. Must not affect periodic jobs and already accepted sporadic jobs.
  - Aperiodic jobs: Optimize response time (average) without affecting periodic and accepted sporadic jobs



Approaches: Aperiodic

- ***Background:*** **scheduled when processor is idle**
- ***Interrupt-driven:*** **scheduled on arrival**
- ***Periodic server:*** **defined by (p_s, e_s). Budget replenished at p_s intervals. If scheduled and queue empty then budget set to 0.**
- ***Bandwidth-preserving server:*** **Improves on the periodic server by preserving budget (bandwidth) when aperiodic queue is empty:**
  - Deferrable servers
  - Sporadic Server
  - Constant utilization and Total bandwidth servers

Example of a Polling Server



- **To prove it works**
  - the polling server is periodic and has a WCET of e_s
- **When the polling server is eligible and there is no aperiodic task**
  - the budget is lost
- **Combine with a background server**

Aperiodic Servers

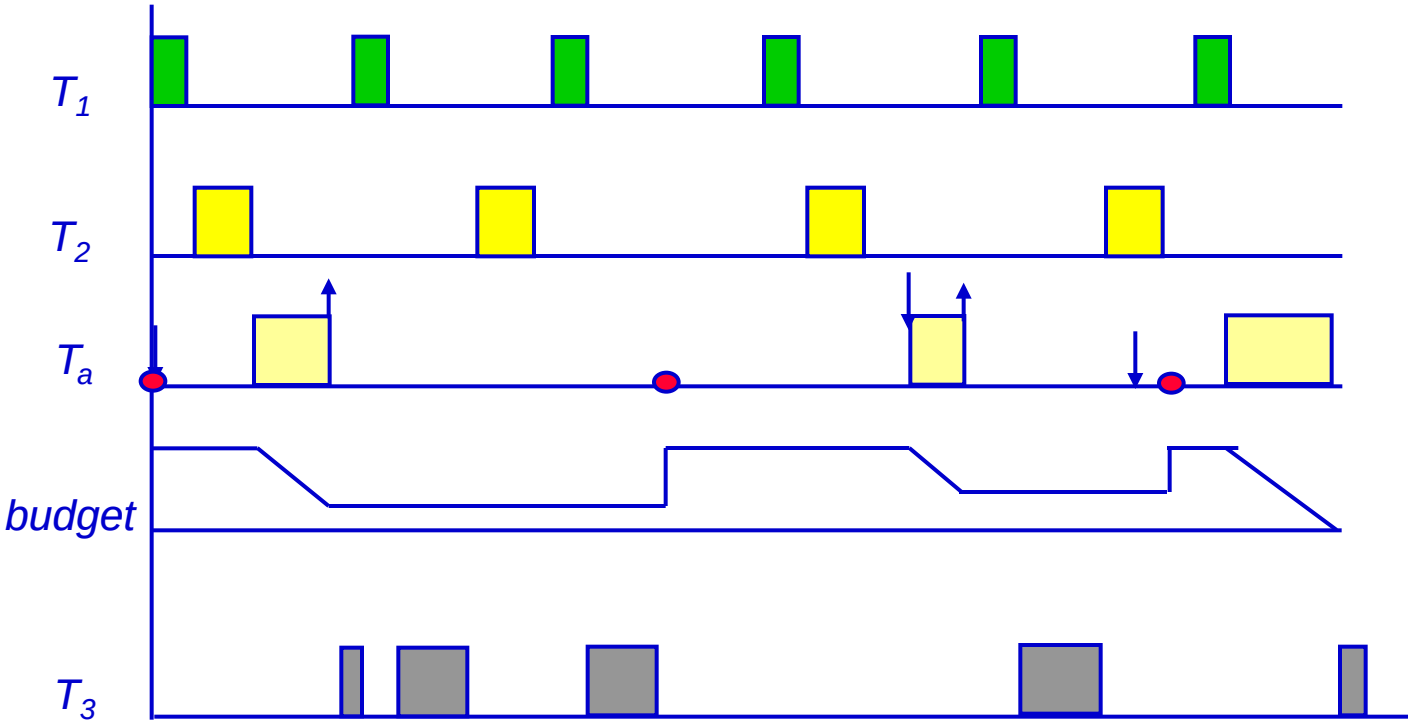
- **A service thread waiting for the external trigger(s)**
  - fixed execution budget
  - replenishment interval (period)
- **Can be compared to periodic tasks**
  - if it is ready, run according to priority scheduling scheme
- **Priority adjusted to meet requirements**
- **Issues:**
  - How to reserve the bandwidth when no aperiodic task exists
  - how to replenish the budget.
  - Example: Polling server
    - no bandwidth preserving
    - fixed replenishment time

Deferrable Server

- **A periodic server task is created.**
  - When the server is invoked with no outstanding aperiodic tasks, the server does not execute but defers its assigned time slot.
  - When an aperiodic task arrives, the server is invoked to execute aperiodic tasks and maintains its priority.
- **Unlike the priority exchange policy, the server's time is preserved at its initial priority.**
- **The computation time allowance for the server is replenished at the start of its period.**
- **Provides better response time for aperiodic tasks than Polling server**

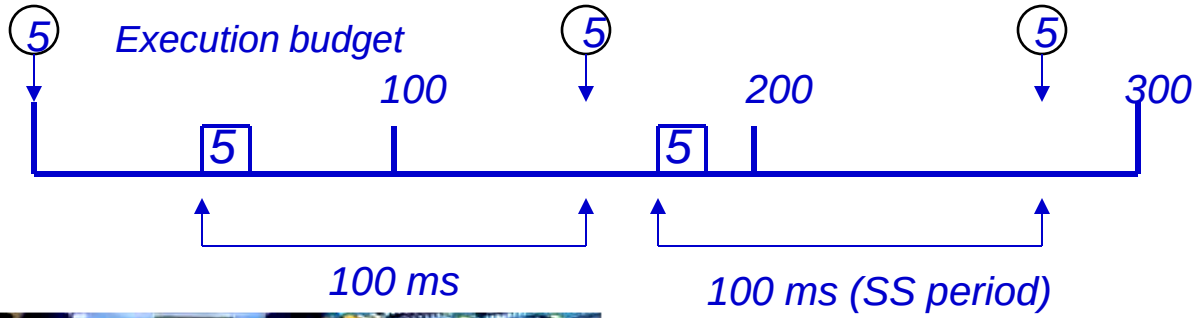
Deferrable Server (DS)

- **Periodic task (p_s, e_s) model with rules:**
  - budget consumed only when executing
  - budget replenished at kp_s, budget = e_s at kp_s



Sporadic Servers

- **The deferrable server has this one additional preemption and reduces the schedulability of periodic tasks.**
- **Vary the points at which the computation time of the server is replenished, rather than merely at the start of each period.**
  - allows to enhance the average response time for aperiodic tasks without degrading the utilization bound for periodic tasks
  - any spare capacity (i.e., not being used by periodic tasks) is available for an aperiodic task on its arrival
- **Sporadic server (p_s, e_s) does not demand more processor time than a periodic task with the same parameters**



Supplementary Slides