Resource allocation in a Cloud partially powered by renewable energy sources

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Project EPOC

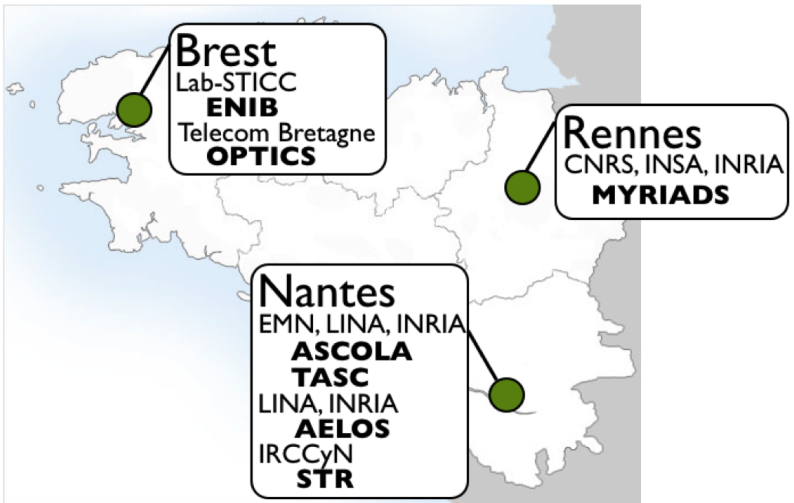


FIGURE 4: Maps

Figure : Collaboration

Project EPOC: **E**nergy **P**roportional and **O**pportunistic **C**omputing system.

- 4 Phd students
- 5 partners
- 6 teams

→ It aim at optimizing energy consumption at the level of hardware, software, network and the trade-off between energy costs and performance.

My subject

My subject: Resource allocation in a Cloud partially powered by renewable energy sources.

$\rightarrow$ At the infrastructure level, by designing an energy-aware distributed system in charge of optimizing the energy consumed by the infrastructure running the jobs.

Analysis the energy consumption in datacenters

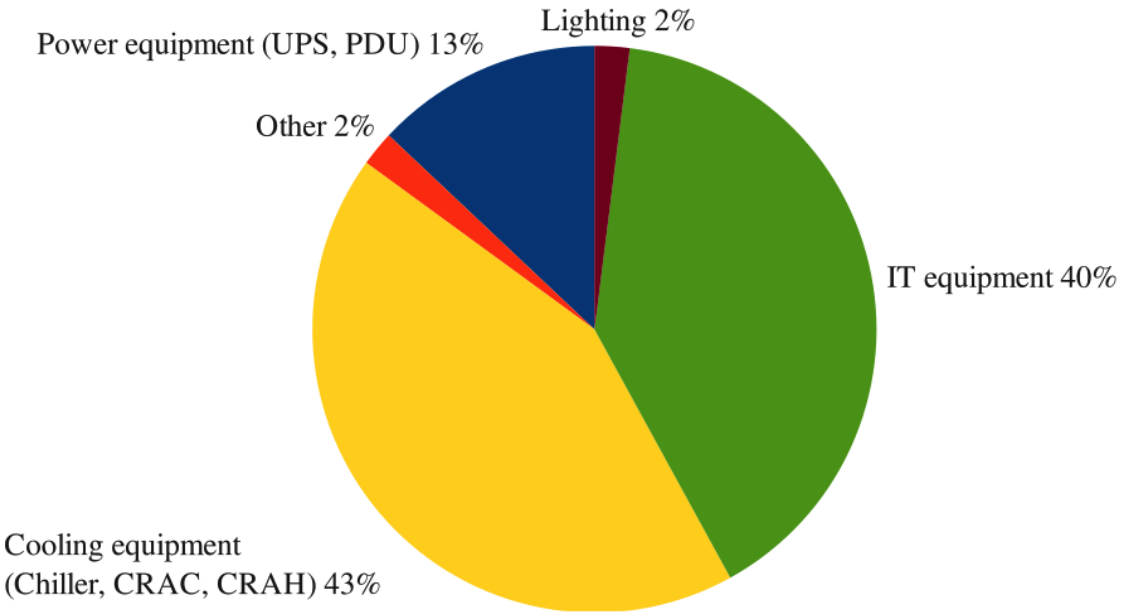


Figure : Energy consumption in datacenters

How can we reduce the energy consumption in datacenters?

Ref: Eugen Feller Phd thesis

Problem

Actual

Survey from Google: 5000 servers, average CPU utilization [10%, 50%] [1].
An idle server consumes between 50% and 80% of its peak power[2].

How can we reduce the energy consumption in datacenters?
$\rightarrow$ Increase the CPU/RAM utilization for each Physical Machine (PM) and switch-off the unnecessary powered-on PMs.

Advantage:

- More green by using the solar/wind power
- Reduce CO_2 emission footprint
- Reduce brown energy consumption and save money

[1]Luiz Andr e Barroso and al. The case for energy-proportional computing. Computer, 40 :33–37, December 2007.
[2]Stephen Dawson-Haggerty and al. Power optimization, a reality check. Technical Report UCB EECS-2009-140, EECS Department, University of California, Berkeley, Oct 2009.

System assumption

- In *a mono-site* [50 servers]. PMs hardware can be either homogeneous or heterogeneous.
- Three kinds of modes to provide power (Green energy, brwon energy, hybrid)
- No batteries to store electricity

Job scheduling

- **When**

  Time is divided into slot.
  Job classification:

  1. web-job - Non-Interruptible
  2. batch-job - Interruptible within deadline

  Schedule/Reschedule jobs at the beginning of each slot:

  - Schedule web-job first (Algo-webjob)
  - Then schedule the batch-job (Algo-batchjob)
  - If there is not enough green energy (Algo-consolidation if necessary)

- **Where** (e.g. #node/#server) The chose serve should satisfy job's demand
  - Constraints of servers:
    1. CPU resource (e.g. number of cores)
    2. Memory resource

The system model

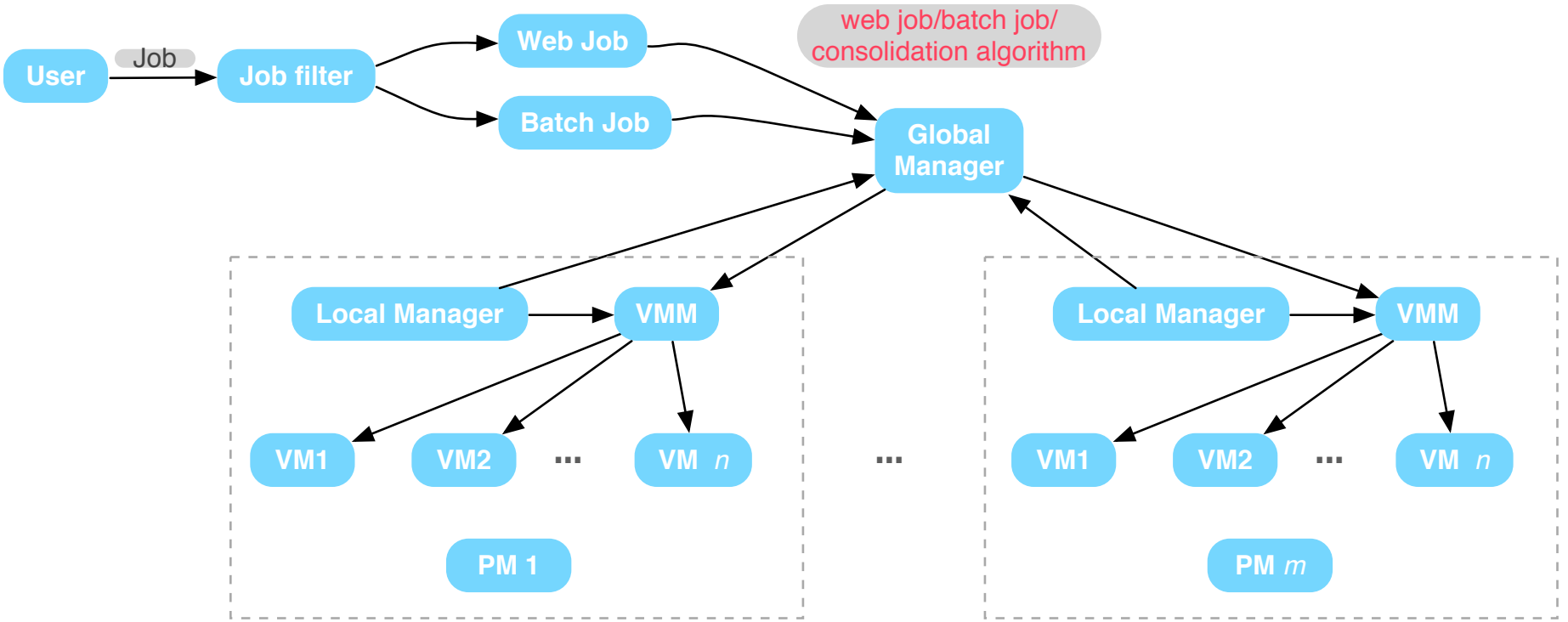


Figure : The system model

Switch ON servers

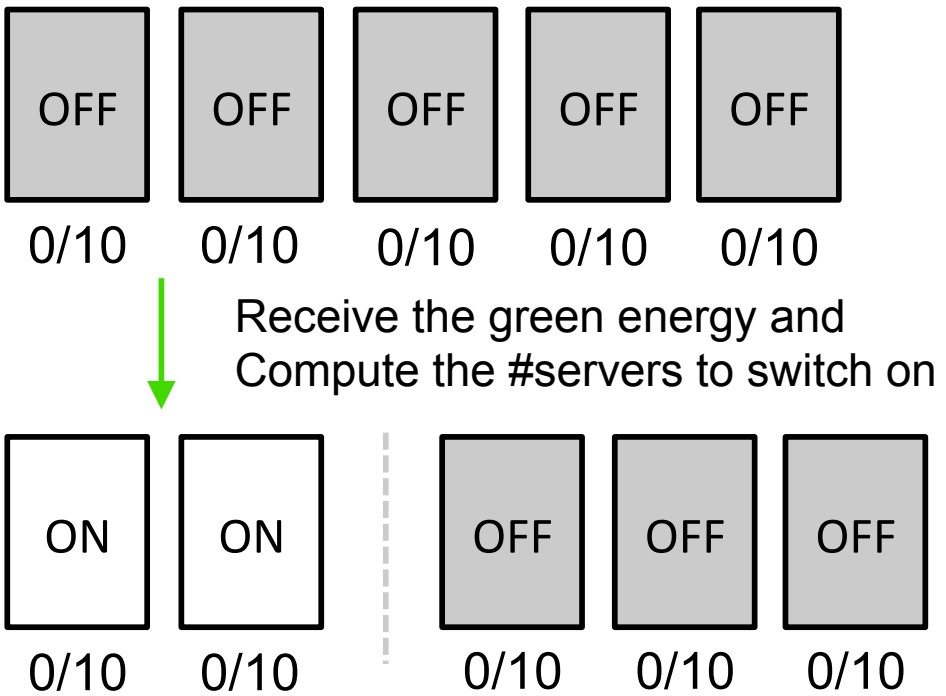
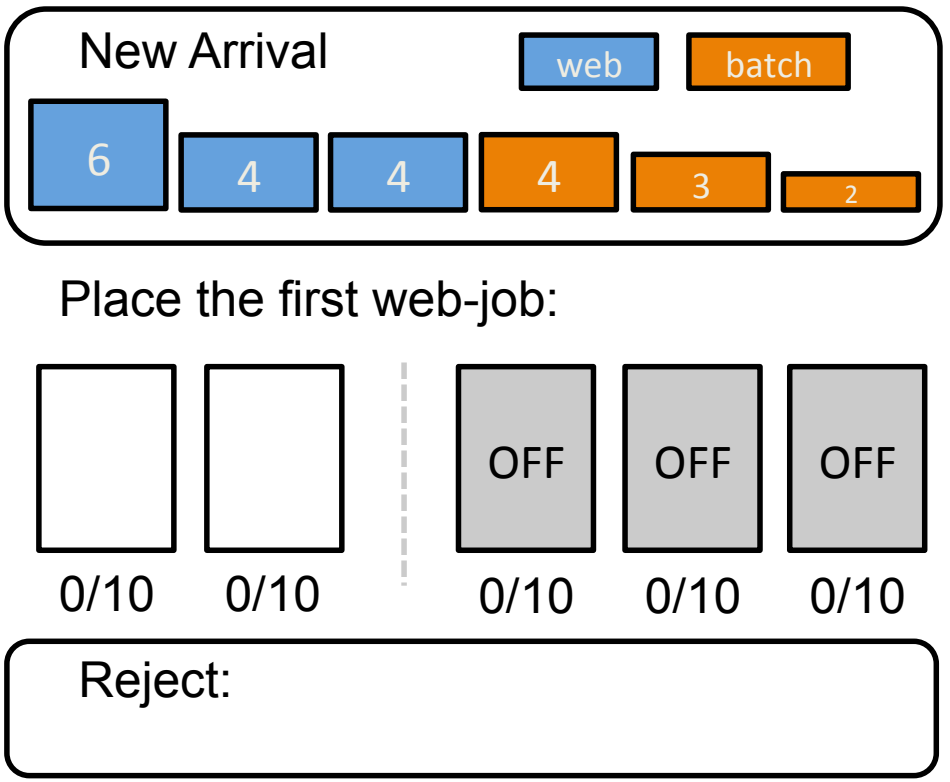


Figure : Switch ON servers

Job placement algorithm



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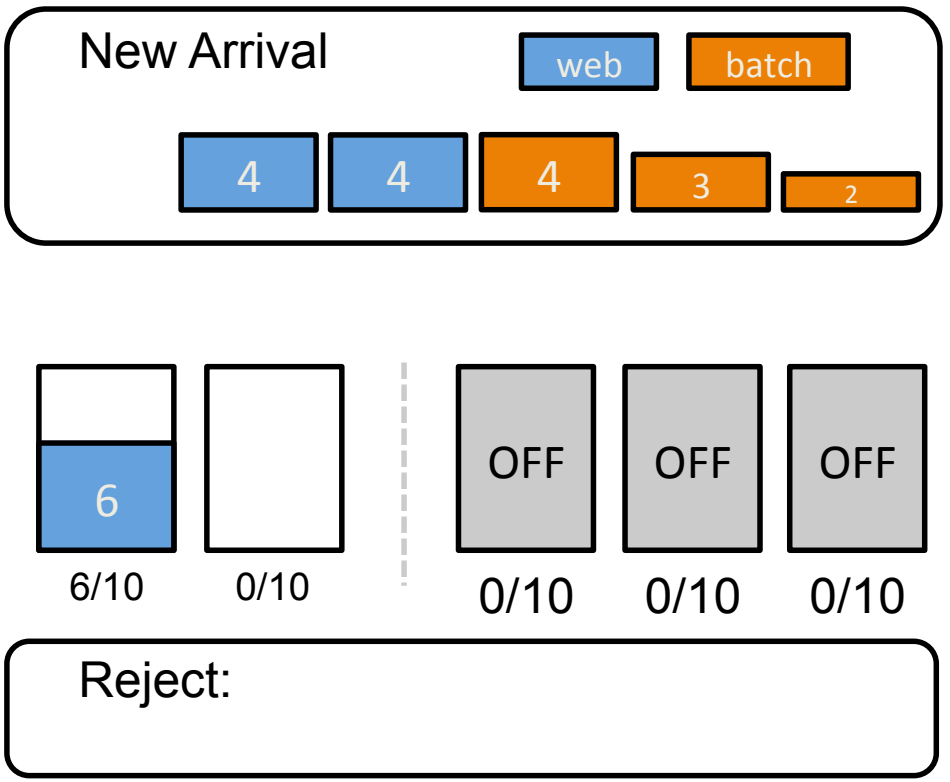

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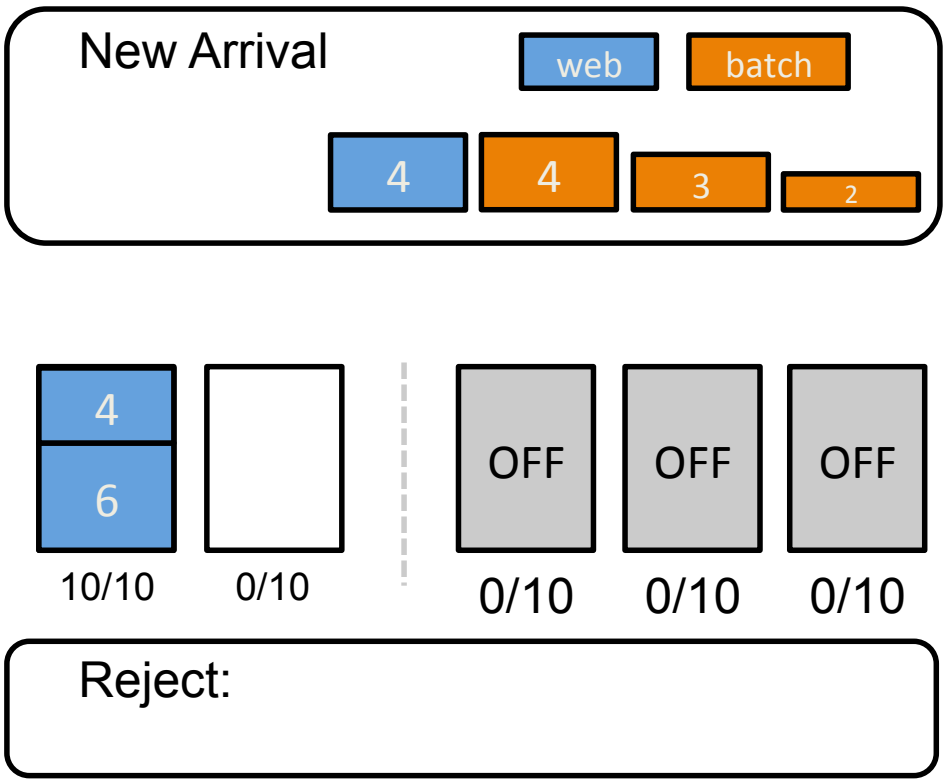

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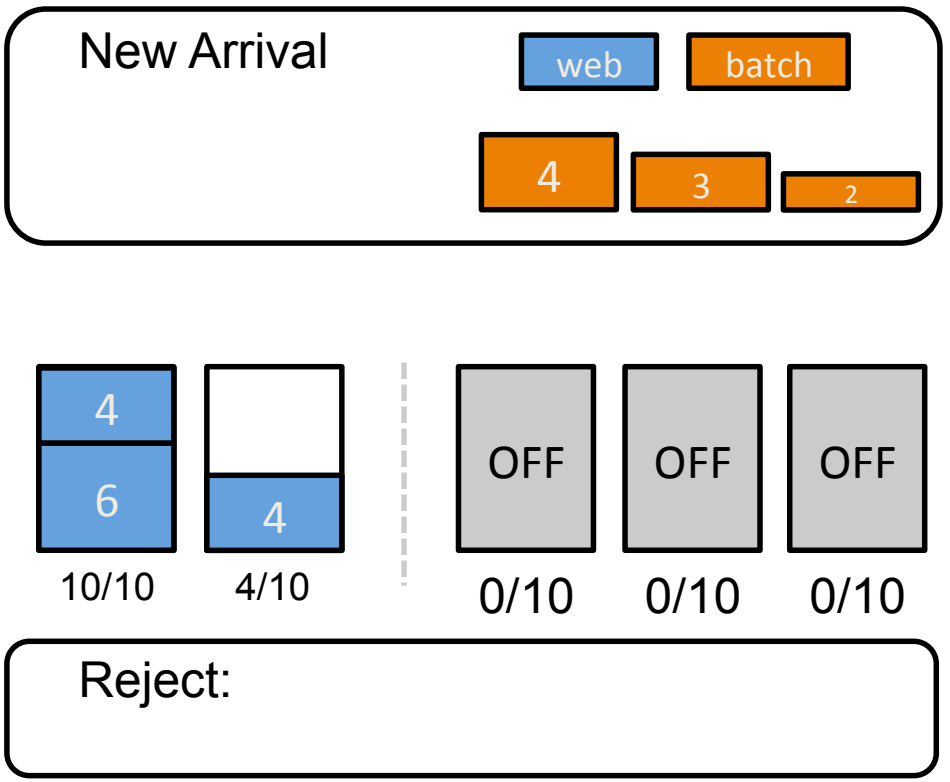

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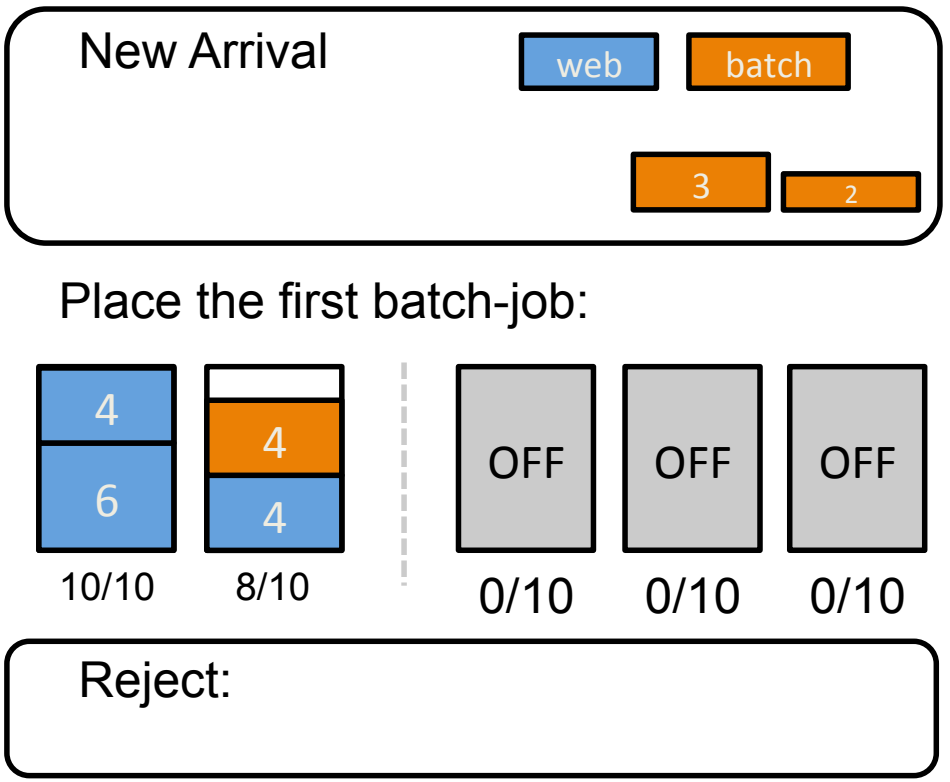

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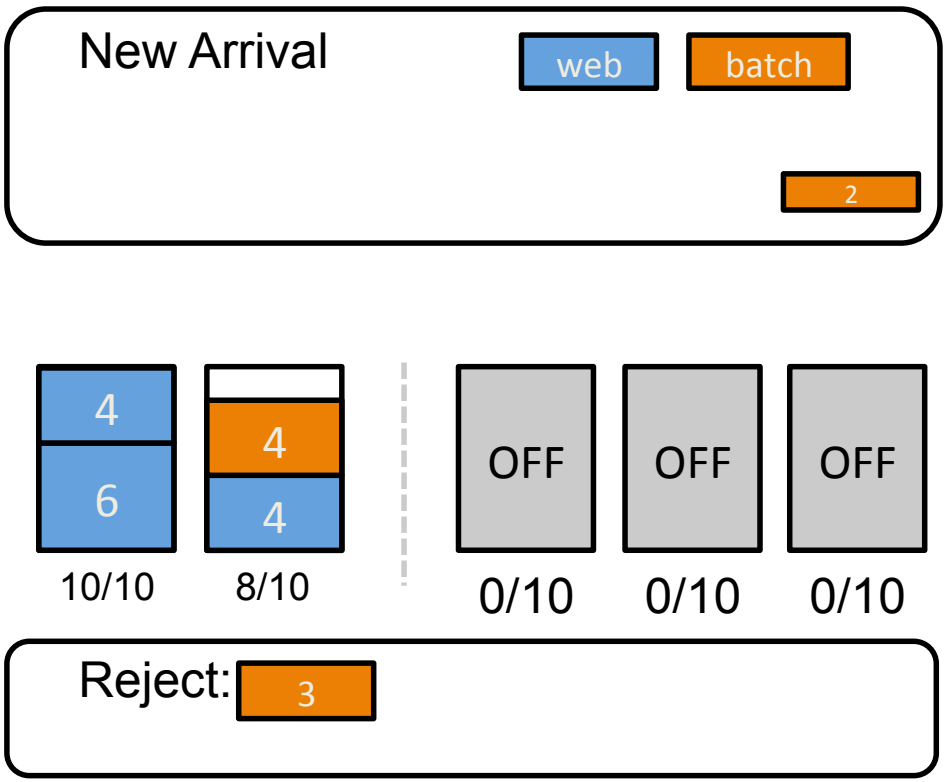

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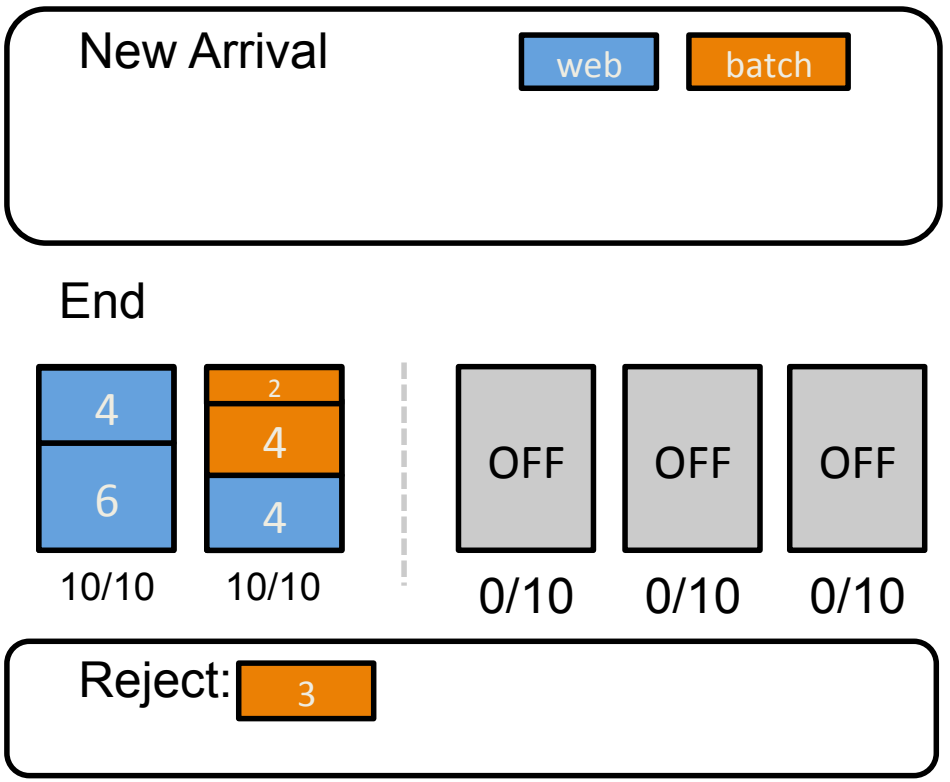

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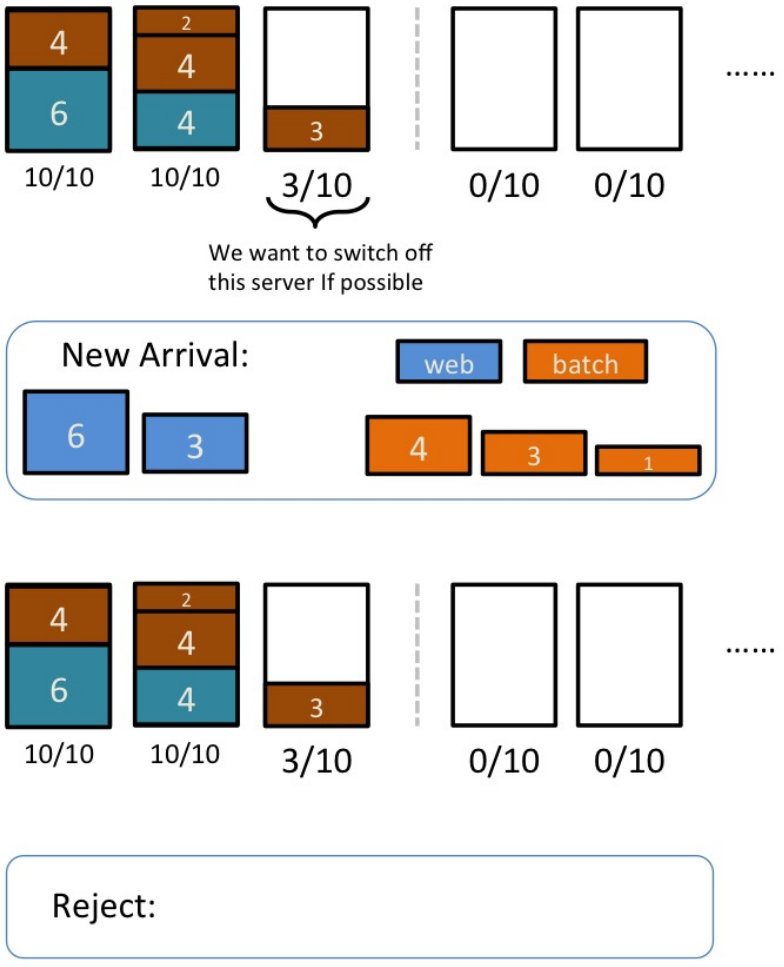
Switch OFF servers



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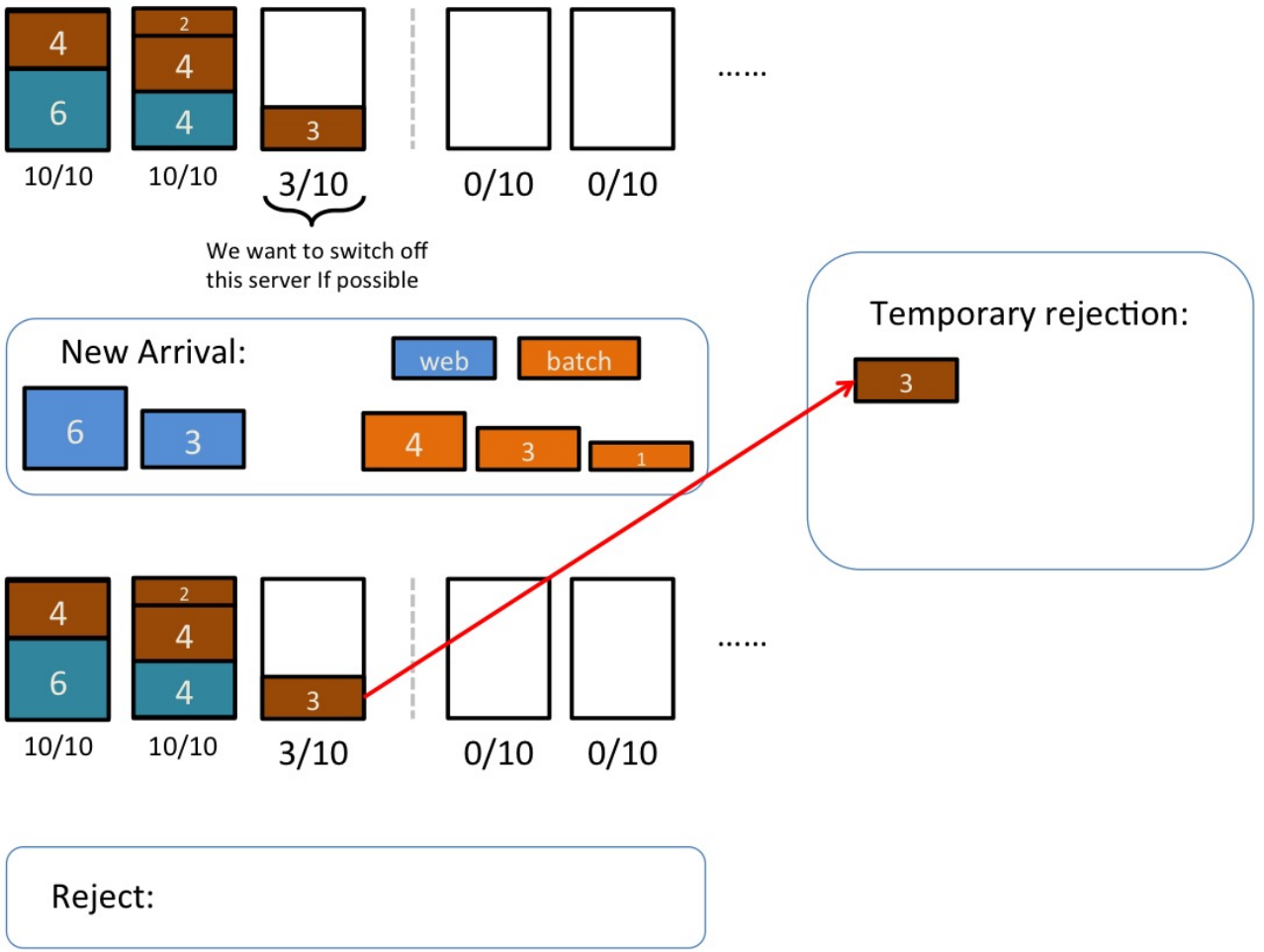

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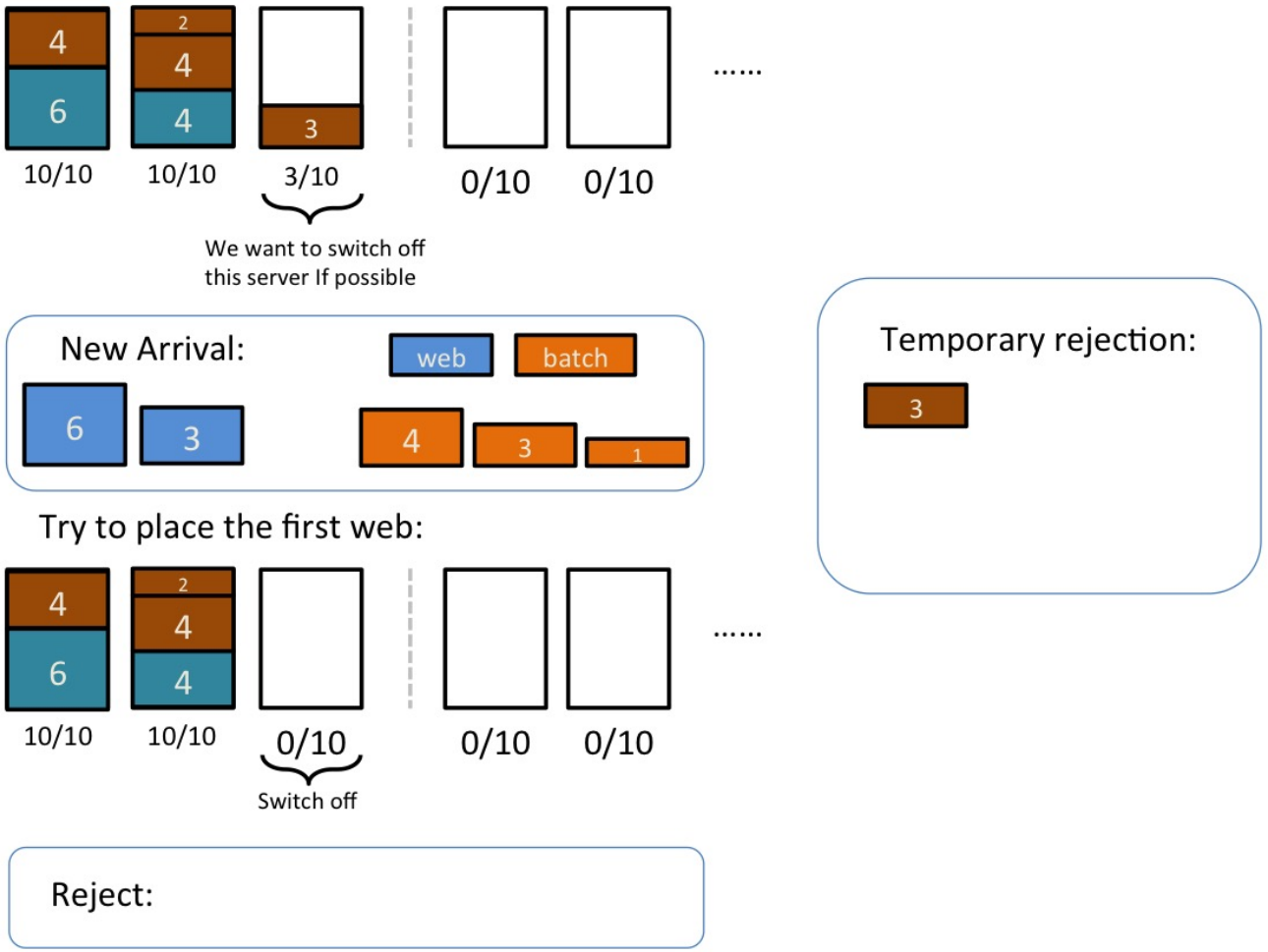

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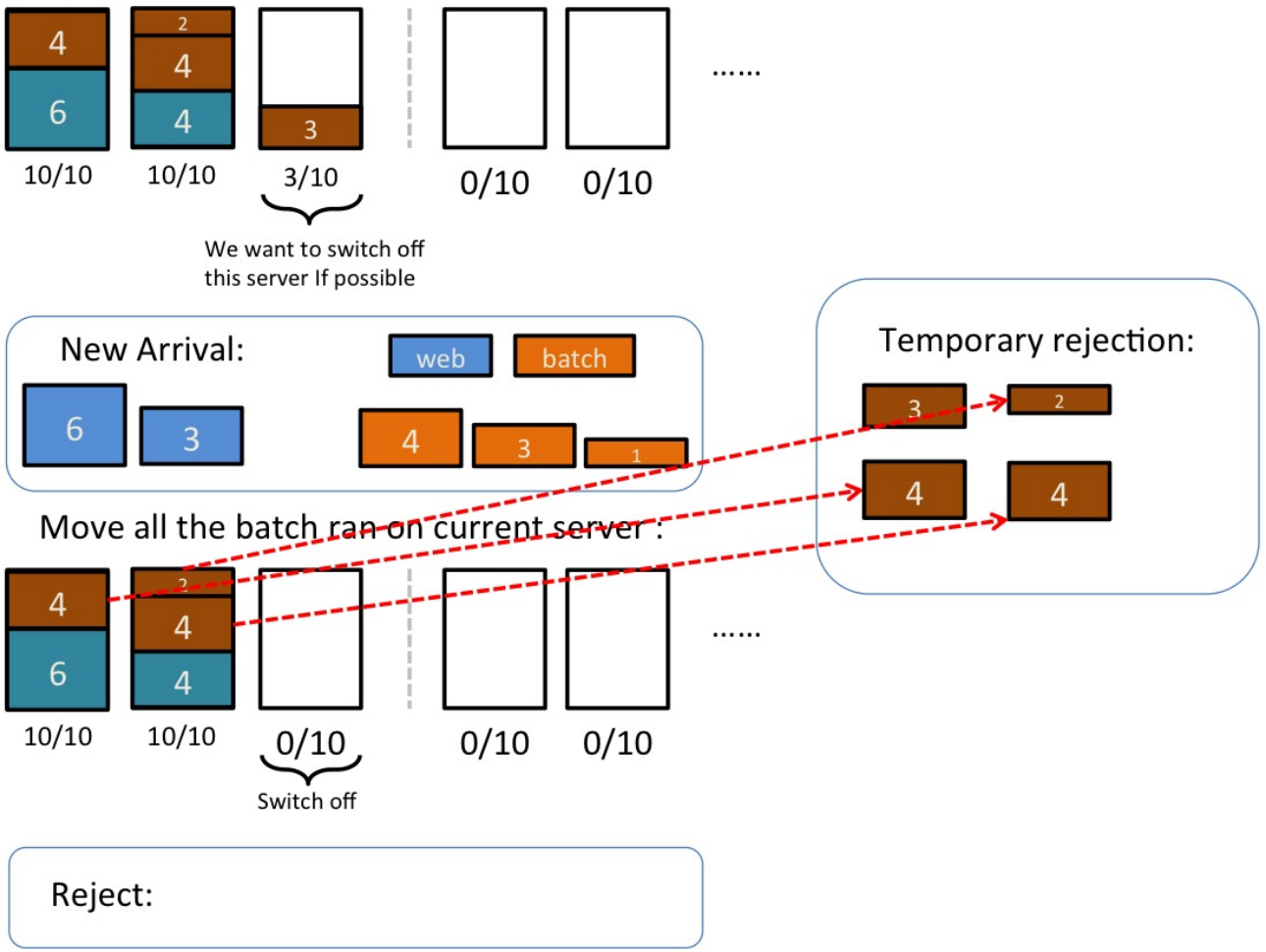

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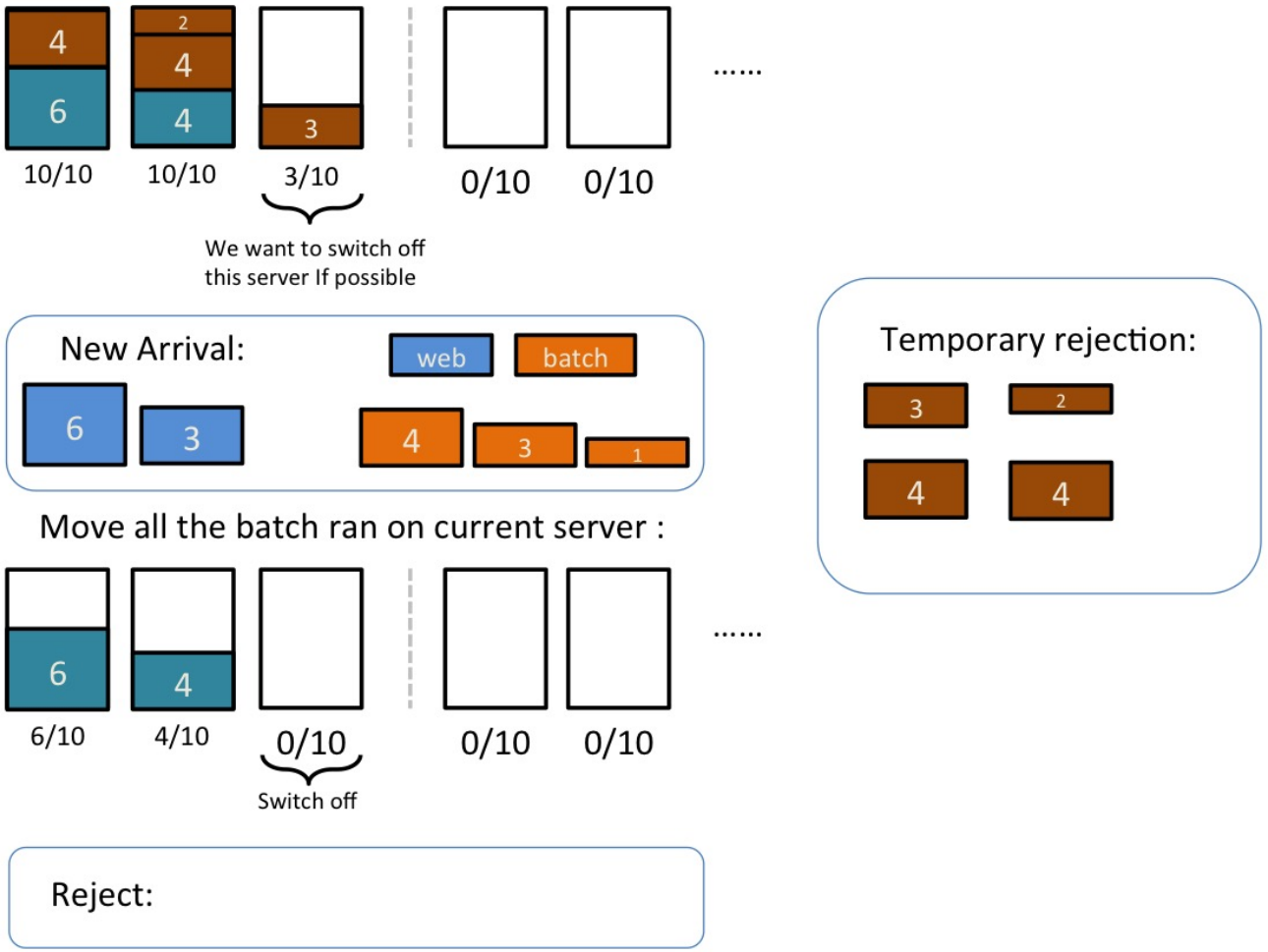

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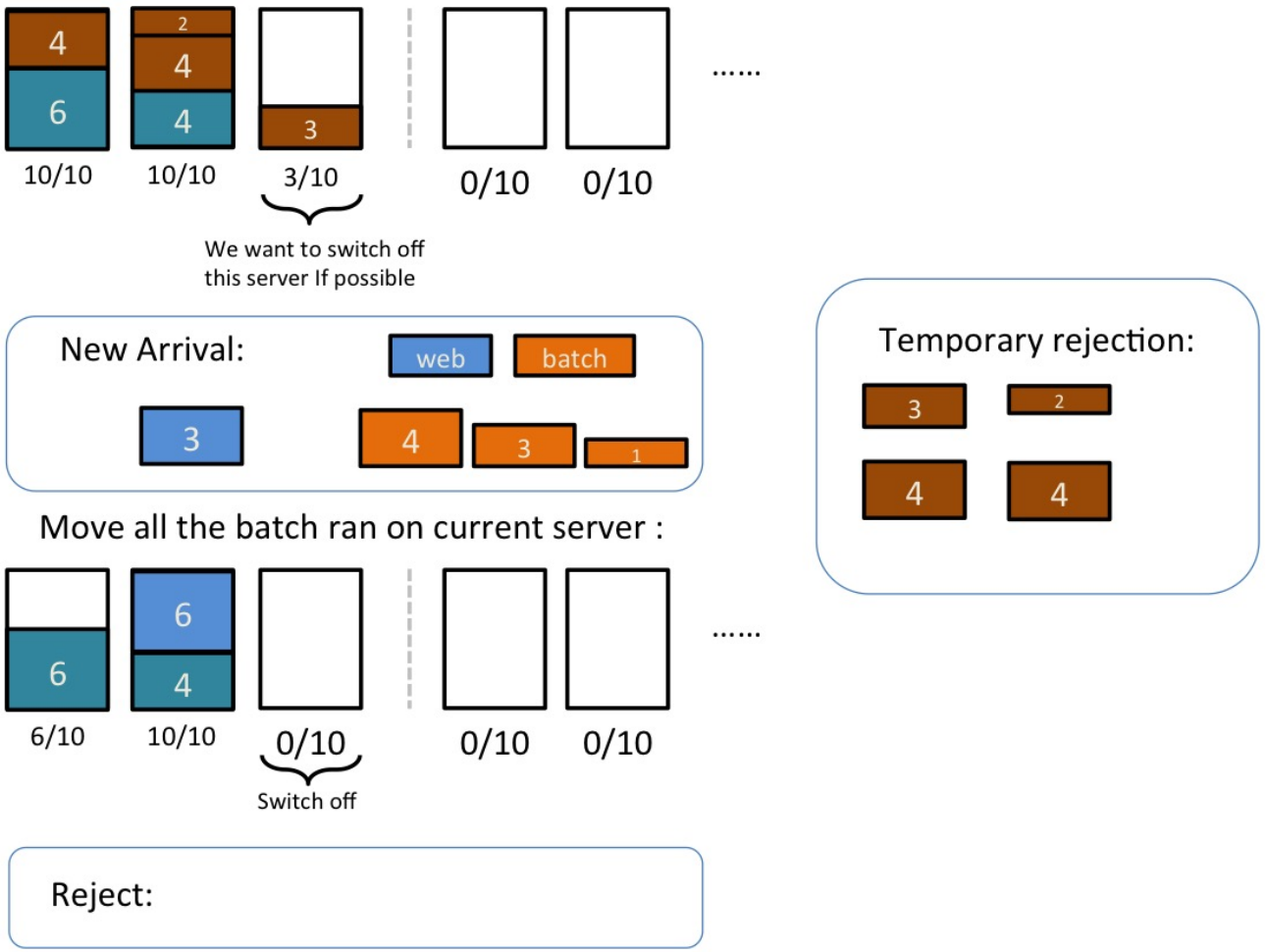

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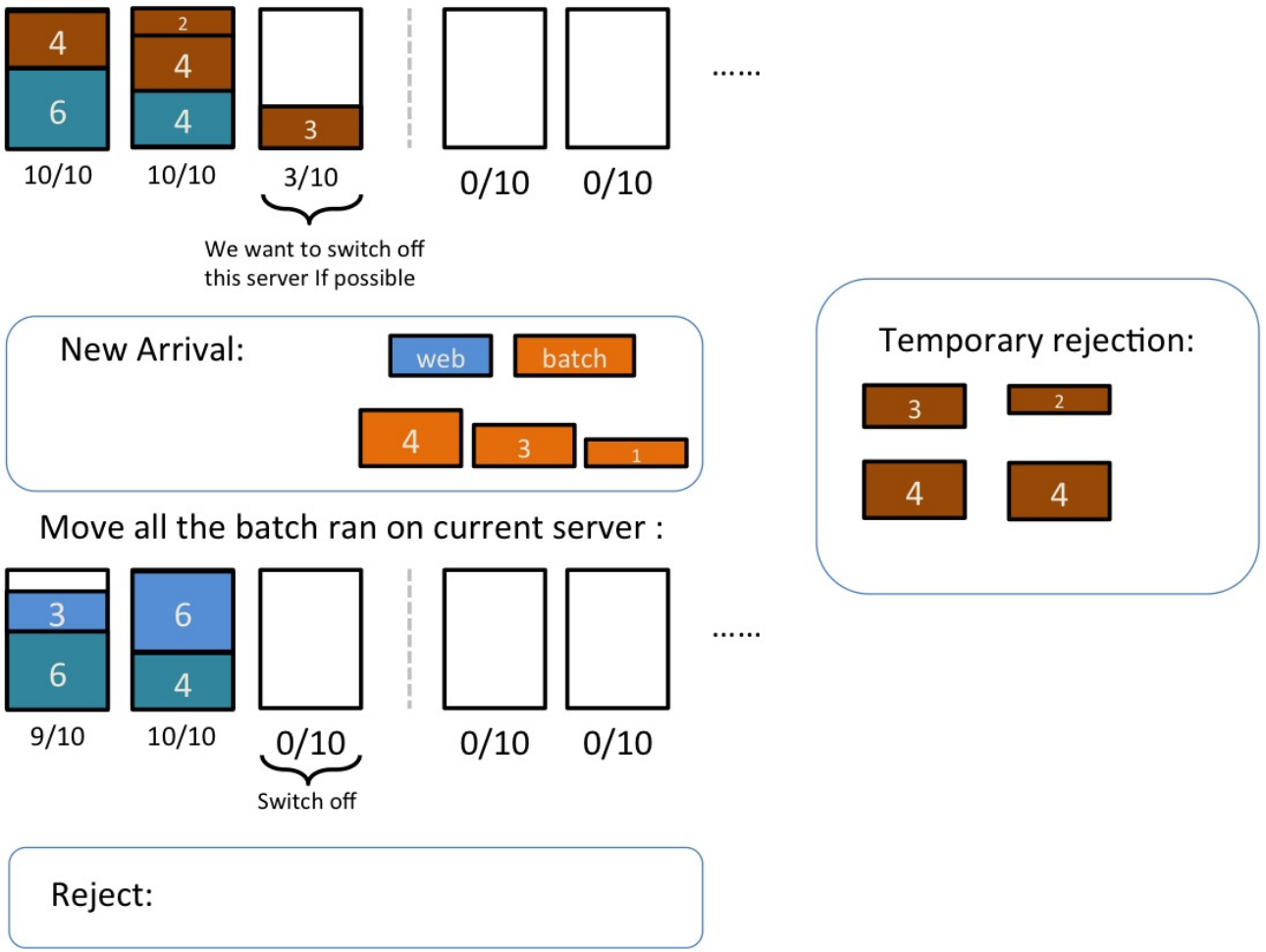

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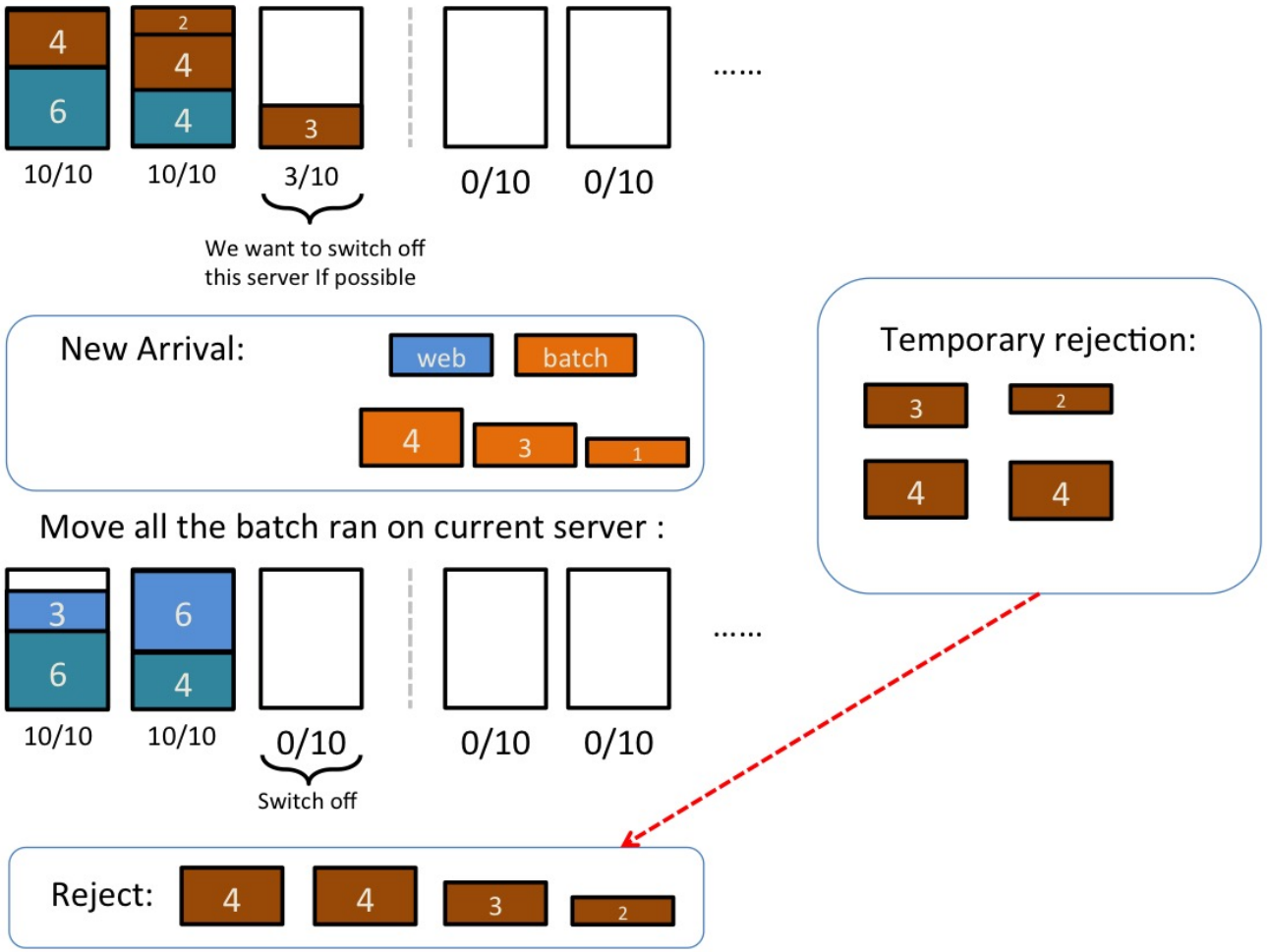

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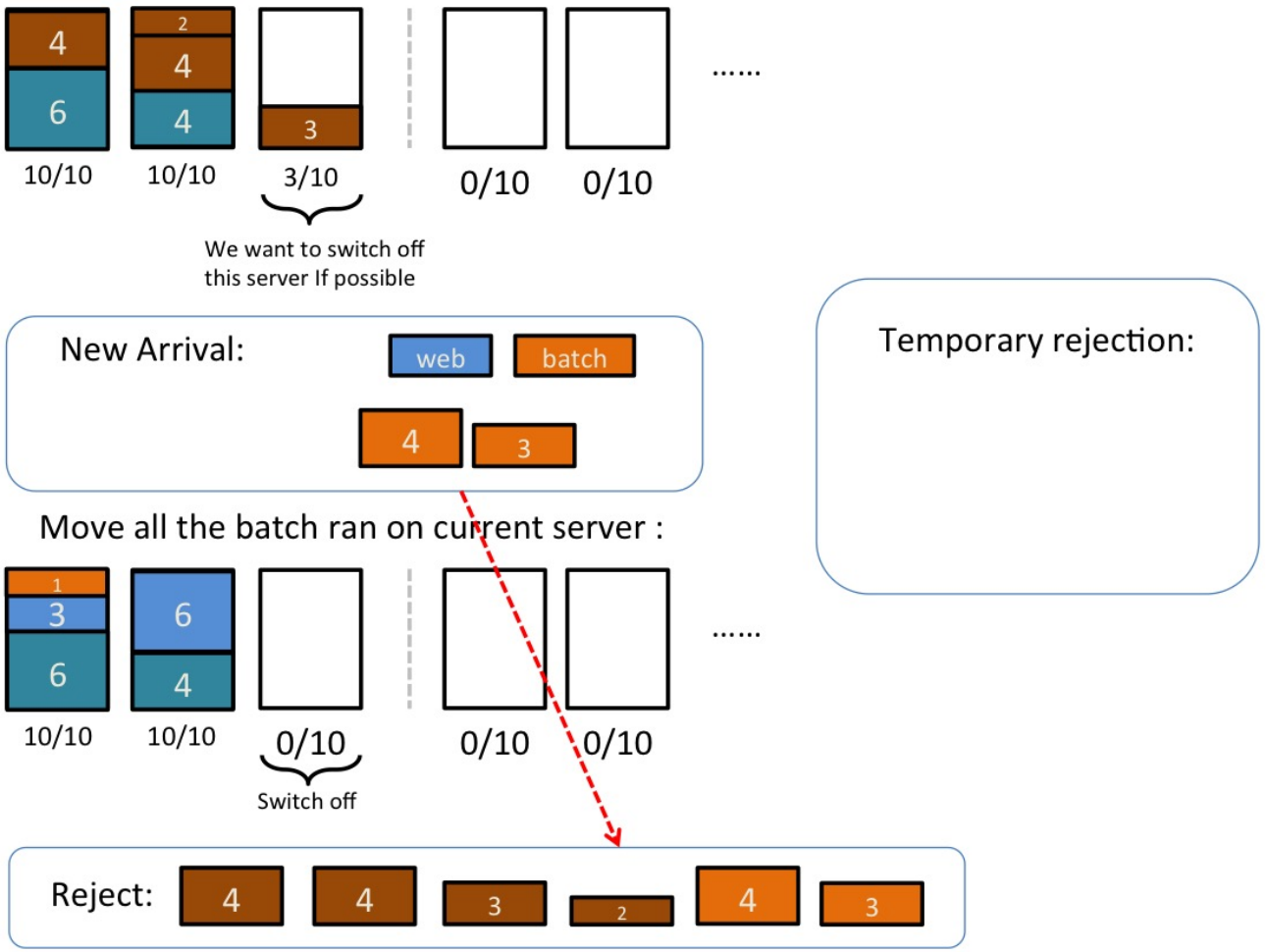

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Solar power (1)

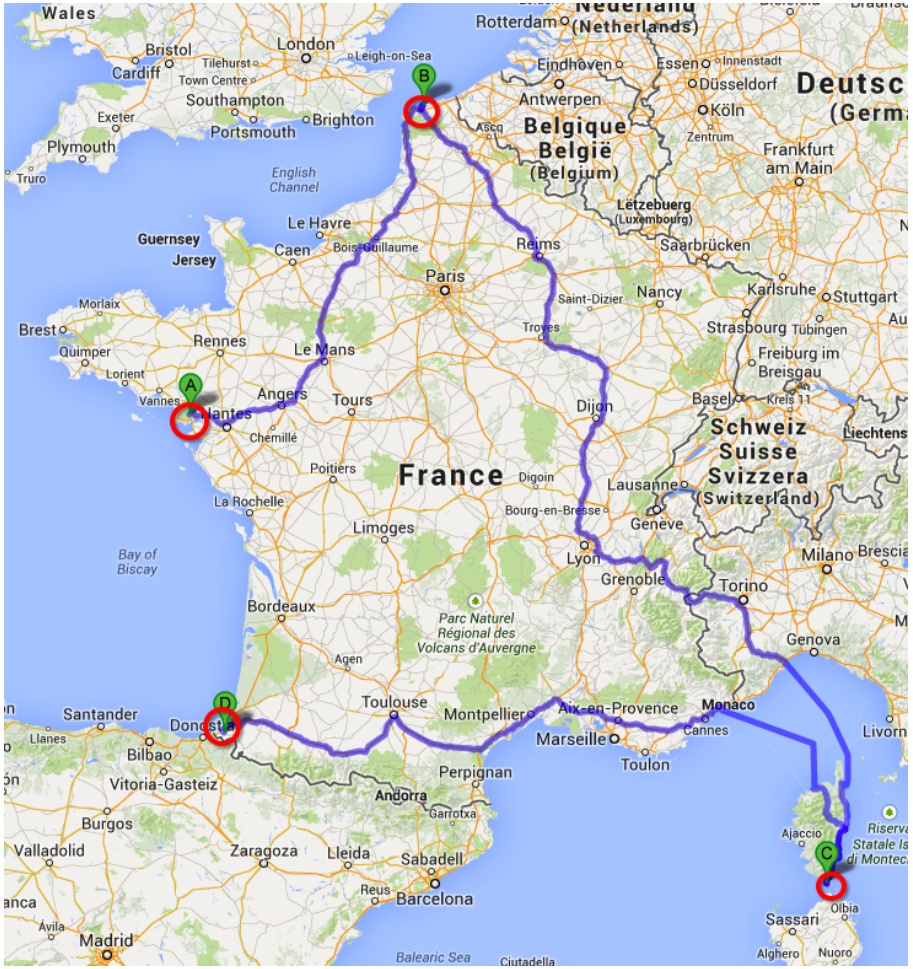

Figure : 4 sites' coordinate in France

History from the 1 jan 2005 to 31 dec 2012

Solar power (2) - Real trace

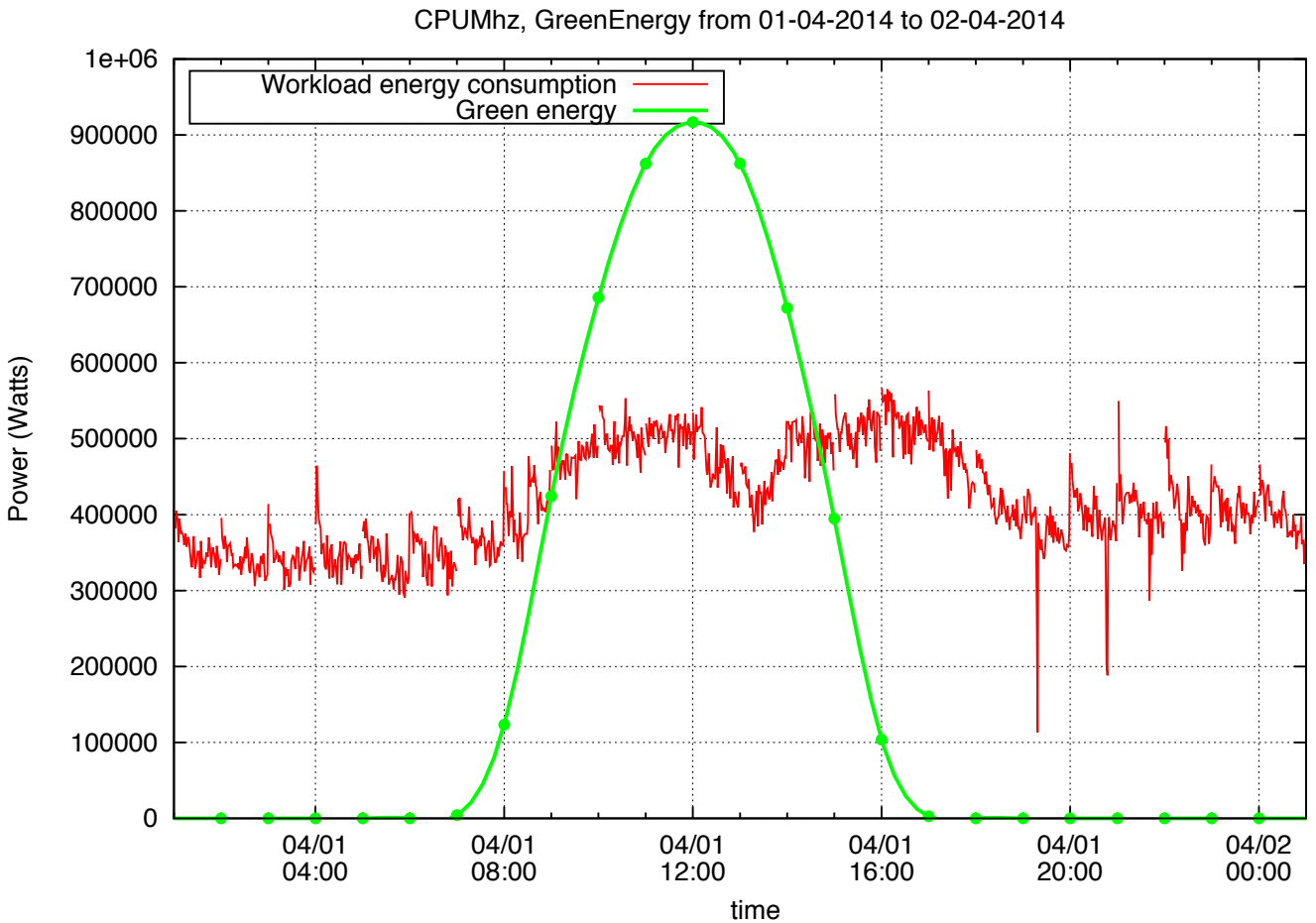

Figure : 2009 solar radiation, site North near Calais
Database provided by **EasyVirt**.

Validation

End of development a simple simulator to valid our algorithm.
Code source : Java
After valid this prototype, we will experimenter it on Grid'5000.

Conclusion

Topic: Resource allocation in a Cloud partially powered by renewable energy sources
General problem to solve :

- Resource allocation
- Maximize on using the renewable energy instead of the Brown energy .

For VM consolidation, our research is focus on the three following points.

- VM placement $\rightarrow$ The server manager rank the PM and VM by combining different weighting factors.
- Reduce the number of powered-on physical machines by increasing the VM consolidation ratio

The End
Merci:)