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Descartes
research

Heat-aware Loadbalancing - Is it a thing?

Lukas Iffländer, **Norbert Schmitt**, Andreas Knapp, and Samuel Kounev

Chair of Software Engineering – Universität Würzburg

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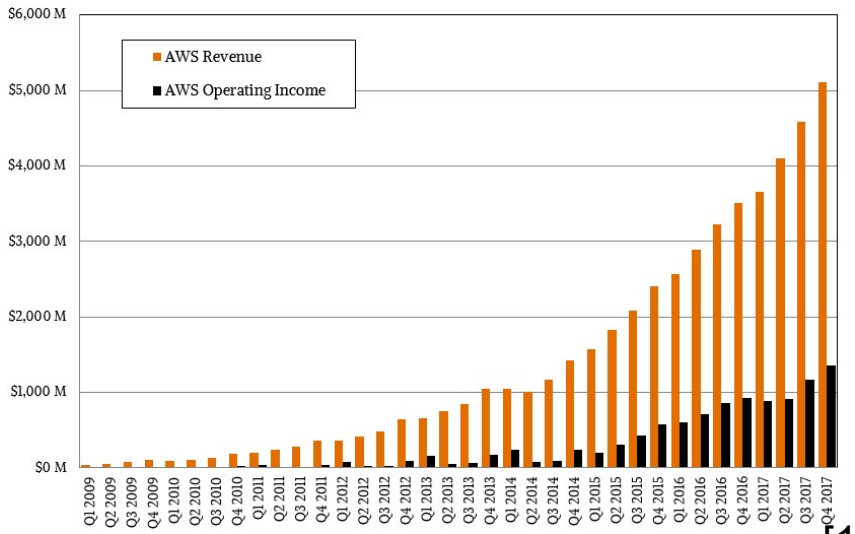
https://se.informatik.uni-wuerzburg.de/

Motivation

- Increasing amount of cloud users and services



[1]

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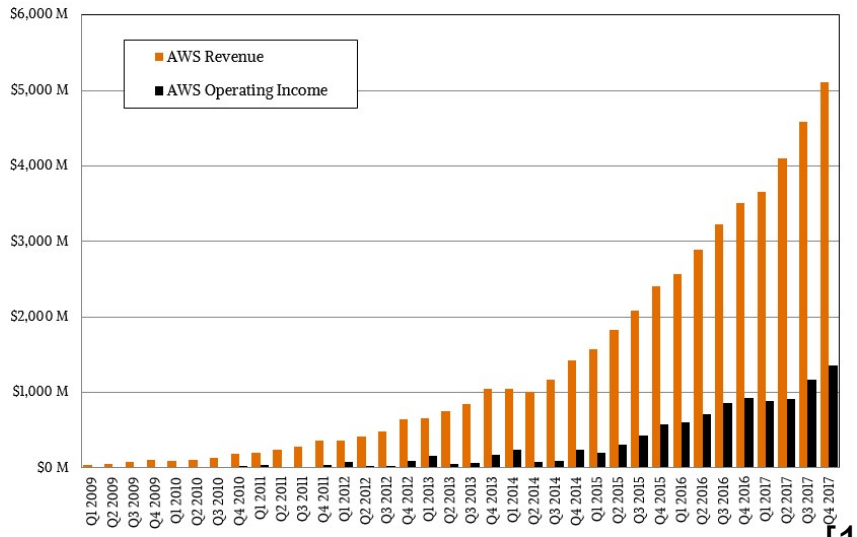
- Increasing amount of cloud users and services
- Increasing requirements on computing power by more traffic

➔ Increasing computing power needed



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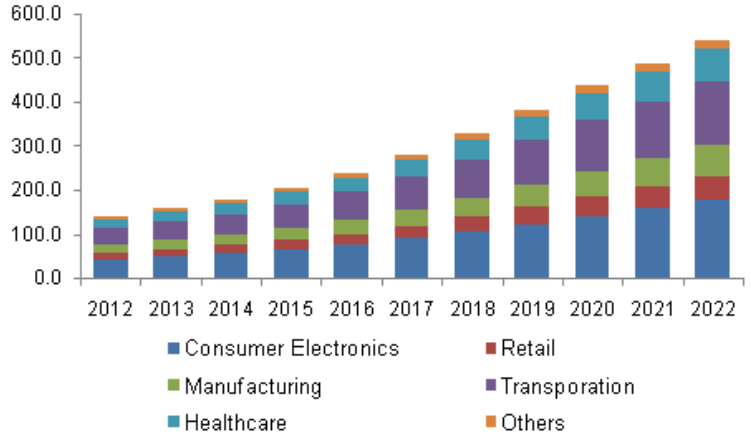

[2]

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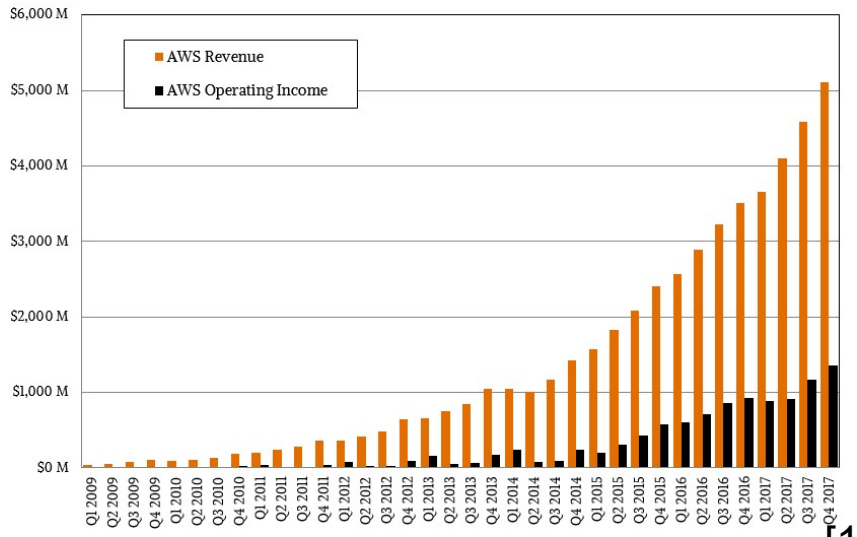

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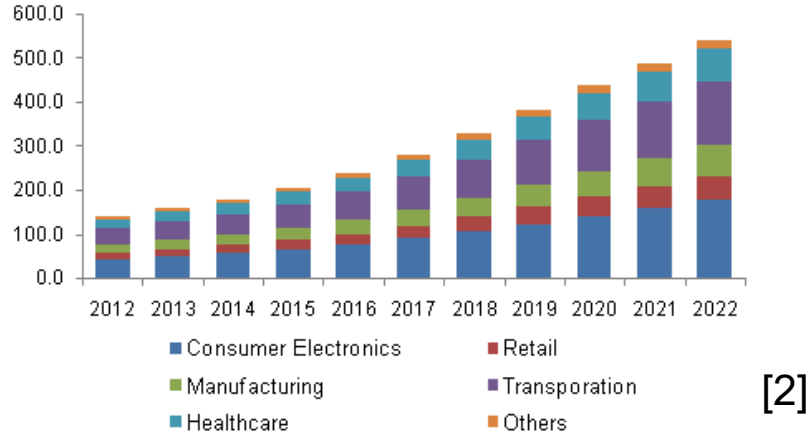
- Solution 1: More servers? ↯



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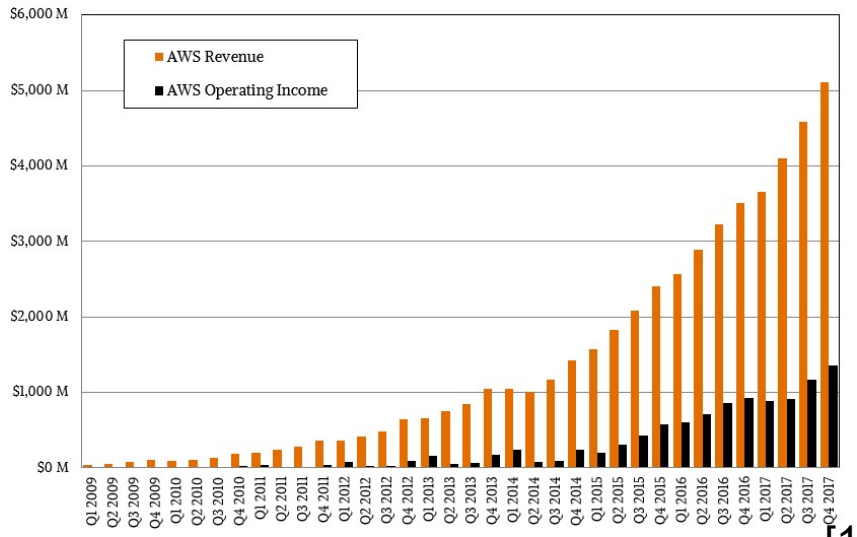
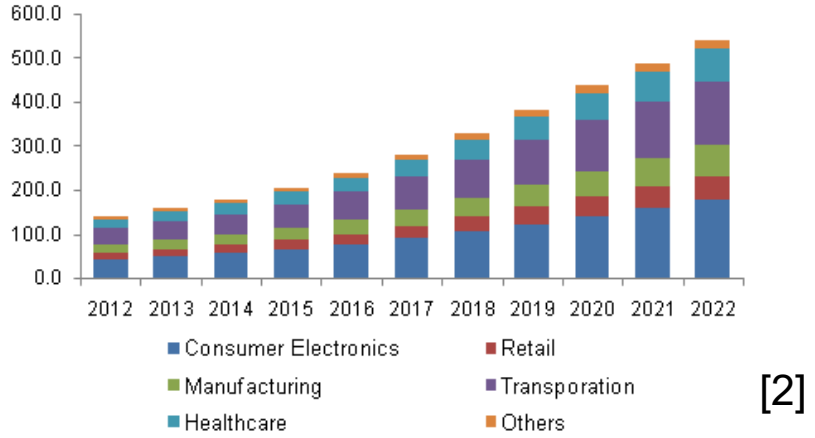


[1]

- Solution 1: More servers? ↯
- Solution 2: Better/Full usage of existing computing power ✓

➔make use of unallocated CPU boost power



[2]

Goals

1. Is it possible to exceed permanently and feasibly the clock rate with host relay?

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2. What is the effect on the computing power compared to normal behavior?

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2. What is the effect on the computing power compared to normal behavior?

3. What is the effect on the energy consumption compared to normal behavior?

Contributions

1. A first approach to heat-aware load-balancing

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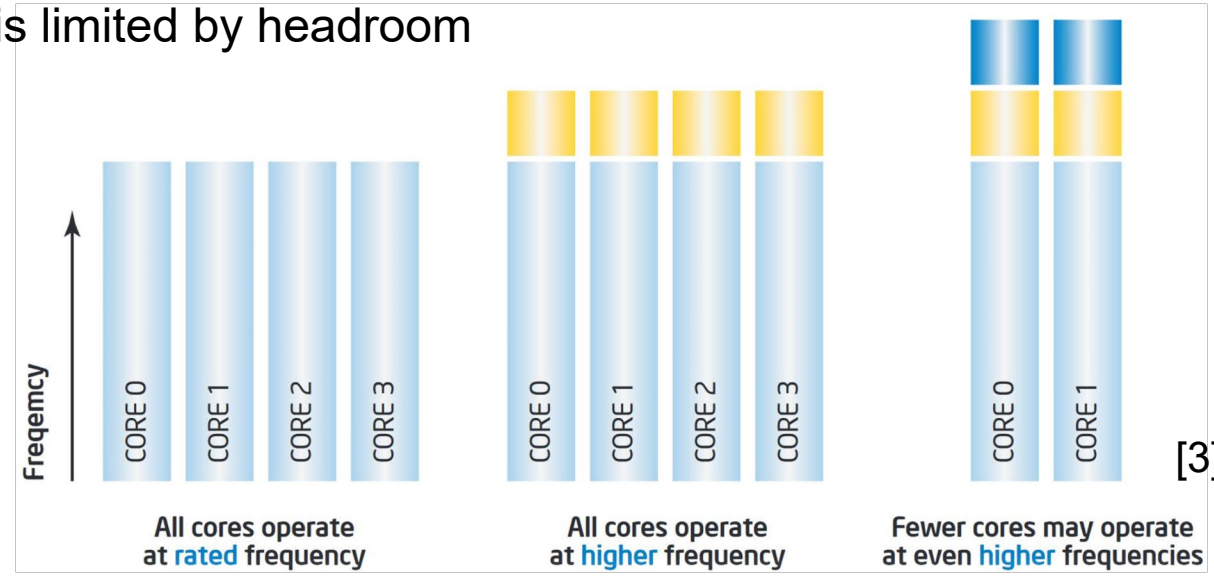
2. A prototype implementation with SDN and an initial evaluation

Approach - Boosting

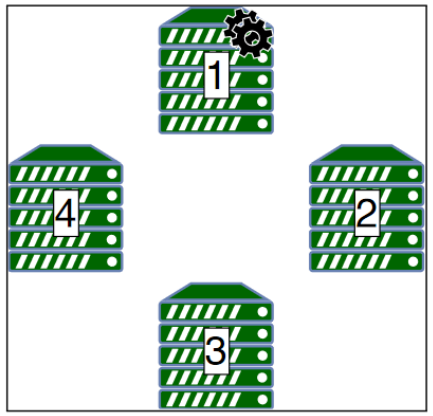
- Intel Turbo Boost:
  - CPU-Boost ≠ Overclocking in general
  - CPU Boost respects specifications of hardware
  - Max. n° of boosted cores and max. frequency is limited by headroom
  - OS requests more computing power ➔ Boost
  - Example Intel:
    - Stepwise increasing clock with 133,33 MHz
    - Time in boost state depends on:
      - Temperature
      - Energy



[3]

- Other common used boost: AMD Turbo Core / AMD Precision Boost
- Boosts are usually disabled in related work and HPC environments due to unpredictability

Approach



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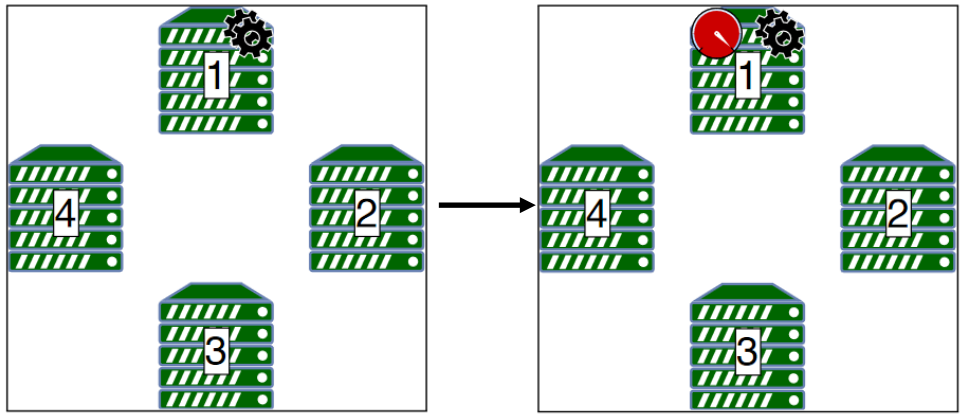

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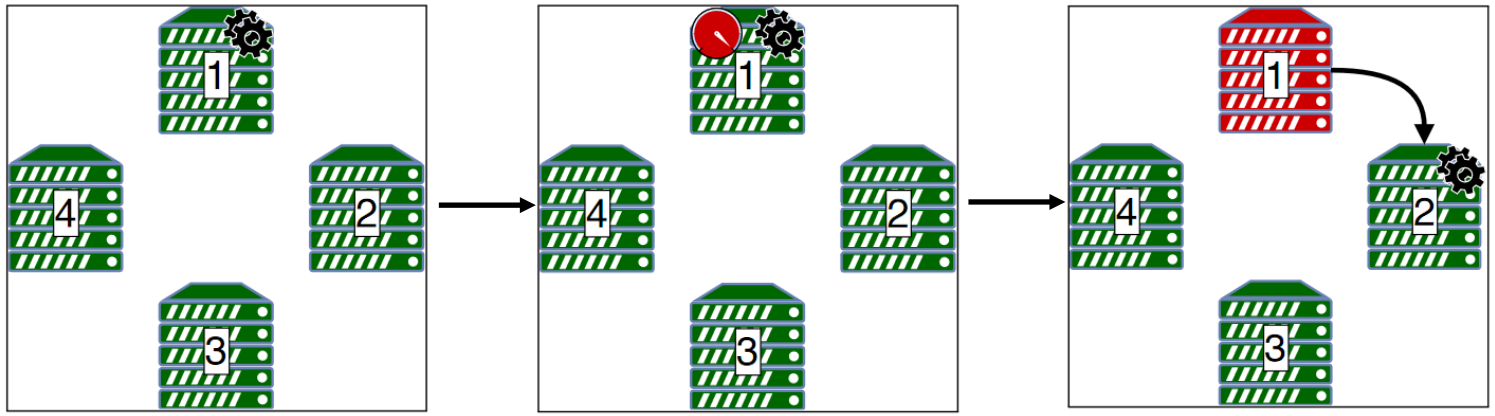

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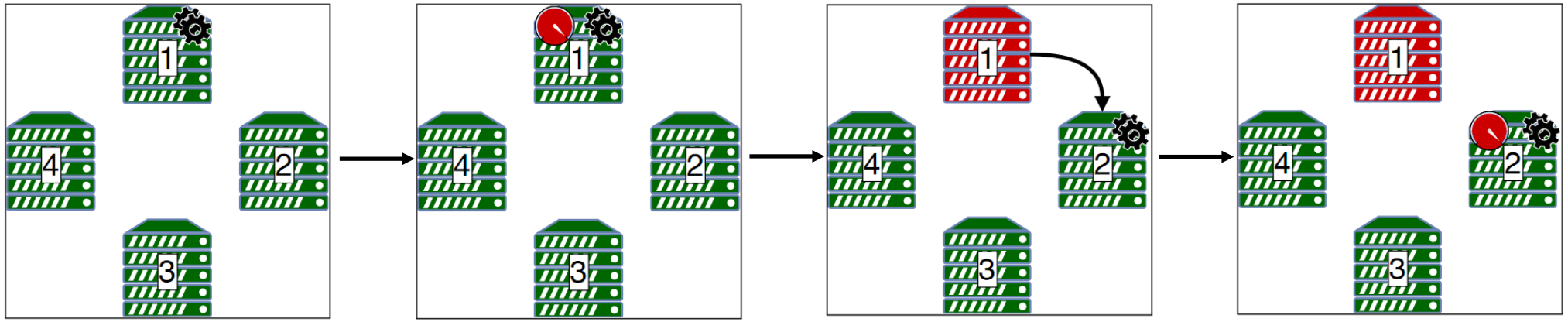

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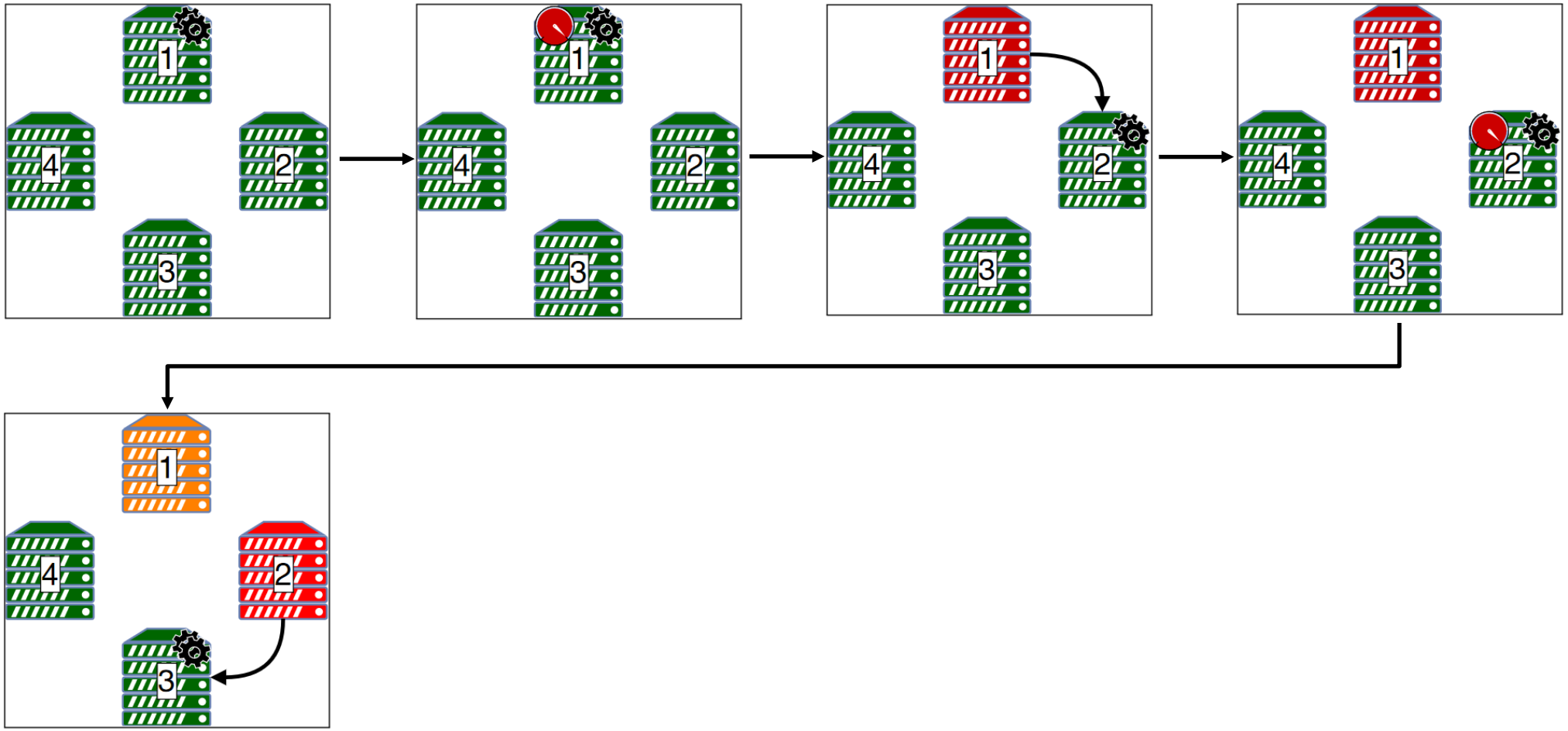

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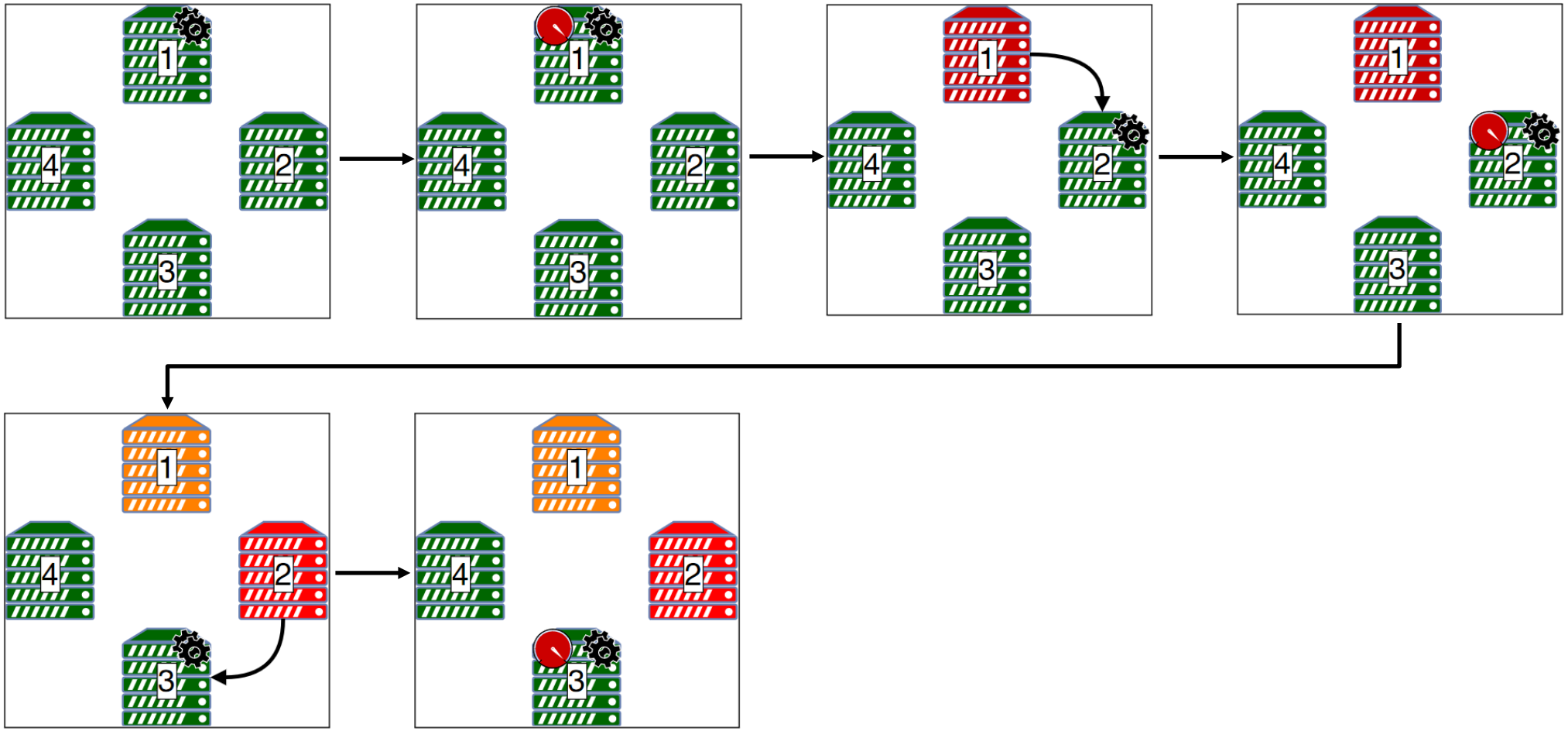

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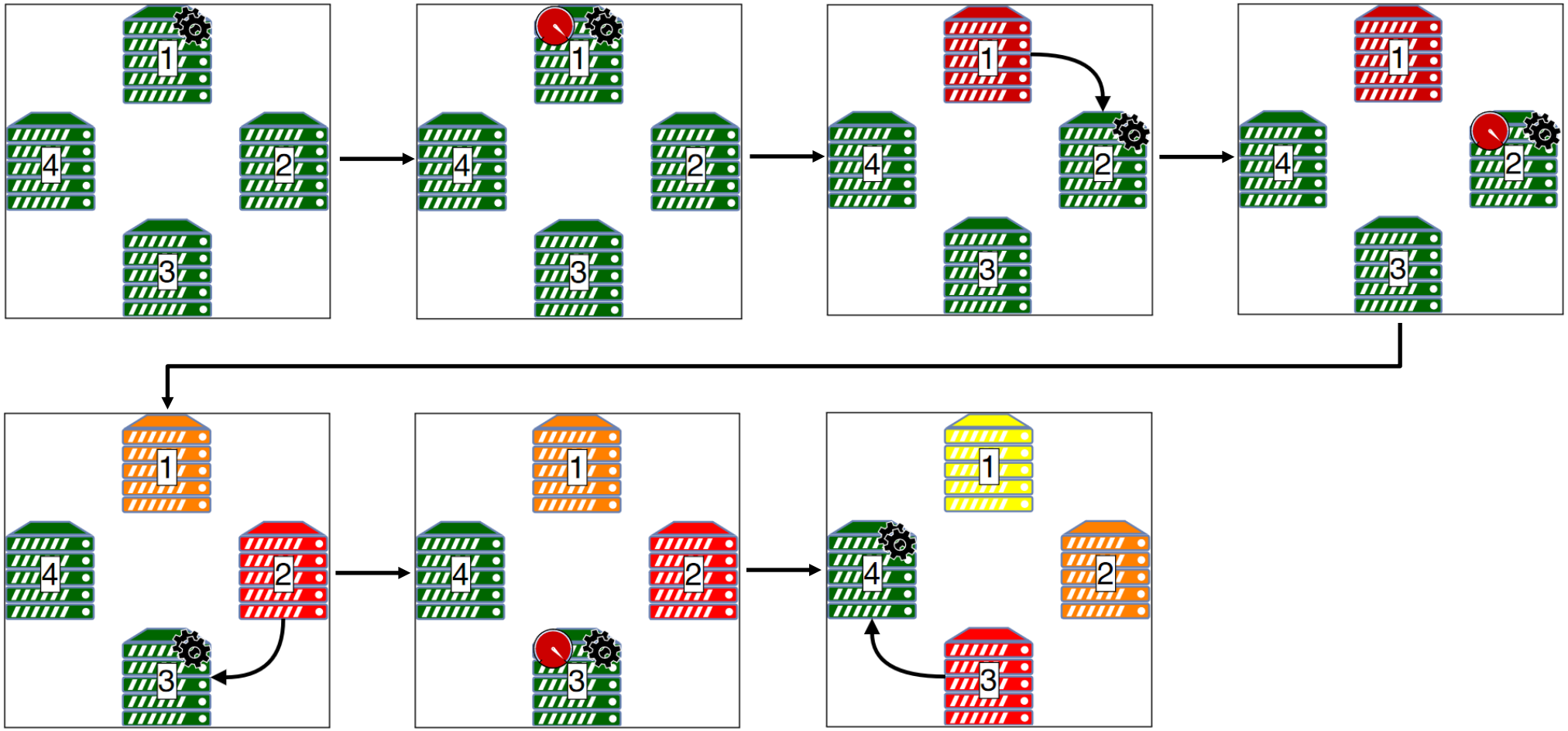

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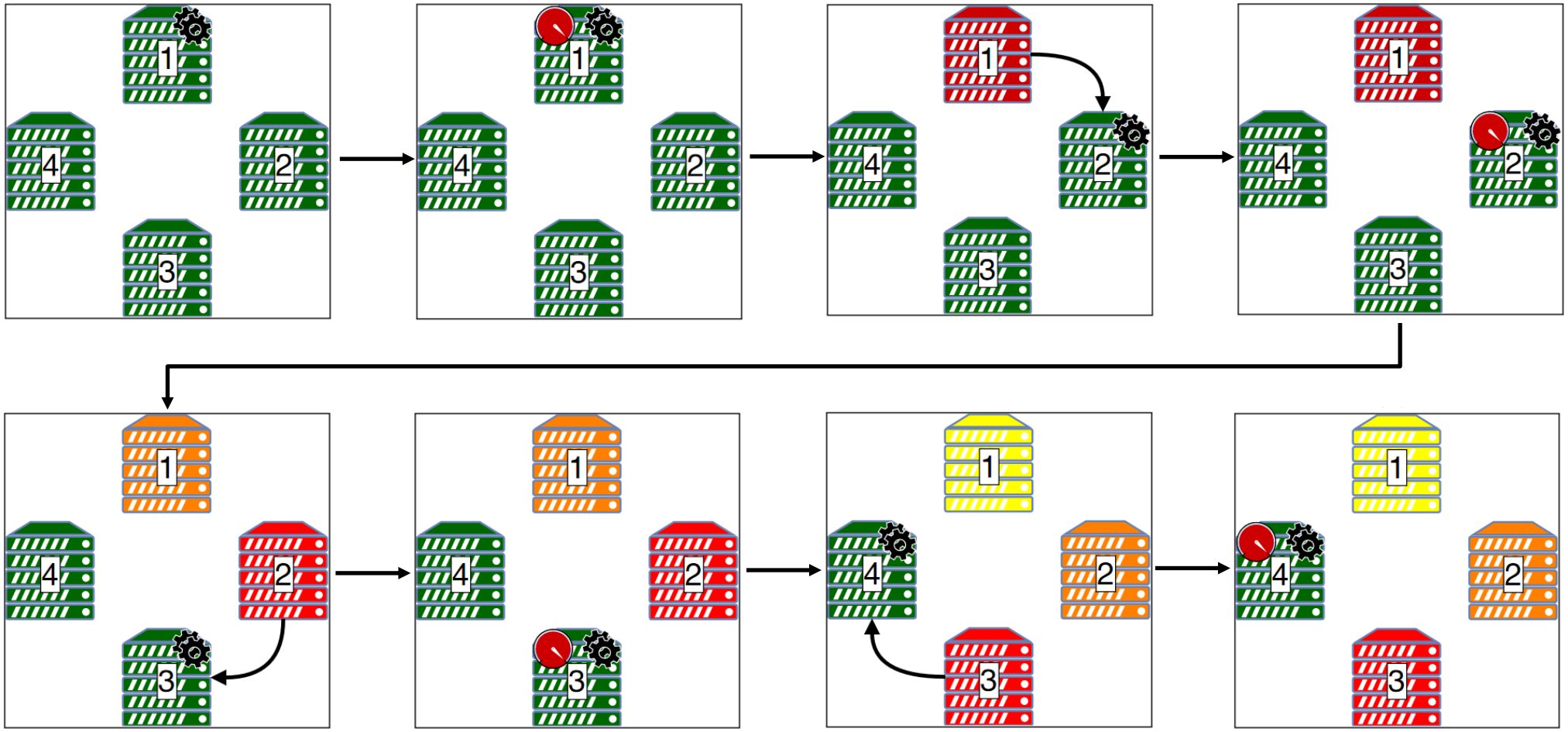

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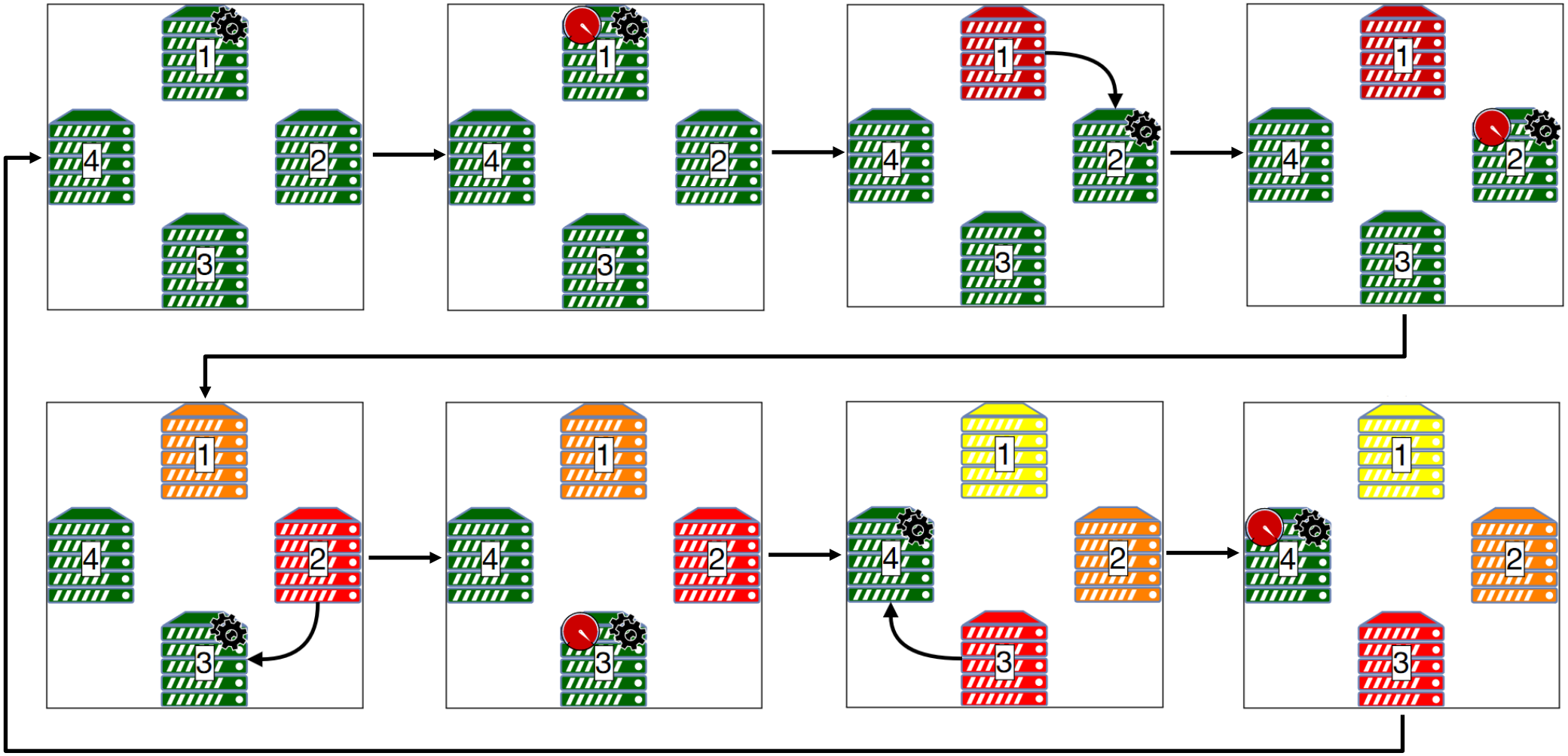

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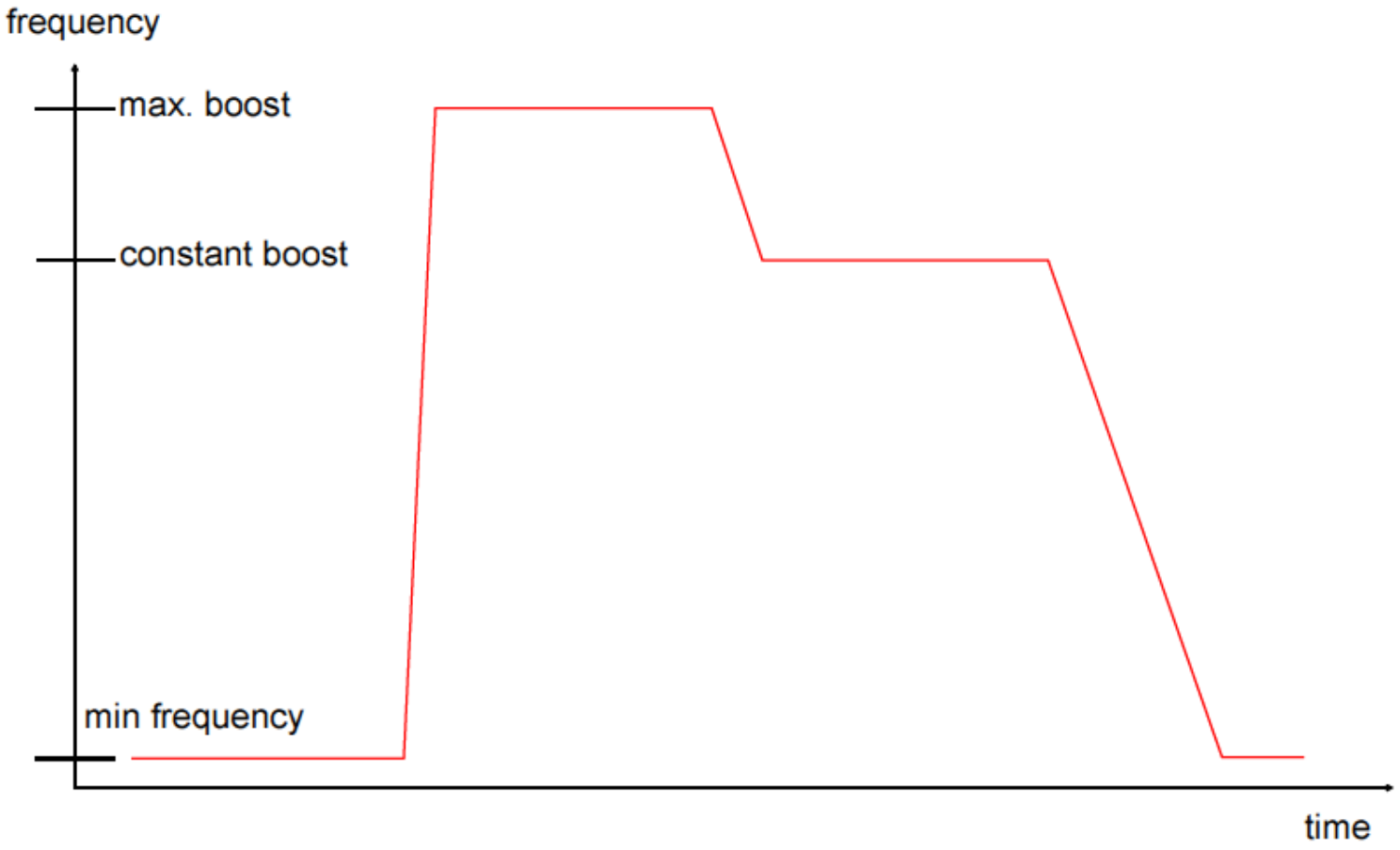

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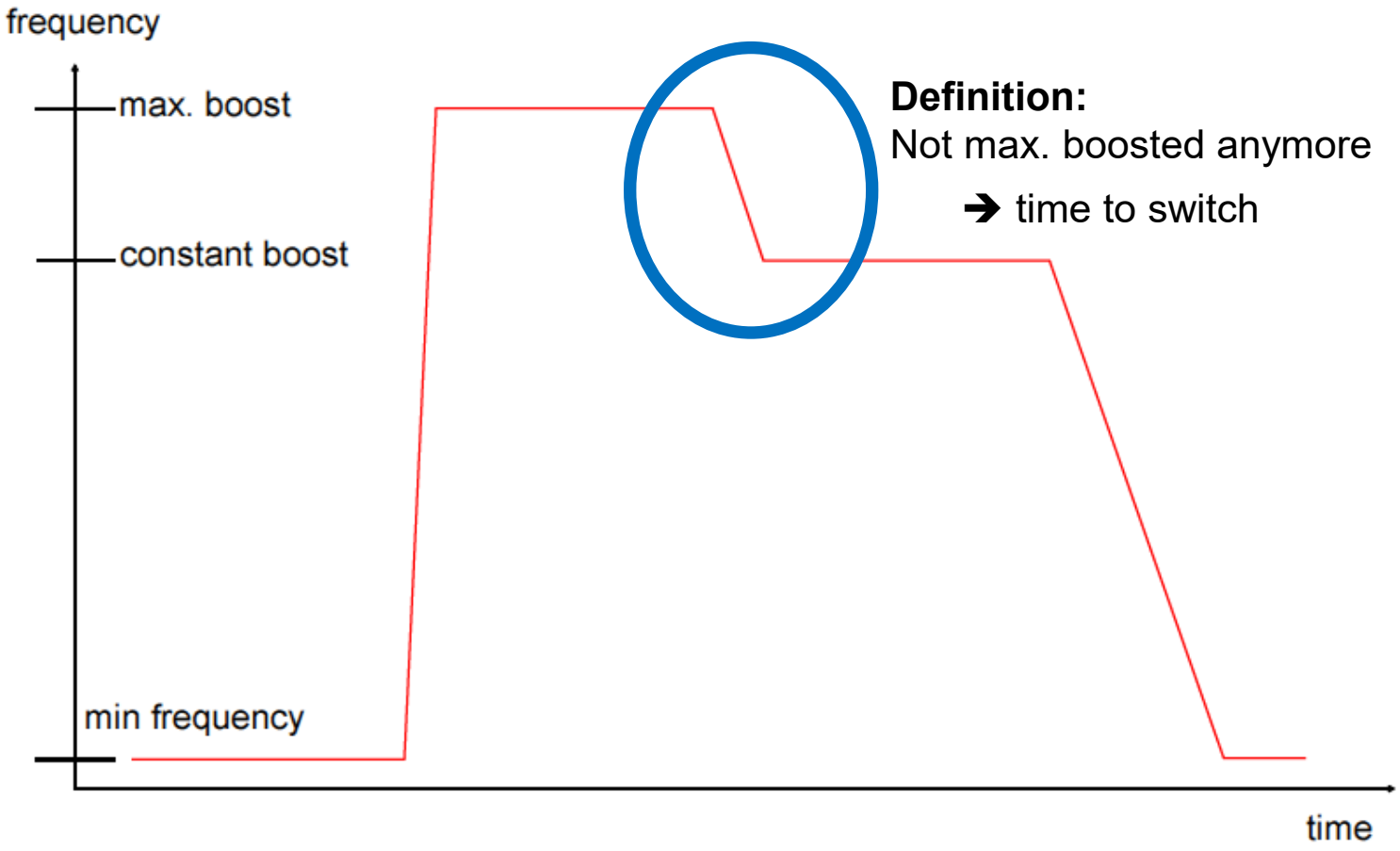
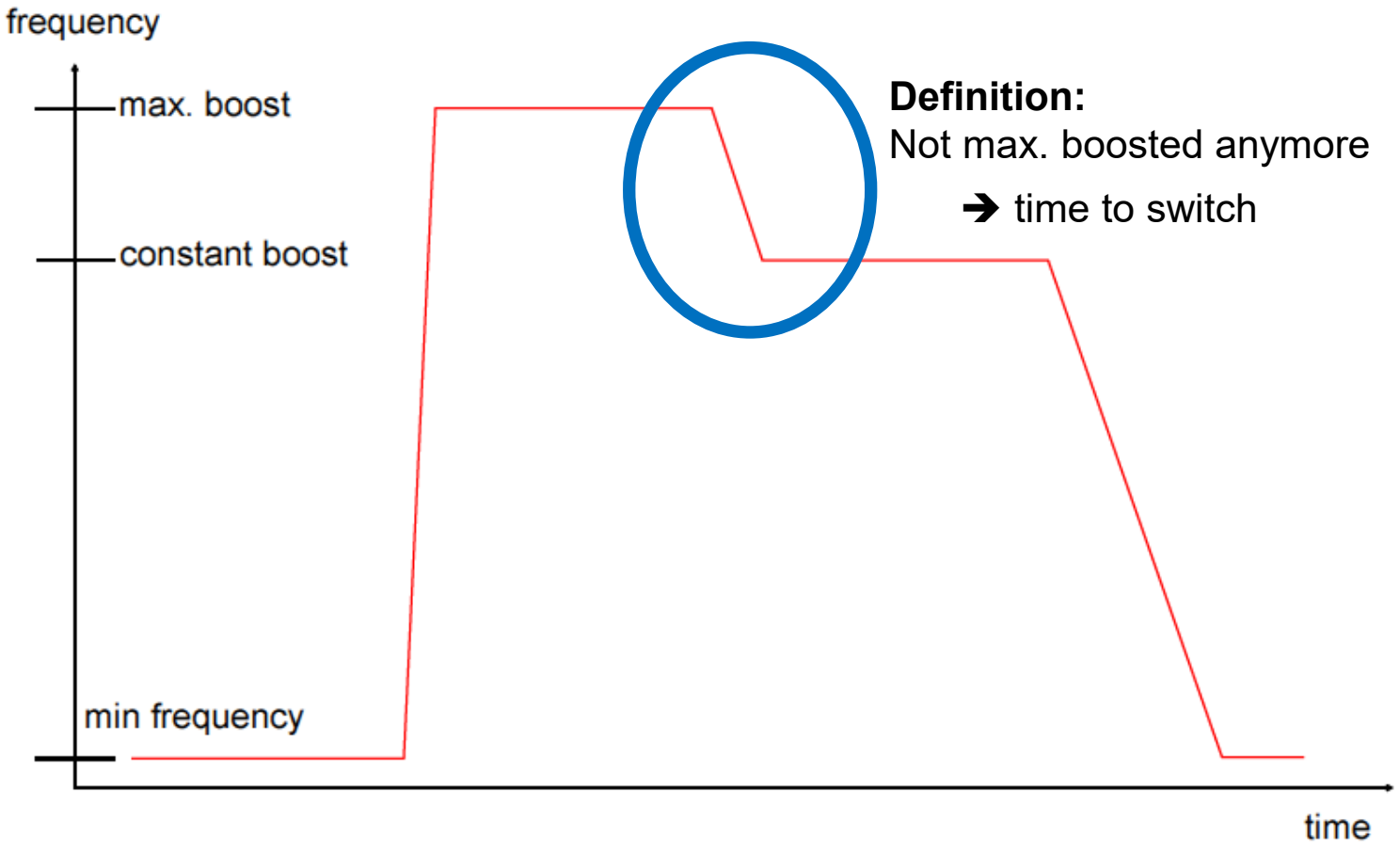


Definition:
Not max. boosted anymore

➔ time to switch

Approach



- Assumptions
  - The workload puts enough stress on a server that it will boost
  - The server is under stress that the migrated workload will only be adequately serviced when boosted

Prototype Implementation

- Client: **HTTP Load Generator**

[4]

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  - Workload: **Bungee-LU-Servelet**

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  - Data collector: **Telegraf**

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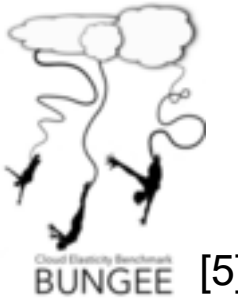

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  - Data collector: **Telegraf**

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- Monitor
  - Database: **InfluxDB**

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  - Dashboard: **Chronograf**

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  - SDN-Controller framework: **Ryu**

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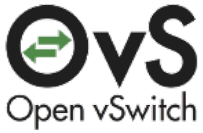
- Switch: Software-Switch with **Open vSwitch**



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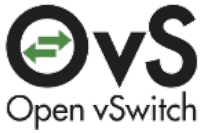
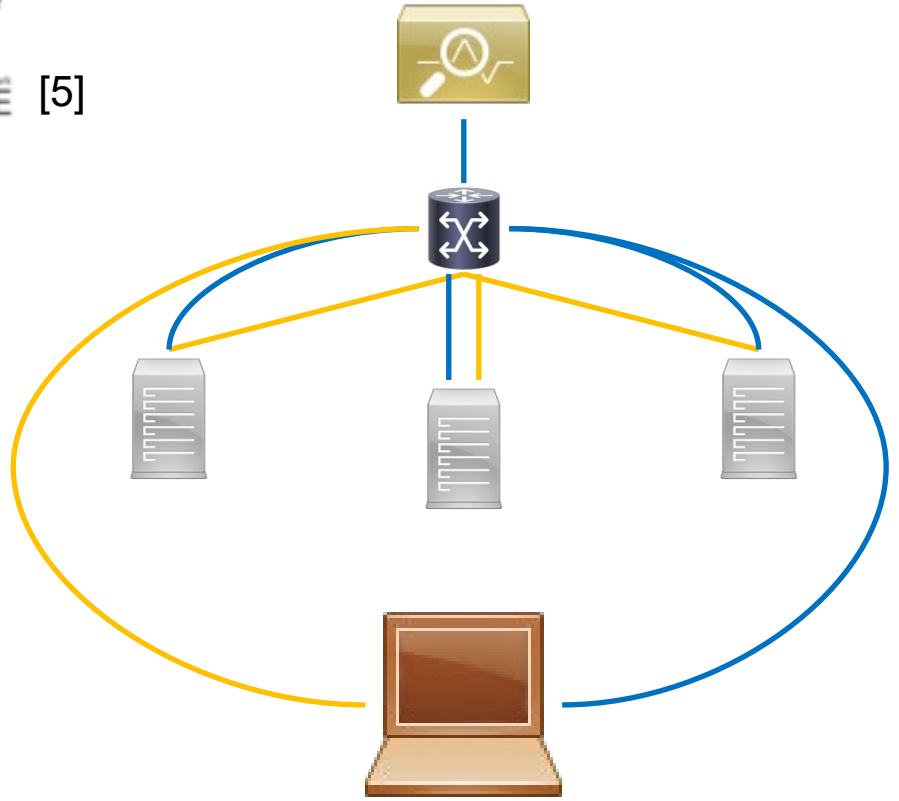


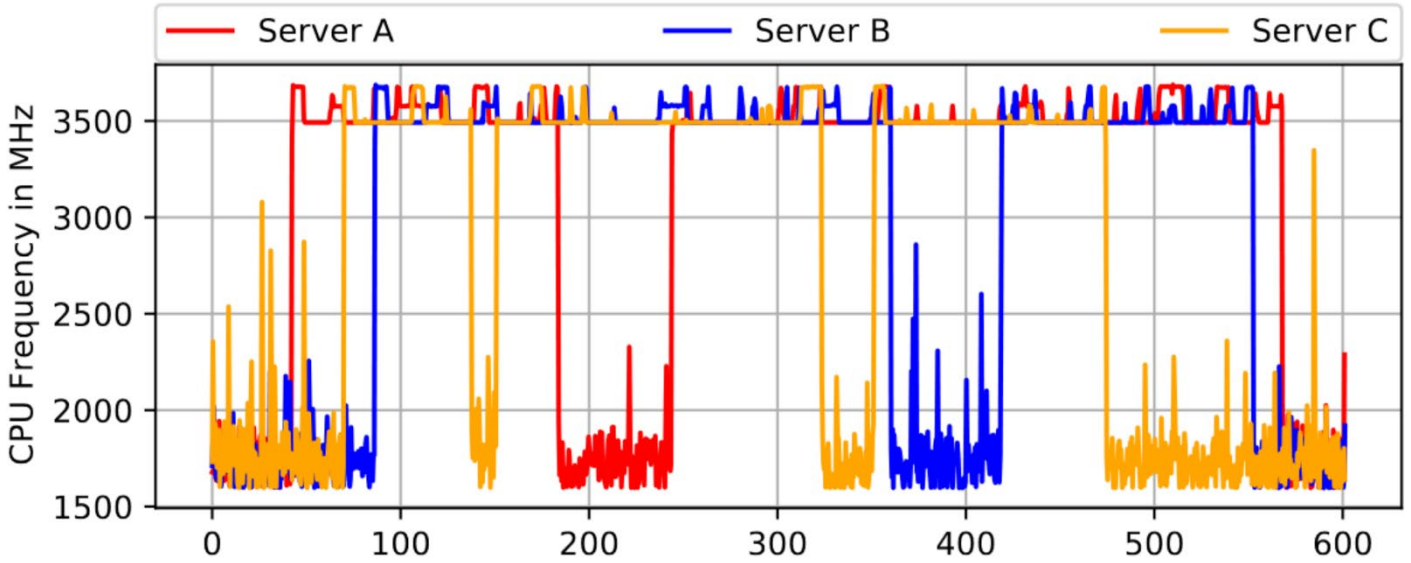
[8]

- Testbed with three servers, SDN, and controller



Evaluation

- Three evaluated scenarios:
  A. Highly overbooked
  B. Medium overbooked
  C. Not overbooked



A

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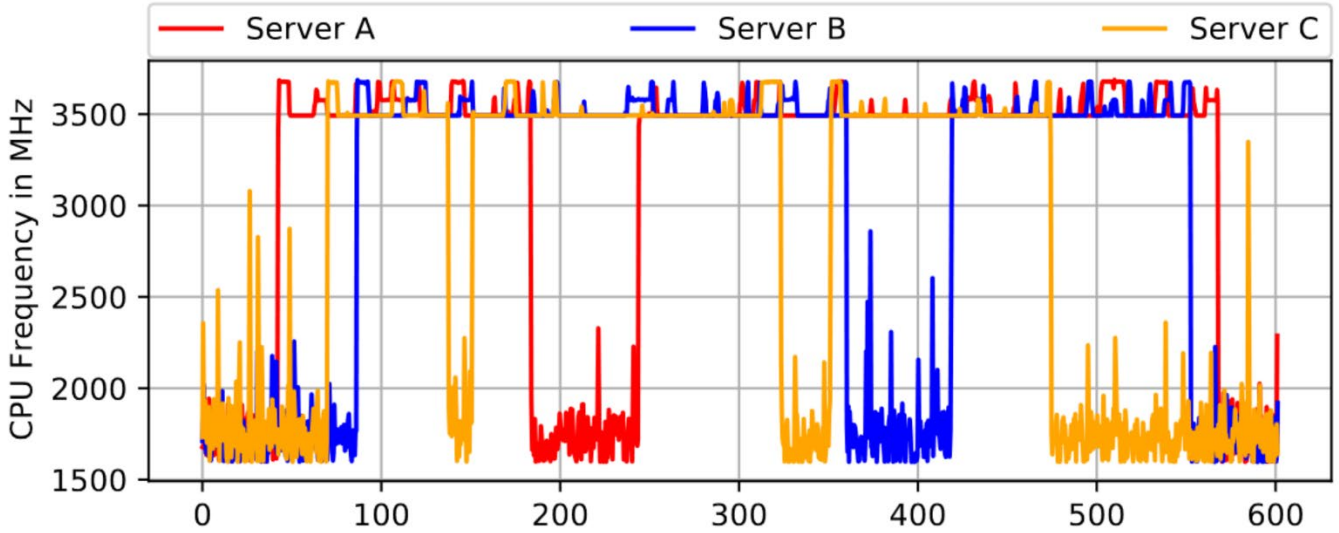

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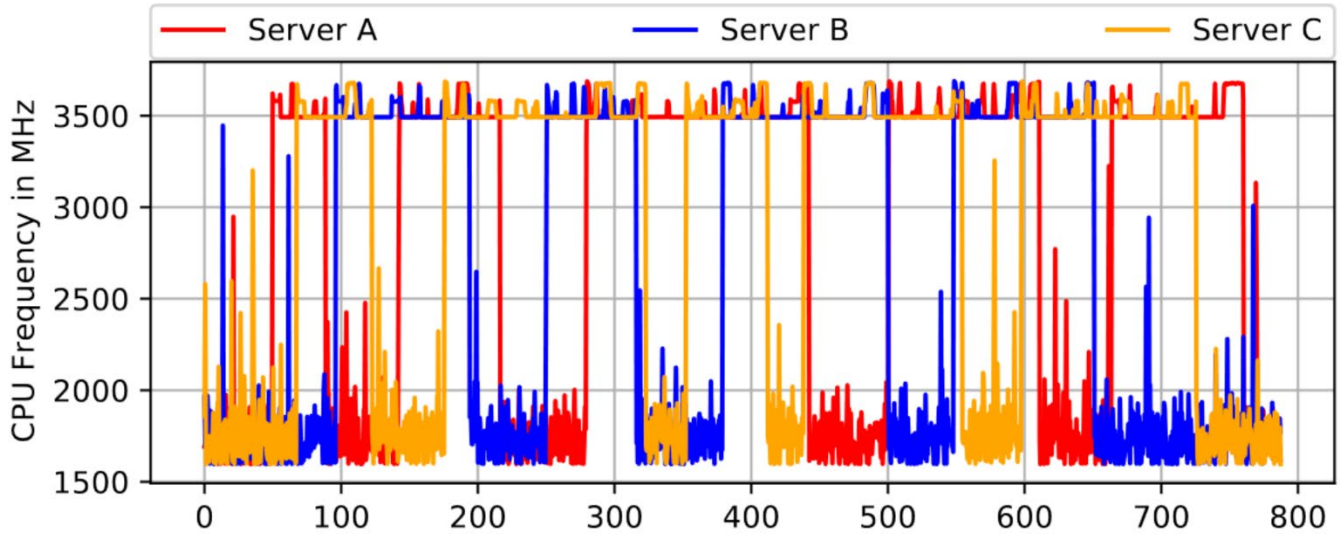

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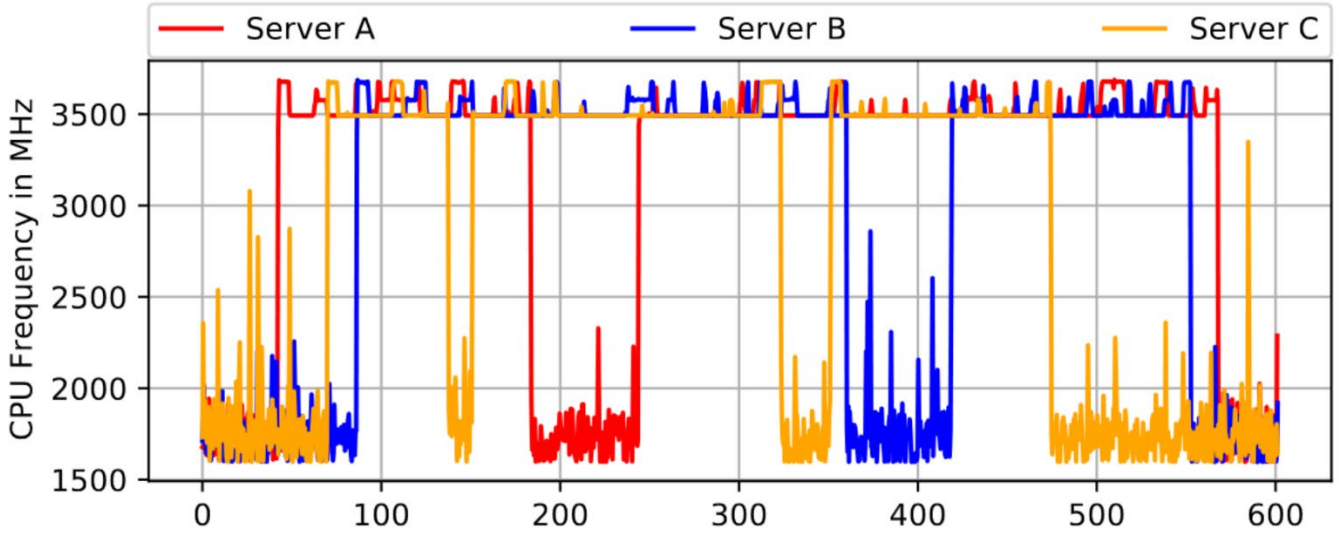

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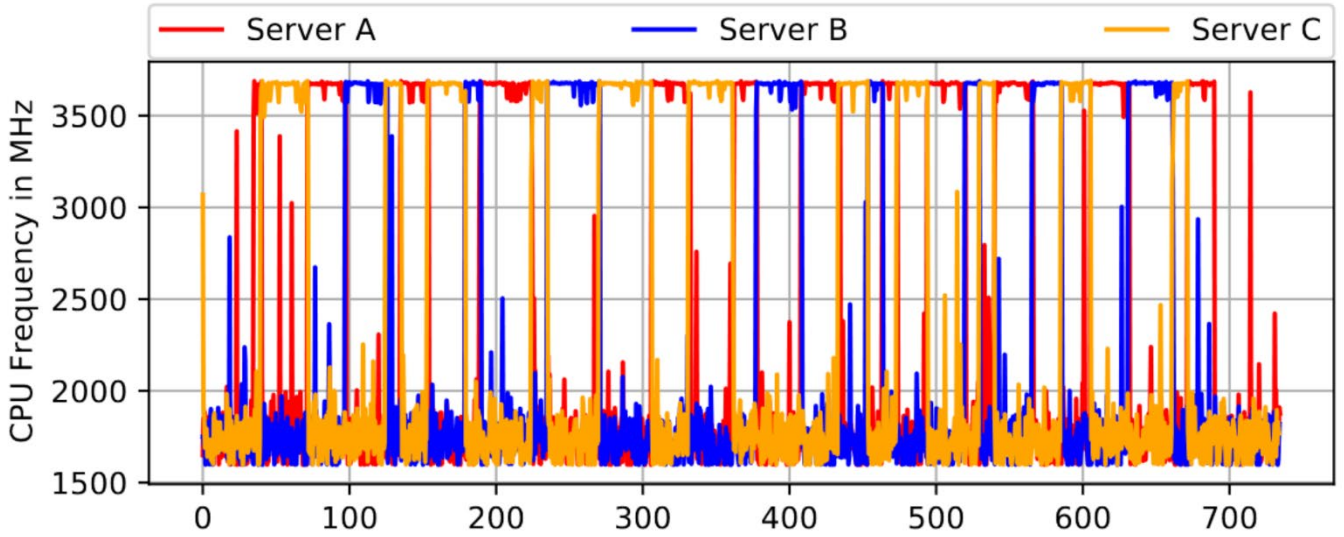

C

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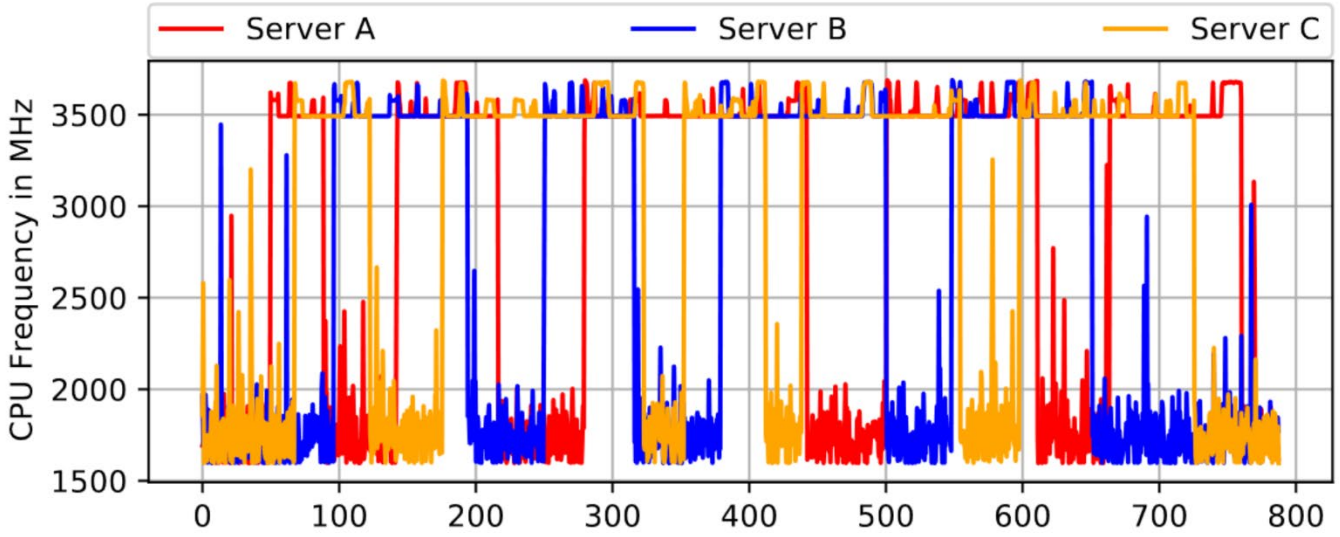
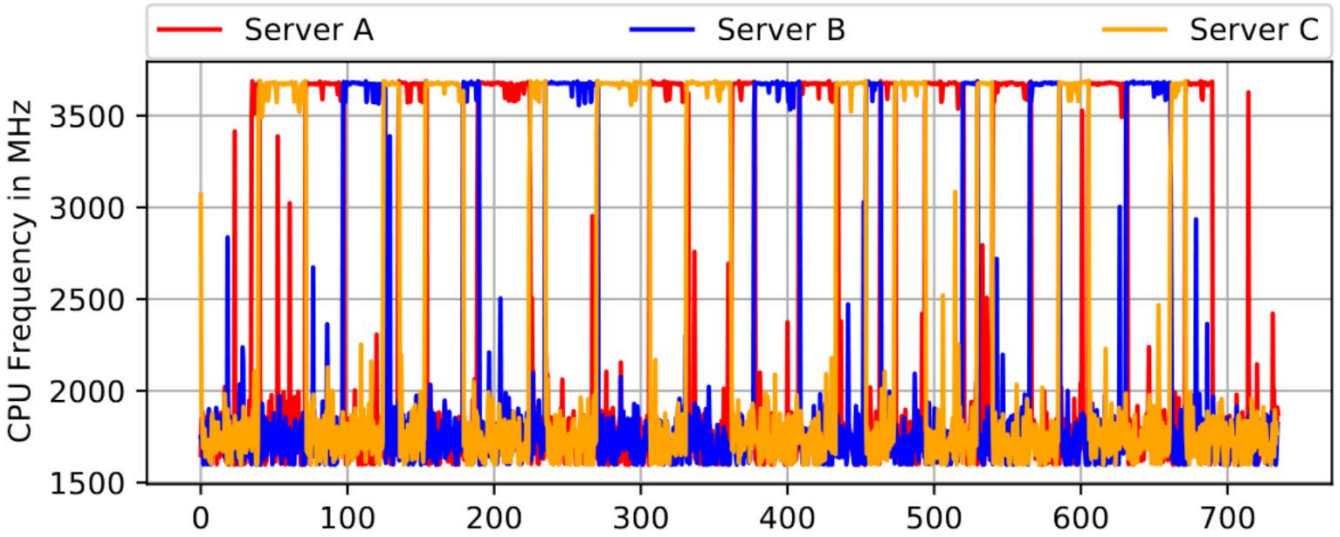


B



C

Preliminary Measurements

	Switched	Unswitched
Average response time in seconds	**0.85**	**1.83**
Number of requests sent/reveiced/lost	1310 / **1310** / **0**	1310 / **1304** / **6**
Temperature max. r04/r05/r06 in °C	**61.99** / **61.13** / **61.35**	**69.76** / * / *
Temperature average r04/r05/r06 in °C	**59.29** / **58.81** / **59.13**	**65.96** / * / *
Average CPU frequency in MHz r04/r05/r06	2459.86 / 2147.86 / 2333.61	3518.44 / * / *
Average CPU maximum in MHz	**3670.24**	**3580.32**
Average power consumption (idle: 98.19W) in Watt	**135.54**	**147.98**
Additional power consumption in total and percent	37.35 / 38.03%	49.79 / 50.71%

Conclusion

Achievements

- Working heat-aware and boost-oriented load rotation
- Higher average of max. CPU frequency

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- Working heat-aware and boost-oriented load rotation
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Open Tasks

- Include performance metrices
  - Throughput
  - Latency
- Eliminate simplifications
- Stateful migration
- Tests with additional workloads
- Extend to heterogenous systems
- Power and temperature evaluation

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Thank You!

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References

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