QoS-Aware Resource Allocation for Mobile IoT Pub/Sub Systems

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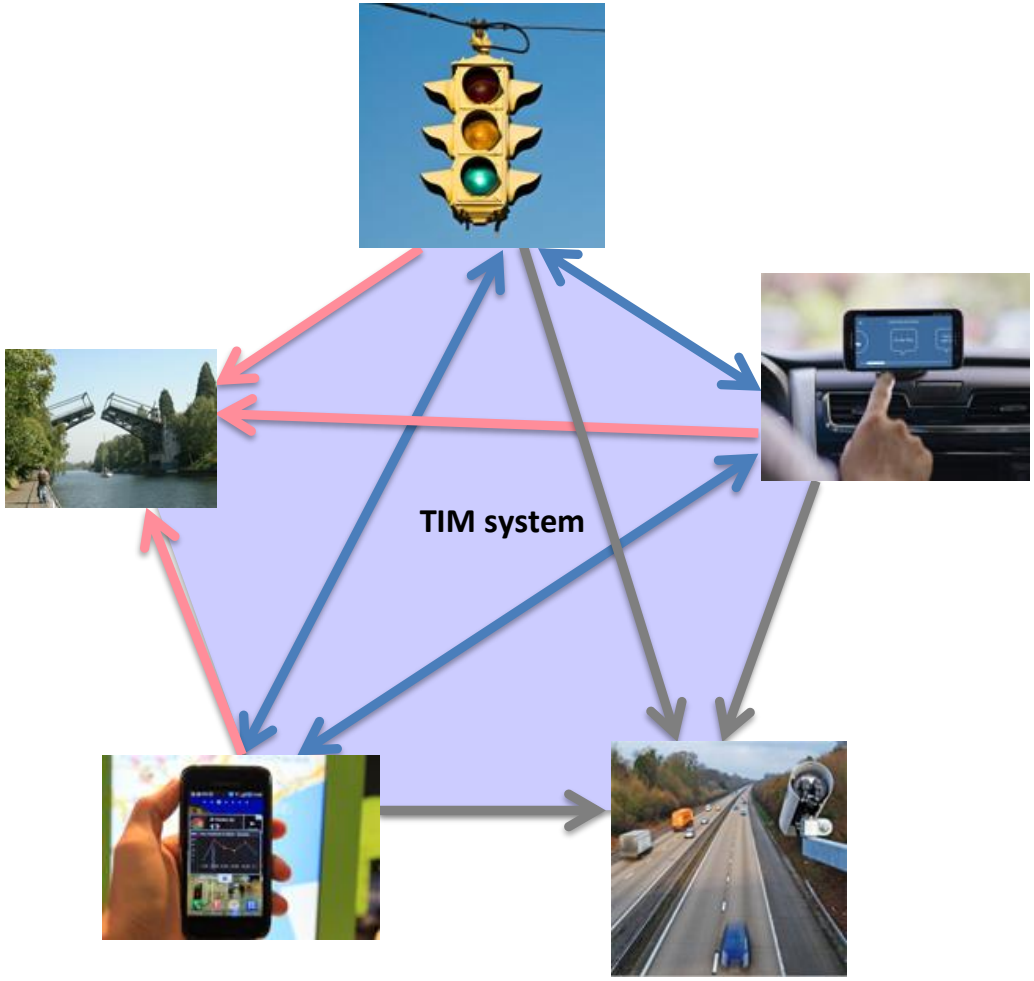
Motivation

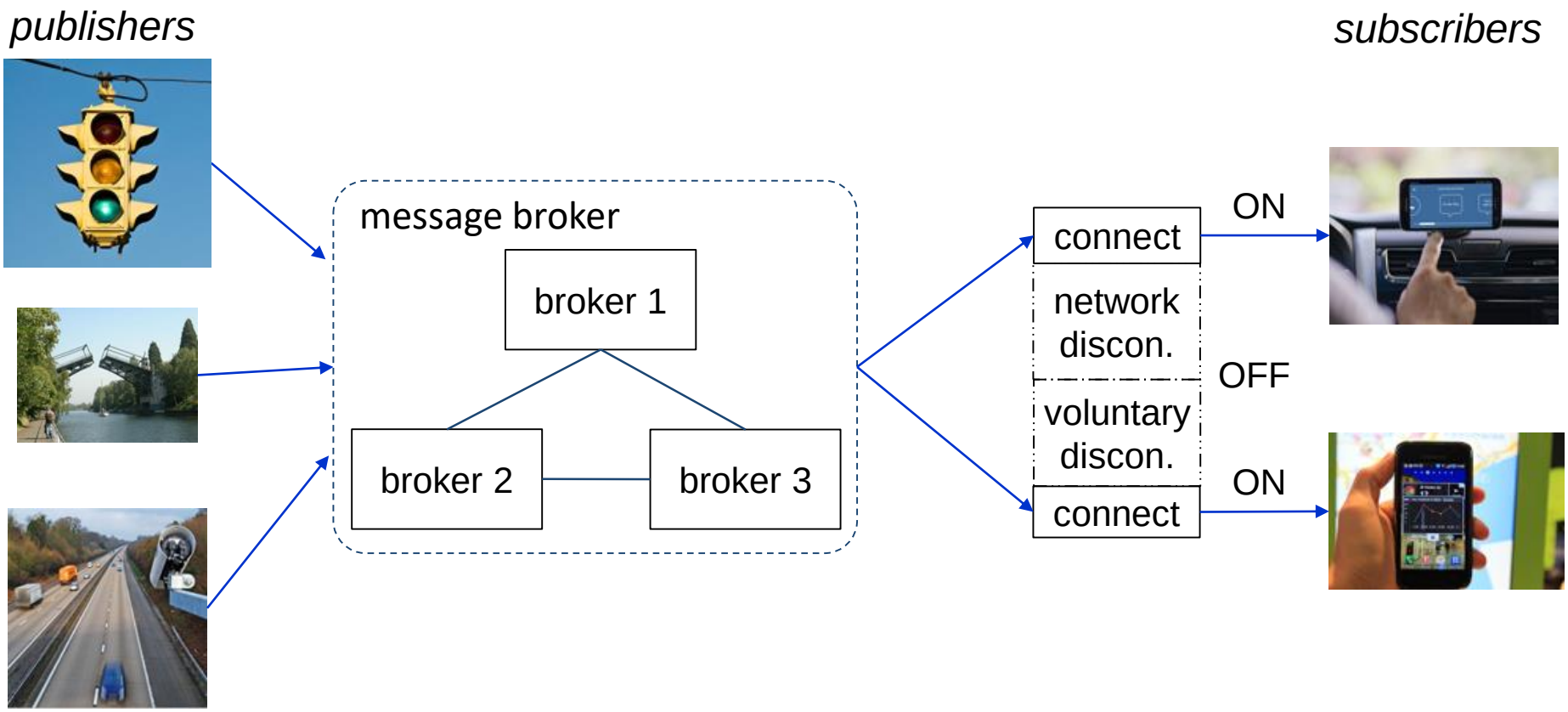
- Traffic Information Management (TIM) system:



Heterogeneous

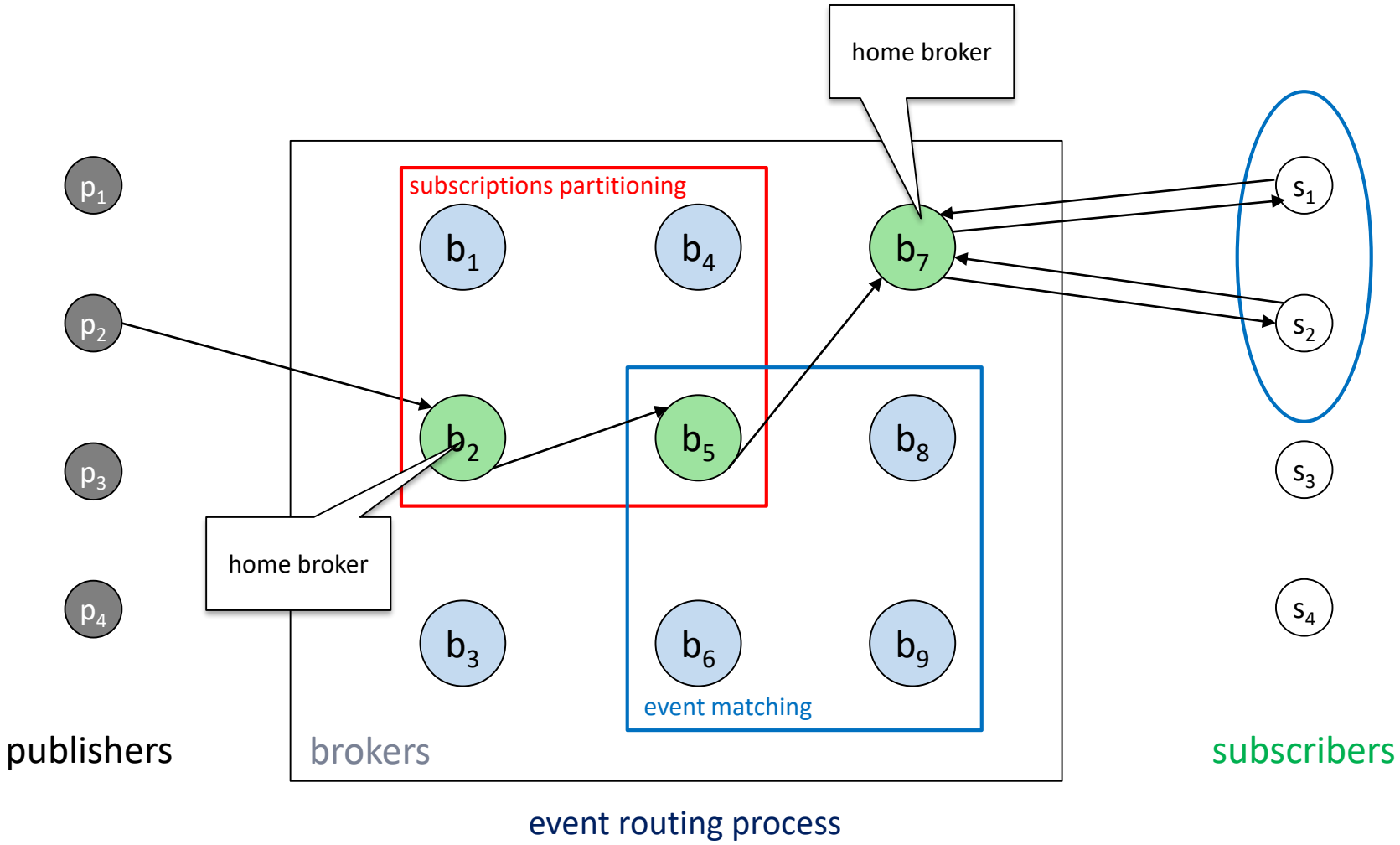
Dynamic

Motivation



- Message broker network can be allocated on Cloud:
  - Can we ensure specific end-to-end QoS between publishers and subscribers?
  - Does the Things' intermittent connectivity affects the cost of resource allocation?

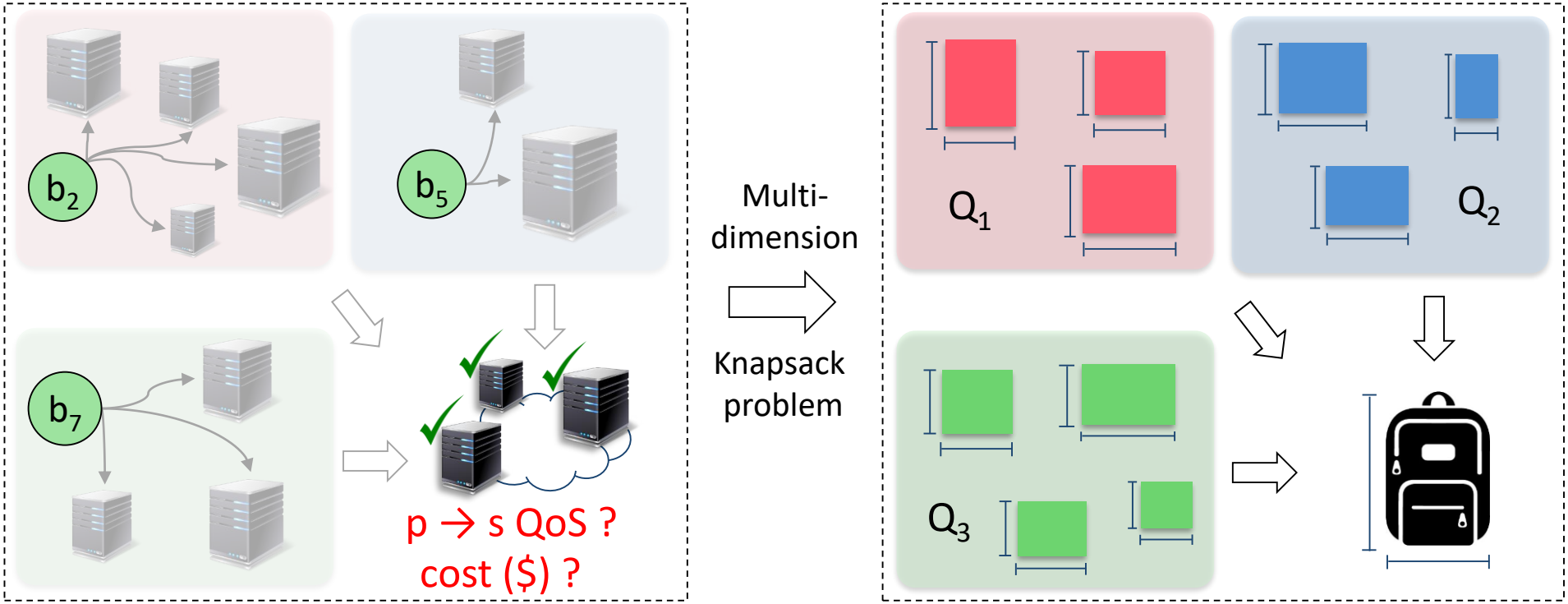
Publish/Subscribe System



[1] R. Baldoni et al., "Distributed event routing in publish/subscribe communication systems: a survey," DIS, Universita di Roma La Sapienza, Tech. Rep, 2005.

Resource Synthesis with Intermittent Connectivity

- How can we allocate message brokers of the pub/sub system ?

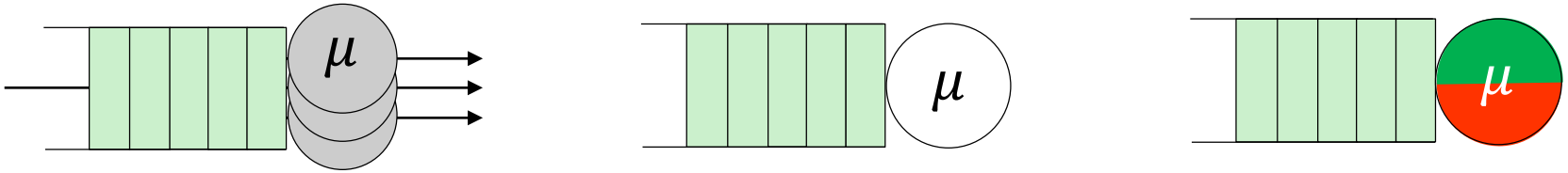


- Use of the WS-HEU heuristic to efficiently select the resource types.
- Additional message broker instances, if necessary.

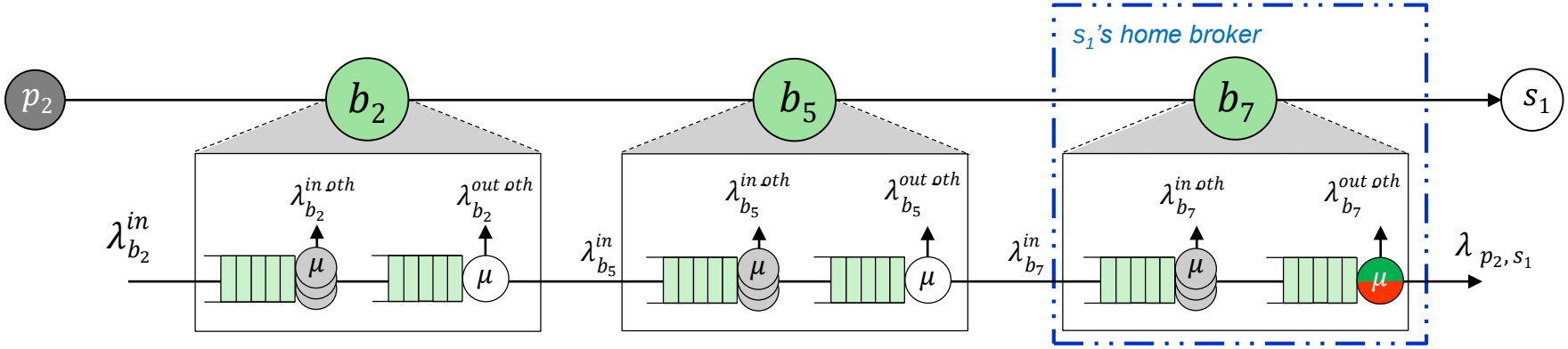
End-to-end QoS Estimation

- We rely on Queueing Theory to estimate end-to-end response times between publishers and subscribers.
- We use 3 different queueing models:

M/M/c Queue[1] **M/M/1 Queue[1]** **ON/OFF Queue[2]**

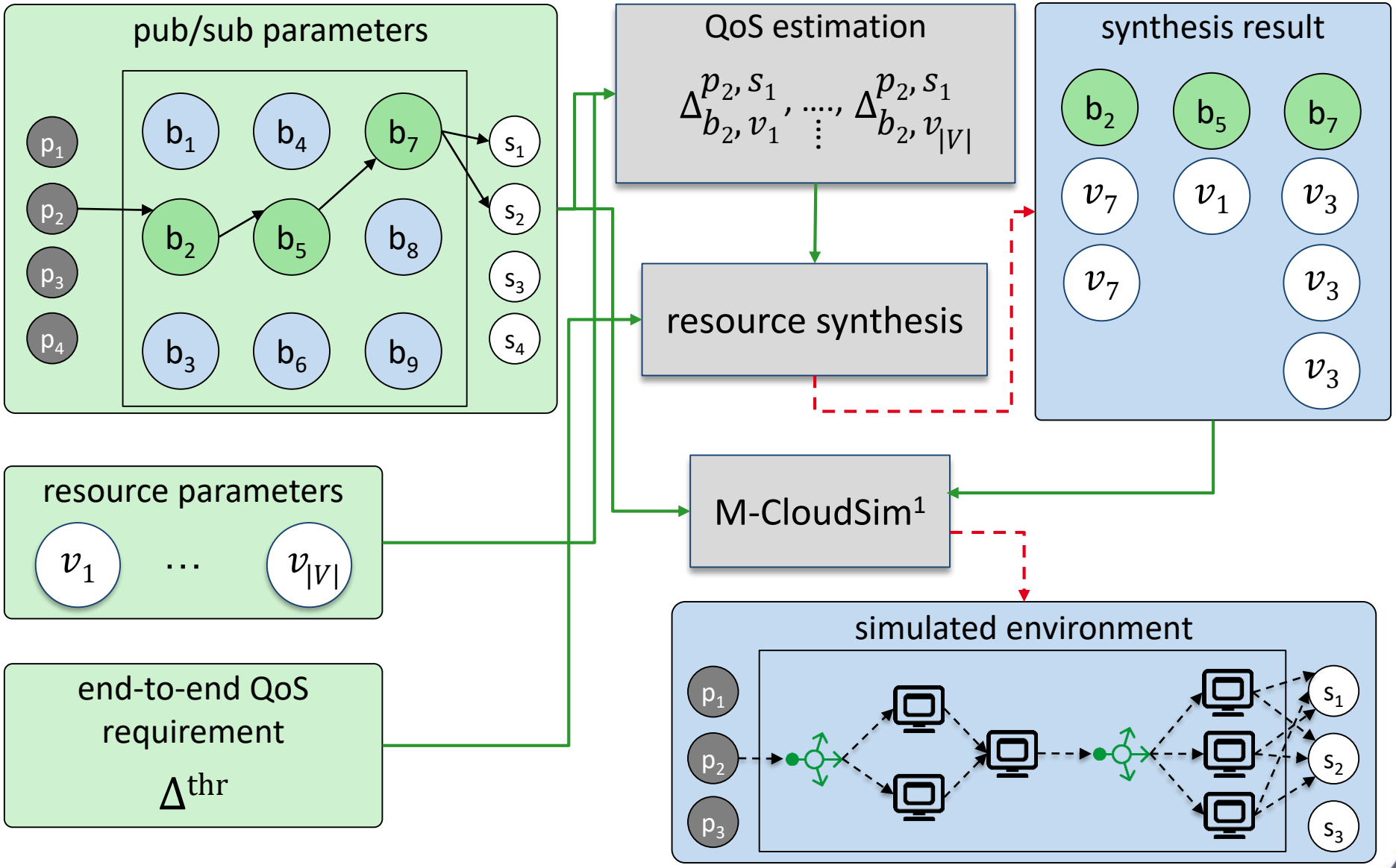


- End-to-end response time between p_2, s_1:



[1] D. Gross et al., Fundamentals of queueing theory, 2008.
[2] G. Bouloukakis et al., ICC 2017, ICPE 2017.

Experimental Evaluation



[1]https://github.com/raphaeldeaquino/mcloudsim

Evaluation Setup & Results (1)

event size (E) = 200 bytes
λ = 0.5 to 23 events/sec

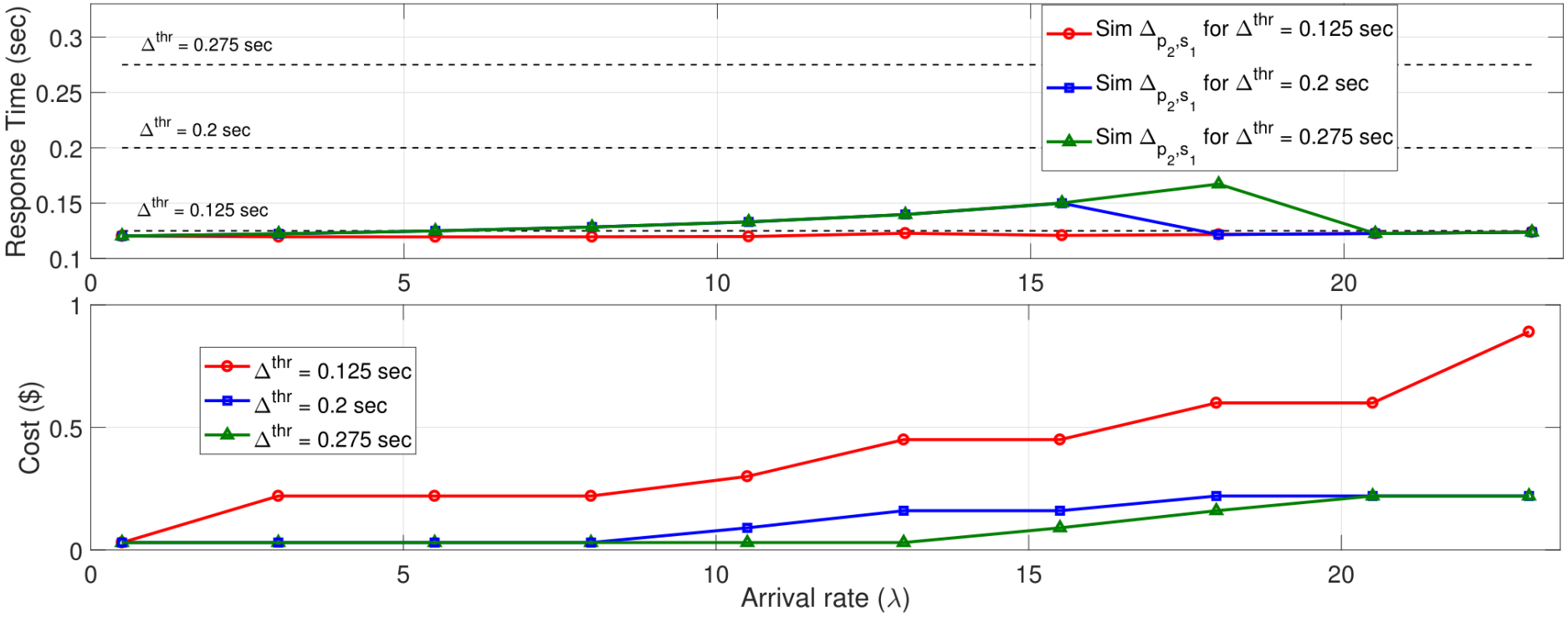
VMs by Amazon, Microsoft, Google

μ = 33.2 CPU instructions

Δ^{thr} = 0.025 sec

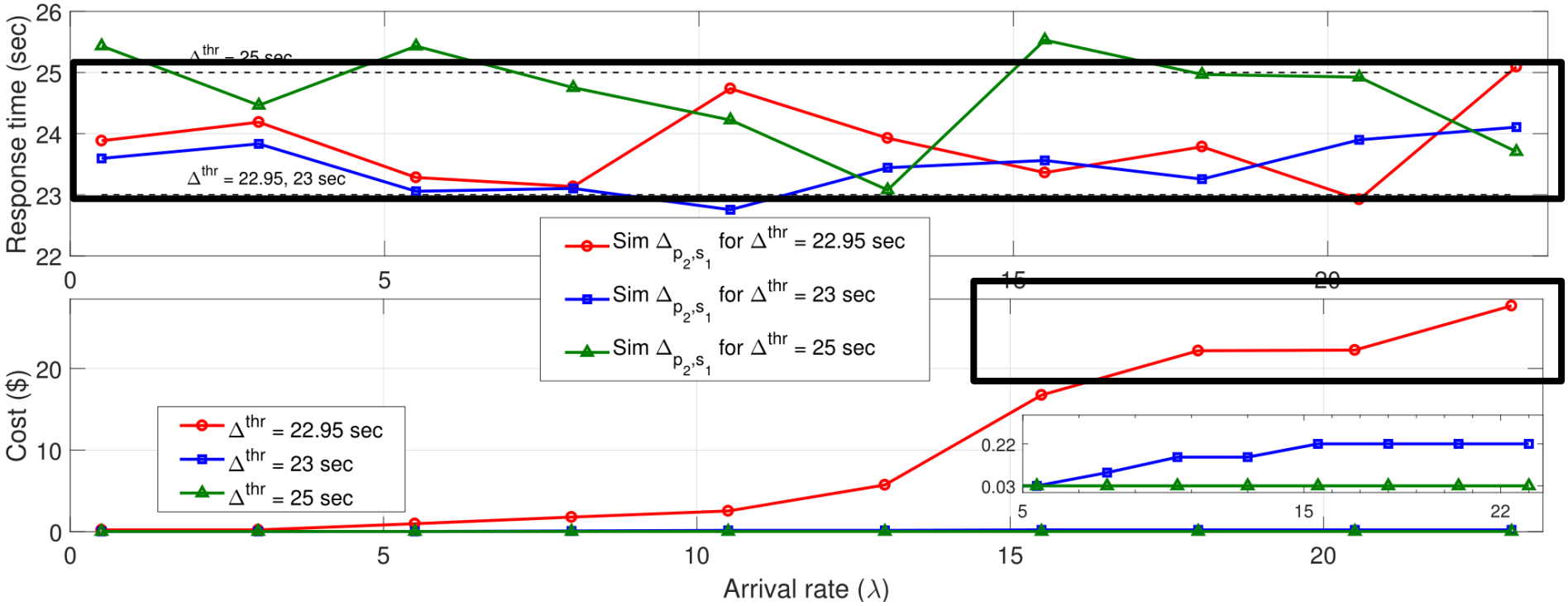
1. always connected
2. intermittent connected

➢ Subscriber always connected:



Evaluation Results (2)

- Subscriber intermittent connected: T_{ON} = 155 sec, T_{OFF} = 96 sec.



- The response time is tightly coupled by the subscriber's intermittent connectivity.
- By slightly describing Δ^{thr}:
  1. the cost increases significantly.
  2. the response time remains at the same level.

Next steps

- We allocate Cloud resources of IoT applications by considering **end-to-end QoS requirements** and the **Things' intermittent connectivity**.

- Future work:
  - Introduction of additional QoS parameters: e.g., memory.
  - Estimation of end-to-end QoS between peers by using well known pub/sub routing algorithms.
  - Resource allocation of interoperability software artifacts.

Thank you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