

Communication-Aware Application Placement in Combined Fog-Cloud Computing

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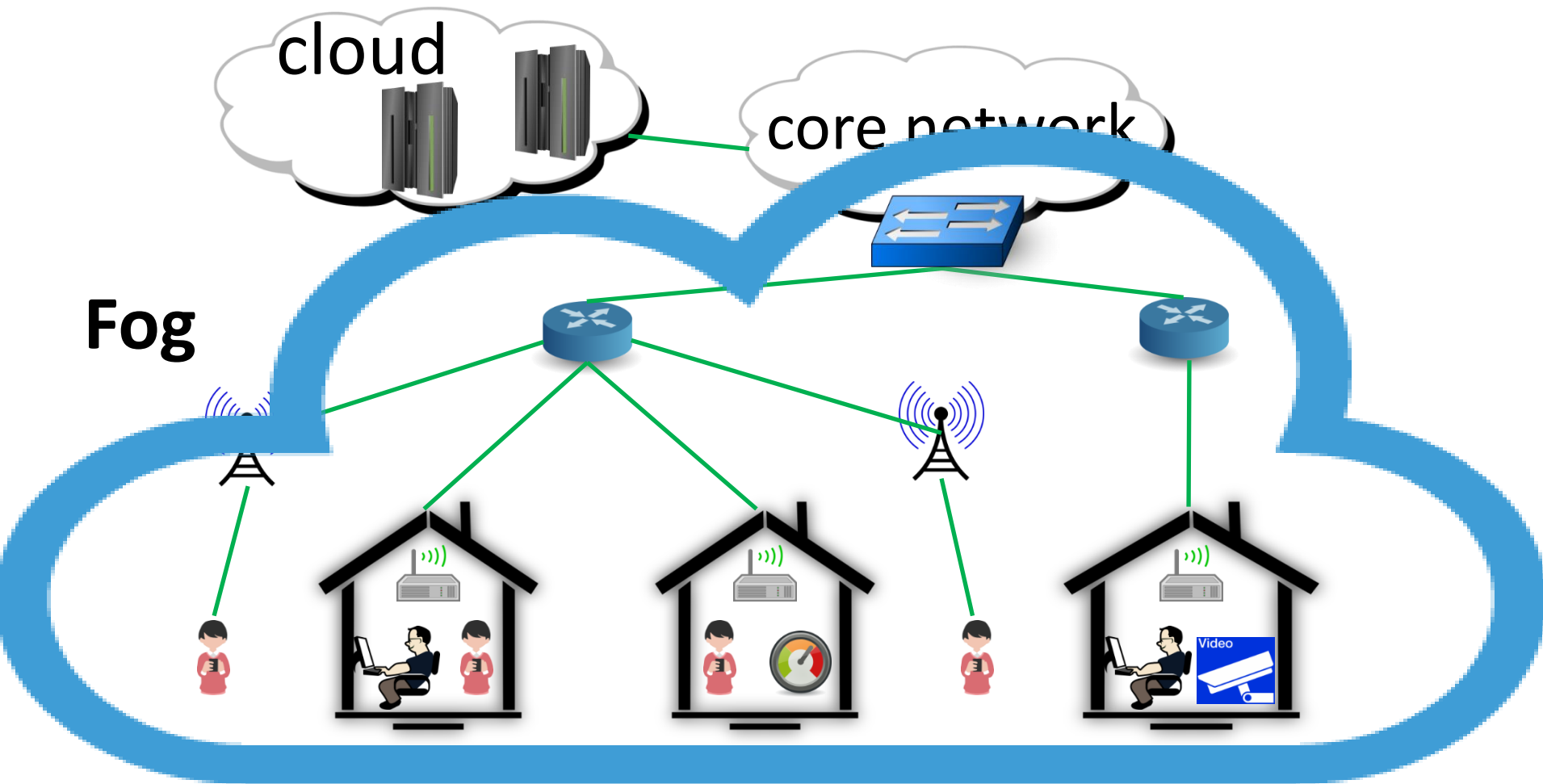
Outline

- 1 Context
- 2 Model
- 3 Placement
- 4 Heuristics
- 5 Future Work

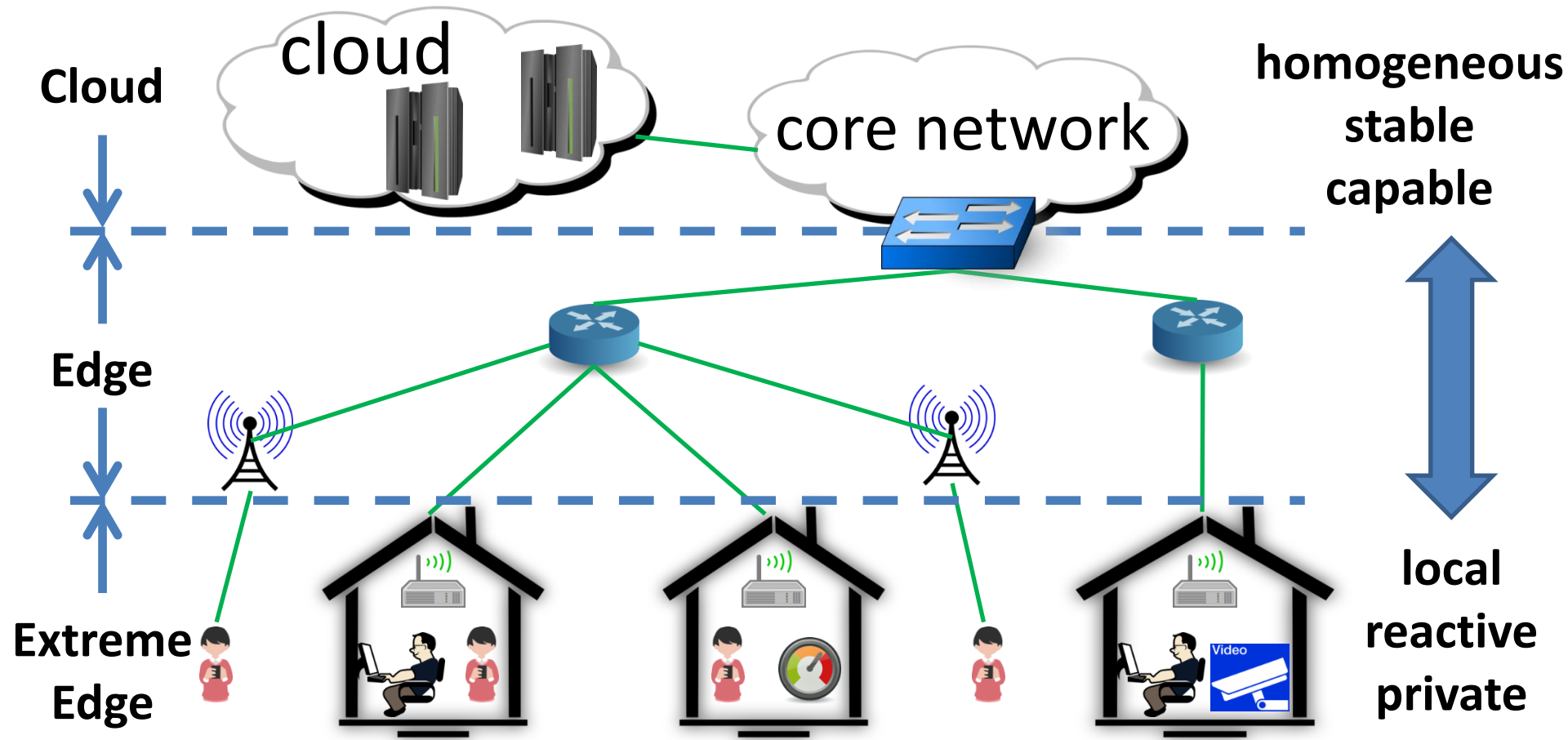
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Context - Infrastructure

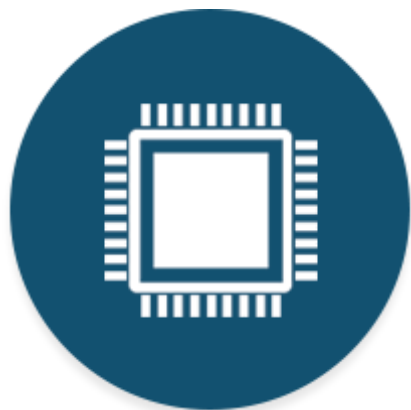


Context - Infrastructure



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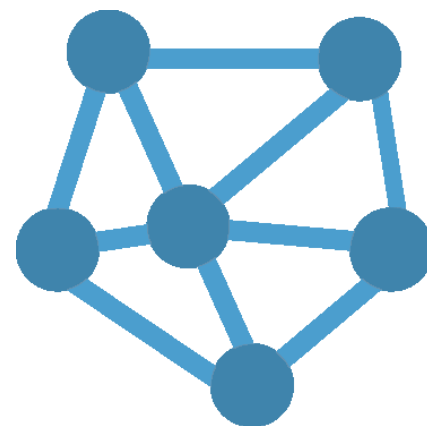
Compute

CPU (FLOPS)
RAM



Storage

DISK

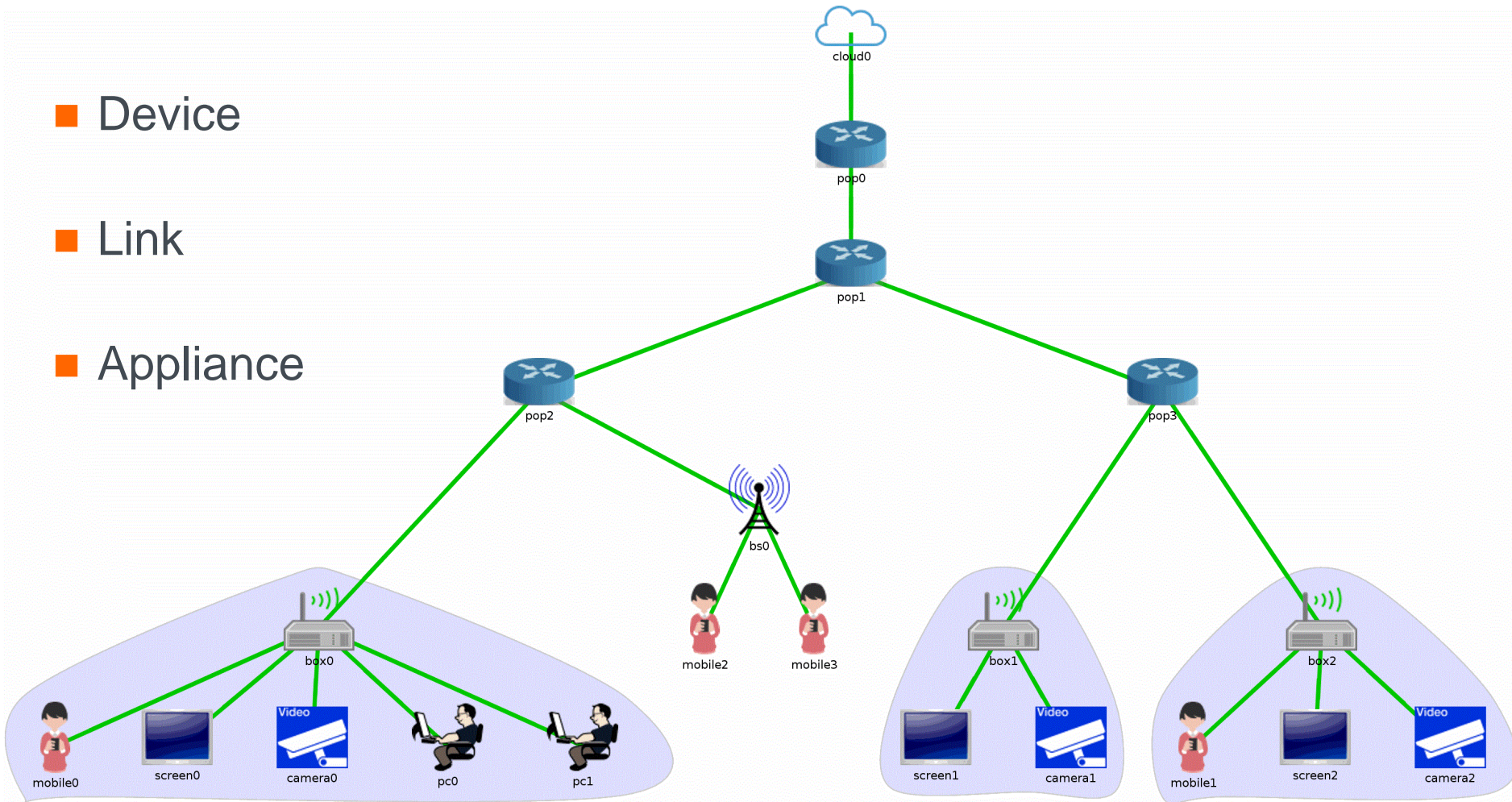


Network

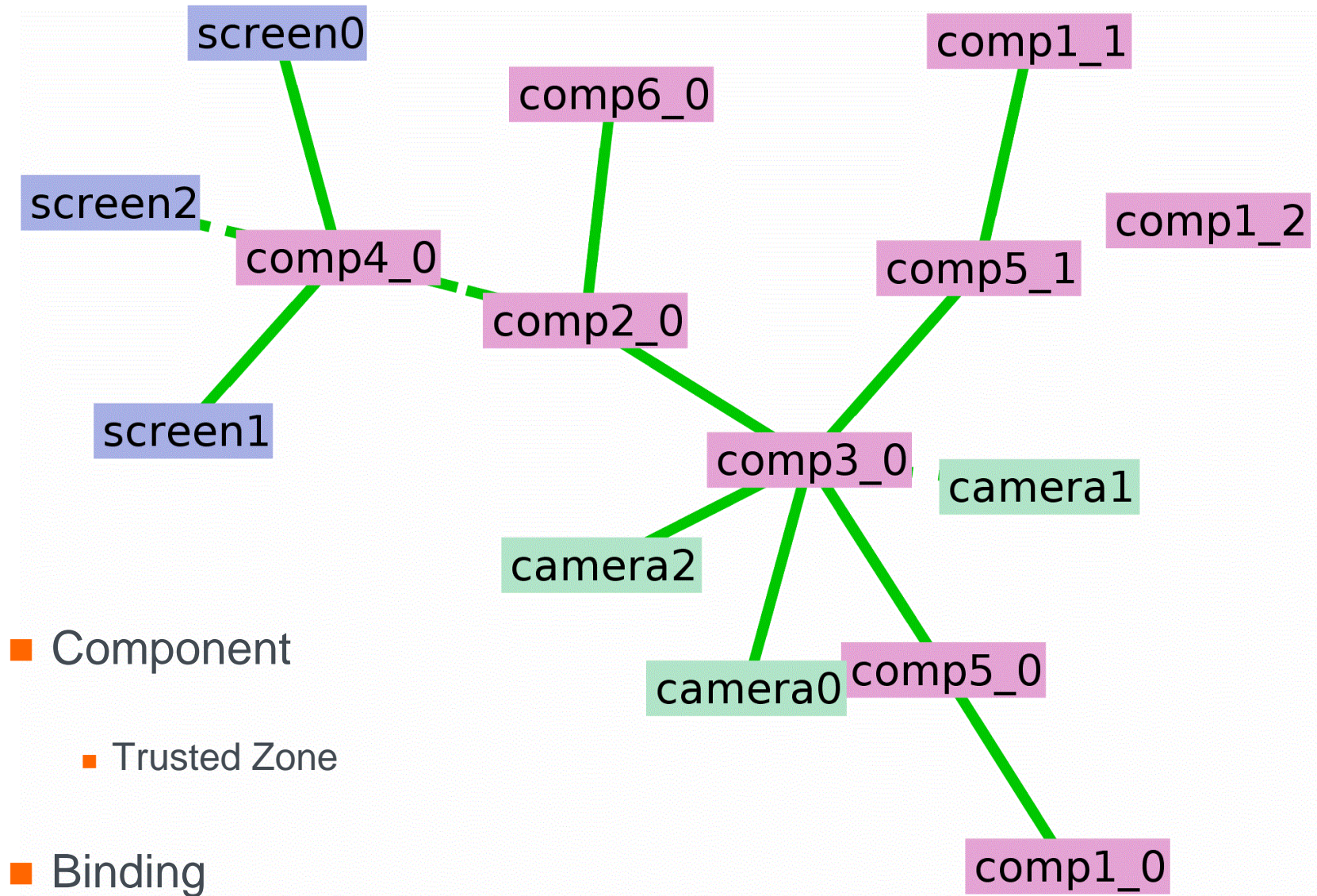
Latency
Bandwidth

Model - Infrastructure Model

- Device
- Link
- Appliance



Model - Application Model



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Placement - Constraints

Placement Constraint

- Each component is placed in a device

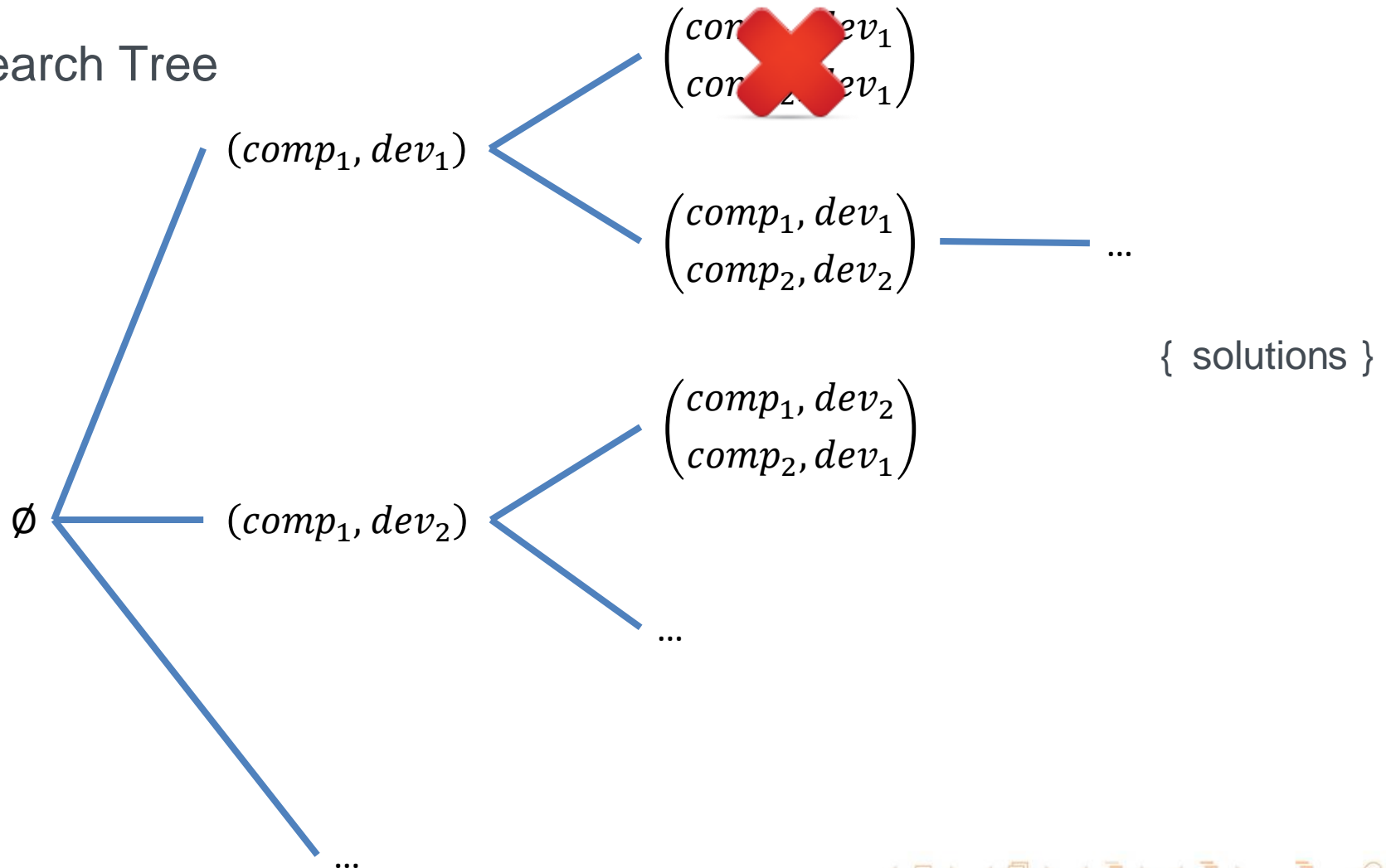
Solution Constraint

- Consumption of Compute & Storage Resource
- Consumption of Bandwidth
- Latency
- Trusted Zone

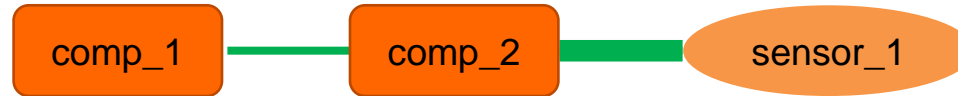
Placement - Solution Search

- Backtracking algorithm

- Search Tree



Placement - Solution Selection



weighted average latency

$$\text{weight : } \frac{bw(bind)}{bw(app)}$$

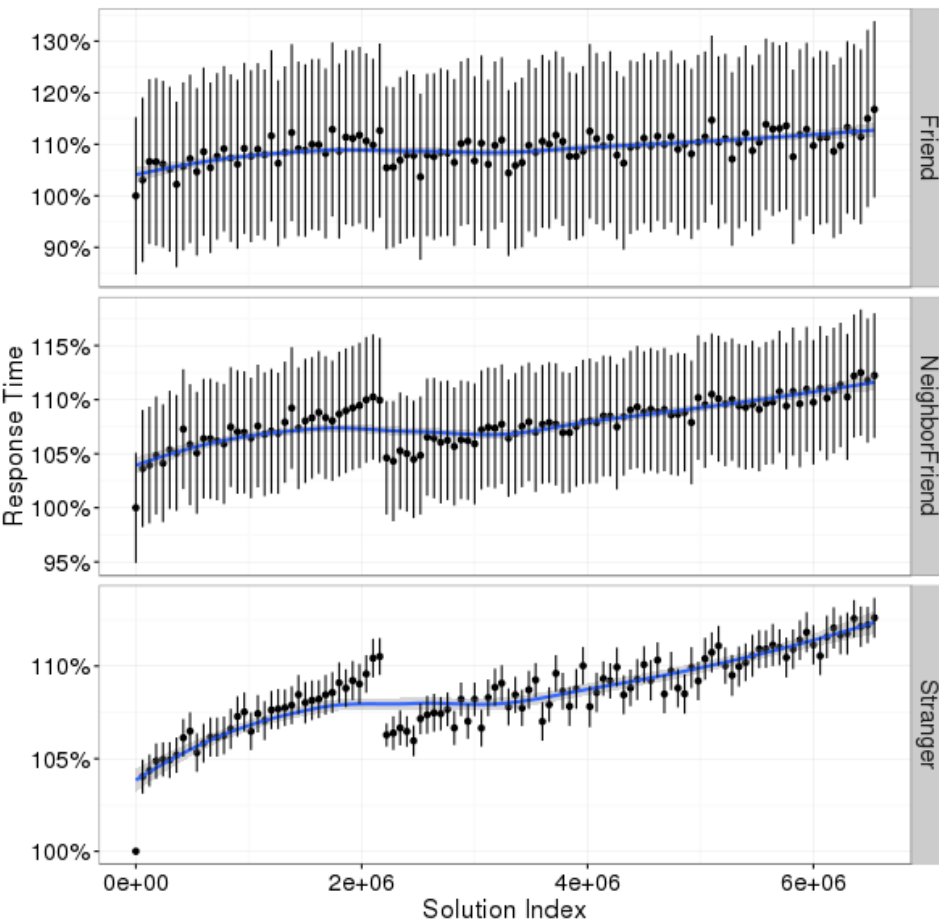
$$w_avg_lat(app) = \sum_{bind} \left(lat(bind) * \frac{bw(bind)}{bw(app)} \right)$$

minimize : $w_avg_lat(app)$

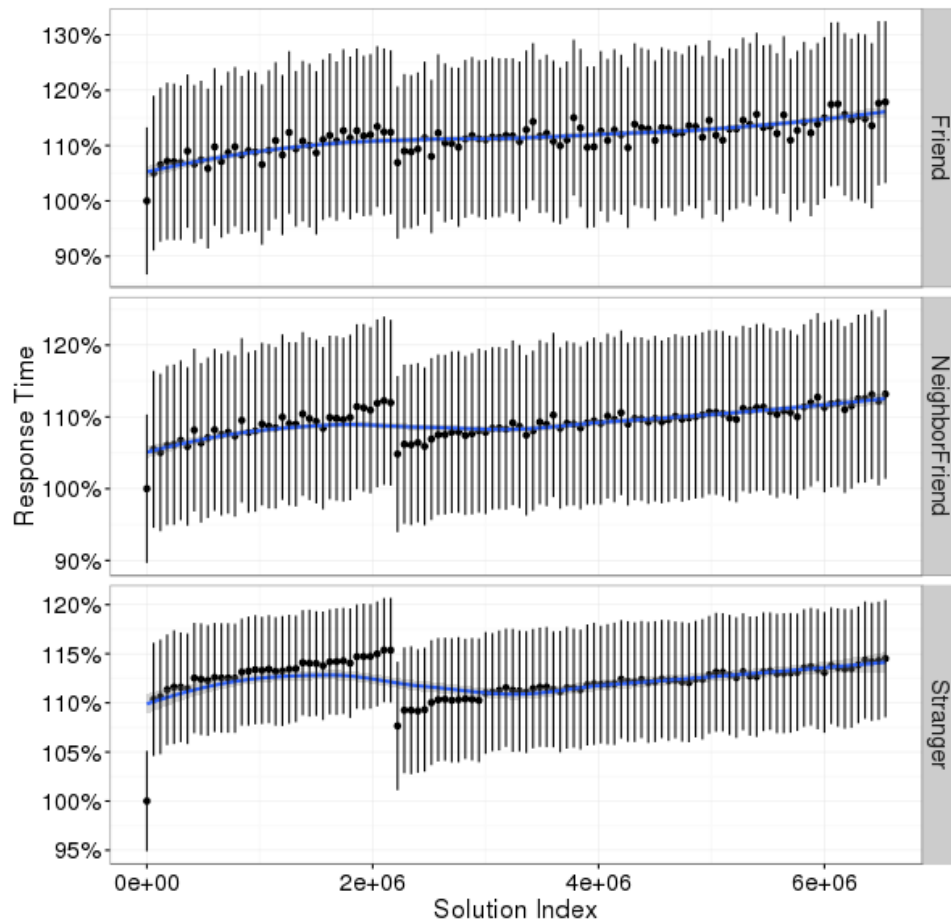
Placement - Evaluation



Unit Test



Extreme Test



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Searching Algorithm

- Depth-First
- Random-Order test

Target Device

- Avoid whole-searching
- Sort candidate devices
- Evolution process
- Consider only Trusted Zone

Heuristics - Evolution Process Example

comps2evolve:

comp_1

comp_2

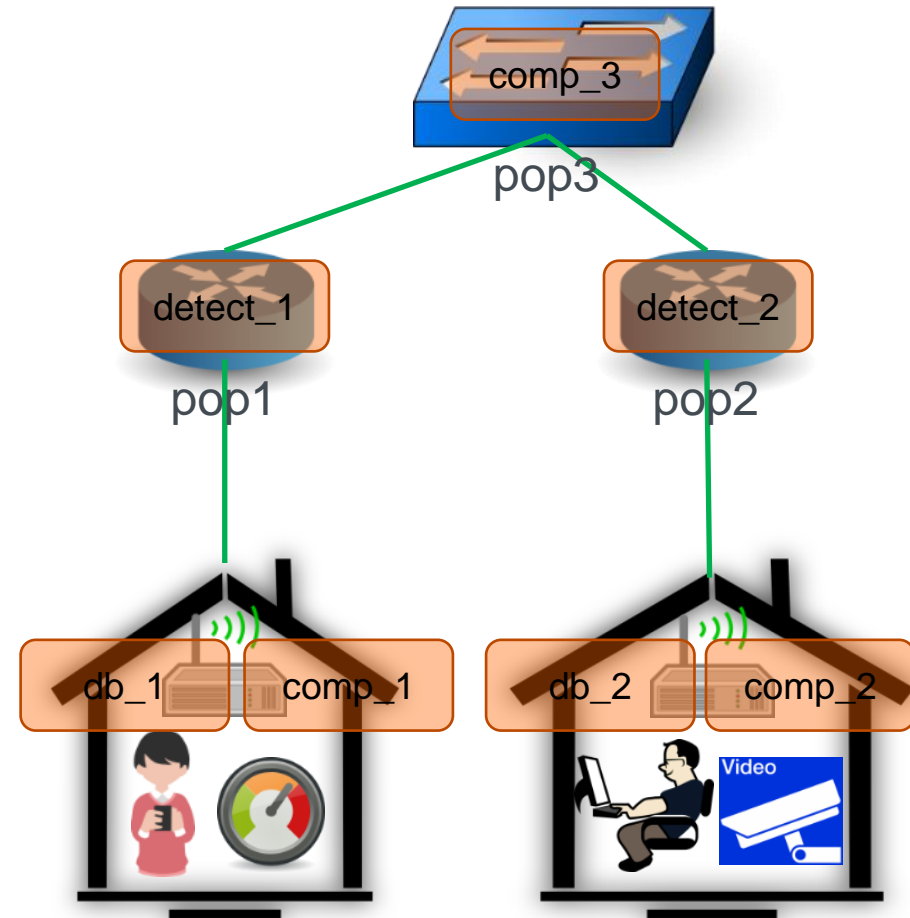
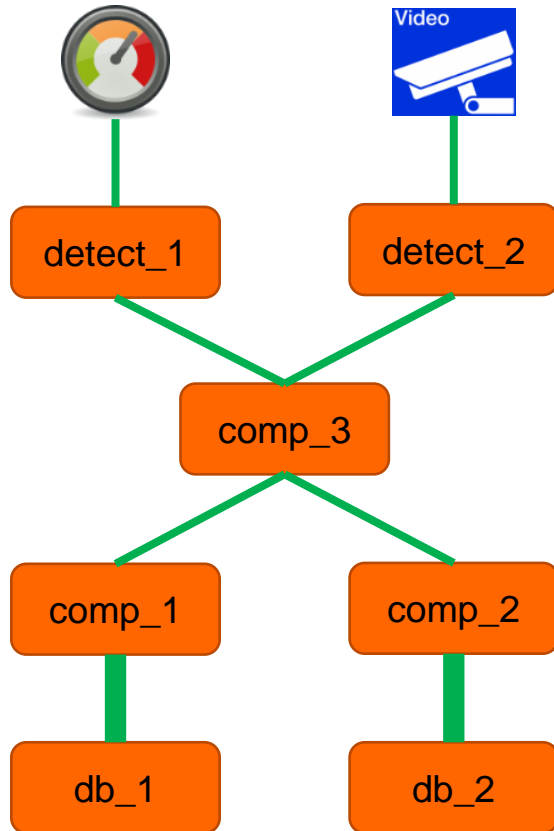
comp_3

detect_1

detect_2

db_1

db_2

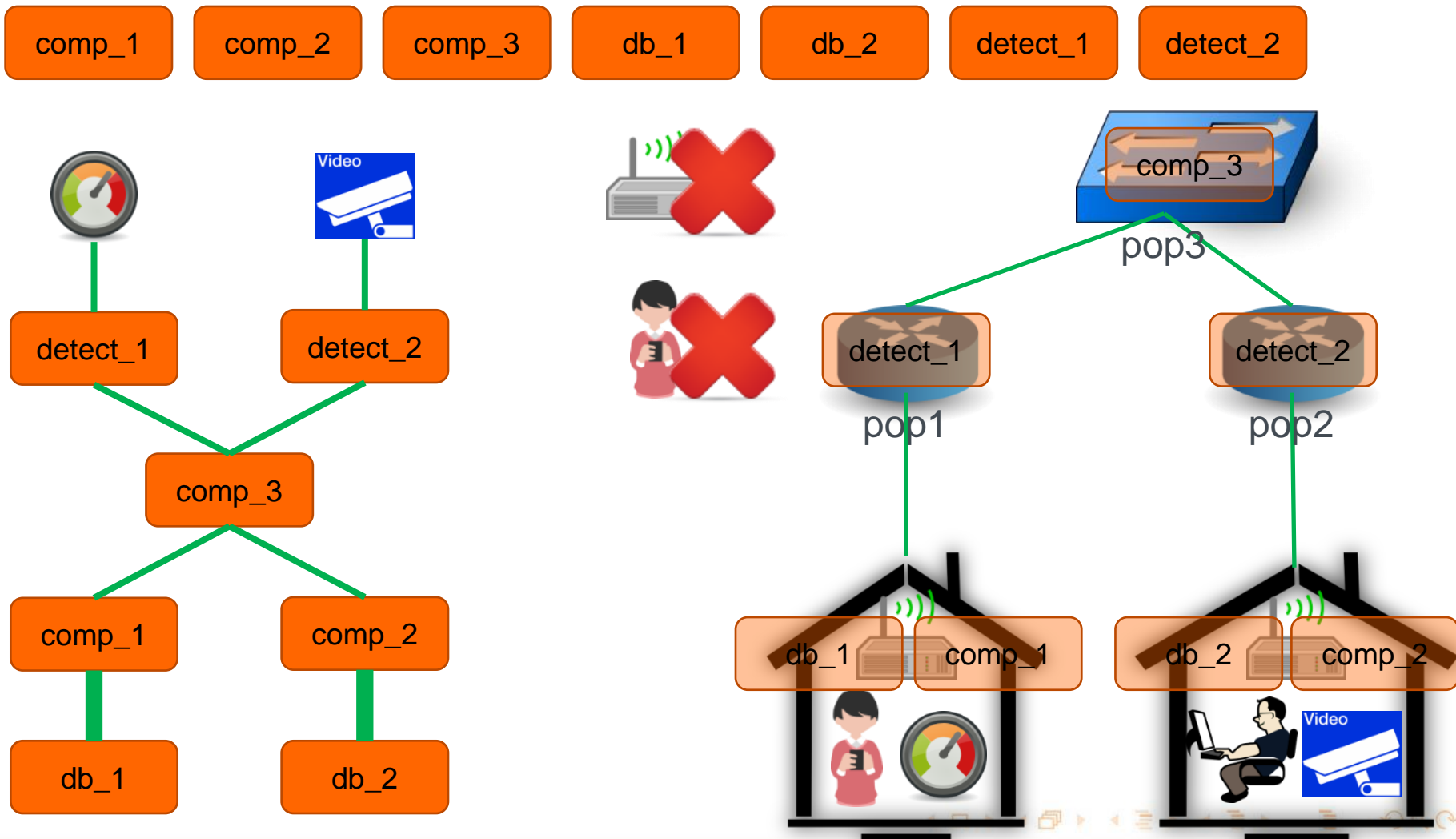


$$\sum_{bind \in getBinds(comp)} \left(lat(bind) * \frac{bw(bind)}{bw(app)} \right)$$

Heuristics - Solution Search Acceleration

- Critical compute/storage resource – dynamic priority

comps2place:



Heuristics - Evaluation Setup

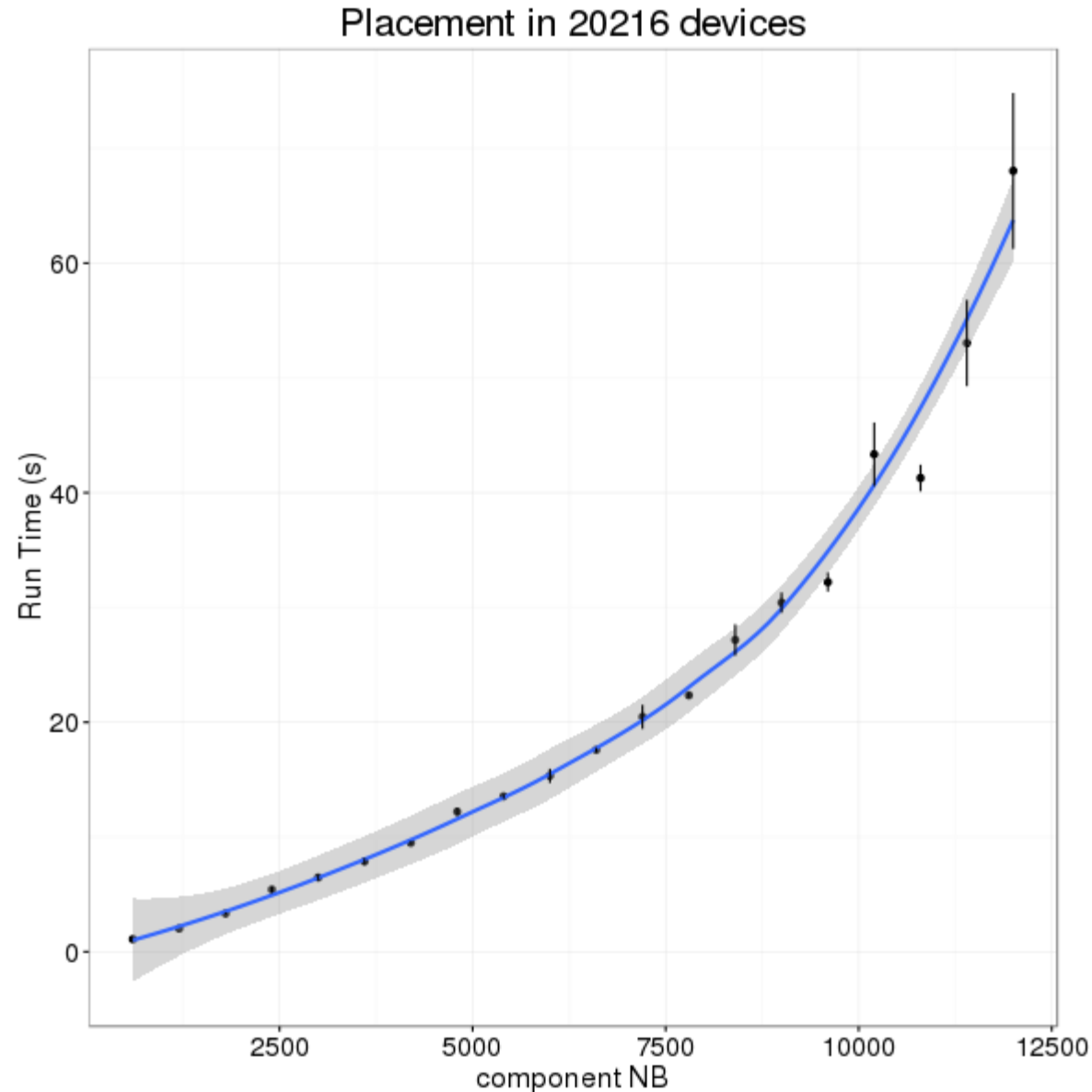
NB(Cloud) : NB(Edge) : NB(Extreme) = 1 : 10 : 1000

Trusted Zone	Full	House
Comp NB Proportion	1	5

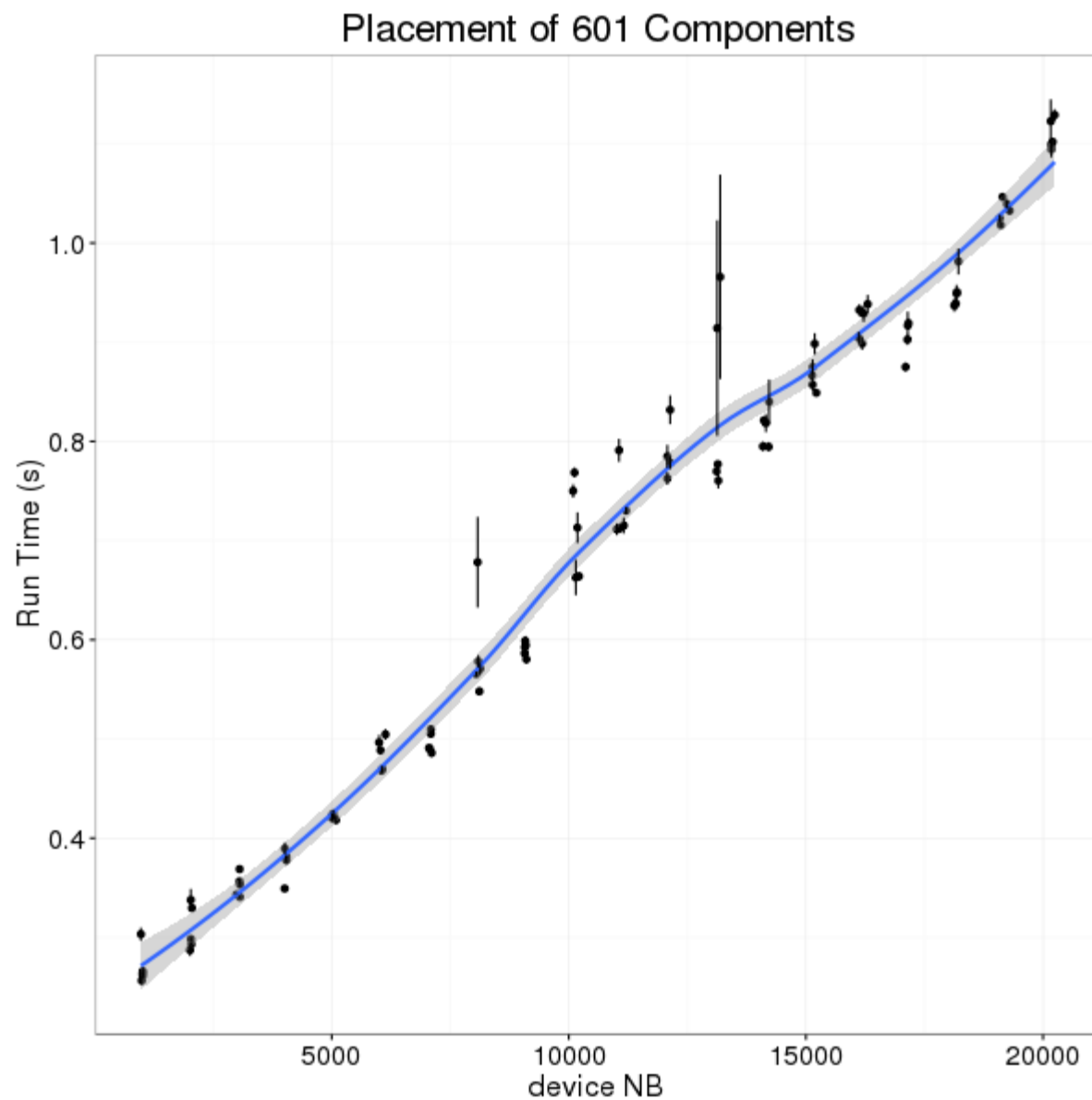
$1 \leq \text{Size}(\text{House}) \leq 3$

CPU	Intel i5 - 5300U @ 2.3 GHZ
RAM	16GB
OS	Windows 7 Enterprise
JAVA Version	1.7.0_80

Heuristics - Evaluation with Fixed Infra



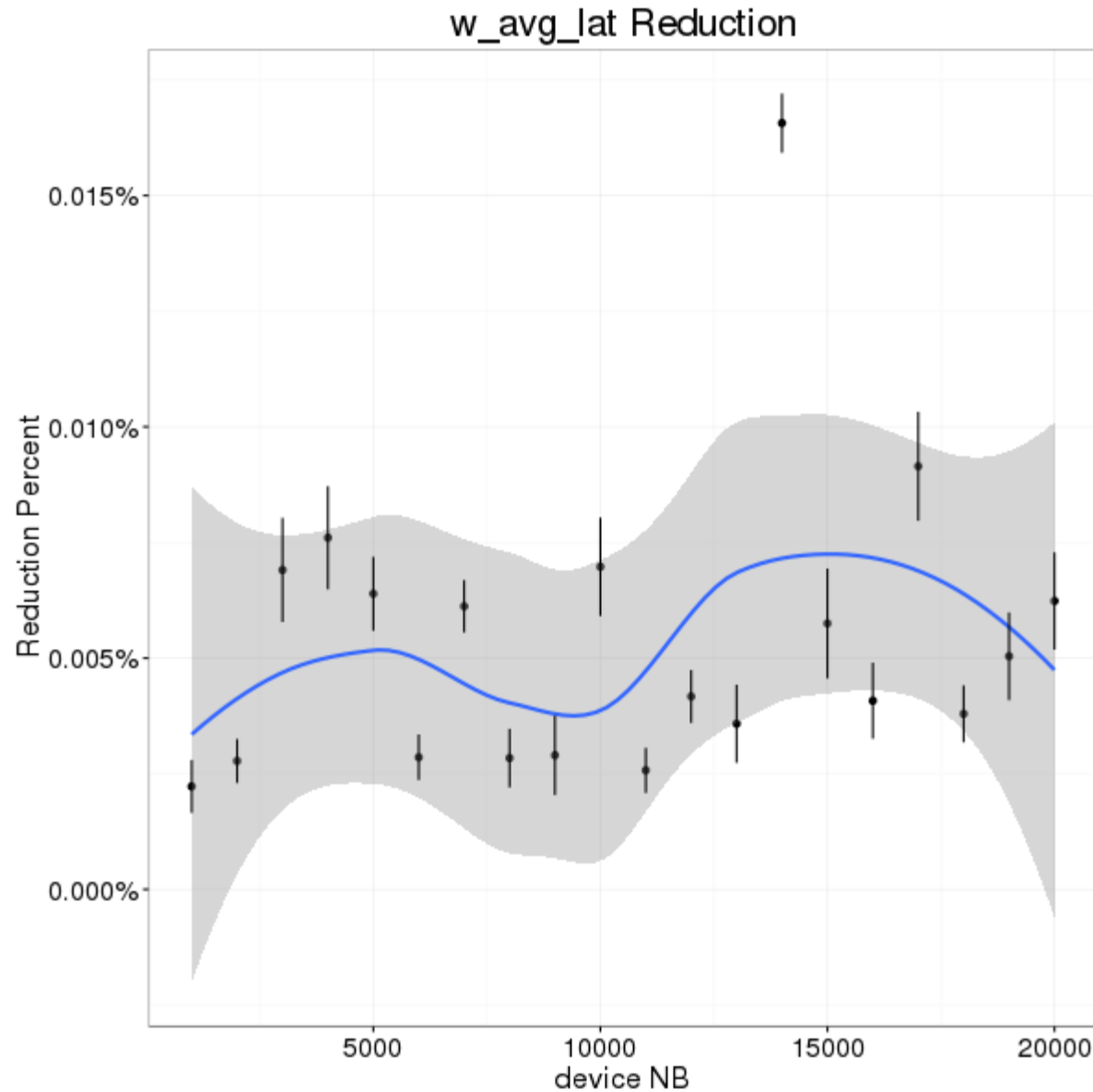
Heuristics - Evaluation with Fixed App



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Heuristics - Evaluation with Fixed App

timeout : 5min



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Future Work

Solution Search Acceleration

- Critical Latency
- Critical Bandwidth

Evaluation

- Avoid Garbage Collection

Thanks for your attention