An Edge-based Abstraction for Enabling Cooperation in Internet of Things Applications

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The IoT is the merging of the physical and the digital.

- Connected roads/transit
- Smart homes/buildings
- Environmental monitoring
- Personal health improvement
Why The Edge?

- The edge provides numerous benefits over the cloud
  - Latency
  - Privacy
  - Security
## Industry Edge/Cloud Solutions

<table>
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<th>Pros</th>
<th>Cons</th>
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<td>● Writing applications is often much easier, especially if you utilize their sensors and actuators.</td>
<td>● Lack of interoperability</td>
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<td>● Few standards</td>
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<td>● Systems just call functions, little (or no) understanding of context.</td>
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Applications sharing the same physical space are likely to interfere

- Cooperation
  - E.g., using the same sensor can enable reuse
- Conflicts
  - E.g., setting the same light(s) to different intensity
A single person wants to control their environment
Many stakeholders seeking control of many devices
An Edge-based OS-like abstraction for managing access to underlying IoT resources.
FIND DEVICES WITH Temperature geoLoc=(12.345, 11.111) AS TEMPS

FIND DEVICES WITH furnaceOn geoLoc=(12.345, 11.111) AS FURNACE

SENSE Temperature FROM TEMPS PERIOD 30 SEC

ACTUATE furnaceOn ON FURNACE PARAMS intensity=40

EVENT maintainTemp

ACTUATE furnaceOn ON FURNACE PARAMS intensity=40

WHEN (SENSE Temperature FROM TEMPS PERIOD 30 SEC) < 70
FIND DEVICES WITH toggleLight geoLoc=(12.345, 11.111) AS LIGHTS

- DevSets are sets of functionally equivalent devices.
Semantic Runtime schedules what device to use when

- Based on metric to be optimized (latency, accuracy, energy, etc.)

Example strategies for energy consumption:

- Round-robin
- Greedy
- Dispersion
Preliminary Results

Relative Energy Consumption

Number of Activations

Device Selection Strategy

Relative Energy Consumption

Number of Activations

Device Selection Strategy

- Round Robin
- Greedy
- Dispersion

Device 1, Device 2, Device 3, Total
Devices may be deemed functionally equivalent if they have similar effects, e.g., increasing light.
The Internet of Things requires systems which can account for the semantic richness of the physical world.

Constellation provides many examples and optimizations based on such semantics.
Questions/Discussion

❖ Desired feedback
  ➢ Thoughts on potential use cases
  ➢ Thoughts on the practicality or difficulties involved in putting such a system into practice

❖ Controversial Points
  ➢ Assumption of interoperability
  ➢ Privacy concerns

❖ Open Problems
  ➢ Security
  ➢ Extending for wider areas

❖ Depreciating Circumstances
  ➢ Moore’s Law, Next-Gen Networking, Heterogeneity/Interoperability