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Orchestrating Masses of Sensors: A Design-Driven Development Approach

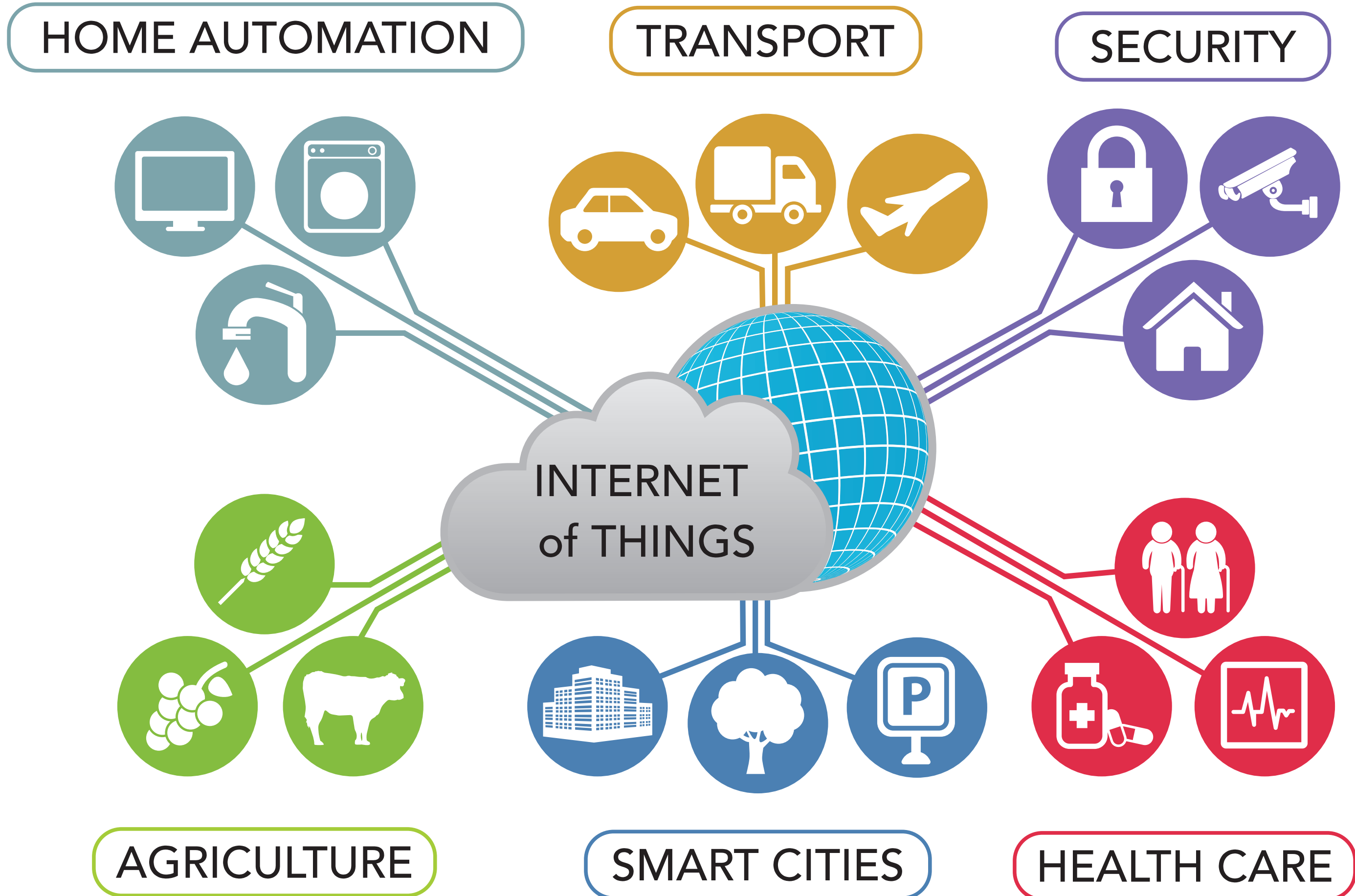
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Goal

Propose a software development approach to taming the many dimensions of the orchestration of masses of objects.

Context



Scaling Up

Actuating

What support is needed for actuating devices?

Data Gathering

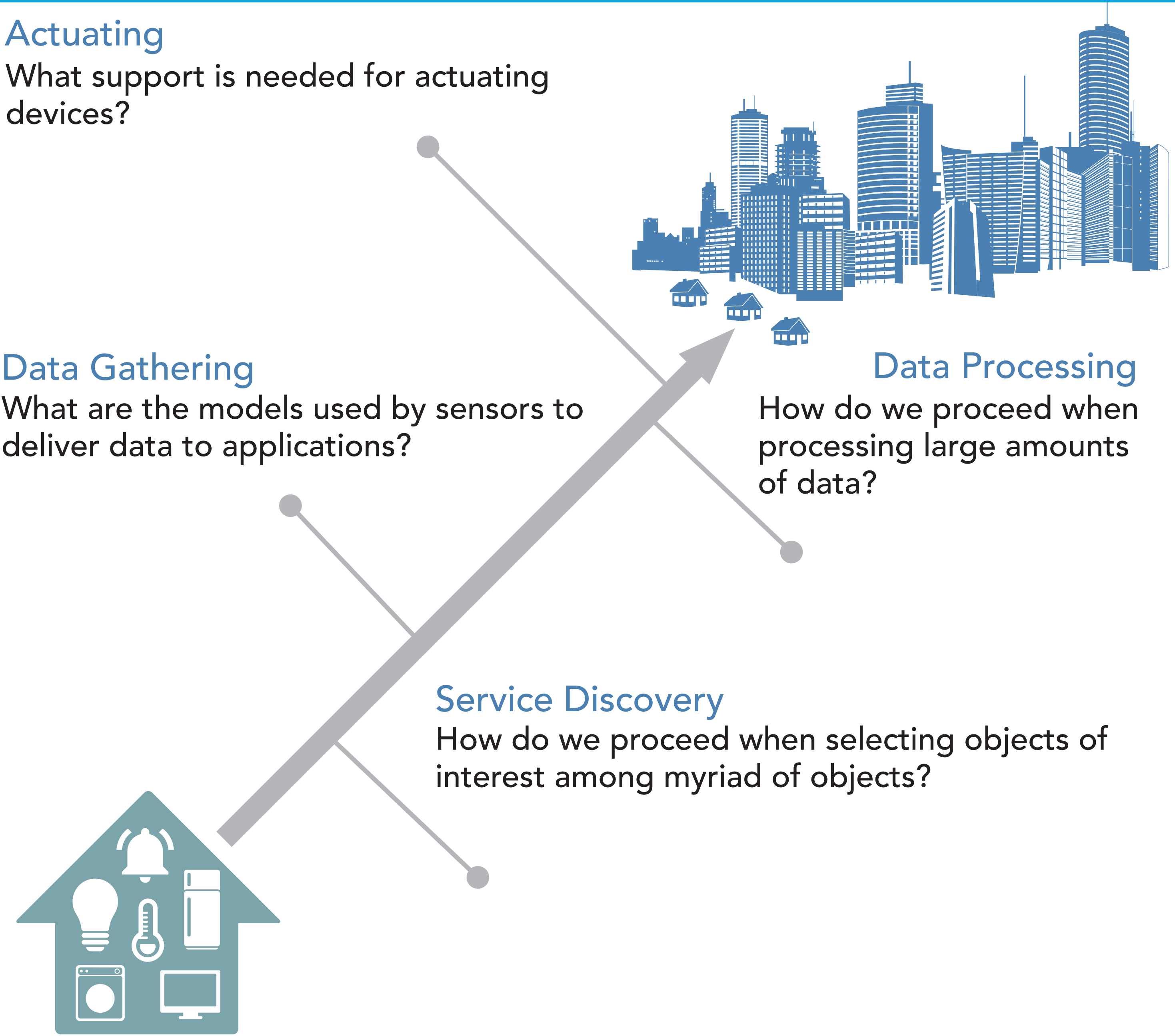
What are the models used by sensors to deliver data to applications?

Data Processing

How do we proceed when processing large amounts of data?

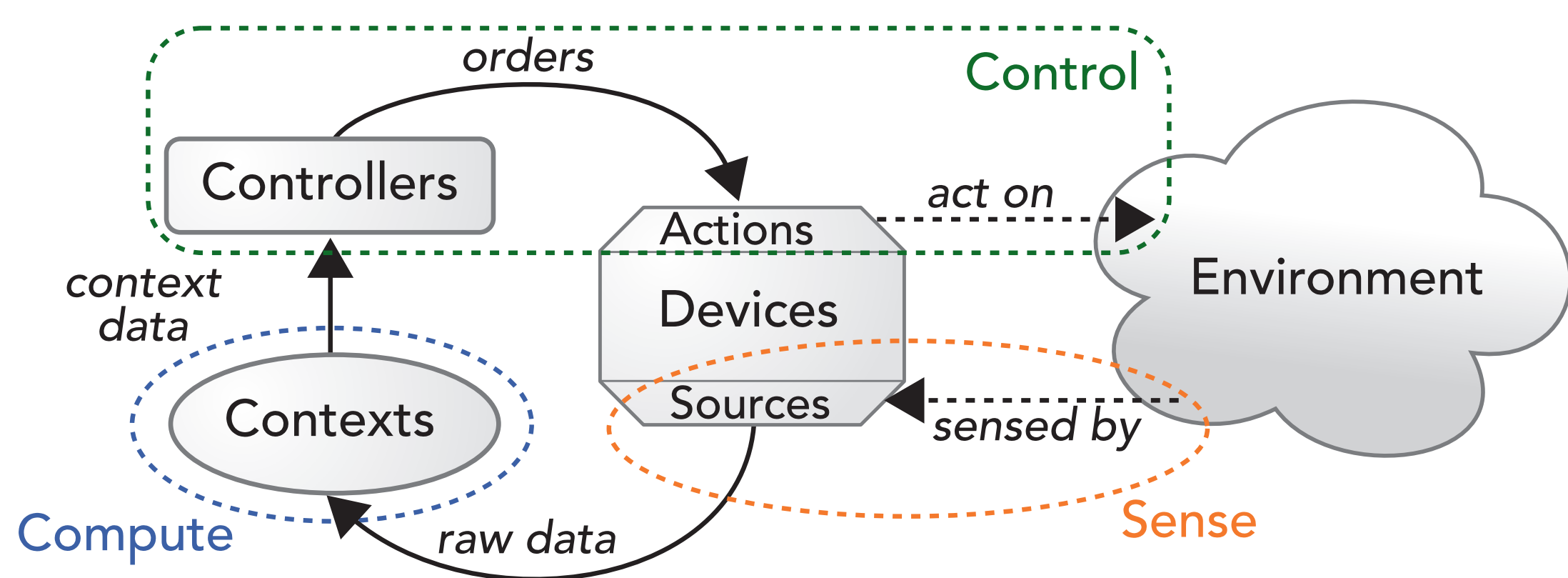
Service Discovery

How do we proceed when selecting objects of interest among myriad of objects?



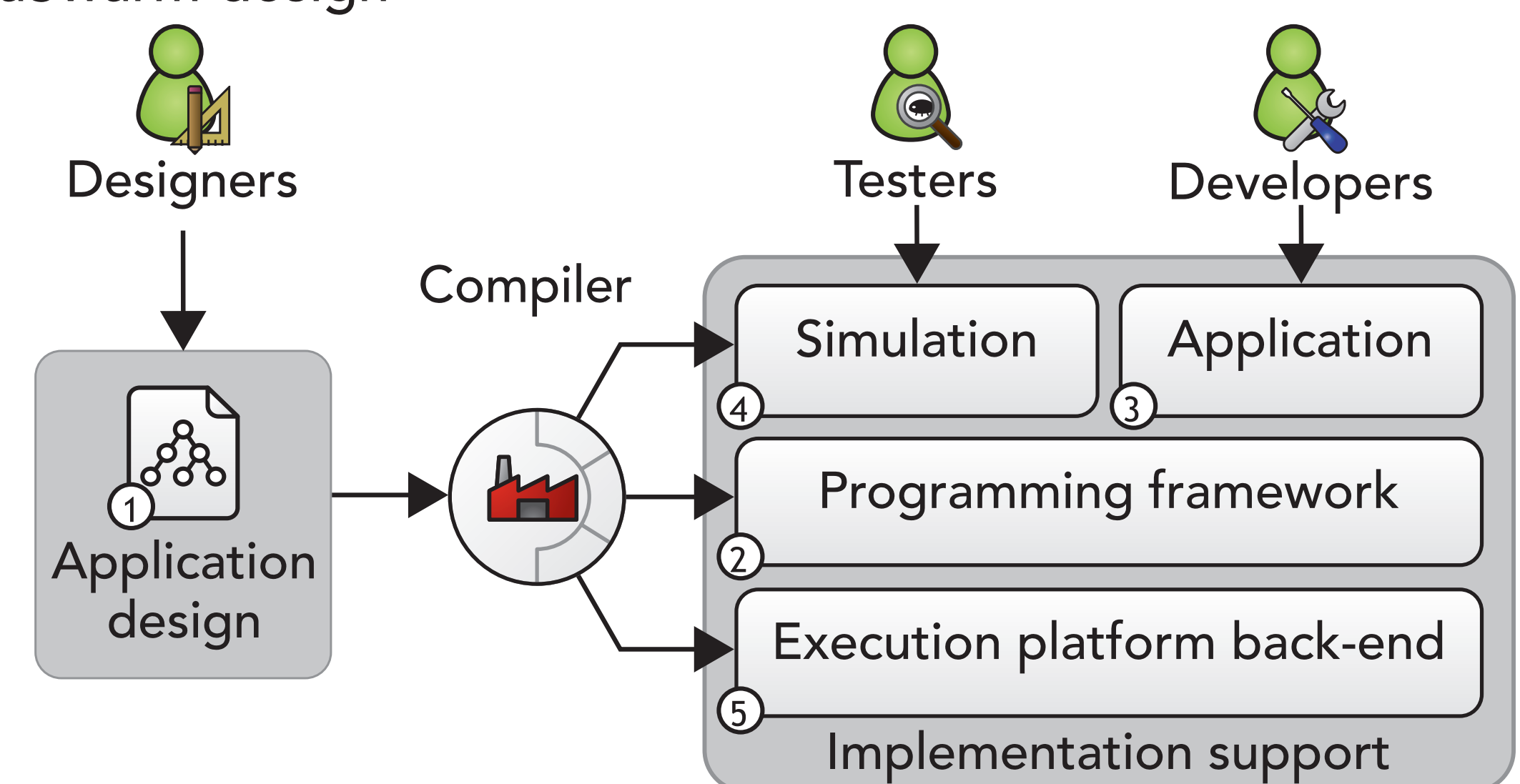
DiaSwarm

- Domain-specific design language, which builds upon DiaSpec
- Provides high-level declarative constructs dedicated to manipulating objects at a large scale
- Revolves around the Sense/Compute/Control paradigm



Design-Specific Programming Frameworks

- A compiler produces programming support customized with respect to a given DiaSwarm design



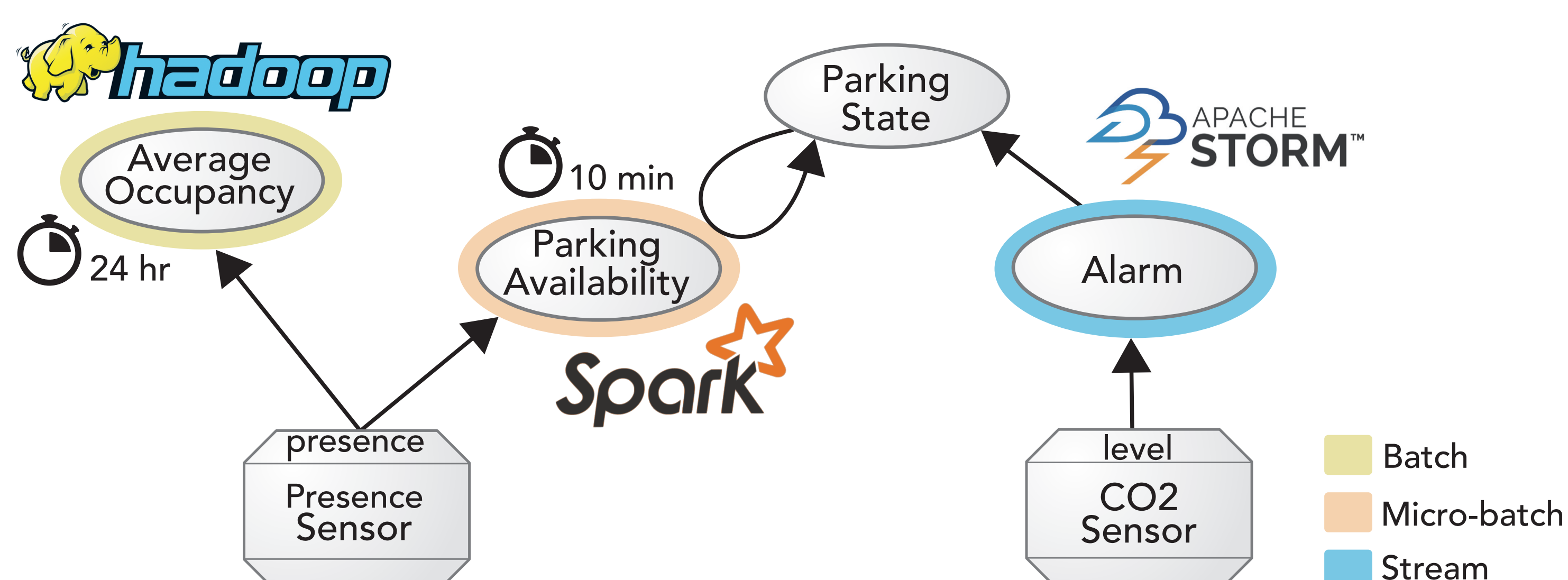
Large-Scale Orchestration with DiaSwarm

By assessing the new requirements induced by scaling to city-wide sensor networks, we can extend DiaSpec to improve orchestration, specifically by:

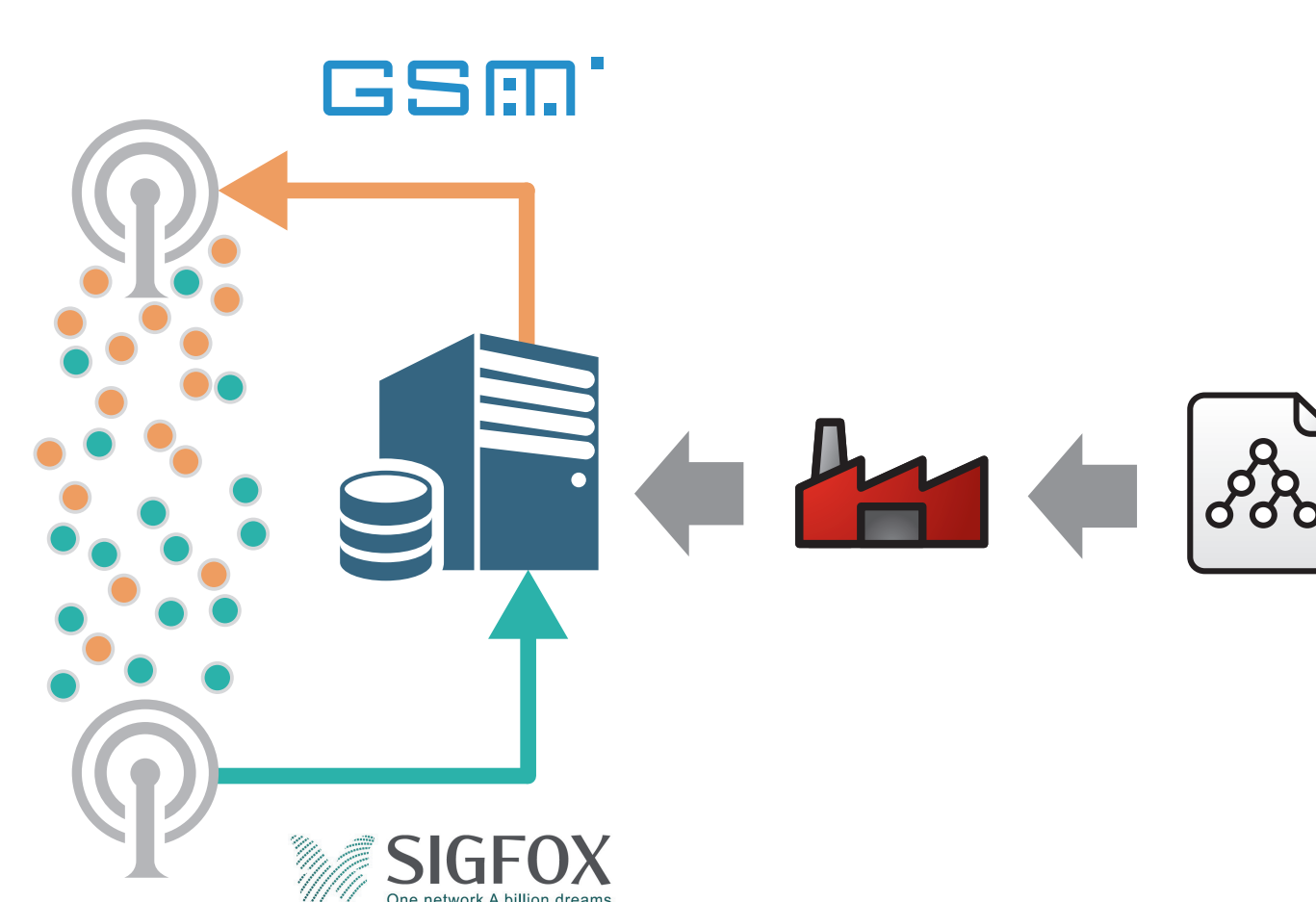
- Introducing periodicity for gathering data from sensors
- Grouping sensors using application-tailored high-level constructs
- Exposing structural parallelism for data processing

```
context ParkingAvailability as Availability[] {
  when periodic presence from PresenceSensor <10 min>
  grouped by parkingLot
  with map as Boolean reduce as Integer
  always publish;
}
```

Data Processing



Network Retargetability



References

- [1] Charles Consel, Milan Kabáč. *Internet of Things: A Challenge for Software Engineering*, ERCIM News, Smart Cities, 2014, Smart Cities.
- [2] D. Miorandi et al.: *Internet of things: Vision, applications and research challenges*, Ad Hoc Networks, vol. 10, no. 7, 2012
- [3] D. Cassou, et al., *Towards A Tool- Based Development Methodology for Pervasive Computing Applications*, IEEE Transactions on Software Engineering, 2011