Smart Buildings as Cyber-Physical Systems (CPS) In Smart Cities: Living Building

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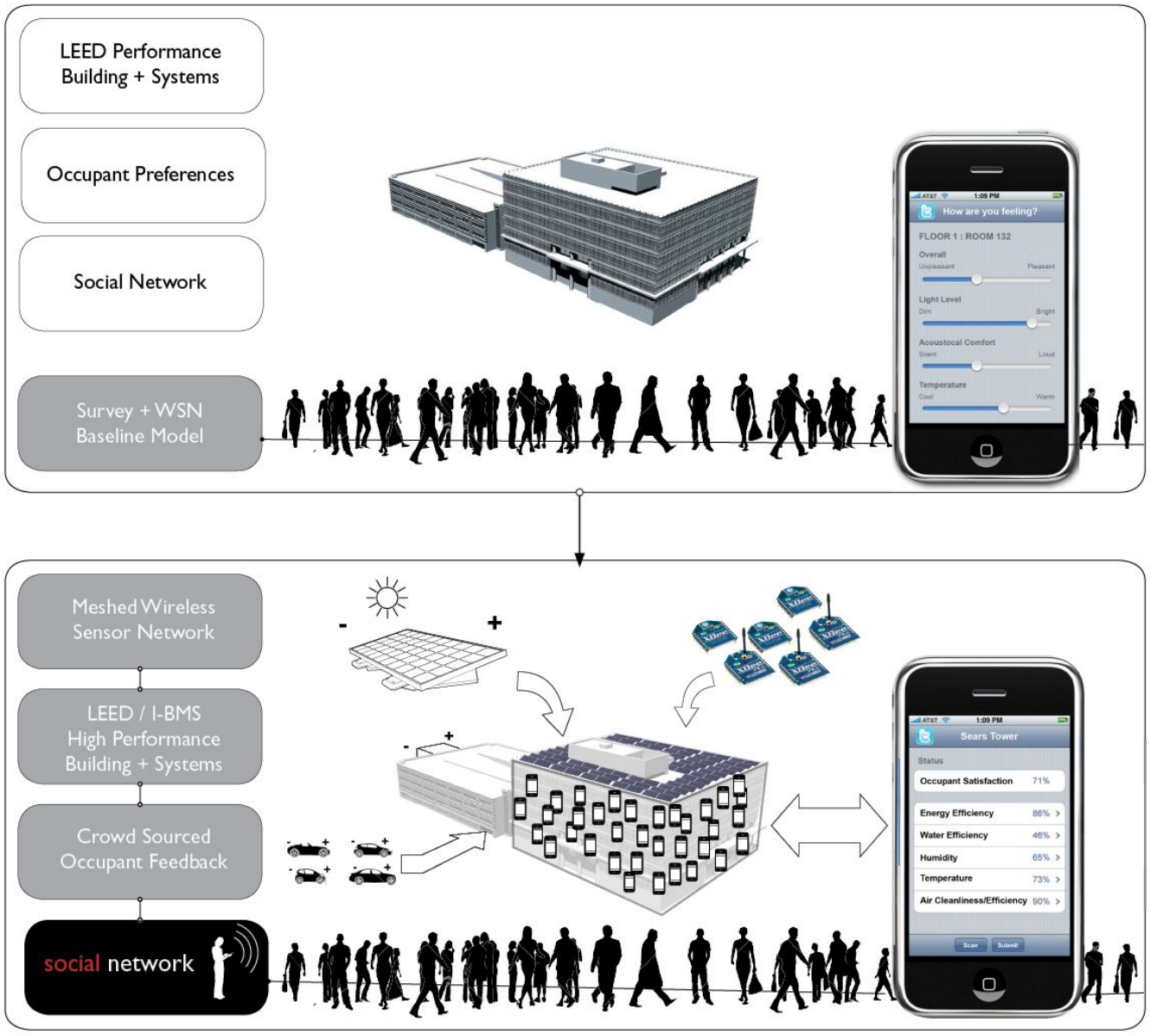
Sensor & Wireless Network Driven Intelligent Building Systems



Outline

Motivation

Living Building Vision and metaphor

Description of the system

Sensor Information Processing Model

Fundamentals Challenges

What can we do now

Research opportunities

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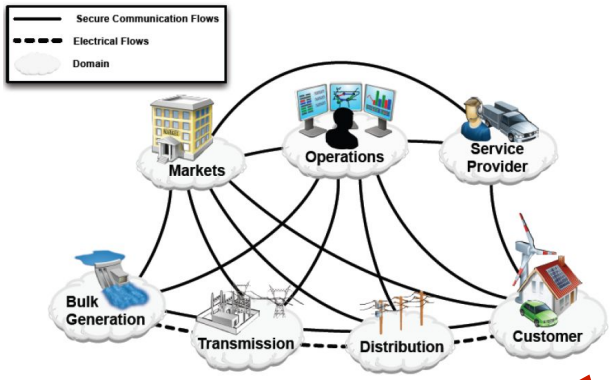
Motivations

Smart Grid



Energy Efficiency

Cyber Physical Systems

Smart Cities

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Our Vision: a Living Building Paradigm

- A Building/campus/neighborhood that can **autonomously** manage its power **consumption**, **generation**, and **control** as it is a **living organisms**.
- A Building that can **optimize** energy consumption
- A Building as **Microgrid .**
- A Building that is **context aware**: It interacts with its **occupants** and adapts to **their preferences**.

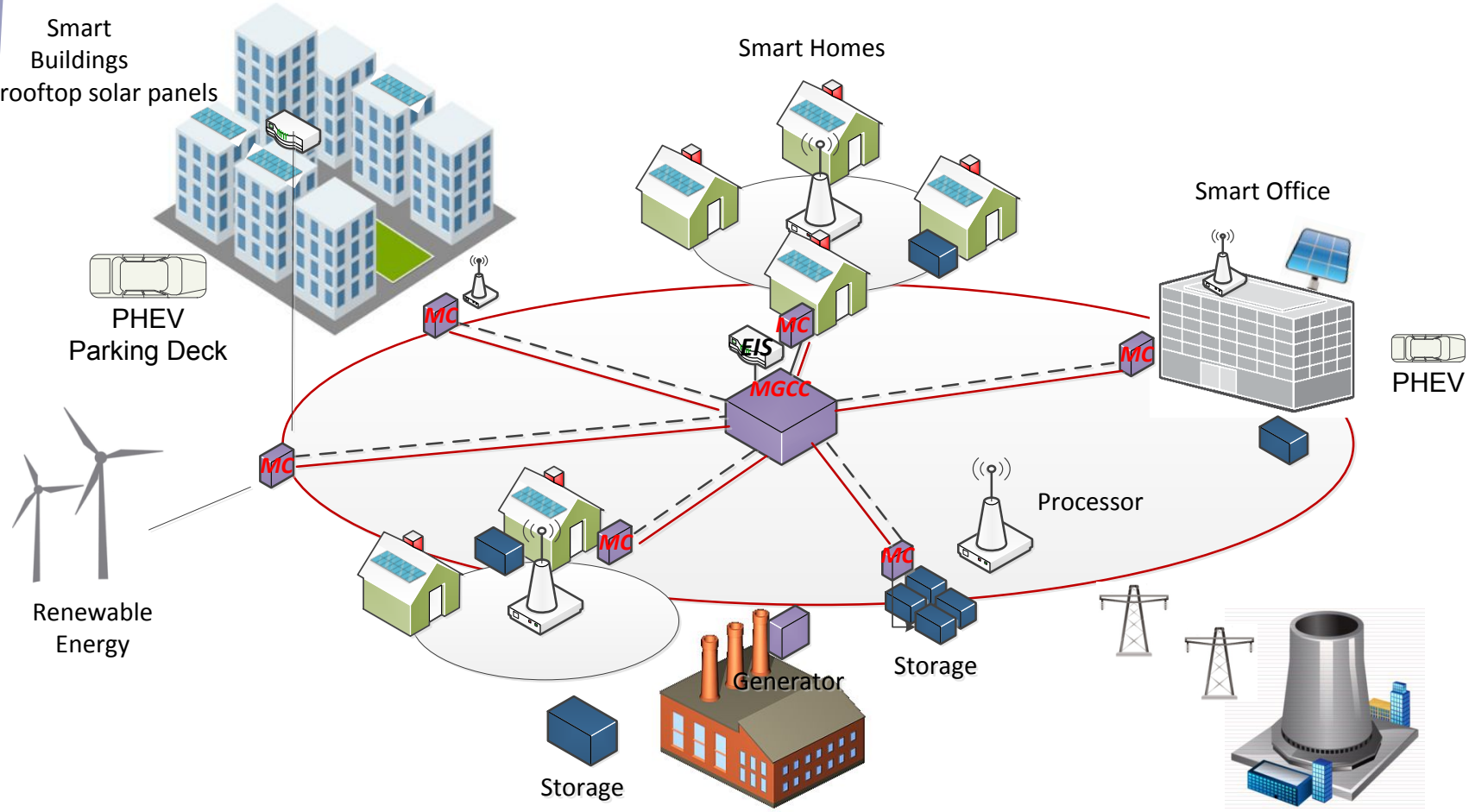
Living Metaphor

- **Nervous System**: made of a network (wireless) of sensors, actuators, and computing infrastructure.
- **Regulatory:** Building Control algorithms.
- **Immune functions:** Made of fault tolerant and failure avoidance and detection algorithms.

Building as a Cyber-Physical System

- These intelligent buildings are ***Cyber-Physical Systems (CPS)*** that will require a deep integration of Artificial Intelligence (Sensing and computation), communication (e.g. WSN, middleware), and control.
- These parts are implemented as **layered** services.

The Physical Layout



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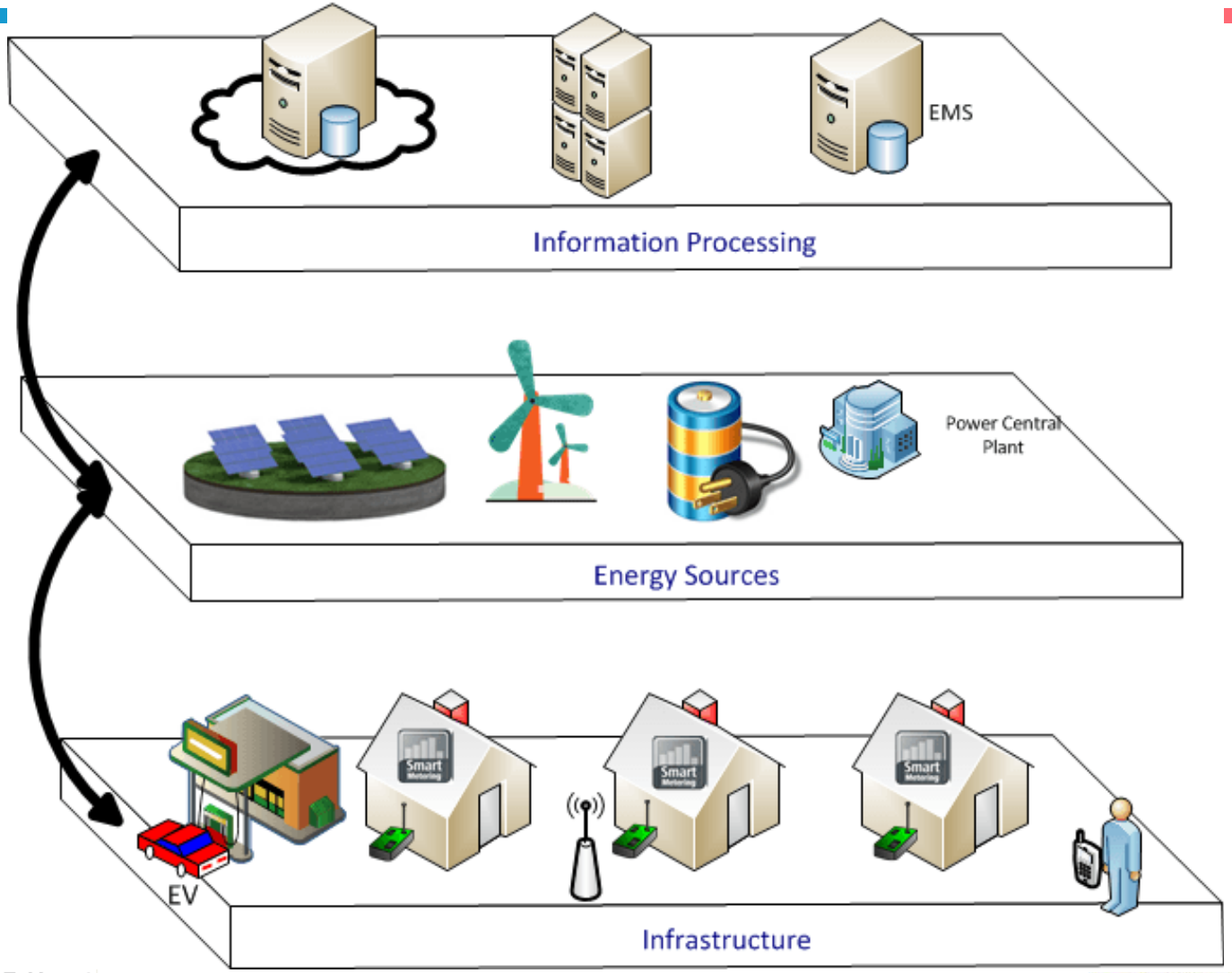
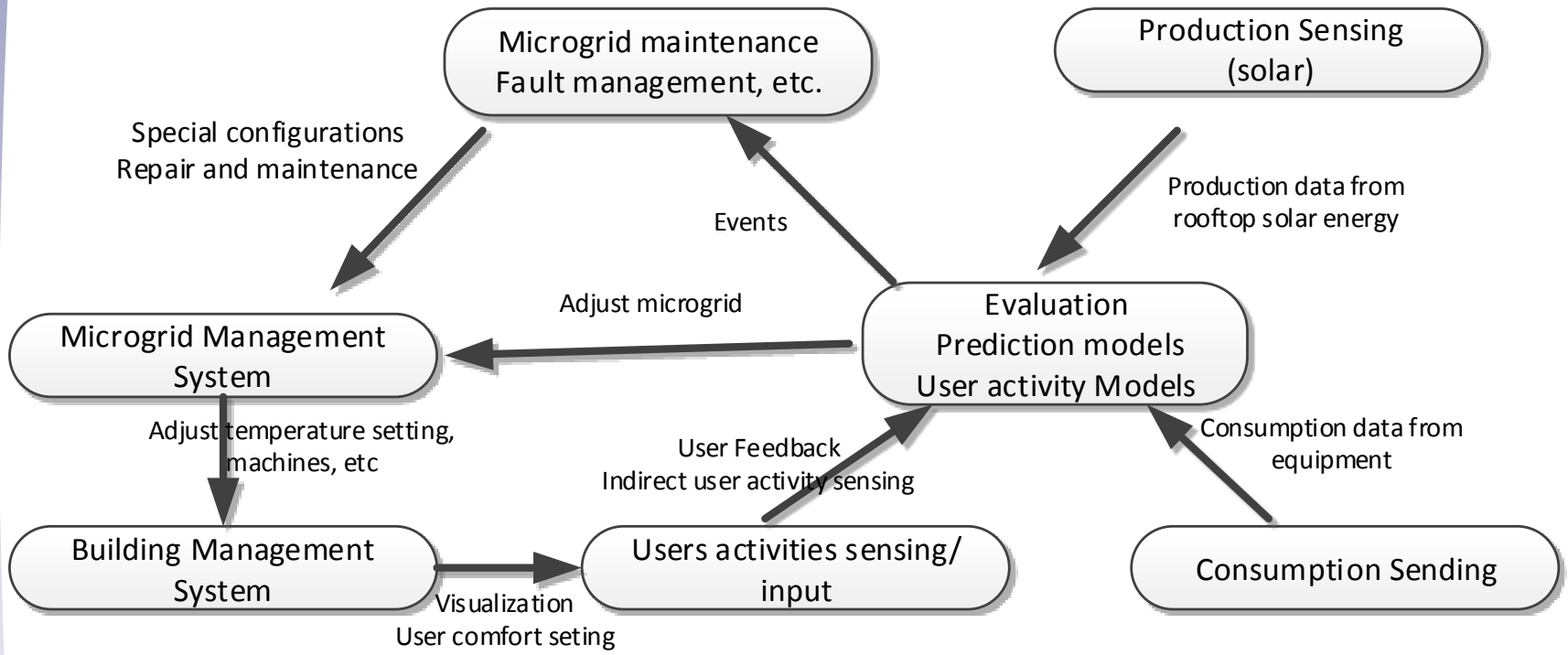
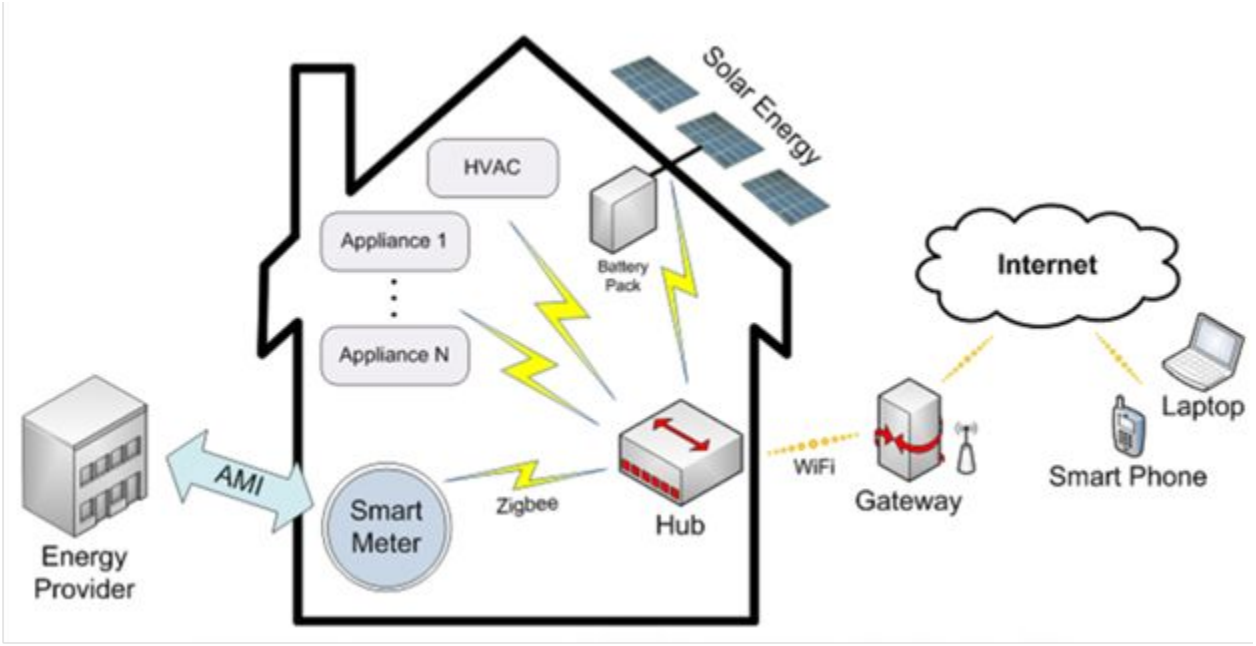
Abstraction Layers



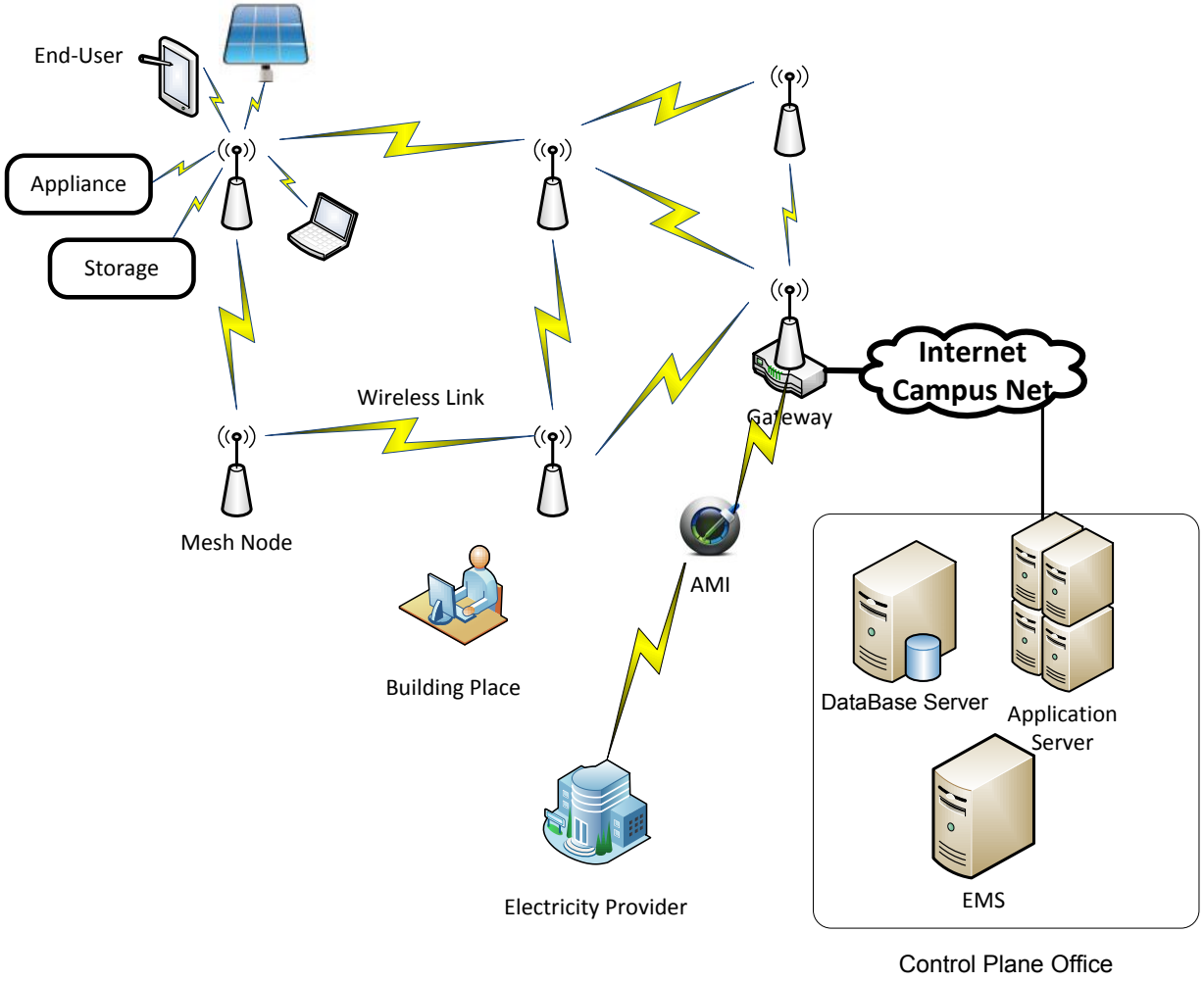
Sensed Information Processing



CPS and Smart Grid: Home Scenario



Multi-domain Perspective campus/ neighborhood view



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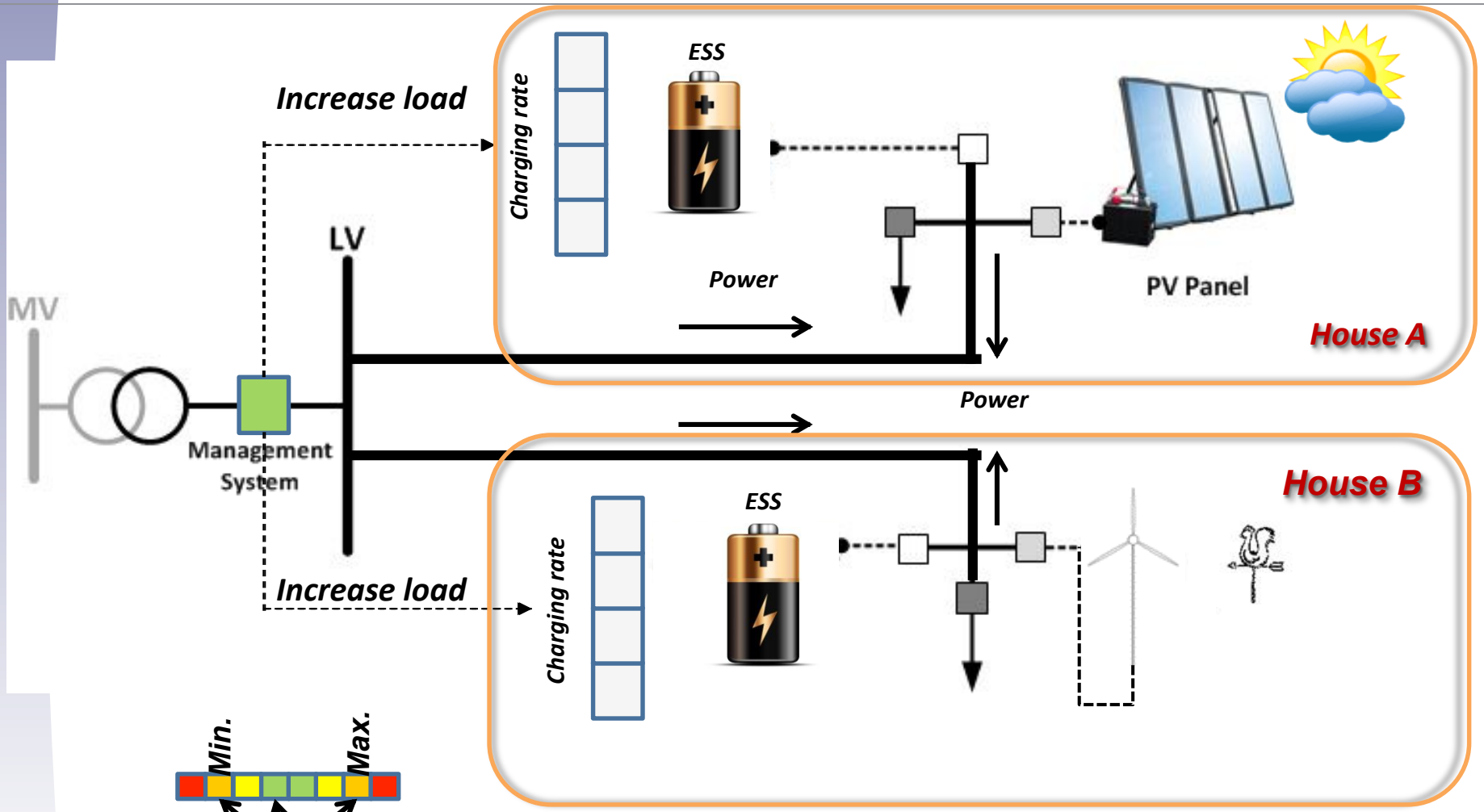
SECRETS – Sustainable Energy Clusters REalized Through Smart Grids *(IRESEN funded)*



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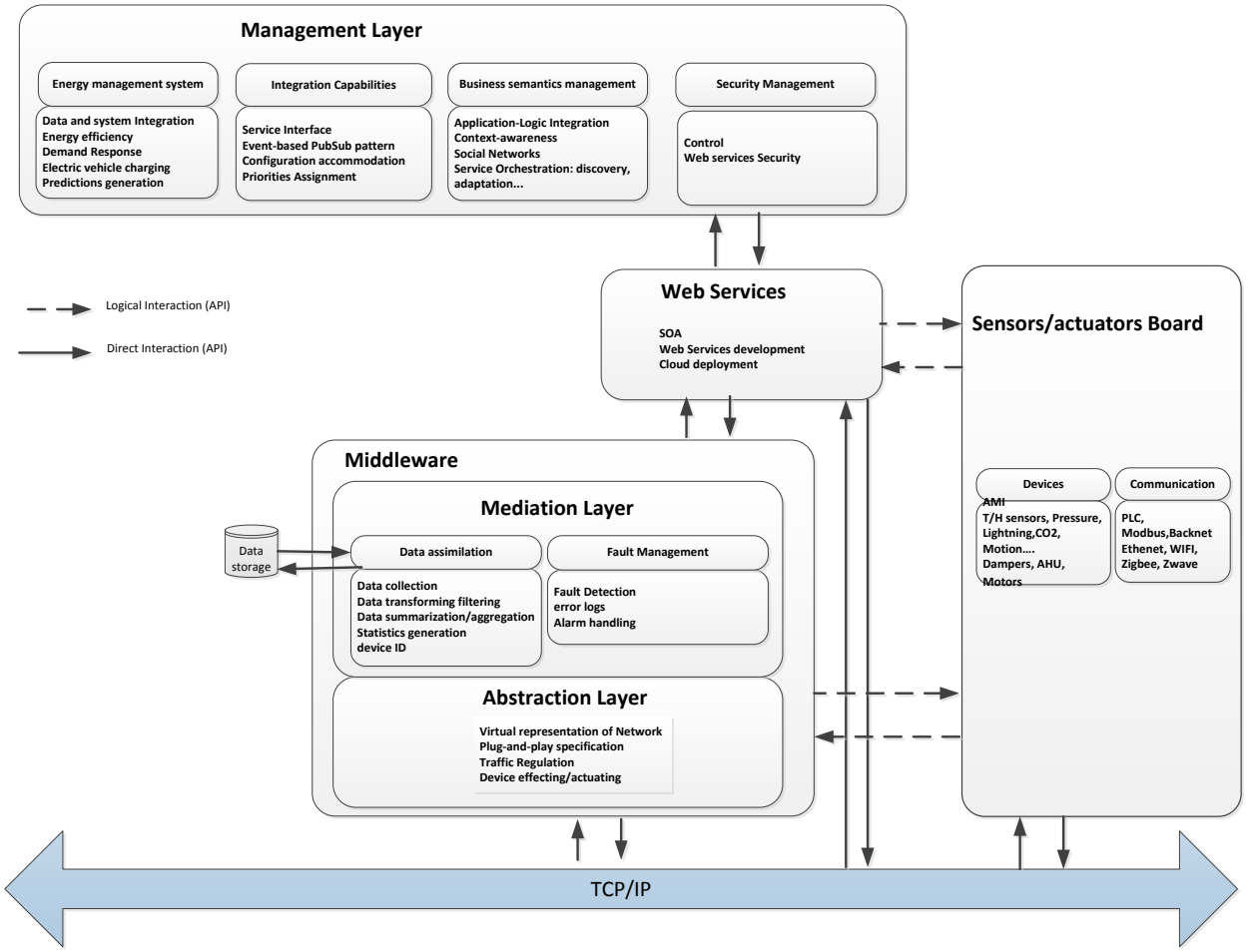
Middleware Design



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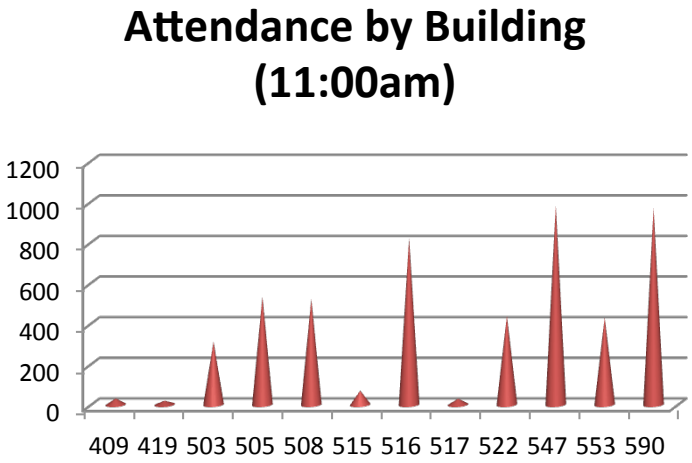
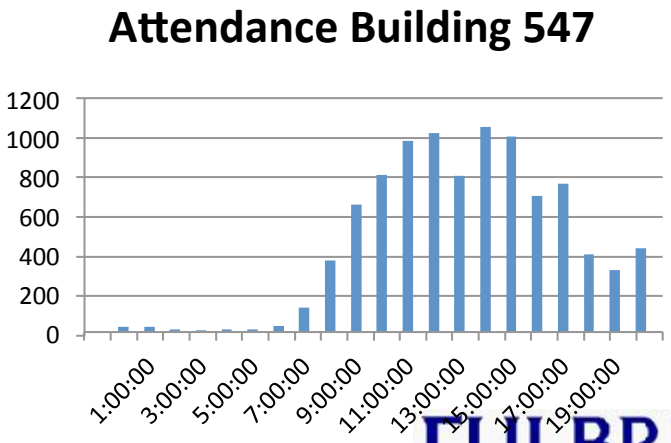
Fundamental Challenges

- Smart Sensing: smart doors, smart windows, charger, Solar, etc.
- Network and Complex System Modeling for reliability
- Human Behavior: Sensing, impacting, and Modeling
- Learning: applied machine learning

What can we do now: Estimation of Building Attendance using WiFi

- Input: WiFi Network Logs
- Output: Attendance estimation
- Future work: Attendance prediction based on Markov and/ or regression models.





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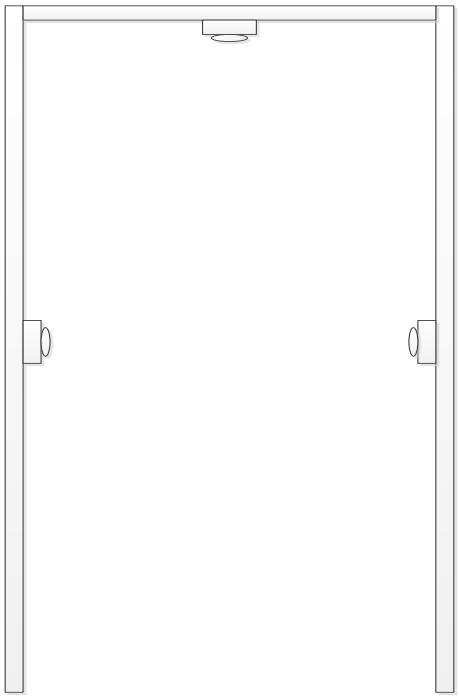
Smart Doors

- *Ultrasound Sensors*
- *Infrared Sensors*
- *Machine Learning*
- *Identification*



What Next

- Dense Sensing
- Deep Learning
- Non intrusive
- Smartness in the network
- Reliable networks
- Autonomous building that can act on its own, understands and feels its occupant

Thank You!

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