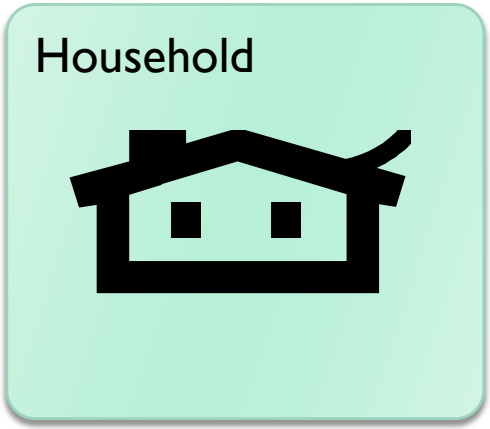
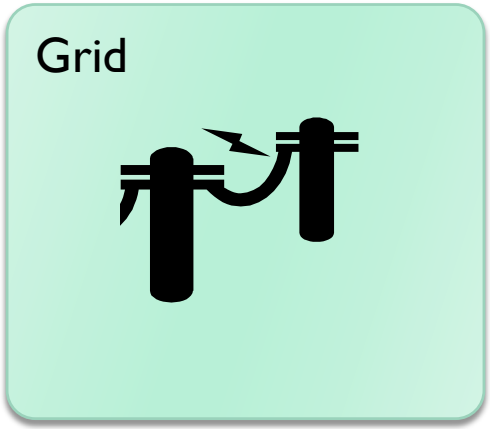
IDSIA – Istituto Dalle Molle di Studi
Sull'Intelligenza Artificiale

S2G: concepts of control algorithms and simulation

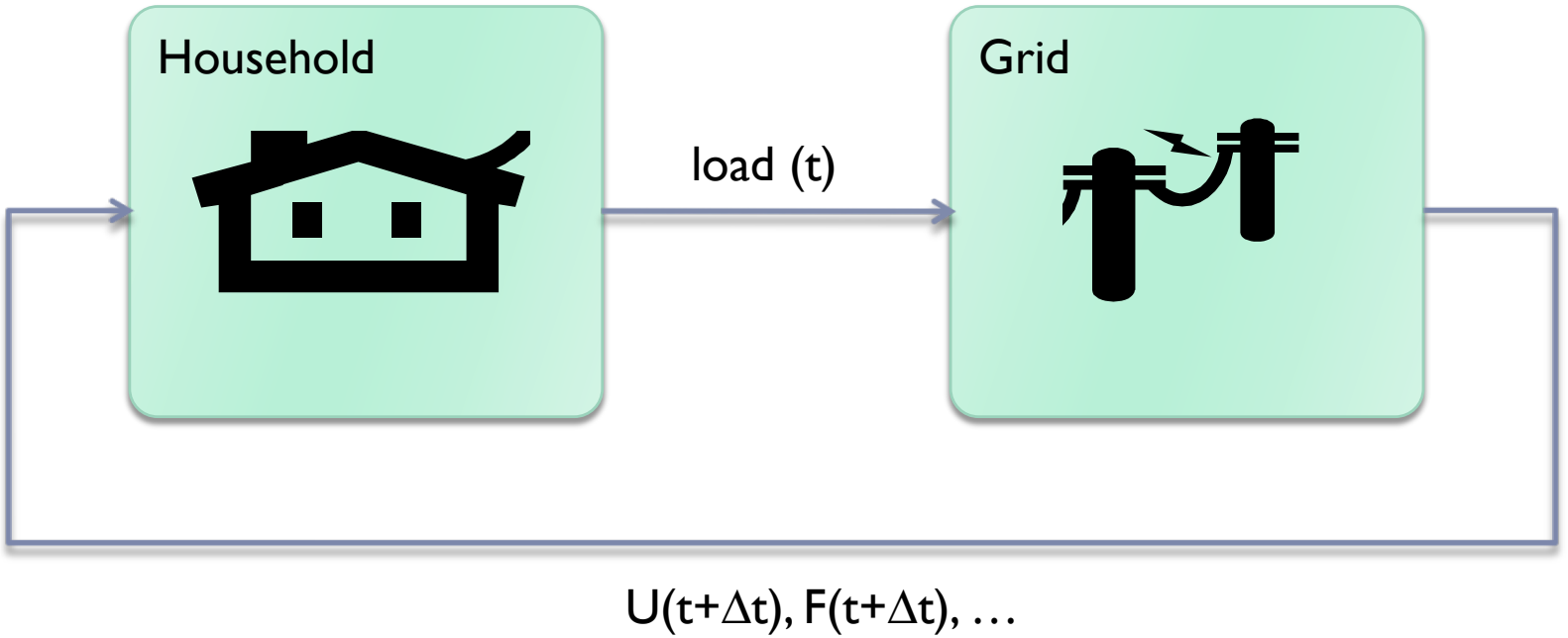
Project Meeting - October 29, 2010

Vision: Components and Interactions

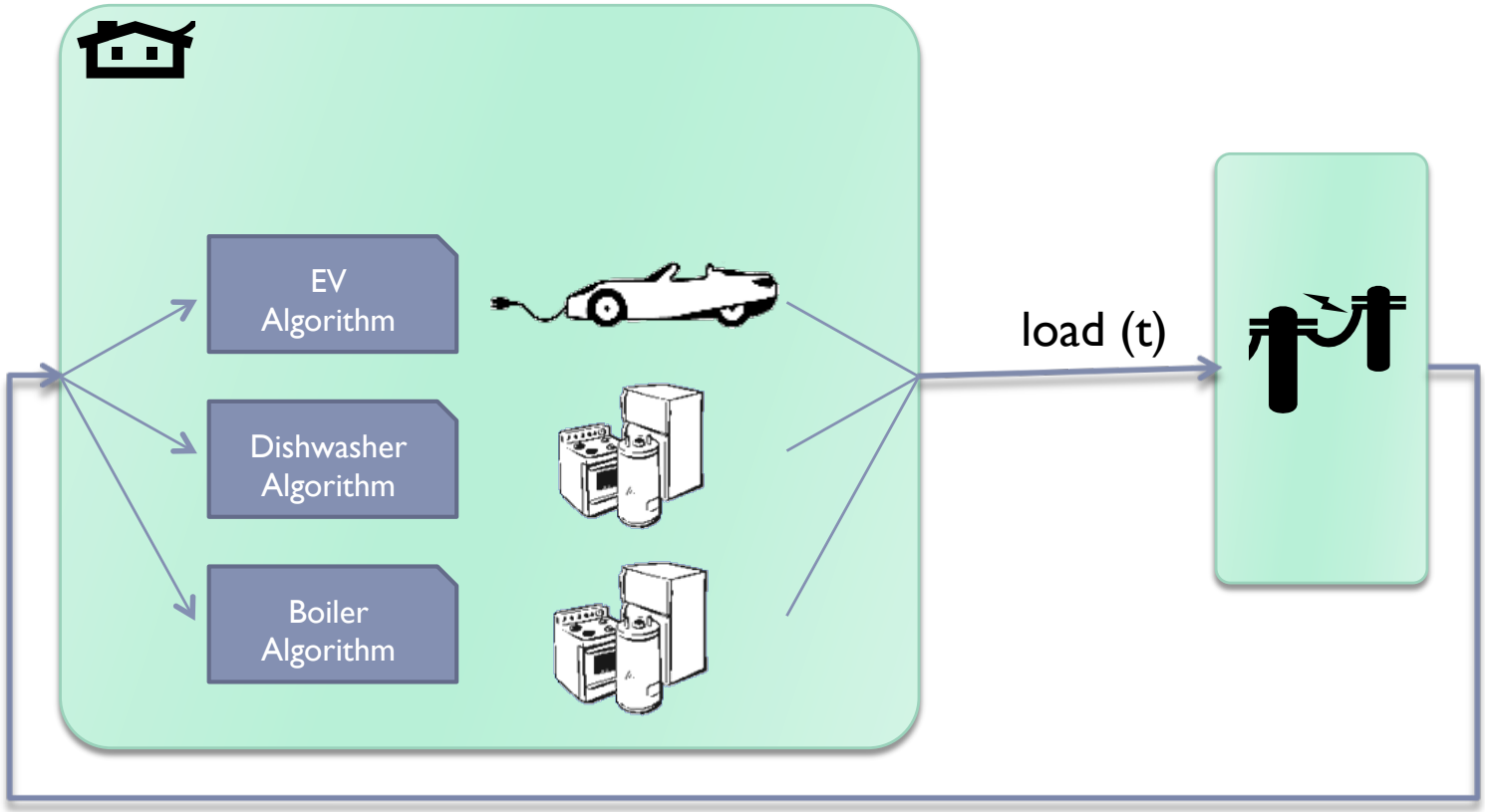




Vision: Components and Interactions



Vision: Components and Interactions



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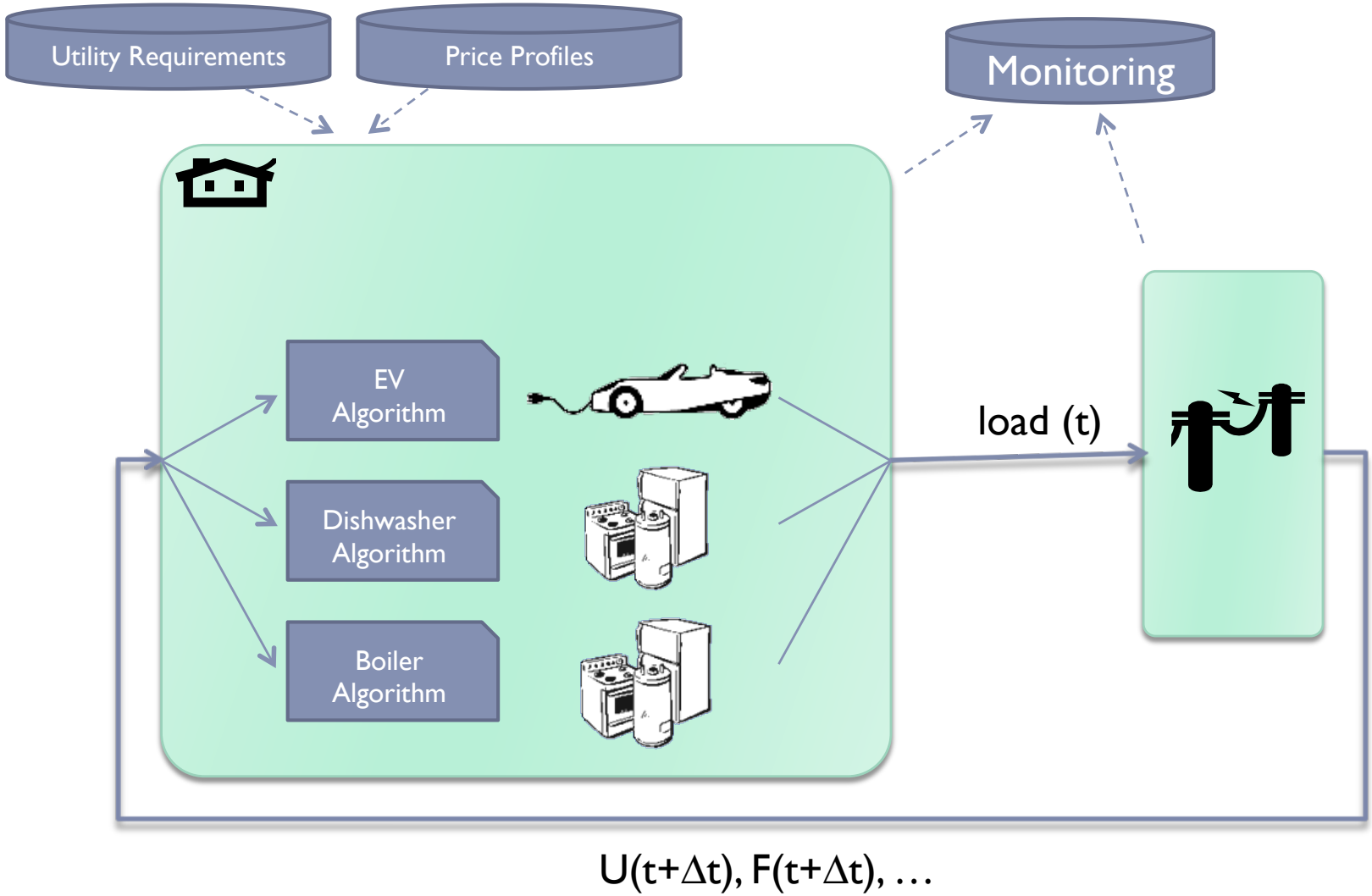

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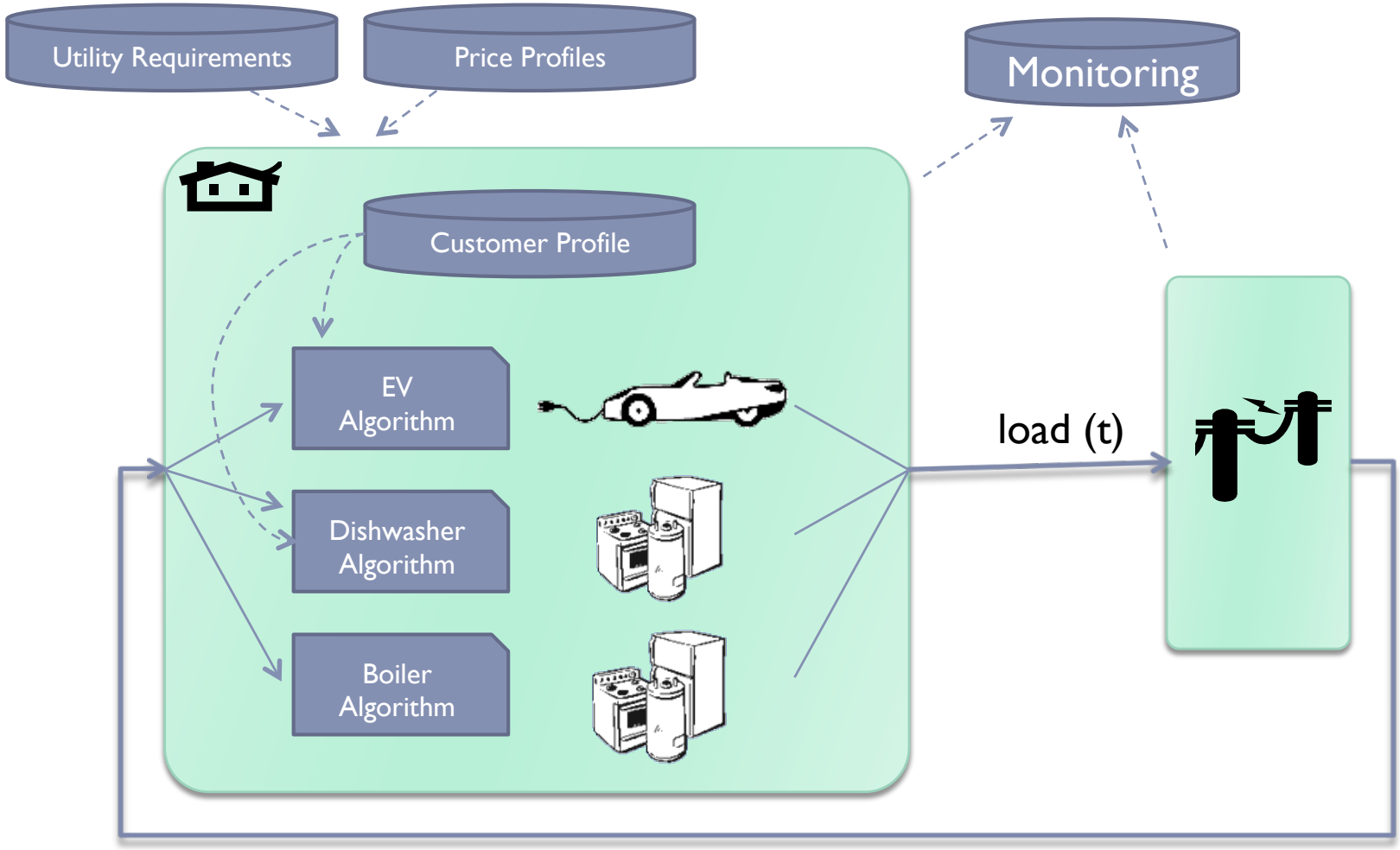

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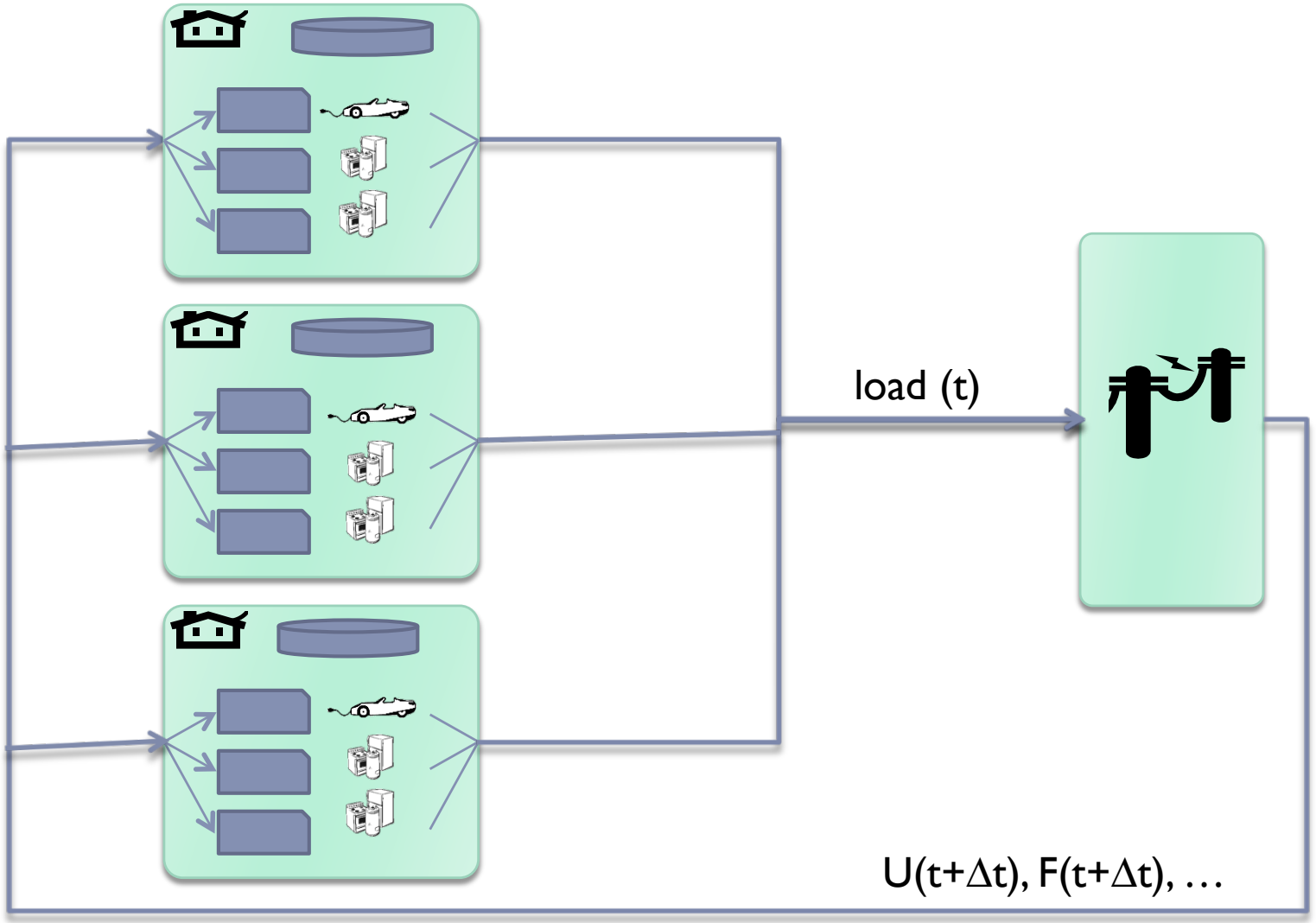
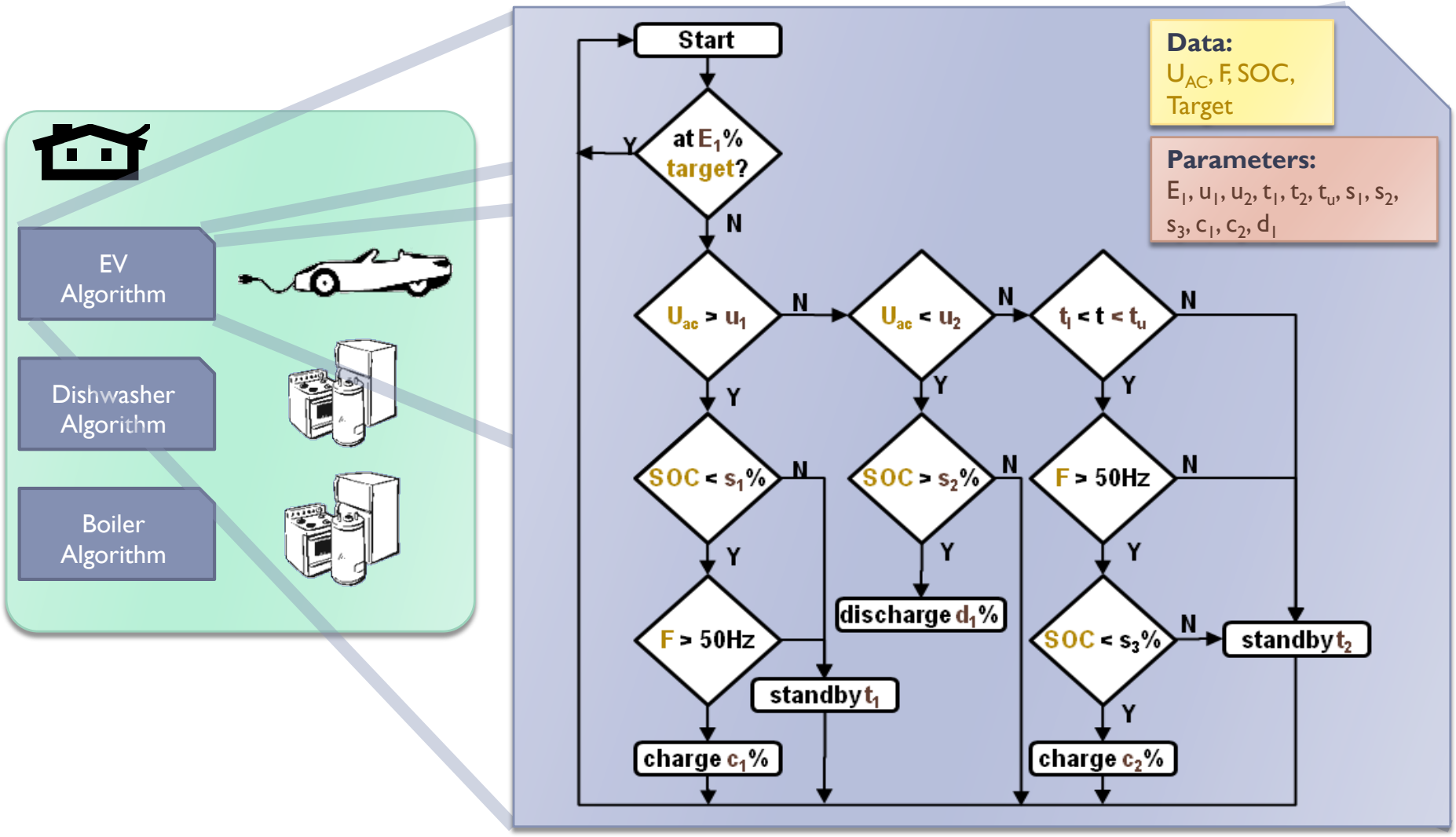


Example of control algorithm for EV *



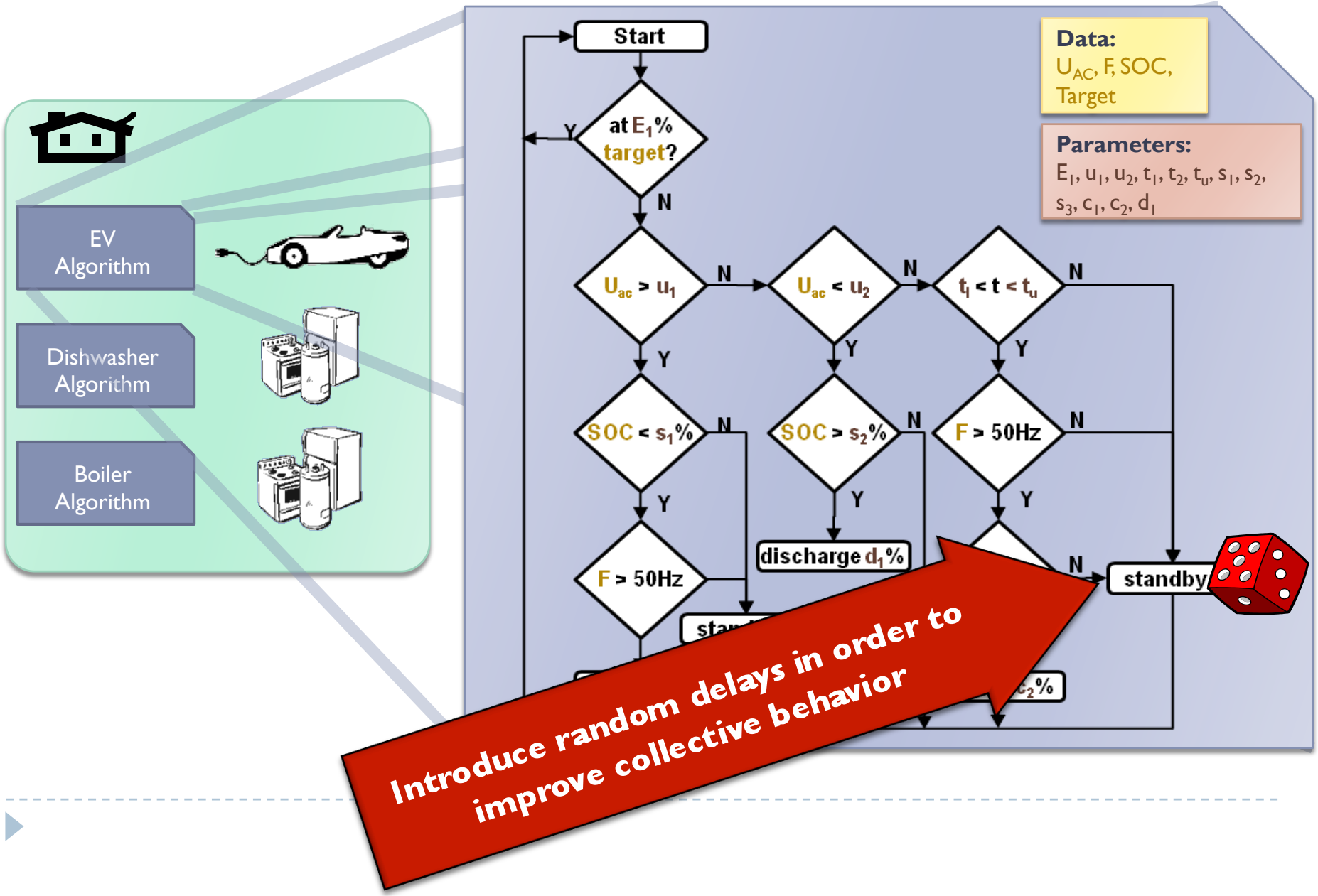
* Inspired by Cord Dustmann control algorithm

Questions on the control algorithm

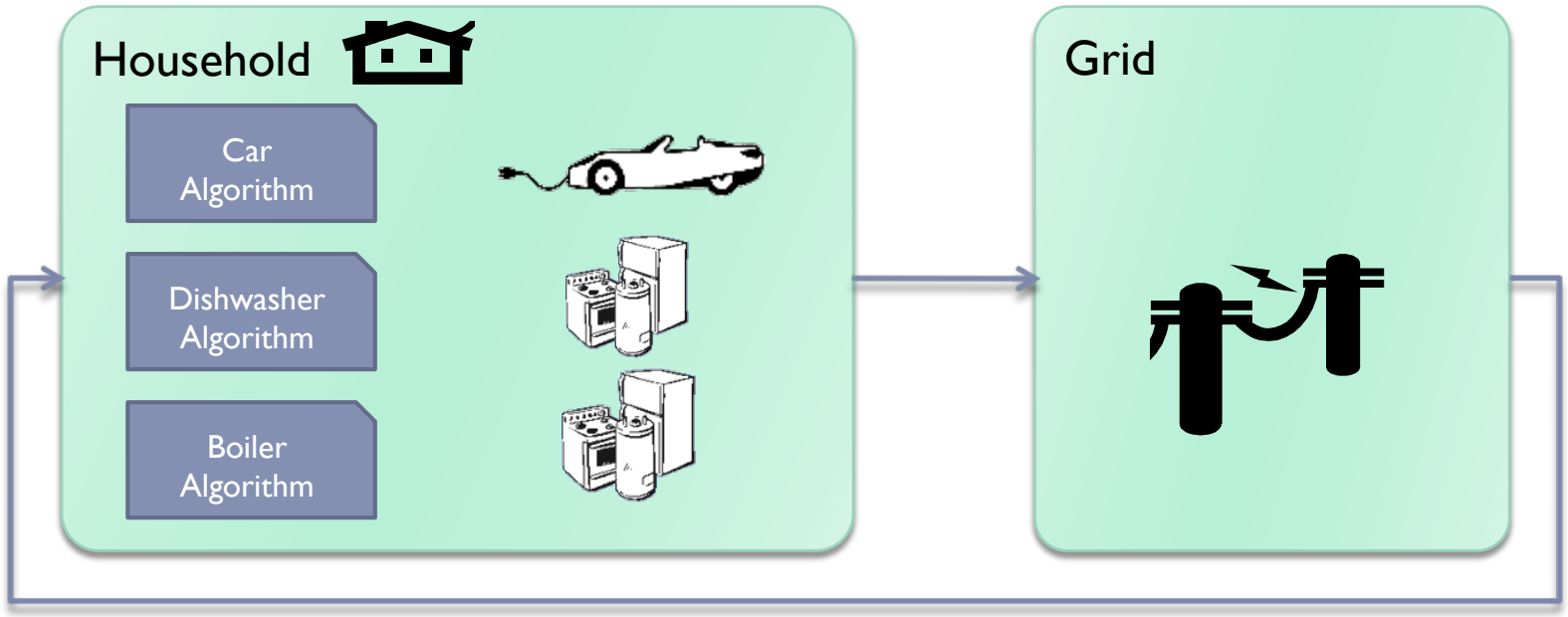
We intend to explore two types of control algorithms:

- Control algorithms with **fixed parameters**
  - deployed on the controllers with fixed settings
  - parameters are estimated before deployment in two ways:
    - by hand (based on experience)
    - tuning by system's simulation
- Control algorithms with **adaptive parameters**
  - dynamically modify the parameters:
    - using feedback (impact on system's quality)
    - using historical data (to forecast data trends)

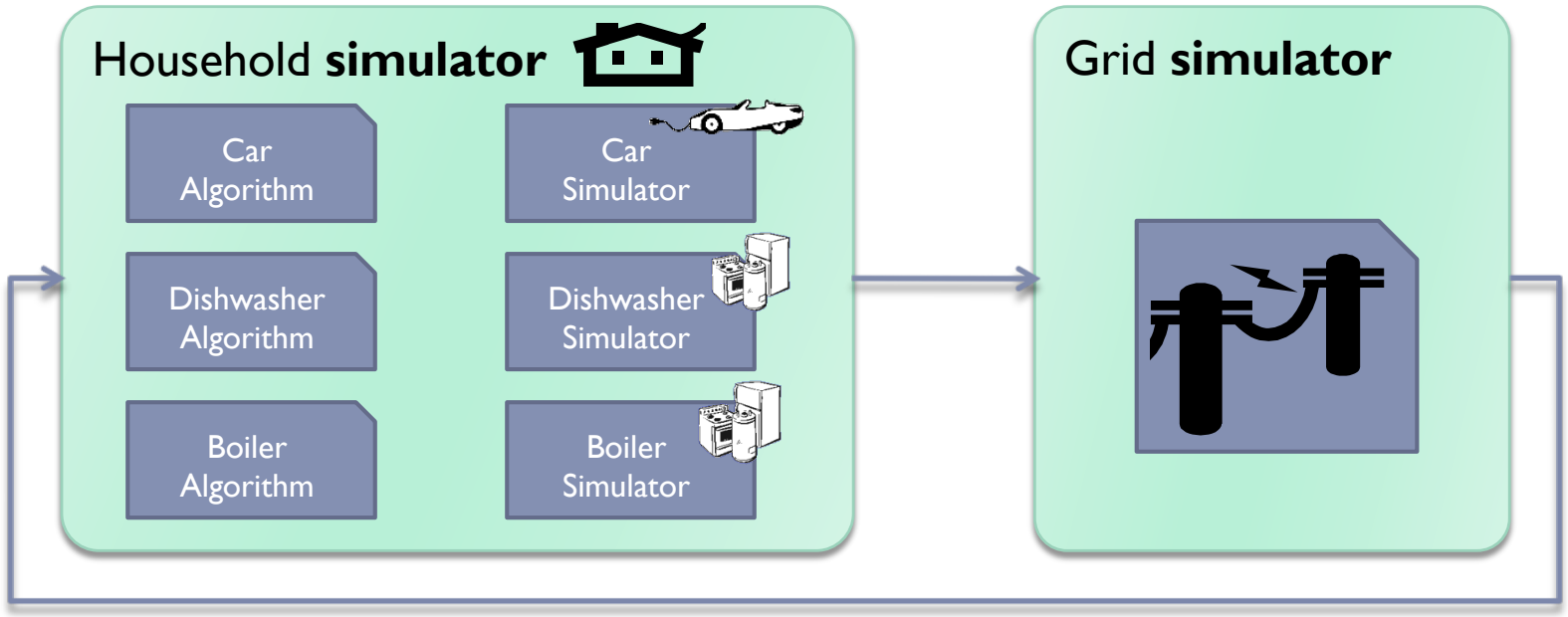
Randomized control algorithms



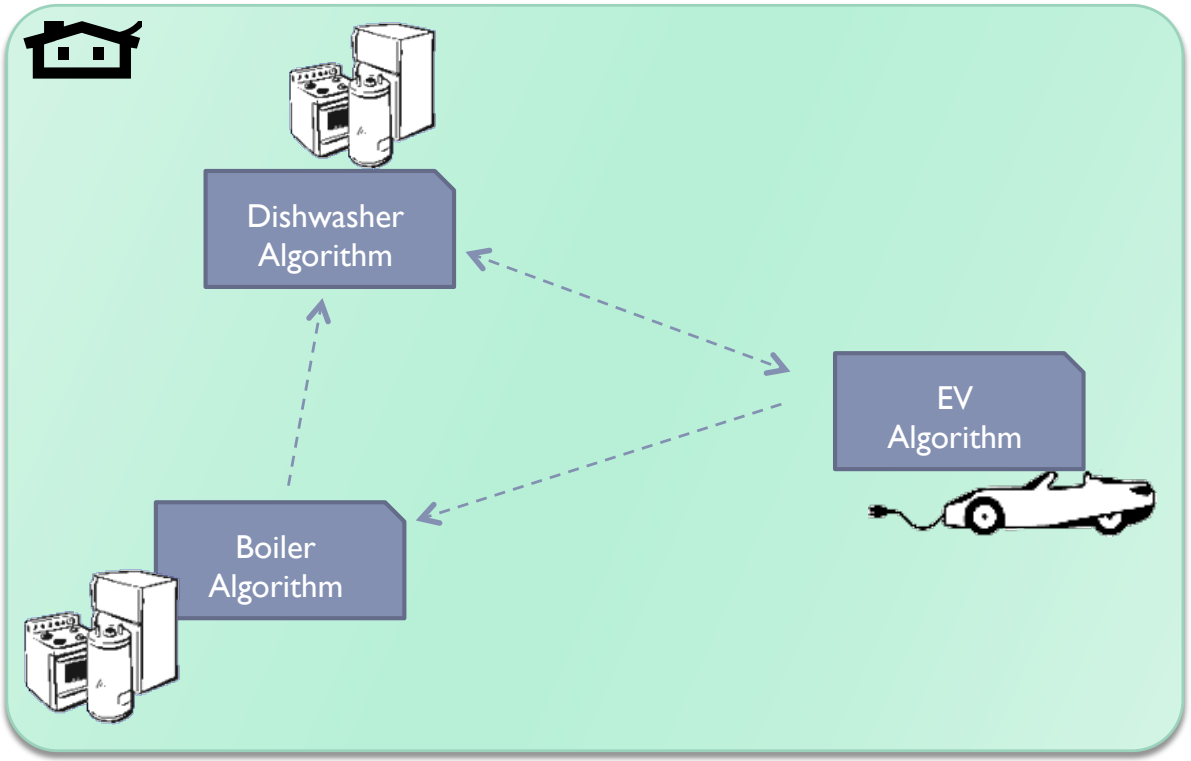
Simulation


Household
Car Algorithm
Dishwasher Algorithm
Boiler Algorithm
Grid

Simulation

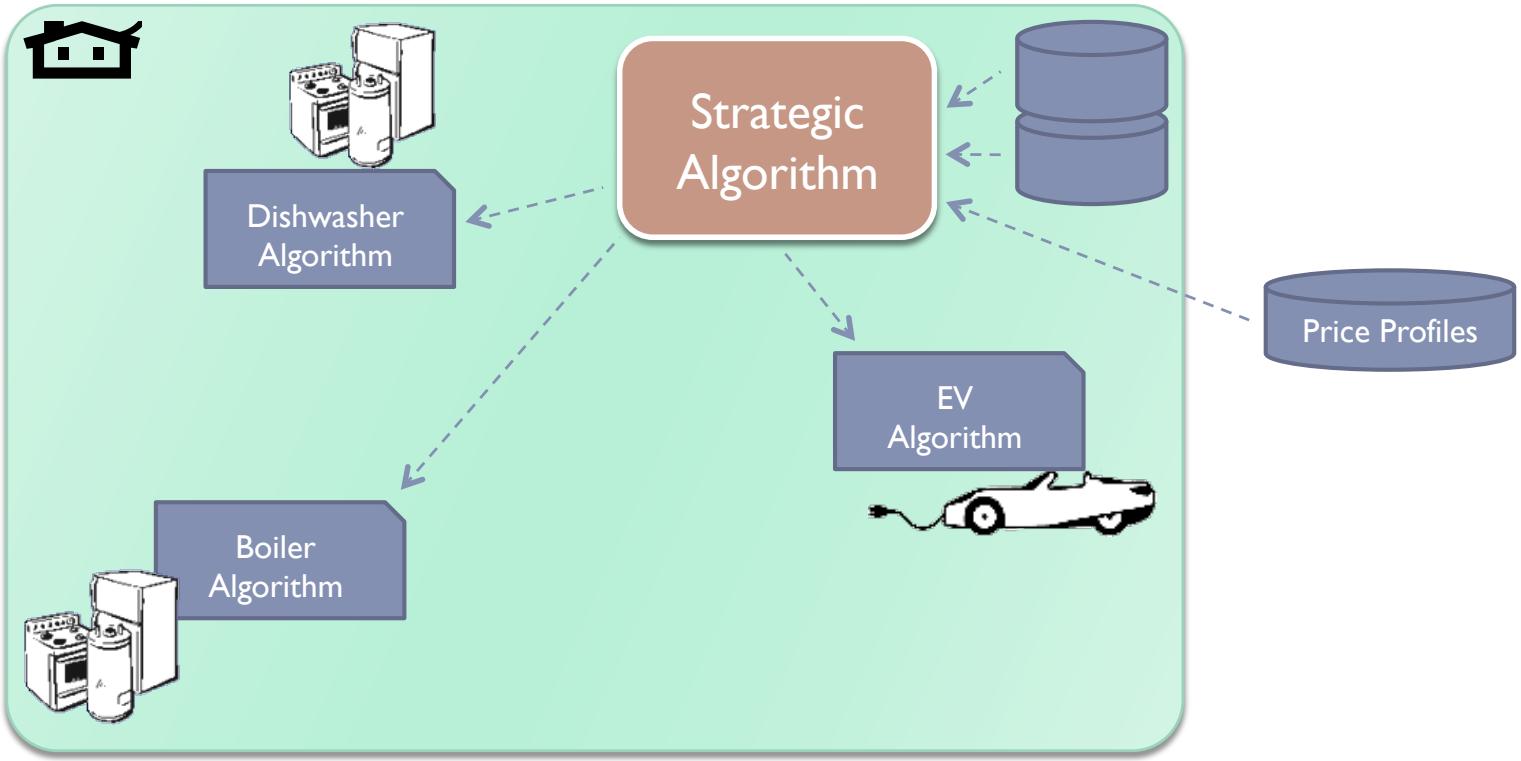

Household **simulator**
Car Algorithm
Car Simulator
Dishwasher Algorithm
Dishwasher Simulator
Boiler Algorithm
Boiler Simulator
Grid **simulator**

Research: control and communication (1)



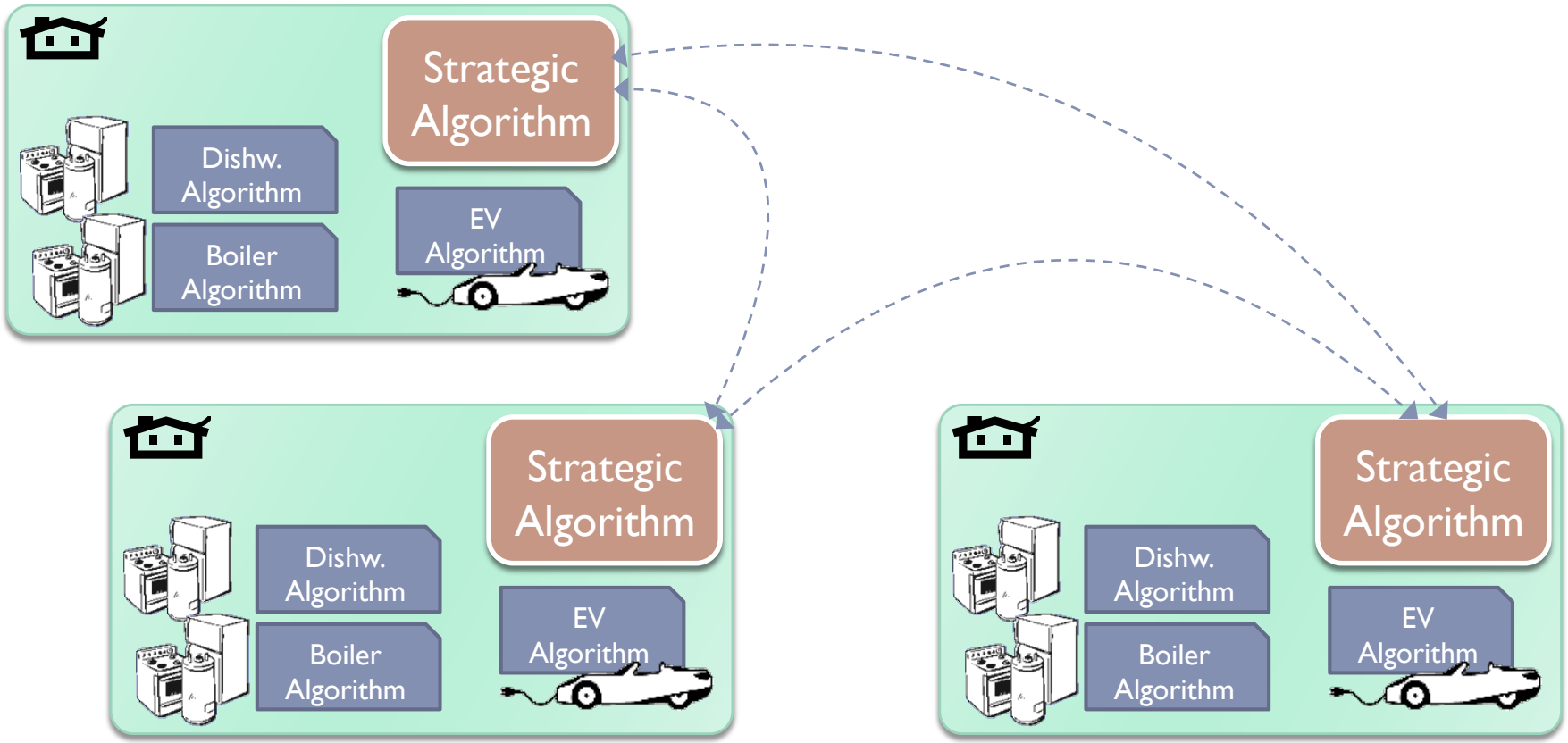
Test the ability of (some of the) **local controllers** to **communicate** via power line

Research: control and communication (2)



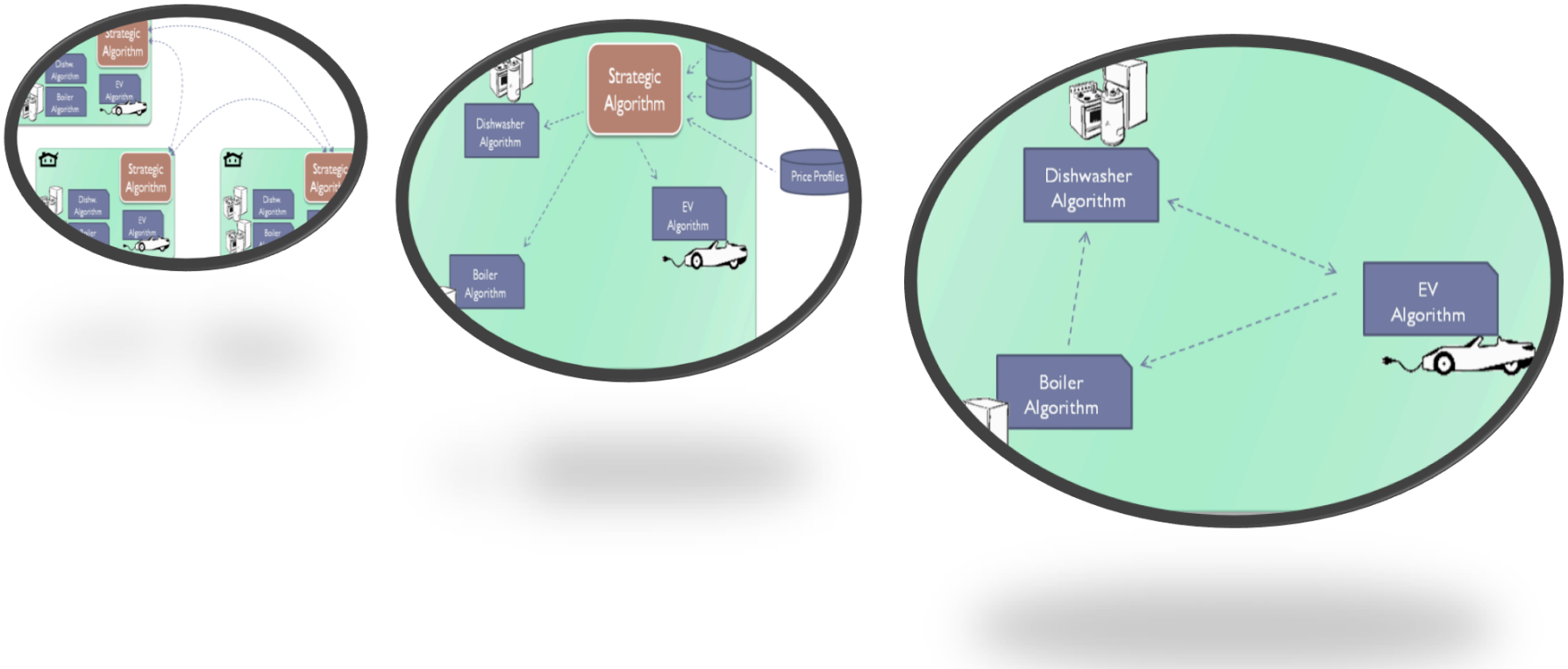
The presence of a **strategic algorithm at household level** able to produce a long term optimized policy taking into account: user preferences, historical data, price profiles

Research: control and communication (3)



The ability of **strategic algorithms** to **communicate within a neighborhood**

Research: control and communication



Compare **performance gains**, **costs** and **infrastructural requirements**.

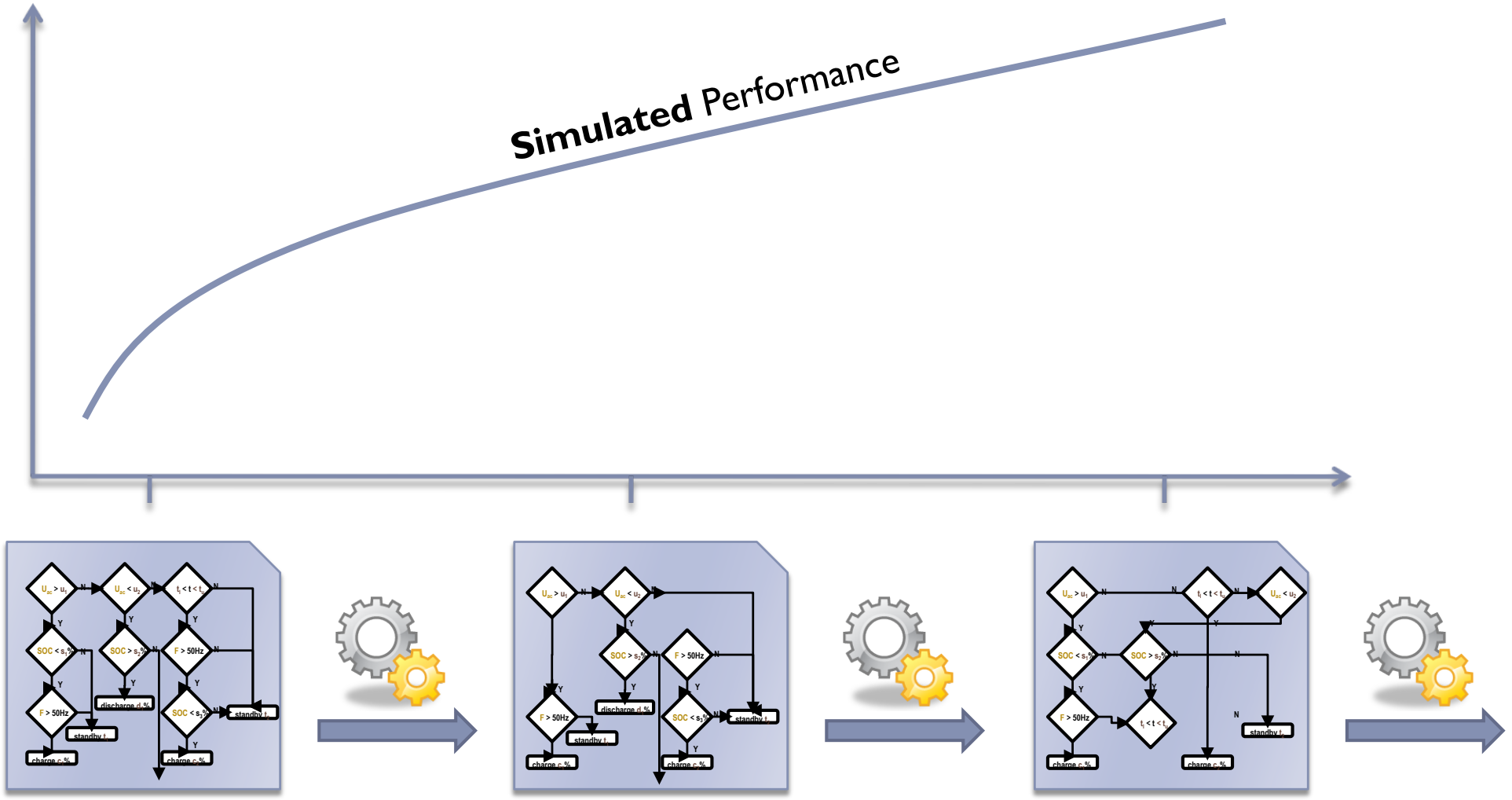
Research: control and communication

Additionally, we intend to test:

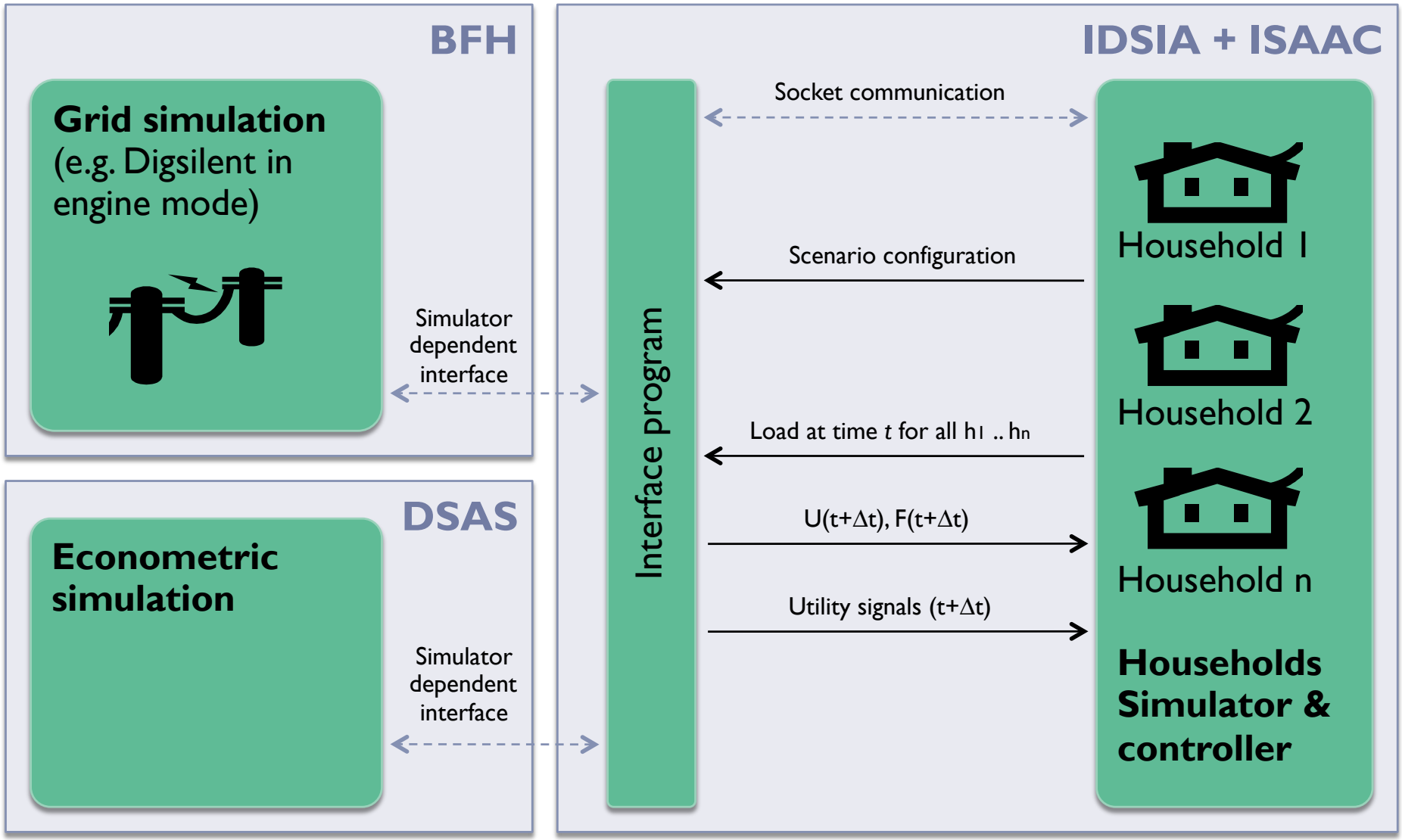
- The presence of a **strategic algorithm at household level** able to produce a long term optimized policy taking into account: user preferences, historical data, price profiles
- The ability of **local controllers** to **communicate** via power line
- The ability of **strategic algorithms** to **communicate within a neighborhood**

Compare performances, costs and infrastructural needs.

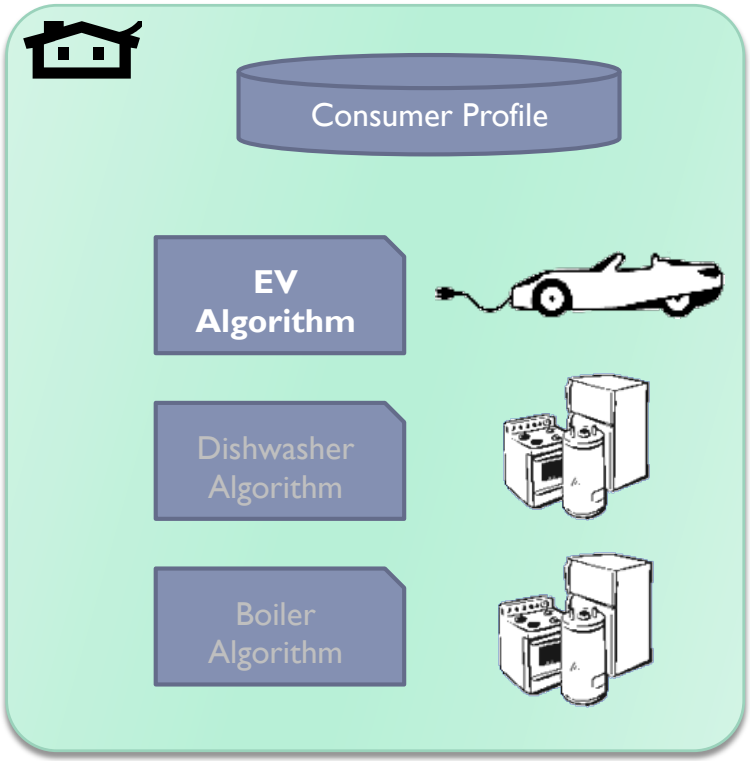
Research: evolving control algorithms



Software Architecture



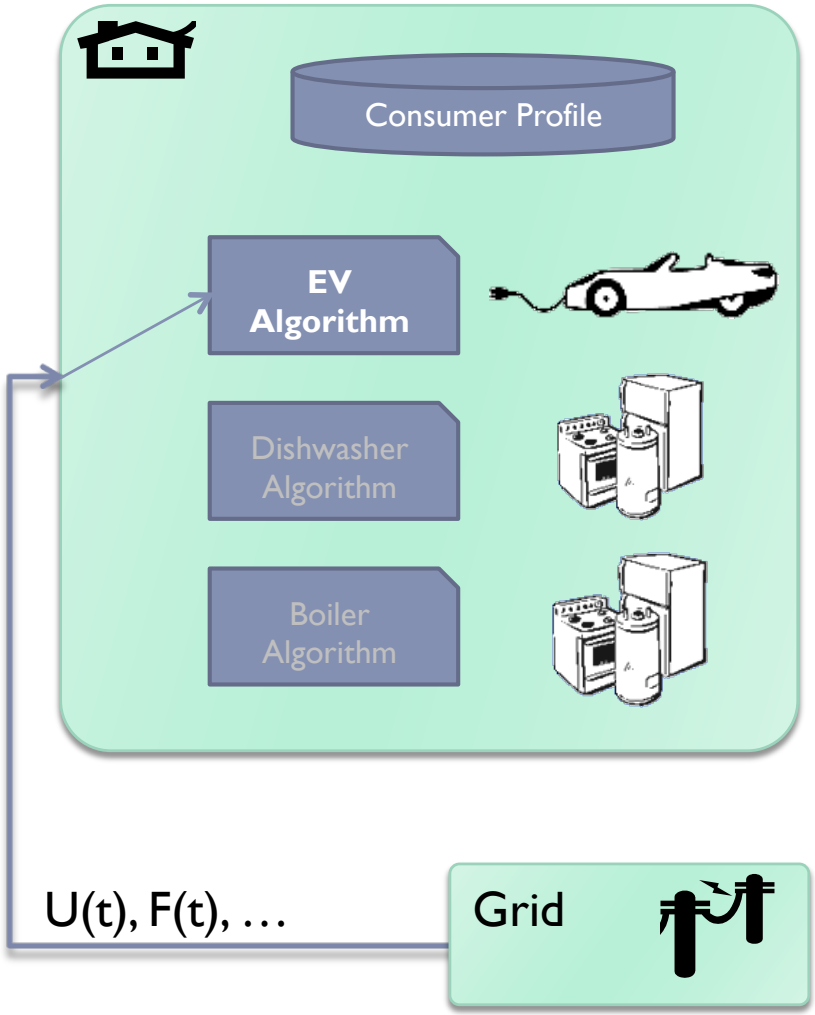
Example: EV model



EV algorithm considers:

- Physical characteristics:
  - Minimum, maximum SOC [KWh]
  - Charging, discharging efficiencies
  - Charging, discharging rates [KW]
- Consumer profile parameters:
  - Release date, due date
  - Required SOC
- Control variables
  - Battery operation at time t {charge | discharge | standby}

Example: EV model



EV algorithm considers:

- Physical characteristics:
  - Minimum, maximum SOC [KWh]
  - Charging, discharging efficiencies
  - Charging, discharging rates [KW]
- Consumer profile parameters:
  - Release date, due date
  - Required SOC
- **Network status U(t), F(t)**
- Control variables
  - Battery operation at time t {charge | discharge | standby}

Other Appliance models

- **EV** (see above)

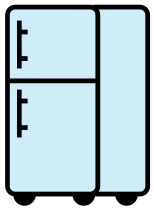
- **Setpoint-**driven loads
  - Boiler
  - Electric air conditioning / heating
  - Refrigerator / Freezer
  - …

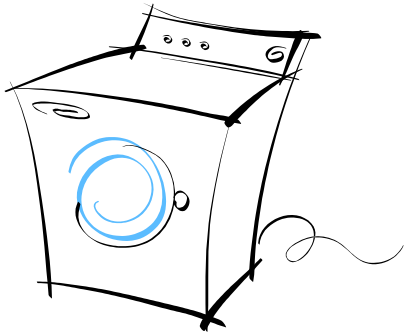
Parameters:
Physical characteristics
Setpoint
Deadband
→ **Cyclic activity pattern**
Control variable:
activity pattern offset

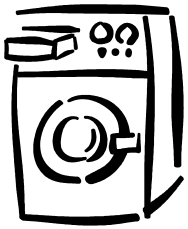
- **Nonpreemptive** load jobs
  - Dishwasher
  - Washing machine
  - …

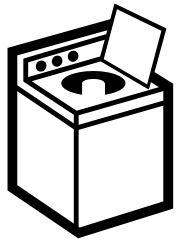
Parameters:
Release date
Due date
Load profile
Control variable:
start time

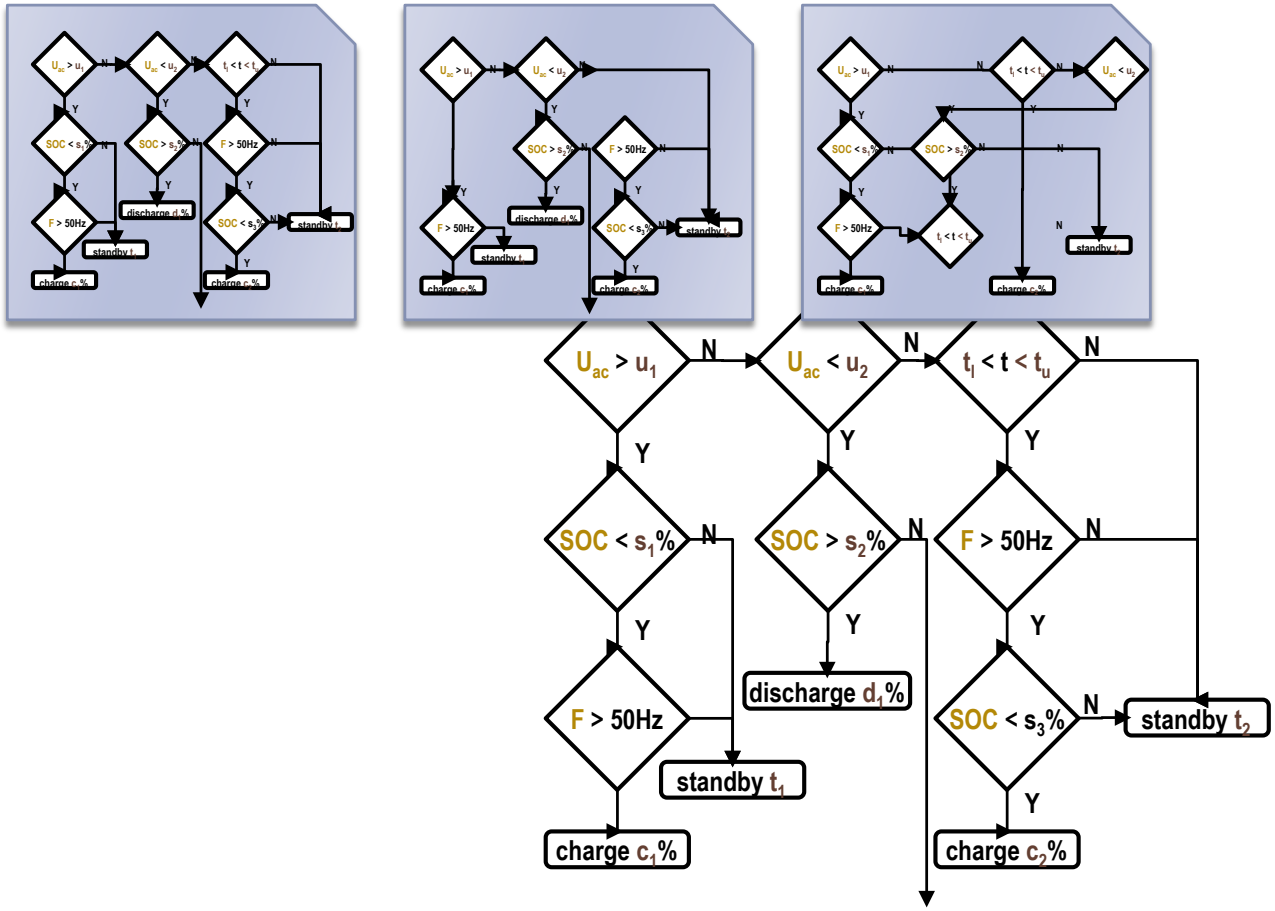
Cliparts










$U_{ac} > u_1$
N
$U_{ac} < u_2$
N
$t_l < t < t_u$
N
Y
Y
Y
$SOC < s_1\%$
N
$SOC > s_2\%$
N
F > 50Hz
N
Y
Y
Y
F > 50Hz
discharge $d_1\%$
$SOC < s_3\%$
N
standby t_2
standby t_1
Y
Y
F > 50Hz
standby t_1
charge $c_1\%$
charge $c_2\%$