ENERGY USE CASE
Multi-level smart charging & Grid Balancing (EDP)

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EDP NEW

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Energy Concept

The Baseline for Grid energy has two inconveniences:

- expensive energy cost for customer
- carbon intensive sourced.

Solution (I):

Build Energy Communities

- Cheaper Energy since is coming from neighbour Renewables through micro-grids
- Almost carbon neutral
- Still can use main grid as backup

Inconveniences:

- Need a Community Orchestrator (CO) to managed deficit or surplus of energy and faults
- It Is complicated for the CO to manage all the members in the community

Solution (II):

Handle the peers in the Energy Community as a heterogeneous swarm and let them talk!
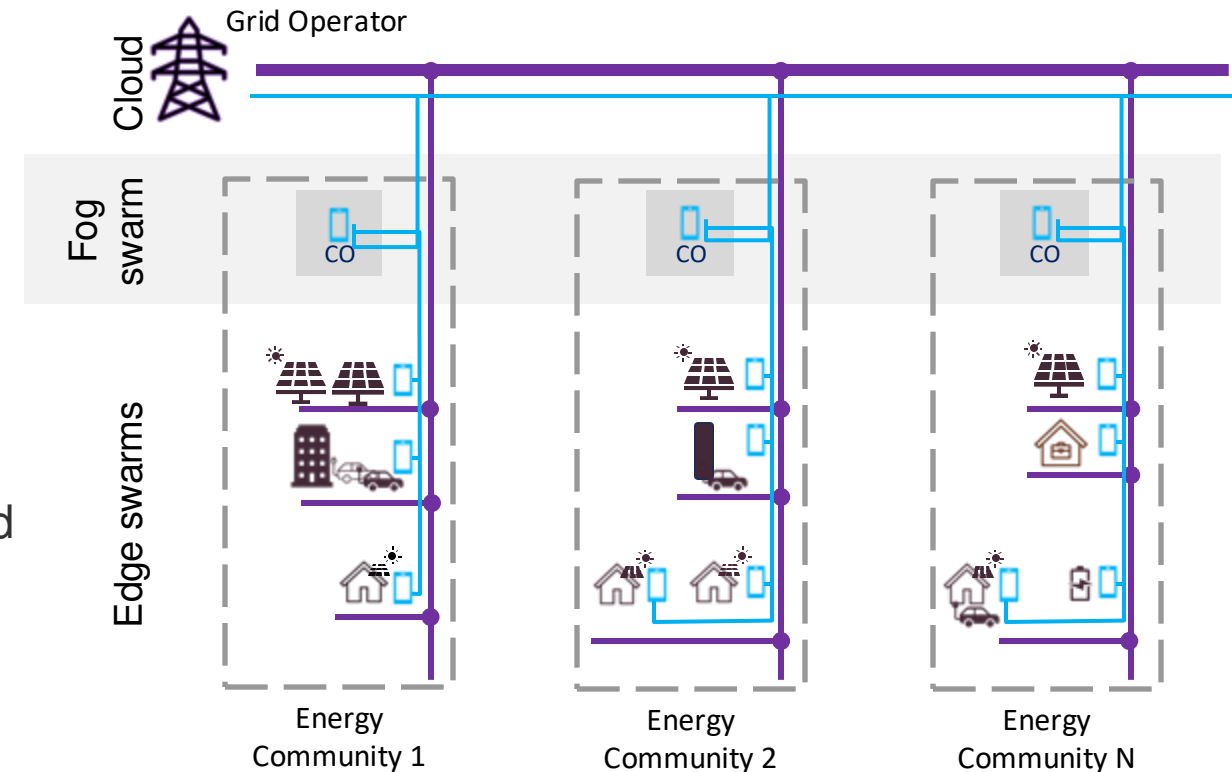
What does the swarm need to work?

- **Forecast** each peer energy consumption and production:

Fedra, a tool that enables the decentralized federated learning of ML models that are deployed locally on several edge devices (NKUA).

- Enable **reliable communication** support:

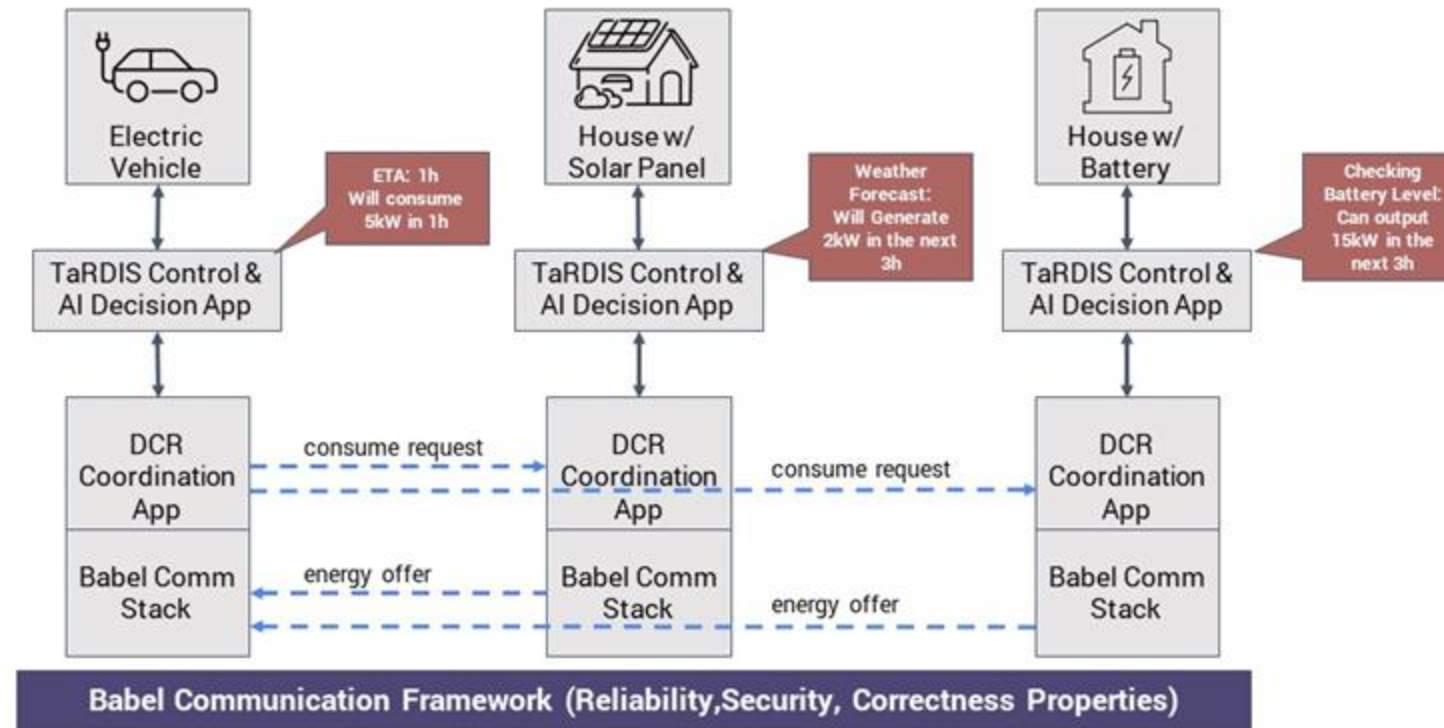Babel, Java framework designed for developing distributed protocols, serving as the communication backbone (NOVA)

- Assure **security** within agreements:

IFChannel, an information flow analysis checks that secret data does not "flow" into less secret sources (DTU).

- Swarm **easily programmed**:

DCR choreographies, an event-based programming model (NOVA).

- Fail safe!

Electric Vehicle — ETA: 1h Will consume 5kW in 1h

House w/ Solar Panel — Weather Forecast: Will Generate 2kW in the next 3h

House w/ Battery — Checking Battery Level: Can output 15kW in the next 3h

TaRDIS Control & AI Decision App

DCR Coordination App — consume request

Babel Comm Stack — energy offer

Babel Communication Framework (Reliability, Security, Correctness Properties)

All of this is fulfilled by the TaRDIS toolbox!

Multi-level smart charging & Grid Balancing

Impacts and benefits

- Energy use within the community could **reduce** by **>30%** electricity coming from **carbon intensive sources** through the grid.

- The application of swarms to Energy communities' management **might reduce faults by >60%**

- **The Customers are empowered** to choose the best **trading** option : self-consumption, buy from grid vs from neighbour, discharge EV to home…

- **The Retailer/Aggregator** is in fact the **CO** the advantages are:

  1- Moving its business from **HW** (home devices monitoring) to **SW** (overlay network management)– better margin and reducing asset management risk;

  2- Trading (risk) is moved to the final user;

  3- Ability to engage the storage elements, namely EVs, into **grid service** in a transparent way for customers.

- **The Grid Operators** will be able to improve QoS due to faster response of swarm agents at Fog level and better visibility about the resources available for grid service.

Use case testbed @ EDP LABELEC Smartlab

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THANKS