



Forseeing New Control Challenges in Electricity Prosumer Communities

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Introduction

- Electricity Prosumer Community
 - Distributed generation
 - Storage
 - Information technologies
- Objectives
 - Propose a rigorous mathematical framework for studying energy prosumer communities
 - Present a new class of interesting control problems and challenges, to increase the hosting capacity of LV networks.

Outline

- The Electricity Prosumer Community
- Formalisation
- Control challenges
- Centralized vs distributed schemes

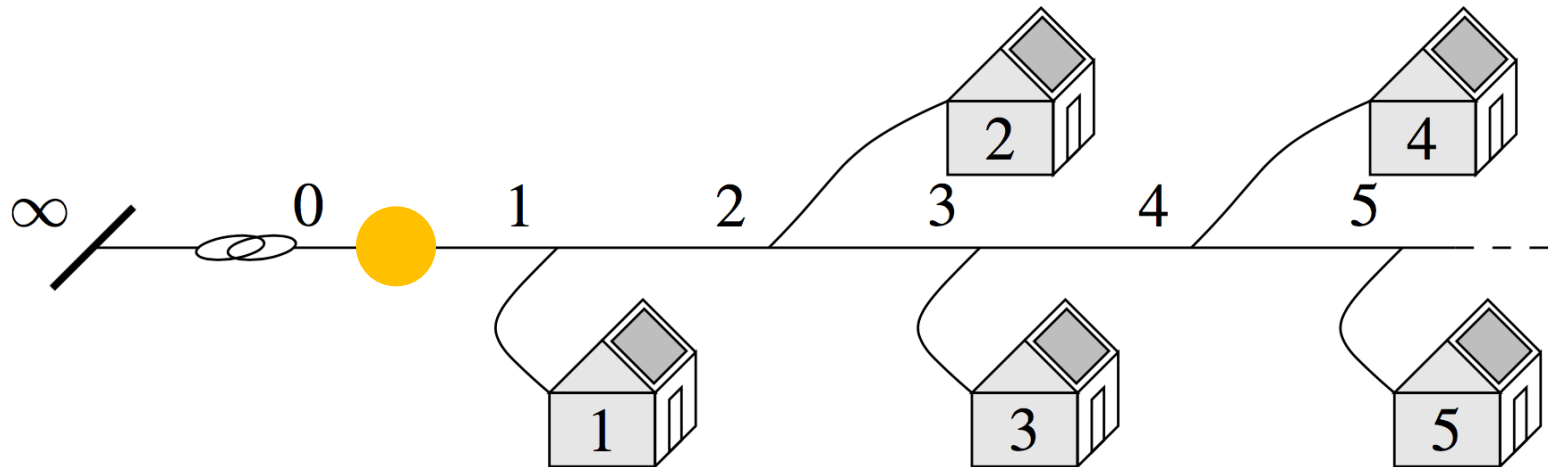
The electricity prosumer community

- Definition

Electricity distribution system containing loads and distributed energy resources (such as distributed generators, storage devices, or controllable loads), that can be operated in a controlled, coordinated way

The electricity prosumer community

- Similar to microgrids
- Cannot operate in island mode
- Comprises consumers cooperating for the satisfaction of their energy needs using local production sources

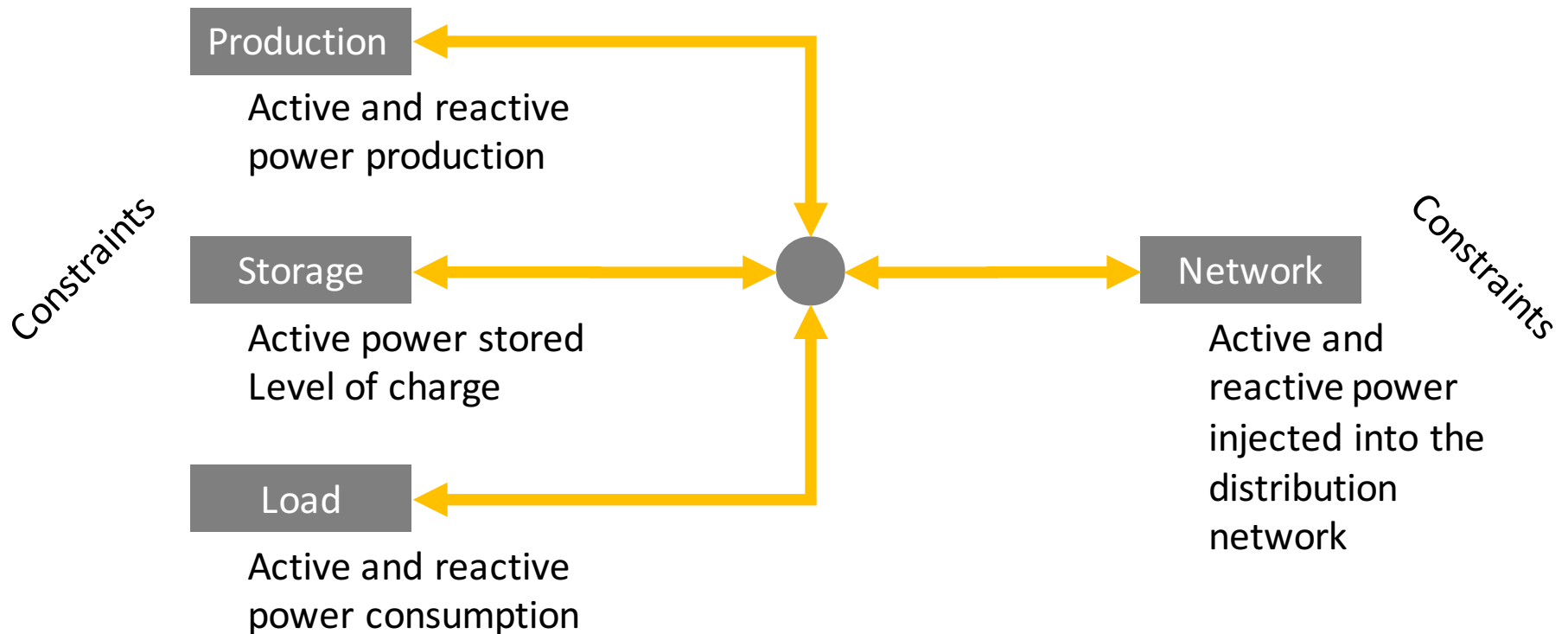


The electricity prosumer community

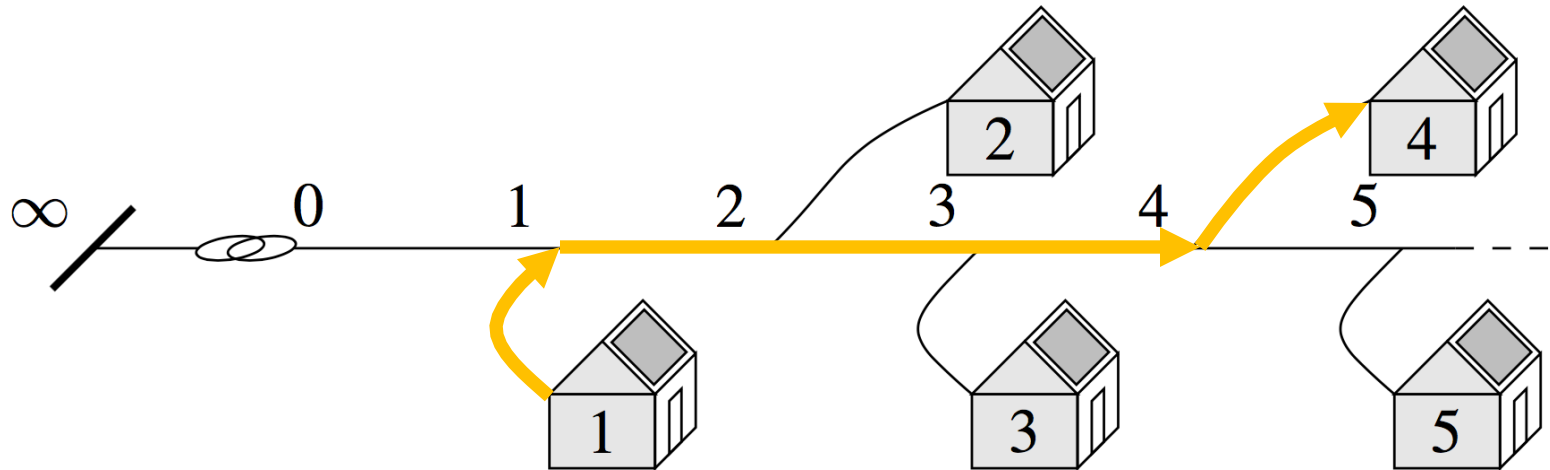
- Drivers
 - With a shared infrastructure between the members
 - Without a shared infrastructure
 - Network operation
 - Energy market

Communities extend the perimeter of self-consumption from one prosumer to several to pool production and flexibility means

Formalisation - The prosumer



Formalisation – The community



- Power exchanges between prosumers
- Losses equal to the difference between the houses and the root of the community

Formalisation

- Cost and revenues for each prosumer
 - Price between each member of the community
 - Price for electricity from the distribution network
- Community behaviour
 - Discrete time setting
 - For each time step, the variables change as a function of the previous states and exogeneous variables, with some uncertainty

Control challenges

- Decision making problems
- Maximising the distributed production
 - And increase the network's hosting capacity
 - And limit losses
- Optimising overall costs and revenues
 - Minimise the total electricity bill of the community

Centralised vs distributed

Requirements

- Inverters that are controllable in active and reactive power
 - Controllable loads can be considered
 - Voltage et power measurements
- Model of the network
- Extensive communication
 - Centralised computer/controller
- No model
- No or little communication

Distributed schemes

- Generating a data set using multiperiod OPF
 - Different load patterns, PV production profiles, prices
- Learning regressors using Extremely Randomized Trees
- Constraining the prediction
- Simulating the behaviour of the agents

Community electricity bill compared to a distributed rule of thumb	
Centralised (FBS-OPF)	19,6%
Distributed (Rule of thumb)	100%
Distributed (Extra trees)	47,3%

Conclusion

- In the paper:
 - Mathematical framework for modelling Electricity Prosumer Communities and energy exchanges between prosumers
 - Introduction of a distributed approach using machine learning
- Future work:
 - Using reinforcement learning for agent self-improvement