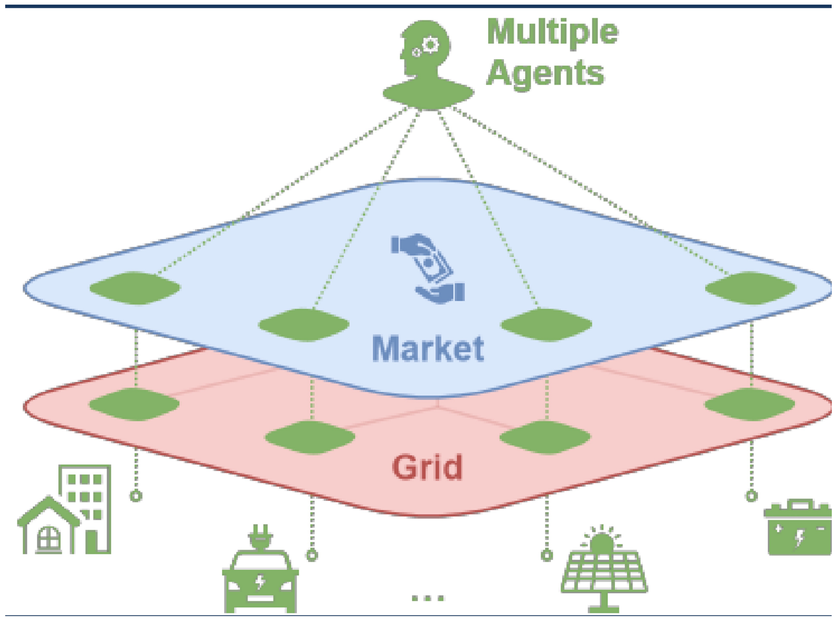
Empowering Prosumers in Electricity Markets Through Market Design and Learning

Srinivas Shakkottai (Texas A&M), Le Xie (Texas A&M), Vijay Subramanian (U Michigan), Subhonmesh Bose (UIUC)
https://sites.google.com/tamu.edu/2020-nsf-cps/

Challenge:

Distributed energy resources (DERs) provide prosumers the ability to actively participate in the energy economy. *How should prosumers and aggregators learn how to participate in the wholesale-retail energy marketplace?* Different actors in this system have different computational resources and access to information about the overall system.



Solution:

Modeling and analysis of heterogeneous actors in the energy marketplace

- Auction that distribution system operator (DSO) can utilize to allocate distribution network access limits to DER aggregators
- Adaptive stability certification via meta neural Lyapunov function
- Strong duality result for cooperative decentralized constrained POMDPs, and Thompson sampling for countable state-space MDPs

Scientific Impact:

- Advancement of single and muti agent RL, and its practice within electricity markets
- Consideration of both transmission and distribution grids

Societal Impact: Interaction with electric utilities and independent system operators need frameworks to analyze the impact of rapid DER integration at the grid-edge. Facilitating DER integration at different timescales and quantities promotes a reliable and sustainable smarter grid.

Educational Impact: Engaged in curriculum development on ML for power systems and market design. Short course at the intersection Data science for power systems cutting edge methodologies in RL. Supported CPS oriented K-12 activities resulting in students receiving Turing Scholarships.

Quantitative Impact: The work on learning for POMDPs is being applied to networked control systems. OpenGridGym simulation platform to study grid and market interaction has been released for broad dissemination among the research community.

Award ID#: CPS-2038963, 2038416, 2038775