UC-Lab Center for Distribution System Cybersecurity

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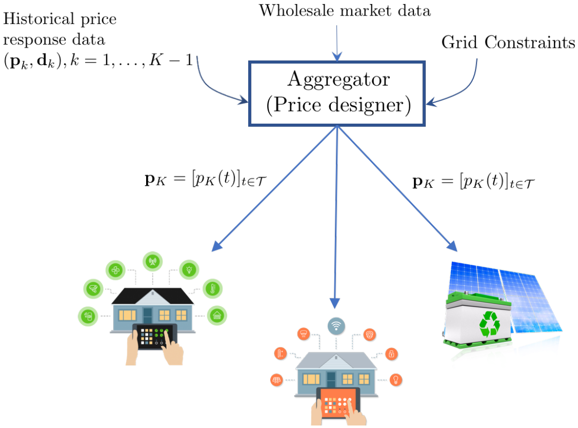
Centralized real-time pricing algorithms

- The main part of my talk was focused on learning the price response of customers through bandit models:



Real-time pricing based on multi-armed bandits

Goal: keeping the grid safe while learning price response

Aggregator's problem

$$\min_{\mathbf{p}_t} \sum_{t=1}^{T} g(\boldsymbol{\ell}^\star(\mathbf{p_t}), \mathbf{d_t})$$

s.t. dist-flow constraints

where

$$\boldsymbol{\ell}^\star(\mathbf{p}_t) = \sum_{i=1}^{Q} a_i(\boldsymbol{\theta}, \mathbf{p}_t)\boldsymbol{\ell}_i^\star(\mathbf{p}_t)$$

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We have considered both Thompson Sampling and UCB based solutions and we are making progress on providing **performance guarantees**

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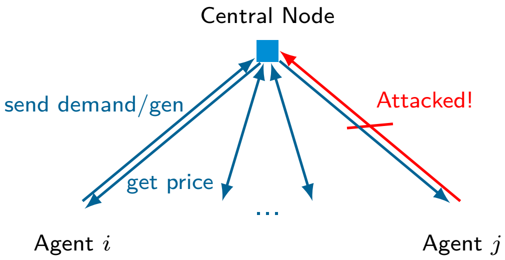
Unlike distributed algorithms, the only feedback from RTP users is physical (load) and the cost of attacks will be on physical reliability

- We will study the physical costs of adverserial response from a limited set of loads (depends on location in network, appliance type)
- Certain appliance clusters may be affected all at the same time (say someone hacks Chargepoint)

Attack-resilient distributed demand response algorithms

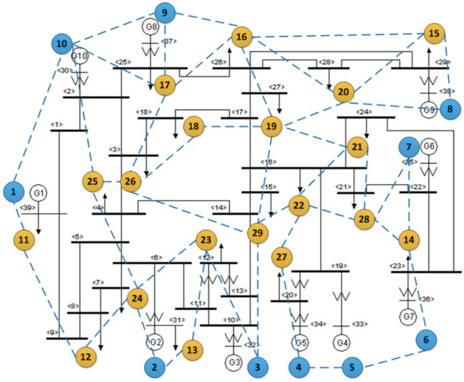


We will continue our analysis of robustified distributed resource allocation algorithms and its specific applications in demand response:

- Finalize our results and then improve our guarantees
- What do our guarantees look like in distribution systems?

Robust decentralized demand response algorithm

- Numerical study in power networks.
- Other attack models: node and link failures



Center-free Algorithm: Node failures

- We consider a Byzantine attack model.
- We model the measurement of a node under attack as

$$\mathbf{z}_i(t) = \mathbf{x}^* + \mathbf{a}_i(t),$$

where $\mathbf{a}_i(t)$ is the disturbance induced by the attacker.

- Bounded perturbation: $\|a_i(t)\|_p \leq \delta$.
- Analyzing the tradeoff of optimization performance and ratio of attacked nodes.

Center-free Algorithm: Link failures

- We consider a time-varying attack model on links.
- The communication link is not jammed anymore, but completely broken.
- Once a link is broken, it will be established again after finite amount of time (few iterations).
- This attack results in random and time-varying connectivity graph.
- Goal: Design a robust algorithm and analyze the performance.