

TWC: Small: Privacy Preserving Cooperation among Microgrids for Efficient Load Management on the Grid



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URL: <http://cs.iit.edu/~yhong/projects/ppmc.html>

The objective of this project is to propose a series of privacy preserving techniques for distributed energy consumers and suppliers (integrated as microgrids) to cooperatively advance their global and local load management without disclosing local data.



Commercial Microgrids



Residential Microgrids

Technical Research Challenges

- Design efficient cryptographic protocols in real-time applications and systems
- Two-tier privacy models: secure computation and implementation of optimal solutions
- Highly fluctuated and/or stochastic data
- Nonlinear optimization with local and global constraints (arbitrary data partitioning)
- Relaxing infeasible optimization problems
- Incentive compatible mechanisms

- Addressing the privacy concerns to *unlock the cooperation among microgrids* for advancing the performance of power grid
 - Global and local load balancing
 - Load Leveling
 - Energy Sharing & energy communities
 - Power Network Topology Design/Upgrade
 - P2P Supply in Power Blackouts
 - P2P Energy Trading & Auction
- Advancing privacy preserving data analysis
- Designing & implementing real-time systems

Data Analytics & Systems

- Real data collection
- Collaborative optimization & data mining
- Real-time load management implementation
- Distributed system implementation
- Integration of secure computation, communication and power systems

Privacy & Security

- Protocol security for the cooperative models under secure multiparty computation (MPC)
- Verifiability for ensuring data integrity
- Additional privacy notions for implementation
- Formal security/privacy analysis
- Incentive compatibility

Relevant Publications

- Privacy preserving cooperative load balancing (AAMAS '19, TIFS '19)
- Energy communities discovery (MPCE '19, SmartGridComm '17)

- Network trace anonymization: CCS '18
- Privacy preserving energy sharing: ICASSP '18, IJER '16
- Privacy preserving smart meter streaming: TIFS '17
- Load leveling: Energies '17
- Smart Grid Security: Springer Book

Broader Impacts

- Smart energy data privacy and confidentiality impact the national energy security
- Microgrid cooperation increases the reliability, stability, and efficiency of the electric grid
- The designed protocols and systems integrate the secure computation, communication and power systems into the smart grid infrastructure
- Schemes can be extended to privately derive decisions for other multi-agent systems

Education and Outreach

- New course "Data Privacy and Security" (CS528) in the computer science department of Illinois Institute of Technology
- Privacy-related contents (e.g., privacy in CPS) are integrated into the undergraduate and graduate curricula at IIT and SUNY-Albany
- Security summer camps for high school students
- Annual local cybersecurity conferences in upstate New York

