

GMLC 1.4.10: Control Theory

Project Description

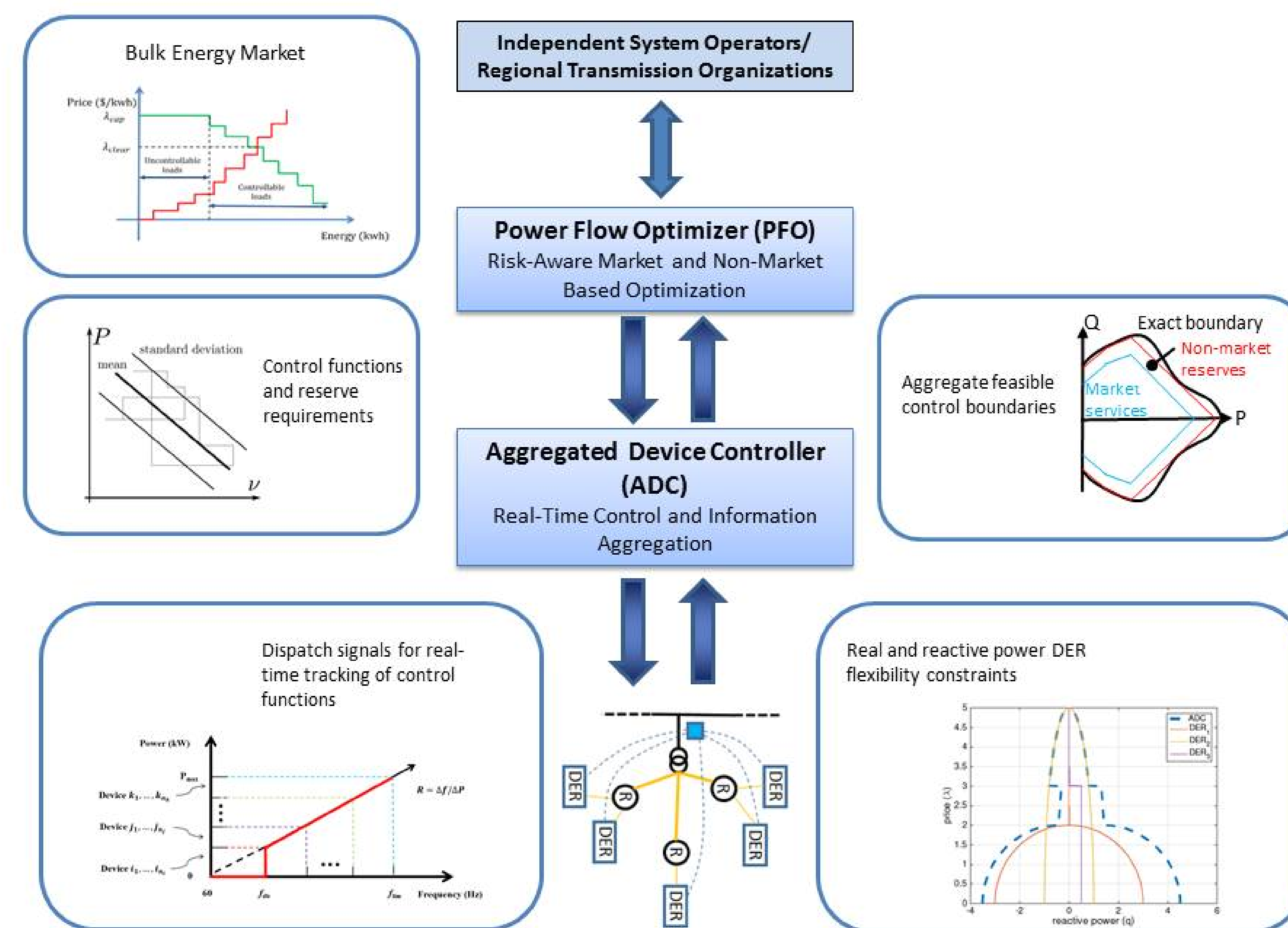
The focus of this project is to develop new integrated optimization and control solutions, including architectures, algorithms, and deployment strategies for the U.S. power grid. This effort will support the GMLC multi-year program plan vision for transitioning the power grid to a state where a huge number of distributed energy resources (DERs) are participating in grid control. The specific objectives of the project are to:

- Ensure architectural compatibility of control theory and solutions.
- Coordinate and control diverse DERs (>10,000) with widely different responses.
- Incorporate power flow physics and network constraints into control solutions.
- Systematically manage uncertainty from intermittent generation and large number of controlled DERs.
- Integrate with legacy and bulk power system markets.

Expected Outcomes

- Integrated optimization and control systems that are more effective at maintaining operating margins.
- A 33% decrease in cost of reserve margins while maintaining reliability by 2025.
- Interconnection of intermittent power generation with less need for electrical storage and lower integration costs.

Significant Milestones	Date
Documented architectural reference models for control	11/1/2016
Completed integrated optimization and control theory roadmap	11/1/2016
Documented real-time control strategies for providing ancillary services from aggregated DERs	10/1/2017
Completed risk-aware control of ~10,000 DERs	10/1/2018



Interfaces for PFO and ADC systems

Progress to Date

- Completed integrated optimization and control theory roadmap consisting of:
 - Reference control system architectures
 - Cataloged existing and alternative power flow approximations and relaxations
 - Method for determining aggregate DER real and reactive power controllable domains
 - Design of real-time control strategies for aggregated DERs with uncertainty quantification.
- Validated architecture and development roadmap with Industry Advisory Board (Go/No-Go milestone).
- Submitted 5 conference papers and 2 journal articles.