Role of Synchrophasor Measurements in Management of the Integrated Grid

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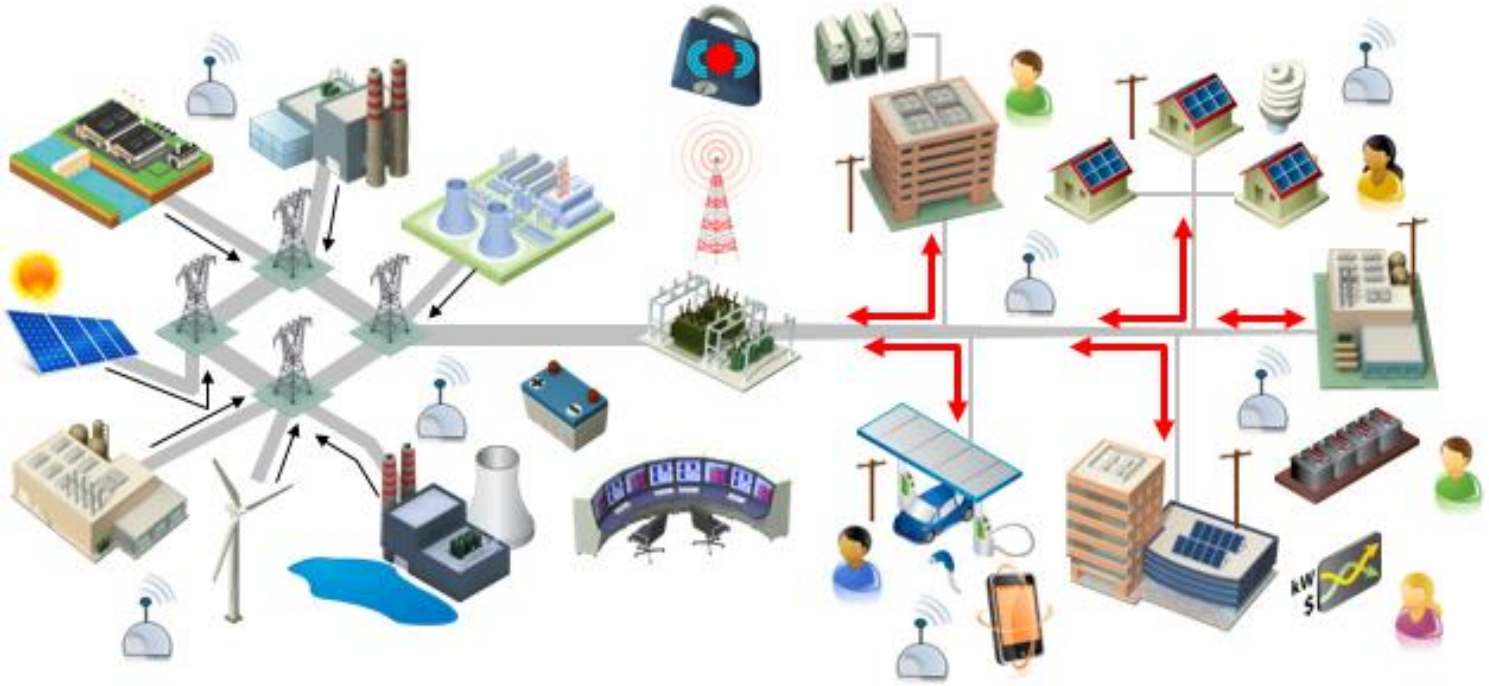
Outline

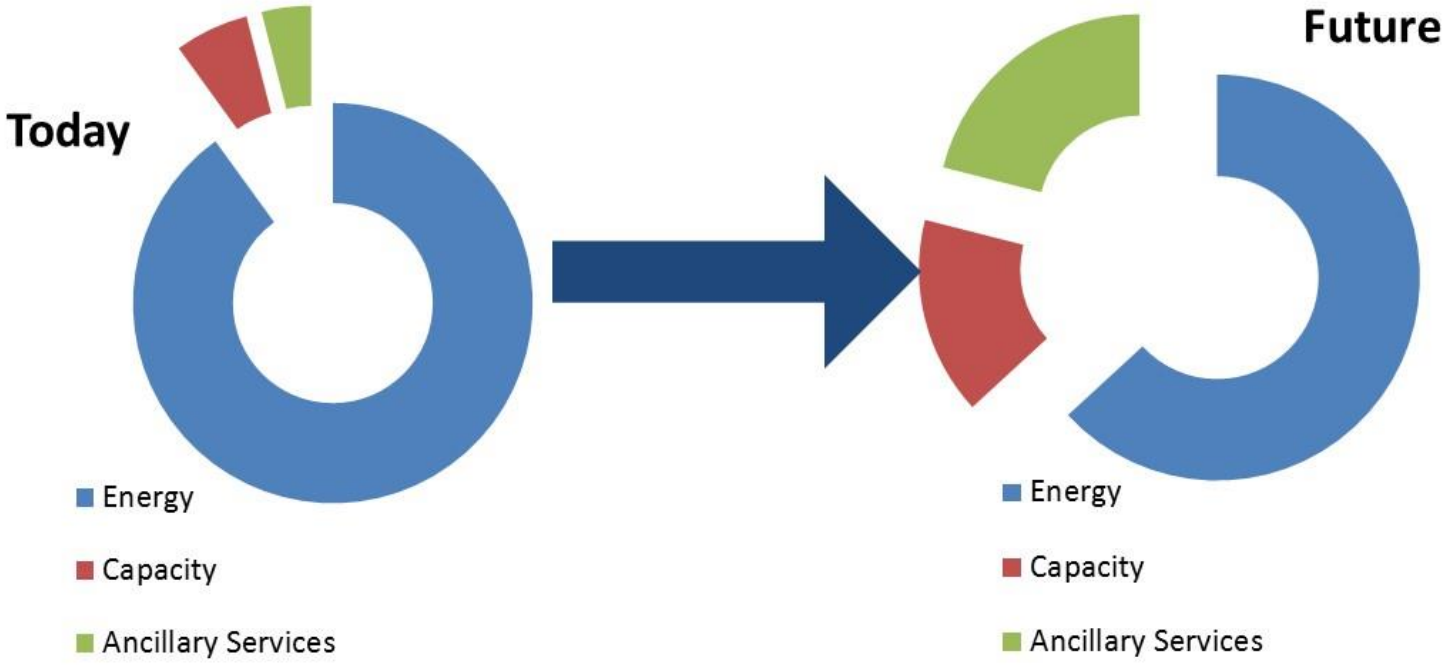
- Integrated Grid
- What's different?
- Need for real time information
- Developing applications
- Coordinating the research

The Vision: A Robust Integrated Grid



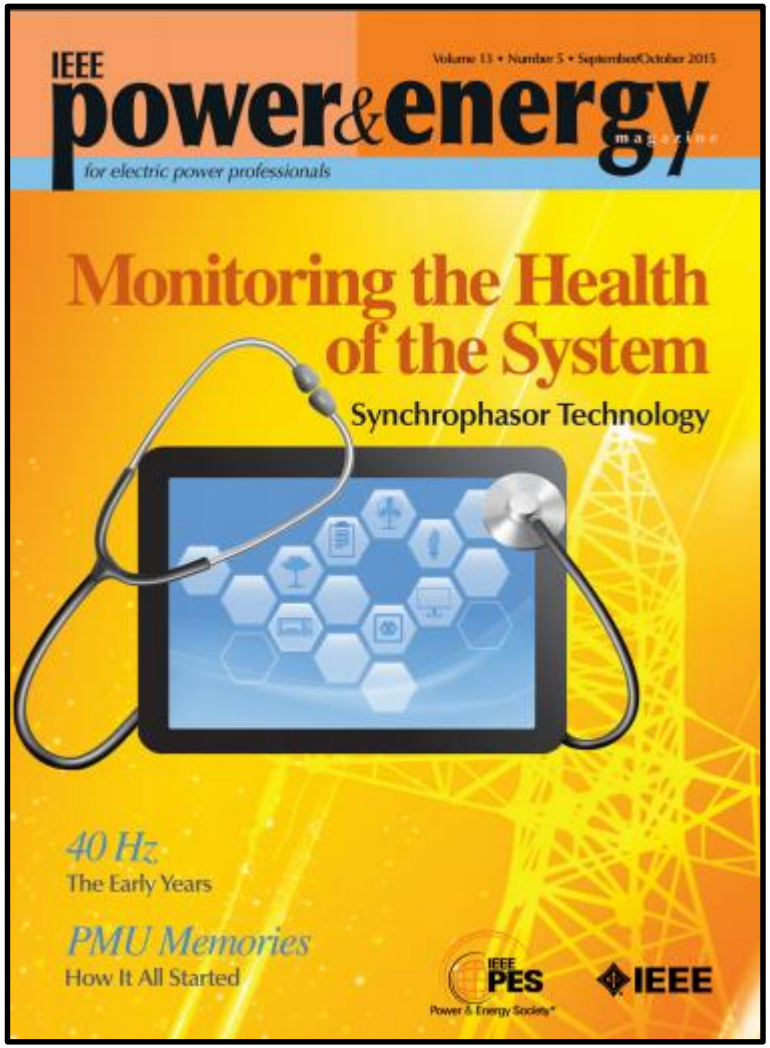
A Robust Grid is required to
unlock the value streams for distributed resources
as well as
assure continuity of power that is critical to society.

Challenge – Capacity and Flexibility



Synchrophasors – tool for system condition assessment

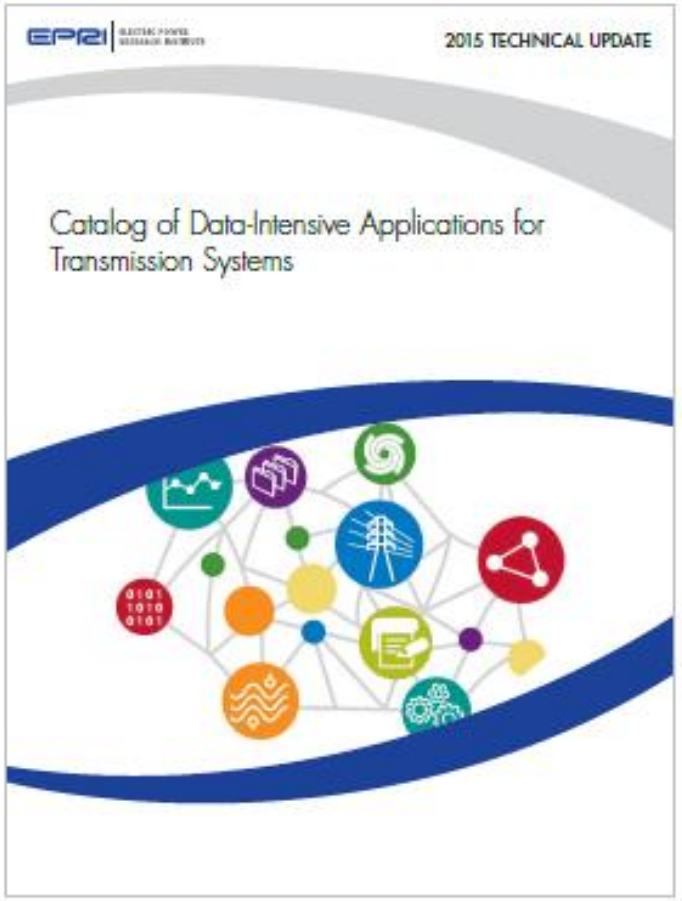
Synchrophasors provide foundation for real time assessment of system condition based on measurements



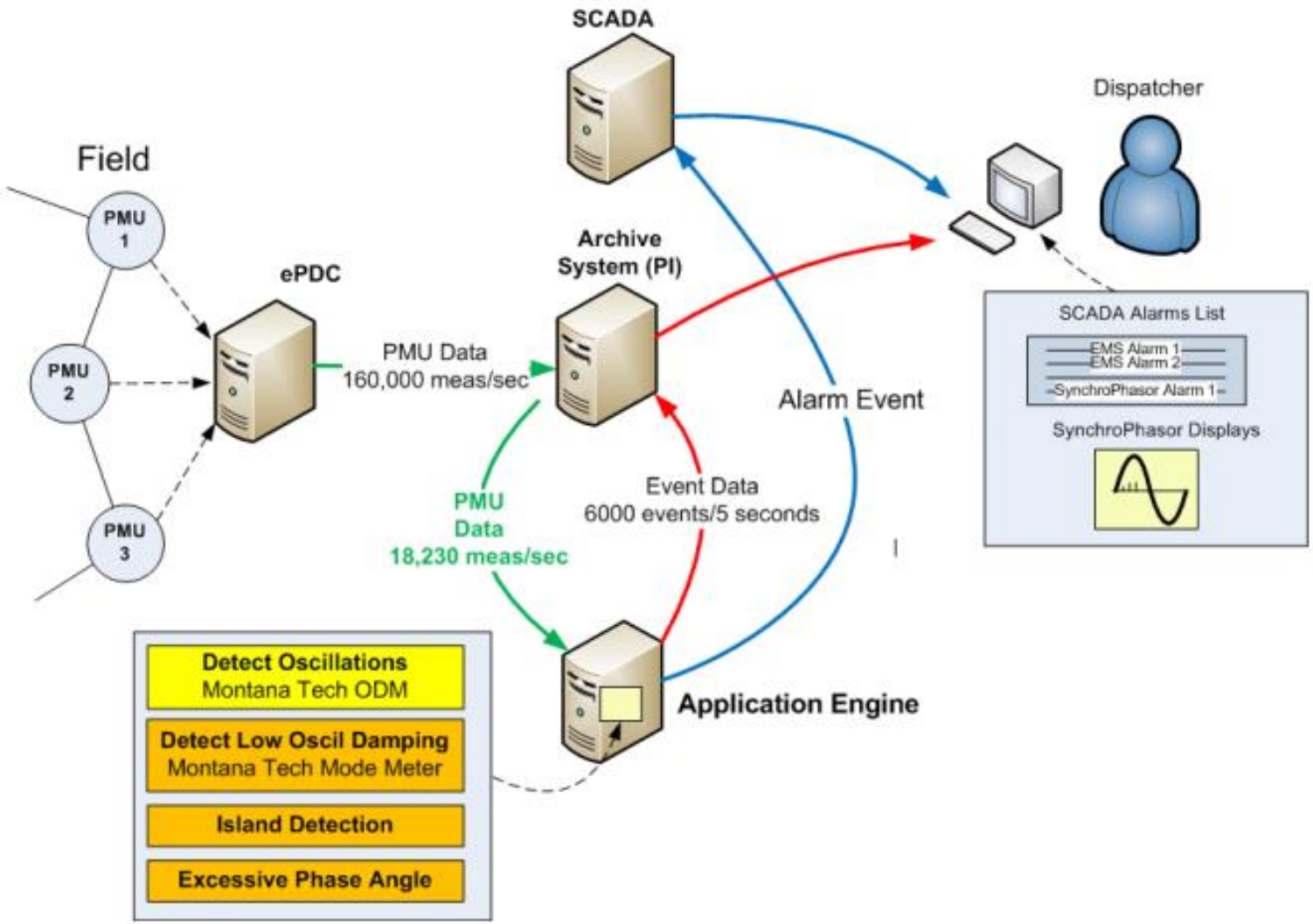
Wide variety of applications

- State Estimation
- Wide-Area Visualization
- On-line Dynamic Security Assessment
- Measurement-Based Voltage Stability Analysis (MBVSA)
- Fault Location
- Adaptive Protection
- Voltage Control

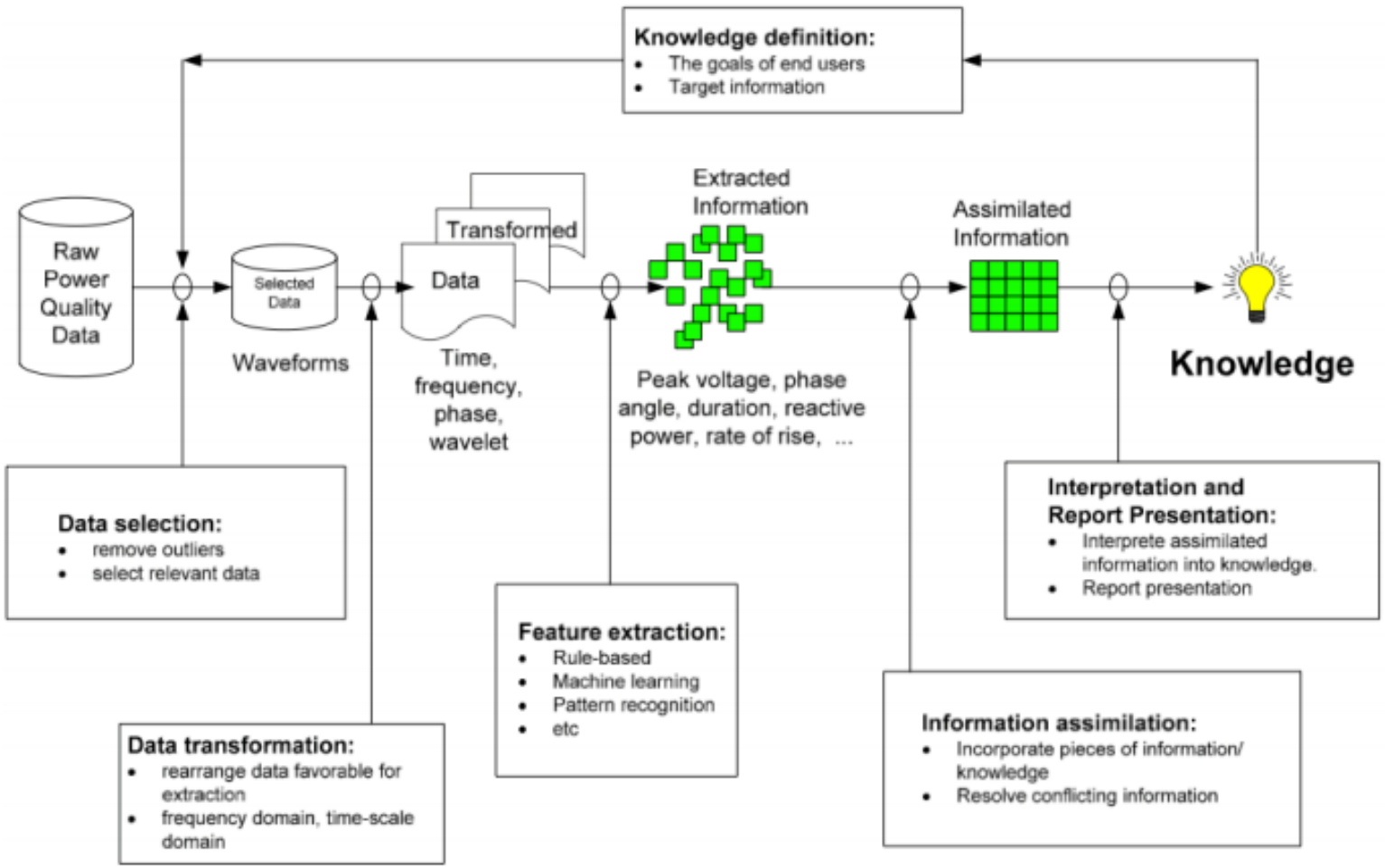
- Model Validation
- Event Analysis



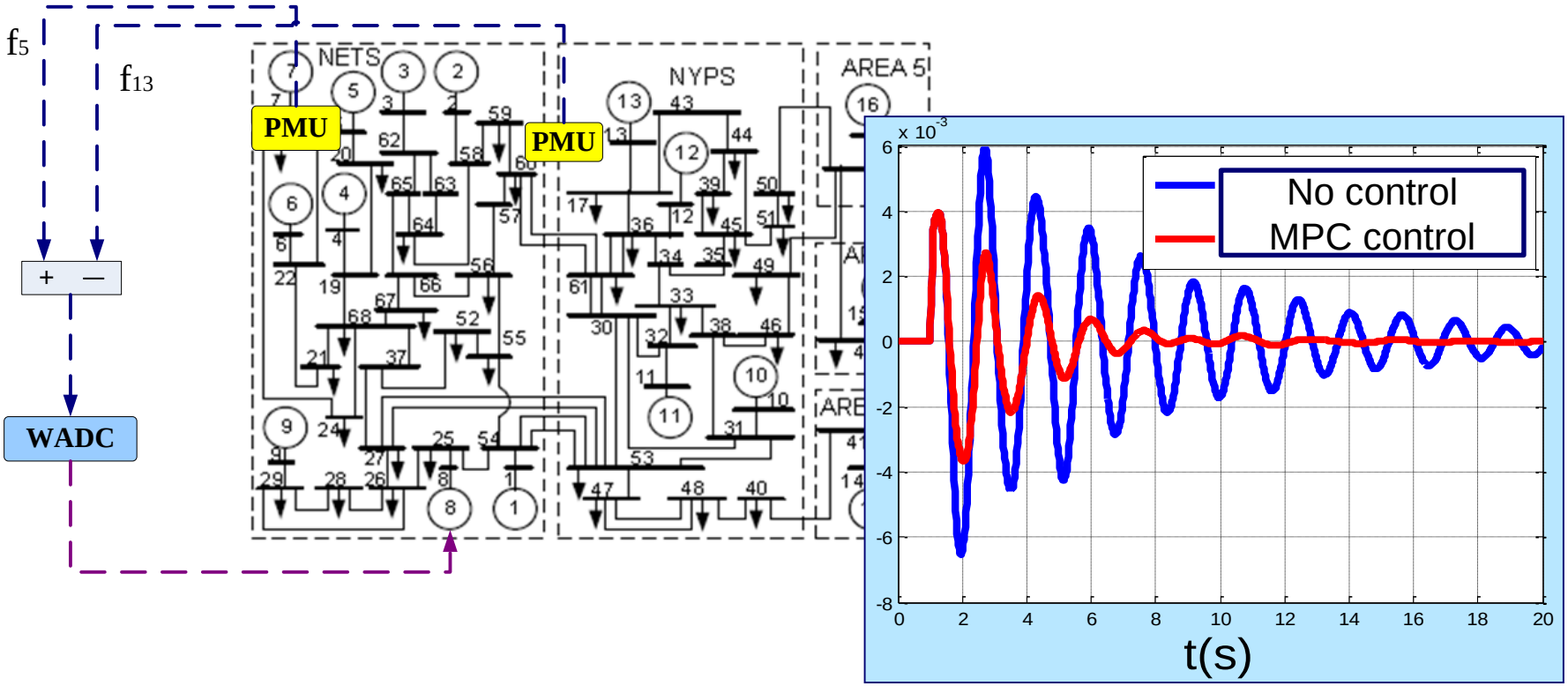
Data Management (BPA)



Data Analytics



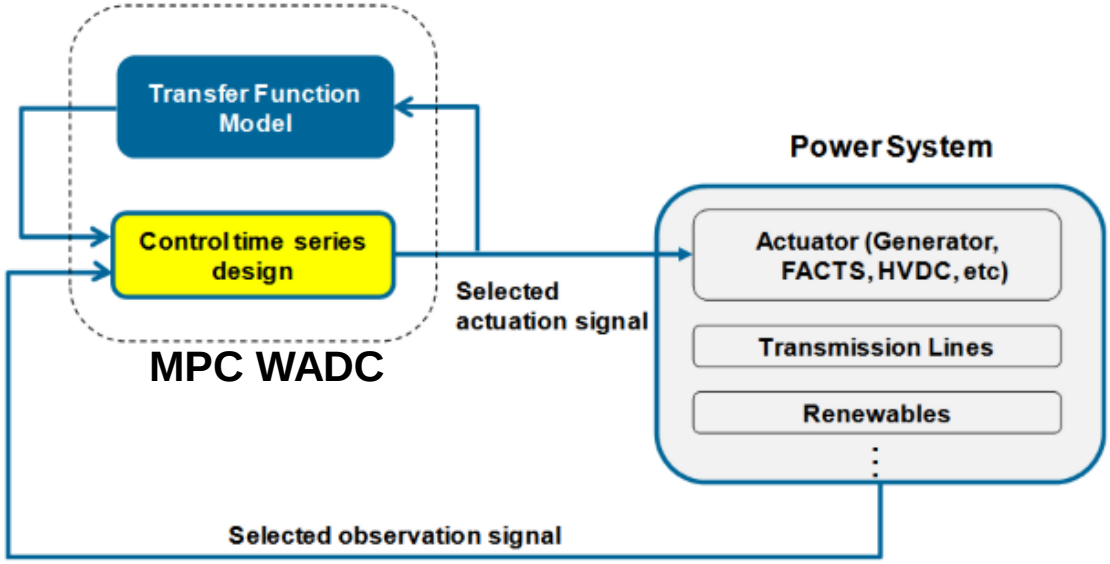
Synchrophasor-Based Wide Area Oscillations Damping Controller



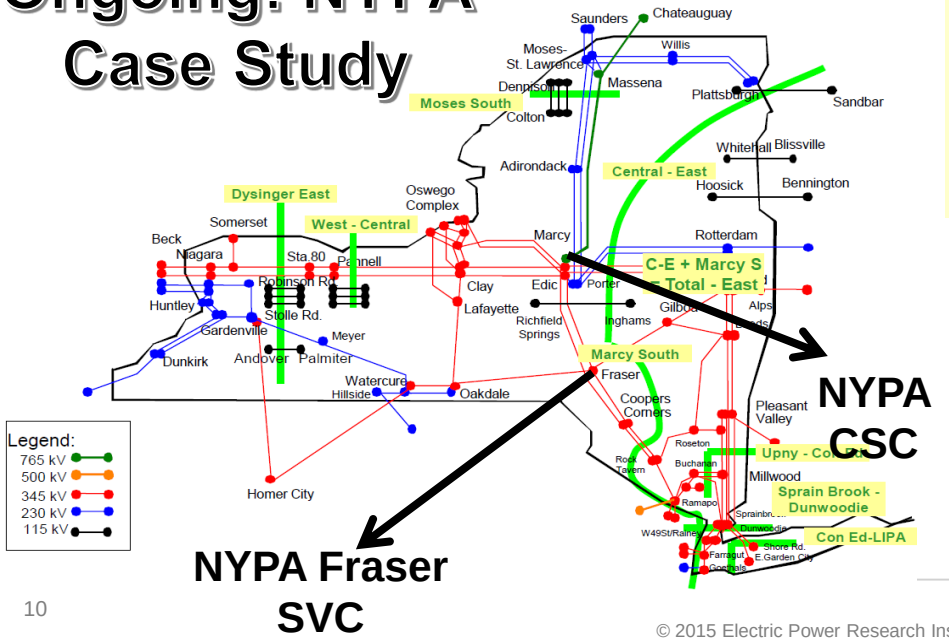
- **Improved Damping of Target Inter-area Oscillations Mode**
- **Application of Synchrophasor Technology in Closed Loop Wide Area Control**

Wide Area Oscillations Damping Controller Design

- **Adaptive Controller**
  - **Measurement-derived transfer function model**
- **Coordinated damping control of local & interarea modes**



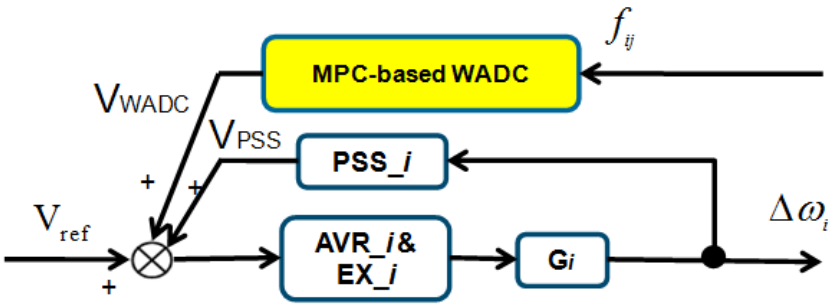
Ongoing: NYPA Case Study



NYPA CSC

NYPA Fraser SVC

WADC via additional input to generator excitation system or FACTS/HVDC controller



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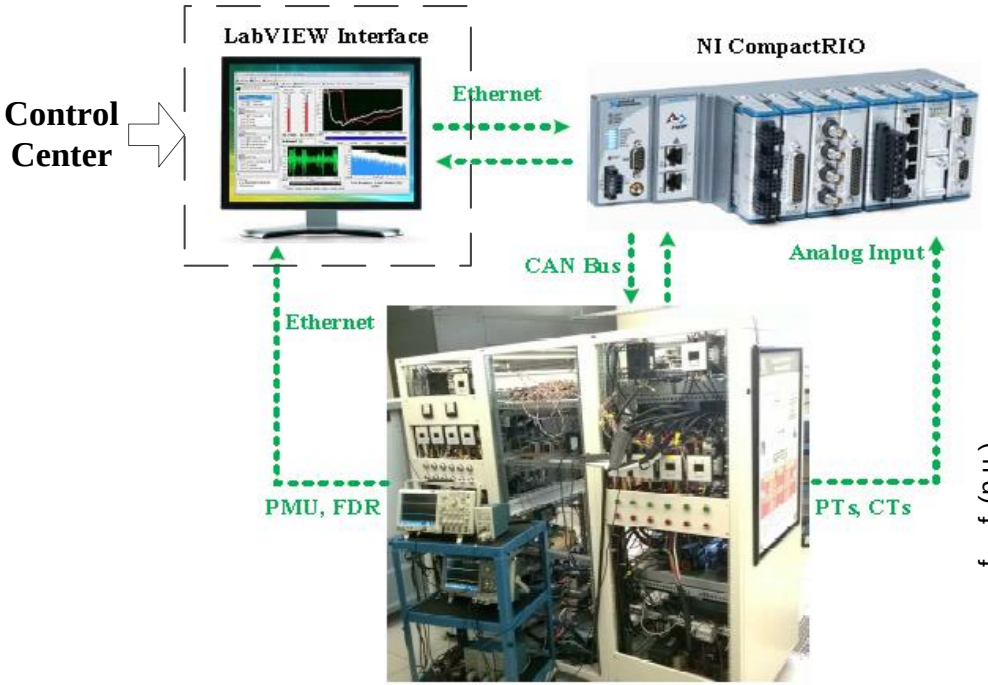
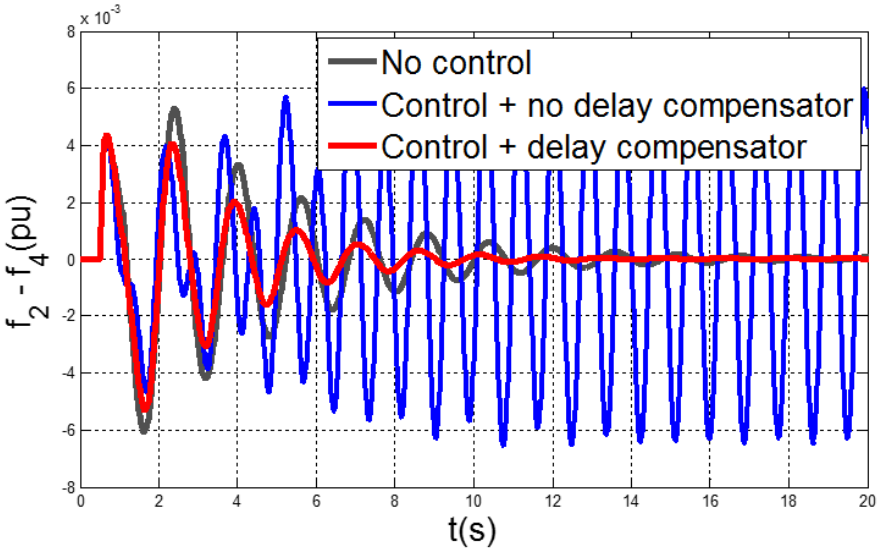
Hardware in the Loop Implementation

Establishing feasibility of implementation in real-time operation mode

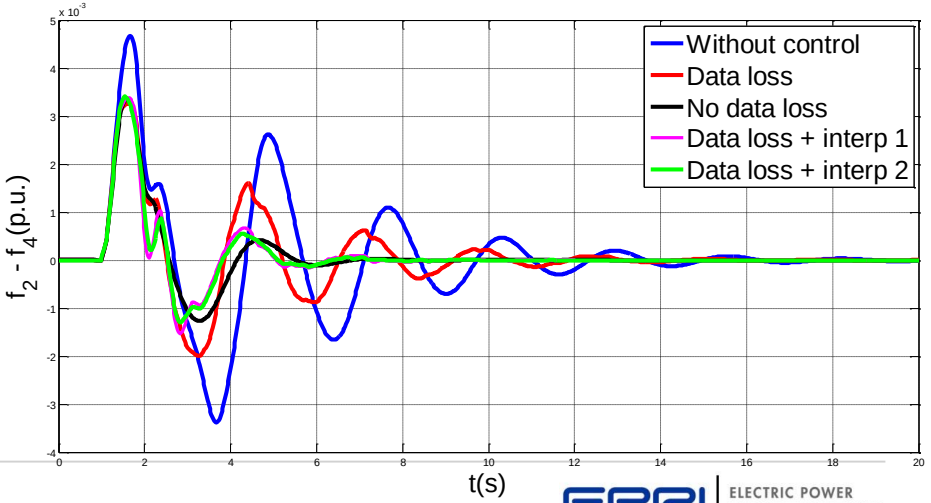
CURENT/UTK Hardware Testbed



Random time delay compensation



Data packet loss



Coordination of research activities

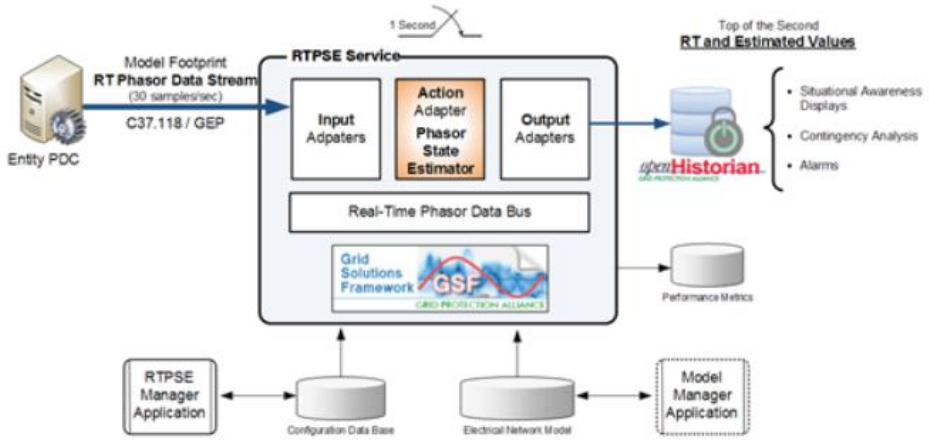
- DOE
- National Labs
- Universities/NSF
- ARPA-e
- EPRI

Technology Innovation Project — Project Brief

TIP 299: Synchrophasor Linear State Estimator and PMU Data Validation & Calibration

Technology Innovation Project — Project Brief

TIP 332: Open Source Platform for Accelerating Synchrophasor Analysis



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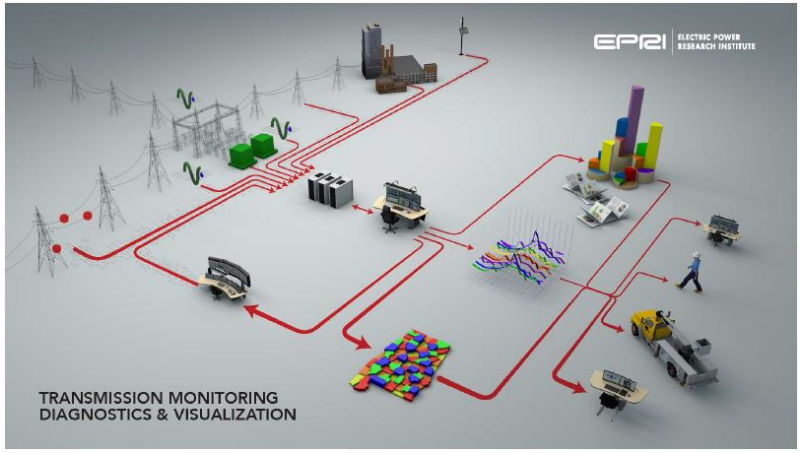
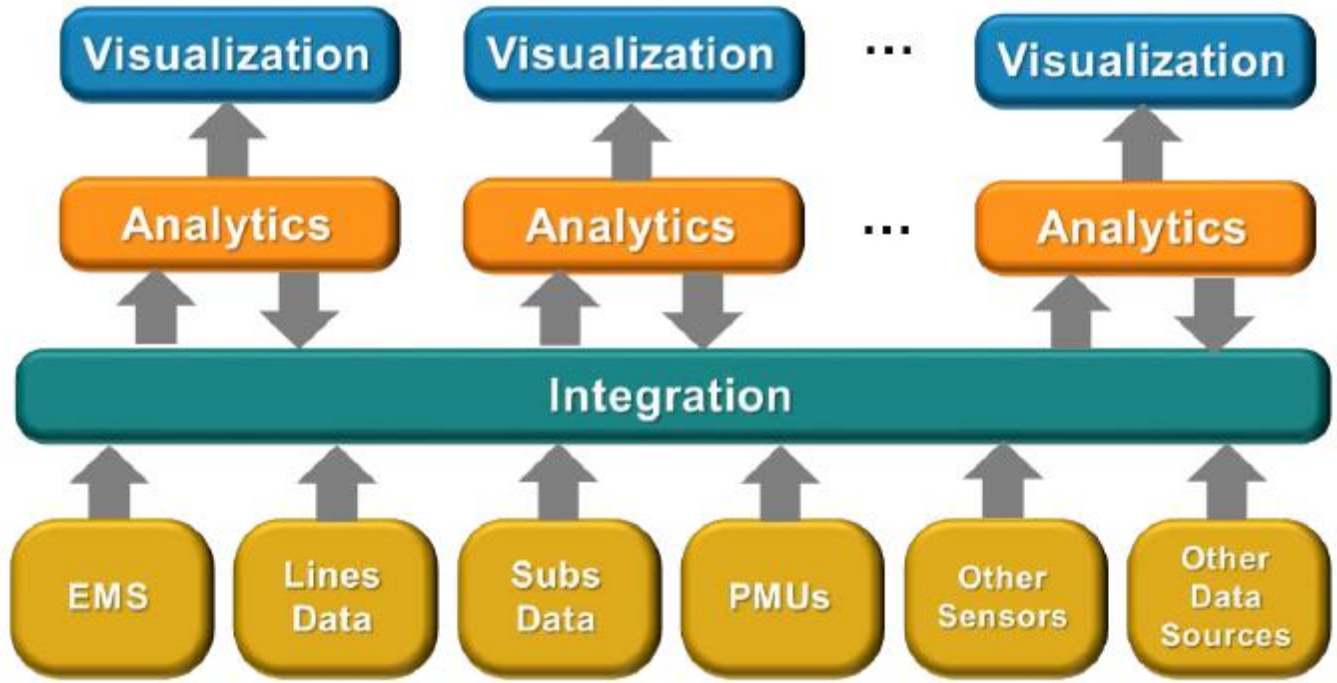
Integration and Visualization

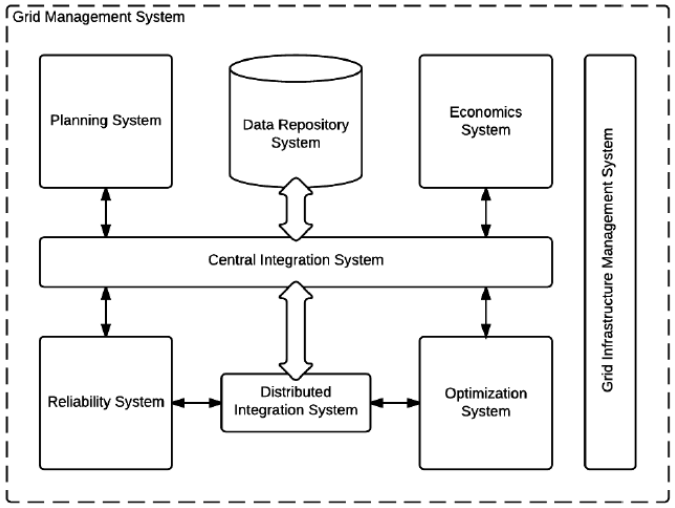


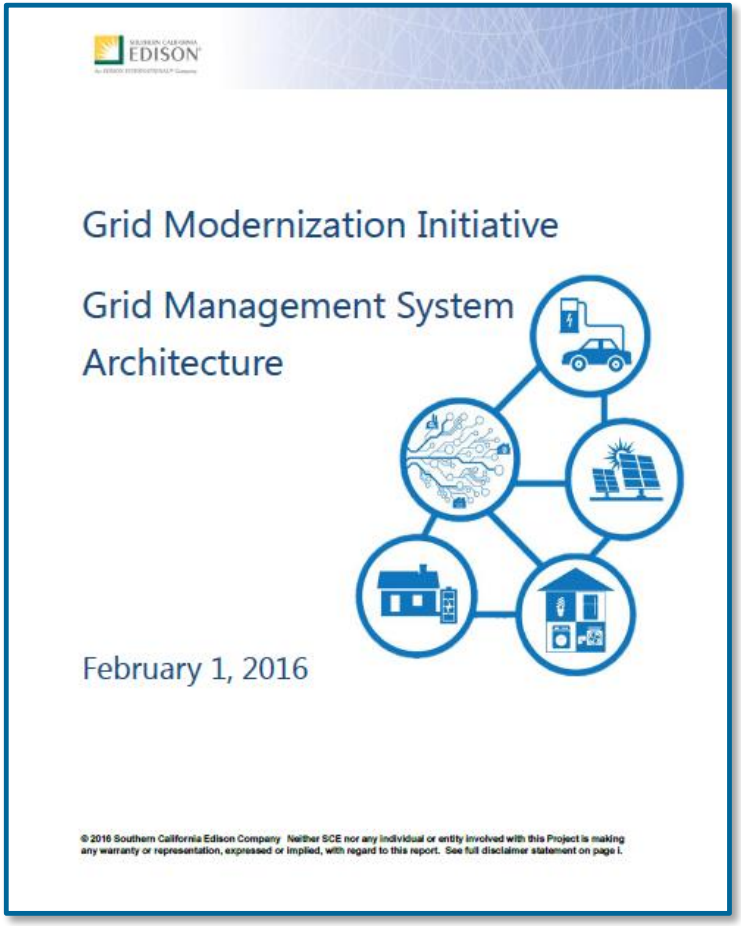
TMDV Tool Development



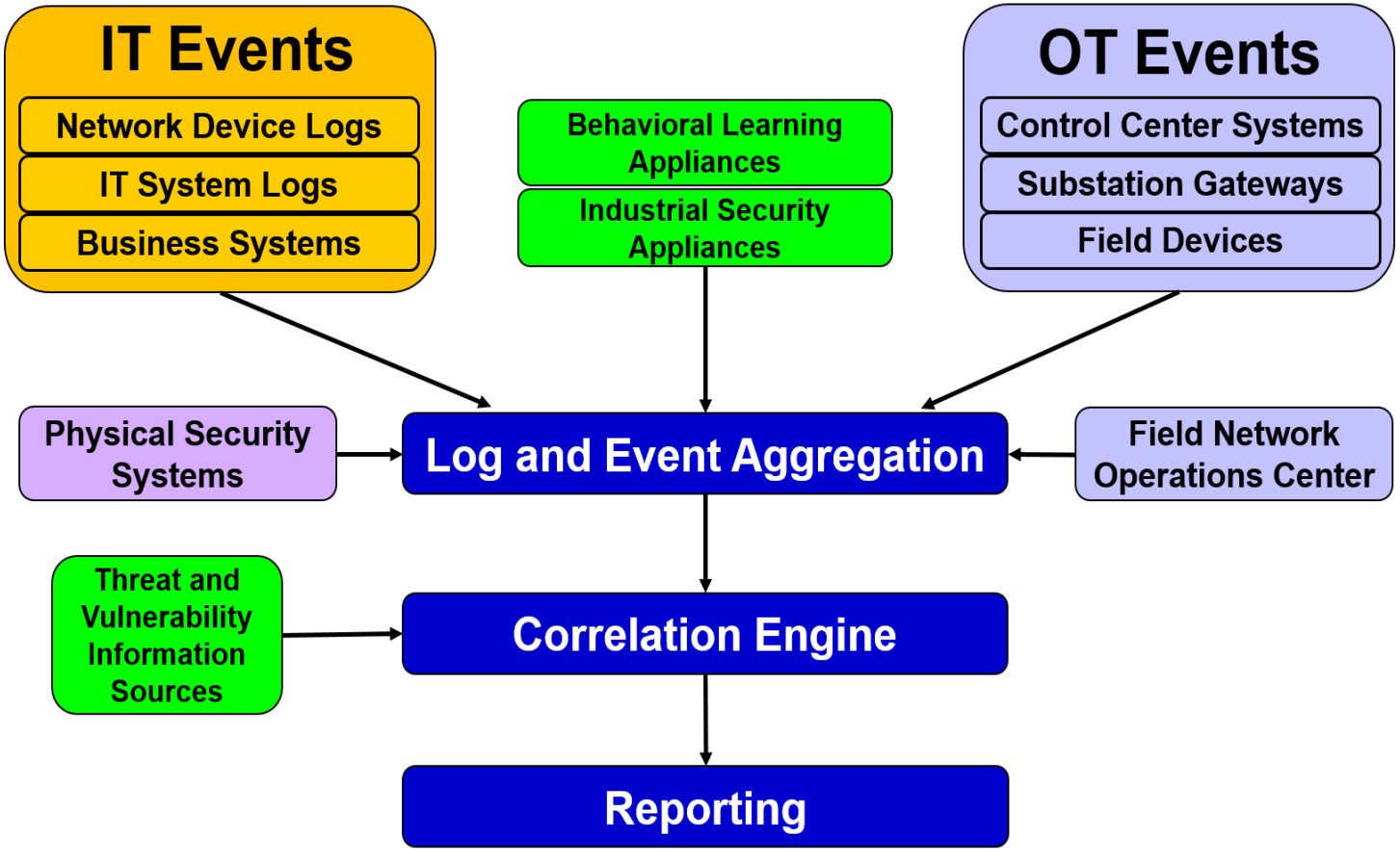
Integrated T&D Modeling and Control

- Grid management system, DMS, DERMS, etc.
- Architecture
- Distributed Controls
- Model management
- GIS
- OMS





Cyber security and physical security – Integrated Security Operations Center



Efficiently detect events across utility domains

The need for collaboration is greater than ever

Together…Shaping the Future of Electricity