

# Role of Synchrophasor Measurements in Management of the Integrated Grid



**Mark McGranaghan**  
Vice President, Power Delivery and Utilization

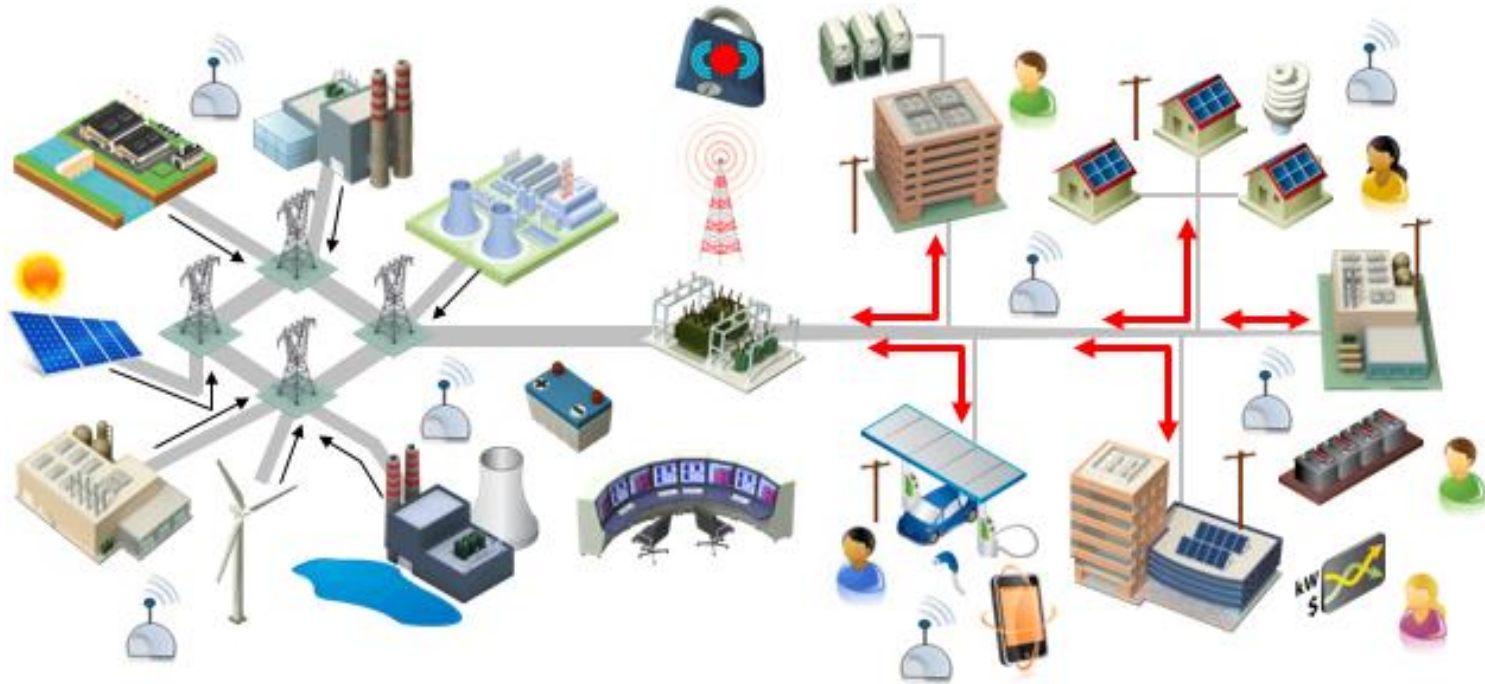
**NASPI**  
Atlanta, GA

March 22, 2016

# Outline

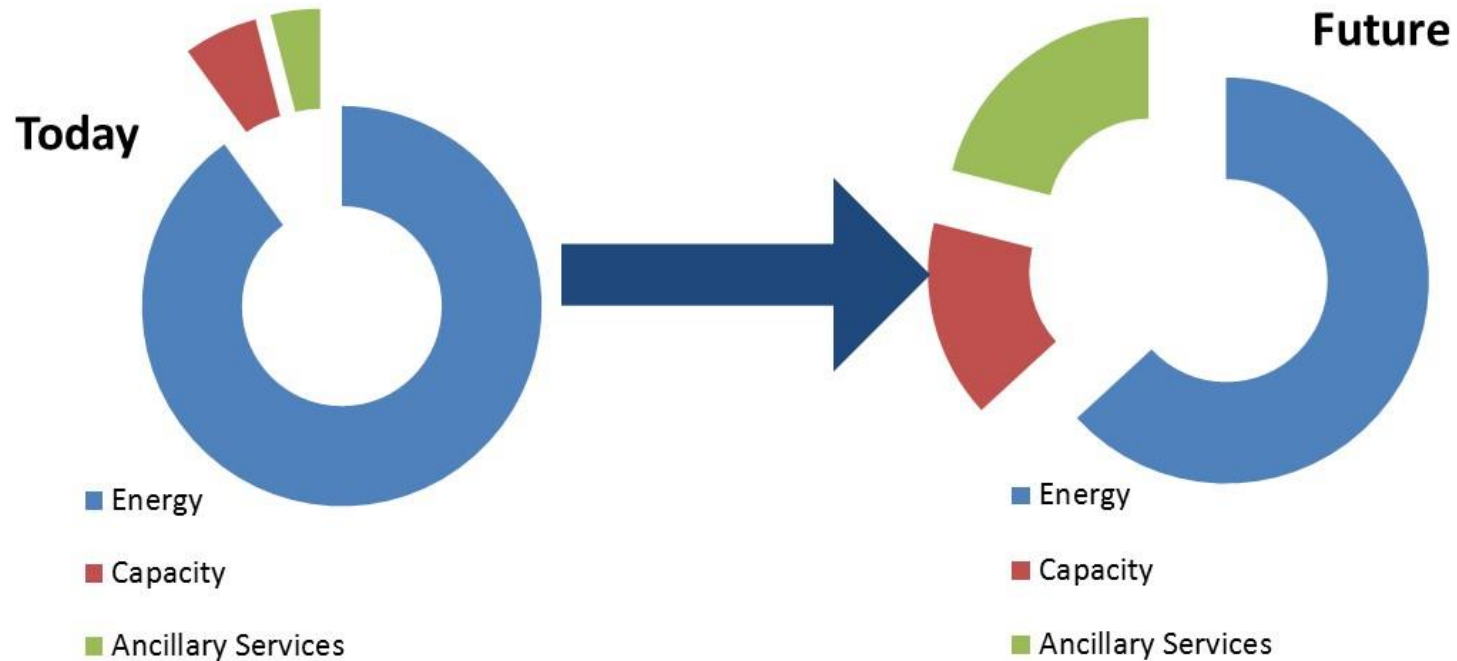
- Integrated Grid
- What's different?
- Need for real time information
- Developing applications
- Coordinating the research

# The Vision: A **Robust** Integrated Grid



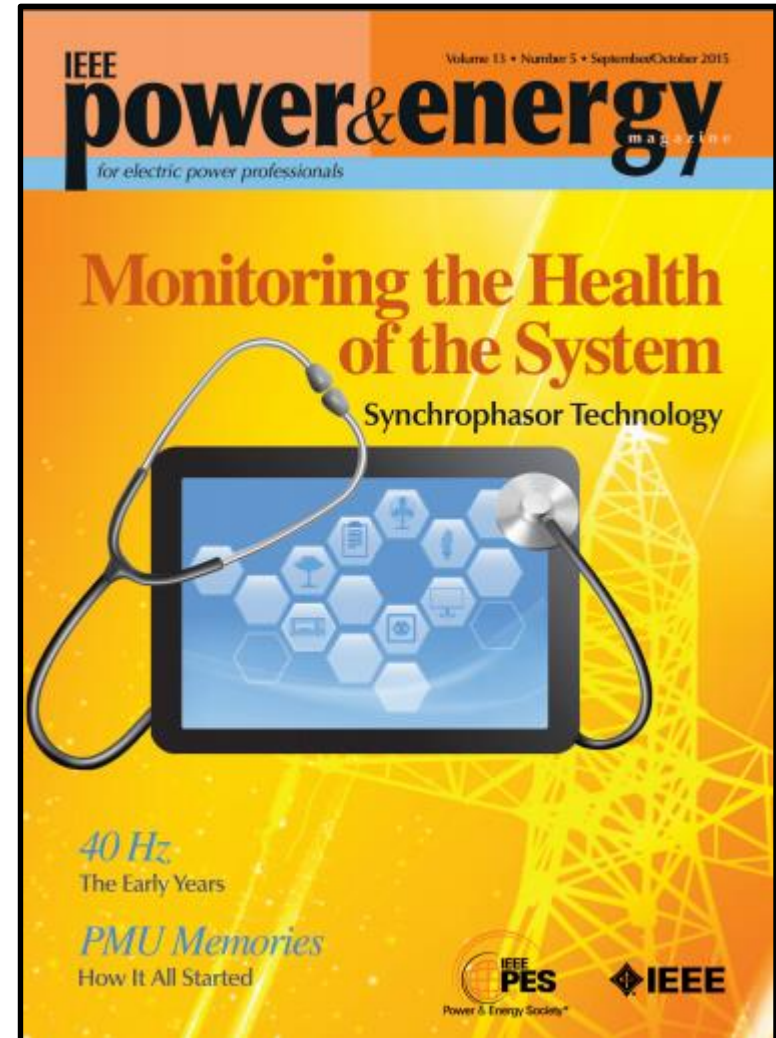
A **Robust Grid** is required to  
unlock the value streams for distributed resources  
as well as  
assure continuity of power that is critical to society.

# Challenge – Capacity and Flexibility



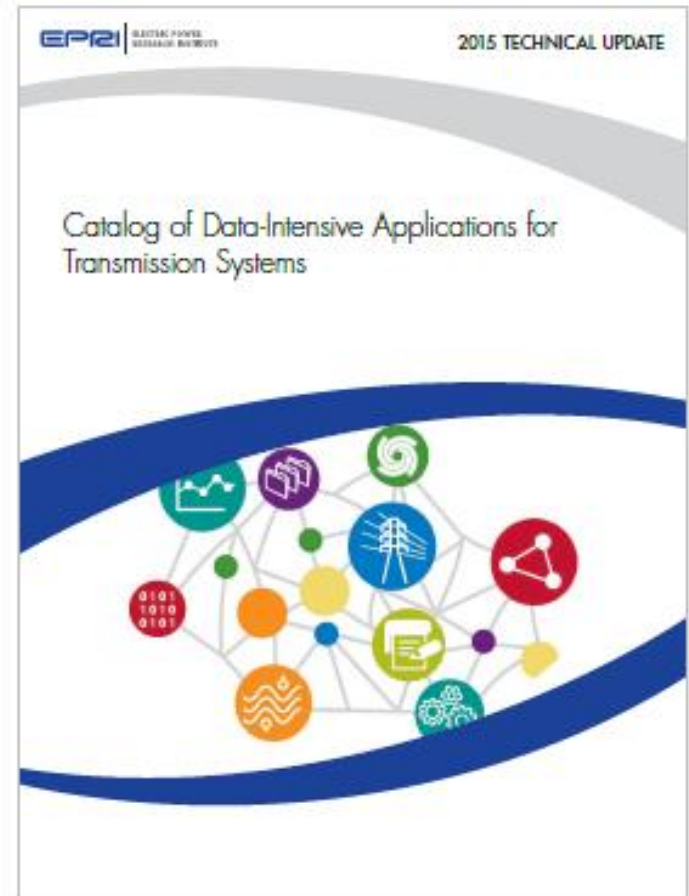
# Synchrophasors – tool for system condition assessment

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

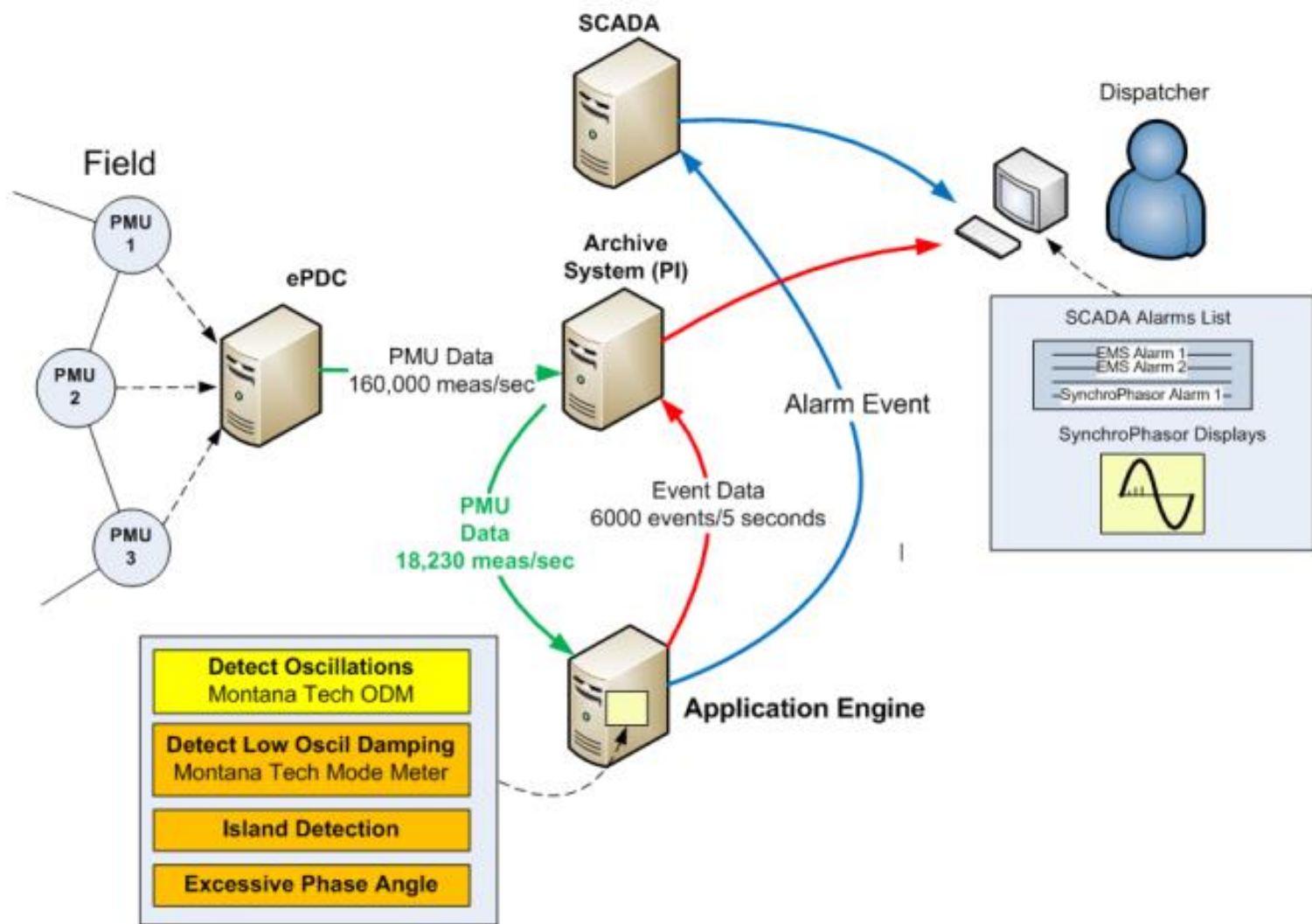


# Wide variety of applications

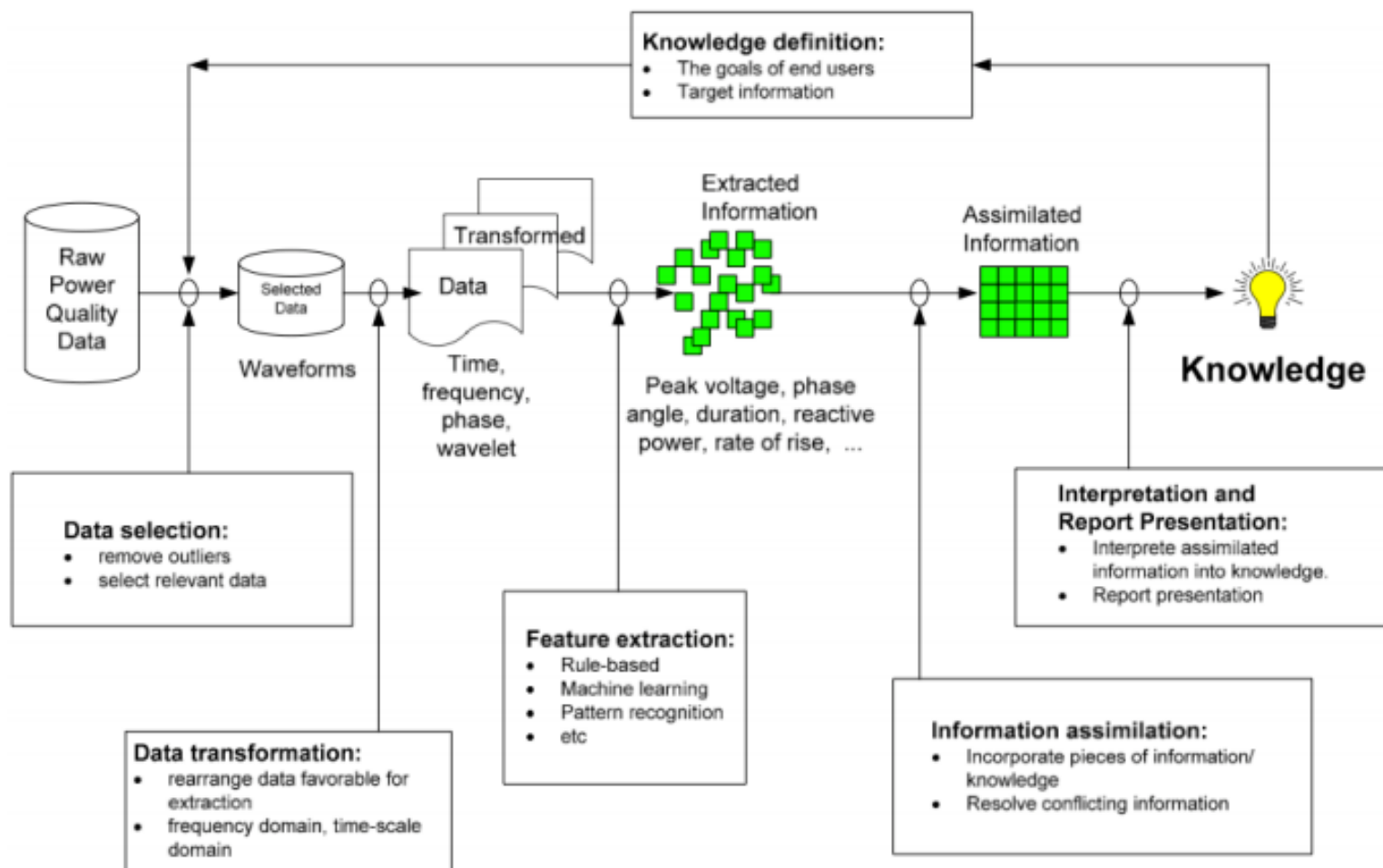
- State Estimation
- Wide-Area Visualization
- On-line Dynamic Security Assessment
- Measurement-Based Voltage Stability Analysis (MBVSA)
- Fault Location
- Adaptive Protection
- Voltage Control
  
- Model Validation
- Event Analysis



# Data Management (BPA)

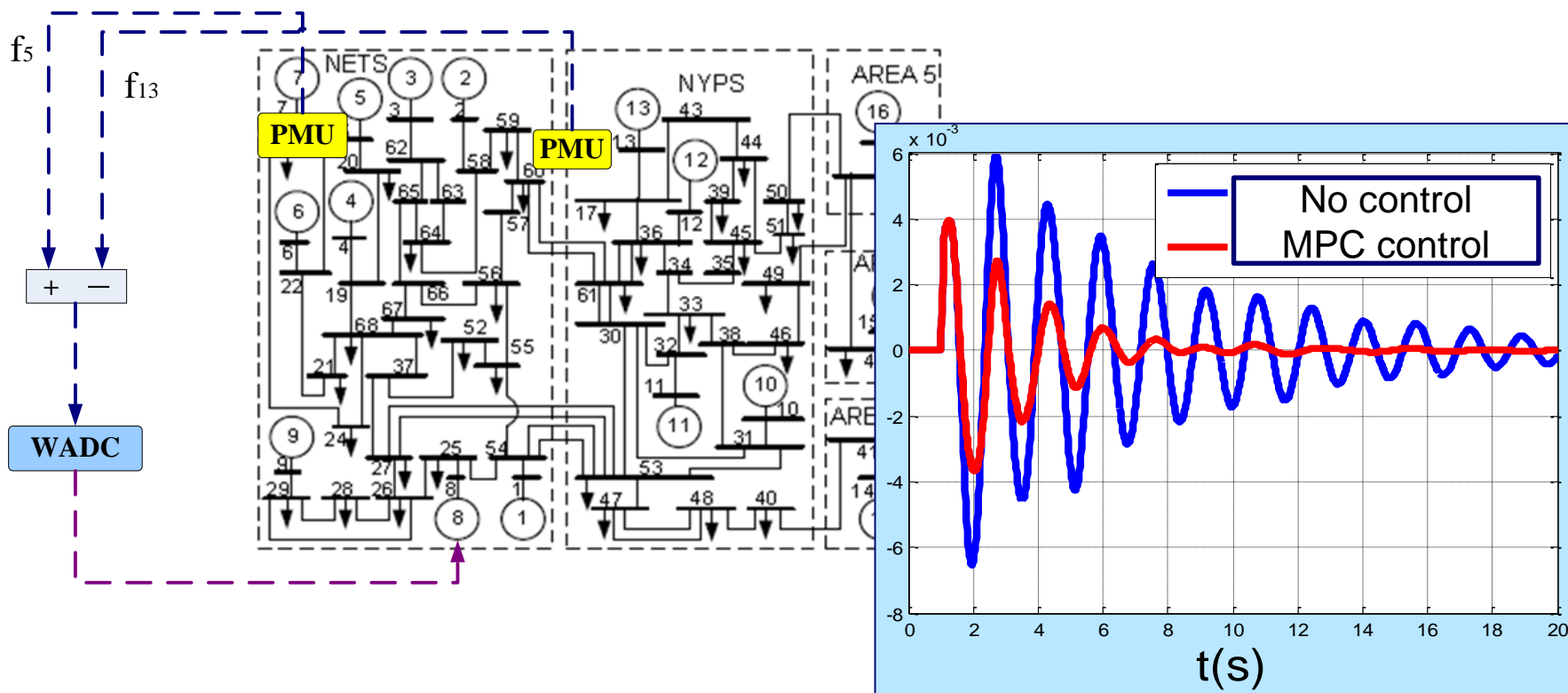


# Data Analytics





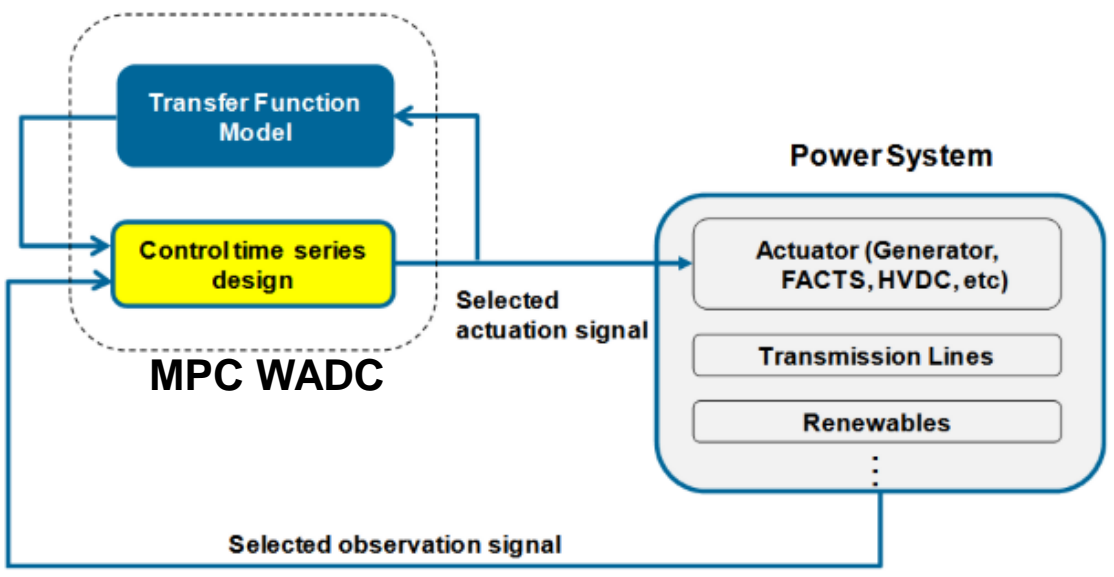
# Synchrophasor-Based Wide Area Oscillations Damping Controller



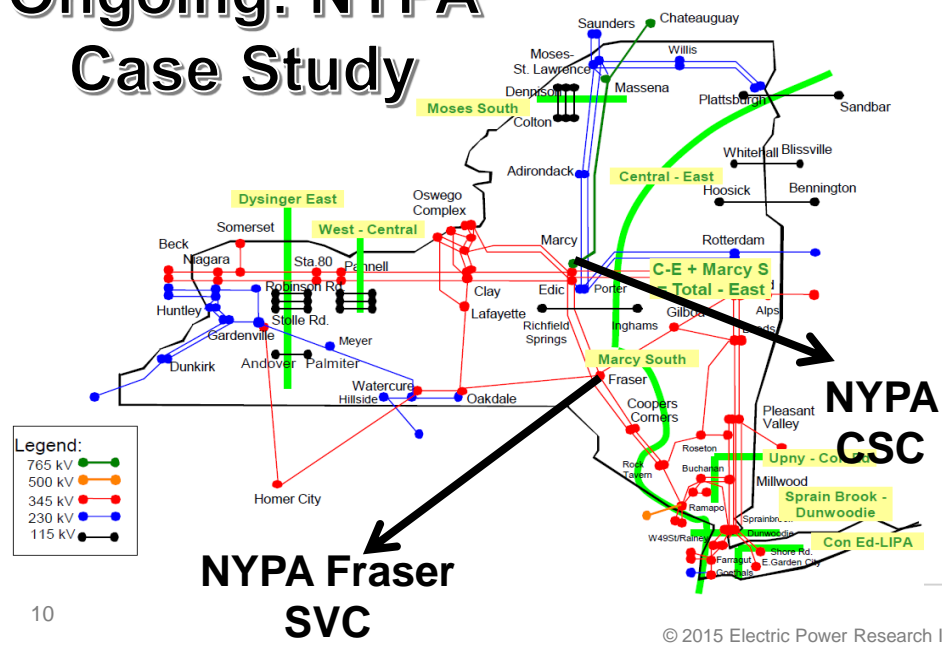
- Improved Damping of Target Inter-area Oscillations Mode
- Application of Synchrophasor Technology in Closed Loop Wide Area Control

# Wide Area Oscillations Damping Controller Design

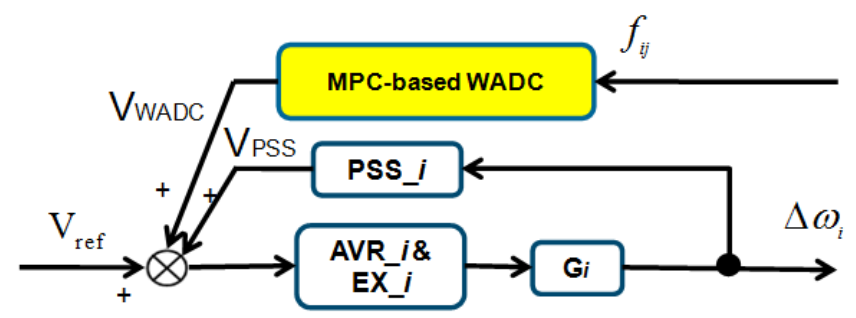
- Adaptive Controller
  - Measurement-derived transfer function model
- Coordinated damping control of local & interarea modes



## Ongoing: NYPA Case Study



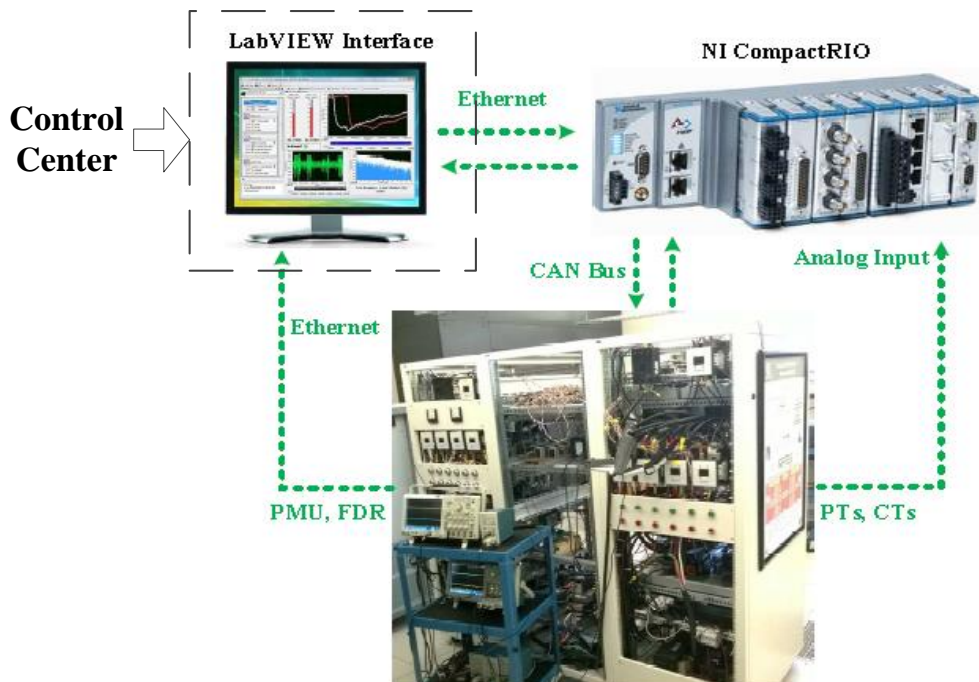
WADC via additional input to generator excitation system or FACTS/HVDC controller



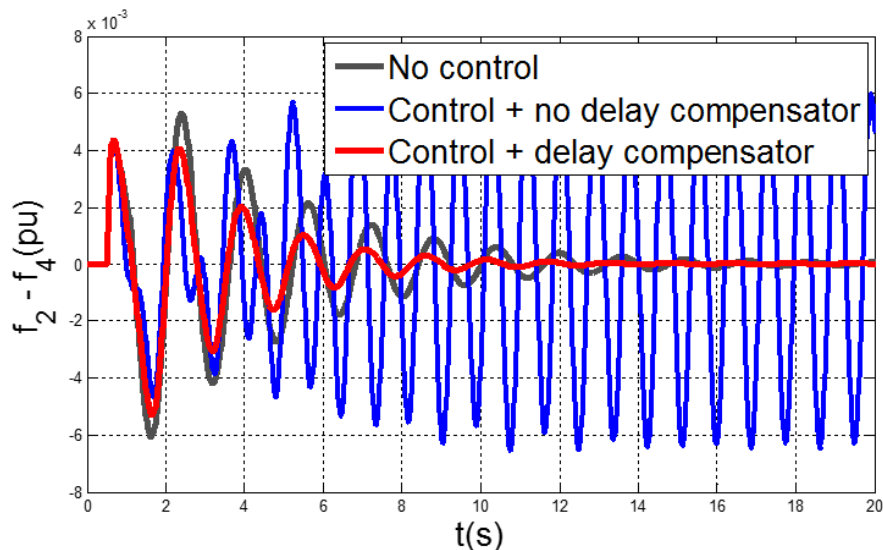
# Hardware in the Loop Implementation

Establishing feasibility of implementation in real-time operation mode

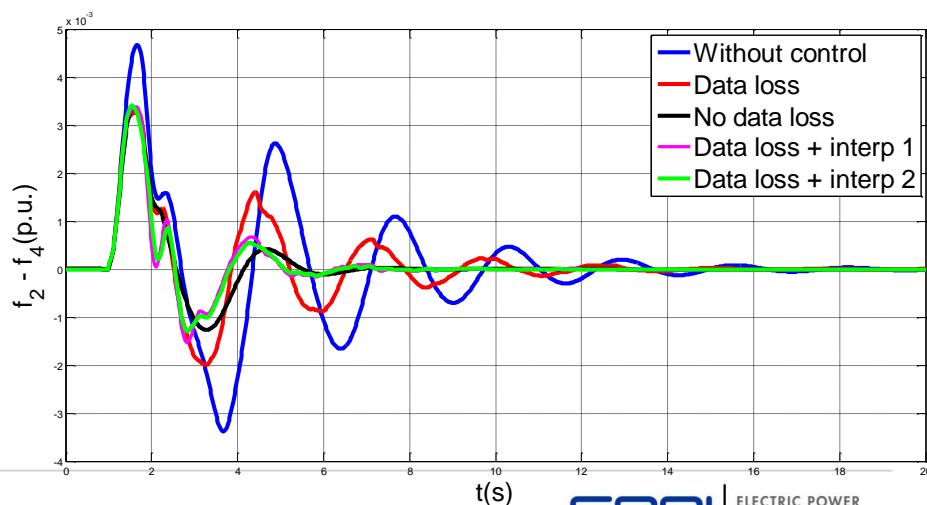
## CURRENT/UTK Hardware Testbed



## Random time delay compensation



## Data packet loss



# Coordination of research activities

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



Technology Innovation Project



Project Brief

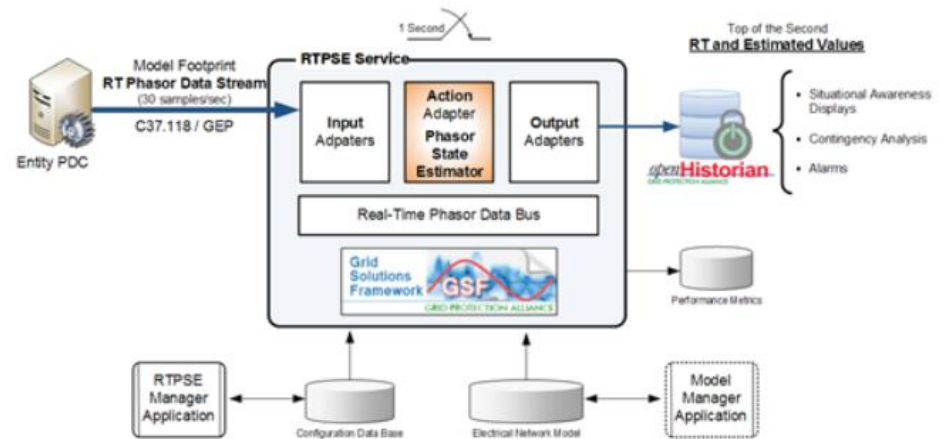
**TIP 299: Synchrophasor Linear State Estimator and PMU Data Validation & Calibration**

Technology Innovation Project



Project Brief

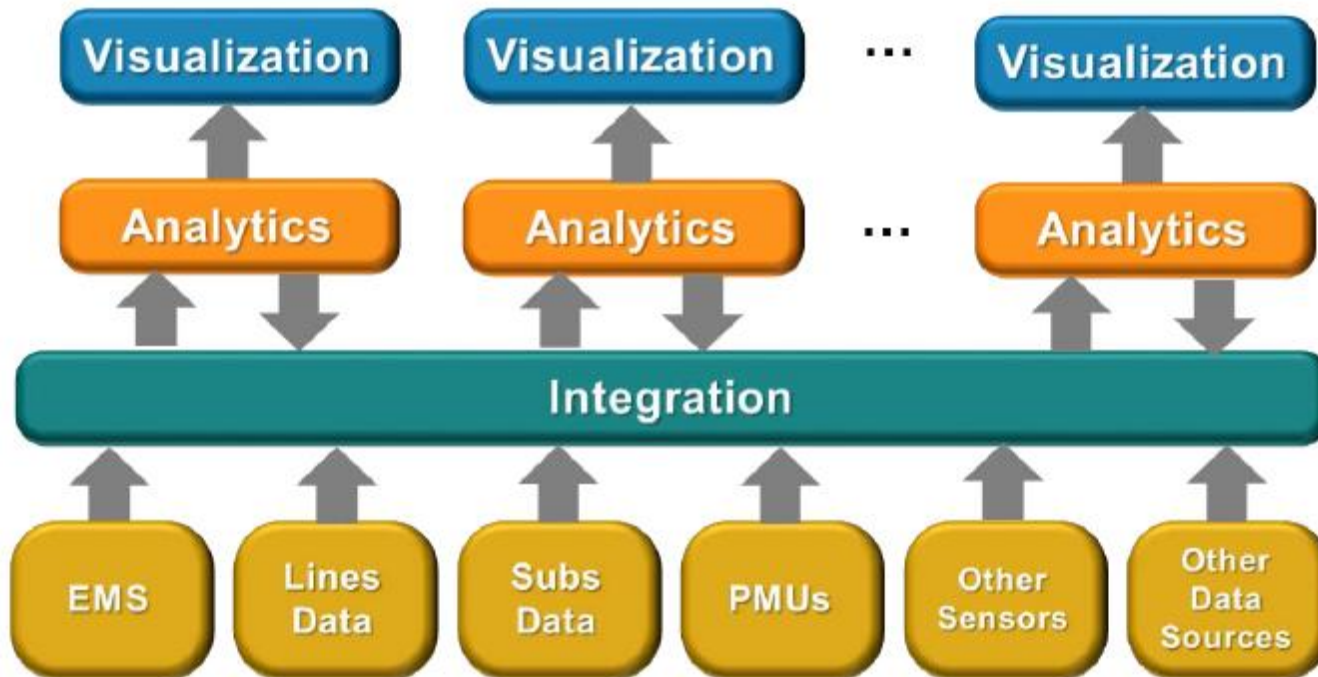
**TIP 332: Open Source Platform for Accelerating Synchrophasor Analysis**



# Integration and Visualization

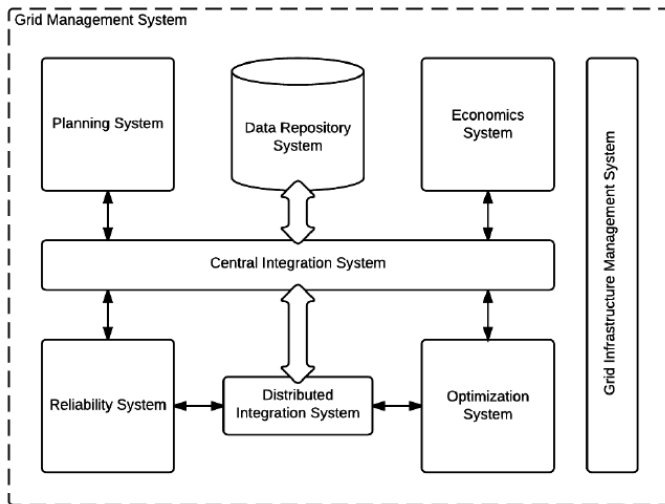


## TMDV Tool Development



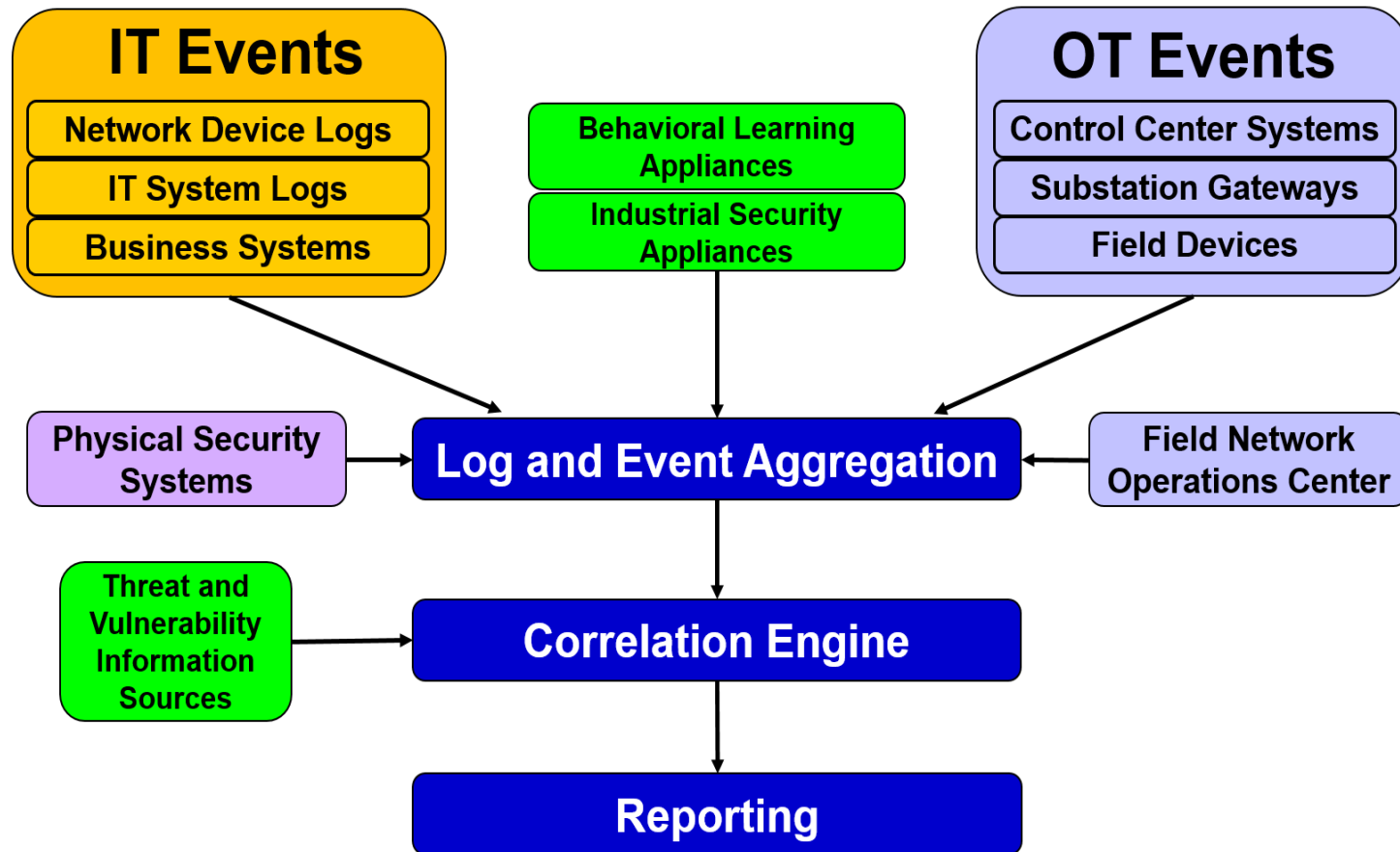
# Integrated T&D Modeling and Control

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



The cover of the report features the Southern California Edison logo at the top left. The title 'Grid Modernization Initiative Grid Management System Architecture' is centered. To the right is a circular diagram with five nodes: a car with a battery, solar panels, a house with a battery, a house with a solar panel, and a map of a power grid. The date 'February 1, 2016' is printed below the title. At the bottom, a small disclaimer reads: '© 2016 Southern California Edison Company. Neither SCE nor any individual or entity involved with this Project is making any warranty or representation, expressed or implied, with regard to this report. See full disclaimer statement on page 1.'

# Cyber security and physical security – Integrated Security Operations Center



**Efficiently detect events across utility domains**

# The need for collaboration is greater than ever

## Data Analytics Initiative for Transmission and Distribution

### Year Two Update

Transmission Modernization Demonstration (TMD)  
Distribution Modernization Demonstration (DMD)

Data Management & Analytics to  
Support Electric System Operations,  
Planning, and Asset Management





## Together...Shaping the Future of Electricity