PJM Interconnection

Smart Grid Investment Grant Update

Bill Walker
walkew@pjm.com

NASPI Work Group Meeting
October 17-18, 2012

Acknowledgment: "This material is based upon work supported by the Department of Energy under Award Number: DE-OE0000373"

NASPI North American SynchroPhasor Initiative

PJM Project Participants

- PJM Leads:
  - Project Manager: Bill Walker (walkew@pjm.com)
  - SynchroPhasor Technical Lead: Mahendra Patel (patelm3@pjm.com)
- Vendor Partners:
  - Electric Power Group (PDC and visualization software)
  - Quanta Technology (engineering/project management)
  - Virginia Tech University (PMU/PDC device testing)

Project Summary

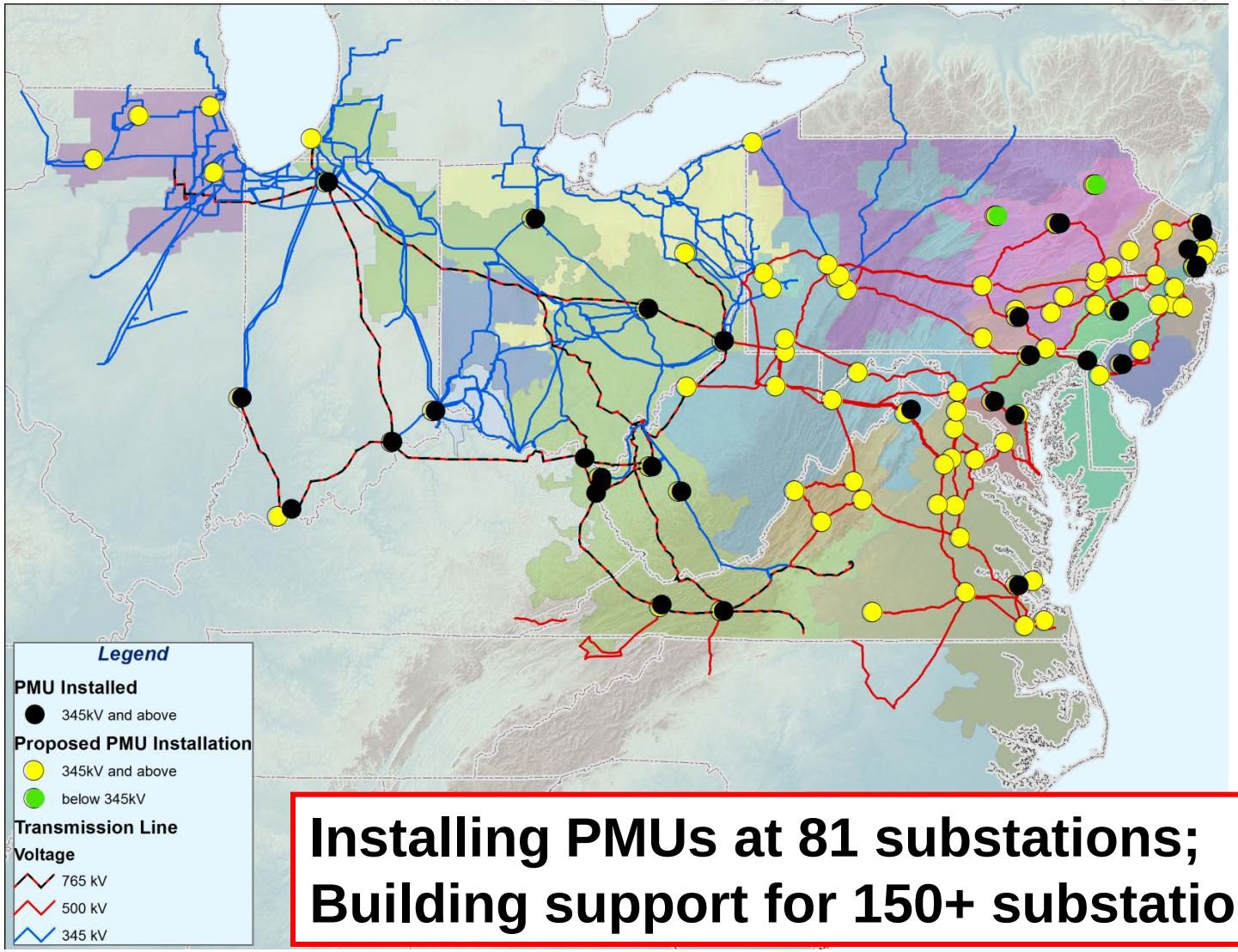
- 12 Transmission Owners installing measurement devices at 81 substations
  - TO's selected their own vendors
- Transmission Elements Monitored
  - 64 SS > 345kv
  - 17 SS < 345kv
- Approx. 20% of regional footprint monitored
- Installing PMU's, Relays, DFRs, DDRs

Participating Transmission Owners

Transmission Owner	# of Substations with PMU Installations	# of Central PDCs
Allegheny Power	8	0
American Electric Power	15	1
Baltimore Gas & Electric	2	2
Commonwealth Edison	4	1
Duquesne Light	2	2
FirstEnergy Services	7	2
PECO Energy	3	1
PEPCO Holdings Inc.	4	2
PPL Electric Utilities	12	2
Public Service Electric & Gas	12	2
Orange & Rockland Electric	1	1
VA Electric & Power (Dominion)	11	2
Duke Ohio	3	1

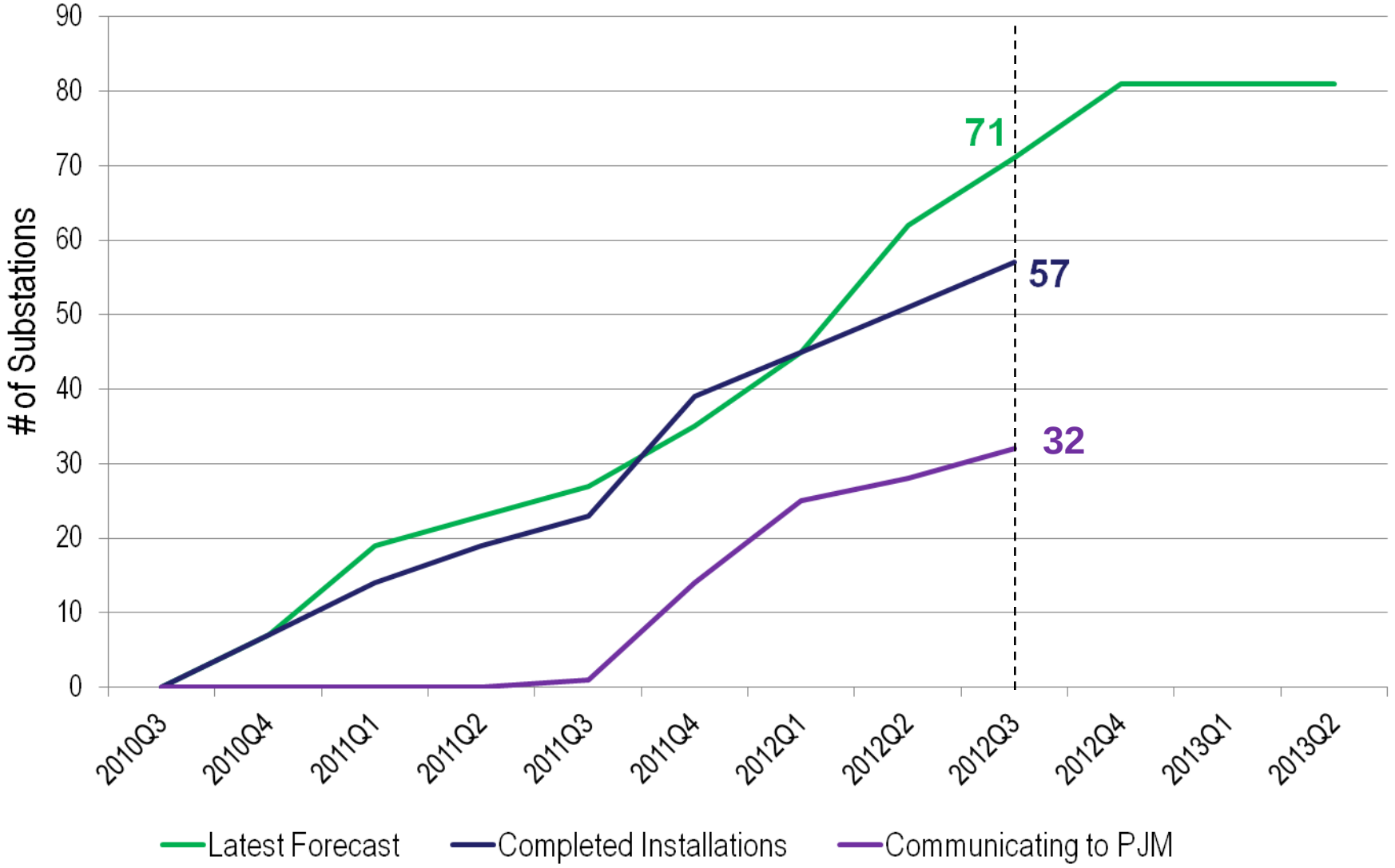
NEW

SynchroPhasor Locations



Installing PMUs at 81 substations;
Building support for 150+ substations

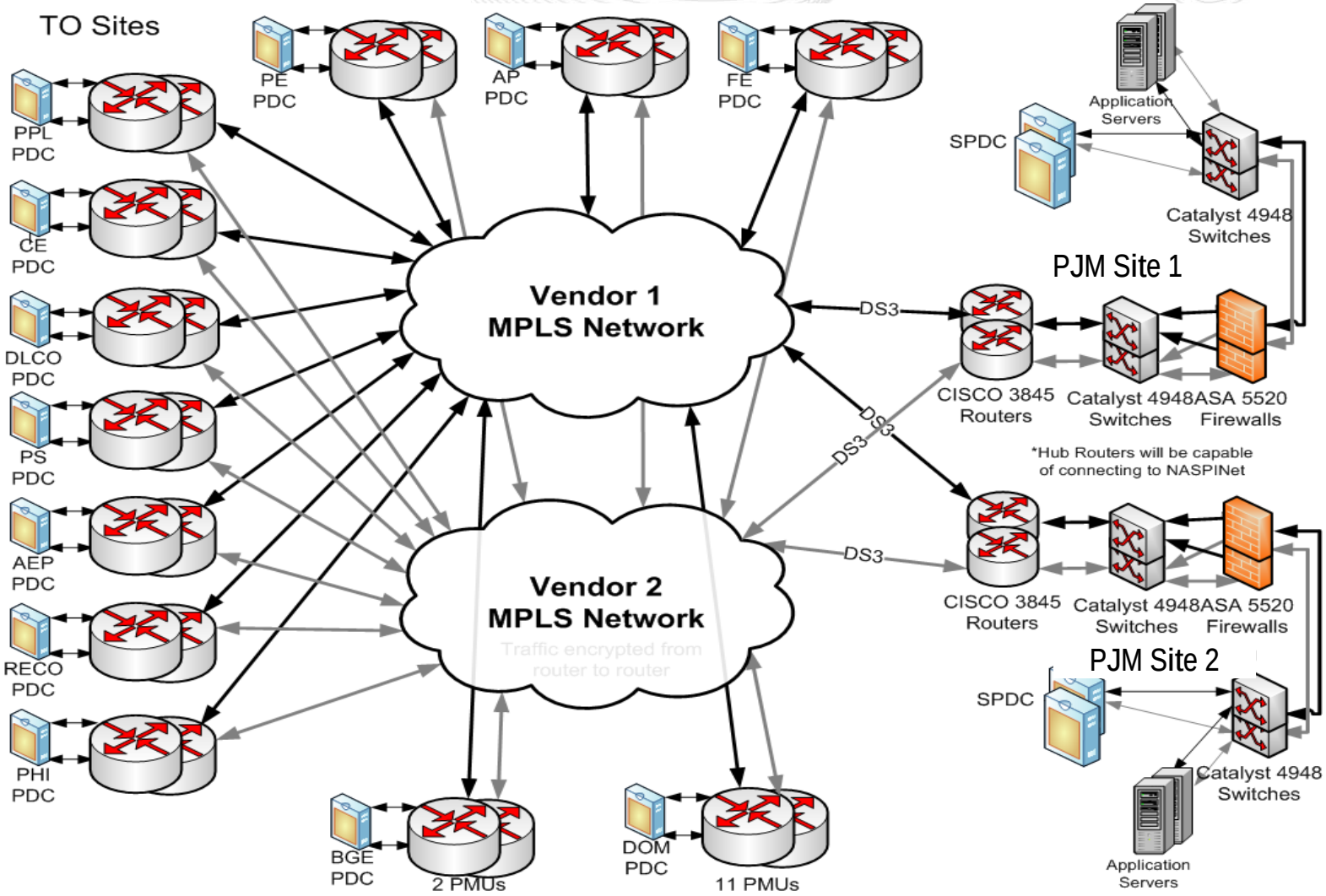
PMU Installations (Substations)



PDCs and Communications

- PDCs
  - 11 (+5) TO Control Centers with Central PDC
  - Archive Database Status
    - Storage Size – 220 TB (approx 3 years retention)
    - Data archive considerations
      - 90 days real-time; 1 year near-real-time; 7 year archive
  - PDC Availability: 99.99%
- Communication System
  - 11 (+5) dedicated links to TOs (T1 lines)
  - 2 dedicated MPLS Clouds; 1 Verizon and 1 AT&T
  - System Availability: 99.99%

Telecommunications Network



Project Timeline

- Q4 2012
  - Complete initial TO connections (final 5)
  - Data Quality and Availability
  - TO Operator Training
  - Production Hardware/Software installation
  - System Testing

Project Timeline

- Q1 2013
  - "Go Live" with Production hardware/software
  - Implement backup communications network
  - Deploy visualization & analysis software to TO's

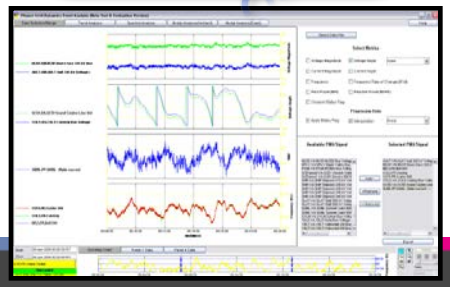
- Q2 & Q3 2013
  - Additional PJM and TO Operator Training
  - Full Transition to Operations Support
  - Initiate pilot projects to gain insight
  - Test EMS/SE Modifications

SynchroPhasor Applications

Data Analysis

- Use recorded data
- Verification of operations
- Analyze dynamic performance
- System model maintenance

OFF-LINE



Wide Area Monitoring

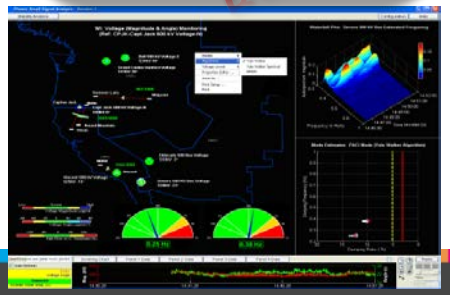
- Situational awareness display & alerts
- Visual status displays
- Interface into EMS
- Limit alarms
- State measurement

REAL TIME

System Dynamics Monitoring

- Visual displays and Alarm Processing
- Dynamic operation limits (oscillations, mode shapes…)
- Parameter estimation
- Oscillation detection

REAL TIME

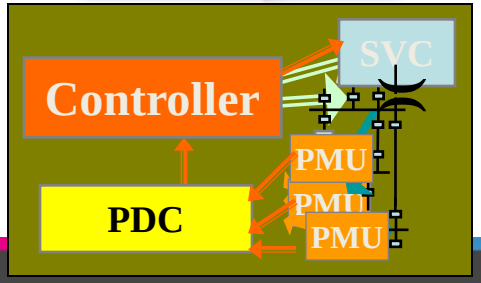


System Control, Protection & Reliability

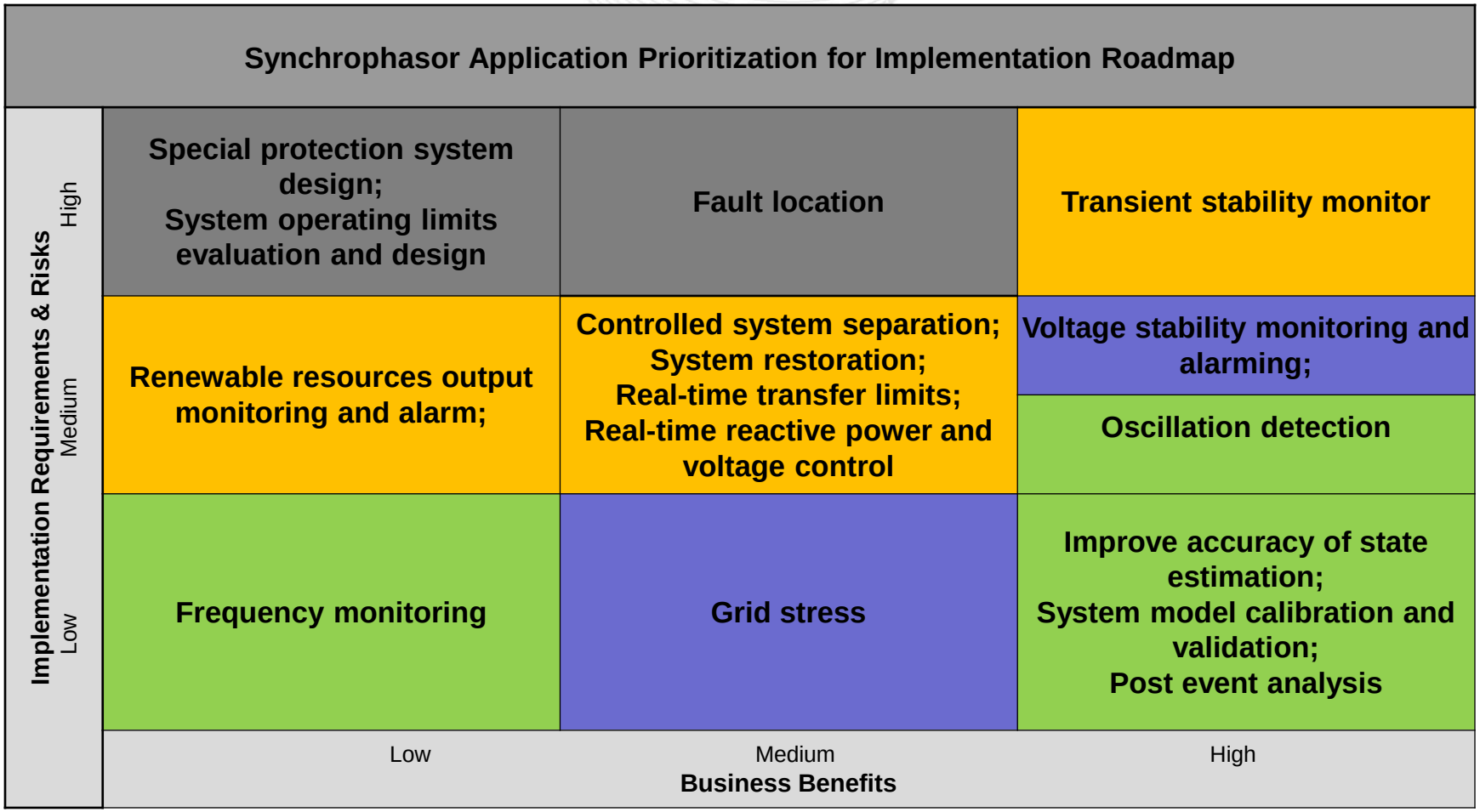
Control Actions For:

- Wide area problems
- Out-of-step detection
- Excessive power flow, high phase angles
- Both low and high speed operation

REAL TIME



Application Assessment - Future Deployment



DEFER | Long Term | Medium Term | Short Term

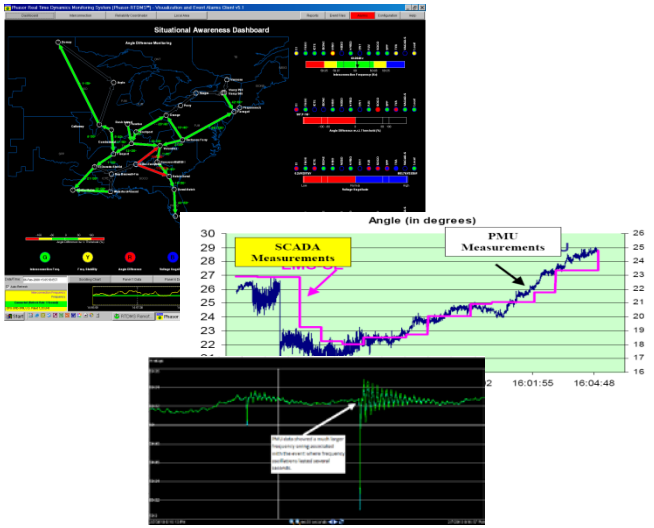
Data Quality

- 71% of PMUs with “Good” (or better) rating
- 45% of PMUs delivering Timely data
  - With latency under .5 seconds
- 35% of PMUS are both “Good” and “Timely”

- Poor Quality – Root Cause
  - PMU Calibration
  - GPS Clock issues
  - Data Name limitations
  - Loose cables
  - Loss of telecom connection
  - Server overload
  - Aliasing at PDC
  - PDC configurations

Phasor Data Sharing

- RTO/ISO Data Sharing
  - MISO (send/receive)
- Application Outputs
  - 12 PJM TO's (target Dec/Jan)
- Research Projects
  - Multiple planned



Project Challenges

- High-level Project Challenges
  - TO Installation Schedule Changes
  - Data Quality and Availability
  - Coordination of all project stakeholders
    - TOs, Vendors, ISO/RTOs, DOE
  - Expanding scope to use available funds
  - Ensuring the architecture is scalable
  - Storage, Storage, Storage
  - R&D approach vs. “touch it once” approach
  - Data Exchange with other RTO/ISO’s

Looking Ahead

- Future Roadmap
  - Data Sharing with other RTO/ISO's
  - Integrate Phasor Data into existing applications/tools
  - Determine data archival/retention requirements
  - "Big Data" Analysis
  - Data Mining Applications
- Research Needed
  - Transient Stability
  - Dynamic Model Derivation
  - Bad Data Detection (near real-time)
  - Data Storage Efficiencies

Thank You