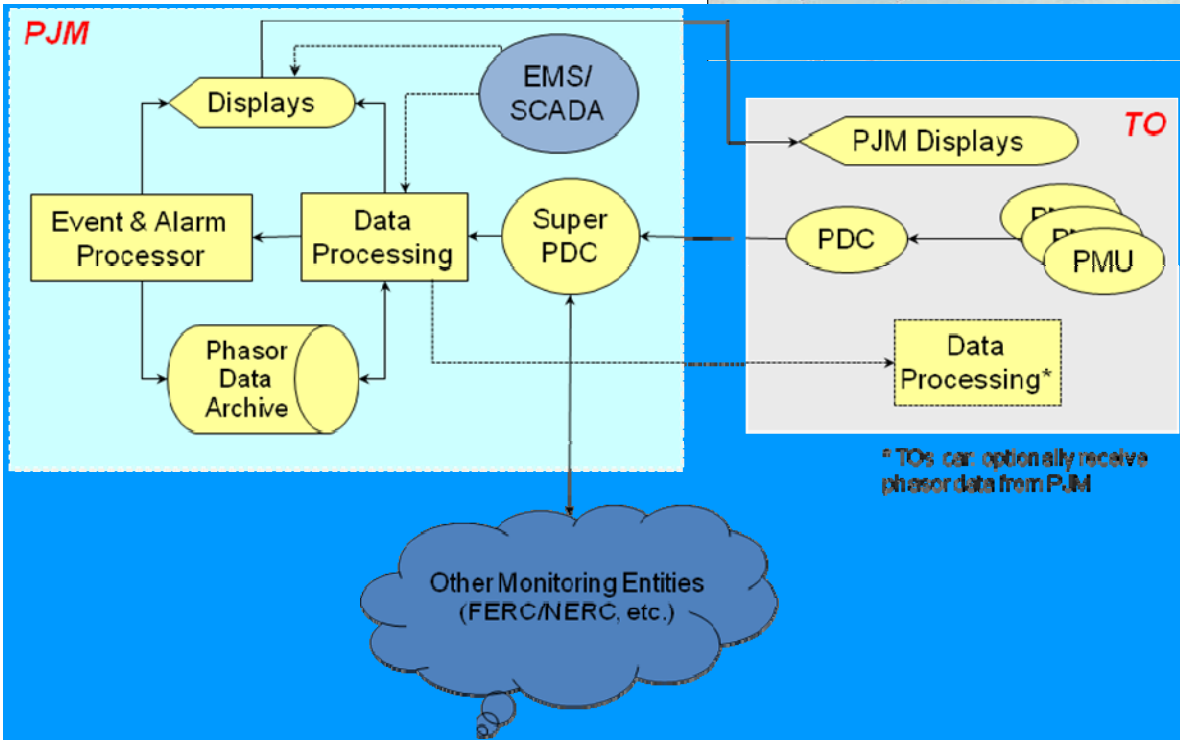
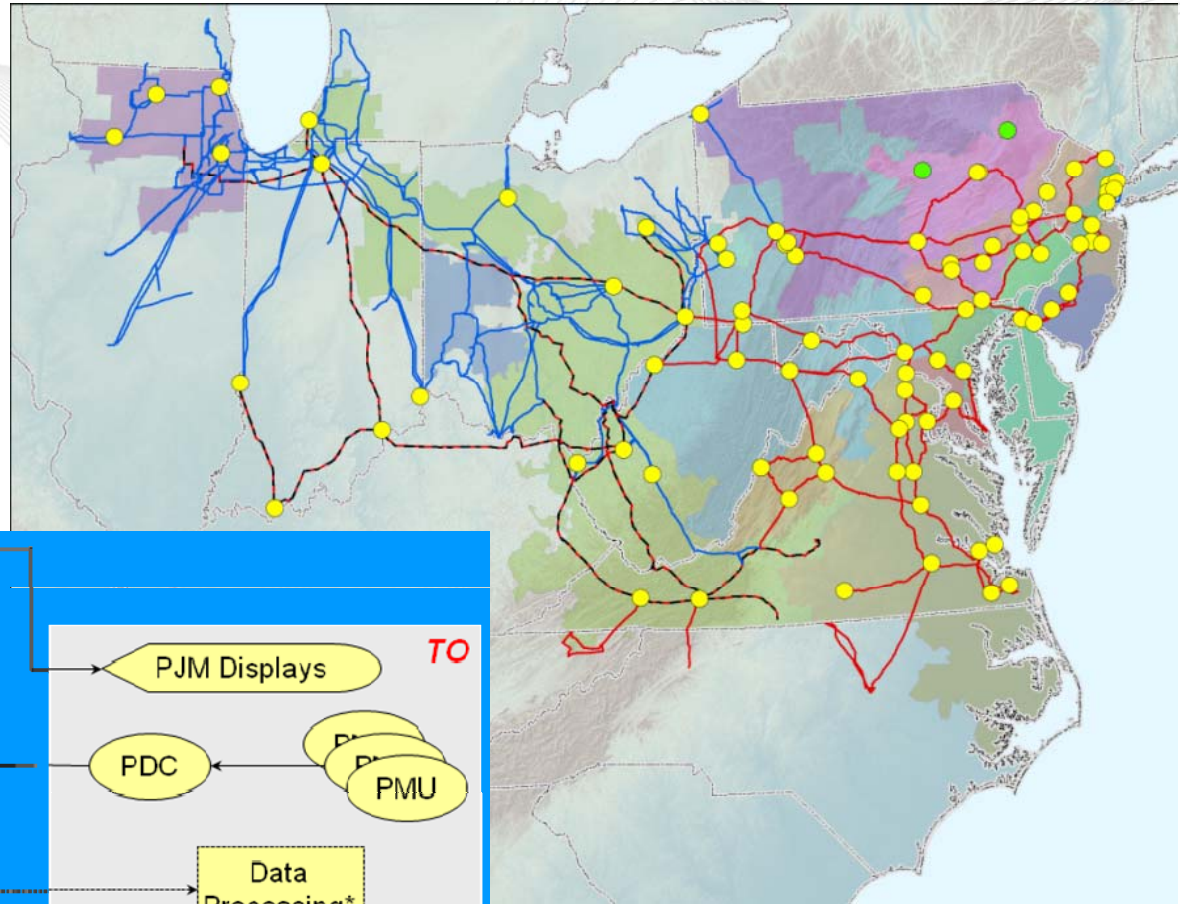


# **PJM SynchroPhasor Technology Deployment Project System/PMU Requirements**

## **(DOE ARRA Project)**

NASPI Work Group Meeting  
February 24-25, 2010  
Austin, TX

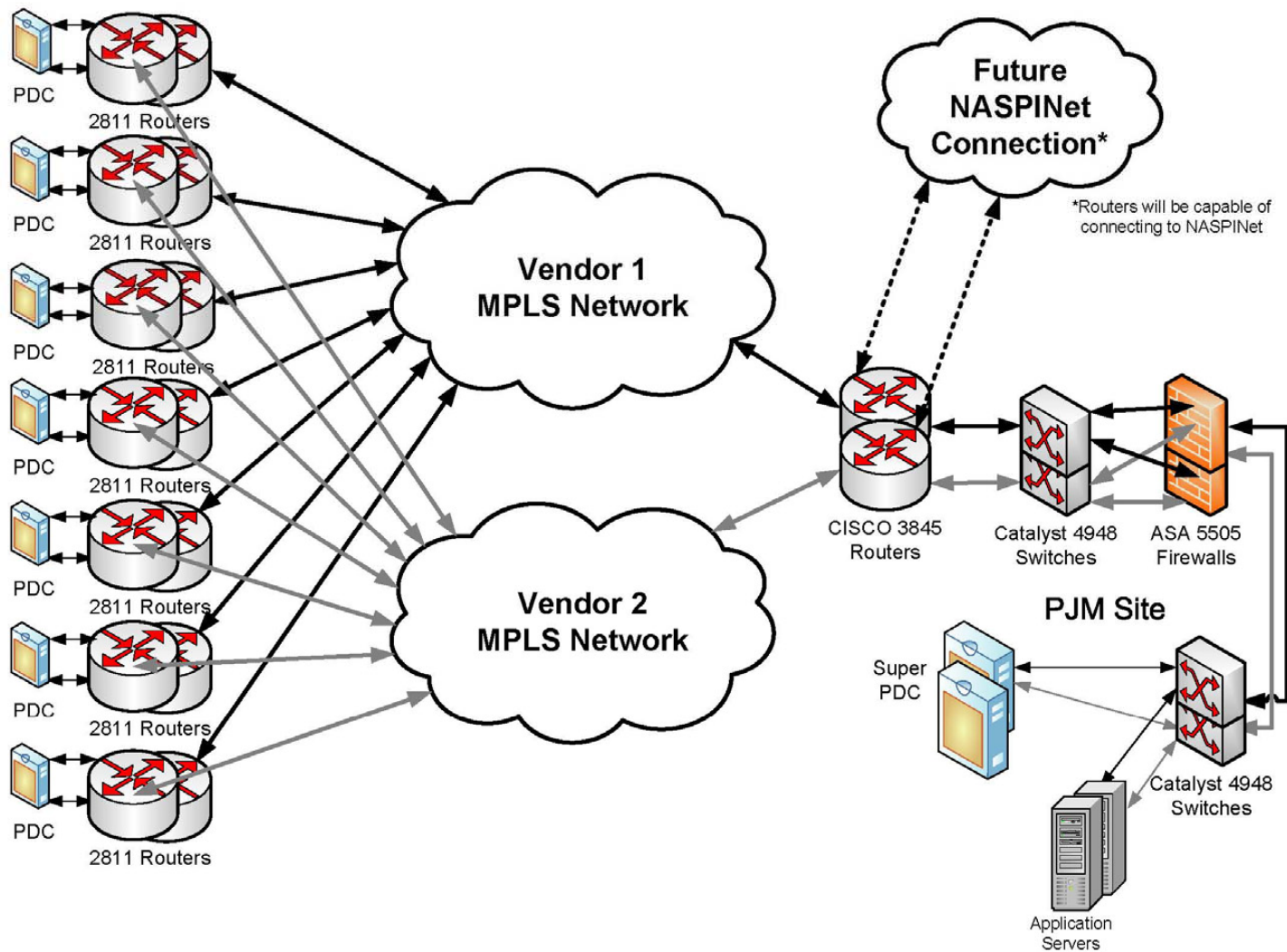
Mahendra Patel  
Applied Solutions, PJM



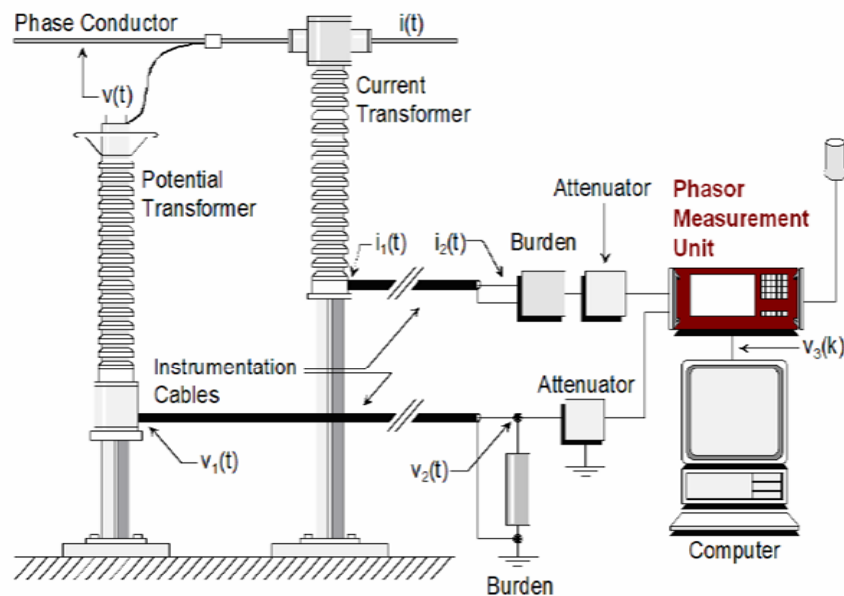
\* TOs can optionally receive phasor data from PJM

- 'Production Grade' / reliable real-time wide area monitoring system to support on-line applications
- Robust archival system

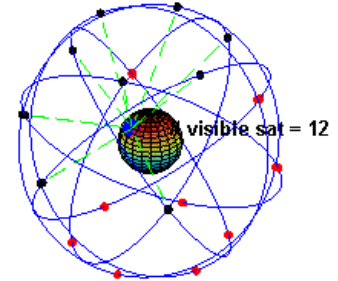
TO Sites



- Positive Sequence Current Phasors for all High Voltage Side lines/transformers & Voltage Phasors for all bus sections (based on three phase values)**
- Uniform 30 Phasors per Second reporting rate throughout the system**
- Practical archival system with data not aligned by PDC in real-time retrieved from local storage & archived with additional arrival time-tags**
- PMU/PDC and System performance & inter operability to be verified by tests**
- Systems to maintain and provide logs, performance and other diagnostic information**



- ❑ SynchroPhasor measurements in compliance with IEEE Std. C37.118 Level 1
- ❑ Reporting in compliance with C37.118
- ❑ Additional Dynamic Performance of measurements to comply with specified responses under step response, frequency ramps and modulation tests



- All data recorded shall be in the **Coordinate Universal Time (UTC)**
  
- The PMU shall be able to automatically switch to **local clock** in case of loss of **GPS** signal, and resynchronize automatically when **GPS** signal is available
  
- Data stream shall indicate whether it is using **GPS** clock or **local clock**
  
- Accuracy of time synchronization & resolution shall be equal or under 1 micro second

- ❑ Substation PDC!
- ❑ Local Storage  
– 2 weeks!
- ❑ Data retrieval system



- ❑ **Total Latency : 100 mS**
- ❑ **50 mS from time tag to Phasors streaming out of TO router**
- ❑ **30 mS for Measurement device, rest for TO communication/PDC(s)**
- ❑ **50 mS for MPLS network & PJM - PDC**



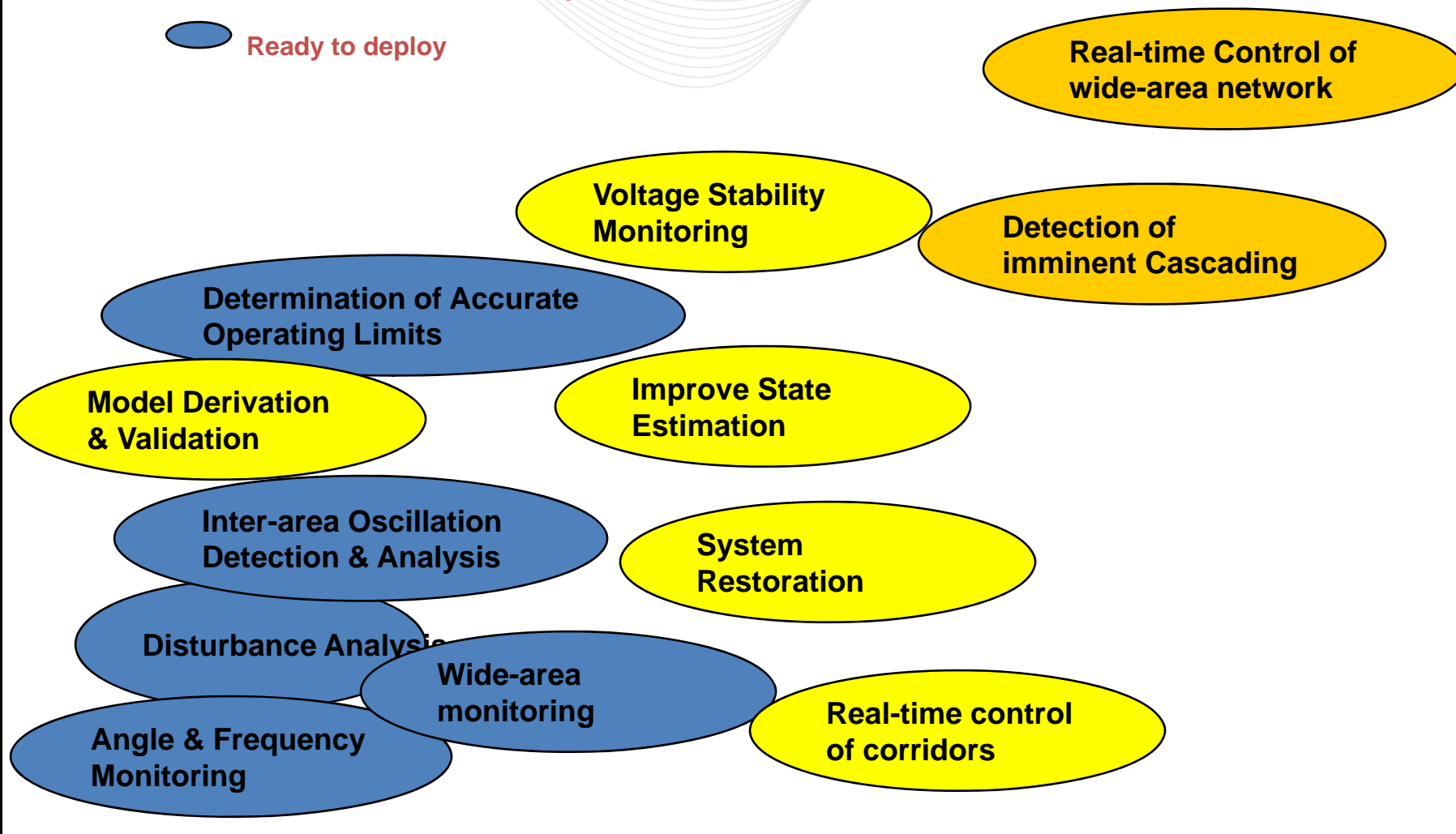


## Additional Requirements

- Registry – will also include Time Synchronization Information**
  
- Plan to develop recommendations for Upgrade/Maintenance/Calibration system**
  
- In Future:**
  - Where possible, State Estimation using (only) SynchroPhasor data**
    - **For bad data rejection**
    - **Fill in missing data (with proper identifiers)**
  
  - Explore ways of incorporating other IED and Other Controls and events data**
  
- What's Missing:**
  - Synchrophasor Measurements at Generator Terminals**

- Requires more research
- Need moderate development
- Ready to deploy

Deployment Challenge



1-2 years

2-5 years

>5 years

**Situation Awareness:**

**Base-lining studies**

**Effects of Reactive Resources**

**Effects of Simultaneous Transfers**

**Investigate Synchrophasors Signatures during Cascading Outages (Simulations based )**

**Congestion Management (Voltage Stability Limits)**

**Events Analysis/ Model Validation**

□ **PMUs**

- **SynchroPhasor measurements in compliance with IEEE Std. C37.118 Level 1**  
**& Additional Dynamic Performance requirements (not yet in the standards)**
- **Total System Latency not to exceed 100 mS**