



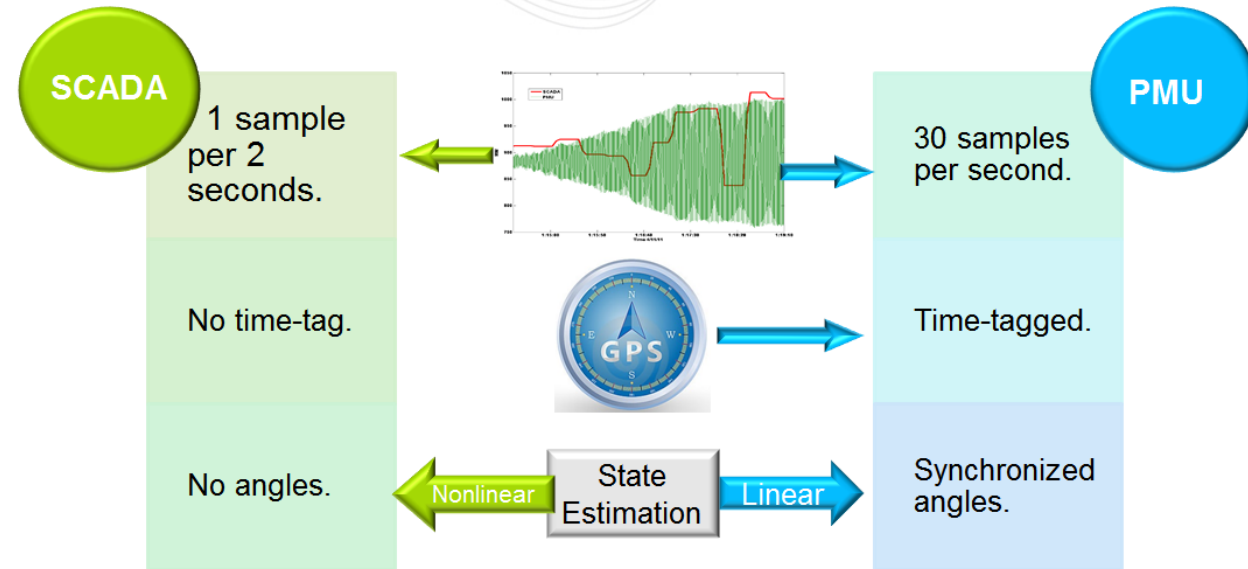
# 2018 PJM Synchronphasor Update

March 2018, OC  
Shaun Murphy

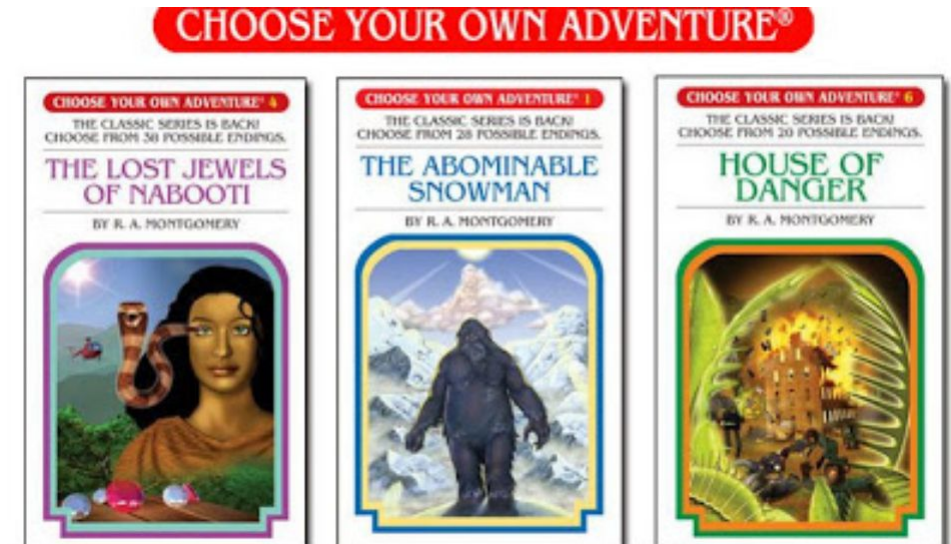
- ✓ Simulator Based Operator Training
  - PMU Resilience
  - DIMA Visualization
  - TO Outreach Meetings
  - Improving PMU Data Quality

## Training Outline

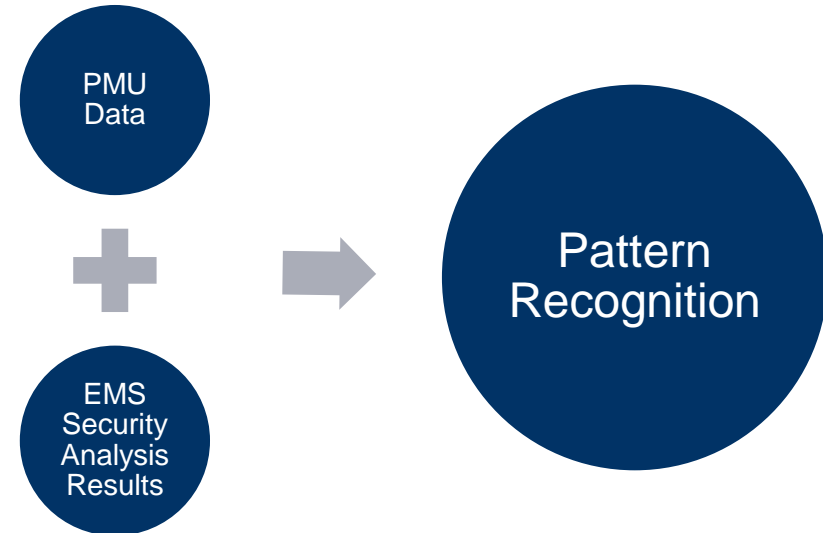
- Recap on Synchrophasors
- Recap on system oscillations
- Oscillation mitigation procedure in M03
- Using synchrophasor data to diagnose system oscillations:
  - Locating nearby PMUs (DIMA)
  - Accessing PMU data (RTDMS)
  - Determine amplitude
  - Determine frequency
- Quiz
- Simulation
  - Surry oscillation
  - Island event



- Adjust north-south transfers
  - A. Increase north-to-south transfers
  - B. Decrease north-to-south transfers
- Adjust Surry voltage schedule
  - C. Raise voltage
  - D. Lower voltage
- Change system topology near Surry
  - E. Return transmission lines to service
  - F. Remove transmission lines from service
- Other
  - G. Increase load (pumps) at Bath County
  - H. Return PSS
  - I. Switch on 150 MVAR reactor at Clover
  - J. Trip Surry units



- PMU Team reviewing operational tasks performed by PJM that can be replicated or enhanced with Synchrophasors.
- Possible areas of exploration:
  - Intelligent islanding
  - IROL monitoring
  - Pseudo ACE
  - Data mining



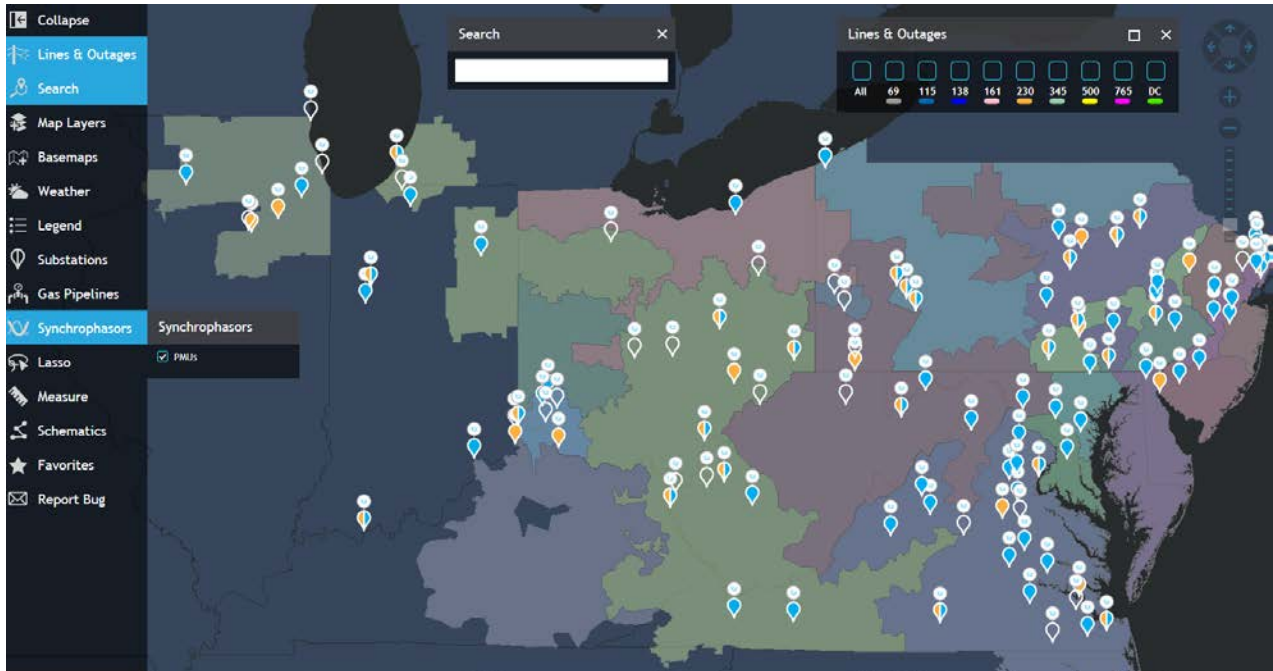
- The team is also reviewing the PMU IT infrastructure to further harden and improve networking and archive redundancy.



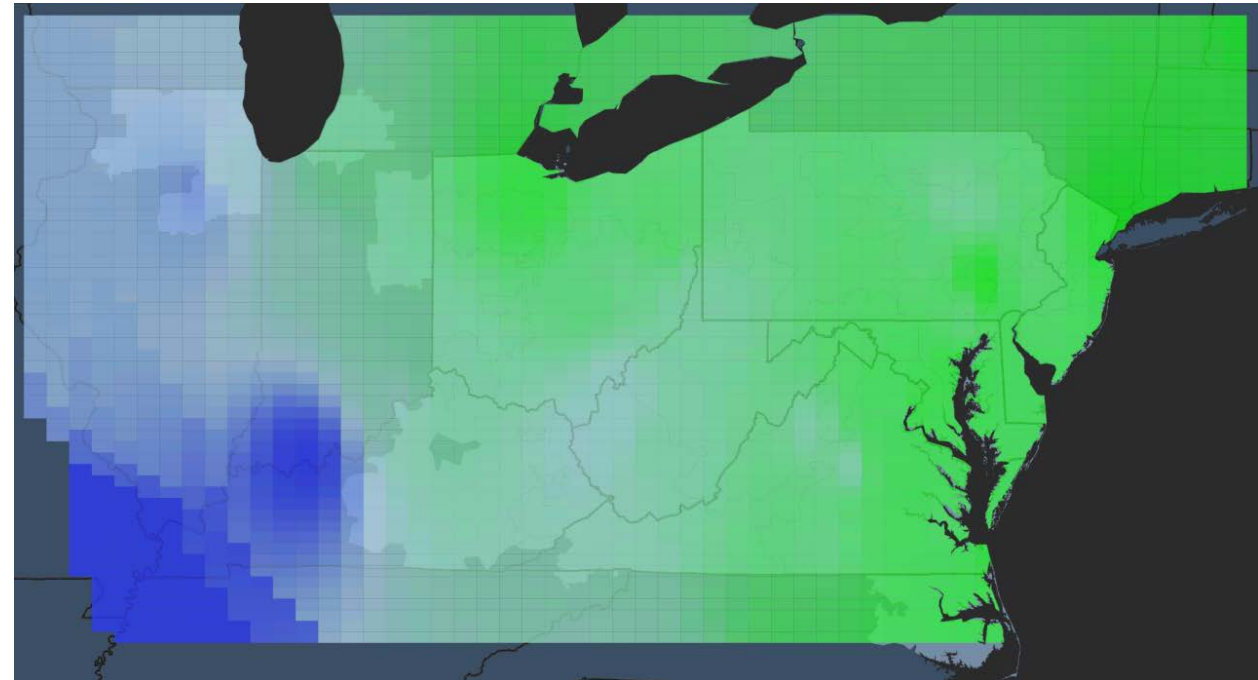
- PMU Location information added to DIMA in 2017

2018 plans include:

- Expanding PMU location information to external areas
- Data heatmaps



PMU Location Markers



Wide-area angle display

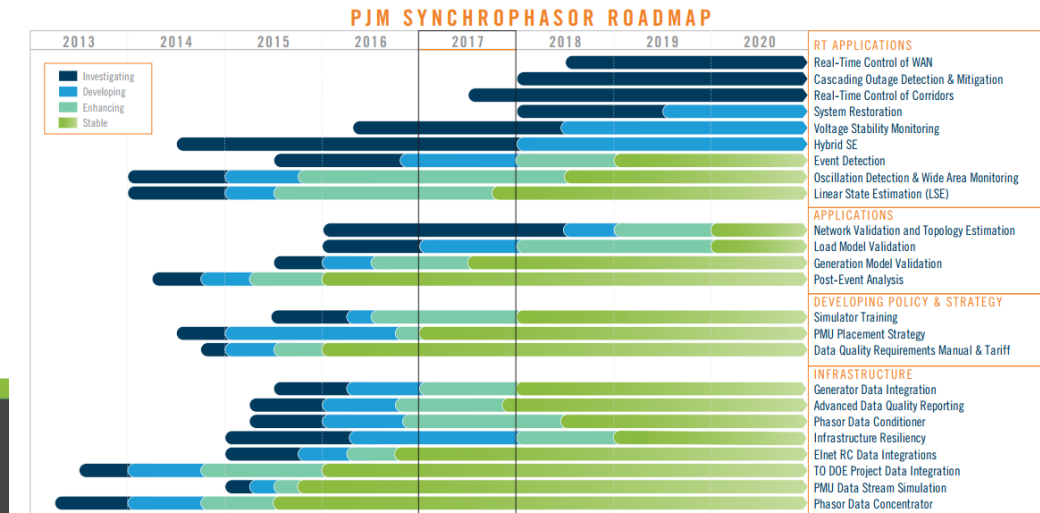
- Face to face meetings to:
  - Discuss PJM’s long term synchrophasor roadmap and vision
  - Learn about PMU developments at the Transmission Owner
  - Review PJM’s PMU Placement Strategy
  - Discuss open data quality issues
  - Update contact information

## PJM Benefits

- Oscillation Detection
- Island Detection
- IROL backup

## TO Benefits

- Generator model validation
- Asset health monitoring



- 2009 – PJM Phasor project begins
- December 2013 – Phasor Data Quality Task Force (PDQTF) established
  - Overall error rate - 14.35%
- February 2016 – Overall error rate down to 2.45%
- March 2016 – PDQTF Sunset into Data Management Subcommittee (DMS)
  
- Items for 2018:
  - Further refining data quality with DataNxt application
  - Improved tracking around PMU outage rates





# 2018 PMU Resilience Plan Update

April 2018, OC  
Shaun Murphy

## *How can Synchrophasor data improve PJM's operational resilience?*

- PMU data can be used to replicate and reinforce existing operational functions
  - IROL
  - ACE
  - Voltage monitoring
  - Thermal monitoring
- In-use applications unique to synchronized measurements
  - Detecting system islands
  - Oscillation monitoring

- Key opportunity identified to redundantly monitor PJM's IROL interfaces with PMU data.
- Previous EMS event caused operator screens to temporarily freeze. IROL monitoring became a manual process.
- **TOP-001-3 R13:** *Each Transmission Operator shall ensure that a Real-time Assessment is performed at least once every 30 minutes.*
- **IRO-008-1 R2:** *Each Reliability Coordinator shall perform a Real-Time Assessment at least once every 30 minutes to determine if its Wide Area is exceeding any IROLs or is expected to exceed any IROLs.*

Interface	Number of Transmission Lines in Interface	Number of Transmission Lines Observable	Number of PMU installations needed	Number of PMU Modifications needed
Eastern	6	3	3	0
Central	3	3	0	0
5004/5005	2	2	0	0
Western	4	4	0	0
Bedington – Black Oak	1	1	0	0
AP South	4	3	0	1
AEP - Dominion	3	3	0	1
Cleveland	7	0	4	1
COMED	6	2	4	0
BC - PEPCO	12	4	3	1
Total			14	4



# PMU Data Quality Update

Shaun Murphy, Synchrophasor Project Manager  
6/5/2018 Operating Committee Meeting

## Current

- Oscillation Detection
- Post-Event Analysis
- Generator Model Validation

## Future

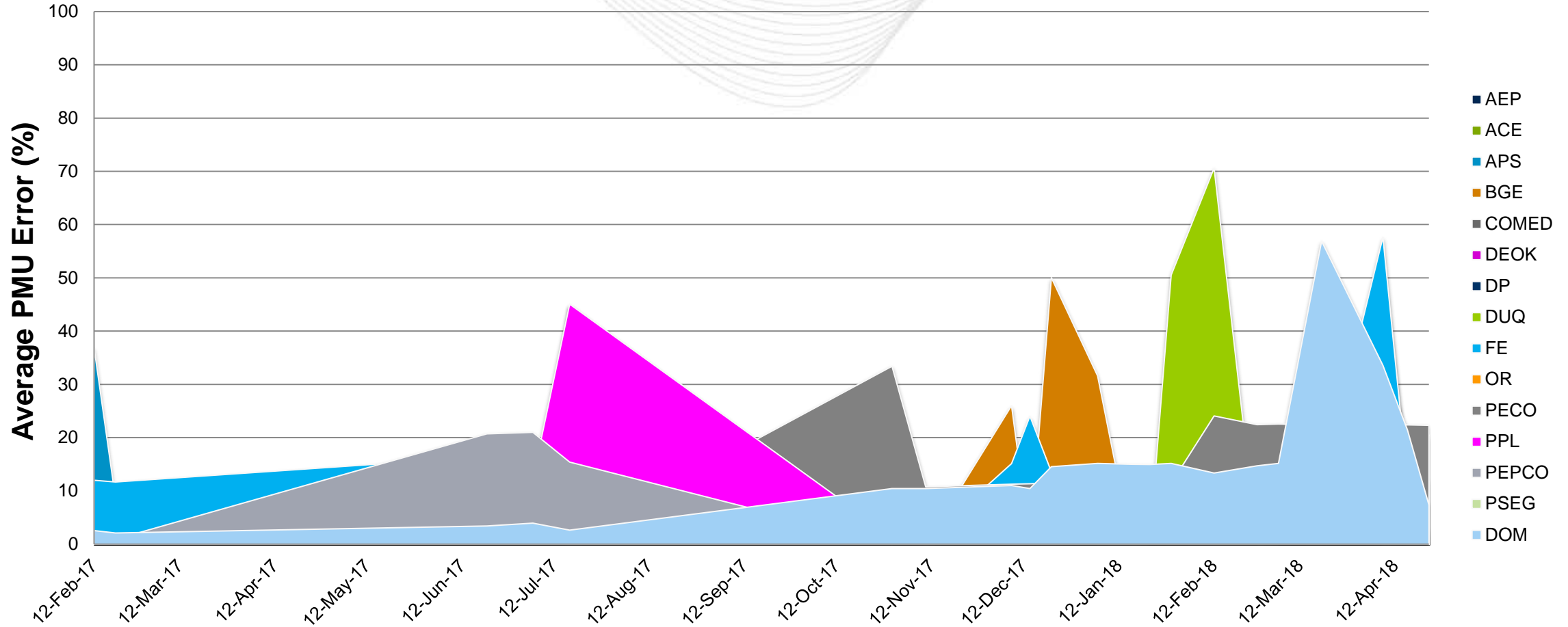
- System Island Detection
- Backup IROL Monitoring
- Backup ACE Monitoring
- Event Detection
- Automated Model Validation



- Phasor Data Quality Task Force (PDQTF)
  - Created in December 2013
  - Sunsetting April 2016
- Data quality tools purchased and built:
  - DataNxt
  - Linear State Estimator

## Types of Data Quality

- Time Error
- Synch Error
- Drop Error
- Planned Outage
- Missing Samples
- *Engineering limits*
  - *Threshold*
  - *Noise*
  - *Topology*



- **Send issue to Data Management Subcommittee (DMS)**
  - DMS to investigate and return to OC with plan for resolution
- **Items to be investigated:**
  - Impact of data quality on PJM's PMU applications
  - Enhanced definition of data quality
  - Improved real-time data quality monitoring
  - Review PMU data quality requirements in Manual 01 and Manual 14D
  - Guidelines on PMU device outages

