Modeling and Assessment of Synchrophasor Data Quality

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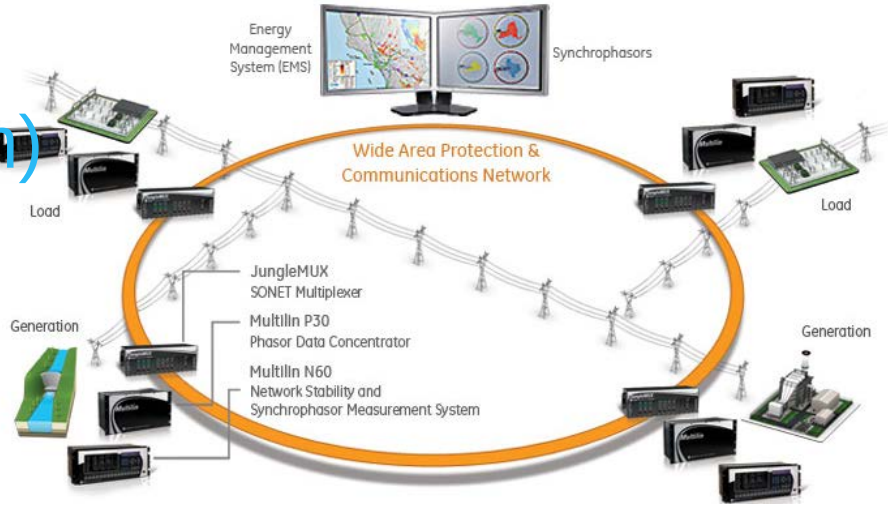

GE Global Research
Niskayuna, NY

NASPI Work Group Meeting
San Mateo, California
March 23, 2015

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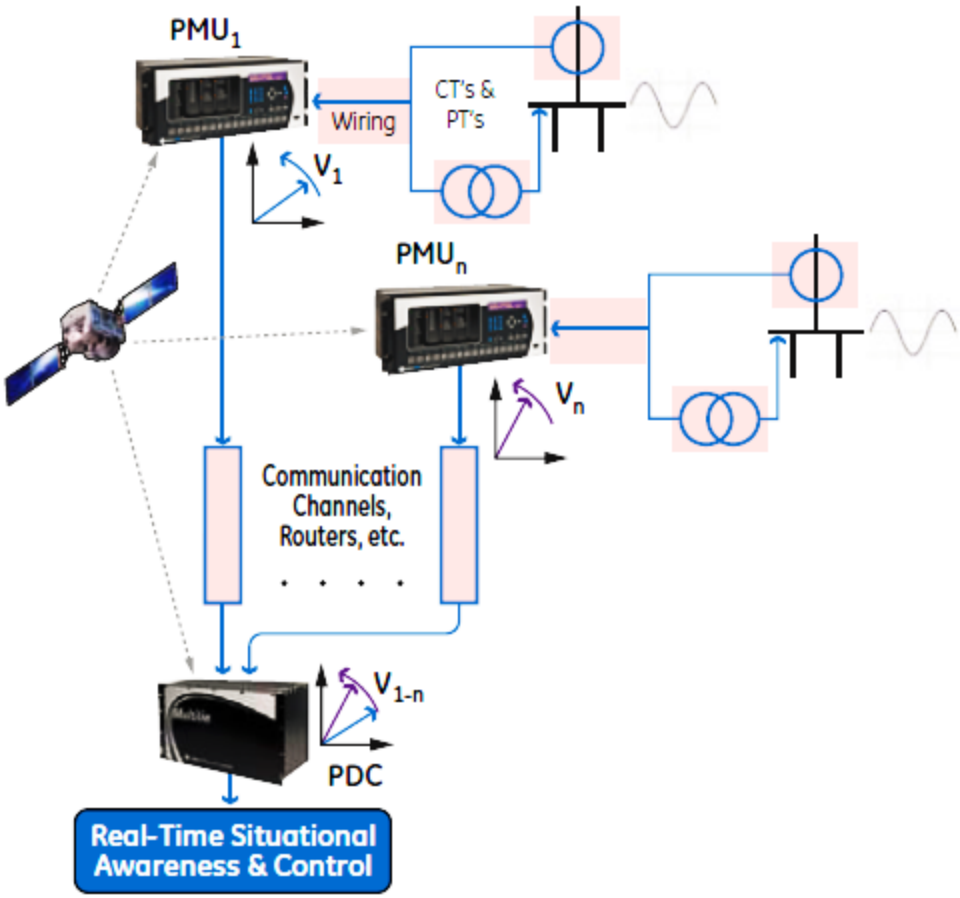
The authors gratefully acknowledge support provided for this work under the Technology Innovation Program (TIP-306) administered through the Bonneville Power Administration. Contract No.

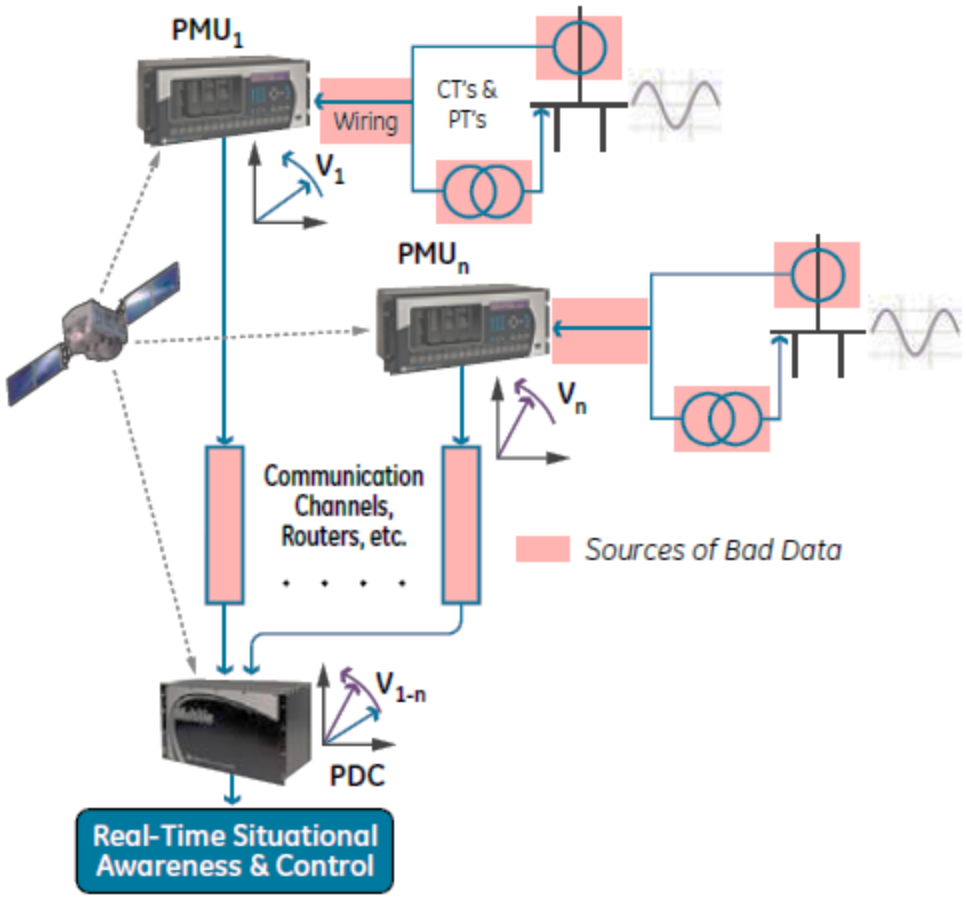
Typical WAMS Architecture

- Phasor Measurement Units (PMUs) convert analog currents and voltages into time-synchronized phasors
- Reporting rates as high as 60 samples a second
- Substation PDCs collect phasors and transmitted upstream after time alignment
- One or two more layers of SuperPDCs pool the phasor data at a central location



Synchrophasor Data Quality

- Large number of signals transmitted at high reporting rates
- Large volume of data collected (Several Gigabytes of data a day)
- Data Quality is important for enabling real-time controls
- Data Quality Concerns:
  - Missing Data
  - Outliers
  - Atypical Data



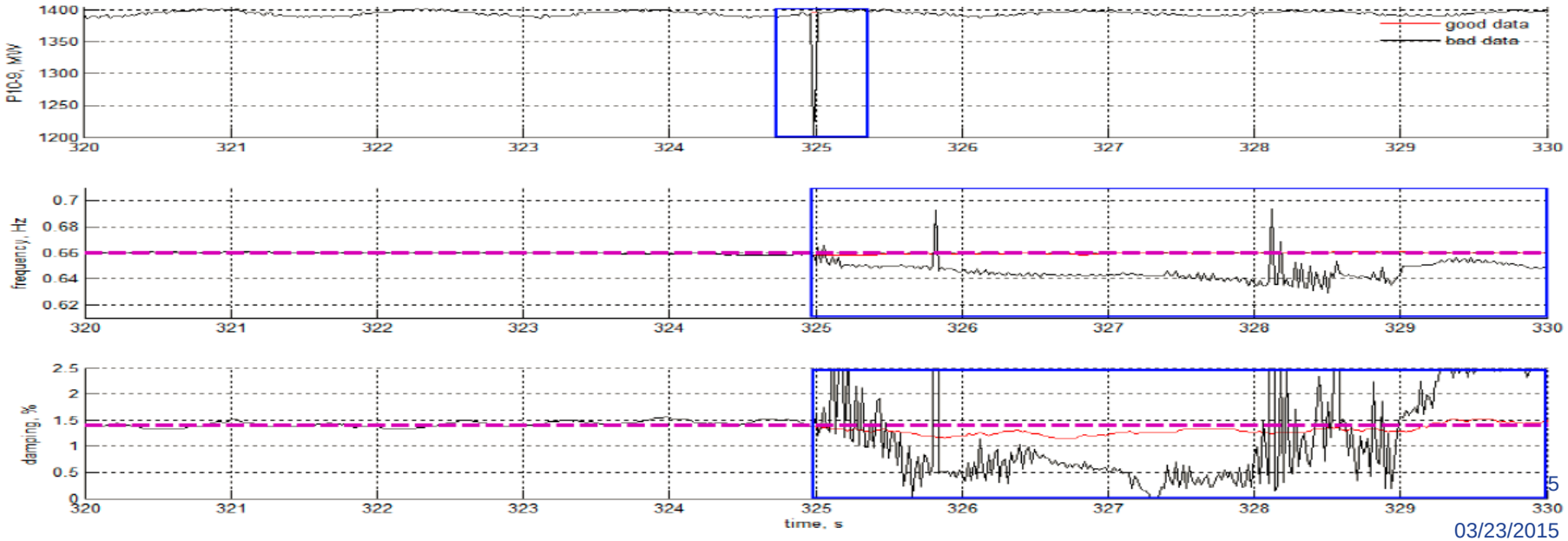
Framework for Assessment of Data Quality

Need for a holistic measure of synchrophasor data quality

- Completeness – adequately describe system state
- Correctness – accurate representation of the state
- Concordance – data being transmitted across the various layer is the same
- Plausibility – trustworthiness of the data in the light of other measurements
- Currency – relevance of the measurement data

Impact of Data Quality on Oscillation Monitoring Algorithm

- Impact of bad data depends on the application
- Matrix Pencil – block processing algorithm
- Synthetic Data – two-machine test system

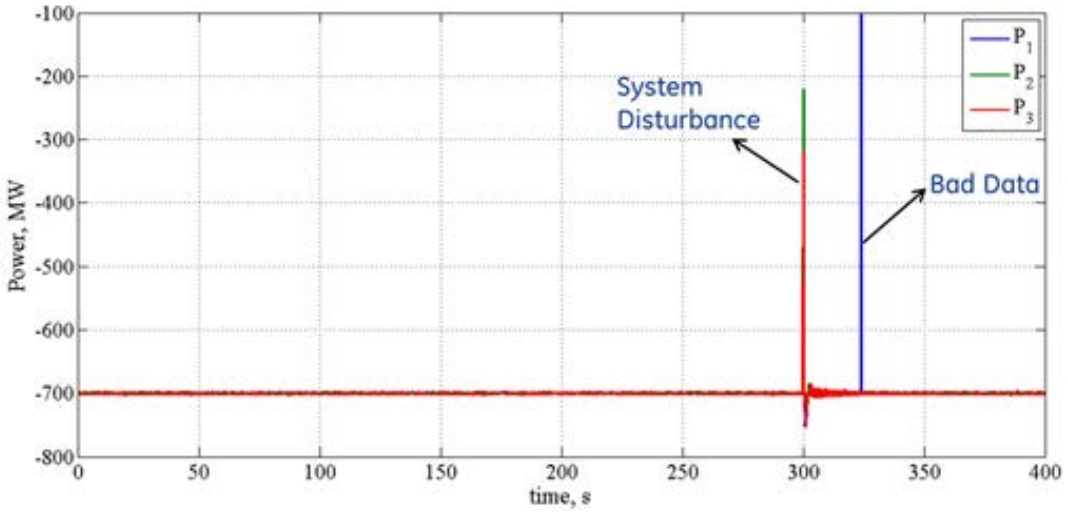


Assessment of Impact of Bad Data

- Parameters Identified: No. of missing samples in one processing window (Tw), magnitude of outlier, proximity to atypical data like transient events
- Impact more pronounced on damping ratio estimation
- Adverse impact during low damping conditions

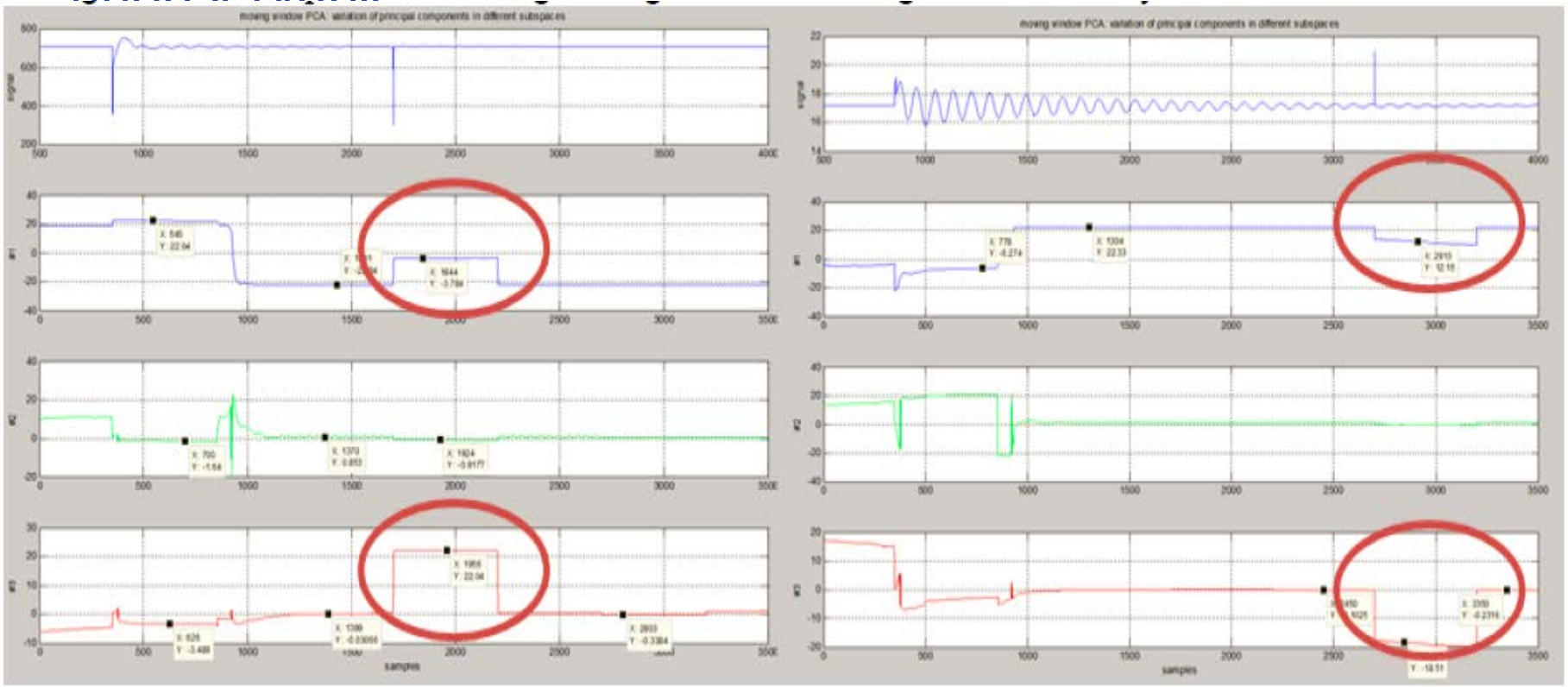
Detection of Bad Data using Data Mining Techniques

- SVD is a feature extraction technique that compresses data matrix by removing information with small gains
- By using SVD on a data stream and correlating the results from other data streams, presence of bad data can be discerned.



Principal Component Analysis (PCA) –based Tool

- PCA is a another coordinate transformation that decomposes one or a set of data streams into orthogonal components. These components can be compared across multiple signals to identify data features that are otherwise unobservable



Conclusion

- Need for a framework for assessing data quality to enable greater adoption of WAMS-based controls
- Need for assessment of impact on application-specific basis
- Need for data mining-based bad data detection to complement model-based approaches

Thank You!

Questions?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