

FUNDAMENTAL QUESTIONS/CHALLENGES

Background:

- Synchrophasor measurement devices (e.g., Phasor Measurement Units) have many applications in the power grid and have been deployed around the United States.
- PMU data are collected by the Phasor Data Concentrator (PDC) device.

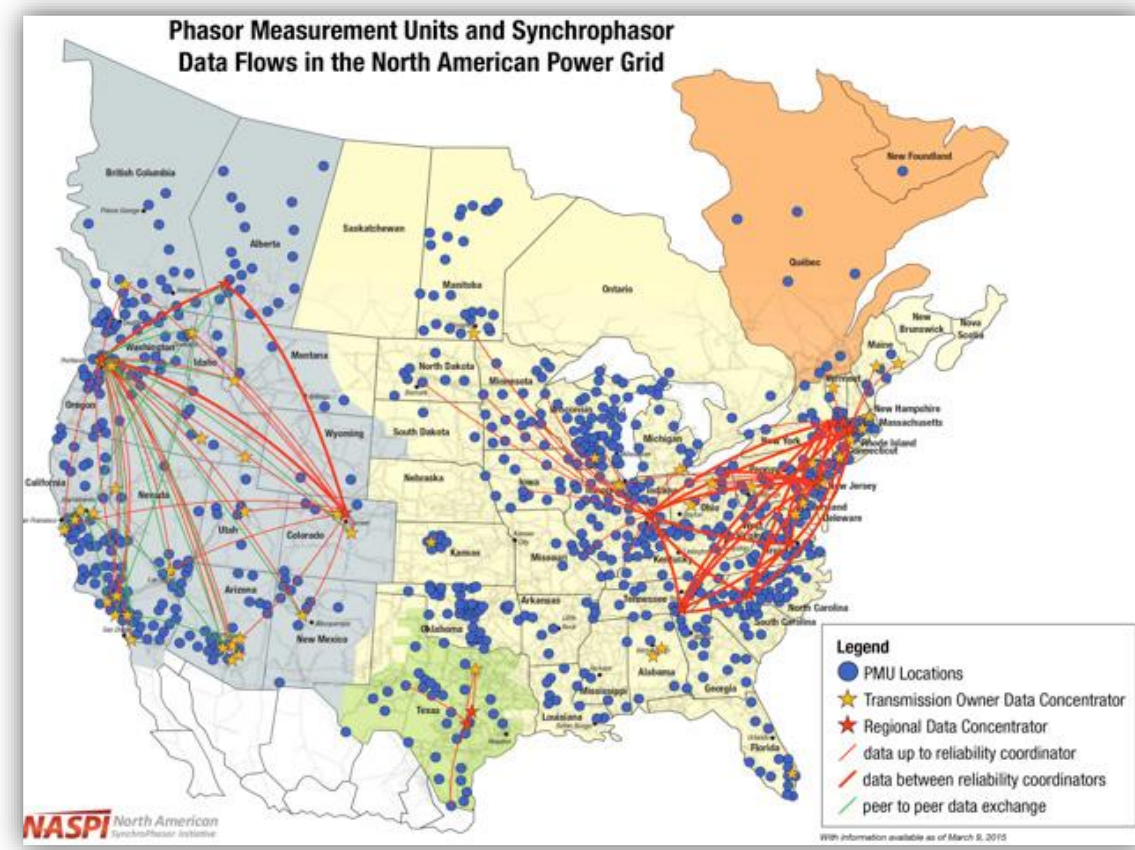


Fig. 1. PMU Deployment in North America

Challenges:

- The PMU data we use for analysis are from PDC and always in csv or COMTRADE format. Those formats are good for saving storage space, but lack much information that could be used in data quality analysis.
- PDC cannot receive the data stream from a PMU simulator (e.g., PowerWorld®). The software openPDC can receive the data, but it cannot record the raw data stream and generate a COMTRADE file for analysis.

OBJECTIVES

- To **read** and **record** the data stream from a synchrophasor measurement device (e.g., Phasor Measurement Unit) or other commercial power system software that can simulate the power grid operation and generate the phasor measurement data.
- To **generate** the standard phase data file from the raw synchrophasor data received.

RESEARCH PLAN

- Establish how PMU communicates with PDC.
- Connect to PMU via TCP/IP using Matlab.
- Read PMU data stream, and decode the data according to IEEE Std C37.118.2 - 2011.
- Record the decoded data stream, and convert the data to satisfy the IEEE Std C37.111 - 2013 (COMTRADE).
- Generate the COMTRADE file for research analysis.

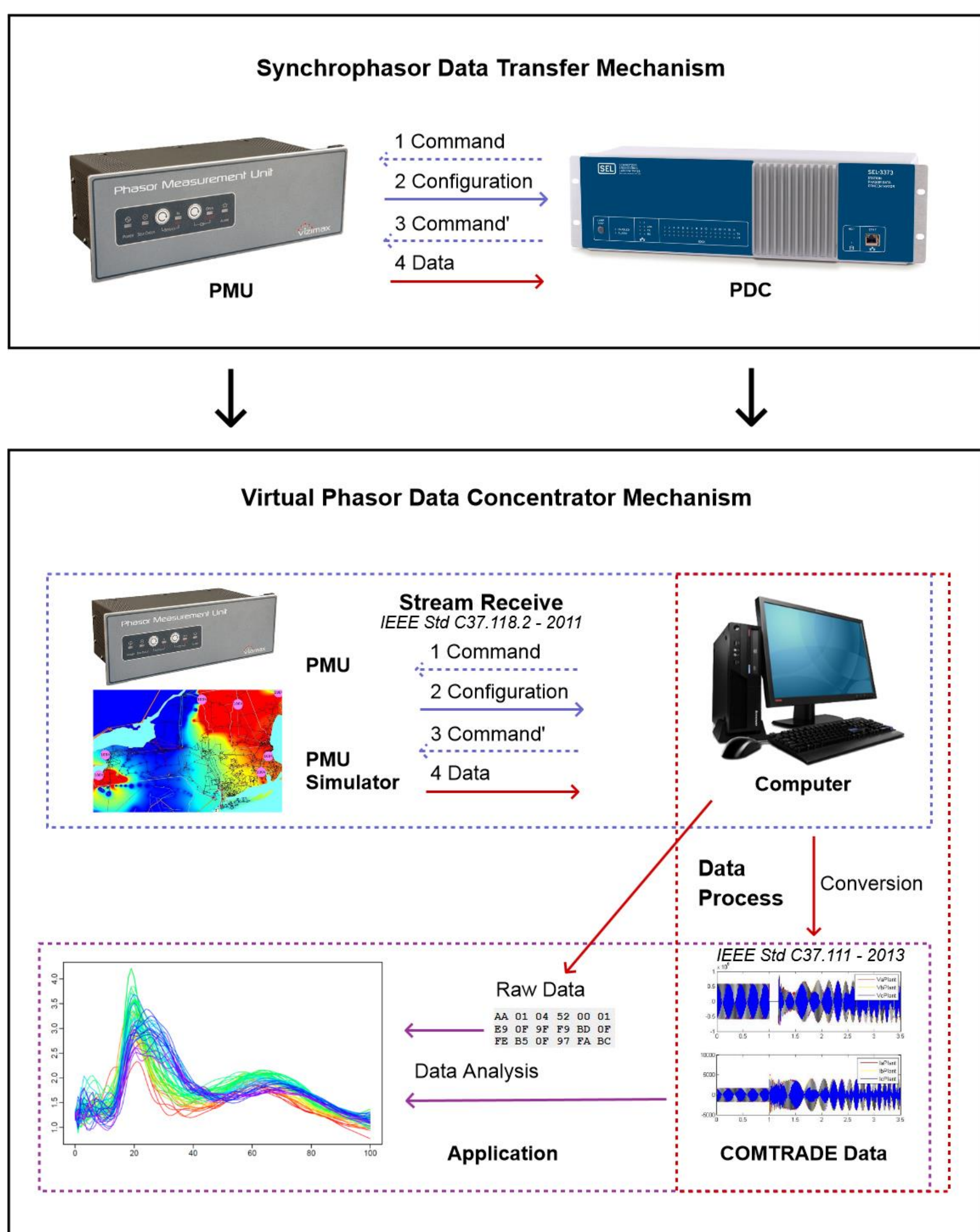


Fig. 2. Research Steps: Connect, Read, Record, Convert, Generate

RESEARCH RESULTS

- The client is currently able to:
 - Connect to PMU and other PMU simulator software via TCP/IP;
 - Read the PMU data stream and verify that the set of data has not been corrupted;
 - Extract the information according to IEEE Std C37.118.2 - 2011, and record the raw data in .mat or .csv format; and
 - Record the phase data and generate the COMTRADE format file for further analysis according to IEEE Std C37.111 - 2013.

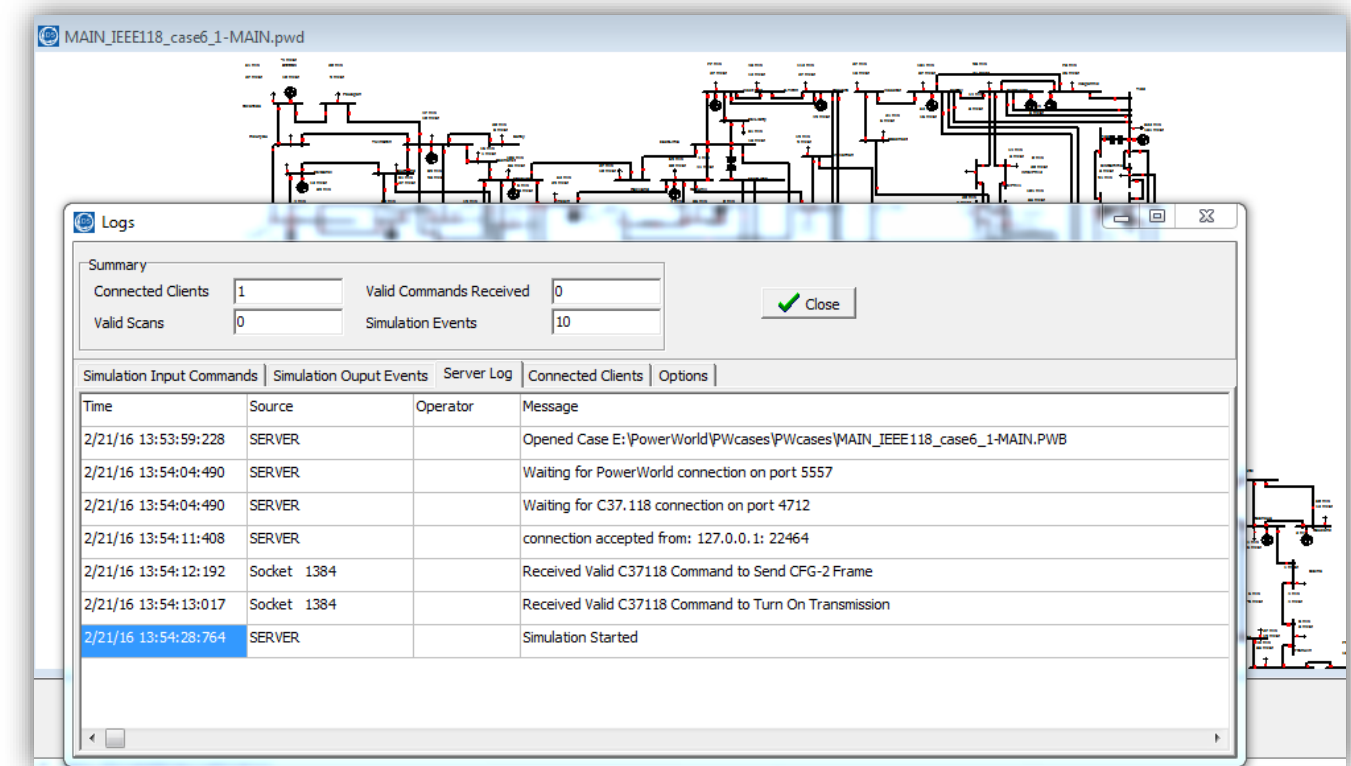


Fig. 3. Connection to PowerWorld® Dynamic Studio

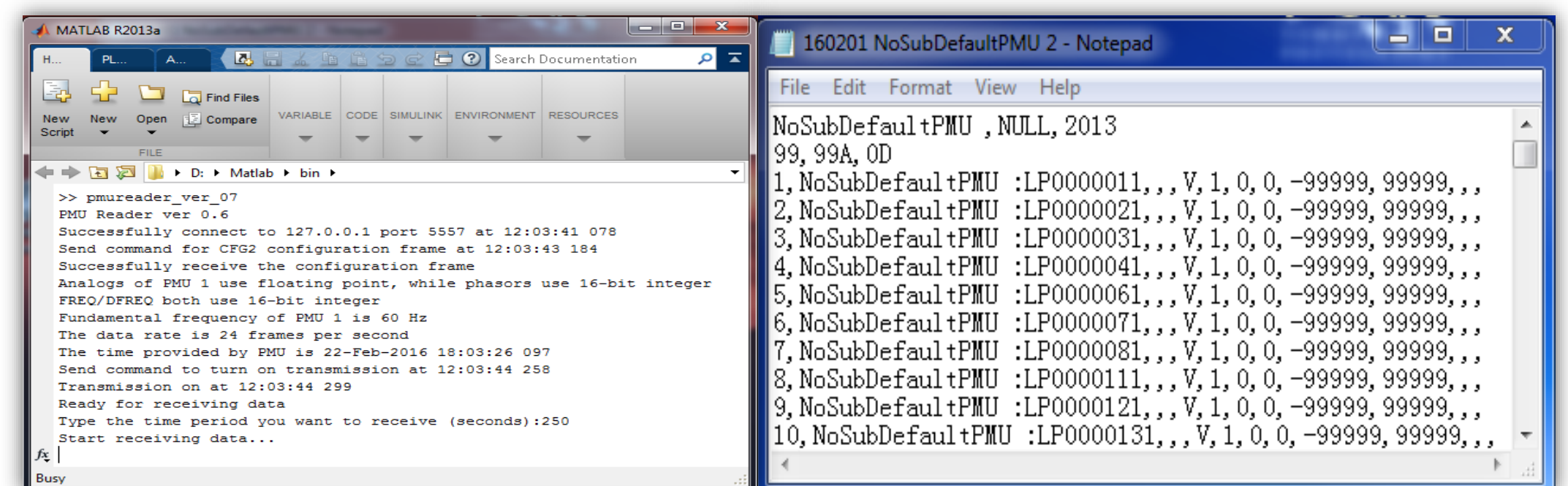


Fig. 4. Client Operation Interface

Fig. 5. COMTRADE File (.cfg)

BROADER IMPACT/INTERACTION

- The client is designed to acquire PMU data and generate the COMTRADE file for analysis. Also, the client stores and decodes the raw data stream, so all information received from the PMU is preserved and can be used for analysis, e.g., data quality analysis.
- The client can be used in many related projects:
 - **PMU Data Quality**
 - Dropouts/packet loss.
 - Latency.
 - Repeated values.
 - Bad/missing timestamps.
 - Planned/unplanned outage.
 - Poor server performance.
 - Improper device configurations.
 - **Power System Analysis**
 - State estimation.
 - Model validation.
 - GIC detection.
 - **Power System Visualization**
 - Angle/frequency monitoring.
 - Voltage stability monitoring.

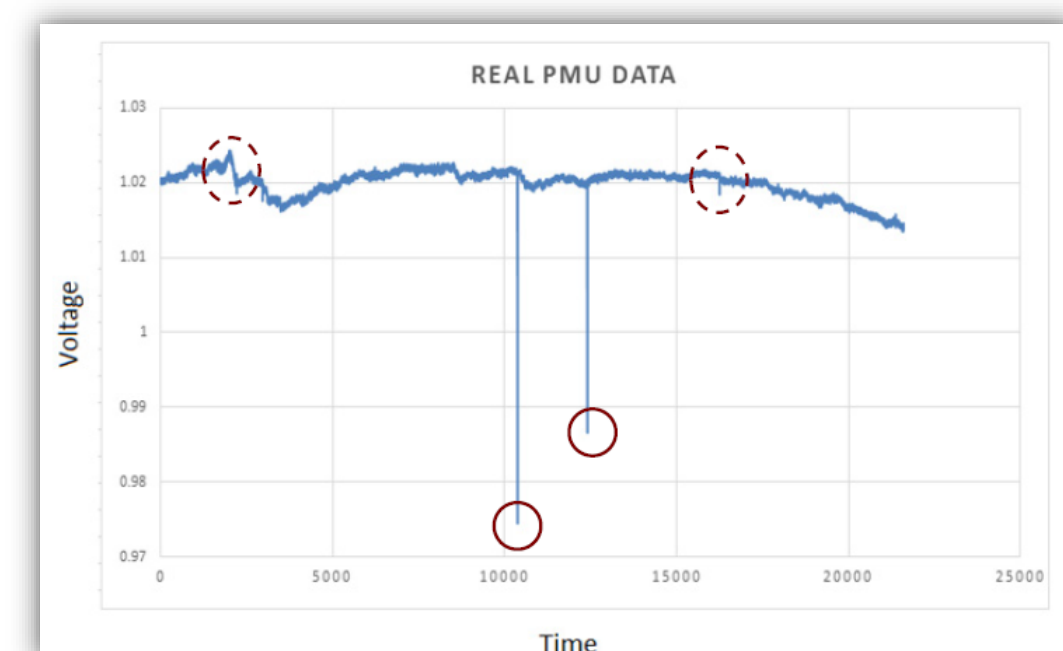


Fig. 6. Bad Data

FUTURE EFFORTS

- Develop a new graphical interface.
- Support older versions of IEEE Std 37.118.2 and Std 37.111.
- Provide data for power system visualization.

CONTACT INFO

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