



the power of

Plans for the integration of new synchrophasor based information to Dominion control room environment—an operators perspective

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Presentation Outline

- Dominion PMU Project Description
- PMU applications Visualization Challenges
 - New information to be available to the operators
 - Increased granularity of the information
- Sample of Dominion's PMU application Visualization tool
 - Monitoring of voltage imbalances in 500 kV buses
 - Monitoring the negative sequence currents in generators
- Current plans and future work
 - Training needs and adoption of the technology.
 - How the visualizations tools can capitalize the value of PMU technology?

Synchrophasor Project Summary.

- Project Participants and roles of the team
 - Dominion: PMU installation and electric power system
 - Virginia Tech: PMU Applications routines
 - Quanta Technology: PMU Application Results Visualization
- Main Applications
 - Three phase, PMU only, State estimator
 - Instrument Transformer Calibration
 - Unbalanced current flows
- Today, the focus is on visualizations of PMU application results

New information to be presented to the operator

- What is the current information that operators normally have access to in the current EMS/SCADA environment?
 - Trending of MW in key transmission lines
 - Voltage magnitude, frequency...
 - Alarms for equipment, high voltage, among others.

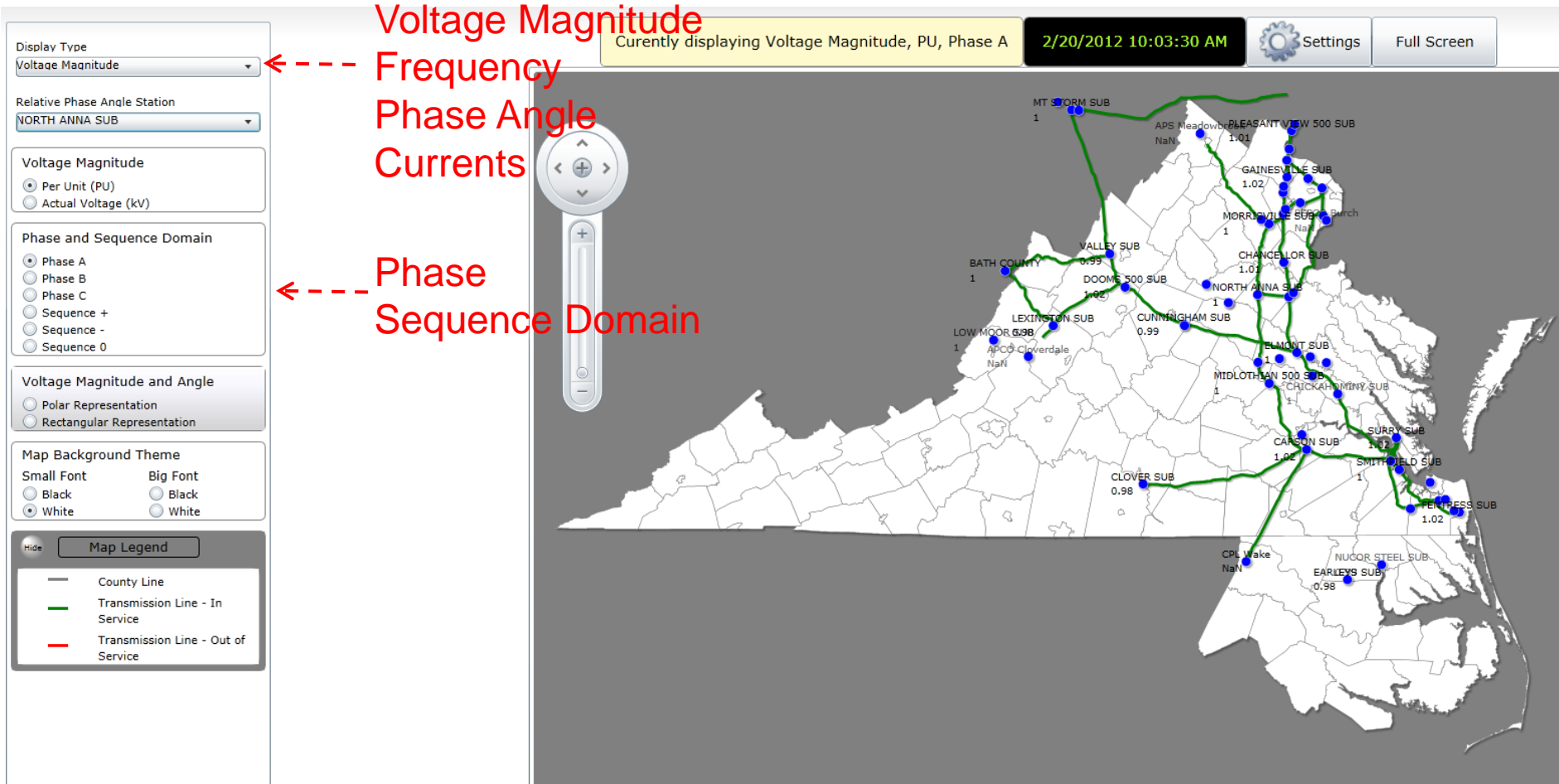
- What is the new information that the operators will be able to see with the PMU system
 - Phase angles
 - Three phase Voltages: Phase A, Phase B, Phase C
 - Negative sequence currents

Increased granularity of information to be accessible to the operator

- What is the current level of granularity of the information that operators normally have access to in the current EMS/SCADA environment?
 - State Estimator solving every 2.5 minutes
 - Faster after the occurrence of an event such as a breaker operation.
- What is the new level of granularity of the information that the operators will have access with the PMU system?
 - Three phase state estimator solving 30 times per second
 - New information in screens updating once a second
- The new level of data granularity is huge. Visualization techniques become critical for effective integration and assimilation of information.

Sample of Dominion's PMU application Visualization tool

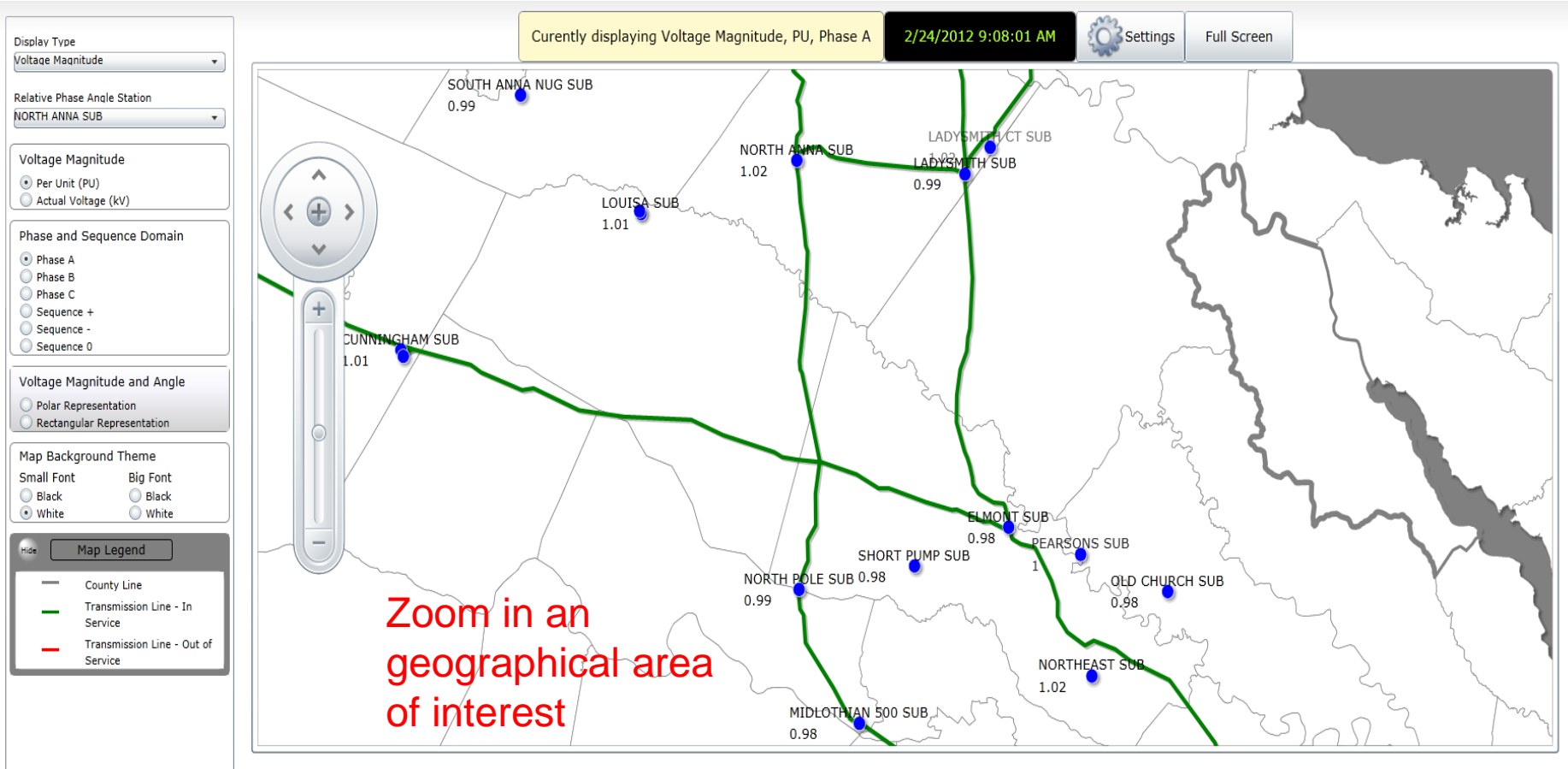
- How a visualization tool can help the operator better understand a concern?



Monitoring of voltage imbalances in 500 kV buses

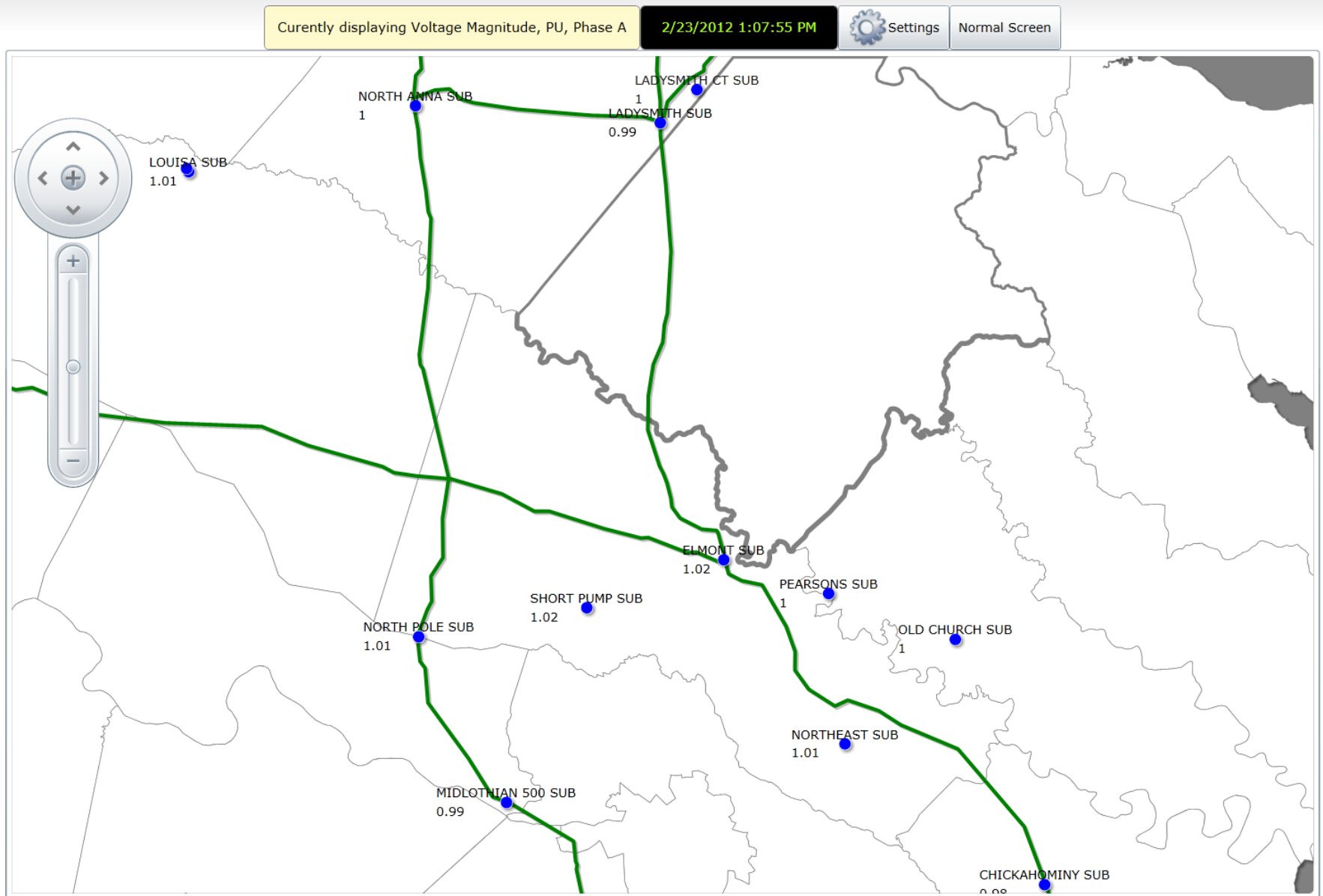
- New variables to monitor
 - Phase A, Phase B, Phase C bus voltages
- Why
 - Excessive voltage imbalance (up to 10% over-voltages) can result in insulation stress and eventually equipment failures
- Increased granularity of information
 - Monitor the phase imbalance in 500 kV buses more frequently: once a second
- Opportunities and Challenges
 - It can shed new light on voltage imbalances situation
 - Operators have not seen this information before. It can result in three times more information to the operators and more burden
 - Actionable information?

Monitoring of voltage imbalances in 500 kV buses



- Select display type "Voltage Magnitude"
- Change in real time phase A, phase B, phase C to better understand the situation
- This could also be done off-line

Full Screen in accessible in all parts of the map



Monitoring of negative sequence currents in generators

- New variable to monitor
 - Negative sequence currents in generators
- Why
 - Excessive negative sequence currents can damage the generators. Protection schemes are typically used.
- New granularity of information
 - Monitor the negative sequence current against the relay setting to monitor potential problems
 - Intention is to provide this information to operators as a “heads up” of a potential generation unit that may become offline.
- Visualization tool for is in progress.

Next Steps

- Current plans and future work
 - Visualization tools are still work in progress for the PMU applications
 - Dominion training plans for synchrophasor technology adoption are to be developed
- Visualizations tools is a great vehicle to demonstrate the value of PMU applications
 - It can shed new light on voltage/current imbalances situations
 - There is a significant amount of new information
 - The new information is of increased granularity
- Dominion, Virginia Tech, and Quanta will have a Demonstration on July 31, 2012.