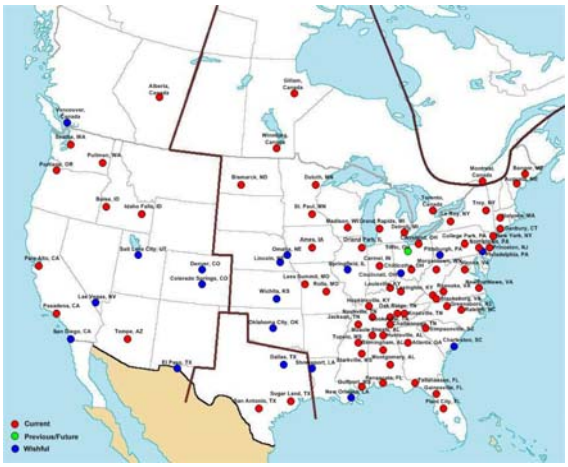
GridEye

DOE has invested in the GridEye project to build a wide-area grid monitoring network that covers the three North American power grids. The objective of the current work is to provide additional monitoring points at planned renewable generation sites—such as wind farms—to characterize the system's dynamic behavior before and after the installation of the renewable sources. This will produce dynamic system behavior data that will provide insight into how renewable generation assets change the dynamic behavior of the electric grid. These data can also be used to estimate dynamic modeling parameters for planning and operation.

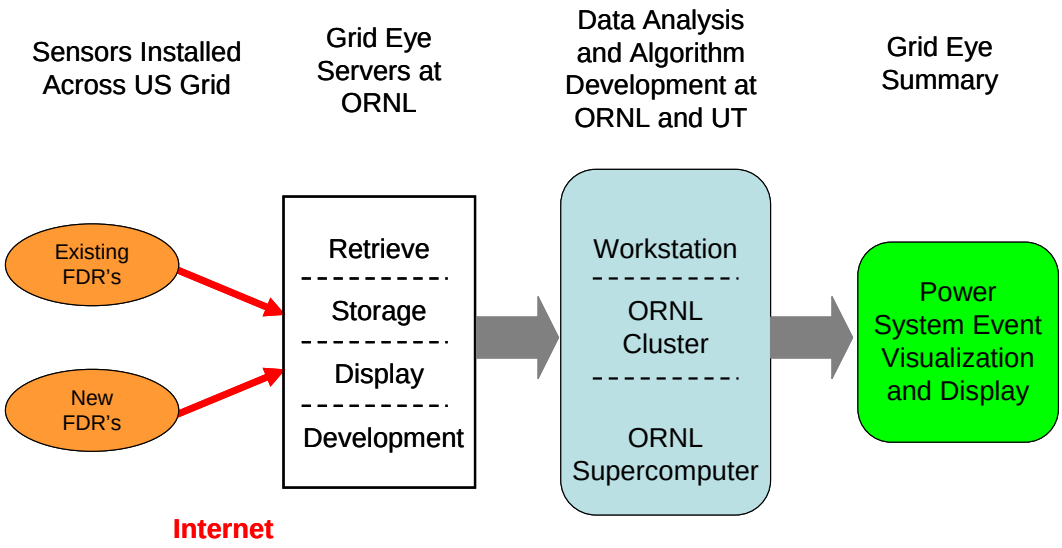


The GridEye system at ORNL is a unique wide-area grid monitoring network that provides independent observation of the entire electrical grid's dynamic performance continuously and in real time. GridEye uses monitoring devices that are essentially GPS time synchronized single-phase phasor measurement units (or PMUs) to capture the dynamic responses (frequency, voltage and phase angle) of the grids to major disturbances such as generator trips and load shedding, as well as provide insight into inter-area oscillations. Since the monitors (which are referred to as frequency disturbance recorders, or FDRs) are connected at 110V, they do not require extensive installation as is the case for PMUs at high voltage substation. FDR monitors are low cost, easy to install, and are currently installed in offices, school buildings, and residential households.

ORNL's most recent deployment of GridEye sensors focuses on portions of the grid where high penetration of renewables are planned. The sensors will monitor these critical smart grid investment grant (SGIG) awardee service areas and collect dynamic data on their system before and after the SGIG equipment goes in.

Approach

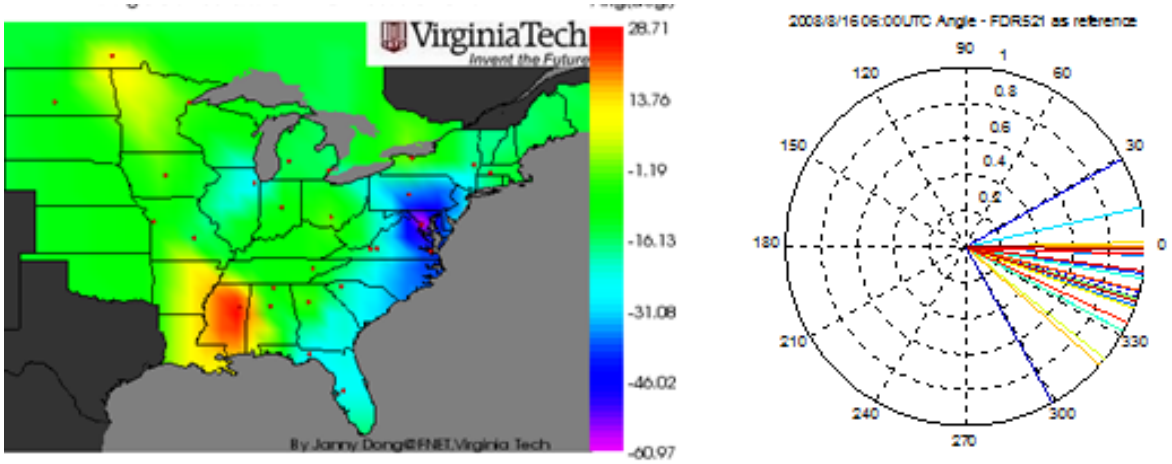
- Select measurements sites. Establish contacts with hosts and define requirements. The sites will be in locations where new renewable energy projects are planned.
- Prepare monitors and acquire communication parameters (IP, gateway, etc) by working with site hosts.
- Deploy monitors.
- Collect, store, and analyze high-resolution data.
- Visualize power grid events and insightful trends.



GridEye Architecture

Real-time dynamic power angle measurement can be used to assess the stress the electric grid is under and gives an indication of the stability of the system. Frequency Disturbance Recorders measure voltage and calculate phasors 1,440 times per second with GPS time synchronization within a micro-second. These phase angle measurements taken by FDRs in different locations provide a precise view of an entire region or interconnection. Greater phase angle differences imply larger static stress across that interface; larger stress could move the grid closer to instability.

Application Example: Real-Time Visualization of Angle Distributions



Conventional monitoring technologies such as supervisory control and data acquisition (SCADA) measure every two to four seconds without precise time synchronization. This is useful in steady-state operations but not granular enough for understanding the dynamic behavior of the system. The fast sampling rate provides insight into the dynamic behavior of the system under various conditions such as generator trips and line trips.

Frequency data recorder technology can also be used to estimate or validate dynamic modeling parameters for wind turbine or combined cycle gas generating units and to monitor and control responsive loads at the aggregation point. GridEye technology provides a readily-available real-time data source to monitor inter-area oscillations in the electric grids.

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