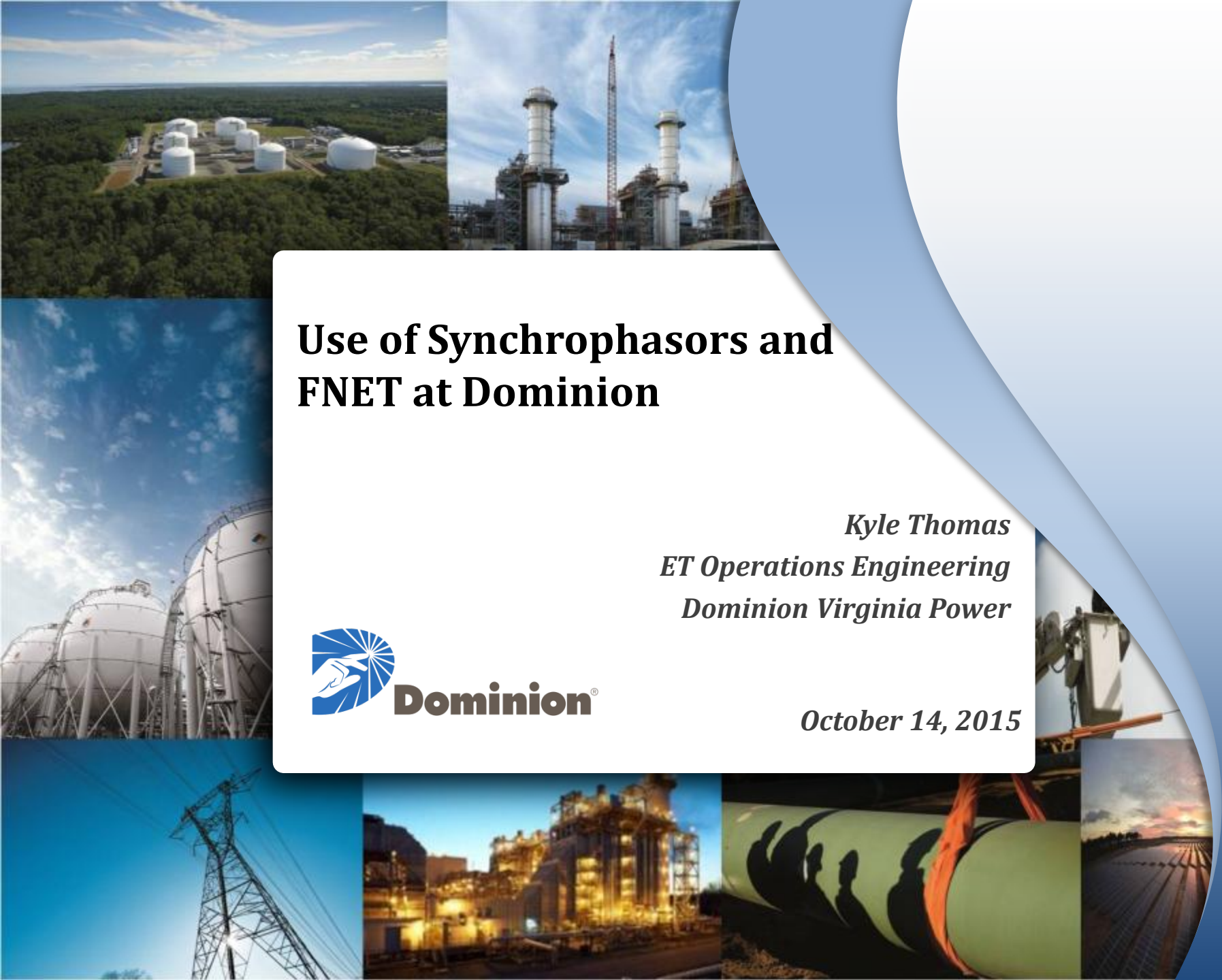


Use of Synchrophasors and FNET at Dominion

Kyle Thomas
ET Operations Engineering
Dominion Virginia Power

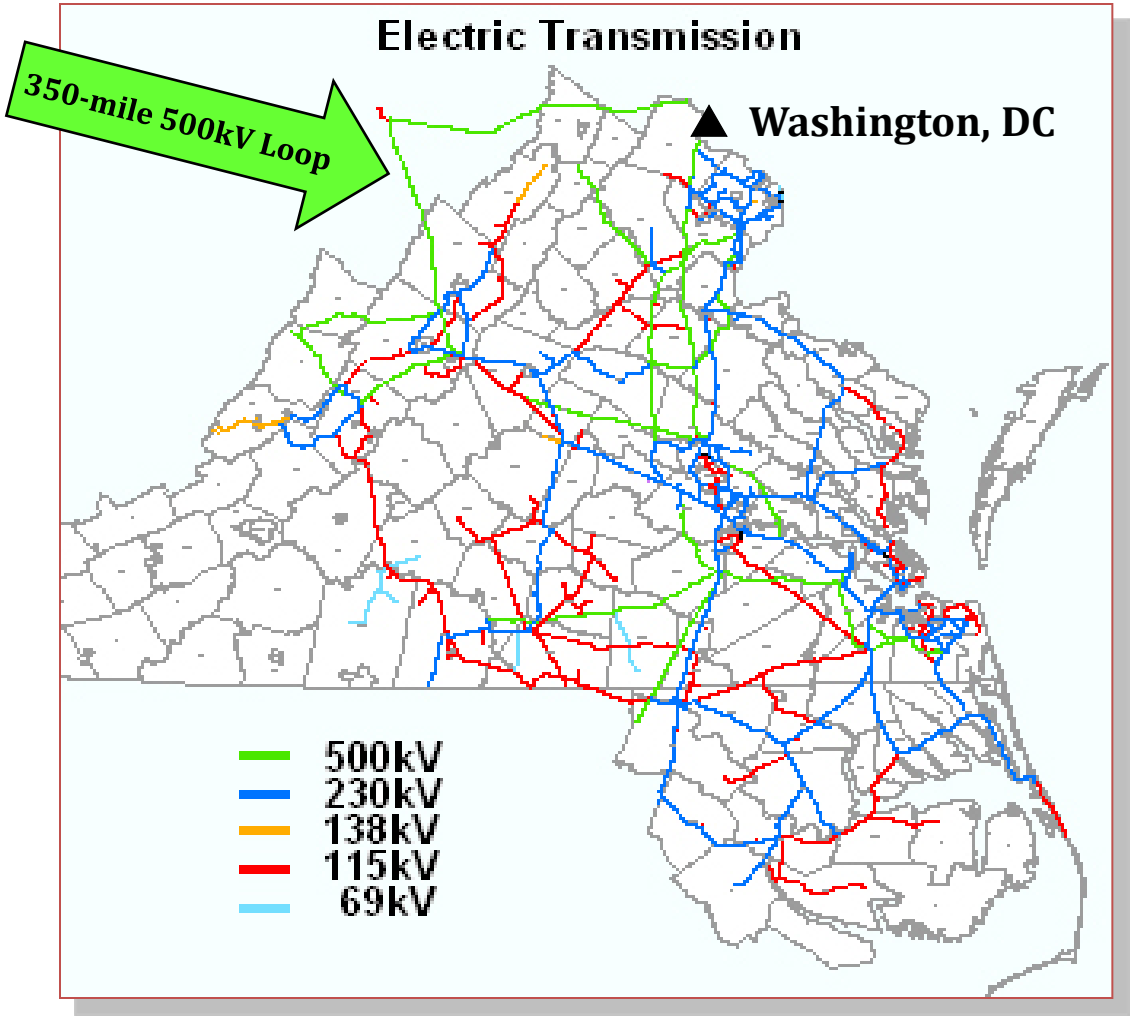
Dominion®

October 14, 2015

Dominion Electric Transmission System

Over 6,490+ miles of transmission line

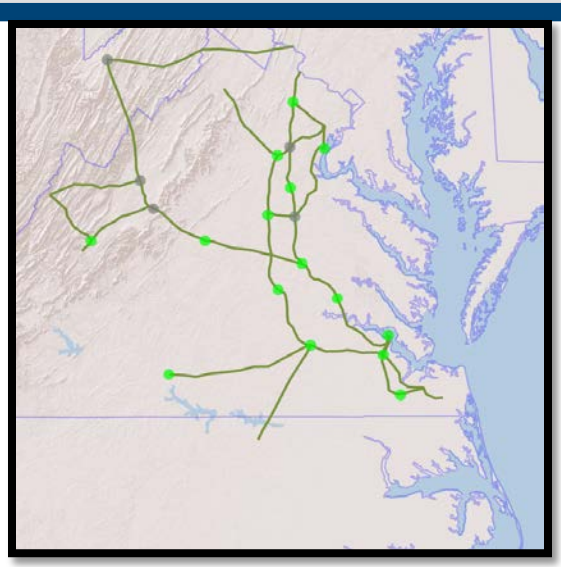
- 6,490+ miles of electric transmission lines:
  - 500kV – 1,275 miles
  - 230kV – 2,775 miles
  - 115kV – 2,275 miles
  - 138kV – 65 miles
  - 69kV – 90 miles
- 400+ transmission substations
- Dominion geographic footprint covers:
  - Major load centers
  - Government agencies
  - Military bases
  - Data centers



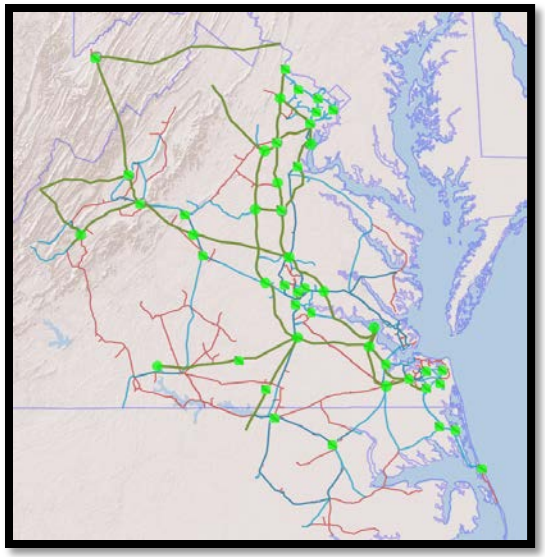
Synchrophasor Deployment

Initial focus on Transmission system

- **DOE SGIG Projects**
  - 80 PMUs
  - 21 500kV substations
  - Sharing with PJM
  - Advanced applications



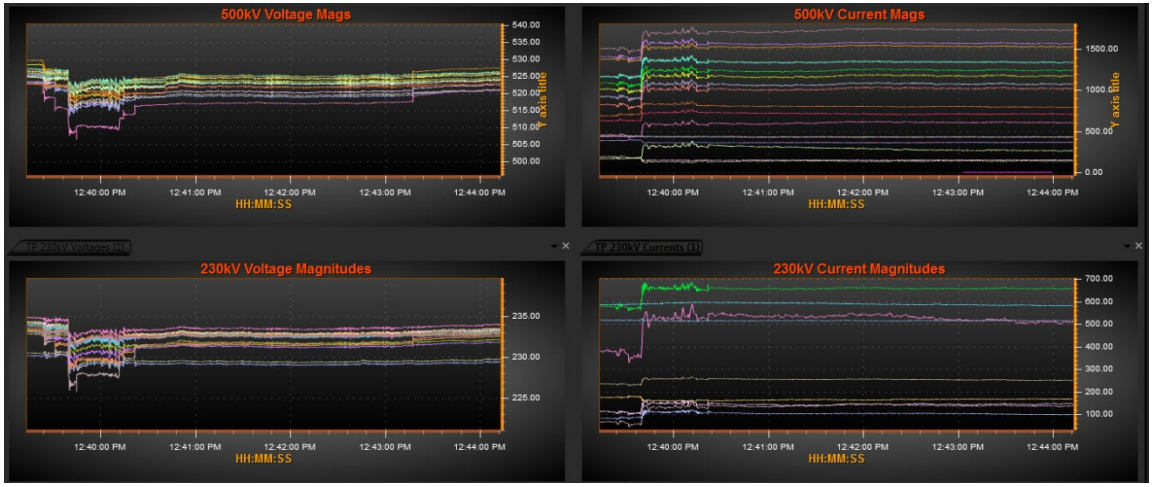
- **Standardization in 2013**
  - 300+ PMUs installed
  - 230kV and 115kV systems
  - < 0.5% of Total CapEx



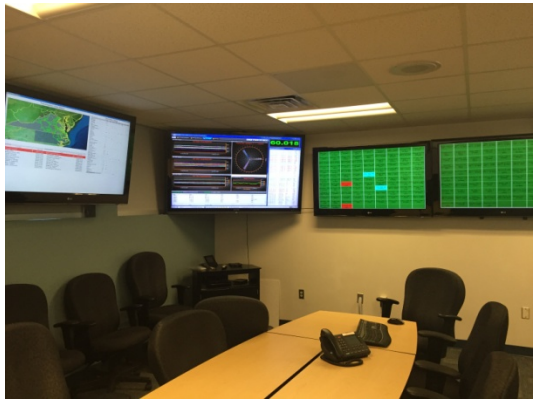
Synchrophasor Data & Applications

Across the business unit

- **Data available to all Electric Transmission departments**
  - Transmission Planning
  - Protection & Control
  - Operations & Engineering



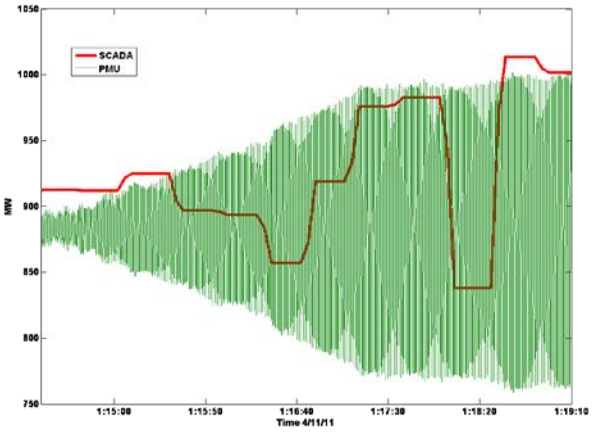
- **Visualizations**
  - Deployed across all Electric Transmission



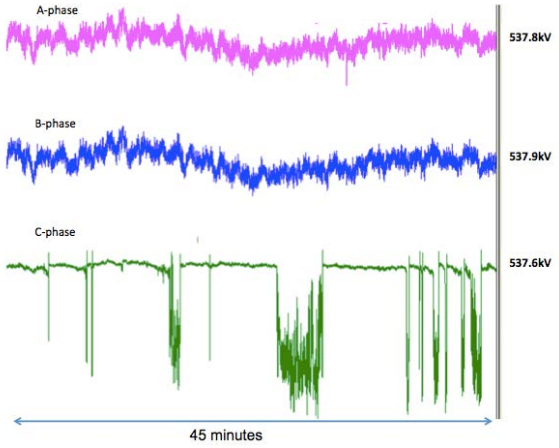
Synchrophasor Data & Applications

Across the business unit

- **As transmission events occur, group responsibilities and responses are supported with synchrophasors**

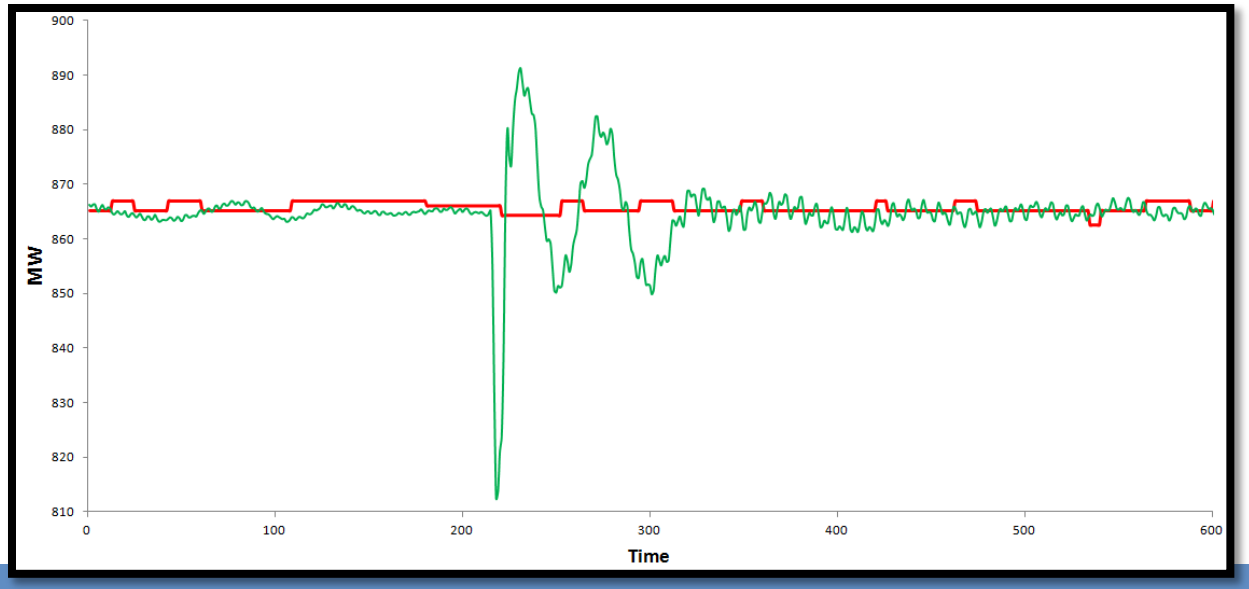


- **Transmission Planning**
  - Generator activity
  - Stability analysis
  - Model validation
- **Operations & Engineering**
  - Event analysis
  - Root cause investigation



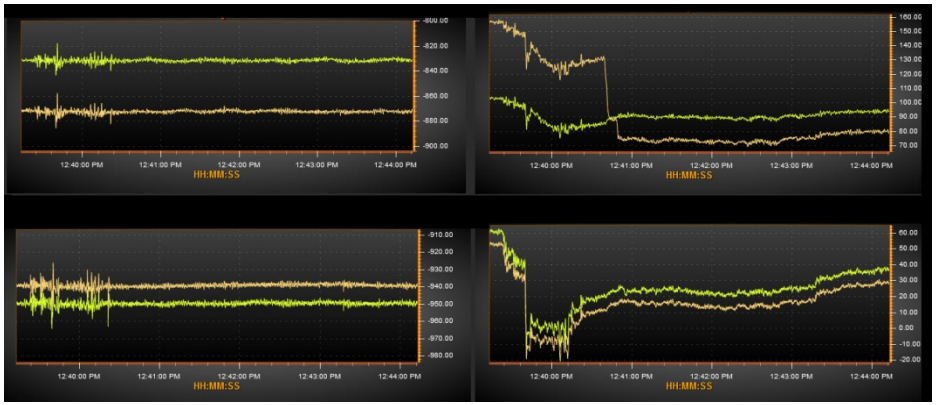
Event Analysis with Synchrophasor Data

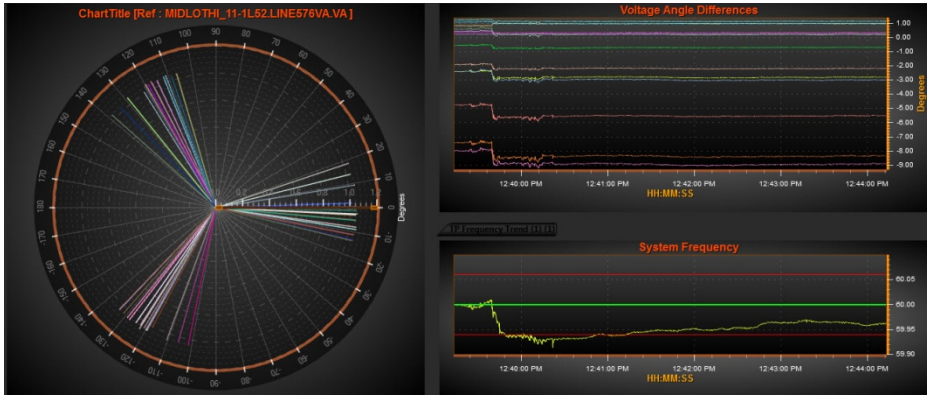
- **Main question always asked:**
  - Why did generators swing?
- **Any activity on Transmission system?**
  - System faults
  - Transmission breakers opening
  - Activity in neighbor's system
  - DFR and other devices triggered?
- **Any similar activity on Distribution system?**



Event Analysis with Synchrophasor Data

- Instances occur where nothing occurred inside Dominion territory
- Faults far away are not typically observed, especially if cleared high speed
- Large frequency excursions are observed

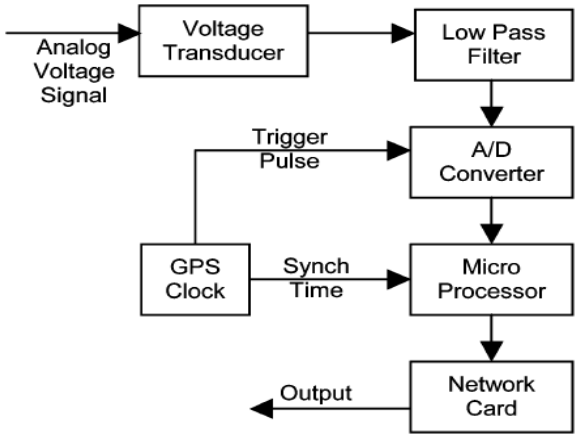




Use of UTK FNET/GridEye

Application used to identify grid disturbances

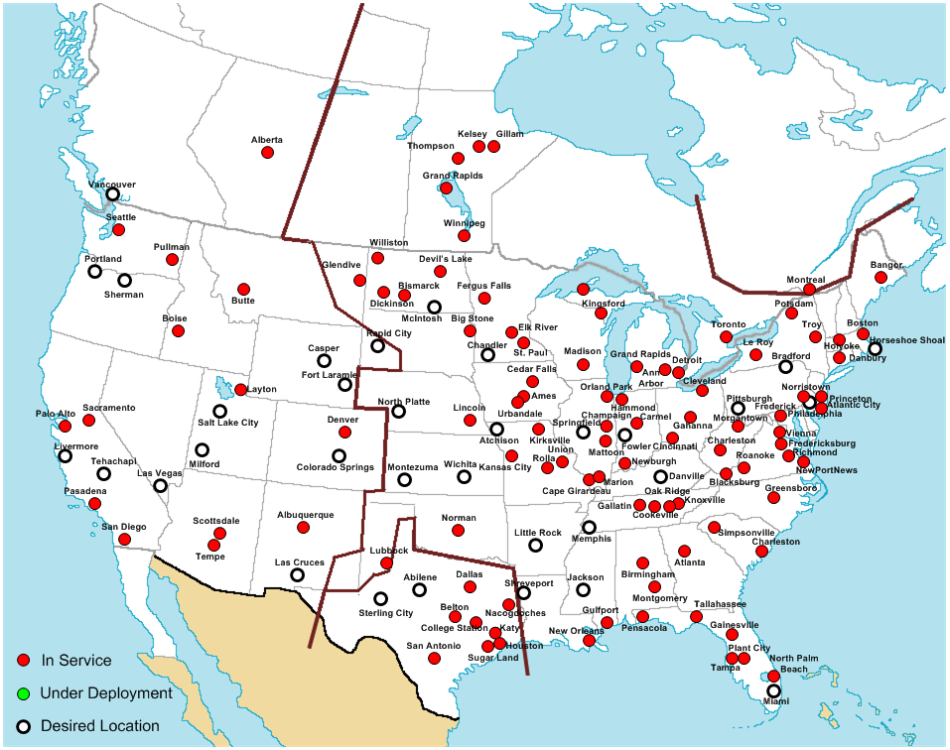
- **A network of Frequency Disturbance Recorders (FDRs) installed throughout the world**
- **Measures the voltage phasor from an electrical outlet**
- **Voltage magnitude, angle, and frequency is synchronized by GPS time reference**
  - Produces voltage synchrophasors
- **Data transmitted to servers at UTK and ORNL**



FNET GridEye

Use of UTK FNET/GridEye

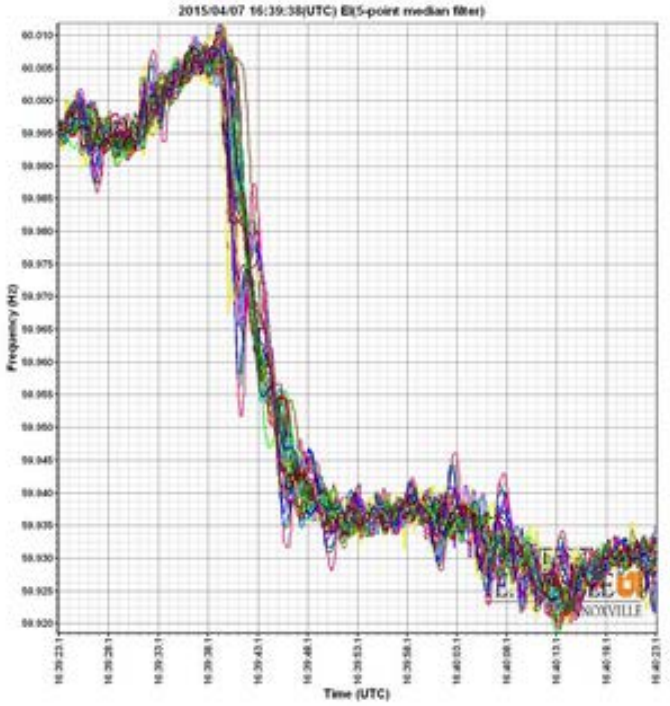
Application used to identify grid disturbances

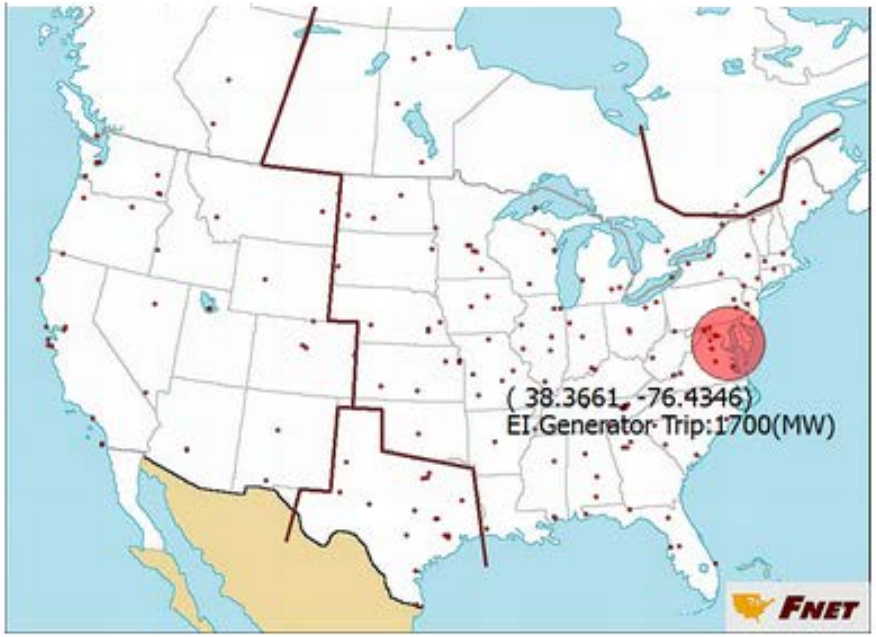


Use of UTK FNET/GridEye

Automatic event disturbance detection

1700MW EI Generator Trip at 16:39:38 UTC, on mm/dd/yyyy near *name* Power Plant
(city,state zip; Latitude: 38.3661, Longitude: -76.4346)





Use of UTK FNET/GridEye

Immediate information to support many parties

- **FNET processes data, detects events, and sends notification emails within 1-2 minutes of actual event**

- **Allows for immediate verification of observations seen in other data, such as synchrophasor and SCADA data**

- **When these large events occur, can quickly provide information to grid operators and plant operators**

- **Creates a database of significant grid events to use for further study**
  - Generator model validation
  - FACTs model validation

Dominion®