



On-line Event Location Determination and Reporting Using Distribution Level Synchro-Phasor Measurement

March 7, 2007

NASPI

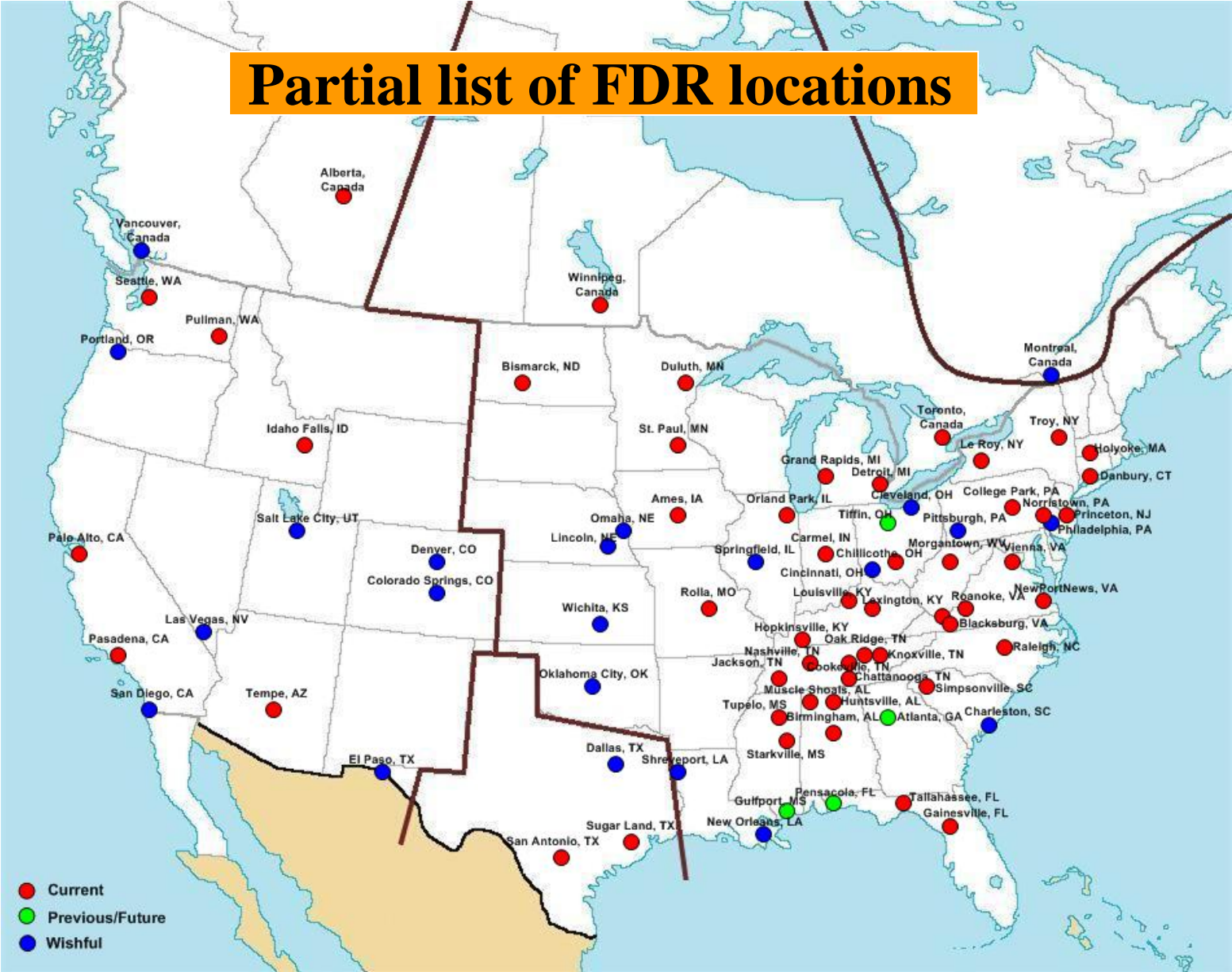
Yilu Liu and Robert M. Gardner of Virginia Tech

James Ritchie Carroll of TVA

540 231 3393, FDR@vt.edu



Partial list of FDR locations



Acknowledgement

FNET Research sponsors

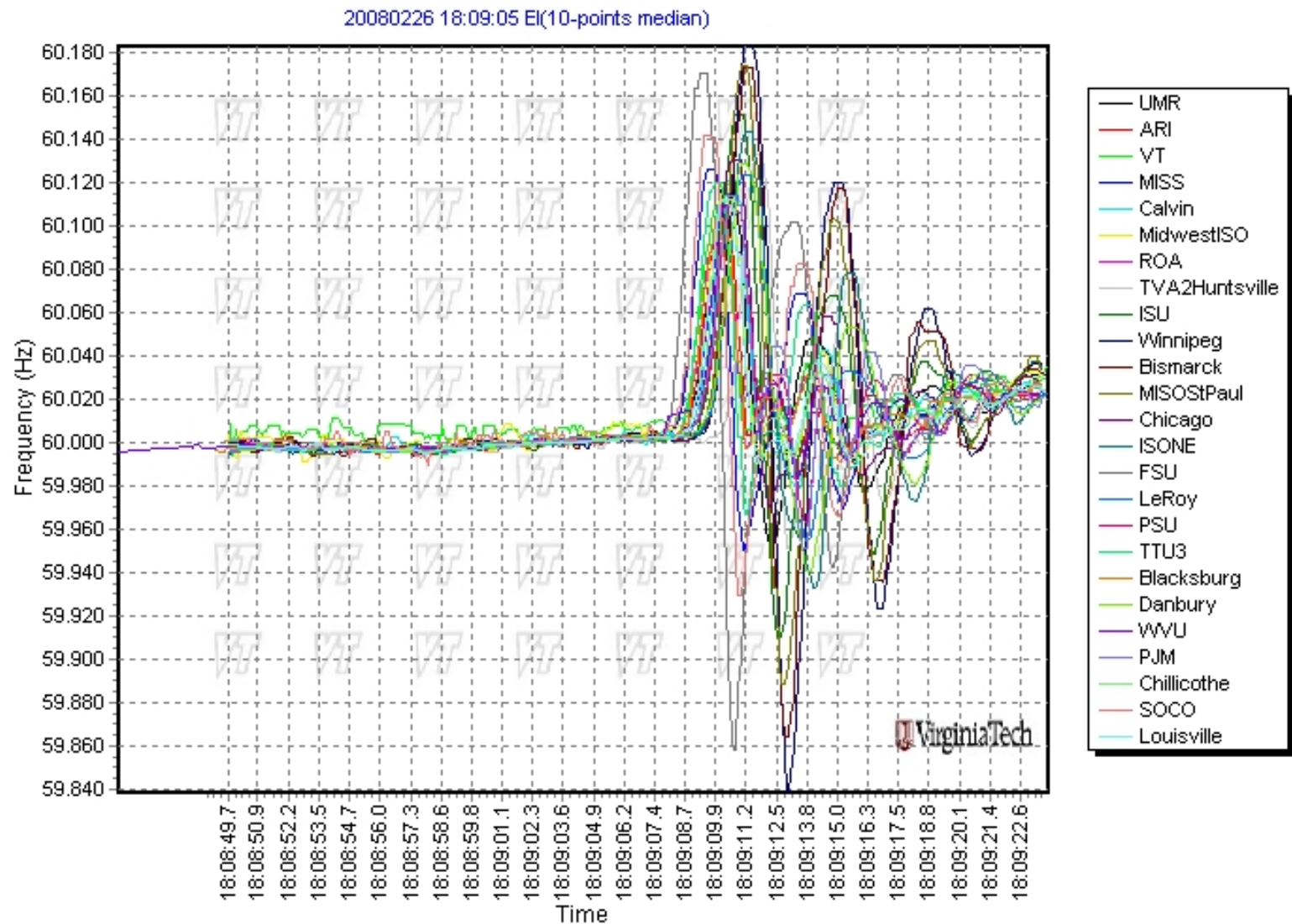


***Special thanks to our FDR
host universities, companies,
high Schools, and individuals
all over US and Canada!***

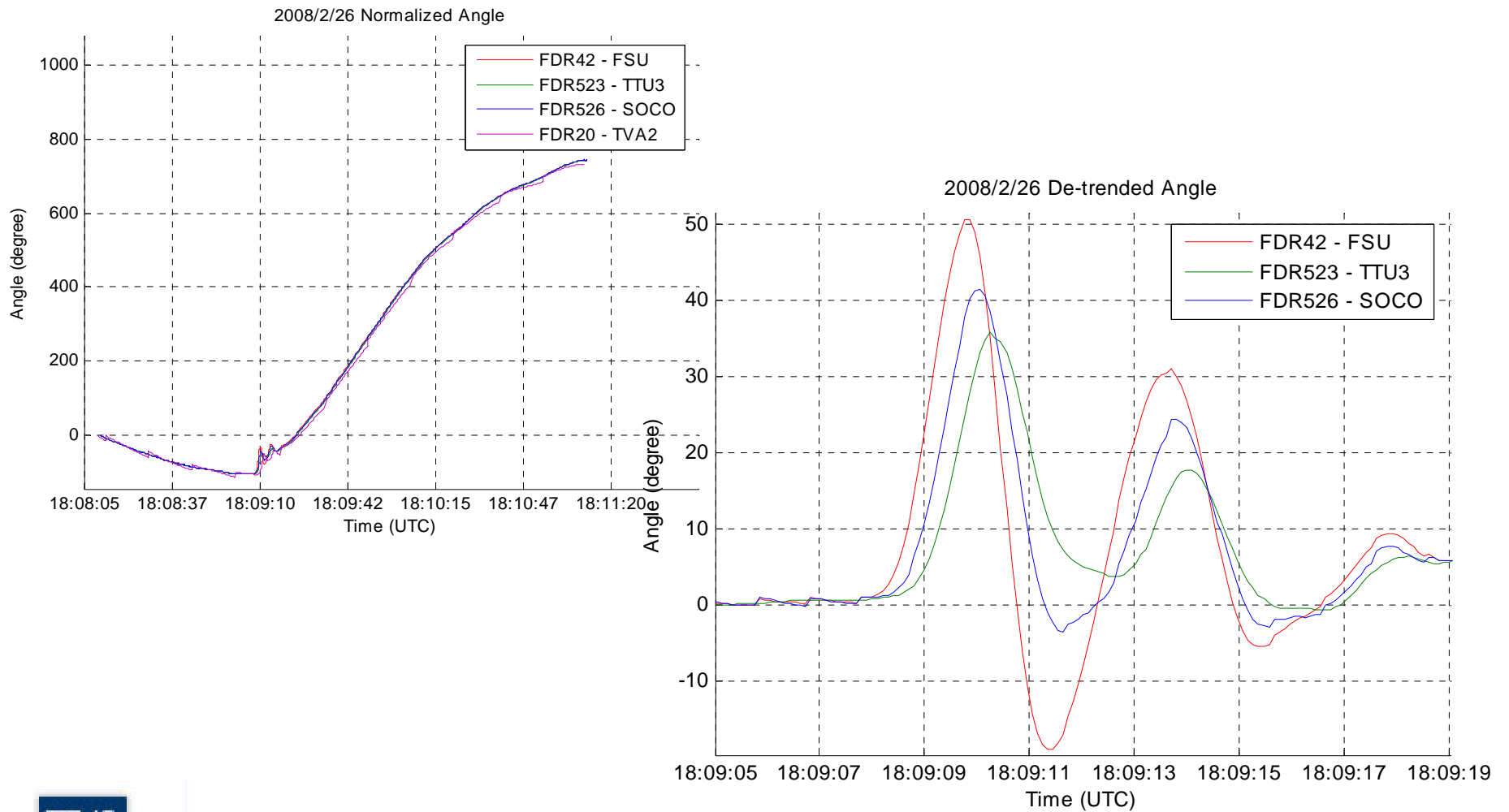


The FNET Team Summer of 2007

FL Event detected at 13:09:05 EST

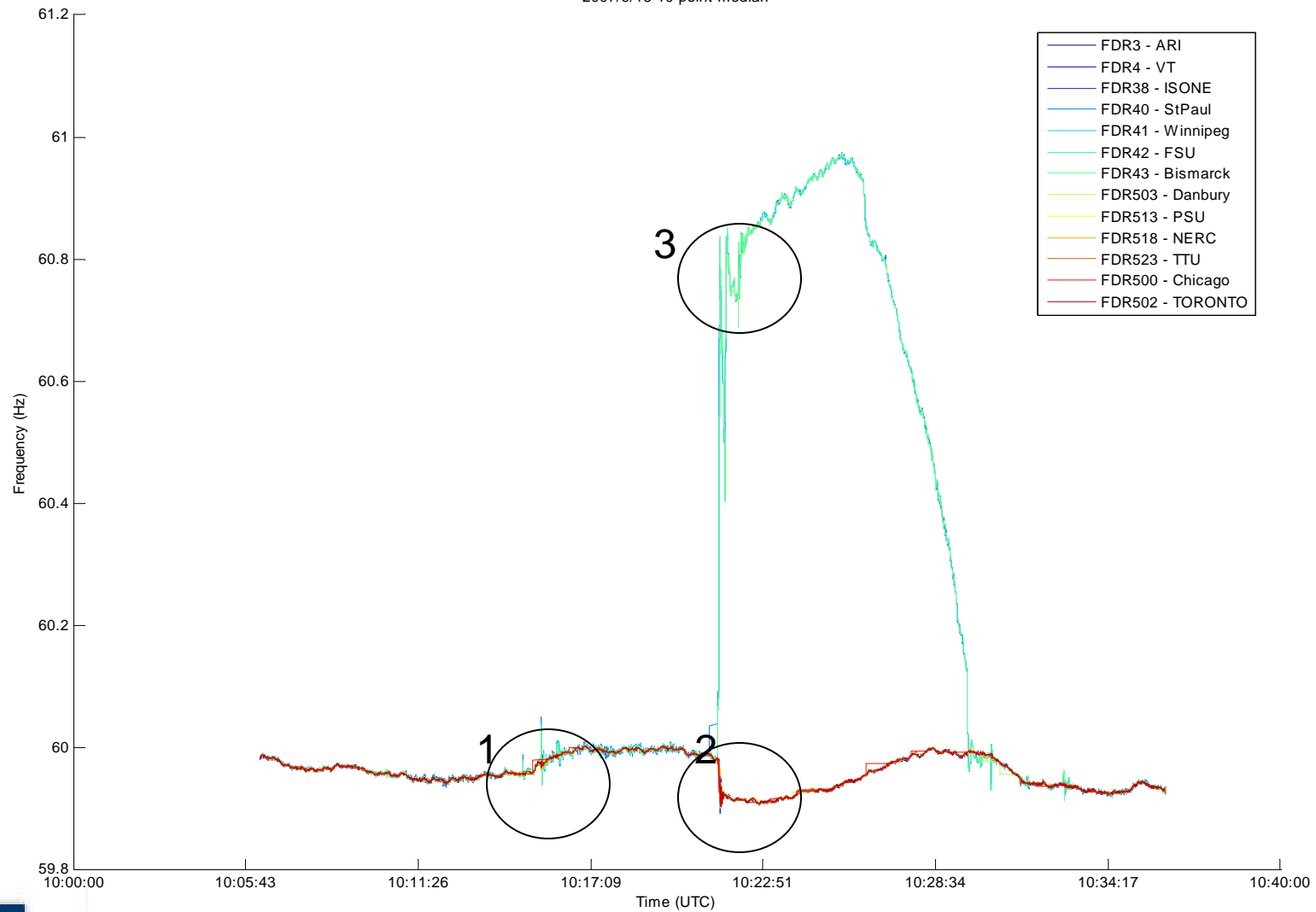


FNET Angle Measurements at 13:08 – 13:11 EST

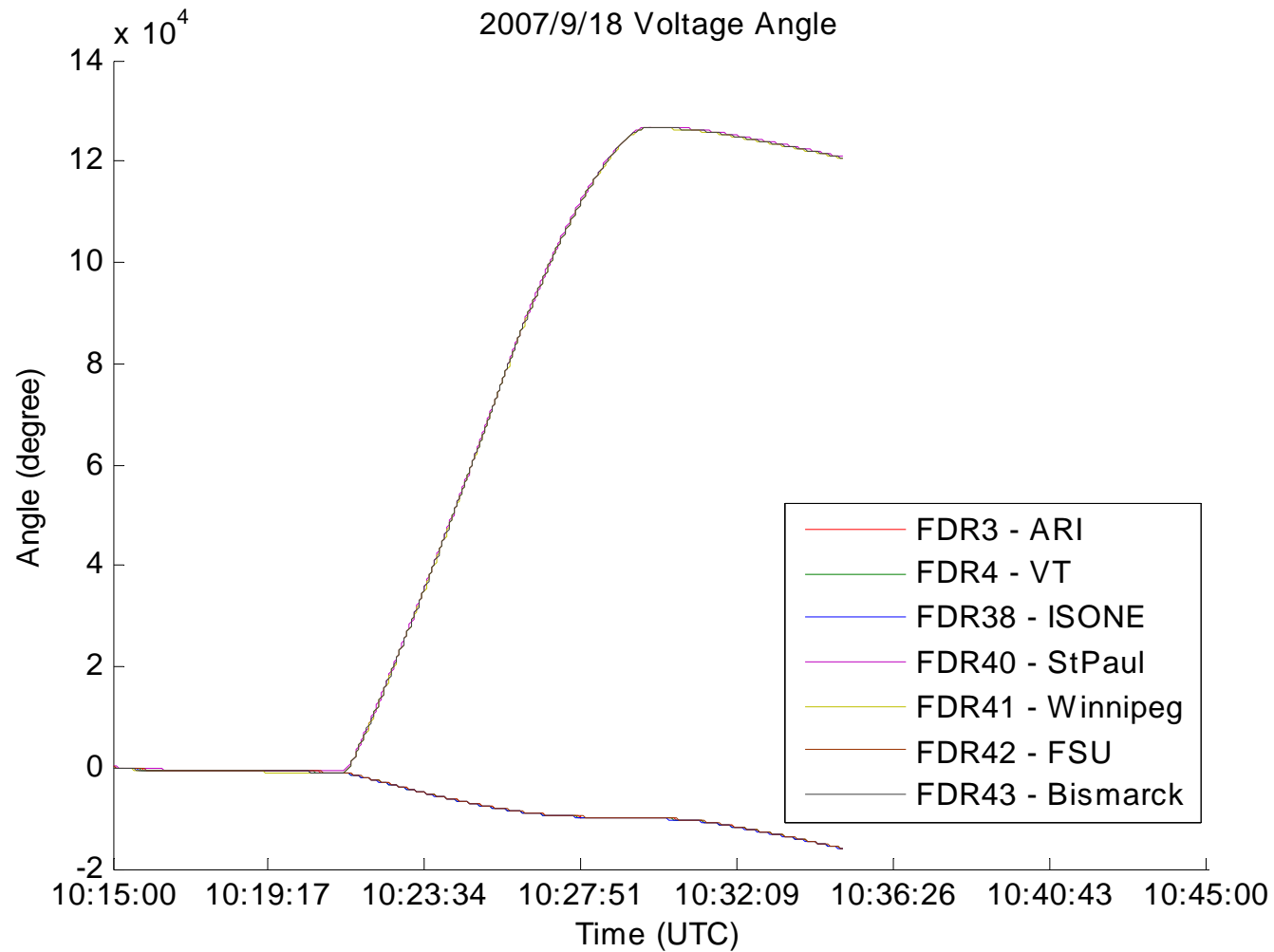


The EI system islanding frequency data 9 minutes

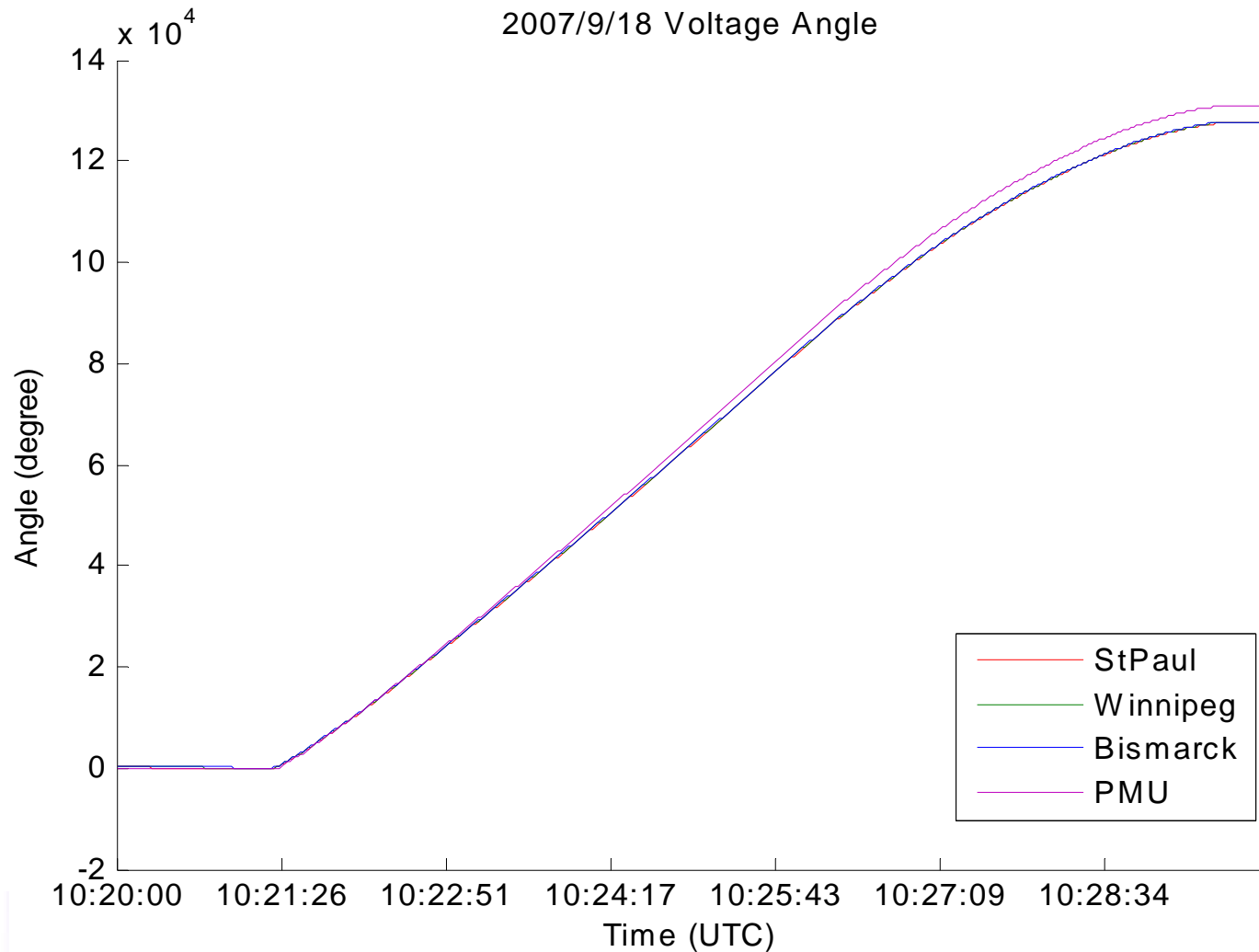
2007/9/18 10-point median



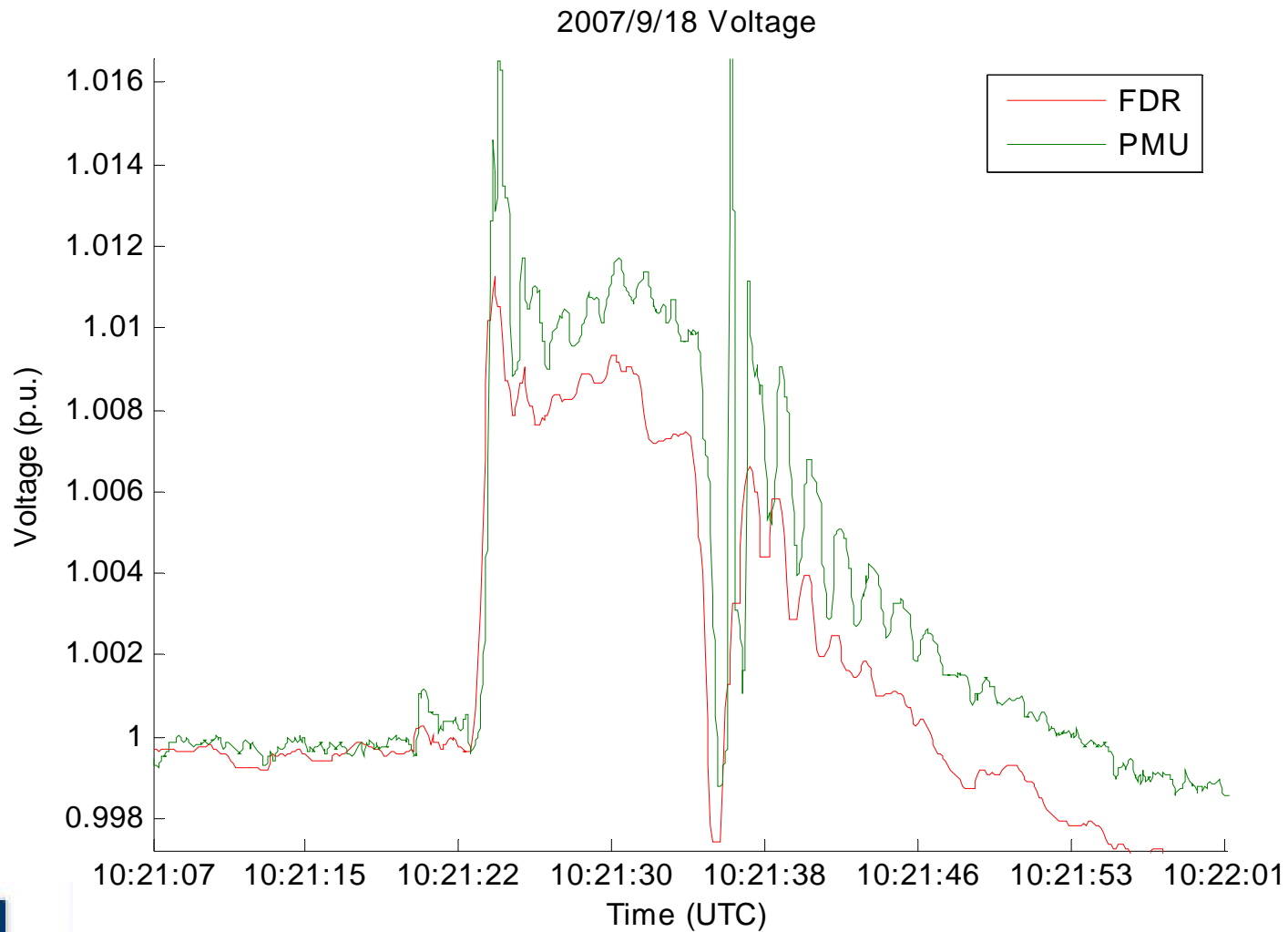
EI Separation, FNET Angle Data



Angles of 3 FDRs and 1 PMU

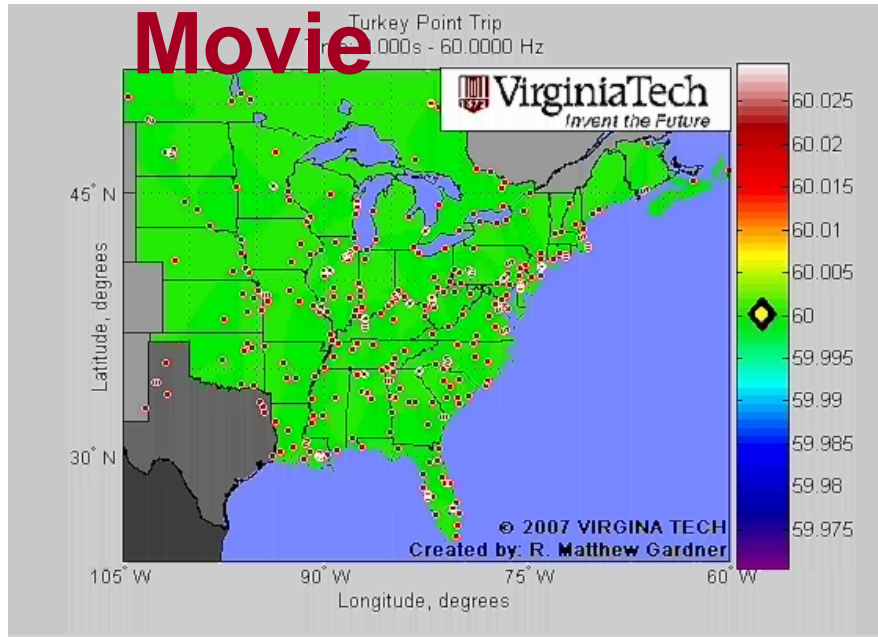


Voltage of FDR and PMU(Winnipeg)

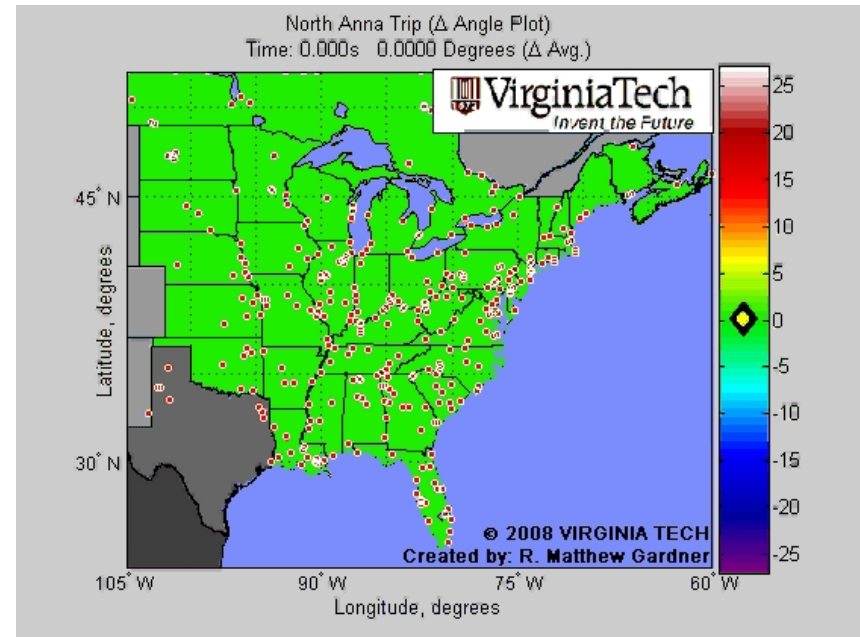


Disturbance Propagation from Simulations

Movie



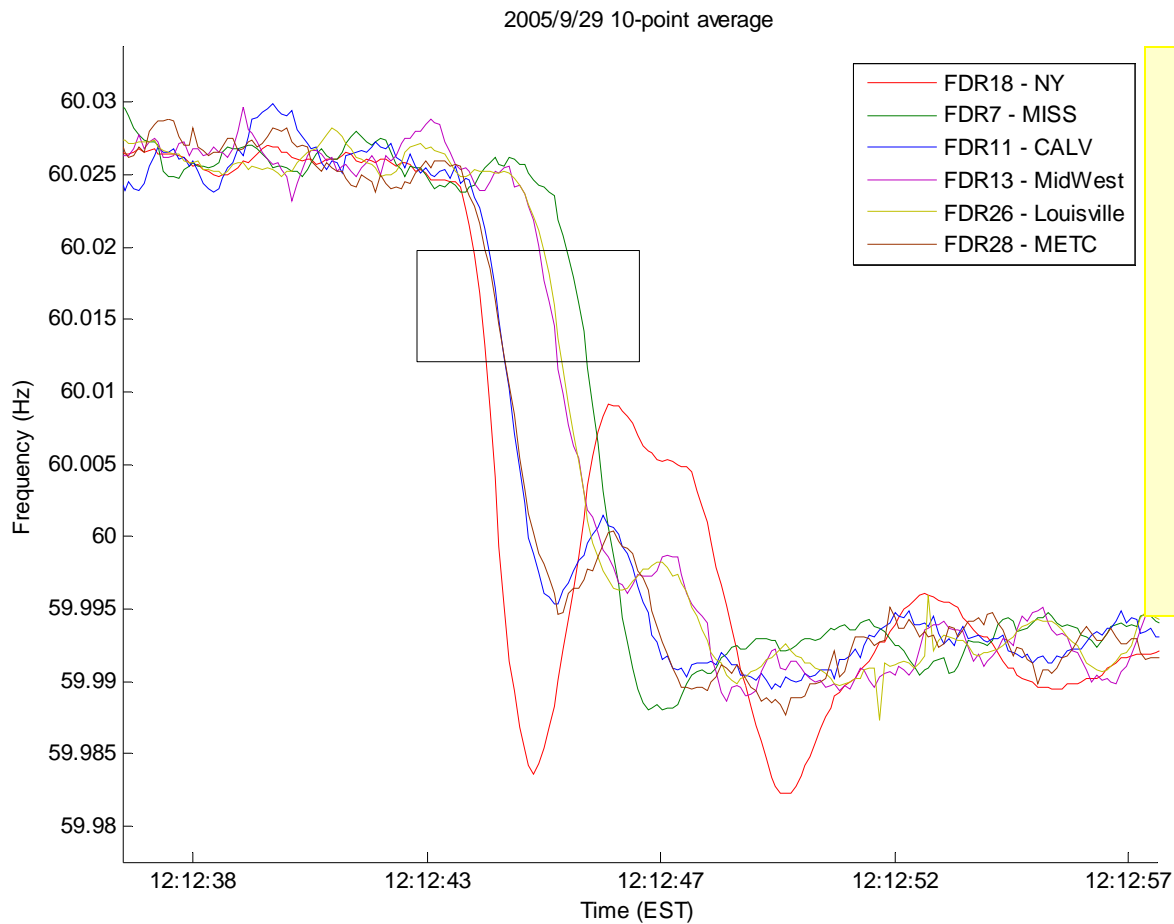
Frequency
Turkey point trip simulation



Angle changes
North Anna plant trip Simulation



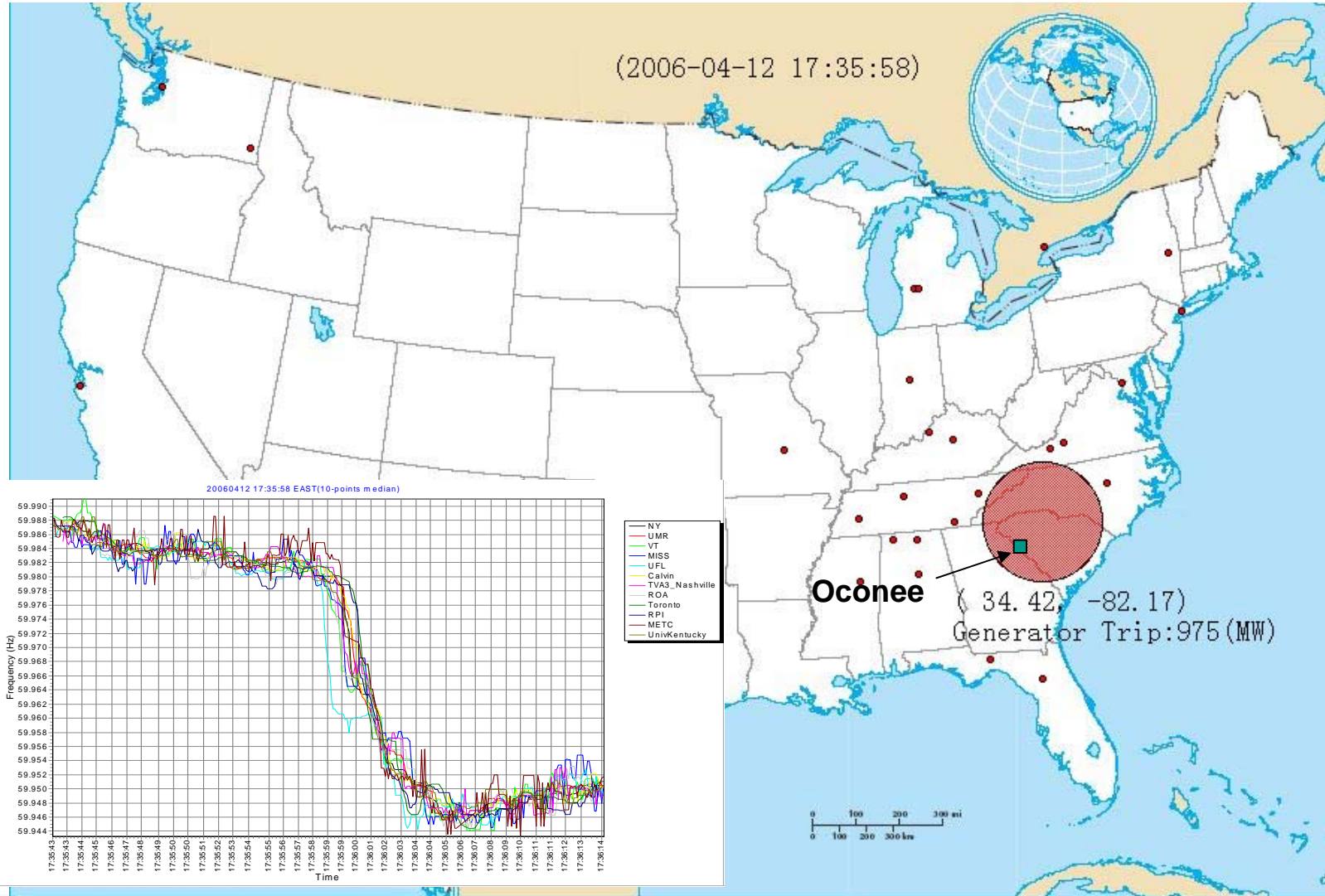
On-line Event Location



Virginia Tech has a Patent pending on the concept of using frequency time delay of arrival in determining the location of the source of power system disturbances



Event of Oconee, 4/2/06



Summary of On-line Functions

- On-line event trigger and MW estimation
- On-line event location estimate and reporting
- On-line oscillation trigger
- On-line oscillation analysis and reporting tool
- On-line event movie generation (coming soon)

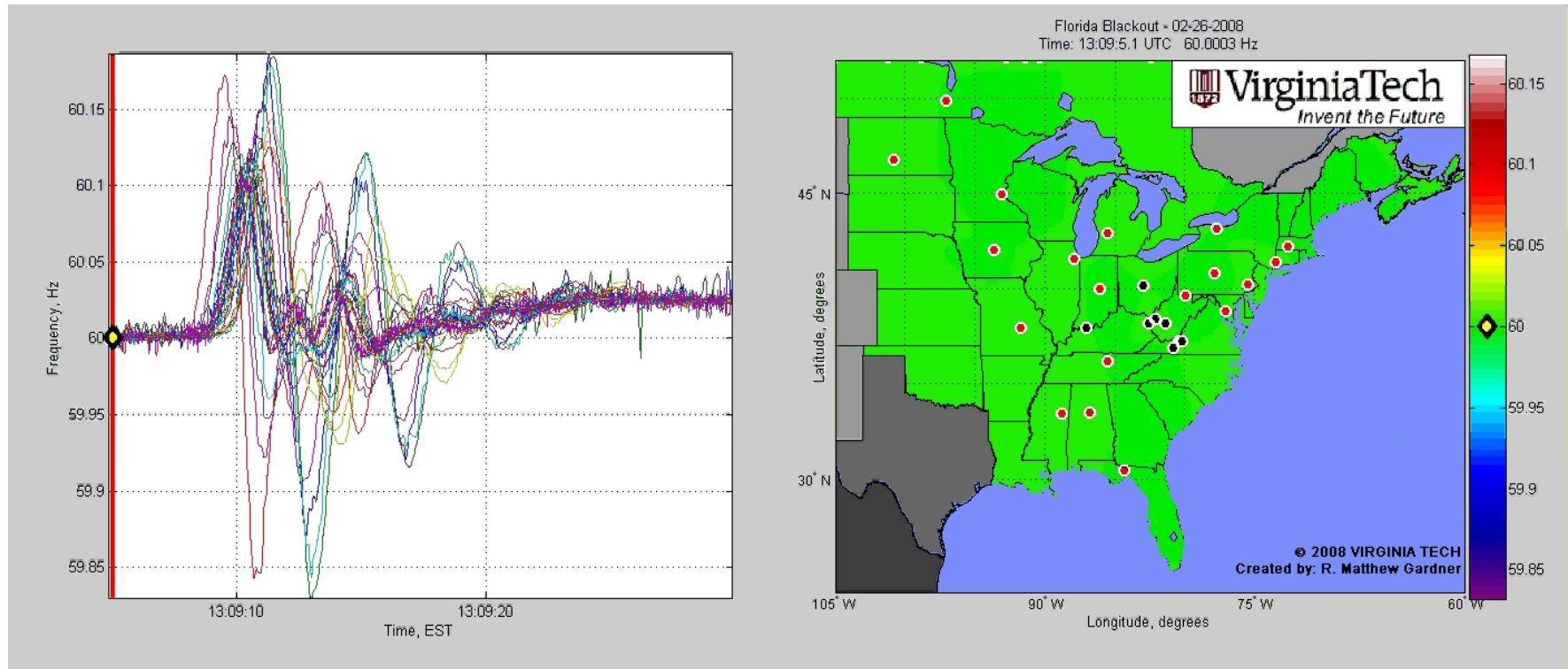
Information Delivery:

- Automatic e-mail alert (*to FNET user group*)
- Automatic web display (*mostly Internal*)

FNET public site: www.fnetpublic.ece.vt.edu



Disturbance Propagation Playback from FNET and PMU measurements 2-26-08 event



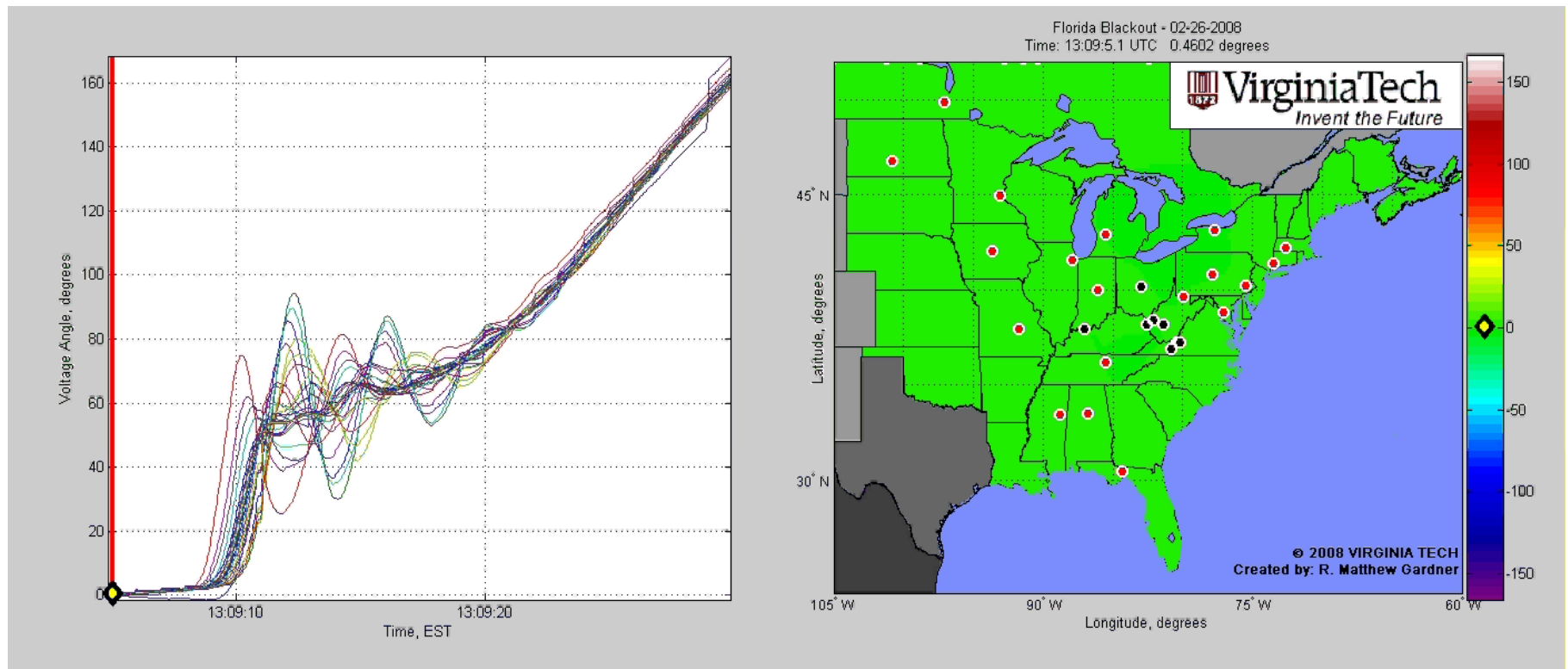
Actual measurement data reply - Frequency



Click to play the movie



Disturbance Propagation Playback from 2-26-08 measurements

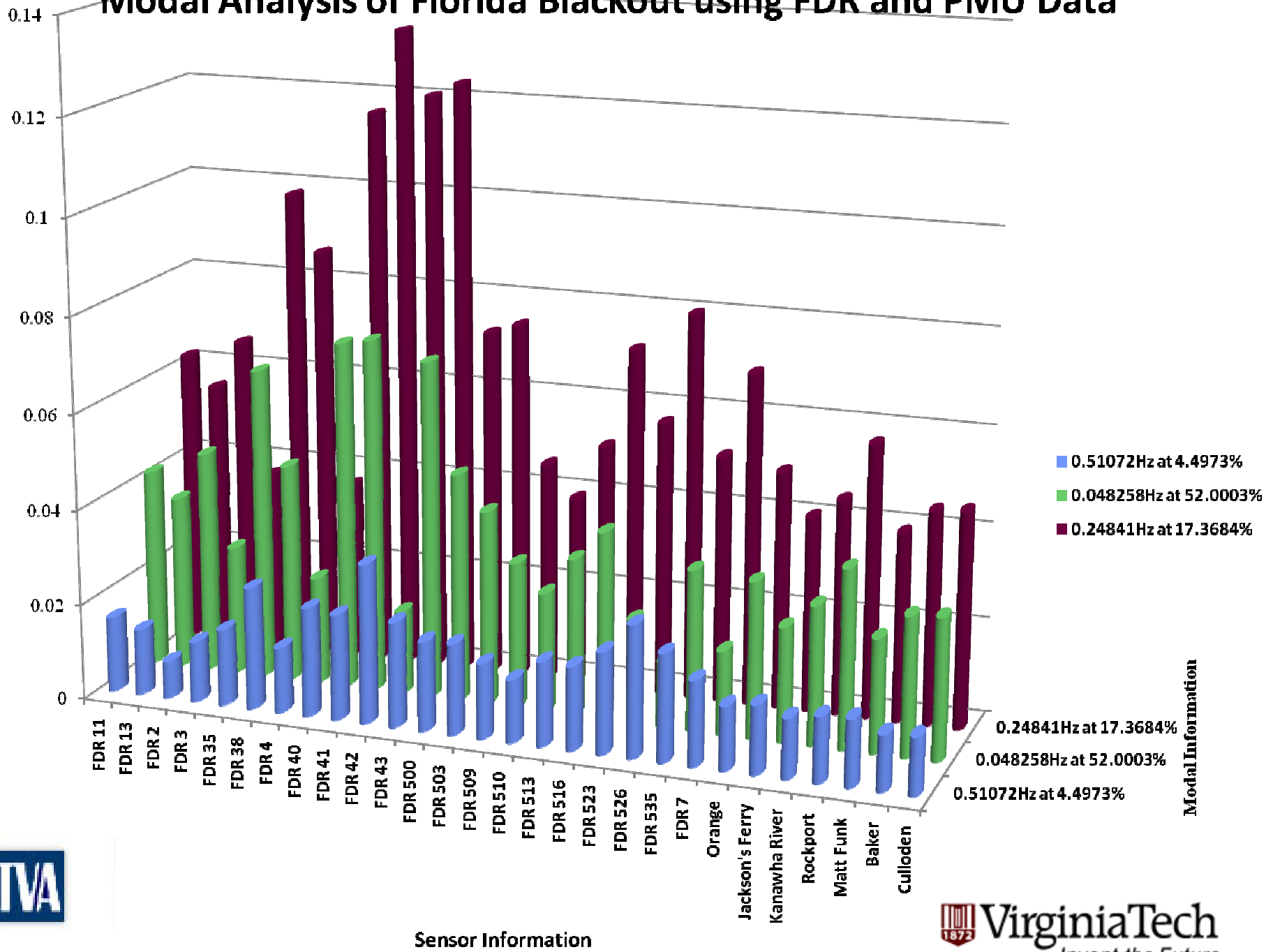


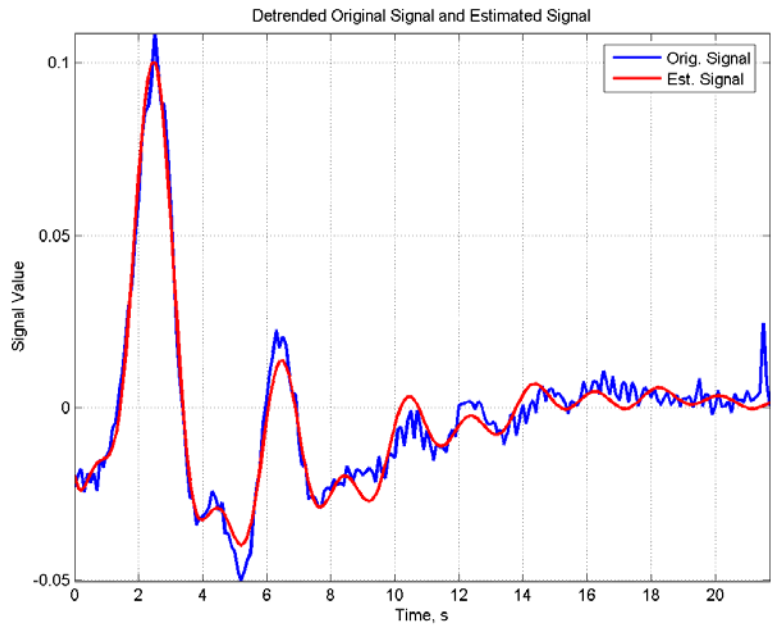
Measurement data reply – Relative Angle



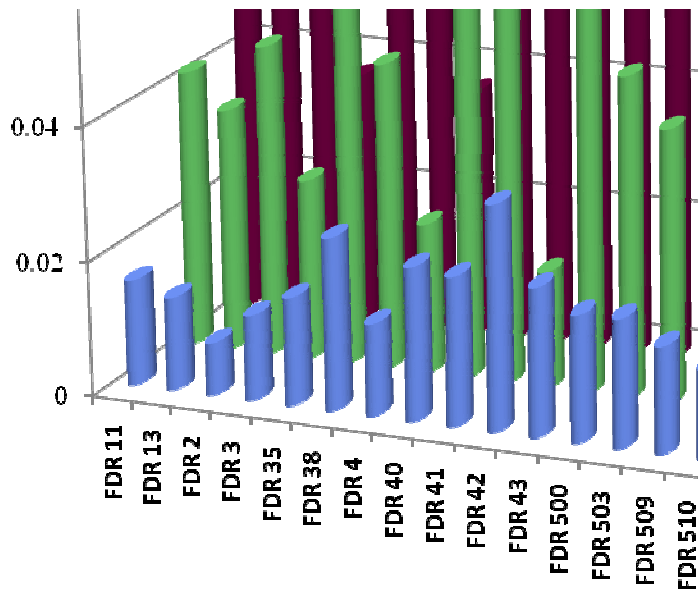
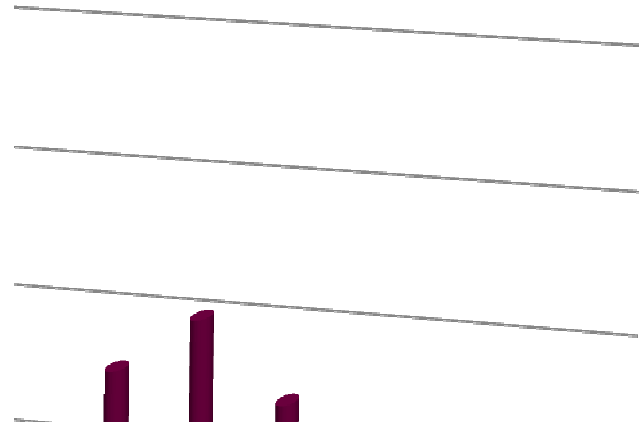
[Click to play the movie](#)

Modal Analysis of Florida Blackout using FDR and PMU Data

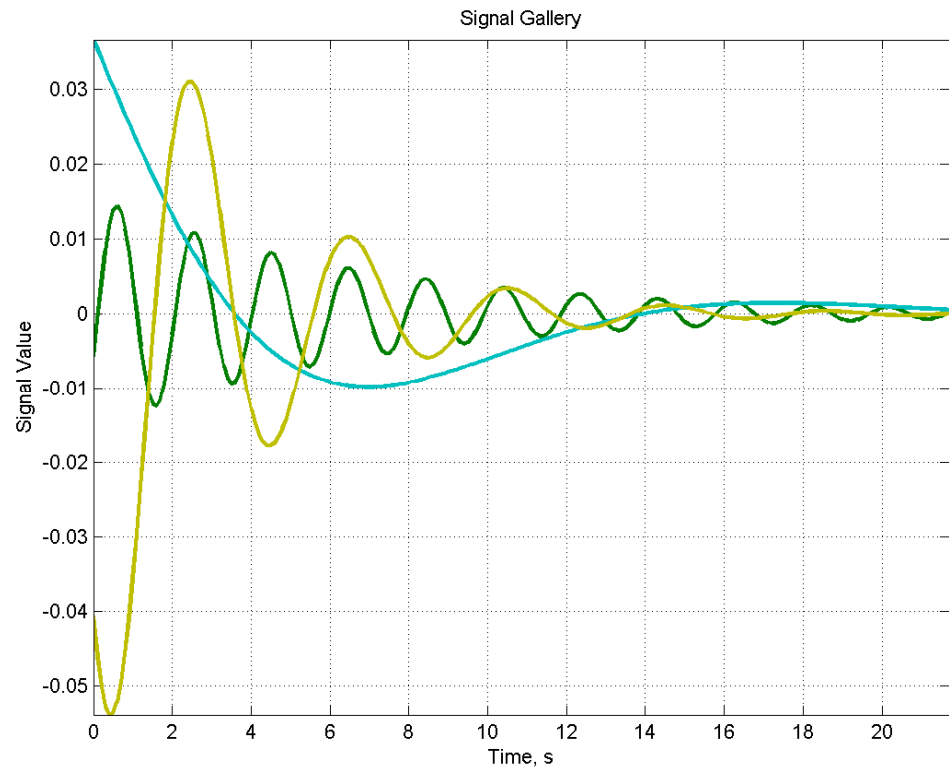




lackout using FDR and PMU Data



Sensor Info



Automatic Report Generation

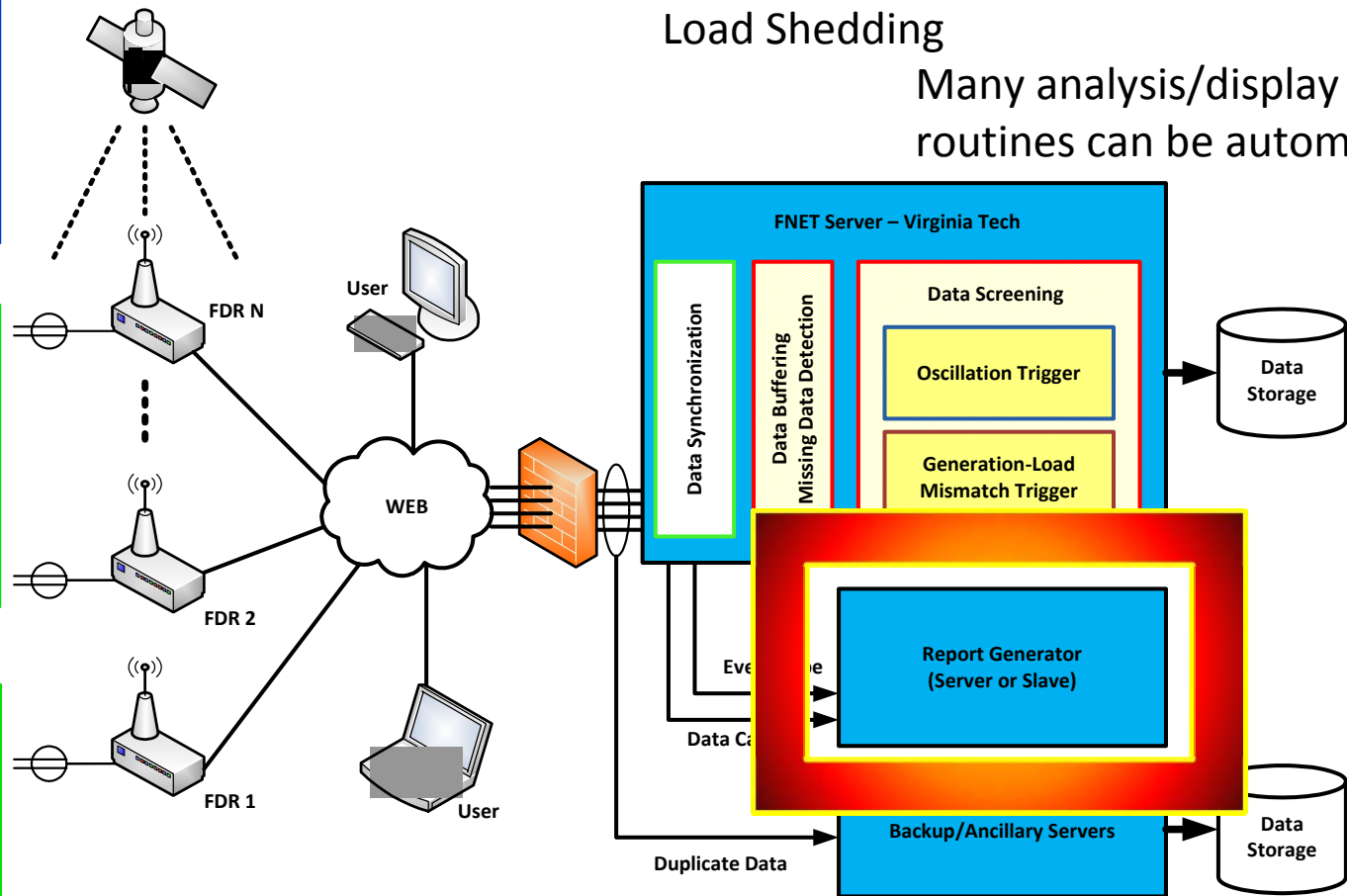
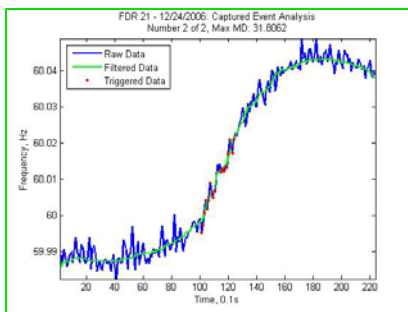
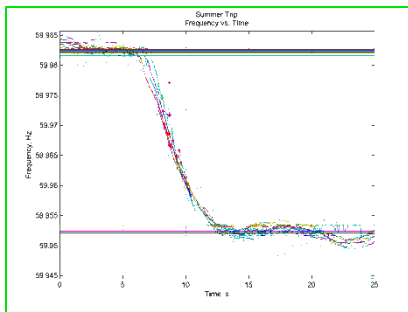
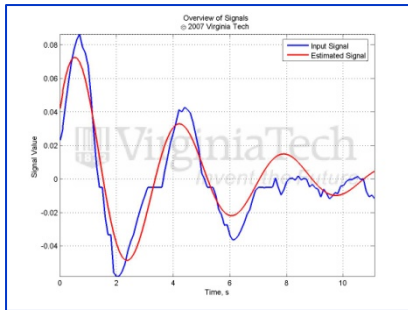
Events occur at all times

Oscillations

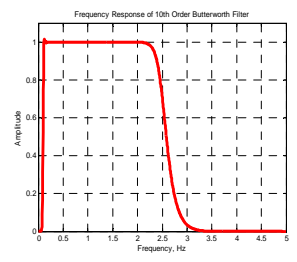
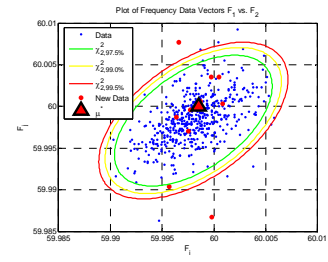
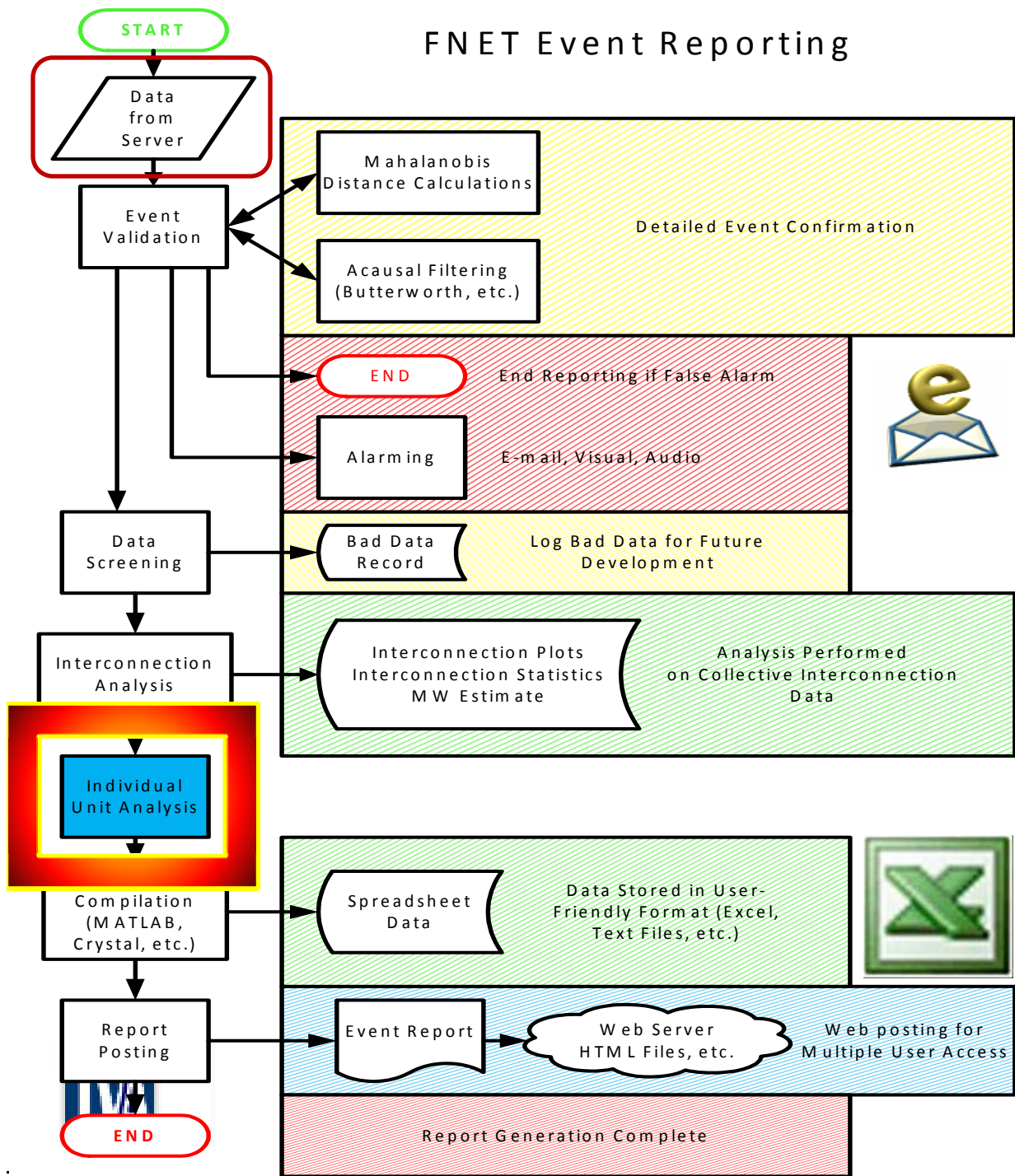
Generation Trips

Load Shedding

Many analysis/display routines can be automated



FNET Event Reporting



Virginia Tech Generator Trip Report

Data collected from FNET: Wide-Area Frequency Monitoring Network

R. Matthew Gardner
Copyright © 2007 Virginia Tech

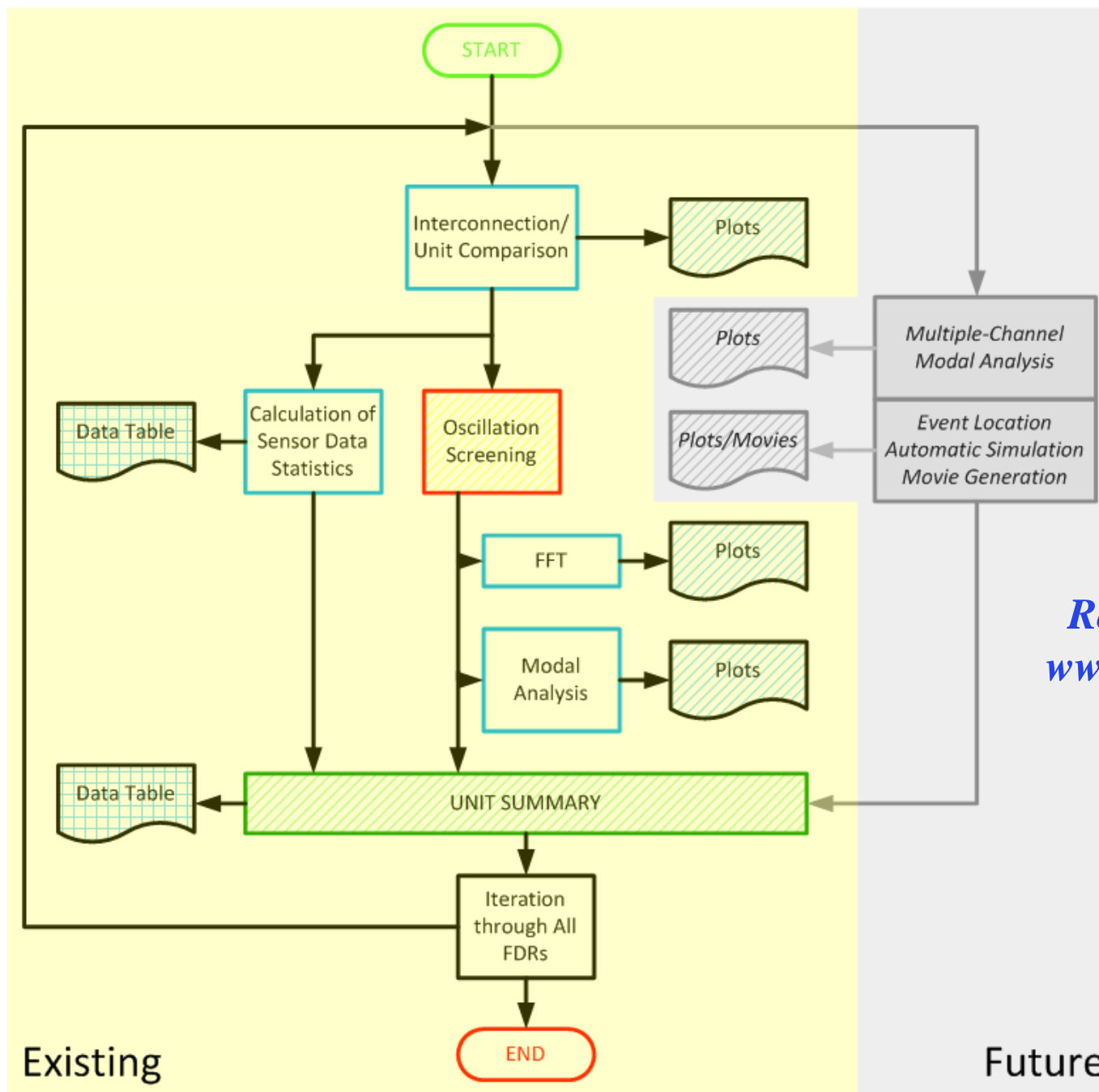
VirginiaTech
Invent the Future

All data, images, and analysis remain the sole property of Virginia Tech.
05-Oct-2007 11:56:28

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- 3. Data from FDR-2
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Individual Unit Analysis



EI Separation Report

FL Blackout Report

Report download site at www.fnetpublic.ece.vt.edu

Existing

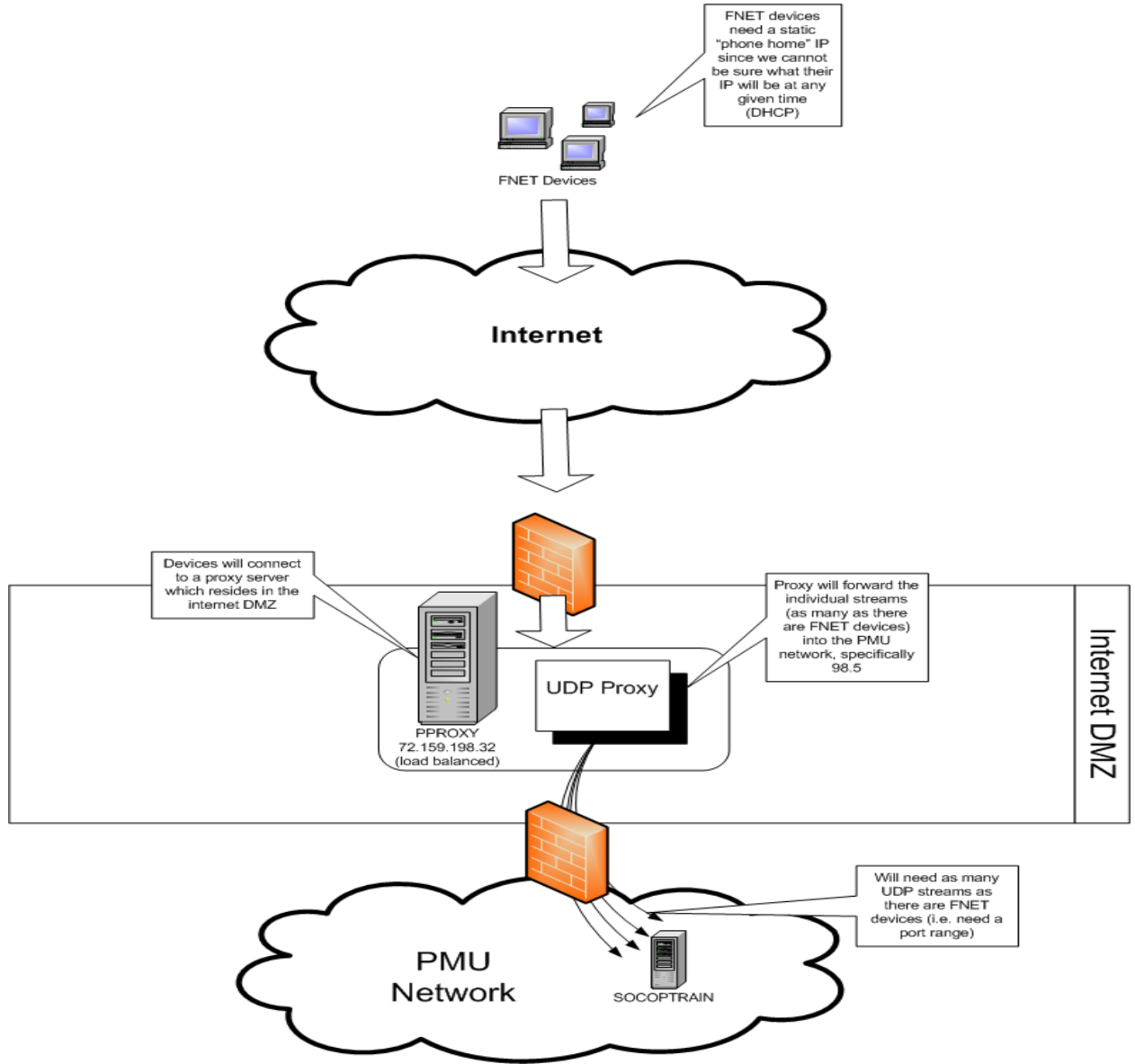
Future

FNET interface at TVA SPDC

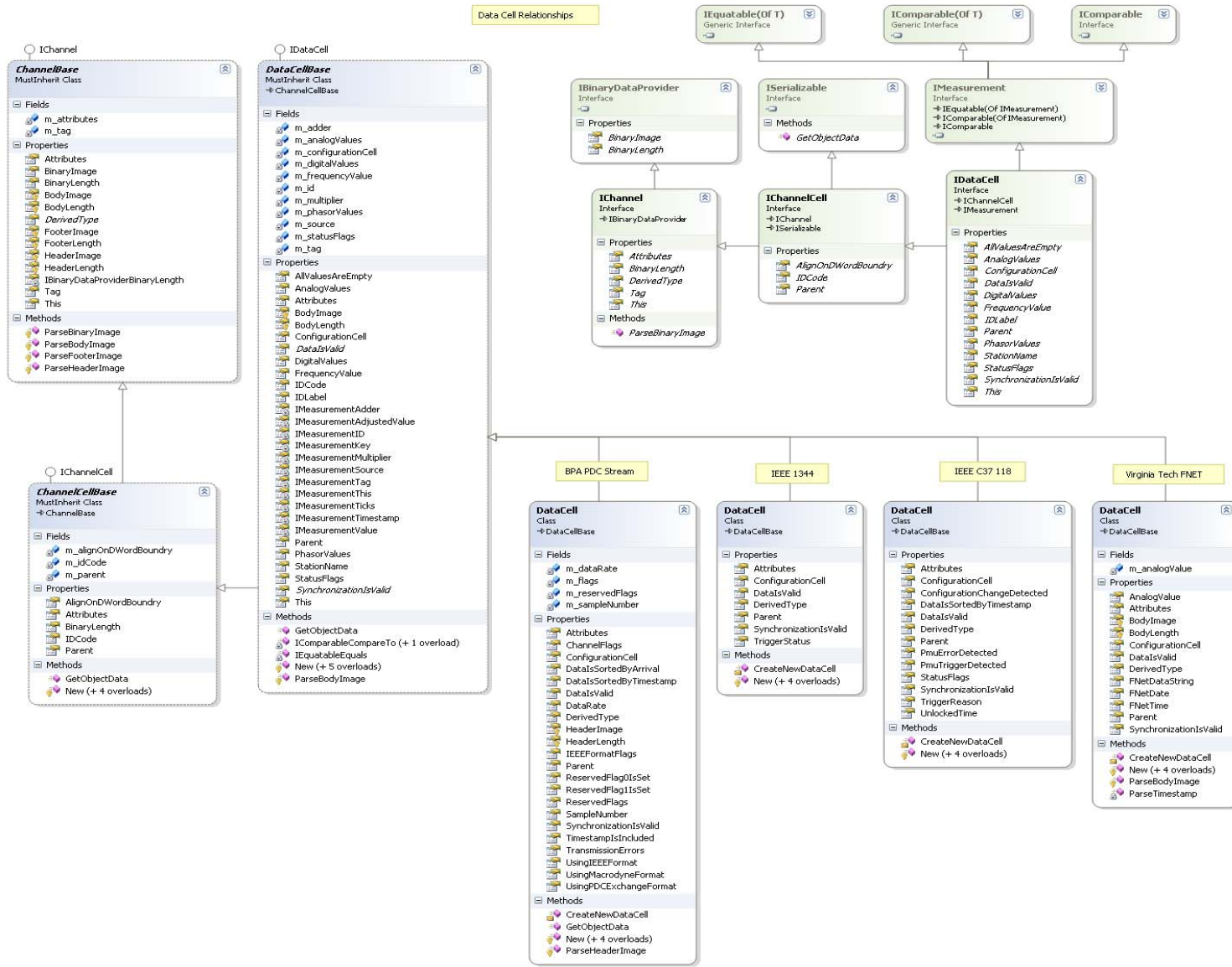
James Ritchie Carroll

- **One interface**
- **Multiple protocol implementation**
- **Interface remains the same for upper level application**
- **Easy to add new protocol implementation supporting upcoming protocol**





“Interface” Technique



FDR Data Flowing to SPDC

