SynchroPhasors to Enhance Control Center Capabilities

NASPI Working Group Meeting

GRID

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February 23rd, 2011

ALSTOM

Presentation Outline

1. Our Vision & Partners
2. ALSTOM's Integrated SynchroPhasor Solutions
3. Customers Successes
    1. *PG&E SynchroPhasor Project*
    2. *ISO-NE SGIG Project*
4. Our Products: PMU, PDCs, Visualization, Applications
5. Concluding Thoughts

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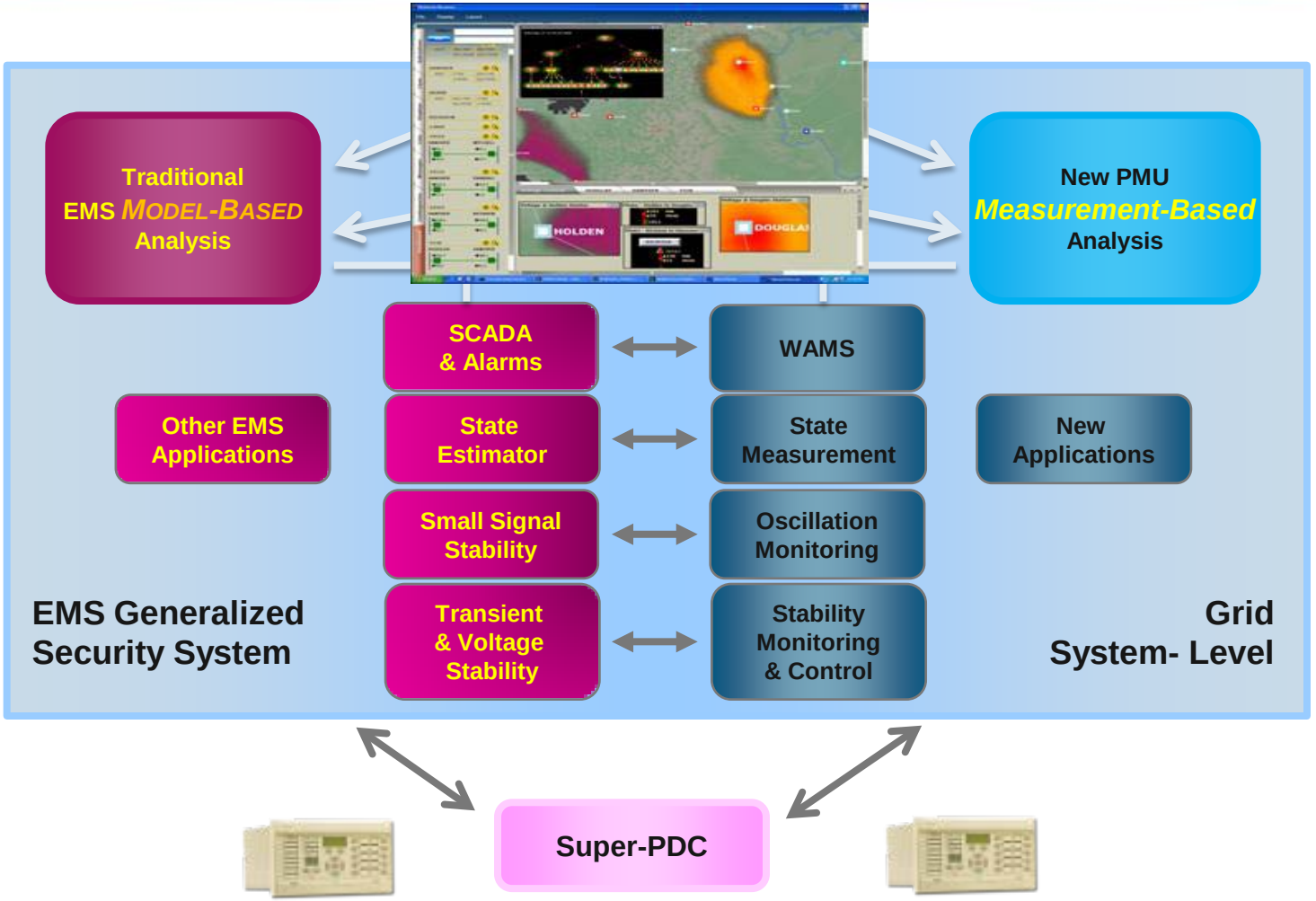
Our Vision



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Our Partners

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World-wide leader in providing technology solutions for transmission & distribution of energy.

PSYMETRIX

Commercial provider of synchronized measurement & monitoring solutions:

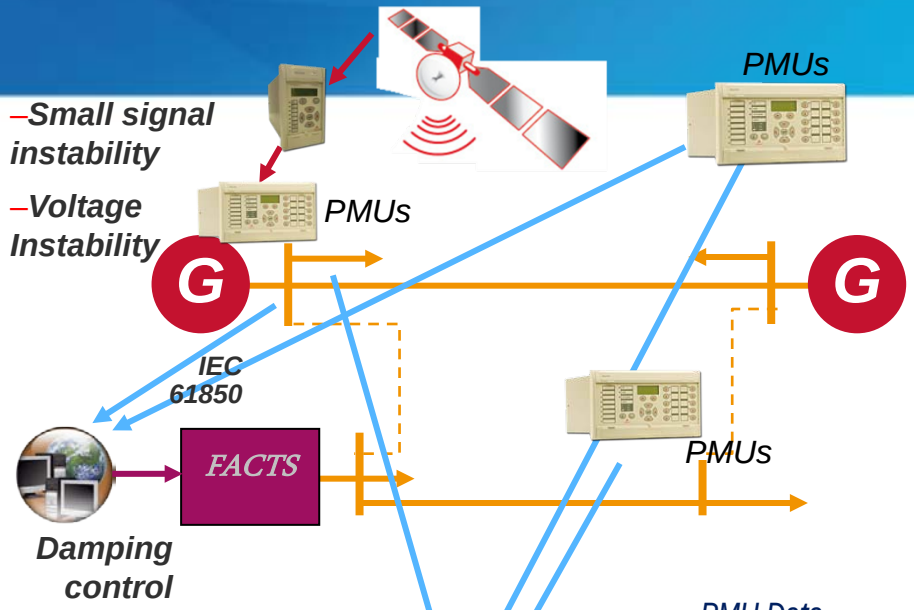
- *PhasorPoint (SynchroPhasor Framework)*
- *PMU-based applications*

Powertech

Model-based dynamic analysis:

- *Voltage Stability Analysis (VSAT)*
- *Small Signal Stability Analysis (SSAT)*
- *Transient Stability Analysis (TSAT)*

ALSTOM's Integrated SynchroPhasor Solution



Phasor Data Concentrator (PDC)

PMU Data (1 per second)

PMU Data (30-60 per second)

Dynamic Security Assessment

- Transient Stability Analysis
- Small Signal Stability Analysis
- Voltage Stability Analysis

e-terrastability

SE snapshot (1 per min)

Energy Management System (EMS)

- Improved State Estimation
- Grid Security Assessment
- SynchroPhasor State Estimator

e-terratransmission

PMU based Information/Alerts (few seconds)

SynchroPhasor Applications Framework (PhasorPoint)

- Oscillatory Stability Monitoring
- Disturbance Detection
- Composite Events
- Islanding/Restoriation/Blackstart
- Post-Event Analysis, Baselining

Wide-Area Advanced Visualization

e-terravision

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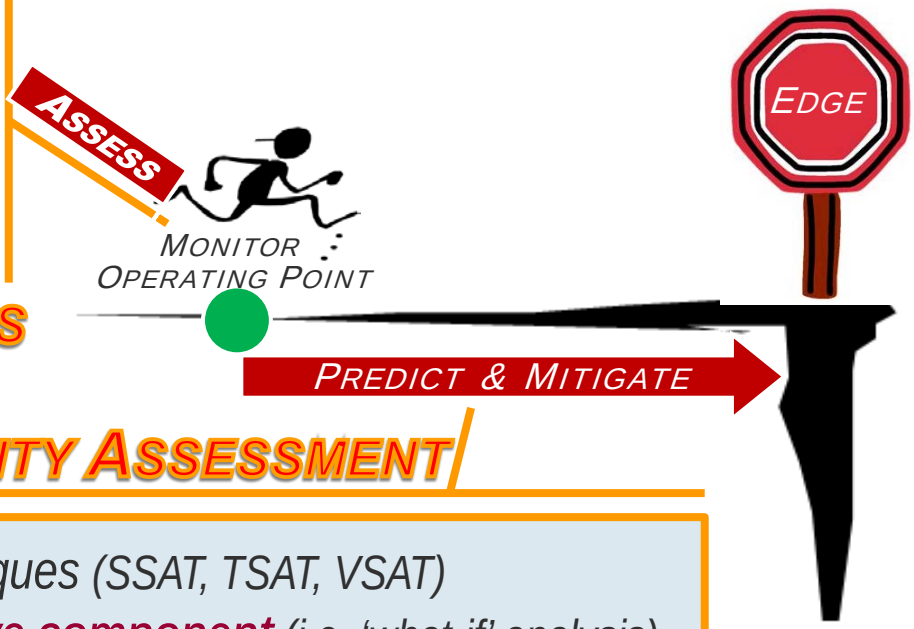
Online Stability Solutions

An ***integrated measurement-based*** and ***model-based stability*** assessment application that ***runs in real time.***

PMU measurement-based methods monitor grid stability in real-time:

- *Track current damping levels.*
- *Detect & alarm on dangerous oscillations & sudden events.*

SYNCHROPHASOR APPLICATIONS



DYNAMIC SECURITY ASSESSMENT

Model-based techniques (SSAT, TSAT, VSAT) provide the predictive component (i.e. 'what-if' analysis)

- *Available MW transfer capability ('distance' to the edge)*
- *Assess impact of critical contingencies. (e.g. change in damping levels)*
- *Recommend controls based on sensitivity information.*

Stability assessment ***visualization*** within **e-terra***vision*.

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Select Customers for SynchroPhasor Applications

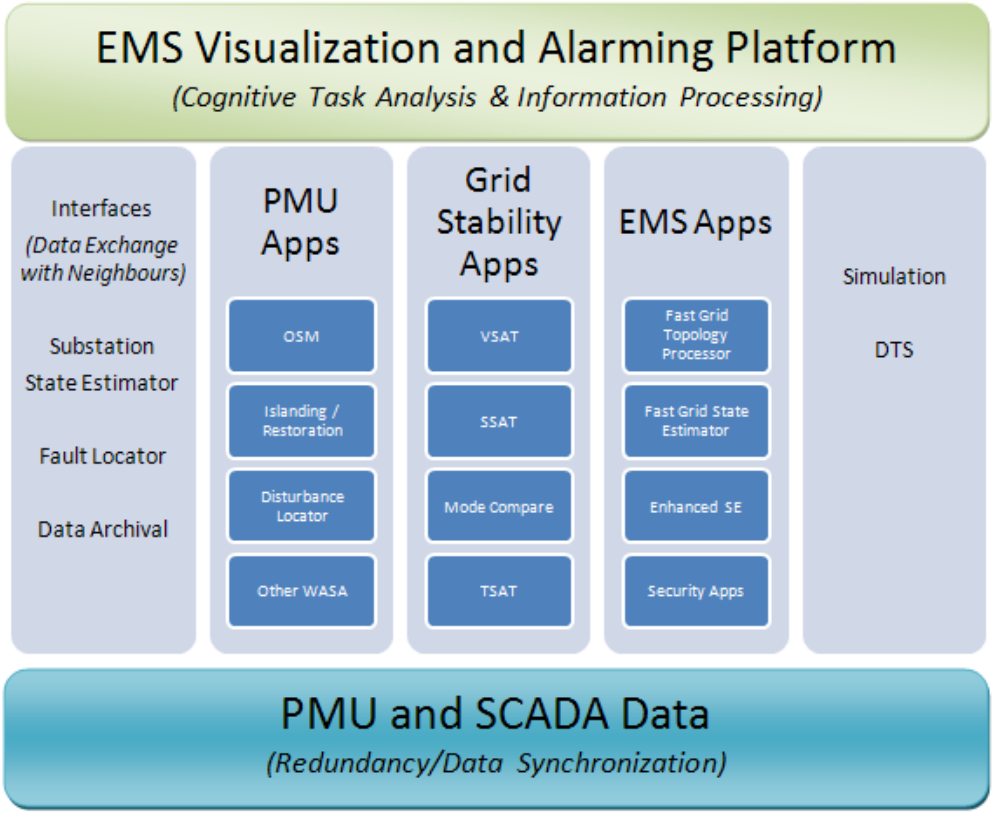
- Eskom (South Africa based Power Utility)
- Svenska Kraftnät (Swedish Electricity Transmission System Operator)
- Pacific Gas & Electric (PG&E)
- Florida Power & Light (FPL)
- Duke Energy
- ISO New England (ISO-NE)
- *Active proposals being submitted to others……*

PG&E SynchroPhasor Project

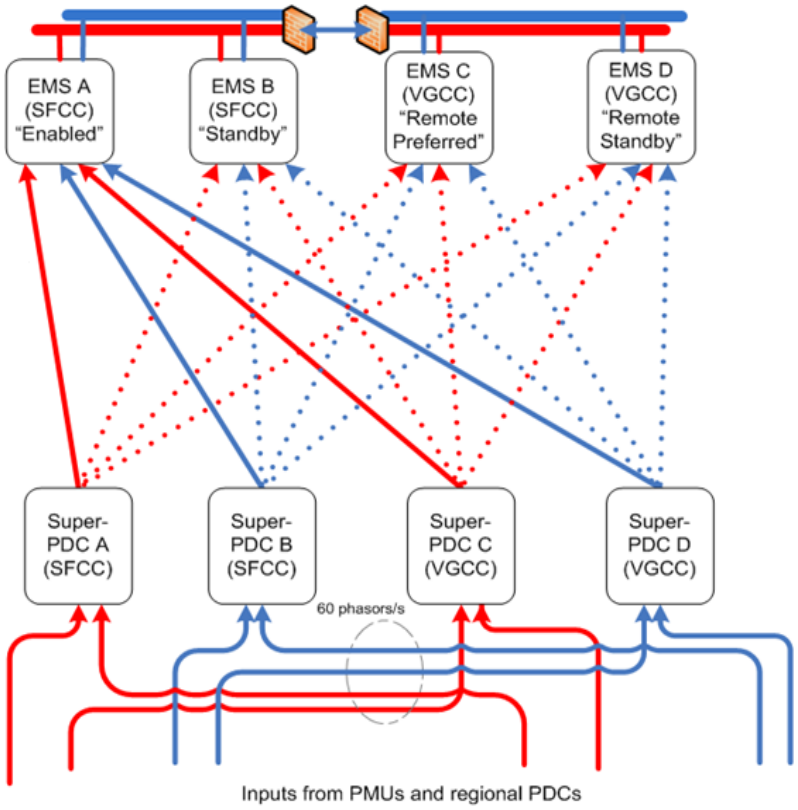
Vahid Madani – Project Technical Leader

Strategic Team: *PG&E, ALSTOM, GE, Mississippi State Univ., Quanta*

Academic & Testing Partners: *GeorgiaTech, Omnicron/VirginiaTech, Washington State Univ.*



SynchroPhasor Applications for the Control Center



Multi-host Redundancy (ISD Link)

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Expansion of IEC 61850 outside Substation environments

IEC 61850 as communication interface with EMS

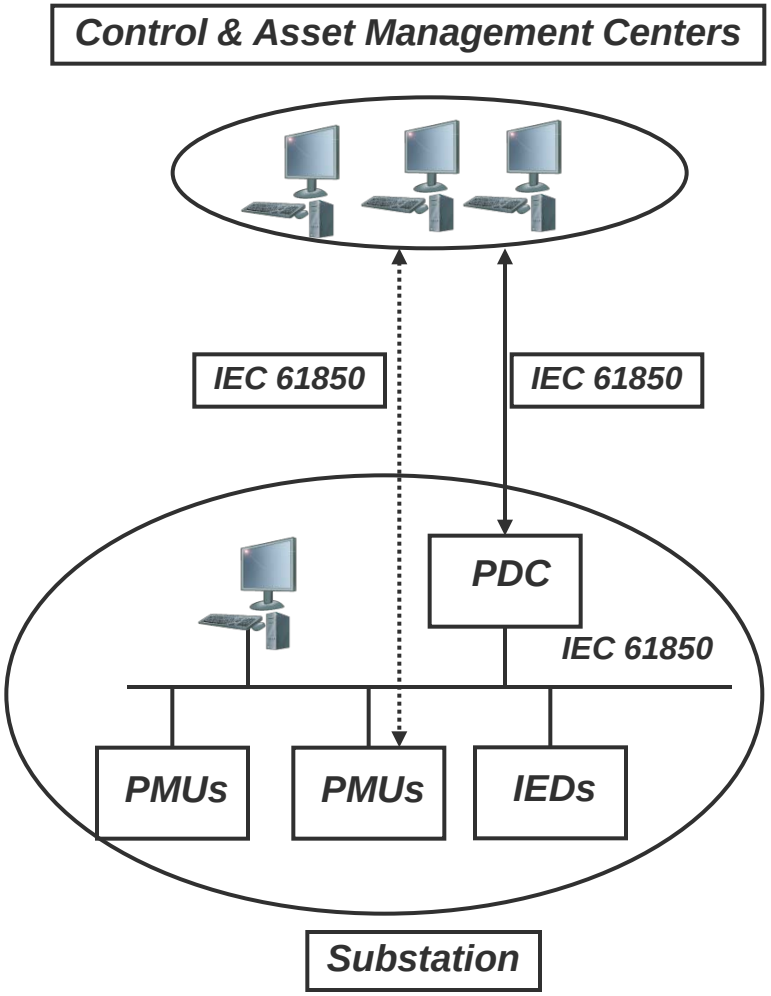
- Simplified Substation integration

IEC 61850 as single substation model

- Single IEC 61850/IEC 61850 Substation PDC used as single Substation interface
- Single access for remote control, maintenance & asset management
- Version management for Hardware, Software, Configuration and Setting

IEC61850 as a fast automation back bone to support Wide Area Automation

Support for Enterprise Level Applications



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Alstom Grid – ISO New England

Courtesy Mike Gilmore, ISO-NE

- ISO-NE SIDU project scope:
  - increase synchrophasor data measurements from key transmission sub-stations within New England region and
  - provide analytical tools based in part on phasor data.
- ISO-NE using OpenPDC as foundation
- Alstom Grid selected as the prime vendor for integration services of OpenPDC at ISO-NE as well as seven Transmission Owners(TO). These services include:
  - Installation/configuration/testing at ISO-NE and TO sites;

    TO PMU(s) → TO OpenPDC →ISO-NE OpenPDC
  - Coordination of OpenPDC releases with ISO-NE;
  - Management of OpenPDC releases as GPA releases new versions;
  - Creation of OpenPDC installation, testing, administration and user documentation;
  - Training;
  - As needed support for maintenance and troubleshooting;
  - Consulting services.

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MiCOM P847 Series PMU Functionality

Analog Channels

- Va, Vb ,Vc,V1, V2,V0
- I1 , I2 , I0, Ia , Ib ,Ic
- Frequency & Rate of Change of Frequency

Digital Channels

- Any 8 status signals available

MiCOM Substation PDC Functionality

- *Concentrates up to 15 phasor data sources (e.g PMUs)*
- *Based on solid-state ruggedized PC rated for substation applications*
- *C37.118 data archiving*
- *Remote configuration, license and archive management*
- *Supports multiple simultaneous input and output reporting rates*
- *State-of-the-art graphic user interface*

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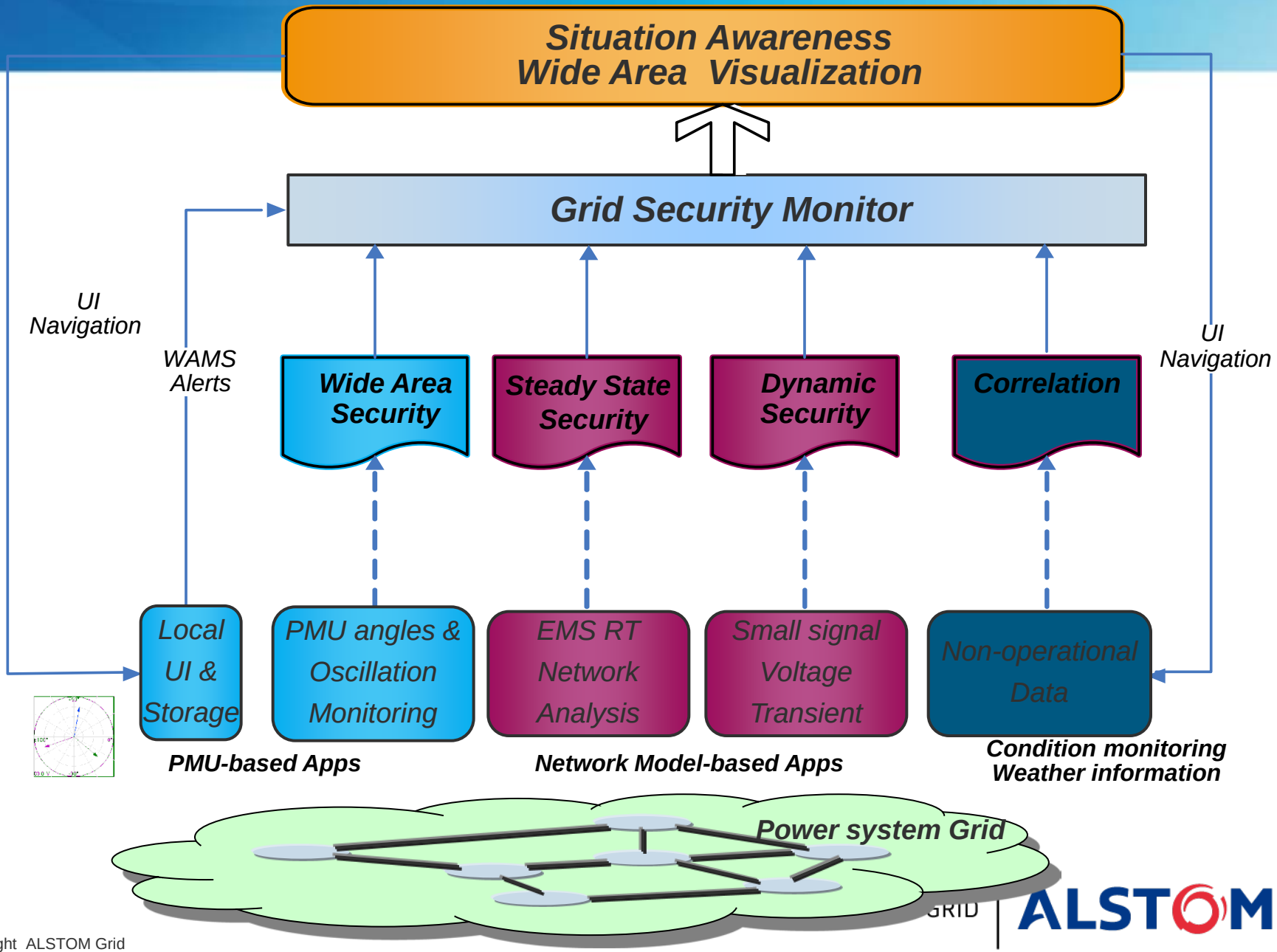
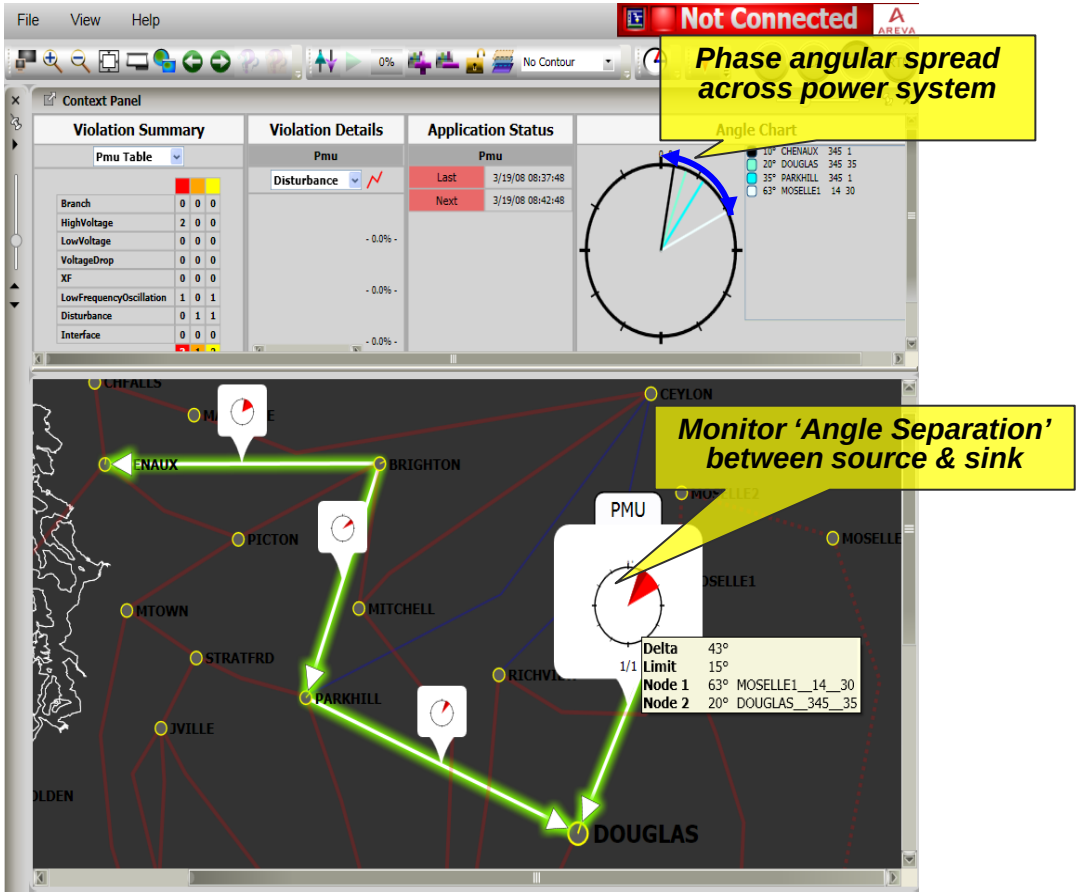
Wide Area Situational Awareness Visualization

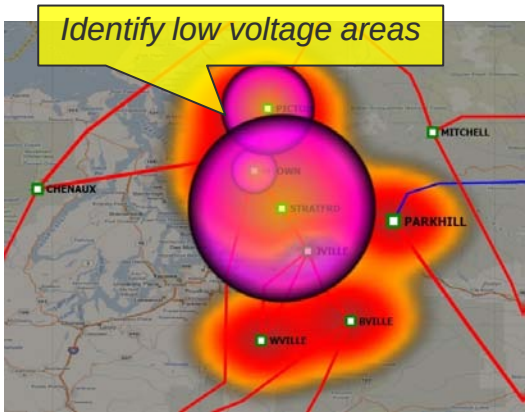


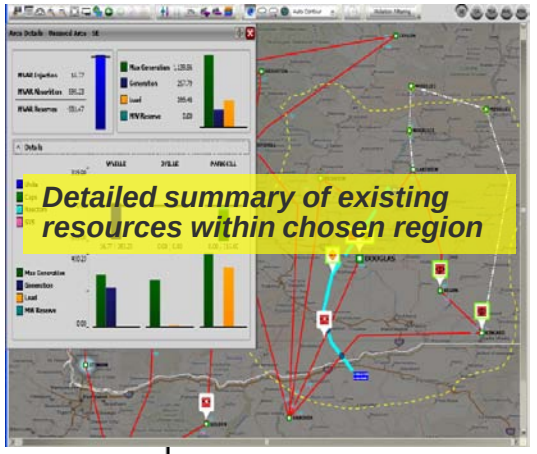
Wide-Area Situational Awareness with PMUs

Monitor 'angular separation' as an indicator of increased grid stress due to:

- *increased transmission path loading between 'Sources' & 'Sinks' of power*
- *sudden events such as line outages (i.e. weakening of the grid)*







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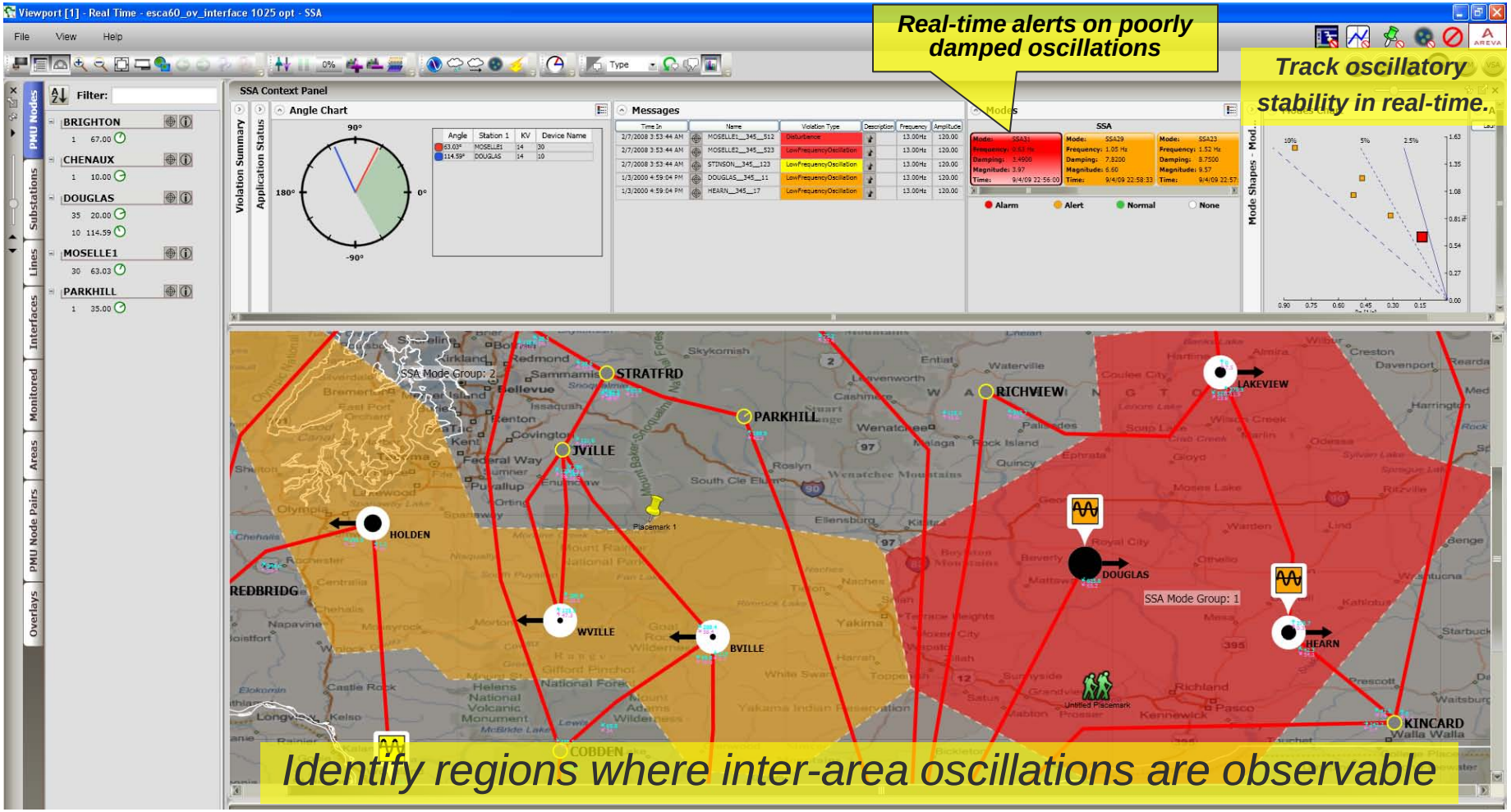
OSM Visualization within e-terra*vision*

Modes shapes, amplitudes, damping, frequency, etc



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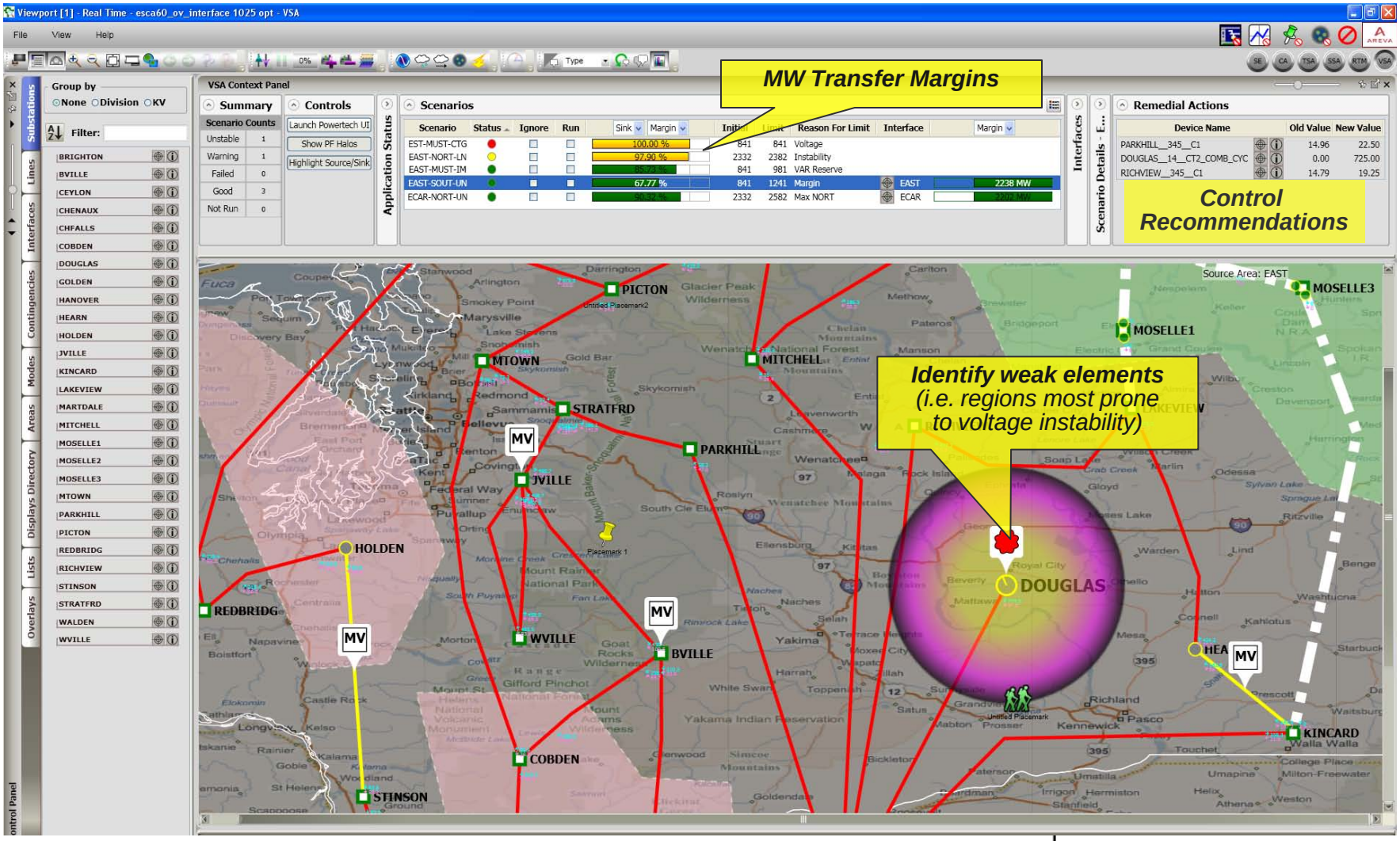
Voltage Security Analysis in e-terra*vision*

Voltage Contours, MW Margins, Weak Elements, Remedial Actions



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SynchroPhasors in EMS

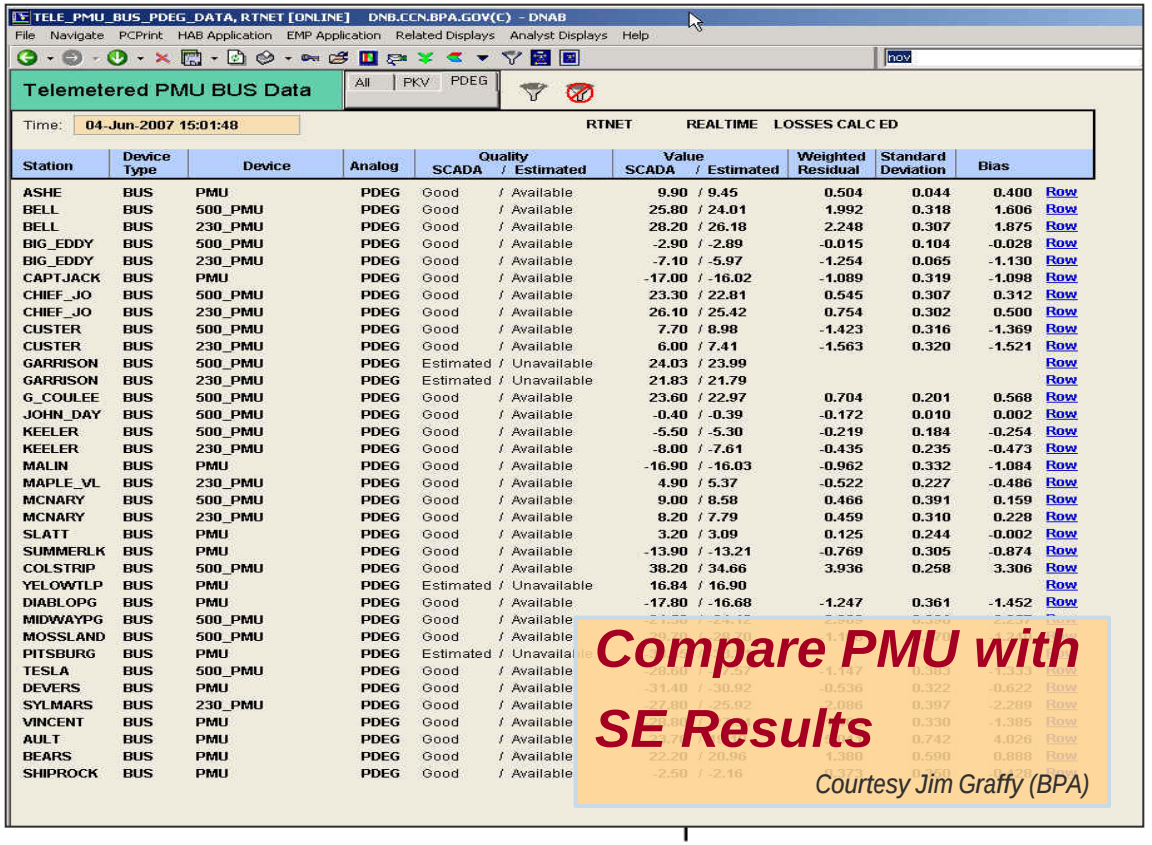
Enhanced State Estimator with PMU data at the 1 sample/sec rate

Utilization of PMU data (voltage & Current Phasors) in SE to improve round-the-clock reliability & robustness.

- *Increase the number of 'Valid Solutions'* ⇒ ***improved reliability***
- *Reduce dependency on 'Critical Measurements'* ⇒ ***better observability***
- *Improved SE solution quality to minimize 'Variance of State'*

  ⇒ ***higher accuracy***
- *Fewer SE iterations*

  ⇒ ***faster performance***



ALSTOM's Product Offerings Today!

PMU Functionality *(MiCOM P847):* Multi-function device with PMU capability.

Substation PDC *(MiCOM S800):* Ruggedized PDC for substation environment.

Control Center PDC*:* Processing and Synchronizing time series data.

Wide Area Situational Awareness & Visualization *(e-terravision**):***

- *Monitoring angle differences for instability*
- *Identifying low voltage areas & available voltage support sources*
- *User-created, on-the-fly, dynamic dashboards*

Synchrophasor Applications:

- *Oscillatory stability monitoring (OSM)*
- *Fast detection & alarming of unexpected disturbances; Composite events.*
- *Islanding, restoration, blackstart.*
- *Post Disturbance Analysis & Baselining.*

Improved State Estimation using Voltage and Current PMU data

Online Stability Solutions *(OSS):* Comprehensive dynamic security assessment

- *VSAT /SSAT/TSAT integration with Visualization platform*

Engineering Services– PMU Placement Studies, PSS Tuning, Baselining Analysis

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Alstom - Concluding Remarks

- Ready & committed to providing synchrophasor solutions for a control center environment.
- Well-defined vision & roadmap for deployment of synchrophasor technology.
- Offer a complete suite of synchrophasor products:
  PMU, substation PDC, control center PDC, synchrophasor applications, visualization.
- Utilize standard technologies and protocols:
  web-services, C37.118, IEC 61850
- Range of solution choices for the customer:
  - "Plug & play" with applications with other vendors' solutions:
    PDCs, non-ALSTOM EMS, Historians, visualization, etc
  - Open framework for "plugging-in" 3rd party solution engines.
  - Full suite of solutions from PMUs…to Operator Visualization.

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Questions/Comments ?

Thank You