PhasorPoint: Oscillatory Stability Management

NASPI Meeting
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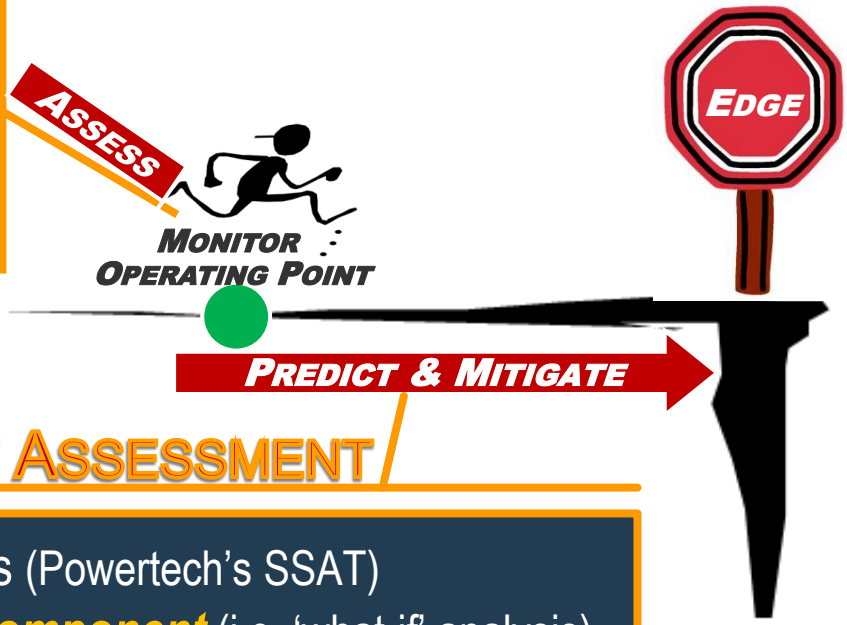
Our Vision for Oscillatory Stability Monitoring and Assessment

PMU ***measurement-based*** methods
Oscillatory Stability Monitoring in real-time:
- *Track current damping levels*
- *Detect & alarm stability risks & sudden events*



SYNCHROPHASOR APPLICATIONS

Validate
Dynamic Limits

DYNAMIC SECURITY ASSESSMENT

Model-based techniques (Powertech's SSAT)
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)*
- *Recommend controls based on sensitivity information.*

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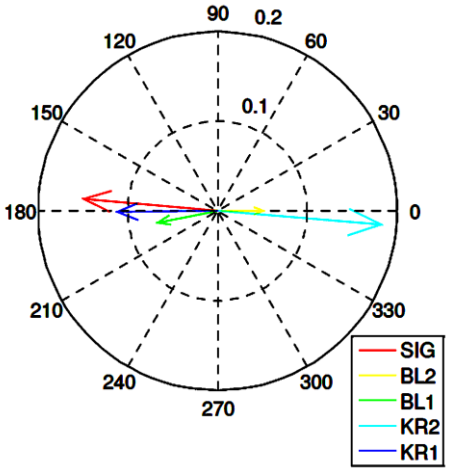
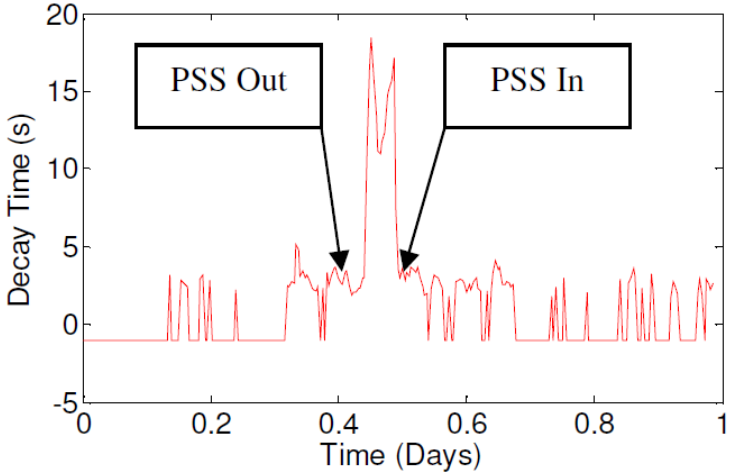
Combined Measurement- & Model-based Approach for Model Validation

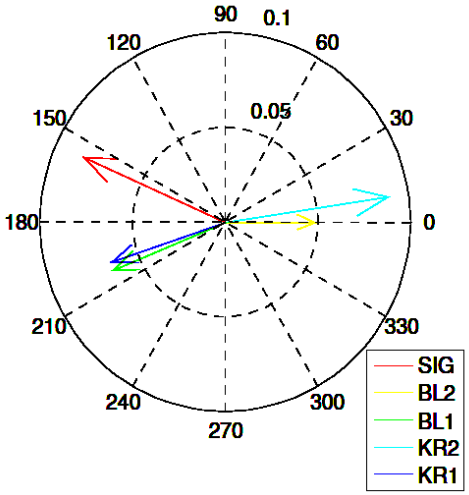
0.6Hz mode record including PSS test

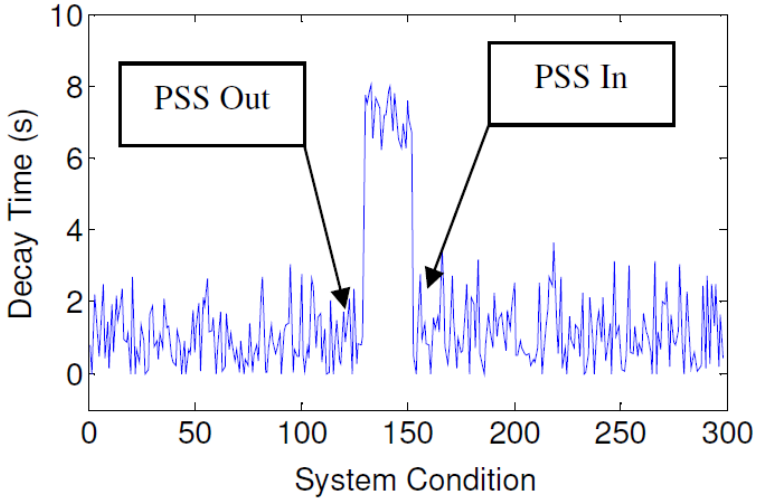
Measured





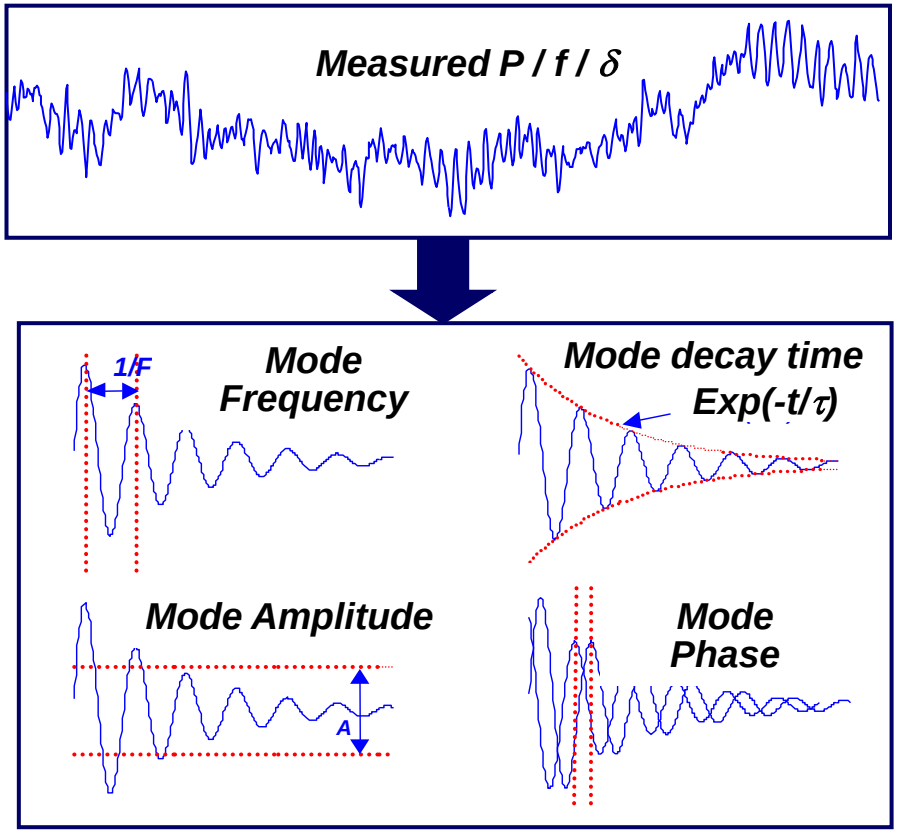
Modelled





Oscillatory Stability Management

Simultaneous multi-oscillation detection and characterisation direct from measurements



Fast Modal Analysis: Alarms

Trend Modal Analysis: Analysis

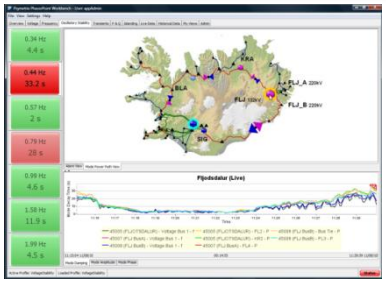
Operations

Early warning of poor damping (two level alarms)

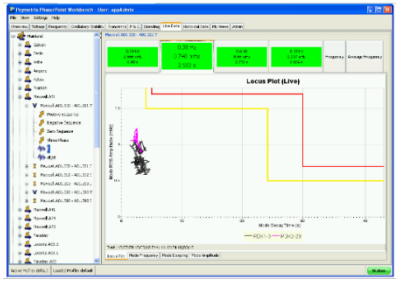
Unlimited oscillation frequency sub-bands

Individual alarm profiles for each sub-band

For each oscillation detected, alarm on:
mode damping and/or
mode amplitude for



Wide area mode alarms



Mode locus plot with alarm thresholds

Planning & Analysis, Plant Performance

Post-event analysis

Dynamic performance baselining

Dynamic model validation

Damping controller performance assessment

Oscillation Source Location

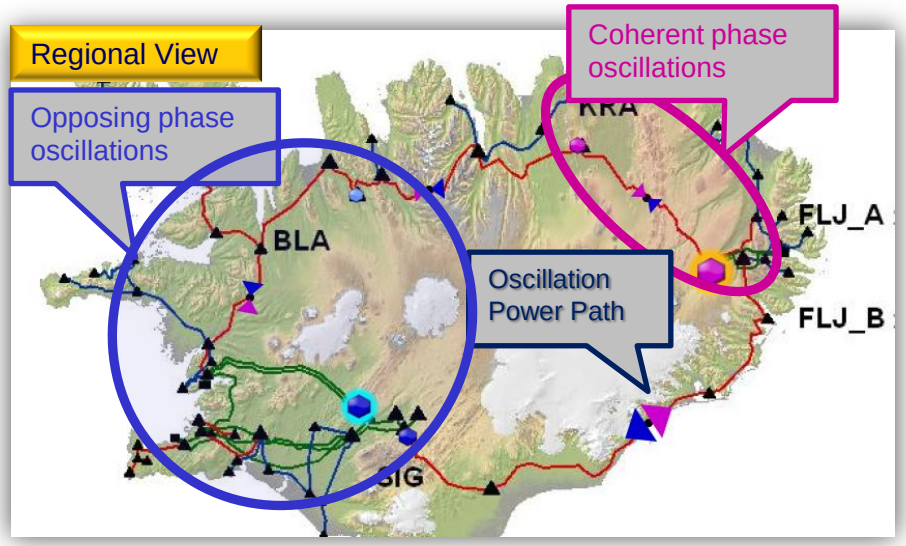
Mode Power Path

Identify contributions from regions

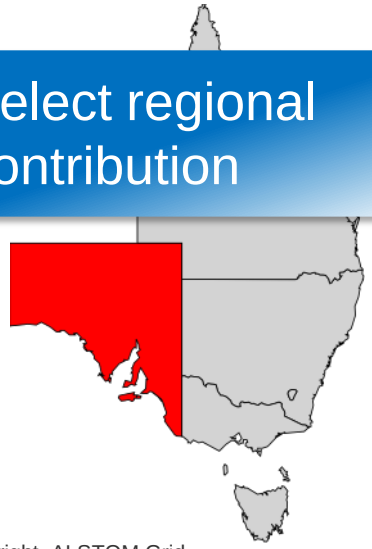
Uses only PMU data

All region boundaries monitored

“Regions” can be any size



1 Select regional contribution



2 Identify local contribution

3 Action guidelines

Auto-Report

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PhasorPoint in Operations

Success Stories

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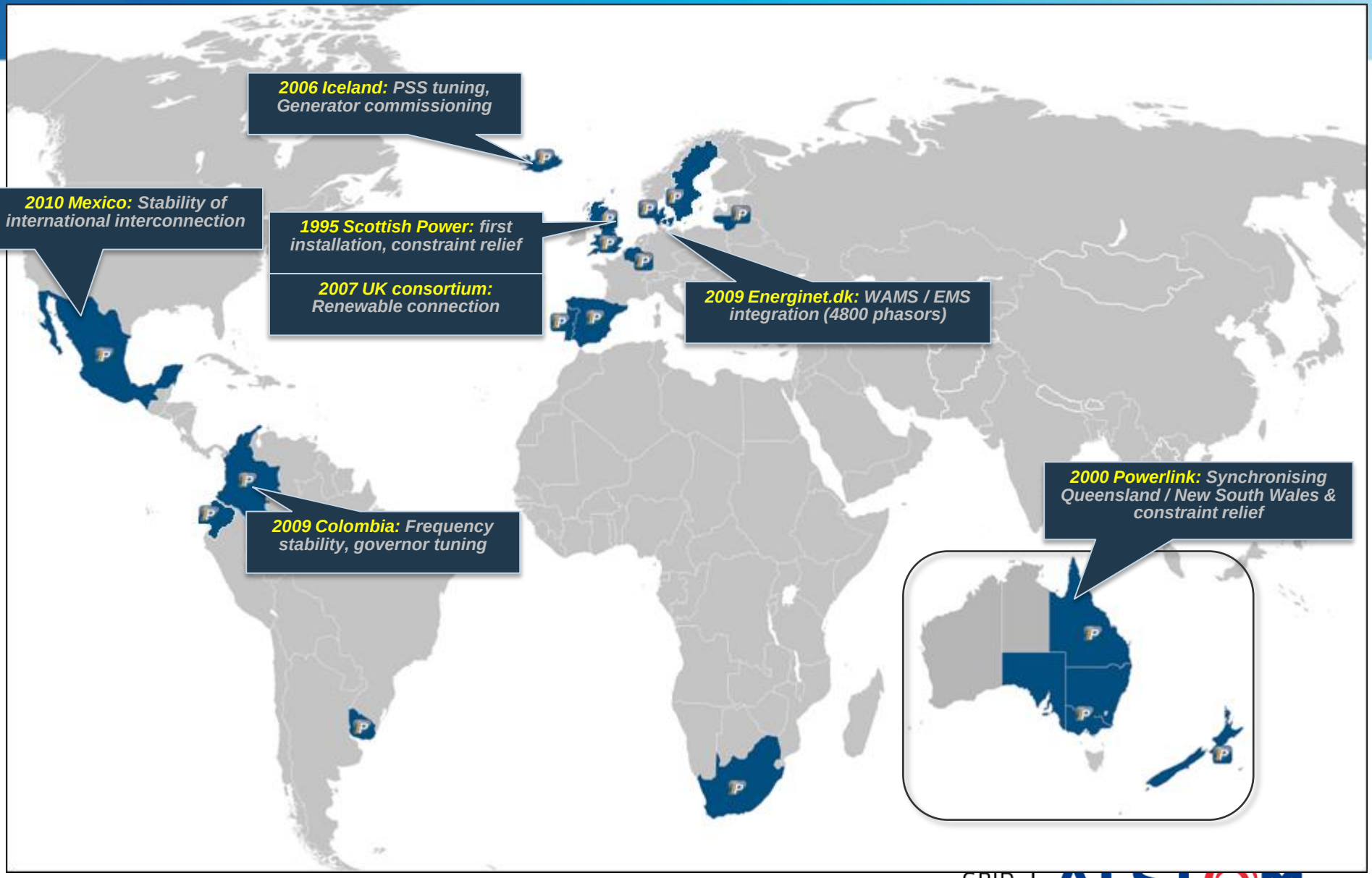
Global Activities



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Eskom, South Africa - 2009

Pilot project complete, next stage 4200 phasor system

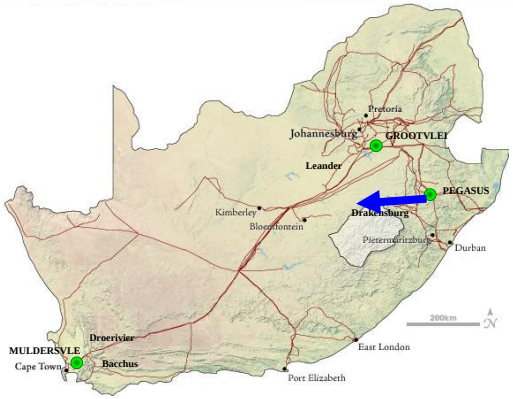
Key features

- Flexible user configurable displays (e.g. wallboard)
- Flexible alarms (level, ROC, composite) & notification (via EMS)
- Oscillatory stability
- Disturbance capture & analysis
- High availability

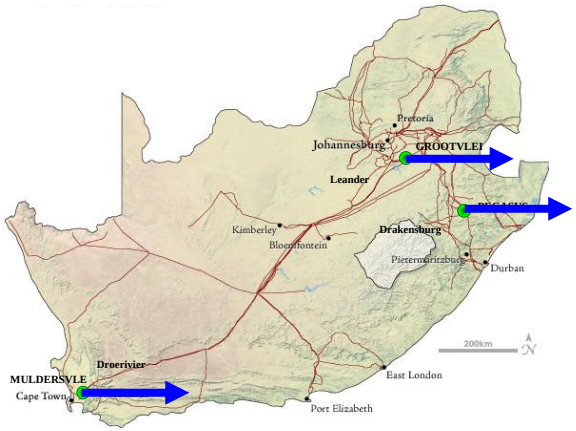
Exploring new application areas e.g.

- Constraining by angle

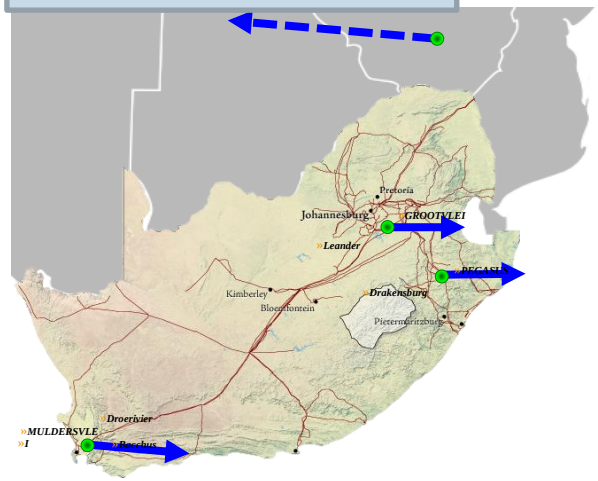
»Local Modes (various)



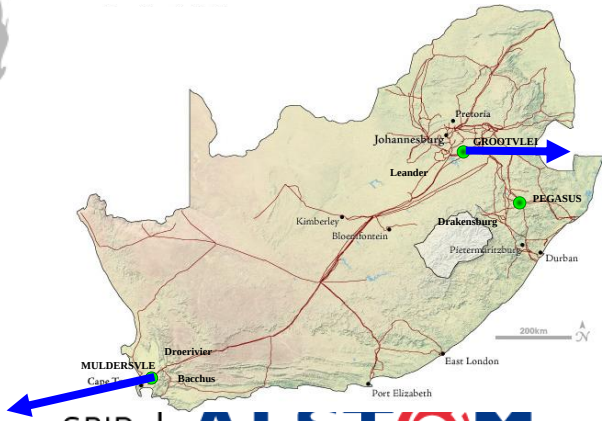
»0.05Hz Common Mode



»0.3Hz SAPP Mode



»0.7Hz Interarea Mode



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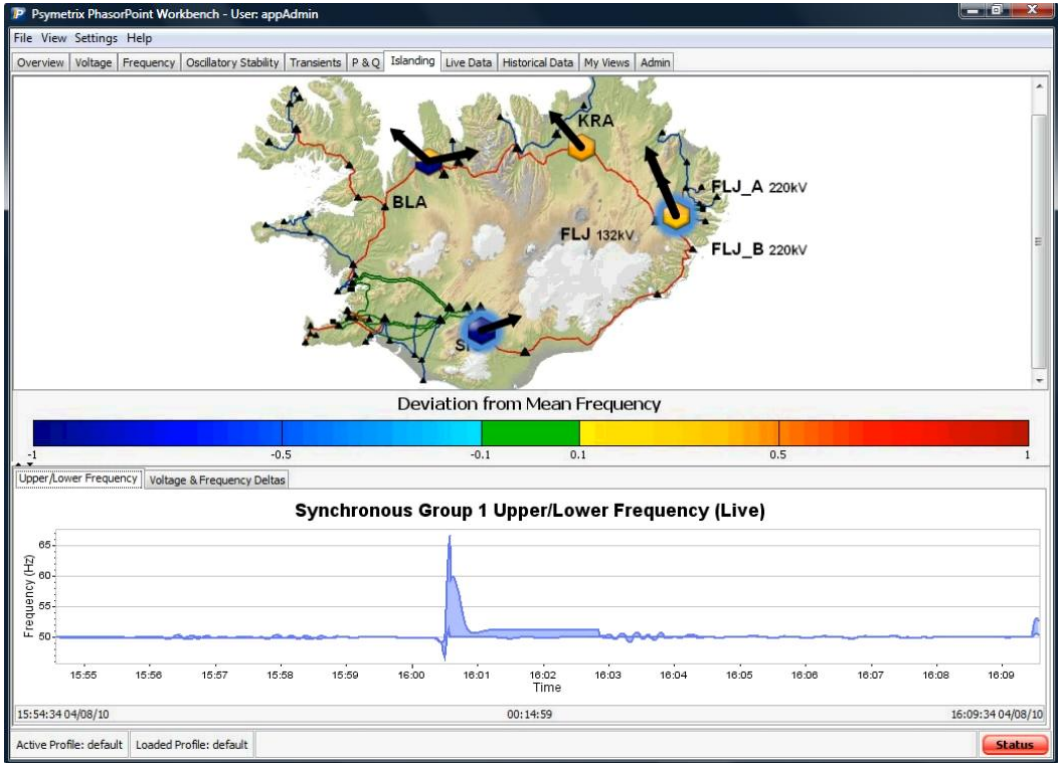
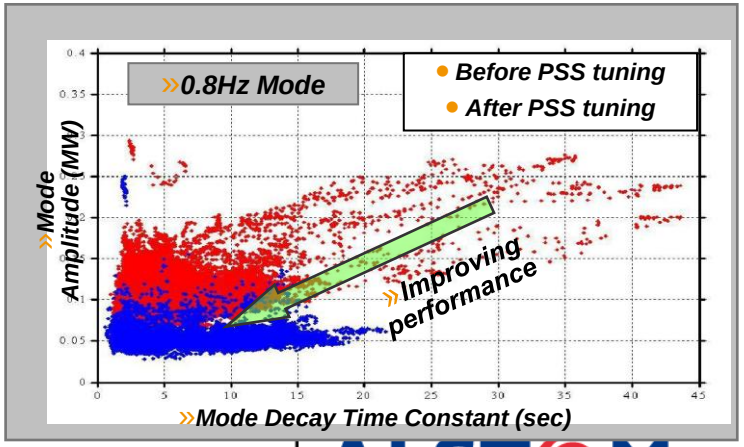
Landsnet, Iceland 2007

Oscillations & PSS Tuning

Governor stability





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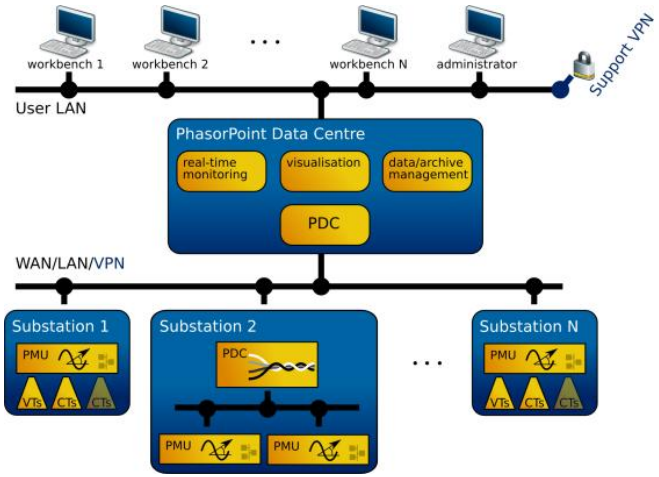
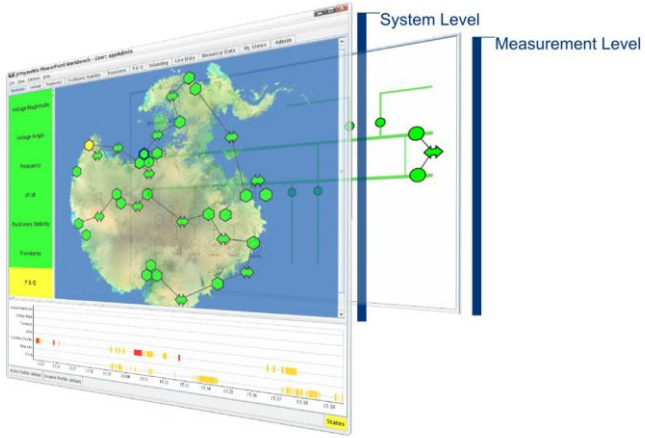
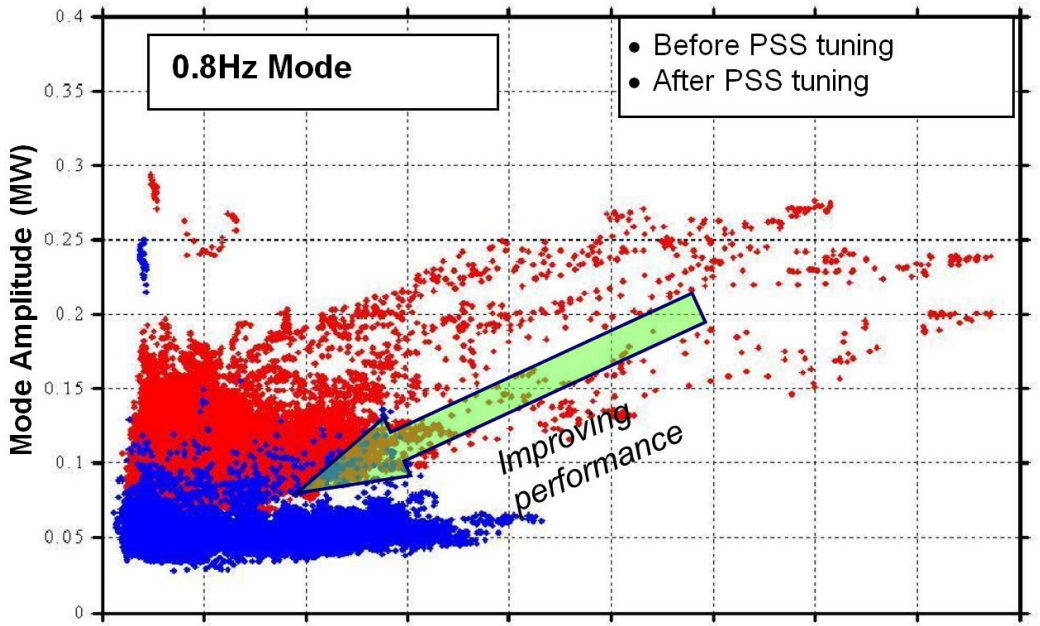
Iceland - 2007

PSS Tuning & Dynamic Model Validation

1. Observe
2. Model
3. PSS Design
4. Testing & Commissioning
5. Operation







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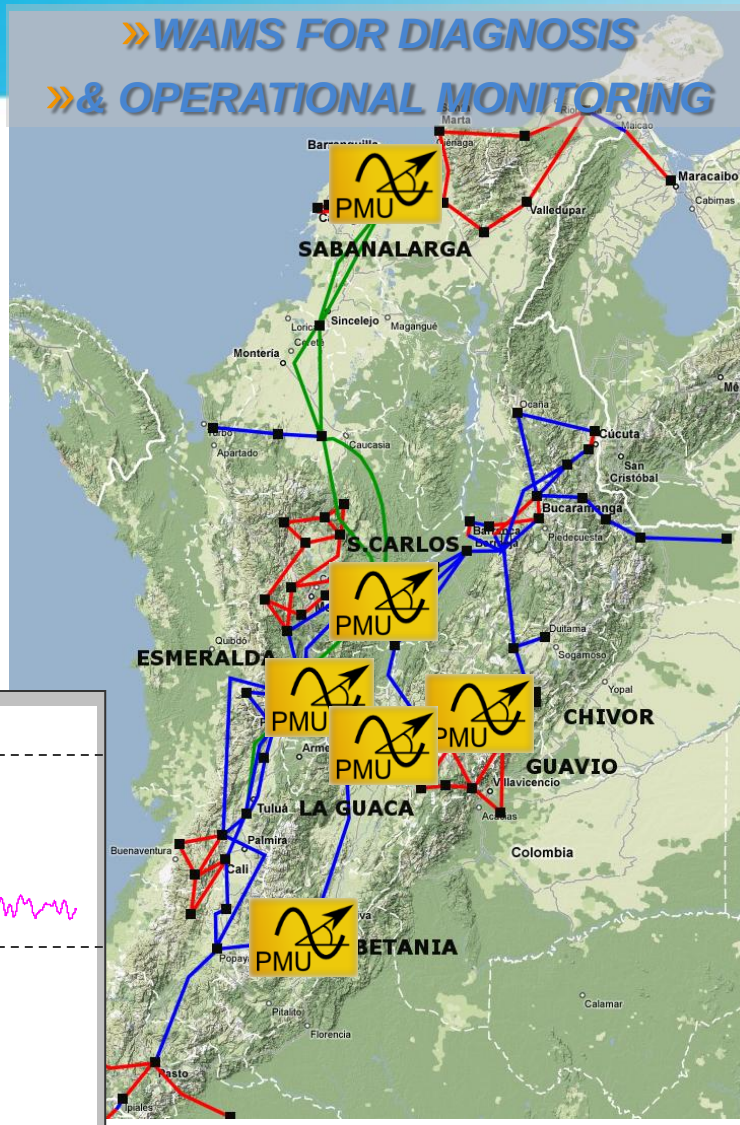
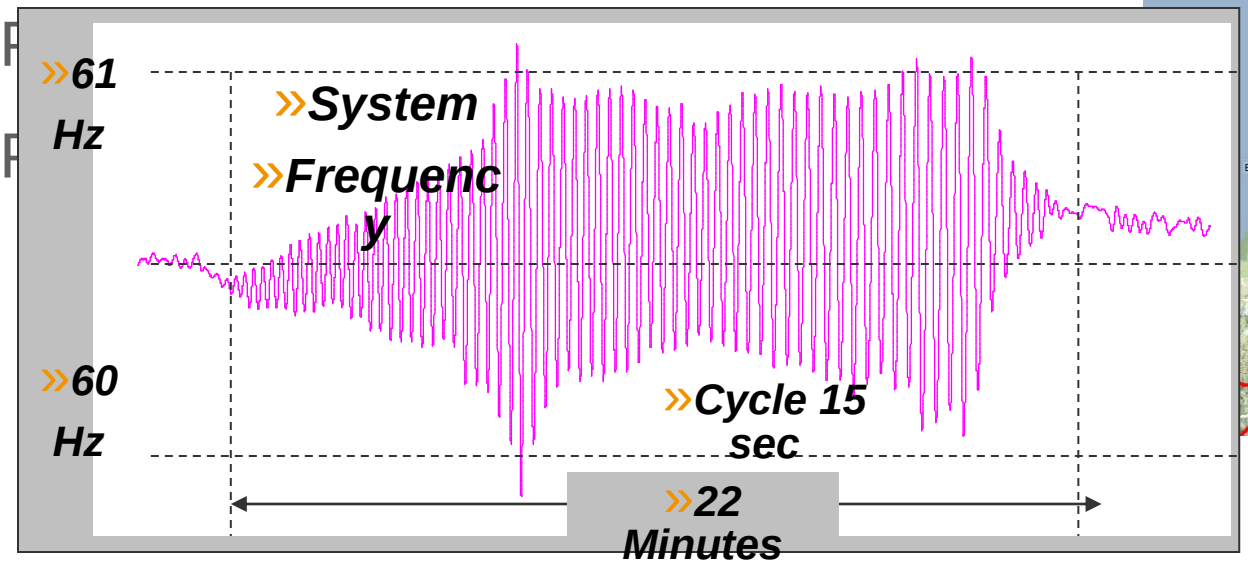
XM, Colombia - 2009

- Identifying & resolving frequency instability
- Governor testing & tuning
- Islanding, Resynchronisation & Blackstart
- Control room warning/response





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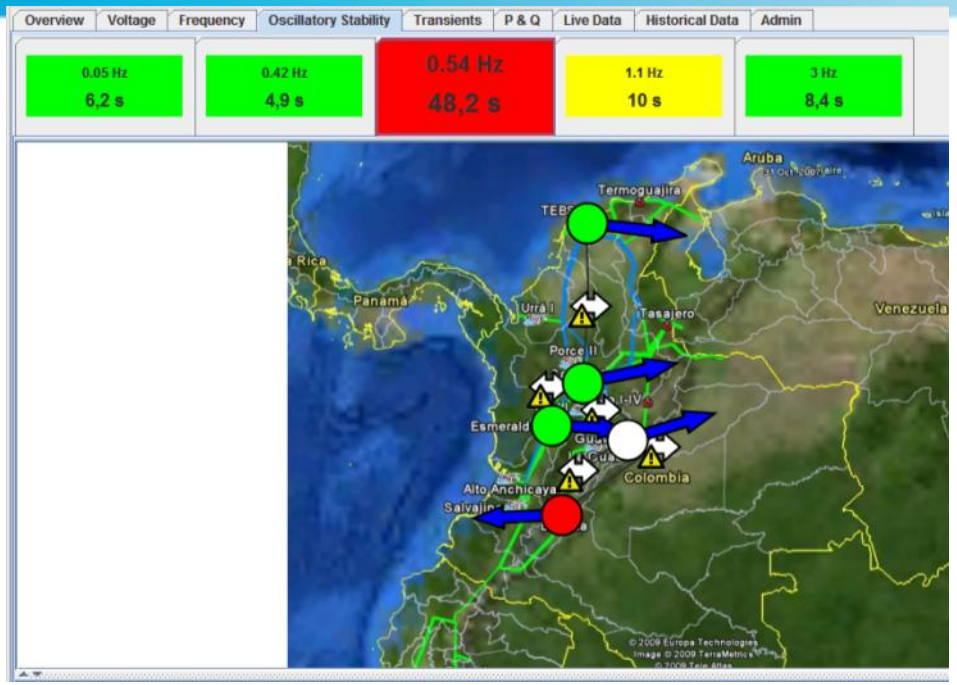
XM Colombia - 2009

Modes Observed in Colombia (Inter-Area and Common-mode)

Inter-area mode at 0.49Hz (Colombia-Ecuador). Opposing phase in South



Governor common-mode: whole system oscillates in coherent phase

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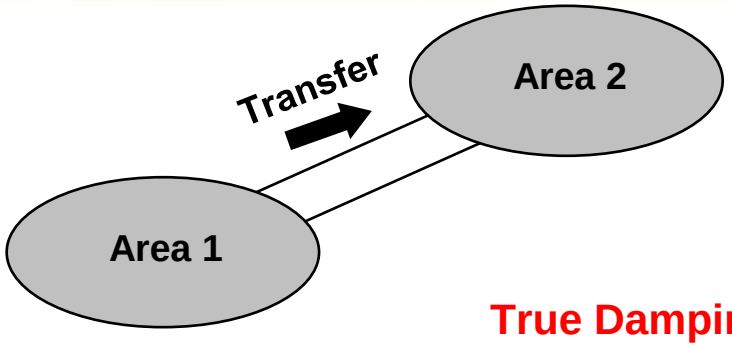
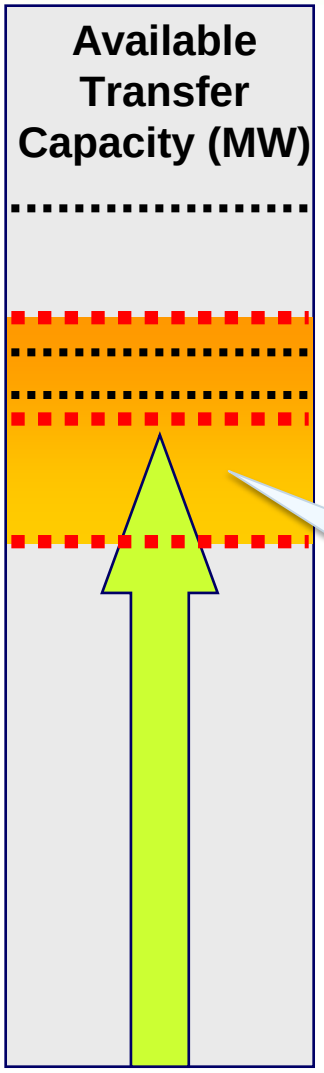
Powerlink Australia - 2000

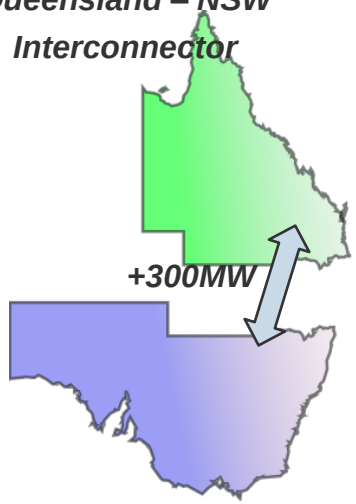
Transfer Constraint Relief

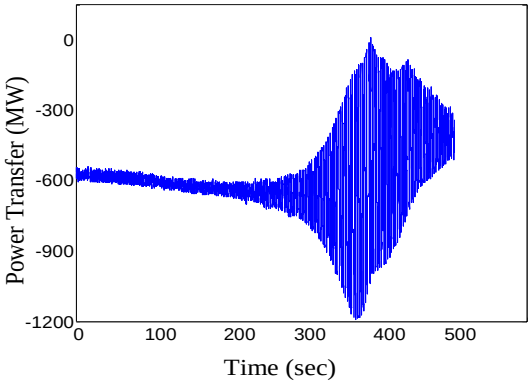
Applied in Australia & UK
+300MW





Australia Queensland – NSW Interconnector





Capacity available provided measured damping is acceptable

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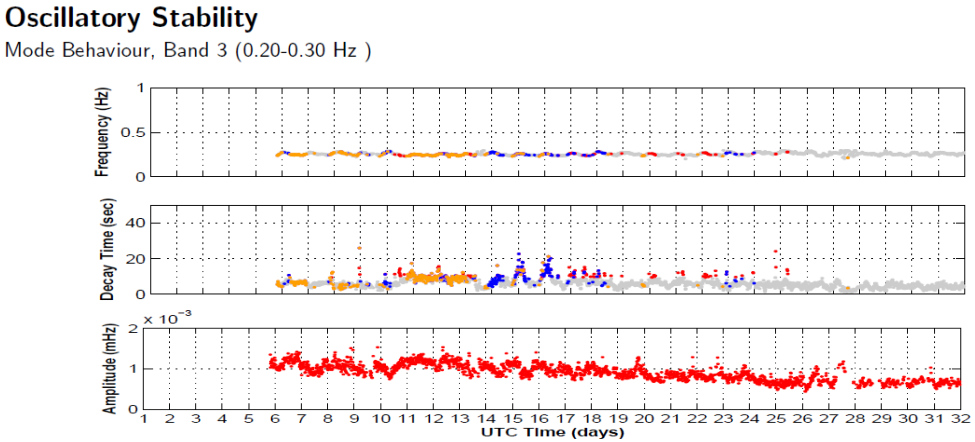
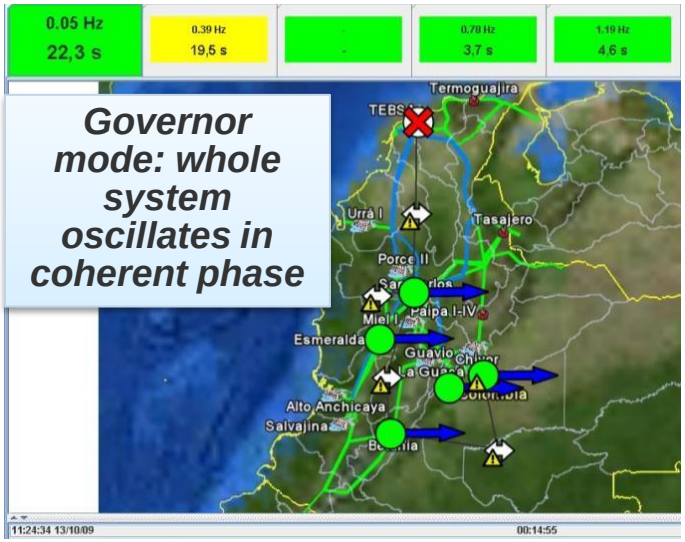
Baselining for Assessment and Issue identification

Assessment: Dynamic Performance Reporting



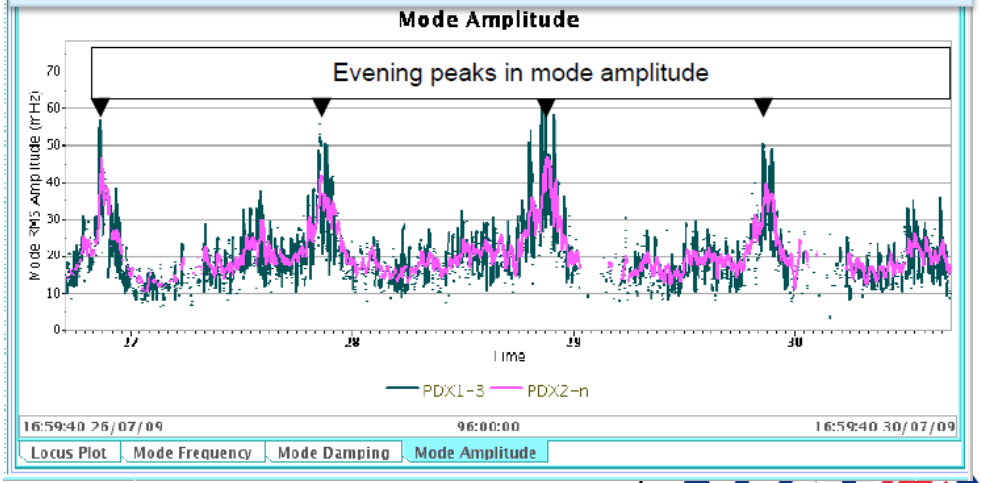
Baselining: Monthly reports identify normal & unusual oscillation behavior and patterns.

Issue Identification: Governor Stability



Governor mode: whole system oscillates in coherent phase

Characteristic behaviour pattern



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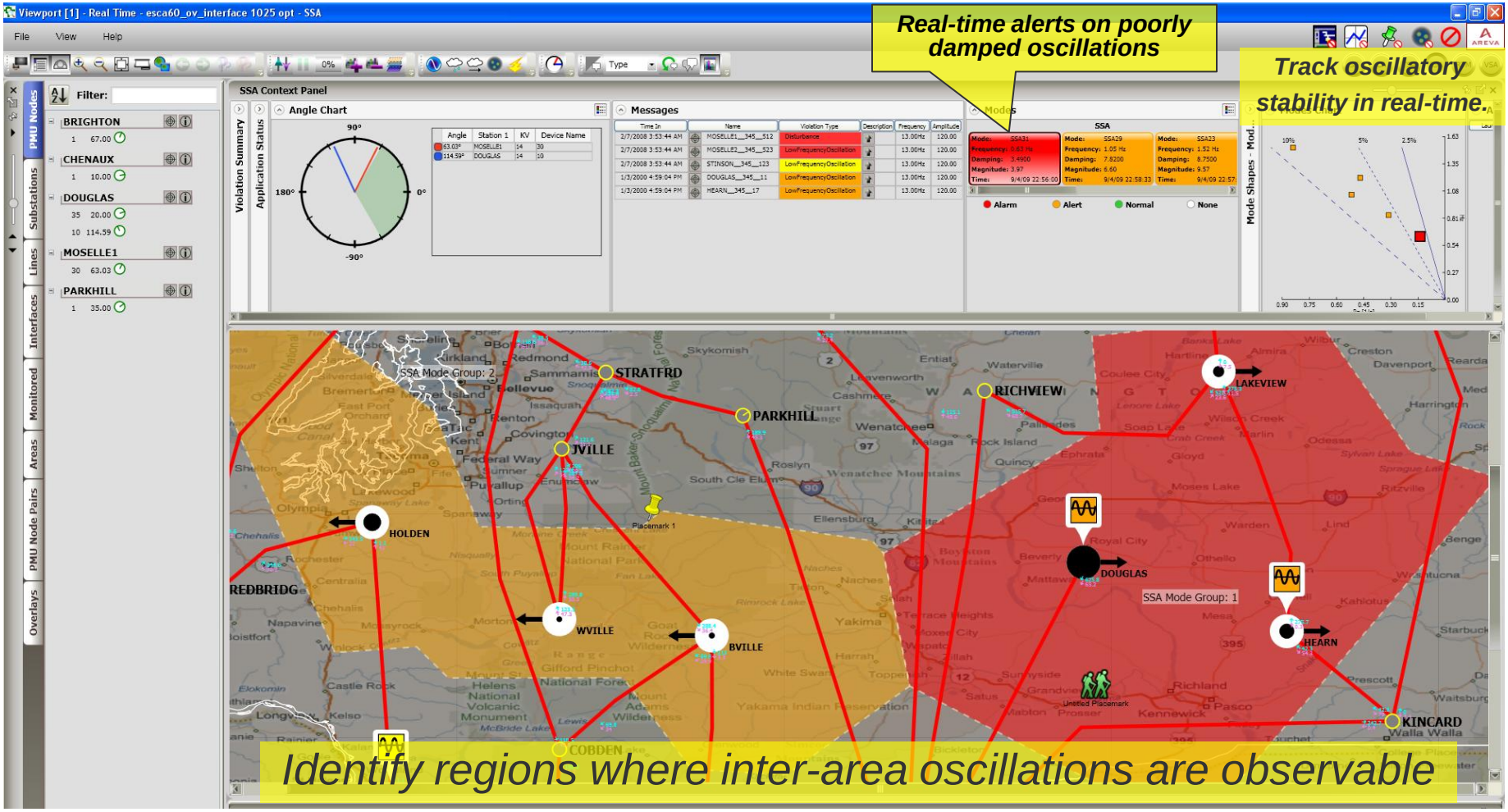
Small Signal Stability within e-terra*vision* – *Sample Display*

Modes shapes, amplitudes, damping, frequency, etc



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THANK YOU

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