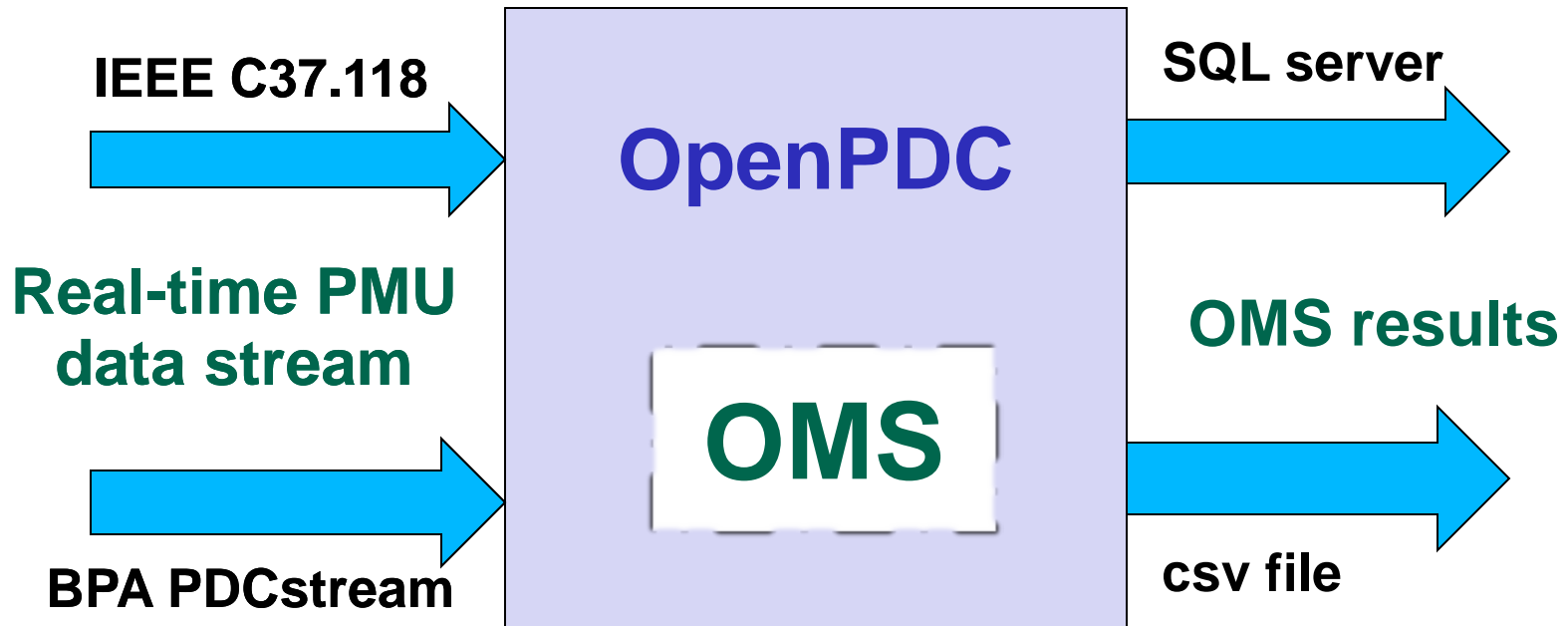


Oscillation Monitoring System using Synchrophasors

Mani V. Venkatasubramanian

**Washington State University
Pullman WA**

Oscillation Monitoring System

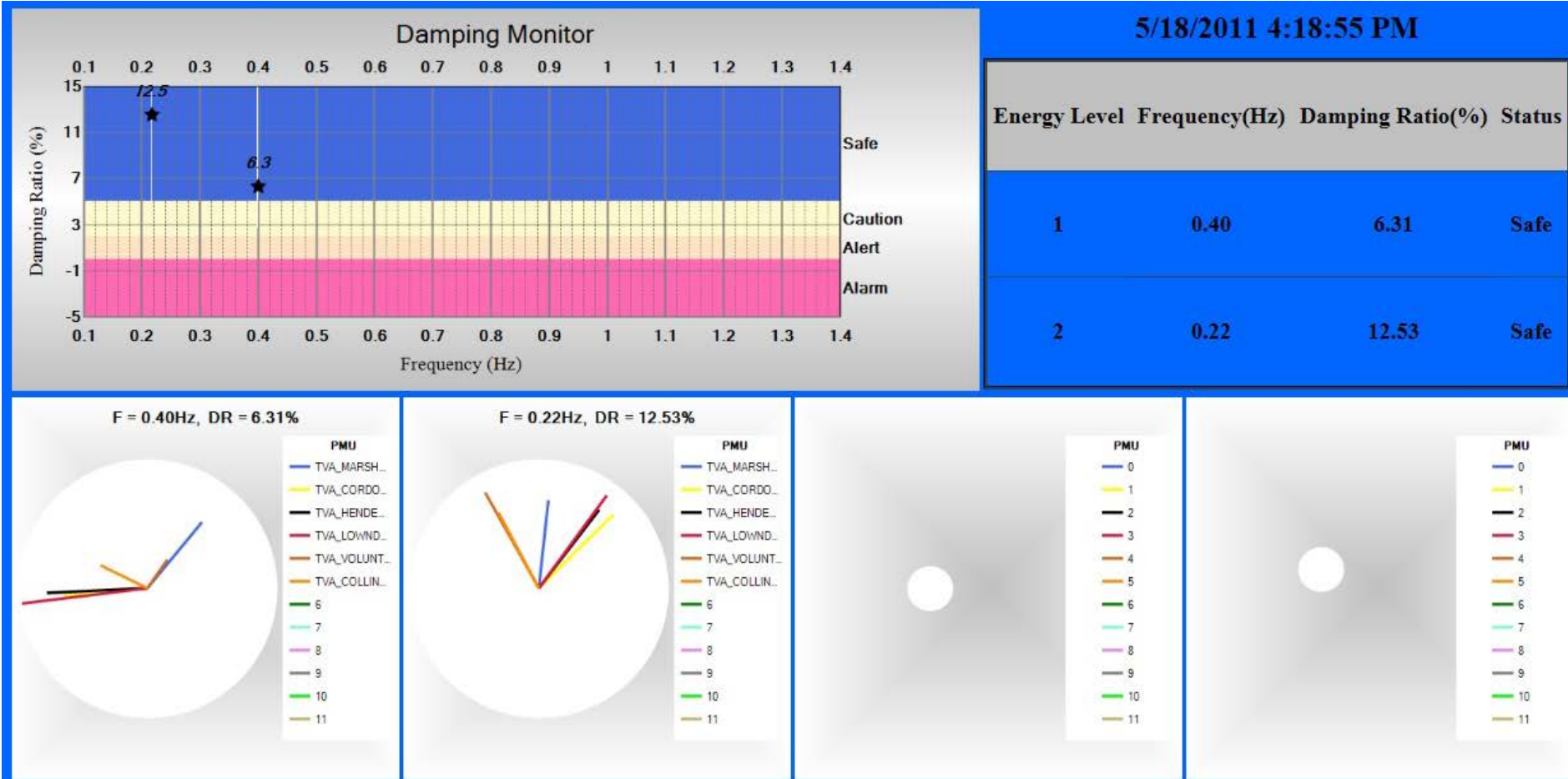


OMS action adapter built into OpenPDC 64 bit version 1.4 sp1. Available for beta testing.

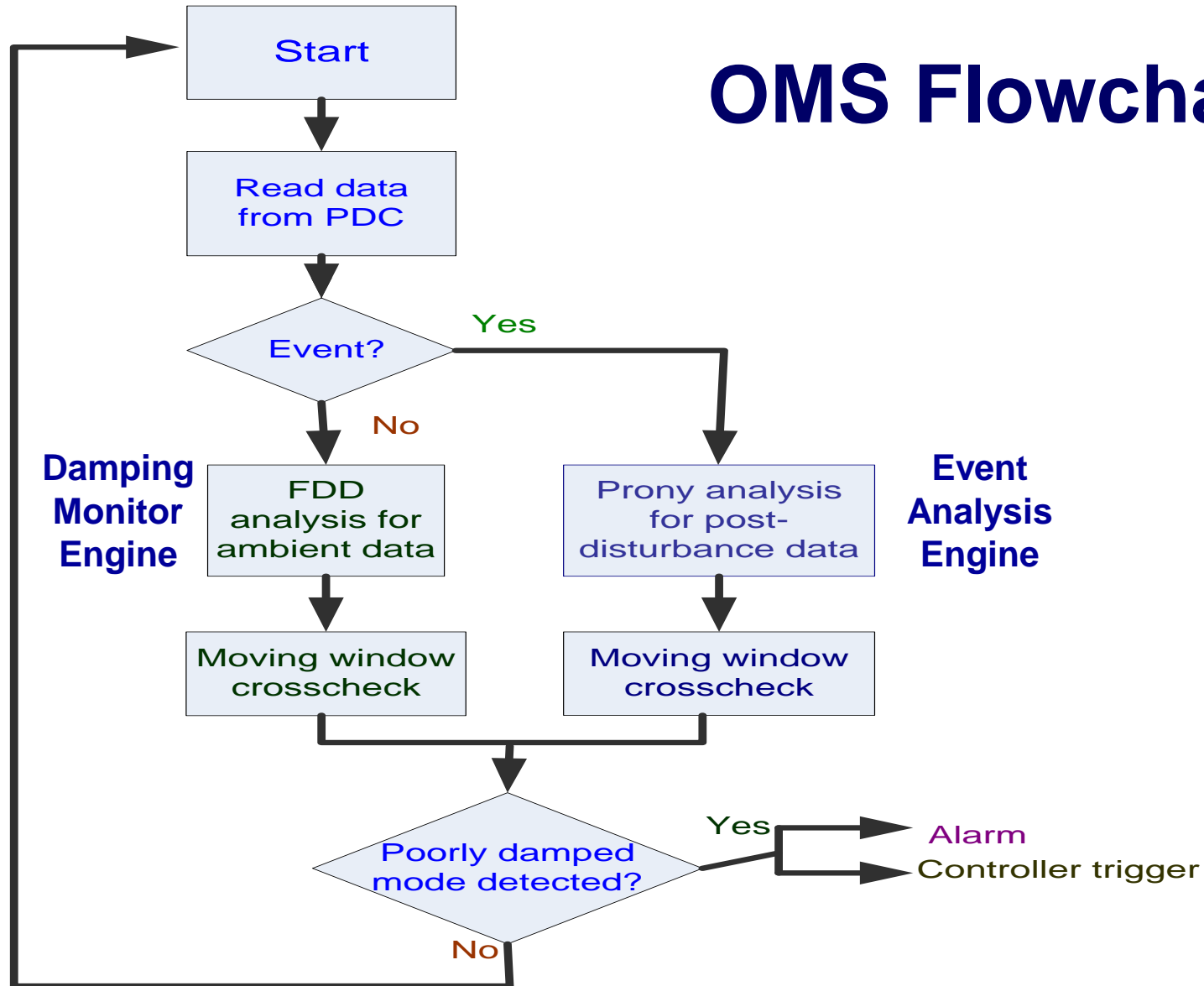
Oscillation Monitoring System

- US patent awarded
- Real-time code integrated into GPA 64 bit openPDC
- Stand-alone OMS test engine available
 - can interface with any PDC
- TVA-GridApp project to monitor eastern system modes
- OMS results will be posted on a protected website hosted by TVA – operator displays in progress
- SGIG project to implement in Entergy – beta version

Recent test results at GPA



OMS Flowchart



Complementary Engines

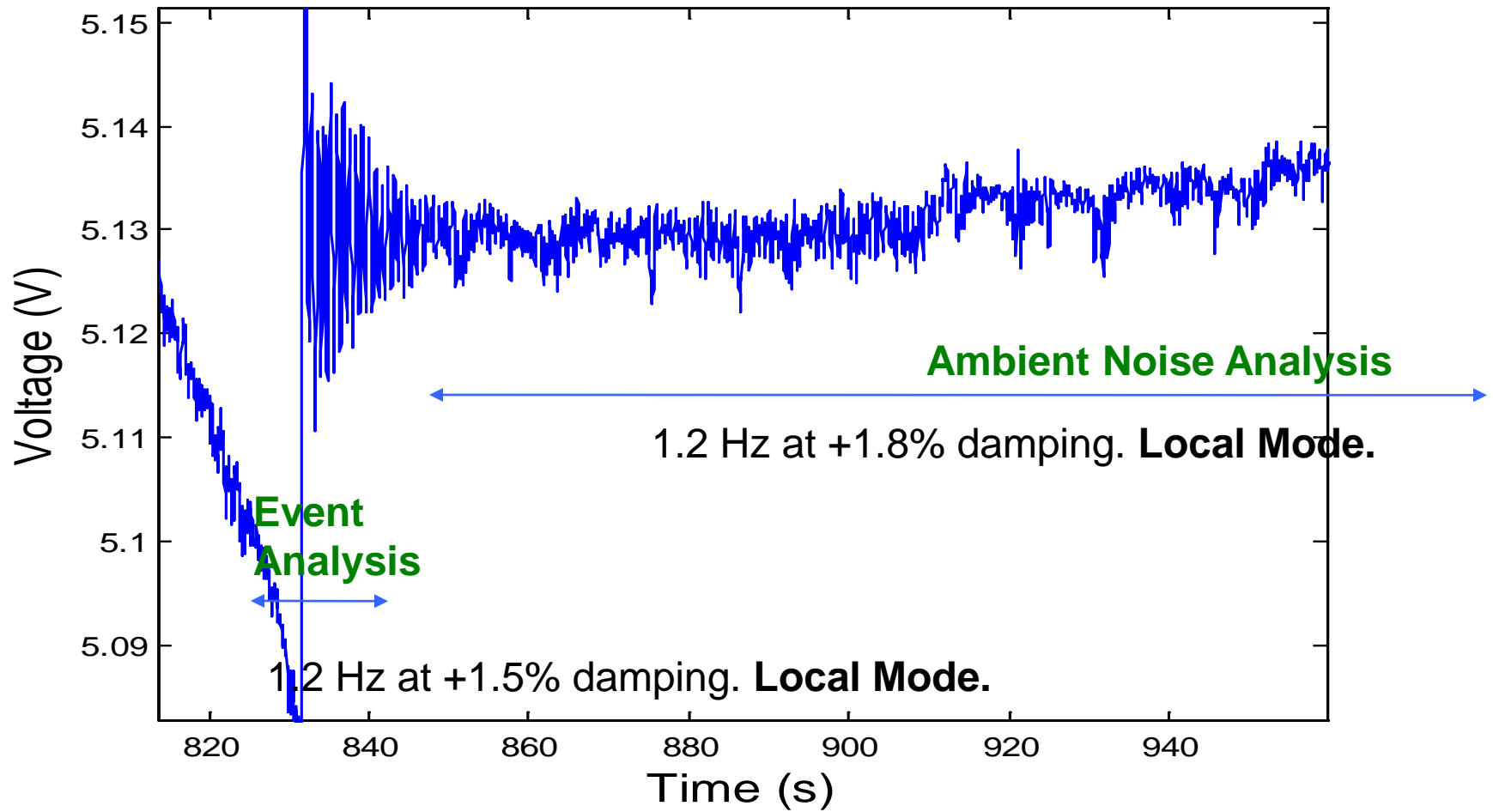
- **Event Analysis Engine**

- ◆ Three algorithms: Prony, Matrix Pencil and Hankel Total Least Square.
- ◆ Aimed at events resulting in **sudden changes** in damping

- **Damping Monitor Engine**

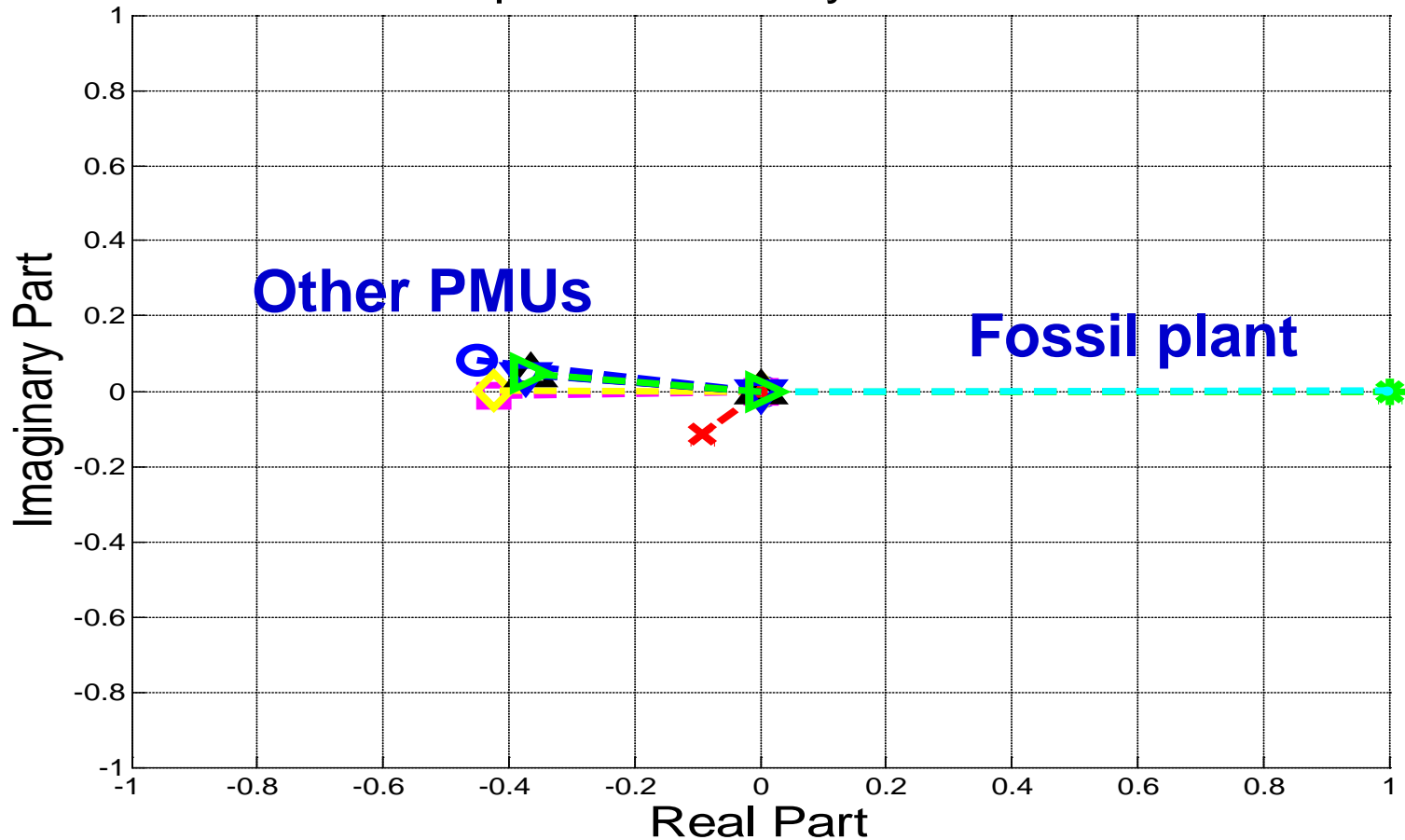
- ◆ Ambient noise based. Continuous.
- ◆ Two algorithms: Frequency Domain Decomposition, Frequency Domain Optimization
- ◆ Provides **early warning** on poorly damped modes

Results from Two Engines



Mode Shape – Local Mode

Mode Shape Identified by FDD at 1.224 Hz



Cumberland oscillating against rest of system – local mode

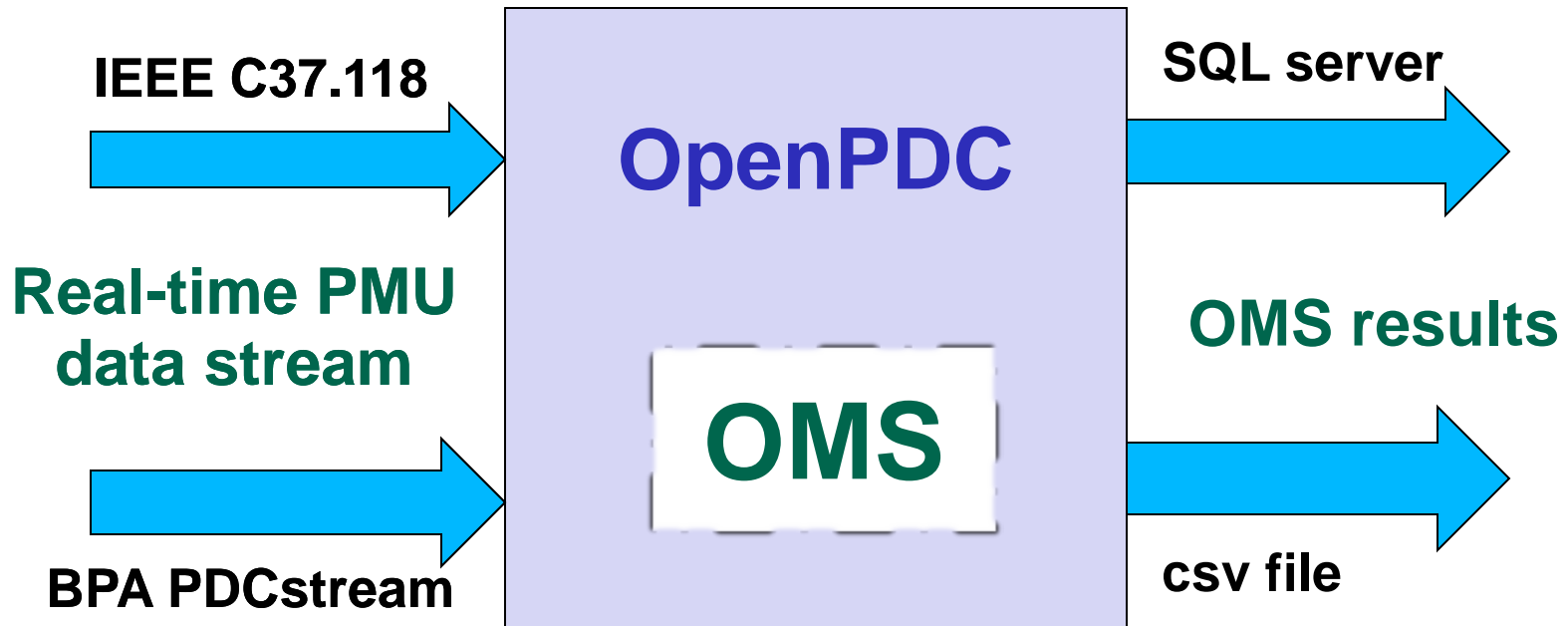
OMS Engines

- Event Monitor Engine
 - ◆ Automated Prony type analysis of oscillatory ringdown responses
 - ◆ *Five seconds* of PMU data analyzed every *one second*
- Damping Monitor Engine
 - ◆ Automated analysis of ambient noise data
 - ◆ *Four minutes* of PMU data analyzed every *ten seconds*

Recent OMS results at TVA

- OMS helpful in detecting when PSS went off-line at Cumberland
- OMS helpful in showing PSS not effective even when on-line. Hardware problem (faulty board) fixed.
- OMS helpful in showing poor damping of local mode at Cumberland is related to the total amount of MW output. PSS may have reached a hardlimit. Still under investigation.
- All recent alarms related to 0.45 Hz and 0.21 Hz eastern system inter-area modes.
- Benefits of real-time continuous monitoring from PMUs. Can detect oscillation problems early.

Oscillation Monitoring System



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