

Power Grid Simulator

GridSim

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GridSim - Real Time Simulation of Power Grid Operation & Control

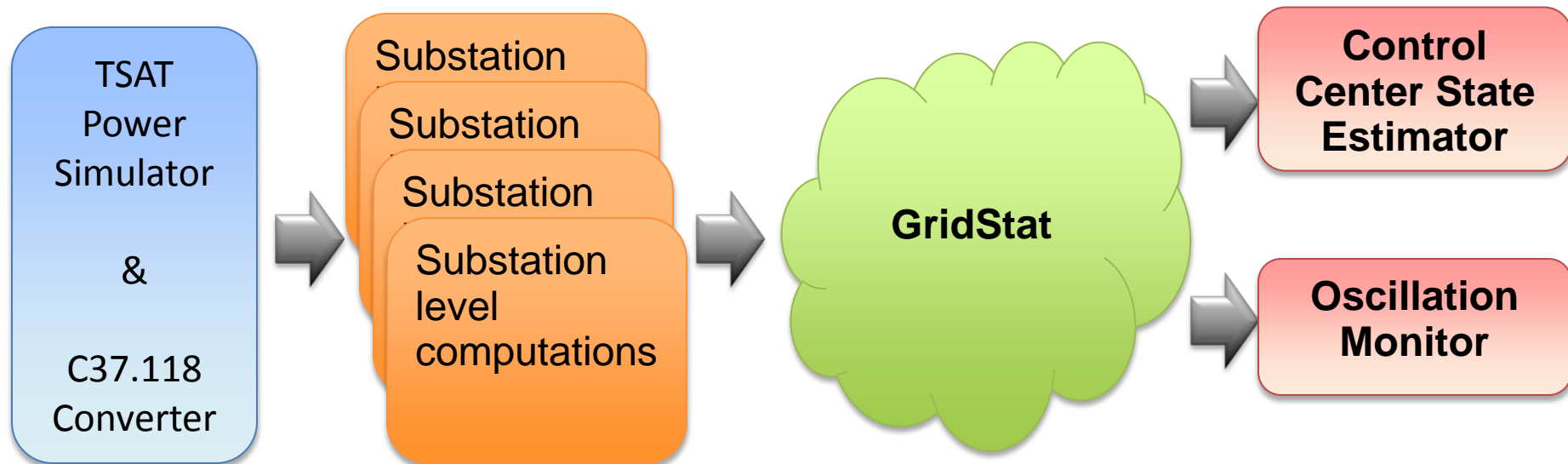
- Funded by USDOE
- Project team: Mani Venkatasubramanian (Project Lead), Anjan Bose, Dave Bakken, Carl Hauser, Chuanlin Zhao, Dave Anderson, *Alex Ning, Ming Meng, Lin Zhang, Zaid Tashman*
- Simulate PMU like real-time responses of large-scale power system including power grid dynamics and communication network

Project Objectives

Improve Reliability and Security of the Electric Power Grid by developing

- A real-time large-scale power system transient stability simulator, including detailed dynamic models and communication middleware
- A platform for studying interactions of automatic algorithms for instability detection and wide-area controls with communication networks
- New operator support tools, like next generation state estimators, for better human decision making

Simulation Test Bed for the Smart Grid



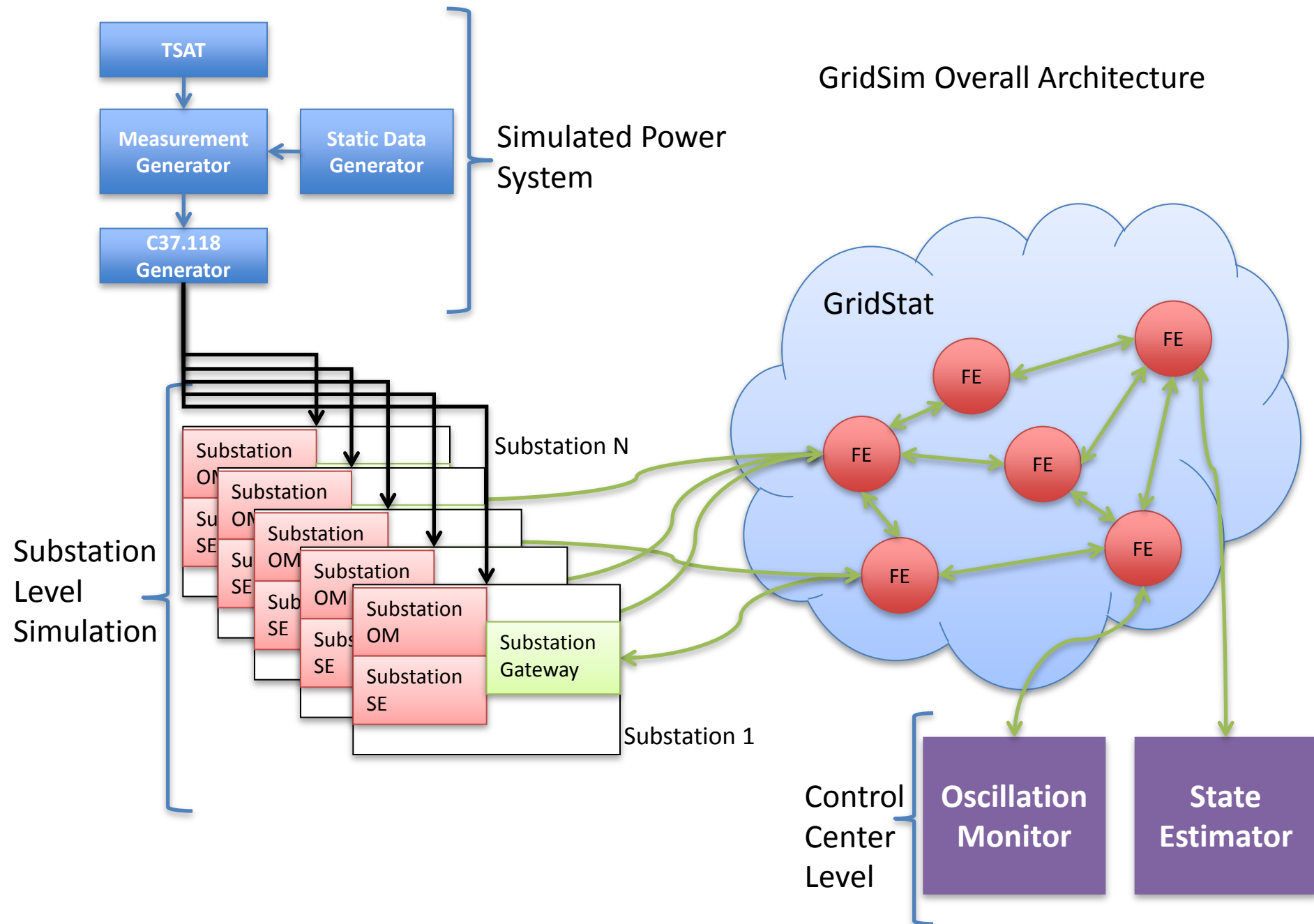
Project Tasks

1. Real Time Power Grid Simulation
2. Streaming Measurement Data
3. Data Communications – Gridstat Middleware
4. Distributed Oscillation Monitoring
5. State Estimation – Real Time Modeling

Tasks 1 and 2

- Real Time Power Grid Simulation
 - Use commercial grade transient stability program – Powertech TSAT
 - Simulate a large real system in real time
 - Replace output file with streaming data
- Streaming Measurement Data
 - Streaming data needed at PMU locations
 - Measurement data in IEEE C37.118

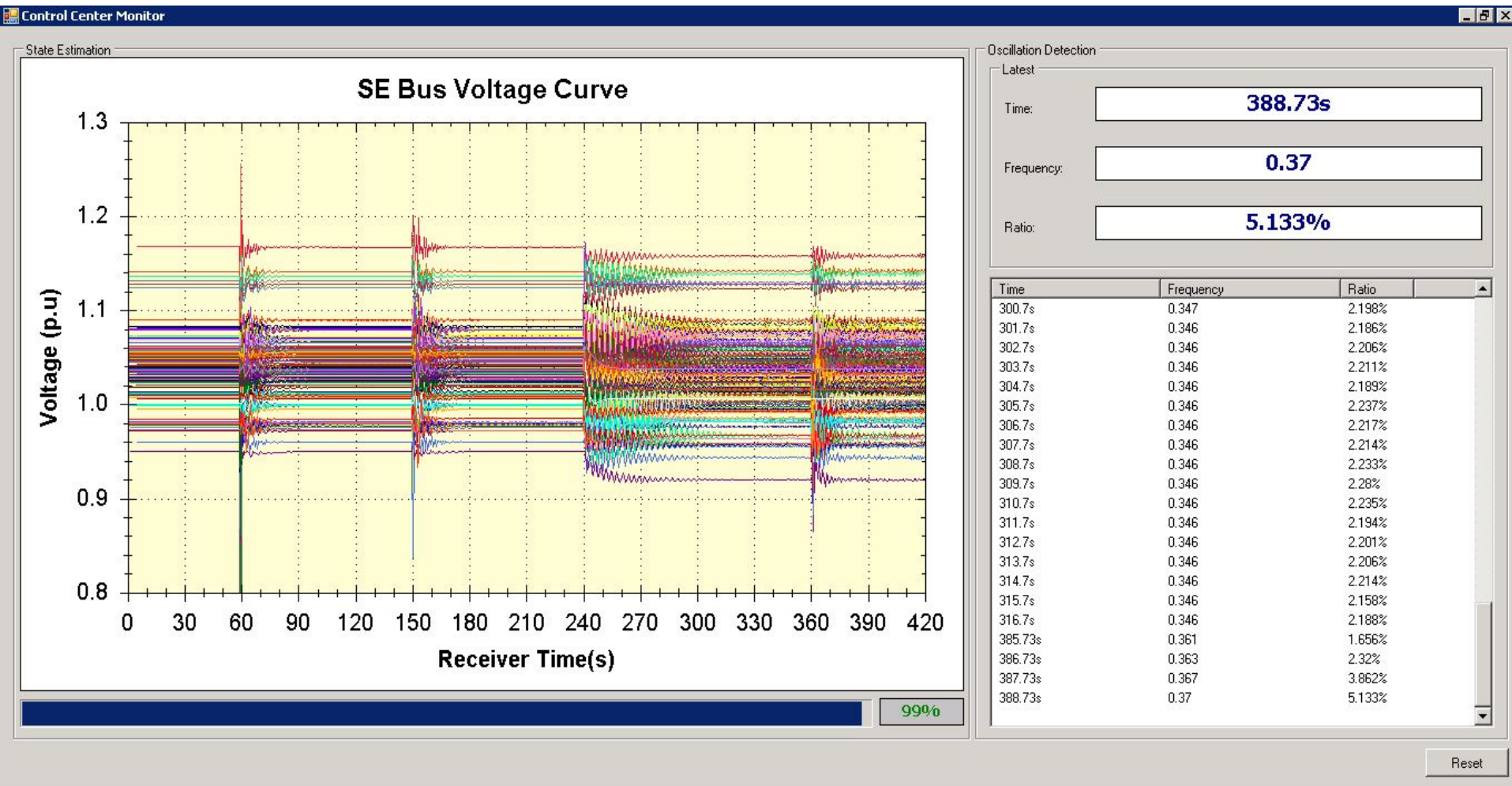
GridSim Overall Architecture



Test Systems

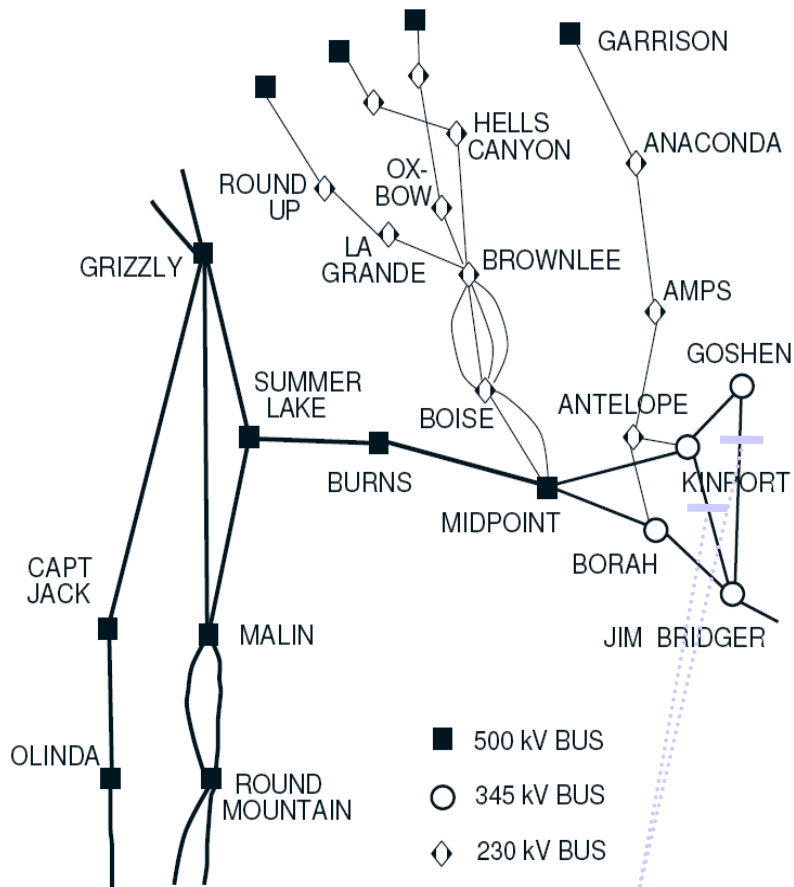
- Kundur 11-bus test system
 - 4 generators
- 179-bus Western system model
 - 29 generators
- WECC July 2, 1996 blackout case
 - 6180 buses
 - 1005 generators
 - Idaho area monitored

179 Bus Example

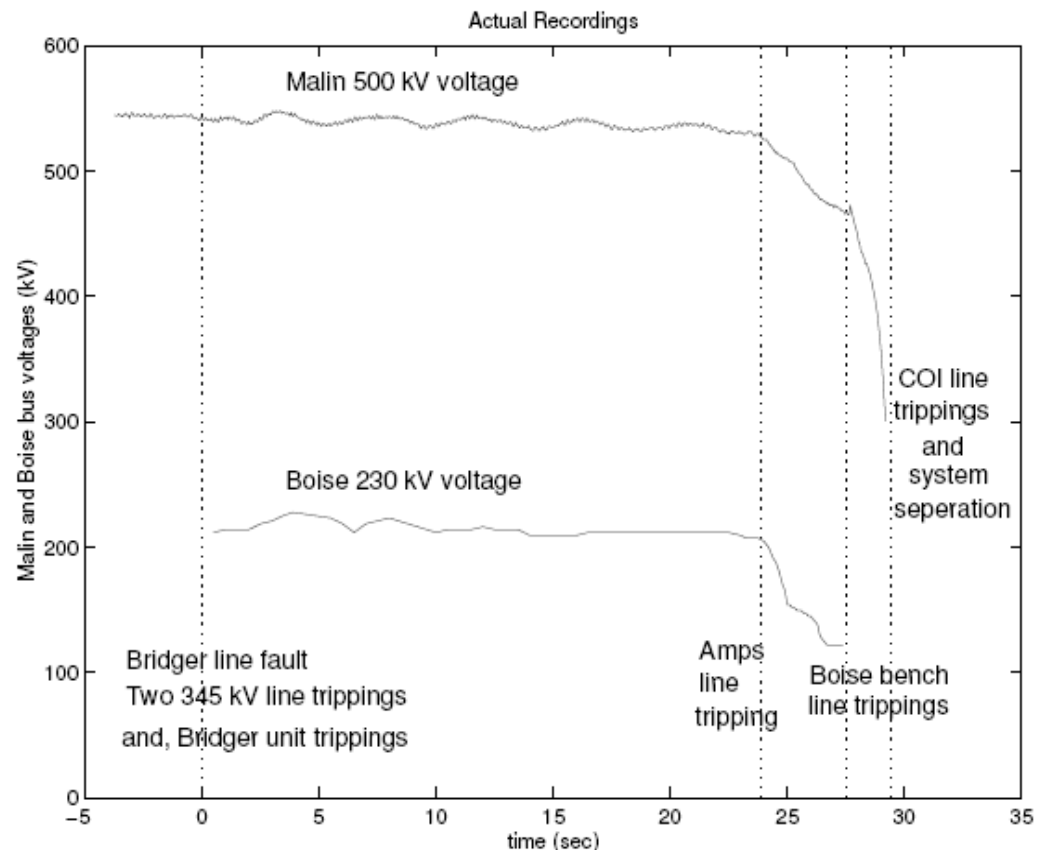


July 2, 1996 WECC Blackout

- Heavy loads
- Double line outage near Bridger plants



These Two Lines Tripped



WECC Test System

- WECC July 2, 1996 blackout case
 - 6180 buses
 - 1005 generators
 - 11982 branches
 - Idaho area monitored by PMUs
 - 109 buses in Idaho
 - 223 branches, 25 generators, 46 loads, 77 transformers
 - 480 PMUs streamed from simulator



GridSim

- Enables real-time simulation of large scale power system transient stability models, communication and applications
- Platform for testing PMU applications
- Platform for testing wide-area controls
- Test bed for communication architectures and protocols
- Operator training of PMU responses and wide-area controls

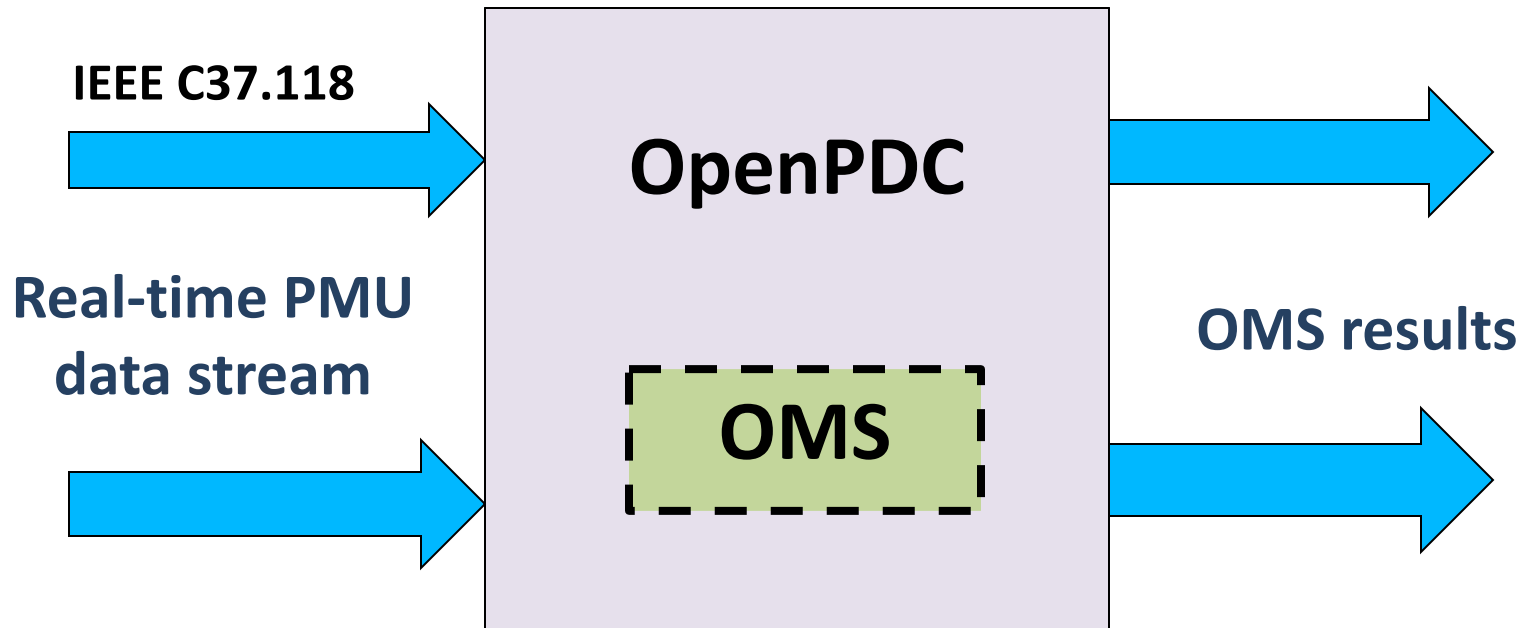
OpenPDCLite

- WSU open source contribution to openPDC project
- Light platform of openPDC developed at WSU for GridSim project
- Code being transferred to GPA
- Simplified architecture of openPDC modules for ease of code development and debugging
- Takes up less resources. Attractive for light installations such as substation computers.

GridStat

- Data delivery middleware for Smart Grid
- Data plane components provide pub-sub model for data sources and applications
 - Multi-cast to use resources efficiently
 - Per-subscriber rate and latency management
 - Conserves network resources and simplifies applications
- Management plane handles resource allocation and subscription setup
 - Reserve multiple paths per-subscription
 - Provides authentication and authorization for access to published data streams

Oscillation Monitoring System



**Substation level OMS and Control center level OMS.
Light version of OMS for substations developed.**