Distributed Asynchronous Algorithms & Software Systems For Wide-Area Monitoring of Power Systems

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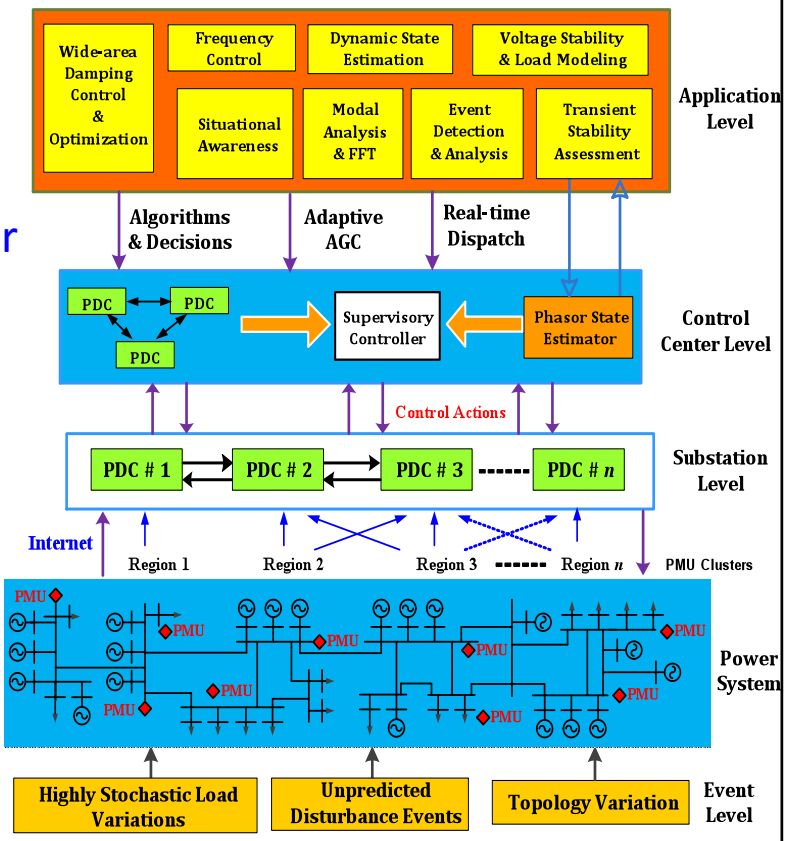
Attention Grabber:

A completely distributed CPS architecture that enables communication and processing of Synchrophasor data for real-time dynamic monitoring and control of next-generation power systems.

Problem:

Majority of current wide-area monitoring algorithms are:

1. Executed offline (postmortem), not real-time
2. Centralized
3. What happens in 3-4 years when 1000s of PMUs in the US power grid?



Solution:

1. Distributed numerical algorithms
   - i. Oscillation monitoring
   - ii. Transient stability
   - iii. Voltage monitoring
2. Fault-tolerant Distributed middleware
   - ➢ Cloud computing
   - ➢ Software Defined Networks (SDN)
   - ➢ Experiments: BEN-WAMS testbed at NCSU, Exo-GENI, and GENI

Difference from competition:

1. "Real-time" computational constraints
2. Stability and convergence problems when executed in the real world
3. Software defined networks
4. Distributed hash tables for power system middleware
5. Real-time testbed implementation

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Target Market and Growth Prospects:

1. Utility companies (eg: Southern California Edison, Duke Energy)
2. Software and hardware vendors (eg: Alstom, ABB, Schweitzer, V&R)
3. Regional Transmission Operators (RTO) & Independent System Operators (ISO)

• Growth of market will depend on middleware implementation, usability and inter-operability of SDNs across utilities, and data-sharing contracts.

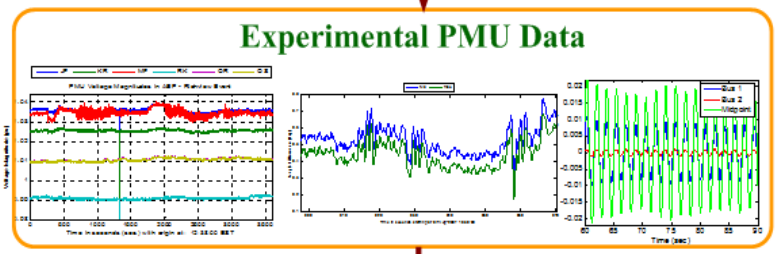
How can we make money?

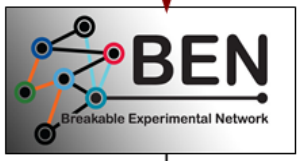
1. Collaborate with existing software vendors (ABB, V&R) to sell software packages to RTOs and ISOs
2. Monetization will depend on volume of usage (eg. 1000 point use of PI Historian)
3. Apply for vendor-driven joint NSF/DOE projects
4. Possible start-up company for power system software development
5. Work with Tech-transfer office of NSF ERC FREEDM Systems Center at NC State.

BEN-WAMS Testbed

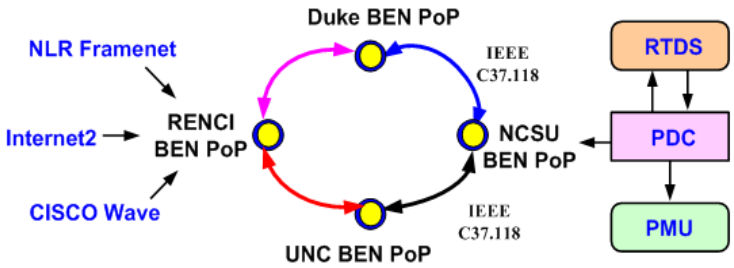
Joint Work with computer scientists at
UNC Chapel Hill & Duke University

Multivendor PMU-PDC Testbench at NCSU





Data Centers



- Latency & Processing Delays
- Packet Loss
- Network Jitters
- Cyber-security
  - Man-in-middle attacks