openPDC Specifications

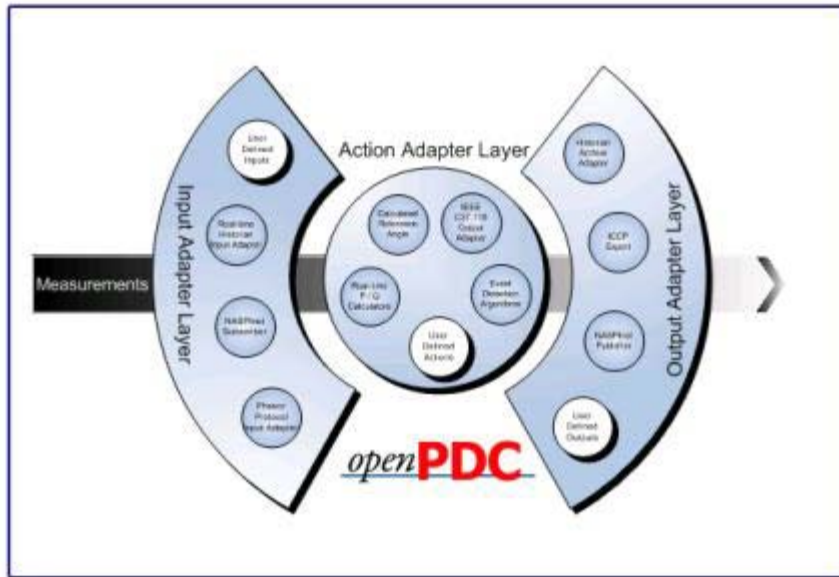NASPI Work Group Meeting

February 25, 2010

J. Ritchie Carroll

openPDC — Phasor Data Concentrator

http://openpdc.codeplex.com

- TVA's original SuperPDC is now an open source project called the openPDC

- Objective is to better support Stimulus/DOE plans to accelerate use of synchrophasors in the US

- Source code is released under a very liberal open source agreement that supports vendor commercialization

- Key design element is the ability for others to easily extend the openPDC at the input, action or output layers

- TVA's hope is that this code will be an enabling technology for the industry and vendors at the international level
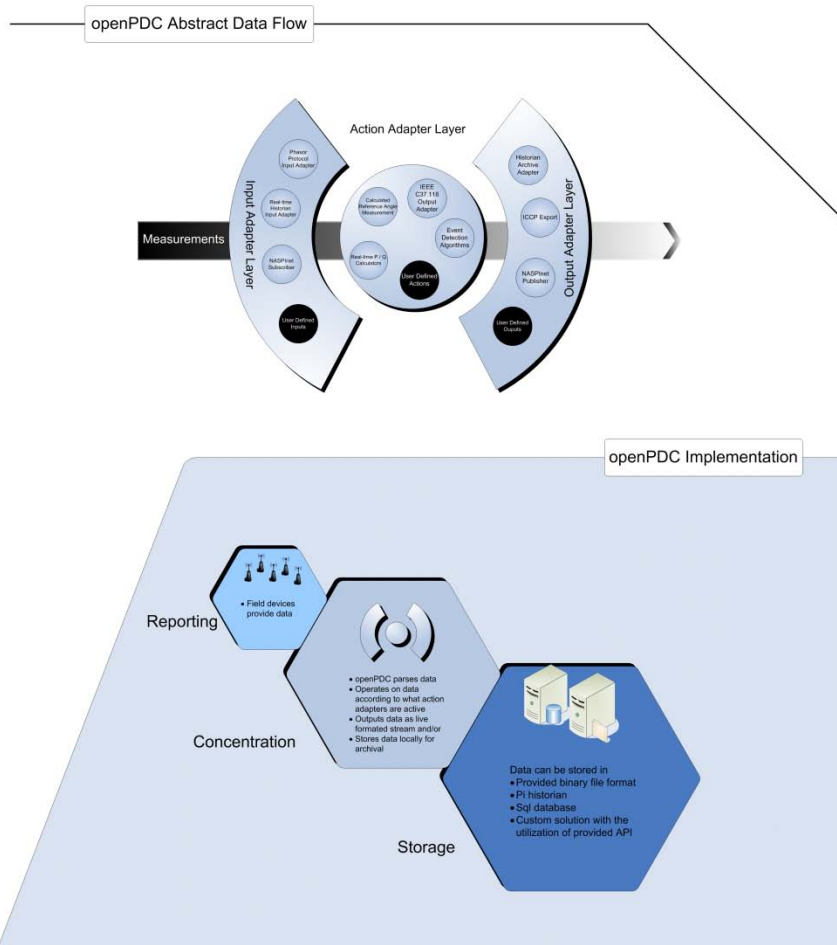
openPDC Vision

The Open Source Phasor Data Concentrator

The openPDC is a foundational adaptive technology that can be used for streaming, analyzing and processing any kind of time-measured data.

It is our hope that this code will be used to support the development of the smart grid and facilitate the Department of Energy plans to accelerate the use of synchrophasors in the U.S. as part of the federal economic stimulus programs.

We believe this code will be an enabling technology for both vendors and the electric power system industry as billions are invested to modernize the power grid over the next several years.

What's Included…

- TVA Code Library

- openPDC synchrophasor projects

  – All phasor data concentration components

  – Web based openPDC management system

  – PMU Connection Tester

- An experimental *prototype* implementation of NASPInet

Commercialization and Support

- AREVA is now offering a commercial implementation of the openPDC with 24x7 support.

- Please contact Jay Giri for more information:

jay.*giri*@areva-td.com

- AREVA benefits from and contributes to ongoing development of the open source PDC.

- I like to think of this like the Linux / Red Hat relationship

Source Code Status

- Based on TVA's SuperPDC that has been used since 2004.

- Based on .NET 3.5 and written almost exclusively in C#.

- Has over 300,000 lines of fully documented code spanning 630+ classes.

- Includes detailed API help files

- Allow users to create their own operational PDC

- Being continually updated and improved – but ONLY by approved participants and NO UPDATES are committed to the official source code unless they are reviewed for security.

New Updates: *Simplified System Configuration*

- Web based management system "openPDC Manager" – allows automated device configuration

- Configuration editor allows low-level system settings to be updated from a simple to use application.

- Phasor concentrator is remotely manageable with a secured system console that allows monitoring and control of system.

openPDC Management System

Geospatial View of all Configured Devices
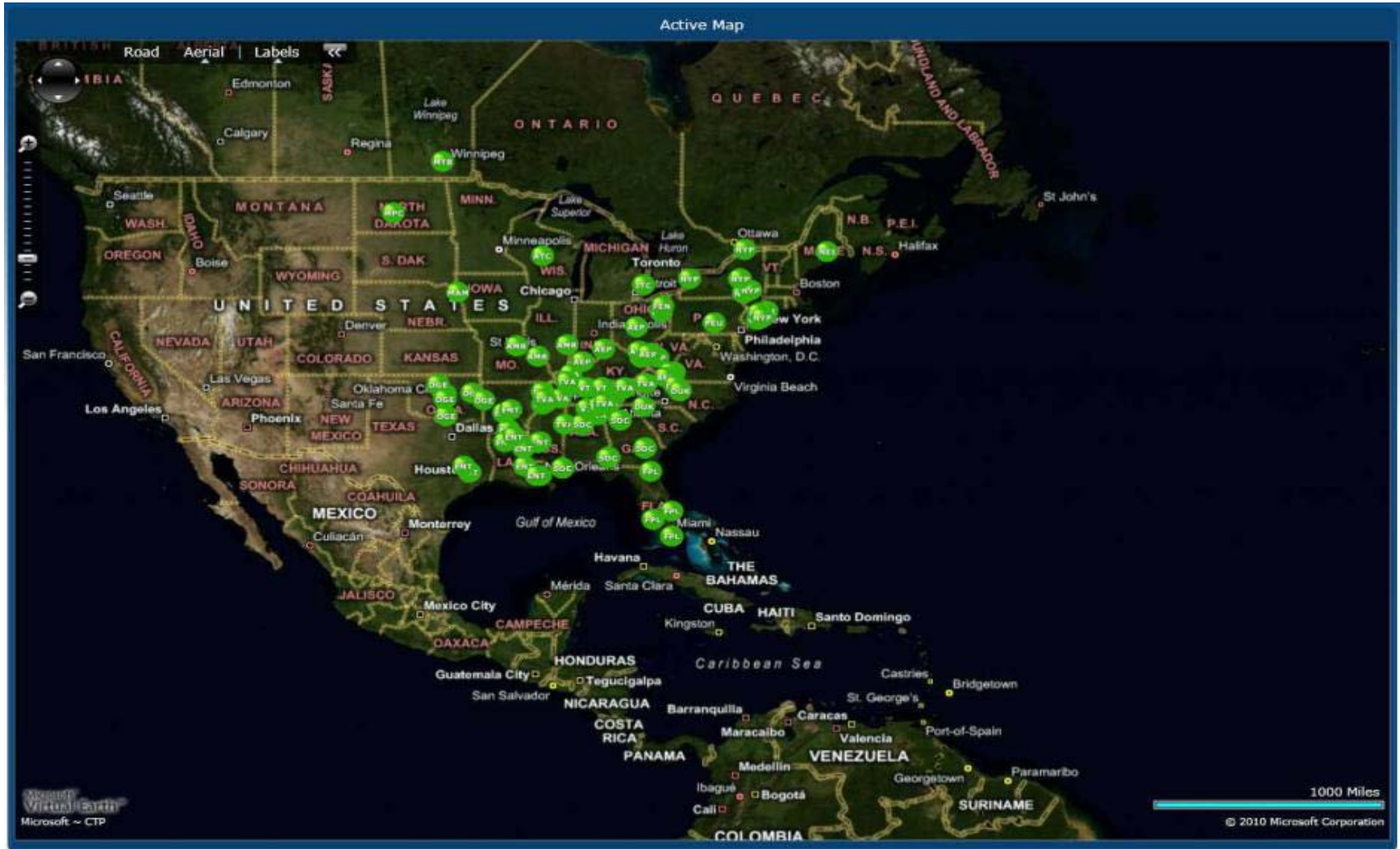
openPDC Redundancy Options

Fail Over Cluster:

openPDC Fail Over Cluster

Failover Cluster

Primary openPDC

Hot Standby openPDC

Load Balanced Cluster:

openPDC Load Balanced Cluster: *Server Farm*

Through clustering technology openPDC server farm appears like one box to the outside world, more boxes can be added as needed

openPDC Instance 1

openPDC Instance 2

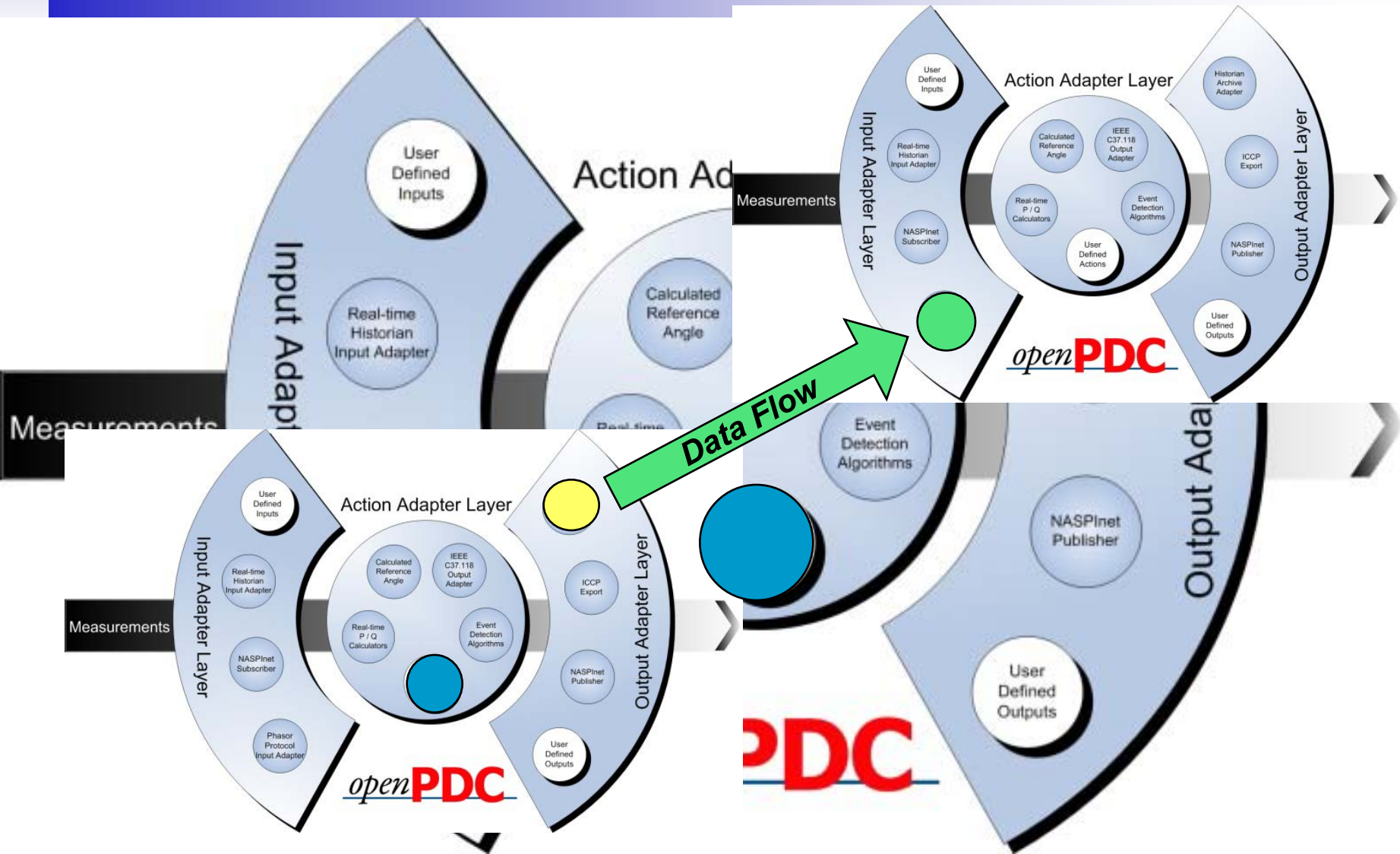openPDC Instance (n)
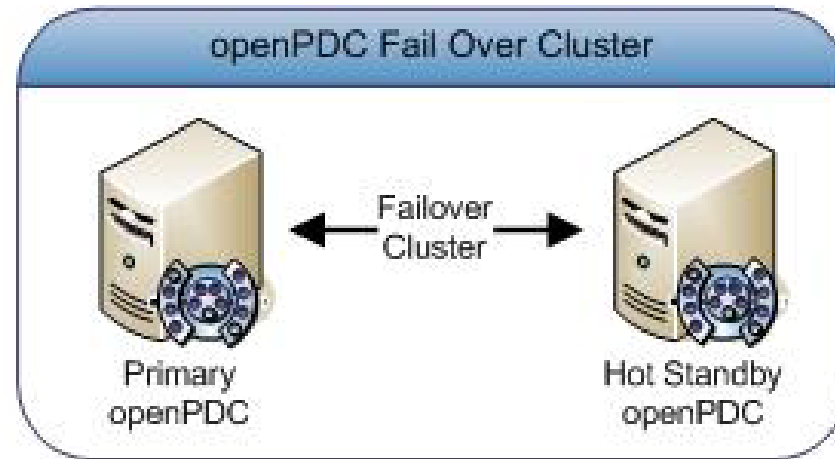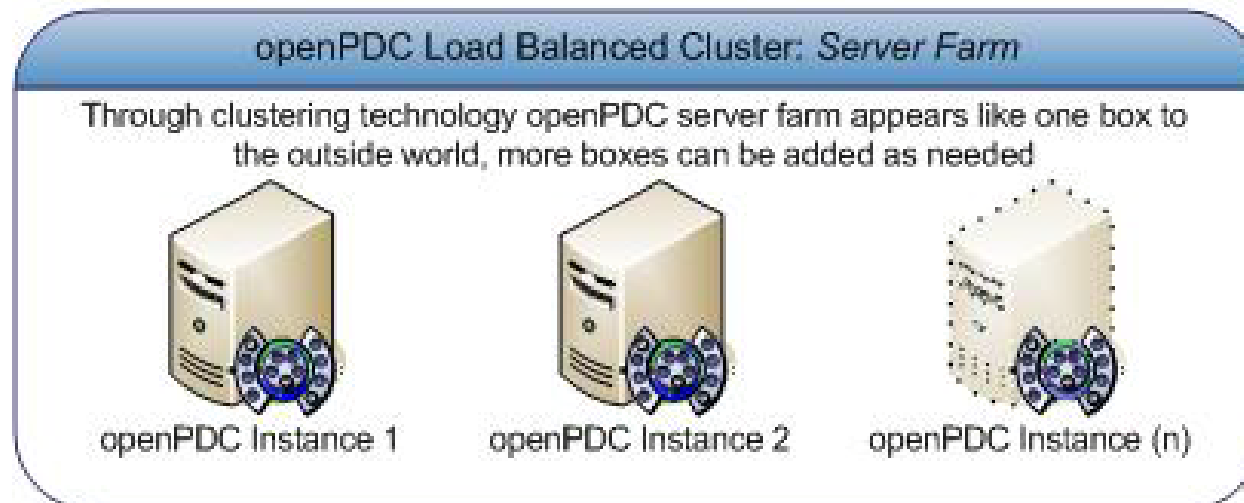
Extensible with Event Detection and Alarming

9/18/2006
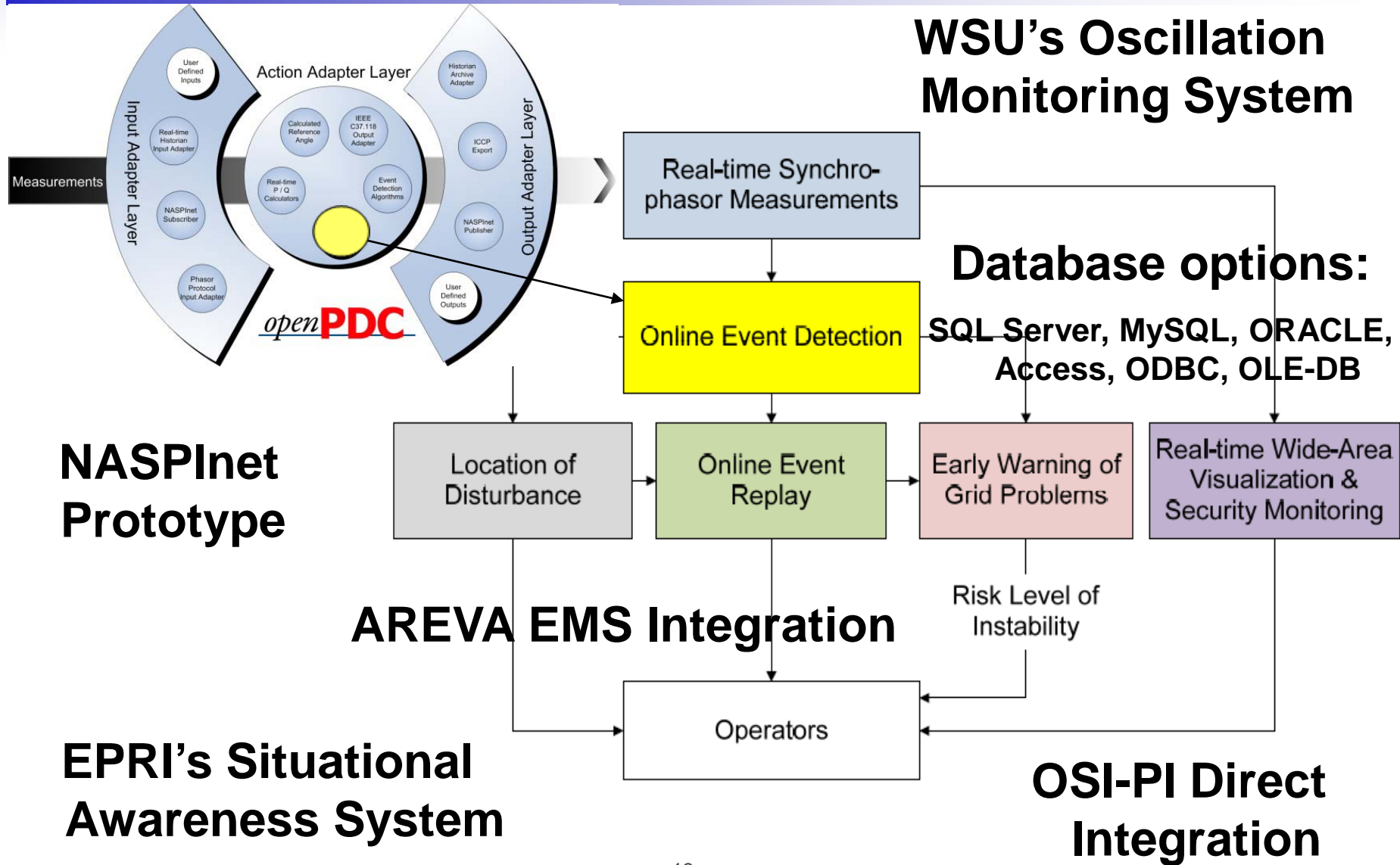MW Oscillations on Generators

Line summation = Unit 1 + Unit 2 MW
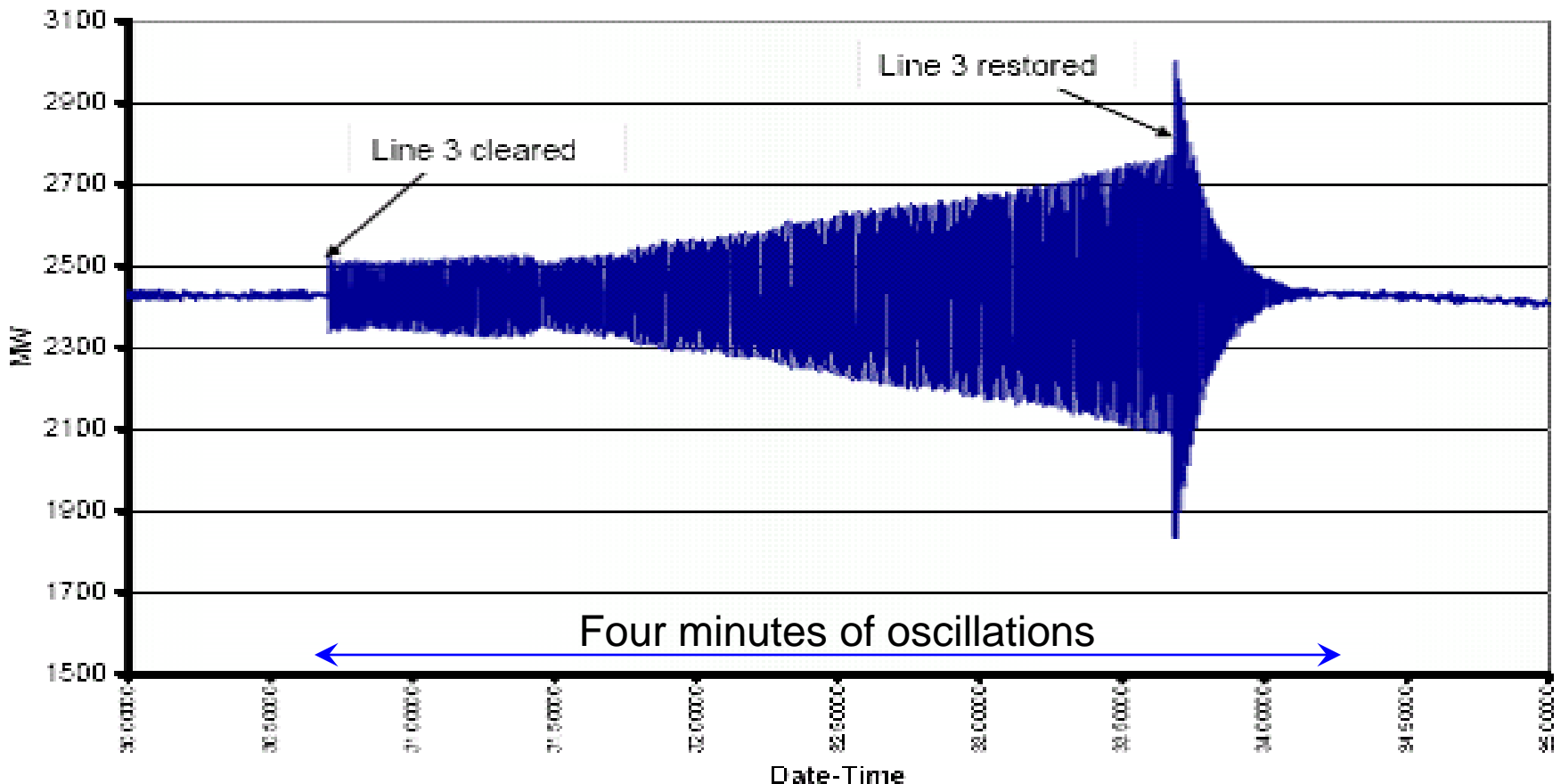
*This kind of event is why synchrophasors matter*

openPDC Scalability Options

openPDC Extensibility Options:

WSU's Oscillation Monitoring System

Database options:

SQL Server, MySQL, ORACLE, Access, ODBC, OLE-DB

NASPInet Prototype

AREVA EMS Integration

EPRI's Situational Awareness System
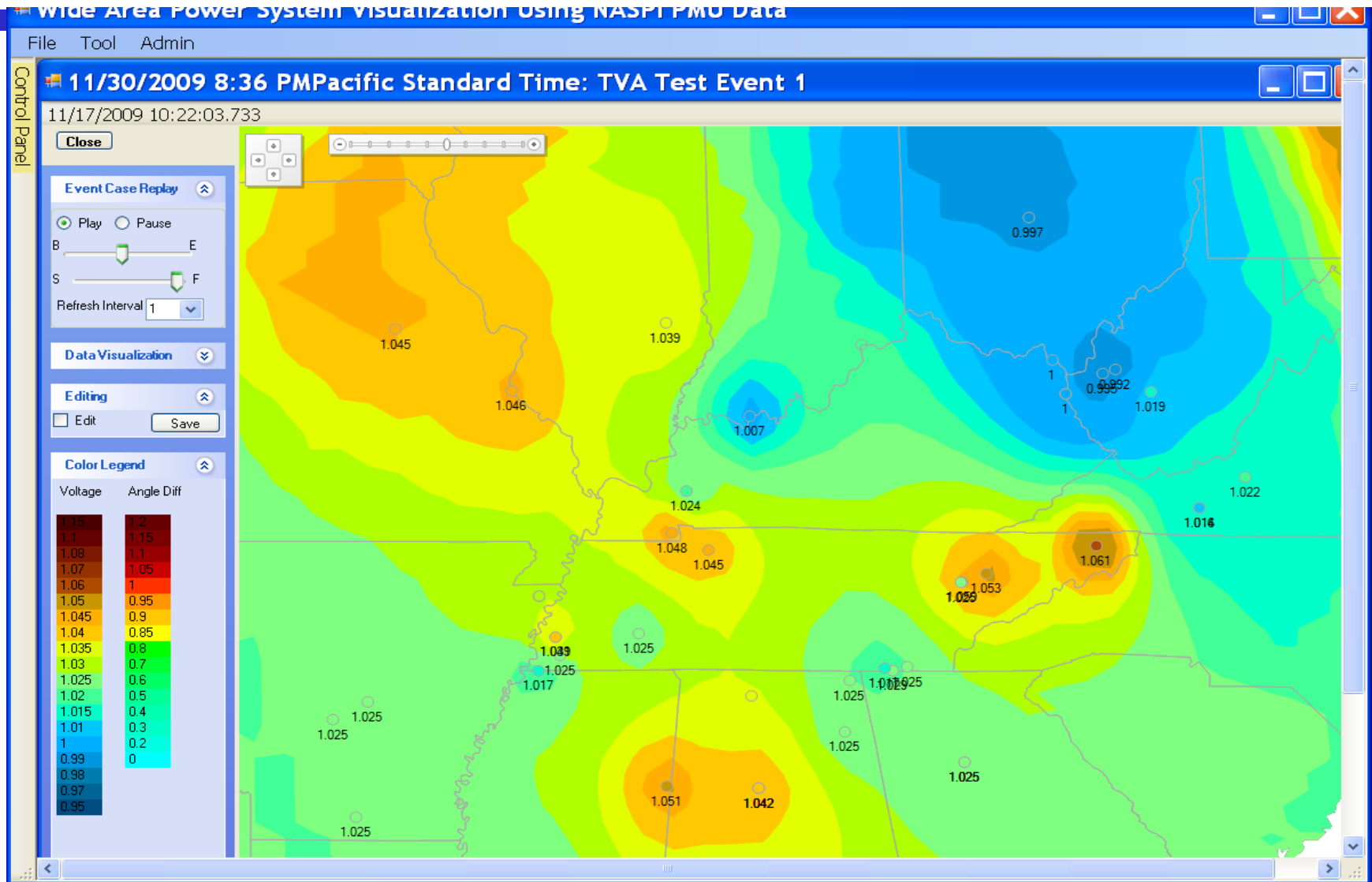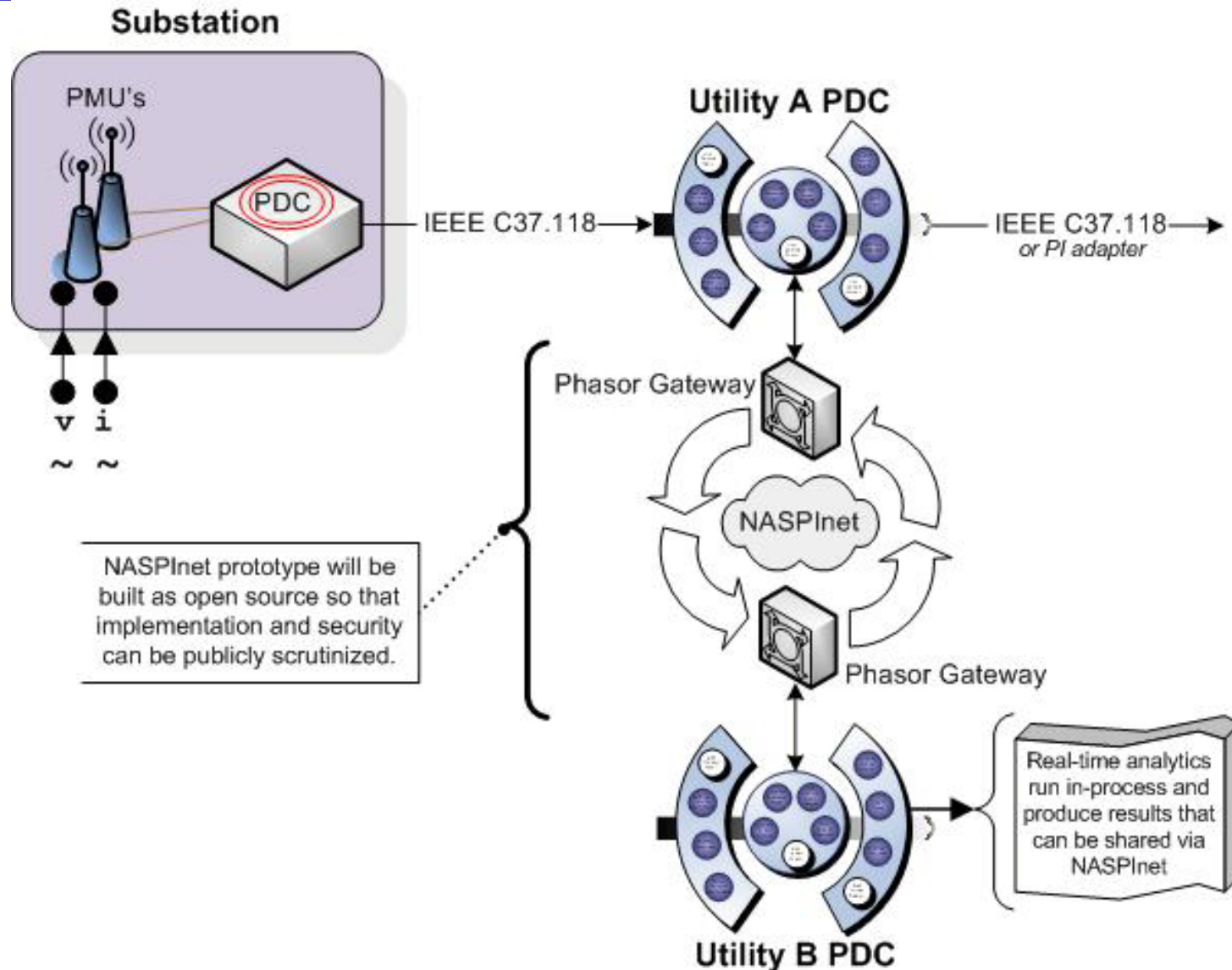
OSI-PI Direct Integration

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WSU Oscillation Monitoring System

- **Goal of Oscillation Monitoring System (OMS)**
  - **Early detection of poorly damped oscillations as they appear**
  - **Trigger warning or control signals**
- **OMS is made possible by Wide Area PMU Measurements**
  - **Growing numbers of PMU's across the power grid**
  - **Fast algorithms available for online measurements**
  - **Rule based automatic analysis of PMU measurements**
  - **Prototype implementation running in openPDC at TVA**
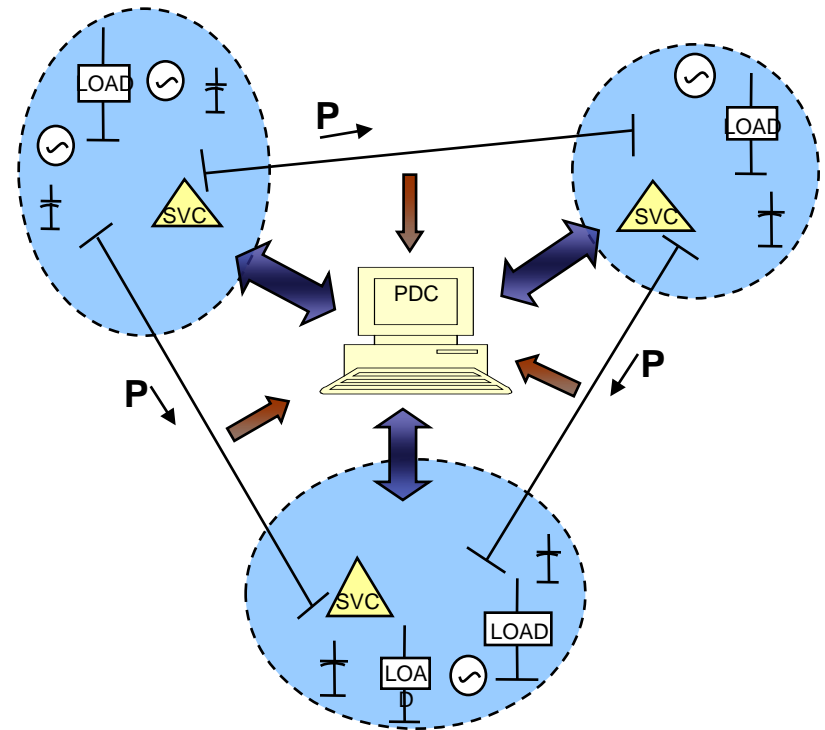
EPRI Voltage Magnitude Visualization Display Real-time SynchroPhasor Measurements
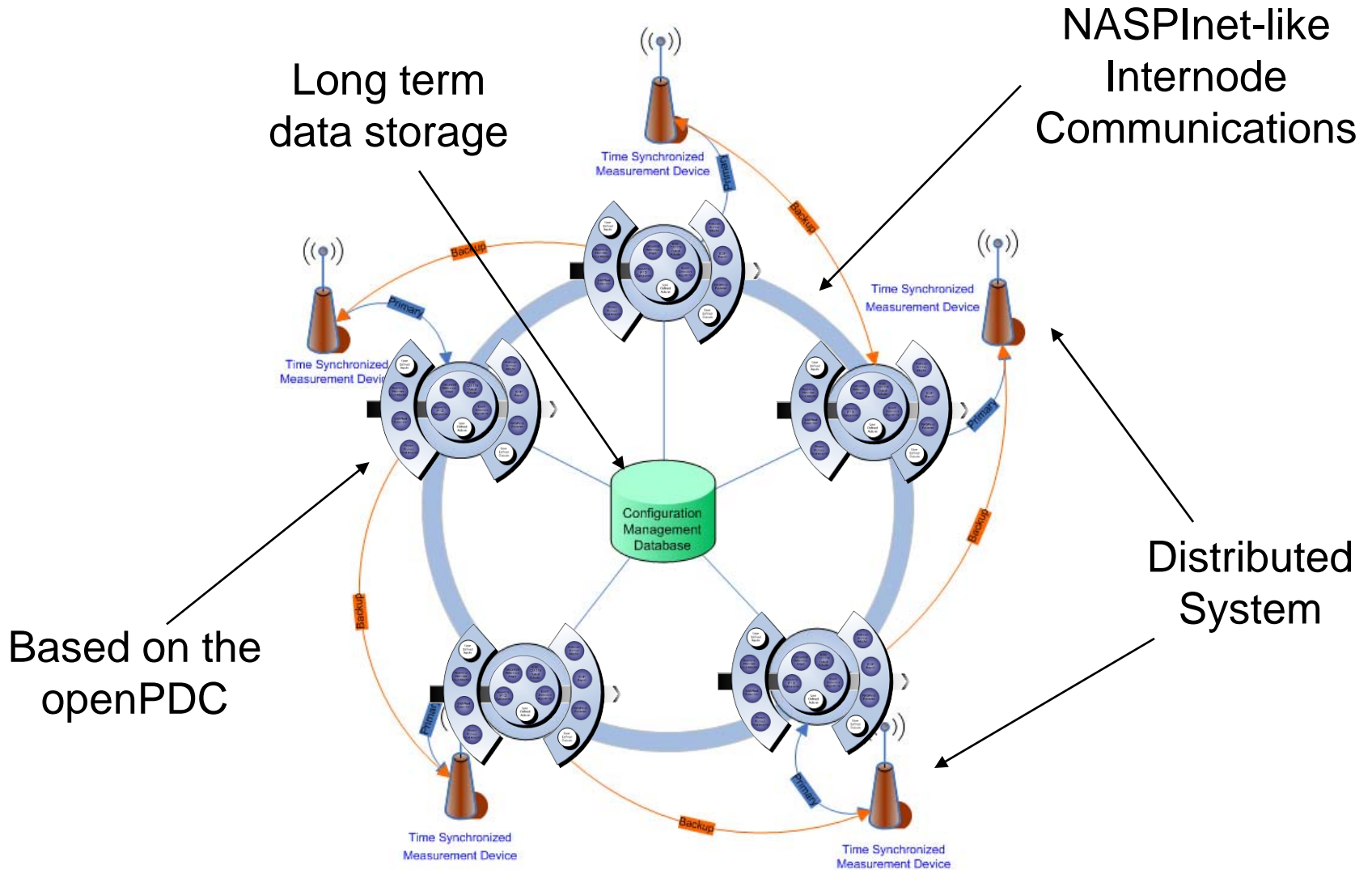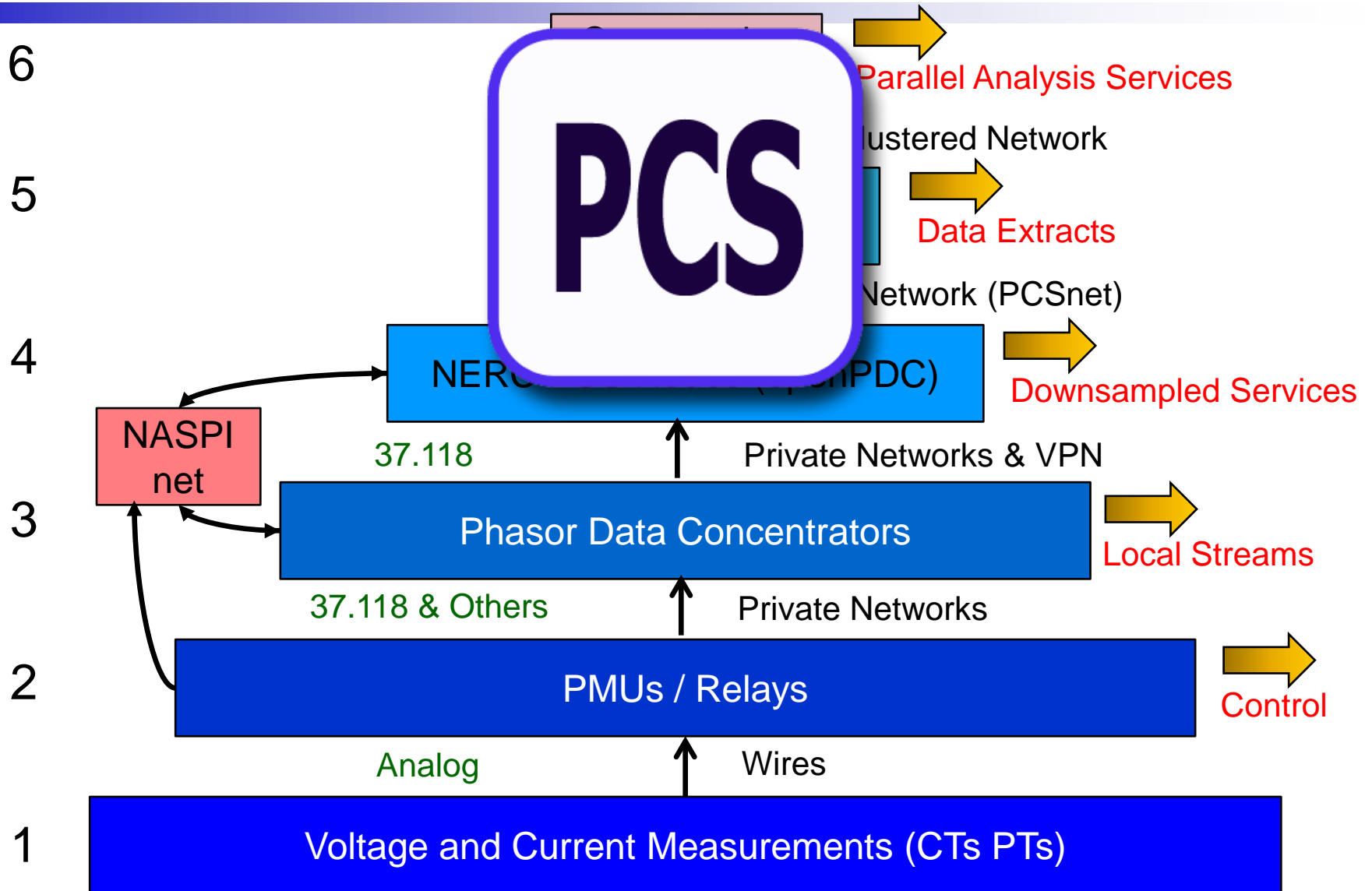
openPDC NASPInet Prototype

Substation

PMU's

PDC

IEEE C37.118 →

Utility A PDC

IEEE C37.118 →
or PI adapter

v   i
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NASPInet prototype will be built as open source so that implementation and security can be publicly scrutinized.

Phasor Gateway

NASPInet

Phasor Gateway

Real-time analytics run in-process and produce results that can be shared via NASPInet

Utility B PDC

NERC Phasor Concentration System

NASPInet-like Internode Communications

Long term data storage

Distributed System

Based on the openPDC

The technology layers

6 Parallel Analysis Services

Clustered Network

5 Data Extracts

Network (PCSnet)

4 NERC ... (openPDC) Downsampled Services

NASPI net

37.118   Private Networks & VPN

3 Phasor Data Concentrators Local Streams

37.118 & Others   Private Networks

2 PMUs / Relays Control

Analog   Wires

1 Voltage and Current Measurements (CTs PTs)

See website for more information…

http://openpdc.codeplex.com