Smart Grid Education for Students and Professionals (4.3)

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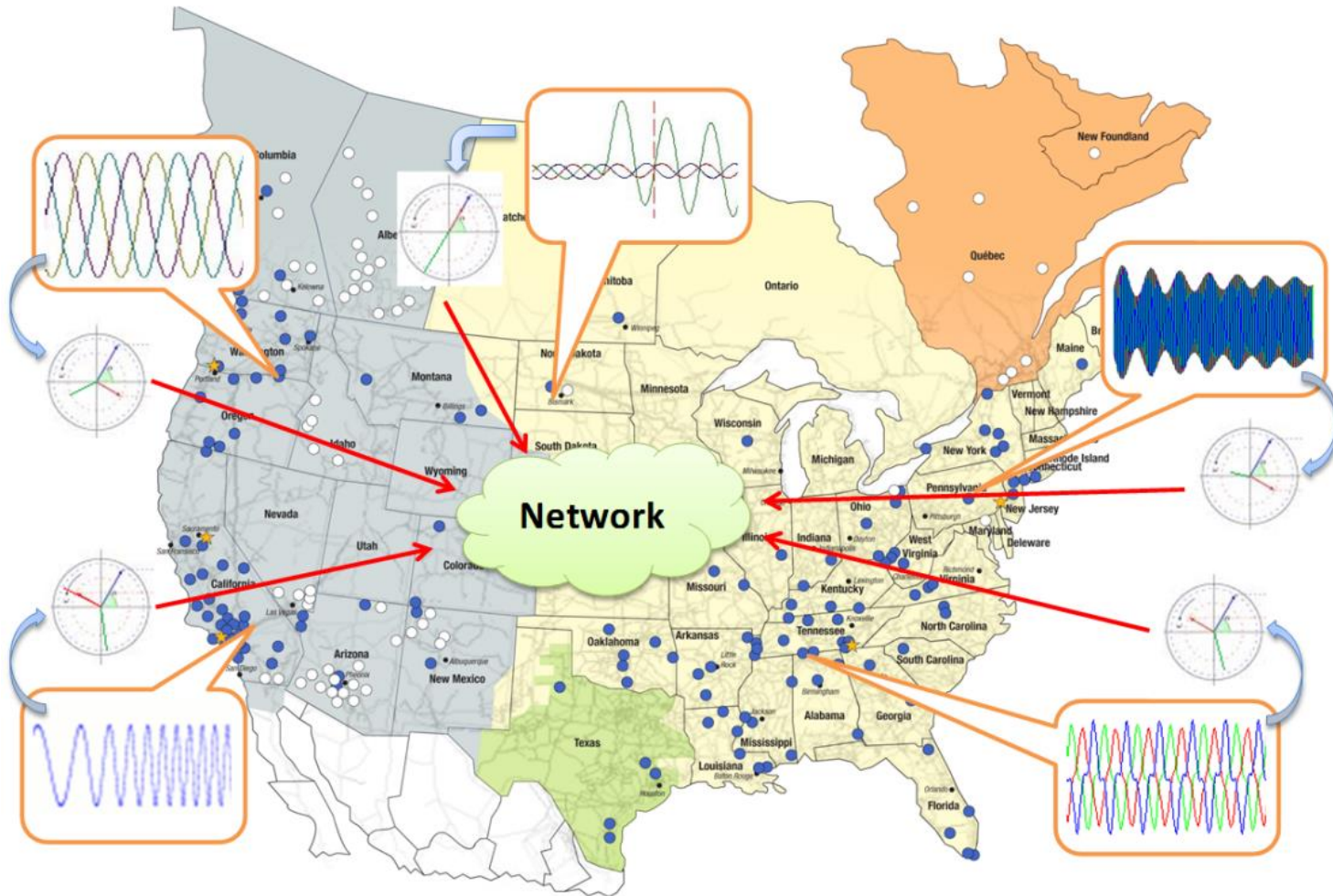Arizona State University
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PSERC Future Grid Initiative
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PSERC

Outline

- Introduction
- Synchrophasor Devices and Network
- Online Transient Stability Assessment
- Wide-Area Stability Monitoring Algorithm
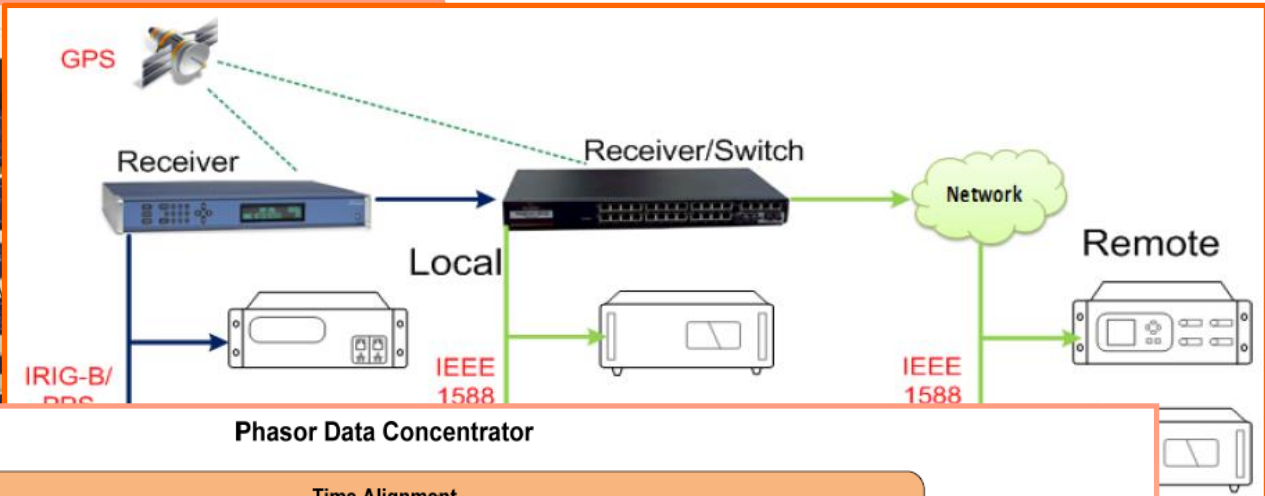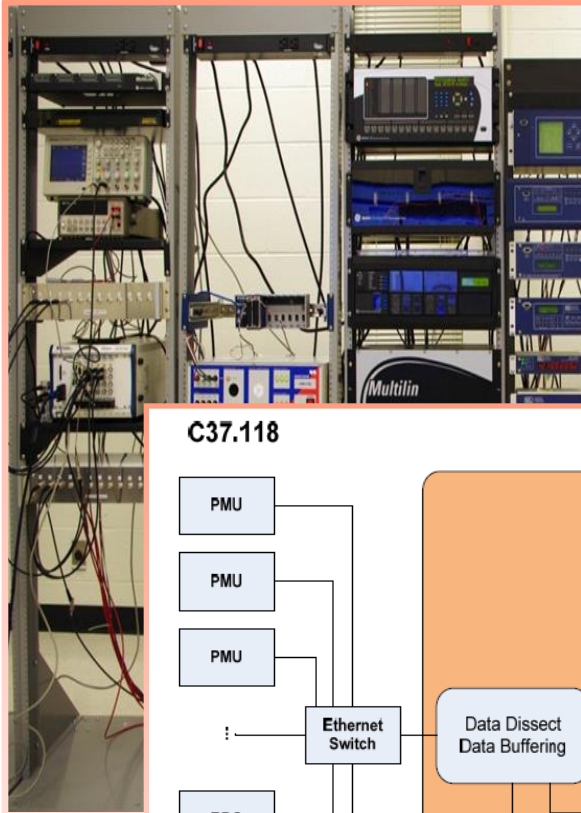- Fault Location Analysis
- Conclusion

Introduction

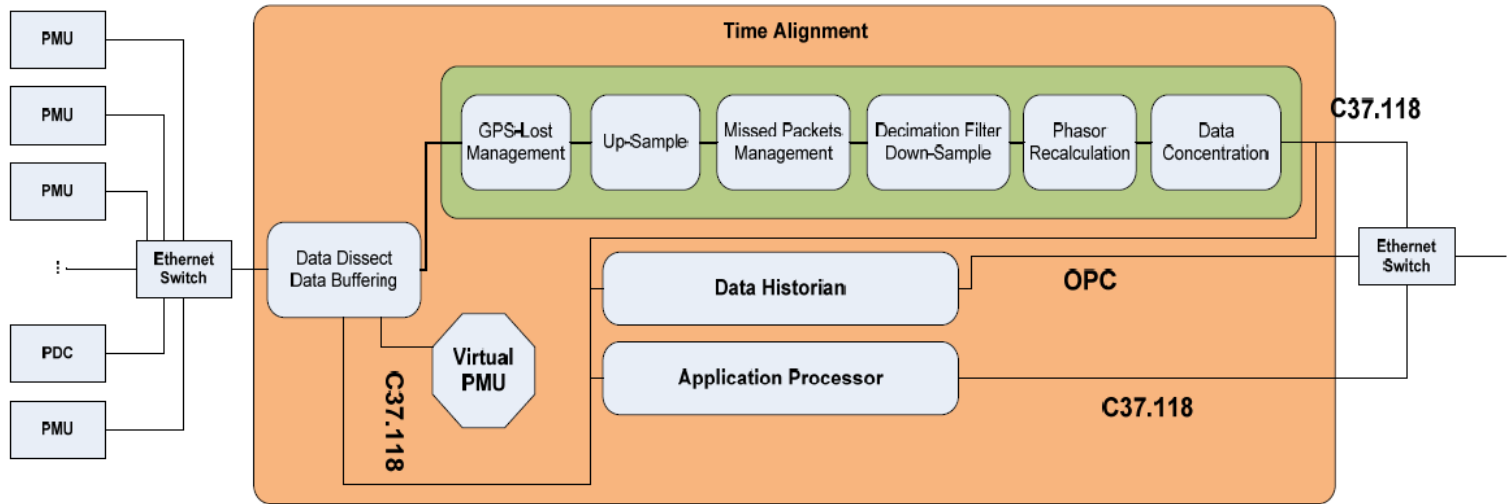Synchrophasor measurements aggregated across North America

- Number of PMUs: close to 1000.
- Number of PMU-enabled IEDs: in millions.

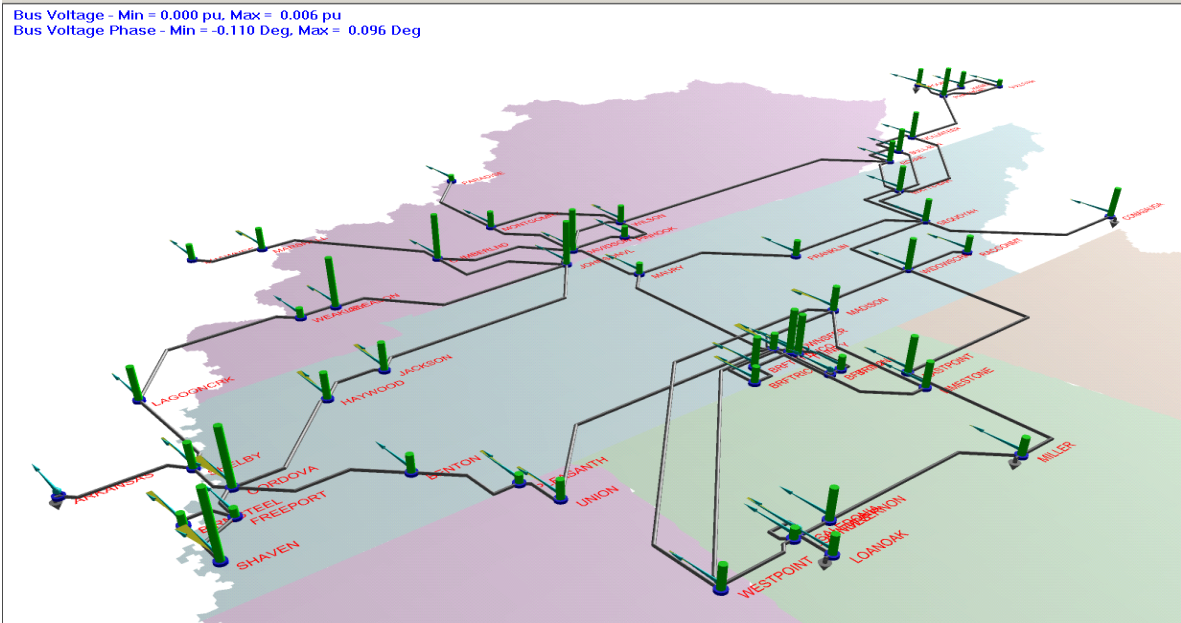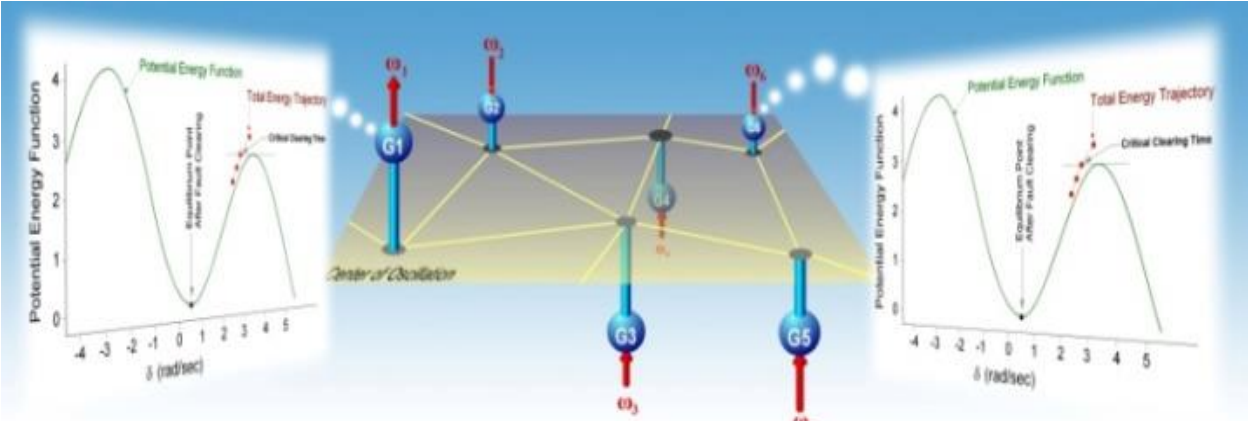# Synchrophasor Devices and Network

Phasor data concentrator

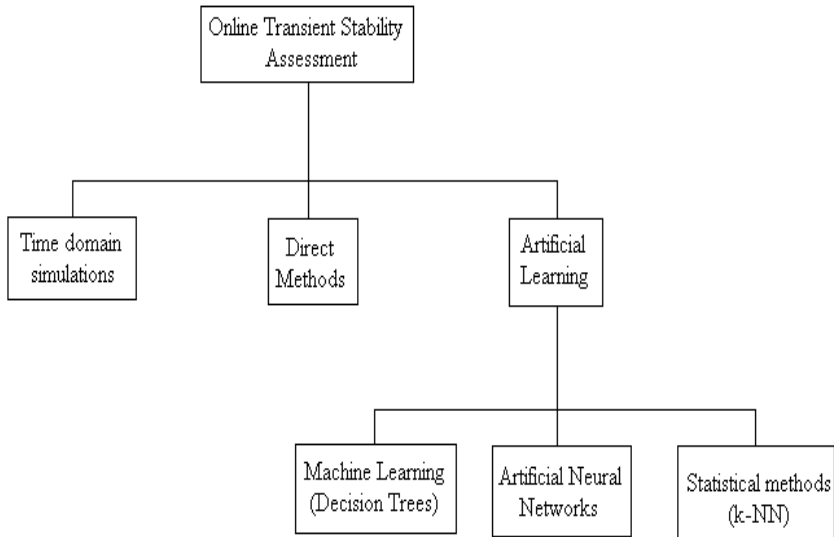# Online Transient Stability Assessment
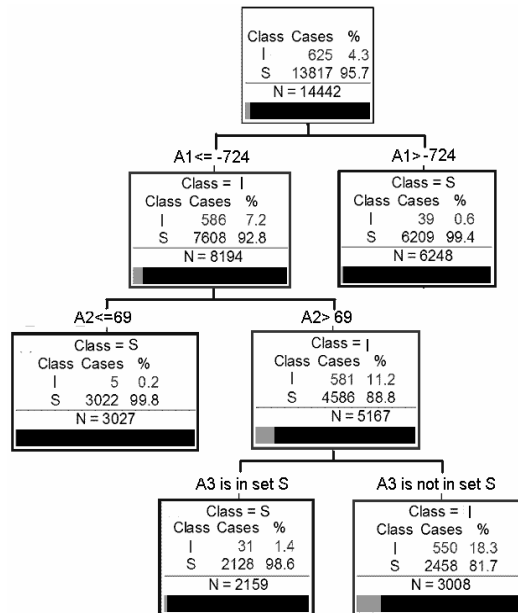

3-D Rendering

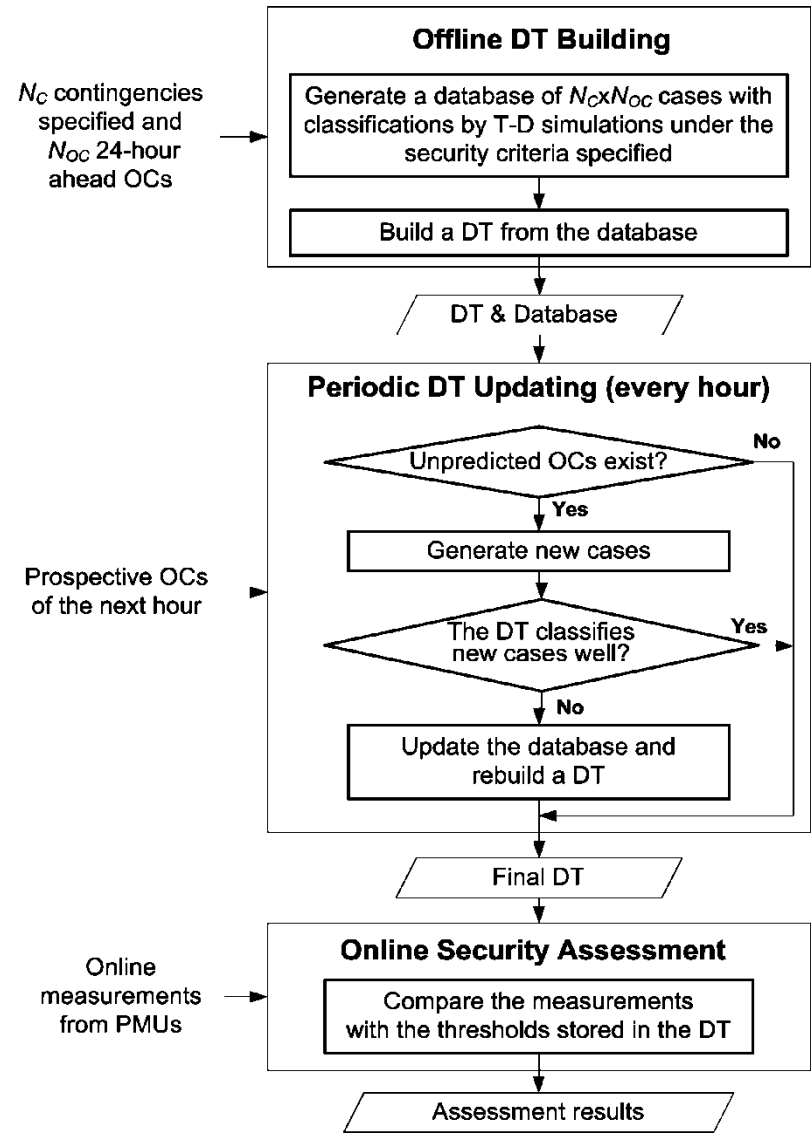Visualization of Transient Stability

Online Transient Stability Assessment

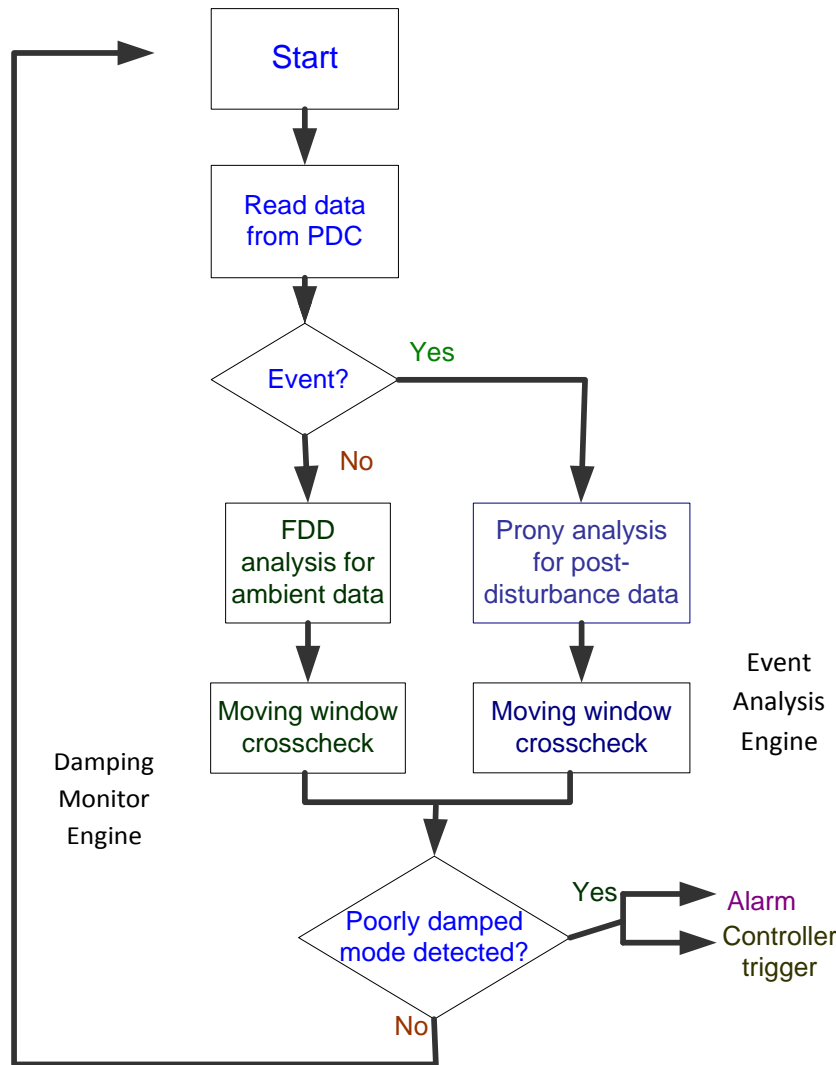Classification of online transient Stability assessment methods

Decision Tree

Proposed DT-based online security assessment scheme

Wide-Area Stability Monitoring Algorithm

Flow chart of Oscillation Monitoring System

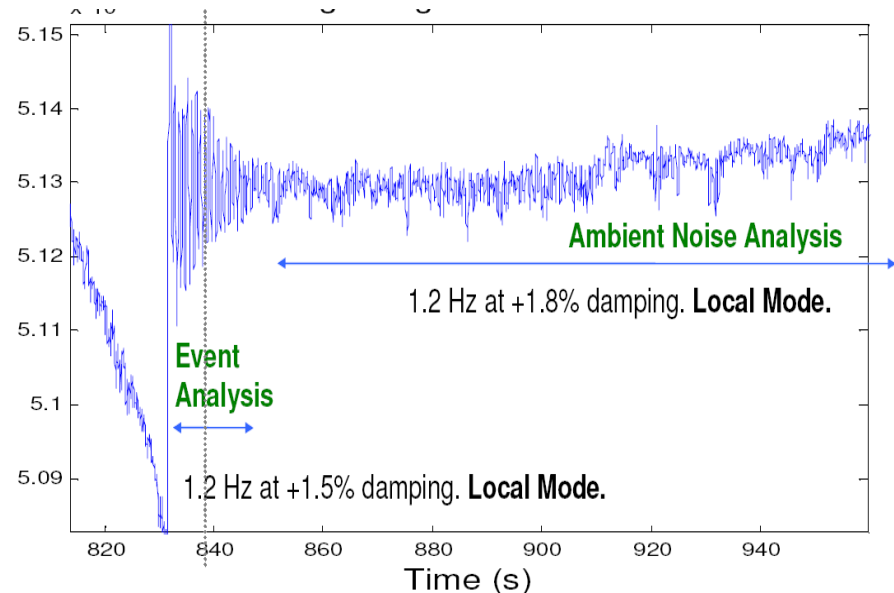

Illustration of modal estimation results from OMS

The system encountered a routine event at about 830 seconds. The event analysis engine of OMS then carries out moving time-window analysis of the PMU measurements towards real-time Prony analysis and concludes the oscillation to be from a local mode (involving mainly one PMU or few nearby PMUs) of 1.2 Hz oscillations with +1.5% damping ratio.

Fault Location Analysis

- Use synchronized sampling at both ends
- Use synchrophasors at both ends
- Use sparse sychrophasors
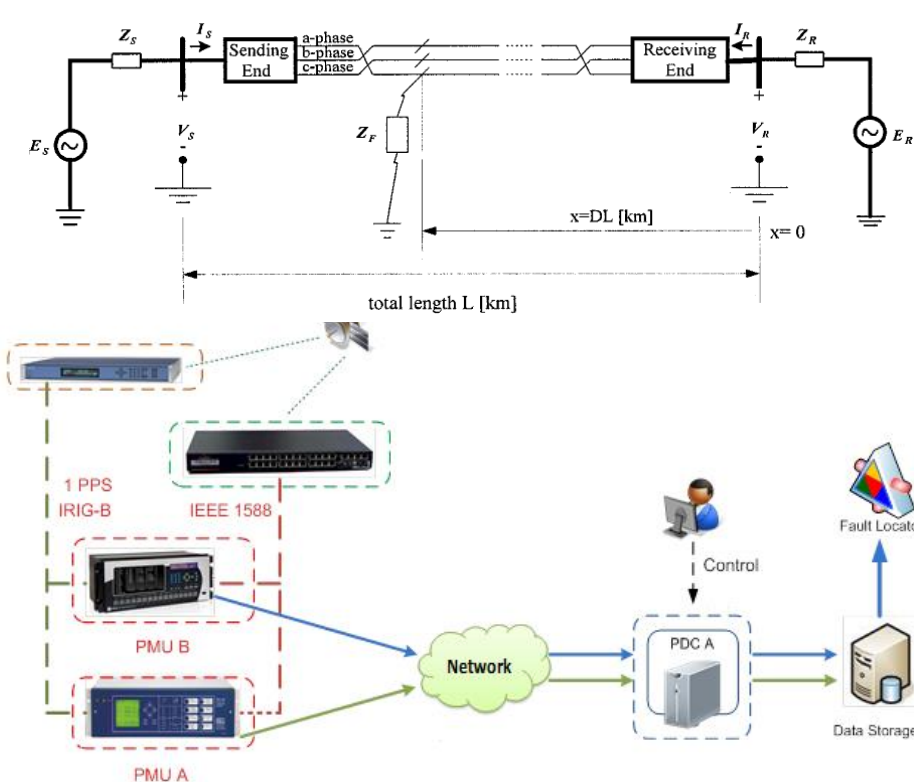
Typical Communication Network for Fault Location
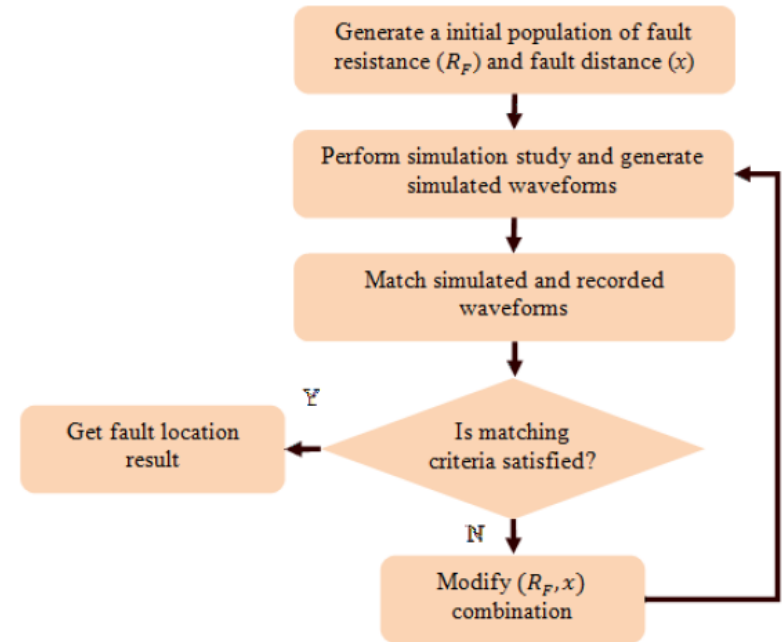
Flowchart of sparse measurement algorithm

Synchrophasor landscape

Timing Standards:
- GPS L1
- IRIG 200-04
- IEEE 1588 PTP
- C37.238 Profile

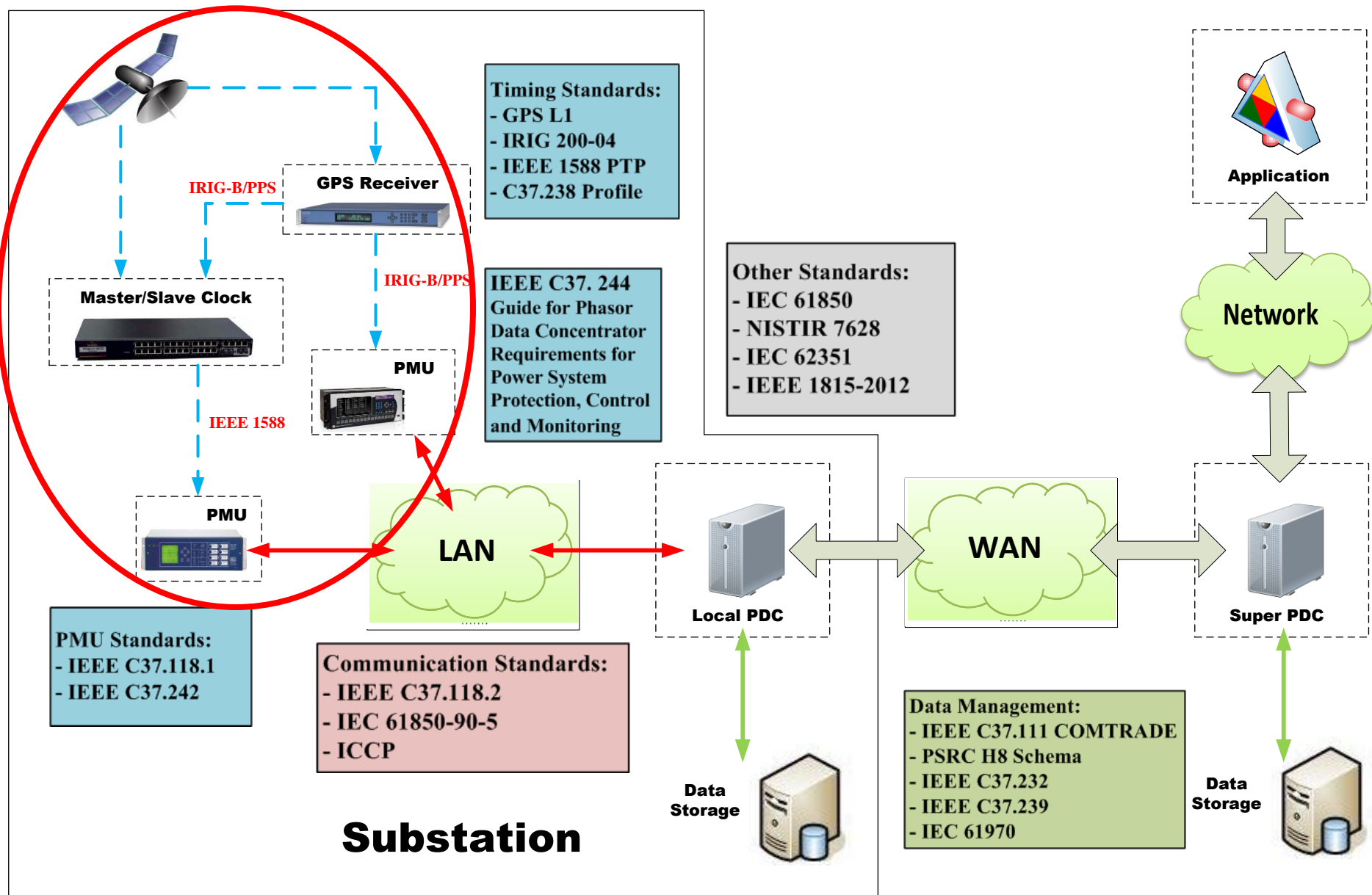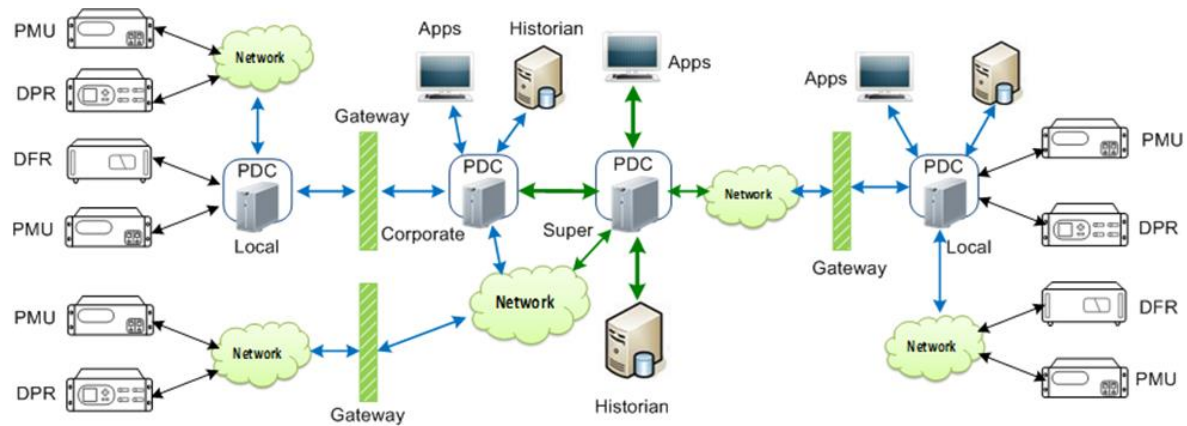**IEEE C37. 244 Guide for Phasor Data Concentrator Requirements for Power System Protection, Control and Monitoring**

Other Standards:
- IEC 61850
- NISTIR 7628
- IEC 62351
- IEEE 1815-2012

PMU Standards:
- IEEE C37.118.1
- IEEE C37.242

Communication Standards:
- IEEE C37.118.2
- IEC 61850-90-5
- ICCP

Data Management:
- IEEE C37.111 COMTRADE
- PSRC H8 Schema
- IEEE C37.232
- IEEE C37.239
- IEC 61970

IRIG-B/PPS

IRIG-B/PPS

IEEE 1588

GPS Receiver

Master/Slave Clock

PMU

PMU

LAN

Local PDC

WAN

Super PDC

Network

Application

Data Storage

Data Storage

Substation

Future system expansion
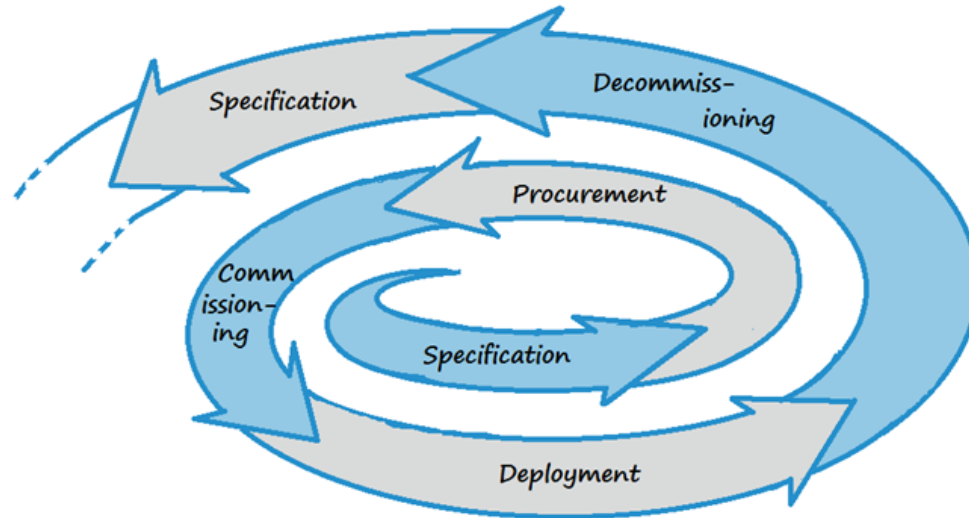
Conclusions

- This project summarizes the effort related to development of a book on synchrophasor measurement systems and their applications, which is a part of the project task 4.3.

- The book proposal has been submitted to a publisher for peer evaluation and as soon as the review is done and contract is signed, the manuscript will be in production stage.

- The book is expected to be published in late 2013 or early 2014.

Questions?