Next Steps: Taking Synchrophasor Technology to ERCOT Operations

Sarma Nuthalapati, ERCOT
Bill Blevins , ERCOT
Kris Koellner, LCRA
Sidharth Rajagopalan , ERCOT
Patrick Gravois , ERCOT
Wei Liu , ERCOT
Isabel Flores , ERCOT

INTERNATIONAL SYNCHROPHASOR SYMPOSIUM
MARCH 22-24, 2016, Atlanta, Georgia, USA
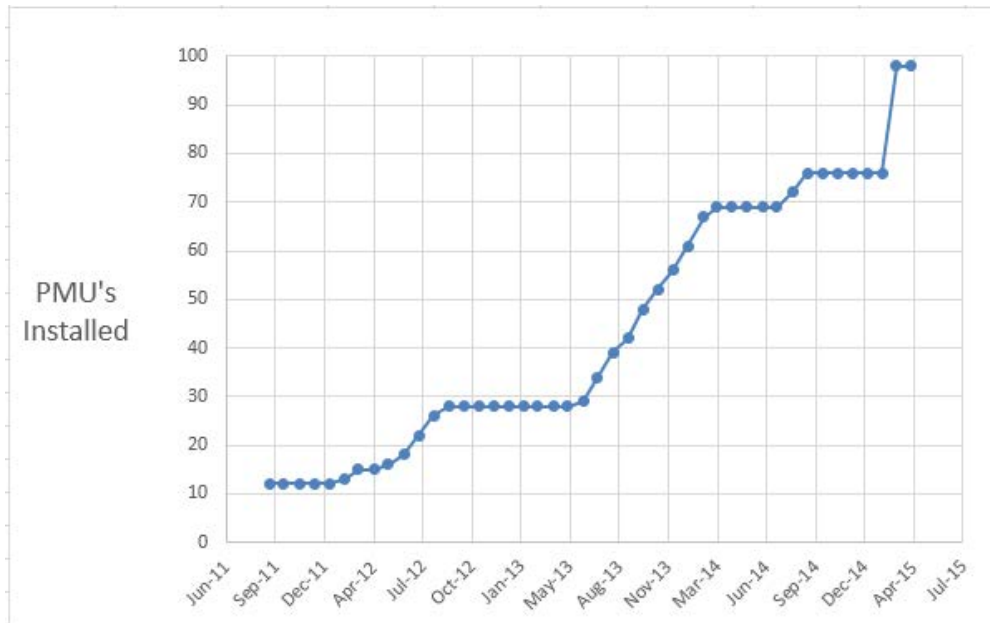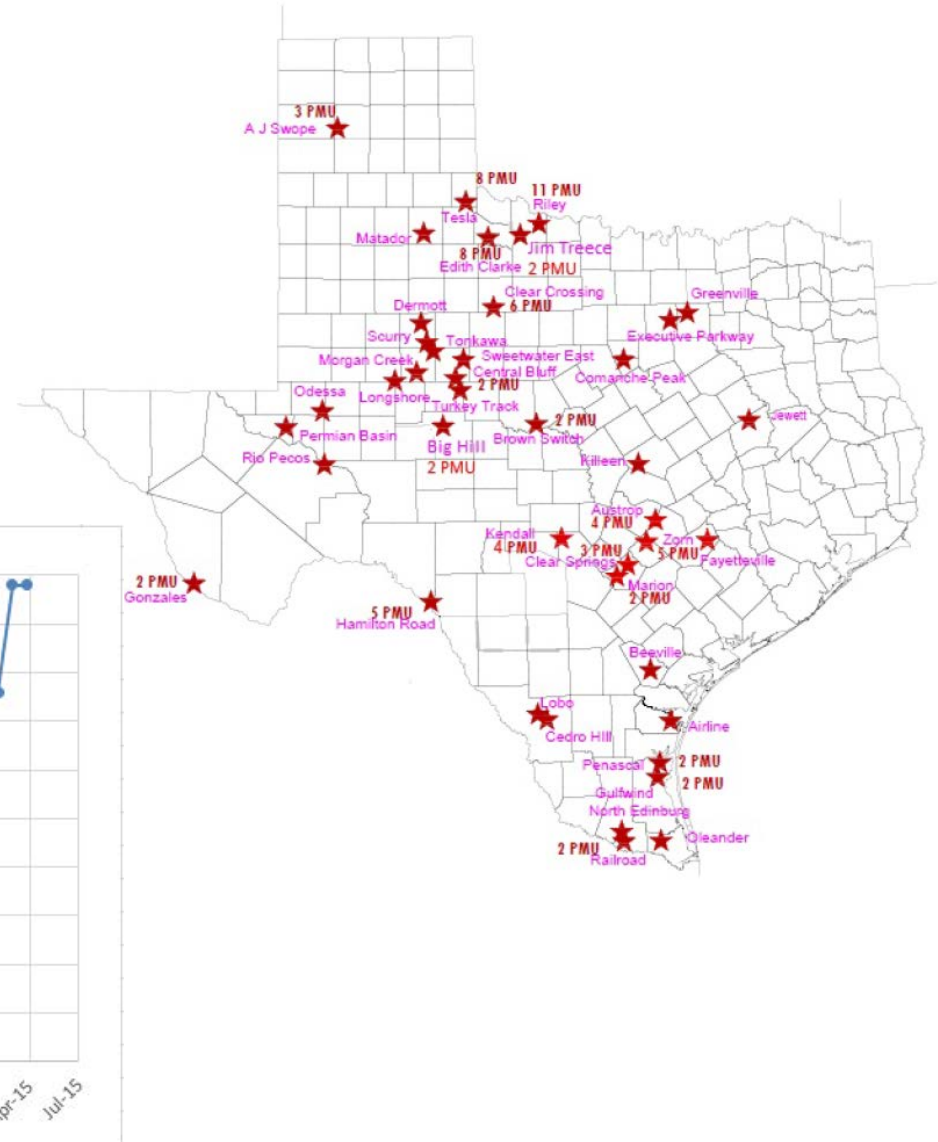
The ERCOT Synchrophasor (PMU) Project

- **Awarded to CCET** - Texas 501(c)6 non-profit formed in 2005

- **CCET Members and Mission**: 21 corporate members and 5 university cooperators. Mission - enhance the safety, reliability, security, and efficiency of the Texas electric transmission and distribution system through research, development and commercialization of emerging technologies (http://www.electrictechnologycenter.com)

- **Awarded Jan 4, 2010**: DE-OE-0000194; Value $27 million (DOE 50%); 17 participants; 3 Components – Synchrophasors, Smart Meter Texas Portal, and Smart Grid Community of the Future; 3 phases – Planning, Design, Demonstration

- **Title**: *Discovery Across Texas*: *Technology Solutions for Wind Integration in ERCOT*

- **Goal**: Demonstrate a synergistic approach to managing fluctuations in wind power (currently 8 GW increasing to 18 GW) in the ERCOT transmission grid through better system monitoring capabilities, enhanced operator visualization, and improved load management

- **Synchrophasor Project Participants:** ERCOT, TOs, Electric Power Group – Lead for Synchrophasor portion of the project

- **Project ended in Dec 2014**
- **Reports submitted to DOE**
- **Some presentations available on NASPI website (www.NASPI.org)**

Details: http://www.ercot.com/gridinfo/etts/ccet/index.html
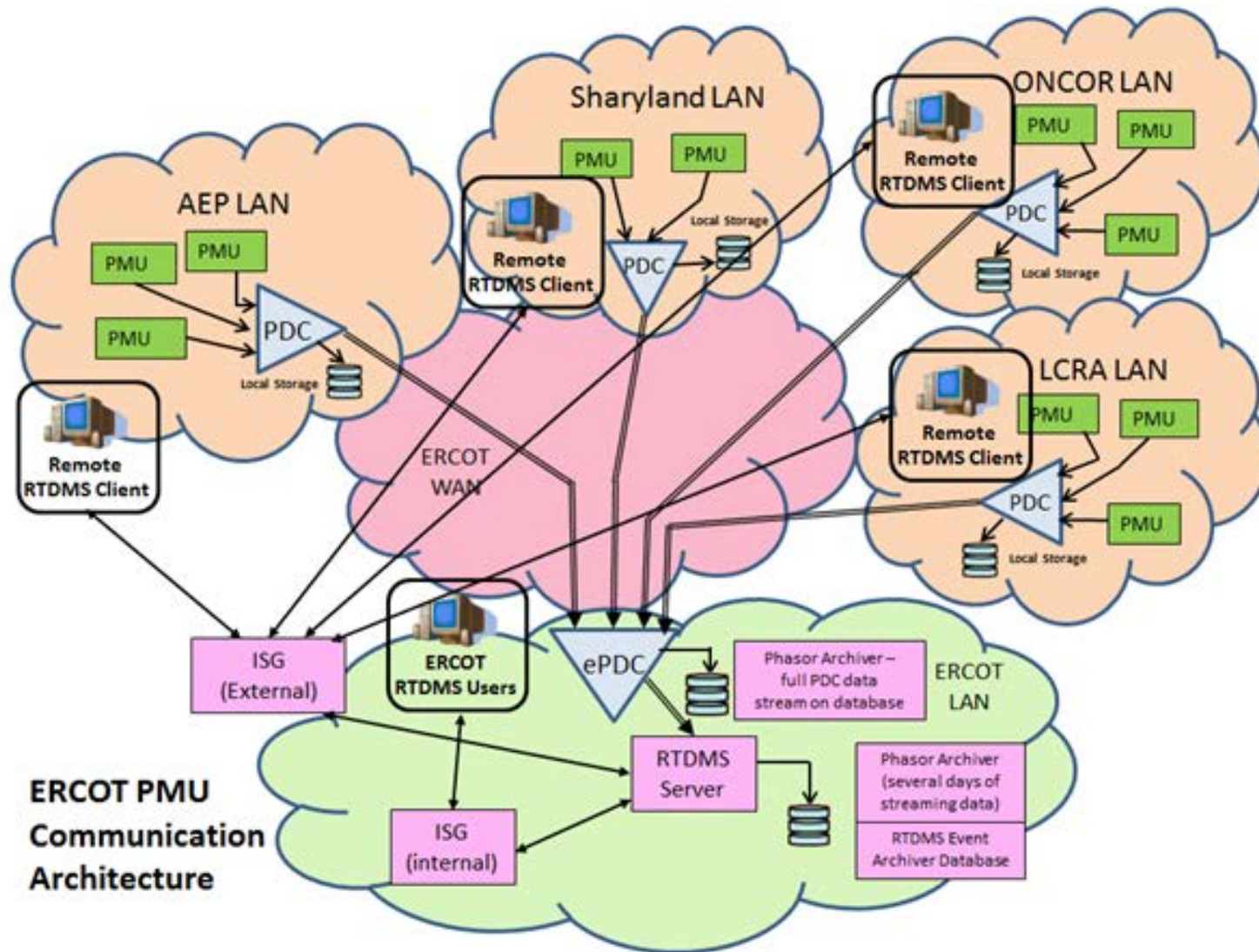
ercot

Number of PMUs in CCET Project (as on Dec 2015)

- **Total 98 PMUs @ 42 Locations**
  - AEP: 55
  - ONCOR: 17
  - Sharyland: 5
  - LCRA: 21 (Not part of DOE Project)

The Synchrophasor Data Communication Network

ERCOT ROS Synchrophasor Task Force

- Synchrophasor Technology Assessment
  - Addresses the major questions posed to the PMTF by ROS
  - Includes an overall summary of key recommendations
- Synchrophasor Communication Handbook
  - Provides guidance for connecting new PMUs to ERCOT's network
- Draft Nodal Operating Guide Section 6 language
  - Recommends language to formalize the placement and usage of PMUs within ERCOT
- ERCOT's NOGRR142
  - Approved on May 28, 2015 and effective from June 1, 2015
  - http://www.ercot.com/mktrules/issues/NOGRR142#summary

Details of ERCOT's NOGRR142

- **Approved on May 28, 2015 and effective date: June 1, 2015**
- **http://www.ercot.com/mktrules/issues/NOGRR142#summary**

Details of ERCOT's NOGRR142 (Contd.)

- **Sections of Protocol**
  - ➢ 6.1.3 Dynamic Disturbance Recording Equipment
    - ✓ 6.1.3.1 Recording Requirements (new)
      - Sampling rate, format, transmitted or locally stored
    - ✓ 6.1.3.2 Location Requirements (new)
      - FACT devices, GTCs, new generating sites ≥ 20MVA
    - ✓ 6.1.3.3 Data Recording and Redundancy Requirements (new)
      - Voltage, current, frequency, df/dt
    - ✓ 6.1.3.4 Data Retention and Reporting Requirements (new)
      - 10 day for all data, 3 year for event data

How Synchrophasor Data Is Being Used

- **System Oscillations**

- **Event Analysis**

- **Generator Model Validation/Tuning**
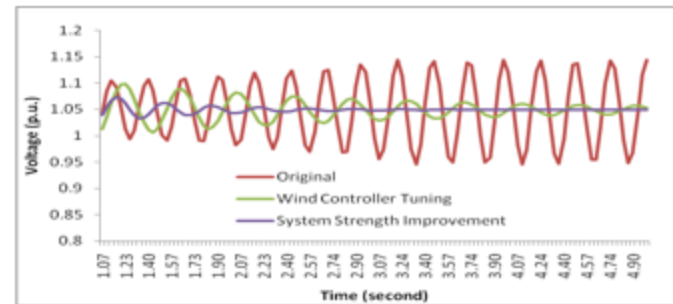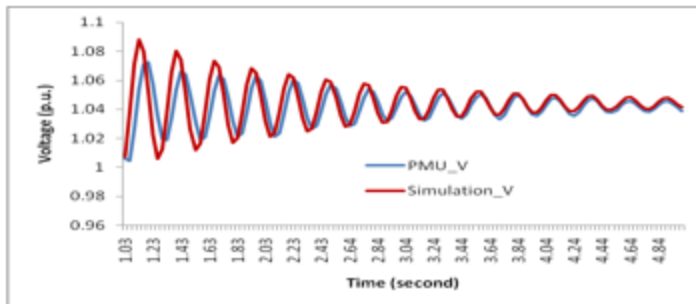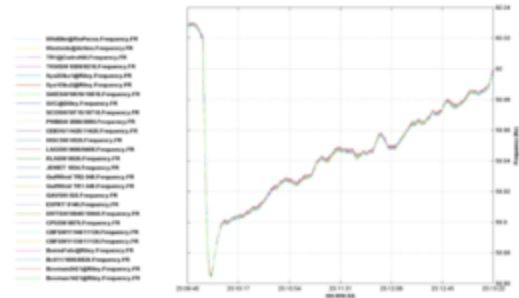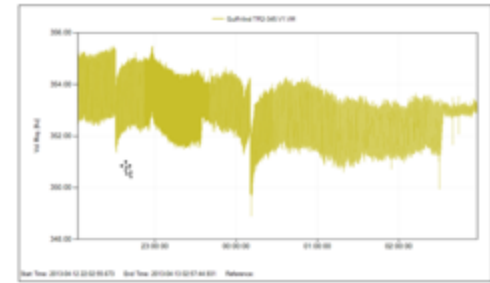
Synchrophasor technology in ERCOT Control Center
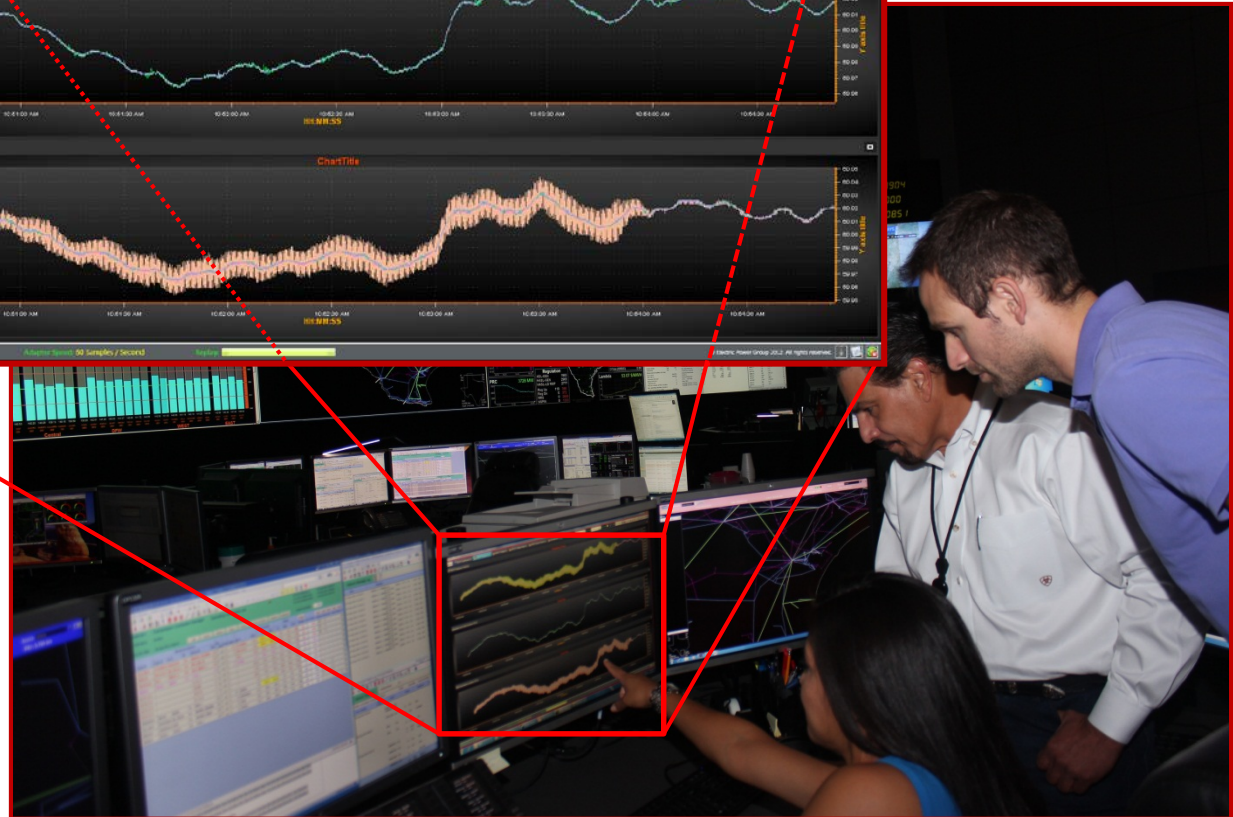
PSOT Project

PHASOR SIMULATION FOR OPERATOR TRAINING (PSOT)

Event Libraries and Integration with TSAT and RTDS for Real Time Simulations

DOE Grant Award DE-OE0000702

NASPI Presentation

Cost Share Partners- Bill Blevins, ERCOT and Frank Ashrafi, SCE
Prime Contractor – Jim Dyer, EPG
March 24, 2015

PSOT Project (Cont'd)

PSOT Project Participants

- **Southern California Edison (SCE)** – Cost Share Participant
  - Project Manager/Alternate - Frank Ashrafi/Nagy Abed

- **Electric Reliability Council of Texas (ERCOT)** - Cost Share Participant
  - Project Manager/Alternate - Bill Blevins/ Sarma (NDR) Nuthalapati

- **Dominion Virginia Power** (Dominion)
  - Adviser/Observer - Matt Gardner

- **Electric Power Group, LLC** – Prime Contractor
  - Project Manager - Jim Dyer
  - Key Project Personnel – Bharat Bhargava, Prashant Palayam, Simon Mo, Iknoor Singh

- **Powertech Labs Inc.** – Added to Project for Real Time Simulations with TSAT
  - Project Management - Lie Wang and George (Gang) Zheng

PSOT Project (Cont'd)

PSOT Project Objectives & Goals

- Research, design, develop and demonstrate a pre-commercial phasor-based training simulator to train power system operators on the use of synchrophasor technology

- Designed for operators to:
  - Understand phasor technology
  - Get familiar with dynamic metrics
  - Enable operators to visualize events using simulations
  - Utilize a library of events, both generic and utility specific, for use in training sessions
  - Test different actions and their effectiveness using simulations
  - Gain a wide area perspective, early warning indications and situational awareness of the interconnected grid
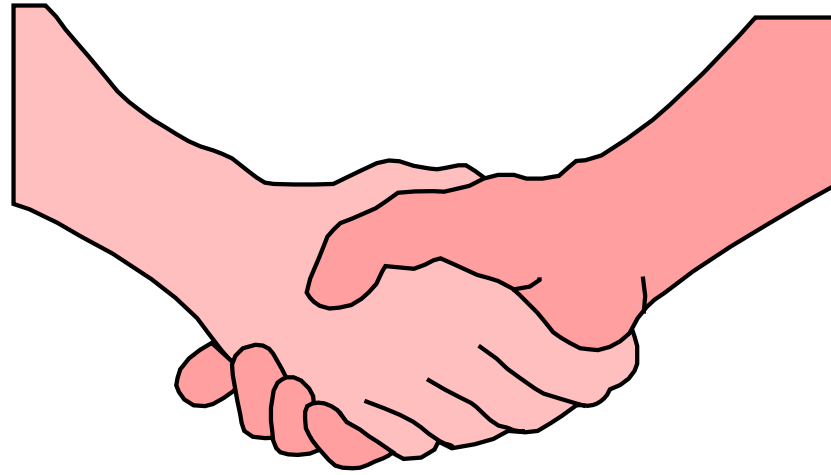
PSOT Project (Cont'd)

PSOT Flow Diagram for ERCOT

Configuration at ERCOT for Off-Line Simulation and Training – Event Library Method

Configuration at ERCOT for Near Real-Time Simulation and Training By Integrating TSAT with PSOT
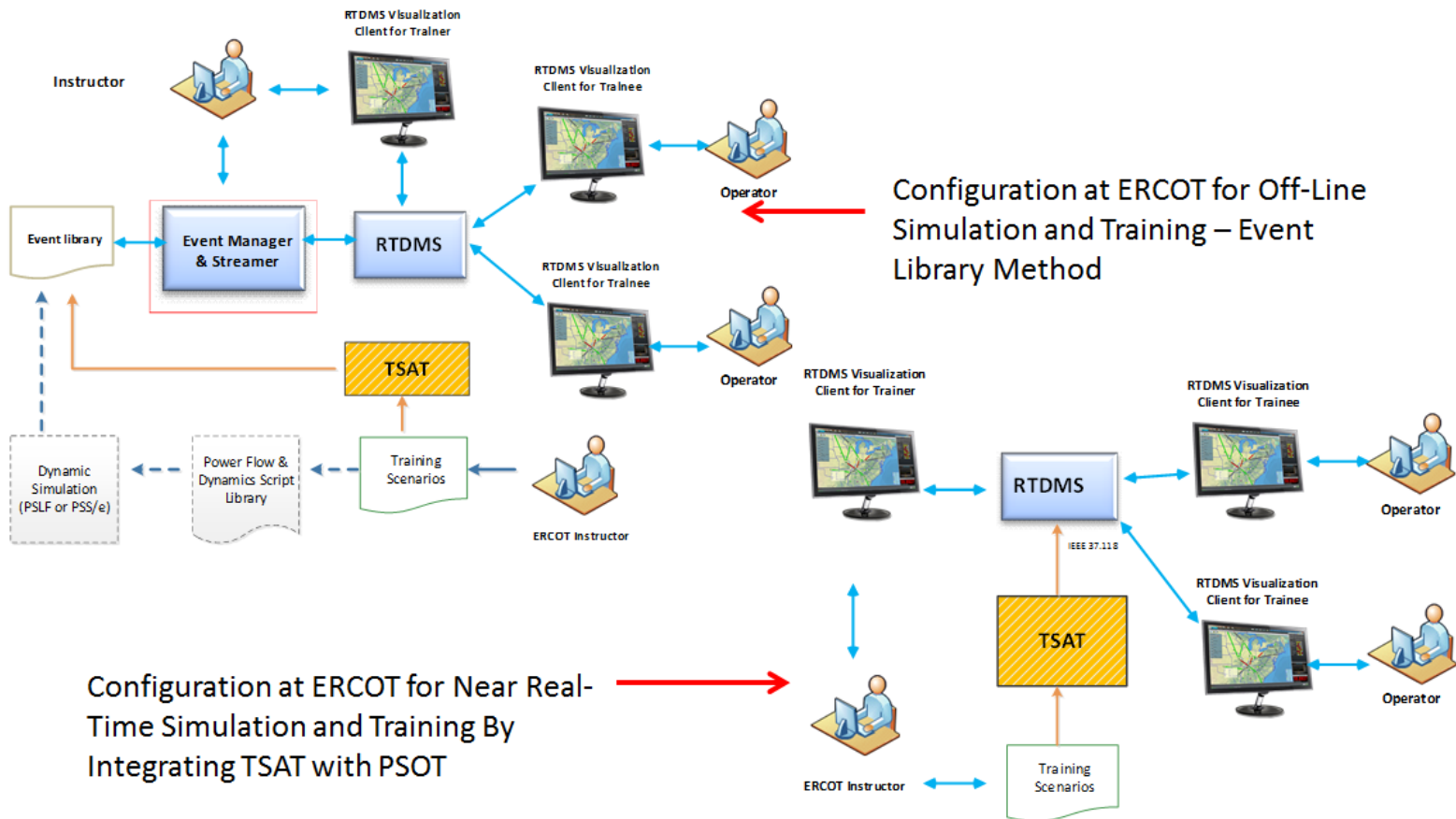
Future (Next To Next) Steps

- **Develop redundant RTDMS Systems in ERCOT Control Centers**
- **Provide Training to Operators using PSOT system**
- **Develop procedures for the operators in the control center**
- **Incorporate in Blackstart training**
- **Include in new EMS state estimator**
- **Potential linear state estimator for specific interfaces as a backup**
- **Add to existing Operator displays such as PI displays**
- **Add to Macomber Map**

Thank You !!

ercot