North American SynchroPhasor Initiative

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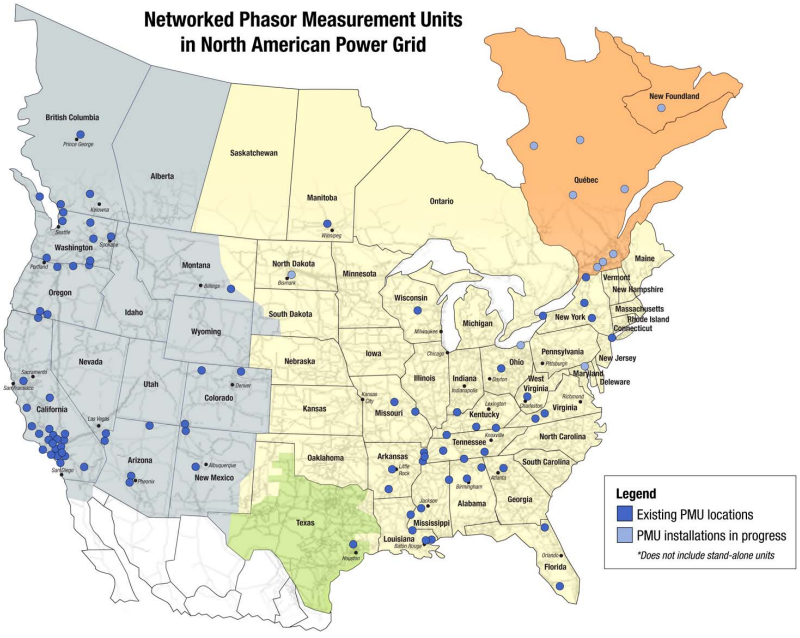
Abstract

In 2007, the U.S. Department of Energy (DOE) and the North American Electric Reliability Corporation (NERC), along with involved electric utility companies and other organizations, formed the North American SynchroPhasor Initiative (NASPI). This effort combines the previous Eastern Interconnection Phasor Project (EIPP) and various activities associated with Wide Area Measurement System (WAMS) research, development, and deployment activities that have been underway in the North American electric power system for a number of years as the primary focal point for continued DOE and NERC support and facilitation. This paper provides an update on this activity, building on a paper presented at last year's forum [1].

1 Introduction

This paper builds on papers previously presented to this symposium associated with synchronized measurements and their application in the North American electric power grid. [1,2] This paper provides an update to the status and directions of the NASPI.

The EIPP, supported by DOE through the Consortium of Electric Reliability Technology Solutions (CERTS), began in 2002 to facilitate the introduction of this technology and the exchange of system-wide information in the east. The August 14, 2003 blackout brought attention to the need for reliable, large area situational awareness and enhanced post-event analysis. In particular, the U.S.-Canada



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Power System Outage Task Force identified the need for such a system as part of their blackout findings [3, 4]. The EIPP created task teams to support the working group activity, and DOE provided staff support and facilitated industry engagement through a series of workshops. While NERC was an active supporter of the EIPP since its inception, beginning in 2007 it was decided to enhance the role of NERC to facilitate and coordinate industry engagement. Therefore, the last EIPP meeting in September 2006 and the first NASPI meeting in May 2007 were hosted by DOE, while subsequent NASPI meetings will be hosted by NERC.

The next section of this paper will present the structure, accomplishments, and status of the NASPI Task Teams, followed by a discussion of next steps for the initiative.

2 Task Team Structure

NASPI is structured as a working group made up of voluntary members from electric power operating organizations, reliability coordinators, suppliers of monitoring and communications network hardware and software, and researchers from industry, universities, and national laboratories. The working group is composed of seven task teams who focus on various aspects of developing and deploying synchrophasor measurement technology. DOE, through CERTS and in collaboration with NERC, provides technical support to the task team activities. The task team leaders together with the DOE program manager and representatives from NERC and CERTS make up a Leadership Committee whose role is to plan and coordinate the working group activities. An Executive Steering Group provides oversight to the working group and engages the power industry at a senior management level to spread the word about the benefits of system-wide measurements and enlist support for the program.

Membership in the working group and each task team is open to all interested parties. More information about the working group, including membership enrollment can be found on-line at *http://www.naspi.org/*.

2.1 Business Management Task Team

The scope of the Business Management Task Team (BMTT) includes the oversight of all business functions necessary to implement the work group vision. These include managing the contractual needs, the business environment, and the communications of the Working Group both internally and externally.

2.2 Operations Implementation Task Team

The scope of the Operations Implementation Task Team (OITT) includes deployment and training for tools enabling operators, reliability coordinators, and others engaged in operational aspects of grid reliability to effectively monitor and assess the real-time operations of the bulk power grid on a wide area basis. The scope of the OITT specifically includes applications that utilize synchrophasor data for state estimation and the development of real-time applications where adequate tools are not commercially available.

2.3 Planning Implementation Task Team

The scope of the Planning Implementation Task Team (PITT) includes identifying, facilitating the development of, deployment of, and training for, the tools that enable planners, analysts, and others to support the assessment of system performance, model validation, and to enhance decision-making related to bulk grid reliability.

2.4 Performance & Standards Task Team

The scope of the Performance and Standards Task Team (PSTT) includes coordinating and acting as liaison to standards efforts and determining consistent and satisfactory performance of synchronized measurement devices and systems by creating guidelines and reports in accordance with best practices.

2.5 Data & Network Management Task Team

The scope of the Data and Network Management Task Team (DMTT) includes the development of the hardware and software requirements to collect and store the PMU data at the master storage site(s). The group is also responsible for the communications from the PMU(s) or local storage site(s) to the master storage site(s), and development of future network architecture options.

2.6 Equipment Placement Task Team

The scope of the Equipment Placement Task Team (EPTT) is to gather installation statistics for phasor measurement units (PMU) and phasor data concentrators (PDC), including current status and implementation plans. The EPTT will maintain regular contact with the participating companies to remain

cognizant of pending changes to the network by any of the participating organizations.

2.7 Research Initiatives Task Team

The scope of the Research Initiatives Task Team (RITT) is to establish contact with various organizations involved in PMU research, development, and demonstration activities, and maintain regular contact to remain cognizant of current activities and future plans.

3 Recent Accomplishments

At the most recent working group meeting in Montréal in September 2007, the task teams met and reported progress and key goals for 2008. One of the key technical challenges facing NASPI is determining the future data and network architecture options for post-2010, when the initial phase of support from the Tennessee Valley Authority (TVA) super PDC will require transition to a long-term sustainable solution. The DMTT presented a vision for a massively distributed architecture based on a publish-subscribe model that includes the functionally a Phasor Gateways. This team also proposed a classification of applications shown in the following table.

Application Classification

Class	*Description*
A	Feedback Control
B	Open Loop Control
C	Post Event Analysis
D	Visualization
E	Research/Experimental

Detailed performance requirements can then be developed for each application class. For example, considering measurement sample rate (e.g., 30 samples per second vs. 1 sample per second) and required latency, the following table illustrates different requirements between these application classes.

Example Requirements

Class	*Data Rate*	*Required Latency*
A	Fast	Fast
B	Slow	Medium
C	Fast	Slow
D	Slow	Medium

The measurement hardware and associated data networks can then be specified to support these application classes, and future users would understand for example that a network built to Class B specifications would not support Class A applications. Detailed specifications are under development.

Another example of progress reported at the September working group meeting by the OITT was the deployment of new wide area visualization tools and daily summaries of measurement information. This will be important for baselining normal operation to determine thresholds for detecting abnormal events.

The RITT provided an overview of progress cataloging research activities underway in this arena, with the goal of developing an information repository and methods for facilitating interaction within the research community. The other task teams provided a status summary of progress to date and ongoing work activities.

4 Path Forward

Key issues moving forward include ensuring full coverage of monitors throughout the North American electric power grid to ensure that there is sufficient data to support the data requirements associated with the synchrophasor applications. Additionally, data sharing issues remain to be resolved, including non-disclosure arrangements and ensuring proper confidentiality of the information is preserved. Data quality issues requiring resolution include data streaming issues between the PMU and the various PDC and archiving sites, but also managing data flows between the concentrators and the subscribers of the data. A sustainable data architecture that can support future data requirements with scalability and a proper financial support mechanism is an issue that is also being addressed. Finally, a research and development agenda that provides advanced applications in situational awareness, operator tools, and real-time wide-area control is being developed.

4.1 DOE Role

In coordination with NERC, DOE will continue to provide leadership and support to the NASPI activities. In addition to overall leadership and coordination, specific technical support will continue to be provided to the task teams. DOE will also continue to facilitate the task teams in their meetings and work activities.

In the data and network management area, PMU device installation and measurement integration into the information-sharing network needs to be streamlined so that new equipment can come on-line more quickly and with less effort. Network information availability and data quality issues also need to be identified, prioritized, and resolved. A major activity of this group is to develop the requirements

specification of the next generation network to share real-time measurements system wide. This work must be coordinated with the directions emerging from NERC in this area.

In the operations and planning implementation areas, data quality requirements for various applications need to be specified and passed on to the data and network management team. Operators need to be engaged on display visualization and other human factor issues, and guidelines for visualization and procedures need drafting. Now that we capture measurement information from across the interconnection, a baseline of "normal" operations needs to be investigated if we are to distinguish "abnormal" behavior and alert operators. While work is progressing in industry collaborative efforts (such as integrating synchrophasors into state estimation), a project task to investigate the system baseline has been initiated.

Integrating efforts between the eastern and western interconnections remains an important focus for NASPI activities that includes event analysis, PMU equipment testing, support of analysis tools, technology development efforts, and other activities to validate and calibrate system models.

4.2 NERC Role

NERC's intent is to investigate and analyze the use of high-speed real-time system measurements, including phasors, in predicting the behavior and performance of the North American Interconnections. NERC is approaching this area consistent with its role as the Electric Reliability Organization (ERO) for the North American electric power grid. Any infrastructure costs associated with the measurement technology, data networking and archiving facilities, and analysis tools, will be carried by the operating entities. NERC's focus is on supporting the interconnections to provide guidance on the high-level network architecture, data management requirements, standards for devices and information exchange, and common specifications of reliability management applications for the vendor community to implement.

NERC will continue to provide transitional leadership supporting NASPI. In addition, NERC will lead planning and facilitation of key working group and other meetings, establish clear reporting for on-going NASPI efforts within the ERO organizational structure, and will add NERC staff support to all of the task teams. Finally, NERC will continue to facilitate ongoing activities in all of the North American interconnections in support of NASPI.

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6 Acronyms

BMTT	Business Management Task Team
CERTS	Consortium for Electric Reliability Technology Solutions
DMTT	Data and Network Management Task Team
DOE	U.S. Department of Energy
EIPP	Eastern Interconnection Phasor Project
EPTT	Equipment Placement Task Team
ERO	Electric Reliability Organization
NASPI	North American SynchroPhasor Initiative
NERC	North American Electric Reliability Corporation
OITT	Operations Implementation Task Team
PDC	Phasor Data Concentrator
PITT	Planning Implementation Task Team
PMU	Phasor Measurement Unit
PSTT	Performance and Standards Task Team
RITT	Research Initiatives Task Team
WAMS	Wide Area Measurement System

7 References

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[4] Dagle JE. 2006. "Postmortem analysis of power grid blackouts - The role of measurement systems." IEEE Power & Energy Magazine, Volume 4, Issue 5, Sept.-Oct. 2006, Pages 30-35.