Summary of the North American SynchroPhasor Initiative (NASPI) Activity Area

Supporting industry adoption of next-generation monitoring equipment to increase reliability and reduce costs for consumers

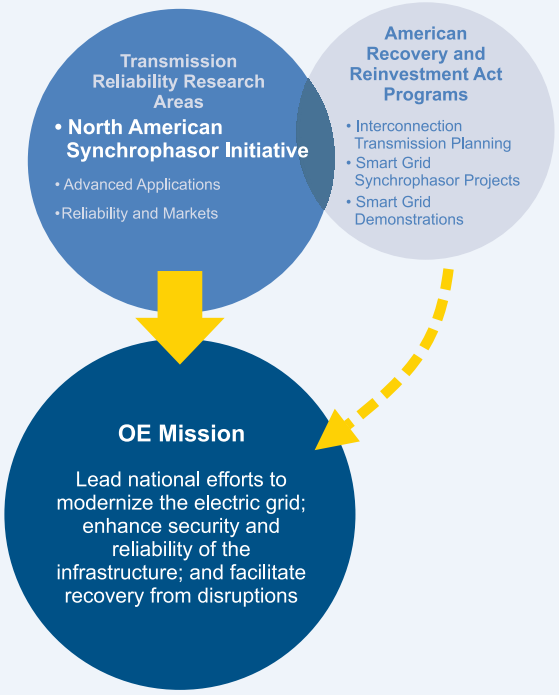
U.S. DEPARTMENT OF ENERGY | Electricity Delivery & Energy Reliability

Transmission Reliability and Renewables Integration Program

The North American SynchroPhasor Initiative (NASPI) is a collaboration between the electric industry, the North American Electric Reliability Corporation (NERC), and the U.S. Department of Energy (DOE) to advance the use of synchrophasor technology to enhance grid reliability and economics through high-speed, wide-area measurement, monitoring, and control.

The NASPI community is contributing to the development of secure, high-speed, time-synchronized data about bulk power system conditions. This requires infrastructure development, including phasor measurement units, data concentrators to synchronize and archive the data, secure communications systems to deliver the data, and analytical tools to process and interpret the synchrophasor data and its implications.

Synchrophasor technology is expected to offer automated controls for transmission and demand response as well as great benefits for integrating renewable and intermittent resources, increasing transmission system throughput, and improving system modeling and planning.



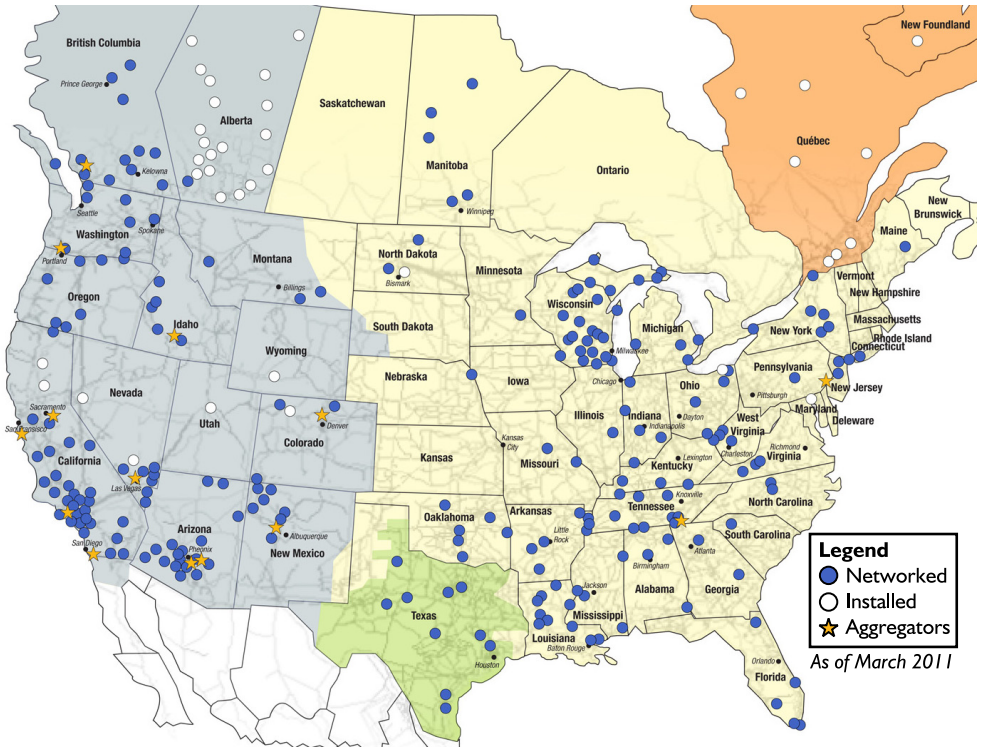
NASPI is one of three key activity areas funded by the Transmission Reliability and Renewables Integration Program. This activity has a collaborative role with American Recovery and Reinvestment Act programs in helping to improve grid monitoring and operations and ultimately achieve the OE mission.

What Is Synchrophasor Technology?

Synchrophasors are precise electrical grid measurements of values such as voltage or power that are available from monitors called phasor measurement units (PMUs). These measurements are taken at high speed (30 observations per second), and each measurement is time-stamped according to a common time reference. Time stamping allows synchrophasors from different utilities to be time-aligned (or "synchronized") and combined together, providing a detailed and internally consistent operational "picture" of the entire interconnection. This picture can help grid operators detect disturbances that would have been impossible to see with older supervisory control and data acquisition (SCADA) systems, which typically collect one measurement every 2-4 seconds.

Synchrophasor Technology Deployment

For the past decade, DOE has been investing in the research and development (R&D) of new synchrophasor data analysis tools and making synchrophasor data available across the Eastern Interconnection. This R&D has served as a critical framework to maximize the investment from the American Recovery and Reinvestment Act (ARRA). By 2014, this ARRA investment will help bring the total of installed PMUs to more than 1,100, offering nearly 100 percent coverage of the transmission system.



Synchrophasor Technology Benefits

NASPI advances the use of synchrophasor technology to provide the following benefits to the electric delivery system:

Real-time operations applications

Wide-area situational awareness

Frequency stability monitoring and trending

Power oscillation monitoring

Voltage monitoring and trending

Alarming and setting system operating limits, and event detection and avoidance

Resource integration

State estimation

Dynamic line ratings and congestion management

Outage restoration

Operations planning

Planning and off-line applications

Baselining power system performance

Event analysis

Static system model calibration and validation

Dynamic system model calibration and validation

Power plant model validation

Load characterization

Special protection schemes and islanding

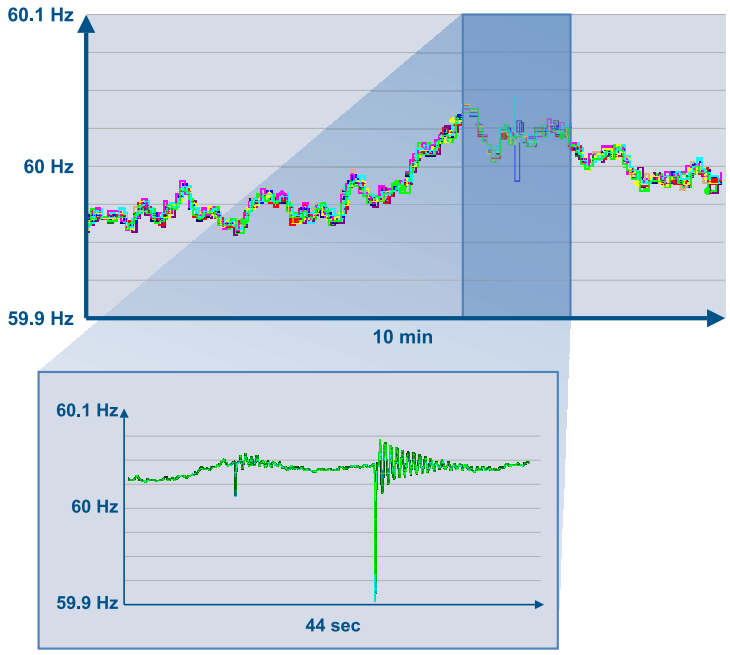
Primary frequency (governing) response

A Comparison of SCADA and PMU Data

Because PMUs collect data at a much higher sampling rate than SCADA systems, the granularity of the data can reveal new information about dynamic stability events on the grid. The figures at right illustrate this difference for the same event, offering an example of the information that SCADA misses because its relatively slow scan times cannot capture the dynamic response of the system.

The top image shows four-second scan rate SCADA frequency data for several sites in a small geographic area. Some small fluctuations in system frequency are visible, but because only two units recorded a change, the signals appear to be noise rather than a measurement of anything noteworthy.

The bottom image shows PMU data from several sites for the same event. Note that the observed frequency excursion captured by the PMUs was much larger than what the SCADA data indicated (59.91 Hertz [Hz] minimum versus 60.00 Hz). The PMUs also captured system oscillations that continued for approximately 7 seconds after the event.

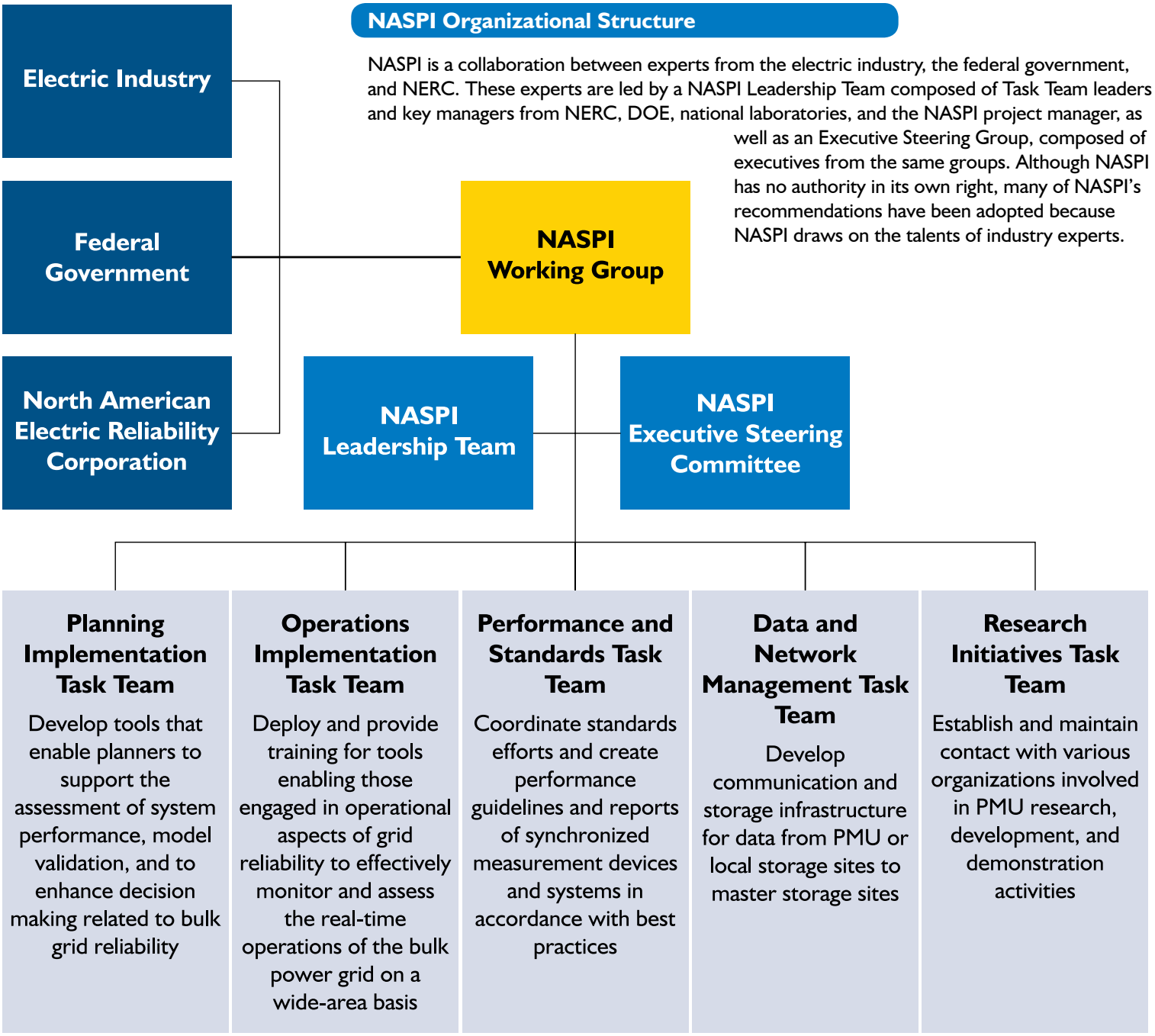


Accomplishments and Outstanding Issues to Date

Accomplishments	Outstanding Issues
Development of PMU communications framework (known as NASPInet Architecture)	Improving and expanding communication system architecture and integration
Development of several key technical interoperability standards	Developing independent interoperability testing and certification methods
Maturing PMU functionality, including successively higher measurement speeds	Defining production-grade systems
Identifying the baseline performance of relationships across an interconnection	Improving the baseline for further understanding of normal grid conditions, thus aiding identification of disturbances
Development of educational materials to facilitate deployment	Delivering widespread industry training on synchrophasor technologies
	Mainstreaming NASPI by migrating activities to other organizations
	Further improving data quality and availability

NASPI Organizational Structure

NASPI is a collaboration between experts from the electric industry, the federal government, and NERC. These experts are led by a NASPI Leadership Team composed of Task Team leaders and key managers from NERC, DOE, national laboratories, and the NASPI project manager, as well as an Executive Steering Group, composed of executives from the same groups. Although NASPI has no authority in its own right, many of NASPI's recommendations have been adopted because NASPI draws on the talents of industry experts.



Planning Implementation Task Team

Develop tools that enable planners to support the assessment of system performance, model validation, and to enhance decision making related to bulk grid reliability

Operations Implementation Task Team

Deploy and provide training for tools enabling those 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

Performance and Standards Task Team

Coordinate standards efforts and create performance guidelines and reports of synchronized measurement devices and systems in accordance with best practices

Data and Network Management Task Team

Develop communication and storage infrastructure for data from PMU or local storage sites to master storage sites

Research Initiatives Task Team

Establish and maintain contact with various organizations involved in PMU research, development, and demonstration activities

Further Reading

"Real Time Application of Synchrophasors for Improving Reliability". NERC report. *http://www.nerc.com/docs/oc/rapirtf/RAPIR%20final%20101710.pdf*

North American SynchroPhasor Initiative website, *https://www.naspi.org*

Office of Electricity Delivery and Energy Reliability: *http://energy.gov/oe/office-electricity-delivery-and-energy-reliability*

Recovery Act Smart Grid Programs: *http://www.smartgrid.gov/recovery_act*

About the Transmission Reliability Program

The Transmission Reliability Program was established by Congress in 1999 to support a national laboratory/electricity industry partnership to conduct research on the reliability of the nation's electricity delivery infrastructure during the transition from regulated markets to competitive markets under restructuring. Competition and market forces are creating an exponential increase in the volume of power transactions and causing the grid to be used in ways for which it was not designed. The Transmission Reliability Program is developing advanced technologies, including information technologies, software programs, and reliability/analysis tools, to support grid reliability and efficient markets during this critical transition.