

NIST Vision in Support of Energy & Smart Grid

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NIST Smart Grid Framework and Roadmap

www.nist.gov/smartgrid

NIST Special Publication 1108

NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0

Office of the National Coordinator for Smart Grid Interoperability

NIST National Institute of Standards and Technology • U.S. Department of Commerce

Release 1
January 2010

NIST Special Publication 1108R2

NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0

Office of the National Coordinator for Smart Grid Interoperability,
Engineering Laboratory
in collaboration with
Physical Measurement Laboratory
and
Information Technology Laboratory

NIST National Institute of Standards and Technology • U.S. Department of Commerce

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February 2012

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NIST Special Publication 1108r3

NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 3.0

Smart Grid and Cyber-Physical Systems Program Office
and Energy and Environment Division,
Engineering Laboratory

in collaboration with
Quantum Measurement Division,
Semiconductor and Dimensional Metrology Division,
and Electromagnetics Division,
Physical Measurement Laboratory
and
Advanced Network Technologies Division
and Computer Security Division,
Information Technology Laboratory

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NIST
National Institute of
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Release 3
September 2014

PMUs and Merging Units

- IEEE conformity assessment program for PMUs is running
- NIST will perform testing on Merging Units and interoperability testing on them
- Should there be a conformance testing program for Merging Units?

Distribution PMUs or μ PMUs

- We plan to test PMUs in a distribution setting at NIST
- Accuracy testing to be performed in the lab
- What would be possible in distribution system if these were economically viable?

Electric Power Metrology

- Electric power measurements tie to fundamental constants via Josephson voltage standard
- Working on expanding distorted power measurement capability to 600 volts and 50 amps.
- What uncertainty is needed for the 50th harmonic?
- Will be participating in an international key comparison on sinusoidal power along with one for distorted power measurements

ANSI metering

- ANSI C12 metering stds. cover performance specifications and also data and networks
- Metering performance with auxiliary devices operating is not in Type Testing
- What other Type Tests are needed?
- Canada has a group working towards fundamental frequency only watthour and varhour billing, this could lead to interesting opportunities

Electricity Meters

- What will be possible if 1% of meters were sending voltage and current readings every 5 seconds, how about 10% of the meters on the system?
- How well could meters be time synchronized on a feeder? What would that enable?
- Have any utilities looked into using success of IoT implementation at factories dramatic improvements for justifications for sensors in the grid?

Communication Standards

- ANSI C12.19
- DLMS/COSEM
- IEC 61850
- DNP3
- Others
- Communications between field devices
- I want to hear your thoughts on what you think would be a good metering/sensor protocol 10 years from now

Metering not under PUC Jurisdiction

- EV Charging - Commercial transactions covered by Weights and Measures
- Measurement testing procedures are being developed for EV chargers
- Type evaluation program is starting for accuracy testing of EV chargers
- Test equipment is being developed for field inspectors
- Submetering topic is getting underway

Smart Grid Testbed Facility Summary

Problem: NIST/industry do not have an interactive platform to research SG technologies and measurement science, and demonstrate solutions to a full range of SG interoperability issues.

Solution: Develop a fully integrated SG measurements/validation testbed, with emphasis on microgrids.

Vital Role: Addresses national priority of SG interoperability, standards traceability, dissemination of data

Attributes: Open-architecture, physics-based, scalable, renders fully characterized and validated model for residential and commercial/industrial microgrids.

NIST Smart Grid Interoperability Testbed

- **Objectives:**
 - To provide the foundational infrastructure for smart grid interoperability research
 - To accelerate the development of smart grid interoperability standards by addressing the measurement needs of smart grid industry
 - To develop and participate in a community of federated testbeds
- **Scope**
 - Designed to be composable, collaborative, and federated
 - Perform measurements of system-level, end-to-end device level smart grid performance and interoperability
 - Measure and characterize key components, standards, and protocols of smart grid systems and devices
 - Focus research on microgrids



NIST Smart Grid

Gaithersburg, MD

PHASE 1

Timing and Synchronization

Time-stamping and location for devices on the grid

Cyber Security

Develop / evaluate requirements to keep the grid secure

Rooms A29-31

Microgrid Power

Simulates the power generation on the microgrid

Room A27

Microgrid Communication and Control

Controls the operation of the microgrid

Rooms A23-25

Electrical Flow

EXPANSION

Smart Storage

Electric vehicle and residential batteries

Room A21

Smart Sensors

Situational Awareness-- smart sensors that tell operators what's happening on the grid

Rooms A13-19

Smart Meters

Watt-hour meters that communicate with the grid

Rooms A13-19

Network and Communication

Simulates networks and protocols used to communicate among sensors, substations and other grid components

Rooms A13-19

NIST Cyber-Physical Testbed

NIST Cyber-Physical Systems Testbed

Platform for cross-sector research in the integration of networks, physical systems, and analytics

Rooms A45-65

Other NIST and Federated Testbeds

Sharing of resources, models, and data to allow flexibility and scalability, and enable more complex investigations

NIST and External

Communication/Data Flow

National Institute of Standards and Technology
U.S. Department of Commerce

NIST Smart Grid Testbed

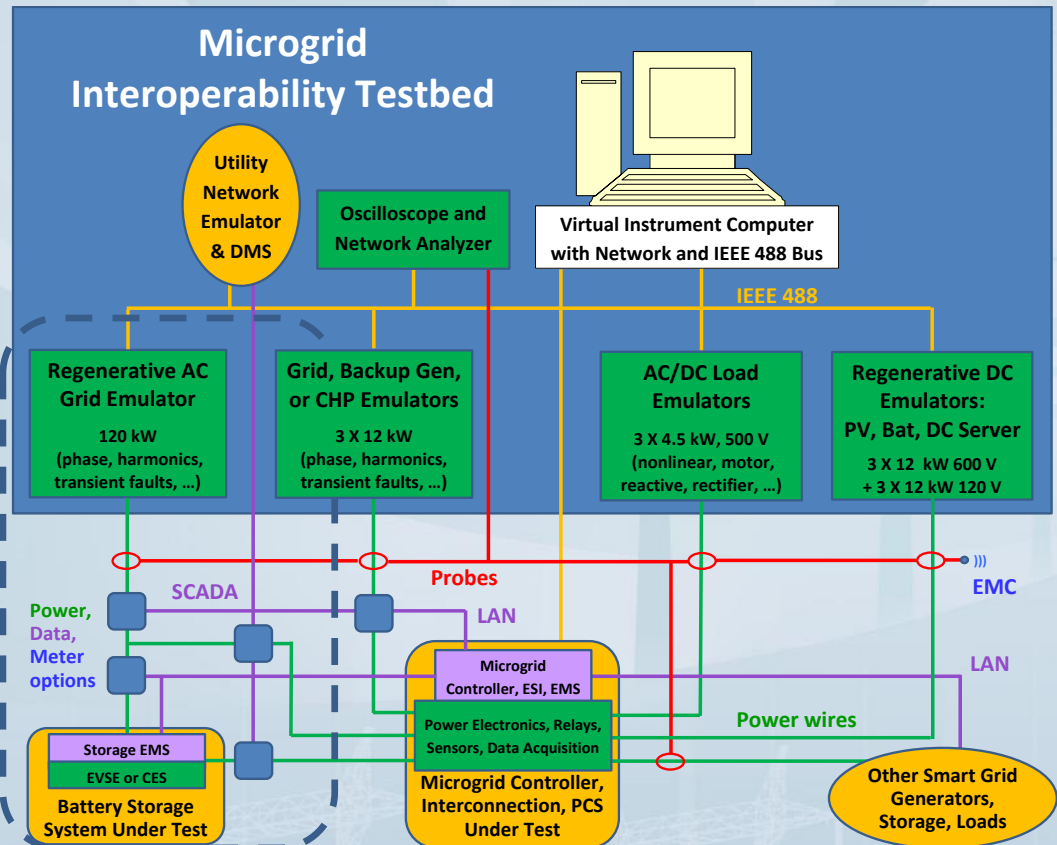
A031-A029	A027-A025	A023	A021	A019	A017	A015	A013
Cyber Security V. Pillieteri	Microgrid Power Conditioning A. Hefner	Synchro -phasor/ Sensors J. FitzPatrick	Metering Accuracy T. Nelson	Comm Modeling N. Golmie	Energy Storage A. Hefner	Sensor Interfaces K. Lee	Guest Researcher

- Deploy commercial PMUs with advanced sensors
- Develop interoperability tests for distribution PMUs/micro-PMUs (IEEE C37.118.2/IEC 61850-90-5)
- Develop/test smart sensors interoperability requirements based upon IEEE 1451.1
- Beyond PMUs – Merging Units (Mus)
 - Develop interoperability tests for MUs based upon IEC 61869-9

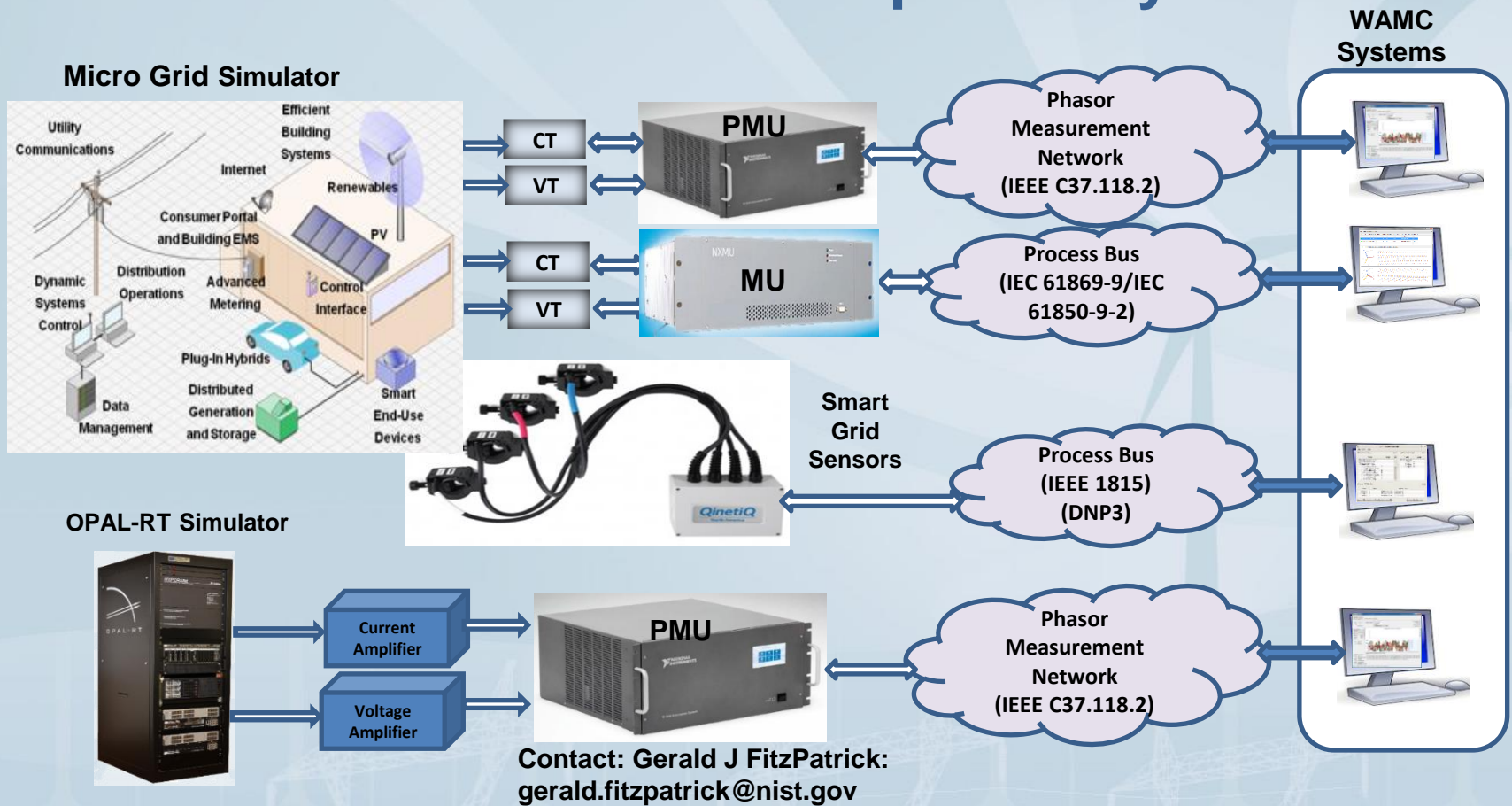
NIST Smart Grid Microgrid Testbed

- Addresses metrology needed for interoperability of advanced microgrid devices and systems
- Extensible to all aspects of multilevel distributed control
- Focused on unique NIST mission of Smart Grid interoperability and leverages SGIP activities
- Incorporates elements of many of the projects in the NIST smart grid portfolio
- Coordinated with other agencies and industry programs
- Aligned with partner test bed architectures to enable interchangeability of devices between test beds
- Support standard development (IEEE 1547 series, IEEE p2030.7, IEEE p2030.8)

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Smart Sensors Interoperability Testbed



- Thank you for your attention
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