Interoperability and Standards

Dr. George Arnold, IEEE PES ISGT Technical Chair and National Coordinator for Smart Grid Interoperability National Institute of Standards and Technology U.S. Department of Commerce

February 26, 2013
Panelists

• Dr. Ralph Sporer - Smart Grid Coordination Group Europe
• Mr. Tatsuya Shinkawa – Smart Grid Standardization Activities in Japan
• Dr. W. Charlton Adams, Jr. – IEEE Standards
• Mr. Patrick Gannon – Smart Grid Interoperability Panel (SGIP) 2.0
Smart Grid Coordination Group
Europe

Ralph Sporer

CEN-CENELEC-ETSI Smart Grid Coordination Group
Policy Drivers

Sustainability: 20-20-20 targets
- Reduction of CO₂ emissions
- Increased generation based on renewable sources and
- Need to increase grid and consumption efficiency - decrease losses

Security of supply
- Increase grid robustness and resilience
- Integration of different generators (centralised and distributed)

Competitiveness and Internal Market development
- Better management of supply and demand
- New market opportunities and increased efficiency of the market
- Empowerment of consumers

All these challenges call for the restructuring of the grids, e.g. the structure of generation, market and the use of electricity
European Standards Organizations

European Committee for Standardization
31 Members (NSB/NC of 27 EU Members + 3 EFTA countries + 1 EU applicant)

European Committee for Electrotechnical Standardization
31 Members (NSB/NC of 27 EU Members + 3 EFTA countries + 1 EU applicant)

European Telecommunications Standards Institute
700 ETSI member organizations from 60 countries worldwide

“Recognized” by the European Union under Directive 98/34 (new 1025/2012)
International cooperation

- Formal agreements
  - IEC
  - ISO
  - ITU-T, 3GPP

ESOs: European Standardization Organizations

ESOs operate numerous further liaisons e.g. 3GPP etc.

Vienna Agreement
Dresden Agreement
MoU

ESOs

SG-CG

DIN
DKE
Individual Company membership

e.g. Germany

Ralph Sporer, SG-CG Chairman
Current Setup of standardization

EU Mandate on Smart Grid Standardization

- Legislation
  - EU Commission
    - Smart Grid Reference Group
      - EC Steering Group for Mandate Execution (consists of EC representatives and experts)
    - Smart Grid Co-ordination Group
      - Coordination of ESOs work (consists of ESO representatives and associations)
  - Accept and work on
    - CENELEC, CEN, ETSI

Issues

Ralph Sporer, SG-CG Chairman
Reference architecture
A technical reference architecture, which will represent the functional information data flows between the main domains and integrate many systems and subsystems architectures.

Sustainable processes
Sustainable standardization processes and collaborative tools to enable stakeholder interactions, to improve the two above and adapt them to new requirements based on gap analysis, while ensuring the fit to high level system constraints such as interoperability, security, and privacy, etc.

Set of consistent standards
A set of consistent standards, which will support the information exchange (communication protocols and data models) and the integration of all users into the electric system operation.
SG-CG Who are we?

SMART GRID Coordination Group
(established June 2011)

Ralph Sporer, SG-CG Chairman
Organization

Setup

• Successor of Joint Working Group (JWG) on standards for Smart Grids (Mai 2010-June 2011)

• 4 Working Groups with more than 300 experts (First Set of Standards, Reference Architecture, Sustainable Processes and SG Information Security)

Main tasks

• Coordinate and manage the whole work process concerning the smart grid mandate M/490

• Keep and drive contact to other regional and international activities
Expectations

Easy to use
Give guidance - Support implementation

Inclusive
Include all stakeholders

Comprehensive
Show available and coming standards

Future proof
Open to include new developments

International outreach
Promote European Approach

Distribution system operators
European Commission and Politics - Regulators
Standardization Organization
Transmission system operators
Energy suppliers
Technology supplier manufacturers
system integrators
ICT / Telcos

Ralph Sporer, SG-CG Chairman
Systematic approach

SG-CG process for First set of standards

1. Start with typical industry arrangements
   - Entry point: “Systems = typical industry arrangements”

2. Identify related functions
   - List of use cases supported and implemented by “system”

3. Map to architecture model
   - Identification of interfaces on component, communication and information layer

4. Identification of standards
   - Identification of list of standards ready for implementation
## Entry Point

<table>
<thead>
<tr>
<th>Domain or Function</th>
<th>Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation</td>
<td>Generation management system</td>
</tr>
<tr>
<td>Transmission management system</td>
<td>Substation automation system</td>
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<tr>
<td></td>
<td>WAMS Wide Area Measurement System</td>
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<td></td>
<td>EMS SCADA system</td>
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<td></td>
<td>Flexible AC Transmission Systems FACTS</td>
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<tr>
<td>Distribution management systems</td>
<td>Substation automation system</td>
</tr>
<tr>
<td></td>
<td>Feeder automation/smart reclosers system</td>
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<tr>
<td></td>
<td>Distributed power quality control system</td>
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<td></td>
<td>DMS SCADA system &amp; GIS system</td>
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<td></td>
<td>FACTS system</td>
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<tr>
<td>DER management systems</td>
<td>DER operation system</td>
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<td></td>
<td>DER EMS and VPP system</td>
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<tr>
<td>Smart Metering systems</td>
<td>AML system</td>
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<td></td>
<td>Metering back office system</td>
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<tr>
<td>Demand and production (generation)</td>
<td>Aggregated prosumers management system</td>
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<td>flexibility systems</td>
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<tr>
<td>Marketplace system</td>
<td>Marketplace system</td>
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<tr>
<td></td>
<td>Trading system</td>
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<tr>
<td>E-mobility (connection to grid)</td>
<td>E-mobility systems</td>
</tr>
<tr>
<td>Administration systems</td>
<td>Asset and maintenance mgt system</td>
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<tr>
<td></td>
<td>Communication network management system</td>
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<td></td>
<td>Clock reference system</td>
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<td></td>
<td>Authentication authorization accounting system</td>
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<tr>
<td></td>
<td>Device remote configuration system</td>
</tr>
<tr>
<td></td>
<td>Weather observation and forecast system</td>
</tr>
</tbody>
</table>

**First set of standards systems...**

- cover all domains of the Smart Grid plane
- cover all actors of the Smart Grid
- support the high level services and functions as defined by the EC

List of covered systems
Smart Grid Architecture Model

Mapping to SGAM

(Smart Grid Architecture Model)

• SGAM provides common base for all stakeholders
• Description of interoperability layers business, function, information, communication and component
• Typical representation of the system on SGAM
• Identification of interfaces on component, communication and information layer

Mapping to interoperability layers
List of standards

- Description of available and coming standards for the specific system
- Average of 10-20 standards per system
- Available standards: published by July 2012
- Coming standards: currently in work at standards organizations

<table>
<thead>
<tr>
<th>Layer</th>
<th>Standard</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>EN 61970-1</td>
<td>Energy management system Application Program Interface</td>
</tr>
<tr>
<td></td>
<td>EN 61970-2</td>
<td></td>
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<td></td>
<td>EN 61970-301</td>
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<td>EN 61970-401</td>
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<td>EN 61970-453</td>
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<tr>
<td></td>
<td>EN 61970-501</td>
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<tr>
<td></td>
<td>IEC/TR 62325</td>
<td>Framework market communication</td>
</tr>
<tr>
<td>Communication</td>
<td>EN 60870-5-101</td>
<td>Telecontrol protocols</td>
</tr>
<tr>
<td></td>
<td>EN 60870-5-104</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 60870-6</td>
<td></td>
</tr>
<tr>
<td>Information</td>
<td>IEC/EN 61850 (all parts)</td>
<td>See substation automation system in 8.3.1</td>
</tr>
<tr>
<td>Information (guidelines)</td>
<td>IEC 62351</td>
<td>Security - all parts</td>
</tr>
<tr>
<td></td>
<td>IEC 62357</td>
<td>Reference architecture power system information exchange</td>
</tr>
<tr>
<td></td>
<td>IEC 62361</td>
<td>Harmonization of quality codes</td>
</tr>
</tbody>
</table>
First Set of Standards in brief

Focus on existing industry arrangements

- Relevant, current systems are covered
- 24 systems described in detail with functions, use cases, architectures and relevant standards (More than 80 tables and figures)

Selection guide for all market players

- Guidance for use of standards in implementation and offers

plus

- 5 horizontal issues, including security etc.
- Preview of coming standards
- Work programme for new standards

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Work programme for 17 topics

Ralph Sporer, SG-CG Chairman
Quick User Guide to SG-CG

Set of Standards – Selection Guide
• First Set of Standards (*SGCG/M490/B_Smart Grid Set of Standards*)

• Reference Architecture (*SGCG/M490/C_Smart Grid Reference Architecture*)

Use Cases Management, Examples: Flexibility
• Use Case Management (*SGCG/M490/E_Smart Grid Use Cases Management Process*)

Information Security, Privacy, Toolbox
• SGIS (*SGCG/M490/D_Smart Grid Information Security*)

Overall Process
• Framework document (*SGCG/M490/A_Framework for Smart Grid Standardization*)

Weblink
• [http://www.cencenelec.eu/STANDARDS/HOTTOPICS/SMARTGRIDS/Pages/default.aspx](http://www.cencenelec.eu/STANDARDS/HOTTOPICS/SMARTGRIDS/Pages/default.aspx)
International activities

International plenary
- Brussels, June 2012
  - Participation US, Brazil, Japan, China, Korea, IEC, ITU

USA
- NIST - White Paper
  - White Paper NIST/SG-CG published Sept.11 at Grid Week
- SGIP – Letter of Intent
  - Letter of Intent signed Dec.11 at Grid-Interop

Japan
Outlook

Mandate iteration

• Extension is planned for 2013-14
• Focus of the work on interoperability and conformance testing
  Improve interoperability by offering approaches for testing and implementation of standards

Next steps

• Plenary 21.02.2013
• Approval of new structure, working groups and officers

Standardization is ready

• Systematic process in place
• Selection guide available - easy entry for all stakeholders
• Work programme describes time table for new standards
• Future requirements can be easily included in systematic framework
THANK YOU FOR YOUR ATTENTION

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www.cen.eu
www.cenelec.eu
www.etsi.org
Smart Grid Standardization Activities in Japan

February 26, 2013
Tatsuya SHINKAWA
Chief Representative, NEDO Washington, DC
New Energy and Industrial Technology Development Organization (NEDO), Japan
NEDO’s Role in R&D

Ministry of Economy, Trade and Industry (METI)

- Coordination with policy making authorities
- Promotion of R&D projects
  - Autonomous and advanced R&D project management
  - R&D activities with flexible and agile project management
- Combined efforts of industry, government, and academia

Budget: US$1.3 billion (FY2012)
Number of personnel: Approx. 900
NEDO’s Activities in Smart Grid Area

National Projects Related to Smart Grid Technology

- Grid interconnection (Distributed and Large-scale)
- Microgrid
- Energy storage
Leading Demonstration Projects in Japan

**Kyoto Keihanna District**
Kyoto Prefecture, Kansai Electric Power, Osaka Gas Kansai Science City, Kyoto University
- CO₂ emissions: Residential 20%↓ and Transportation 30%↓ (compared with 2004 levels)
  - Install PV at 1,000 homes, EV car-sharing system
  - Management of grid connected PV and fuel cells in houses and buildings (visualization of demand)
  - Grant “Kyoto eco-points” for green energy usage

**Yokohama City**
Yokohama City, Toshiba, Panasonic, Meidensha, Nissan, Accenture, others
- CO₂ emissions: 30%↓ by 2025 (compared with 2004 levels)
  - Energy management system that integrates HEMS, BEMS and EVs
  - PV (27,000 kW)
  - Use of heat and unused energy
  - 4,000 smart houses, 2,000 EVs

**Kitakyushu City**
Kitakyushu City, Fuji Electric Systems, GE, IBM, Nippon Steel
- CO₂ emissions: 50%↓ (compared with 2005 levels)
  - Real-time management at 70 companies and 200 houses
  - Energy management using HEMS and BEMS
  - Energy system that coordinates demand side management with overall power system

**Toyota City**
Toyota City, Toyota Motor, Chubu Electric Power, Toho Gas, Toshiba, Mitsubishi Heavy Industries, Denso, Sharp, Fujitsu, Dream Incubator, etc.
- CO₂ emissions: Residential 20%↓ and Transportation 40%↓
  - Use of heat and unused energy in addition to electricity
  - Demand response at more than 70 homes 3,100 EV, V to H and V to G

Source: Ministry of Economy, Trade and Industry
NEDO’s Overseas Projects

Maui Island, State of Hawaii (USA)
Construction of a low-carbon model city for remote islands using an EV charging control system on Maui, where the introduction rate of renewable energy is extremely high.

Gongqingcheng City, Jiangxi Province (China)
Realizing a new model (to avoid urban growth problems that occurred during the development of cities in coastal areas) for small and medium cities in inland China.

State of New Mexico (USA)
Demonstration of smart grid systems that combine demand response, storage batteries and heat storage devices in a residential area introducing PV on a large scale.

Malaga City (Spain)
Construction of a new community lifestyle through infrastructure renovation that includes large-scale EV introduction.

Grand Lyon (France)
Demonstration of a new urban lifestyle through smart redevelopment of an existing city combining EV systems and other energy saving technologies.
Evolution of Smart Grid Standards in Japan
The role of standards in Smart Grid

- Smart Grid is “System of systems”.
- Interoperability makes it possible for smart grid to work securely and effectively.
- Standards are essential enabling to have interoperable systems and components.
Japan’s Structure for Smart Grid Standards

Evolution

**International Organization for Standardization (ISO)**
274 TCs + 515 SCs + 786 WGs

**International Electrotechnical Commission (IEC)**
94 TCs + 80 SCs + 442 WGs

As of Nov. 28

Japanese Industrial Standards Committee (JISC)

Secretariat: Technical Regulations, Standards and Conformity Assessment Policy Unit, Industrial Science and Technology Policy and Environment Bureau, METI

Mirror Committees Corresponding to TCs and SCs

- Consumer organizations
- Industry associations
- Academic societies
- Others

JISC’s tasks: Establishment and maintenance of Japanese Industrial Standards (JIS)/Administration of accreditation and certification/Participation in and contribution to ISO, IEC, etc.

**Japanese Smart Community Alliance**

Secretariat: NEDO
“Study Group on International Standardization for Next Generation Energy Systems” was set up to deliberate roadmap for Japan’s contribution for international standardization activity in Smart Grid area. The roadmap was released on January 2010.

Roadmap on Smart Grid standardization:
- Examine a comprehensive smart grid international standardization strategy
- Identify 26 focus areas including control equipment in distributed power supplies and equipment for EV charging infrastructure
- Establish an international standardization roadmap

-Recommendations-
- Contribute to the international standardization activities
- Collaborate with other countries;
  - Collaborate with NIST
  - Exchange information with CENELEC
- Implement policy;
  - Standardization roadmap with R&D, pilot projects, and other measures
- Establish private-sector smart grid implementation consortium

Draw a future-focused big picture
Identify
  - business
  - use case
  - key systems
Analyze strength/weakness
  - Identify priority areas
Analyze overseas market
## 26 Focus Areas Identified by the Study Group

<table>
<thead>
<tr>
<th>Focus Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wide-Area Situational Awareness (WASA)</td>
<td>14. Stationary energy storage systems</td>
</tr>
<tr>
<td>2. Grid storage application</td>
<td>15. Storage cell modules</td>
</tr>
<tr>
<td>3. Distribution network storage application</td>
<td>16. Methods for evaluating the residual value of energy storage for EV</td>
</tr>
<tr>
<td>4. Building/Community energy storage application</td>
<td>17. Quick EV charger-vehicle communications</td>
</tr>
<tr>
<td>5. High-efficiency inverters for energy storage</td>
<td>18. Quick EV charger connectors</td>
</tr>
<tr>
<td>6. Distribution automation systems</td>
<td>19. Quick EV charger unit design</td>
</tr>
<tr>
<td>7. Inverters for distributed energy resource</td>
<td>20. Safety testing of lithium-ion batteries for vehicles</td>
</tr>
<tr>
<td>9. Demand Response</td>
<td>22. EV charging control from Grid</td>
</tr>
<tr>
<td>10. HEMS</td>
<td>23. Wide-area meter communications</td>
</tr>
<tr>
<td>11. BEMS</td>
<td>24. Local meter communications</td>
</tr>
<tr>
<td>12. FEMS</td>
<td>25. Gas metering for AMI systems</td>
</tr>
<tr>
<td>13. EMS for the Community</td>
<td>26. Authentication method between meter communicators and higher-level systems</td>
</tr>
</tbody>
</table>
Current Status in Japan – framework for discussion

- Established “Subcommittee on Smart Grid International Standardization” under JISC in early 2012.

- Members from
  
  Hitachi, Panasonic, TEPCO, KEPCO, Japan Automobile Manufactures Association, Kyushu University
  
  Chair: Professor Yokoyama, Tokyo University
  
  Vice Chair: Dr. Hayashi, Toshiba

- To enhance Japanese activities:
  
  - build on 26 focus areas
  
  - make a roadmap for most important areas
  
  - take a systems approach
  
  - participate in development of standards and regulations
  
  - contribute to certification process
  
  - coordinate with international standardization initiatives
### Coordination of International Standards Development

- To harmonize Japanese standards with other countries’ developing standards and accelerate core international standardization such as an energy management system for a smart house, a three-year demonstration project was undertaken.
- Two centers were launched at universities with smart house experience for:
  - Conducting a certification test of home appliance interconnectivity
  - Testing of optimum energy management through peak cut/peak shifting

<table>
<thead>
<tr>
<th></th>
<th>FY 2012</th>
<th>FY2013</th>
<th>FY2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>▪ Accelerate international standardization (prepare work schedule)</td>
<td>▪ Accelerate international standardization (prepare work schedule)</td>
<td>▪ Accelerate international standardization (prepare work schedule)</td>
</tr>
<tr>
<td></td>
<td>▪ Consider and prepare for future expansion of smart houses, etc.</td>
<td>▪ Consider and prepare for future expansion of smart houses, etc.</td>
<td>▪ Consider and prepare for future expansion of smart houses, etc.</td>
</tr>
<tr>
<td>2</td>
<td>▪ Construct a test bed for grid connection and control to establish</td>
<td>▪ Carry out systematic test for harmonization with ECHONET Lite, SEP or</td>
<td>▪ Conduct overall performance test for HEMS and other systems</td>
</tr>
<tr>
<td></td>
<td>demand response technologies, etc.</td>
<td>others, etc.</td>
<td>▪ Organize deliverables, identify issues, etc.</td>
</tr>
<tr>
<td>3</td>
<td>▪ Establish interconnectivity</td>
<td>▪ Create a development support tool for small business use</td>
<td>▪ Create a development support tool for small business use</td>
</tr>
<tr>
<td></td>
<td>▪ Create a development support tool for small business use, etc.</td>
<td>▪ Establish operating guidelines, etc.</td>
<td>▪ Establish operating guidelines, etc.</td>
</tr>
</tbody>
</table>
NEDO actively participates in interoperability and standards activities in the U.S.

● IEEE 1547.8, Recommended Practice for Establishing Methods and Procedures that Provide Supplemental Support for Implementation Strategies for Expanded Use of IEEE Standard 1547
  - Clause and Annex on anti-islanding

  - Clause on microgrids and energy storage

● SGIP, Distributed Renewables, Generators and Storage Domain Expert Working Group Subgroup C – microgrids and hierarchical distributed control systems

NEDO contributes use cases and provides technical input to writing groups from its demonstration projects in Japan, such as the Sendai Multi Power Quality Microgrid. NEDO prepared a use case on this microgrid and a Case Study describing its performance following the 2011 Tohoku Earthquake and Tsunami.
14 Use Cases, uploaded to EPRI USE CASE REPOSITORY

New Mexico Project: 4
- Cooperative Control among Smart Grid and External Area EPS Energy Management Systems
- BEMS control of DERs and HVAC equipment in a commercial building which enables islanding operation and demand response
- Equipment Control within Smart House by HEMS
- PV output forecasting

Yokohama Project: 2
- Online Power System Control by Battery Aggregation (Virtual Energy Storage)
- Peak Shift Contribution by Battery Aggregation (Virtual Energy Storage)

Hachinohe Project: 2
- EMS of grid-connected Microgrid for optimum use of biomass and mitigates negative effects on distribution grid
- EMS under islanding operation for optimum use of biomass and maintains PQ

Kyotango Project: 1
- EMS by configuring a Virtual Microgrid using public communications

Aichi Project: 2
- EMS of grid-connected Microgrid for optimum use of city gas and mitigates negative effects on distribution grid
- Autonomous control of Microgrid with grid-connected inverters, under the islanding operation

Hawaii Project: 2
- Hierarchical Control of DMS and μDMS for local load/supply control to mitigate transformer/secondary feeder overload, and prevent voltage violations
- Hierarchical Control of EMS, EVECC, DMS and μDMS to coordinate EV charging to enable simultaneous mitigation of renewable Energy on system frequency and mitigation of feeder level disruptions (P,Q)

Sendai Project: 1
- Microgrid to Supply Power at Multiple Power Quality Levels
Sendai Case Study

- Sendai Microgrid (Former NEDO project facility) continued to supply power to a hospital in the period of blackout by the 2011 Tohoku Earthquake and Tsunami.

<table>
<thead>
<tr>
<th>System</th>
<th>Mar 11</th>
<th>Mar 12</th>
<th>Mar 13</th>
<th>Mar 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility Grid</td>
<td>Grid Connection</td>
<td>Voltage Collapse</td>
<td>Grid Outage</td>
<td>Grid Recover Grid Connection</td>
</tr>
<tr>
<td>Gas Engine</td>
<td>Grid Connection</td>
<td>Disconnection</td>
<td>Around 12:00 Islanding operation</td>
<td>Islanding operation Grid Connection</td>
</tr>
<tr>
<td>DC supply</td>
<td>Grid Connection</td>
<td>Supply from Battery</td>
<td>Supply from Gas Engine</td>
<td>Grid Connection</td>
</tr>
<tr>
<td>A Quality</td>
<td>Grid Connection Battery</td>
<td></td>
<td>Supply from Gas Engine</td>
<td>Grid Connection</td>
</tr>
<tr>
<td>B1 Quality</td>
<td>Grid Connection Battery</td>
<td></td>
<td>Supply from Gas Engine</td>
<td>Grid Connection</td>
</tr>
<tr>
<td>B3 Quality</td>
<td>Grid Connection Outage</td>
<td></td>
<td>Supply from Gas Engine</td>
<td>Grid Connection</td>
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<tr>
<td>C Quality</td>
<td>Grid Connection Outage</td>
<td></td>
<td>Supply from Gas Engine</td>
<td>Grid Connection</td>
</tr>
</tbody>
</table>

From “The Sendai Microgrid Operational Experience in the Aftermath of the Tohoku Earthquake: A Case Study” by Hirose, K (NTT Facilities), Reilly, J. T. (Reilly Associates) and Irie, H. (Mitsubishi Research Institute)
Conclusion

- International cooperation is essential for carrying out both international demonstration projects and standardization activities in the smart grid field.

- NEDO and JSCA hope to contribute to international standardization by developing use cases and by demonstrating that the relevant technology can be commonly used across the world.

- JSCA provides a comprehensive platform for cross-sectoral discussions in Japan, and is committed to cooperating with IEEE, IEC and ISO for international standardization.

Thank you!
IEEE Standards

Innovative Smart Grid Technologies Conference
Interoperability and Standards

Chair: Dr. George Arnold, NIST
(Feb. 26, 2013 1:00pm-2:30pm)

Dr. W. Charlton Adams, Jr.
IEEE-SA Smart Grid

- Support full life cycle of standards to develop a pipeline of standards related activities
Pre-standards Activities

- Long term visions of what the smart grid in each technology space will look like 20 to 30 years out.
- Forward looking use cases, applications scenarios for SG, and corresponding enabling technologies for SG of the future snap shots of years 2015, 2020, 2030, and beyond.
IEEE Smart Grid Research Technology Initiatives

- Electric Vehicles/Wireless Power Transfer
- Power Magnetics/Power Electronics for Distributed Resources
- Data Analytics
- Nano and Molecular Communications
- DC in the Home
- Utility Forum
Standards Acceleration

- Implement support services to facilitate the acceleration of standards development, approval, and publication

Some Areas Covered
- Interoperability
- Networking and Communications (including the home)
- Cyber Security
- Substations Automation
- Distribution Automation
- Renewables
- AMI
- Power Quality and Energy Efficiency
- Electric Vehicles
IEEE 2030® Spans Three Distinct Perspectives

Designed for and developed by:

- **Power & Energy**
  Defines the numerous data flows necessary for reliable, secure, bi-directional flow of power and energy throughout the entire electric power system

- **Communications**
  Identifies the communications infrastructure necessary for smart grid, from high-speed synchrophaser data to in-premise meter and customer notification systems

- **Information Technology (IT)**
  Defines the system-to-system communications requirements and data flow to leverage individual systems into a system of systems
Two-Levels SG System Architecture

Protocols, PHY/MAC layer, data flows mapping table

Entity A

Demarcation Point

Entity B

inter-system (actor) connection/ Interface option between actors

Entity C

System Level (phase 1)

Intra-System Smart Grid Reference Architecture

Sub-System Level (phase 2)
One level down
SG Reference Model Development Methodology

New Technologies

Legacy Systems

P2030 SG-CRA Model

iterate/refine model

Use Case A

Use Case B

Use Case N

Smart Grid use cases map (validation)

Utilities’ Smart Grid map (validation)

Utility A mapping

Utility B mapping

... Utility N mapping

“To-Be” or Target Architecture
IEEE 2030 Series Ongoing Smart Grid Projects

- IEEE 2030 Series – Smart Grid Interoperability
  - IEEE P2030.1 Guide for Electric-Sourced Transportation Infrastructure
  - IEEE P2030.3 Standard for Test Procedures for Electric Energy Storage Equipment and Systems
  - IEEE P2030.4 Guide for Control and Automation Installations Applied to the Electric Power Infrastructure
  - IEEE2030.100 Recommended Practice for Implementing an IEC 61850 Based Substation Communications, Protection, Monitoring and Control System
### IEEE Standards for Smart Networking/Communications

#### Smart Grid Communications Layer

**Wide Area Network (WAN)**
- Substation LAN
- Core/Metro Network/Backhaul Network (Wireline/Wireless)

**NAN/FAN**
- Substation LAN
- Core/Metro-Backhaul Demarcation
- Backhaul-NAN/FAN/AMI Demarcation
- Smart Meters

**HAN, BAN, IAN**
- Workforce Automation
- Power Systems
- Energy Management

### Smart Grid Network Technology & Protocols Standards Mapping

<table>
<thead>
<tr>
<th></th>
<th>Wide Area Network (WAN)</th>
<th>NAN/FAN</th>
<th>Smart Meters</th>
<th>HAN, BAN, IAN</th>
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<tbody>
<tr>
<td>Substation</td>
<td>Core/Metro Network/Backhaul Network</td>
<td>Substation</td>
<td>Several Options</td>
<td>Wireline</td>
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<td>LAN</td>
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<tr>
<td></td>
<td>IEEE 802.1</td>
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<td>IEEE 802.3</td>
<td>IEEE 1901</td>
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<td>IEEE 802.22</td>
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<td>802.15.4</td>
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</table>

**Technology Standards**
- IEEE 802.1
- IEEE 802.3
- IEEE 802.16d/e
- IEEE 802.15.4
- IEEE 1377 (1701, 1703, P17104)
- IEEE 802.15.4
IEEE Standards for Security

• IEEE 1686 - Standard for Substation Intelligent Electronic Devices (IED) Cyber Security Capabilities
• IEEE P37.240 - Standard for Cyber Security Requirements for Substation Automation, Protection and Control Systems
• IEEE 1711 - Cryptographic Protocol for Cyber Security of Substation Serial Links
• IEEE 1402 - Standard for Physical Security of Electric Power Substations
IEEE Standards...

- **Power Quality**
  - IEEE 1159 Recommended Practice for Monitoring Electric Power Quality
  - IEEE 1159.3-2003 Recommended Practice for the Transfer of Power Quality Data
  - IEEE 1250 - Guide for Identifying and Improving Voltage Quality in Power Systems
  - IEEE 1409 - Guide for the Application of Power Electronics for Power Quality Improvement on Distribution Systems Rated 1 kV Through 38 kV
IEEE Standards for Utility Automation

- IEEE C37 Series for Synchrophasers
  - C37.118 series, P37.242 PMU testing and installations, PC37.244 Phasor Data Concentrator Requirements
- IEEE 1815 – Distribution Network Protocol
- IEEE P1815.1 - Exchanging Information Between Networks
- IEEE C37.1 Standard for SCADA and Automation Systems
- IEEE 1588 – Time Synchronization
- IEEE C37.238 - Precision Time Protocol in Power System Applications
- IEEE PC37.237 Standard Requirements for Time Tags Created by Intelligent Electronic Devices - COMTAG(TM)
- IEEE P1854 Guide for Smart Distribution Applications
Building Automation

- **IEEE 1888-2011** Standard for Ubiquitous Green Community Control Network Protocol
- **IEEE P1888.1** Draft Standard for a Ubiquitous Community Network: Control and Management
- **IEEE P1888.2** Draft Standard for Ubiquitous Green Community Control Network: Heterogeneous Networks Convergence and Scalability
- **IEEE P1888.3** Draft Standard for Ubiquitous Green Community Control Network: Security
IEEE-SA Builds Strong International Collaboration

Asia

Middle East

Europe

Africa
Global Industry Leaders Participate in the IEEE-SA

- Stream Management for Media Devices - SanDisk
- Ultra High Voltage – CEPRI Testing for Storage Systems - SGCC
- Building Automation – BII Group
- DYSPAN - NEC
- 3D Devices - Yonsei University
- Home Networking Convergence - France Telecom
Standards Published under the IEC/IEEE Dual Logo Agreement

• **Dielectrics & Electrical Insulation**

• **Instrumentation & Measurement**
  - IEEE Std 1588™-2008 [IEC 61588 Ed.2 (2009-02)]: Precision Clock Synchronization Protocol for Networked Measurement and Control Systems

• **Switchgear**
  - IEEE C37.60™-2012 [IEC 62271-111 Ed.2 (2012-09)]: High-voltage switchgear and controlgear - Part 111: Automatic circuit reclosers and fault interrupters for alternating current systems up to 38 kV
Standards Published under the IEC/IEEE Dual Logo Agreement (Cont)

- **Transformers**

- **Power System Relay**
  - IEEE Std C37.94™-2002 [IEC 62843 Ed. 1 (2013-01)]: Standard for N times 64 kilobit per second optical fiber interfaces between teleprotection and multiplexer equipment

- **Nuclear Power Engineering**
  - Nuclear power plants — Instrumentation and control important to safety — Electrical equipment condition monitoring methods
IEEE-SA Smart Grid – Looking Forward

- Post-standards activities
  - Enable SG interoperability and market acceptance via support and/or creation of: Market implementation activities; Conformity assessment programs; Testing & Certifications; Branding; etc.
Thank You!

February, 2013
SGIP 2.0

Patrick Gannon
Executive Director
Customers are an integral part of the SGIP and smart grid vision.
What is SGIP?

• Entity created by EISA 2007 to provide a framework for coordinating all Smart Grid stakeholders in an effort to accelerate standards harmonization and advance the interoperability of Smart Grid devices and systems
How Does SGIP Do That?

• Facilitate standards development for Smart Grid interoperability
• Identify necessary testing and certification requirements
• Oversee the performance of these activities & continue momentum
• Inform and educate Smart Grid industry stakeholders on interoperability
• Conduct outreach to establish global interoperability alignment
NIST Three Phase Plan

• Establish a dialogue—multiple workshops in 2009, culminating in *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0*

• Develop organization and consensus process—creation of SGIP

• Transition to industry-funded organization—evolution of SGIP activities to SGIP 2.0, Inc.
SGIP Accomplishments To Date

• Nearly 2,000 people representing almost 800 organizations were members of the initial SGIP effort

• Hundreds of standards have been considered for inclusion in the SGIP Catalog of Standards, the primary reference guide for Smart Grid interoperability
  – 56 standards published in SGIP’s Catalog of Standards

• SGIP has been recognized by FERC, NARUC, and NIST as the forum to resolve standards coordination issues

• Efforts like Green Button have already been adopted by utilities serving more than 30 million customers
International Presence

100 Member Orgs
SGIP 2.0, Inc.

SGIP 2.0, Inc. – Board of Directors

- Executive Committee
  - ITF
  - BSPWG
- Audit Committee
- Marketing & Membership Committee
  - CMEWG
- Technical Committee
  - GasWG
  - EMIWG

- SGIP Member Stakeholder Category
- Elected Directors (20)

- Nominating & Governance Committee
  - BOPWG
  - IPRWG

- Executive Director
  - Administrative support

- Elected Chairpersons

- Program Management Office (PMO)
  - Coordination functions

- SGIP Member Organizations
  - H2G
  - B2G
  - TN
  - I2G
  - BNP
  - V2G
  - DRGS
  - Domain Expert Working Groups

- Priority Action Plan (PAP) Teams
  - PAP 1
  - PAP 2
  - PAP 3
  - PAP...

- International LOIs
  - Japan
  - Korea
  - Ecuador

- SGIP Products
  - Interoperability Knowledge Base
    - Conceptual Model & Roadmaps
    - Requirements
    - Use Cases
    - White Papers
    - Standards Descriptions
    - Catalog of Standards

- Implementation Methods (IMC)

- Testing & Certification (T&C)

- Quality Assurance (QA)

- Architecture (ASG)

- Standards Committees & Working Groups
Active Committees/Work Groups

• Architecture Committee
• Implementation Methods Committee
• Testing & Certification Committee
• CyberSecurity Committee
• Electromagnetic Interoperability Issues Working Group
• Gas Infrastructure Working Group
Active Priority Action Plans

2  Wireless Communications for the Smart Grid
5  Standard Meter Data Profiles
7  Electric Storage Interconnection Guidelines
8  CIM for Distribution Grid Management
12 Mapping IEEE 1815 (DNP3) to IEC 61850 Objects
14 Transmission and Distribution Power Systems Model Mapping
15 Harmonize Power Line Carrier Standards for Appliance Communications in the Home
16 Wind Plant Communications
17 Facility Smart Grid Information Standard
20 Green Button ESPI Evolution
21 Weather Information
## Closed Priority Action Plans

<table>
<thead>
<tr>
<th>Number</th>
<th>Topic</th>
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<tr>
<td>0</td>
<td>Meter Upgradeability Standard</td>
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<tr>
<td>1</td>
<td>Role of IP in the Smart Grid</td>
</tr>
<tr>
<td>3</td>
<td>Common Price Communication Model</td>
</tr>
<tr>
<td>4</td>
<td>Common Schedule Communication Mechanism</td>
</tr>
<tr>
<td>6</td>
<td>Common Semantic Model for Meter Data Tables</td>
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<td>9</td>
<td>Standard DR and DER Signals</td>
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<tr>
<td>10</td>
<td>Standard Energy Usage Information</td>
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<tr>
<td>11</td>
<td>Common Object Models for Electric Transportation</td>
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<tr>
<td>13</td>
<td>Harmonization of IEEE C37.118 with IEC 61850 and Precision Time Synchronization</td>
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<td>18</td>
<td>SEP 1.x to SEP 2 Transition and Coexistence</td>
</tr>
<tr>
<td>19</td>
<td>Wholesale Demand Response (DR) Communication Protocol</td>
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</tbody>
</table>
Domain Expert Working Groups (DEWGs)

• Building-to-Grid/B2G
• Business and Policy/BnP
• Distributed Renewables, Generation, and Storage/DRGS
• Home-to-Grid/H2G
• Industry-to-Grid/I2G
• Transmission and Distribution/TnD
• Vehicle-to-Grid/V2G
SGIP Technical Committee

- New Board Committee in SGIP 2.0
- Oversight of architecture, testing, cyber security and implementation committees, plus PAPs and DEWGs
- Responsible for prioritization of resources to support for technical activities
- Several accomplishments to date
- Focusing progress on key areas
SGIP 2.0 Current Transition

• Continued engagement by NIST staff and funding for administrative services (through March 2013)
  • George Arnold on Board of Directors, Technical Committee

• Preparing and posting RFPs for support services

• Hiring of full-time leaders in process
  • Director of Technical Operations
  • Director of Marketing & Membership

• Submitted proposal for NIST Federal Funding Opportunity (FFO)

• Transitioning Program Management Office and Catalog of Standards functions
  • including PAP progress, standards balloting, and CoS inclusion
Who’s Already Joined?

Some of our 100+ members . . .

- Ameren Services
- American Electric Power
- Amer. Public Power Assoc. (APPA)
- Arizona Public Service Company
- ASHRAE
- Bonneville Power Administration
- California ISO
- California PUC
- CenterPoint Energy
- CNT Energy
- Cooper Power Systems
- DTE Energy
- Eaton Corporation
- Edison Electric Institute (EEI)
- EPRI
- ERCOT
- EIS Alliance
- EnerNOC, Inc.
- EnerTech Capital
- Exelon Corporation
- FirstEnergy Service Company
- Florida Power & Light Company
- General Electric Company
- Home, Building & Utility Systems
- Honeywell
- Hydro-Québec
- India Smart Grid Forum (ISGF)
- ISO New England
- Itron
- Japan Smart Community Alliance
- Johnson Controls
- Michigan Public Service Commission
- NEMA
- NIST
- National Rural Electric Cooperative Association (NRECA)
- NYISO
- New York State Department of Public Service
- Oncor Electric Delivery
- Pepco Holdings,
- PJM Interconnection
- Portland General Electric Company
- PPL Corporation
- Sacramento Municipal Utility District
- Schneider Electric
- Southern California Edison
- Southern Company Services, In
- Taiwan Smart Grid Industry Association (TSGIA)
- Tendril
- Toshiba - Landis + Gyr
- Zigbee Alliance,
- ZIV USA
Participating Membership Privileges

• Right to stand for membership on committees
• Right to stand for board election
• Right to vote on issues
• Right to participate and vote on standards setting
• Right to have multiple employees serve on multiple committees
• Right to members-only information, insights, and SGIP proprietary information
## Participating Membership Dues

<table>
<thead>
<tr>
<th>General Membership</th>
<th>Annual Revenues</th>
<th>Participating</th>
<th>Observing</th>
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<tr>
<td>≥$1 billion</td>
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<td>$22,500</td>
<td>$7,500</td>
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<tr>
<td>$≥500M to &lt;$1B</td>
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<td>$12,000</td>
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<td>$7,500</td>
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<td>$≥ 10M to &lt;$ 50M</td>
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<td>$2,850</td>
<td>$950</td>
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<td>$≥500K to &lt;$ 10M</td>
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<td>&lt;$500,000</td>
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<tr>
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<td>Municipal/City Gov't</td>
<td>$750</td>
<td>$250</td>
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THANK YOU FOR YOUR ATTENTION!

FIND MORE INFO AT WWW.SGIP.ORG