NIST Interim Smart Grid Roadmap Overview and Conceptual Model

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The NIST Role

Energy Independence and Security Act (EISA) of 2007
Title XIII, Section 1305.
Smart Grid Interoperability Framework

In cooperation with the DoE, NEMA, IEEE, GWAC, and other stakeholders, NIST has “primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems…”
The Need for Standards is Urgent

Example: Smart Meters

• $40 - $50 billion dollar deployment nationwide
• Underway now
• ARRA will accelerate
• Rapid technology evolution
• Absence of firm standards

Source: Congressional Research Service Report
Comparison of Smart Grid with Next Generation Telecom Network

<table>
<thead>
<tr>
<th></th>
<th>Telecom Next Generation Network</th>
<th>Smart Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real-world examples</td>
<td>Verizon FiOS, AT&amp;T Uverse</td>
<td>Xcel Boulder, Colorado</td>
</tr>
<tr>
<td>First trials</td>
<td>2004</td>
<td>2008</td>
</tr>
<tr>
<td>Standards coordination started</td>
<td>2003</td>
<td>2008</td>
</tr>
<tr>
<td># key standards bodies</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Release 1 standards issued</td>
<td>2005</td>
<td>2009</td>
</tr>
<tr>
<td>Release 2 issued</td>
<td>2008</td>
<td>Will be issued on rolling basis</td>
</tr>
<tr>
<td># standards documents</td>
<td>~600 so far</td>
<td>Will be hundreds</td>
</tr>
<tr>
<td>Nature of standards</td>
<td>Mostly mix &amp; match of existing standards</td>
<td>Mix &amp; match of existing standards and many new</td>
</tr>
</tbody>
</table>
White House Meeting May 18

- Chaired by Secretaries Locke and Chu
- 66 CEOs and senior executives, federal and state regulators

- We need to move fast – it can be done!
- Consensus does not mean unanimity
- SG investments being made now cannot be ignored
- Standards need to allow for innovation
- Open standards are essential
- Today’s regulatory assumptions may have to evolve
We Need A Standards Roadmap

- Capabilities
- Priorities
- Reference Model
- Standards
- Release Plan
- Responsibilities
- Governance
- Testing and Certification
NIST Three Phase Plan

**PHASE 1**
Identify an initial set of existing consensus standards and develop a roadmap to fill gaps

**PHASE 2**
Establish public/private Standards Panel to provide ongoing recommendations for new/revised standards

**PHASE 3**
Testing and Certification Framework

March 2009 — September 2009 — 2010
Roadmap Focus Areas

• FERC-identified priority applications:
  – Demand Response
  – Wide-Area Situational Awareness
  – Electric Storage
  – Electric Transportation

• Additional priority applications:
  – Advanced Metering Infrastructure
  – Distribution Grid, including Distributed Energy Resource Integration

• Cross-cutting priorities
  – Cyber Security
  – Data networking
NIST Draft Interim Roadmap - Outline

Executive Summary
Chapter 1: Purpose and Scope
Chapter 2: Smart Grid Vision
**Chapter 3: Smart Grid Conceptual Model**
Chapter 4: Smart Grid Applications and Requirements
Chapter 5: Cyber Security Considerations for the Smart Grid
Chapter 6: Prioritized Actions
Chapter 7: Definitions
Chapter 8: References
Appendix A: Standards Profiles by Domain
Appendix B: Alphabetical Standards List
Appendix C: Requirements, Standards Gaps, and Issues
Appendix D: Key Use Cases for Cyber Security Considerations
Appendix E: Vulnerability Classes
Appendix F: Crosswalk of Cyber Security Standards
Conceptual Model: Core Principles

• System of Systems – multiple architectures
• General
  – Loose Coupling
  – Layered Systems
  – Shallow Integration
• Interface Related
  – Symmetry
  – Transparency
  – Composition
  – Security
Conceptual Model – Views as a Tool
Levels of the Conceptual Model

Domain Diagram

Model Level
Domain
Actor or Application
Drill-Down / Domain Expansion
Use Cases: Paths Through the Model

= information path
Interoperability Layers and the Model

Organizational: Policy, Business Objectives, Business Procedures

Informational: Business Context, Semantic Understanding

Technical: Syntactic Interoperability, Network Interoperability, Connectivity

Cross-Cutting Issues: Security, Resource Identification, Time Synch, etc.
Bulk Generation

Operations

Markets

Coal
Gas
Nuclear

Hydro

Biomass

Geothermal

Pump Storage

Wind

Solar

Renewable, Variable

Renewable, Non-Variable

Non-Renewable, Variable

Non-Renewable, Non-Variable

Transmission

External Communication Interface

Internal Communication Interface

Electrical Interface

Domain

Control

Measure

Protect

Record
Service Provider

Operations → Customer Management → Account Management → Emerging Services → Markets

- Operations
- Billing
- Customer Management
- Account Management
- Emerging Services
- Installation & Maintenance
- Building Management
- Home Management
- Customer

External Communication Interface
Internal Communication Interface
Domain
GWAC Stack – Levels of Interoperability

**Interoperability Categories**

**Organizational**
- 8: Economic/Regulatory Policy
  - Political and Economic Objectives as Embodied in Policy and Regulation
- 7: Business Objectives
  - Strategic and Tactical Objectives Shared between Businesses
- 6: Business Procedures
  - Alignment between Operational Business Processes and Procedures

**Informational**
- 5: Business Context
  - Awareness of the Business Knowledge Related to a Specific Interaction
- 4: Semantic Understanding
  - Understanding of the Concepts Contained in the Message Data Structures

**Technical**
- 3: Syntactic Interoperability
  - Understanding of Data Structure in Messages Exchanged between Systems
- 2: Network Interoperability
  - Mechanism to Exchange Messages between Multiple Systems across a Variety of Networks
- 1: Basic Connectivity
  - Mechanism to Establish Physical and Logical Connections between Systems

**Cross-cutting Issues**

- \(\uparrow\) Resource Identification
- \(\uparrow\) Time Synchronization
- \(\uparrow\) Security & Privacy
- \(\uparrow\) Logging & Auditing
- \(\uparrow\) Transaction & State Management
- \(\uparrow\) System Preservation
- \(\uparrow\) Performance/Reliability/Scalability
- \(\downarrow\) Discovery & Configuration
- \(\downarrow\) System Evolution

**Logos** (bottom left and right)
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NIST CSCTG

Risk Management Framework

Security Considerations

Mapping of Security Req’mts

Smart Grid Cyber Security Requirements

Smart Grid Security Profile Blueprint

Risk Assessment

Advanced Metering

Network Type

Distribution Automation

Substation Automation

Security Profiles

ASAP-SG

US DOE

FFRDC’s

25
Key Findings

- **Developing a common semantic model** - NIST should work with the appropriate standards development organizations to form a common representation of information models for the smart grid.

- **Developing a common pricing model standard** - NIST should work with the relevant standards development organizations to develop an approach for developing a common pricing model to traverse the entire value chain.

- **Developing a common semantic model for advanced metering, demand response and electric transportation** – NIST should coordinate the various industry activities to accelerate the development and adoption of a unified semantic model for these high-priority applications.

- **Conducting an analysis to select Internet Protocol Suite profiles for smart grid applications** - NIST should commission a group to perform a comprehensive mapping of smart grid application requirements to the capabilities of protocols and technologies in the Internet Protocol Suite to identify Internet protocol Suite subsets as important for various applications in the various smart grid domains.
Key Findings, Continued

- **Investigating Communications Interference in Unlicensed Radio Spectrums** - NIST should commission a group of experts to study the issue of communications interference in unlicensed radio spectrums for smart grid applications.

- **Developing common time synchronization and management** - NIST should work with the appropriate standards development organizations to develop or adopt application or role based time synchronization guidelines.

- **Coordinating efforts across Standards Development Organizations** – NIST should coordinate cross-SDO efforts for harmonizing and extending their standards and addressing new standards requirements.
Priority Action Plans (PAP)

1. Use of IP
2. Wireless Guidelines
3. Pricing Model
4. Scheduling
5. Meter Profiles & Upgrade Std
6. ANSI C12 to Common Info Model (CIM)
7. Storage Interconnect
8. CIM Distribution Models and Harmonization
9. Standard DR Signals
10. Energy Usage to Customer
11. Models for Electric Transportation
12. IEC 61850 to DNP3
13. Time Synch
14. Integrate Transmission & Distribution Models and Relay Settings
15. Cyber Security
Smart Grid Standards Acceleration Workshop
August 3-4 Workshop Objectives

- Review PAPs
  - Each PAP will be reviewed, modified, and completed to the best of the ability of the members of the breakout sessions.
  - Outcome: Revised PAP
- Develop and refine PAP tasks
  - For each of the PAPs, the breakout teams will develop tasks to meet the PAP objectives.
  - Outcome: List of Task Owner / Description / Task team
- Assign tasks and develop timelines
  - Once the tasks have been developed, assignments and timelines for each task will be discussed. We are looking for commitments from SDOs to agree to these tasks. More than likely, this will not be something people are willing to do. However, we should expect commitments from SDO representatives to help move the ball forward – at least presenting to their organizations and getting decisions on what they are willing to take on.
  - Outcome: Task timelines
- Overall: Produce list of Action Items to be addressed and a timeline for addressing them
  - Outcome: Action list of owner/due date/details
Questions?

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