Green Button: Creating the Open Standard for Secure Consumer Access to Energy, Natural Gas, and Water Data

Motivation and development of the Green Button data-sharing program

Dr. David Wollman, Deputy Director, Smart Grid and Cyber-Physical Systems Program Office, NIST
Cyber-Physical Systems | NIST

Smart Grid and CPS/IoT | NIST

NIST Mission: To promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

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1. Context

2. Technical Foundation for Energy Usage Information

3. Green Button Initiative

4. Building a Green Button Ecosystem

5. Passing the Baton to Industry (Green Button Alliance)
What are Frameworks?
Frameworks are documented conceptual structures that organize and make clear collective wisdom (vision, principles, underlying structure, functions, requirements, ...). Frameworks are created with technical expertise/stakeholders and consensus-based process.

A Few NIST Framework Examples:

**NIST Smart Grid Interoperability Framework**
Legislation: Energy Independence and Security Act (2007) gave NIST “primary responsibility to coordinate development of a framework that includes ... standards ... to achieve interoperability of smart grid devices and systems...”

**NIST Cybersecurity Framework (& Privacy Framework)**
Executive Order 13636 (2013): NIST CSF 1.0 (2014) developed in collaborative process; NIST role reinforced by Cybersecurity Enhancement Act of 2014 and IoT Cybersecurity Improvement Act of 2020;

**NIST Cyber-Physical Systems (IoT) Framework**
NIST CPS Public Working Group; NIST SP 1500-201,-202,-203
Key concepts:
Identified 75 standards, 16 action plans, cyber, architecture conceptual model, energy services interface

Priority Action Plan #10 on Energy Usage Information

Case Study: Creating Value Through Data Interoperability

Release 1
NIST Special Publication 1108
NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0
Office of the National Coordination for Smart Grid Interoperability
Jan 2010

Release 4
Feb 2021
NIST Special Publication 1108r4
NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 4.0

Avi Gopstein, Cung Nguyen, Cheney O’Fallon, and David Wolfman
Smart Grid and Cyber-Physical Systems Programs Office
Engineering Laboratory

Nelson Hantes
Applied Security Division
Information Technology Laboratory

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February 2021

Key concepts:
Revised Models, Operations, Economics, Cybersecurity, Testing and Certification

Identify the Need
Energy Usage Information is Key to Empowering Customers

Identify the Landscape
Multiple Stakeholders, Standards Developing Organizations, Competing Interests

Identify the Goal
Energy Usage Information Model (openly available, also including gas, water, etc.)

Identify the Issues and Path Forward
Negotiated stakeholder compromises leading to North American Energy Standards Board (NAESB) for core Energy Usage Information Model, and ASHRAE for complementary Facility Smart Grid Information Model
2. Technology Foundation

Zigbee SEP2 (home area network)
IEC CIM (utilities core info model)
Building/Facility info models
SGIP PAP#10
OpenADE (California mandates)
NAESB PAP#10 Energy Usage Info Model
NAESB Energy Services Provider Interface (ESPI)

David Wollman & Marty Burns, NIST
2. Technology Foundation

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Kinds of Data:
- Readings
- Interval data
- Summary Information
- Power Quality Metrics

- Measurements of power, energy, gas, water, ...
- Quality: Raw, validated, estimated, ...
- Source: Meter near real-time, utility back end, third party
- Identification: by customer, device, location (but privacy)
- Economics: Cost beneficial (but not originally included)
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**NIST AT A GLANCE**
Industry’s National Laboratory

- 3,400+ Federal Employees
- 3,500+ Associates
- 2 Campuses
  - Gaithersburg, MD [HQ]
  - Boulder, CO
- 5 Nobel Prizes
- 10 Collaborative Institutes
- 400+ Businesses using NIST Facilities
- National Office Coordinating 14 Manufacturing Institutes
- 51 Manufacturing Extension Partnership Centers
- U.S. BALDRIGE Performance Excellence Program
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Outline

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### NIST SMART GRID FRAMEWORK

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<thead>
<tr>
<th>Release 1</th>
<th>Release 2</th>
<th>Release 3</th>
<th>Release 4 Feb 2021</th>
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<tr>
<td>NIST Special Publication 1108</td>
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**Key concepts:**
- Identified 75 standards, 16 action plans, cyber, architecture conceptual model, energy services interface
- Identified 98 standards, 19 action plans, stakeholder organization (SGIP) structure & ops, Testing & Certification framework
- Stakeholder organization transition to non-profit organization, architecture harmonization
- Revised Models, Operations, Economics, Cybersecurity, Testing and Certification

**Priority Action Plan #10 on Energy Usage Information**

NIST SMART GRID FRAMEWORK

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NIST Special Publication 1108r4
NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 4.0
Feb 2021

Key concepts:
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Oversight Committee Members:
- Smart Grid and CPS/IoT, NIST
2. Technology Foundation

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**Dimensions**
- **Kinds of Data**
  - Readings
  - Interval data
  - Summary Information
  - Power Quality Metrics

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- Measurements of power, energy, gas, water, …
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**Smart Grid and CPS/IoT**
- DAVID WOLLMAN & MARTY BURNS, NIST

**Smart Grid and CPS/IoT**
- CALEIFORNIA MANDATES
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Composition of Energy Usage Information

- UsagePoint
- ServiceCategory
- MeterReading
- IntervalBlock
- ElectricPower Summary
- ReadingType
- IntervalReading
- ElectricPower Quality Summary
- ReadingQuality
- ReadingQuality

Note: Information is multidimensional and modeled in UML; which is used to generation documentation and XML Schemas. Many different reading types, summaries, and readings possible.
2. Technology Foundation

- Smart Grid
- NIST
- IEC CIM (utilities core info model)
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- XML Web Presentation

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2. Technology Foundation

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Implementatio

Customer interest

Business value

Policy

Mandate

Interoperability

David Wollman & Marty Burns, NIST
Role of Government

Federal Government – Agencies and Missions
Federal Government as convener, motivator, first user, regulator, funding...

State Government – Regulators and Policy
Jurisdiction distribution systems, state energy policies...

Top-down & Bottom-up
Vision/policy .. early R&D .. foundations (tech/standards/interoperability) .. tech development tools .. pilot implementations .. ecosystem development .. testing & certification .. broader rollouts .. consumer awareness ..

- industry leadership is important for long term impact (common US perspective)
2. Technology Foundation

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- NAESP Energy Services Provider Interface (ESPI)

3. Green Button Initiative

- White House “call-to-action”
- SGIP PAP#20: Standards and Testing/Certification
- Growing the Green Button Ecosystem
- Green Button Alliance (GBA) established
- California utilities implementations
- www.greenbuttondata.org

David Wollman & Marty Burns, NIST
3. Green Button Initiative

White House and Interagency Partners
Office of Science and Technology Policy (OSTP), NIST, Department of Energy ...

Alignment with Federal Government Priorities and Initiatives
Open Data/My Data (Green Button modeled after Blue Button health data), Smart Grid, Privacy Blueprint, ...

A Challenge to Industry: How can we safely and securely provide customers electronic access to their energy information, thereby supporting the continuing development of innovative new products and services in the energy sector?

A Challenge – Design a “Green Button”

Aneesh Chopra – former U.S. Chief Technology Officer – September 2011

Conference Keynote followed by OSTP Blog: Modeling a Green Energy Challenge after a Blue Button
3. Green Button Initiative

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*white house inspired. industry led.*

In response to the Obama Administration’s call to action, 35 utilities and energy providers committed to provide 36 million homes and businesses with their own energy usage information in the consensus, industry-standard Green Button format.

Learn more >>
3. Green Button Initiative and 4. Building an Ecosystem

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Active Engagement with the “Coalition of the Willing” and Skeptics
Regulators; California utilities and other implementers; industry; privacy; start-ups; ...

Solved Many Challenges (Tech and Non-Tech) and Grew Ecosystem
Websites; branding/copyright; API sandbox; interoperability test harnesses; T&C; standard updates based on real-life experiences; DOE Data Guard (privacy) program;

Leveraged Many Different Government Mechanisms for Support
Challenges (DOE Apps for Energy), Executive Orders, Agency Programs (GSA, EPA)
5. Passing the Baton to Industry

**Creation of Green Button Alliance**
Establishment of non-profit organization, launched in 2015

**Continuing Engagement**
NIST has ex-officio board position; NIST-GBA cooperative agreement (small grant)
Thank you!

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