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Home-to-Grid Domain Expert Working Group (H2G DEWG)

Accomplishments and Plans

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H2G DEWG Overview

The objective of a smart grid is to integrate the elements of an electric power system for enhanced reliability. These elements extend beyond the meter into buildings and homes.

The Home-to-Grid DEWG (H2G DEWG) mission is to provide technical guidance for the U.S. National Institute of Standards and Technology (NIST) and the Smart Grid Interoperability Panel (SGIP). The H2G DEWG produces white papers that may help NIST in responding to the mandate in the Energy Independence and Security Act of 2007 for reporting to Congress about the sufficiency of standards to support smart grids. The H2G DEWG also reviews standards, specifications, and reports as candidates for the SGIP Catalog of Standards. NIST, the SGIP, and the H2G DEWG members select topics to investigate based on the needs of NIST, the SGIP, and the expertise of the H2G DEWG participants.

The H2G DEWG maintains a web site using a collaborative web-publishing tool called a TWiki. All the papers mentioned in this report are available at:

http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/H2G

H2G Membership and Outreach

The H2G DEWG is open to anyone with membership currently standing near 200. The H2G DEWG members represent a balance of utilities, utility equipment suppliers, and consumer product developers.

The H2G DEWG seeks collaboration with organizations whose scope includes home-to-grid. The chair of the H2G DEWG contacted the leadership of the following

organizations who then assigned officials to attend and to contribute to the H2G DEWG:

- Association of Home Appliance Manufacturers (AHAM)
- ClimateTalk Alliance
- Consumer Electronics Association (CEA)
- Electric Power Research Institute (EPRI)
- OpenADR (Open Automated Demand Response) Alliance
- Telecommunications Industry Association (TIA)
- U-SNAP (Utility Smart Network Access Port) Alliance
- ZigBee Alliance
- Z-Wave Alliance

H2G Meetings

The H2G DEWG was created jointly by NIST and the GridWise Architecture Council (GWAC) in August 2008. GWAC is a panel of 13 experts appointed by the U.S. Department of Energy to provide strategic guidance for the utility industry on smart grids. NIST and GWAC created DEWGs to focus on the business and policy of smart grids and the interfaces to transmission and distribution networks, homes, buildings, industry, and electric vehicles. Each DEWG was established with co-chairs from GWAC and NIST.

The H2G DEWG meets via teleconference biweekly and face-to-face at SGIP conferences, and, when there are time-slots, at ConnectivityWeek (annually in May) and Grid-Interop (annually in December). Each meeting is announced with an agenda at least twice in advance by the chair and attracts about 20-30 attendees. This core of active participants proposes projects and volunteers for project subcommittees.

The H2G DEWG has held 96 meetings since inception in August 2008. Following are the meeting statistics for the H2G DEWG:

2008	11 meetings	(8/22, 9/19, 10/2, 10, 10/17, 10/26, 10/31, 11/7, 11/12, 12/5, 12/19)
2009	20 meetings	(1/9, 1/23, 1/30, 2/6, 3/6, 3/13, 3/20, 4/24, 5/8, 5/15, 6/5, 6/19, 7/7, 7/24, 8/28, 9/18, 10/2, 10/16, 10/30, 12)

2010	24 meetings	(1/15, 2/12, 2/26, 3/12, 3/19, 4/2, 4/23, 5/14, 5/21, 5/26, 6/4, 7/9, 7/23, 8/6, 8/23, 9/17, 10/1, 10/8, 10/26, 11/12, 11/19, 12/10, 12/17, 12/3)
2011	21 meetings	(1/14, 1/28, 2/25, 3/30, 4/15, 4/29, 5/13, 6/10, 6/24, 7/14, 7/22, 8/5, 8/19, 9/2, 9/23, 10/7, 10/14, 11/4, 11/18, 12/6, 12/16)
2012	20 meeting	(1/6, 1/19, 2/3, 2/17, 3/9, 3/21, 4/13, 4/27, 5/4, 5/18, 6/1, 6/15, 6/29, 7/10, 7/27, 8/10, 8/24, 9/7, 9/21, 10/5)

A meeting is scheduled for October 26, 2012 with another three anticipated for November and December.

H2G Resources

The vital resources for the success of the H2G DEWG come from the members who volunteer their time and expertise. The chair proposes an agenda, announces the meetings, conducts the meetings, and maintains the TWiki and Quad Chart that summarizes progress and accomplishments.

The meeting support from the SGIP includes teleconference facilities and occasional web-based presentation tools, such as gotomeeting.com. Meeting space for the H2G DEWG at SGIP face-to-face meetings should continue to be allocated. The H2G DEWG has not required any technical development time from SGIP personnel and does not anticipate any such needs in 2013.

The H2G DEWG chair and vice-chair meet monthly with the other DEWG leaders and the SGIP Program Management Officer. Discussions include procedures for cooperation among the DEWGs and for enhancing the operating procedures. The H2G DEWG maintains liaisons with the following SGIP committees:

- Business and Policy (BnP) DEWG on topics related to demand response communications with devices and appliances in the home.
- Building-to-Grid (B2G) DEWG regarding the Energy Services Interface.
- Vehicle-to-Grid (V2G) DEWG to determine the interaction between charging stations and home networks for demand response.
- Smart Grid Privacy Group of the Cyber Security Working Group (CSWG) for technical guidance on maintaining privacy for consumer data in the home.
- Electromagnetic Interoperability Issue Working Group (EMIIWG) to supply information about electromagnetic compatibility issue regarding devices in the home.

- PAP 18 (Priority Action Plan 18), “SEP 1.x to SEP 2.0 Transition and Coexistence proposal” (now completed).

- Home Area Network Task Force (now disbanded).

The H2G DEWG would appreciate an expedited approval process for Catalog of Standards candidates. Additional resources for candidate reviews by the SGIP Architecture and Cyber Security Committee would help. Also, a fast-track process should be considered for standards that have already been approved by an SDO, such as ANSI, ISO, IEC, and ISO/IEC. These organizations all follow a rigorous review process to achieve consensus.

H2G Governance

The guiding principles of H2G DEWG governance are discussion, debate, and consensus.

H2G projects are usually assigned to a subcommittee of volunteers from the H2G DEWG. A subcommittee leader is chosen. The H2G chair monitors the work, the schedule, and offers guidance. During the development phase of each report, the members are encouraged to engage in open dialogue and to ask probing questions.

Once a report is complete, it is subject to a formal review of the H2G members using the procedures of a standards-developing organization (SDO). All comments must be in writing identifying by line number the problem text with a recommended change. The subcommittee then proposes a resolution of comments with following options:

- **Accepted** Change the text as proposed.

- **Accommodated** Make a different change, but one that is related to the proposed change and accomplishes much of what was proposed.

- **Noted** Explain why no change is needed, or acknowledge that the proposal is a suggestion for additional work.

- **Rejected** Explain why the proposed change is not acceptable.

All comments are considered. The Rejected option is used sparingly in order to achieve consensus on the report. After all comments have been resolved, the H2G members review the report for any further comments. When the document is stabilized, the H2G members are asked for consensus (substantial support) for forwarding the report to NIST and the SGIP. All reports of the H2G DEWG have achieved consensus.

H2G Accomplishments

The H2G DEWG has published the following reports. A summary of each is provided after the list.

1. Home-to-Grid Requirements
2. Roadmap for Interoperable Networks, Systems, Devices
3. Privacy of Consumer Information
4. Electromagnetic Compatibility (EMC) for H2G Devices
5. Appliance Interface (2 papers)
6. Modular Communications Interface for Demand Response
7. Installation Guide for Smart Grid Applications

1. Home-to-Grid Requirements

To assist NIST in evaluating standards for demand response, the H2G DEWG started by preparing a list of home-to-grid requirements. NIST asked the H2G DEWG to critique a set of requirements for interfacing home devices to a smart grid. These requirements were written by the Open Smart Grid (OpenSG) Technical Committee of the UCA® International Users Group (UCAIug), a trade organization of utilities and suppliers. OpenSG created a specification entitled *UCAIug 2008 Home Area Network System Requirements*.

The H2G DEWG delivered a report to NIST that begins with an overview of demand response based on a published international technical report (ISO/IEC TR 15067-3, Model of an energy management system for the Home Electronic System). Various methods for implementing demand response are described. The choices vary by utility to achieve a load shape that aligns with supply limitations, transmission and distribution capabilities, regulatory constraints, and business considerations.

The 178 requirements proposed in the UCAIug specification were analyzed and organized into categories. The total of all requirements chosen by the H2G DEWG was less than the 178 selected by UCAIug since some are specific to the demand response solution chosen and some were deemed unnecessary.

2. Roadmap for Interoperable Networks, Systems, Devices

A smart grid enhances a conventional electric grid with the addition of sensors, actuators, and controllers. These devices are interconnected via communication networks that are interoperable across the entire utility network. At the home these networks may link to:

- Home networks that support demand response programs
- Local generation sources (wind, solar, etc.)
- Electric vehicles

Each segment of the electric network uses different communication methods and application models. It is not feasible to specify a uniform communications protocol for all aspects of utility operations because they have different requirements. However, for seamless operation of a smart grid, these differences must not impede the flow of data and control. This requires that the various protocols must interoperate, possibly via gateways that translate between protocols.

This paper defines interoperability and explains how to achieve it within the smart grid. It presents guidelines for interoperability including a business and technical plan to build a successful interoperability-testing program regardless of the specific standards or profiles under test. The emphasis is on an installation rollout with interoperability verification that is independent of any particular communication standards and interface technology.

3. Protection of Consumer Privacy

The Energy Independence and Security Act of 2007 mandated that NIST report to Congress on cyber security for the electricity grid. Privacy is an important adjunct to security and uses some of the same data tools. However, privacy goes beyond data tools and confidentiality. How personal information is collected, used, shared, stored, retained, and disposed of all impact privacy. Stringent and effective security can be in place and still result in egregious privacy breaches that fall outside of security controls.

The project was conducted in conjunction with the Smart Grid Privacy Group of the NIST Cyber Security Working Group. Rebecca Herold, the chair of the NIST Smart Grid Privacy Group, was a co-author of this report.

The H2G DEWG issued a paper addressing consumer privacy and possible impacts on:

- Ownership and misuse of consumer data.
- Remote control of consumer premises devices and misuse of that control, and the related data.

The paper proposes policies for:

- Ownership of data

- Stewardship of data
- Types of data (appliance energy consumption)
- Use of data (intended and unintended)
- Sharing of data
- Retention of data
- Disposal of data

4. Electromagnetic Compatibility (EMC)

NIST asked the H2G DEWG to consider whether a reliable smart grid imposes extra requirements on EMC for consumer products. The H2G DEWG was offered and accepted assistance from the EMC Society of the IEEE (Institute of Electrical and Electronic Engineers).

The EMC Society advised the H2G DEWG that there are federal regulations on unintended radio emissions from consumer electronics. However, there are no regulations in the United States on product immunity to radio signals from other devices and licensed radios. (Some other countries do require immunity protection be built into consumer electronics.)

The H2G DEWG with advice from the EMC Society of the IEEE stated in the introduction to the report:

> "For Home-to-Grid devices to function properly and to coexist with other electrical and electronic systems in the home, they must be designed with due consideration for electromagnetic emissions from the grid or home and for immunity to various electromagnetic phenomena near the grid or in the home. They must also take into consideration the devices that are already present in the home to minimize interference to those products. Finally, EMC considerations must take the view that the home and the smart grid are a system since some issues such as surges caused by sources external to the home like lightning strikes, cannot be remedied at the end device."

The H2G DEWG and the EMC Society jointly developed a report entitled, "Electromagnetic Compatibility (EMC) Issues for Home-to-Grid Devices." This report was provided to the SGIP Electromagnetic Interoperability Issues Working Group (EMIIWG). Is has been incorporated without change in a report of the EMIIWG to be published this fall entitled *Electromagnetic Compatibility and Smart Grid Interoperability Issues*.

5. Appliance Interface to a Home Area Network

The H2G DEWG has been examining how to assist the appliance and home device industry in adding energy management features to products. This investigation has resulted in the publication of the following papers:

– *Free Market Choice for Appliance Physical Layer Communications*

The home energy management market is at an early development stage. Existing technologies are adapted for energy management applications, while new technologies are being specifically created to address this market. Accordingly, the H2G DEWG decided that it is premature to choose specific home energy-management technologies now.

Therefore, the H2G DEWG will develop high level requirements for a modular appliance socket interface (the "Socket Interface"). The Socket Interface must define the physical characteristics and a data transfer protocol sufficiently to ensure interoperability and extensibility.

The objective of the Socket Interface is to provide original equipment manufacturers (OEMs) with an alternative architecture for enabling innovation. This architecture reduces the risk of obsolescence and relieves the appliance manufacturer of the responsibility for designing and warranting a particular home area network technology.

– *Appliance Socket Interface*

This report proposes the development of a standardized socket interface for appliances that would enable them to be compatible with a specific communications network by simply plugging in the appropriate communications module. In the context of this document, the term "appliance" refers to any load device including residential appliances (also referred to as "white goods"), HVAC systems, water heaters, and pool pumps. Access to the appliance via a gateway (also called an ESI, Energy Services Interface) or energy management console (also called an Energy Hub) that has an Appliance Socket Interface (ASI) is an alternative architecture for accessing an appliance using this method.

An important application of the ASI is support for demand response (DR) involving "smart" appliances connected to a communications network (wired or wireless). The premise of these requirements is that physical sockets are one of the most enduring of all information interfaces.

6. Modular Communications Interface for Demand Response

As part of the H2G DEWG investigation of appliance interface requirements, trade groups were invited to present their work. EPRI and the U-SNAP Alliance made

presentations that proposed very similar solutions. The H2G DEWG chair convinced these two organizations to consider merging their specifications. They agreed and completed work in 2011. The new specification is called *Modular Communication Interface Specification for Demand Response*.

This specification includes a physical interface and communications protocol options for appliance control and demand response. The communications protocol is extensible to carry messages such as ClimateTalk, OpenADR, SEP (Smart Energy Profile) 1 and 2, and U-SNAP.

The H2G DEWG reviewed the merged specification in detail, processed 77 written comments, and approved the final document with no objections. The Consumer Electronics Associations (CEA) agreed to create a standards committee to make this specification an American National Standard, to be called "ANSI/CEA-204, Modular Communications Interface for Energy Management."

7. Installation Guide for Smart Grid Applications

The report on Electromagnetic Compatibility dealt with product design issues. The H2G DEWG proposed an installation guide for wiring residential devices involved with smart grids. This report was intended to deal with practical issues faced by installers and consumers. The Consumer Electronics Association (CEA) offered to help by calling upon the CEA R10 standards committee established jointly by the CEA and CEDIA (Custom Electronic Dealers and Installers Association). CEA is an SDO authorized by ANSI, the American National Standards Institute, to develop standards for home networks, connected devices, and consumer electronics. CEA R10 Working Group 9, "Smart Grid Installation" was established to write this installation guide. The working group investigated electromagnetic compatibility issues such as:

- The relationships of low voltage (<90 volts) and residential line voltage (<240 VAC) media.
- Surge suppression for electrical networks and devices.
- Proximity of transmitters of like frequency ranges.
- Grounding and shielding practices and other elements that are concerned with creating an acceptable installation environment for smart-grid devices and systems.

H2G Candidates for the SGIP Catalog of Standards

At the request of NIST and the SGIP, the H2G DEWG has examined candidates for the SGIP Catalog of Standards. The H2G DEWG members wrote the required supporting documents:

- Standards Information Form
- Development Process Statement
- Criteria and Analysis Report

The following candidates have been reviewed and approved by the H2H DEWG:

1.	ANSI/CEA-709.1-C	Control Network Protocol Specification
2.	ANSI/CEA-709.2-A R-2006	Control Network Power Line (PL) Channel Specification
3.	ANSI/CEA-709.3 R-2004	Free-Topology Twisted-Pair Channel Specification
4.	ANSI/CEA-709.4	Fiber-Optic Channel Specification
5.	ANSI/CEA-852-B	Tunneling Device Area Network Protocols Over Internet Protocol Channels
6.	ANSI/CEA-852.1	Enhanced Protocol for Tunneling Component Network Protocols Over Internet Protocol Channels
7.	CEA/CEDIA CEB-29	Installation Guide for Smart Grid Applications

The H2G DEWG has been awaiting reviews of these standards by the SGIP Architecture Committee and the Cyber Security Working Group. The first six candidates have been in the review queue since December 2011.

H2G Agenda and Plans (through 2013)

1. Modular Communication Interface Specification for Energy Management

This specification was approved by the H2G DEWG in 2011. The H2G DEWG offered and the Consumer Electronics Association (CEA) agreed to develop this specification into an American National Standard (ANSI/CEA-2045). This process should be completed in the fall of 2012.

2. Electromagnetic Compatibility (EMC) Issues for Home-to-Grid Devices

This report was provided to the SGIP Electromagnetic Interoperability Issues Working Group (EMIIWG). Is has been incorporated without change in a report of the EMIIWG to be published this fall entitled *Electromagnetic Compatibility and Smart Grid Interoperability Issues*.

The EMIIWG is considering developing this report into a NIST IR (Interagency Report) next year. The H2G DEWG will review any changes request by NIST in the section on home-to-grid devices.

3. Candidates for the SGIP Catalog of Standards

The H2G DEWG will consider offering the following standards as candidates for the SGIP Catalog of Standard and will develop the supporting documents as required by the SGIP:

- ANSI/CEA-2045: Modular Communication Interface Specification for Energy Management
- ISO/IEC 15045-1: Information technology – Home Electronic System (HES) gateway – Part 1: A residential gateway model for HES
- ISO/IEC 15045-2: Information technology – Home Electronic System (HES) gateway – Part 2: Modularity and protocol
- ISO/IEC 15067-3: Information technology – Home Electronic System (HES) application model – Part 3: Model of a demand response energy management system for HES
- ISO/IEC 18012-1: Information technology – Home Electronic System - Guidelines for product interoperability – Part 1: Introduction
- ISO/IEC 18012-2: Information technology – Home Electronic System - Guidelines for product interoperability – Part 2: Taxonomy and application interoperability model

The preceding ISO/IEC standards are included in Table 4-2 of the *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0*.

4. Appliance Interface White Paper

In the summer of 2012, General Electric Appliances and American Electric Power delivered a presentation on "Consumer Inputs Cost versus Comfort Preferences." They proposed the concept of a "slider" as a generic user interface where the user positions a slider to trade off between energy conservation and energy consumption for appliance operation, comfort, and convenience. The user might be shown the cost consequences of tilting toward consumption.

PNNL (Pacific Northwest National Laboratory) is continuing this project with advice from the H2G DEWG. The H2G DEWG has been asked to review an appliance interface white paper under development by PNNL. The H2G DEWG may offer this paper to NIST and the SGIP after suitable review by the members.

5. Broadcast Communications for Utility Messages

The H2G DEWG is considering two proposals for broadcasting utility price and event notices to home devices such as controllers, thermostats, and appliances. One proposal uses the NOAA (National Oceanic and Atmospheric Administration) weather alert radio system, while the second is based on data carried by FM radio stations in sub-channels authorized by the FCC for data communications. A joint white paper is being developed for evaluation by the H2G DEWG.

6. TIA Standards for Smart Grids

The Telecommunications Industry Association (TIA), an SDO authorized by ANSI, has offered standards that may be relevant for smart grids. The H2G DEWG and NIST are determining which of these standards should be considered by the H2G DEWG and which might be directed to other DEWGS or SGIP PAPs (Priority Action Plans).

7. Load Following

The H2G DEWG has formed a subcommittee to develop a proposal from Portland General Electric for a white paper about adapting home appliances for load following and frequency regulation. Load following and frequency regulation are a type of demand response but on a short time scale (a few seconds to about 15 minutes). These functions are usually performed by utility engineers or utility equipment for balancing supplies with loads. The objective of this study is to determine how these functions will be accomplished with distributed energy resources outside the purview of utility engineers. This project is being combined with a proposal from EPRI to investigate feedback communications for control versus price-based demand response.

8. Data Aggregation and Data Privacy

The completed H2G DEWG privacy paper is being re-examined based on a privacy report recently published by the Federal Trade Commission entitled *Protecting Consumer Privacy in an Era of Rapid Change – Recommendations for Business and Policymakers*.

9. IP (Internet Protocol) over the Modular Communications Interface

An H2G DEWG member has proposed investigating how IP data can passed through an interface based on the Modular Communications Interface for Energy Management. This work may be the basis for a technical report that the Consumer Electronics Association might issue as a companion document to the ANSI/CEA-2045 standard, “Modular Communication Interface Specification for Energy Management”

10. New H2G DEWG projects

The H2G DEWG welcomes proposals for new projects. As illustrated in the GWAC Stack from the GridWise Architecture Council, the scope of smart grids extends beyond traditional communications topics to include informational and business issues. The H2G DEWG welcomes projects that address some of these business issues as they affect H2G. Fundamentally, utilities and their regulators need good business cases to justify deploying demand response programs.