Testing and Certification for Green Button

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Abstract

Green Button has astounded the nation with its rate of marketplace penetration and the numerous and varied applications the availability of energy usage information has inspired.

This paper presents efforts to define a clear interpretation of the NAESB REQ.21 ESPI standard and tools and a testing regime created to allow the definition of basic levels of interoperability for Green Button Download My Data and Green Button Connect My Data.

1. WHAT IS GREEN BUTTON

1.1. Green Button Enabling Vision

Green Button is a common-sense idea that customers should be able to download their own energy usage information in a consumer and computer-friendly electronic format from their utility's secure website.

Green Button promises a common experience, for consumers from energy providers, setting clear expectations that consumers' information is theirs to have – and to share.

The figure above illustrates the primary dimensions of Green Button Data:

- Usage – how much energy is consumed during a billing cycle or any other period?

- History – how much energy is used as a function of time intervals – 15 minutes, hours, days, and even months?

- Cost – what is the actual cost associated with energy usage?

Green Button envisions the development of an ecosystem of providers and consumers of Green Button data. These ecosystem participants collaborate to provide benefits to consumers allowing them to better use and conserve energy.

1.2. The Green Button Initiative

The Green Button Initiative is a combination of three key dimensions:

A policy

Green Button is a White House initiative by the Office of Science and Technology Policy (OSTP), the Department of Energy (DOE), the National Institute of Standards and Technology (NIST), and the Council on Environmental Quality (CEQ).

A brand

Green Button is a brand symbolized by the Green Button logo. The brand implies specific capabilities based on interoperability standards that utilize testing and certifications to ensure those expectations are met.

A set of technologies and associated standards

Green Button is sustained by an underlying set of technologies that define the two principle use cases for the exchange of Green Button Data:

- Green Button Download My Data (ESPI data file)

- Green Button Connect My Data (ESPI automated data exchange)

1.3. An Overnight Success, Years in the Making

While Green Button has had great success in making its way into the consciousness of the Smart Grid community, it is based on a series of technical achievements several years in the making.

Specifically, Green Button got its start in the UCAIug[i] Open Automated Data Exchange (OpenADE) Task Force [5] which developed an initial set of requirements for automated data exchange between utilities and customer authorized third parties.

In late 2009, the US National Institute of Standards and Technology (NIST) established the Smart Grid Interoperability Panel (SGIP) to facilitate and accelerate the development of standards for the Smart Grid. Among its early priorities was Priority Action Plan (PAP) 10 whose goal was to standardize energy usage information.

The OpenADE requirements were used to drive consensus around an information model of Energy Usage Information shepherded through the North American Energy Standards Board (NAESB), an ANSI accredited Standards Development Organization (SDO), to produce REQ18/WEQ19 ratified in 2010.

Finally, in 2011, the OpenADE task force and SGIP helped NAESB develop REQ21 the Energy Services Provider Interface (ESPI) [6] which is a standard specifying a precise syntax and protocol for exchanging energy usage information. And this is the technology standard behind Green Button.

1.4. SGIP PAP20

In 2012, the SGIP seeking to build on the initial success of Green Button sought to further encourage the evolution of this standard in the marketplace via PAP20 Green Button ESPI Evolution [3].
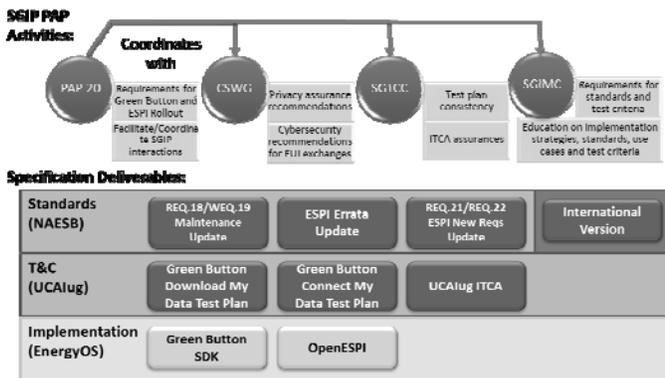
Shown in the above graphic illustrating the organization of PAP20 are the major standards updates and testing and certification deliverables.

Also shown are how the standing committees of the SGIP are designed to interact with PAP20 to ensure considerations of privacy and cybersecurity, testing and certification, and implementation and methods are infused into the deliverables as they progress.

Key to the maturing of Green Button is the establishment of a testing and certification regime to define and certify implementations of Green Button to a minimum degree of interoperability.

2. HOW TO REDUCE BARRIERS TO ENTRY

Technologies penetrate the marketplace based on supply and demand. Underlying this concept is the driving force of desired benefits and retarding force of barriers to entry.

In facilitating rapid provision of benefits, one must minimize barriers. Barriers can be technical, educational, related to complexity, production, distribution, and of course cost.

In facilitating the adoption and use of Green Button, three strategies are implemented to minimize barriers to entry and to encourage the development of the Green Button ecosystem.

2.1. Standards

First and foremost, a well-defined standard allows for the precise definition of the components of Green Button and how implementations must behave.

2.2. User Groups

Due to the nature of standards and standards development organizations, the task of implementing a standard usually falls to groups of implementing stakeholders who define implementation agreements on how a standard is to be interpreted and is often constrained for interoperable reasons. Such agreements are usually codified in certification tests which verify specific behaviors of implementations of a standard. In addition to collecting the experience and thinking of users implementing a standard, a user's group can additionally provide for a service mark that indicates to consumers and other stakeholders that indeed an implementation has been tested to this specific implementation agreement.

2.3. Reference Implementations

Finally, reference or sample implementations of the standard allow implementers to work from a starting point or at least an example which is known to satisfy the certification test requirements of the user group.

3. TESTING AND CERTIFICATION FOR GREEN BUTTON

PAP20 in conjunction with the SGIP, NAESB, and UCAIug are collaborating to create the three dimensions that

facilitate interoperability and hence minimize barriers to entry for implementers of Green Button.

The balance of this paper describes how the technical aspects of testing and certification of Green Button are being developed.

3.1. Why do we need testing and certification for Green Button?

Testing and Certification affords implementers confidence they will likely interoperate with other independently developed implementations. Ultimately there are expected to be several thousand implementers of the DataCustodian role and several hundred implementers of the ThirdParty role in the Green Button ecosystem. Avoiding the need to pair-wise tailor implementations between the independent organizations implementing these roles is an important obstacle to avoid from a barrier to entry perspective. A minimum agreed performance threshold gives interoperability value and therefore increases the value of the brand.

On the other hand, dispersion of implementations costs implementers. Exception handling code quickly exceeds implementation code as adjustments to differences are made. Dispersion of implementations costs DataCustodians due to the need to respond individually to ThirdParties with differing implementation needs. Unwanted support calls from consumers about difficulties with their "apps" due to inconsistent implementations can be onerous.

The goals of testing and certification for Green Button are to define enough interoperability to minimize these risks while maximizing the inventive ability of participants in the ecosystem to flourish.

3.2. How Green Button Testing and Certification is to be Accomplished

Green Button testing and certification is being developed under UCAIug which already provides for testing and certification of IEC 61850 devices as well as IEC 61968 and IEC 61970 interoperability testing.

UCAIug itself is implementing an Interoperability Testing and Certification Authority (ITCA)[ii]. This represents the management infrastructure for a formal testing and certification regime. Under its OpenADE Task Force, a testing and certification capability is under development for Green Button [4].

In order to ensure that this capability is robust and effective at providing for interoperability based on the tests, a systematic requirements breakdown is underway in the development of the Green Button Test Plan [1].

Refer to the following figure which shows the testing and certification requirements hierarchy.
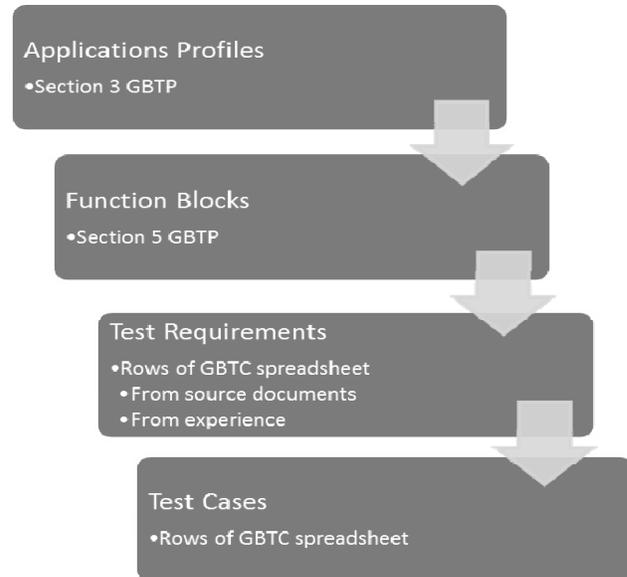
The testing requirements analysis begins with the exposition of a set of Application Profiles for which either a provider of Green Button data, a "DataCustodian", or a recipient of Green Button data, a "ThirdParty" is to exchange Green Button data. The predominant two profiles are Green Button Download My Data which allows a consumer to "download" a file containing standardized Green Button data, and, Green Button Connect My Data, which allows a ThirdParty once authorized by a consumer, to automatically retrieve Green Button data through web services from the DataCustodian with no direct involvement of the consumer.

The test plan document then defines "Function Blocks" which are somewhat orthogonal groupings of behavior required of a successful implementation. An example of a Function Block is the collection of test requirements necessary to achieve the authorization function by which a ThirdParty gains the right to automatically exchange the consumer's data with the DataCustodian.

These Function Blocks are then allocated to the Application Profiles such that each profile has an identified set of Function Blocks that are either required or optional for that profile.

Finally, a set of Test Requirements are identified. Each Test Requirement represents an atomic pass/fail test for a specific feature of a Green Button implementation. For example a specific Test Requirement is that a Green Button data file can pass validation by an agreed-upon XMLSchema.

Test Requirements and Test Case descriptions are collected in a companion spreadsheet [2] that has over 150 individual test cases and corresponding Test Requirements. These Test Requirements are sorted into the Function Blocks such that

the set of Test Requirements for a given Function Block can be judged to sufficiently test the function defined.

Via the just described method a complete test requirements derivation is being developed. This method provides the best opportunity to capture the important tests to maximize interoperability at the lowest degree of complexity. The hierarchical breakdown of the requirements allows the technologist to review and understand the derivation of the ultimate test regime.

3.3. Green Button Download and Automated Data Exchange Conformance Suite

Once the requirements for all the testing is completed, UCAIug with the support of EPRI plans[iii] to take them through a software development effort to produce a set of test tools that can be used to perform the certifications for Green Button.
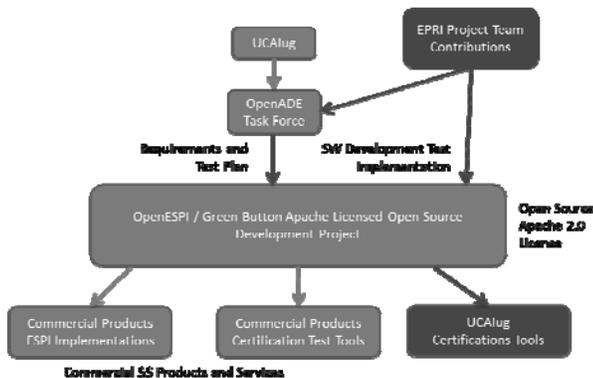
Referring to the above graphic, UCAIug through its OpenADE task force develops the requirements and test plan for Green Button. Then, through an open source project on GitHub[iv] called "OpenESPI", software implementations of test tools and sample implementations of DataCustodian and ThirdParty platforms are in development under the Apache 2.0 open source license[v]. The Apache license encourages commercial implementation of these platforms with only attribution of the license required and so is a facilitator of commercial usage of the software. UCAIug Certification Tools are a primary output of this activity. When complete, therefore, UCAIug and thus the Green Button ecosystem will have the benefits of interoperability with minimal obstacles to its successful achievement through the Green Button Testing and Certification efforts.

4. CONCLUSIONS

This paper has described the nature and evolution of Green Button. It focuses on the development of a testing and certification specification that UCAIug will use to certify implementations of Green Button. Participants and prospective participants in the Green Button ecosystem are encouraged to infuse the efforts nearing completion in

UCAIug with their expertise and experience so that the test suite is robust and effective at producing interoperability.

References

[1] Green Button Test Plan, http://osgug.ucaiug.org/sgsystems/OpenADE/Shared%20Documents/Testing%20and%20Certification/GreenButtonTestPlan/GreenButtonTestPlan.docx

[2] Green Button Test Cases Spreadsheet, http://osgug.ucaiug.org/sgsystems/OpenADE/Shared%20Documents/Testing%20and%20Certification/GreenButtonTestPlan/GreenButtonTestCases.xlsm

[3] SGIP Priority Action Plan (PAP) 20: Green Button ESPI Evolution, http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/GreenButtonESPIEvolution

[4] OpenADE Task Force, Test Plan Development, http://osgug.ucaiug.org/sgsystems/OpenADE/Shared%20Documents/Forms/AllItems.aspx?RootFolder=%2fsgsystems%2fOpenADE%2fShared%20Documents%2fTesting%20and%20Certification%2fGreenButtonTestPlan&FolderCTID=&View=%7b60F72F59%2d7B0F%2d4BA0%2d985C%2dD253868CFCEF%7d

[5] OpenADE Task Force home page, http://osgug.ucaiug.org/sgsystems/OpenADE/default.aspx

[6] NAESB Standard REQ21 Energy Services Provider Interface (ESPI), http://www.naesb.org/ESPI_Standards.asp

Biography

Dr. Martin (Marty) J. Burns as part of Hypertek, Inc. has been involved with avionics development for 10 years, metering and utility standards development and firmware implementations for the past 15 years, home and building automation for the past 30 years.

Marty has been the Technical Champion for the SGIP PAP10 and PAP20 that are responsible for supporting and coordinating the success of Green Button. Dr. Burns helped design a rapidly assembled software development kit for the federal Green Button Initiative. This development kit demystified the standards produced, also with his help and guidance, by the North American Energy Standards Board (NAESB). This in turn enabled the three California Independently Owned Utilities (IOUs) to readily embrace the Green Button standard. Dr. Burns has additionally supported the development of testing and certification of this technology including open source implementation and testing tools. These efforts have helped advance the

penetration of this technology to 35% of all US households in 12 months' time – probably a near record for penetration of any technology into the marketplace.

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[i] http://www.ucaiug.org/default.aspx

[ii] http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SmartGridTestingAndCertificationCommittee

[iii] http://osgug.ucaiug.org/sgsystems/OpenADE/Shared%20Documents/Testing%20and%20Certification/GreenButtonTestPlan/Green%20Button%20Download%20and%20Automated%20Data%20Exchange%20Conformance%20Suite%20PON_052112.pdf

[iv] https://github.com/energyos/OpenESPI

[v] http://www.apache.org/licenses/LICENSE-2.0