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TECHNICAL REPORT

colour inside

Information technology – Home electronic system application model –
Part 3-2: GridWise – Interoperability context-setting framework

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CONTENTS

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM APPLICATION MODEL –

Part 3-2: GridWise – Interoperability context-setting framework

FOREWORD

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ISO/IEC TR 15067-3-2, which is a Technical Report, has been adopted and adapted by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This Technical Report is closely based on the document GridWise®[1] Interoperability Context-Setting Framework (March 2008), prepared by The GridWise Architecture. Also, the original structure of the technical part of this document has been maintained.

1 GridWise® is a registered tradename by The GridWise Architecture Council.

This Technical Report has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

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INFORMATION TECHNOLOGY –
HOME ELECTRONIC SYSTEM APPLICATION MODEL –

Part 3-2: GridWise – Interoperability context-setting framework

1 Executive Summary

As the deployment of automation technology advances, it touches upon many areas of our corporate and personal lives. A trend is emerging where automation systems are growing to the extent that integration is taking place with other systems to provide even greater capabilities more efficiently and effectively. GridWise provides a vision for this type of integration as it applies to the electric system.

Imagine a time in the not too distant future when homeowners can offer the management of their electricity demand to participate in a more efficient and environmentally friendly operation of the electric power grid. They will do this using automation technology that acts on their behalf in response to information from other automation components of the electric system. This technology will recognize their preferences to parameters such as comfort and the price of energy to form responses that optimize the local need to a signal that satisfies a higher-level need in the grid.

For example, consider a particularly hot day with air stagnation in an area with a significant dependence on wind generation. To manage the forecasted peak electricity demand, the bulk system operator issues a critical peak price warning. Their automation systems alert electric service providers who distribute electricity from the wholesale electricity system to consumers. In response, the electric service providers use their automation systems to inform consumers of impending price increases for electricity. This information is passed to an energy management system at the premises, which acts on the consumer's behalf, to adjust the electricity usage of the onsite equipment (which might include generation from such sources as a fuel cell). The objective of such a building automation system is to honor the agreement with the electricity service provider and reduce the consumer's bill while keeping the occupants as comfortable as possible. This will include actions such as moving the thermostat on the heating, ventilation, and air-conditioning (HVAC) unit up several degrees. The resulting load reduction becomes part of an aggregated response from the electricity service provider to the bulk power system operator who is now in a better position to manage total system load with available generation.

Looking across the electric system, from generating plants, to transmission substations, to the distribution system, to factories, office parks, and buildings, automation is growing, and the opportunities for unleashing new value propositions are exciting. How can we facilitate this change and do so in a way that ensures the reliability of electric resources for the wellbeing of our economy and security? The GridWise Architecture Council (GWAC) mission is to enable interoperability among the many entities that interact with the electric power system. A good definition of interoperability is, "The capability of two or more networks, systems, devices, applications, or components to exchange information between them and to use the information so exchanged."[2] As a step in the direction of enabling interoperability, the GWAC proposes a context-setting framework to organize concepts and terminology so that interoperability issues can be identified and debated, improvements to address issues articulated, and actions prioritized and coordinated across the electric power community.

By a context-setting framework, we mean something at a high, organizational level (see Figure S.1), some neutral ground upon which a community of stakeholders can talk about

2 "EICTA Interoperability White Paper," European Industry Association, Information Systems Communication Technologies Consumer Electronics, 21 June 2004.

issues and concerns related to integrating parts of a large, complex system. Borrowing concepts from the Australian National E-Health Transition Authority, a *framework* sits at a broad, conceptual level and provides context for more detailed technical aspects of interoperability. In contrast, "A *model* (or architecture) identifies a particular problem space and defines a technology-independent analysis of requirements. The *design* maps model requirements into a particular family of solutions based upon standards and technical approaches. Finally a *solution* manifests a design into a particular vendor software technology, ensuring adherence to designs, models, and frameworks." [3]

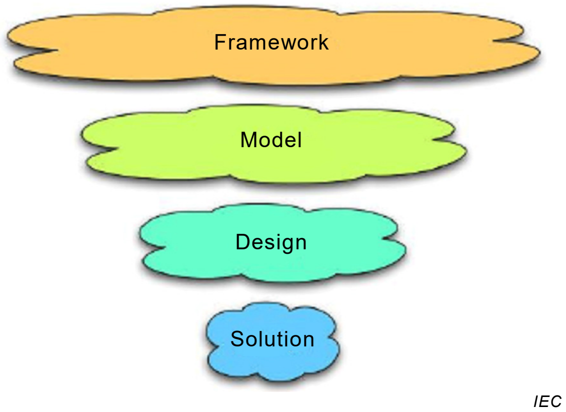

Figure S.1 – A Framework Provides High-Level Perspective

The intent of the interoperability framework is to provide the context for identifying and debating interoperability issues to advance actions that make integration within this complex system easier. The framework recognizes that interoperability is only achieved when agreement is reached across many layers of concern. These layers span the details of the technology involved to link systems together, to the understanding of the information exchanged, to the business processes and organizational objectives that are represented in business, economic, and regulatory policy.

Besides introducing new opportunities and benefits, the application of information technology (IT) also introduces a new set of challenges. As they contribute to all economic sectors, traditionally separate applications and infrastructures get more and more interconnected. Effects and decisions within each critical infrastructure influence the other infrastructures much more than before. The framework identifies the key interoperability issue areas and can help resolve interdependencies within the electric system and with other infrastructures. It reflects the increasingly important role of IT in the electric system, resulting in an electricity plus information (E+I) infrastructure. The framework also enables the representation and exchange of ideas with other critical infrastructure domains. It supports comparing, aligning, and harmonizing technical approaches with accompanying management procedures and business processes.

Figure S.2 summarizes the layered interoperability categories according to technical, informational, and organizational groups. In addition to these categories of interoperability, the framework proposes a classification of interoperability issues that cut across the layers. This document introduces these issue areas with the intent to explore and articulate the detailed nature of each issue area in separate documents engaging interested experts in their creation. The cross-cutting issues represent the areas we believe should be focused on to start improving interoperability across the web of electricity concerns.

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3 National E-Health Transition Authority (NEHTA), "Towards an Interoperability Framework, v 1.8," August 2005. (www.nehta.gov.au)

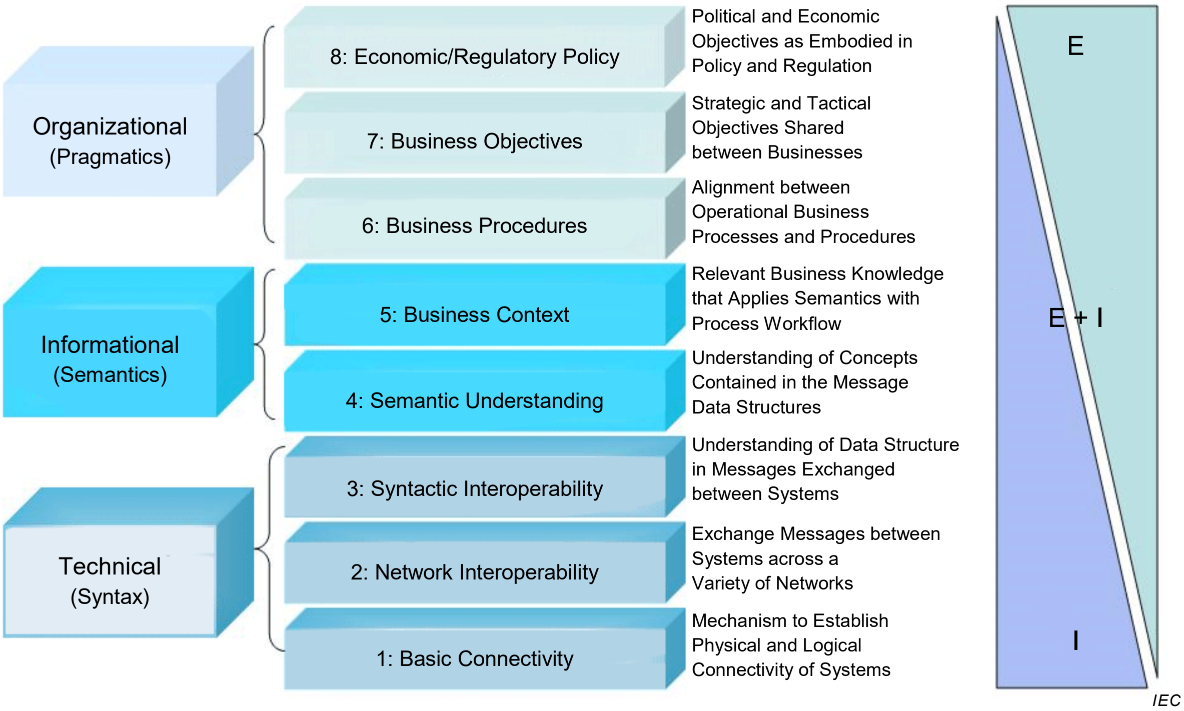

Figure S.2 – Interoperability Framework Categories

The audience for this document are system architects and integrators with the ability to participate in establishing a technical foundation to discuss interoperability, articulate issues to achieving interoperability, and develop proposals to improve the situation. It presumes the reader is knowledgeable of complex system integration and the technical, informational, and organizational issues that surround this area. This technical document lays the foundation for future, companion material to targeted purposes and audiences. Ideally, the reader will consider the application of the concepts presented in this material to their field of interest to help address interoperability challenges as well as to provide suggestions on improvements to this material.

The GWAC realizes that other versions of the framework should be tailored to speak to the interests of other audiences, such as regulators, business decision-makers, system operators, and system suppliers. This material may consist of white papers, checklists, or other forms of presentation.

To introduce this framework, we provide some background for this work in the context of past GWAC activity and establish some basic concepts and terminology. We then state some important points about the system-integration philosophy that influences the way automation components are expected to interface and operate in a collaborative manner in something as complex as the electric power system. These philosophical tenets are important because they emphasize the needs of the system integrator and underlie many of the statements made about the interoperability categories and the cross-cutting issues that are described in subsequent sections. The set of layered interoperability categories and the cross-cutting issues is followed by some clarifying examples.

The document closes with an acknowledgement that such a framework is a living concept, and therefore, a process needs to be put in place to govern its evolution over time both in terms of concepts and the material used to convey these concepts. If such a framework is to be helpful to interoperability improvements, the diverse stakeholders in the electric system should take ownership and have access to participate in its development. This then is the first of an evolutionary series of documents to describe an interoperability framework and articulate interoperability issues that assists discussions with participants at all levels. Providing venues for participation in this work is an important aspect of engaging the electricity community.

The process to specify and develop future material requires the participation of the electricity community. Figure S.3 provides a conceptual view of companion material envisaged to follow from the framework. These works include executive summaries for targeted audiences, technical papers that articulate interoperability issues and proposed approaches to address them, checklists, tools, use case scenarios that provide examples of applying the framework, and other similar documents.

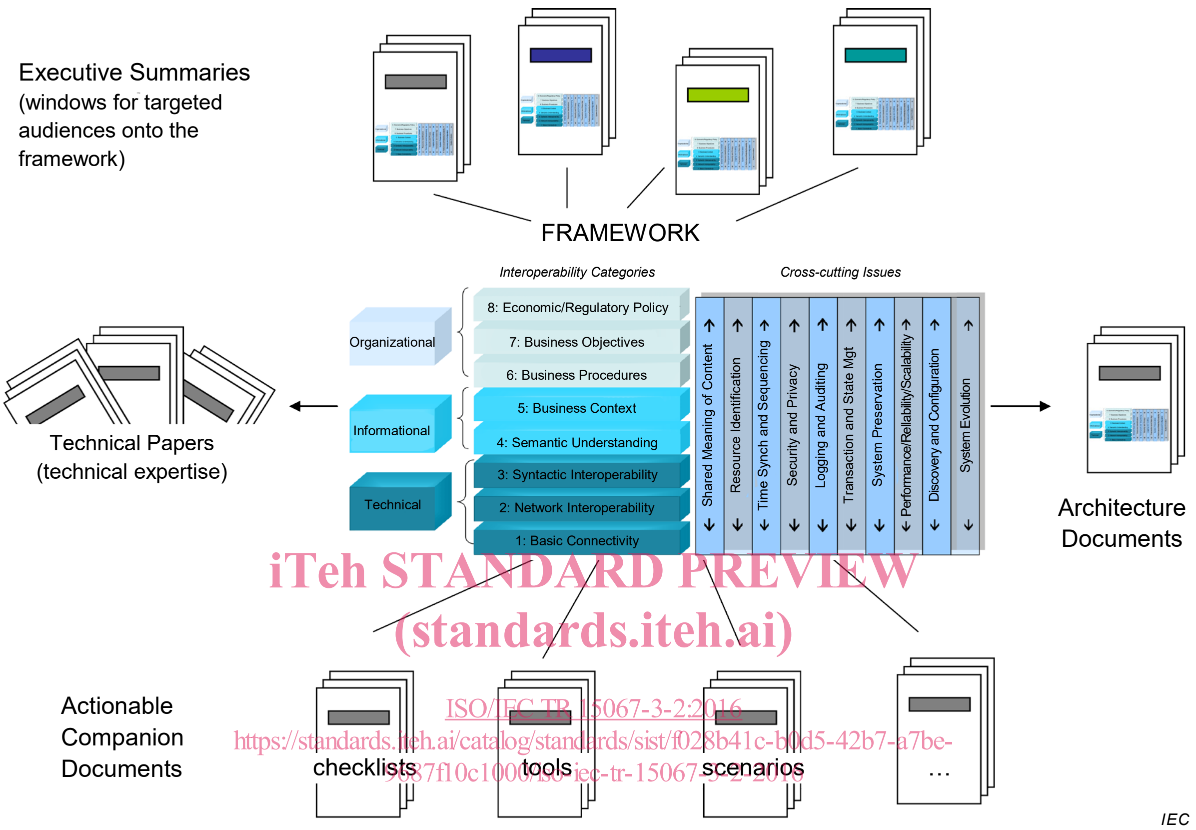

Figure S.3 – Interoperability Framework Companion Material

2 Introduction

The Gridwise Architecture Council (GWAC) exists to enable automation among the many entities that interact with the electric power infrastructure. Though we do not prejudge what this automation will be used for, once it is enabled, we presume that, given opportunity, many possibilities will be explored, and much economic and social good will result. The GWAC mission is merely to enable. The goal is a concept called *interoperability*, which incorporates the following characteristics:

- exchange of meaningful, actionable information between two or more systems across organizational boundaries
- a shared understanding of the exchanged information
- an agreed expectation for the response to the information exchange
- a requisite quality of service: reliability, fidelity, and security.

The result of such interaction enables a larger interconnected system capability that transcends the local perspective of each participating subsystem.

A commonly understood objective for interoperability is the concept of “plug-and-play”. With plug-and-play, the system integrator is able to configure an automation component into the system simply by “plugging” it in. Behind the scenes, automated processes determine the nature of the newly connected automation component and the component determines the nature of the system so that it is properly configured and can begin to operation properly. If we consider the level of integration involved as a length or distance, then the "distance to integrate" for plug-and-play is small [1][4].

As attractive as this concept is, achieving plug-and-play is not easy and in many, complex situations it is not practical to specify standard interfaces to this level of detail. For example, consider specifying an interface to an electricity market. Market participants may use software tools to manage the resources that they trade. Integrating these tools with the market interface usually requires some manual changes so the interface agreements are satisfied. The greater the customization and effort to make and test these changes, the greater is the distance to integrate. However, standards or best practices can be used to shorten this distance. For example, a commonly used information model can provide semantics that a community of integrators readily understands. Standard syntax, such as XML, provides a familiar format and structure for use without significant training. With time, things can more closely approach plug-and-play. At least by reaching agreements in specific areas of interoperation, a community can improve system integration and the effort to achieve interoperation. Figure 1 visualizes this concept.

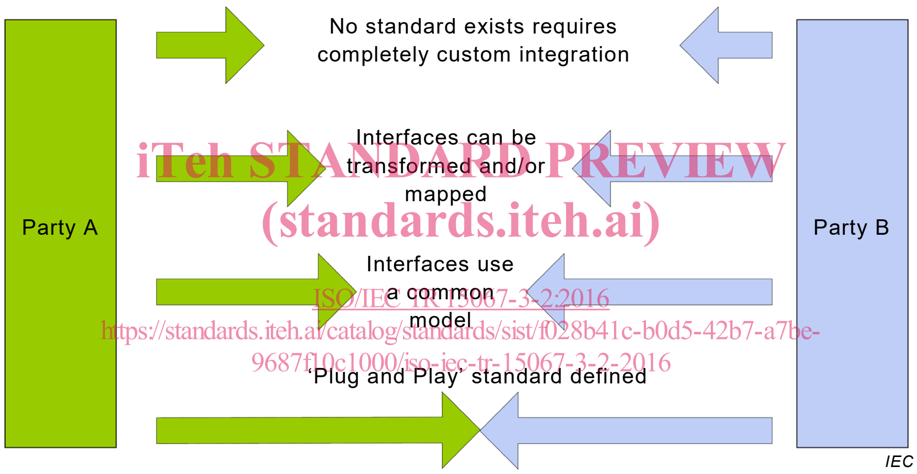

Figure 1 – Distance to Integrate

Why do we want to improve interoperability? Reducing the distance to integrate has a direct impact on installation and integration costs; however, it also creates well-defined points in a system of automation components and business enterprises that allow for new automation components and businesses to connect. This can enable one automation component to be substituted for another with a reasonable amount of effort; it can also provide a path to upgrade automation components in a localized fashion that preserves overall integrated system operation. The power system should accommodate such upgrades so that it can evolve to satisfy changing resources, demands, and more efficient technologies. Substitutability can create an environment where multiple vendors can compete to provide the same automation component capability, where things such as price and reliability become distinguishing characteristics. The same well-defined point of connection can also allow for new capabilities or features to be integrated into the system.

While we emphasize the local point of interaction aspect of interoperation, attention should also be given to broader system issues. Not only should the local dynamics of an interaction be resolved, but also the implications of behavior between automation components and

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4 Numbers in square brackets refer to Clause 9, References.

business enterprises should be understood in the context of larger system dynamics. Seemingly, unrelated processes may interact in unforeseen ways to affect system stability in positive or negative ways. The way individual automation components and businesses interact may need to reflect constraints imposed because of larger systemic dynamic conditions.

A path toward enabling interoperability was outlined in GWAC's "Interoperability Path Forward Whitepaper" [2]. An important early step in the path forward is to develop a common understanding of interoperability, the various levels of interoperability, and a categorization of issue areas where a consensus on improvements can better enable interoperability. This document presents a context-setting framework to organize concepts and terminology so that interoperability issues can be identified and debated, improvements articulated, and actions prioritized and coordinated across the electric power community.

2.1 Why Develop a Framework?

The context-setting framework was developed as a tool in support of making the GridWise vision reality. To understand the value of the framework it is necessary to remember that GridWise is not an engineering product to deliver power, but that it is an entirely new way to think about how we generate, distribute and use energy. The framework strives to communicate and organize ideas about distributed system integration that can be used by decision makers, architects, designers, and solution providers within the electric system community. This document supports the discussion of ideas and steps to improve the present system integration situation by providing a structure to identify domains of concern and their interdependencies that need to be addressed through follow-on activities.

Our society is in a paradigm shift regarding the management and evolution of our electric infrastructure as well as other critical infrastructures and the resulting system engineering processes. The traditional approaches helped us to set up successful infrastructures for energy, water, transportation, communication, and many more. System engineering focused on all aspects of the lifecycle of a system, being able to draw clear lines between the system and its environment. This paradigm started to shift with the development of information technology (IT) in the recent decades. IT in the form of communication and computing power is ubiquitous. It allows a new way of information generation and transformation that influences the rules that govern all infrastructures.

While this introduces a new set of opportunities and potential benefits, IT also introduces a new set of challenges. As they contribute to all economic sectors, traditionally separate applications and infrastructures get more and more interconnected. Effects and decisions within each supply chain or critical infrastructure influence the others much more than before. The framework identifies the key interoperability issue areas and can help resolve interdependencies within the electric system and with other infrastructures. It reflects the increasingly important role of IT in the electric system, resulting in an electricity plus information (E+I) infrastructure. The framework also enables the representation and exchange of ideas with other supply chain and critical infrastructure domains. It supports comparing, aligning, and harmonizing technical approaches with accompanying management procedures and business processes.

Within the electricity community, the framework represents a context-setting level in a serious of specification and actions necessary to support the engineering and management processes required to make the GridWise vision a reality. The framework concept was inspired by a similar coordinating effort by the National Electronic Health Trust of Australia [3]. The framework sits at the top level of a hierarchy of well-known system engineering categories:

- A *framework* captures the key domains and their interdependencies in a way that partners can address how their contributions are placed within the overall context. As such, a framework makes no architectural or technical recommendations but establishes a context to discuss alternatives and complementary approaches. The framework is a high-level, operational view common to the electricity community used to communicate within the electricity system to compare, align, and harmonize solutions and processes as well as with the management other critical infrastructure.