The Need for Technical Reference Interoperability Architecture

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The GWAC Interoperability Framework provides a high-level context and structure within which interoperability discussions can occur. It identifies key categories and issues that need to be addressed. What it doesn't provide is reference architecture and a high-level model that identifies the primary systems involved in the future "Smart Grid" along with key system boundaries, information exchanges and interactions. It is the position of this paper that such an architecture and model is needed. For discussion purposes, it will be referred to as a Technical Reference Interoperability Architecture or TRIA.

As background, the concept of a reference architecture and model is not new. The concept has been successfully used in the manufacturing world as the basis for several standards, including the ISA S95 standard for business-to-manufacturing system integration. These standards leveraged the "Purdue Reference Model for Computer Integrated Manufacturing" which was developed some 15 years ago (http://iies.www.ecn.purdue.edu/IIES/PLAIC/PERA/ReferenceModel/index.html). Even though many of the technologies mentioned have been supplanted by newer ones, the basis concepts are still viable and have become "part of the vernacular". This is the value of reference architecture. It provides an abstract model upon which concrete standards can either be mapped or be developed.

A Technical Reference Interoperability Architecture would address the need for a comprehensive macro-level, advanced vision and target roadmap into the future. The Architecture would be based on the foundation that Distributed Generation, Demand Response and Transmission/Distribution technologies will become automated through the use of modern large-scale, distributed computing technology. It would relate the different components of the future electric system as an advanced, interoperable, complex "system of intelligent semi-autonomous systems".

A major component of this Architecture would be the identification of key vendor-neutral interfaces at well-understood component boundaries that must be clearly and explicitly defined to promote a dynamic and interoperable grid that will meet the energy demand needs of the future while providing vendors with economic opportunities. These key interfaces would be evaluated in terms of existing interoperability standards in an effort to identify areas that lack sufficient standardization or are weighted-down with too many competing standards. An example of a key interface is the household "electric plug". There are several plugs for different voltage/current levels but only one 3-prong plug that is the accepted standard for 120V/15A/60Hz service in a U.S. home. This promotes interoperability and permits manufacturers to produce and sell the same product throughout the country in large volumes. Vendor-defined plugs might provide an aftermarket for adapters, such as the phone power adapter market, but customer dissatisfaction would rise and vendors would have a harder time selling into existing homes.

As a feasible and plausible strategic vision, the Architecture could be a foundation for further study and research. One potential research opportunity might be an analysis of the dynamic system behavior that results from large-scale variable generation capacity that can disturb the grid and cause potential power disruptions if not controlled properly. It could also be of value to existing Smart Grid initiatives and standards organizations as a strategic model and could help identify gaps in current standards as well as identify advantages and disadvantages of alternate designs.

In summary, the Technical Reference Interoperability Architecture would provide a strategic system-level blueprint for industry professionals including regulators. It would articulate the different types of components that make up the electric system and how these systems could interact in a Smart Grid environment. By providing a strategic, yet tangible, vision of the future, the GWAC would be furthering the goal of promoting the emergence of an electric system that leverages modern information technology.