SGIX – Smart Grid Information Exchange

This document is intended to stimulate conversation about the longer term goals for grid interoperability. It also proves information about two standards committees that are currently in formation. It is not a substitute for the short term consensus about existing standards for telemetry and real time control that are the work of the Phase 1 of the Interoperability Roadmap

1. Overview and Goals

For this roadmap, we need to coalesce quickly the standards that will enable interoperability for telemetry and real time operations of the grid. To meet the goals of the smart grid, we need to look ahead to the higher level business interoperability that will enable innovation and new markets.

The smart grid is more than improved top down control; it is a grid ready for unreliable energy sources (such as wind, waves, and sun), distributed generation, and Net Zero Energy (NZE) buildings. NZE buildings sometimes buy energy, sometimes sell energy, and balance out energy use over the day, season, or year. The NZE building presents particular problems as it may switch from buying energy one minute, and selling energy the next. Plug-in electric vehicles, whether hybrid or not, present challenges similar to those of NZE buildings with the added complexity of mobility. The smart grid requires distributed decision making, distributed responsibility for reliability, and easy interoperability to integrate an ever-changing mix of technologies.

The smart grid will be transactional, with each decision to buy or sell power a separate transaction at a separate price. The price of these transactions will vary dynamically, as a live energy market determines the clearing price at each moment for each sale or purchase. The smart grid will be open and transparent, wherein consumers can choose what kind of power to buy, and providers can prove that they are selling the kind of power they promise.

Alex Levinson has named the suite of standards we will need for the smart grid Smart Grid Information Exchange (SGIX). What follows is a straw man view of SGIX, including information about some new standards that are just underway. These interfaces will use the semantics of the CIM while applying the e-commerce disciplines of symmetry, transparency, and composition.

2. SG-Energy Interoperation

OpenADR is a tested specification for achieving automated demand response to meet the needs of the regulated utilities in California. The work done on OpenADR at the University of California's Lawrence Berkeley National Laboratory (http://drrc.lbl.gov/openadr/) is being developed for use as a standard in OASIS. Mary Ann Piette and her team have been working with William Cox to develop a charter for this technical committee.

This work will include a change of focus to embrace enterprise interactions as well. By including the enterprise inhabiting a building, factory, or home in the message, we will be able to induce a larger response and wider participation. The committee will also draw upon European work in transmission, distribution, and cooperative energy use, and will include discussion of security and privacy requirements.

The OASIS committee will meet for the first time on Monday, June 22 at 1:00pm EDT/10:00am PDT. Participation details will be available by May 8. A parallel effort launching within UCA will offer advice and support to the OASIS work.

3. SG-Energy Market Information Exchange

The charter for Energy Market Information Exchange (EMIX) is in pre-public circulation and is drawing interest from ISOs and RTOs as well as building system integrators. Energy Market Information Exchange will be chartered to produce an XML vocabulary for exchanging price and energy characteristics (hydro, hard coal, nuclear, wind, etc, with a place for carbon information) to facilitate energy markets and device understanding/communication of so-called Real Time Pricing or Dynamic Pricing.

A goal of EMIX its to interact easily with financial and commodity market mechanisms such as the Financial Information Exchange (FixML) and cell phone instant provisioning protocols. EMIX also anticipates the development of new energy products that allow energy choice based on environmental issues as well as price (the energy attributes portion).

The draft charter (and the approach) drew a great deal of attention at GridEcon in mid-March, including an evening session on pricing and markets. Contact either author for more information or to get involved.

4. Ancillary Energy Standards

Enterprise standards are composed of smaller standards. Composition improves interoperability and discoverability. The descriptions below are a personal view on how these ancillary standards might develop. Where indicated, these smaller standards are likely to be developed as part of the committees described above.

4.1 SG-Load Management

The OASIS standard oBIX offers an extensible WS framework for communication with building control systems. OBIX defined a concept of Contracts, used to define higher level interactions. The ASHRAE BACnet Load Control Object offers a model for building systems to report on their energy use, to negotiate responsiveness, and to make load shedding agreements. SG-Load Control would build on the BACnet model to define web service standards for contacts as defined by oBIX.

SG-Load Management is part of the deliverable of the Energy Interoperability TC.

4.2 SG-Curtailment

Sometimes, no matter how you plan, stuff happens. The daily temperature is 5 degrees warmer than expected. The turbine seizes. A truck drives into the transmission tower. Shed load NOW! Prices and markets for curtailment have been evolving rapidly; perhaps this addresses the grid integrity issues more directly.

SG-Curtailment is part of the deliverable of the Energy Interoperability TC.

4.3 SG-Quality Of Service (SG-QOS):

Participants in the smart grid must exchange information about reliability and performance. QOS information must be exchanged both as a promise and as a result.

We may be able to adapt the Business Process QOS (BQOS) work from the SOA-EERP (End-to-End Resource Planning) technical committee. This work could fit in to either Energy Interoperability, as a component of demand response.

4.4 SG Pricing

Price is more than a number. If I ask you if prices are up or down at the store, the answer is not "7". It is not "Tomatoes are $3.00." The price is "$3.57 per pound for the organic vine-ripened greenhouse heritage Cherokee tomatoes." Each buyer can choose which attributes affect their purchase decision. A buyer may choose the cheapest tomatoes. A buyer may choose to buy only organic. A buyer may grudgingly accept the only tomatoes available. SG Pricing will flow throughout the system—a model known as Prices to Devices. Under prices to devices, each system within a home or building may make its own decisions based upon budget and priority.

SG-Pricing will be part of the SG Energy Market Information Exchange TC.

4.5 SG Transaction

This is a simple standard of energy flows by time slice. It also includes direction, as power may flow one way for a time, and then the other in a distributed world. To achieve transparent clearing markets, SG-Metering reports what amount of what kind of power was purchased at what price at what time. If my neighbor and I buy the same amount of power at the same time, we may pay different prices because we may have made different decisions on how to buy. I may owe my utility or my neighbor for that purchase of solar power. SG-Transaction is in effect the accounting journal entry for each purchase or sale of energy.

5. Other Enterprise Standards of Interest

One of the benefits of composition is that it enables interoperability between systems that can interact while understanding only a part of the shared message. Coordination, measurement, and accounting are examples of where this sort of interoperability is useful.

Most of those that follow are standards that would enable coordinated enterprise interoperation, except that today the rest of the enterprise lacks them as well.

5.1 UnitsML

UnitsML offers an unambiguous way to describe all physical measurements, and an unambiguous ability for a computer to look up the translation of any units of measure to any other units. SG-Pricing, SG-Transaction, and Energy Market Information Exchange will use UnitsML. UnitsML is an existing OASIS committee with NIST backing which will need some assistance and wider participation to complete.

5.2 WS-Calendar

We all use ICALENDAR (IETF RFC 2445), to unambiguously exchange information about time intervals. You used it the last time you clicked on an email attachment and suddenly had a meeting on your personal calendar. We need the same functionality standardized for web services. We will need it as part of pricing, and weather predictions, building management, and other decisions. (http://www.ietf.org/rfc/rfc2445.txt)

WS-Calendar should be developed outside the SG effort as its anticipated uses extend into many business interactions.

5.3 Digital Weather Markup Language

DWML is an existing specification developed by NOAA. NOAA offers a web service to which one can submit a longitude and latitude and receive in reply a DWML forecast. Most forward forward-looking energy markets are based on assumptions about weather. Most historical analysis of energy use includes recalling the weather environment. The most successful energy middlemen base their business on understanding microclimates. We need to define a DWML profile for reporting as well as forecasting, to enable the exchange of actual conditions as well as forecasts. Such a profile would be used when querying local weather stations and even personal weather systems. Such a standard should include UnitsML (for internationalization) as well as time (WS-Calendar).

We should encourage NOAA to develop the DWML specification into a standard; DWML also is of interest to the Emergency Response community.

5.4 WS-DD and WS-DP

Device discovery and device profiles have been used in computer networking for some time. These specifications for the web services implementation are going to a standards vote in May. A major manufacturer of electrical equipment has already announced that they will include WS-DD and WS DP for all the equipment it sells. There are open source implementations for small devices (https://forge.soa4d.org/). We think they will have a big role in the future world of distributed generation and Net Zero Energy facilities.

5.5 SG CyberSecurity

Cyber security is drawing more attention and concern every day. Today's cybersecurity is concerned primarily with defending the isolated system with relatively static interactions. Tomorrow's cybersecurity will apply to systems interacting with others owned by many different people, of uncertain skill and diligence in securing their own systems. (Think home generation and net zero energy systems). Security issues need to be integrated within every TC from the beginning—and not merely a veneer layered on after the fact. We need a separate security toolkit/framework, perhaps a profile from current fine-grained security standards, key management, and related areas. Broader integration of physical security, fine-grained networking and commercial security, and situation awareness technologies need to be part of the mix.

6. For More Information

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