A FUTURE PROOF ARCHITECTURE FOR SMART GRID AND SMART METERING

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ABSTRACT

This paper discusses how to select a smart grid / smart metering architecture that is able to adapt to change. The presentation will provide guidelines, criteria about how to select for the short term and limit risk for the long term. The focus will be on selecting solutions that create an open architecture and do not lock you into a specific standard. Solutions include web services based interoperability layer to exchange information between subsystems and ones that provide a future proof architecture for both smart grid and smart metering.

INTRODUCTION

Many utilities mistakenly approach their smart metering and smart grid projects by first focusing on what standards to select rather than starting with their business needs and the use cases they want to fulfil both today and over time as their systems evolve. Over a 10 or 20 year operating life, the smart grid and metering systems installed today will have to be able to adopt new technologies and integrate open standards as they become available. And, in the smart grid, a DSO will need to exchange information between many different types of automation devices in the field, all of which has their own standard(s). So how should utilities handle the uncertainty surrounding standards?

OPEN ARCHITECTURE

In order to support the various networks and interfaces within the smart grid now and into the future, one of the most important and basic requirements is an open architecture. This type of architecture will support not only today's services and applications but also the provision of new services and meeting new market demands without replacing the core infrastructure and associated equipment.

Technologies will continue to evolve and multiple standards are being used and will continue to be used across the utilities operation. Therefore, utilities need a smart grid system with an open infrastructure, one that many companies have adopted and upon which they are able to build custom solutions. These solutions can even be proprietary to each vendor, but because they're built upon a common, open infrastructure they can be mixed and matched, offering the utility competition, innovation and choice. Various EU standard initiatives, including M441 and M490, support this type of approach and indicate there will be many appropriate smart metering and grid standards, not just one.

The key factor is that interoperability exists, not necessarily at the device level, but at the higher levels within the systems enabling a more future-proof solution ready to adopt new technologies. Many utilities, including Vattenfall in Sweden, Fortum in Finland, LINZ in Austria, and SEAS and NRGi in Denmark, have proven projects based on implementing this type of open architecture based solution. This has enabled them to reduce costs, improve efficiencies, and improve quality of service.

To ensure utilities and consumers succeed in the modernization of power grids across the globe, everyone in the ecosystem needs to consider all the moving parts involved. An open-infrastructure approach will rapidly lead to innovation and achievements, while limited, closed approaches will ultimately kill innovation and benefit very few.

It is not just about smart meters

The critical issue in defining "smart metering" is that it's not just about the meter. It is really about enabling the smart grid -- an energy infrastructure that runs from generation to distribution and includes thousands of grid-connected devices and systems that consume energy. Smart metering sets the stage for a smart grid "system" offering increased functionality via built-in two-way communications and smart grid applications, many of which provide improved and expanded customer service. Thinking "beyond the meter" and toward an overall system solution delivers dramatic improvements in utility operations, reliability, and customer-service capabilities by offering detailed usage information, demand metering, detailed power-quality data, speedy outage information and flexible billing options.

Smart metering systems serve as the key information-gathering source and foundation for a smart grid that helps utilities better manage their operations. The smart grid also helps customers better manage their energy use, of course. Utilities need to ensure a high level of reliability and service to their customers, and this will become more challenging in the near future because of the additions of renewable energy sources, electric vehicles and distributed generation. Smart metering and the rest of the smart grid will make it possible for Distribution System Operators (DSO), also referred to as Distribution Network Operators (DNO) to more effectively and efficiently manage the distribution network.

Smart grid stakeholders – benefits to all

Consumers, distribution companies and retailers all benefit from smart grid development. A smart grid can improve management of the transmission and distribution assets, as well as their generation portfolio, in order to keep pace with their customers' increasing electricity usage and peak demand. For the supplier and retailer, it makes possible and accelerates the adoption of new services to help them differentiate their offerings in increasingly competitive energy markets. All of these vast benefits to utilities also mean, of course, that the consumer wins.

The many diverse benefits associated with the smart grid should be viewed collectively. Think of them as an aggregate of benefits to all parties. It is very difficult to build a compelling business case around just one set of benefits to a specific stakeholder. Of course, the consumer, and society in general, will benefit from the smart grid in part because it provides a means to energy conservation – by raising consumer awareness of the cost and impact of electric devices in our homes and offices. The most obvious direct benefit to consumers will be in the form of lower energy bills.

Energy empowerment, demand response and services beyond

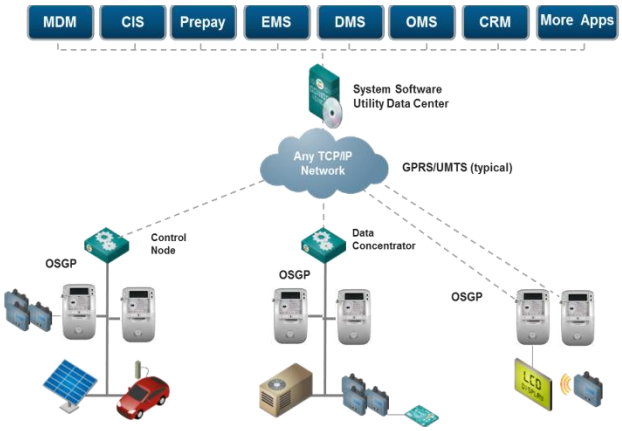
The true smart grid creates an energy network that will detect and address emerging problems in the system before they negatively affect service. It will be able to respond to local and system-wide inputs, provide much more information about broader system problems and, most importantly, be able to immediately react to or resolve problems that do occur.

For example, demand response (DR) is becoming instrumental in managing the growing demand for energy, especially where it is combined with new and innovative pricing plans and consumer energy use portals. The combination of heightened awareness, an ability to track and manage energy use and financial incentives will give consumers a sense of "energy empowerment" that they have never before experienced. This requires smart metering and smart grid systems that offer distributed local intelligence at the neighbourhood transformer to effectively manage the edge of the grid -- where decentralized generation, electrical vehicles and customers must constructively co-exist.

Future-proof: The case for open smart grid architecture

In order to support the various networks and interfaces within the smart grid now and into the future, one of the most important and basic requirements is an open architecture. This is to support not only today's services and applications but also the provision of new services and meeting new market demands without replacing the core infrastructure and associated equipment. The following is a picture of an open type of our architecture.

The figure shows an example of an open smart grid architecture. The system's standard interface uses XML messaging and Web services, between the IT applications at the head end level and the smart grid infrastructure. In this way, it is possible to run different protocols and technologies in parallel that maximize the flexibility of utilities, which provides a healthy competition in the market between different technologies, data models and protocols.



This type of System, based on Open Smart Grid Protocol (OSGP) supports the following capabilities:

- End-to-end device communications & control
- Three tier architecture for decentralized applications
- Multi-vendor, multi-device interoperability
- Reliable communications (proven reliability level > 99.8%)
- Automatic topology management, meaning that OSGP-based systems automatically discover the power line topology, the smart meters and other smart grid devices connected to the power line and can report this information back to the utility data center
- An adaptive, directed, self-healing PLC mesh
- Rich power-quality data to enable sophisticated smart grid applications
- Secure firmware upgrades over the utility network
- Non-meter devices can use the open infrastructure to communicate with the utility's enterprise software.
- Meter and other smart grid device data is available to all kinds of smart grid applications

This type of open architecture supports other future-proof features required in a smart grid system including: advanced functionality in smart meters, such as power-quality measurements, remote-firmware upgrades and an

open interface for interoperability with multiple home area network (HAN) technologies; open interfaces at the head-end applications via standard web services; and open interfaces along with distributed intelligence at the neighbourhood transformer. These features will allow utilities to be able to upgrade and add new devices and systems even after the smart grid system is deployed within the home, within the electric grid or at the utility head-end the network. Open Smart Grid Protocol (OSGP) is one example of standard that delivers these types of future-proof features and functionality. In addition, OSGP enables an open architecture and infrastructure supporting both smart metering and smart grid applications.

Interoperability

Interoperability is too often used as an excuse to push a particular technology, regardless of its actual suitability for the application. Such agendas manifest themselves as a "choose one standard" technology approach. Technologies will continue to evolve. Instead of requiring a single standard, utilities need a smart grid system with an open infrastructure, one that many companies have adopted and upon which they have built custom solutions.

The best approach is to define interoperability at the web services, enterprise level. Using APIs (application programmer interfaces), a utility is able to maintain and leverage their large investment in IT systems and applications and allow them the option to work with a variety of underlying metering systems. This approach allows utilities to take advantage of the largest competitive market possible and also enables them to take advantage of new technologies as they emerge from any potential vendor.

An additional benefit of standardizing at the enterprise level is that this will leverage and optimize the implementation of multiple smart grid applications rather than focusing on a single application, such as metering. The implementation of a specific metering interoperability standard limits innovation and promotes the smart grid as a point solution rather than as an enterprise infrastructure for an entire corporate solution, which is what it should be.

SUMMARY

As utilities face increasing pressure to reduce their costs and lower their environmental impact — by reducing emissions of greenhouse gases, for example — they must fundamentally change their attitude toward power generation and resource planning. An open smart grid and smart metering infrastructure approach will allow utilities to deploy a solution that lets them extend the smart grid and communications infrastructure to intelligent devices both on the distribution network and inside customers' homes, make power delivery more efficient, reliable, and safe, and help customers better control their energy use. The ideal smart grid and smart metering solution utilizes an open architecture that lets utilities and their customers implement and access a truly intelligent smart grid — meaning one that benefits both sets of stakeholders — through a variety of technologies.