MICROGRID OPEN ARCHITECTURE: THE NEED FOR AN OPEN ARCHITECTURE THAT PROMOTES FLEXIBILITY, SCALABILITY, AND SECURITY

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ABSTRACT

Many utilities mistakenly focus on what standards to select for smart grid or smart metering. However, depending on the decision, it has the risk of stopping innovation; not being able to adopt new technologies and open standards as they come 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? This paper will cover how to select an architecture that is able to adapt to change. The paper 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 that include web services based interoperability layer to exchange information between subsystems and it should provide a future proof architecture for both smart grid and smart metering. 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

INTRODUCTION

Today, utilities need to address a variety of business and social issues associated with the environment. They must also constantly improve how they manage their transmission and distribution assets as well as their generation portfolio in order to keep pace with their customers' increasing peak electricity demands. With limited options, many electric utilities are investing in smart grids: intelligent electricity transmission and distribution networks that use two-way communications to make power delivery more efficient, reliable, and safe; and to help customers better control their energy use. One vital part of the solution to leverage the existing infrastructure is to implement a smart grid. A smart grid is an electrical system that becomes increasingly more self-healing and self-operating. And of course, the smart grid must be able to support microgrids

A microgrid is a discrete energy system that includes distributed energy sources (including demand management, storage, and generation) and loads capable of operating in parallel with, or independently from, the main power grid. The primary purpose of a microgrid is to ensure local, reliable, and affordable energy security for urban and rural communities, as well as offering solutions for commercial, industrial, and federal government consumers. Some consider microgrids as smaller versions of traditional electricity grids. Like current electrical grids, they consist of power generation, distribution, and controls including voltage regulation and switching equipment. The main difference is that microgrids offer a closer proximity between the power generation and the power consumption, resulting in efficiency increases and transmission reductions. Microgrids can integrate with renewable energy sources such as solar, wind power, small hydro, geothermal, waste-to-energy, and combined heat and power (CHP) systems.

OPEN ARCHITECTURE

As utilities look to deploy microgrids and smart grid infrastructure, the importance of selecting an open platform that utilizes existing control and networking standards has increased exponentially. Unfortunately, in the smart grid market, "open" means different things to different people. Instead of looking for systems that define themselves with this word, consider these questions to ensure that a system is open in ways that benefit your utility.

How many suppliers offer systems based on the selected infrastructure?

Clearly, a system that's available only from its supplier is not open. An open infrastructure is one that many companies have adopted and built custom solutions on top of. These solutions may be proprietary to each vendor, but since they are built upon a common, open infrastructure they can be mixed and matched, offering the utility competition, innovation, and choice.

Is the system interface open?
Is the system open at the top? To fully realize the benefits of a smart grid and an advanced metering system, it must be able to exchange data between disparate utility systems. These systems often use a variety of data exchange formats and mechanisms that have historically prevented the systems from effectively communicating with each other. To address this, the Internet community has already developed Web services (SOAP/XML), a standards-based way for applications to integrate with each other. Web services use ubiquitous protocols and the Web infrastructure that exists in every organization, so they require little, if any, additional technology or training investment. The inherent interoperability that comes with using vendor-, platform-, and language-independent Web services technologies is vital in obtaining the maximum benefits from smart grids and advanced metering systems for the least amount of integration costs.

Is it open to any NAN/WAN backhaul?
Is the system open in the middle? Sometimes called a neighborhood area network (NAN) or a wide area network (WAN), this component of any smart grid system is designed to reliably and cost-effectively transport data from meters and other devices in the field to the utility. Rather than focus on the data application layer, it's essential that the communications "plumbing" be built on proven IP networking technologies. Only in this way can utilities leverage the investment being made in new networking technologies such as GPRS, UMTS, BPL, WiMax and other IP based networks. This also gives utilities the flexibility to mix and match public and proprietary networking infrastructure to avoid vendor lock-in, reduce system cost, and guarantee flexibly, scalability, and security over the life of the system.

Can devices other than meters be integrated with the system?
Is the system open at the bottom? Smart grids are an investment in communications infrastructure as much as end devices including smart meters but that is only one application within a smart grid environment. To fully benefit the utility and to support demand management, distributed generation, and other programs that may emerge over time, the infrastructure must be able to integrate devices other than meters—such as gas and water meters, street lights, thermostats, and direct load-control devices, distribution equipment, renewable generation—into the smart grid system.

Unlike simple AMR or even SCADA systems, smart grid systems provide valuable information that spans the entire enterprise as well as outside of the organization. Therefore, it is critical that a smart grid solution is based on an open platform that can seamlessly integrate with other systems—that is, open in substance, not just in name. Otherwise, systems will experience vendor lock-in, and the potential benefits will be too expensive to realize.

We believe that there should not be mandates for specific technologies. This approach has negative effects on the market place. There should be support within the community for innovation by not defining specific technologies. Through innovation, vendors and providers will be able to create and offer customers new applications and services that will support the objectives of the industry. Innovation can reduce costs of solutions and also create improvements with energy efficiency. A further benefit from not mandating specific technologies is that it allows individual countries or local markets to take advantage of world market products and associated larger. One idea associated with mandating technologies has been to separate the communications from the device or meter and promote a modular approach to smart grids and smart meters. The most cost effective solutions have been proven to be integrated products that combine the advanced metering and other smart grid components with the communications. This integrated approach allows vendors to leverage components and optimize design and manufacturing costs. Innovation and integrated designs ultimately provide the most functionality and services at the lower cost.

In addition, there should not be mandates for how devices and meters from different vendors and different smart grid based systems interface with each other. Instead, utilities should be free to implement interoperability on their own if desired and required by using the most cost effective interoperability method which is at the system level rather than at the meter. Not only is using high level system interoperability for devices and meters more cost effective but it also continues to support the objectives of the industry. Allowing mandates for unique metering requirements and interoperability standards in a country will ultimately add more costs for the utilities and associated electricity customers in their country. It will also stifle meter innovation by forcing vendors to comply with specific unique mandated requirements.

Suggested Interoperability – At Web Services, Enterprise Level
We believe the best direction for interoperability is to follow a web services and CIM model, which defines interoperability at the web services, enterprise level and is being used by many utilities. This approach can use defined APIs to a "virtual device or meter" which enables utilities to maintain and leverage their large investment in IT systems and applications and allow them the option to work with a variety of underlying smart grid 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 smart grid device or 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.

Standardizing on the lower levels with a standard defining interoperability for meters will increase the cost to utilities and their consumers. It will make the market of meter suppliers smaller, it will prevent innovation, it will lead to higher cost and less function – and the systems will still be closed since some of these types of standards have a proven problem with interoperability between manufacturers. So vendors still have to create custom drivers for each meter.

Allowing utilities to select from the largest possible number of smart grid related suppliers competing to win their business is the best way to drive down costs. Interoperability at the web services layer and utilizing the CIM standard will protect investment in infrastructure systems and is where the focus should be rather than mandating some standard at the low level details within the smart grid and metering systems as some are considering. Interoperability is important and should certainly be supported and promoted but interoperability should be specified at the more appropriate and cost effective, system and enterprise level not the lower levels.

CONCLUSION

We believe that it is important for microgrids including smart grid and smart metering systems to utilize open, existing control and networking standards. Each level of the system should be built on open standards. This will allow for flexibility, cost effectiveness, and future expandability in an effective manner. By standardizing on IP based communication systems and web services (XML/SOAP), the most common standards-based way to realize SOA, smart grid systems can provide utilities with independence and ensure a competitive market over the life of the smart grid for both WAN and enterprise integration.