WHY STANDARDS BASED INTEGRATION IS MORE IMPORTANT THAN EVER: EVERYTHING A NON-IT MANAGER SHOULD KNOW

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ABSTRACT

With the advent of the smart grid, utilities are faced with the requirement to provide a large number of bidirectional integration points between operations and information technology systems. In many cases, this development is further challenged by the evolving applications themselves, as well as, standards. The cost and risks associated with integration have traditionally held back many large scale systems initiatives. In the absence of an efficient means to address integration issues, utilities will find their smart grid initiatives to be challenged. Moving forward, standards-based integration will provide an approach to address many of these previous challenges. This paper will provide an overview of conceptual aspects of standards based integration, as well as, some of the benefits.

1. INTRODUCTION

While it is difficult to challenge the benefits of standards based integration, many in the industry are letting others take the lead in developing integration standards. This applies to both individual distribution companies, and more specifically, the vendor community. While standards based integration models have struggled for utilities, momentum is gaining to make it a requisite for any credible smart grid initiative. A component of the ARRA grants has been the development of a more comprehensive set of standards applicable to the smart grid: in fact the development of standards is identified by NIST as a critical activity. For many T&D managers, integration and standards discussions are intimidating: a non-intuitive and cryptic vocabulary is defined that provides clarity for some and confusion for others, and a cumbersome process erodes the upfront benefits. While the implementation of the physical integration should be in the domain of IT, the standards and data definition should be driven by the end-user community.

This paper includes six sections. Section two identifies the need for standards based integration. Section three provides an overview for the infrastructure required to enable standards based integration. Section four identifies the current state of the standards applicable to the distribution business. Section five describes the initial planning necessary to implement an ESB using a/ standards based approach. Section six gives concluding remarks.

2. THE NEED

Many utilities suffer from what can best be described as an "Accidental Architecture" [1]. The "Accidental Architecture" is often the result of the evolution of systems and point-to-point integration. With the promise of further integration through smart grid deployments, the industry is recognizing that the traditional utility integration paradigm is not sustainable long term. This integration approach has the following weaknesses:

- Time consuming upgrades;
- Difficulties in integrating business rules and process;
- An overall lack of definition of which interfaces exist and their details;
- An overall lack of understanding of timing and dependencies; and
- The inability to develop reusable integration on the part of vendors.

Proprietary interfaces often require dedicated IT professionals and demand a significant amount of effort when changes are required. Routine software upgrades can cause long projects focused on revalidation of the customized interface. Since custom interfaces are always vendor-to-vendor and often site specific, this work is not reusable. An individual utility bears the total cost of the effort.

These weaknesses often lead to a higher total cost of ownership and prevent the utility from remaining current with the software revisions. With the complexity in terms of the number of evolving integration points of the smart grid projects underway and envisioned future integration requirements, utilities have identified that realization of the goals of the CIM model become unattainable using the traditional integration approach [2]. As the smart grid provides an alignment of operational or field based technologies and traditional information technologies, the need for effectively addressing the integration dilemma currently faced with utilities will become even more important.

3. INFRASTRUCTURE REQUIREMENTS

An enterprise service bus (ESB) provides an event-driven messaging engine: Figure 1 provides an overview of the typical ESB / service oriented architecture (SOA). For the purposes of this paper, the terms ESB and SOA are used interchangeably. We are making an explicit assumption that implementing an ESB also means moving to a SOA [2].

The messaging engine provides an abstraction layer which allows messages to be passed between systems without the need for writing application and data model specific code. When an ESB is implemented in conjunction with a standard, such as CIM or MultiSpeak®, a vendor can supply a generic adaptor that can be used to communication with other systems. Needless to say, as the complexity of the information architecture increases, the cost / benefit for the implementation of an ESB based integration scheme becomes more compelling. Implementation of a full featured Meter Data Management System (MDMS) often creates an environment that alone justifies implementation of an ESB.

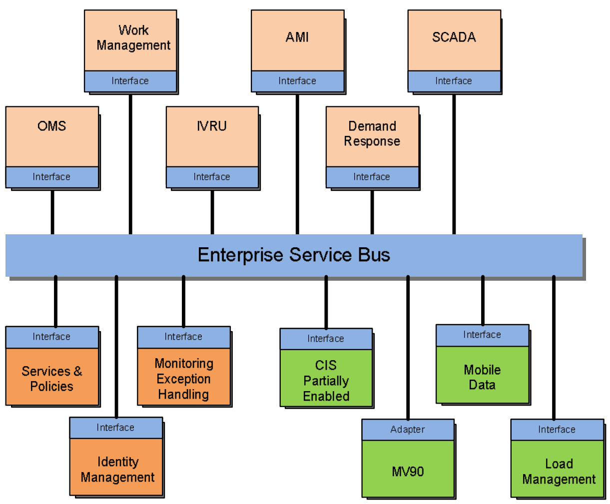

Figure 1: Typical ESB Enabled Utility

It is also important to understand how to effectively apply ESB technology and where the ESB technology is less suited. For example, ESB technology is typically not well suited to transfer of large volumes of data that has traditionally used batch processing. The characteristics of the ESB include:

- Freedom from operating system specific features;
- Support for common integration patterns;
- Ability to loosely couple systems, and;
- Service orchestration.

An ESB will be most effective when it is used in a structured, system wide implementation. An ESB is just a tool that provides a structured, consistent platform for enterprise integration. However, without governance, a well thought architecture, standard and guidelines, the ESB could wind up implementing point to point interfaces, with nothing gained.

The implementation of an ESB is often part of a smart grid initiative or the implementation of a major system (or "large package") at a utility. Figure 2 illustrates a model, called the GWAC Stack [3], which represents the elements of a Smart Grid. The GWAC stack was developed by the GridWise Architecture Council, an organization formed by the U.S. Department of Energy to promote and enable interoperability among the many entities that interact with the electric power system. The same model, however, could be used to think about any large package implementation or re-architecturing effort.

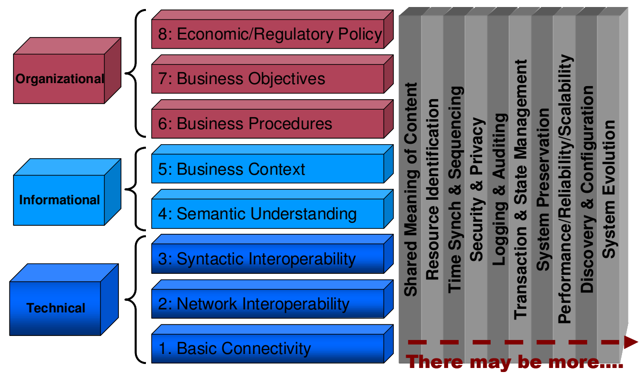

Figure 2: GWAC Stack

A key component of success ESB implementation is a well structured plan.

4. THE CURRENT STATE

There are two popular data models currently in use by utilities are the Common Information Model (CIM) and MultiSpeak. Traditionally, MultiSpeak has been most popular within rural electric cooperatives, while investor owned utilizes (IOUs) have generally chosen the CIM. CIM, which is maintained by Technical Committee 57 (TC57) of the International Electrotechnical Commission (IEC), encompasses both IEC61968-9 and IEC61968-13). MultiSpeak definitions and reference material can be found at (www.multispeak.org). A good introduction to the CIM can be found in *The Common Information Model for Distribution: An Introduction to the CIM for Integrating Distribution Applications and Systems* [2], along with a brief comparison to MultiSpeak. Version 4 of Multispeak (V4) promises to make harmonization of the CIM and MultiSpeak models an easier task [4]: this is in support of a longer range industry goal of harmonizing and possibly unifying the CIM and MultiSpeak models.

In 2010, EPRI and Gartner Group issued a joint survey on integration technology to the industry,144 responded about their use of CIM, including 49 utilities. Figure 3 provides an overview of the adoption rate of CIM amongst the 144 responding utilities [5]. It is important to note that a large number of utilities are currently investigating CIM standards. The utility interests in CIM is likely due to the recognition that with the Smart Grid, cost effective maintenance and upgrades becomes a challenge in the absence of an ESB that leverages standards based integration: this is reflected in a table that identifies the drivers for implementing CIM, as depicted in Figure 4.

In summary, with the advent of the smart grid, legacy point to point and even EAI based hub and spoke architecture can no longer be sustained. By adopting an integration standard, such as CIM, in conjunction with an ESB, a utility can better leverage vendor provided integration adaptors to remain current on the software release versions and lower the total cost of ownership. While widely accepted in other industries, particularly financial markets, use of ESB technologies is emerging for utilities. Analogous to CIM, the financial services industry has realized the benefit of standards based integration through the Banking Industry Architecture Network (BIAN) [6]. Ahead of utilities in the adoption of ESB, the financial services industry has acknowledged that ESB enablement alone is offers benefit but that standards based integration, through BIAN, makes the business case for SOA even more compelling. Market research indicates that the SOA market is valued between $9 and $52 billion annually, and that at least 77% of business will have an SOA initiative underway by 2012 [5]. Even if these predictions are overly optimistic, these forecasts attest to how SOA enablement will transform the paradigm with which utilities perform integration.

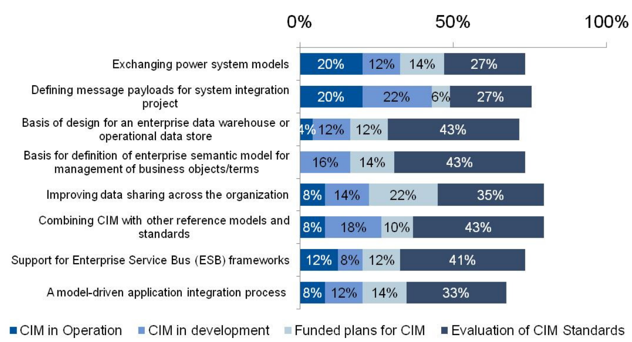

Figure 3: CIM Adoption Rates [5]

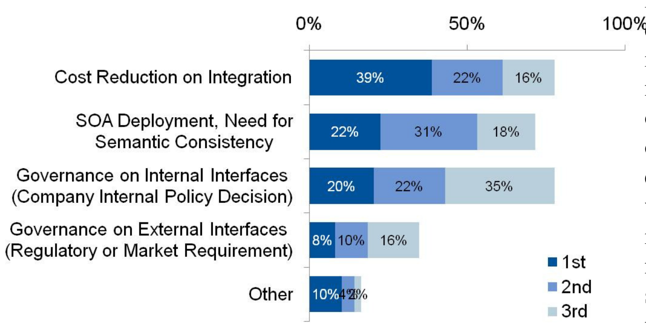

Figure 4: CIM Drivers [5]

5. PLANNING

A key component of success ESB implementation is a well structured plan. Preliminary planning activities should include [7]:

- Staffing – Architecture roles should be defined;
- Syntax and semantic model definition – CIM provides a set of preferred integration patterns, even a simple convention can have a huge impact on implementation and maintenance costs and risks;
- Survey of existing interfaces and touch points – it is essential to understand existing integration;
- Authority – mandate that all suitable integration is performed in adherence to standards, e.g. ESB and common data pattern such as CIM; and
- Realistic expectations – identifying a high impact, low technical risk integration point for the initial deployment, often this is performed over the course of a new system implementation or upgrade of an existing one.

There are two key architecture roles needed when implementing SOA in an organization- the enterprise architect, and solution architect.

The enterprise architect role is concerned with defined standards:

- Define semantic model and maintain repository;
- Define and recommend design patterns;
- SOA Product selection, strategy for use;
- Infrastructure, non functional requirements; and
- Oversight and approval of integration solutions.

The solution architect applies standards to specific projects:

- Defining integration points and requirements;
- Selection of patterns; and
- Message definition and xml schemas.

It is important to recognize that certain types of integration aren't suited to be placed on the ESB. For example, massive blocks of data, especially when they will not be consumed by more than one application, should not be implemented using the service bus. Another example is nightly, or other periodic exports of meter interval data, only transmitted from AMI to an MDM. For a system with only a million meters, daily interval data could easily exceed 100M records: this would consume the service bus with the record volume, when it is a true point to point interface, and no expected future applications exist. This is not to say that interval meter data has no place on the service bus. Consider a customer facing web portal, which needs to display interval usage data. In this situation, a service that retrieves a limited amount of data per customer is an ideal candidate for the service bus.

GIS updates and downloads of data are always problematic. A CIM message exists for model exchange in RDF format. This message has proved difficult to implement for near-real-time application. Alternative technologies, such as protocol buffers have been suggested. The limitation in these cases is often at the application or database level – basically being unable to process such large files in a real time context. For the time being, data might be more efficiently presented via database queries.

With a consistent method of integrating business systems, a utility can make consistent decisions on where to implement business logic. It is necessary for the utility to consider if any business logic will be maintained within the service bus. Some ESBs embrace this concept, providing suites of tools geared for business process management, while others provide only a communication backbone approach. Whichever approach is right for the specific utility, the core capabilities of your ESB should be understood, standards and guidelines developed and adhered to.
Adaptors and flow control are not intended to contain business logic, but they often do, because it is usually much quicker and easier to implement that changing an existing application. An example is outage restoration callbacks - during normal processing when everything works smoothly: customers are contacted in a timely fashion, and confirm their current power status. However, in a major storm event, there may be a delay in recording switching operations. Customers would be notified several hours after their power is restored, if no provision exists to disable callbacks. In this case, adaptor / flow logic could be added to check the restoration time against the current time, and if the delta is too great, not pass the callback request along to the call system, perhaps even logging it to a database instead.

5. CONCLUSION

The cornerstone of the smart grid is getting accurate information in a timely manner, consequently enabling real-time management of the distribution infrastructure. Integrating various operation technology and information technology systems into a continuous flow enables not only cost-effective infrastructure, but also minimizes sub-optimal conditions associated with information delays. Bottlenecks can lead to duplication of effort, redundant data, and the inability to make effective decisions about system operations and planning. All of these factors can lead to an increased cost.

A successful integration between the operational technologies and information technologies can only be sustained through the use of an enterprise serviced bus enabled through the use of standards. While the CIM model is in a similar state of evolution to the smart grid, the CIM model currently provides utilities with the most cost effective means of growing its integration infrastructure. As the vendor community adopts the CIM model at a greater pace, utilities will find further benefit from the use of standards based integration.

The first step of the journey towards standards based integration is selection of the most suitable ESB. Once the ESB is selected, the transformation is only starting. The utility should work with experienced resources to ensure that the product is architected and configured to meet their needs. When developing the adaptors and messages, adherence to a standard such as CIM will greatly assist in reducing the maintenance and upgrade burdens, as well as, reducing the total cost of ownership of the solution.

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