Integrating GIS and AMR to Increase Enterprise Benefits

Geospatial information systems (GIS) and automated meter reading (AMR) are two of a power distribution utility's largest IT investments, but most utilities plan, design, implement and integrate the two technologies into the utility enterprise independently: GIS to provide asset and customer location data and AMR to provide timely customer usage data. There is, however, a growing realization within utility IT departments that they can achieve considerable business benefits by better integrating IT systems such as GIS and AMR, as well as other systems like mobile workforce management and outage management.

In the past, it was acceptable to have separate systems with limited interactions to the rest of the IT suite, but the potential of a utility's individual legacy systems are not maximized when they are employed in isolation. Most utilities have realized this and developed some degree of point-to-point connectivity across the organization. Connections and dependencies are added on an as-needed or impromptu basis, leading to a jumbled, difficult-to-maintain architecture. The data that drives these systems is maintained separately and may be extracted multiple times for use by separate systems, leading to inefficiencies and data corruption.

An enterprise-level look at integration is needed to truly unlock the potential of utility IT systems working together in a coordinated fashion.

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Enterprise Integration

The ultimate goal of "enterprise integration" is to provide an accurate and seamless information exchange between different systems. A GIS normally provides asset and customer location data; AMR provides timely customer usage data. One potential synergy in combining information from these two systems is that the load on distribution components can be analyzed for reliability and maintenance purposes, and a field inspection/maintenance program can be built around that same information along with asset location data.

Enterprise integration is an evolving field composed of several major elements, including enterprise application integration (EAI), business process integration (BPI) and enterprise information integration (EII). When utilities think of enterprise integration, they typically look at an EAI suite or framework to enable business process optimization. EAI usually uses middleware to integrate the application programs, databases and legacy systems involved in a utility's critical business processes.

While the benefits of enterprise integration are great and a business case can usually substantiate a sizeable return on investment (ROI), there are significant technical challenges to implementing enterprise integration in a utility IT environment:

- Legacy systems are "silos" and "islands" and often are not readily adaptable to an integration framework.
- Information residing in systems can be proprietary, hard to get to and not designed for sharing to external applications or systems.
- Migrating or consolidating data from old systems to new can be complicated and time-consuming.
- Organizational change issues are large as multiple silos are broken down and business processes optimized.

Studies have shown that as many as 80 percent of IT projects fail to meet technical, cost or schedule objectives. Given their complexity and multiple touch points across the organization, enterprise integration projects are especially susceptible to failure unless the project team employs strong project management, excellent system engineering, detailed enterprise planning and executive level buy-in.

Integration Framework

Enterprise application integration is related to middleware technologies such as message-oriented middleware (MOM), and data representation technologies such as XML. Newer EAI technologies use web services as a means of integration.

The current state of the art recognizes that an enterprise service bus (ESB) approach that connects previously "stovepiped" systems together is the strongest EAI methodology. Although other approaches, such as connecting at the database or user-interface level, have been tried, the ESB approach has generally proved itself to be the most successful in the utility industry.

Figure 1 illustrates the non-enterprise integration method of point-to-point or ad-hoc connectivity between systems. Each of the interface lines in Figure 1 could represent an interface sharing one data point, or perhaps dozens. As additional systems are added, the

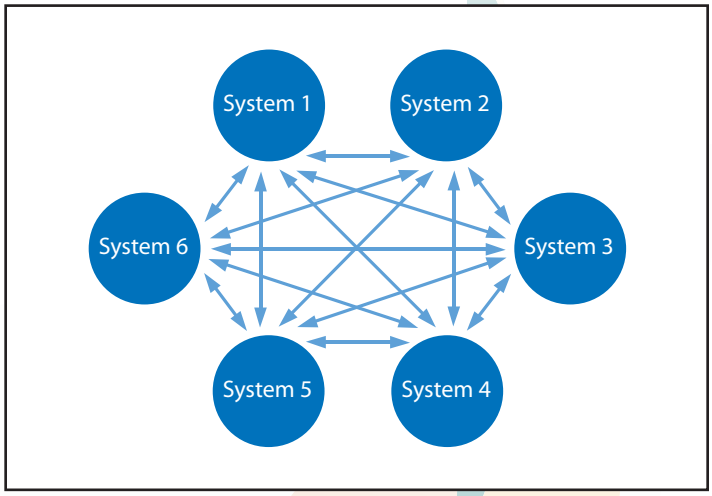

Figure 1. Point-to-point connectivity between systems.

number of unique interfaces grows by the formula n(n-1)/2 in a fully connected system. The connectivity model quickly degrades to a complicated and unwieldy clutter, and the cost to add on and maintain the system rises as the complexity increases.

An ESB approach on the other hand, is conceptually elegant, as shown in Figure 2. Individual applications in an ESB arrangement publish messages to the bus and subscribe to receive certain messages from the bus. Each application requires only one connection to the bus, which makes this approach very scalable and extensible. It is important to note that in an optimized integration structure, not every single transaction between systems has to occur through the ESB. There may be valid reasons or interface characteristics, such as a high volume and unidirectional data stream, that are best served by a dedicated point-to-point link.

EAI benefits both maintenance of the IT suite, and its initial construction. Studies have shown that EAI reduces the cost of new interfaces by much as 50 percent and the cost of maintaining those interfaces by a whopping 80 percent. Implementing an ESB solution not only maximizes the benefits of previously "stovepiped" systems, it also improves IT budgets and resources throughout the product lifecycle.

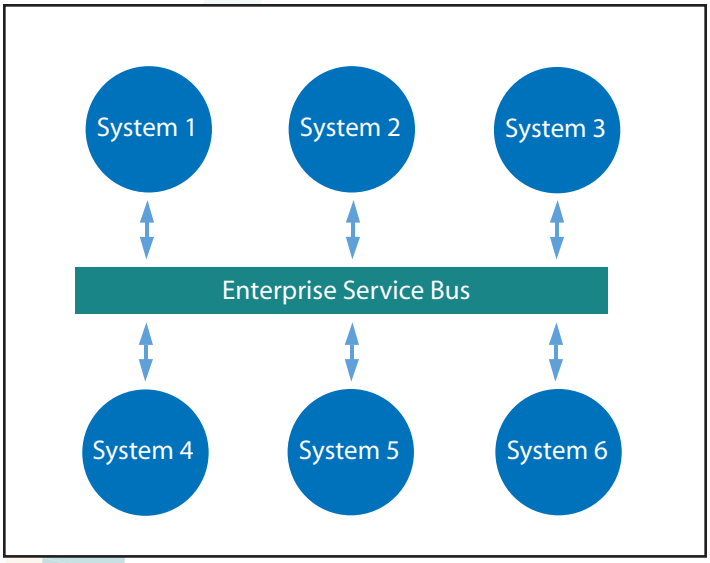

Figure 2. Enterprise service bus connectivity between systems.

Finally, by providing a stable integration environment, an ESB solution can reduce the implementation cost and risk of future systems. Together with a set of "messages" which have the propensity to easily add value to any future systems being considered, ESB can in turn improve the business case for those systems.

GIS and AMR systems are two of a utility's largest IT investments and each provides tremendous benefit. If properly integrated, however, they have the potential to unleash even greater payback.

GIS-AMR Integration

GIS and AMR benefits are traditionally viewed within the "silo" mindset. For example, an AMR business case typically looks at impacts to meter reading operations, such as increasing the accuracy and number of physical meters read per billing cycle, reducing the total cost to read a meter, and reducing the probability of field injuries. These are important benefits that can be quantified to justify an ROI on that one system alone. However, combining AMR-generated data with GIS data opens a new world for improving asset effectiveness, operational efficiency and customer service.

To visualize how utilities can use enterprise integration to unlock further return from their GIS and AMR investments, picture the possibilities of having data that is normally inherent in one system, freely available to be combined with data in any other system. For instance, asset management is traditionally viewed as the purview of GIS systems. Combining that asset data with usage data from an AMR system unlocks an entirely new dimension–i.e. time–to understand distribution component characteristics.

Looking from an AMR-centric view, adding geospatial information opens new possibilities related to mapping usage by customer premises and identifying the spatial properties of meters and meter usage, such as the locations of meters that exhibit abnormal performance, mapping tampering frequency to target protection efforts, mapping meter outages with time components, etc.

The potential benefits of well-integrated GIS and AMR systems can affect every utility business operation in a positive way. Consider an effective integration with an outage management system (OMS). AMR, integrated in near real-time with an OMS, can provide outage notifications and on-demand outage verifications. Once the OMS identifies the likely isolating device, the GIS provides the asset location data, device history, and existing field notes. The GIS also provides location details so the nearest crew can be dispatched through a mobile workforce management system. AMR then provides a restoration notification, and an operator can perform an on-demand restoration verification by pinging a meter. The net result for a utility is an efficient and effective outage identification and restoration process that improves performance indices.

Another example of well-integrated systems improving utility operations is integration with a customer information system (CIS). By integrating AMR data with the CIS, a customer service representative has access to a customer meter read history in small time increments, usually daily for most meters and hourly for demand meters. The customer service representative can ping a meter to verify a problem and initiate a work order that is sent to a nearby crew via a mobile workforce management system. The crew can quickly examine the distribution system in the area using a mobile GIS application. Customer problems are thus taken care of quickly and efficiently.

A third example of the benefits of integrating GIS and AMR is the mapping of asset operations based on usage data from the AMR. Analyses and maps can be generated to show stressed areas of a T&D system to target for upgrades, hereby effectively targeting investment to poorly performing areas. Better load research, rate design and demand response results in reduced capacity requirements and improved capacity utilization. Many utilities today use a GIS–or data extracted from a GIS–as the input to external distribution planning systems. However, the data is typically "design" time data based on static, aged, or estimated information regarding the load on a network. Integration with an AMR can provide near real-time results on the state of devices and corresponding load, improving not only the current performance of assets but also future predictive analysis. Overall system performance is enhanced in the most cost effective manner.

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Summary

Using the enterprise service bus approach to utility IT system integration unlocks the potential of the entire legacy suite of utility products and applications, enabling a leap forward in capability and efficiency. Not only are substantial business benefits unleashed, the cost of building and maintaining interfaces between existing and new systems is cut in half or more. Before investing in more "silos" of functionality, utilities would be wise to investigate the potential ROI of employing an EAI architecture to their enterprise.

About the Authors

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