Enhancing Outage Management with AMI*

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With the advent of advanced metering infrastructure (AMI) and its associated near real-time meter information, many utilities are examining how that information can enhance their outage management systems (OMS). Interfacing AMI systems more effectively with other utility IT systems in general is the next logical step after the core AMI benefits of improved meter reading and billing are achieved.

Outage management systems use customer outage reports, knowledge of distribution system infrastructure, and predictive algorithms to determine where a failure has occurred in the network. An OMS process has two principal stages: outage detection/analysis and outage restoration. AMI systems can help significantly in both stages to reduce a utility's System Average Interruption Duration Index (SAIDI). Using the power of near-real time information has improved electrical utilities' SAIDI by an average of four to six minutes through faster and more accurate response.

OUTAGE DETECTION AND ANALYSIS

Service outages are one of the most critical and stressful business events for a utility. Catastrophic outages caused by severe weather seem to routine nowadays. A utility's OMS is the key line of defense and typically interfaces with a customer information system (CIS) and/or an interactive voice response (IVR) system for trouble reports. To be effective, an OMS needs as little as 15 percent of affected customers to call in. It is in this reliance on customer phone calls where integrating with an AMI system can have significant benefits.

Most of the advanced meters used in AMI systems have a "last gasp" capability. This last gasp is a high-priority message transmitted by a meter when electrical service is out. The meter has a battery or capacitor which provides power to the meter for a few minutes. Providing this information to an OMS can dramatically improve outage notification times — as much as 60 minutes for one utility.

There are limitations, however, to the last gasp functionality. A large outage can overwhelm an AMI system with last gasp messages because of message collisions in the communication network and prevent the notification from being received in the AMI software before the capacitor or battery power on the meter is consumed. This message collision and bandwidth limitation can block as much as 80 percent of last gasp messages in a large system. Another consideration is that the outage may affect power to the AMI communication backhaul as well, limiting the data that can get through. As stated previously, however, OMS systems can function well with as little as 15 percent of outages reported, hence AMI last gasp functionality is still an ideal input to the OMS outage detection process.

Another element of the outage detection/analysis process is avoiding trouble calls. As many as 75 percent of calls are single-service outages.

With AMI, an operator can perform an on-demand read to verify if the premise is energized. In the current generation of AMI systems with two-way communication capability, an operator can "ping" a meter as well. The verification speed depends on many variables but is usually near-real time, not instantaneous. Even if the customer cannot be given instant verification of the outage, the

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*Published in February 2008 issue of Utility Automation & Engineering T&D.

system can responds before the time and expense of a crew dispatch. Exelon was able to cancel more than 1,200 trouble calls during a single thunderstorm event near Philadelphia in 2006 by using its AMI system.

The capability of pinging meters can also improve the efficiency of the entire business process that a utility uses for outage analysis. A sophisticated utility can use its distribution map to verify power around sectionalizers and other fault isolators to give the OMS stronger confidence in pinpointing a failed device or line.

Some AMI systems can provide meter performance and status information to operators in a graphical manner. Further integration with a mobile workforce management system enables these representations to be pushed out on maps to service crews. These same capabilities can be utilized in the restoration process.

OUTAGE RESTORATION

Confirmation of outage restoration is another significant benefit that AMI systems bring to the outage management process. By providing positive verification through on-demand reads of meters or pinging, confidence is achieved that the outage is closed before restoration crews leave the vicinity. Efficiency is increased an SAIDI times reduced, particularly when there exists a nested outage which previously led to crews being sent out multiple times. This is another integration point that can benefit from some level of automation, for instance by having the system automatically ping meters when crews report the work is done, either through a mobile workforce management system or dispatcher notification.

Customer satisfaction is increased through several factors, including minimizing customer re-calls, providing near real-time outage information, and eliminating the need to phone a customer to verify restoration. In addition, some utilities, such as Wisconsin Public Service, have stated that eliminating the call back to customers reduced the load and stress on operational personnel who performed that function while dispatching orders and working with crews. All together, these efficiency gains can total 15 percent or more.

A note of caution when integrating AMI and OMS. It is important to take system loading and bandwidth into consideration when architecting these interfaces. It is possible to overwhelm an AMI system's two-way communications capability or force data too quickly into an OMS. Mechanisms to throttle load and operator training are vital for smooth operations.

IT ENTERPRISE INTEGRATION

AMI is the newcomer to the utility IT suite, and the first implementation goal of AMI was to provide the expected benefits in the meter reading area, including more accurate data, interval data access and labor savings. Now that these core benefits are being realized, leading utilities are looking to unlock the benefits of integrating AMI with the rest of the utility IT suite. Most utilities already integrate their OMS with geographic information systems (GIS), mobile workforce management, CIS, SCADA, and others.

From an It point of view, AMI is just another interface. The old way of doing things would entail extracting data needed, creating a custom channel, or making new applications to share information. Without using a strategic, structured approach to enterprise integration, most utilities have developed these point-to-point connections across the organization. Connections and dependencies are added on an as-needed or impromptu basis, leading to a jumbled and 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 increased possibilities of data corruption. As the number of systems grow, the architecture becomes increasingly complex, unwieldy and inefficient. The trend today is to move to systems that work in a structured enterprise integration framework.

The ultimate goal of enterprise integration is to provide an accurate information exchange between different systems such that the integration appears seamless and that information residing in any one system can be leveraged by other systems, thereby optimizing business processes. When utilities think of enterprise integration, they typically look at an enterprise application integration (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.

The current state of the art recognizes that an enterprise service bus (ESB) approach that connects previously "stove piped" systems together is the strongest EAI methodology. Although other approaches such as connecting at the database or user-interface level have been tried, generally, the ESB approach has proved the most successful in the utility industry. An ESB approach to integrate OMS and AMI as well as other enterprise systems is shown in Figure 1.

Individual applications in an ESB arrangement publish messages to the bus and subscribe to receive certain messages from the bus. Each application only requires one connection to the bus, making the message bus 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 high volume and unidirectional data stream, that are best served by a dedicated point-to-point link. Studies have shown that EAI reduces the cost of new interfaces by as much as 50 percent and the cost of maintaining that interface by up to 80 percent.

An ESB also unlocks other business integration benefits of AMI by the ease of new interfaces to other applications. For instance, asset management is traditionally viewed as the purview of GIS. Combining that asset data with usage data from an AMI system unlocks an entirely new dimension, i.e. time, to understand distribution component characteristics. Another example is that adding geospatial information opens a new universe of 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.

An ESB solution can reduce the implementation cost and risk of future systems by providing a stable, known environment for integration. 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.

Meter data management systems (MDMS) from an integral part of many AMI implementations. MDMS helps the utility process and manage meter operations data as well as meter read data. MDMS provides a single repository for this data with a variety of analysis capabilities to facilitate the integration with other utility information systems. For utilities with MDMS, the interface of AMI to the rest of the utility suite will probably occur through MDMS, and the AMI/MDMS interface will occur outside the ESB.

BUSINESS PROCESS INTEGRATION

Of equal importance to IT integration is how utilities change their internal business processes to handle outages by utilizing AMI capabilities and data. The ESB approach allows ease of creating and maintaining interfaces, by t what messages are needed and sequence of actions across the enterprise is also vital.

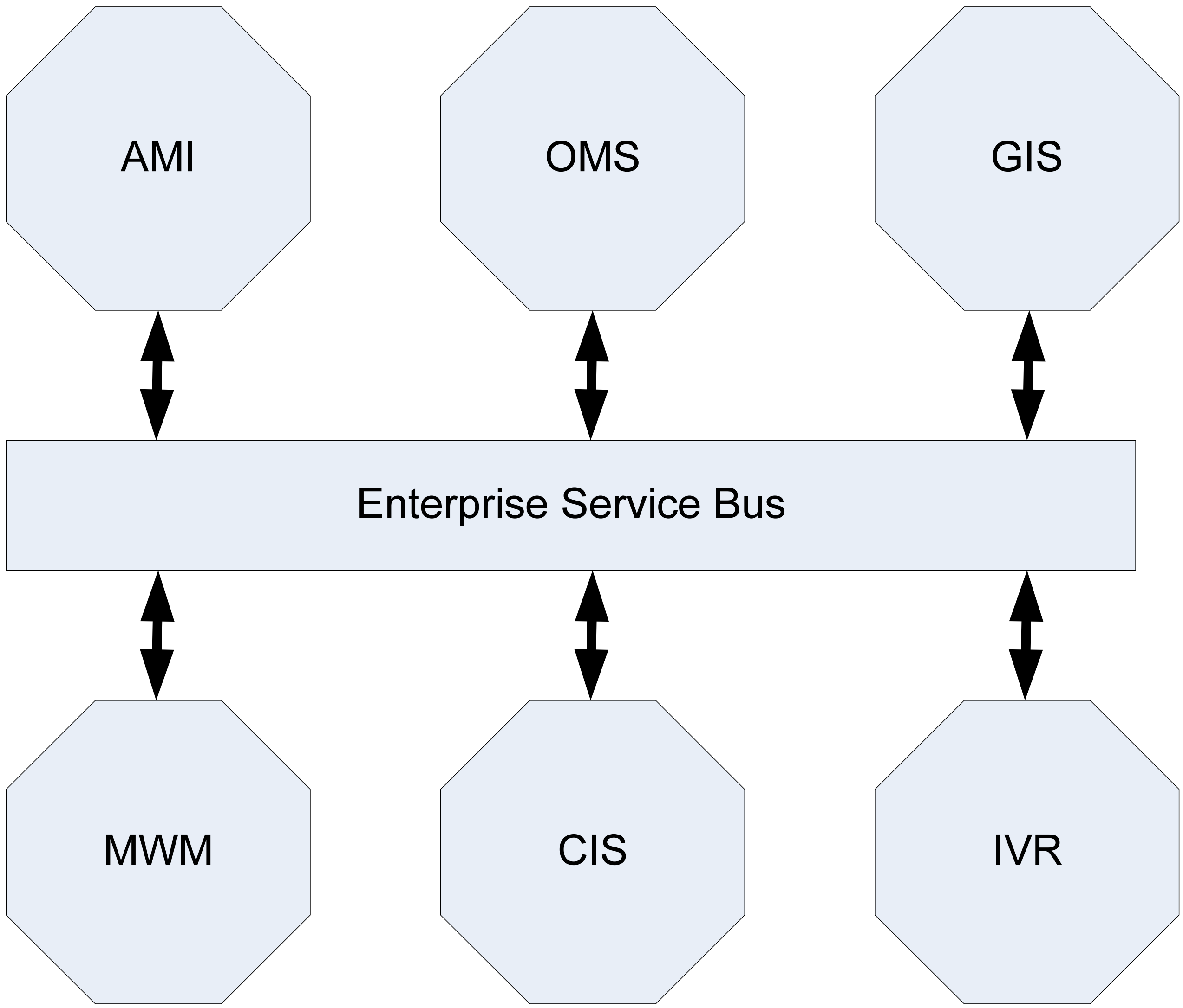

Figure 1. Enterprise Service Bus Approach

Various degrees of automation and sophistication can be employed during the outage detection/analysis process and restoration process. While the human in the loop may never be totally replaced, the workload and efficiency of the process can be greatly improved. As part of the architecture design process, all affected stakeholders in the outage management process should have input on how to incorporate the new capability of the AMI system. While there are certainly best practices in using AMI to assist with outage detection and restoration, unique regulatory, customer, or internal constraints may necessitate modifications.

ARCHITECTING AMI AND OMS INTERACTION

With the advent of AMI and its associated near real-time meter information, the outage management process can be greatly enhanced. While AMI systems with two-way meter communications or on-demand reads can enhance OMS systems, they can't truly replace those systems except in the most limited circumstances. The last gasp messages from affected meters can be very effective OMS input, and the capability to read meters remotely or ping them is of great use in the restoration process. The great synergies possible by properly architecting the AMI and OMS interactions and interfaces through a structured enterprise integration framework can leverage the power of both systems to improve utility outage performance indices and the outage management process in general.

About the author

James Ketchledge, PMP, is the director of project management at Enspiria Solutions, where he manages the project management office and directly leads AMI implementation and integration projects. He has 22 years of systems/software engineering and 11 years of project management experience. He holds masters and bachelors degrees in electrical engineering.

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