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AMR Improves **Outage Management**

PECO OMS integration provides operation and maintenance savings, shorter outages and more satisfied customers.

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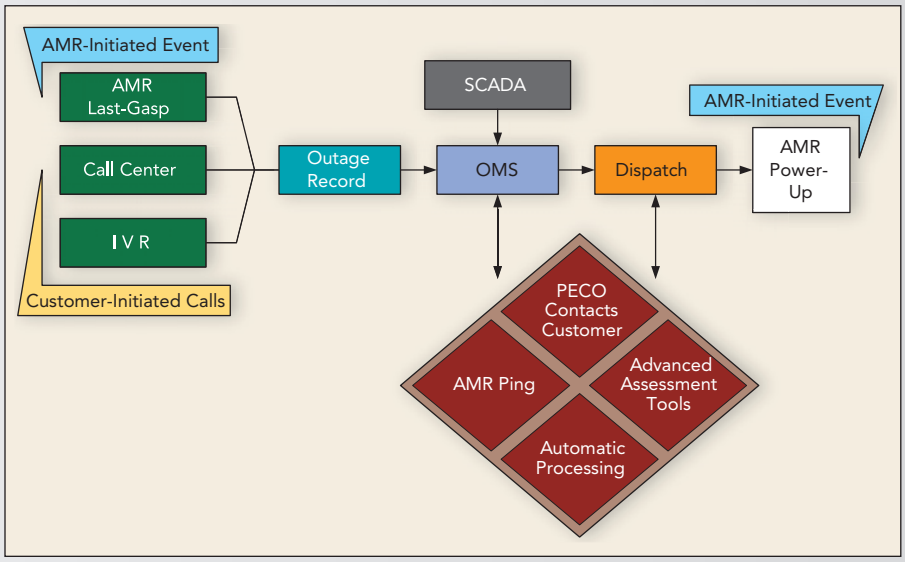
OUTAGE MANAGEMENT IS TYPICALLY NOT ONE OF THE FIRST CONSIDERATIONS in a utility's selection of automated meter reading (AMR) technology. The primary drivers for a utility's AMR investments are billing improvements and revenue management. Yet, AMR systems offer significant outage management benefits that can result in utility cost savings and enhanced customer satisfaction. Several utilities, such as PECO, an Exelon Company (Philadelphia, Pennsylvania, U.S.), are tapping into these benefits through an integration of outage management and AMR. The integration of AMR data into outage management system (OMS) business processes offers utilities like PECO several benefits:

- Increased crew and dispatch productivity
- Reduced outage durations
- Enhanced customer satisfaction and better customer perception
- Improved planning and engineering.

Let's explore the AMR OMS benefits, with real benefits documented from PECO's own experiences.

After a severe band of thunderstorms passed through southeast Pennsylvania and knocked out service to more than 400,000 customers, PECO operations personnel worked around the clock to repair the distribution network and restore electric service. PECO's AMR system helped ensure that the crews were dispatched to actual outage jobs.

PECO'S OUTAGE MANAGEMENT PROCESS



PECO's outage management process begins with either a customer call, a last-gasp from a meter or a message from the Interactive Voice Response system. An Outage record is created and is sent to the OMS system. SCADA Events are sent directly to the OMS system. A dispatcher reviews the outage record and assigns it to an appropriate crew. When power is restored, the event is closed and validated with the power-up message from the meter.

More effective repair crew utilization is the OMS goal.

ROADMAP TO DAY-2 BENEFITS

When PECO began deploying its Cellnet Fixed RF network AMR system in 1999, the utility based its decision on hard AMR benefits including reduced meter-reading costs, reduced estimated bills, more accurate meter readings and improved customer service. PECO recognized the potential benefits of using AMR data to improve outage management, but the utility could not quantify the economic savings and performance enhancements at the time. The development and implementation of these "soft" benefits were deferred and labeled "Day-2 Benefits."

As AMR deployment was nearing completion in late 2003, PECO began exploring sources of additional benefit and savings from its AMR system. One of the most attractive areas was outage management. PECO began its OMS integration initiative, which was to provide the ability to remotely identify customer power status, to process outage messages and to provide restoration verification via the AMR network.

PECO also established two specific goals. The first goal was to set a target of US$400,000 of annual operation and maintenance (O&M) savings in avoided costs from reduced overtime and outside contractor requirements through better outage event management. The second goal was to reduce the customer average interruption duration index (CAIDI) by 2 to 4 minutes through improved event analysis, including nested outage recognition.

PECO took a deliberate approach in integrating AMR capabilities into its outage management process and its Intergraph InService OMS system. After the deployment of the Cellnet AMR system, the utility had several years to adapt to the AMR system. It gained an understanding of the AMR data and how to integrate it into its business processes.

In 2003, PECO initiated the AMR OMS integration by performing a thorough analysis of the AMR data. PECO's Cellnet system is based on a hybrid network topology and offers push, pull and polling outage management notification (see "How Does AMR System Functionality Impact Outage Management?").

The second phase was to build an on-demand request application to use the AMR system for determining power status at an electric meter. This application was deployed in early 2004 and was followed by the development of more sophisticated tools to process batches of requests (pings) and several tools for manually assessing outages. These tools included a transformer analysis application and a circuit analysis application.

Once the tools were accepted by the operations dispatch center, the next phase was to automate the tools. This phase, labeled "Reactive Automation" (RA) because the tools were designed to react to trouble calls made to PECO, occurred during mid-2004. Every 20 minutes, all single customer no-light calls that are not otherwise assessed are automatically pinged by the RA tool to evaluate their validity and, if necessary, determine the full extent of the outage.

The "Last-Gasp Outage Notification" phase was implemented next, in late 2004. An application was developed to

receive, process, filter and deliver the last-gasp outage notification messages to PECO's OMS. The outage notification application has been demonstrated to reduce the outage assessment time by delivering more timely and more accurate outage messages from the affected area.

The final phase was conducted in 2005 to leverage the power-up restoration messages. This was accomplished by developing several reports that highlight discrepancies between the field crew's reported power-on time and the time reported by the AMR meters. The power-on report is automatically generated each morning and sent to operations personnel for review and analysis. When justified, corrections are entered into the OMS system to reflect the actual power-on time, thus defining CAIDI.

CREW AND DISPATCH PRODUCTIVITY

About 70% to 75% of typical outage reports are related to single-service outages, and nearly one-third of them are customer problems (not a utility outage) that do not require troubleman trips. Using AMR to verify a customer-reported outage by querying the customer meter may save an hour or more of unnecessary crew time for each avoided trip.

There may be even greater benefits of the AMR service-restoration-verification function, particularly in storm situations where nested outages are common. When AMR enables the utility to recognize whose power is still out, crew drive time is saved because they know that more problems need to be repaired before they leave the area. Overall, storm outage-restoration time is reduced by recognizing the nested outages early.

HOW DOES AMR SYSTEM FUNCTIONALITY IMPACT OUTAGE MANAGEMENT?

The extent that an AMR system can support outage management is largely a function of the underlying communications technology and network topology. It also depends on the degree of system and process integration between AMR and a utility's existing outage management and customer information systems and practices.

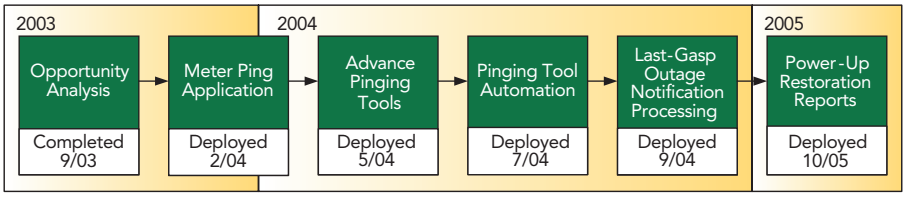
Fixed-network AMR systems rely on pervasive communications networks to perform centralized AMR. Fixed-network AMR systems can be either wired (phone, power-line carrier (PLC), fiber or CATV) or wireless (public or private terrestrial RF and satellite), with the majority being PLC and RF. Typical network topologies for fixed-network AMR systems are hierarchical and peer-to-peer (or mesh). A new generation of hybrid networks has hit the market, which combines both peer-to-peer and hierarchical network elements.

The current generation of AMR systems provides additional outage information to a utility's OMS through one or more of the following techniques: push, pull and poll. The table below shows the impact of the AMR communications technology and network topology on an AMR system's ability to improve outage management.

Communications and Topology Considerations

Outage Information from AMR	Communications Technology Considerations	Network Topology Considerations	Other Considerations
Push: This is the real-time notification of an outage or restoration (called last-gasp on loss of power)	Requires a communications channel that persists through an outage	Hierarchical systems typically perform better than peer-to-peer systems because of the single communications path from meter to concentrator	Must be accompanied by some form of outage filtering (for example, momentary, bell weathers and throughput throttling) Reliability of event communication tends to degrade proportionally to the size of the outage
Pull: This is on-demand, or ad-hoc, querying of one or more specific meters	Requires either two-way communications to the meter, or two-way communication to the concentrator that is in direct one-way communications with the meter in question.	Peer-to-peer networks are two-way The number of mesh layers may result in lower reliability than that of hierarchical networks Hierarchical networks Full two-way networks with sufficient battery carry-over should provide reasonable reliability and low latency of pull outage information One-way communications may not provide very accurate pull outage information	Communications persistence and latency of the on-demand query and response are of significant importance
Poll: This is an automated pull that queries, on a periodic or continual basis, the energized status of specific or total populations of meters	Requires two-way communications to the meter Favors systems that are poll response (that is, the metering devices cannot initiate communications without first being spoken to)	Refer to "pull" considerations above	Polling can be focused within suspected outage areas and rapidly provide results of which meters are energized and which ones are not

PECO has exceeded its goal of realizing $400,000 annually in O&M savings. The RA tools alone have resulted in more than $1 million in savings to date via avoided crew dispatches and more effective outage analysis. In 2005, PECO evaluated more than 31,000 single customer outages with the RA process. More than 7500 of those outages were cancelled because the meter indicated that power was on. More than 2750 outage reports were escalated into primary events. This equates to more effective dispatch for more than 10,000 jobs.



PECO's AMR OMS project, split into several phases, started in the summer of 2003 and concluded in the fall of 2005.

Additional benefits have been realized during post-storm critiques when the AMR-reported restoration times are compared to the field-reported times. In many cases, such comparisons have led to significant reductions in the overall recordable outage duration for an event. PECO currently uses a similar tool daily to ensure that all outage restoration times are accurately reported. When corrections are needed, they are communicated to the field forces. The end result has been more accurate reported restoration times by the field forces.

REDUCED OUTAGE DURATION

All of the benefits discussed previously—improved outage detection, better event analysis, improved restoration detection and improved crew efficiencies—yield not only O&M cost savings, but they also improve utility reliability indices by reducing customer outage duration times. And AMR systems offer additional potential for cutting crew response times through integration to utility mobile systems. GPS-enabled AMR meters can provide accurate locations and directions to crews via mobile devices.

PECO has exceeded its goal of realizing 2 to 4 minutes in reduced system CAIDI. The last-gasp outage notification has resulted in between 1½ to 2 minutes of CAIDI savings by causing the OMS system to identify outages more quickly. Power-up restoration messages have led to a 3½-minute reduction in CAIDI via more accurate power restoration time reporting.

PECO found that only about 20% to 40% of customers who experienced an outage actually reported it to PECO. Many assumed their neighbor would make the call. The automatic last-gasp message generated by PECO's AMR system shaves time off outage durations by reducing the amount of time required to identify the true extent of an outage. Analysis times for typical fuse and transformer outages have been reduced by more than 15 minutes.

PECO's power-up restoration messages have reduced outage durations by providing spot verification of customer outage restoration. The AMR system also has led to reductions in outage durations resulting from confirmation of actual outage-restoration time. The power-on report was successfully used to analyze all of PECO's storm days for 2005. The analysis was responsible for eliminating more than 4.5 million customer outage minutes that did not agree with the times reported by AMR.

CUSTOMER SATISFACTION

An important benefit of AMR OMS integration is enhanced customer satisfaction and improved customer perception. With AMR, the utility knows which customers have experienced an outage prior to the customer reporting the outage, even if they do not report the outage. Also, the utility can provide customers with more accurate estimates of when power will be restored. And, the utility does not need to disturb the customer to confirm service restoration. The utility will not mistakenly think that a customer's outage has been restored (for example, unsolved outages in storm situations where the utility may not know the status for hours or even days).

Such benefits are realized regularly at PECO. It is becoming more common that crews are dispatched and the power is restored before customers call in to report them. One notable example of this was when a school lost power on a Saturday morning. PECO recognized the outage, a crew was dispatched and the school manager was notified so that the crew could gain access to the building and restore power. Without the AMR notification, the outage would probably have gone unnoticed until Monday morning and classes would likely have had to have been cancelled.

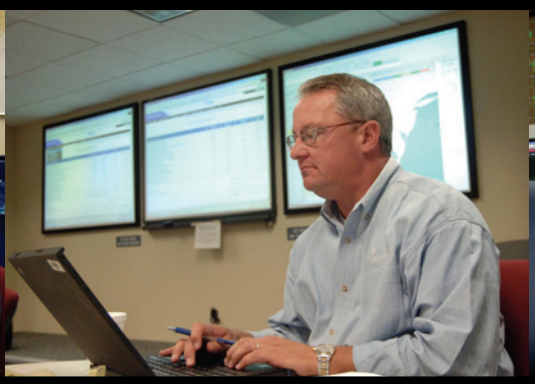
With the additional outage notification from AMR, the OMS system operates more efficiently, and more accurate information about the source is generated. This allows PECO to offer more information about the outage to customers calling PECO, including more accurate restoration time estimates. This ultimately results in improved customer satisfaction and increased confidence in the utility.

PLANNING AND ENGINEERING IMPACT

While less commonly recognized, AMR also brings engineering design and planning benefits that can significantly reduce capital expenditures. AMR systems are capable of generating a wealth of additional information on the routine operation of a distribution system. It is now possible to conduct feeder and transformer load analysis with AMR data. Daily meter-reading data is actively being incorporated into engineering models to better understand the day-to-day utilization and response of the electric distribution system.

PECO has begun to explore the use of AMR data for such purposes. Initial work is focused on building more accurate feeder load models to better understand circuit performance during heavy-use periods and how growth may be impacting the circuits. The AMR data will supplement the traditional load models to produce a more representative picture of the circuit loading. As these programs are implemented, it is expected that

AMR DELIVERS OUTAGE MANAGEMENT BENEFITS TO PECO


On July 18, 2006, a severe band of thunderstorms raced across the PECO territory in southeastern Pennsylvania. These storms caused power outages for nearly 400,000 customers. Using its AMR system, PECO was able to identify which customers had power and which required restoration.

During the restoration process, PECO was able to cancel more than 1200 single customer outage calls where there was power available at the premise. As the job was cancelled, a message was sent automatically to the customer informing them that power was available to their premise and to check their internal fuses/circuit breakers if they still had trouble.

The AMR system also helped to escalate more than 750 single customer outage calls into primary transformer events. By pinging the meters for customers who share the same transformer as the customer who reported the outage, PECO was able to distinguish between a single customer and a primary event. This process ensured that a properly equipped crew was sent to the job.

In several cases, feedback from the field crews indicated that they felt like they were working more effectively because they had very few assignments that were "OK on arrival." Susan Kennedy, operations center shift manager, said "AMR has definitely made dispatching more effective by filtering out the lights OK jobs." This helps maintain morale during extended outages.

The reliability team is actively in the process of reviewing the storm data to ensure that the field reported power on times match those indicated by the AMR system. It has been estimated that AMR has helped save nearly $200,000 in avoided labor costs during this storm alone.

several engineering areas, including capacity planning, design standards and asset management, will realize benefits.

GOOD BUSINESS SENSE

The integration of AMR systems with outage management offers significant benefits, resulting in utility cost savings and enhanced customer satisfaction. Utilities with existing AMR systems can leverage AMR for OMS improvements. For utilities looking to invest in AMR technologies, it makes good business sense to evaluate their ability to support outage management.

Learning from the PECO deployment will enable Exelon Energy Delivery to consider outage management benefits in future business cases for its other operating units. Furthermore, the concept of the staged deployment may not be necessary for future efforts because the benefits have already been proven and demonstrated. A future AMR deployment could start receiving outage management benefits as soon as a critical mass of meters are deployed in contiguous geographic areas. TDW

David Glenwright currently serves as manager, meter reading operations and strategies for Exelon Energy Delivery. In this role, he is responsible for operating the PECO AMR system and evaluating the use of new metering technology across Exelon. Glenwright joined Exelon in 1987, where he held various positions, most recently as director, supply management for InfraSource, an Exelon subsidiary. He holds a master's degree in business administration and a bachelor's degree in mechanical engineering from Drexel University.
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