Power System Engineering, Inc.

When is the Timing Right to Migrate from PLC to Wireless AMI?

By Power System Engineering, Inc. (PSE)

Assessing all the options, and considering new, enhanced customer programs, will enable the utility to make a well informed, confident decision regarding the future of AMI.

Introduction

A utility's decision to migrate to a wireless AMI system is dependent on numerous factors, including business objectives, customer expectations, and the ability to offer advanced customer programs and operational improvements. Whether transitioning from manual meter reading to a first generation AMI, or gradually migrating away from a PLC AMI, the change comes with high stakes and high costs. Prior to making the decision to migrate, a utility needs to fully understand the associated costs and benefits by completing a comprehensive business case that outlines all the options and opportunities available. Being prepared with this accurate information ensures a well-informed decision will be made, while getting the most out of the investment.

Benefits of a Wireless AMI Migration

The following describe some of the benefits in further detail.

1 Data Collection and Analysis

One of the key benefits of an AMI system is the ability to collect interval readings, in addition to a wide range of other data and analytics. The increased flow and availability of data allows a utility to present more information to its customers and employees, validate energy and cost saving programs, and gain an overall better understanding of the utility's system, assets, and energy consumption.

Wireless AMI systems are capable of providing flexible interval reads and reports that can be accessed several times a day to hourly, or for some customers, as often as every five minutes. Interval reads can be used for a multitude of purposes.

Other data collected includes kWh hourly readings, kW, voltage min/max, voltage profile, load profile, and alarms/events.

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Some new programs improve grid reliability while others focus on providing new services to customers.

2 Advanced New Services Over AMI

There are more opportunities to implement new programs and initiatives that benefit both the utility and the customer when greater amounts of customer usage data and analytics are available. Some new programs are designed to improve grid reliability, while others focus on enabling new services and capabilities for customers. Potential new programs to consider include:

Enhanced Demand Response (DR) Programs

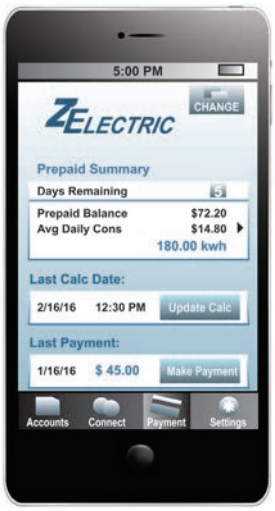
Many utilities dealing with aging load management technology have started to evaluate their technology replacement alternatives. In some situations, AMI may be the best alternative for demand response, but in other situations, other technologies may deliver the best economic benefits.

As with PLC, wireless AMI also delivers a solution for direct load control of air conditioners, water heaters, irrigation, and other applications. However, with the deployment of new meters with wireless AMI, pricing programs based on shifting demand, such as peak time rebate (PTR), critical peak pricing (CPP), and time-of-use (TOU) can also be introduced.

Accurate interval data and predictive modeling capabilities are a must in implementing successful DR programs. Whether or not the programs are beneficial depends heavily on wholesale rate structures, load shapes, cost, and useful life of the investment. Over the last couple of years, many G&Ts have introduced new wholesale rates with a higher demand component, opening up greater incentives for additional or new types of demand response.

Prepaid Metering

A prepaid metering program allows customers to pay in advance for power. It also provides balance notifications and the ability to pay remotely via multiple channels (website, IVR, cash stations, etc.).



A sample web app showing prepaid metering.

Implementing a prepaid metering program requires an AMI system, a disconnect/reconnect meter/module that integrates with the CIS, a means to notify and receive payment from customers (via the web, IVR, or cash stations), and the ability to show updated customer balances on the utility's website.

With a PLC or wireless AMI system, a utility can provide prepaid customers hourly interval data and updates through their website, typically within one to twelve hours. A meter data management system (MDMS) has the ability to notify customers via text or email when their account balance drops to a certain level. Because there are more frequent updates, this process is much faster with a wireless AMI system than it is with a PLC system. Of course, prepaid metering can be provided over PLC, but given that many utilities are migrating to wireless AMI in the near future, the cost of installing new PLC meters with disconnect switches for new subscribers may not be worth the investment.

3 Automated Remote Disconnect/ Reconnect

A wireless AMI system's ability to perform automated remote disconnects and reconnects provides many benefits. Staff time and labor costs are saved by eliminating truck rolls to perform manual disconnect/reconnects. Additionally, crew safety is improved by eliminating the need to confront upset customers, dogs, etc.

While a PLC system is also capable of performing automated disconnect/reconnects, there is a financial impact of investing in new meter/modules and disconnects for the aging PLC system. Similar to the prepaid metering example above, purchasing a significant number of new PLC meters needed to enable automated remote disconnects and reconnects doesn't make economic sense for such a short service life, assuming a near-future transition to wireless AMI. Rather, investing in these new meters at the same time as the new wireless AMI system is deployed allows a utility to target 15 years of service life—a much more sound investment.

4 Automated Outage Notifications (Last Gasp)

Wireless AMI outage notification capabilities have improved greatly over the last several years. Now, when power is lost, smart meters have the ability to automatically send outage notifications alerting the AMI master system and then the outage management system (OMS). The proactive process offers considerable value over the manual "pinging" process PLC systems use to verify outages.

Newer wireless AMI technologies are also able to distinguish momentary outages from sustained outages, though functionality in this area varies quite a bit by vendor. Additionally, automated notifications can be sent when power is restored. Sending more accurate and detailed restoration time estimates, as opposed to generic outage messages, ultimately provides better customer service.

In order to determine which AMI option is best, it is important to perform a cost/benefit analysis.

5 Improved Meter Reading Coverage

PLC AMI systems often experience harmonic issues that can impact meter reading coverage, including the inability to gather scheduled AMI interval readings (typically daily). Interference issues can range from a few misplaced intervals that take days to recover, to completely omitting a number of register meter reads altogether.

A wireless AMI system removes the harmonic issues as power lines are not part of the solution. However, wireless AMI does present its own set of coverage challenges that have to be carefully considered upfront and monitored post deployment.

6 Extended Life of Existing PLC System

Several utilities have found that **gradually** migrating to a new wireless AMI solution is their most viable option to avoid sunk costs and write-offs related to their existing PLC AMI system. During a gradual migration, working PLC meters are still used. Wireless AMI meters and modules are installed for new services such as prepaid metering or load management, some larger accounts (C&I), or when old meters fail.

Purchasing new meters and disconnect switches gradually as part of this migration, the utility can benefit from the expected longer, 15-year lifecycle of the new wireless system while simultaneously getting the most out of the old PLC system. Of course, the exact economic outcome of this approach varies greatly by utility.

Wireless AMI Technology Alternatives

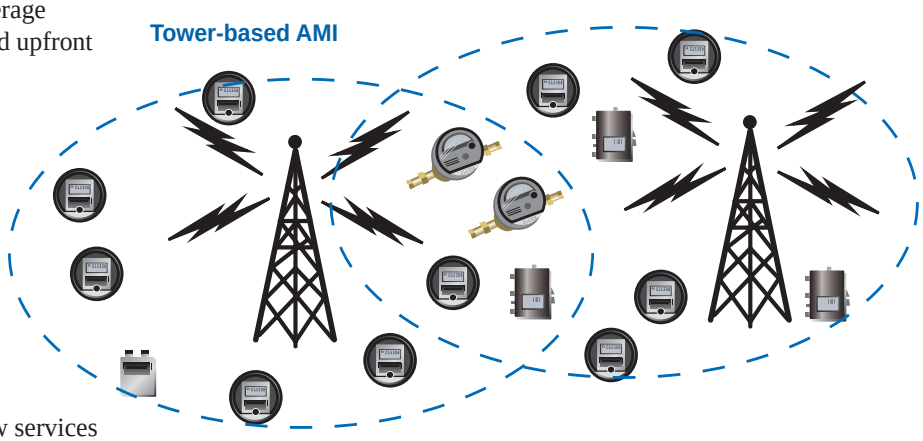
Each wireless AMI technology alternative has its unique costs, strengths, and weaknesses, and any of these technology types – tower, mesh, or cellular – could be the best match given a utility's unique situation. In order to uncover the differences and determine which option is best, it is important to perform a cost/benefit business case analysis. While AMI vendors will gladly offer to complete propagation modeling of your system for free and even offer to pilot their technology for free as well, we suggest that an independent source such as PSE or another firm complete the AMI propagation modeling to remove bias from the assessment. Given the high maturity of wireless AMI, we do not suggest performing a pilot. Chances are, there is a co-op in your state you could visit that already has wireless AMI deployed, and you can learn a lot from their experiences.

Tower-based AMI

Tower-based point-to-multipoint (PMP) AMI systems require communications between a tower and multiple endpoints (meters, DA devices, street light controls, load management switches, etc.). The components involved in this type of system include towers, master radios at each tower, and AMI meters/modules.

Advantages include a simplified communications backhaul and a wide-ranging coverage area. If the utility has ownership of or access to the required towers, this solution becomes even more attractive.

Tower-based AMI



Point-to-Multipoint: Licensed radio signals from tower to meters and from meters to towers.

Mesh-based AMI

In a mesh-based or multipoint-to-multipoint AMI system, meters communicate peer-to-peer using 900 MHz or 2.4 GHz unlicensed wireless frequency. Devices called collectors and repeaters are strategically placed so they can talk to as many meters as possible. These AMI collectors require a backhaul communications media such as fiber, various types of radio technology, or cellular to be used to transport the AMI data from the collector to the office.

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In the event that the primary mesh radio signal is unavailable, systems typically self-heal.

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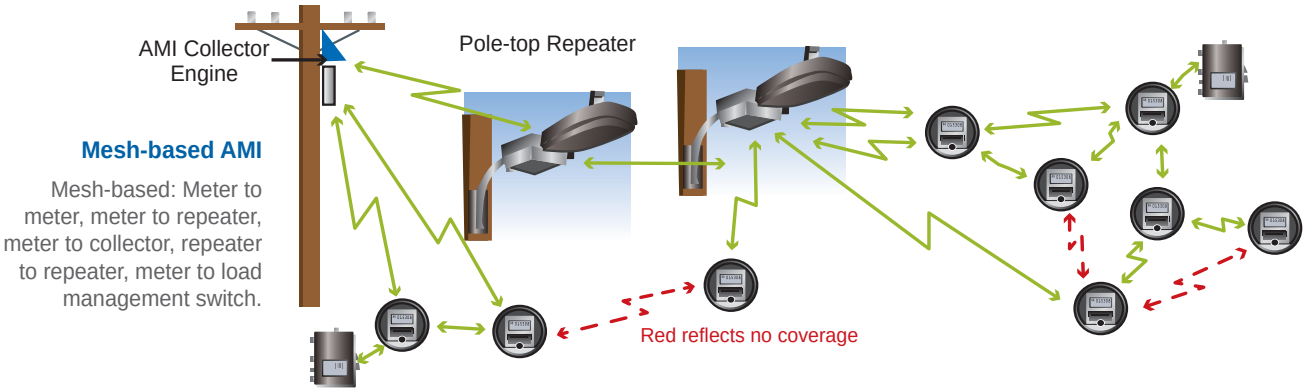
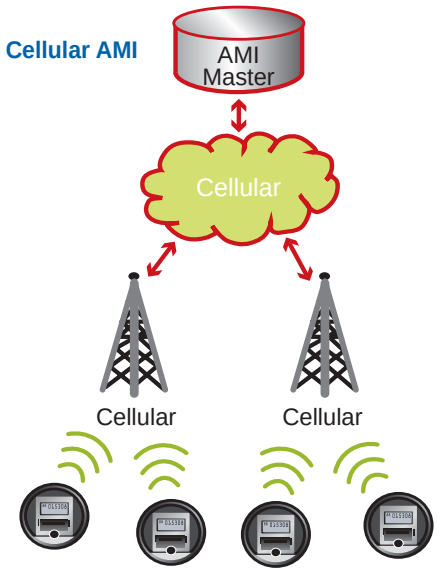
Coverage is impacted by the collectors' and repeaters' mounted height, endpoint receiver sensitivity, endpoints' quantity and density, as well as terrain and other obstacles such as buildings.

In the event that the primary mesh radio signal is unavailable, systems typically self-heal and are capable of automatically rerouting messages. In the diagram below, the dotted red arrows reflect a mesh signal that has become unavailable, and the solid green arrows reflect the successfully rerouted path.





Cellular AMI

Some cellular providers offer a turnkey, cellular-based AMI solution for the entire AMI deployment. Only a very small number of utilities have elected to use cellular for their entire deployment to date; however, recent price changes by the cellular providers are beginning to make cellular-based AMI more viable than in the past.

Most AMI vendors now include a cellular alternative as a potential coverage gap filler for hard-to-reach meter locations. PSE has seen several AMI vendor proposals that assume ~95% or more of the meters would be reached with mesh technology, and the remaining ~5% (depending on utility) would be reached with cellular. However, it is not uncommon for the hard-to-reach mesh meters to be located in areas with poor cellular coverage.

Therefore, cellular AMI can be beneficial in specific, hard-to-reach areas where other wireless AMI technology would be costly. But most cellular AMI modules run on current 4G (in some cases 3G) networks, which means it may not be a viable option in areas with poor cell coverage.

Making the Migration to Wireless AMI

In addition to determining the most optimal type of wireless AMI technology, a utility also needs to consider the most economically beneficial method of migration. The following lists some possible wireless AMI deployment scenarios.

1. **Deploy 100% of electric meters within 12 months after completing all required system integrations.**
2. **Replace 25% of meters in Year 1**.

   Then continue to replace 20-25% each subsequent year until 100% of meters have been converted to wireless.

Complete an AMI technology business case to help assess all the options and a make a well-informed decision.

3 **Deploy wireless AMI only to high-value areas (10-25% of meters).**

High-value areas include C&I accounts, new prepaid metering subscribers, frequent disconnect for non-pay premises, or bellwether meters for E&O purposes. The remaining meters would not be replaced until a business case justifies a full wireless AMI deployment.

There are many ways to accomplish the migration. For example, in a gradual AMI deployment, a utility deploys AMI to select high-value areas and then replaces remaining meters as they fail, or as customers enroll in advanced programs.

A partially deployed wireless system, together with the existing PLC system can function as a hybrid technology system for the period of time before the full migration to wireless is completed. The selected wireless technology will impact the investment and coverage of the wireless AMI. For example, a partially deployed tower-based wireless AMI system has the ability to cover larger areas without depending on meter locations and meters meshing to obtain coverage. Alternatively, a partially deployed mesh system might require a greater number of collectors and repeaters in order for meters to communicate with each other. However, while the need for more AMI equipment might be costly, gradually migrating to wireless AMI using this hybrid approach ultimately increases the resiliency and redundancy of your AMI network.

Summary

PLC and drive-by AMR technology have provided significant value for many years. But as these technologies begin to age, we find that the state of technology infrastructure at utilities varies widely. A wireless AMI migration may or may not be the right solution for you at this time, and that depends on your utility's specific situation (including how long the PLC system and its associated meters and modules have been in place, whether a blend of mechanical and solid-state meters exist, and whether certain programs are being administered or are on the roadmap, such as load management). Performing a business case, assessing all the options, and considering new, enhanced customer programs, will enable the utility to make a well-informed, confident decision regarding the future of AMI. Simply upgrading with the same vendor from PLC to wireless may not be the most optimal migration strategy. PSE can assist utilities with the type of analysis described above.

About the Author

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Rick leads PSE's automation and communications technology group with more than 30 years of professional experience. Rick and his staff provide consulting and engineering services to utilities, including: technology work plans, strategic communications plans, procurement, design and project management of SCADA, DA, substation automation and design, AMI, demand response, CIS, GIS, MWM, AVL, OMS, and asset management. Communication area services include land mobile radio, fiber and microwave backbones, and mobile data. Rick earned his MBA from Cardinal Stritch University, Milwaukee, WI.

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