SOLUTION BRIEF

AMI and Beyond: How Wireless Broadband Enables the Smart Grid Today and Tomorrow

As they plan to take their first step towards their Smart Grid vision, most utilities are beginning their journey with the implementation of an AMI (Advanced Metering Infrastructure) system. More and more of these utilities are also realizing that to truly harness the power of the Smart Grid, they must also have a separate wireless broadband infrastructure capable of delivering 24/7 high-speed communication to enable a variety of additional Smart Grid benefits. These include more cost-effective backhaul of AMI data, delivery of sophisticated energy management/control programs and real-time connectivity within the utility to help improve service delivery, outage management and overall productivity. In essence, the deployment of a wireless broadband communications network for Smart Grid applications enables the utility to become a truly "Connected Utility."

Many utilities around the world are also discovering that partnering with a wireless innovator such as Motorola to implement a private wireless broadband communications network for their AMI systems makes both operational and economic sense… not just for today, but also for the future.

In recent months, there has been increased attention to green energy and alternative energy sources. But even as the world searches for innovative new solutions, most energy experts seem to agree on one point. Our very first priority should be using the energy we already have more efficiently and cost-effectively. Under the rallying cry "Energy Efficiency is the First Fuel," this emphasis on greatly improving energy efficiency is driving significant change in the utilities industry and is the driving force behind the Smart Grid.

Resurgence in Regulation

The push for greater energy efficiency is coming from numerous sources, many of them regulatory. Typically, regulations include stringent conservation policies, higher safety levels, demand-response service requirements, specified levels of energy efficiency and more. They come from a variety of international, national, regional and local resources. In the United States, for example, a series of regulations have sent utilities a clear signal that they should be prepared to leverage the Smart Grid sooner rather than later. But the Smart Grid will do more than help the environment; utilities are also tapping into the Smart Grid to gain a technological advantage in an increasingly competitive marketplace.

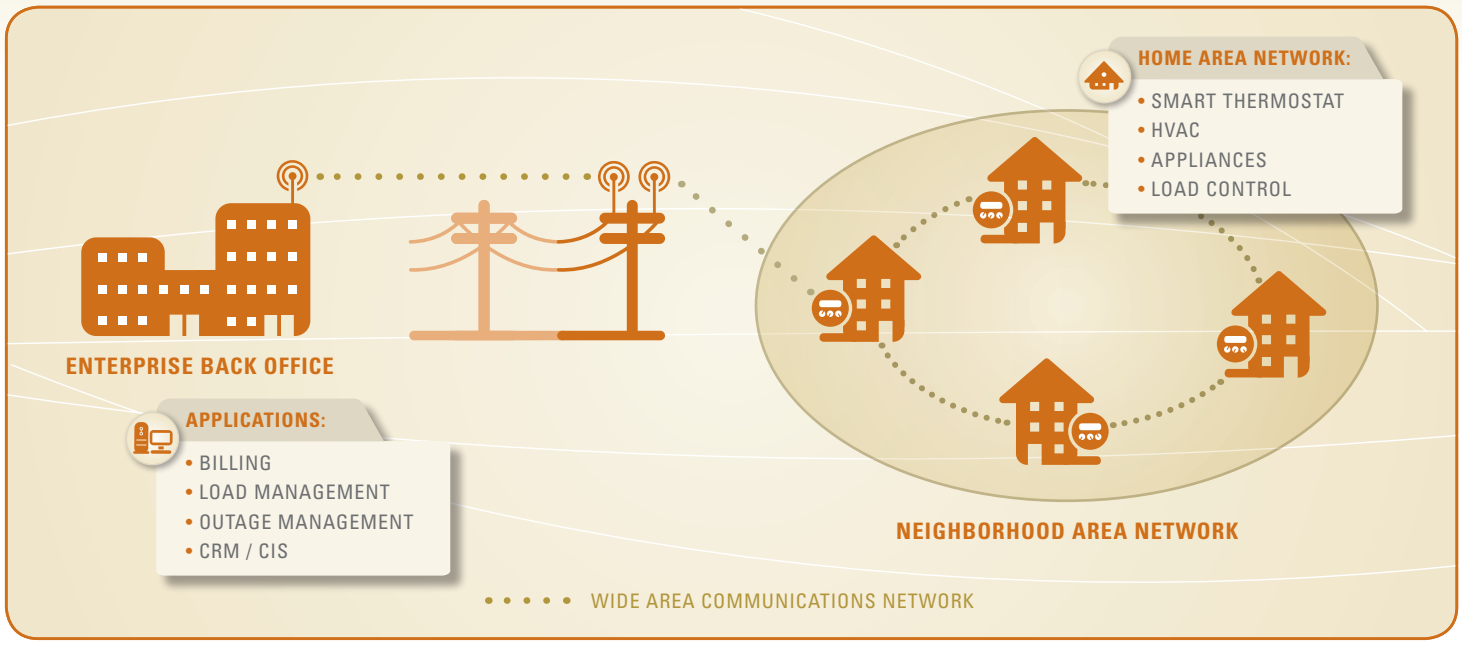
The Realities of AMI

AMI initiatives are moving forward on a global basis and at great speeds despite their high cost. In the United States alone, more than 140 million electro-mechanical meters will be converted to smart meters. Utilities are investing millions — even billions — of dollars in AMI systems, including the costs of the smart meters themselves, meter installation and collection points. Utilities have invested a lot of time in evaluating various AMI vendors in numerous small-scale pilots usually consisting of one or two collection points. Typically, these pilots use public cellular as the backhaul for the AMI data for three reasons: wide coverage footprint, zero implementation cost and low monthly fee. As these pilot systems become fully operational, however, utilities with thousands of AMI collection points can be caught off guard by the large O&M costs of continuing to use public carriers for backhauling the AMI data. In the future, adding more Smart Grid applications over the cellular network could easily drive O&M costs through the roof.

Backhaul operations make up a relatively small portion of the overall technology costs for an AMI system and account for approximately 10 to 15 percent of the cost. Nevertheless, since the cost of backhauling AMI data over a public network can be substantially higher than anticipated, some utilities have suspended AMI installation until a more cost-effective, scalable backhaul network can be utilized. "It's kind of like the tail wagging the dog," says Jim Hanson, industry principal, Motorola Energy & Utilities Group. "When you factor in the recurring costs associated with relying exclusively on public cellular service providers for backhaul with the likelihood that they will not be able to provide 100 percent coverage of a utility's entire customer base, the ROI for deploying a scalable private AMI backhaul network that covers the entire utility service territory — with enough bandwidth to support future Smart Grid applications — becomes very attractive."

HIGH-LEVEL VIEW OF AMI SYSTEM

In a typical AMI system, a wireless communications network collects data from consumer homes and feeds it into neighborhood collection points that send the data into the enterprise system. There the data is used in applications such as system billing, load management, outage management and more.



"For most utilities, building a high-speed wireless network on the back of their AMI systems is an investment that will provide value well beyond AMI. Once deployed, the organization will have real-time two-way communications with the bandwidth to support virtually everything they want to do."

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The Advantage of Going Private

It's no surprise then that a growing number of utility companies have decided to build their own private wireless broadband communications networks to support their AMI and Smart Grid applications. "For most utilities, building a high-speed wireless network on the back of their AMI systems is an investment that will provide value well beyond AMI," says analyst Rick Nicholson, vice president, Energy Insights. "Once deployed, the organization will have real-time two-way communications with the bandwidth to support virtually everything they want to do." In the overall AMI picture, the cost of building a private wireless broadband network is relatively small, but the advantages can be huge.

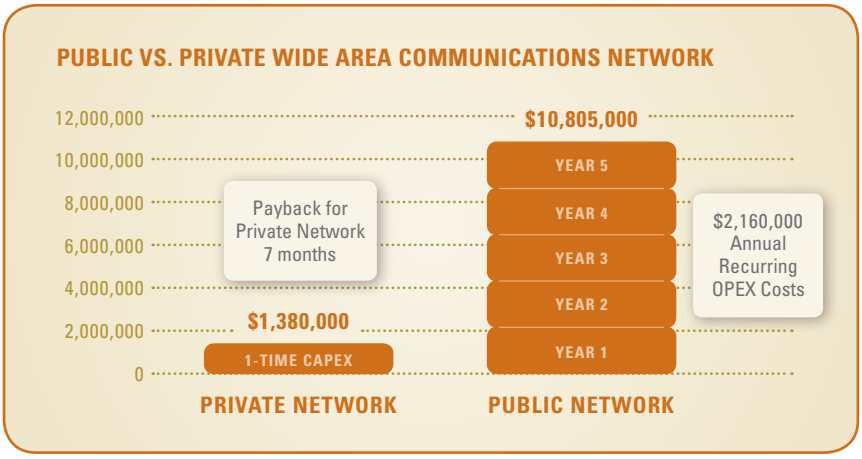
One Size Does Not Fit All

"As much as everybody would like to have just one network to meet all their wireless needs, it is just not feasible," says Mike Koch, solution architect for Motorola's Enterprise Mobility business. A variety of factors, including lack of a coordinated frequency band and the variance in requirements between AMI backhaul and the various distribution automation applications, have led many utilities to the same conclusion: multiple networks are required to meet their Smart Grid vision. In the past, each business unit independently selected a network for its application, but today's network selection must take the Smart Grid needs of all business units into account. This is a major paradigm shift for utilities and it is leading to business cases that are much stronger and much more favorable to investors and public utility commissions (PUCs).

Two types of networks are required to achieve a Smart Grid vision — access networks and backhaul networks.

- **Access networks** are typically used by remote devices for communication at the edge of the network. Examples of access networks are Zigbee, WiFi, HomePlug and proprietary meshing networks.

- **Backhaul networks** are the high capacity, low latency broadband networks that extend the enterprise network to remote areas, bringing the data from the access networks back to the enterprise. Examples of backhaul networks include both wired and wireless point-to-point and point-to-multipoint broadband systems, fiber and microwave systems. These backhaul networks form the backbone for all Smart Grid access networks.



A Sound Business Case

Let's examine a sample business case for a public versus private wide area communications network that includes 1,000,000 smart meters, 2,000 AMI collection points and 10,000 Smart Grid devices (e.g. capacitor banks, reclosers, switches, etc.). The network provides 100 percent coverage to each collection point and 1 kb of data is read daily from every meter. Finally, $15 per month is assumed for charges for the cellular data plan.

As shown in the illustration, the results are rather astounding. For the public network, OPEX costs equate to approximately $2,160,000 annually for a total cost of $10,805,000 over five years. This is in sharp contrast to the private network that required a one time CAPEX of $1,380,000 and delivers payback

within 7 months. It is truly amazing how quickly $15 per month adds up.

Capital Investment vs. O&M

A private wireless broadband network makes a great deal of sense in terms of reducing the high cost of backhaul and enabling a utility to keep costs under tighter control. PUCs tend to look at backhaul costs using leased lines as operational expenses, and thus, they are normally not recoverable. On the other hand, building a private wireless network is usually considered a capital investment that helps improve efficiency, service, reliability and security. Therefore, a utility can typically recover much of the cost of the entire network.

Deployment itself is a significant advantage. Wireless networks like those from Motorola offer affordable start-up costs, simple installation that can be accomplished in a matter of days instead of weeks or months, and an exceptionally low Total Cost of Ownership. The most important advantages of a private wireless broadband network are summed up in what Motorola calls the Five C's:

- **Coverage.** Even in very remote areas, coverage is not only possible, but efficient and affordable.
- **Capacity.** High bandwidth capacity and scalable to support growth requirements.
- **Control.** Particularly during disasters, the utility controls their own network and is not subject to the mercy of a public carrier.
- **Capabilities.** Security, reliability and rugged equipment.
- **Cost.** As a capital investment, costs can be recoverable — and recurring costs are eliminated.

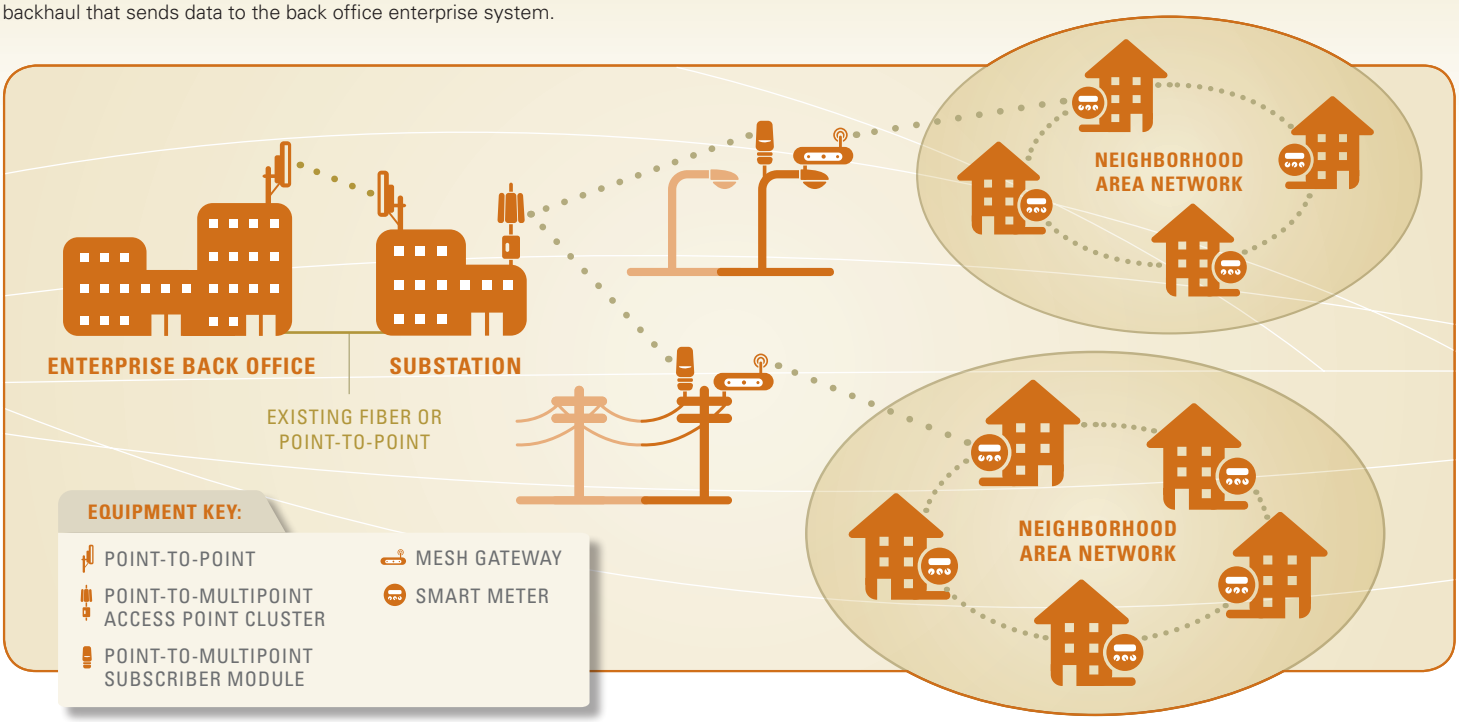
As more and more utilities examine the communications capabilities of their new AMI systems, the benefits of a private wireless communications network solution are becoming readily apparent. But the advantages of deploying a private network go well beyond AMI as utilities look to the future and their goals of becoming true connected utilities.

Beyond AMI

"As utilities spend enormous time and resources building AMI networks," says Jim Hanson, "they are also beginning to look beyond AMI and discovering that properly designed two-way wireless telecommunications systems are the great enabler of the connected utility of the future." As the rush to deploy AMI solutions intensifies, savvy utilities are also planning to leverage their high-speed communications networks for a variety of additional applications. These networks are built upon sound business cases for providing enhanced productivity, service, security and ROI. Additionally, wireless communications networks make it easier to add new distributed energy resources (such as solar and wind power) to the grid as they become available. Other expanded applications include:

DETAILED VIEW OF AMI SYSTEM

AMI systems are made possible by a wireless communications network. Network elements include: smart meters that collect information from the home; mesh data collection points; point-to-multipoint subscriber modules that transmit data back to an access point cluster at a remote facility; and point-to-point backhaul that sends data to the back office enterprise system.



- **Remote Monitoring and Control.** Most utilities have long wished for automation, real-time monitoring and remote control of system elements such as primary and secondary substations, power lines, capacitor banks, feeder switches, fault indicators and other physical facilities. So far, the major deterrent has been cost. Now, with affordable wireless broadband solutions, networks can be extended simply and cost-effectively, allowing remote facilities to be monitored around the clock with applications such as SCADA and video surveillance. The result is not only fewer and shorter disruptions, but also significantly improved management of power quality.

- **WiFi Hot Spots.** Wireless broadband networks can also significantly improve productivity through the creation of WiFi hot spots that allow real-time communications to and from employees in the field. Now, for example, a worker can transmit data from a substation directly into the utility's main system without having to drive back to the nearest office. Field engineers can also download or view blueprints and network diagrams on their computer screens precisely when and where they need them. This instant two-way connectivity improves customer service and eliminates wasted time, dollars and fuel.

- **Demand-Response Services.** Two-way customer communications empowered by system-wide wireless networks enable the automated demand response and management programs being mandated by many regulatory agencies. These networks, coupled with the utility's AMI system, provide connectivity and bandwidth to each installed smart meter, enabling support for demand side management programs that can help reduce energy consumption through voluntary and involuntary programs. These include programs that send pricing signals to customers and/or automatically control customer devices such as thermostats, pool pumps, water heaters, air conditioning and more.

- **Load Management.** By empowering applications such as Critical Peak Pricing (CPP), Time of Use (TOU) and Direct Load Control, private wireless broadband networks can help utilities reduce the strain on the grid during peak usage times. Even small reductions or shifts in peak load can reduce a utility's need for increased capacity, which in turn can help lessen the need for new power plants. In addition, because wholesale energy prices spike during critical peak periods, reduction in peak demand can lower the spot price for wholesale energy, providing cost savings that can be passed on to customers.

- **6 GHz Underbuild Network Expansion.** Many utilities continue to rely heavily on licensed microwave communication networks that are now in need of digital upgrades and incremental capacity to meet increasing demand for services and higher performance. An increasing number of these utilities are utilizing Motorola wireless broadband solutions to provide an efficient and cost-effective unlicensed alternative to expensive 6 GHz link replacement. Motorola radios can

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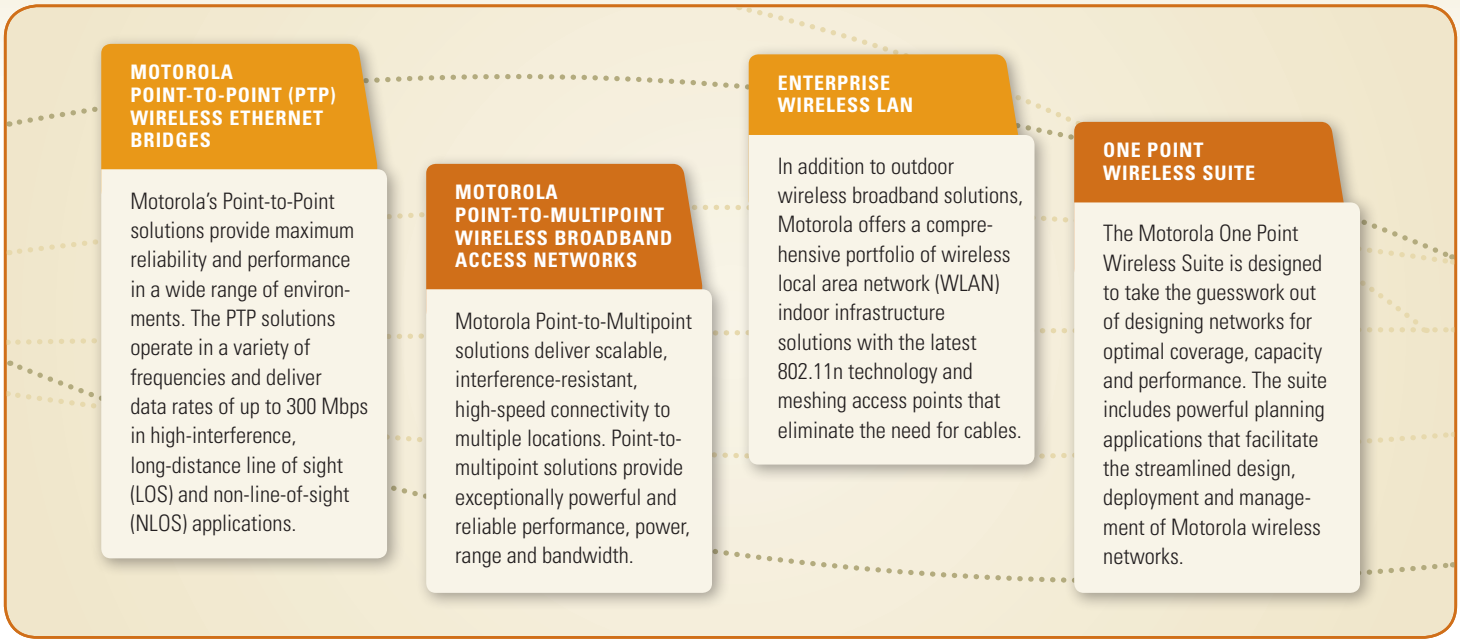
MOTOROLA'S WIRELESS BROADBAND PORTFOLIO

Motorola's comprehensive portfolio of reliable and cost-effective wireless broadband solutions offers high-speed network solutions that support data, voice and video communications, enabling a broad range of applications that leverage the Smart Grid.



operate in parallel with existing microwave radios; they can be placed on the same towers and use the same antennas and cabling, providing additional capacity using existing infrastructure.

Even as they work at breakneck speed to implement their initial AMI systems, a great many utilities are planning for increased usage of the Smart Grid. By installing private wireless broadband networks to complete their AMI solution, these utilities are ensuring future growth in both service and profitability by preparing themselves for these and other energy-wise applications that are on the horizon.

The Ultimate Goal

Ultimately, the goal of the new Connected Utility is the empowerment of the entire utility enterprise through mobile and fixed intelligent devices and high-speed two-way connectivity with virtually every part of the organization. As they complete deployment of their powerful AMI systems, the best-in-class utilities will leverage their own private wireless broadband networks to deliver increasing value from a broad range of powerful and productive automated applications. Bottom line, the connected utility will be able to leverage the Smart Grid and its AMI system to efficiently and cost-effectively meet public service, environmental, regulatory and competitive needs today… and well into the future.

Motorola Innovation

Motorola's comprehensive portfolio of reliable and cost-effective wireless broadband solutions together with our WLAN solutions provide and extend coverage both indoors and outdoors. The Motorola Wireless Broadband portfolio offers high-speed Point-to-Point, Point-to-Multipoint, Mesh, WiFi and WiMAX networks that support data, voice and video communications, enabling a broad range of fixed and mobile applications for public and private systems. With Motorola's innovative software solutions, customers can design, deploy and manage a broadband network, maximizing uptime and reliability while lowering installation costs.

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