

Iberdrola USA: Central Maine Power

Multi-tier AMI Network to Support a Sophisticated Smart Grid Vision



Central Maine Power (CMP) successfully deployed an advanced metering infrastructure (AMI) with more than 600,000 smart meters across its entire service area on an aggressive schedule and within a tight budget. What makes this success even more impressive is the broad long-term vision CMP has for its smart grid, which will require the wide area and neighborhood area networks to support applications beyond AMI, including consumer applications, and distribution and substation automation where reliability and real-time performance are mission-critical. To satisfy these demanding requirements while keeping the total cost of ownership as low as possible, CMP chose to implement a private, multi-tiered network in the unlicensed wireless spectrum using the Trilliant® Communications Platform SecureMesh® solution.

The Need: Cost-effective Advanced Solutions to Support a Sophisticated Smart Grid Vision

CMP had been planning a smart grid with an advanced metering infrastructure (AMI) since 2007, but decided in 2008 not to proceed because the company operates in a fully unbundled environment where customers purchase their electricity from various competitive power producers. For this reason, demand response—one of the primary benefits of the smart grid—offered no potential for cost savings to CMP, and therefore, the nearly \$200 million investment would have required a rate increase for its customers.

The situation changed in 2009, however, with the availability of Smart Grid Investment Grants (SGIG) from the U.S. Department of Energy (DoE) under the American Recovery and Reinvestment Act (ARRA). The DoE approved a grant of \$96 million to fund half of the \$192 million CMP project. This DoE grant represented the third-largest grant in the country, and was expected to deliver benefits to both homeowners and businesses in Maine. The Maine

Introduction

Central Maine Power At-A-Glance

- 11,000 square-mile service area in central and southern Maine
- 620,000 residential, commercial and industrial customers (~ 80% of Maine's population)
- 6,329 kWh average annual usage per residential customer
- 1,680 MW system peak demand
- 640 thousand poles
- 24,000 miles of distribution lines
- 250,000 transformers

Accolades for Customer Satisfaction

J.D. Power and Associates ranked Central Maine Power first in business customer satisfaction among midsize electric utilities in the eastern states in its 2012 Electric Utility Business Customer Satisfaction Study.

CMP also ranked first in business customer satisfaction in the 2009 study, and since 2008 CMP has received four first-place rankings for residential customer satisfaction in the J.D. Power and Associates annual studies.

The Solution: The Trilliant Communication Platform's Multi-tier SecureMesh WAN/NAN/HAN

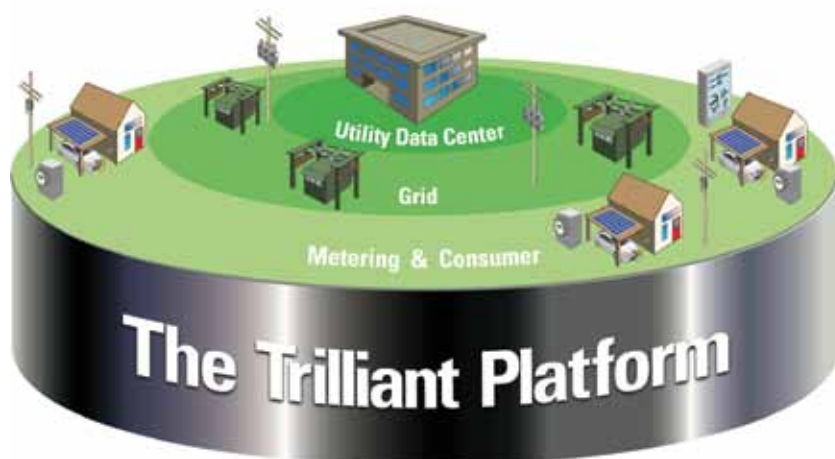
CMP's RFP identified some demanding requirements that the AMI network would need to support, in part to satisfy the DoE's goals for standards-compliant solutions. These included:

- full two-way communication between customer meters and the CMP control center;
- an 80 kbps minimum data transfer rate;
- full cyber security including AES 128 encryption, identification, and authentication;
- standards-based design, such as AMI-SEC, CIPS, FCC, IEEE, NERC, NIST and network-based upgrades;
- situational network awareness with auto-configuration and fault tolerant and transparent operation; and
- less than three second message-layer latency.

During the evaluation one solution stood out for its ability to offer the most advanced capabilities at a competitive total cost of ownership: the Trilliant Platform's SecureMesh. "We have ambitious goals to improve our service and deliver value for customers through our smart grid network," said Sara Burns, CMP's president and chief executive officer. "Trilliant provided the right combination of communications and metering technology to suit both our initial and long-term needs."

Project At-A-Glance

- \$192 million budget including \$96 million Smart Grid Investment Grant from the Department of Energy (50% match)
- Multi-tier private WAN/NAN mesh AMI network covering the entire service area
- Over 600,000 smart meters for residential, commercial and industrial customers (100% replacement of existing meters)
- Full integration with the meter data management system and the customer Web Portal
- Ability to add distribution/substation automation and demand response/HAN in the future
- Completion of AMI and smart meter installation in the summer of 2012



Case Study: CMP

Distinguishing characteristics of CMP's project identified in the DoE grant application include:

- Rapid Deployment to 100% of CMP's Customers
- Valuable Example for the Electric Utility Industry
- Dynamic Pricing Capabilities for All Customers
- Experienced Project Team
- Significant Customer Need
- Highest Customer Satisfaction Reflects CMP's Excellence in Understanding and Communicating with Customers

Public Utility Commission (MPUC) quickly and unanimously authorized CMP to proceed with its smart grid contingent upon receipt of the DoE grant.

Building on its prior effort in 2007 to evaluate AMI vendors and make final technology recommendations, CMP immediately issued a Request for Proposal (RFP) to formally launch the smart grid project. The RFP identified four major components of CMP's smart grid: the AMI network; smart meters; a meter data management system (MDMS); and meter and network installation, along with related field services required for the implementation.



The initial phase of the project involved deploying the AMI's wide area and neighborhood area networks (WAN and NAN), and replacing all of the existing electro-mechanical meters with smart meters. This first phase also included integrating the existing customer information system with the meter data management system, a customer Web portal, remote connect/disconnect, outage management, asset management, and making customer load information available to the power producers.

The RFP emphasized the need to support additional applications in future phases. Indeed, CMP had quite a broad vision for its smart grid with the need to support everything from a home area network (HAN) for demand response to substation and distribution automation. These and other applications would add substantial traffic to the WAN and NAN, and require support for real-time communications. Because these applications also require robust security, CMP developed a comprehensive Cyber Security Plan (CSP) for the network and all related systems. The CSP adopts industry best practices for identifying risks, adhering to applicable security standards, implementing robust solutions, and validating the effectiveness of all security provisions.

Case Study: CMP

“The Commission views AMI as an important technology that will ultimately reduce utility operational costs, improve customer service and provide customers with necessary tools to use electricity more efficiently and lower their electricity bills...”

— MPUC Order Approving Installation of AMI Technology, July 2009

CMP received the prestigious “Emergency Recovery Award” from the Edison Electric Institute for its excellence in restoring power to 364,000 customers following Tropical Storm Irene in August 2011. The Trilliant Communications Platform assisted CMP with its rapid restoration efforts by helping to clear repair orders.

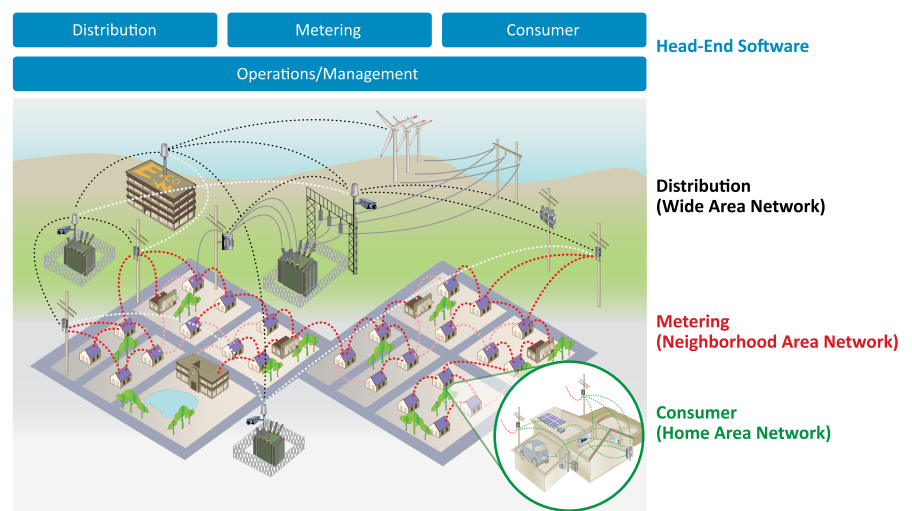
The Trilliant Platform’s SecureMesh solution also provides:

- Broad application support with high throughput and low latency
- Multi-tier deployment flexibility across the WAN, NAN and HAN
- Modular extensibility to add coverage and/or capacity
- Lowest total cost of ownership of any public or private network solution

Central Maine Power is implementing Trilliant’s multi-tier SecureMesh network in three tiers:

- A WAN operating in the unlicensed 5.8 GHz spectrum for backhaul of AMI and future system-wide applications. The WAN delivers up to 54 Mbps of raw throughput and a maximum latency of 12 ms per round-trip hop with up to 10 miles between nodes.
- A NAN operating in the unlicensed 2.4 GHz for the AMI network and other future field applications. The raw throughput of 250 kbps exceeds DoE’s requirement of 80 kbps.
- A future wireless HAN (already integrated into the smart meters) to support demand response and home energy management applications.

Trilliant’s solution also includes UnitySuite™ head-end software for integrating security and device management with data acquisition and communications management.



Trilliant’s multi-tier WAN/NAN/HAN SecureMesh Network

2009		2010				2011				2012			
Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Vendor Selection & Negotiations													
		Augusta Demo System											
				Portland 45,000 Meter Deployment									
				Full System Deployment									
				Information Research Study (includes IHD)									

CMP's aggressive schedule required completing the Full System Deployment of more than 600,000 smart meters in less than 2 years.

The Results: Implementation on Schedule and within Budget

Despite some unusual challenges and the aggressive schedule for the Full System Deployment (see timeline chart), Central Maine Power successfully deployed the entire AMI network and more than 600,000 smart meters on schedule and within budget. The fast-tracked project was even more challenging given the diversified terrain in CMP's service area, consisting of both urban and rural environments with islands, rolling hills and dense forests.

Based on a successful Portland Deployment pilot, CMP proceeded directly to the Full System Deployment. To help ensure the project's continued success, CMP created an AMI Project Governance Plan, held weekly project team meetings, and identified mitigating measures for eight separate risk areas, including Technology Performance, Supply Chain, IT Integration, Field Exception, Records Exception, Dynamic Pricing Acceptance, Regulatory and Financial. CMP also conducted a major educational campaign to keep customers, community leaders and stakeholders informed of the project and its benefits.

For the majority of the private AMI network installation, CMP was able to mount many of the systems on its own existing poles, service centers, substations, etc., which simplified the deployment. Trilliant played a major role during the deployment by acting as prime contractor for the network installation and meter procurement. As a key member of the project team Trilliant worked in partnership with CMP and all other vendors, including GE, Landis+Gyr, Black & Veatch, Itron, IBM and Siemens to help ensure the project's success.

Anticipated Benefits of CMP's Smart Grid:

- Lower distribution costs
 - o Reduced meter-reading labor costs
 - o Reduced meter-reading related fleet costs
 - o Reduced call center costs
 - o Reduced outage restoration costs
 - o Reduced billing expenses
- Lower customer electricity supply costs
 - o Reduced cost of generation capacity to meet electricity needs
 - o Customers buy less electricity
 - o Reduced cost of power interruptions
- Environmental
 - o Lower carbon emissions for vehicles
 - o Lower emissions (CO2, NOX and SO2) from reduced generation output

"This is transformational technology for consumers, the environment and the utility industry," says Burns. "Smart grid technology empowers people with better information, and it can enable choices for supply and price that Maine consumers just don't have today. It also will help us plan and operate our business more efficiently."

- Sara Burns, CMP

Case Study: CMP

Future-proofing the Smart Grid

CMP has designed and implemented its smart grid to include these future-proofing elements in anticipation of new applications and changes to existing ones:

- geographic expansion to any area including areas isolated from a main service segment;
- bandwidth expansion capability by adding network infrastructure or increasing data rate;
- functional expansion capability by adding new application devices or reprogramming existing devices;
- interoperability allowing the addition of new third party devices over time;
- reconfigurability allowing existing devices to have existing capabilities customized, as needed;
- reprogrammability allowing existing devices to be reprogrammed to add/change/delete capabilities;
- best-of-breed data rate to enable low latency and large message capacity before any expansion;
- dynamic bandwidth allocation to support real time and long term network use in optimum ways;
- transparent networking with no internal data processing that could compromise data; and
- cyber security protecting all changes, variations, and enhancements to the Smart Grid over time.

The deployment of the SecureMesh WAN/NAN in each area preceded the installation of the smart meters by two months with a goal to convert each customer from manual to automated billing within 30 days of the installation. CMP used a third-party organization with a team of some 75 field personnel to install the meters.

CMP is on track to realize some of the many anticipated benefits for its smart grid:

- Based on the experience of other utilities, the Electric Power Research Institute (EPRI) estimates that the economic costs of power outages amounts to approximately \$120 billion annually in the U.S. Using EPRI's estimate, a reduction of 10% in outage duration, for example, would be expected to reduce the economic impact of outages for CMP's customers by over \$100 million annually.
- Indeed, CMP has already received the prestigious "Emergency Recovery Award" from the Edison Electric Institute for its excellence in restoring power to 364,000 customers following Tropical Storm Irene in August 2011. The aftermath of the storm left washed out roads, flooding and downed trees, and caused substantial damage to CMP's delivery infrastructure. The Trilliant Communications Platform assisted CMP with its rapid restoration efforts by helping to clear repair orders, even though the system was not fully functional at the time.
- Additional savings in payroll and telecommunications costs beyond rapid restoration will be realized with the reduction in the number of estimates, read-related exceptions and billing adjustments, as well as with the reduction or elimination of certain types of calls by giving customers online access to their energy utilization (per hour for up to a year) on CMP's Web portal.
- Green house gas (GHG) emissions are expected to be reduced substantially based on improvements in efficiency and increased consumer conservation, as well as from the elimination of nearly 2 million annual vehicle miles for meter reading and connect/disconnect. CMP estimates long-term annual reductions of 42,000 tons of CO₂, 46,000 tons NO_x and 107,000 tons SO₂.



The Future: A Full Suite of Smart Grid Applications

The advanced metering infrastructure and smart meters are just the beginning of CMP's smart grid. Additional planned applications include:

- Replacement of two separate meters for customers now generating wind or solar energy with a single bi-directional meter to support distributed generation
- Distribution and substation automation throughout CMP's grid
- Demand response programs from power providers (contingent upon the MPUC's permission to implement dynamic pricing)
- Support via the HAN (included in the smart meters) for in-home displays (IHD), programmable communicating thermostats (PCT) and direct load control (DLC)
- Intelligent charging for electric vehicles to avoid additional strain on the grid

Grid



Metering



Consumer





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