Unlock the Potential of Smart Water Metering with Cellular Communications

SIERRA WIRELESS®

Executive Summary

Water utilities, governments, and original equipment manufacturers (OEMs) are increasingly exploring the application of "smart" metering, or advanced metering infrastructure (AMI), to water systems. AMI can deliver important benefits such as eliminating leaks and inefficiencies, lowering operating costs, and improving water conservation. But water metering also presents a unique set of challenges for AMI.

To succeed, utilities and OEMs must address a variety of cost and technical considerations for power consumption, longevity, global scale and security. Cellular wireless wide-area network (WWAN) technology can play an important role in addressing these concerns, and provide distinct business and technical advantages over conventional radio communication networks.

This paper explores the development of smart water metering technology and the ways that cellular technology can enable metering infrastructure. It addresses the key technical considerations and best practices for successful AMI solutions for water systems. And it discusses the ways that Sierra Wireless can help water utilities and OEMs make the leap to tomorrow's cellular smart water metering solutions.

Introduction: The Emergence of "Smart" Water Metering

According to the United Nations Department of Economic and Social Affairs, 1.8 billion people will be living in countries or regions with absolute water scarcity by 2025, and two-thirds of the world's population could be living under water stressed conditions. For these reasons, applying AMI to water metering addresses a pressing global problem: the need to conserve and optimize the world's water supply. By enabling two-way communications between meters and water utilities, and providing more accurate information about the status of the water system, smart water meters can play an important role in water conservation.

"Smart" water meters use AMI to allow for two-way remote communications with meters, using either point-to-point cellular WWAN technology deployed at the meter, or "fixed-network" solutions with cellular gateways connecting groups of meters using low-power RF mesh networks. Smart water metering also typically includes meter data management (MDM) software and services that provide utilities with end-to-end capabilities to remotely read meters and integrate data with back-end systems.

Today, most governments around the world have not yet mandated investment in smart water meters as has been the case with AMI for energy infrastructure. But analysts expect this to change soon, for a number of reasons. First, AMI can help utilities reduce non-revenue water (NRW) by allowing them to accurately pinpoint leaks and potential theft. In the United States, the Environmental Protection Agency estimates that about 6 billion gallons of water are lost to leaks each year. Worldwide, the World Bank estimates that NRW costs governments and utilities approximately $14 billion annually.

Smart water meters also offer cost advantages over the "advanced meter reading" (AMR) technologies typically used today, in which utilities collect readings using low-power RF technologies at the meter, requiring technicians to walk or drive by each meter to get a reading. AMI solutions allow utilities to acquire meter readings remotely, more frequently, and at a much lower cost.

For all of these reasons, analysts expect to see significant growth in smart water metering technology over the next several years. According to Navigant Research, the installed base of smart water meters will reach more than 153 million worldwide by 2022. MarketsandMarkets forecasts the smart water management market will be worth more than $12 billion by 2018.

Requirements and Best Practices for Successful Smart Water Metering Deployments

An effective smart water metering solution must meet a number of core requirements, some of which are different from connected gas or power meters. These include:

- **Longevity and durability:** Smart water meters must be built for longevity, with the ability to perform reliably in the field for many years—often a decade or even longer. Since water meters are often deployed outdoors, they must be extremely durable, with the ability to operate in harsh environmental conditions.
- **Low power consumption**: Unlike electricity meters, which can use a built-in power source, water meters typically have no ready access to external power. They must be designed to consume as little battery energy as possible. In most cases, this means the meter will be off nearly all the time, and will transmit a reading once every 24 hours.
- **Global scalability:** To keep development costs lower and accelerate time to market, OEMs should use solutions that allow them to implement the same hardware footprint

in every market they serve, without the need to re-engineer the entire platform to contend with regional variations in cellular or RF technologies.

- **Cost-effectiveness:** For smart water metering to be deployed on a large scale, OEMs and utilities need to keep costs under control. This includes hardware and materials costs, but it also means thinking about lifetime installation, operation and maintenance expenses.
- **Security:** No utility will implement remote meter reading capabilities unless it is confident that data transmitted between the device and the cloud is protected.
- **Interoperability:** To reduce system integration complexity and costs for utilities, OEMs should build solutions to support proven standards and protocols. By using smart water meters that embrace standards, utilities will be able to more easily add products and technologies to the water system, and improve both operational and capital efficiency.

The Role of Cellular Communications in Smart Water Metering

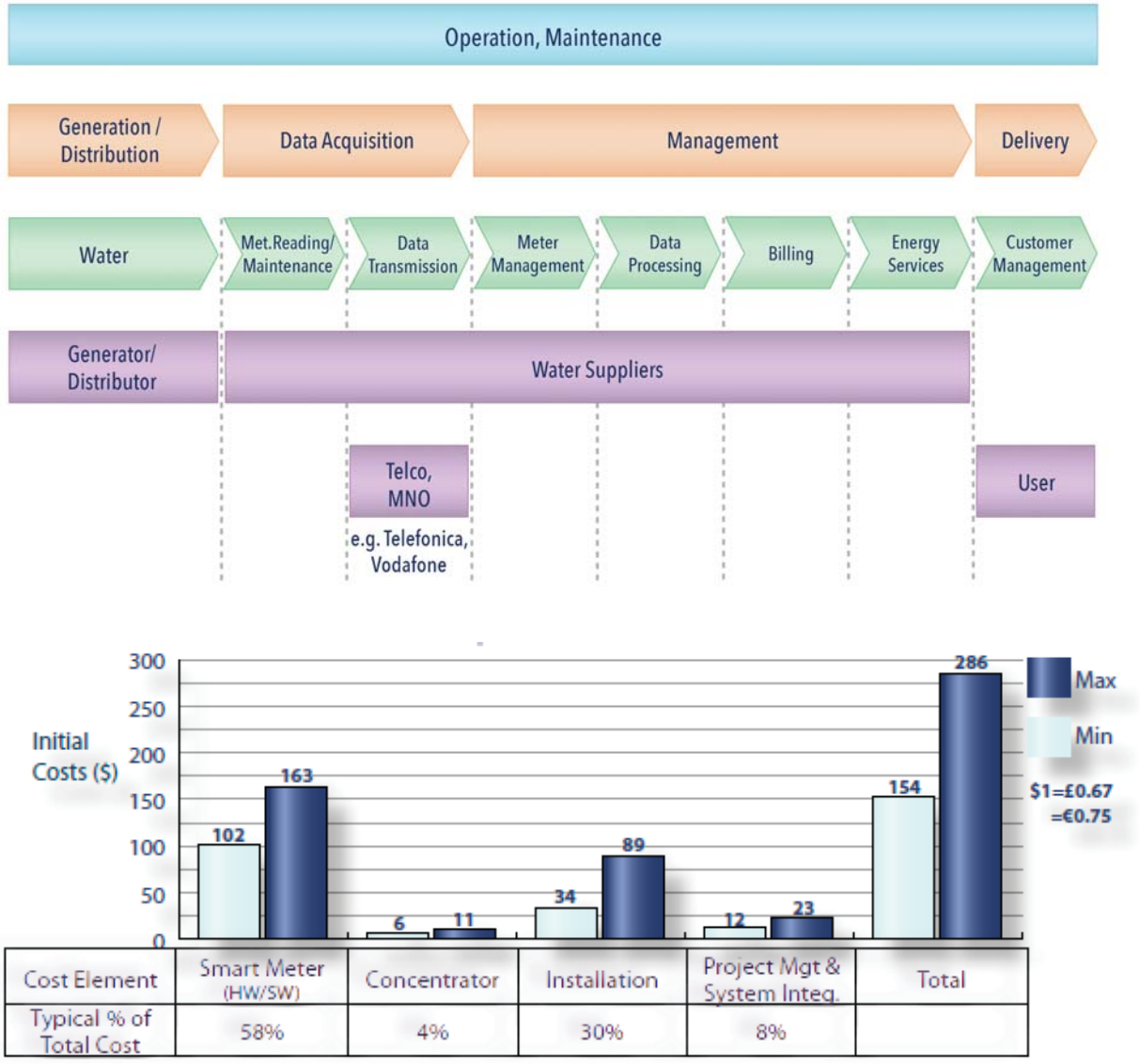
Early water metering AMI deployments have often combined RF mesh networks using traditional Industrial, Scientific and Medical (ISM) radio bands (i.e., parts of the radio spectrum reserved for ISM applications rather than telecommunications purposes) with cellular concentrators. These RF mesh networks can support smart water metering but they have drawbacks as well.

First, using a conventional fixed-network AMI means that the utility must deploy, operate and maintain the network over the life of the implementation—typically many years. While the costs may be lower than traditional AMR

Real deployments exist today on a worldwide basis. In India for example, Chetas Control Systems has deployed thousands of water meters to serve the water supply boards and water distribution authorities in Mumbai, Hyderabad, and Bangalore. As Mr. Mahesh Deshmukh, Chairman & Managing Director at Chetas Control Systems explains, "Unlimited data transmission without a repeater is advantageous for cellular networks. RF has short range and obtaining public permission to install RF data repeaters atop of the highest building locations is often time consuming. Often practical surveys are mandatory to fix optimum data collection points, which also add to the complexity of these types of deployments and make cellular deployment much more efficient."

solutions, they are still substantial. (Figure 1 breaks down the typical lifetime costs of a fixed-network AMI solution.) Fixed-network AMI is also more complicated (and expensive) to install than AMI using cellular wireless wide-area network (WWAN) connectivity, as short-range RF networks are subject to line-of-sight performance limitations and radio interference.

Figure 1. Fixed-Network AMI Value Chain



Source: Beecham research, 2014

For these reasons, many utilities are considering cellular technology in their AMI implementations—not just to support gateways or concentrators for RF mesh networks, but as a replacement for them, with point-to-point cellular connectivity extending all the way to the meter. By using cellular-connected endpoints, utilities can:

- **Eliminate the need to own and maintain the communications infrastructure**: Instead, they can use proven, secure, and ubiquitous cellular networks. They can let the mobile network operator (MNO) worry about maintaining the network, while they focus on their core business.
- **Improve operational efficiency and time to market:** Using a robust, proven cellular communications network instead of complex RF mesh networks often means less downtime, and less repair and maintenance effort. It also allows utilities and OEMs to implement smart water AMI much faster, as there is no need to build and test a new communications network.
- **Simplify deployments**: Cellular endpoints are not subject to the same line-of-sight and radio band propagation and interference issues as RF mesh networks. Installation technicians need not be skilled radio engineers to get the

Whenever a water utility decides to fully deploy AMI across its service territory, it needs to find a solution that will serve 100% of its customers. Finding a 90% solution is quite easy, even a 95% solution, but serving those last few percent can be a major challenge. That's where cellular communications is so valuable. There are many places in the world where cellular coverage is ubiquitous. Furthermore, the reliability of the devices is rarely an issue. As a result, cellular is an excellent alternative to 'fill in the holes' in an AMI network. Usage of cellular to serve an entire utility is an economic decision that varies for every utility, but 'filling in the holes' is a very different decision and in many instances it is the right answer. The only major challenge that affects such usage is whether a cellular provider will guarantee access to this service for the lifetime of the AMI system. Most major carriers now understand the importance of such a guarantee, but its availability does vary from one service territory to another.

I expect the use of cellular AMI to significantly increase over the next several years as equipment and service providers work together with water utilities to ensure that cellular systems meet the service criteria needed by these utilities.

–Howard A. Scott, Ph.D,
Managing Director
Cognyst Advisors

AMI up and running reliably; they simply need to activate the cellular connection. This translates to faster, less complicated and less expensive installations.

- **Global reach**: Modern cellular networks reach virtually every inhabited area of the globe. So utilities can quickly expand their smart water metering implementations virtually anywhere.
- **Easy integration with back-end management, billing and remote cloud management systems:** Cellular vendors offer mature, proven platforms to integrate data from AMI deployments into utilities' existing back-end systems, as well as to support secure remote management and maintenance of devices through the cloud. Once again, this means that utilities need not architect such solutions from scratch. They can take advantage of MDM software and partnerships on proven cloud platforms that already support millions of devices, and that employ strong encryption, secure connectivity, and secure access mechanisms.

Choosing the Right Cellular AMI Technology

Utilities and OEMs have a number of options when using cellular WWAN for their smart water AMI, including 2G GSM, 3G and 4G/ LTE. Different technologies will make sense for different markets, and each offers advantages in certain circumstances.

LTE

At first glance, LTE may seem like overkill for smart water metering, as meter communications are typically short transmissions that will not make use of LTE high-speed data rates. However, LTE is extremely power-efficient due to its much lower latency compared to other cellular technologies. In addition, as the latest-generation cellular technology, LTE offers significant longevity. Utilities need not worry whether the LTE networks connecting their meters will still be operating 10 or more years in the future. LTE is also becoming the dominant cellular technology in several markets. For OEMs focusing on North American, Japanese and Australian markets in particular, LTE can provide a well-supported, reliable, long-lasting solution.

OEMs and utilities are also now preparing for LTE for M2M (LTE-M) future technologies,

such as emerging LTE Cat 0 (Adopted in Rel 12) and LTE Cat M (Targeted to be adopted in Rel 13) standards. These new standards will bring significant benefits to the water meter industry, including lower-cost solutions due to simplified RF chain designs, leading to less expensive microprocessors and lower RF component counts in solutions, dramatic power savings (due to new low-power states or extended DRX feature), and improvements in RF penetration (Coverage Enhancement feature). Sierra Wireless is a key contributor to these standards currently being negotiated within 3GPP, with commercial availability expected in early 2017

3G

3G cellular solutions are also a sound choice from a scale, longevity and cost perspective. For OEMs prioritizing scale and time-to-market, 3G pentaband technology will allow them to use the same hardware platform in virtually any market worldwide. 3G networks don't offer the same longevity as LTE, but they are likely to remain in operation in most markets for many years.

2G

For utilities and OEMs concerned chiefly with hardware and development costs, 2G GPRS technology can provide the lowest-cost cellular solution. This option makes good sense in Europe, Latin America, Russia, the Middle East and some parts of Asia (especially China), where 2G networks are still widely used and likely to remain so for several years.

However, from a longevity perspective, 2G is less applicable in several markets, as utilities do not want to risk the massive costs of having to upgrade devices deployed in the field if they are forced to migrate to a newer cellular technology. In North America and Australia in particular, MNOs are already turning down their 2G networks and "re-farming" that wireless spectrum to expand LTE services.

There is no single "right" cellular solution, and OEMs may use different technologies for different utilities and markets. However, OEMs that plan to serve multiple markets and want to minimize R&D and implementation costs should look for cellular solutions that allow them to use the same basic module form factor for every market they serve, regardless of cellular technology.

Sierra Wireless: Helping Utilities and OEMs Fulfill the Potential of Cellular Smart Water AMI

As the global leader in machine-to-machine (M2M) communications, Sierra Wireless offers important capabilities to help utilities and OEMs make the leap to point-to-point cellular communications for AMI. Sierra Wireless can provide:

- **Flexible, scalable hardware**: Sierra Wireless is committed to providing continuity from product to product and cellular standard to cellular standard, to help OEMs scale their solutions to any market more cost-effectively. A prime example of this is the new AirPrime® HL Series of embedded wireless modules, which provides simple, scalable, secure connectivity in any market, using a single hardware footprint that accommodates variations for 2G, 3G and 4G/LTE networks. It allows OEMs to use one R&D effort, one design and one development process across all the markets they serve, regardless of cellular technology.

- **Compact, durable, low-power solutions:** The new AirPrime HL Series provides the smallest 2G-to-4G form factor cellular modem available. It is designed to reduce hardware footprint and optimize energy consumption and standby current in industrial and metering deployments. HL Series modules are also built for harsh environments. They feature conformal coating to protect electronics against moisture and extreme temperature swings, and offer solder-down integration to increase longevity in the field.

- **Mature, proven management and development platform:** The Sierra Wireless AirVantage® M2M Cloud platform provides a comprehensive solution for OEMs and utilities. It addresses the entire lifecycle of cellular devices, allowing operators to manage and upgrade deployed devices over the air (OTA) and easily integrate metering data with MDM platforms and back-end systems. The AirVantage M2M Cloud is already used in high-profile deployments around the globe, managing millions connected meters and other devicesOEMs and enterprises developing M2M applications, especially those building solutions for longer-term deployments, will need to weigh several important business questions:

- **Strong security:** Sierra Wireless technology is built to accommodate the unique security needs of any M2M implementation. The AirVantage M2M Cloud provides OTA firmware management with strong encryption using the bandwidth-efficient M3DA protocol and support for multi-factor authentication, VPN connectivity and secure access control to

protect the integrity of customer data.

- **Ready-to-deploy solutions across all cellular technologies:** Sierra Wireless has a broad and deep portfolio spanning 2G, 3G, 4G and LTE technologies. Whichever cellular technology OEMs and utilities choose, Sierra Wireless can provide pre-certified, field-proven solutions for virtually every market and cellular network worldwide.
- **Track record of leadership in smart metering:** Sierra Wireless has more than a decade of leadership in M2M, and millions of smart meters around the world use Sierra Wireless technology. Sierra Wireless has also participated in the development of many M2M standards and protocols, and continues to play an important role in shaping the future of the smart metering and M2M market.

Conclusion

The benefits of smart water metering are substantial for water conservation, recapturing lost revenue from leaks and theft, and reducing utility operating costs. Cellular technology will play an important role in the growth of the smart water AMI market as more governments and utilities look for reliable, long-lasting solutions that can be deployed quickly and cost-effectively.

Sierra Wireless is ready to partner with OEMs and utilities building the new generation of smart water metering technology. Providing flexible hardware, strong security, and a comprehensive device-to-cloud solution, Sierra Wireless can help OEMs capitalize on this growing global market and help optimize the world's water supply.

For more details, visit www.sierrawireless.com/energy.