Smart Antenna Technology Enhances AMI Network Reliability

The challenges of obtaining reliable water meter reads from pits and other harsh environments are many. Heavy rains, snow coverage, thick foliage, and human activity are just some of the many potential causes of signal transmission interference. Further, when meter pits are full of water, that water directly affects the antenna resonance frequency, causing frequency shift, decreased signal strength, and reduced transmission range.

The results of any of these obstacles and disruptions are inefficiency and unreliability that can prove costly to a utility and consume the time and energy of water system managers, engineers, and employees. For starters, there are the obvious financial implications for unreliable meter reads being delivered – literally leading to valuable revenue flowing down the drain. Unreliable connections also put a strain on batteries, by shortening their lives, thus requiring more maintenance, and leading to more frequent and costly replacements.

Beyond the direct financial impact of these temperamental network connections are the soft costs associated with unreliable performance. Crews need to be repeatedly dispatched to remedy these intermittent problems and repair or adjust equipment as needed. It's little wonder that a recent survey by Black & Veatch found that water managers list reliability as their top concern, trumping all other considerations.

Advancements targeting the challenges related to a flooded meter pit environment have occurred slowly over the years, with limited success. Now, a solution has emerged that may prove a game changer in signal transmission reliability and accuracy. This white paper will provide an overview of that solution, known as multiple resonance internal antenna technology, and highlight the many potential benefits of implementing the new approach.

The Next Critical Step In Water Consumption Management

Developed by Master Meter, this innovative new transmission technology relies on a patent-pending dual-band antenna design for their advanced metering infrastructure (AMI) solution. The antenna mitigates adverse performance effects, which flooded pits and other challenging environments and conditions present for wireless data transfer. This smart antenna technology is capable of adapting to fast-changing conditions by leaning on smart sensor technology that continuously monitors the dual inputs and automatically switches between the input measuring the higher signal strength and the weaker signal.

The dual-band antenna solution is the next step in what has been a positive evolution in water consumption measurement in recent decades. Automatic meter reading (AMR) systems and automatic metering infrastructure (AMI) have gone a long way toward automating and refining the metering process. These systems largely replaced the labor-intensive (and error-prone) practice of manually recording water consumption. This has reduced the practice of estimating monthly usage, with billing now based on actual readings, adding considerable accuracy to the meter reading process.

A breakdown of how AMR/AMI systems work offers insight into why these challenges can be so prevalent. AMR/AMI systems rely on a wireless network and several key components, including an Interpreter® endpoint register that actually records and transmits water consumption at the entrance point of houses, offices, or any civilian or industrial construction with a water connection. This endpoint accu-

rately measures the water flow in a pipe and transmits the measured data to a base station or repeater by using an advanced RF (radio frequency) network.

When conditions are ideal, all is typically well and good with this system. Yet, as any water system manager knows, ideal conditions are often the exception as opposed to the rule. The link between the endpoint and the base station or repeater can present a significant challenge. Data needs to be wirelessly transferred between these two components, but the electromagnetic wave can fade or weaken as distance increases or obstacles block transmission.

Multiple Resonance "Smart" Antenna

The dual-band antenna offers an economical solution to these challenges by adapting to harsh conditions to dramatically improve the network reliability and consistency of meter read delivery. Here's how the new technology works: The crux of the theory is based on multiple resonance antenna technology, which allows the antenna to cover more than one frequency band with a single radio. For Master Meter's application (water), one or more resonant frequencies of the antenna serve the system in instances in which water or other obstacles are present. For example, in the 450 and 470 MHz range, when water fills a meter pit, the resonant frequency shifts roughly 6 MHz due to medium diffraction. The smart-sensing technology designed into the endpoint is constantly sampling the input power levels coming in from the dual-band antenna and will select the band with the highersignal strength. The benefits of this breakthrough technology are many, offering a range of potential economic and efficiency benefits, including:

Extended battery life – Shortened battery life can prove costly from a financial perspective, in terms of replacement and maintenance costs. Beyond that, when multiplied over an entire water system, there can be a sizable negative environmental impact through less-efficient energy consumption. A stable connection between AMI end unit and data collector, offered in the dual-band antenna technology, provides increased signal strength, which limits surges and battery drain leading to a shorter battery lifetime.

Higher network reliability – As previously stated, the improved reliability is a product of the smart antenna technology that automatically adapts to changing conditions. In traditional systems, the connection is lost when the transmission frequency shifts by 5 or 6 MHz. The dual-band antenna technology accounts for this shift and adapts to the changing harsh pit environment ensuring a more consistent connection to the collector unit. Multiplied over many endpoints within a water system, this significantly improves overall network reliability, assuring that users benefit from the most consistent read delivery possible.

Increased range and endpoint performance – Many times an AMI network will be designed with flooded pit conditions in mind. The network will be laid out in a more conservative manner, requiring an increased number of AMI network elements to cover the system. The dual-band antenna technology enhances endpoint performance by adapting to changing conditions and accounting for frequency shift in a flooded pit. This ensures better continuity of service and maximum transmission range, regardless of conditions.

Reduced AMI total network costs – In many ways, Master Meter's new technology serves as the catalyst for better performance of the broader AMI network. By enhancing the range, consistency, and accuracy of readings and data transmissions — and also prolonging battery life — the smart antennas lead to fewer service calls and holes in the meter reading data within the Meter Data Management (MDM) software. That means fewer trucks on the road for maintenance and service calls, improved data accuracy, resulting in fewer billing complaints, and cost efficiency for the water system as well as its customers.

Exclusive, Efficient and Effective Solution

The patent-pending dual-band antenna technology is unique and highly differentiated from other products in the industry. The antenna is exclusive to Master Meter's Allegro AMI system, a robust RF communication network that interfaces between water ultilities and their residential and business customers. The tower-based system operates in the licensed 450 to 470 MHz frequency spectrum. While offering considerable capabilities, Allegro also features plug-and-play simplicity that promises easy and intuitive installation, because the endpoints and repeaters automatically connect to the base station's preprogrammed frequency pairs. With the backhaul connected via a cellular network, interval data is transmitted along a reliable and stable path. In addition, the propriety RF protocol incorporates a time-synced system to alleviate network RF collisions and provides time-stamped data.

The state-of-the-art technology and capabilities incorporated into the Allegro system are only enhanced by the addition of the dual-band antenna technology that helps assure more consistent, accurate, and reliable operation of Allegro when conditions are less than ideal. To date, Master Meter customers are already experiencing positive results from the solution. More than 30,000 endpoints have been installed with the dual-band antenna technology, leading to improved performance and reliability for water systems of varying sizes.

The harsh conditions that exist in pits and other unfriendly meter environments will always be a challenge to any water system. Yet improving technology like Master Meter's dual-band antenna promises to significantly enhance reliability by making the most efficient use of network components and maximizing the RF footprint. By synchronizing and improving the communication between the endpoint and collector, the result is the most cost-effective AMI system available today. ■

To find out more about Master Meter's dual-band antenna technology, visit: http://www.mastermeter.com/en/Allegro-Water-AMI.html or contact your local Master Meter representative.