Antenna selection is critical for successful wireless water meter reading applications

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Water utilities worldwide are increasingly migrating to wireless to enable automated meter reading (AMR). By 2016, annual wireless water meter shipments will hit 10 million worldwide, with the majority going to North American utilities, IMS Research predicts [1]. In 2010, North American utilities accounted for 70 percent of the $500 million global wireless water meter market, IMS says.

Water utilities wouldn't be investing in wireless AMR if they didn't believe that it has a strong business case. A key consideration to achieving those bottom-line benefits is selecting the right wireless architecture. That's not as straightforward as it sounds.

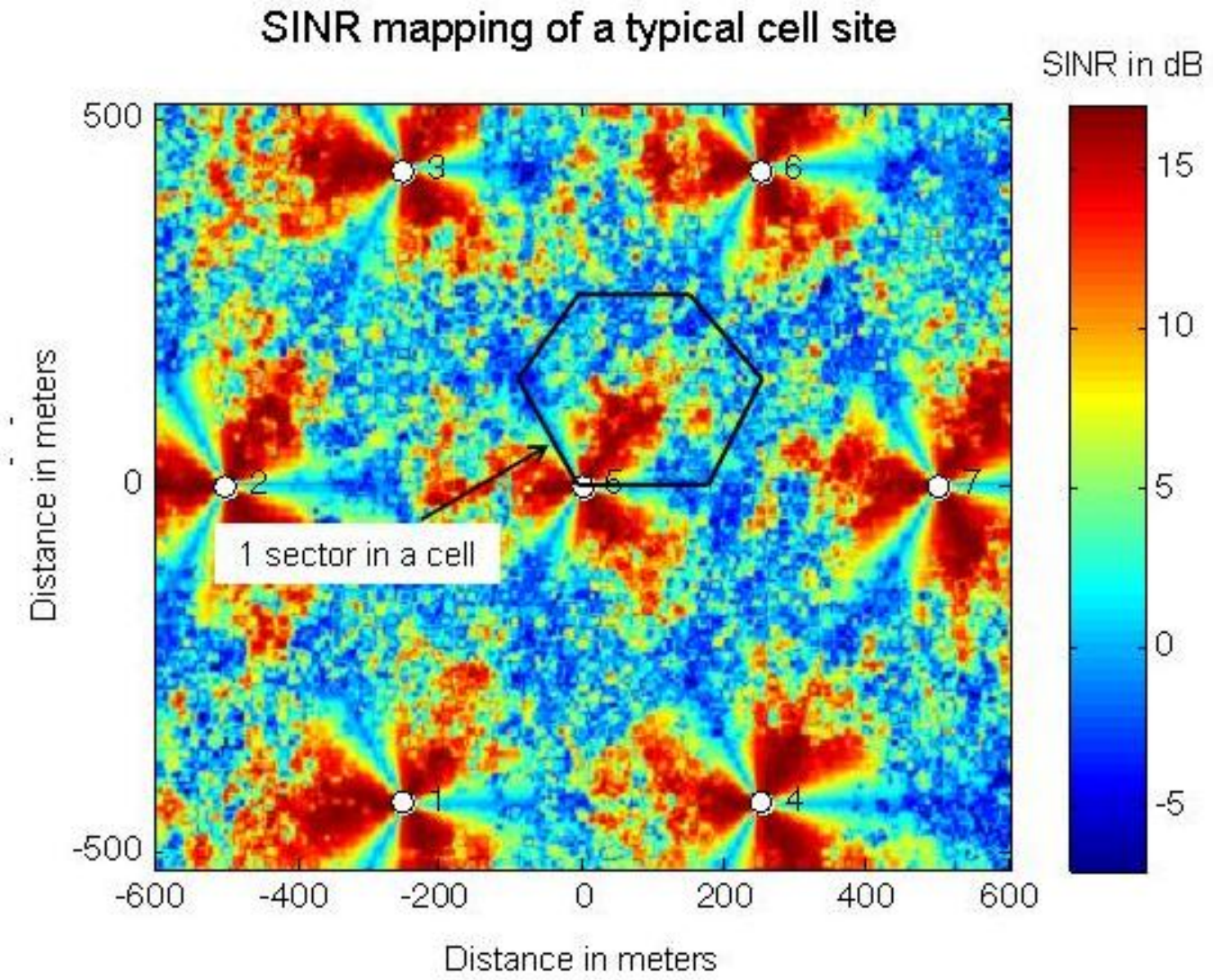
One challenge is that there are so many potential bands spaced so far apart: from 400 MHz through 900 MHz and up to 2.4 GHz, including 2G/3G/4G cellular and the industrial, scientific and medical (ISM) frequencies. Signals travel farther at lower frequencies, making 400 MHz and 900 MHz attractive because the collector network needs fewer base stations. That reduces the cost of building and operating the network.

The catch is that lower frequencies require larger antennas, and finding room for them can be a challenge. Although water meters look big, the space available for antennas is frequently minimal and in less than an ideal RF environment. So when systems designers are selecting an antenna system solution for AMR applications, it helps to focus on RF vendors that have extensive experience in the cell phone and tablet markets because they've proven their ability to work in tight spaces.

Here's why: Cell phone and tablet antennas are typically custom solutions because each device has different spectrum band requirements and a unique, limited amount of space available inside for the antenna. The more cell phones and tablets that an antenna vendor has designed and implemented, the more likely that it has an existing solution that can be quickly and cost-effectively adapted for a water meter application. That in turn reduces the module's development costs and time-to-

market.

However, some water meter applications still require a custom antenna solution. One common reason is the unusual and challenging environments that water meters are in. Some meters are installed in underground vaults or deep inside buildings, both of which make it difficult for the antenna to connect to the outside collector network. In other cases, the antenna is mounted inside the meter, whose metal or composite case attenuates signals, requiring an antenna solution capable of punching through.



An off-the-shelf antenna might sound like the fastest way to bring products to market quickly. This can prove false when the product is sent to carriers for certification or when the devices are deployed in the field. At that point, it’s expensive and time consuming for the OEM to find an antenna systems company to design a custom antenna solution capable of providing the reliable connections that water utilities require.

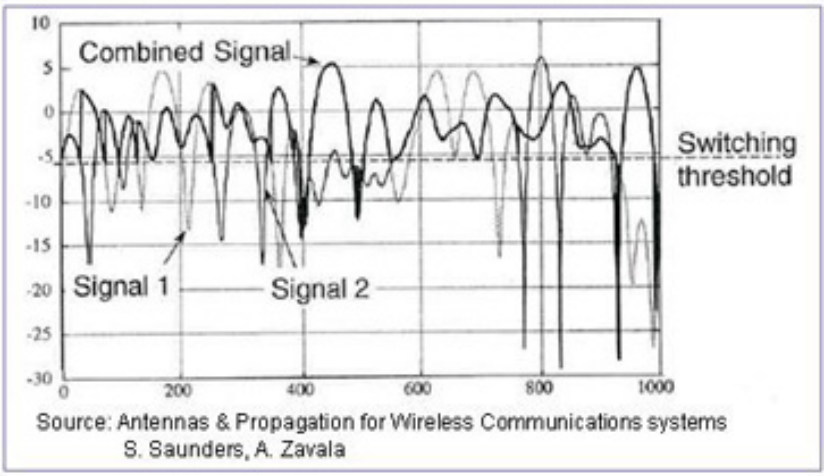
ISM or Cellular? Active or Passive?

If the utility wants to use cellular rather than ISM frequencies, another consideration is wireless carrier certification. This is another example of the benefits of working with an antenna supplier that has extensive experience in the cell phone and tablet

markets: the antenna systems vendor has significant experience with TIS and TRP testing, so they can provide an AMR product that passes certification the first time, reducing development time and avoiding the expense of reengineering.

A related consideration is whether to use an active or passive antenna. Active antennas can be dynamically tuned, through active components and algorithms, to cover significantly wider bandwidths, achieve 50% smaller physical volumes and provide more degrees of freedom in the design process. That flexibility can help with certification because they can be quickly and cost-effectively modified to meet a particular carrier's requirements. With both cellular and ISM, that flexibility also enables an active antenna to be modified to meet unique customer requirements, such as installing the antenna system by a metal surface that would wreak havoc with a passive antenna.

When water meter applications use cellular, they currently use 2G, 2.5G and sometimes 3G. But a growing number of carriers, have announced plans to shut down their 2G and 2.5G networks within the next few years. As a result, some machine-to-machine (M2M) applications are now considering 4G LTE. Although 4G modules are currently more expensive simply because LTE is a relatively new technology, many M2M customers are willing to bear that cost because it's cheaper than replacing 2G, 2.5G or 3G modules after the carrier has shut down those networks.



Active antennas are ideal for 4G applications because they can be dynamically tuned to cover all of the 4G bands while remaining physically small. They also can support fallback to 2G/3G bands, such as when a utility decides to deploy 4G modules as future proofing but needs to have them operate on a 3G network for the first few years. A passive antenna must provide full instantaneous bandwidth, so it has to be physically large enough to cover all of the 3G and 4G bands. That length can be a problem in water meter applications where space is limited.

An active antenna also can help future-proof against the changing physical environment around each meter. For example, a building might get remodeled in a

way that affects the antenna's ability to connect to a particular collector or base station. With a passive antenna, that might result in connections that are unreliable. But an active antenna system can create multiple radiation patterns and sample and switch between them in real-time using an algorithm to maintain a reliable connection. This technology can help the meter to maintain a connection when the environment around it changes, such as when a large truck is parked by the meter and blocks the normal signal path.

That real-time capability is particularly valuable for dealing with multipath, which occurs when objects in the path between the antennas on either end of a communication link – walls, buildings, vehicles, equipment, people, etc. – cause the signal to scatter and ping-pong. The signal level received at the antenna will fluctuate because of the multiple reflected signals adding in and out of phase. If the fluctuation is low enough, the link is lost, causing the data session to end. Activate antennas have the unique ability to overcome multipath.

Finally, regardless of whether the environment changes or remains fixed, an active antenna also can provide significantly better performance including efficiency than a passive one. Higher efficiency enables better performance and longer range for a network design with fewer collectors, reducing the cost of building and operating that network.

Choosing the right antenna system solution is key to ensuring that wireless water AMR implementations live up to their potential in terms of savings and operational efficiency. The right antenna system also enables module vendors, integrators and other M2M companies to develop competitive, market-differentiating solutions quickly and cost-effectively.

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