Introducing "Private Mobile WiMAX"

By Carl Townsend

How one company is leveraging the 802.16e mobile WiMAX technology profile to work over a wide range of spectrum and channel sizes to serve the demands for smart grid and other niche vertical applications. Interview with Stewart Kantor, CEO of Full Spectrum.

New electrical utility smart grid and other vertical applications are placing ever-increasing demands on existing data networks. Starting initially with smart meters, electric utilities are needing to use their existing data networks for new mission critical distribution automation applications - including re-routing power in real-time from one geography to another where it is needed most.

Today most utilities typically operate their own private wireless mobile networks, delivering voice and a limited amount of data connectivity over a wide variety of technologies in both licensed and unlicensed bands.

While unlicensed spectrum solutions may have worked in the past in the most remote rural areas, the increase in new smart grid and work-force applications has driven the need for licensed solutions that can deliver consistent, high data throughput without possible interference from other networks.

Of course obtaining licensed spectrum comes with its own set of challenges. Utilities are not always able find the spectrum they need, and assuming they do, are often at the mercy of obtaining it from the spectrum holder.

One company founded in 2006 has come up with an interesting approach. "We went out and listened to what customers said they wanted," says Stewart Kantor, CEO of Full Spectrum. "One of the things that utilities told us is that they wanted to use licensed frequencies with their existing tower locations."

In fact according to Kantor, almost every utility in the country has their own tower sites for their existing private LAN mobile radio systems. "They all have mission critical voice applications that they run on their own," says Kantor. "What we wanted to do was use their existing tower infrastructure with our base stations over the same frequencies they use for LAN mobile radio and provide them similar coverage."

Coverage is indeed one of the challenges as some utilities have up to 50% of their service area not covered by their existing networks. Utilities often operate in a mix of dense urban to extreme rural areas and need the flexibility of operating in both.

The solution came in the form of a highly-customizable software defined radio. The company has developed a single radio that covers all frequencies between 40-958 MHz. The operator can tune it based on the frequencies he has access and only needs to change the antenna. "We took the mobile WiMAX standard and modified it to work in low frequencies below 1 GHz and in very narrow channels at higher power," says Kantor. "For example, in the 217 MHz band there are 2x 500 kHz channels that we can operate 4 watts of transmit power and can do this for both mobile and fixed data."

> *"With our technology operating at 217 MHz utilizing 500 kHz channels at 4 watts, we are able to achieve a coverage radius of 20 miles (1,200 square miles)."*

In fact, Kantor often refers to Full Spectrum's technology as "inverted WiMAX" since it replaces high spectrum, wide channels and low power with low spectrum, narrow channels and high transmit power.

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While the negative side of using narrow channels is less throughput or data capacity, the advantage is that it propagates much further. Of course customers that need higher data rates can achieve them assuming they have more spectrum to work with. Additionally, because of their lightly loaded network approach, utilities can increase data throughput with aggressive frequency reuse, taking the same narrow channels and using them in three sectors to increase data rate three times when needed.

"Take the Sprint/Clearwire network in Baltimore as an example," says Kantor. "Utilizing 2.5 GHz spectrum in a 5 MHz channel at 200 milliwatts provides a coverage area of about 1.5-2 miles (12 square miles). With our technology operating at 217 MHz utilizing 500 kHz channels at 4 watts, we are able to achieve a coverage radius of 20 miles (1,200 square miles)." The savings from not having to put additional towers can add up quickly, with additional towers costing up to $250,000 each, not to mention the long lead times required.

But just how much capacity do utilities really need and what kind of performance can they get with such narrow channels? In the past, the data demands of devices have been low, but the proliferation in the number of units and the use of new application such as video is pushing this further.

"Today utilities that use 9.6 kbps to communicate are now looking for 1 Mbps," says Kantor. "They want to do video streaming for security and Wi-Fi at the sub-station for VoIP phones, and other work-force applications. While not all of the devices may be operating at high speed, there are now literally thousands of smart grid devices and the network needs to be able to handle all of them reporting frequently."

"For our radios, a good average number between QPSK modulation and 64-QAM at 2 bits per second per Hertz in a 500 kHz channel would be around 1 Mbps," says Kantor. "Customers that have 6MHz of spectrum to work with can achieve up to 12 Mbps, increase this to 36 Mbps with 3 sectors and frequency reuse."

But why not just piggy-back off the data networks of one of the major 3G or 4G carriers? With their new data networks being built-out, Verizon, AT&T and others are aggressively marketing their services to utilities for smart meters as well as other M2M (machine to machine) applications in other industries.

"While providing services for automated meter reading is very competitive with many cellular companies participating, we feel that utilities eventually are going to want to move to a licensed, private solution," says Kantor. "Some utilities may choose to use cellular in the short term, but with the complexity of smart grid technologies will eventually want to move to their own private network, especially with something this mission critical."

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Although not able to disclose the names of specific companies, Full Spectrum is planning pilots this summer with several large US public utilities, testing the equipment and applications in various frequency bands and channel sizes. They will be testing performance of frequency, range, data-rate as well as distribution automation and mobile workforce management applications. The results of the testing will be used to determine which applications work best in a given spectrum and geography.

So why use mobile WiMAX as opposed to other wireless technologies? "We often have to explain to customers why we chose WiMAX," says Kantor. "We could have chosen LTE and made the changes, but we figured the robustness of WiMAX for TDD and quality of what you get with the standard made it the right choice."