WiMAX moves ahead

By Cheryl Ajluni

While 802.16e is now official and 802.16-2004 certified products have begun making their way to market, many obstacles still threaten to block WiMAX's adoption as it takes the next steps forward.

In recent months, WiMAX has taken significant steps forward. In December 2005, the 802.16e (mobile WirelessMAN) standards development project, which was begun in late 2002, finally reached completion. Earlier this year, 802.16-2004 WiMAX Forum Certified products began arriving on the scene. The official certification of four such products (Aperto Networks' PacketMAX 5000 base station, Redline Communications' RedMAX AN-100U base station, SEQUANS Communications' SQN2010 SoC base station solution, and Wavesat's miniMAX customer premises equipment (CPE) solution) was announced in mid-January. Additional certification announcements are forthcoming. Despite all of these recent successes and completion of critical milestones, a number of obstacles, such as CPE availability and cost, still lie ahead for deployment of WiMAX.

Recent success

The end of 2005 marked a unique first for WiMAX—the launch of the world's first mobile broadband network based on the 802.16e standard. The WiBro personal broadband service from Korea's KT (www.kt.co.kr) demonstrates how mobile WiMAX technology can be used for the real-time delivery of multimedia-rich applications to mobile handsets. It is proving, on a daily basis, that mobile WiMAX may indeed soon become a reality for consumers worldwide.

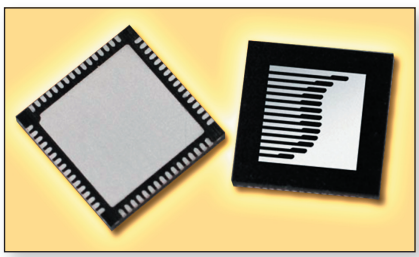

Figure 1. Sequoia's SEQ5400 multimode transceiver chip, based on its FullSpectra polar architecture, not only achieves a high level of integration, but also lowers the cost and increases the battery life of 3G phones.

Further bolstering the existing efforts under way in Korea, the WiMAX Forum (www.wimaxforum.org) announced its selection of Telecommunications Technology Association's (TTA) IT Testing & Certification Lab in Seoul, Korea as the first WiMAX Certification Lab in Asia. The TTA Lab (www.tta.or.kr) is an organization established to develop new standards and provide third-party, independent testing and certification services for a range of standards-based telecommunications and IT products. It is expected to begin receiving mobile WiMAX equipment for certification testing in the fourth quarter of 2006, with the first commercial mobile WiMAX products achieving WiMAX Forum Certified designation by the first quarter of 2007. Deployment of networks will follow shortly thereafter.

On top of this, the last six months have witnessed a slew of new WiMAX-related products. One such product is the Morpho Technologies' (www.morphotech.com) integrated 802.16e system solution. Comprised of the new reconfigurable MS2 PHY communications engine, MT 802.16e SoftPhy software and MT 802.16e MAC software, it provides semiconductor companies a significantly quicker and lower risk entry into the WiMAX market. Another product, the SEQ5400 single-chip WEDGE transceiver from Sequoia Communications (www.sequoia-communications.com) can support multiple air interface protocols and enables effective communications across numerous wireless standards, including WCDMA, EDGE, GSM/GPRS, GPS, Wi-Fi, WiMAX and more (Figure 1).

All of these achievements mark significant progress forward in establishing WiMAX as a key mechanism for delivering personal broadband to consumers around the globe. That does not mean, of course, that WiMAX has resolved all of the obstacles in its path.

Obstacles ahead

According to Jeff Orr, director of marketing, WiMAX Forum, "Many of the obstacles that exist today are less about technical issues and more about marketing. For example, we've had to deal with the issue of whether or not WiMAX is competitive with tradition-

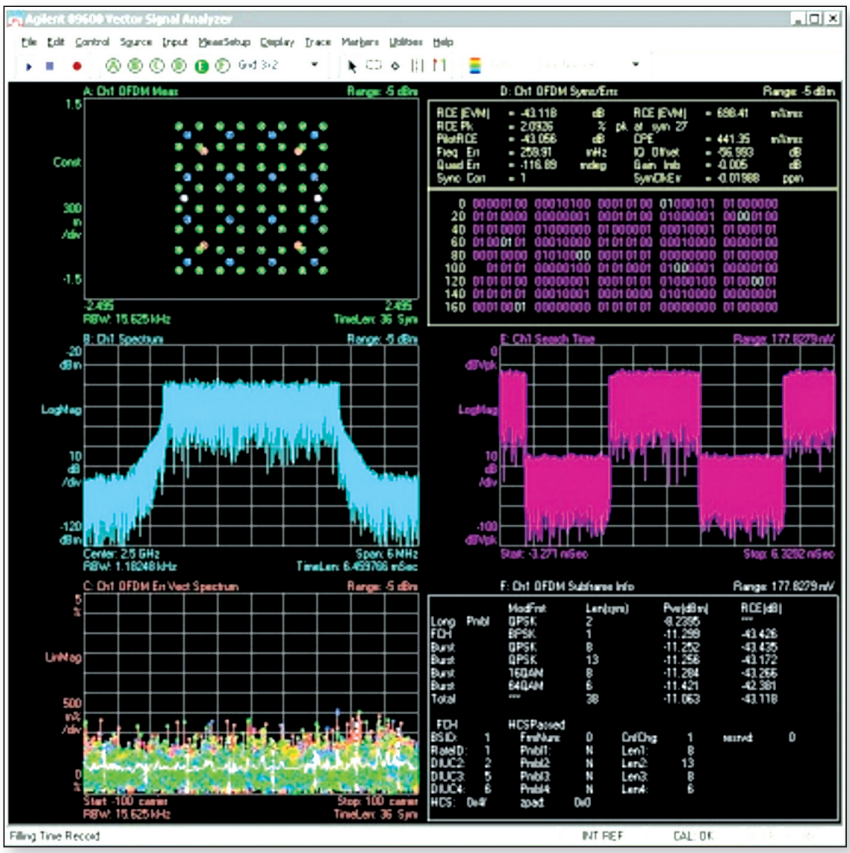

Figure 2. Companies like Agilent, with its 89600 series vector signal analyzers (VSAs), are uniquely able to address the emerging RF test needs for WiMAX vendors. Here, the 89600 VSA WiMAX screen shot shows the multicolor constellation diagram.

al cell phone service or Wi-Fi. Rather then being competitive, we envision a scenario in which multiple networks are co-existing. Spectrum policy is another issue. While it is not necessarily an obstacle today, it could easily become a barrier one day if ignored. As an industry, we need to make sure that more spectrum is allocated or reclassified for services." The WiMAX Forum currently promotes a means of spectrum access that is technology neutral. It is lobbying for this change through its regulatory working group.

Chris Baumann, wireless business unit director for Atmel Corporation (www.atmel.com) asserted that one obstacle may lie with certification. As he explained, "With any standard, the certification process can be quite tedious and difficult. This is especially true for WiMAX, as many early vendors trying to transition from WLAN or proprietary approaches have had performance issues with meeting certification requirements."

These same vendors may also face difficulties stemming from the fact that they only have pieces of the WiMAX system, as opposed to a total system solution (radio, baseband and MAC). In this instance, partnering on a system solution becomes critical. The recent announcement of a miniPCI solution between Atmel and WaveSat (www.wavesat.com) is a perfect example of such partnering.

For many vendors though, the first issue they face when it comes to WiMAX is the uncertainty over rollout. Do they roll out a fixed system based on 802.16-2004 where all the profiles have been defined, or wait for mobility? In the latter case, 802.16e has only recently been released and its profiles are still largely pending; creating a hold up in the physical radio and baseband implementation and resulting in a delay of the physical platform being available to start the certification and product cycle. On the other hand, with no clear migration of fixed to mobile solutions from a system integrator perspective, those who jump in now with a fixed solution may have to redeploy a separate mobile solution later.

Some of the other key obstacles facing WiMAX today include:

■ **Time-to-market pressures.**

More often than not today, to meet the ever stringent time-to-market pressures, the RF, baseband and digital pieces of the WiMAX chipset are created by different groups working in different geographic regions. To make this development work though, system modeling tools such as the Agilent EEsof EDA (www.agilent.com) Advanced Design System (ADS) are required. By accurately predicting performance, it allows the different groups to progress with their work despite the fact that they may not have all the blocks in development in one place.

■ **Mobile profiles, tests and test models needed.**

Now that 802.16e is official, profiles, tests and test models need to be defined. Mobile profiles are critical to the timing of mobile solutions. Decisions on frequency bands, bandwidths, FDD, HFDD or TDD have to be made before viable system solutions are available. Additionally, tests and test models are critical for companies pushing to have their products on the market in late 2006 or early 2007.

A potential solution to a lack of profiles is the use of an advanced radio platform that takes into account the radio needs of mobile, as well as fixed standards. One such solution comes from Atmel Corporation. It allows for metal mask variants of the radio platform to align with the emerging profiles with minimal time and effort. In addition, test and measurement companies are now actively working to fill the need for tests and test models by leveraging experience with 3G and 3.5G; both of which share a lot of the same core modulation formats with WiMAX.

■ **Network synchronization.**

Symmetricom's (www.symmetricom.com) business development manager, Barry Dropping, noted that "One of the key implementation advantages of WiMAX over 3G is its relatively flat, all IP architecture." As a result, WiMAX can be rapidly deployed in a

simple and flat structure. At the same time though, as the technology moves forward to support full mobility profiles, key technical challenges arise. According to Dropping, "Many customers are now focusing on network synchronization and other quality of service (QoS) mechanisms required for advanced mobile services. Seamless handover is always one of the key technical challenges for new mobile networks."

■ **Processor loads.**

Most fixed solutions have a dedicated processor to run the MAC and system software. However, many proposed mobile solutions use an existing processor in the mobile application (laptop, handheld, etc.) to run the WiMAX software. Vendors must determine how much processing power is available and will be used in a mobile solution. Also, they need to understand what impact using an existing processor from the application would have on the performance of the remaining applications. Addressing this issue may mean the use of additional co-processors with increased power and cost, or a more powerful main processor.

■ **RF test equipment.**

According to Phil Lorch, WiMAX program manager for Agilent's signal analysis division, "We see two primary categories of companies interested in WiMAX: those coming from a WLAN background and traditional cellular companies. For those companies used to working with WLANs (e.g. chipset vendors), working with WiMAX is a new experience and requires a great deal of education." Because WiMAX blends RF and analog measurements with digital baseband, it also requires them to face a new set of test problems, which in turn is creating an emerging market for RF test equipment that can be used in R&D as well as in manufacturing (Figure 2).

■ **Power consumption.**

Since mobile WiMAX solutions will incorporate a battery for consumer applications, power consumption becomes a major issue. Fixed WiMAX solutions consume between 4 W and 5 W of power in operation, but this level is too high for viable battery life in mobile laptops or handhelds. Current solutions allow less than one hour of operation in a typical laptop and less than half an hour in a cell phone. The average use time for mobile applications would, therefore, need to be minimally doubled or tripled.

Given the current state of the art in physical silicon for the system, reduced power consumption may be difficult to achieve. The radio and baseband power can be reduced by using technologies in the <0.13 μ range, but it will take time to develop advanced radios and basebands and still meet the other standard requirements. Another proposed solution from Atmel calls for implementing next-generation radio designs in low-power RFCMOS at aggressive technology nodes.

■ **OFDMA issues (deployment cost, performance and technology maturity).**

According to Byron Young, vice president of marketing and product management for ADAPTIX (www.adaptix.com), "mobile WiMAX and other broadband wireless access (BWA) technology operators will want to prove in the technology at a relatively low cost of capital. Unfortunately, the traditional model of large, expensive macro-cell base stations flies in the face of this goal with typical CDMA or WCDMA macro base stations building out to $100K or more." A lower cost of entry for initiating mobile WiMAX services will be crucial for widespread deployment.

The issue of performance also poses an interesting challenge. Consider, for example, that OFDMA-based mobile WiMAX presents a compelling technology for boosting per-user and aggregate per-sector data throughput. While this makes WiMAX/OFDMA ideal for multimedia services like video on demand, mobile IPTV and direct-to-player music downloads, achieving these high connection rates means that users must be in close range to the base stations. For multimega-bit rates that range is usually within 1 km to 5 km. According to Young, "This means that ideal deployment scenarios for mobile WiMAX will involve smaller cell radii with a much larger number of deployed sites. In turn, this will bring about the need for micro or even pico cell deployment models with average coverage in the sub-5 km range. Clearly, existing macro base stations will not meet this need."

In addition to deployment cost and performance, the fact that OFDMA is a relatively new technology means that very few companies have direct experience developing and deploying working systems. Those companies that have announced intentions to build mobile WiMAX solutions have been working in this space for less than a year. Past history has shown though that new wireless technologies require at least three to four years of active development and deployment time prior to deployment on a wide scale.

A company like ADAPTIX, who has been developing OFDMA since 2000, will likely be among the first to market with deployable products. It has the experience required to deal with the complexity of implementing WiMAX's sophisticated PHY and MAC level algorithms.

Conclusion

There is an undeniable, growing interest in WiMAX from a large group of widely diverse companies. Chipset vendors and companies that make modules and subsystems are now throwing their support behind WiMAX. Even traditional fixed-line companies are getting involved in the hope that it may provide a way to compete with the cellular industry.

To date, there are substantially more license holders for things that could potentially use WiMAX than there are license holders of 3G spectrum. And, while it may take up to two years before WiMAX reaches mainstream adoption, trials are now under way. Greatly adding to its chances of success, WiMAX is one of the few global standards in existence today; making it much more attractive for vendors looking to deploy WiMAX networks. With such a level of interest and the continuing work of organizations like the IEEE 802.16 Working Group and the WiMAX Forum, WiMAX looks to have a bright future indeed. EWT