



WiMAX, LTE and Broadband Wireless Worldwide Market Trends 2008-2014 -5th Edition-

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EXECUTIVE SUMMARY

Maravedis is proud to provide you with the 5th annual edition of our analysis of broadband wireless worldwide trends. We have been part of this emerging industry for almost a decade. The report has been completely rebuilt in order to reflect the many changes that occurred in the industry since the last edition.

FIXED MARKET TRENDS

The fixed/portable broadband wireless access equipment market (sub-11 GHz) has grown from US\$562 million in 2005 to US\$1.2 billion in 2007. Maravedis predicted this in the 4th edition of this report.

WiMAX is an important, highly visible part of the evolving fixed/portable field and is gaining momentum with the recent BSNL deployment announcement as well as Sprint's 4G vision. However, the WiMAX fixed deployments market is diverse and includes service for other technologies including DOCSIS, TD-CDMA, and proprietary equipment such as Canopy from Motorola.

The fundamentals for continued growth of broadband wireless remain sound. Broadband is becoming a necessity for many residential and business subscribers worldwide. The demand is exploding as the pricing of broadband services is rapidly decreasing. There were close to 350 million broadband subscribers worldwide at the end of 2007, up from 130 million at the end of 2004.

More than 200 million users still access the Internet with dial-up analog technologies, and more than 900 million are using the Internet occasionally but do not subscribe to a monthly service. The opportunity for BWA/WiMAX to serve those who want to switch to broadband service is huge in many parts of the world where wireline technologies may not be feasible.

WiMAX – as part of a growing market for point-to-point backhaul and grid networks that connect increasingly to localized servers and storage and for person-to-person and group communications, entertainment, and file sharing – will see rapid growth from its current starting point.

Select Key Findings

- ⇒ CPE shipments totaled US\$644 million, while base stations were valued at US\$547 million, for a total BWA and WiMAX market of US\$1.2 billion in 2007.
- ⇒ Europe and Asia represented the largest market opportunities with 22% each. The Middle East and Africa region is increasing quickly to reach 16% of the total market size, from being marginal in 2004.
- ⇒ WiMAX-certified (802.16-2004) equipment market size reached US\$172 million, representing 14% of the total market size.

- ⇒ Motorola was the leader in BWA and WiMAX combined markets , with a 23% market share, followed by Alvarion at 18%.
- ⇒ The average cost of a WiMAX 802.16-2004 baseband IC has decreased from \$35 in 2006 to less than \$20 today. The cost of an RFIC was also cut in half from \$20 in 2006 to less than \$10 today.

BWA/WiMAX SERVICE PROVIDER TRENDS

Most of the current deployments of BWA/WiMAX systems are still being driven by greenfield operators in licensed bands or by WISPs that are using unlicensed spectrum. However, Maravedis believes that 2G operators and incumbents in developing countries will constitute an important driver for WiMAX adoption, as illustrated by the recent BSNL announcement. Our team conducts regular interviews with WiMAX operators worldwide as part of our WiMAXCounts service¹ to understand their WiMAX business models and plans for the future. Important results of these surveys are presented in this report.

Select Key Findings

- ⇒ WiMAX operators care about certification, standardization , and economies of scale in the medium to long term, but they want robust equipment with NLOS capabilities today. The case of BSNL or Clearwire is an illustration.
- ⇒ Operators are anxious to see the development of rich ecosystems that comprise handset suppliers and application developers.
- ⇒ 65% of service providers interviewed prefer to wait for the 2005 version of WiMAX to be available before investing large amounts into network build -out or expansion. 802.16e-2005 is now increasingly perceived as a total solution for both fixed and mobile applications.
- ⇒ At the end of 2007, there were 1,650,000 BWA and WiMAX subscribers (based on 250 WiMAX operators analyzed in Maravedis' Operator Tracking Service , WiMAXCounts).
- ⇒ About 635,000 subscribers were using 802.16-based WiMAX technology as of Q3 2007.
- ⇒ At the end of September 2007, WiMAX service revenues among WiMAXCounts operators totaled US\$668 million, with recorded ARPU of US\$45.08 and US\$144.27 for residential and business subscribers, respectively.
- ⇒ The split by subscriber type among WiMAXCounts operators was 64% residential and 36% business.

MARKET DRIVERS

Government initiatives to reduce the digital divide are making gains for broadband wireless. Countries including Australia, South Korea, Taiwan, and the United States have programs in place today, along with a push by the European Commission for more flexible spectrum policies.

¹ www.wimaxcounts.com

A lack of uniform and widely available Internet service is the primary reason that dial-up Internet access remains available. Countries including India, Brazil, and Russia remain dominated by dial-up users.

As individuals, businesses, and communities demand broadband access anytime and anywhere, the need for high-speed, IP backhaul flourishes. Growth in broadband wireless network backhaul will occur, but it remains a guessing game as to when the major expenditures in capacity increases will occur.

Consumer value-added services that operators can offer to differentiate services over broadband wireless networks include home networking, music downloads, online gaming, video on demand (VoD), and voice over IP (VoIP).

2007 trends in wireless services included operator walled gardens being poised to fall in favor of semi-open networks; experimentation with unlimited data plans; the ITU adding a new 3G interface and allocating 4G spectrum; consumer electronics devices to overcome PC side-loading; and the continual FMC hype.

WiMAX PROGRESS

The ecosystem vendors participating in the WiMAX Forum topped 500 in 2007. Unless the group can attract new companies representing device manufacturers, application developers, and content owners in 2008, its membership critical mass may have been reached.

Network operators are the largest segment of the WiMAX Forum. Most 3G mobile operators have remained focused on current services and are not participating in WiMAX trials or deployments, which are dominated by new entrants and landline broadband providers. The WiMAX industry entered 2007 as a year for ecosystem build-up in preparation for regional and nationwide deployments of WiMAX services. 2008 appears to be a make-or-break period for WiMAX.

Select Key Findings

- ⇒ As predicted, more than 100 Mobile WiMAX devices have been announced or made available commercially
- ⇒ While certification of conformance and interoperability is the WiMAX Forum's main charter, it failed to deliver on the promised Mobile WiMAX certified products in 2007. Mobile WiMAX certification kicked off in December for the Release 1.0 certification program within the 2.3 and 2.5 GHz frequency bands. Complexities associated with developing mobile test procedures have resulted in narrowing of requirements into waves and phases.
- ⇒ The 3GPP/3GPP2 mobile industry has responded to development of WiMAX and other moves for open access by accelerating 3GPP LTE. LTE has been positioned as the evolution of 3G to Universal Terrestrial Radio (UTRAN), while opponents position WiMAX as a system limited to Broadband Wireless Access. Despite active pursuit of IMT-Advanced, the WiMAX Forum has not effectively positioned WiMAX technologies as an evolutionary platform for the wireless industry.

- ⇒ Operators are obtaining guarantees from equipment suppliers that WiMAX networks will be upgraded to Certified status when those certifications become available. Operators are also opting to single-source initial network build-outs, on a city-by-city basis.
- ⇒ Initial 802.16m proof-of-concept systems will appear in early 2010, with certification of commercial systems possible as early as the first half of 2011.
- ⇒ Rather than a primary focus on emerging markets, Cisco will target WiMAX development at smart distributed wireless networking. The longer term goal is dominance of “the WBB network as the new computer.”

SPECTRUM AND REGULATORY TRENDS

Maravedis frequently talks and shares information with regulators worldwide. This dialogue is reflected in our detailed online database, ClearSpectrum.²

There are many regulatory issues that Maravedis tracks and is involved with. Some are in a constant state of evolution and reform, which affect WiMAX and other evolving aspects of wireless. These include the lack of sufficient spectrum for commercial deployments in important countries like India and Russia, a level of uncertainty on the part of regulators regarding the timeline of future spectrum availability, and the lack of harmonized spectrum and regulation for BWA/WiMAX.

Select Key Findings

- ⇒ The ITU recommendation adding WiMAX as an official 3G protocol has already yielded positive results with new spectrum auctions. In the Netherlands and New Zealand, spectrum winners pledged to roll out WiMAX networks in bands previously exclusive to 3G mobile phones.
- ⇒ Spectrum suitable for future mobile broadband services in the 2-3 GHz range along with sub-1 GHz spectrum has been allocated by the ITU for future IMT services.
- ⇒ Opportunities exist in sub-1 GHz spectrum for both WiMAX and LTE protocols. 700 MHz appears to be a common band of interest in multiple geographies.
- ⇒ Ongoing spectrum allocation activities for mobile broadband are underway in Brazil, France, Hong Kong, Italy, Japan, New Zealand, Norway, Portugal, Sweden, Switzerland, Taiwan, Thailand, United Kingdom, United States, and others.

STRATEGIC COUNTRIES

Maravedis has recently published specialized country reports detailing the opportunities and challenges in Brazil, India, Russia, and the USA. We believe that understanding the overall worldwide market trends requires in-depth knowledge of those strategic countries, which represent half of the world's population and are showing record wireless adoption in the last few years.

² www.clearspectrum.net

We believe that broadband wireless technologies and WiMAX in particular will have great success in those markets because they are well suited to meet the growing needs of residential, business, and government users. This year we added Taiwan, Japan, and Australia to our list of strategic countries for WiMAX because of the recent spectrum allocations and government initiatives that are boosting the potential for WiMAX success in those countries.

4G CONVERGENCE

The number of mobile subscribers worldwide reached 3 billion at the end of 2007 and is predicted to rise to 4 billion by 2011.

Whether it is 3G, 802.16e-2005, or TD-CDMA, the success of mobile broadband will be driven by the development of user-friendly applications and handsets. In this section, Maravedis provides a fresh overview of the applications driving the mobile broadband market, including mobile music, multimedia messaging, gambling, and mobile TV.

Highly demanding business users will fuel the concept of personal broadband for productivity, but the mobile consumer market will represent the lion's share of mobile data services in the long term. End-users are no longer just consumers of media applications; they are becoming producers of content such as photos, videos, music, and additional formats sent wirelessly.

WiMAX and LTE are converging upon 4G technology that includes seamless hand-over, QoS, security, and higher-level compatibility such as user authentication and billing across yet dissimilar low-level interface networks. As the broad industry IC manufacturers become the primary arbiters of WiMAX and LTE IPR, use of both will have fewer barriers and costs than for 3G. WiMAX will retain an open market advantage despite pressure for LTE to open up technology and network access.

Select Key Findings

- ⇒ The case for WiMAX with alternative operators is clear-cut: WiMAX can now offer a unified fixed-mobile solution with highly competitive, open-market Internet and custom tailored services.
- ⇒ WiMAX is part of the converged 4G wireless future but can have stand-alone merit for an individual business case.
- ⇒ WiMAX benefits from allies including Google, eBay, Microsoft, and a host of Internet and wireless service providers, while LTE attempts to craft semi-captive solutions and revenue-sharing agreements.
- ⇒ While LTE may enter the market as early as late 2009 according to Nokia and Ericsson, their primary market – 3G operators – will be unlikely to adopt LTE until several years later. That lag between 3G and the next generation network will greatly benefit commercially available technologies, such as WiMAX.
- ⇒ WiMAX has the Apple Macintosh “1984” Marketing Advantage: Its uniqueness and Internet orientation will have strong appeal to early adopters and those who will rebel against the contrived nature of the cell phone.

⇒ The evolution of networks to femtocell will evolve further to SDWN (Smart Distributed BWA Networks), which favors more control by users, in turn favoring WiMAX over LTE.

WiMAX PATENT PORTFOLIO, POLICY , AND MARKET ANALYSIS

Patents and other intellectual property are a vital spur of technological and market development. At its best, the patent system helps stimulate engineers, mathematicians, scientists, and other talented people to toil diligently in pursuit of inventions that benefit themselves and society in the process. WiMAX and other advanced fields of wireless are built on the accomplishments of thousands. IPR for IEEE 802.16m/j (WiMAXm) and 3GPP LTE are converging as they move forward. This has significant impact on the competition between these two 4G rivals.

- ⇒ LTE IPR is likely to be lower cost than 3G IPR , with 6%-10% total cost captured in end devices.
- ⇒ WiMAX 802.16e will likely be low cost, with 3%-5% royalties captured in end devices. WiMAXm will likely be a bit higher due to the nature of patent ownership. We expect royalties in the range of 5% to 8%.
- ⇒ Court and trade authority rulings enforce SSOs FRAND policies and raise the bar of consideration for patent infringement. This lowers overall risk of IPR in WiMAX and LTE.
- ⇒ WiMAX and LTE have initiated early efforts to establish a favorable patent regimen that may reduce conflicts down the road. However, uncertainties due to absence of key stake holders remain.
- ⇒ Emerging segments of technology including MIMO, MIMO -AAS, MU-MIMO, Co-MIMO, virtual MIMO, virtual server aggregation, and advanced BWA network architectures are increasing in activity and importance as they leverage WiMAX and LTE performance and cost benefits.
- ⇒ 3G Licensing Ltd. is an admirable effort to lower IPR contention , but important 3G IPR stake holders have not joined because of commercial difficulty of the IPR regimen. NGMN may prove to be a more acceptable regimen.
- ⇒ WiMAX should consider establishing a patent regimen outside of NGMN . We recommend a “defensive patent pooling” pro-competitive organization, which will help clarify the advantage of WiMAX in IPR.

MARKET SIZE FORECASTS

We said in previous editions that Maravedis did not expect WiMAX to become a “3G killer” in the near future. This remains true with the recent progress made by technical specifications and vendor technology demonstrations for LTE in 3GPP Release 8. WiMAX provides a framework for 4G mobile services . In fact, with the prospects for introduction of multimode devices starting in 2008-2009, WiMAX will become an exceptional enhancement to existing cellular 3G networks. Operators who adopt WiMAX multimode offerings are not pressed into either replacing or displacing service to customers.

WiMAX chipsets will start to be embedded into laptops in the second half of 2008, into handheld devices in the beginning of 2009, and into consumer electronics in the beginning of 2010. This is obviously a key assumption, as multimode devices will expand dramatically the potential markets for WiMAX, especially when WiMAX chipsets are embedded into cellular handsets and base stations.

The fundamental question about WiMAX is whether it can ramp to volumes that enable it to compete in a wireless world ruled by huge volumes of cellular phone sales. WiMAX and future wireless networks that aspire to offer 4G services will attempt to become unified communications systems that fit diverse markets and have very different sets of customers and requirements. The common architecture is supposed to result in an overall advance in technology and a reduction in costs: the “virtuous circle” enabled by a large ecosystem.

A buzzword that has filtered through discussions of WiMAX is the “tipping point” – where WiMAX momentum skyrockets due to a nexus of contributing factors. The many pieces to the puzzle include

- ⇒ Gaining availability to sufficient spectrum for wide-area coverage and roaming.
- ⇒ Assembling large numbers of component, core system, and device suppliers and ODMs to fuel creative development and provide users with options for diverse markets.
- ⇒ Fostering an IPR environment that lowers the barriers and risks.
- ⇒ Creating an open system that leverages developments in other industries including Internet, PC and server software, network systems and OS, service industries including voice phone, entertainment, advertising, and unified messaging services.

Select Key Findings

- ⇒ Maravedis predicts that there will be an accumulated 55 million WiMAX subscribers by the end of 2012, then accelerating to 127 million at the end of 2014.
- ⇒ The 802.16e-2005 share of new WiMAX subscribers will peak in 2012, after which it will slowly decline in favor of 802.16m-based clients.
- ⇒ The WiMAX equipment market, including only active WiMAX subscribers, will reach an annual US\$4 billion in 2012 – US\$11 billion when including non-active WiMAX devices shipped.
- ⇒ The accumulated equipment market size for combined demand and supply of WiMAX equipment will total \$42 billion by 2014.
- ⇒ If additional incumbent and mobile carriers adopt an operating model that includes multi-mode WiMAX plus EV-DO/DV GSM and IMT2000, then expected volumes of WiMAX will be subject to stepwise revision upward. In our optimistic scenario, WiMAX subscribers will reach 127 million in 2012. Take up rates in the USA (Sprint), Korea, Japan, India and Taiwan will determine the likelihood of this optimistic scenario.
- ⇒ In our pessimistic scenario, cumulative WiMAX subscribers will only reach 25 million by 2012. Scenario assumptions are explained in detail in the report.