



MARAVEDIS

Telecom Market Research & Analysis

Spectrum Analysis - The Critical Factor in BWA/WiMAX versus 3G

An updated and expanded appraisal

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Maravedis is a leading research and analysis firm focusing on Broadband Wireless Access technologies including BWA/WiMAX, 802.20, TD-CDMA and Wireless Local Loop Systems. Maravedis' mission is to be the most trusted bridge between the world of emerging technologies and the world of actual deployments and sound business models.

Maravedis has established itself as the most credible and reliable resource for market intelligence in the broadband wireless industry. Maravedis works with equipment vendors, service providers and the investment community to produce sound analysis of equipment sales, identify emerging trends and provide realistic worldwide market forecasts.

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FOREWORD

In January 2006, we published the first ever spectrum comparison analysis between WiMAX and 3G in 55 countries. Maravedis is pleased to provide its customers with this 2nd edition expanded white paper comparing WiMAX and 3G spectrum in 100 nations.

We believe that the industry is at a critical juncture for gaining widespread acceptance and sales momentum: this report addresses a critical factor for the success of WiMAX. We have been surveying regulators for three years on a regular basis. Some of the regulators who are in the process of establishing national allocations for WiMAX also requested our guidance about what is being done elsewhere.

We are pleased to share with you the result of hundreds of hours of research. Detailed country and operator information remains premium information contained in our landmark database, branded **ClearSpectrum**, available to subscribers only. (www.clearspectrum.net)

1. KEY FINDINGS

The low cost of the BWA/WiMAX spectrum compared to 3G is a clear driver for service providers to enter the field of wireless services with BWA/WiMAX. This difference in cost/Hz is particularly significant in Europe, where the average 3G spectrum cost/Hz is 353 times higher than the average BWA/WiMAX spectrum cost/Hz. The proportion is smaller in other regions, but remains in favor of BWA/WiMAX.

It is important to highlight that the aggregate 3G spectrum is in lower frequency bands than the aggregate BWA/WiMAX spectrum. This shifts the cost/Hz on a deployed-equipment basis, due to the requirement for at least twice the equipment for each doubling of the frequency. However, even with that adjustment it is clear that the BWA/WiMAX spectrum is more economical, particularly when it is mapped to trends of devices designed to mitigate spectrum bands and modulation schemes.

The much lower cost of BWA/WiMAX licenses¹ resulted in a high number of licensees, with a total of 1028 and 276 license holders for BWA/WiMAX and 3G, respectively. Last year we accounted for 720 WiMAX licenses worldwide. However, the average amount of spectrum owned by a carrier is similar for the two technologies.

North America is by far the leading region in number of BWA/WiMAX awarded licensees, with a total of 404 BWA/WiMAX license holders, against 256 in Europe, 162 in Central and Latin America (CALA), 135 in the Asian Pacific (APAC) region and 71 in the Middle East and Africa (MEA). Note that EBS (Educational Broadband Services) in the US were not included in the North America figure.

In contrast to 3G licenses, the BWA/WiMAX licenses awarded around the world are essentially regional. North America is a perfect example, where 100% of its BWA/WiMAX licenses are regional, against 81% in Asia, 80% in the CALA region 71% in Europe and 61% in the MEA region.

¹ Note: the terms “licensee” and “license holder” are used interchangeably, and refer to any entity that holds one or more licenses.

This crowded environment will result in a highly fragmented, unpredictable and more competitive market, open to smaller and cost-aggressive players. **Note that not all licensees are active.** In fact, we estimate that more than half of the license holders in the BWA/WiMAX spectrum are still in the evaluation or trial stage.

On the other hand, the low-cost spectrum has also attracted players that have fewer resources than the large mobile operators. One must remember that the BWA spectrum was initially allocated for fixed-only applications and remains so in many countries.

While 3G, with the emergence of enhanced 3G technologies like HSDPA/HSUPA, Scalable Bandwidth EV-DO, 3.9G and Super 3G, is expected to reinforce its head start over Mobile (BWA/WiMAX) in terms of performance, it appears that 3G carriers will have to compete with new players once BWA/WiMAX mobile technology is embedded in cell phones and reaches attractive price points and significant volume sometime in 2008.

Most regulators have not kept pace with the progress of technology that **makes fixed-mobile convergence a reality.** 77% of regulators still limit 3.5 GHz usage to fixed-only applications. More importantly, the 2.5-2.9 GHz band remains locked to BWA/WiMAX in most European countries, but the pressure on regulators to include BWA/WiMAX in the IMT 2000 definition will increase over time.

Whether it is fixed applications with CDMA technology or mobile applications with BWA/WiMAX, the two fields are converging and will be competing for a share of the one-billion-subscriber market.

2. METHODOLOGY & RESOURCES

To conduct this comparative analysis between 3G and BWA/WiMAX, Maravedis proceeded as follows:

- **Step 1:** Selecting a similar list of countries by region (Europe, North America, Central America / Latin America (CALA), Asian Pacific (APAC) and Middle East and Africa (MEA)) for both 3G and BWA/WiMAX, which encompasses **100 countries**. They include:

European Union: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

Other European countries: Croatia, Norway, Russia, Serbia, Turkey, Ukraine.

CALA Countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, Uruguay, Venezuela.

APAC: Australia, Bangladesh, Cambodia, China, Hong Kong, India, Indonesia, Iran, Japan, Laos, Malaysia, New Zealand, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, Vietnam.

North America: Canada & US.

Africa: Algeria, Burkina Faso, Cameroon, Egypt, Ghana, Ivory Coast, Kenya, Morocco, Nigeria, Senegal, South Africa, Tunisia.

Middle East & CIS: Armenia, Bahrain, Georgia, Israel, Jordan, Kazakhstan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, UAE, Uzbekistan.

However, some important countries such as Russia and India have not allocated any formal 3G+ licenses yet. Therefore, the spectrum cost comparison between 3G and BWA/WiMAX remained limited to the countries where auctions/allocations have taken place for both spectrums.

- **Step 2:** For both 3G and BWA/WiMAX, gathering the following information for each license holder, country and region:

- * Total amount paid by the license holder for its licenses
- * Total amount of spectrum (MHz) acquired
- * Geographical scope of licenses acquired (national, regional)
- * Number of people living in the covered areas

In the case of BWA/WiMAX, we used **ClearSpectrum** – our unique database covering over 100 countries and their BWA/WiMAX spectrum allocation policies (licensing and technical information per frequency band and license holder). This database is updated on a quarterly basis, by gathering information from the national regulators. For the sake of this analysis, we only took into consideration the 2.3-2.7 GHz and 3.5 GHz bands.

For 3G, we gathered the information for each of the 100 countries directly from regulators as well.

- **Step 3:** Calculating the cost per Hz paid by each 3G and BWA/WiMAX license holder, by dividing the total amount paid by those license holders for their licenses by the total amount of spectrum (MHz) acquired. We added those costs paid by all the license holders in order to obtain a cost per Hz per country. We finally summed the costs across countries in order to calculate a regional cost per Hz. This process was repeated for each region.
- **Step 4:** Calculating the cost per Hz per population paid by each 3G and BWA/WiMAX license holder, by dividing cost per Hz paid by those license holders, by the population (expressed in millions) in the served areas. We summed those costs across license holders in order to obtain cost per Hz per million population by country. We finally took the average of the per-country costs, in order to obtain a regional cost per Hz per million population. We repeated this process for each region.
- **Step 5:** Conducting a regional comparative analysis respectively for 3G and BWA/WiMAX, in terms of amount paid for licenses, cost per Hz and cost per Hz per million population. Then we compared 3G and BWA/WiMAX in terms of cost per Hz by region, cost per Hz per million population by region, number of licensees and coverage areas. Note that we did not consider the CALA region in comparing 3G with BWA/WiMAX auction results, since this is the only region that has not auctioned 3G licenses to date.