WiMAX & LTE IPR and Market Impact Report- 2nd Edition

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Maravedis is a leading objective, third party research and analysis firm focusing on Broadband Wireless technologies including WiMAX, 802.20, ETSI LTE, TD-SCDMA, SC-FDMA and Wireless Local Loop Systems. Maravedis' mission is to be the most trusted bridge between the world of fixed-mobile convergence and the world of real deployments and sound business models.

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EXECUTIVE SUMMARY

Maravedis is proud to provide you with its 2nd edition ***WiMAX & LTE Intellectual Property Rights (IPR) and Market Impact Report***.

Maravedis, an innovative market research and analysis firm, is launching the first and only **WiMAX & LTE Intellectual Property Rights (IPR) and Market Impact** report. The report combines market input with wisdom gained over the course of the past eight years to produce an exhaustive analysis on relevant IPR that is informed by an understanding of policies, industry development, market trends and long term goals.. The best way to judge a book is not by the cover, but rather by how well past versions have withstood the test of time.

The **WiMAX & LTE Intellectual Property Rights (IPR) and Market Impact Report – 2nd Edition** gives service providers powerful insight into potential IPR expenses and market impacts, and provides manufacturers with valuable information to position their IPR portfolio in the global patent scheme to drive their R&D strategy. Investors will gain insight on upcoming trends to identify investment opportunities and build intelligence on how IPR may pressure new IPOs.

Since its inception, the **WiMAX & LTE Intellectual Property Rights (IPR) & Market Impact Report** has provided the wireless community with keen incites in IPR developments, policies and industry trends that are critical in understanding how commercial products and markets will develop. The report looks at IPR in both WiMAX and LTE. Although developed by two different standards groups, the patents and commercial markets inextricably overlap and include additional segments of technology that can only be overlooked at peril of lawsuits and trade disruption. Therefore, the conventional wisdom of analysis primarily on the basis of essentiality no longer castes a wide enough net to capture all concerns and opportunities. While the report does not focus on patents outside of the wireless standards, it considers IPR that is used in WiMAX and LTE to extend and leverage products to deliver leveraged market advantage.

The report provides factual and forward-looking tools for all of the industry's stakeholders and covers policies, regulations, climate, forecasts, and trends, to name a few.

What sets Maravedis' WiMAX & LTE Intellectual Property Rights (IPR) and Market Impact Report apart?

- Independently developed Patent Database
- Both the Database and Reports are available
    - Companies can validate premise of reports and competitive positions on IPRs
    - Extend the database and do your own analysis
    - Track patents and trends daily as needed
- Maravedis has been consistent in our analysis using IPRs as a basis for predicting major trends in MIMO-OFDM starting in 2001
    - When others doubted the promise of MIMO-OFDM and other major trends, Maravedis was the lone analyst firm accurately predicting the course of the industry.
    - When the industry went down the path to develop 802.16d, Maravedis cautioned that this would not meet the required needs of the future. Our guidance was to 'bite the bullet' to pursue MIMO-AAS-OFDMA within an adaptive 'framework standard' methodology that has become adapted as the way forward for both WiMAX and 3GPP LTE. This inevitable course of development is now seen as necessary to fulfill the goals of IMT-Advanced.
    - Our 1st edition IPR report anticipated and promoted forming of IPR pools. We outlined the difficulties experienced with past attempts, and warned that starting out too late could impact the course of IPR licensing.
    - We foresaw the now mushrooming developments in virtual, mutual and collaborative MIMO that contribute to smarter, more granular, self-configurable and more cost effective wireless networks that comprise the most active segments of technology development.
    - We envisioned the extensive development of IPR that comprise 'smart distributed wireless broadband networking', SDWN, that is now echoed in development of ETSI E-UTRA LTE and IEEE 802.16m/16j standards.
    - These insights have helped clients target R&D resources that have led to effective products and marketing programs.
    - The 'The Clash of the Titans' is now giving way to greater converging of semiconductor, networking and wireless industries developments. There is potential for clash as industries and service and business models conventions collide, but the industry is compelled by the needs of a greater industry vision that is yet to come.

Part I. IPR Policies, Regulations and Climate

The influence of standards-setting bodies, trade groups and government trade authorities helps companies to shape agreements and IPR royalties.

This report discusses:

- the context for understanding the effect of standards developments and how WiMAX and 4G fit into the evolving landscape. We look at how this environment is likely to influence the outcome of negotiations and potential for -- and outcome of -- legal disputes.
- how China is growing in importance as IPR positions and commercial markets accumulate.
- 4G in the context of its implications on convergence.
- the high levels of legal conflict that can be characterized as the ”patent thicket problem” or the “tragedy of the anti-commons” .
- patent licensing strategies, including patent pools.
- how the agreement between Nokia and Qualcomm will affect the industry.
- the pro- and anti-competitive nature of patent pools and how this might be influenced by the international exposure found in the wireless field.
- the division between companies that hold large numbers of patents, with some discussion of why/how that has come about.
- the relative merits of large numbers of patents versus quality of patents iin terms of relative value and how this may be used in the strategies of stake holders.
- the differences in IPR strategies between large and small companies and emerging countries.
- defensive measures most appropriate for small to mid-sized IPR stake holders.
- the IEEE and WiMAX Forum IPR policies and how they influence IPRs.
- case studies from prior literature as context for the evolving influence of standards-based developments. This includes recent rulings in the Rambus case.
- positive and negative impacts of growing legal disputes over markets
- the impact of consolidation and migration to NG communications operations on supplier IPR strategies.
- the affects of consolidation of IPR pools for major stake holders

Part II. WiMAX & LTE 4G IPR Analysis

In this section we discuss the patents related to WiMAX. An understanding of the patents is critical to understanding the relative pressures major stake holders can place on the industry in terms of licensing or potential for legal and trade actions. This understanding is developed using an integrated IPR analysis tool, INav (Invention Navigator 4.2). We have used INav to search the leading patent office databases and literature. Over 40 million patents are searchable from over 70 countries. Our search

primarily concentrated on patents form leading repositories including EP (Euopean), US (United States), CN (Canada), CH (China), KR (Korea), JP (Japan), and WTO. Prior art is sometimes referenced but is not analysed extensively in this report.

- An overview of IPRs in WiMAX and LTE, setting the stage for ensuing discussion.
  - Organization of patents into segments
  - What are essential and fundamental patents?
  - How essential and fundamental patents affect pursuit and outcomes of litigation.
  - What determines the essential and fundamental status of IPRs?
- Who owns WiMAX and LTE IPRs?
  - Who owns essential IPRs?
  - Who owns important or fundamental IPR?
  - The relative importance of particular patents and IPR portfolios held by key stake holders.
  - How IPRs cross between competing areas of wireless development.
  - Observations and conclusions.
    - Current assessment of IPR holdings and impacts
    - Areas to watch and impact for development of IPR positions as 4G systems evolve.
- An analysis of major 4G patent portfolio holders
  - Samsung, Qualcomm, Nokia, Ericsson, Intel, Motorola, and other IPR holders.
  - IPRs held by "WiMAX pure plays" and outliers including Alvarion, Airspan, Aperto, Redline, Wi-Lan, and Cisco-Navini.
  - A fresh look at Qualcomm's white paper titled: *Patent Counting, A Misleading Index Of Patent Value: A Critique Of Goodman & Myers And Its Uses* by Donald L. Martin and Carl De Meyer.
  - How groups of companies effect IPR outcomes: Qualcomm vs. Intel (and aligned companies) and aspects of the general debate.
  - Acquisitions and cross-licensing, offensive and defensive strategies are discussed.
- Analysis of trends in patents and applications:
  - Where technology spending is accelerating and relatively declining.
    - How this figures into the roadmaps for WiMAX and other 4G systems evolution.
  - Trends analysis by technology segments and groupings, company, and company size.
  - Chronological patent lists by segments and companies (Patent Roadmaps). Due to size, the full detailed lists are included in the appendix in print form and are included with the report in the form of Excel spreadsheet files.
- A review of emerging trends in IPRs:
  - New patent trends that predict WiMAX/LTE 4G, IMT-Advanced direction
- How patent trends will affect the positions of major stake holders including Qualcomm, Intel and Samsung

Part III – Key Market Impacts

This section evaluates the impact of IPR as it is forged into the major standards and used beyond optional provisions to enhance performance and integrate with broad communications network and consumer content and electronics industry developments. IPR is shifting to a broader set of factors that, in addition to a wider array of technologies, also includes globalization that shifts the balance of influence from Europe and North America to BRIC and other rapidly evolving economies. The more intimate involvement of the economic engines of China and India will have a profound influence on the direction of wireless standards and markets. We analyze both from an IPR strategy and business perspective as well as in terms of regional and segment influences and global shifts.

The unified communications field can appear to change in terms of decades rather than years, but the scope of change that is now upon the industry as it ventures toward 4G is a more dramatic compounding of technology and market developments that is being organized around standards and business alliances.

We analyse the broad vision of technology development a bit further downstream to attempt to answer some key questions:

- What segments and combined areas of patents/technology development will flourish in coming years?
- What is the relative value in filing in particular patent segments versus others?
- How will China influence development of the LTE standard? Commercial success?
- What role will India play in the success of WiMAX? LTE?
- Does India significantly influence IEEE 802.16 or 3GPP E-UTRAN LTE standards?
- How does the role of India contrast that of China?

KEY FINDINGS

This section provides a summary and conclusions of individual sections.

Key Findings:

- Acceleration of patent filings has occurred, compounding the diversity of IPR used in the standards and extended systems and device developments.
- Many additional patents overlap between 802.16m WiMAXm and LTE, including patents essential to in-band adjacent channel coexistence.
- For exemplary purposes, a search of major patent offices for the term 'WiMAX' results in over 8,837 patents and 5,248 patent families (a patent family is one or more patents filed for the same invention) since 2003 (the effective start of filings that mention LTE or WiMAX). This does not imply the patents are important or essential to the standard or products. Many patents are simply 'covering the bases' of possible applications. This does provide a reference point to show the level of interest related to WiMAX.
- Similarly, a search for terms LTE, E-UTRAN, and EUTRAN resulted in 4,871 patents and 3,169 patent families since 2003. While this is of limited value in determining essential or fundamental value of patents, the results, as confirmed by similar searches and review of patents, shows a relatively higher level of filings for WiMAX than for LTE. New segments of IPR have been recognized that, while not essential to the standards, are leveraged to have potential impact on the commercial field. These include multi-mode standards operation, inter-network hand-off, authentication and roaming, and methods for co-located operation of WiMAX and LTE within the same frequency bands and cells.
- Additional patents have been recognized in segments of IPR that will take advantage of the IP broadband network to do transaction processing, as well as implement business and social networking methods. These are noted due to their commercial impact, even though they are not required for network development. Services that take direct advantage of these next generation networks will be important to commercial success.
- Extended performance, over-the-top services, and enhanced network architectures are examples of IPR that will differentiate supplier and operator offerings. These are expected to have magnified impact on the success of next generation networks. This understanding is confirmed by the rapid increase in the number of patents filed.
- Accelerated WiMAX IPR and industry momentum has pushed forward LTE development by 3-4 years from prior expected rollout in 2012-14 to 2009-10.
- As a result of the IPR and market shift, Qualcomm will likely produce WiMAX plus cellular 3G multi-mode chips.
- IPR disputes for WiMAX/4G will be a less costly concern than in cellular. The positions of IPR stake holders with respect to both current and future versions of WiMAX as it evolves towards 4G, IMT-Advanced will influence royalties.

- Trends and consolidation among smaller players indicates further acquisitions by the larger players such as Intel, Qualcomm, Samsung and Motorola, who will strongly influence the overall IPR costs.

- Qualcomm's position in 802.16e-2005 is limited but patent trends indicate a stronger position for a few areas of development that will become increasingly important: “Smart Wireless Network” topology, multi-mode, video multi-casting and other advances and extension fields of development will strongly impact 4G.
- What Qualcomm is likely to do in pursuit and extension of legacy IPR positions
- Qualcomm’s settlement with Nokia is a recognition by both parties that:
    - The landscape of competition for wireless is shifting to a new openness of standards, including competition with WiMAX.
    - Emergence of IP-based wireless that converges products, services and IPR with IT/Networking, PC, Internet, and consumer electronics fields. In that each firm recognizes new opportunities and limitations.
- How are key stake holders positioned and what is their stated intent for pursuit of IPR, either in the form of product revenue or direct payment of royalties?
- Wi-Lan, an IPR corporate licensor, has early agreements for WiMAX and related licenses with Redline, Cisco and Nokia, which set early benchmarks for commercial precedents of IPR agreements. This represents the limited direct commercial or legal precedent yet available for establishing IPR licensing trends in the emerging field.

- Several developing technology trends are critical to the evolution of WiMAX and 4G LTE products and markets. These developments will help to differentiate vendors that, in turn, help decide success or failure for 4G systems and device suppliers.

- Convergence between WiMAX/802.16 plus 802.22, and 3GPP LTE is taking place in core link technologies, which will increasingly be based on MIMO-OFDM/OFDMA modulation schemes. The envelope of wireless invention (IPR) is being pushed in the “enhancement” technologies including MIMO-OFDMA and smart networking methods that leverage the core link platform to greater advantage.

- Patent activity has accelerated, particularly in the areas mentioned. MIMO-OFDM/OFDMA activity has dominated recent patent application and publishing.

- Segments of patents noted in the 1st edition of this report have ramped up from a few patent applications to a few hundred. These include patents on ‘smart distributed WBB networking’ (SDWN) methods including network architecture, cooperative MIMO, and use of adaptive MIMO-AAS in conjunction with remote and virtual station aggregations.

- A few large companies file for large numbers of patents. As Qualcomm has pointed out, many of these can be characterized, as “fractional” or derivative patents. The report discusses how important the “numbers game” is in estimation of IPR portfolio value.

- Several "WiMAX pure plays" who have been instrumental in standards development efforts have filed comparatively few patents in 4G/WiMAX. However, being closely tied to the standards, the research evaluates the essential nature of their holdings.

- WiMAX and other applications of MIMO-OFDM based systems marks a demarcation between it and prior fields of wireless development. The "evolution" from prior cellular systems is not achieved at a wireless link interface level that is necessary for transition of a majority of prior technology patents.
- Essential patents in the field are held by a large number of companies. But some consolidation has taken place through acquisitions. Some patents have not been reassigned to the acquiring company. The research database has categorized patents based on current holders.
- Some fundamental and essential patents on OFDM and MIMO go back several years. In some cases, the companies involved in important areas of early development are not those now considered wireless telecommunications industry dominant market leaders.
- Trends in competitive product developments and projections for new products are discussed.
- Competitive positions and moves are analyzed for impact on about five years forecasting of developments.
- Prospective acquisitions, partnering, pooling, and other activity can be learned from a study and is briefly discussed in the report of the database analysis.
- The guidelines for determining fair and reasonable royalty rates for WiMAX are analyzed based on what is considered fair and reasonable for similar fields of development, particularly in context for standards- based developments.
- Recent history of IPR in standards shows "fair and reasonable" agreements of standards groups are often contested. Lack of dominant fundamental IPR position and diversity indicates lower levels of contention can be expected for WiMAX IPR.
- Surveys show that service providers want certainty. A reasonable cost for IPR paid in royalties or cost of goods is acceptable. Disruption of business is not desired.
- Interviews with IPR holders indicate that they want/expect reasonable compensation for R&D: either reasonable royalties or expressed in the cost of goods sold; The report identifies

    - Over 850 patents that are essential to WiMAX 4G.
    - The number of "fundamen*tal"* patents is lower than 20.
    - The total number of patents that relate directly to the field that are contained in the Maravedis database is 2,060.
    - The number of patents including related areas of OFDM such as DVB/DVB-H, FDMA, and FH-OFDM and related segments of wireless development such as CDMA and 802.11 related to OFDM is 3,520.