



The WiMAX™ 802.16e Advantage

A comparison between WiMAX 802.16d
and 802.16e TDD technologies

Objective

WiMAX technology has spurred tremendous interest from operators seeking to deploy high-performing, cost-effective broadband wireless networks. However, the availability of 802.16 OFDMA (aka 802.16e) and 802.16 OFDM (aka 802.16d) as two different and incompatible options of the WiMAX standards adds confusion to an operator's investment decision.

This document is intended to support operators who are weighing the merits of the two WiMAX standards: 802.16d and 802.16e, when making investment decisions.

Market Perspective

Since late 2006, the WiMAX industry has shown a shift in focus from OFDM to OFDMA, clearly indicated by chip vendors such as Intel, Sequans, Beceem and GCT who no longer offer any new 802.16d chipsets, some of which even consider to end-of-life existing 802.16d offerings, and infrastructure vendors who are releasing new 802.16e base stations and terminals. Operators are already beyond 802.16e trials and are in the process of launching large commercial 4G 802.16e networks. These include Clear USA, Yota Russia, UQ Japan, KT Korea, VMAX Taiwan, Comstar Russia, PacketOne Malaysia and others. Consequently, as the ecosystem evolves around 802.16e, prices of terminals and infrastructure elements decline while performance steadily increases. As a result, the business model is improved with the deployment of new WiMAX networks based on 802.16e.

The dissolve of the WiMAX Forum® Evolutionary Technical Working Group (ETWG) handling 802.16d profiles implies that new 802.16d profiles will not likely be introduced by the WiMAX Forum. All efforts of the WiMAX Forum have shifted to 802.16e, its extension in recently ratified 802.16-2009 (supported by WiMAX Forum Release 1.5), and further to 802.16m that is targeted to be ready by mid 2010 (supported by WiMAX Forum Release 2.0). In late 2007, 802.16 OFDMA TDD was approved by the International Telecommunications Union (ITU) as the sixth approved interface within ITU-R's IMT-2000. The WiMAX Forum is now investing efforts in having 802.16m TDD/FDD included in IMT-2000.

While 802.16e is not backward compatible to 802.16d, IEEE is making sure that 802.16m is fully backward compatible with 802.16e. Hence, 802.16e terminals will inter-work with 802.16m base stations and 802.16m terminals will inter-work with 802.16e base stations. Operators making WiMAX business decisions must be aware of this matter, as they plan rolling out networks that are future ready. 802.16d has reached its end as an evolving technology while 802.16e indeed has an evolution path.

Technical Differences

The 802.16e-2005 amendment is typically associated with mobility but it actually greatly improves radio performances for fixed and nomadic services vs. 802.16-2004. These improvements are critical for operators and help improve the business case by enabling reduced total cost of ownership, implied by fewer base stations, higher capacities and lower power consumptions.

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Parameter	802.16d (TDD)	802.16e (TDD)	802.16e Advantages
Access Method	OFDM	S-OFDMA	IEEE includes OFDM and OFDMA PHY options in 802.16-2004 however, the WiMAX Forum profiles only support OFDM. WiMAX Forum profiles support Scalable OFDMA in 802.16e providing: <ol style="list-style-type: none"> 1. Easily scalable bandwidth 2. Better immunity to interferences and channel fading
BW	Typically 3.5 MHz	5 and 10, 8.75 MHz, 20 MHz	802.16e is ready for higher capacity needs
FFT size	256	512, 1024, 2048	Longer FFT provides better Non-Line-of-Sight (NLOS), better multi-path and channel fading handling
HARQ	No	Yes	HARQ with 802.16e provides better coverage, improved immunity to interferences and faster error correction
Frequency Reuse Schemes	No	Yes	Better spectrum efficiency with 802.16e: 16e can accommodate the reuse 1 scheme which enables operators to utilize the same frequency in all sectors
Multicast/Broadcast support	No	Yes	802.16e provides additional services, e.g. payTV
MIMO	STC (MIMO A only)	Yes (MIMO A and MIMO B)	MIMO A and MIMO B are smart antenna technologies that provide better capacity and coverage over 802.16d
Extended Real Time Polling Service	No	Yes	Extended Real Time Polling Service allows 802.16e solutions to improve bandwidth allocation and voice quality
CTC (Convolution Turbo Coding)	No	Yes	Convolution Turbo Coding increases sensitivity and improves link budget which enhances sector capacity and coverage

Conclusion

There are currently more 802.16e products available in the market compared with 802.16d products. Leveraging on ecosystem and improved performances, 802.16e offers a better business case with faster Return on Investment (ROI) than its predecessor 802.16d.

802.16d has all appearances of being an interim technology with no forward compatibility to modern technologies. Operators should protect their WiMAX investments by selecting solutions based on 802.16e standard which has an evolution path to 802.16m. 802.16e provides outstanding performance by utilizing advanced antenna technologies and other sophisticated techniques (e.g. HARQ, OFDMA) that improve the capacity, coverage and QoS of the network resulting in an improved business case and user experience.

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Alvarion (NASDAQ: ALVR) is the largest WiMAX pure-player with the most extensive WiMAX customer base and over 250 commercial deployments around the globe. Committed to growing the WiMAX market, the company offers solutions for a wide range of frequency bands supporting a variety of business cases. Through its OPEN WiMAX strategy, superior IP and OFDMA know-how, and proven ability to deploy end-to-end turnkey WiMAX projects, Alvarion is shaping the new wireless broadband experience.

