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## Frequently Asked Questions

### 1. What is WiMAX technology?

WiMAX is a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL. WiMAX will provide **fixed, nomadic, portable** and **mobile** wireless broadband connectivity without the need for direct line-of-sight with a base station. In a typical cell radius deployment of three to 10 kilometers, WiMAX Forum Certified™ systems can be expected to deliver capacity of up to 40 Mbps per channel, for fixed and portable access applications. This is enough bandwidth to simultaneously support hundreds of businesses with T-1 speed connectivity and thousands of residences with DSL speed connectivity. Mobile network deployments are expected to provide up to 15 Mbps of capacity within a typical cell radius deployment of up to three kilometers. WiMAX technology already has been incorporated in notebook computers and PDAs, allowing for urban areas and cities to become “MetroZones” for portable outdoor broadband wireless access.

### 2. What is the WiMAX Forum™?

The WiMAX Forum is an organization of more than 400 leading operators, communications component and equipment companies. The WiMAX Forum’s charter is to promote and certify the compatibility and interoperability of broadband wireless access equipment that conforms to the Institute for Electrical and Electronics Engineers (IEEE) 802.16 and ETSI HiperMAN standards. The WiMAX Forum was established to help remove barriers to wide-scale adoption of Broadband Wireless Access (BWA) technology, since a standard alone is not enough to incite mass adoption of a technology. Along these lines, the Forum works closely with service providers and regulators to ensure that WiMAX Forum Certified™ systems meet customer and government requirements.

### 3. What are the next milestones for the WiMAX Forum?

Certification of products is on-going. This includes additional conformance and interoperability procedures for implementation of specific applications. The Application Working Group (AWG) of the WiMAX Forum has established a baseline set of system requirements for key and future applications to be supported on a WiMAX Forum Certified™ system. These requirements can be profiled and tested as part of the certification process and the first mobile WiMAX Forum Certified™ products are expected in early 2007.

### 4. What does WiMAX Forum Certified™ mean? How is this different from “WiMAX compliant?”

As the exclusive organization dedicated to certifying the interoperability of BWA products, the WiMAX Forum defines and conducts conformance and interoperability testing to ensure that different vendor systems work seamlessly with one another. Those that pass conformance and interoperability testing will receive the WiMAX Forum Certified™ designation.

Vendors claiming their equipment is “WiMAX-like,” WiMAX-compliant,” etc., are not WiMAX Forum Certified™, which means that their equipment is *not* independently certified to be interoperable with other vendors’ equipment. Only WiMAX Forum Certified™ equipment is proven interoperable with other vendors’ equipment that is also WiMAX Forum Certified™.

**5. When will the WiMAX Forum begin certifying equipment? Where will the equipment be tested?**

In January 2006, the WiMAX Forum announced the first fixed wireless broadband network products to achieve the designation of WiMAX Forum Certified™. To date, approximately 30 fixed wireless broadband network products have attained certification.

In February 2006, the WiMAX Forum announced the selection of Korea's Telecommunications Technology Association's IT Testing & Certification Lab in Seoul, Korea as the first lab in Asia. The TTA Lab is expected to begin receiving mobile WiMAX equipment and start the test procedure validation process in Q4 2006.

The WiMAX Forum selected AT4 wireless (formerly known as CETECOM Spain) as its first official certification laboratory, and began testing WiMAX Forum member companies' products to certify that they meet WiMAX Forum conformance and interoperability standards. The selection of AT4 wireless was a critical milestone on the path to enabling the commercial availability of WiMAX Forum Certified™ products.

**6. When will WiMAX Forum Certified™ products be commercially available?**

It is important to remember that the WiMAX Forum does not control when BWA products will enter the market. As an industry association, our role is to drive standardization and certification – we do not launch products or build networks. Service provider lab trials began in Q3 2005, followed by commercial trials. Fixed WiMAX networks based on WiMAX Forum Certified™ equipment began commercial deployment in 2006.

**7. What companies offer products that have received the WiMAX Forum Certified™ designation?**

Approximately 30 fixed wireless broadband network products from Airspan Networks, Alvarion, Aperto Networks, Axxcelera Broadband Wireless, Proxim Wireless, Redline Communications, Selex Communications, SEQUANS Communications, Siemens, SR Telecom and Wavesat have received the WiMAX Forum Certified™ seal.

WiMAX Forum Certified™ tests conformance and interoperability of only base station and subscriber station products. There is no testing or certification of chipsets, semiconductors, or networks.

**8. When does the WiMAX Forum expect systems to take off in the marketplace?**

WiMAX is not a new technology per se, but a more innovative and commercially viable adaptation of a proven technology that is delivering broadband services around the globe today. In fact, wireless broadband access systems from WiMAX Forum members are already in trials and being deployed commercially in more than 65 countries around the world. That said, WiMAX Forum member companies have been the first to bring standardized solutions to the marketplace, making broadband services more cost-effective to deploy on a wide scale.

**9. Which companies are involved with the WiMAX Forum?**

Over 400 companies are members of the WiMAX Forum, representing the entire ecosystem of companies necessary for bringing WiMAX Forum Certified™ products to market, including equipment manufacturers, operators, system integrators, silicon and component makers, and application providers. For a complete list of current members, visit [www.wimaxforum.org](http://www.wimaxforum.org).

**10. What are the benefits of WiMAX Forum Certified™ products?**

The ultimate goal of the WiMAX Forum is to accelerate the introduction of cost-effective broadband wireless access services into the marketplace. Standards-based, interoperable solutions enable economies of scale that, in turn, drive price and performance levels unachievable by proprietary approaches, making WiMAX Forum Certified™ products cost-effective at delivering broadband services on a wide scale. Designed for

carrier-class deployments as well as low-cost, license-exempt deployments, WiMAX Forum Certified™ systems deliver high-capacity service throughput (up to 36 Mbps in a 10MHz channel) and provide a range of up to five kilometers in near to non-line-of-sight conditions. The systems are scalable for up to thousands of users, and because they are interoperable, service providers will be able to purchase equipment from more than one vendor, thereby reducing the overall risk and creating a price-competitive marketplace.

#### **11. How will WiMAX Forum Certified™ products benefit enterprises? Residential users?**

For enterprises, WiMAX can provide a cost-effective broadband access alternative. Since most businesses are not zoned for cable, their only option for broadband service is from the local telco, creating a monopoly situation. The ease of deployment for WiMAX Forum Certified™ systems can benefit enterprises by bringing new competition into the marketplace and lowering prices, or by enabling enterprises to set up their own private networks. This is especially relevant for industries like gas, mining, agriculture, transportation, construction and others that operate in remote locations.

For some residential customers in suburban and rural areas (where DSL or cable modem service is not available), WiMAX can provide the ability to finally have the broadband access they need. This is particularly true in developing countries, where traditional telecom infrastructure is not readily accessible.

#### **12. What will the customer premise equipment (CPE) be like and what will it cost?**

The first generation of WiMAX Forum Certified™ CPEs are outdoor-installable subscriber stations akin to a small satellite dish. These became available in 2005 and are priced around \$500. The second generation of CPEs are indoor self-installable modems similar to a cable or DSL modem and are priced around \$300. Third-generation CPEs will be integrated into laptops and other portable devices, are expected to initially cost approximately \$100 and are expected to be available in 2007.

#### **13. What is the difference between IEEE 802.16 and WiMAX technology?**

One of the main objectives of the WiMAX Forum is to create a single interoperable standard from the IEEE 802.16 and ETSI HiperMAN standards. This is achieved by the creation of System Profiles. Based upon what the WiMAX Forum sees in terms of service provider and vendor equipment plans, the WiMAX Forum has decided to focus first on profiles for the 256 OFDM PHY mode of the 802.16-2004 standard, which was ratified by the IEEE in June 2004. This physical layer (PHY) will be combined with a single media access controller (MAC), ensuring a uniform base for all WiMAX implementations.

Compliance with the 802.16 standard does not mean equipment is WiMAX Forum Certified™ or that it is interoperable with other vendors' equipment. However, if a piece of equipment has earned the WiMAX Forum Certified™ designation, it is *both* compliant with the 802.16 standard and interoperable with other vendors' equipment that is also WiMAX Forum Certified™.

#### **14. What are the different “versions” of 802.16 – such as 802.16a, 802.16-2004 and 802.16e?**

IEEE 802.16a standardization focused on fixed broadband access. IEEE 802.16-2004 enhanced the standard by providing support for indoor CPE. The IEEE 802.16e standard is an extension to the approved IEEE 802.16-2004 standard. The purpose of 802.16e (also known as IEEE 802.16e-2005) is to add data mobility to the current standard, which is designed mainly for fixed operation.

#### **15. When were the IEEE 802.16 standards approved?**

IEEE approved the initial 802.16 standard for wireless MAN for the 10-66 GHz frequency range in December 2001. The 802.16a extension for sub-11 GHz was approved in January 2003. The 802.16-2004 standard was ratified by the IEEE in June 2004. The 802.16e-2005 standard was approved in December 2005.

## **16. Which profiles/spectrum bands does the WiMAX Forum address?**

The WiMAX Forum has begun the process of certifying initial fixed and stationary equipment in the 3.5 and 5.8 GHz bands. The WiMAX Forum is working with service providers and equipment manufacturers to expand the frequency allocation to cover all the key spectrum bands that our member companies identify as interesting to potential WiMAX service providers. For mobile applications, initial profiles have been developed for 2.3, 2.5, and 3.5 GHz. These are in response to the early and strongest market opportunities. WiMAX Forum has the ability to respond rapidly to development of additional profiles as additional spectrum is auctioned or markets changed.

## **17. How does the WiMAX Forum's certification process and organization structure compare to other certifying and testing groups, such as the Wi-Fi Alliance or ZigBee Alliance?**

The structure and process of WiMAX Forum certification is most like that of Wi-Fi Alliance, except that Wi-Fi Alliance only tests products for interoperability, whereas WiMAX Forum tests for both conformance to the technical standard and device interoperability. Testing conformance to the standard means that products just don't work with each other out of luck, rather they are designed in a manner that allows them to implement the protocols in exactly the same way. This ensures that over time the products can be enhanced or new models can be issued with a higher likelihood of deployment in a common network.

## **18. Will the WiMAX Forum work with the Wi-Fi Alliance and 3GPP?**

WiMAX Forum members are working with other industry groups, including the Wi-Fi Alliance, to enable seamless handoffs between multiple wireless standards, furthering the development of a cohesive wireless ecosystem. WiMAX Forum is also collaborating with groups like 3GPP on implementing IMS with WiMAX networks.

## **19. What are the key elements of WiMAX Technology?**

One the main element of WiMAX technology is the interoperability of WiMAX equipment, certified by the WiMAX forum, resulting in mass volume and confidence for service provider to buy equipment from more than one company and that everything works together. The WiMAX forum put for the first time together leaders in the communications and computing industries to drive a common platform for the global deployment of IP-based broadband wireless services. Other key elements include cost, coverage, capacity and standard for both fixed and mobile wireless access.

### Lower cost

The common platform drives down costs with volume opportunity.

Fixed wireless Customer Premise Equipment (CPE) will be able to use the same modem chipset used in personal computers (PCs) and PDAs, for short distance CPEs indoor self-installable modems will be similar to a cable or DSL and the base stations will be able to use the same chipsets developed for low-cost WiMAX access points, and finally increased volume will also justify the investment for higher-level integration of radio frequency (RF) chipsets, further driving down costs.

### Wider coverage

The technology behind WiMAX has been optimized to provide excellent non line of sight (NLOS) coverage, Non Line Of Sight advantages are coverage of wider area, better predictability of coverage and lower cost as it means fewer base stations and backhaul, simple RF planning, shorter towers and faster CPE install times.

Thanks to techniques for improving NLOS coverage, such as diversity, space-time coding, and Automatic Retransmission Request ARQ the distances of coverage are increased.

### Higher capacity

A key advantage of WiMAX is to use OFDM over single carrier modulation schemes with the ability to deliver higher bandwidth efficiency and therefore higher data throughput, with more than 1 Mbps downstream and even much higher data rates, even in NLOS with multipath conditions. Adaptive Modulation also increase link reliability for carrier-class operation and the possibility to keep 64 QAM modulation at wider distance extend full capacity over longer distances.

### Standard for fixed and mobile wireless access

By leveraging the same technology networks WiMAX will become the most cost-effective solution for carriers to deploy for fixed wireless applications and for mobile applications for notebooks and PDAs. The WiMAX Forum will certify products for conformance and interoperability based upon the standards IEEE 802.16 and ETSI HiperMAN standard.

Finally a powerful Network Management System managing QoS profiles to configure Service Packages complete these keys elements.

## **20. What is orthogonal frequency division multiplexing (OFDM)?**

OFDM is a digital encoding and modulation technology. It has been used successfully in wire-line access applications, such as Digital Subscriber Line (DSL) modems and cable modems. Products from WiMAX Forum member companies are using OFDM-based 802.16 systems to overcome the challenges of Non Line Of Sight (NLOS) propagation.

OFDM achieves high data rate and efficiency by using multiple overlapping carrier signals instead of just one. The key advantage of OFDM over single carrier modulation schemes is the ability to deliver higher bandwidth efficiency and therefore higher data throughput even in the face of challenging deployment scenario such as NLOS links suffering from significant degradation due to multipath conditions.

## **21. What is the WiMAX Physical Layer (802.16/HiperMAN OFDM PHY)?**

The PHYSical Layer (PHY) defined by 802.16 has three variants: Single Carrier, 256-carrier OFDM and 2048-carrier OFDMA. The 256 OFDM PHY has been selected by WiMAX Forum for the 802.16-2004 (formerly 802.16REVd).

## **22. What is the WiMAX Media Access Control (MAC) Layer?**

The IEEE 802.16 standard provides for the same Media Access Control (MAC) layer for all PHYs (single carrier; 256 OFDM; 2048 OFDMA). This MAC is connection oriented and provides for a Time Division Multiplex (TDM) downlink coupled with a Time Division Multiple Access (TDMA) access in the uplink.

The standard as defined supports both Time Division Duplex (TDD) and Frequency Division Duplex (FDD) operation and provides for a Half Duplex FDD (HD-FDD) mode. TDD is a technique in which the system transmits and receives within the same channel assigning time slices for transmit and receive mode. FDD requires two separate spectrums.

## **23. What is the state of WiMAX spectrum harmonization efforts?**

The WiMAX Forum continues to see the allocation of spectrum evolve. Underused spectrum is being recalled and reclassified by governments and new allocations are being issued. For the initial WiMAX Forum Certified™ products serving fixed wireless applications, the majority of spectrum continues to be witnessed in 3.4 – 3.6 GHz spectrum. We also see market demand for license-exempt spectrum in the 5 GHz region. Not surprisingly, these are the first frequency bands that WiMAX Forum created certification profiles around.

For mobile applications, we see regulators allocating spectrum below 6 GHz, namely in the 2.3 and 2.5 – 2.6 GHz regions, as well as the 3.4 – 3.6 GHz band. The WiMAX Forum continues to track regional and country-specific policies and promote the availability of technology-neutral spectrum.

The WiMAX Forum has formed an agreement with AT4 wireless (formerly known as CETECOM Spain) to provide the WiMAX Forum Spectrum and Regulatory Database, allowing member companies access to real-time data regarding worldwide spectrum licensing and regulatory information. The database focuses information on the 3.5 GHz frequency that already has WiMAX Forum Certified™ equipment and additional key frequency bands targeted for deployment of WiMAX Forum Certified™ equipment based on market need including 2.3, 2.5, 3.7 and 5.8 GHz.

**24. Has WiBro taken the lead on becoming the mobile version of WiMAX? How did WiBro, based on TTA standards, come to be compatible with 802.16e before the main line of 802.16e development?**

To clarify, WiBro is a service based on IEEE 802.16e that has been rolled out in South Korea, as mandated by the South Korean government. The WiMAX Forum is being looked to in order to provide the conformance and interoperability program for the WiBro service. Early implementers of the WiBro service including Samsung, KT, and SK Telecom are active members of the WiMAX Forum and have been quite active in the IEEE 802.16e standards work.

As WiMAX Forum Certified™ profiles are approved based on the IEEE 802.16e standard, we expect products that are operating the WiBro service will become WiMAX Forum Certified™ during 2007.

**25. What does the intellectual property rights (IPR) landscape for WiMAX look like? What is the WiMAX Forum's position on IPR and WiMAX technology?**

As of September 2006, there were more than 1,500 patents distributed among 330 companies on WiMAX technologies. Of the 23 companies that hold more than ten patents, 74% are WiMAX Forum members. As additional products become WiMAX Forum Certified™ and additional patent holders join the Forum, we believe that we will be able to achieve our goal of interoperability between OEMs and carriers.