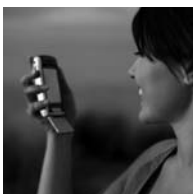




# Mobile WiMAX

## Personal Broadband Services For Enhancing Lifestyles and Productivity

White Paper







## Mobile and Broadband Convergence

Rarely has a technology developed as quickly as mobile voice with users adopting this innovation into all aspects of their daily lives in just over a decade. Since the widespread adoption of mobile phones, a broadband evolution has been occurring worldwide with the demand and adoption of xDSL, cable modem, and broadband wireless services. Today we see the progression and convergence of both trends – mobile and broadband – towards Personal Broadband as the next major evolution in communications.

Accustomed to broadband in their offices, homes, and now airports, hotels, and other public spaces, along with the constant convenience of a mobile phone, end users are increasingly interested in multimedia services that require both capabilities. This demand is for services that are both personal and convenient – i.e. “what I want, whenever, wherever I want them” shows that a shift in consumers’ mindset is underway. Starting with the personal communication services (PCS) of second generation digital phones in the late 1980s and culminating in Wi-Fi services now offered in laptops and PDAs, Personal Broadband will use these same devices to launch a new era in communications where users will be able to communicate and receive any and all types of information wherever they may be and directly to their device of choice in what might be termed – “Personal Broadband Services for Enhancing Lifestyles and Productivity”.

Success of any new technology can be claimed only when it reaches mass-market adoption, and this adoption directly depends on integrating the technology into affordable, easy-to-use devices that support a wide range of added-value applications. Mobile WiMAX technology, with its open standards and all-IP architecture combined with high capacity, wide coverage and quality of service, is the most suited for delivering Personal Broadband services. WiMAX uses the IEEE 802.16 air interface standard and the ETSI HiperMAN wireless metropolitan area network (MAN) standard to deliver value-added applications, including live video broadcasting, high-speed data, toll-quality voice and other multimedia content.

This document describes the key elements of mobile WiMAX in delivering Personal Broadband services, while keeping the actual services simple to use and affordable.

## Mobile and Broadband Markets and Trends

Personal Broadband is a fusion of the two explosive markets of mobile voice and broadband. As a result, the size of the market is determined by looking at four types of customers: those migrating from mobile voice services and seeking higher speeds for additional applications, fixed users who want mobility, Wi-Fi users seeking additional range, and new users who will desire the many new applications of Personal Broadband services. Until now, the early adopters of WiMAX and other broadband wireless access systems have been operators serving areas not covered by traditional wireline broadband connections.

**Personal Broadband is the next major evolution in communications.**

**This demand is for services that are personal and convenient - i.e. “what I want, whenever, wherever I want them”.**



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Although the phenomenal growth of mobile voice subscriptions has slowed in recent years, the overall time from its technology introduction to mass adoption was relatively short, as shown in the diagram below:

**Billion Lines**

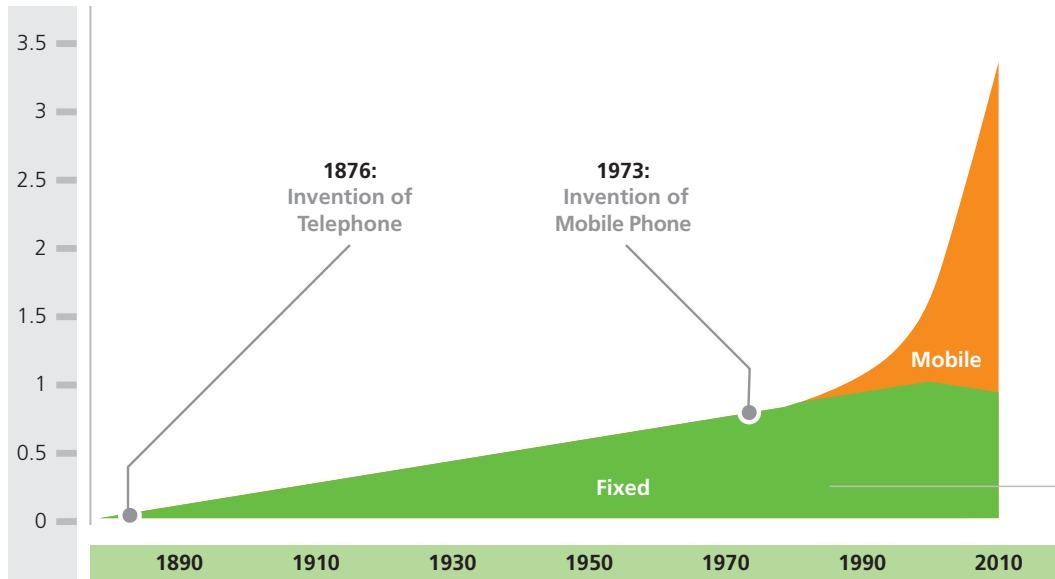
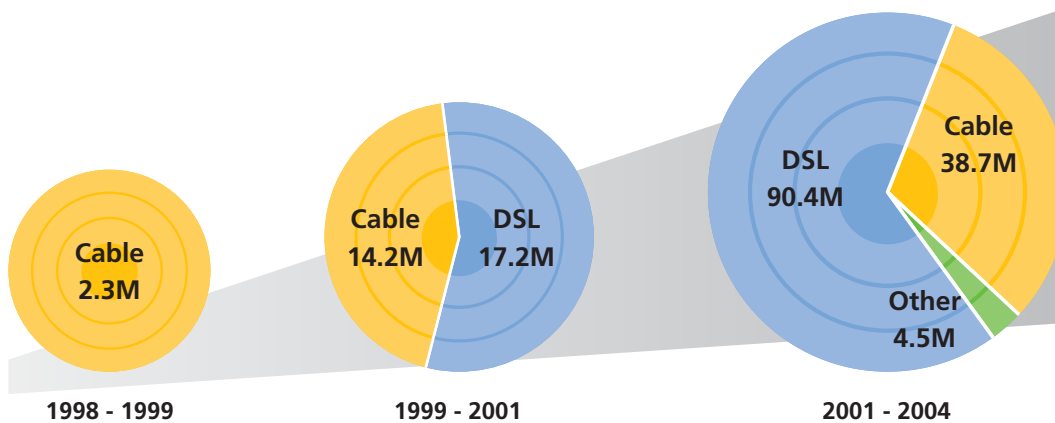


Figure 1: Growth of Voice Services

As detailed below, while broadband's overall growth has been less in absolute terms, its rate of growth is similar to the early days of mobile voice services. Even higher growth can be expected with the move to Personal Broadband services.



Number of subscribers in millions

Figure 2: Broadband Mix



Upon the introduction of Personal Broadband services, Alvarion forecasts the mobile WiMAX market size to reach between \$10 billion to \$20 billion with more than 80 million subscribers. Following early trials expected in 2007, major breakthroughs in the deployment of mobile WiMAX technology will occur during 2008 and 2009. Key initial challenges, such as technology maturity and integration with operator networks, followed by the availability of added value services, will greatly affect market growth.

With such huge market potential and a clear vision of market needs, vendors and operators alike are putting more and more resources into defining and developing solutions for Personal Broadband services using mobile WiMAX. Clear indications of the excitement surrounding mobile WiMAX include the growing number of RFIs and RFQs issued by both large and small operators and the planning and execution of numerous trials in various parts of the world. Mobile WiMAX is progressing rapidly and will soon form the basis of many large networks around the world.

### Mobile WiMAX For Personal Broadband

The two markets—broadband and mobile voice—are well into the process of converging to create the broadband mobility market, with each market being represented by its own standards body and group of vendors, service providers, application and content developers and early adopter customers.

By occupying different spectrum and working with different modulation schemes, the various technologies can co-exist and enable multi-mode devices to communicate with more than one technology. This increases the flexibility and availability of various services and allows the optimal access method for each service.

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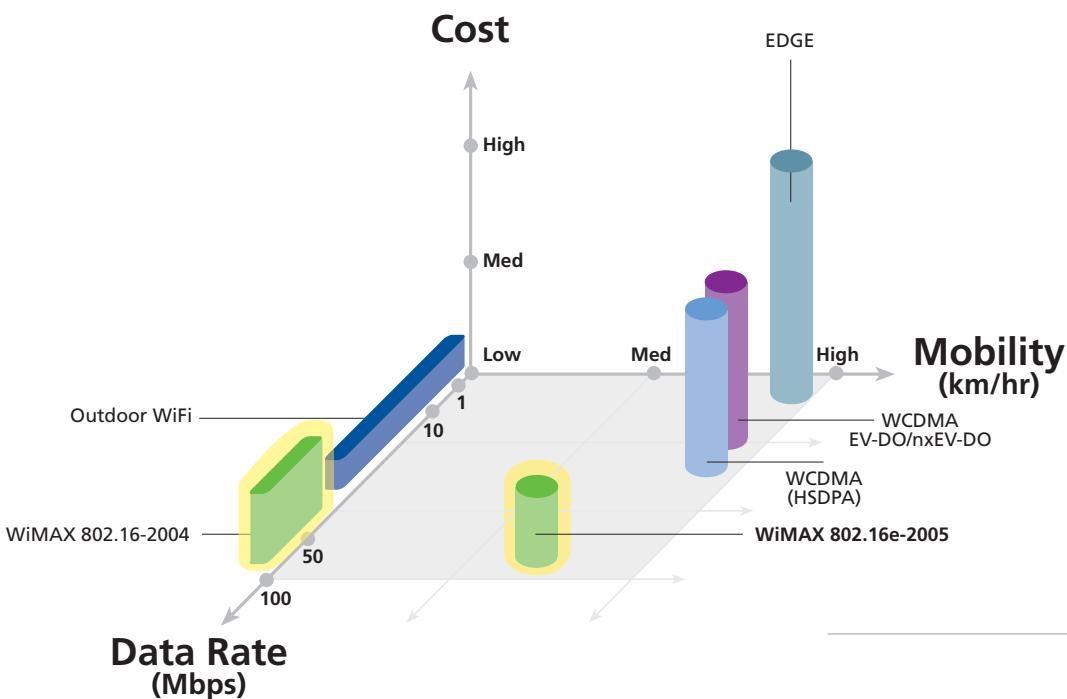


Figure 3: Mapping of Wireless Technologies



Figure 3 and Table 1 map the two technology groups according to their broadband characteristics and as would be expected, the broadband group has a wider range of data rates, while the mobile voice group has greater mobility today. Over time, as mobile voice goes to its next generation and as WiMAX mobility as enabled by IEEE 802.16e-2005 becomes available, both solutions, broadband and voice, become more affordable and increase in mobility.

	Burst Speed	Average User Throughput	Capacity	Other Features
GPRS	53 Kbps	30-40 Kbps		
EDGE	200 Kbps	100 - 130 Kbps	Double that of GPRS	Backward compatible with GPRS
UMTS	384 Kbps	220 - 320 Kbps	Increased over EDGE for high-bandwidth applications	Simultaneous voice and data operation, enhanced security, QoS, multimedia support, and reduced latency
UMTS - HSDPA	2 to 3 Mbps	550 - 1100 Kbps	2.5 to 3.5 times over WCDMA	Backward compatible with WCDMA
CDMA2000 1XRTT	144 Kbps	50 - 70 Kbps		
CDMA2000 1XEV-DO	800 Kbps	300 - 500 Kbps		Optimized for data, VoIP in development
Mobile WiMAX	8 Mbps IN 5 MHz channel	1 Mbps+ in 5 MHz channel	20% higher than HSDPA or EV-DO	

Source: Rysavy Research April 2005

Table 1: Technology Comparison

## Affordable Service For Operators and Consumers

The business case for mobile WiMAX works by enabling affordable mobile broadband services that will lead to mass adoption. The cost elements of mobile WiMAX that enable service providers to keep its service offering affordable include: an advanced over-the-air protocol that minimizes the number of base stations required, thereby reducing deployment costs; the ability to add applications in response to service demand; and the option to begin with a limited network deployment and increase capacity according to demand. Another key factor is the availability of low cost, advanced terminals, which affect not only the total cost of the equipment, but also the user experience and acceptance. Advanced terminals can be, for example, smart handsets with video capabilities or PC based PDAs with wide screens. When low cost advanced terminals are available and tested for interoperability among the different vendors, the business case for mobile WiMAX is ensured.

In addition, a mobile WiMAX all-IP network is based on low cost IP routers that form the network core. Compared with other types of core networks, an all-IP network is much simpler to operate and maintain. The scalability of an IP based core network is a natural part of any IP network, allowing operators to develop their network capabilities in response to subscriber demand. Therefore, the mobile WiMAX business case based on all-IP network architecture has a clear advantage over other core network designs.

**Mobile WiMAX business case, based on all-IP network architecture, has a clear advantage over other core network designs.**



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Mobile WiMAX, built from the onset to fulfill requirements for mobile broadband applications, presents the following advantages over all other mobile and broadband technologies:

- Mobile IP (MIP) algorithms at its core include elements such as home agents that allow seamless handover of services when a subscriber moves from one coverage area to another. With a complete set of IP functions and interfaces as part of the standard, Mobile WiMAX enables the delivery of IP based services, while maintaining end-to-end quality of service (QoS). Core networks based on IP routers and switches are lower cost and easier to install and operate than other alternatives. As today's multimedia services are IP based, all IP networks can easily support the provisioning and QoS for the different services.
- Scalable Transmission Coding – by offering several options for each device, mobile WiMAX maximizes the performance, service availability and quality. Each device can communicate with the closest base station using one of various transmission coding schemes depending on signal quality, interference, its internal processing capabilities, and many other parameters. The coding also adapts periodically to match the current status of the device.
- Spectral Efficiency – combining the latest transmission coding schemes with several channel size options (up to and including 20 MHz) and the ability to group sub-carriers allows operators to use their available spectrum in the most efficient manner.
- Advanced over-the-air QoS – offering multimedia services, which combine voice, data, and video in a single air link to numerous users means that QoS is critical for the proper operation of the network. As WiMAX is all IP, QoS correlation between the IP network and broadband services, most of which are IP based, is straightforward. QoS over-the-air is part of the mobile WiMAX standard in which a design transmission scheduler is used to ensure proper QoS for each and every service.
- Non line-of-sight (NLOS) and Smart Antennas – enabling communication through walls and other physical obstacles in both urban and rural environments, mobile WiMAX is a true NLOS technology. Employing smart antenna technology including beam forming capabilities, power control and other standard-defined parameters means that mobile WiMAX maximizes the number of services delivered and their quality regardless of operating environment.

## Vendor Interoperability – WiMAX Forum™

WiMAX is the first technology that maximizes the concept of standards in its approach to the application of wireless technology to a wide array of products and uses. Credit for these innovative efforts goes to the WiMAX Forum, an industry-led, non-profit organization made up of more than 300 members, among them equipment manufacturers, component suppliers and service providers. In addition to promoting the broadband wireless industry overall, the WiMAX Forum pushes the industry-wide adoption of the IEEE 802.16 and ETSI/HiperMAN wireless MAN air interface standards through testing and certification of products and components to offer fixed, portable and mobile IP broadband services. WiMAX is an open standard with well-established interoperability processes. Mobile WiMAX operators can enjoy the flexibility to use any WiMAX product and the price reduction resulting from interoperability economics.

As today's multimedia services are IP based, all IP networks can easily support the provisioning and QoS for the different services.

Employing smart antenna technology, mobile WiMAX maximizes the number of services delivered and their quality.



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## Every Service Provider May Offer Mobile Broadband

Many service providers are looking at their current and future plans and debating the direction of their service roadmap to remain competitive in the long term. As mobile broadband has clearly emerged as the next revenue generator, how does it fit within providers' current networks?

Fixed line incumbent operators face intense competition for basic voice services as the number and type of competitors have increased sharply. Mobile WiMAX offers these operators the ability to regain and increase revenues. By offering mobile broadband and voice services, while taking advantage of their existing backhauling infrastructure and points-of-presence, incumbents can offer broadband, voice, and other services using a single wireless infrastructure.

For 'innovative challenger' operators, mobile broadband is the way to avoid using incumbent infrastructure, while providing services at competitive prices with low initial investment. With mobile WiMAX services, they can offer services in population-dense urban areas or rural areas where there is no coverage by the incumbent. Mobile WiMAX can also be used to offer backhaul to Wi-Fi hotspot services.

Cable operators are looking to mobile services to gain market share in broadband and voice services towards the overall convergence of services on their networks. With arrangements such as the Sprint-Comcast cooperation in the U.S., cable operators are starting to gain an advantage over other fixed line operators as they now begin to offer the 'triple play' services of voice, video and data with the convenience of mobility. With this combination, they can offer mobile users increased in-home coverage and the ability to switch calls between their mobile and fixed infrastructure, including the use of in-home Wi-Fi connections. In areas where cable operators do not have a cable network installed, Mobile WiMAX enables cable operators to offer services in public places or rural environments, with the high bandwidth required for real-time demand of mobile video applications.

Mobile operators are focusing on and investing in third generation technology as an adjunct to their current GSM or CDMA network systems. The result is two different networks – one for voice calls and one for broadband – running simultaneously, since adding broadband to the voice network which was designed for point-to-point voice applications may result in network overload. Mobile WiMAX allows these operators to reduce congestion on their networks in the areas where needed, adding more capacity and enjoying the benefits of an all-IP architecture. Leveraging their existing base stations, RF knowledge, field equipment and personnel, mobile operators can quickly and easily deploy a mobile WiMAX network.

Therefore, mobile WiMAX is a next generation solution for all types of service providers enabling them to enhance their revenues through a better business case and user experience for mobile broadband services.

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Mobile WiMAX operators can enjoy the flexibility to use any WiMAX product and the price reduction resulting from interoperability economics.





## 4Motion™: Alvarion's Mobile WiMAX Solution

With already more than 150 operators in over 30 countries having deployed the company's fixed WiMAX system, BreezeMAX™ 3500, since its launch in mid-2004, Alvarion is the undisputed leader of the WiMAX market today. As a result, the company is well positioned to lead the evolution of the industry as mobile WiMAX solutions designed around the IEEE 802.16e-2005 standard begin to be deployed. Leveraging the success of BreezeMAX and more than ten years of experience with advanced core OFDM and OFDMA technologies, Alvarion now introduces its mobile WiMAX solution, called 4Motion™. 4Motion is the natural extension of the company's WiMAX leadership to provide a comprehensive, end-to-end, mobile WiMAX solution.

## History with WiMAX

Alvarion has been instrumental in driving WiMAX technology to its current place of prominence. Since 2002, company representatives have been serving in two board positions of the WiMAX Forum, as well as in other capacities, including co-chairing the Forum's working group for developing specific profiles for IEEE 802.16e-2005.

With WiMAX, the company is continuing its longstanding involvement and commitment to standards' compliance and their respective organizations. For example, Alvarion chairs the ETSI BRAN HiperMAN Alliance and serves on the board of the Wireless Communication Association (WCA). Overall, Alvarion has been a pioneer and major contributor in the creation and development of wireless technologies over the past decade, including making significant contributions to the IEEE 802.11, 802.11a, 802.16, and HiperMAN standards.

As a credit to its industry leading broadband wireless technology and products, Intel selected Alvarion to be its first development partner for WiMAX systems, an agreement that resulted in the market introduction of BreezeMAX PRO, the first commercially available WiMAX customer premises equipment (CPE) that uses Intel's WiMAX chip, the Intel® PRO/Wireless 5116 broadband interface. In addition, Alvarion has several global strategic partners for selling and deploying its broadband wireless and WiMAX systems including Alcatel, Lucent, Siemens, and others.

Given its market position, investment of resources, and involvement in early technology development on a global basis, Alvarion has been and continues to be a compelling, driving force in the wireless broadband industry and the most likely company to lead the market in the sales and deployment of standard mobile WiMAX solutions offering Personal Broadband services.

## 4Motion – Standard . . . Plus

Answering the requirements for Personal Broadband services, including mobile, portable, and 'handheld' personal broadband, Alvarion's 4Motion solution offers many technical and economic advantages over other mobile WiMAX solutions. With its unique design, 4Motion offers customers a complete solution including radio base stations (modems, radio units, antennas), a wide variety of subscriber terminals, mobility management equipment (ASN Gateway<sup>[1]</sup>) and standard interfaces to core network devices.

Alvarion, continues to be the driving force in the wireless broadband industry and is the most likely company to lead the Mobile WiMAX industry and bring true Personal Broadband to the market.



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The following diagram shows the Alvarion mobile WiMAX solution:

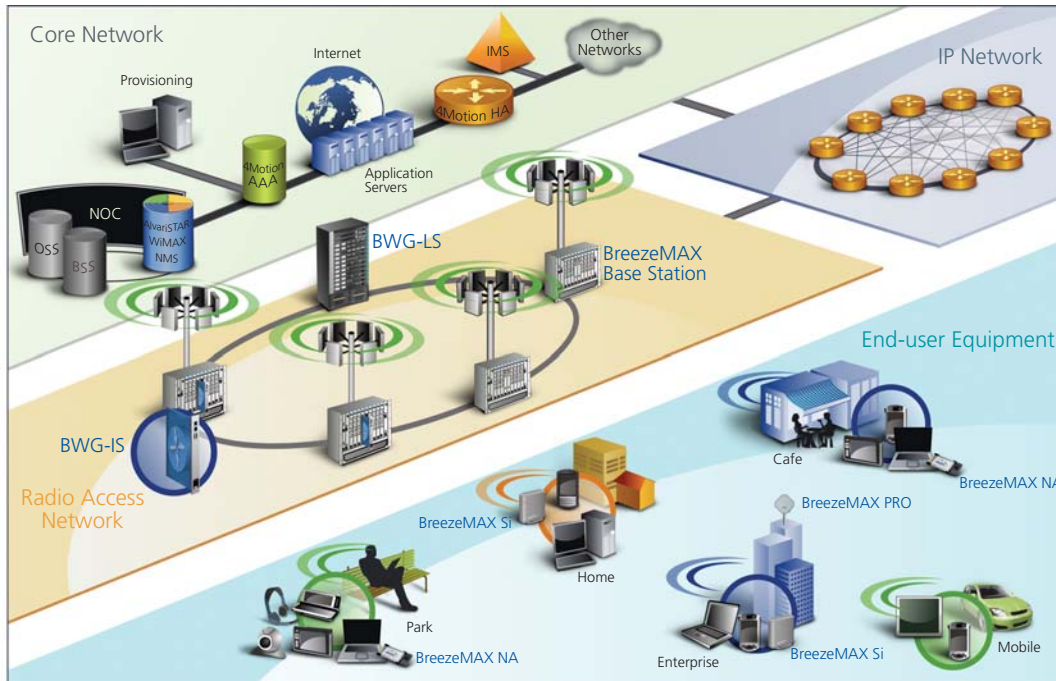


Figure 4: Alvarion's 4Motion Solution

Using the IEEE 802.16e-2005 mobile standard as a foundation, Alvarion's 4Motion solution adds enhancements featuring:

- An integrated fixed and mobile WiMAX solution using a single base station that supports a mixture of mobile, residential and business users.
- Clear migration from a fixed-only WiMAX network, to a mixed network, and even a fully mobile WiMAX network.
- Modular base stations - Various base station types capable of addressing a wide variety of service and network deployment models from high capacity, performance solutions for dense urban areas to cost-effective broad coverage solutions for suburban and rural areas.
- Combined IP and mobility control with radio base stations - combining a smart mobility gateway with smart radios into a single base station to offer the highest performance in the industry.
- Providing exceptional WiMAX coverage and capacity through the use of unique beam forming and MIMO technologies.
- All-IP technology which lowers the total cost of ownership (TCO) for the operator while paving the way for fixed and mobile core IP and service delivery convergence.
- A complete end-to-end solution that goes beyond 802.16e-2005 specifications, combining radio access network equipment, core network equipment including IMS – all in an open architecture network environment. The solution conforms with the WiMAX Forum Networking Working Group architecture and specifications tested for full compatibility with IEEE 802.16e-2005 profiles for conformance and interoperability with industry leading WiMAX chip sets and user terminals.

With full compliance to the 802.16e-2005 standard and the many additional features, which improve network performance and user satisfaction, Alvarion's 4Motion is the new standard in mobile WiMAX.



## Conclusion

WiMAX, an all IP, fixed, portable and now mobile standard, can offer a variety of services and business models for established operators as well as innovative challengers. Specifically, WiMAX provides the infrastructure, which naturally supports fixed-mobile convergence (FMC).

Coming from the broadband world and using an all-IP architecture, mobile WiMAX is the leading technology for implementing Personal Broadband services. With a huge market potential and the ability to be affordably deployed, mobile WiMAX is on the verge of a major breakthrough.

Mobile WiMAX networks use open standards, based on IP, and focus on end user and consumer devices. No other technology offers a full set of chargeable, differentiated, voice, data, and premium video services in various wireless fashions: fixed, portable and mobile, while allowing innovative services to increase revenue and reduce subscriber churn rates.

Leveraging the best technology and favorable economics of broadband and mobile services today, Alvarion's mobile WiMAX 4Motion solution is the next evolution - with both social and business impacts on our daily lives.

With its 4Motion solution, Alvarion offers a diversified range of products/services for all operators. From wide coverage areas to high performance base stations and localized access points for enterprise and in-building use, 4Motion integrates the most advanced and adaptive radio management and control technologies. It offers optimal utilization of the operator's spectrum and network resources, while supporting the most stringent of QoS requirements for next generation applications such as gaming, video, IMS and others. As a mobile platform, it also serves multiple applications in tandem with other existing networks including 3GPP, DSL, satellite, and cable. In conclusion, Alvarion, with its leadership position in WiMAX driven by the BreezeMAX system, and now with its 4Motion solution, takes the market to the next level, to mobile WiMAX.

With full compliance to the 802.16e-2005 standard together with many additional features that enhance network performance and user satisfaction, Alvarion's 4Motion is the ultimate mobile WiMAX solution.

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