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Overcoming the limitations of today's fixed wired access technologies

A White Paper issued by:
Siemens Information and Communication Networks
Solution Management Access

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Executive Summary

Governments globally are starting to prioritize broadband as a key political objective for all citizens to overcome the “broadband gap” also known as the “digital divide”. In last mile markets where traditional cable or copper/fiber infrastructures are either saturated, outdated or simply out of reach, Broadband Wireless Access (BWA) technology fills the void admirably, providing highly efficient and cost effective access services for a large number of subscribers who would otherwise be left out of the loop in developed markets.

WiMAX = Worldwide Interoperability for Microwave Access Systems

With the advent of WiMAX, Broadband Wireless Access is undergoing a dramatic change. What differentiates WiMAX from earlier BWA developments is *standardization.* Current broadband wireless deployments are based on proprietary solutions in which each BWA vendor custom-builds their solution, which adds time and cost to the process. Similar to what has happened recently in the WLAN arena with Wi-Fi, WiMAX plans to enforce standards compliance among vendor members. This compliance will result in interoperability and ultimately plug-and-play products, the cost of which will benefit from economies of scale and hence bring dramatic improvement to the business case for the operator. First WiMAX products will be available by the beginning of 2005 and is set to become the mainstream broadband wireless platform with more than 50% market share used by the predicted 3,8 million broadband wireless subscribers in 2008. While the overall number of subscriber lines is quite small relative to DSL or cable, the dollar value is growing to the point where even major carriers are beginning to pay close attention.

It is not only the developed markets that can benefit from WiMAX. For emerging markets, operators are interested in using WiMAX for low cost voice transport and delivery, which has been very difficult with proprietary solutions. Overall, the markets without any fixed infrastructure pose the greatest opportunities.

In 2006 we will see the start of the second stage in the WiMAX evolution with WiMAX chipsets embedded in laptops and other mobile devices. This step will lead to broadband portability and to CPE-less business model, which makes the case even more compelling for an operator, because the user is subsidizing the model.

1. Outlook for Broadband Wireless Access

1.1 Historical Challenges

In the past, many operators analyzed the business case for deploying non-standardized broadband wireless access as an alternative to DSL/cable. Although a few operators made deployments, many operators decided not to invest in this equipment and some of the reasons for them not having done this **were**:

Former Wireless Show Stoppers

- Non-standardized equipment using proprietary interfaces leading to high risk one-vendor strategies
- Uncompetitive prices for broadband wireless equipment in comparison to wire line equipment with lower throughput (including CPEs)
- Line of sight requirements in densely populated areas
- No clear unique value added differentiator (wireless could only deliver services similar to traditional wired technologies)

All of these reasons together lead to the fact that the fixed broadband access business case was not compelling. This is changing.

1.2 The Wireless (R)Evolution and WiMAX

The following table illustrates the improvement and advancement of Broadband Wireless technologies from 2000 to 2005 as well as the evolution from proprietary to standard-based solutions.

Figure 1: Broadband Wireless Product Development

2000 2001	2002 2003	2004 2005
Proprietary Solutions →		**Standard-based wimax Solutions**
Data rate: 2-11 Mbps peak **Chip sets:** use 802.11 RF and PHY or proprietary **Air Interface:** frequency hopping and Direct Sequence	**Data rate:** 6-54 Mbps peak **Chip sets:** OEMs forced to develop their own Silicon - Some use 802.11a RF & PHY **Air interface:** OFDM & S-CDMA approaches	**Data rate:** Up to 72 Mbps peak **Chip sets:** Volume silicon supplier **Air Interface:** 256 FFT OFDM and OFDMA

1.2.1 Standardization

The telecoms industry has recognized the shortcomings of non-standardized broadband wireless access and as within the wireline sector, the IEEE has been working towards an extension of the 802.16 standard for 10 – 66 GHz published in April 2002. The sub-11GHz frequency ranges are standardized in IEEE 802.16a. IEEE 802.16a is also known as the IEEE WirelessMAN air interface.

Interoperability and WiMAX (Worldwide Interoperability for Microwave Access Forum)

WiMAX is a non-profit industry organization formed by equipment and component suppliers to promote the adoption of IEEE 802.16 compliant equipment (such as base stations and CPEs). While vendors have been providing proprietary solutions for many years now, WiMAX promises to standardize the equipment (Base Stations and CPEs), making it interoperable and more affordable. This will in turn lead to less risky multi-vendor strategies for operators.

Internationally, WiMAX has agreed to cooperate with ETSI to support certification of products employing the ETSI HIPERMAN standard for European broadband wireless metropolitan area access.

1.2.2 Volume production

Economies of scale

Major chip vendors, such as Intel, are developing standards-based WiMAX chipsets, (which can also later be integrated into laptop computers), and are leading this revolution towards volume production which will in turn help to reduce equipment prices ensuring that wireless products can be competitively positioned against their wired counterparts. WiMAX promises to drive down the costs of broadband wireless equipment, allowing operators to expand networks and provide lower access fees-

Technological Advance

1.2.3 Overcoming the technical limitations of today's BWA

The WiMAX frequency ranges can be licensed or license-exempt and enable non-line-of-sight (NLOS) performance, making the IEEE 802.16a standard the appropriate technology for carrier-grade last-mile applications where obstacles like trees and buildings are often present and where base stations may need to be unobtrusively mounted on the roofs of homes or buildings rather than towers on mountains.

Application and installation differentiator

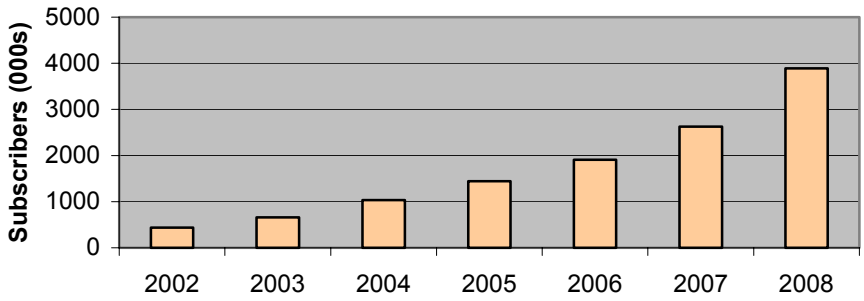
1.2.4 Portability and CPE-elimination

A further enhancement (the second-stage) of the standard is the IEEE 802.16e extension, which enables nomadic capabilities for laptops and other mobile devices allowing users to benefit from metro area portability of an xDSL like service. This extension will boost development of built-in chipsets thus eliminating the external modem altogether and allowing transmission directly to the laptop. This built-in CPE could lead to a CPE-less business model, which makes the case even more compelling for an operator, because the user is subsidizing the model

1.3 Broadband Wireless Access Market Trends

The BWA is an industry that is growing at a rapid pace regardless of WiMAX. The following market forecasts do not account for WiMAX, since it is assumed that WiMAX will only increase the size of the market (in revenues or subscriber lines) from 2006. After 2006, the second-stage WiMAX (IEEE 802.16e and mobility) could have a significant impact on subscriber lines and revenues.

Figure 2. Global Broadband Fixed Wireless Subscriber Lines



Source: Pyramid Research

While the overall number of subscriber lines is quite small relative to DSL or cable, the size of the market and the revenues associated with it is growing to the point where even major carriers are beginning to pay more close attention.

The 802.16 standard is set to revolutionize the broadband wireless market with research showing that by 2008 up to 50% of all broadband wireless equipment could support this standard.

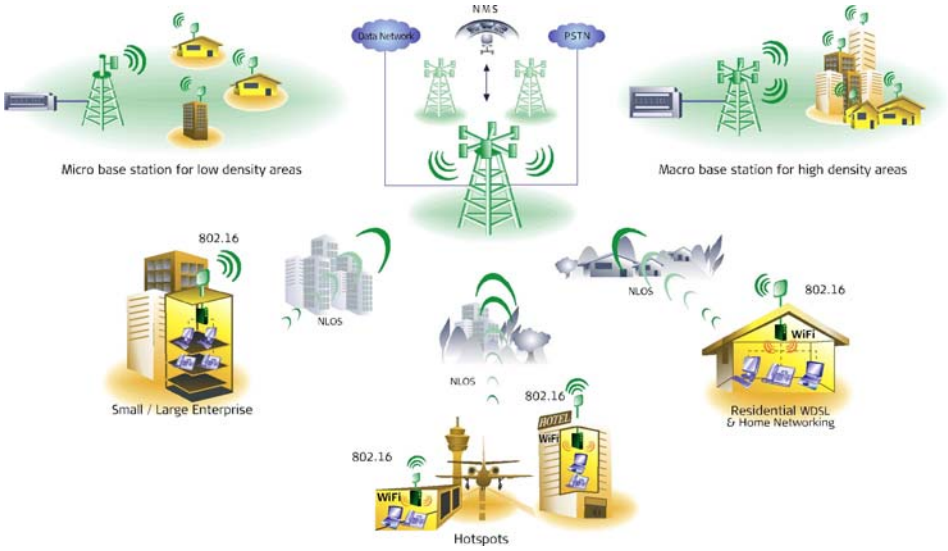
- Large BWA vendors are concentrating on developing WiMAX equipment because they also see many benefits from migrating to WiMAX: such as exiting the CPE business and concentrating on their core business: base stations.
- Operators can improve their business model by deploying interoperable, lower cost equipment – which is particularly important in emerging markets

Siemens believes that the BWA market will have a substantial share of the broadband access market and that WiMAX is going to change the broadband map globally.

2 WiMAX Equipment and Networks

2.1 Application Scenarios

Figure 3. Application Scenarios with WiMAX equipment



Typical point to multipoint Broadband Wireless Access (BWA) systems are composed of two key elements: base station and subscriber equipment. The base station connects to the network backbone and uses an outdoor antenna to send and receive high-speed data and voice to subscriber equipment, thereby eliminating the need for extensive and expensive wireline infrastructure and providing highly flexible and cost-effective last-mile solutions.

Business Advantages

The main business advantages of wireless systems based on IEEE 802.16 are:

- the ability to overcome the physical limitations with ranges of traditional wired infrastructure and still provide residential and business users with comparable throughputs at up to 40km
- broadband service provision in areas where existing plant is not allowing copper based xDSL based services
- cost efficient service supply in areas where traditional xDSL is not suitable due to small number of customers per DSLAM
- the avoidance of steep installation costs – no outside plant costs necessary for copper/fiber and
- the ability to quickly provision service, even in areas that are hard for wired infrastructure to reach, helping operators to overcome the digital divide.

2.2 Equipment Capabilities

Carrier-Class Performance with WiMAX equipment

This 802.16 technology is designed from the bottom up to provide wireless last-mile broadband access in the Metropolitan Area Network (MAN), delivering carrier-class performance comparable to traditional cable, DSL, or E1/T1 offerings.

The main technical properties are:

- Broad bandwidth - up to 134 Mbit/s in 28 MHz channel
- Multiple services supported simultaneously with full QoS to efficiently transport multifaceted protocols like IPv4, IPv6, ATM, Ethernet, etc.
- Bandwidth on demand (frame by frame)
- MAC designed for efficient used of spectrum
- Comprehensive, modern, and extensible security
- Multiple frequency allocation support from 2-11 GHz - OFDM and OFDMA for non-line-of-sight applications (licensed and license-exempt spectrum)
- TDD and FDD
- Link adaptation: Adaptive modulation and coding - subscriber by subscriber, burst by burst, uplink and downlink
- Point-to-multipoint topology, with mesh extensions
- Adaptive antennas support and space-time coding
- Conformance test specifications as defined in IEEE 802.16d
- Mobility extensions (IEEE 802.16e).

3 WiMAX - The Business Case

3.1 Business Case Overview

Siemens and Alvarion investigate

Siemens and Alvarion have completed a techno-economic assessment together to analyze the effects of introducing WiMAX based equipment in various scenarios by performing detailed business case analysis. The demand driven approach taken brings clarity and understanding to the development process of a competitive business plan that embraces alternative market, technical and economic futures.

3.2 Major Assumptions

The market investigated consists of both residential and business users who subscribe to various services similar to those offered by existing wireline broadband operators. The base station equipment used to address these customers is modular and scalable, allowing operators to pay-as-you-grow.

The most common 802.16a/d configuration consists of a base station mounted on a building or tower that communicates on a point to multi-point basis with subscriber stations located in businesses and homes (as shown in figure 3). Depending on topography and antenna height IEEE 802.16a/d based equipment may achieve up to 50km of range with a typical cell radius of 6-10 km

Since the high cost of CPEs has been the principal obstacle to making the consumer fixed wireless business model work in the past, the business case has been considered for different types of CPE (depending on end-user needs)

- A modem attached to an external antenna
- A modem with an indoor antenna
- Integrated antenna since as further integration into silicon by major chip suppliers takes hold, CPEs can be integrated into laptops, phones and other devices.

3.3 Key Findings

The business case makes sense

The results of the investigation show that there is a positive business case for operators who want to add services and applications which are comparable to other existing broadband technologies (e.g. cable or DSL) for both high-volume residential and high-revenue business customers in greenfield and overlay scenarios and to address the problems associated with the digital divide (e.g. limited range and hence limited penetration in underserved areas).

The growing demand for broadband services on a global scale is clear and uncontestable. Businesses, public institutions and residential users regard it as an enabling technology and it has become a given requirement for delivering communications services in the Information Age. DSL operators, who initially focused their deployments in densely populated urban and metropolitan areas, are now challenged to provide broadband services in suburban and rural areas where new markets are quickly taking root. In last mile markets where traditional cable or copper/fiber infrastructures are either saturated, outdated or simply out of reach, Broadband Wireless Access (BWA) technology fills the void admirably, providing highly efficient and cost effective access services for millions of subscribers who would otherwise be left out of the loop.

The emerging markets can also benefit from the WiMAX technology, particularly those operators who are interested in using WiMAX for low cost voice transport and delivery, which has been very difficult with proprietary solutions. Overall, the markets without any fixed infrastructure pose the greatest opportunities. They benefit from the avoidance of steep installation or rental costs – since no outside-plant costs are necessary for copper/fiber and from scalable equipment, matching the rollout to the acquired subscribers.

4 Siemens and Alvarion

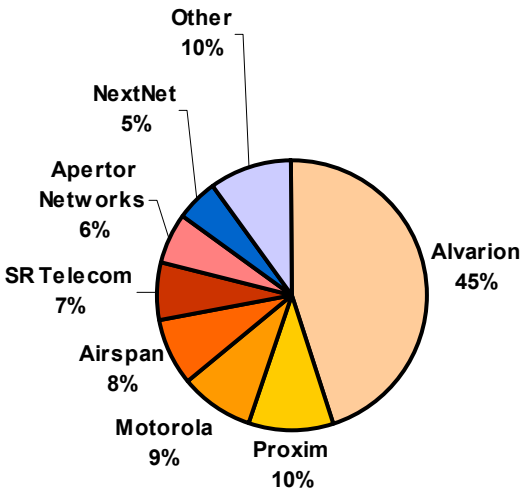
Networking Expertise

Siemens is a market leader in networking solutions and equipment. We understand that finding the right solution for our customers' business requires careful planning and analysis. Based on our experience and expertise we can offer you assistance in assessing and evaluating your WiMAX Business Case and needs to help you define your market position and the future business goals and help to decide which technological investments are necessary in order to achieve them. Siemens is a major shareholder and also has a global OEM agreement with Alvarion. The partnership has now successfully deployed with over 30 operators in more than 20 countries - major wins in 2003 include Russia, Sweden, India, China and New Zealand

Market Leadership

Alvarion is recognized as market leader for Wireless Access Technology and has deployments in 130 countries.

Figure 4: Global BWA Equipment Market Share (Access and Backhaul)



Source: Pyramid Research

In 2003 Alvarion continued to play a key role in the design and development of new and improved wireless industry standards. The following is a list of high-level positions that reflects Alvarion's leadership within the industry.

- WiMAX Forum - Vice President and CFO
- ETSI BRAN HiperMAN – Chair
- Wireless Communications Association (WCA) - Board member and Chair of BWA Task Force for Mobile Operators
- IEEE 802.16e part of the team drafting the mobile PHY / MAC features
- IEEE 802.11a standard committee - Chair

Leading the Revolution

Alvarion-and Intel entered into a WiMAX system cooperation agreement in summer 2003, which means that they have a strategic relationship to develop and produce industry leading chips (Intel) and systems based on these chips (Alvarion).

5 Conclusion: Increased Revenues with WiMAX

Standardized Equipment

Broadband Wireless Access is being revolutionized by standardization. Operators can benefit from interoperability and economies of scale of WiMAX equipment that will dominate the wireless technologies available on the market, with first products becoming available later this year.

Overcome the digital divide

While operators have deployed broadband services to many subscribers who are within reach of central office locations, there is still an untapped market of subscribers who do not benefit from broadband services. Governments globally are starting to prioritize broadband as a key political objective for all citizens to overcome the "broadband gap" also known as the "digital divide". With WiMAX, operators are being given the chance to extend their customer base to include these subscribers using a highly efficient and cost effective complementary access technology. In emerging markets, operators will be able to capitalize on the benefits that are associated with standardized equipment: economies of scale.

The killer application

WiMAX deployment will follow at two-stage development. Once mobility and broadband have been combined in step two in the form of in integrated CPEs in 2006, WiMAX will coexist alongside UMTS.