



BROADBAND WIRELESS DATA SOLUTIONS

A MARKET IN TRANSITION FROM EARLY ADOPTER TO EARLY MAJORITY

*Option's assessment and view of the key trends that will shape
the wireless broadband market over the next 12-24 months*

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INTRODUCTION

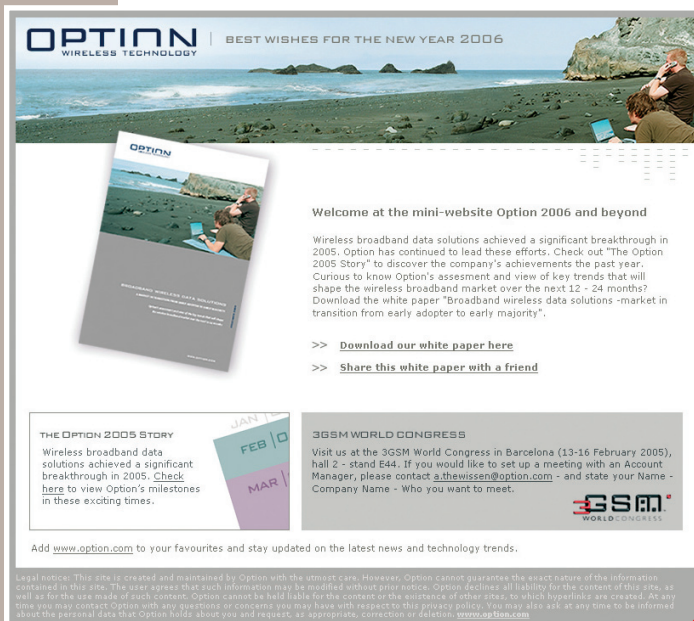
In many countries, broadband access is increasingly common at home and in the office. As users find they can achieve more with faster broadband connections, their expectations rise. **Broadband's very real efficiency and productivity benefits are stimulating interest across society for ubiquitous broadband access.**

It is increasingly apparent that wireless technologies will make a significant contribution to the creation of the "broadband society". However, there is confusion over the roles and capabilities of the various wireless technologies that currently exist or are in development. There is also confusion between "wireless" and "mobile" broadband.

Drawing on more than 20 years experience in the design and development of wireless data solutions, this paper provides **Option's assessment of current wireless data technologies.** It explains the important distinction between wireless and mobile technologies and shares our view of the key trends that will shape the wireless broadband market over the next 12-24 months.



Jan Callewaert
Chief Executive Officer Option
December 2005



The screenshot shows the Option 2006 mini-website. At the top, it says "OPTINN WIRELESS TECHNOLOGY" and "BEST WISHES FOR THE NEW YEAR 2006". Below this is a banner image of a beach with people. The main content area features a "Welcome at the mini-website Option 2006 and beyond" section, which includes a link to "Download our white paper here" and "Share this white paper with a friend". There are also sections for "THE OPTION 2005 STORY" and "3GSM WORLD CONGRESS". At the bottom, there is a footer with a legal notice and the website URL "www.option2006andbeyond.com".

DRIVERS OF WIRELESS BROADBAND

In the 20 or so years since the introduction of cellular technology, the mobile has evolved from being a premium communication tool for the wealthiest in society to become a part of day-to-day life for more than two billion people worldwide. Many users now expect their mobile to keep them connected wherever they happen to travel.

In many parts of the world fixed broadband services based on DSL or cable are being heavily promoted. As broadband users discover they can achieve more, they become frustrated when high-speed access is not available. For those who use both broadband and a mobile, “wireless broadband” is an attractive and easily-understood concept.

There are several factors driving interest in wireless broadband:

- > Rising penetration of laptop personal computers
- > The convenience of wireless technologies
- > Continuing enhancement of the data capabilities of the mobile operators
- > Emergence of market segmentation as mobile operators develop propositions to penetrate small businesses, SOHO and even consumer segments
- > Limited availability of fixed broadband solutions in some markets
- > Increasingly widespread acceptance of wireless LAN within enterprises, in public “hotspots” and even in the home
- > Heavyweight promotion of various technologies including 3G UMTS, 3G HSDPA, WLAN and WiMax.

Despite its numerous forms, wireless broadband as a concept is reaching levels of acceptance that will see it transition from “early adopter” to the “early majority” phase of market development during 2006-07.

WIRELESS OR MOBILE?

However, there is an important distinction between wireless and mobile broadband. While mobile broadband relies on a wireless connection, it is not the case that all wireless connections provide a mobile solution. Mobile systems need to be able to support users while they travel over wide areas: to be viable in the developed world, a mobile system must be able to sustain the connection while the user is travelling at speeds of up to 200 km/h. For some important types of service, mobile networks also need to be able to find users, wherever they happen to be. For truly wide area coverage, a mobile system needs to enable users to roam on to the networks of other operators while being billed for usage by their usual operator. Wireless systems that do not include features are only suitable for fixed, or, at most, static users.

WIRELESS FUNDAMENTALS

In comparing wireless technologies, it is instructive to remember that some aspects of radio performance are determined more by the laws of physics than by the characteristics of the technology. In several instances, radio technologies are approaching fundamental limits.

Shannon's Law states that for a given spectrum bandwidth, the theoretical maximum rate of error-free data transmission is defined by the ratio of the energy per data bit to the noise at the receiver.

This law also implies that data rates must fall as range increases. In multi-user networks, cell range is determined by the desired uplink data rate and uplink transmitter power. For portable devices, transmitter power is constrained by battery capacity and permissible EMF exposure limits, both of which are largely independent of the device's radio technology.

The spectrum deployed also has an influence on performance. For non line-of-site radio paths, diffraction losses increase with rising frequency. For a given antenna gain, non line-of-sight range falls by slightly less than 50% for a doubling of frequency. Although some of the losses can theoretically be recovered by increasing antenna gain, in reality the scope for step-change advances in antenna design in the space constraints of a portable device are limited. On the other hand, the greater availability of spectrum at higher frequencies does offer wireless solutions the potential to keep pace with advances in data rates available from fixed broadband.

And, despite some claims to the contrary, **antenna design and location will impact quality of service.** A laptop equipped with a wireless PC Data Card and used indoors on the ground floor will inevitably experience poorer reception than a device with an external roof-top antenna and line-of-sight to the transmitter.

While technologies that can deliver high data rates, long range and non line-of-sight operation are the holy grail, unfortunately the laws of physics dictate that the three characteristics are mutually exclusive and overall performance is inevitably a compromise.



*The GlobeTrotter COMBO EDGE,
with superb antenna design*



CURRENT TECHNOLOGY LANDSCAPE

“Mobile” technologies are currently the primary drivers of wireless broadband.

MOBILE TECHNOLOGIES

CDMA played a significant early role in its native US stimulated by the early and widespread adoption of laptop PCs in the country. The technology has also enjoyed some success with operators in Japan and Korea.

CDMA 2000 EV-DO, the broadband version of CDMA, was commercially available from 24 operators in 18 countries as 2005 drew towards its close. However, as these networks are deployed across six different spectrum bands, the EV-DO market is intrinsically fragmented. Even in its core US, Japanese and Korean markets, which will account for some 95 percent of the forecast end-2005 global EV-DO user base of 22 million, four quite different spectrum configurations are used: dual-band 800/1900 MHz in the US, separate 800 MHz and 1700 MHz implementations in Korea and 800 MHz with reversed transmit and receive bands in Japan.

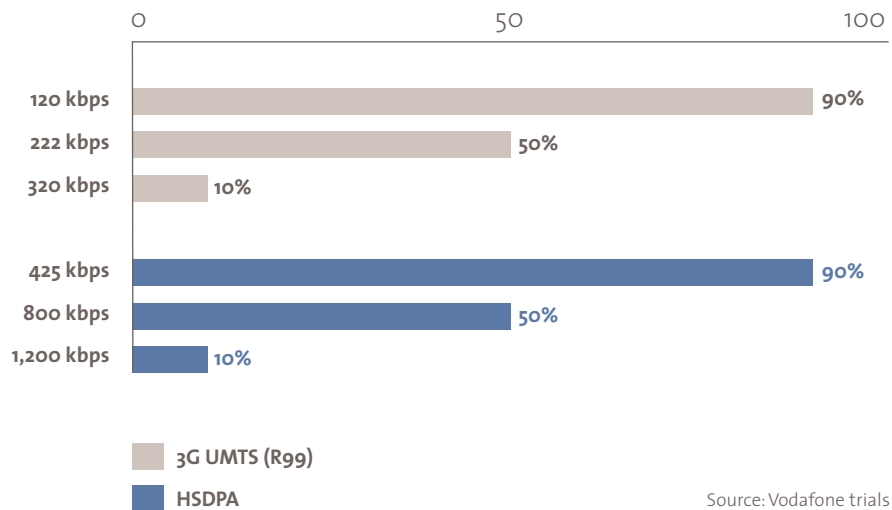
After a slow start, **3G UMTS** started to gain significant traction during 2004: by the year-end, some 60 operators were delivering 3G UMTS services in 30 countries including most of western Europe. By the end of 2005, this community will have grown to 94 operators serving 48 million users in 40 countries spanning Europe, Asia, Australasia, the US and even Africa. Enterprise mobile data services based on wireless data cards were the first 3G offering from a significant proportion of these operators. With all but one of the 3G UMTS networks currently operating in the 2.1 GHz core 3G frequency band, this technology is beginning to reap the benefits of global scale that are not available in the fragmented CDMA EV-DO sector.

Developed over many years through a partnership involving manufacturers, technology companies and mobile operators from around the world, 3G UMTS is designed to evolve with the phased release of new higher performance features and functionality. Extensive field trials of the next enhancement, **HIGH SPEED DOWNLINK PACKET ACCESS (HSDPA)**, were undertaken during 2005 in advance of what is likely to be a significant wave of commercial launches through 2006.

Offering considerably higher download data speeds compared with standard 3G UMTS, HSDPA will further enhance the wireless broadband experience for mobile users. Trials undertaken by Vodafone, the world's largest international mobile operator group, suggest HSDPA delivers user data-rates nearly four times faster than the widely deployed Release 99 version of 3G UMTS.



Performance experienced by % of users



With further phased enhancements of 3G UMTS and HSDPA in development, realizable maximum data rates are expected to rise from 1.8 Mbps in 2006, to 3.6 Mbps in 2007 and 7.2 Mbps in 2008. **These speeds compete with those offered over fixed broadband networks, with the added convenience of being wireless, and will open up new market opportunities for 3G UMTS operators and their device suppliers.**

Despite the rapid roll-out of 3G UMTS, GPRS and EDGE remain relevant to the delivery of wireless data services. While GPRS has only limited bandwidth, this packet-switched overlay now deployed by the majority of GSM operators offers users an unrivalled default level of connectivity on an international basis.

EDGE, an upgrade to GPRS that significantly increases spectral efficiency and data rates, continues to find favour as a complement to 3G UMTS in rural areas and among operators who have yet to secure 3G spectrum. EDGE is already competing with under-developed fixed broadband services in some markets in eastern European and Asia.

UMTS TDD is a mobile broadband solution designed for deployment in unpaired spectrum. To date, the technology has been deployed by 20 operators, although most currently only offer relatively localised and limited coverage. Many 3G UMTS operators have unpaired allocations that are suitable for UMTS TDD, although alternative technologies may be a more attractive complement to their core service by the time they are ready to exploit their spectrum reserve. The technology is likely to remain a niche offering in the medium term.

China's TD-SCDMA is another candidate technology for unpaired spectrum allocations, but has yet to be deployed commercially.

WLAN FOR NOMADIC USERS

Wireless LAN remains an important influence in the wireless broadband landscape. With its restricted range – typically limited to tens of metres - and no hand-off between base stations, WLAN is a “nomadic” rather than mobile broadband solution. Based on the 802.11x standards, WLAN is increasingly being exploited to offer high-speed connectivity to laptop and PDA users in offices and public “hot-spots”. It is also becoming commonplace in the home, providing wireless access to broadband connections. Although the technology is theoretically capable of data rates of up to 54 Mbps over-the-air, the actual usable data rate is determined by the bandwidth of the network or connection the WLAN provides access to and the number of users accessing the hotspot.

However, the underlying technology is being incorporated within an increasing number of products.

It is now standard in all but the most basic of laptop computers and is beginning to appear in mobile phones.



*GlobeTrotter FUSION+ HSDPA Ready
combines 3G UMTS, EDGE, GPRS, WLAN*

WiMAX: ONE OR TWO TECHNOLOGIES?

WiMAX is widely, yet incorrectly, perceived to be a single technology to rival both fixed broadband and 3G mobile. In reality, two incompatible variants of WiMAX are under development: one, based on the IEEE 802.16d standard, is intended to deliver wide area broadband access to static users; the second, based on IEEE 802.16e, aims to serve mobile users. While both deliver high-speed IP connectivity, neither is specifically designed to deliver a robust voice service. WiMAX is likely to be deployed first at 3.5 GHz and subsequently at 5.8 GHz: both bands have been allocated to wireless broadband in most regions of the world. The technologies' proponents are also lobbying for access to other bands, notably the 2.5-2.69 GHz band currently reserved in several regions for future allocation to 3G mobile services. Given Shannon's Law, the spectrum actually allocated will impact on the investment required to provide coverage. **Despite the delays in finalising the standard and agreeing an interoperability certification regime WiMAX will become a reality with its enthusiastic support from some of the leading companies in the IT sector.** Commercial availability of fixed WiMAX devices and infrastructure are now expected during 2006.

The underlying IEEE 802.16e technology was formally standardised on 7 December 2005 and analysts Frost & Sullivan estimate that certification for mobile WiMAX equipment will commence around the third or fourth quarter of 2006. However, development of the mobility management functionality required to deliver a true mobile service continues within the WiMAX Forum.

OPERATOR PERSPECTIVES

Operator investment remains central to the widespread availability of wireless broadband services.

Most operators prefer to use standard-based technologies in order to benefit from a competitive supplier environment. Equally, internationally co-ordinated spectrum bands – such as the 2.1 GHz core 3G band - realize economies of scale that benefit operators, manufacturers and users. In true mobile systems, common frequency bands also facilitate seamless global roaming. GSM/3G UMTS operators already score well against these criteria.

GSM also has a major asset in its ability to authenticate customers and bill them, its established roaming culture and global customer base that exceeds 1.5 billion. A secure, roaming protocol based on GSM's secure SIM authentication already allows mobile users to roam onto hotspots with charges being billed to the mobile account and has made GSM operators attractive partners for hotspot owners.

Another important feature that differentiates both 3G UMTS from alternative broadband wireless technologies is that it delivers robust and ubiquitous voice services. In an environment where voice still accounts for some 80% of operator revenues, this remains a significant factor in the viability of operator business cases.

GSM/3G UMTS operators have a clearly defined evolution path towards further performance enhancements. As a relatively simple software upgrade to existing 3G networks, HSDPA operators will be able to offer high-speed broadband access, complemented by full voice capability, across a wide area very quickly. HSDPA roaming is likely to become a reality by the end of 2006.

Against this background, there is little commercial incentive for an existing 3G UMTS operator to migrate to WiMAX – especially when the alternative technologies are still immature and Shannon's Law suggests they are unlikely to deliver more than a marginal improvement in performance in the real world.

Fixed WiMAX networks will, however, be deployed and will be able to offer a range of "last-mile" and backhaul services to individuals and enterprises. The prospects for mobile WiMAX networks are less clear cut in the medium term given the global scale and reach of the GSM family of mobile standards and the head start and momentum behind 3G UMTS and HSDPA.



GlobeSurfer 3G - easy wireless cellular connection for mobile offices, small office or home office environments

MARKET AND DEVICE SEGMENTATION

3G UMTS/GSM has already demonstrated a market for wireless broadband. Although it was developed as a mobile technology, the performance of HSDPA and its growing economies of scale, will make it a viable alternative to fixed broadband solutions for many users. The emergence of WiMAX and other technologies can only further increase the role wireless in the overall broadband market.

To date, wireless broadband has been driven by PC Data Cards. The installed base of laptops, will ensure PC Data Cards remain at the heart of the market throughout 2006 and 2007. Within the GSM world, 3G/GPRS cards will become the entry-level mass-market device. Combination cards incorporating HSDPA, WLAN and other mobile technologies will remain the choice of professional users for whom “anytime, anywhere” connection is important. PC Data Cards are also likely to be among the first fixed WiMAX products to reach the market.

Although the PC Data Card market will continue to see a strong growth, the market acceptance of wireless broadband has reached the level where new devices will emerge, expanding the market as whole.

WIRELESS MODULES

The functionality of a wireless data card can now be manufactured in a compact wireless module small enough to be built into a laptop. Broadband wireless-ready laptops will appear during 2006.

Some manufacturers may choose to incorporate a module in top-tier machines while build-to-order suppliers will be able to offer the functionality as an option. With the predicted arrival of fixed WiMAX and widespread HSDPA launches, competition for the available real-estate within the laptop could become heated during 2006.

FIXED MOBILE SUBSTITUTION PRODUCTS

ROUTERS: for multiple users, whether a family at home or a team working at a client's site, routers capable of connecting a group of WLAN-equipped PCs to a single wireless broadband connection are already entering the market, including devices from Option. Where 3G mobile technologies are deployed in such devices, they will be able to offer voice as well as broadband data services.

Whether it's the PC manufacturer embedding a wireless module or a VAR or PC retailer selling a USB device or router, **new business models will be required to reflect the role of these new distribution channels in helping operators acquire new customers.** By selling 3G PC cards through consumer PC stores in some markets, Vodafone is already demonstrating that it is preparing to exploit the wireless broadband opportunity.

USB DEVICES: offering USB-connected devices will allow wireless broadband operators to compete with fixed broadband operators to connect the legacy installed base of desktop PCs. As a mass-market proposition, plug-and-play installation, intuitive ease-of-use and attractive physical design will all be important.



CONCLUSION

Wireless solutions are playing an increasingly important role in creating the “broadband society”.

The innovator and early adopter phases of the wireless broadband market were characterised by strong relationships between device manufacturers and the **mobile operators who have been, and will continue to be, the primary channel to market.** As the market moves into its early majority phase, operators will need to embrace new channels such as IT VARs and consumer PC retailers to meet accelerating demand.

Successful device manufacturers will be those with the experience and awareness to **spot the technological trends** and the skill to identify, integrate and package the **best mix of technologies** to meet the needs and demands of new market segments. They will be able to **customise** product, packaging, operating software and user interface to enable their operator customers to differentiate themselves in an increasingly competitive marketplace. They will have the logistical flexibility to **deliver** directly to network operators.



ABOUT OPTION

Option, the wireless technology company, is a leading innovator in the design, development and manufacture of 3G UMTS-HSDPA, EDGE, GPRS, GSM and WLAN technology products for wireless connectivity solutions. Option has built up a solid reputation being first to identify key trends and for creating products that enhance the performance and functionality of wireless communications.

Technological achievements include the world's first GSM-Ready PC data card (1992), first tri-band GPRS data card (2001), first combined GPRS/WLAN data card (2003), world's first 3G UMTS/GPRS/WLAN data card (2004) and the world's first HSDPA-ready 3G/EDGE/GPRS/WLAN data card (2005).

Option's expertise in developing and bringing multi-technology products to market is highlighted in its 2004 shipments: 3G was a feature of 70% of Option's European shipments during the year, increasing from virtually zero in the first quarter to 82% in quarter four. WLAN was an element of 10% of annual shipments, rising to 25% in Q4. Success continued into 2005: Option shipped its one millionth 3G data card in November 2005. Option's record of generating cash gives the company the financial strength and confidence to execute multiple simultaneous development programmes.

Current customers include (not exhaustive): Cellcom, Cingular Wireless, Mobitel, Monaco Telecom, Optus, Orange, Polkomtel, Swisscom Mobile, Telenor, Telefonica, TMN, T-Mobile, Vodafone, Voxmobile, Wind and many others.

Option's headquarters are in Leuven, Belgium. The company has Research & Development in Leuven (Belgium), a Software and Applications development centre in Adelsried (Germany), a wireless router development centre in Stockholm (Sweden) and an ISO 9002 production engineering and logistics facility in Cork (Ireland), where multiple production lines customizes products, user software and packaging to the specific needs of individual network operators.

Option is listed on Euronext (OPTI) and ADR's (OPNVY) can be traded on the OTC market in the USA

Option's achievements have been acknowledged in the following awards:

- > "Company of the Year" 2005 in Belgium/Flanders
- > Selected as "Red Herring Top 100 Small Cap" company 2005
- > Winner of the "The Golden Bridge" for its achievements in exporting to the United Kingdom
- > Europe's 500 Award for Most Innovative Use of IT – for Option's contribution to addressing the communications challenges of today's travelling business person.
- > Swisscom Mobile's Mobile Unlimited service, which is based on Option's GlobeTrotter FUSION data card, won the Best Enterprise Application category of the 2005 GSM Association Awards
- > Vodafone's Mobile Connect Card, based on Option's GlobeTrotter GPRS data card won the Best Mobile Application – Corporate Market category in the 2004 GSM Association Awards



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