
Mobile Internet

The Mobile Internet and Wireless Networking: Opportunities, Challenges and Solutions

A Revolution in Motion

The future of the Internet is increasingly wireless, and includes devices that go beyond today's PCs. These include personal digital assistants (PDAs), browser-equipped mobile telephones and devices yet to be imagined. However, significant questions are raised by the telecommunications industry approach for providing high-speed wireless, pervasive networking called "third generation" (3G) mobile networks.

Central among these questions is the very structure of the communications industry itself. While the Internet is all about freedom, flexibility and entrepreneurial efforts, the communications industry is still dominated by a few large carriers, with extensive vested interests in rigidly inflexible and expensive infrastructure. These carriers resemble the earlier business models of America Online, CompuServe and Microsoft Network in the days before the Internet rendered such large, closed services obsolete.

The mobile Internet is poised to transform this industry, allowing numerous small, agile and focused providers of content and services to challenge entrenched carriers in this new market opportunity. Such new players leveraging emerging technologies are absolutely essential for bringing creative offerings to market that meet the user demands and desires.

Axis Communications has developed a solution platform designed to accelerate this evolution by delivering wireless, pervasive networking that embraces and extends significantly today's alternatives, while leveraging existing network and Internet investments. This platform creates a system solution of local access points and Internet server software that employ high-bandwidth, license-free, wireless connectivity to link devices to the Internet and corporate networks. The Axis solution can be implemented in locations ranging from offices and homes to airports, hotels and shopping malls. Opportunities abound for the emergence of new service providers based on these technologies.

<http://www.axis.com>

Axis Communications (USA)
Tel: (978) 614-2000
Fax: (978) 614-2100

Axis Communications (Europe)
Tel: +46 46 272 18 00
Fax: +46 46 13 61 30

Axis Communications (Japan)
Tel: +81 3 3545 8282
Fax: +81 3 3545 8280

The Current Situation: The Rise of Internet Appliances and Untethered, Pervasive Networking

As explosive as the growth of the Internet have been, that growth has been a prelude for an emerging phase with even more impressive potential. In short, the future of the Internet is predominantly untethered, pervasive and no longer centered on the traditional personal computer.

KPMG International stated in a recent study that "the collision of the world's two fastest growing sectors – mobile technology and the Internet – [is] creating an opportunity that no organization can afford to ignore. The revolution is called the Mobile Internet and the impact it will have on telcos, ISPs and any organization wishing to transact in the new world economy will be immense."

The expected growth of the mobile Internet is best illustrated by the aggressive predictions made by analysts and industry experts:

- IDC recently forecast that users who access the Internet wirelessly will outnumber wired users by the end of 2002.
- Wireless Web-based portal revenues will grow from \$747 million in 2000 to \$42 billion in 2005, according to recent research from Ovum Research.
- IGI Consulting predicts that the number of wireless devices accessing the Internet will grow from 76 million in 1999 to 830 million in 2005.
- During that same year, both KPMG and mobile telephony market leader Nokia predict there will be more than a billion mobile telephones in use. KPMG adds that at least 750 million of these will include enhanced data and networking features.

Government agencies, vendors and carriers across Europe and the Asia-Pacific region have already launched initiatives focused on wireless electronic commerce, sometimes called "mobile e-commerce" or simply "m-commerce." In Japan, NTT DoCoMo has been enjoying strong popularity for its imode services, which endow cellular telephones with a range of data communications and messaging services. Clearly, the demand for wireless, Internet-based data and communications services is significant and growing, around the world. All of these factors lead to one inescapable conclusion. The mobile Internet is already here, and the vast majority of its users will soon use a variety of wireless, connected devices other than PCs to access it.

Users need simple, direct and seamless wireless access to the network resources they need to do their jobs and live their lives. Carriers, especially traditional telcos, are already beginning to endure forced growth and change, as they strive to develop new business models that can deliver and capitalize upon the benefits of the mobile Internet.

The Bad News: A Telco-Centric Approach Won't Get Us There

Today's carriers and technologies simply cannot deliver the true power and value of the mobile Internet. Slow connection speeds, limited data functionality, inconsistent availability and interoperability of services and the need to support their entrenched infrastructures prevent the fulfillment of the promise of pervasive, wireless networking.

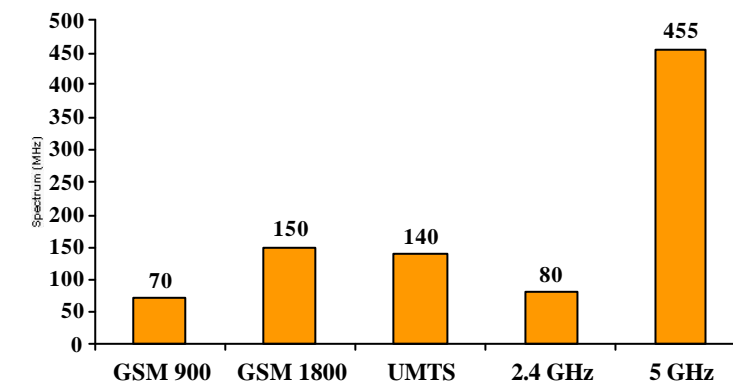
Now, leading participants in the wireless, networking and computing industries are joining forces and focus on a few key technologies to deliver the mobile Internet, at least as defined by these carriers. Most prominent among the technologies they are supporting is the third-generation mobile networks (3G). Defined by the International Telecommunications Union (ITU) standards body, 3G provides a global framework for high-speed, high-quality, integrated, mobile digital data and voice communications.

Carriers have already paid tens of billions of dollars for licenses to the frequencies reserved for 3G services, and prices are unlikely to fall far for future licensees. Such figures mean that 3G licenses will only be available to the privileged few, and beyond the reach of small, innovative and emerging carriers and service providers. These stratospheric licensing fees, combined with the need to pay for extensive, expensive infrastructure, guarantees that 3G services will be expensive for users – and most expensive for the earliest adopters.

Not only must these 3G carriers recoup their multi-billion-dollar license investments, but they must face additional technological challenges. These are summarized below.

- **Limited Spectrum.** According to the UMTS Forum (www.umts-forum.org), an industry consortium, there is currently approximately 340 megahertz (MHz) of spectrum available for use over GSM and 3G networks. However, the UMTS Forum predicts that demand for high-speed data and voice services will begin to exceed available 3G spectrum by 2005. The World Radio communication Conference (WRC) of the International Telecommunications Union (ITU) recently identified additional spectrum for deployment of 3G systems, but the amount reportedly agreed upon does not eliminate the shortfall projected for 2010. Unlike the situation with fixed networks, available "air space" is actually limited. The challenges of wireless networking are great to those used to delivering wired solutions, 3G only scales so far, and the technology so far offers no apparent remedies.

Wireless Spectrum Allocation



Source: UMTS Forum

- **Cell Size Trade-off.** In addition, 3G technology requires establishment of many more and much smaller "cells" in the carrier network to support high-speed data traffic than supported by current second-generation (2G) mobile telephone networks. According to UTMMS cell sizes as small as 75 meter radius will be required to deliver the promised 2-Mbps data rate. The more cells required, the

greater the need for advanced infrastructure and tools for connection and cell management. Since 3G requires basically all new equipment, support of advanced wireless services will require a very expensive build-out of carrier infrastructure.

- **Costly infrastructure and slow deployment.** 3G services require a whole new network infrastructure. When considering the requirement of very small cell sizes, it is clear that the roll-out of 3G will be both very costly and slow. The few carriers that have been, or will be, awarded 3G licenses face a tremendous deployment challenge, and users will have to wait for adequate coverage and performance.

Even though these technological challenges are severe, perhaps the single biggest impediment to the success of 3G services is the centralized telco business model upon which these services are being built by many of the existing carriers. The old-style telco business model stands in direct opposition to the wants and needs of mobile Internet users and service providers. Mobile access to services from a monolithic central corporation is not at all the same thing as the wireless, flexible mobile Internet. Control of mobile data services by a handful of corporate giants is no more desirable or sustainable than earlier attempts to control the Internet by America Online, CompuServe and the Microsoft Network. Just as these earlier giants were forced to change by the dynamics of the Internet, 3G carriers will face similar market pressures.

Thus, 3G is hobbled by multi-billion dollar license fees, insufficient spectrum allocation, the requirement for multitudes of very small network cells and high infrastructure costs. In addition, the economics of 3G as currently implemented all but exclude participation by small, agile, focused innovative companies such as those that have driven the growth of the Internet.

These factors make it likely that worldwide implementation of 3G technology will be slower and less effective than anticipated by 3G enthusiasts. This, in turn, creates significant opportunities for providers that use alternative approaches to untethered, ubiquitous networked computing. Such approaches can complement 3G technologies and services, as well as provide alternatives that are more flexible and economical.

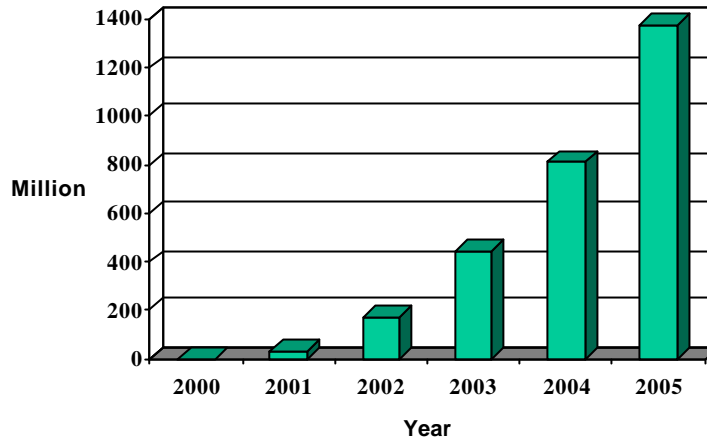
The Better News:

Bluetooth and Other Unlicensed-Bandwidth Options

Perhaps the most promising of the wireless technologies are those that depend on unlicensed spectrum. These include 5-GHz alternatives such as HyperLAN/2 and the 802.11a industry standard, as well as current 2.4-GHz technologies such as Bluetooth and 802.11b. Among these, Bluetooth enjoys the most broad industry support, and is the only leading wireless technology already being deployed or developed for deployment in small, truly mobile devices, such as PDAs and mobile telephones. The low power requirements of Bluetooth technology support greater mobility and flexibility at lower costs than alternatives such as 802.11.

Bluetooth is an open specification for radio-based voice and data communications, across multiple operating systems, wireless network architectures and devices. The Bluetooth specification is supported by the Bluetooth Special Interest Group (SIG). Member companies include industry leaders 3Com, Ericsson, IBM, Intel, Lucent, Microsoft, Motorola, Nokia, and Toshiba, as well as more than 2,000 Associate and Adopter Member companies. With such massive and rapidly growing industry support, a billion or more mobile electronic devices could support Bluetooth wireless technology within just a few years, according to market-watchers such as Cahners In-Stat.

Bluetooth Enabled Equipment



Source: Cahners In-Stat Group, 2000

Designed specifically to allow cable-free connections among small, often handheld, low-power devices, the potential advantages of Bluetooth wireless technology to mobile network users are significant and numerous. These advantages go well beyond just eliminating cables, deployment of Bluetooth wireless technology provides the opportunity for creating local on-demand, ad hoc wireless connections, both among devices and between devices and networked resources.

Thanks to broad industry support, development tools for and expertise in Bluetooth wireless technology are increasingly available around the world. This means that applications powered by Bluetooth should rapidly become faster, easier and less expensive to develop, resulting in more innovative and novel applications and services for users.

Perhaps most important, Bluetooth wireless technology operates at radio frequencies that are unbound by the regulatory and commercial strictures. This means that anyone can setup a local network and provide tailored wireless services based on Bluetooth technology. This parallels the open, accessible and entrepreneurial nature of the Internet itself, significantly lowering market entry costs and creating numerous opportunities for mobile Internet services providers.

With simple, economical access to high-bandwidth network connections, devices based on Bluetooth technology could soon provide primary access to networked resources for more people than PCs do today. Simultaneously, the combination of Bluetooth technology with the Internet could result in an entirely new class of multiple, locally focused, responsive and flexible providers of mobile Internet and location-based services for users of Bluetooth devices. In fact, anyone could create or become an application service provider (ASP) delivering services based on this free wireless spectrum, at low cost and with very rapid time to market.

The Bluetooth specification may not evolve into the ultimate technological impetus for the broad advent of the mobile Internet. However, it does represent a powerful lever traditional brick-and-mortar organizations can use to enable their businesses with mobile services and commerce.

The Best News: Market Opportunity for Everyone

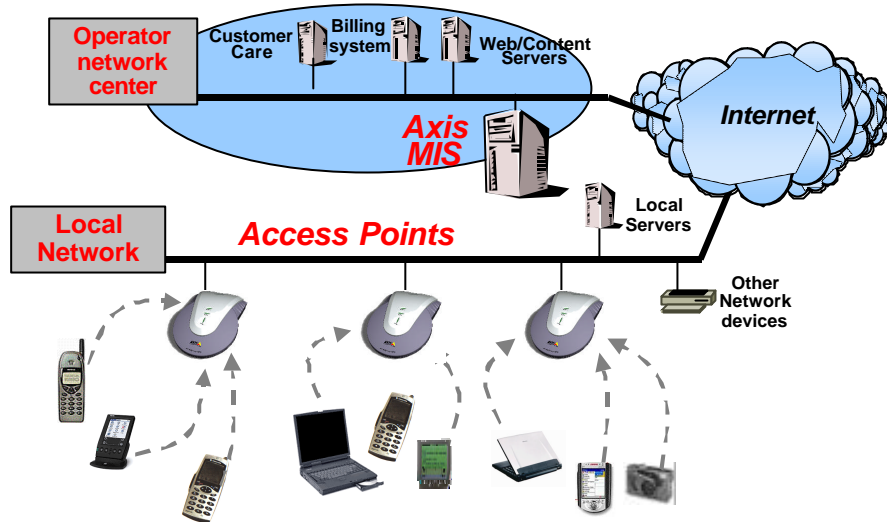
Unlicensed radio spectrum, combined with seamless connectivity to the Internet and wired networks, creates exciting new opportunities for service providers, content providers and users alike. The ability to create wireless access points almost anywhere, and to deliver a range of services to almost any communications-capable device, means real flexibility and freedom for users, as well as new revenue opportunities for entrepreneurial service and content providers.

The Axis Mobile Internet solution consists of two primary components – The Bluetooth Access Point and the Mobile Internet Server.

- **The *Bluetooth Access Point*** provides the "missing link" between devices powered by Bluetooth technology and corporate networks and the Internet. Wireless devices within range now have a simple and high-speed means for accessing any network based on the Internet Protocol (IP). The *Bluetooth Access Point* from Axis also provides a firm, flexible foundation for access control, security and other management and administration functions. Furthermore, it is based on the well recognized ETRAX "system on a chip" technology developed by Axis and runs an embedded Linux operating system and built-in web-server.
- **The *Axis Mobile Internet Server (MIS)*** enables the creation of wireless proximity networks by deploying multiple *Bluetooth Access Points*, transforming pure wireless access into powerful mobile networks. The Axis MIS manages and optimizes network connections, provides secure access and service management for individual users, and tracks location of client devices for delivery of location-dependent services. By providing third parties a platform with a set of APIs, the AXIS MIS also greatly simplifies integration of other applications and features into wireless services. For example, application developers can take advantage of information such as physical location and capabilities of currently visiting devices to enhance value-added, tailored proximity services. The AXIS MIS also supports roaming of subscribers between different locations within a service provider's network and, if desired, between different service provider networks, and provides interfacing with billing and customer care systems.

The *Bluetooth Access Point* enables the rapid creation of wireless ad-hoc connection to the Internet and local area networks (LANs). Combined with the Axis MIS, the system serves as a platform for delivery of high-performance, secure and innovative voice and data services to the growing number and range of devices equipped with Bluetooth wireless technology, in offices, airports, shopping malls, homes and other environments. Such on-demand, wireless networking services and applications will prove attractive alternatives and adjuncts to existing 2G and forthcoming 3G networks, while creating new revenue opportunities for new and incumbent service and content providers. Partnerships with existing 2G/3G carriers could enhance these new mobile Internet services by providing seamless roaming into the carrier's network whenever users go out of range of the local provider's network.

Access Points and Axis MIS



The Future

The mobile Internet will likely go beyond Bluetooth and 2G/3G access technologies, taking advantage of 5 GHz spectrum wireless networking technologies, such as HiperLAN/2 and IEEE 802.11a. These alternatives promise wireless networking with even higher performance than currently provided by today's initial Bluetooth offerings, and also operate over unlicensed segments of the radio spectrum. Applications and services that leverage these technologies will arise quickly, as users and operators alike recognize the opportunities they represent. The Access Point product family and the AXIS MIS will be enhanced to provide connectivity solutions for other wireless protocols beyond Bluetooth, as market demands evolve.

Axis will leverage its history of positive industry alliances to deliver comprehensive support services to those who build applications and services based upon the *Bluetooth* Access Point product family and the AXIS MIS. The flexibility of the Axis architecture will enable Axis and its partners to take advantage of important future wireless and wired networking technologies as they emerge, quickly, economically and effectively.

Axis and its partners will therefore be among the first to market with unlicensed wireless solutions, and best situated to deliver complete solutions to their customers. By leveraging the strengths and popularity of open standards and Open Source technologies, such as Linux, third-party applications will be embraced to speed development and time to market.

The Strengths of Axis

Axis formed its Mobile Internet Division in January 2000, and launched the first in the world Bluetooth Access Point in May of that year. These steps were the latest evolution of Axis Communications, founded in 1984 and dedicated to delivering easy-to-use products and services that link people and organizations, via wires and wirelessly. Headquartered in Lund, Sweden, Axis employs more than 500 people in 28 offices across Asia, Europe and North America. Axis is surrounded by the hotbed of wireless development and service deployment Scandinavia has become.

Axis is also active in advancing industry standards. The company is an Associate Member of the Bluetooth SIG and charter member of the Universal Plug and Play (UPnP) Forum Steering committees. Axis also enjoys close working relationships with industry leaders, such as Ericsson, Microsoft and Sun Microsystems.

Axis is also a pioneer in embedded Linux. Axis was one of the first vendors to ship products based on embedded Linux, and the first to make available Open Source code for Bluetooth. In 2000, Axis developed the first implementation of Bluetooth for the Linux operating system. The company also made its software freely available via the same type of General Public License (GPL) under which other Open Source software is distributed around the world.

Axis has extensive, relevant, proven and successful experience in the areas essential to success in delivering infrastructure support for the mobile Internet and other wireless connectivity solutions. The company's combination of novel technologies and effective business relationships ideally position Axis Communications and its Mobile Internet Division to gain and maintain a leadership position in the exploding market for networking solutions that span wired and wireless networks.

Axis is a registered trademark of Axis Communications AB. BLUETOOTH is a trademark owned by Aktiebolaget LM Ericsson and licensed to Axis. Linux is a trademark of Linus Torvalds. All other company names and products are trademarks or registered trademarks of their respective companies.