3G Technology As A Fixed Wireless Solution

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Overview

The $100 billion residential services marketplace has been a challenge for telecom providers. Although demand for broadband Internet access has soared, competitive local exchange carriers (CLECs) and long-distance companies (IXCs) seeking entry into local markets have struggled with lackluster customer response due to limited availability of offerings, cost, and big regulatory hurdles. Consumers themselves are accustomed to separate networks for voice and data, "sneakernet" for multi-PC households, separate cable TV networks, utility networks, security systems and more. In short, the residential services proposition is still scattershot. Without an integrated concept for home networking – ideally, a single solution that would offer ready access to multiple services at a cost savings, that provides fast speed and reliability – the home services market will remain contentious.

There is a solution today that could change the face of residential networks: third-generation (3G) wireless technology. Also referred to as IMT-2000, 3GPP, and UMTS – 3G is commonly associated with wireless mobility standards, specifications that offer high bandwidth for voice and data (144 Kbps up to 384 Kbps). Other less publicized benefits of 3G include speeds of up to 2 Mbps in fixed mode as well as increased network capacity, noise resistance, more effective use of spectrum and support for multimedia applications (e.g., Internet, image capture, JAVA, wireless Web, video). Although primarily thought of as a future technology, certain versions of 3G can be implemented today over currently available spectrum.

Combined with Internet Protocol (IP), 3G technology can deliver a rich suite of broadband services, including voice, data, video, energy management, security and telemetry directly to a home gateway. For competitive service providers, 3G can also be implemented without the lead time and expense associated with negotiating "hard plant" – cables, fiber, rights of way, trenches, and all the cost and complexity of making physical connections with each and every home or small business served.

In addition to these other benefits, since it is based on wireless, 3G is a pay as you grow communications technology. Because of such advantages as toll-quality voice, direct access to the Internet, and a

more economical usage of capacity and infrastructure, the technology presents an intriguing opportunity for RSPs (residential service providers) seeking low entry costs and a compelling business case for home networking, SOHO and business customers at large.

Evolution to Wireless 3G Networks

First generation wireless referred to analog cellular transmission, which became popular in North America throughout the 1980s and early 1990s. Second generation wireless refers to the current, most common forms of digital cellular and personal communications services (PCS) – primarily voice transmission technologies that utilize digital encoding and provide some low-speed, circuit-switched data for such handheld applications as phone-based e-mail, news and stock services, and short message service (SMS). By contrast, 3G wireless is a form of sophisticated broadband transmission that in addition to handling vast amounts of voice capacity, is optimized for transmission of data and multimedia.

Development of third generation wireless air interfaces and switches has been going on intensively in universities, research centers, and wireless manufacturer settings in Europe, Japan and North America since the early 1990s. The International Telecommunications Union (ITU) released its first studies on 3G in 1994. By 1996, however, most wireless infrastructure providers recognized the need for a more robust network technology that could surpass the "second-generation" mobility concept of PCS.

Interim data strategies, sometimes known as 2.5G services have since been devised to accommodate wireless users' needs for higher speed data and image transmissions over currently available spectrum. Among these 2.5G networks which are being deployed on a selective basis are GPRS (General Packet Radio Standard, an evolution of GSM technology which transmits data up to 115 Kbps) and EDGE – Enhanced Data Rate for Global Evolution, a TDMA evolution which delivers 384 Kbps for mobile applications.

In the CDMA world, a data-only 2.5G standard, known as HDR (High Data Rate), will deliver as much as 1.4 Mbps to wireless data customers in fixed mode. Concurrently, 1XRTT, an advanced version of IS-95 for mobile users, delivers transmission speeds up

to 144 Kbps and is the first step in a perceived evolution to full-blown, multimedia-capable 3G networks.

Standards Groups Shape a Multifaceted 3G Concept

While some carriers announce plans to migrate to high-speed broadband wireless in incremental steps, international standards groups are busy finalizing 3G mobile and fixed standards.

In 1998, for example, working groups at the European Telecommunications Standards Institute (ETSI) and the International Telecommunications Union (ITU) in Geneva, the reigning worldwide standards body, assembled to evaluate no less than five competing proposals for 3G wireless networks. Some of the proposals offered backward compatibility with existing 2G networks; others did not. Today, the 3G international standard, known as IMT-2000 (or UMTS), represents an amalgam of many international interests. Groups as diverse as the GSM Association, the Universal Wireless Communications Consortium (UWCC), ETSI, the North American CDMA Development Group, the ITU, and the Third Generation Partnership Project (3GPP) have provided technical input into the IMT-2000 specification, which is still undergoing modification.

ITU defines the combined 3G wireless standard as "a comprehensive set of terrestrial and satellite radio interfaces," a standard that actually encompasses specs for both narrowband and wideband CDMA and TDMA (the spec was originally approved by the European Telecommunications Union). The specification accommodates fixed, mobile and Internet wireless users. IMT-2000 is a "standard that allows operators the freedom of radio access methods and core networks to openly implement and evolve their systems depending on the regulatory, market or business requisites," ITU states. Key features of the 3G standard include compatibility of services within IMT-2000 mobile and fixed networks; high voice quality; small terminals for worldwide use; worldwide roaming; and the capability of supporting multimedia applications and services, such as videoconferencing, high-speed Internet, e-commerce, voice calling, and high-rate data.

Wireless Internet Access Drives 3G

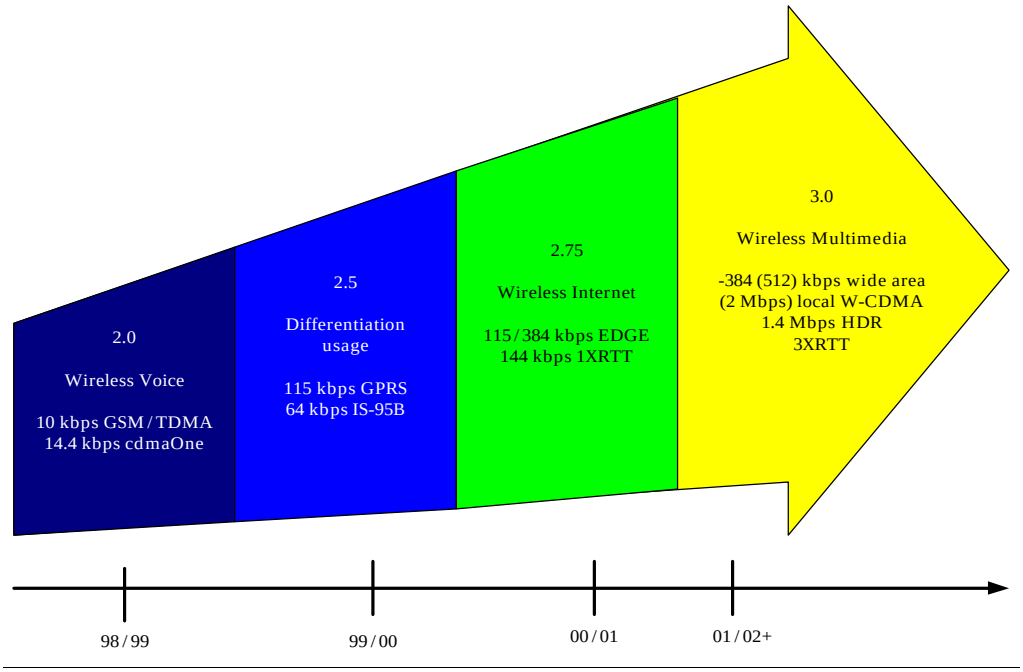
The IMT-2000 wideband standard is driven by skyrocketing demand for wireless Internet applications. According to Cahners In-Stat Group research, in the United States alone more than 85 million people subscribe to wireless services, and consumers in 46 million U.S. households have Internet access. It was only a matter of time before people would want to have access to the Internet from their wireless handsets. Cahners In-Stat Group projects that more that nearly 25 million people in the U.S. will use mobile wireless Internet services by 2003. In Japan, demand for the much publicized i-Mode service is primarily driven by the fact that the vast majority of Japanese people do not have wireline Internet access. Within less than six months, more than 5 million Japanese people subscribed to this service, and phenomenal future growth is inevitable.

Internet users are becoming wireless users, and expect applications to converge and fit smaller, untethered form factors. Cahners In-Stat Group expects that consumers, whether mobile or at their home PCs, will exhibit insatiable appetites for Web downloads and messaging; streaming media, color graphics, gaming, Java-enabled location-based applets, Internet browsing, and access to corporate intranets through secure firewalls. (Moreover, there are bandwidth-intensive applications, as yet unknown, that will unfold within the next few years.)

3G Options and Timeline

Figure 1 illustrates the timeline for 3G implementation and the associated applications that can be supported at each stage.

Figure 1: 3G Technology Timeline



Source: Cahners In-Stat Group

This technology roadmap is more complicated than it actually looks. Within the CDMA umbrella, various new standards have been proposed.

Figure 2: CDMA Technology Comparisons

CDMA Technology	Peak Data	Average Data Throughput	Approved Standard	Company Backing
CDMA 2000 1x: phase 1	153.6 Kbps	150 Kbps	√	--
CDMA 2000 1x RTT A	614.4 Kbps	415 Kbps	√	--
1x Plus (phase 1)/Extreme	1.38 Mbps	560 Kbps		Motorola
W-CDMA (5 MHz)	2.048 Mbps	1.126 Mbps	√	--
HDR	2.4 Mbps	621 Kbps		Qualcomm
CDMA 2000 3x Multicarrier	2.072 Mbps	1.117 Mbps		--
1x Plus (phase 2)/Extreme	5.184 Mbps	1.200 Mbps		Motorola

Source: RCR Magazine 4/2000, Cahners In-Stat Group

Regardless of the option selected, it is important to understand that in the final stages of true 3G implementation, fixed high-speed wireless will support transmissions of large files, graphics and streaming multimedia at 2 Mbps rates.

IMT-2000 And Fixed 3G Wireless

The IMT-2000 specification makes specific provisions for 3G Fixed Wireless Access (FWA). The International Telecommunications Union specifies that "IMT-2000 aims to exploit the potential synergy between the digital mobile telecommunications technologies being developed as part of the dramatic growth of personal telecommunications, and those rapidly evolving for Fixed Wireless Access." According to the ITU, this means that IMT-2000 will offer wireless access to the global telecommunications infrastructure which will serve both mobile and fixed users in both public and private networks.

Fixed wireless 3G is a converged, multimedia-driven technology that surpasses early concepts of wireless local loop which relied principally on RF and line-of-sight connections to deliver basic POTS and narrowband data (mostly to under-served or sparsely populated areas). In fixed mode, 3G utilizes a point-to-multipoint network architecture that can transmit data and voice simultaneously at high speeds across core wireless infrastructure. Potential applications for 3G fixed services include SOHO, business and home networking which creates a high-speed interface/gateway between an in-building 'network of networks' (e.g., wireless interworking of telephony, data, video, home energy monitoring, and security networks) and the outside world – e.g., the Internet and the PSTN.

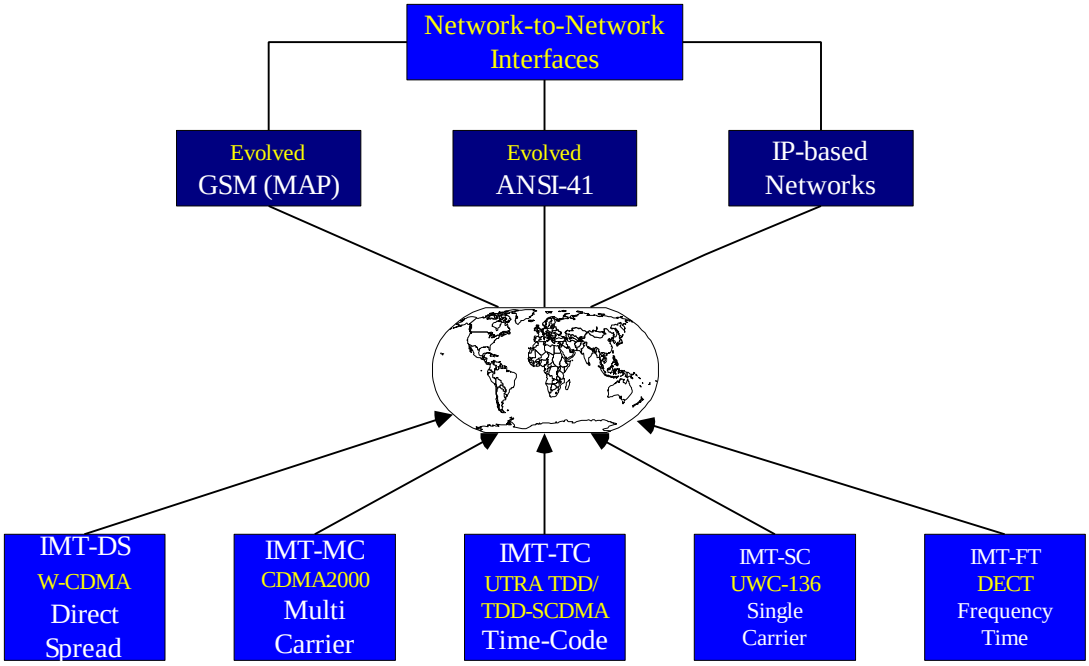
Massive Harmonization Efforts for 3G Required

To achieve this level of wireless connectivity over wide areas – a continent or oceans, for example, basic core networks must be interconnected. Cooperation among industry 3G groups has been

imperative, enabling network engineers to embark on massive 3G harmonization efforts to promote IMT-2000 compatibility worldwide. These efforts include developing software and hardware upgrades to core networks that prepare for high-bandwidth multimedia services; as well as developing systems to harmonize two different emerging 3G CDMA operating solutions. Both will ultimately talk to each other across the global network space.

The two solutions include W-CDMA (wideband CDMA), a standard that supports fixed network speeds up to 2 MHz, and is endorsed by European standards groups and NTT DoCoMo, the largest wireless carrier in Japan, which has led the first 3G tests and commercial implementations. The second 3G operating solution is CDMA-2000, which is an evolution of the North American IS-95 CDMA standard (also supported under the IMT-2000 3G specification.). Ultimately, both standards will accommodate the high data rates (up to 2 Mbps for fixed apps) specified in IMT- 2000 in both fixed and mobile modes. Figure 3 illustrates the commonly used wireless air interfaces as currently defined in the ITU's IMT-2000 Harmonization specification.

Figure 3: IMT-2000 Harmonization of Terrestrial Interfaces



Source: RCR Magazine 4/2000, Cahners In-Stat Group

The five primary air links have been integrated into the core carrier specification. The five evolved standards are:

1. IMT-DS (W-CDMA direct spread spectrum)
2. IMT-MC (cdma2000 multi-carrier)
3. IMT-TC (TDD-SCDMA time-code division multiplex)
4. IMT-SC (TDMA IS-136 single carrier EDGE)
5. IMT-FT (DECT frequency time division)

In practical terms, the expectation today is that Fixed Wireless Access will become a mainstay of developing countries without adequate wired infrastructure. In developed countries, however, 3G residential wireless represents a new horizon for competitive access providers. The advent of cable modems and DSL has raised the bar substantially for data services, which means that users now readily expect a wireless connection to provide somewhere between 1.5 Mbps and 2 Mbps. In the US, some of the alternative providers are considering broadband, fixed wireless options. But

these fixed systems are economical only when shared among small to medium-size businesses, and many have stringent line of sight requirements and suffer from weather-induced impairments. The residential and business marketplace is still ripe for a wireless access alternative such as fixed 3G which can be deployed in many different spectrum bands, offers superior in-building penetration, and provides better noise immunity and signal strength than other fixed wireless options.

Spectrum Issues

Although spectrum (roughly 155 MHz in the core band around 2GHz) for 3G has been allocated specifically in Europe and many other parts of the world, the US has not yet finalized a 3G spectrum plan. While the FCC has announced it will free up spectrum located in the 700 MHz band for 3G auctioning later this year, further allocations will be required to accommodate a range of competitive 3G service providers in different parts of the country. However, because of 3G's ability to be implemented across any number of bands, operators and the FCC are working toward a solution. As yet, the FCC has not completed all spectrum considerations, and the question of whether to provide new allocations remains open. Importantly, infrastructure providers are currently working to create solutions that will deliver the same functionality as 3G without requiring the extra spectrum.

Advantages of Fixed 3G

Although 3G fixed implementations have not yet been finalized, there are both technical and economic advantages to the technology that seem ideal as an entry point to competitive residential services. Vendors are already developing radio transmission systems for 3G that correct some of the weaknesses of other wireless local loop technology. For example, previous WLL systems that are not based on 3G have required line-of-sight or near line-of-sight from the radio transmitter to the home or building being served. Common weather conditions such as heavy rainstorms, dense fog and blizzards can adversely affect transmission.

By contrast, fixed wireless systems based on 3G technology are designed without line-of-sight limitations or requirements. Unlike wireless local loop solutions, which required use of externally mounted antennas, a 3G-based solution can use an integrated antenna in the home terminal unit. This is a significant benefit, enabling self-installation and over-the-air service activation. This can save consumers and carriers significant cost – $700 to $750 today per home.

Another related advantage of 3G service is spectrum reuse. A 3G network, though requiring a wider "spread" of bandwidth than conventional 2G technologies, uses spectrum more efficiently. In the case of wideband CDMA, the technology takes advantage of "voice quiet" periods to boost communications capacity. No single user is assigned a particular channel (as in analog wireless); conversations are encoded and reassembled at the receiver site, so that the full spread of bandwidth is utilized. In effect, any user can gain access to the entire channel that is thought of as a shared radio resource.

3G fixed wireless is also sparing in the use of frequency; in other words, it is spectrally efficient. A 3G fixed system allows for one-to-one spectrum reuse; which means that multiple base stations and multiple sectors within a base station can operate on the same frequency. This contrasts with cellular networks, which must be carefully designed today so that adjacent cells do not operate on the same frequency. Since this issue does not arise with 3G, network planning is much simpler. In the case of wideband CDMA, cell splitting and sectorization are also both enhanced by W-CDMA's ability to cope with the resulting signal overlap and interference. This helps improve signal penetration and increases the level of noise immunity.

Fixed 3G: An Alternative CLEC Option

With its comparatively low power consumption and robust techniques for dealing with interference, 3G fixed wireless technology remains a very attractive competitive carrier option. Combined with Internet Protocol, 3G technology can be leveraged to support the voice and data requirements of the most demanding residential and business users. While standards groups continue to

finalize mobility 3G standards for roaming and other mobile applications, an extraordinary opportunity now exists to leverage the mature, lower-level 3G physical capabilities for fixed-point wireless. These open solutions, combined with IP-enabled networking, computing platforms offering varied API support, plus an open services gateway concept, lay the groundwork for a more comprehensive, differentiated set of residential and business services than has ever been attempted.

In sum, 3G fixed wireless technology offers the potential for consumers and telecommuters to get the bandwidth and services of sophisticated private network users – at very reasonable cost. For competitive service providers, 3G can help launch a low cost, comparatively lower-risk service creation platform, and an over-the-air infrastructure based on a software-defined softswitch model that bypasses the expensive Class 5 PSTN switch. With implementations of 3G happening now, next generation fixed wireless represents a great leap forward. Real fixed-point implementations will be possible by mid-2000, and within the next few years, a revolution in competitive residential access could result.

Glossary

IMT-2000: The International Mobile Telecommunications-2000 third generation wireless standard. IMT-2000 is an advanced mobile and fixed communications concept intended to provide telecom services on a worldwide scale. Also known as UMTS (Universal Mobile Telecommunications Services).

CDMA: Code Division Multiple Access (CDMA). An air interface technology that uses spread spectrum technology to provide specific encoding of digital conversations over a wide channel in order to improve network capacity and voice quality.

Cell Splitting: The process of splitting one cell into two in order to support more subscribers.

TDMA: Time Division Multiple Access (TDMA). A timeslot-based air interface for high and low mobility and large and small-cell licensed band applications.

MMDS: Multichannel Multipoint Distribution Service -- A broadband terrestrial wireless service that now competes with hybrid fiber coax, fiber rings, DSL, and other wireless technologies. MMDS spectrum, located just above the 2.5 Ghz band was allocated in the 1980s originally for the purpose of television distribution, and is now used to deliver comparatively inexpensive broadband data and Internet services.

LMDS: Local Multipoint Distribution Service: An alternative broadband wireless technology designed for Internet access and data distribution principally for business. LMDS operators and 38 GHz licenses command a gigahertz of spectrum.

3G: Third generation wireless networks that support mobility rates up to 384 Kbps and fixed rates up to 2 Mbps. 3G networks will be harmonized using different air interfaces and core networks, and will support higher bandwidth multimedia, image transfer, and wireless Internet apps.

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SOMA Networks is the first and only company to provide a single, integrated system that enables a new breed of telco called residential service provider (RSP). SOMA Networks allows any carrier or spectrum license holder to quickly, easily and cost-effectively become a facilities-based RSP, providing transport, services and applications – independent of the incumbent telco infrastructure. The residential services gateway supports a powerful combination of advanced capabilities for consumers, telecommuters, SOHO workers and small businesses, including feature-rich telephony, broadband Internet access, IP-enabled applications, and emerging home networking services. The SOMA Networks value proposition allows RSPs to enter markets rapidly, reliably, and profitably. For more information please visit www.somanetworks.com