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CRS Report for Congress

Third Generation ("3G") Mobile Wireless Technologies and Services

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Summary

Rapid growth in the number of subscribers of mobile wireless telecommunications services in the United States and abroad is fueling interest and developments in the next generation of wireless technology services, known as 3G. 3G services might include high-speed mobile Internet access and the ability to use the same handset anywhere in the world. Issues related to the implementation of 3G center mainly on the allocation of spectrum and adoption of technology standards by each of the countries developing this new service. While some steps have been taken to coordinate these activities, much work remains before 3G services will be available to the American public.

Background

There are currently over 100 million subscribers of mobile wireless telecommunications services in the United States. That number has been growing rapidly for many years, and is projected to continue growing at about 25% per year for the foreseeable future.[1] The growth of wireless subscribership in many other industrialized countries is even higher. As a result of the anticipated future growth and the demand for enhancements to existing services, preparations for the third generation of mobile wireless services, known as 3G, have been underway in the telecommunications industry for several years.[2] U.S. and foreign government involvement in these efforts has focused on two areas: allocation of spectrum for 3G services, and adoption of standards for 3G technologies.

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[1] *Standard and Poor's Industry Survey*. Telecommunications: Wireless, p. 2-4. June 22, 2000.

[2] The first generation of mobile wireless services was the original analog cellular telephone system first deployed in the early 1980s in the United States. The second generation is the digital mobile wireless network known in the United States as personal communications services (PCS) and as DCS-1800 in Europe, deployed in the mid-1990s.

What Are 3G Services?

According to industry forecasts, future 3G applications will provide public telecommunications capable of high-speed applications (called broadband) including voice, video, and data transmissions. The industry claims that 3G signal transmission rates will reach 2 million bits per second (Mbps) for users at fixed locations, more than 35 times faster than today's fastest dial-up personal computer modems. For mobile users, 3G data rates (and the service capabilities) will be significantly lower. 3G services could include mobile wireless Internet access, mobile videoconferencing, real-time digital music, and storage and retrieval of personal information. The handsets may be operated by a touch-sensitive screen or by voice commands, and be used in a manner similar to hand-held computers. The ultimate goal is to enable mobile service subscribers to use the same service, as well as the same handset, anywhere in the world (i.e., *global roaming*) with a minimal number of different technologies (called operational modes) embedded in the handset.

Spectrum Developments

The International Telecommunication Union (ITU), a United Nations (UN) agency, is sponsoring the adoption of 3G standards and the allocation of spectrum to integrate various satellite and terrestrial mobile systems into a globally interoperable service.[3] The ITU conducts World Radiocommunication Conferences (WRCs) every two to three years to reach consensus among member states on changes to the ITU Radio Regulations and Table of Frequency Allocations, which contains spectrum allocations for over 40 radio communication services, and technical, operational, and regulatory conditions for the use of the radio spectrum and satellite orbits. WRC agreements have treaty-binding status. In the 1992 Conference, 230 MHz[4] of radio spectrum was designated for International Mobile Telecommunications-2000 (IMT-2000, the official ITU term for 3G services), including spectrum bands for terrestrial and satellite components. Today, several countries in Europe and Asia are in the process of implementing 3G in these bands. Since 1992, ITU working groups have forecasted the need for 160 MHz of additional spectrum to satisfy the terrestrial 3G needs through the year 2010.

In the United States, the Federal Communications Commission (FCC) decided to implement personal communications services (PCS) in a portion of the 3G bands (1850-1990 MHz), preventing the global use of these bands for the implementation of 3G (called "global harmonization"). Leaders in the European Union (EU) have expressed concern about that FCC action, arguing that as a result, the identified 3G spectrum may not be available for future 3G use in the United States, creating uncertainty for European investors in U.S. telecommunications markets. U.S. negotiators contend that 3G services can be placed within bands allocated for PCS, and that initial implementation of 3G in the United States will be in the PCS and cellular bands. The FCC is planning for the United

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[3] In mobile terrestrial systems, the individual handsets send and receive the telecommunications signals to and from nearby ground-based stations that connect to the public switched telephone network. In mobile satellite systems, the handsets send and receive signals to and from orbiting satellites that relay the signals to a single ground station that serves a large geographic area, and then connects to the public switched telephone network.

[4] A MHz (megahertz) is one million cycles per second, a measurement of radio spectrum.

States to evolve to 3G services according to market demand, within the context of existing mobile services.

Over 2000 delegates and advisors from 150 countries attended WRC-2000, which ended on June 2, 2000. One of the key issues at WRC-2000 was the identification of global spectrum bands that could meet the additional spectrum requirement for 3G services. The U.S. delegation to WRC-2000, led by the FCC and the National Telecommunications and Information Administration (NTIA), negotiated with other member states. At the conclusion of the conference, a consensus was reached among member states to identify three common spectrum bands, available on a global basis, for countries wishing to allocate for terrestrial 3G services, and several bands for 3G satellite services.[5] These were the primary bands proposed by the United States going into the conference, and U.S. officials and industry representatives were pleased with the outcome. While the WRC-2000 decision enables the immediate licensing and manufacturing of 3G products in the designated bands, each country decides when to begin implementation activities. Several countries have begun selecting parts of the identified bands most suitable for sharing with, or relocation of, existing mobile services, and distributing spectrum licenses for 3G services within their national borders.

Technology Standards

The main competing technologies for the 3G standard are based on the most prevalent existing digital mobile wireless modes, including code division multiple access (CDMA), time division multiple access (TDMA), and Global System Mobile (GSM, a variation of TDMA). While all of these modes are used PCS systems in the United States, GSM has been established as the ubiquitous standard in the European Union. In 1998, the EU Commission adopted a "Common Position" to promote its implementation of 3G, called the Universal Mobile Telecommunications Service (UMTS) with a variation of CDMA (called Wideband-CDMA or w-CDMA) as a common standard. In May 2000, the ITU approved a set of five technology standards (called radio interface specifications) for 3G systems (one of which is w-CDMA). These specifications are intended to provide technology flexibility while promoting a common system design in all UN member countries, compatibility of services, worldwide roaming capability, and a wide range of services (e.g., high-speed Internet). In addition, the ITU plans to develop 3G signaling and communications protocols, a common inter-system numbering plan, and related network capabilities to facilitate global roaming.

Another 3G standard is used to control how data is delivered from the world-wide web to a mobile handset. Internet access is already being provided by mobile service providers in today's systems, which might set the precedent for future 3G systems. One standard for performing that function, developed through an international cooperative effort by the wireless industry, is called wireless application protocol (WAP). The predominant mobile Internet service in Japan (called *i-mode),* however, uses an incompatible standard to perform that function. A debate has begun in the industry over

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[5] The terrestrial bands are 806-960 MHz, 1710-1885 MHz, and 2500-2690 MHz. Ten bands located from 1525 to 2690 MHz were identified for mobile satellite services. Most of those bands had already been allocated by WRC on a co-primary (i.e., shared) basis for mobile satellite services and other wireless services.

which standard offers superior performance, and addressing potential interoperability problems of each standard. The number of i-mode subscribers has grown rapidly in Japan (over 10 million, compared to less than 1 million mobile Internet services subscribers in the United States). This trend could portend a market advantage to i-mode. However, problems have been cited with both WAP and i-mode technologies, such as frequent inability to provide Internet access to customers, and slow rates of data transmission when customers are connected. Other service reliability issues have also been raised. Some question whether these problems are merely the result of the rapid increase in subscribership, or are indicative of a more fundamental problem with bringing Internet services to mobile phones.

Regulatory and Oversight Issues

Although the U.S. mobile wireless industry has been very profitable and prospects for its continued growth are high, there are several issues in which the government (and the FCC and Congress in particular) might become involved. One ongoing question concerns the adoption by the European Union of a 3G standard, and whether that action might confer a market advantage on UMTS over other competing services. EU officials have stated that to ensure a pan-European service, one 3G licensee in each national market is required to use w-CDMA technology, but the EU will not prohibit other technologies for other licenses issued (i.e., a "technology neutral" approach). It is not clear, however, what rules the EU governments will adopt to allow alternative 3G technologies to compete in their markets. Even if government policies are technology-neutral, market incentives in Europe could cause w-CDMA to predominate.

Another issue concerns the allocation of spectrum within the United States. Once the spectrum bands for 3G were identified internationally, each country had to decide what frequencies within those bands to use for the initial implementation of 3G services, as well as the long-term expansion of those services. One problem concerns a portion of one of the identified bands, 1755-1850 MHz, that is currently allocated in the United States for exclusive government use. While the EU would like that spectrum to be allocated for 3G services in the United States, some federal agencies, particularly the Department of Defense (DOD), are concerned that any 3G services that are licensed in that band could interfere with existing communications.

The need to expedite spectrum 3G allocations was highlighted on October 13, 2000, when President Clinton directed all federal agencies to work with the FCC and the private sector to identify the spectrum needed for 3G services. On October 30, DOD released a report on the electromagnetic compatibility interactions between major DOD radiocommunications systems operating in the 1755-1850 MHz band and potential 3G systems. The report stated that the band is heavily used by government users. On November 15, NTIA released an Interim report on the potential of that band for accommodating 3G deployment. Based on the DOD analysis, the NTIA report suggested that sharing on the band might be feasible if 3G operations can be restricted in space or time, and if 3G operators reimburse certain federal operators to relocate to new frequencies prior to commencing operations near those federal operations. On January 18, 2001, NTIA released a Notice of Proposed Rule Making (NPMR) on the reimbursement procedures associated with the use of that band, and will issue a final rule later this year (for further details see NTIA's 3G web site [http://www.ntia.doc.gov/ntiahome/threeg/index.html].

Another band identified for 3G at WRC-2000, 2500-2690 MHz, also has incumbent licensees in the United States. Incumbents include multi-channel multipoint distribution systems (MMDS, a commercial "fixed wireless" service originally used for television broadcasts, and now being developed for mobile wireless applications), and Instructional Television Fixed Service (ITFS, similar to MMDS but licenced for educational programming). In November 2000, the FCC released its Interim report on the potential for this band for accommodating 3G services. The report stated that sharing between these services and 3G services would be very difficult. In December, the FCC released an NPRM proposing to allocate portions of the 1710-1850 MHz and 2110-2165 MHz bands (previously transferred from federal government to non-government use) for 3G services, and seeking comment on various approaches for using the 2500-2690 MHz band. The FCC also adopted an Order denying a petition by the Satellite Industry Association for parts of the 2500-2690 band to be reallocated to mobile-satellite services (for further details see the FCC's 3G web site [http://www.fcc.gov/3G/]). The FCC expects to release a final report in March 2001 examining whether to reallocate spectrum for incumbents.

Under provisions of the Balanced Budget Act of 1997 (P.L. 105-33), the FCC could decide to use auctions to distribute the new 3G licenses. Based on similar previous auctions in the United States for licenses for other mobile services, the proceeds could be significant. Recently, several EU countries have conducted auctions for UMTS licenses (the EU implementation of 3G) within their respective borders. The auction of five UMTS licenses in the United Kingdom raised $36 billion for the U.K. government treasury, the auction of six UMTS licenses in Germany raised $46 billion. Both totals were far greater than anticipated. Other European governments, however, received lower revenues in their UMTS auctions, while others have not yet conducted their auctions.

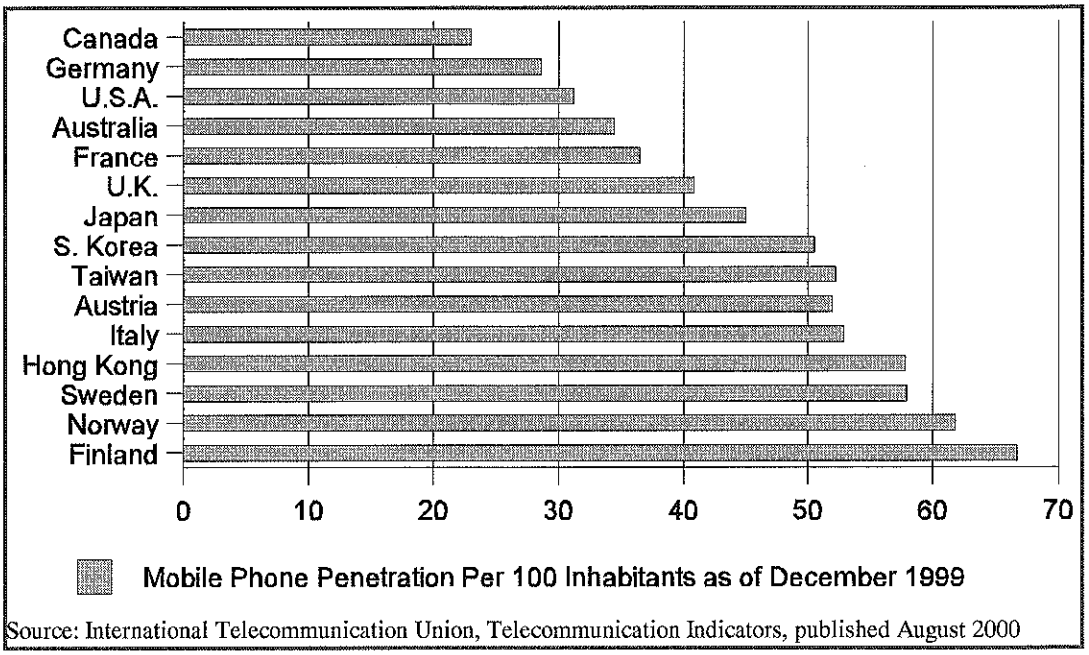
A set of spectrum licenses that could potentially be used for 3G services will be auctioned by the FCC in the 700 MHz range, which is currently occupied by UHF television broadcasters. There are some complications, however, associated with these licenses. While the spectrum is considered very desirable, the new licensees cannot use the licenses until the incumbent television broadcasters relocate to other frequencies. The incumbents have legal rights to that spectrum until the completion of the transition to digital television services in the United States. The FCC had planned for the transition to occur in 2006, but delays are expected as a result of provisions in the Balanced Budget Act of 1997. The auction of these licenses is scheduled to begin on March 6, 2001. Some potential bidders are negotiating with the incumbents to relocate the incumbents to other frequencies earlier than 2006, subject to approval by the FCC. While some estimate the auction will produce $6-$30 billion in proceeds for the federal treasury, there is a great deal of uncertainty over the outcome, as well as when the new licenses may be used.

Questions remain over when the new European UMTS licensees will begin offering new services, to compete with existing mobile wireless services and to provide lower costs for consumers. Many UMTS license winners plan to build their networks and start offering services quickly in order to pay off their debt from the auctions. In addition, some consumer issues might need to be resolved internationally in order to achieve a truly globally harmonized mobile network. These include whether to establish a flat rate for roaming, whether to set limits on roaming charges for international calling, and whether to impose content restrictions on the Web-based applications of 3G services or minimum age requirements for users.

Many claim that the United States is lagging behind other industrialized nations in implementing 3G services. That assertion may be true for the penetration rates of existing mobile services, as shown in the figure below. The graph compares the penetration rates, in terms of the percentages of subscribers, in some of the more developed economies, as of December 1999 (note that these numbers are changing rapidly). The United States had reached a penetration of 31%, while some countries (particularly in Scandinavia) had greater than 50%. Two reasons cited for the lag is a shortage of available spectrum and a lack of a single technology standard in the United States. Many agree with the FCC's policy of not adopting a technology standard to introduce competition, and to give consumers a choice among the various technologies. Some predict that U.S. mobile penetration levels will eventually catch up with and surpass many countries. Some argue that there is less of a demand for mobile wireless telecommunications in the United States because the wireline infrastructure is well established throughout the country, unlike in some other countries. Nevertheless, some European countries and Japan are expected to begin deploying 3G services this year, while the U.S. wireless industry is not expected to offer 3G services until at least 2004.[6] Some are concerned that early foreign 3G deployment could force a de facto standard in U.S. markets.

Relevant Legislation in the 106th Congress

The Third Generation Wireless Internet Act (S. 1923, introduced November 16, 1999) and the Spectrum Resource Assurance Act (H.R. 4758, introduced June 26, 2000) would have enabled incumbent mobile services operators to bid for 3G spectrum licenses by eliminating the spectrum aggregation limit on spectrum licenses assigned by auction (currently set at 45 MHz by the FCC). No action was taken on either bill, but similar legislation could be introduced in the 107th Congress.



Source: International Telecommunication Union, Telecommunication Indicators, published August 2000

[6] U.S. mobile services providers are, however, planning to offer interim services, referred to as "2.5G," that will have some of the features planned for 3G, but at an earlier date.