Wireless Technology and Spectrum Demand: Advanced Wireless Services

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Summary

Advances in wireless telecommunications technology are converging with Internet technology to foster new generations of applications and services.

Presently, the United States and other countries are moving to third-generation (3G) and fourth-generation (4G) mobile telephony. The leading choices for 4G technology are Long Term Evolution (LTE) and WiMAX (an industry designation for the broadband standard). A related trend is the growth in use of Wi-Fi (wireless fidelity).From the perspective of spectrum management, a significant difference in the technologies is that 3G and 4G services operate on designated, licensed frequencies, while Wi-Fi shares unlicenced spectrum with other uses.

Unlicensed spectrum is not sold to the highest bidder and used for the services chosen by the license-holder but is instead accessible to anyone using wireless equipment certified by the FCC for those frequencies. New technologies that can use unlicensed spectrum without causing interference are being developed for vacant spectrum designated to provide space between the broadcasting signals of digital television, known as white space. In November 2008, the FCC established rules that permit the use of this white space.

During 2007, M2Z and several other companies petitioned the Federal Communications Commission (FCC) to release some spectrum licenses for a national broadband network. M2Z offered to provide basic service for free to consumers and public safety and offer content filtering for family-friendly access. In September 2007, the FCC issued a Notice of Proposed Rulemaking to establish service rules to auction the licenses, designated as Auction AWS-3. The FCC did not act on the auction proposal and the issues surrounding it remain unresolved.

Policy issues before the 111th Congress could include the competitive impact on commercial wireless carriers when municipalities offer wireless broadband services, promoting the development of broadband wireless access, and assuring the availability of appropriate spectrum for both licensed and unlicensed applications.

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In order to deploy advanced wireless technologies, telecommunications carriers, broadcasters, cable companies, content providers and others are seeking effective strategies to move to new standards, upgrade infrastructure, and develop new services and content. This migration path includes decisions about acquiring and using spectrum. Spectrum is managed by the Federal Communications Commission (FCC) for commercial and other non-federal uses and by the National Telecommunications and Information Administration (NTIA) for federal government use. International use is facilitated by numerous bilateral and multilateral agreements covering many aspects of usage, including mobile telephony.[1] Spectrum is segmented into bands of radio frequencies and typically measured in cycles per second, or hertz.[2]

Commercial wireless communications typically rely on bandwidth below 3 GHz because of limitations in current technology. Although developments in technology increase the efficiency of spectrum and expand its usable range, there is persistent demand for spectrum to carry new services as other technologies reach the market. New developments in wireless technology support many services for business and consumer markets, such as enhanced Internet links, digital television and radio broadcast reception, high-quality streaming video, and mobile commerce (m-commerce)—including the ability to make payments.

Mobile Telephony

Mobile communications became generally available to businesses and consumers in the 1980s. The "first generation" was built on analog technologies. Second generation (2G) wireless devices are characterized by digitized delivery systems. Third generation (3G) mobile technology represents significant advances services in cell phone technology. 3G and 4G networks provide capacity for broadband applications that include video and mobile (transportable) television.[3] These leading-edge technologies can easily support multi-function devices, such as the BlackBerry and the iPhone. Business and consumer demand for mobile services is considered by many to be an important engine for future growth in American and global economies. The United States had over 270 million mobile phone subscribers in January 2009.[4]

[1] The International Telecommunication Union (ITU), part of the United Nations, is the primary organization for coordinating global telecommunications and spectrum management.

[2] Radio waves are usually identified by frequency. Standard abbreviations for measuring frequencies include kHz—kilohertz or thousands of hertz; MHz—megahertz, or millions of hertz; and GHz—gigahertz, or billions of hertz.

[3] Broadband refers to the capacity of the radio frequency channel. A broadband channel can transmit live video, complex graphics, and other data-rich information as well as voice and text messages, whereas a narrowband channel might be limited to handling voice, text, and some graphics. For an in-depth study of wireless broadband, see *Connected on the Go: Broadband Goes Wireless*, Wireless Broadband Access Task Force, Federal Communications Commission, February 2005 at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-257247A1.pdf.

[4] Statistic updated regularly at http://www.ctia.org/.

Wi-Fi, WiMAX, and LTE

In 1999, what is now known as the Wi-Fi Alliance formed to develop and promote a worldwide standard for localized, high-speed wireless networking.[5] Today, most new laptop computers come equipped with the technology that allows wireless access to the Internet using Wi-Fi technology. Wireless Local Area Networks (WLANs) operate on unlicenced spectrum, using radio frequencies in the free 2.4 GHz and 5.4/5.7GHz spectrum bands. A group of standards for frequency use in these bands is known as the 802.11 family, or legacy. The 802.11a/n standards are commonly referred to as Wi-Fi, for wireless fidelity. Wi-Fi provides high-speed Internet access for personal computers and handheld devices and is also used by businesses to link computer-based communications within a local area. Links are connected to a high-speed wireline (landline) either at a business location or through hotspots. Hotspots are typically located in homes or convenient public locations, including many airports and café environments such as Starbucks. Another standard for wireless Internet is Bluetooth, which has a shorter range than Wi-Fi but works well in cell phones. Bluetooth handles both voice and data; Wi-Fi is mostly data but also supports Voice over Internet protocol (VoIP) calls, sometimes known as VoWiFi.

WiMAX (Worldwide Interoperability for Microwave Access) refers to both a technology and an industry standard, the work of an industry coalition of network and equipment suppliers[6] that have agreed to develop interoperable broadband wireless based on a common standard (IEEE 802.16) for point-to-point transmissions. WiMAX technology can transmit data over distances of up to 30 miles and is used in the United States as a "last mile" technology, that is, a means to provide fixed wireless service to locations that are not connected to networks by cable or high-speed wires. Mobile WiMAX is still in the early stages of development.[7] WiMAX uses multiple frequencies around the world in ranges from 700 MHz to 66 GHz. In the United States, frequencies where WiMAX is being tested or used include 700 MHz, 1.9 GHz, 2.3 GHz, 2.5 GHz and 2.7 GHz.

Future technologies for wireless broadband include WiMAX and Long Term Evolution (LTE) networks. LTE is the projected development of existing 3G networks built on Universal Mobile Telephone System (UMTS) standards.

Broadband Wireless Access to the Internet

As demand for Internet services grows, policymakers at all levels of government are seeking ways to make access—especially high-speed, or broadband, access—to the Internet available to all. As wireless technologies have improved, they have become a popular option for deploying municipal broadband, especially to disadvantaged sectors of a community. Successive Congresses

[5] Website at http://www.wi-fi.org.

[6] Founding members of the WiMAX Forum include Airspan, Alvarion, Analog Devices, Aperto Networks, Ensemble Communications, Fujitsu, Intel, Nokia, Proxim, and Wi-LAN. For additional information, see http://www.wimaxforum.org/.

[7] A global standard for mobile WiMAX, 802.16e has been established by the IEEE 802.16 Working Group; documentation is at http://www.wimaxforum.org/technology/documents/. Viewed October 23, 2007. WiMax has been accepted as a 3G standard by the International Telecommunications Union.

have seen the introduction of bills supporting programs to bridge what is often called the digital divide, the inequality of access to the Internet because of technical or economic constraints.[8]

Municipal Deployment of Broadband

The two main broadband technologies that are particularly attractive to communities, in part because they support existing community services such as Internet access for schools and communications for public safety, are fiber-optic cable networks and wireless access—WiFi today, possibly WiMAX in the future. The spread of wireless services such as access to the Internet and anticipated advances in wireless technology are modifying the business case for choosing a broadband technology. Networks that depend on a fiber-optic cable backbone are capital-intensive and usually more profitable in high-density urban areas. A number of rural communities have used their resources to install fiber-optic broadband services in part because they were too small a market to interest for-profit companies. Increasingly, communities are looking at wireless technologies to support their networks.

Several states have passed laws prohibiting or limiting local governments' ability to provide telecommunications services. An effort to challenge such a law in Missouri by municipalities offering local communications services in the state was heard before the U.S. Supreme Court in 2004.[9] In the Telecommunications Act of 1996, Congress barred states from "prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service."[10] The Court ruled that "entity" was not specific enough to include state political divisions; if Congress wished specifically to protect both public and private entities, they could do so by amending the language of the law. This Court decision and the steady improvement in broadband communications technologies that municipalities wish to have available in their communities have provided fuel for a policy debate about access to broadband services. The central debate is whether municipal broadband services are part of essential infrastructure with many public benefits, including stimulus to the local economy, or whether they provide unfair competition that distorts the marketplace and discourages commercial companies from investing in broadband technologies. In particular, the fact that urban areas are creating Wi-Fi networks and providing, among other services, free wireless links to the Internet is viewed as a threat to commercial companies and a form of unfair competition.

Municipalities installing free Wi-Fi zones often contend that generally available access to the Internet through wireless connections has become an urban amenity, arguably a necessity in sustaining and developing the local economy. Municipal Wi-Fi also provides the opportunity to improve social services and Internet access in disadvantaged communities that often are not served by fiber optic networks.[11]

[8] For further information, see CRS Report RL30719, *Broadband Internet Access and the Digital Divide: Federal Assistance Programs*, by Lennard G. Kruger and Angele A. Gilroy.

[9] U.S. Supreme Court, Docket Number 02-1238.

[10] 47 U.S.C. 253 (a).

[11] The Federal Trade Commissions' Internet Access Task Force has published a report discussing many aspects of municipal broadband implementation and related issues, at http://www.ftc.gov/opa/2006/10/muniwireless.htm.

National Deployment of Free Broadband

During 2007, M2Z and several other companies petitioned the FCC to release 20 MHz of spectrum licenses at 2155-2175 MHz for a national broadband network. M2Z offered to provide basic service for free to consumers and public safety and offer content filtering for family-friendly access. In return for the grant of the license, which would be assigned without auction, M2Z offered to pay a percentage of gross revenues to the U.S. Treasury. In September 2007, the FCC issued a Notice of Proposed Rulemaking to establish service rules for the auction of a license or licenses at 2155-2175 MHz, designated as Auction AWS-3.[12] Proposed provisions include obligations to offer free broadband service similar to that proposed by M2Z and family-friendly access. The proposed spectrum band is adjacent to bands previously auctioned in the Advanced Wireless Service (AWS-1) auction that concluded in 2006. There are allegations that the proposed network would cause harmful interference to users on the AWS frequencies. There are also concerns that the filtering would be applied in such a way as to constitute censoring. The concept of a lifeline broadband service has significant support from many policy makers. The FCC did not act on the auction proposal and the issues surrounding it remain unresolved.

White Space

Unlicensed spectrum is not sold to the highest bidder and used for the services chosen by the license-holder but is instead accessible to anyone using wireless equipment certified by the FCC for those frequencies. New technologies that can use unlicensed spectrum without causing interference are being developed for vacant spectrum designated to provide space between the broadcasting signals of digital television, known as white space. On September 11, 2006, the FCC announced a timetable for allowing access to the spectrum so that devices could be developed and ready for retail sales by February 2009.[13] One of the potential uses for white space is wireless broadband access to the Internet.[14] These unlicensed applications could be used as an extension of the licensed applications that will be possible on the 700 MHz band once it is cleared of analog broadcasts. The National Association of Broadcasters (NAB), and others, protested the use of white space for consumer devices on the grounds that they could interfere with digital broadcasting and with microphones used for a variety of purposes. Companies such as Microsoft, Dell, and Motorola, however, stated the belief that solutions can be found to prevent interference. In November 2008, the FCC established rules that permit the use of the white spaces, with special provisions to protect microphone use.[15]

[12] FCC, *Notice of Proposed Rulemaking*, WT Docket No. 07-195, released September 19, 2007.

[13] FCC, *First Report and Order and Further Notice of Proposed Rule Making*, ET Docket No. 04-186, released October 18, 2006.

[14] "Tech Firms Push to Use TV Airwaves for Internet," by Charles Babington, *The Washington Post*, March 13, 2007.

[15] FCC News, "FCC Adopts Rules for Unlicensed Use of Television White Spaces," November 4, 2008.

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