



*Commercial Spectrum
Auctions Report*

November 1997

EXECUTIVE SUMMARY

This report presents a detailed account of the 14 commercial spectrum auctions conducted by the Federal Communications Commission (FCC). The report presents a broad overview of the commercial spectrum auctions beginning with a historical brief on early spectrum management, examination of spectrum auctions and licensing procedures, narrative of licensing boundaries, auction details on the 14 auctions that have previously occurred, and information on upcoming auctions.

Spectrum policy and management has undergone significant changes since the advent of radio technology. In the early 20th century, the government placed no or relatively few restrictions on the granting of licenses. As the demand for radio spectrum became greater, Congress declared radio spectrum a public resource, and began issuing licenses through comparative hearings and lotteries. In 1993, the FCC, at the direction of Congress, instituted competitive bidding procedures to award electromagnetic licenses to the highest bidders. To date, the auctions have brought in an unprecedented \$23.1 billion in bids. Thus far the U.S. Treasury has collected \$11.8 billion¹.

Since the FCC has begun to auction spectrum, it has taken a new approach to spectrum management. Instead of the controlled, highly regulated process of assigning channels, spectrum is now auctioned and assigned on a block basis. FCC's granting of spectrum blocks to commercial users, with general usage guidelines, including interference protection rules for existing operators and system construction deadlines, is in stark contrast to the more restrictive offering of channels to the public safety community.

This document is the first of what will be a quarterly report on commercial spectrum auctions. As the inaugural edition, this report intends to provide an introductory examination of the commercial spectrum auctions by presenting a detailed account of the preceding 14 auctions. The quarterly reports will provide—

- Updates on the first 14 auctions
- New auction information and analysis
- Analysis of commercial spectrum management policies and practices to understand and highlight potential lessons for the public safety community.

¹ FCC. "Wireless Bureau Chief Daniel Python Hails Success of Market-Based Spectrum Policies," New Release, September 11, 1997.

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COMMERCIAL SPECTRUM AUCTIONS REPORT

1. INTRODUCTION

The issue of spectrum allocation and the recent developments in commercial wireless systems market are important aspects of the overall environment for public safety communications. When assessing spectrum needs, it's imperative for the public safety community to know which commercial entities have purchased blocks of spectrum, where the spectrum is located, and the types of services intended to be deployed. Further information on the various methods for spectrum allocation and the identification of related FCC policies will assist the public safety community in assessing the impact of commercial wireless systems and in understanding the relative position of the public safety community in obtaining available spectrum.

1.1 Purpose

This report overviews the spectrum auctions and related developments in the commercial wireless industry. The report presents a historical overview of spectrum allocation, from the use of comparative hearings and lotteries to the recent transition to competitive bidding procedures. This report also provides detailed information on successful commercial bidding activities in completed auctions. This information is intended to provide Federal, state, and local public safety users with insights regarding commercial activity conducted within each respective public safety community's geographic area. This report will serve as a primer for the public safety community to understand how the commercial sector is granted authority to use spectrum and what services they can deploy in various regions nationwide. This report is intended to provide basic information on spectrum auctions and to serve as a catalyst for further discussion on the effect of commercial spectrum use on the public safety community.

1.2 Audience

This report is intended for the public safety community at the Federal, state, and local levels. The audience includes public safety communications managers, radio frequency coordinators, and other senior management and decision makers involved in securing adequate spectrum and financing methods for system deployment.

1.3 Scope

This report overviews the spectrum allocation process. Because its purpose is to serve as a high-level primer, the report provides a summary of FCC licensing approaches, from comparative hearings and lotteries to the current spectrum auctions process; identifies FCC activity pertaining to spectrum auctions and services; analyzes current schemes for spectrum management and; overviews the types of services commercial entities can provide through licenses obtained through auctions.

1.4 Organization

This report is composed of five sections, including this introduction and the conclusion.

2. METHODOLOGY

This report overviews the issues and facts related to spectrum auctions. The FCC auction process, the services auctioned in each band, the new licensees and the geographic boundaries of the licenses, and the history of spectrum management constitutes a large amount of information. The vast amount of information available on these topics necessitated an organized, multi-layered research process that used diverse resources. The methodology followed to develop this report began with a data gathering process on the FCC commercial spectrum auctions. The main sources of information for this report were—

- Internet searches of government web sites
- Internet searches of wireless industry web sites
- Trade magazines
- Telephone interviews with FCC staff.

The FCC Auctions Bureau and the Wireless Telecommunications Bureau web sites² were useful in obtaining background information and summaries of individual FCC auctions pertaining to the auctions and related services. The date and types of auctions, services, license winners, frequency blocks, and spectrum allocations and allotments were derived from FCC web sites. FCC public notices, new releases, reports, and orders were examined to ascertain the rules for spectrum auctions and regulatory guidelines for services to be offered and for the build-out requirements that applied after the auctions were completed.

Commercial service providers, and manufacturers, web sites, industry association web sites, and news gathering organizations' sites were instrumental in providing up-to-date information on where license holders were planning to launch services, the types of services to be offered, and the technology they would deploy to offer services. In addition, these sites were searched to obtain company and service profiles. Trade magazine articles also proved to be valuable sources for information on developing markets and technologies.

Telephone interviews, which consisted of brief conversations with individuals in the FCC Auctions Bureau and Wireless Telecommunications Bureau, were useful in obtaining more in depth information on particular auctions and on rules regarding commercial services. The interviews also provided direction in the research process.

Although data collection continued throughout the entire report process, an initial plan was formulated to determine which information would enter the report. It was determined that the first *Commercial Spectrum Auctions Report*, to be provided by the PSWN program, would best serve the public safety community if it were written as a high-level primer on how the commercial sector obtains its licenses, key definitions and terms used, and services that the commercial sector plans to provide. Therefore, the end result consists of a report that provides a

² FCC Wireless Telecommunications Bureau Homepage, <http://www.fcc.gov/wtb/>

historical overview of the auction process, recent auction details, spectrum management terminology, and analysis of relevant wireless technology and service offerings.

3. AN OVERVIEW OF COMMERCIAL SPECTRUM MANAGEMENT AND THE ROLE OF THE FEDERAL COMMUNICATIONS COMMISSION

U.S. spectrum management has undergone substantial transformation, evolving from a simple registration process to today's current process of auctioning spectrum. This transformation stems from the desire to develop a vehicle in which commercial spectrum would be fairly and expeditiously allocated. To date the U.S. "has the most developed auction methodology and the most experience using auctions to assign radio spectrum in the world."³ The FCC's recent practice of employing simultaneous multiple round auctions allows bidders to bid on as many licenses as they wish in successive discrete bidding rounds. This method ensures that that license is awarded to the bidder who actually values the license the most. By examining the processes used to auction commercial spectrum, the public safety community can gain valuable insight into a spectrum management process decidedly different than their own.

3.1 History of Spectrum Management^{4,5,6}

The U.S. Government — in response to the call for regulation stemming from widespread radio interference caused by unchecked transmission — first addressed radio spectrum management through congressional passage of the Radio Act of 1912. The 1912 act required transmitters be registered with the Department of Commerce, but did not provide for the control of their frequencies, operating times, and station output powers. Thus, in 1922, eight federal agencies banded together under the Secretary of Commerce to coordinate their use of spectrum, forming a committee called the Interdepartment Radio Advisory Committee (IRAC).

The earliest commercial use of spectrum began with the broadcast of Pittsburgh station KDKA on November 2, 1920. When a vibrant market for radio spectrum emerged, the courts began applying common-law standards in creating a system of property rights for radio spectrum. However, in April 1926, the courts ruled in *United States v. Zenith Radio Corp.* that the Secretary of Commerce had no legal basis for restricting licenses.

For this reason, Congress passed the Federal Radio Act of 1927. The Federal Radio Act of 1927 gave the U.S. Government the needed authority to coordinate use of radio spectrum. The act declared that radio spectrum was a public resource and created the Federal Radio Commission, which was charged with the ability to regulate spectrum by assigning licenses. The Federal Radio Act of 1927 also introduced the public interest standard. The public interest standard, a concept that has endured to the present day, requires that spectrum licenses be assigned on the basis of "public interest, convenience, or necessity."

³ Martin Spicer, FCC. "International Survey of Spectrum Assignment for Cellular and PCS." Sponsored by the: Wireless Telecommunications Bureau. September 1996.

⁴ CBO. "Where Do We Go From Here?" *The FCC Auctions and the Future of Radio Spectrum Management*. April 1997.

⁵ Evan Kwerel and John Williams. "Moving Toward a Market for Spectrum." *CATO Review of Business & Government*. 1993.

⁶ Evan Kwerel and Alex Felker. "Using Auctions to Select FCC Licenses." *FCC OPP Working Paper Series*. May 1995.

The Federal Communications Act of 1934 created the Federal Communications Commission and empowered the President, or the President's designated manager, with the task of managing the Federal government's spectrum use. The President designated the Commerce Department's Office of Telecommunications (OT) to work in conjunction with the IRAC and the White House's Office of Telecommunications Policy (OTP) to manage Federal Government use of the radio spectrum.

In 1978 the President established the National Telecommunications and Information Administration (NTIA) by Executive Order and gave it full responsibility to manage Federal government use of spectrum by allocating and assigning licenses to Federal users.

3.1.1 Comparative Hearings

Before the 1993 Omnibus Reconciliation Act, which authorized the auction process, the FCC issued spectrum licenses on a first-come, first-serve basis. When faced with mutually exclusive⁷ applicants, the FCC used comparative hearings to determine which party would make best use of the license. As a result of the Radio Act of 1927, comparative hearings became the primary mode of assigning licenses.

In comparative hearings, two or more parties appear before an administrative law judge, a FCC review board, or the full FCC, depending on the level of review. Using a complex set of criteria, including financial qualifications and other largely subjective measures, the judge would use the "public interest standard" to determine which applicant's proposed use of the particular portion of the spectrum would best serve the public's interest. The losing party in a comparative hearing, after interagency appeals were exhausted, often appealed the decision to the U.S. Court of Appeals. This process which often took years to complete, delayed the awarding of licenses.

3.1.2 Lotteries

Recognizing the problems associated with comparative hearings, Congress enacted legislation in 1982 that gave the FCC the authority to assign licenses by lottery. However, lotteries did not make the licensing process any more expedient. In these license lotteries, which were set up much like state lottery systems, bidders were given a number and the winner was determined by random selection. The theory behind the lottery system was that it would assign licenses quickly and that it did not matter which applicant, among those who met basic financial qualifications, was awarded the license. FCC applications to enter a lottery were offered at a modest price. Low entrance fees encouraged large numbers of applicants to participate. For example, the FCC received more than 60,000 applications for licenses to provide data transfer services and nearly 400,000 for cellular telephone licenses.⁸ This flood of applications eroded the expected cost savings and increased the time frame for awarding licenses.

⁷ "Mutually exclusive" refers to applicants that apply for use of the same frequency in the same geographical service area.

⁸ John McMillan. "Why Auction the Spectrum?" *Telecommunications Policy*, vol. 19, no 3, April: 1995.

3.2 Spectrum Auctions

In the 1993 Omnibus Reconciliation Act (the “Budget Act”) Congress added Section 309(j) to the Communications Act of 1934. Section 309(j) authorized the FCC to employ competitive bidding procedures to award electromagnetic spectrum licenses to mutually exclusive applicants. The decision to use auctions was based on the need to remedy the problems with comparative hearings and lotteries and to generate revenue to reduce the budget deficit. On March 8, 1994, the FCC issued FCC Order 93-253 *Second Report and Order in the Matter of Implementation of Section 309 (j) of the Communications Act*⁹ *Competitive Bidding*, which promulgated bidding and spectrum allocation rules. The FCC believed that a distinct advantage of competitive bidding over comparative hearings and lotteries was that it reduced licensing delays and ensured that successful applicants were those who most valued the license and who would most rapidly deploy new technology and services.

After a lengthy regulatory proceeding, the FCC decided to use a simultaneous multiple-round auction method for Personal Communication Systems (PCS) auctions.⁹ In simultaneous multiple round auctions, all the licenses are placed for auction concurrently, and bidders can bid on as many licenses as they choose in discrete bidding rounds. Bidding remains open until no new bids are made on any of the auctioned licenses. Rules embedded into the process prevent bidders from holding back until other bidders have placed a value on a license. Thus, simultaneous multiple round bidding generates the greatest amount of information for bidders on a particular spectrum license to ensure that the license is awarded to the bidder who values the license most. In addition, this auction method allows bidders to formulate contingency bidding strategies as more information about the value of the license becomes available.

Simultaneous multiple round auctions are conducted electronically using an automated auction software program. Through the automated auction software program, bidders are able to place their bids from remote locations either via a computer or telephone. Thus, bidders are given flexibility to place their bids without having to travel to Washington, DC, for the duration of the auction.

Before holding an auction, the FCC often solicits comments from the public by issuing a Notice of Proposed Rulemaking (NPRM). Following the release of the NPRM, there are several additional steps that most auctions will follow as illustrated in Figure 3-1. Once the FCC receives and reviews comments and issues an explanation of the rules, the auction terms and conditions are released. Potential bidders must file applications and will subsequently have the option of attending FCC sponsored seminars and mock auctions. At the conclusion of the actual

⁹ FCC. Second Report and Order, *PP Docket N. 93-253, FCC 94-61* March 8, 1994.

auction, winning bidders possess the right to be the exclusive applicant for a particular area and frequency and must file the long form application and make their down payments in order to obtain the license in question. Once the FCC accepts the application, this triggers the start of a 30-day window in which other parties can file a petition to deny the license. At the end of the 30-day period, the FCC issues a public notice with the names of those to be granted a license. In some auctions, the FCC has attempted to encourage competition by issuing bidding credits to qualified small businesses and permitting installment payments on licenses. A bidding credit generally is a discount of up to 35 percent on a license for companies meeting the FCC's financial criteria, usually based on annual gross revenue.

During the four years that the FCC has had auction authority, it has conducted 14 auctions and granted more than 4,300 licenses for spectrum based services. The auctions have raised \$23.1 billion for the United States Treasury. The FCC has specified dates for the following auctions—

- Local Multipoint Distribution Service (28 Gigahertz [GHz]) — February 18, 1998
- 800 Megahertz (MHz) Specialized Mobile Radio (SMR) — October 28, 1997

The FCC announced its auction schedule for 1998. Some of the services listed are subject to the outcome of rulemaking proceedings or resolution of other contingent matters before auction. Table 1-1 lists FCC 1998 auctions schedule.

**Table 3-1
FCC 1998 Auction Schedule**

SERVICE	FREQUENCY RANGE
Public Coast Stations	2-26, 156-162, and 217-220 MHz
Private Land Mobile Radio (PLMR)	220 MHz band
Lower 200 Channels – Specialized Mobile Radio (SMR)	806-809.750, 851-854.750 MHz
Common Carrier Paging (CCP)	929 MHz band
Private Carrier Paging (PCP)	931 MHz band
Lower Band Paging	35-36, 43-44, 152-159, 454-460 MHz
General Wireless Communications Services	4660-4685 MHz
Multiple Address Systems	928-929, 932-932.5, 941-941.5, 952-952.85, 956.25-956.45, 959.85-960 MHz
Narrowband PCS	901-902, 930-931, 940-941 MHz
Location Monitoring Services	904-909.750, 927.750-928, 919.750-921.750, 927.500-927.750, 921.750-927.250, 927.250-927.500 MHz
37/39 GHz (Point to Point Fixed Wireless)	38.6-40 GHz

Due to an increased number of reported cases of fraud and telemarketing investment scams in emerging telecommunications industries, the FCC makes a point of warning the public about this phenomenon. The FCC has issued the following bidder alerts—

“The Commission does not approve any individual investment proposal, nor does it provide a warranty with respect to any license being auctioned. Potential applicants and investors are reminded that winning a license in an FCC spectrum auction is not a guarantee of success in the marketplace.¹⁰”

3.3 Current FCC Spectrum Licensing Procedures

As noted previously, for most commercial users, the FCC grants licenses to eligible and successful bidders through the auction process. Certain types of licenses, however are granted not through the spectrum auction process, but through the application and public proceeding process, such as public safety licenses, Instructional Fixed Television Service (ITFS) licenses, and Amplitude Modulation/Frequency Modulation (AM/FM) radio broadcast licenses. For these types of licenses and services, the FCC uses a dual process to manage spectrum. First, the FCC allocates bands of frequencies to a specific purpose; this is comparable to the process for zoning land except that spectrum allocations are usually nationwide. Then the FCC subdivides a band into channels, which it assigns to individual licensees on a local, regional, or nationwide basis.

¹⁰ FCC. Spectrum Auction Schedule for 1998, *Public Notice*, DA 97-2024 Rel. September 18, 1997.

4. ANALYSIS OF COMMERCIAL USE OF AUCTIONED SPECTRUM

The FCC spectrum auctions have not only reorganized the way that the Federal Government manages spectrum allocation, assignment, and usage for existing services, but have also created entirely new industries. Licenses are issued for larger blocks of frequencies in newly defined geographic boundaries, and the FCC is attempting to encourage competition in the telecommunications industry by imposing fewer regulations on the use of radio frequencies. The spectrum auctions are part of a larger change in the FCC's approach to commercial spectrum management.

4.1 Commercial Spectrum Allocation

Spectrum allocation refers to spectrum that is organized into blocks of contiguous frequencies for particular radio services with somewhat uniform technical standards. Frequency assignment refers to granting licenses, in the case of the FCC, or granting authorizations, in the case of the NTIA, to individual users or organizations, providing them with the right to use specific frequencies.

Before 1993—when Congress ordered the FCC to auction radio spectrum—the FCC issued licenses on a channel-by-channel basis and established the technical standards that equipment manufacturers followed when building their equipment. Rules for services such as AM/FM radio, Interactive Video and Data Service (IVDS), Specialized Mobile Radio (SMR), and Multipoint Distribution Service (MDS), for example, were formulated during this time. Thus, licenses for these services continue to be issued on a channel-by-channel basis.

With the advent of the auctions, the FCC assumed a more hands off approach to licensing and industry regulation. Since 1993, new services are licensed on a block-by-block basis, and the private sector establishes technical specifications for equipment. Thus, spectrum allocated for Personal Communications Service (PCS) and Wireless Communications Service (WCS), for example, was sold and is licensed by block. These licensees are free to channelize within their respective blocks as they see fit. The rules for block-allocated services vary based on FCC rulemakings. The FCC formulates rules to prevent interference on the high range and low range border of a frequency block, but there are no interference rules within the blocks. Licensees are typically obligated to construct their system and offer commercial services within a certain time period and follow certain technical rules that the FCC establishes.

As technology has progressed, new ways to use less spectrum for transmission of the same amount, and increasingly a larger amount, of information have been found. Technological developments such as data compression and digital transmission can increase the amount of voice, video, and data that can be sent using the same amount of bandwidth¹¹ as using traditional analog technologies. Also, different techniques such as Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), and Frequency Division Multiple Access (FDMA) can

¹¹ Bandwidth refers to the total width of frequencies occupied by a radio signal. In practical terms, the bandwidth of a signal refers to the amount of spectrum needed to transmit a signal without excessive loss or distortion.

increase the efficiency in which a radio signal is sent, thereby using less bandwidth and freeing up spectrum for additional use.

4.2 Reallocation of Public Safety Spectrum for Commercial Auctions

The FCC, in a 1992 Emerging Technologies docket (ET Docket No. 92-9) outlined a process for the relocation of microwave incumbents, including public safety organizations, currently operating on 2 GHz frequencies. In order to clear spectrum for PCS operators in the 2 GHz band, the FCC is requiring incumbents to relocate to another frequency. The FCC has developed a framework for incumbent 2 GHz users and PCS licensees to negotiate relocation agreements. Public safety organizations have a 3 year voluntary period,¹² and a subsequent 2 year mandatory period, to negotiate with PCS licensees regarding their relocation. Public safety microwave users are migrating to several places on the spectrum, including 6, 7, and 11 GHz. The PCS licensee, as part of the relocation process, may be obligated to compensate incumbent users by retuning or retrofitting existing equipment for operation on alternative spectrum or by assisting in the physical removal of various microwave equipment.

The FCC has also developed a cost sharing plan to distribute relocation costs more equitably among PCS providers. The cost sharing plan helps ensure that when new PCS entrants establish their networks they will share the costs incurred from relocating an incumbent. 1996 saw the development of a nonprofit cost sharing clearinghouse for PCS microwave allocation. The FCC holds that a PCS relocater must submit documentation of the relocation agreement to the Clearinghouse within ten business days once a relocation agreement is signed with an incumbent. The clearinghouse administrator determines whether a cost-sharing obligation is required. Notice of reimbursement obligations will be sent to PCS licensees who are required to participate in the relocation cost sharing. In 1997 the FCC issued an order allowing incumbents who voluntarily relocate their systems to participate in the cost-sharing plan. Microwave incumbents now are able to obtain reimbursement for a proportional share of their relocation costs from PCS licensees that subsequently benefit from the incumbent's relocation.

4.3 FCC Licensing Boundaries

In addition to issuing licenses for a particular frequency range, the FCC also licenses on the basis of geography. Once the FCC grants a license, the licensee is authorized to offer service within the given geographic area designated for the particular service. The FCC divided the United States in several different geographic categories for the 14 spectrum auctions. This was done based on the nature of the services and technologies with a consideration for the amount of existing licensees. These geographic parameters include—

- Basic Trading Areas (BTAs) and Major Trading Areas (MTAs)
- Metropolitan Statistical Areas (MSAs) and Regional Service Areas (RSAs)

¹² The three-year voluntary negotiation period for public safety microwave licensees operating in the C block will expire May 22, 1999.

- Regional Area Economic Grouping (REAGs) and Major Economic Areas (MEAs)
- Regional licensing
- Nationwide licensing

4.3.1 Major Trading Areas and Basic Trading Areas

An MTA is Rand McNally's unit of division of the United States into 51 distinct areas based on physical geography, population, newspaper circulation, rail service, and other related factors. MTAs usually contain one metropolitan area and range in geographic size. MTAs are drawn across county boundaries and usually cross state lines. MTAs are used as area parameters in the PCS and SMR auctions.

A BTA is Rand McNally's unit of division of the United States into 493 distinct areas based on physical geography, population, newspaper circulation, rail service, and other related factors. BTAs consist of small cities and an occasional metropolitan area and they range in geographic size. A group of BTAs comprises an MTA. BTAs are used as area parameters in the PCS and MDS auctions. Appendices H and I contain the MTA and BTA maps, respectively.

4.3.2 Metropolitan Statistical Areas and Regional Serving Areas

The FCC divided the United States into 734 markets for cellular service. The 734 markets are represented as MSAs (largest 306 markets), and RSAs (the remaining 428 markets). MSAs are defined as counties containing cities with 50,000 or more people including the surrounding counties. The FCC used 1980 census numbers to create the MSAs.

There are 423 rural cellular telephone service areas, called RSAs, as defined by federal regulators. An RSA may cross county boundaries, but cannot cross state boundaries. The average sized state contains about eight RSAs, with each RSA covering 150,000 people. RSAs cover rural counties between metropolitan areas. The MSA and RSA maps can be found in Appendix F in this document.

4.3.3 Major Economic Areas and Regional Economic Area Groupings

The WCS licenses were auctioned based upon MEAs and REAGs that in turn are based upon the 172 Economic Areas (EAs) as defined by the Bureau of Economic Analysis (U.S. Department of Commerce). The FCC combined the EAs into large groupings creating 12 REAGs. The FCC also grouped the EAs into 52 smaller areas forming the MEAs. A single REAG consists of multiple MEAs.

4.3.4 Regional and Nationwide Licensing

The FCC auctioned 10 nationwide and 30 regional narrowband Personal Communications Service (PCS) licenses. With the authorizations auctioned in the nationwide narrowband auction, winning bidders can offer narrowband PCS service anywhere in the United States. For the regional narrowband PCS auction, the FCC divided the U.S. into five regions and auctioned six licenses per region.

4.4 Commercial Services

In addition to geographic boundaries, the FCC issues licenses for channels or blocks, depending on the service. Under the current block allocation system, the FCC dedicates bands of contiguous frequencies to specific services provided under uniform technical standards for nonfederal users. The FCC assigns frequencies in blocks for services that they created since instructed in 1993 by Congress to auction radio spectrum. Spectrum assigned for PCS and WCS, for example, is assigned on a block-by-block basis. Frequencies for services for which the FCC established rules prior to the auctions, such as MDS, IVDS, and SMR are assigned on a channel-by-channel basis. Entities who obtained licenses prior to the spectrum auctions are referred to as incumbent licensees and are in competition with companies who obtained licenses in the spectrum auctions. Figure 4-1 illustrates the frequency ranges of the service types that have been auctioned.

4.4.1 Narrowband Personal Communications Service —Auction #s 1 & 3

Table 4-1
Narrowband Personal Communications Service Statistics

The FCC allocated blocks of spectrum in the 900 MHz range to narrowband PCS. The nationwide narrowband auction concluded on July 29, 1994, bringing in \$650 million in bids. The regional narrowband PCS auctions concluded on November 8, 1994, raising \$395 million in bids. The list of winners in the nationwide and regional narrowband PCS auctions can be found in Appendix C and E, respectively. The narrowband PCS licenses are divided as such—

- 5 nationwide licenses consisting of 2 50 kHz blocks
- 3 nationwide licenses consisting of a 50 kHz and a 12.5 kHz block
- 3 nationwide licenses consisting of a 50 kHz block
- 10 regional licenses consisting of 2 50 kHz blocks
- 20 regional licenses consisting of a 50 kHz and a 12.5 kHz block

The FCC established the following build-out requirements for nationwide narrowband PCS licensees—

- Licensees must construct base stations that provide coverage to a composite area of 750,000 square kilometers or serve 37.5 percent of the U.S. population within 5 years of the initial license grant date
- Licensees must construct base stations that provide coverage to a composite area of 1,500,000 square kilometers or serve 75 percent of the U.S. population within 10 years of the initial license grant date.

There are more than 3,500 narrowband PCS authorizations available, but only 40 have been auctioned (30 in the regional narrowband PCS auction, and 10 in the nationwide narrowband PCS auction). Three more narrowband auctions have yet to be scheduled.

The FCC established the following build-out requirements for regional narrowband PCS licensees—

- Licensees must construct base stations that provide coverage to a composite area of 150,000 square kilometers or serve 37.5 percent of the service area within 5 years of the initial license grant date
- Licensees must construct base stations that provide coverage to a composite area of 300,000 square kilometers or serve 75 percent of the service area within 10 years of the initial license grant date.

Failure by a licensee to meet the construction requirements shall result in forfeiture of the license and ineligibility to regain it.

4.4.2 Interactive and Video Data Service — Auction # 2

Table 4-2
Interactive Video and Data Service Statistics

Service	Frequency Range (MHz)	Auction Closing Date
Interactive Video and Data Service	A–218–218.5 B –218.5–219	July 29, 1994

Interactive and Video Data Service (IVDS) is a point-to-multipoint, short distance communications service. IVDS systems will allow viewers to respond to polls and order merchandise, and provide utility and cable companies with remote meter reading and use reading capabilities. Mobile operation is permitted on IVDS frequencies. IVDS spectrum consists of two 500 kHz channels in the 218–219 MHz range.

The IVDS auction concluded on July 29, 1994, and fetched more than \$213 million in bids. The FCC established the rules, including channel regulations, for IVDS in the early 1990s before the implementation of the auctions. The FCC divided the IVDS spectrum into two 500 kHz channels and used MSA boundaries to create geographic borders for the licenses. The list of auction winners can be found in Appendix G.

The IVDS rules contain specific construction benchmark requirements to deter speculation or warehousing of spectrum. Licensees are required to demonstrate their ability to serve 30 percent of the service area population or land area within 3 years after the licenses are granted, and 50 percent of the service area population or land area within five years. The IVDS license cancels automatically if the licensee does not meet these construction requirements.

IVDS service has not yet been deployed due to problems with the technology and availability of equipment. In addition, numerous IVDS auction winners defaulted on their payments to the FCC, and the future of their spectrum rights is undecided. The FCC originally planned to hold a second IVDS auction on February 18, 1997, but the auction was postponed. The second IVDS auction was to consist of 125 defaulted MSA licenses and 856 RSA licenses.

4.4.3 Broadband Personal Communications Service — Auction #s 4, 5, 10, 11

Table 4-3
Broadband Personal Communication Service Statistics

Service	Frequency Range (MHz)	Auction Closing Dates
Broadband Personal Communications Service	A– 1850–1865/1930–1945	A & B Blocks - March 13, 1995
	B – 1870–1885/1950–1965	C Block – May 6, 1996
	C –1895–1910/1975–1990	C Block Reauction – July 16, 1996
	D –1865–1870/1945–1950	D,E, & F Blocks – January 14, 1997
	E– 1885–1890/1965–1970	
	F –1890–1895/1970–1975	

Broadband Personal Communications Services (Broadband PCS) is broadly defined by the FCC as “radio communications that encompass mobile and ancillary fixed communication services that provide services to individuals and businesses and can be integrated with a variety of competing networks.” Broadband PCS also can be used to develop more advanced wireless phone services that will be able to pinpoint the subscriber in any given location. Broadband PCS will most likely lead to a variety of mobile services including new types of multi-function cordless phones, advanced devices with two-way data capabilities. Also, Broadband PCS may lead to an entire family of new communications devices that use very small, lightweight, multi-function portable phones, portable facsimile and other imaging devices. Broadband PCS, with its ability to communicate with other telephone networks, will enable subscribers to send and receive data and video messages without connection to a wire.

The FCC Broadband PCS auctions signaled the creation of a new industry segment. Analysts predict that within the next 10 years, there could be 100 million wireless telephone subscribers—an increase of more than 80 million. The FCC’s licensing plan for this spectrum will allow several new full service providers of wireless services in each market.

The FCC divided the 120 MHz of spectrum allocated to Broadband PCS into six frequency blocks as shown in Table 4–3. The A & B Block auction consisted of 2 15 MHz blocks sold in MTA boundaries, and the C Block and D, E, and F Block auctions consisted of 2 15 MHz blocks sold according to BTA boundaries.

To obtain spectrum for broadband PCS service, the FCC ruled in 1995 that current microwave users, including public safety organizations, must negotiate with PCS providers in their region to vacate the lower 2 GHz portion of the spectrum. The FCC has established a framework for incumbent 2 GHz users and PCS licensees to negotiate relocation agreements. Public safety organizations have a 3 year voluntary period, which expires May 22, 1999, and a subsequent 2 year mandatory period to negotiate with PCS licensees. Public safety microwave users are migrating to several places on the spectrum, including 6, 7, and 11 GHz.

The FCC has auctioned all 120 MHz of Broadband PCS spectrum. The A and B block licenses were offered in the FCC’s first Broadband PCS auction. The auction began on December 5, 1994, and closed on March 13, 1995, accumulating \$7.7 billion in bids.

The C block, often referred to as the “entrepreneurs’ block,” consists of 30 MHz blocks and was auctioned according to BTA boundaries. The FCC held this auction for those classified as “entrepreneurs” (companies having gross revenues of less than \$125 million and assets less than \$500 million), and “small businesses” (companies with less than \$40 million in gross revenues). The C Block auction closed on May 6, 1996. Two winners in the C block auction (holding a total of 18 markets) defaulted on their license payments, and their licenses were re-auctioned from July 3, 1996 to July 16, 1996. At issue is a remedy to satisfy C-block bidders seeking relief from high debts incurred in bidding and to minimize the risk that companies will declare bankruptcy because of an inability to pay the FCC for licenses.

The FCC has issued a freeze on C Block installment payments until March 31, 1998. In

October 1997, the FCC offered C-block licensees four financing options and gave companies until January 15, 1998 to choose one of the following—

- Status quo, in which companies would continue to make installment payments
- Amnesty, in which a company could return all its licenses and have its outstanding debt forgiven
- Desegregation, in which companies could return half of their spectrum (15 MHz of each 30 MHz license) for any or all licenses and have 50 percent of the corresponding of debt forgiven
- Prepayment, also called a full-price buyout plan, in which a C-block licensee could purchase as many of its licenses as possible by pooling 70 percent of down payments already made plus any additional money it could raise. Buyout would involve full up-front payment, with no financing terms.

Although the plan requires licensees to resume quarterly payments by March 31, 1998, licensees could elect to use a 60-day grace period early next year to further ease cash pressures. For the A, B, and C block PCS licenses, the FCC has ruled that the licensees must construct base stations that provide coverage to at least one-third of the population of the MTA/BTA within 10 years.

The D, E, and F blocks, containing 10 MHz each, were auctioned from August 26, 1996 to January 14, 1997. The FCC received \$2.5 billion in bids from 125 winners in the D, E, and F auctions. All the applications for the 125 D, E, and F blocks were accepted for filing on February 19, 1997. The FCC requires these licensees construct base stations that provide coverage to at least one-quarter of the BTA population within 5 years, or make what the FCC has yet to define as a “showing of substantial service.” The list of PCS auction winners can be found in Appendix J.

4.4.4 Multipoint Distribution Service — Auction #6

**Table 4-4
Multipoint Distribution Service Statistics**

Service	Frequency Range (MHz)	Auction Closing Date
Multipoint Distribution Service	2150–2152 2596–2684	March 28, 1996

Multipoint Distribution Service (MDS), also known as Multipoint Multichannel Distribution Service (MMDS), or wireless cable, is a subscription based television and data service that closely resembles cable television service. However, it uses over-the-air microwave frequencies instead of coaxial or fiber optic cable to transfer subscription television and high-speed Internet access to subscribers. Wireless cable rules were established prior to the FCC

auctioning radio spectrum; thus, wireless cable spectrum is assigned on a channel by channel basis. Currently, the FCC authorizes one-way transmissions over wireless cable frequencies, but the industry is seeking two-way authorization for its spectrum to enable interactive video, two-way high-speed data services, and voice services.

Before the auctions, wireless cable operators obtained broadcast licenses for channels through the FCC comparative hearing and lottery processes. Wireless cable operators holding licenses procured before the MDS auction are permitted by the FCC to broadcast their signal on a 6 MHz channel in a 35 mile Protected Service Area (PSA). In most instances, auction winners won a BTA where an incumbent licensee or operator already existed. In order to offer a commercially viable service, auction winners lease channels from the incumbent licensee, or vice versa. Several incumbent licensees bid on and won the BTA that already contained some or all of their PSA in an effort to protect their existing operations from competition or takeover by another entity.

Obtaining enough channel rights to offer a commercially viable wireless cable service sometimes necessitates that the operator must manage numerous different incumbent commercial and educational licensees who have channel rights in a specific geographic area. In the 1970s, the FCC set aside a portion of the spectrum called Instructional Television Fixed Service (ITFS) in the 2 GHz range for educational institutions to promote educational programming and distance learning. ITFS licensees, whose spectrum is located within the MDS range, can hold up to 20 channels in the 2 GHz range in a given geographic area. The FCC does not auction ITFS licenses; applicants obtain licenses through the FCC application and proceedings process. In 1983, the FCC authorized ITFS licensees to lease their channel to commercial operators. The commercial operators must meet the FCC requirement to broadcast up to 40 hours of educational programming per week on the ITFS designated channels. Generally, this gives wireless cable operators access to 33 6 MHz channels in the 2150–2162 and 2500–2684 MHz range in each market.

The MDS auctions concluded on March 28, 1996. The auction raised a total of \$216 million for 493 BTAs from a total of 67 winners. Out of the 151 bidders, 141 claimed small business status. Seventy seven percent of the authorizations went to companies claiming small business status. Auction winners are authorized to be the exclusive applicant in their respective BTAs; however, the FCC issues licenses within each BTA by channel. All licensees are required by the FCC to be operational in 5 years from the auction. In the MDS auctions, small business status was defined as companies with less than \$40 million in gross annual revenue. Those who qualified as small businesses received bidding credits, which were given in the form of a discount on the bid price a bidder would actually have to pay to obtain a BTA authorization. However, most of the winning bidders for the largest BTAs represented the largest players in the industry, including some of the Regional Bell Operating Companies (RBOCs) like Pacific Telesis and CAI Wireless Systems (a company started by a joint venture between Bell Atlantic & NYNEX). The list of MDS auction winners can be found in Appendix J.

4.4.5 900 MHz Specialized Mobile Radio Service — Auction #7

Table 4-5
Specialized Mobile Radio Statistics

Service	Frequency Range (MHz)	Auction Closing Date
900 MHz Specialized Mobile Radio	A–J Blocks – 896–901 K–T Blocks –935–940	April 15, 1996

An SMR system is a radio dispatched system comprised of base stations and mobile units. A base station can be defined as a fixed station that transmits and receives communications to mobile units within a specified coverage area. There are two main types of SMR systems, conventional and trunked. A conventional SMR system is limited to the use of one channel for transmission, forcing one to wait if someone is using that end users' assigned channel. Trunked systems avoid this problem by using microprocessing technology to search the base station for an open channel.

SMR operators, to date, have focused on radio dispatch service, such as the provision of communications links for companies that have mobile fleets that require tracking, inventory and communications services. Some providers are now deploying Enhanced Specialized Mobile Radio (ESMR) networks. ESMR systems use digital technology whereby multi-site configuration allows for frequency reuse. This system enables calls to be handed-off as a mobile unit moves from the territory of one base station to another. Integrated Dispatch Enhanced Network (iDEN) is the most prevalent ESMR network currently deployed and offers dispatch services, telephone interconnect services, messaging and data transmission.

The FCC established SMR service in 1979 when it allocated 800 MHz for Land Mobile Radio (LMR). Beginning in 1986, the 900 MHz SMR service, which was allocated 10 MHz of spectrum, went through a two-phase licensing process. In Phase I, the FCC assigned licenses in 46 Designated Filing Areas (DFAs), which composed the largest 50 markets and followed county boundaries. The FCC placed a temporary freeze on licensing outside the DFAs until the completion of Phase I. The Omnibus Budget Reconciliation Act of 1993 amended the Communications Act of 1934, reclassifying all mobile services as either CMRS or as Private Mobile Radio Services (PMRS). Most SMR licensees are in the CMRS classification, as are cellular systems and PCS systems. SMR licenses are issued on a channel-by-channel basis.

The FCC began Phase II when it established final rules for the completion of licensing in the 900 MHz SMR band in September 1995. The FCC decided to divide the 900 MHz SMR band into 20 blocks of 10 contiguous 12.5 (kilohertz) kHz paired channels in each of the 51 MTAs. The FCC also decided to use a competitive bidding process and stipulated that incumbent licensees in the 900 MHz MTAs would be granted co-channel protection but would be required to obtain relevant MTA licenses if they wished to expand their systems.

The 900 MHz Specialized Mobile Radio (SMR) auction lasted from December 5, 1995 through April 15, 1996. Out of the 128 qualified bidders, 101 registered as small businesses. The

FCC awarded 1020 MTA licenses through a simultaneous multiple round auction. At the close of the auction, the FCC raised \$202 million from 80 winning bidders. Withdrawal payments consisted of \$131,980, lowering the net bids to \$204 million. Licensees will be required to build out their systems to one third of the service area's population within 3 years. By year five the build-out requirement increases to two thirds of the population or the licensee must demonstrate "substantial service."¹³ A list of SMR auction winners can be found in Appendix J.

4.4.6 Direct Broadcasting Satellite — Auctions #s 8 & 9

Table 4-6
Direct Broadcast Satellite Statistics

Service	Frequency Range (MHz)	Auction Closing Date
Direct Broadcast Satellite	12,200–12,700	110° – January 25, 1996 148° – January 26, 1996

Direct Broadcast Satellite (DBS) is the digitally compressed satellite transmission of voice, video, and data direct to the consumer. Currently, DBS is a direct-to-home (DTH) service that provides multichannel video programming and is a competitor to traditional hard-wired cable and wireless cable (i.e., MDS). The consumer receives the data by means of an 18-inch dish receiving antenna. Because DBS satellites are capable of broadcasting enormous amounts of data, (about 30 million bits per second), DBS technology has the ability to offer one-way, high-speed Internet downloading to subscribers, using a telephone line for the subscriber to send data.

Direct Broadcast Satellites occupy what are referred to as orbital slots above the earth. The FCC auctioned 2 orbital slots: the 110 degree slot and the 148 degree slot. There a total of 8 orbital slots covering all or part of the United States. The FCC has allocated 500 MHz of spectrum to each orbital slot for DBS. Because DBS rules were formulated in 1982, before the start of spectrum auctions, the FCC adheres to channel regulations for DBS. Within each 500 MHz slot, 32 channels are available. FCC, through the International Bureau, regulates DBS not as a broadcast or common carrier service, but according to its own rules.

The DBS 110° auction concluded on January 25, 1996, and raised a total of \$682,500,000 from one bidder. The 110° west orbital location covers the entire United States, and was awarded after 19 rounds to MCI Telecom Corp. This is the first orbital satellite slot for MCI.

The DBS 148° auction concluded on January 26, 1996 and raised a total of \$52,295,000 from one bidder. The 148° west orbital location covers most of the United States with the exclusion of parts of the East Coast. Echostar DBS Corp. won the auction, bringing the total number of DBS channels it owns to 35. Both MCI and Echostar have filed their respective applications and have been granted the license by the FCC. Details of the DBS auction can be found in Appendix K.

¹³ C.F.R. 90.665

4.4.7 Cellular Unserved — Auction #12

Table 4-7
Cellular Unserved Statistics

Service	Frequency Range (MHz)	Auction Closing Date
Cellular	A-824-849 B-869-894	January 21, 1997

A cellular system is a network of interconnected low-powered radio transmitters and receivers that provide coverage to specified segments of the total service area. Each transmitter or receiver covers a small geographic cell within the entire cellular system. When a cellular user moves from one cell to another, the user's call is automatically transferred, or "handed off" to the transceiver of the cell the user is entering.

Each cellular base station is allocated a group of radio channels to be used within a cell. The same channels are assigned to multiple nonadjacent cells to limit interference between base stations. When coverage is limited to the boundaries of each cell, the same group of channels can then be reused within cells that are far enough away as to limit interference. Spectrum efficiency is thereby increased through channel reuse.¹⁴ All the cells within a cellular system are connected to a mobile telephone switching office (MTSO) which switches calls between the cell site and the public switched network (PSTN).

On January 21, 1997, the FCC concluded its auction of 14 licenses for the provision of cellular service in unserved areas. Of the 14 licenses, 13 are based on MSA boundaries and one is based on RSA boundaries. The FCC collected \$1,842,533 from the 10 winning bidders. Of the 10 winners, four small business bidders won five licenses and six other bidders won the remaining nine licenses. The FCC auctioned 50 MHz of encumbered spectrum ranging from 824-849 MHz and 869-894 MHz. Wyoming and Montana, both areas that surround Yellowstone National Park, proved to be two highly contested markets bringing in \$625,000 and \$388,000, respectively.

As part of the effort to develop rules and procedures for licensing cellular systems, the FCC divided up the United States into 734 MSA and RSA markets, licensing two cellular systems per market. The MSA and RSA license holders have 5 years to build out their systems and at the end of that period are required to notify the FCC as to what area they are actually covering within their designated areas. The area in which cellular service is being provided is called the Cellular Geographic Service Area (CGSA). An area may be licensed for cellular unserved if it's not an entity's CGSA at the close of the 5 year build-out. The list of cellular unserved winners can be found in Appendix M.

4.4.8 Wireless Communication Service — Auction #14

¹⁴ The ability to use the same frequencies within a distinct system is also known as frequency reuse.

Table 4-8
Wireless Communications Service Statistics

Service	Frequency Range (MHz)	Auction Closing Date
Wireless Communication Service	Block A – 2305–2310/2350–2355 Block B – 2310–2315/2355-2360 Block C – 2315 –2320 Block D – 2345-2350	April 25, 1997

WCS spectrum may be used for any fixed, mobile, radiolocation, or broadcast-communications services to individuals and businesses. The WCS is capable of providing advanced wireless phone services that would be able to pinpoint a subscriber in any given locale. According to the FCC, the WCS will most likely be used to provide a variety of mobile services, including an entire family of new communication devices using very small, lightweight, multi-function portable phones and advanced devices with two-way data capabilities. WCS systems will be able to communicate with other telephone networks and with personal digital assistants, allowing subscribers to send and receive data and video messages without connection to a wire.

The WCS auction concluded on April 25, 1997, with 17 winning bidders a total of \$13.6 million to the U.S. Treasury. The FCC used MEA/REAG boundaries for the WCS auction. The bids in the WCS auction ranged from \$1.00 for areas such as Omaha, NE; St. Louis, MO; Milwaukee, WI; and Minneapolis/St. Paul, to \$552,000 for New York City. The biggest winners in terms of number of licenses won were BellSouth, PCSCP Partnership (a Bell Atlantic/NYNEX partnership), Comcast WCS Communications (a hard-wired cable multi-system operator), Coloma Wireless, and Metricom (a wireless Internet access provider). BellSouth subsequently

4.4.9 Digital Audio Radio Service — Auction #15

Table 4-9
Digital Audio Radio Service Statistics

Service	Frequency Range (MHz)	Auction Closing Date
Digital Audio Radio Service	License 1–2320–2332.5 License 2–2332.5–2345	April 2, 1997

The Digital Audio Radio Service (DARS) auction concluded on April 2, 1997. DARS will provide nationwide radio programming with compact disc quality sound via satellite. DARS has the potential to offer high quality radio signals to those who receive few terrestrial signals. The licenses are 12.5 MHz in bandwidth. In addition to audio programming, the transmission of data services directly to users also is being explored. Existing analog radios will not be able to receive DARS signals; consumers will need to buy new radios.

The FCC requires that DARS licensees must begin construction of their first satellites within 1 year, launch and operate a satellite within 4 years, and have its whole system operational within 6 years. American Mobile Radio Corporation and Satellite CD Radio, Inc. each won an authorization in the auction, and the FCC has granted licenses to both. CD Radio has been testing its system using two NASA satellites, but neither company has begun to offer commercial services.

5. CONCLUSION

The U.S. Government has designated spectrum as a public resource that needs to be managed and utilized in the most efficient manner possible to protect the public interest and provide maximum benefit to American consumers. The management of this public resource has evolved with the development of new technologies, new markets, and changing attitudes toward government regulation. It's important for the public safety community to understand the broader framework of spectrum management and the changes that have occurred in commercial spectrum allocation. In contrast to public safety spectrum management, the government manages commercial spectrum allocation by imposing less regulation. Auctions are becoming the predominant way in which commercial spectrum users obtain spectrum rights. The FCC has auctioned spectrum for —

- Industries that existed prior to the commencement of the auctions, such as SMR, MDS, and cellular
- New industries, such as PCS, WCS, and DARS.

In addition, the FCC is holding one more auctions in 1997 (SMR), and has announced the addition of twelve services to be auctioned in 1998.

The commercial sector and the public safety community are both experiencing significant demands for increased radio spectrum. The availability of new technologies for the transmission of voice, data and video has contributed to the demand for additional bandwidth. The government has responded to these developments by auctioning commercial spectrum. However, effective spectrum management is increasingly essential for both the commercial sector and the public safety community to reach their respective goals.

APPENDIX A

ABBREVIATIONS AND ACRONYMS

BTA	Basic Trading Area
CCP	Common Carrier Paging
CDMA	Code Division Multiple Access
CGSA	Cellular Geographic Service Area
CMRS	Commercial Mobile Radio Service
DARS	Digital Audio Radio Service
DBS	Direct Broadcast Satellite
DFA	Designated Filing Areas
DTH	Direct to Home
ESMR	Enhanced Specialized Mobile Radio
FCC	Federal Communications Commission
FDMA	Frequency Division Multiple Access
GHz	Gigahertz
iDEN	Integrated Digital Enhanced Network
IRAC	Interdepartment Radio Advisory Committee
ITFS	Instructional Fixed Television Service
ITU	International Telecommunication Union
IVDS	Interactive Video and Data Service
kHz	Kilohertz
LMDS	Local Multipoint Distribution Service
LMR	Land Mobile Radio
MHz	Megahertz
MDS	Multipoint Distribution Service
MEA	Major Economic Area
MMDS	Multichannel Multipoint Distribution Service
MO&O	Memorandum of Opinion and Order
MSA	Metropolitan Statistical Area
MTA	Major Trading Area
MTSO	Mobile Telephone Switching Office
NASA	National Aeronautics and Space Administration
NOI	Notice of Inquiry
NPRM	Notice of Proposed Rulemaking
NTIA	National Telecommunications and Information Administration
OET	Office of Engineering and Technology
OT	Office of Telecommunications
OTP	Office of Telecommunications Policy
PCP	Private Carrier Paging

PCS	Personal Communications Systems
PLMR	Private Land Mobile Radio
PMRS	Private Mobile Radio Service
PSA	Protected Service Area
PSTN	Public Switched Telephone Network
PSWAC	Public Safety Wireless Advisory Committee
RBOC	Regional Bell Operating Company
REAG	Regional Area Economic Grouping
RSA	Regional Service Area
R&O	Report & Order
SMR	Specialized Mobile Radio
TDMA	Time Division Multiple Access
UHF	Ultra High Frequency
VHF	Very High Frequency
WCS	Wireless Communications Service
WTB	Wireless Telecommunications Bureau

APPENDIX B

GLOSSARY OF TERMS

Channel¹⁵ — The portion of the electromagnetic spectrum assigned by the FCC for one emission. In certain circumstances, however, more than one emission may be transmitted on a channel. See, for example, Sec. 22.161.

Channel bandwidth¹⁶ — The spectral width of a channel, as specified in this part, within which 99 percent of the emission power must be contained.

Channel block¹⁷ —A group of channels that are assigned together, not individually.

Channel pair¹⁸ — Two channels that are assigned together, not individually. In this part, channel pairs are indicated by an ellipsis between the center frequencies.

Communications channel¹⁹ — In the Cellular Radiotelephone and Air-Ground Radiotelephone Services, a channel used to carry subscriber communications.

Communications Act of 1934 — Congress's first comprehensive attempt to regulate the communications industry. This act established the Federal Communications Commission (FCC).

Federal Communications Commission (FCC) — The government agency that regulates commercial and non-federal public safety use of the radio spectrum.

Federal Radio Act of 1927 — Act of Congress that declared radio spectrum a public resource. Also created the Federal Radio Commission, which is the precursor organization to the FCC.

Frequency Allocation —Spectrum is organized into blocks for contiguous frequencies for particular radio services. Blocks are designated, or "allocated," to specific services.

Frequency Assignment — The granting of licenses or authorizations that give an individual user or organization the right to use specific frequencies. The FCC assigns frequencies through issuing licenses; the NTIA assigns frequencies through issuing authorizations.

¹⁵ Code of Federal Regulations, Title 47, Volume 2, Parts 20 to 39, Revised as of October 1, 1996 From the U.S. Government Printing Office via GPO Access 47 CFR22.99

¹⁶ *ibid.*

¹⁷ *ibid.*

¹⁸ *ibid.*

¹⁹ *ibid.*

National Telecommunications and Information Administration (NTIA) — The government agency that regulates federal government use of the radio spectrum.

Radio Frequency — A point on the radio spectrum.

Radio Frequency Interference²⁰ — The disruption of the radio signal reception caused by any source that generates waves at the frequency and along the same path as the desired wave.

Radio Spectrum²¹ — That group of electromagnetic energy whose wavelengths are between the audio and light range. Electromagnetic waves are usually transmitted between 500 KHz and 300 GHz.

Telecommunications Act of 1996 — An Act passed by Congress in an attempt to foster competition in the telecommunications marketplace. Most significantly, the act cleared the way for cable and telephone companies to enter into each other's markets, and allowed the entry of public utility companies into telecommunications markets. The Act allows local telephone companies' entry into the long distance market and preserves traditional local zoning authority