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Staff Paper

Private Land Mobile Radio Services: Background

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The views expressed in this Staff Paper do not necessarily represent the views of the Federal Communications Commission or any individual Commissioner. This Staff Paper is not a statement of policy by the Commision, nor does it bind the Commission in any way. We do not intend by this Paper to prejudge the outcome of any proceeding that is now or may in the future come before the Commission.

Executive Summary

Since the 1920s, the private land mobile radio services (PLMRS) have been meeting the internal communication needs of private companies, state and local governments, and other organizations. These services provide voice and data communications that allow entities to control their business operations and production processes, protect worker and public safety, and respond quickly in times of natural disaster or other emergencies. The private land mobile community is quite diverse; 21 separate radio services have been defined that provide communications to many specific industries including, among others: manufacturers, utilities, transportation companies, state and local governments, and a wide variety of small businesses such as taxis, plumbers, and delivery services.

The private wireless community has specialized needs and requirements that private radio systems are designed to meet. Commercial services can serve some of these needs, but private users generally believe that their own systems provide them with capabilities, features, and efficiencies that commercial systems cannot. Some of the requirements and features that PLMRS users believe make their systems unique include: immediate access to a radio channel (no dialling required); coverage in areas where commercial systems cannot provide service; peak usage patterns that could overwhelm commercial systems; high reliability; priority access, especially in emergencies; and specialized equipment required by the job or federal regulations. Many private users are also concerned about greater use of commercial systems because of liability issues. Some private users already use commercial services to meet some of their needs, and as the number and variety of commercial services grows, it is likely that the use of such services will grow as well. Given the specialized nature of some of the private community's requirements, however, it also appears that the need for private systems and services will continue well into the future.

Over the past 70 years, the PLMRS have grown steadily and evolved. At different times, as congestion worsened and advances in technology made the use of higher frequencies possible, the Federal Communications Commission (FCC) allocated more frequencies for PLMRS in several different spectrum bands. Today, different private systems operate in a number of discrete frequency bands, many of which the users share. As the use of private systems has grown, the regulatory treatment of PLMRS has evolved as well; to differentiate more clearly between private and commercial services, to provide for more effective and efficient use of the spectrum, and to update licensing rules and procedures. The FCC continues to refine its approach to PLMRS, and is conducting several important rulemakings that will significantly change how PLMRS is regulated.

The historical forces that have pushed the evolution of the private wireless services continue to produce great changes. Needs and requirements are expanding as operations become increasingly complex. The use of data communications, especially, is expected to grow as users demand more information about and control over their processes. Technology advances have created a wide range of new commercial services, including cellular, personal communication services, specialized mobile radio, advanced paging, and satellite systems. And the economics and regulation of PLMRS continues to change as a result of continued congestion of the various PLMRS bands, advancing technology, and a changing philosophy of regulation that generally focuses on marketplace solutions--promoting competition, recovering the public value of the spectrum, and encouraging greater efficiency.

INTRODUCTION

The first private land mobile radio services (PLMRS) were established almost 70 years ago to meet the internal communication needs of private companies and other organizations. As technology progressed and the value of wireless communications for meeting such private needs became more evident, use expanded to an increasing number of industries and users. Today, in the land mobile radio services, there are over 1,000,000 licensed stations authorized to operate over 12 million transmitters, representing an investment of over $25 billion. Private radio systems are a vital tool that allows many businesses and organizations to accomplish their mission or deliver their services or products to their customers. For these users, their radio communication system is the lifeblood of their activities, and is an important factor in their ability to compete--with each other and abroad.

Private radio systems are used by companies, local governments, and other organizations to meet a wide range of communication requirements, including coordination of people and materials, important safety and security needs, and quick response in times of emergency. These systems, which often share frequencies with other private users, make possible many every-day activities that people across the country have come to rely on, either directly or indirectly. Public safety agencies, utilities, railroads, manufacturers, and a wide variety of other businesses--from delivery companies to landscapers to building maintenance firms--rely on their radio systems every day.

In today's rapidly changing radiocommunications environment, however, private wireless services and systems are in the midst of great change. The advent and rapid growth of new commercial mobile radio services (CMRS) such as cellular, Personal Communications Services (PCS), specialized mobile radio (SMR), paging, and now mobile satellite services, have raised questions about the need for radio services dedicated to serving private needs. The public value of spectrum has been increasingly recognized and is now perceived as quite high, adding weight to questions of giving away licenses to private companies and other entities for free. Finally, in response to congestion and advances in technology, the regulatory structure of the private services is in the midst of a substantial overhaul that will reshape the technical aspects as well as the regulation of the PLMRS.

To inform its internal policymaking process, the Wireless Telecommunications Bureau of the Federal Communications Commission (FCC or Commission) examined the needs of the private radio community and the technical, competitive, and regulatory environment that now exists. This paper is designed as a broad-based

introduction to those services.[1] It will describe the services that comprise the private land mobile category, briefly discuss the history of private wireless services, examine some of the characteristics and capabilities that make private wireless systems unique, and identify some of the challenges now facing the private land mobile community. The goal of the paper is to provide a background for future policy decisions by explaining what the private land mobile radio services are: how they came into being, how they are regulated, and what special needs they fulfill. The paper does not make policy recommendations, but does identify policy issues that should be considered as future decisions are made.

WHAT IS PRIVATE RADIO?

Private radio communications systems are used by companies, organizations, public safety agencies, and other entities to support their internal communications requirements. Many different entities use private systems for a variety of purposes, and the systems themselves operate on a number of different frequency bands. Although there are general commonalities across private wireless services and systems[2] (there is a common base of equipment--for both infrastructure and user radios/handsets, for example), each company or organization has unique needs, and the different frequency bands used have different technical characteristics. As a result, private radio systems are often customized to meet the specialized and unique needs of the company or organization that owns and operates the system. Thus, there is no "typical" private system or private system user. Likewise, it is more

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[1] Although there are some similarities between private land mobile and other private wireless services, this paper will not discuss those other services, including aeronautical, marine/maritime services, or services that are usually used by individuals for their own personal communications, including the Personal Radio Services (General Mobile Radio Service, Family Radio Service, Radio Control Radio Service and Citizen's Band Radio Service), or the Amateur Service. Public Safety Services are also not directly addressed in this paper, although many of the requirements and regulations are quite similar. For more information on the Public Safety Services, see the *Final Report of the Public Safety Wireless Advisory Committee*, September 11, 1996. This document was submitted into the record of the Commission's current public safety proceeding. *See* The Development of Operational, Technical, and Spectrum Requirements for Meeting Federal, State, and Local Public Safety Agency Communication Requirements Through the Year 2010, *Notice of Proposed Rulemaking*, WT Docket 96-86, released April 10, 1996. These other categories of private wireless communications have their own stories and unique aspects and do not fit within the scope of this paper.

[2] It is important to distinguish between private radio "services" and "systems." "Service" is a regulatory term that generally refers to a category of use such as broadcasting, fixed, or mobile services. Often these services are subdivided into more specific uses, such as land mobile service or broadcasting for television, radio, or from satellites. Each radio service is permitted to use (allocated) one or more band(s) of radio frequencies, and eligibility for a license to operate a radio system in a particular private radio service is usually restricted to those companies whose business or uses correspond to the service category or definition. Private radio "systems," on the other hand, refer to the actual radio systems--hardware and software--that allow users to communicate. A radio system is technologically capable of operating in a number of different services depending on what type of entity is operating the system. For example, the dispatch systems used by many different companies in different services are often quite similar.

appropriate to think of the private wireless community as a collection of user groups with varying communication needs rather than as a monolithic "industry." The following section describes some of the common features of private wireless communication systems.

The Private Land Mobile Community

The use of private radio systems dates back almost 70 years. The International Radiotelegraph Convention of 1927 defined "mobile services" as that "carried on between mobile stations and land stations, and by mobile stations communicating with one another . . . " and allocated frequency bands throughout the usable spectrum for mobile use. There was immediate demand for those frequency bands among many private interests like newspapers, public utilities, transportation industries, farmers and foresters, police departments, and manufacturers. These demands were channeled, first by the Federal Radio Commission, then by the FCC, into different radio services. In 1934, shortly after its establishment, the FCC identified four private land mobile services--Emergency Service, Geophysical Service; Mobile Press Service; and Temporary Service, which applied to frequencies used by the motion picture industry.[3] Over the years, the FCC further divided the private wireless services into several distinct categories. PLMRS currently consists of 21 services spread among six service categories: Public Safety, Special Emergency, Industrial, Land Transportation, Radiolocation, and Transportation Infrastructure. The major service categories are briefly described below, and individual services are discussed in Appendix A.

Today's private land mobile community is quite diverse. PLMRS are used by organizations that are engaged in a wide variety of activities. Police, fire, ambulance, and emergency relief organizations such as the Red Cross use private wireless systems to dispatch help when emergency calls come in or disaster strikes. Utility companies, railroad and other transportation providers, and other infrastructure-related companies use their systems to provide vital day-to-day control of their systems (including monitoring and control and routine maintenance and repair), and also to respond to emergencies and disasters--often working with public safety agencies. A wide variety of businesses, including package delivery companies, plumbers, airlines, taxis, manufacturers, and even the American Automobile Association (AAA) rely on private wireless systems to monitor, control, and coordinate their production processes, personnel, and vehicles.

The use of the private wireless services has grown over the years, as measured by the number of transmitters and stations licensed. Appendix B lists the numbers of transmitters and stations licensed in each service dating back to 1980.

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[3] Frederick J. Day, *Policies and Practices In the Regulation of Private Radio Communications Systems*, (Arlington, VA: Industrial Telecommunications Association), 1994.

As noted above, today there are over 1,000,000 licensed stations authorized in the PLMRS, and well over 12 million transmitters are in operation. Each of the six categories of PLMRS is described briefly below, and many of the individual radio services are discussed in Appendix A.

Public Safety Radio Services

The first uses of mobile radio date to the 1920s, when police departments, marine fireboats, and industries that worked in remote locations were the primary users. When the FCC was established in 1934, these uses were classified into four Emergency Services: marine fire, municipal police, state police, and special emergency. Since then, they have evolved into six different public safety radio services: Local Government, Police, Fire, Highway Maintenance, Forestry-Conservation, and Emergency Medical. These are discussed in more detail in Appendix A.

Special Emergency Radio Service

The Special Emergency Radio Service was once categorized under the public safety services, but now is governed separately, even though it serves similar needs. "Special Emergency" originally applied to telegraph stations used by power companies when regular communications were disrupted by storms or other emergencies.[4] In 1946, however, most power companies switched to a new service for public utilities and the term "special emergency" became restricted to matters directly related to public safety and the protection of life and property. Special Emergency is now classified as a service for the communications needs of hospitals and clinics, ambulance and rescue services, veterinarians, handicapped persons, disaster relief organizations, school buses, beach patrols, persons or organizations in isolated areas, and emergency standby and repair facilities for telephone and telegraph systems. Special Emergency stations can transmit messages related only to safety or to the service provided by the licensee to safeguard life or property.

Industrial Radio Services

The FCC created an "industrial" classification of radio services in 1949, after most of the industrial uses of radio had already been established under "miscellaneous" or "experimental" categories. By that time, such diverse industries as oil exploration, mining, news reporting, and motion picture production had been using radio for 20 years or so. Like other early users, these industries first relied on radio mainly for the safety of work crews in remote locations, but they quickly learned the value of mobile radio as an economical tool for carrying company instructions to

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[4] *See* 47 C.F.R. Part 90, Subpart C.

remote operations, for dispatching and diverting work vehicles, and for coordinating the activities of workers and machines "on location." Today there are nine Industrial Radio Services: Power, Petroleum, Forest Products, Film and Video Production, Relay Press, Special Industrial, Business, Manufacturers, and Telephone Maintenance. These are discussed in detail in Appendix A.

Land Transportation Radio Services

Land Transportation Radio Services also became a special classification in 1949. Before that date, most transportation industries shared two frequency bands in the experimental "General Mobile Radio Service." One band served vehicles operating over highways, like intercity buses and large trucks, and the other band served urban vehicles like taxicabs, delivery vans, and tow trucks. As the various transportation industries grew, however, the FCC allocated more frequencies and created exclusive radio services for different types of transportation: Railroad, Urban Transit, Taxicab, Intercity Bus, Highway Truck, and Automobile Emergency. Today, Railroad, Taxicab, and Automobile Emergency remain separate categories, but urban transit, intercity bus, and highway truck are now classified together under the Motor Carrier Radio Service. Land transportation radio stations may not be used for passenger communications. The individual services are discussed in detail in Appendix A.

Radiolocation Service

Radiolocation is the use of radio waves to determine an object's distance, direction, speed, or position for any purpose except navigation.[5] The Radiolocation Service authorizes persons engaged in commercial, industrial, scientific, educational, or government activities to use radiolocation devices in connection with those activities. Various types of radar (like police radar and weather radar) are examples of radiolocation applications.

Transportation Infrastructure Radio Service

The Transportation Infrastructure Radio Services category was created in 1995 to integrate radio-based technologies into the nation's infrastructure and to develop and implement the nation's intelligent transportation systems.[6] It includes the Location and Monitoring Service (LMS). LMS systems are used to determine the location and status of vehicles and equipment. The railroad industry, for example, operates an extensive automatic equipment identification system that allows

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[5] *See* 47 C.F.R. Part 90, Subpart F.

[6] *See* 47 C.F.R. Part 90, Subpart M.

companies to track, identify, and monitor the movement and location of over 1.3 million rail cars and equipment throughout the United States.[7]

Other Private Radio Services

Private Land Mobile Paging

A private paging service is a paging service that is not-for-profit and that serves the licensee's internal communications needs as defined in Part 90 of the Commission's Rules.[8] Private paging systems in general provide the same applications offered by commercial paging services: tone, tone-voice, numeric or alphanumeric. Shared-use, cost-sharing, or cooperative arrangements, multiple licensed systems that use third-party managers, or users combining resources to meet compatible needs for specialized internal communications facilities are presumptively private paging services.

Private Operational Fixed Microwave Systems

In addition to their mobile operations, many private companies, public utilities, and state and local governments, also make extensive use of Private Operational-Fixed Microwave Systems. These systems connect specific locations in either a point-to-point or point-to-multipoint configuration, and can carry or relay voice, data (including teletype, telemetering, facsimile, and other digital communications), and video communications. Such fixed links often connect mobile radio base stations or far-flung offices, but are also used for a variety of other purposes, including to operate unattended equipment; open and close switches or valves; record data such as pressure, temperature, or speed of machines; telemeter voltage and current in power lines; and perform other control or monitoring functions, such as would be necessary for pipelines, railroads, and highways.

In early 1996, the Commission consolidated Parts 21 and 94 of the Rules into a new Part 101 to update and streamline the regulations governing common carrier

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[7] Thomas Keller, on behalf of the American Association of Railroads, personal communication to David Wye, Aug. 23, 1996.

[8] Subscription-based private carrier paging (PCP) systems operating on shared paging channels were formerly regulated as private radio systems (they are still under Part 90). Because they compete with common carrier paging systems, they are offered for hire to the public, and they are often interconnected, they are now regulated as commercial entities (with the onset of certain sunset provisions) as a result of the 1993 Omnibus Budget Reconciliation Act. The only remaining paging in the private radio services is paging for an entity's own internal communications needs. *See* 47 C.F.R. § 90.494.

and private operational fixed microwave services.[9] These rules, which became effective August 1, 1996, allow common carrier systems to also offer private services. Specifically, the new rules permit common carrier licensees to use the same transmitter to provide common carrier service, as well as their own internal communications and services to entities eligible in the private services, on a concurrent basis. The rules continue to prohibit the leasing of excess capacity by private services for common carrier communications, but make it relatively simple for a private carrier to convert its status to common carrier in order to operate a combined common carrier/private system.

What Are Private Land Mobile Systems Used For?

Private radio systems serve a great variety of communication needs that common carriers and other commercial service providers historically have not been able or willing to fulfill. Companies large and small use their private systems to support their business operations, safety, and emergency needs. Although each licensee uses their system to serve specific requirements that vary from entity to entity, several broad categories of need and use can be identified.

The one characteristic that all these uses share, and that differentiates private wireless use from commercial use, is that private wireless licensees use radio as a tool to accomplish their missions in the most effective and efficient ways possible. Private radio users employ wireless communications as they would any other tool or machine--radio contributes to their production of some other good or service. For commercial wireless service providers, by contrast, the services offered over the radio system is the end product. Cellular, PCS and SMR providers sell service or capacity on wireless systems, permitting a wide range of mobile and portable communications that extend the Nation's communications infrastructure. This difference in purpose is significant because it has historically been the foundation of the different regulatory treatments afforded to the different communities.

Operational Communication

In general, private radio system owner/operators use their systems to manage their business operations. Radio is used to coordinate the activities of employees and supervisors, including remote loggers, field workers (plumbers, electricians, landscape crews, cable installers), taxi drivers, workers on a factory floor or in a production facility, and public safety and service personnel that operate throughout the country. Radio is also used to communicate information and coordinate a variety of day-to-day as well as emergency activities. Radio plays a vital role, for example,

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[9] *See* Reorganization and Revision of Parts 1, 2, 21, and 94 of the Rules to Establish a New Part 101 Governing Terrestrial Microwave Fixed Radio Services, WT Docket No. 94-148, CC Docket No. 93-2, RM 7861, *Report and Order* 11 FCC Rcd 13449 (1996).

in the airline industry, where baggage handlers, pilots, gate agents, traffic controllers, mechanics, fuelers, and de-icing crews all must work together to ensure that planes leave safely and on time. Just-in-time manufacturing is another example of private radio's impact on productivity. The tight control and immediate access to information that permits just-in-time manufacturing to work is highly dependent on radio systems that provide immediate access to people and databases and coverage in all areas of a plant (e.g., between assembly line and inventory).

Radio is also used extensively in the transportation of raw materials and finished products. Companies use radio to coordinate delivery of their own products, and package delivery companies use radio extensively to dispatch drivers for pickup, coordinate activities in hubs, and for safety. The forest industry, for example, uses radio to direct trucks and speed repairs. The Nation's railroads use radio extensively for dispatching and controlling train operations throughout the country, including voice communications with train operators as well as data communication for the remote control of switches and signals and the monitoring of rail cars and equipment. These systems serve not only to enhance efficiency and ensure timely delivery of the product, but have safety functions as well.

Radio is also extensively used to remotely monitor and control a wide variety of equipment such as valves on a pipeline, meter reading, and robotic machine control. Radio systems are also used to monitor the structural integrity of pipelines and to detect and report electrical overloads. Such applications give companies direct and immediate control over their operations; a critical factor in maintaining efficient performance, preventing accidents, and responding to emergencies.

Safety

Safety is one of the most-cited reasons private users give for needing their own systems. Personnel often work in remote areas, and the work itself can often be quite hazardous; taxi drivers, for example, have the highest rate of work-related homicide in the country.[10] Radio provides an important (and sometimes the only) link in case of accident or emergency. The manufacturing industry, for example, makes extensive use of "man down" radios in those situations where personnel work in isolation or in potentially hazardous situations. In such cases, federal requirements for worker and operational safety also lead many users to private systems in order to

[10] Alfred LaGasse, International Taxicab and Livery Association, personal communication to David Wye, Aug. 23, 1996, citing National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, "Violence in the Workplace," June 1996.

meet Federal mandates.[11] In addition, private radio systems are often used to help when larger scale emergencies, such as a flood, earthquake, plane crash, or terrorist attacks (see below).

Emergency and disaster communications

One of the most important uses of private wireless systems is for communication during emergencies and disaster-relief efforts. During these times, immediate communication is vital to save lives, protect property, and coordinate relief efforts. Public safety agencies have articulated this need in the work of the Public Safety Wireless Advisory Committee.[12]

Private companies and organizations have similar needs, however. During disasters and in times of emergency, private system operators use radio to coordinate personnel and equipment for emergency relief, repair, and rescue efforts. In such situations, many private entities, especially utilities and transportation providers (airlines, railroads, mass transit), can take on an almost quasi-public safety function. Because their operations can affect the lives of hundreds, thousands, or even tens of thousands of people, managing those operations in emergencies is critical to providing relief as quickly as possible.

For these users, radio is a critical tool for emergency response. Manufacturers, for example, often deal with hazardous materials or processes on a daily basis that can be extremely dangerous to the public as well as their workers. Air carriers must be able to quickly coordinate equipment and personnel to respond to emergency landings and airport-area aircraft accidents. During forest fires, radio communication is essential within the timber industry and to coordinate with firefighters. Many of the largest private users, including the oil, electric, and natural gas industries; pipeline operators, and various transportation entities have extensive operations that must be controlled as quickly as possible in the event of an emergency--electric power must be switched off, pipeline valves must be closed and vehicles of all kinds must be rerouted--radio control allows this to happen. Finally,

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[11] Requirements for high-reliability communications systems are imposed from a variety of places, including the Federal government, state public utility commissions, and various industry groups, and apply to many private wireless users. Examples include the Pipeline Safety Act, which requires that emergency response plans include communication capabilities with local public safety agencies; FEMA requirements for highly reliable primary and backup communications systems for nuclear power plants; and (although not a government requirement) North American Electric Reliability Council standards that require "'reliable and secure telecommunications networks,' and the use of exclusive telecommunications channels between the systems and the control centers of adjacent electric systems." Thomas E. Goode, UTC, personal communication to David Wye, June 28, 1996, p. 3. The railroad industry has similar requirements for its communication systems (*see* 4 USC § 20141(b) and 49 CFR § 220), as do the various utilities.

See Public Safety Wireless Advisory Committee, op. cit., footnote 1.

railroads, airlines, and other mass transit agencies often maintain their own security forces and emergency personnel to keep their operations safe and manage them in emergencies. Users note that it is precisely during these times that commercial services may be damaged or too congested for them to use--private users must rely on their own systems to provide vital services during times of crisis.

Security

Security is an increasing concern for many organizations--for both personnel and property as well as the content of the communications. Alarm companies provide alarm protection services to individuals as well as businesses, using radio to detect fire, intruders, and other emergencies, and to dispatch emergency response personnel when needed. In addition, many companies have internal security officers who protect property, screen visitors, and even exercise police powers. The railroad industry, for example, employs approximately 2,000 security officers who have the same law enforcement and arrest powers (on railroad property) as do government police officers.[13] Wireless communication also plays a vital role in meeting Federal Aviation Administration mandates for airlines to provide their own security, including matching bags for international flights. The needs of these users are generally the same as those for the public safety community. In addition, as competition has intensified around the world, many organizations have defined a need for secure communication. In fact, adequate security measures are a requirement in many government, especially military-related, contracts.

How Do Private Land Mobile Radio Systems Work?

Types of Communication

Probably the most common application of private radio systems is for dispatch communications. Dispatch operations are broadcast or point-to-multipoint in nature; a dispatcher at a central location (company headquarters, for example). This allows a supervisor to send personnel where they are needed, whether a police officer responding to a call, a plumber headed to fix a broken pipe, or a utility worker cleaning up after a major storm or other disaster. Most often, dispatch services are voice-based--the dispatcher broadcasts a message for a particular end user, who then responds and takes his/her directions.

Many private wireless systems are moving to data dispatch systems, where voice is replaced by data communications between the dispatcher and a data terminal in the vehicle. In the taxicab industry, for example, data dispatch systems take advantage of asynchronous transmission to increase the capacity and

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[13] Keller, op. cit., footnote 7.

throughput of the system. Data-based messages take only fractions of a second to send, greatly expanding the number of messages that can be sent, the speed of dispatch, and the spectral efficiency of the system. Such systems also cut down on the ability of the drivers to talk to each other directly--cutting down on system congestion.[14] In some systems, especially those with high safety-related use, voice is likely to remain the preferred mode of communication due to the greater flexibility it offers--especially in cases where time is critical, mobile users need more information, or where interaction is more complex. Individual users may not have the time to type time-sensitive messages.

In the past, only PLMRS licensees were permitted to offer dispatch communications. Today, CMRS licensees are also permitted to offer dispatch services, although such service appears quite limited.

Private systems can also provide interconnection to the public switched telephone network (PSTN) through their private radio systems. The regulations governing the provision of interconnected service and the relationship of interconnection to the evolving definition of the private wireless services are discussed in detail in Appendix E.

Today, interconnected service, although authorized on many private wireless systems, remains relatively rare. Although applicants for PLMR licenses usually include interconnection as a specified feature of their systems, the business entities using the systems generally either elect not to use the service or limit its use. Systems are still optimized for private, internal use; for many institutional users there is no need for interconnected service, and companies often do not want their employees to have access to such service for fear of tying up channels. A typical dispatch exchange, for example, lasts 15-30 seconds or less, while interconnected calls can last more than five minutes (although the average is estimated to be around 2 minutes). As a result, interconnected service on shared channels can result in unacceptable waiting times for other systems licensed to use the same channel. Exclusive channel assignments or trunked systems permit interconnection to the PSTN without adversely affecting other users, but the system is still tied up internally. Because of this, many, especially smaller, businesses use both private and commercial systems. A landscaping company for example, may use a private system to communicate with its workers in the field, while managers use cellular phones and pagers to communicate more effectively with customers and suppliers.

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[14] Comments of the International Taxicab and Livery Association, prepared by BIA Consulting, Inc., May 10, 1996.

System Operation

Just as there are a wide range of private wireless users and many different needs, there is a correspondingly wide variety of private wireless systems. They range from a small user with one base station and a few mobile units to larger, more complex systems that involve dozens of interconnected base stations operating with many channels and serving hundreds or thousands of mobiles over a multistate area.

The most basic type of private wireless system consists of a single base station serving a number of mobile or portable radios. In this configuration, the mobile/portable unit communicates to a base station, which connects the user to a central control point. The central control point may be the end of the call--a business's headquarters or dispatcher--or the call may be connected to the public switched telephone network (PSTN--see below for more detail).[15] The call can also be relayed to another mobile/portable user. The range of the system varies depending on its design (power) and the frequencies employed. A base station typically reaches 25-30 miles, although some may reach as much as 50 miles. Conversely, some systems are designed to serve very small, specified areas, such as an industrial complex, airport, or university campus.

More complex systems employ mobile relay stations (commonly called "repeaters") to extend the reach of mobile/portable units. In this case, a signal coming from a central control point or base station is sent to the repeater, which then retransmits the signal to the mobile. In the largest systems--statewide or regional in geographic scope--additional mobile relay stations are linked by fixed relay stations. Such designs can extend the coverage area of a system for hundreds of miles. Systems of this size and scope are relatively few in number.

The basic elements of a private land mobile radio system utilizing a mobile relay station are: (1) the mobile relay, which is positioned on a tower and is immobile; (2) one or more mobile units, which are installed in vehicles operated by the station licensee, and/or hand-held portable units; and (3) a control station or control point. A control point is any location from which the operation of the transmitter may be controlled. It is connected to the transmitter by a wireline or electrical connection. When licensees use a radio link for this function instead of a

[15] Mobile units are installed in vehicles including trucks, police cars, boats, and all types of aircraft. Mobile units also operate in various types of machinery including the cranes used to unload cargo ships, highway and construction equipment and logging and timber harvesting equipment. Portable units generally refer to the hand held units that are used extensively by workers.

wireline or electrical connection, the term "control station" is used instead of "control point" (although the station is still treated in regulation as a control point).[16]

The primary function of a mobile relay is to relay radio communications between mobile/portable units or between mobile/portable units and a base station. The elevated site of the mobile relay is critical to successful operations. When located at a higher elevation, the mobile relay casts its signal over a significantly larger area than it could if the transmitter were located at ground level. Antennas serving wide areas are typically mounted on tall towers or located on high ground (mountaintops are popular). Towers can reach 1,000 feet (400 feet or less are typical) in order to provide coverage over longer distances.

The majority of private land mobile radio systems are assigned a pair of frequencies, one frequency for the transmissions from a base and mobile/portable units and another frequency for the transmissions from the mobile relay. In the typical paired frequency (half-duplex-see below) mobile relay operation, the base station transmits an omnidirectional signal on one frequency (frequency A). The mobile relay station receives that signal, converts it to another frequency (frequency B) and retransmits it. The mobile/portable listens for frequency B, and transmits back to the mobile relay station on frequency A. Thus, the mobile relay "listens" to both the mobile/portable units and the base station on frequency A, and retransmits these signals on frequency B.

Mobile and portable units operating in a mobile relay system can talk to each other in one of two ways. They can communicate through the mobile relay, especially if they are many miles apart, or they can communicate directly. Because the mobile/portable radios associated with a mobile relay system generally all transmit on same frequency and receive on another, they can communicate with each other through the mobile relay. In order to communicate directly without going through the mobile relay (when users are not far apart, for example), they must use a third frequency to "talk around" the mobile relay.

The most advanced private land mobile systems use "trunking" to increase capacity and efficiency. In a trunked system, a number of channels are shared by a user or number of users--they are aggregated in a larger pool of frequencies. When an individual wants to communicate, the radio alerts the system and an open channel is selected and assigned for that user. Trunked systems are treated differently in a number of ways in the FCC's Rules. For example, since trunking was done automatically and without monitoring, the FCC provided channel exclusivity based upon distances from requested sites in order to facilitate trunked use above 800 MHz.

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[16] In the case of a radio link, licensees may use one of the frequencies available for fixed communications, such as those in the 72-76 MHz band. Alternatively, they may use the mobile "side" of their assigned frequency pair to control the mobile relay.

Shared use existed only for a certain number of channels reserved for conventional non-trunked systems above 800 MHz. Manufacturers developed trunking technology and a significant number of trunked systems began to appear in the 1980s.

Because many, especially larger, private wireless systems tend to be highly customized, general costs are hard to estimate. The largest proportion of cost is for the mobile/portable radios themselves, which can cost up to $3,000 each. Base station equipment (transmitters, amplifiers, antennas, etc.) ranges widely in price, depending on technical features, and can cost from hundreds of dollars to $35,000. A typical trunked site can cost up to $250,000.[17] These figures do not include the costs associated with site acquisition or microwave (or other) links to connect the site with the rest of the system.

In addition to communicating through a base station or repeater, mobile or portable radios can also communicate directly, unit-to-unit. The range of these communications depends on a number of variables, including the power used, the frequency, and terrain. Mobile units (those mounted in vehicles), for example, can communicate over as much as 15-20 miles. Portable radios (handheld units such as a walkie-talkie type device) operate at lower power, and can reach up to 2-3 miles. This capability is extremely useful in close quarters involving a team of workers who need immediate communications with each other in order to cooperate on a specific task. These tasks range from a team of firefighters battling a house fire, to workers in the fields at harvest time, to airline workers servicing an aircraft before takeoff.

Finally, private users also often make extensive use of fixed point-to-point links (the private operational fixed services). In mobile systems, microwave facilities are often used to connect the control center to remote base stations. Private user also make extensive use of point-to-point microwave systems for the monitoring and control of their operations. Utility companies, for example, use fixed links to relay information from remote sensors for detection and isolation of faults on electric transmission lines and gas mains and for controlling equipment remotely. Railroads also use such links in the automatic collection of data from train signals, trackside defect detectors, and even individual cars and locomotive. State and local governments use fixed microwave systems to interconnect offices, police stations, and highway maintenance operations.

Modes of Communication

Private land mobile radio systems may operate in a simplex, half-duplex, or full duplex mode. Simplex systems use one channel for both transmitting and receiving, whether between a mobile and a base station or between mobile/portable units.

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[17] International Taxicab and Livery Association, op. cit., footnote 14, and Sheldon Bentley, Boeing, Inc., Information and Support Services, personal communication to David Wye, Aug. 28, 1996.

Simplex was the dominant mode of operation before mobile relays came into widespread use. Because only one channel is used, only one person can talk at a time. Systems in the 25-50 MHz and 150-174 MHz bands still typically operate in the simplex mode.

Half duplex operation is the most common mode of operation for private land mobile systems. In a half-duplex mode, the licensee employs two different frequencies, one for transmissions from mobile/portable units and control station to the mobile relay station and the other for transmissions from the mobile relay station to the control and mobile/portable units. In reality, only the mobile/portables and control stations operate in a half-duplex mode, the mobile relay is listening and transmitting at the same time. As with a simplex system, in a half-duplex arrangement using a single frequency pair, only one party can speak at a time ("push-to-talk") and only one conversation may take place on the system at a time. Systems using frequencies in the 450-470 MHz and 470-512 MHz bands typically are half-duplex.

In full duplex mode, as with half-duplex, the licensee is authorized to use two different frequencies. The difference is that the mobile units in a full duplex system can transmit and receive simultaneously, and therefore individuals may speak and be heard at the same time--like a normal telephone conversation. This is most useful in systems where users routinely interconnect to the PSTN. In general, such use is fairly limited in the private wireless community. Dispatch-oriented SMR systems, for example, can often provide interconnection, but still operate in a half-duplex mode. Other PLMRS, whether operating above or below 800 MHz, are rarely full duplex because interconnection is either not a feature of those systems or is provided only as an adjunct to the primary features of the system. Even in full duplex systems, direct unit-to-unit communications are usually half-duplex. In such cases, as with simplex and half duplex systems, only one conversation may take place on the same channel at a time.

Private wireless frequencies

Two-way radio began operating on frequencies below three megahertz. As technology advanced and existing frequencies became congested, progressively higher frequencies were allocated for private radio services. Over more than 70 years, the 30-50 MHz, 150-174 MHz, 450-470 MHz, 470-512 MHz, 800 MHz and 900 MHz bands were made available for private wireless operations. Today, private systems use frequencies that are spread over a wide range of spectrum. The individual bands are discussed in detail in Appendix D.

For PLMRS systems that must cover long distances or wide areas, lower frequencies, such as those in the low band (30-50 MHz) or VHF high band (150-174 MHz) are preferred because the radio waves travel further for a given amount of

effective radiated power and antenna height and are less subject to attenuation from terrain and foliage. For more urban areas, higher frequencies are often preferred because of their superior building penetration characteristics.

Regulation of Private Land Mobile Systems and Services

The regulatory structure governing the private radio services has developed over a number of years, and continues to evolve. In large measure, the changes in the regulatory framework have been the result of increasing use and congestion, technological advances, and changing views of the role of Federal regulation. Appendix E contains an extensive discussion of the basic regulation of the private radio services and how the regulatory model has changed over time. This discussion includes the evolution of the political and economic views affecting PLMRS regulation--the legal distinctions between commercial and non-commercial systems, methods to ensure that spectrum is put to most efficient use, definitions of exclusive and private shared use (including community repeaters and multiple licensing)--and the evolution of frequency assignment and licensing mechanisms.

The PLMRS are regulated under Title III of the Communications Act. Private land mobile licensees are generally entities that are not in the communications business and do not derive their profits from providing communications services. Rather, they use wireless communications as a tool in furtherance of their respective business missions. Thus, they are generally distinguished from public mobile services that are also regulated under Title II of the Communications Act. Distinctions between the two evolved from case-by-case determinations before 1982, to legislation differentiating between private and common carriers in 1982, to legislation creating new categories of private mobile radio service (PMRS) and commercial mobile radio service in 1993.

Shared use and multiple-licensed PLMR systems exist below 800 MHz on shared PLMR frequencies. Since 1993, not-for-profit shared use and multiple-licensed systems have been construed as PMRS, not CMRS. The Commission has the discretion to designate PLMR shared systems as CMRS if the service offering is the functional equivalent of CMRS. For-profit shared use that is interconnected and available to the public (or to such classes of eligible users as to be effectively available to a substantial portion of the public) is CMRS.

With regard to the evolution of frequency assignment and licensing mechanisms, Appendix E discusses shared frequencies, the evolution of frequency coordination and exclusive licensing, and the difference between site-based licensing for PLMRS and geographic licensing for CMRS.

Changing Regulation: Refarming

The rules governing the PLMRS are currently the subject of intense review at the FCC. The following discussion gives a brief history of the refarming proceeding and addresses current proposals.

Refarming Inquiry

On July 2, 1991, the Commission released a *Notice of Inquiry* ("*Refarming Inquiry*") to explore options to promote more effective and efficient use of the bands below 512 MHz by PLMR licensees because of an increase in the number of licensees and projections that those numbers would double between 1990 and 2000 and double again by 2010.[18] The Commission identified two primary concerns: 1) frequency congestion; and 2) future shortages of PLMR spectrum as demand potentially surpasses supply. The Commission identified the following goal for the proceeding:

> [T]o develop a regulatory environment for the spectrum below 512 MHz that will provide users the same technical flexibility and licensing options available at 800 MHz and above. That is, we want to assure that users have the flexibility to use the most advanced technology and equipment available and not be frustrated in their efforts to do so by an antiquated set of rules and regulations.[19]

The Commission believed that the problems of increasing congestion and declining quality were avoidable if enough PLMR users could be induced to adopt spectrum efficient techniques and technologies. Accordingly, the Commission specifically sought comments on changes in technical standards to permit and to promote advanced communications techniques such as trunking on shared channels, packet radio, spread spectrum, and digital techniques. The Commission also considered whether broader regulatory and policy changes might be required to encourage and facilitate the use of spectrum efficient equipment on these bands.

The Commission additionally sought comment on regulatory policies that could be used to promote more spectrum efficiency on the PLMR bands: incentive programs such as exclusivity and fee-based incentives, alternative channel assignment policies including band licensing, private carriers, and consolidation of the

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[18] *In the Matter of Spectrum Efficiency in the Private Land Mobile Radio Bands In Use Prior to 1968, Notice of Inquiry (Refarming Inquiry)*, PR Docket No. 91-170, 6 FCC Rcd 4125 (rel. July 2, 1991).

[19] Ibid.

PLMR service pools. The Commission also sought comment on rule changes that would require the use of more efficient technologies.

The Commission identified three general ways to meet current and future PLMR requirements. First, the supply of spectrum available for PLMR services could be expanded. Second, economic incentives could be created. The fee-based spectrum incentive concept, for example, differs from many other economic solutions because it does not try to deter license applicants, but instead seeks to influence their choice of technology. More spectrum efficient users, for example, could be rewarded with lower spectrum fees. The third class of solutions, and the primary focus of this *Refarming Inquiry*, is spectrum efficiency, which may be accomplished through the development of new technology, better applications of existing technology, better administrative procedures, and streamlined regulations.

The Commission received over 120 comments and reply comments to the *Refarming Inquiry*. The Private Radio Bureau, in cooperation with The Annenberg Washington Program, Communications Policy Studies of Northwestern University, also sponsored a conference on this topic on November 14, 1991. Nearly all commenters appreciated that the *Refarming Inquiry* was a necessary step for ensuring that the long-term communications needs of the PLMR community are met. Many comments highlighted the invaluable and irreplaceable need for radio spectrum for one-way and two-way mobile communications. Most commenters suggested that the FCC proceed immediately to increase spectrum efficiency through technical changes as well as various policy changes. Based on the input received in response to the *Refarming Inquiry*, the Commission opened a new Docket and closed PR Docket 91-170.

Refarming Notice of Proposed Rulemaking

On November 6, 1992, the Commission opened the above docket and adopted an *NPRM* that contained a comprehensive set of proposals designed to increase channel capacity in PLMRS bands, promote more efficient use of PLMRS channels, and simplify FCC policies governing the use of the bands by a wide variety of small and large businesses and public safety agencies.[20] In preparing this *NPRM*, the Commission again carefully reviewed the existing environment, with the goal of determining the best possible regulatory framework. The Commission determined that the quality of PLMR communications in the bands below 512 MHz (note that the *Refarming Inquiry* related to PLMR bands below 470 MHz) would likely deteriorate to the point of endangering public safety and the national economy. In this proceeding, the goal was to develop a new regulatory scheme that increased channel capacity for

[20] *In the Matter of Replacement of Part 90 by Part 88 to Revise the Private Land Mobile Services and Modify the Policies Governing Them, Notice of Proposed Rule Making* ("*NPRM*"), PR Docket No. 92-235, 7 FCC Rcd 8105 (1992).

PLMR users, promoted more efficient use of these channels, and simplified the Commission's rules governing the use of these bands. The Commission was also sensitive to the need for a reasonable transition period for users to convert their radio systems to newer, more spectrum-efficient technologies.

In this *NPRM*, the Commission proposed four major changes in the way it regulates the PLMRS below 512 MHz:

1 Spectrum efficiency standards that would generally reduce channel spacing to 6.25 kHz or less, while at the same time providing technical flexibility.

2. Channel exclusivity option in the bands above 150 MHz. This would be accomplished using a market-based approach called "exclusive use overlay," which involves achieving exclusivity through concurrence of existing users. The Commission would, in addition, leave a significant number of channels available for licensing on the traditional shared use basis.

3. Consolidation of the current private radio services.

4. New technical and operational standards. For example, the Commission proposed significantly reducing permissible transmitting power levels. This would permit more efficient geographic co-channel reuse.

The land mobile user community generally accepted the overall concept of refarming as necessary to the well-being of the PLMRS. For example, there is broad support for reducing the occupancy of land mobile radio transmitters in order to improve efficiency. This support, however, was strongly predicated upon reasonable transition times that not only allow ample opportunity to amortize existing equipment, but that also ensure that equipment is not required to be prematurely decommissioned. Support was also conditioned on the continued ability to select from a variety of reliable technologies and equipment to satisfy a diverse set of communications requirements.

Report and Order and Further Notice of Proposed Rule Making

In the Report and Order, the Commission addresses PLMR rules regarding channelization, transition, consolidation of radio services and technical parameters.[21]

[21] 10 FCC Rcd 10076 (1995).

In order to achieve its objective of increasing the efficiency of the PLMR frequency bands, the Commission adopted the following changes to its rules:

1. Established a narrowband channel plan based on current channel centers. Generally, channels will be listed every 7.5 kHz in the 150-174 MHz VHF band and every 6.25 kHz in the 421-430, 450-470, and 470-512 MHz UHF bands. Users will have the flexibility of aggregating up to the equivalent of 4 narrowband channels provided that spectrum-efficient technology is employed.

2. Adopted a transition plan in which users will not be required to replace existing systems; rather the transition to narrowband equipment will be managed through the type acceptance process. The dates for the type acceptance rules are:

   August 1, 1996 - New type accepted equipment must be capable of operating on channels of 12.5 kHz or less or on 25 kHz channels if the narrowband efficiency standard is met.

   January 1, 2005 - New type accepted equipment must be capable of operating on channels of 6.25 kHz or less or on channels up to 25 kHz if the narrowband efficiency standard is met.

3. Provided the industry with three months to negotiate and submit a consensus consolidation proposal of the twenty current PLMR services. Consolidation of the service groups will provide for more efficient allocation of the increased capacity created by the introduction of more efficient technology. The Commission indicates that two to four broad service groups, including one for Public Safety users, appears reasonable. If no acceptable consensus plan is submitted within the allotted time, as none has been, the Commission will devise and adopt a service consolidation plan based on the record.

In the FNPRM, the Commission sought to determine how certain market-based incentives such as exclusivity with the right to lease excess capacity, spectrum user fees, and/or competitive bidding can be introduced into the PLMR bands to promote more efficient use of this spectrum. Although the Commission does not presently

have statutory authority to implement user fees or competitive bidding in these bands, the Commission asked for comment on the following three options:

1 Introducing exclusivity on channels in the PLMR bands, and permitting the leasing of excess capacity on these exclusive channels. The Commission stated that offering users the option of exclusivity with the right to lease excess capacity if the licensee agrees to convert to narrowband technology by a specified date will promote the use of more efficient technologies such as trunking and TDMA. In addition, affording users the opportunity to obtain exclusivity will enable them to benefit directly from the increased capacity which results from their conversion to more efficient technologies, thus encouraging more rapid transition to narrowband technology.

2. Implementing a system of user fees in all PLMR bands to encourage licensees to make the most efficient and effective use of the spectrum. Under this approach, users would pay a fee based on the estimated value of the spectrum, and the relative efficiency with which the spectrum is being used. The Commission proposes to exempt public safety users from any user fees.

3. Introducing competitive bidding into all PLMR bands as an alternative to user fees. Specifically, the Commission seeks comment on a proposal to create geographic overlay licenses and use competitive bidding as the assignment mechanism for these licenses. As with the user fee proposal, the Commission proposes to exempt public safety users from any competitive bidding structure.

Currently, the Commission does not have statutory authority to impose fees or auction most PLMR spectrum.

Where things stand today

In the Report and Order, the FCC decided to hold until August 18, 1996 the new channels 7.5 kHz removed from existing channels in the VHF band and new channels 6.25 kHz removed from existing channels in the UHF band. This was done to give frequency coordinators time to develop coordination guidelines; a process that has not yet been completed. Nonetheless, applicants can now be licensed on both these offset frequencies, but currently there is no type accepted equipment capable of operating on the 6.25 kHz channels.

In *Public Notice* DA 95-1771, released August 11, 1995, the FCC's Wireless Telecommunications Bureau froze the licensing of new high-power stations on the 12.5 kHz offset channels in the 450-470 MHz band. This responded to a request

from Hewlett-Packard, who had voiced concern that until such time as the frequency coordinators established dedicated low power channels, existing low power operations on these channels had to be protected. The Commission is still authorizing low power stations on these 12.5 kHz offset channels.

In *Public Notice* DA 95-1839, released August 22, 1995, the FCC's Wireless Telecommunications Bureau extended the freeze on the filing of new high-powered station applications for 12.5 kHz offset channels to the 421-430 Mhz and 470-512 MHz bands, and this freeze remains in effect. The Bureau believed that the public interest would be best served by giving the land mobile community additional time to develop standards for 12.5 kHz offset channels in those bands. The Bureau imposed the freeze in response to a request by the Land Mobile Communications Council to stay all assignments on these new offset channels in the 421-430 and 470-512 MHz bands. As with the freeze on applications for high-powered stations on the 450-470 MHz offset channels, this freeze will be in effect until the issues related to proper coordination are resolved.

Finally, on July 23, 1996, the Wireless Bureau issued a temporary stay of the implementation of the August 1 date for compliance with the new type acceptance rules. Several Petitions for Reconsideration were filed regarding type acceptance, and the Commission determined that some licensees could be irreparably harmed if the date was maintained and the type acceptance rules were subsequently modified. The Commission has not yet acted on these petitions.

UNIQUE ASPECTS OF PRIVATE WIRELESS SYSTEMS

Private wireless communication systems are generally designed and built to serve the specific communication requirements of the owner/operator of the system. In many cases, these requirements are highly specialized, and the system designed to meet them may be custom-built with unique features and capabilities. Today, however, the need for such systems is coming under increasing scrutiny as a wealth of new commercial services and systems are deployed that are capable of providing a wide variety of innovative applications. Unlike private systems, however, these commercial systems are built to provide mass market services that will appeal to a broad base of potential users/customers. Because of this, private users generally believe that it is inefficient or impractical for commercial operators to provide the specialized features and capabilities they require. This section will examine the needs that make private wireless systems unique, discuss some of the differences between private and commercial systems, and identify where commercial providers may and may not be able to provide services to users that historically have used private systems.

Historical Background

The FCC established the PLMRS based on the unique needs of the various industries. At the time that most of the PLMRS were created, commercial systems were either non-existent or not able to provide the specific services private users demanded. While private land mobile radio systems have been around since the late 1920s, for example, cellular service dates only to 1983. Commercial satellites have been operating since the late 1960s, but until recently were limited mainly to long haul telephone and video services--two mobile satellite services recently began operating, but many more are still several years away. Data services, including unlicensed devices, are only a few years old, and the first PCS system began operating in late 1995 and other PCS systems are just beginning to be deployed. Whether or not these new commercial systems will meet the specialized needs of the private wireless community is still an open question.

General Considerations

Several times over the last 50 years, the FCC has tried to document in some quantifiable way the value of private wireless services and systems.[22] It is clear that such systems contribute to the productivity and efficiency of private users, but calculating their impact on the economy as a whole has proven difficult. Unlike other business inputs, radio systems cross many organizational processes; contributing in many different and subtle ways to the output and operation of a given company or organization. Many users acknowledge its use as a tool in the production of the ultimate output, but do not measure it, for example, as a raw material. In many cases, the benefits of private systems are realized in ways that are not quantifiable--the saving of a life, the winning of a contract, better internal communication. Yet users have no doubts about their value to the company.

Private wireless system operators identify several general communication requirements that characterize their use of radio communications and that they generally believe cannot be provided by commercial service providers. In many cases, private users represent "a thin and unique market" that commercial providers have little incentive to invest in to serve; there is usually not enough of a return

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[22] *General Mobile Radio Service,* Report and Order, Dockets 8658, 8965, 8972, 8973, 8974, 9001, 9018, 9046, 9047, 13 FCC 1190 (1949), *Inquiry into Allocation of Frequencies Between 25 and 890 MHz,* Report and Order, Fcc 64-264, 29 FR 4826; 2 RR 2d 1513 (1964). See also *Report of the Advisory Committee for the Land Mobile Radio Services to the Federal Communications Commission,* (1968); and *Future Private Land Mobile Telecommunications Requirements,* Federal Communications Commission, Private Radio Bureau staff paper, August 1983.

involved to justify the capital investment to serve one or a few private customers.[23] There is also a sense on the part of some companies that if they were to use commercial systems, they would have to adapt or reengineer their production and/or business process to match the capabilities of the commercial service provider--something most companies are not willing to do for fear of losing productivity and a competitive tool.

Private users maintain that their systems are economically efficient and contribute to increased efficiency, lower costs of production and business.[24] They contend that forcing them to use higher cost commercial systems or to bid for spectrum would drive up the cost of their inputs and force them to raise prices in the long run--hampering their ability to compete internationally, and raising prices for consumers. The investments made in private wireless systems are significant. The Land Mobile Communications Council estimated in 1993 that $25 billion of aggregate investment had been made in private land mobile systems in just the 150-174 and 421-512 MHz bands.[25]

Many users of private systems also use commercial services to meet some of their communication needs. The use of private systems is concentrated primarily in those areas where economic or technical considerations make private wireless systems the more effective or efficient choice. There also appear to be some circumstances where Federal (non-FCC) regulations dictate a higher level of performance than commercial services can generally provide.[26]

There is some anecdotal evidence that smaller users of private systems are, in fact, moving to commercial alternatives or are supplementing their private systems with commercial offerings. Many plumbers, architects, landscape companies, and others are switching to cellular phones and pagers to increase their contact with

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[23] Comments of Boeing Company in consolidated comments submitted by Industrial Telecommunications Association, Inc., April 11, 1996, p. A-1; Russell Fox, on behalf of E.F. Johnson, personal communication to David Wye, April 2, 1996, p. 3; Marvin W. McKinley, Manufacturers Radio Frequency Advisory Committee, Inc., personal communication to David Wye, Aug. 23, 1996, p. 1. McKinley goes on to state, "one well-known manufacturer recently inquired as to the price a local SMR would charge for provision of a plain vanilla 800 MHz voice dispatch system. The price quoted was four cents per call with the manufacturer required to purchase all of the mobiles. With 1.65 million calls per month, the cost for the service would have been far greater than the cost of owning and operating private facilities. Moreover, the SMR advised that it would cost $2.5 million to build the system and that, even at the quoted price, it was not worth it since the SMR could earn a greater return by investing in facilities to serve many customers." p. 4.

[24] Russell Fox, op. cit., footnote 23.

[25] Land Mobile Communications Council, comments filed in PR Docket No. 92-235, April 28, 1993, p. 5.

[26] Comments of Exxon in materials submitted by ITA, op. cit., footnote 23.

customers. However, such use is often limited to management and administrative personnel; field workers and technicians often continue their use of private systems. Larger users, including those with correspondingly greater needs and more financial resources, continue to rely heavily on private systems to meet their unique needs.

Immediacy

Immediate access to channels is one of the most important distinguishing characteristics of private wireless systems. Most private wireless systems now are "push to talk." When an individual wants to communicate with his or her headquarters, work group, or an individual colleague, he or she pushes the talk button on the mobile unit and is on the air. Trunked systems work slightly differently in that a channel is assigned to the user dynamically, but the result is the same--immediate channel access. Cellular and PCS systems currently work by dialling a number--just as in an ordinary phone--and call set up times can be in the tens of seconds.

For many private users, instant channel access is vital--for both efficiency and safety concerns. For example, workers trying to coordinate equipment movement or a crane operator working with a spotter on the ground need to have a series of short exchanges: "up," "down," "right," "left," etc. In between there may be pauses of seconds or minutes. In such cases the users cannot wait to dial or gain access to a commercial system. The alternative, holding open a commercial channel for the duration of the activity would clearly waste the channel and the company's money. In safety applications, the need is even clearer and more important. In an emergency situation, dialling phone numbers or access codes could literally be the difference between life and death. In such cases, push to talk, instant communication is critical.

Even though private systems are designed to provide instant access, they can become congested to the point where individuals may have to wait for access to a radio channel. In a system that supports a large number of individual users, access can be difficult during peak times of operation. Trunked systems can relieve such congestion in many cases, but in extreme situations the number of channels available even in a trunked system could be inadequate to support demand.

Control

Users of private wireless systems identify a need to control their own communications networks, especially in times of emergency or disaster. "Control," however, has many different aspects and means different things to different users. For some, control means the ability to configure and manage the system on a day-to-day basis. Manufacturers, for example, rely on their radio systems to control various parts of the production process. For them, ceding control of such a vital business function to a third-party, when a communications breakdown can cost tens of

thousands of dollars a minute in lost production, would be "irresponsible."[27] Control is especially important in times of emergency, when instant changes are required to respond effectively to the situation.

To other users, control also has a longer-term meaning that revolves around the optimization and upgrading of the network. Private users maintain that changes that could upgrade a commercial network may disadvantage them by reducing the effectiveness or increasing the cost of the new service or equipment. In addition, the equipment changes that might be required by such an upgrade may not fit into a private user's business plan along the same planning times. Smaller users are sometimes not even aware of such changes until they are imminent. Related concerns include the unpredictability of cost increases, although such concerns should be able to be effectively dealt with through the service provision contract.

System control is also an issue for some private users in the context of a more competitive telecommunications marketplace. In the commercial radio service sector, mergers, acquisitions, and responses to competitive pressures can cause business plans and priorities to change; possibly changing service provision, upgrade plans, or level of service. Such possibilities raise the level of uncertainty for private users considering commercial systems. The ultimate fear for some private users in such a world is the possibility that commercial providers could go out of business, leaving the user with inadequate or no communications capabilities. Given such potential instability, some users prefer the security of owning and operating their own networks.

Finally, control is also directly related to cost issues. Private users oppose auctions--although not necessarily other valuation models-- because of the large upfront cost and the unplanned and uncertain nature of the expense. They point to the effect of auctions on the bottom line profits of the company and its the potential to affect consumer prices. In addition, some users express concern that auctions could have the effect of denying them access to spectrum that they need to run their operations and meet Federal requirements. For these reasons, some users view spectrum fees as a more acceptable alternative because they can be planned for on a continuing basis.

Capacity/usage

Another concern of private wireless users is related to capacity; specifically, the ability of the system to handle wide fluctuations in use. Some private wireless systems experience heavy use for short periods of time, but light use during other periods. Airlines, for example, have peak operating loads several times during the

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[27] McKinley, op. cit., footnote 23.

day when maximum capacity is needed. During peak times of day, taxi services can reach load averages of over 5,600 one-way transmissions per hour.[28] These peaks tend to be during the morning and evening rush hours, when commercial services such as cellular are also most busy. In addition, users engaged in public safety or other services may use their systems relatively lightly on a day-to-day basis, but when an emergency arises, or disaster occurs, use soars as the agencies and organizations mobilize to respond.

Given this pattern of use, some private users believe that commercial systems cannot handle the unique capacity requirements that many of them have. Two reasons underlie this belief. First, many private users contend that existing commercial systems are already operating near or at maximum capacity in some areas, and adding additional peak load capacity for a single user for a short period may not make economic or technical sense. Second, private users point out that private and commercial systems are designed using different capacity parameters. Private systems are designed and built to handle the peak use described above. Commercial service providers, by contrast, have generally designed and built their networks to meet the demands of a broad customer base, and have engineered their systems to accommodate *average* busy hour loads, not the peaks in capacity required by individual customers. When this average is exceeded, as cellular service is in many cities at rush hour, the system runs out of capacity and calls can be blocked or dropped. Private users maintain that such blockage rates are not acceptable, since many of their most critical operations depend on immediate communications between control centers and employees.

While such concerns may be valid today, the growing number of CMRS providers, coupled with the capacity gains afforded by digital technology, will likely diminish peak period congestion on commercial systems taken as a whole. Nevertheless, on individual commercial systems, peak capacity could continue to be a problem vis-a-vis private users, unless the commercial service provider is willing to design in added capacity from the beginning or add it later as new (private) users become customers.

At this point in time, given the growing demand in the mass market, it does not appear that most commercial service providers are willing to invest to meet the needs of a single large customer with unique coverage and capacity needs, although a few providers are reportedly making such investments. As competition between CMRS providers increases, however, willingness to pursue larger customers with specific needs may increase.

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[28] International Taxicab and Livery Association, op. cit., footnote 14.

Reliability

Closely related to the issue of control is reliability. Many private system users cite high reliability demands that they believe commercial services cannot provide. Especially for those users involved in emergency and disaster operations, reliability is a critical factor in maintaining or restoring communications capabilities during a disaster. Some users cite the susceptibility of the PSTN to breaks and outages as a serious concern.[29] Reliability is a special concern to those users who have geographically diverse networks to control in emergencies, such as utilities, railroads, and telephone companies. As noted previously, some operators of private systems do so in order to meet Federal government regulations or industry association guidelines governing their safety and emergency response efforts.

Coverage/availability

The coverage areas in which private wireless users need access to radio communication services is one of the most commonly cited reasons for having private systems. In some cases, commercial wireless systems, which are generally optimized around higher population areas, may not be available at all.[30] The forest industry, for example, operates in some of the most remote regions of the country where commercial service is not available.[31] Satellite services could meet the coverage requirements, but it is unclear at what cost. Cellular does not cover the most remote regions of the country, PCS would be technically difficult to build in these areas, and would likely not be cost effective. For these reasons, the forest industry believes that commercial services will not be available to them in the future.[32]

User also often have specific coverage requirements that are not easily met by commercial service providers. For example, for organizations that serve wide areas--national, regional, or remote areas--private systems are, in many cases, their only alternative. Delivery companies and public safety organizations require ubiquitous coverage in order to do their jobs. Other private users may have wide areas to cover, but in only specific areas within that wide area. Railroads, pipeline, and other

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[29] Goode, op. cit., footnote 11

[30] Commercial services will tend to build first and/or concentrate their systems in areas with the highest population densities and greatest possible return on investments--urban and suburban areas. There may be some areas of the country that it is just not cost effective or efficient to serve with terrestrial radio systems.

[31] Propagation characteristics make penetration of forests difficult for cellular and more so for PCS providers, especially as distance from the transmitter increases. These factors, combined with low populations, make it difficult for CMRS providers to serve such areas economically.

[32] George Petrutsas, on behalf of Forest Industries Telecommunications, personal communication to David Wye, April 8, 1996, p. 1.

utilities, for example, need communication links that essentially follow their network of lines--producing a coverage pattern that is wide in scope, but generally very narrowly confined to the links--many of which are in remote areas. Wire or fiber optic communications systems may be able to meet some of these needs, but the same accident or problem that damages the operational network may also disrupt the communication links.

And finally, even in areas where commercial services are available, users can have unique needs that lead them to private systems. The Nation's airlines, for example, have extensive operations that are under airports--areas where commercial services do not penetrate. Manufacturers also often need campus-wide coverage for facilities that in some cases are larger than a small town, and that have special radiofrequency issues: underground tunnels where commercial services do not reach or extremely noisy environments that may require specialized installations. In these last two cases, commercial systems may only be able to provide adequate coverage by significantly enhancing their systems--at some cost--in the specific areas.

Another aspect of coverage that larger users cite as a problem is the inability to deal with one commercial provider. For large service areas, a company might have to contract with multiple commercial service providers to get coverage across its service territory. Utilities that operate over multistate areas, for example, would have this problem. On a more local level, even the local taxi service could be caught between two different providers--users could be forced to have two different radios or be forced into more costly contracts to keep common equipment (when the least expensive alternative would mean using an incompatible technology). For such users the coordination problems between different systems could be quite difficult, especially if service offerings or pricing plans differ. Users would also be forced to pay multiple fees. An even more difficult problem would arise with different commercial systems using different technologies. Different connections to each provider might also have to be established. Such concerns also reflect a potential loss of control over the operation and cost of the system.

Priority Access

Another requirement that many users identify, especially those involved in emergency or disaster response, is priority access to channels. In a private system, priority access is relatively easy to build in and manage. On a day-to-day basis or when a disaster strikes, companies have plans in place to make sure that those who need to communicate the most are able to do so. Congestion is a problem in some commercial systems, including paging and cellular, and private users often fear they will not be able to reach their employees quickly or at all. Paging, for example, has been reported to take hours in some cases. During an emergency or natural disaster, cellular frequencies are often over capacity as subscribers attempt to call out and news crews file stories. Critical functions that need to be performed by

police, fire, emergency medical services, or internal safety forces can then be blocked.

This requirement is closely linked with control in that users who control their own system can configure it to give priority access. It is unclear to what extent today's commercial service providers can provide such access, technically and legally. Some private wireless users and associations maintain that commercial systems cannot or will not provide such a service, and that if services are available the prices are extremely high. Some commercial service providers, on the other hand, claim that they have such capabilities in place. It generally appears that priority access is technically feasible in most networks, but it will likely take several years to work through the details--administrative, technical, and economic--before such features are available on a widespread basis.

Equipment requirements

Due to the specialized nature of some of the communications environments private users have, equipment must often be built to meet specific needs that are either required by regulation or common sense. For example, there are few Factory Mutual Approved intrinsically safe radios available for use on CMRS systems. Such radios, which are designed not to spark when activated, are mandatory for communication in explosive environments such as milling operations, paint shops, fuel depots, and in areas where explosive gases are present.[33] Many government and public safety applications likewise require rugged radios designed to withstand much more abuse than consumer models. The lack of equipment may simply reflect current lack of demand. If more private users begin to utilize commercial systems, it seems likely that manufacturers will respond with a greater variety of products.

Liability

Based on the above concerns, especially relating to reliability and control of the system, some private users have stated that liability is a major issue for them. In day-to-day operations, worker and public safety is a principal driver for the use of many private systems. In addition, in times of disaster or emergency, radio systems must work in order to save lives and prevent property loss. In such situations, private users assume liability for communications breakdowns that might occur. This factor helps explain why users require such a high degree of reliability. Given this background, if a private user does not operate the communication system, they generally believe that liability for a breakdown or absence of service should rest with the commercial provider. However, private users report that commercial service providers are often unwilling to assume the liability associated with the provision of

[33] McKinley, op. cit., footnote 23.

safety-related services.[34] Until such relief is given, it is likely that private systems will continue to be preferred by many users.

Summary

These concerns drive many private users to own and operate their own systems. Cost is cited by many as a factor as well, but most often users believe that their needs cannot be effectively met by a commercial provider. This indicates that, at least for some companies, cost is not really a factor--their communication needs require a customized system.[35] It may be the case that this applies mostly to larger system operators; for smaller companies with more generic needs, cost may indeed be the primary factor.

For the immediate future, it seems that the need for private wireless systems will continue. Currently, it appears that commercial service providers can serve some of the needs of the private wireless community, but most have chosen to focus first on the rapidly growing consumer mass market. As a result, in most cases it appears that commercial service providers cannot yet provide many of the services that the unique and varied needs of the private wireless community demand. In the future, however, this could change, although the extent of this change is still unclear; some private users' needs may never be met for technical or economic reasons. From the commercial providers' point of view, the incentive to serve the needs of the private wireless community depends on simple business case/revenue analysis: can the added revenues generated by a private user pay for investments in specialized infrastructure and software?

In the longer term, the relative use of private and commercial services by historically private users is likely to shift, although the extent of such a shift remains to be seen. For some private users, their individual needs will dictate continued use of their own system. For others, who do not want to run their own system, who do not have the financial resources to continually maintain and update their equipment, or whose needs are more generic, the potential benefits of commercial service may outweigh the disadvantages. As new CMRS providers deploy their services, and as competition for wireless customers becomes more intense, users of private systems will have a broader range of communication options to choose from. And as the mass market becomes saturated with providers and services, commercial service providers may pay more attention to private wireless users. It remains to be seen how far commercial service providers will be able and willing to go in meeting the needs of the private community.

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[34] Ibid.

[35] Fox, op. cit., footnote 23.

TRENDS AFFECTING PRIVATE LAND MOBILE COMMUNICATIONS

As the users of private wireless systems look to the future, a number of challenges and opportunities appear. These issues will only be sketched briefly here

Needs

As in all areas of the economy, the need for communication services by private companies and organizations is increasing dramatically. In part this is driven by changes in geographic demographics and the simple rise in population. More people require services, and the development of new subdivisions and population centers means new systems. In addition, companies are faced with an increasingly competitive marketplace that places a premium on immediate service, many options, tighter control over the factors of production, and that depends critically on the flow and control of information.

One noteworthy trend is the increasing use of data communications by almost all segments of the private wireless community. Although data use is still relatively low compared to voice communications, and has been growing slowly, use is expected to increase more rapidly as new applications are developed. Video is another area that, while little used by the private community today, is expected to increase as technology advances make its use more practical and needs are identified.

Technological

The technological forces affecting private wireless communication are the same as those pushing the rest of the communications industry--digitization of information and the quickening pace to digital communication systems. The switch to digital promises greater capacity and more efficient transmission in almost all radio communication systems. In addition, digital information and transmission is leading to the development of a whole range of new services and applications. Increases in the capabilities of hardware and software are expected to drive increasing demand for all types of wireless services--served by both commercial/public and private wireless systems.

For some private users, this switch is changing the nature of their communications networks from voice/dispatch oriented to more data-intensive applications, including remote data gathering, remote file and database access, image transmission, and even video. These types of multimedia applications are expected to become vital tools used by many companies in their internal

communications networks.[36] These new applications promise better services and greater competitive tools, but also require increased spectrum capacity. It may be easier, less expensive, and ultimately more efficient, to provide both voice and data services over one private network rather than contracting out each separately.

Difficulties arise, however, in transitioning to the new technologies. Analog and digital systems cannot generally share the same communication channels at the same time. As a result, digital frequencies usually have to be "carved out" from the analog base to provide new services.

Some manufacturers are exploring the idea of "dual-mode" equipment that would be capable of accessing both commercial and private networks; allowing users to utilize commercial services where possible, and private systems when and where needed.

Regulatory

The regulatory environment facing the private wireless community is currently undergoing a fundamental restructuring (see Appendix E). The FCC's Refarming proceeding seeks to increase the capacity and efficiency of private land mobile systems to ensure the health and vitality of the community into the future. The specific reforms proposed in this proceeding have been the subject of much debate. The FCC is also in the middle of revising the rules regarding the 800 MHz band, which is used by a combination of commercial SMRs, public safety, and private land mobile users. Finally, as noted above, the FCC's new Part 101 regulations became effective on August 1, 1996. Each of these proceedings will have major effects on the private land mobile services over the next decade.

Economic

One of the most important changes that will affect the private wireless community in the years to come is the rise of commercial wireless communication services. As discussed, there were generally few or no commercial alternatives that private users could turn to in order to meet their communication needs. In fact, private wireless systems were originally developed for just this reason.

In the last several years, however, advances in technology have given rise to a wealth of new radiocommunication services and applications. Satellite systems are being developed to link individuals with voice, data, and video. Cellular services are being rapidly supplemented by PCS and SMRs. Finally, the Commission has

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[36] Goode, op. cit., footnote 11

identified more spectrum for "unlicensed" devices that permit communication of voice, data, and even video for short distances on a non-interference basis.

As these new services and systems have become available, the number of potential alternatives to private wireless systems has grown. At the same time, a more market-based approach to regulation has come into favor. Economists, analysts, politicians and regulators have come to appreciate that the spectrum has distinct value that can be directly translated into dollars. There is a strong movement to recover the full value of the spectrum for the public.

Given these trends, many have begun to question why private services should continue to receive spectrum for free when others pay. A corollary question often asked is why services traditionally provided by private systems cannot be provided by commercial systems, thereby freeing up spectrum for more commercial uses, serving a wider base of users, and potentially bringing in more dollars from spectrum auctions. Private users oppose auctions for private wireless spectrum. In general, many see an auction that would pit commercial versus private users as unfair to private interests since the spectrum is used for different purposes. Some equate the money paid at auction to a tax that would have to be passed on to consumers. Many private users, however, do not object to the concept of a spectrum use fee. How a spectrum fee would work is not yet clear, but some users believe that fees should be tied in some way to efficiency. This type of flexibility would allow fees to be tailored to the unique needs and uses of individual licensees.

Over the next five years, the results of these trends will become more evident. Technologies and services just now being developed will become more widespread. The regulatory picture will become clearer as the FCC completes action in a number of rulemaking proceedings. Competition will be better established as a model for the provision of communications services, and the benefits and shortcomings of a more intense marketplace approach will be discernible. And some of the uncertainties surrounding the private land mobile services will be resolved.

Appendix A: Select Private Land Mobile Radio Services[1]

The Public Safety Radio Services

Police Radio Service--The Police Radio Service is the oldest and most familiar of the public safety radio services. Serving state, county and municipal law enforcement, this service provides the communications links among police headquarters, patrol cars, motorcycles, helicopters, boats, and even patrol officers walking a beat. Today, police departments use radio for all kinds of communications -- voice, data, teletype, video, etc.

Fire Radio Service--The Fire Radio Service emerged from the use of radio by boats fighting fires on city waterfronts. First classified as "marine fire" in 1932, then as "municipal fire" in 1944, the service grew along with the cities it helped to protect. Private land mobile radio became essential to fire-fighting in two distinct but complementary ways: to communicate between headquarters and fire vehicles and to coordinate the work of fire-fighters at the scene of a blaze. Although the FCC licenses most fire radio stations as units under some local government control, it also accepts applications from private volunteer or professional fire companies supported by the communities they serve.

Forestry-Conservation Radio Service--The Forestry-Conservation Radio Service was established in 1934 as part of the special emergency services to be used for forest protection and firefighting. In 1939 the FCC made forestry radio a separate classification for such users as state departments of conservation and private forest organizations who set up communications networks among fire lookout towers and ground crews. These networks are used today for game law enforcement, protection of forests from insects and disease, reforestation, and flood and erosion control, as well as prevention and control of forest fires.

Highway Maintenance Radio Service--The Highway Maintenance Radio Service was established in 1949 as an aid to other public safety services to keep main roads safe for vehicular traffic. State and local governments are licensed in this service to provide emergency and routine communications (in that order) for highway departments and maintenance vehicles and crews engaged in snow-plowing, clearing debris, repairing road damage, and otherwise maintaining highways to keep them open for normal travel.

Local Government Radio Service--The Local Government Radio Service was created in 1958 to meet the administrative needs of state, county, and municipal governments. It permits them to use radio for official purposes not covered by other

[1] For more complete descriptions of the services described in this Appendix see 47 C.F.R. § 90.

public safety services. For example, rural school districts can equip their school buses with radio for greater safety; sewer and water departments can dispatch service or repair crews more quickly; and civil defense agencies can set up a reliable communication system during states of emergency. Many communities use the Local Government Radio Service for the routine business of police, fire, and highway departments and reserve the more specific radio services for emergency use only.

Emergency Medical Radio Service--This service was created in 1993 primarily from frequencies reallocated from the Special Emergency Radio Service. It is used by governmental and non-governmental entities that provide on-going medical services for basic or advanced life support.

Industrial Radio Services

Power Radio Service -- This service is the descendant of former special emergency and utility services. It is still meant for utilities like electric, gas, water, and steam companies to use in connection with producing, maintaining, and distributing their services to public or private customers.

Petroleum Radio Service -- This service is available to the oil and nature gas industries, excluding retail distributors, for communications essential to activities like oil exploration, production, collection, refining, and pipeline distribution. Some frequencies in this service are meant to be used primarily for training and actual operations to contain and clear up oil spills. Other frequencies may be used for what are called geophysical operations like transmitting low-power tone or impulse signals to determine the characteristics of strata beneath the earth's surface where new oil fields may be found. The old "geophysical service," created by the Federal Radio Commission for that purpose, was the forerunner of the Petroleum Radio Service, making it one of the oldest industrial services.

Forest Products Radio Service -- This service is allied in some ways to the forestry-conservation service but its use is not limited to safety and forest protection. The lumber and paper industries are the chief users of this service, for activities like farming, logging and hauling trees and manufacturing lumber, plywood, hardboard, wood pulp or paper products, but not for retailing.

Film and Video Production Radio Service and Relay Press Service -- These services are probably the oldest land mobile services besides police radio. Both were started by the Federal Radio Commission shortly after the International Radiotelegraph Convention of 1927. The Film and Video Production Radio Service is used for communications associated with producing films, either "on location" or in the studio. The Relay Press Radio Service is also used "on location," by news reporters and photographers covering assignments away from their editorial offices, and by others involved in publishing the news.

Special Industrial Radio Service -- This service provides communications for certain activities like farming, ranching, road and bridge construction, mining, distributing chemical products, drilling wells, and delivering fuel or ready-mixed concrete. Like some other services, Special Industrial does not allow communications about retail sales.

Business Radio Service -- This service is a miscellaneous industrial service for activities in any of four categories: commercial enterprise, non-profit organization, church, or medical group. Because of this broad eligibility requirement, it is the most widely used land mobile service.

Manufacturers Radio Service -- This service makes radio available to aid production, safety, logistics, and the handling of machines and materials at plants, factories, mills and shipyards.

Telephone Maintenance Radio Services -- This service is for telephone and telegraph companies to use in connection with construction, repair, maintenance and efficient operation of their communications systems.

Land Transportation Radio Services

Motor Carrier Radio Service -- This service is for bus or trucking companies to use. It provides communications between terminals and vehicles carrying passengers or freight on the highway or between dispatchers and vehicles within a single urban area. Excluded from this service are taxicabs, retail and wholesale delivery vans, school buses, and vehicles used for sightseeing or special charter.

Railroad Radio Service -- This service is the oldest land transportation service, getting its start in December 1945 after several years of experimental operations. This service covers all railroad communication, *e.g.*, for intra-train voice and data links, between locomotive links, crews and trackside maintenance personnel, form a dispatcher to a train en route, and in general yard operations. Railroads also use radio under this service for remote control of locomotives and switches and for sensing track and equipment conditions.

Taxicab Radio Service -- This service enables cab company dispatchers to communicate directly with drivers to direct them to their next fare and to help promote the safety of drivers and passengers.

Automobile Emergency Radio Service -- This service enables auto clubs and garages to send tow or service vehicles to disabled cars as quickly as possible. This service is similar in purpose to the Highway Maintenance Radio Service since both contribute to public safety by prompt removal of traffic hazards. The service also promotes safety by aiding motorists in potentially hazardous situations.

Appendix B: Transmitters and Stations Licensed Since 1980

Public Safety Radio Services

	Police		Fire		Local Government		Highway Maintenance		Forestry Conservation		Special Emergency			Total Public Saftey Services	
	Stations	Trans-mitters	Stations	Trans-mitters	Stations	Trans-mitters	Stations	Transmitters	Stations	Transmitters	Stations	Trans-mitters		Stations	Trans-mitters
1994	54,735	1,550,394	47,620	826,773	83,317	1,382,647	16,547	335,109	12,083	336,607	37,689	419,436		251,991	4,870,986
1993	54,284	1,472,233	47,036	787,202	81,157	1,327,976	16,293	300,489	11,943	316,278	39,967	426,516		250,626	4,630,694
1992	52,926	1,372,249	45,953	740,087	78,200	1,262,689	15,913	291,661	11,618	237,981	40,775	413,123		245,385	4,317,790
1991	51,924	1,303,273	45,001	699,960	75,402	1,206,247	15,530	277,611	11,525	220,364	40,864	398,102		240,246	4,105,557
1990	50,525	1,235,361	44,011	662,436	72,585	1,141,493	15,035	262,239	11,291	204,628	41,093	388,470		235,540	3,894,627
1989	49,136	1,179,613	42,799	616,027	69,958	1,089,548	14,587	244,681	11,106	204,616	40,890	363,681		228,476	3,698,166
1988	47,784	1,134,947	41,286	562,138	66,780	1,016,037	14,264	227,528	10,686	184,709	40,510	339,840		221,310	3,465,199
1987	46,100	1,036,052	39,864	519,456	62,921	926,274	13,759	211,369	10,345	138,347	39,628	334,270		212,617	3,165,768
1986	45,044	950,758	38,686	481,340	60,429	860,765	13,434	198,193	10,188	127,815	39,392	319,046		207,173	2,937,917
1985	42,291	821,534	36,632	438,721	55,919	776,508	12,667	173,760	9,573	104,460	37,455	294,624		194,537	2,609,607
1984	41,114	709,967	34,868	385,785	52,029	694,109	11,907	160,343	8,850	83,467	3,566	259,408		184,232	2,293,079
1983	47,714		27,036		44,051		11,615		8,717		32,076			171,236	
1982	47,250		26,071		42,239		11,394		8,571		30,597			166,127	
1981	46,270		24,581		39,688		10,792		8,267		28,760			158,558	
1980	45,292		23,739		37,695		10,503		7,994		27,399			152,622	

Notes:

1. These statistics were gathered from the FCC Annual Report FY 1980-1994.
2. Statistics for the number of transmitters were not reported for FY 1980-1983.
3. Transmitter statistics were not reported for the aviation or marine radio services.
4. Station- a licensed private radio system.
5. Transmitters- the total of base stations and mobiles used by a system
6. In 1993, some frequencies in the Special Emergency Radio Service (SERS) were parceled out, creating a new sub-category of the PSRS (Emergency Medical Radio Service (EMRS)), while the remaining SERS frequencies became their own category.
7. In 1994, however, both SERS and EMRS were reported in the SERS statistic.

Rad

	Special Industry		Business		Power		Petroleum		Manufacturers		Forest Products		Radiolocation		Video Production	
	Stations	Trans-mitters	Stations	Trans-mitters	Stations	Trans-mitters	Stations	Trans-mitters	Stations	Trans-mitters	Stations	Trans-mitters	Stations	Trans-mitters	Stations	Trans-mitters
1994	102,748	843,747	583,232	3,576,223	50,306	768,651	24,598	340,913	25,060	308,227	11,226	119,428	6,570	397,690	335	12,794
1993	107,888	868,930	590,621	4,346,817	48,158	731,369	25,817	343,207	25,151	293,580	11,569	123,141	6,410	54,902	334	10,622
1992	109,774	868,841	602,917	5,083,358	48,210	706,490	26,572	342,485	24,504	270,711	11,857	121,946	5,694	52,622	358	11,489
1991	112,236	876,454	616,067	4,823,087	47,086	668,740	27,096	326,343	23,826	258,122	11,698	121,293	5,630	52,795	367	11,444
1990	113,513	872,695	628,091	4,608,753	46,731	574,873	26,788	309,371	23,246	244,902	11,694	116,831	5,371	53,411	373	10,869
1989	115,418	872,067	637,977	4,303,724	44,256	557,270	26,976	291,564	22,873	231,562	11,591	111,438	4,798	35,580	392	10,795
1988	116,960	869,553	641,751	4,042,025	42,755	524,386	26,813	278,641	21,618	216,031	11,331	102,150	4,921	46,589	389	10,066
1987	117,530	859,800	640,486	3,853,837	40,496	486,660	26,596	265,051	20,571	200,810	10,899	92,807	6,031	51,539	398	9,622
1986	115,206	845,629	636,637	3,702,270	37,888	416,902	26,585	249,276	19,684	186,572	10,565	86,320	7,129	50,669	388	8,601
1985	114,987	824,217	593,487	3,372,853	34,446	384,728	25,257	224,074	18,196	163,866	9,799	79,962	7,812	51,761	383	7,417
1984	110,195	775,479	561,610	3,064,184	31,367	300,231	23,544	197,696	16,822	166,672	9,069	76,869	6,333	63,359	328	6,028
1983	94,279		504,963		28,189		22,272		11,566		8,579		4,566		351	
1982	90,843		483,583		27,258		21,396		10,812		8,568		4,236		297	
1981	86,949		460,198		26,333		19,366		9,897		8,470		3,344		253	
1980	82,177		427,341		24,418		18,226		8,386		8,484		2,781		238	

Industrial Radio Services-- cont.

	Relay Press		Telephone Maintenance			Total Industrial Services	
	Stations	Trans-mitters	Stations	Trans-mitters		Stations	Trans-mitters
1994	1,094	22,017	8,711	137,640		794,877	8,526,230
1993	1,140	22,563	8,636	148,081		827,714	8,942,892
1992	1,120	21,070	8,404	145,418		840,210	7,804,431
1991	1,173	21,978	8,126	136,123		854,384	7,293,377
1990	1,201	22,355	8,812	128,248		864,819	6,942,132
1989	1,221	22,306	8,490	128,450		873,790	6,585,056
1988	1,251	21,698	7,609	122,047		876,599	6,231,168
1987	1,206	20,047	6,888	113,150		871,080	5,922,823
1986	1,177	18,556	6,348	101,760		864,408	5,697,454
1985	1,101	17,166	5,889	88,872		811,306	5,214,806
1984	1,084	15,706	5,553	81,192		787,928	4,764,378
1983	739		3,582			677,046	
1982	744		3,503			648,921	
1981	747		3,399			606,045	
1980	787		3,379			575,176	

Land Transportation Radio Services

	Railroad		Taxicab		Auto Emergency		Motor Carrier (Inter-urban passenger, intraurban property, urban passenger, urban property)		Land Transportation Services	
	Stations	Trans-mitters	Stations	Trans-mitters	Stations	Trans-mitters	Stations	Trans-mitters	Stations	Trans-mitters
1994	18,325	742,464	5,117	123,884	8,847	35,877	11,110	182,598	40,399	1,084,793
1993	18,191	738,586	5,376	123,983	8,409	38,162	11,051	182,613	41,026	1,084,344
1992	17,716	731,860	5,558	124,880	8,639	39,006	10,799	180,897	40,712	1,078,442
1991	17,043	714,544	5,815	120,752	8,993	40,369	10,873	186,643	40,515	1,058,208
1990	16,192	728,177	5,710	122,113	7,260	41,128	10,950	183,660	40,112	1,073,078
1989	15,966	724,829	5,883	121,319	7,818	41,806	10,913	182,154	40,379	1,070,108
1988	15,415	689,955	5,942	124,672	7,874	43,061	10,906	183,942	40,137	1,041,530
1987	15,076	580,118	5,996	121,738	8,097	44,193	10,839	175,903	40,008	921,952
1986	14,887	428,135	6,197	119,203	8,184	48,642	10,504	166,398	39,772	762,578
1985	13,783	213,377	6,148	115,096	7,876	47,025	9,907	153,782	37,893	529,259
1984	12,432	192,630	6,063	110,089	7,745	46,372	9,525	150,953	35,765	499,044
1983	11,969		6,239		7,318		10,133		35,659	
1982	11,446		6,067		7,031		9,813		34,357	
1981	10,786		5,620		6,686		9,393		32,484	
1980	10,580		5,353		6,406		8,826		31,164	

Appendix C: Frequency Coordinators

The Commission has recognized the following frequency coordinators:

Public Safety Radio Services

1	Local Government	Association of Public Safety Communications Officials-International, Inc. ("APCO")
2.	Police	APCO
3.	Fire	International Municipal Signal Association ("IMSA"); International Association of Fire Chiefs, Inc. ("IAFC")
4.	Highway Maintenance	American Association of State Highway and Transportation Official ("AASHTO")
5.	Forestry Conservation	Forestry-Conservation Communications Association ("FCCA")
6.	Special Emergency	IMSA/IAFC/Personal Communications Industry Association("PCIA")
7.	Emergency Medical	IMSA/IAFC

Industrial Radio Services

1.	Power	UTC-The Telecommunications Association
2.	Petroleum	American Petroleum Institute ("API")
3.	Forest Products	Forest Industries Telecommunications ("FIT")
4.	Motion Picture	Alliance of Motion Picture and Television Producers ("AMPTP")
5.	Relay Press	Newspaper Association of America ("NAA")
6.	Special Industrial	Industrial Telecommunications Association, Inc. ("ITA")

7.	Business	
8.	Manufacturers	Manufacturers Radio Frequency Advisory Committee, Inc. ("MRFAC")
9.	Telephone Maintenance	Telephone Maintenance Frequency Advisory Committee ("TELFAC")
10.	Alarm Monitoring	Central Station Alarm Association

Land Transportation Radio Services

1.	Motor Carrier	American Trucking Associations, Inc. ("ATA")
2.	Railroad	Association of American Railroads ("AAR")
3.	Taxicab	International Taxicab and Livery Association ("ITLA")
4.	Automobile Emergency	American Automobile Association ("AAA")

Appendix D: Private Land Mobile Frequency Bands[1]

25-50 MHz

This band is commonly referred to as "low band." It is the lower of the two VHF bands available for private land mobile communications. There are 638 channels available in this band, with a spacing of 20 kilohertz between channels. Transmissions in this band are simplex, in which both parties involved in the conversation use the same frequency for talking. Transmissions in this band tend to be particularly erratic, rendering the band less desirable for land mobile use than bands located higher in the spectrum. Transmissions in the 25-50 MHz band that normally provide adequate signal strength over dozens of miles will at times "skip" hundreds or thousands of miles. As a result, a system in the 25-50 MHz band may sometimes receive interference from signals originating several states away.[2]

There are other inherent difficulties affecting operations in the 25-50 MHz band. The band is more subject to interference from man-made noise, such as the noise emanating from gas-powered engines. Also, antennas commonly used on mobile units operating in the 25-50 MHz band require greater height than for systems using frequencies higher in the spectrum.[3] Because of these problems, most users have begun using higher bands, and two of the largest radio equipment manufacturers have indicated that they will no longer make equipment for the band.

Frequencies in the 30-40 MHz band were allocated for private land mobile use in 1947.[4] Frequencies in the 25-30 MHz and 44-50 MHz bands were allocated for private land mobile use in 1949.[5] Twenty kilohertz channels were introduced in the 25-50 MHz band in 1957.[6] Portions of the 25-50 MHz band were allocated to the Highway Maintenance, Police and Special Emergency Radio Services in 1960.[7]

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[1] This appendix is taken from Frederick J. Day, Jr., *Policies and Practices in the Regulation of Private Radio Communications Systems* (Arlington, VA: Industrial Telecommunications Association), 1994.

Ibid.

[3] *In re* Spectrum Efficiency in the Private Land Mobile Radio Bands in Use Prior to 1968, *Notice of Inquiry*, PR Docket No. 91-170, 6 FCC Rcd 4126, 4144 (1991).

[4] *Public Notice*, Docket No. 6651, 39 FCC 281 (1947).

[5] *Report and Order*, Docket Nos. 8658, 8695 and 8972, 13 FCC 1190 (1949).

[6] *Second Report and Order*, Docket No. 11253, 39 FCC 509 (1957).

[7] *Second Report and Order*, Docket No. 13273, 20 Rad.Reg. 1530a (1960).

150-174 MHz

In contrast to the 25-50 MHz band, this band is referred to as "high band." There are 600 channels available in this VHF band. As with the 25-50 MHz band, the band is designed primarily for simplex operations. Channels in the 150-174 MHz band are normally assigned at intervals of 15 kilohertz. However, most of the radio equipment used in this band is designed to operate in bandwidths of 20 kilohertz or greater. Because the emission commonly used occupies more than 15 kilohertz of spectrum, a geographic separation is imposed between adjacent channel assignments to prevent interference.[8] Otherwise, for example, a high power base station operating on a 157 MHz frequency could interfere with a 20-watt mobile transmission on a frequency 15 kilohertz away if the mobile was operating close to the adjacent channel base station.[9]

Frequencies in the 152-162 MHz band were allocated for private land mobile radio use in 1949.[10] Thirty kilohertz channels were introduced in the 152-162 MHz band in 1956.[11] Additional 30 kilohertz channels were allocated to the 150-152 MHz band in 1957.[12] Certain frequencies in this band were allocated to the Highway Maintenance, Police, Fire and Special Emergency Services in 1960.[13] This frequency band was included in the amendment of Part 90 to permit interservice sharing of frequencies in 1981.[14] This is one of the frequency bands included in the "refarming" proceeding.[15]

220-222 MHz

Spectrum in the 220-222 MHz band was reallocated from the fixed, land mobile and amateur services in 1988 to dedicate spectrum for the development of

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[8] Day, op. cit., footnote 1.

[9] *In re* Amendment of the Rules to Permit Business Radio Use of Certain Channels in the 150 MHz Band, *Memorandum Opinion and Order on Reconsideration*, PR Docket No. 88-373, 5 FCC Rcd 4784, 4787 (1990).

[10] *Report and Order*, Docket Nos. 8658, 8965 and 8972, 13 FCC 1190 (1949).

[11] *Report and Order*, Docket No. 11253, 39 FCC 487 (1956).

[12] *First Report and Order*, Docket No. 12169, 39 FCC 612 (1957).

[13] *Report and Order*, Docket No. 13273, 20 Rad.Reg. 1525 (1960); *Second Report and Order*, Docket No. 13273, 20 Rad.Reg. 1530a (1960).

[14] *Report and Order*, Docket No. 81-110, 46 Fed.Reg. 55701 (November 12, 1981).

[15] *Notice of Proposed Rule Making*, PR Docket No. 92-235, 7 FCC Rcd 8105 (1992); *Report and Order and Further Notice of Proposed Rule Making*, PR Docket No. 92-235, 10 FCC Rcd 10076 (1995).

narrowband spectrum efficient technologies to meet the communications requirements of the land mobile radio services.[16] Service rules were adopted in 1991.[17]

In 1995, the Commission proposed a new framework for the operation and licensing of the 220-222 MHz frequency band.[18] Among other matters, the item sought comment on whether to resolve pending mutually exclusive non-commercial nationwide applications by lottery, comparative hearing, or to return the applications and adopt a new licensing scheme for the 30 channels associated with the applications. The Commission is also considering allowing fixed and paging uses as primary uses in the 220-222 MHz frequency band. Additionally, the proposal would provide for blocks of contiguous spectrum that would be assigned by competitive bidding. Because there has been a freeze on the filing of 220 MHz applications since 1991, the Commission also in 1995 proposed to allow existing licensees to seek minor modifications of their licenses to construct and operate base stations at currently unauthorized locations.[19]

421-430 MHz

The frequency bands 422.1875-425.4875 MHz and 427.1875-429.9875 MHz are available for use in the Detroit, Michigan and Cleveland, Ohio metropolitan areas. The bands 423.8125-425.4875 MHz and 428.8125-429.9875 MHz are available for use in the Buffalo, New York metropolitan area. The channels in these bands are spaced at intervals of 25 kilohertz. In Detroit and Cleveland, there are 28 channel pairs available for Industrial and Land Transportation systems, 28 channel pairs available for Business systems, and 56 channel pairs available for Public Safety systems. In Buffalo, there are 12 channel pairs available for Industrial and Land Transportation systems, 12 channel pairs available for Business systems, and 23 channel pairs available for Public Safety systems. There are also 20 single (non-paired) channels available in each of the three metropolitan areas, with five of these channels designated for Industrial and Land Transportation systems, five channels for

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[16] *Report and Order*, Gen. Docket No. 87-14, 3 FCC Rcd 5287 (1988), *recon. denied*, 4 FCC Rcd 6407 (1989), *aff'd American Radio Relay League, Inc. v. FCC and United States of America*, No. 89-1602 (D.C. Cir. Dec. 3, 1990). This matter was also appealed on other grounds. *United States of America v. FCC*, No. 89-1635, *voluntarily dismissed* (D.C. Cir. December 28, 1989).

[17] *Report and Order*, Pr Docket No. 89-552, 6 FCC Rcd 2356 (1991); *Erratum*, PR Docket No. 89-552, 6 FCC Rcd 4229.

[18] *Second Memorandum Opinion and Order and Third Notice of Proposed Rulemaking*, PR Docket No. 89-252, GN Docket No. 93-252 and PP Docket No. 93-253, FCC 95-312 (released Aug. 28, 1995).

[19] *Fourth Notice of Proposed Rule Making*, PR Docket No. 89-552 and GN Docket No. 93-252, 11 FCC Rcd 835 (1995).

Business systems, and ten channels for Public Safety systems.[20] This spectrum was allocated for use only in Detroit, Cleveland and Buffalo in 1985.[21] Service rules for this spectrum were adopted in 1987.[22]

450-470 MHz

The 450-470 MHz band is often referred to as "the UHF band." The frequencies available in this band include both primary channel pairs and "offset" channels, as well as one-way paging and two-way simplex channels. The primary channels are assigned at intervals of 25 kilohertz. Systems using the primary channels usually employ equipment designed for 25 kilohertz bandwidths. The "offset" channels are centered on frequencies that are spaced 12.5 kilohertz from the primary channels. Licensees operating systems on the offset channels also typically use equipment designed for 25 kilohertz bandwidths.[23]

There are 302 primary channel pairs, 615 offset channels, nine one-way paging channels, and eight two-way simplex channels in the 450-470 MHz frequency band. The pairing arrangement implemented by the Commission for the primary channels permits licensees to employ repeater stations. Licensees operating systems on the offset channels typically use these channels in pairs, similar to the way in which the systems using the primary channels operate, although Business service use is a combination of paired and single channel use. The offset channels are licensed as mobile units but may be used as base, fixed or mobile relay stations. In general, the stations operating on the offset channels are limited to an output power of two watts. The only offset channels licensed on a primary basis are those that are exclusively available for use by Special Industrial Radio entities. Operation on all other offset channels is on a secondary basis to the primary channels, and must protect the primary channels from harmful interference.[24]

A restructuring of the allocation of frequencies in the 450-460 MHz band took place in 1953.[25] New technical standards relating to transmitter deviation, bandwidth

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[20] Day, op. cit., footnote 1

[21] *Report and Order*, Docket No. 85-113, 50 Fed. Reg. 40016 (October 1, 1985).

[22] *Report and Order*, Docket No. 86-163, 2 FCC Rcd 825 (1987); *Erratum*, 2 FCC Rcd 1919 (1987).

[23] Day, op. cit., footnote

[24] *Id.*

[25] *Report and Order*, Docket No. 10323, 39 FCC 467 (1953).

and 25 kilohertz channelization were introduced in 1966.[26] Allocation of 25 kilohertz channels for public safety, industrial and land transportation use occurred in 1968.[27] Permissible uses of the band were expanded in 1975 to include telemetry and control functions, on a secondary basis, using channels offset by 12.5 kHz from regularly assignable frequencies.[28] The availability of the band was expanded to include secondary point-to-point fixed transmissions for the Public Safety and Industrial and Land Transportation Services in 1976.[29] The 12.5 kilohertz offset channels in the band were generally made available on a secondary, non-interference basis in 1981.[30] This frequency band was included in the amendment of Part 90 to permit interservice sharing of frequencies in 1981.[31] Part 90 was amended to permit certain 12.5 kilohertz offset frequencies on a primary basis, as described above, in 1987.[32] This is one of the frequency bands included in the "refarming" proceeding.[33]

470-512 MHz

In a unique allocation decision reached in 1970, the Commission made various portions of UHF Television Channels 14-19 (the 470-512 MHz frequency band) available for private land mobile use in the largest ten cities in the United States.[34] It distributed these frequencies to individual private land mobile service pools in 1971.[35] Access to these channels was expanded in 1974 to the thirteen largest urban areas with the addition of Houston, Dallas-Fort Worth and Miami, although, as a practical matter, use has been limited to eleven areas because Canada has not agreed to this usage in Cleveland and Detroit.[36] Some of the channels in this band were made

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[26] *First Report and Order*, Docket No. 13847, 5 FCC 2d 779 (1966).

[27] *Second Report and Order*, Docket Nos. 13847, 11959, 11991 and 11994, 11 FCC 2d 648 (1968).

[28] *Second Report and Order*, Docket No. 19478, 56 FCC 2d 1004 (1975).

[29] *Report and Order*, Docket No. 20815, 61 FCC 2d 170 (1976).

[30] *Report and Order*, Docket No. 80-605, 87 FCC 2d 647 (1981).

[31] *Report and Order*, Docket No. 81-110, 46 Fed.Reg. 55701 (November 12, 1981).

[32] *Report and Order*, Docket No. 86-169, 2 FCC Rcd 665 (1987).

[33] *Notice of Proposed Rule Making*, PR Docket No. 92-235, 7 FCC Rcd 8105 (1992); *Report and Order and Further Notice of Proposed Rule Making*, PR Docket No. 92-235, 10 FCC Rcd 10076 (1995).

[34] *Report and Order*, Docket No. 18261, 23 FCC 2d 325 (1970).

[35] *Second Report and Order*, Docket No. 18261, 30 FCC 2d 221 (1971).

[36] *Fifth Report and Order*, Docket No. 18261, 48 FCC 2d 360 (1974).

available in the form of a general access pool, rather than in individual service pools, starting in 1977.[37] As a result, in each of eleven urban markets, there are between 108 and 324 channel pairs in the 470-512 MHz band available for private land mobile use.[38] The channels are assigned with a spacing of 25 kilohertz between the center frequencies. This is one of the frequency bands included in the "refarming" proceeding.[39]

806-821/851-866 MHz

There are 600 channel pairs available in these bands. The channelization plan for these bands is based on a spacing of 25 kilohertz between channels. Mobile and control station frequencies are assigned from the 806-821 MHz band and the corresponding base station frequencies are taken from the 851-866 MHz band. The base station frequency associated with each mobile/control station frequency is precisely 45 megahertz higher than the mobile/control frequency. A total of 150 channel pairs are allocated for SMR use in the "General Category" frequency pool and are available for use in either conventional or trunked modes, except in the border areas. The remaining 450 channel pairs are allocated as follows: 280 channel pairs for Specialized Mobile Radio (SMR) systems, 70 channel pairs for Public Safety systems, 50 channel pairs for Industrial/Land Transportation systems, and 50 channel pairs for Business Radio systems.[40]

These channels were originally made available by the reallocation of fourteen broadcast television channels (UHF-TV channels 70-83) for common carrier and private radio land mobile use in 1970.[41] The Commission determined specific spectrum that would be allocated for trunked and conventional private land mobile radio systems, including "entrepreneur-operated, common-user systems," in 1974.[42] In 1975, the Commission affirmed, on reconsideration, the allocations it made in the 806-960 MHz frequency band for public safety and industrial and land transportation

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[37] *Report and Order*, Docket No. 20909, 64 FCC 2d 825 (1977).

[38] The eleven markets are Boston, Chicago, Dallas/Ft. Worth, Houston, Los Angeles, Miami, New York, Philadelphia, Pittsburgh, San Francisco/Oakland, and Washington, D.C.

[39] *Notice of Proposed Rule Making*, PR Docket No. 92-235, 7 FCC Rcd 8105 (1992); *Report and Order and Further Notice of Proposed Rule Making*, PR Docket No. 92-235, 10 FCC Rcd 10076 (1995).

[40] Day, op. cit., footnote 1

[41] *First Report and Order and Second Notice of Inquiry*, Docket No. 18262, 19 Rad. Reg. 1663 (1970).

[42] *Second Report and Order*, Docket No. 18262, 46 FCC 2d 752 (1974).

use.[43] In 1979 the Commission developed a methodology for assigning frequencies for trunked systems at 800 MHz.[44]

Up until 1982, not all the available spectrum in this band for private land mobile use had been released. In 1982 the Commission released the remaining spectrum available for private land mobile radio use, and sequestered frequencies by categories of eligibility in this band for the first time, resulting in the pools of channel pairs we have today.[45] Waiting lists for trunked systems developed in highly congested urban areas. In 1985, the Commission amended Part 90 to grant licensees of fully loaded trunked systems a preference when competing against other applicants for the assignment of channels via the waiting list.[46] In 1988, the Commission consolidated 800 MHz regulations under Subpart S of Part 90, and eliminated minimum channel loading requirements.[47] In 1990, General Category channels, previously reserved for only conventional use, were now also made available for the expansion of trunked systems.[48] In 1993, Part 90 was amended to institute uniform co-channel interference protection criteria for both SMR and non-SMR systems above 800 MHz.[49]

821-824/866-869 MHz

The six megahertz included in these two bands are allocated exclusively for public safety systems authorized in accordance with a "National Public Safety Plan." In response to a directive from Congress, the FCC formulated the National Plan as a means of accommodating the future communications requirements of public safety agencies throughout the country. There are 240 channel pairs available in the 821-824/866-869 MHz bands. The channelization plan developed for these bands is based on a spacing of 12.5 kilohertz between center frequencies.[50]

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[43] *Memorandum Opinion and Order*, Docket No. 18262, 51 FCC 2d 945 (1975).

[44] *Report and Order*, Docket No. 78-394, 72 FCC 2d 658 (1979).

[45] *Second Report and Order*, Docket No. 79-191, 90 FCC 2d 1281 (1982).

[46] *Report and Order*, Docket No. 85-6, 50 Fed. Reg. 32419 (August 12, 1985).

[47] *Report and Order*, Docket No. 86-404, 3 FCC Rcd 1838 (1988).

[48] *Report and Order*, Docket No. 87-213, 5 FCC Rcd 4016 (1990).

[49] *Report and Order*, Docket No. 93-60, 8 FCC Rcd 7293 (1993).

[50] Day, op. cit., footnote 1.

This six megahertz was allocated for public safety operations in 1986.[51] The National Plan for public safety communications systems in this spectrum was implemented in 1987.[52] Part 90 was amended to permit use of these bands in the United States/Canadian border areas in 1990.[53] Part 90 was amended to permit use of these bands in the United States/Mexican border areas in 1991.[54]

896-901/935-940 MHz

There are 399 channel pairs available in this frequency band. The channelization plan for this band is based on a spacing of 12.5 kilohertz between channels. Mobile and control station frequencies are assigned from the 896-901 MHz band, and the corresponding base station frequencies are taken from the 935-940 MHz band. The base station frequency associated with each mobile/control station frequency is exactly 39 megahertz higher than the mobile/control frequency. Of the 399 channel pairs available, there are 200 pairs allocated for Specialized Mobile Radio (SMR) systems, 100 pairs for Business Radio systems, and 99 pairs for Industrial/Land Transportation systems.[55]

These channels were originally made available by the reallocation of fourteen broadcast television channels (UHF-TV channels 70-83) for common carrier and private radio land mobile use in 1970.[56] Unlike other spectrum already discussed, however, these frequencies were held back and became known as the 900 MHz spectrum reserve. In 1986 this 900 MHz spectrum reserve was allocated for private land mobile radio systems.[57] Filing windows and application procedures for Business and Industrial/Land Transportation systems, and Phase I SMR filings, were announced that same year.[58] Part 90 was amended to permit use of these bands in

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[51] *Report and Order*, Docket No. 84-1233, 2 FCC Rcd 1825 (1986); *Correction*, Docket No. 84-1233, 51 Fed. Reg. 39662 (October 30, 1986).

[52] *Report and Order*, Docket No. 87-112, 3 FCC Rcd 905 (1987).

[53] *Order*, 5 FCC Rcd 5793 (1990).

[54] *Order*, 6 FCC Rcd 4766 (1991).

[55] Day, op. cit., footnote 1.

[56] *First Report and Order and Second Notice of Inquiry*, Docket No. 18262, 19 Rad. Reg. 1663 (1970).

[57] *Report and Order*, Docket No. 84-1233, 2 FCC Rcd 1825 (1986); *Correction*, Docket No. 84-1233, 51 Fed. Reg. 39662 (October 30, 1986).

[58] *Public Notice*, 1 FCC Rcd 543 (November 4, 1986).

United States/Canadian border areas in 1990.[59] A two-year delay in enforcement of channel loading requirements for SMR systems affecting these bands was implemented in 1992.[60] Part 90 was amended to permit use of these bands in United States/Mexican border areas in 1992.[61] The 1993 amendment to Part 90 to institute uniform co-channel interference protection criteria for both SMR and non-SMR systems above 800 MHz affected these bands as well.[62]

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[59] *Order*, 5 FCC Rcd 5793 (September 28, 1990).

[60] *Report and Order*, Docket No. 92-17, 7 FCC Rcd 4914 (1992).

[61] *Order*, 7 FCC Rcd 7154 (October 28, 1992).

[62] *Report and Order*, Docket No. 93-60, 8 FCC Rcd 7293 (1993).

Appendix E: Regulatory Structure for Private Wireless Services

The regulatory structure governing the private radio services has developed over a number of years, and continues to evolve. In large measure, the changes in the regulatory framework have been the result of increasing use and congestion, technological advances, and changing views of the role of Federal regulation. This section will discuss the basic regulation of the private radio services and how the regulatory model has changed over time.

Evolution of the Political and Economic Views Affecting PLMR Regulation

The Nature of PLMRS

Internal Communications Needs Definitional

Private land mobile radio use is primarily for dispatch purposes and, generally, does not require interconnection. Private land mobile licensees are generally entities that are not in the communications business and do not derive their profits from providing communications services. Rather, they use wireless communications as a tool in furtherance of their respective business missions. Dispatching vehicles or people, or providing information from a mobile or portable unit to supervisors (and vice versa), are the two primary forms of this use of radio to serve private needs. Neither of these types of communications inherently require interconnection.

Interconnection At Odds With Internal Needs

Over time, private radio licensees began to consider interconnection to the public switched telephone network (PSTN) through their private radio systems. The FCC finally allowed this, but with significant restrictions on shared channels.[1] For instance, in major urban areas every user on a shared channel had to agree to accept interconnection on the channel before any licensee could interconnect. This was in large part due to the amount of time an interconnected call takes as opposed to a dispatch call. Although typical dispatch exchanges lasted 15-30 seconds or less, interconnected calls can last up to five minutes (although the average is probably somewhere around 2 minutes). As a result, interconnected service on shared channels generally resulted in unacceptable waiting times for other systems licensed to use the same channel. Exclusive channel assignments or trunked systems had the potential to permit interconnection to the PSTN without adversely affecting other users.

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[1] *In re* Amendment of the Commission's Rules to Prescribe Policies and Regulations to Govern Interconnection of Private Land Mobile Radio Systems with the Public Switched Telephone Network, *First Report and Order*, Docket No. 20846, 69 FCC 2d 1831 (1978); *clarified* in *Memorandum Opinion and Order*, 71 FCC 2d 1388 (1979); *reconsidered* in *Memorandum Opinion and Order*, 46 Rad. Reg. 2d 774 (1979).

Today, interconnected service is authorized on many private wireless systems. At best, however, interconnection is a nominal ancillary capability for PLMR licensees. Many PLMR licensees were authorized for interconnection as a hedge against having to file a later additional amendment to obtain it. Even where interconnection is a specified feature of PLMR licenses, the business entities using the systems generally either elect not to use interconnection or to severely restrict it. For many institutional users there is no need for interconnected service, and companies often do not want their employees to have access to such service for fear of tying up channels -- systems are still optimized for private, internal use. Because of this, many, especially smaller, businesses use both private and commercial systems. A landscaping company for example, may use a private system to communicate with its workers in the field, while managers use cellular phones and pagers to communicate more effectively with customers and suppliers.

Legal Distinctions Between Commercial and Non-Commercial Systems

Up to 1982

The FCC for decades had a bright line for dividing its regulation of the wireless land mobile services into two separate categories. The first category consisted of radio services intended for the internal communications needs of businesses and non-federal government agencies. These services were regulated as "special radio" services, and then later as "private land mobile radio" services. Private land mobile services are regulated under Title III of the Communications Act (the Act). The second category consisted of mobile radio services that were for hire to the public. These services were regulated as public mobile "common carrier" services. Public mobile services are also subject to common carrier regulation under Title II of the Act, which, among other things, requires common carriers to provide service upon reasonable request[2] and prohibits unjust or unreasonable discrimination in charges, practices, classifications, regulations, facilities, or services for or in connection with like communication services.[3] Private land mobile services, on the other hand, are not subject to these provisions of Title II of the Act.

At first, there was little overlap between these two categories of wireless land mobile services. Initially, one of the reasons that private radio services existed was because common carriers would not or could not provide the specialized types of communications services needed by industry, business, and local and state governments. The Communications Act and FCC rules prohibited common carriers

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[2] Communications Act, § 201, 47 U.S.C. § 201.

[3] *Id.*, § 202, 47 U.S.C. § 202.

from providing dispatch services. FCC rules also prohibited shared private systems from interconnecting to the PSTN.[4]

It was against this entire background that the FCC released 800 and 900 MHz spectrum. Some of this spectrum was allocated for cellular radio on a duopoly basis in each market. Other portions of this spectrum were allocated for private land mobile radio use, and gave rise to the creation of a non-traditional private land mobile radio entity, the Specialized Mobile Radio system, or SMR. In an effort to provide a simple regulatory structure in new spectrum above 800 MHz, the FCC created a this new category of third-party provider that actually obtained a license to provide private land mobile radio service to others for profit. An SMR's customers were initially only private land mobile radio eligibles. It was this fact that preserved the integrity of SMRs as non-common carriers when challenged by the National Association of Regulatory Utility Commissioners in the case now known as NARUC I.[5]

NARUC I affirmed and applied a three-pronged test for determining whether an entity was a communications common carrier: (1) provision of a communications service, (2) for hire, (3) to the public.[6] The courts were typically called upon to make subjective case-by-case judgments in determining whether specific entities were or were not common carriers. In an effort to avoid determinations that they were common carriers, SMRs tailored their offerings narrowly, and restricted them either to only private land mobile radio eligibles, or in such other ways as to clearly make them not generally available to the public.

From 1982 to 1993

In 1982, Congress amended the Act by adding Sections 3(gg) and 332(c). These sections defined private land mobile service, distinguished between private and common carrier land mobile services, and specified the appropriate authorities empowered to regulate these services. Section 3(gg) defined private land mobile service as "a mobile service . . . for private one-way or two-way land mobile radio communications by eligible users over designated areas of operation."[7] Section

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[4] Private systems that are not shared were allowed to interconnect, as were some shared systems located outside the 25 largest urbanized areas.

[5] *National Association of Regulatory Utility Commissioners v. FCC*, 525 F.2d 630 (D.C. Cir. 1976).

[6] *Id. Construed in American Telephone and Telegraph Co. v. FCC*, 572 F.2d 17, 24 (1978); *see also FCC v. Midwest Video Corp.*, 440 U.S. 689 (1979). "[A] common carrier is one which undertakes indifferently to provide communications service to the public for hire...." *American Telephone and Telegraph Co. v. FCC, supra.*

[7] Communications Act, § 3(gg), 47 U.S.C. § 153(gg) (Budget Act, § 6002(b)(2)(B)(ii)(II), struck this provision).

332(c)(3) preempted state authority to impose rate or entry regulation upon any private land mobile radio service.

The Commission interpreted Section 332(c)(1) of the Act as (1) validating that commercial sale of interconnected telephone service was a common carrier offering, and (2) permitting private land mobile services to interconnect with the PSTN and not be common carriers if they did not profit from providing the interconnection.[8] At the same time, the Commission concluded that Section 332 removed any prior barriers to allowing SMRs and Private Carrier Paging (PCP) entities to provide service to individuals as well as PLMR eligibles, with a concomitant broadening of their customer base with only minimal restrictions.[9]

This created the prospect of direct competition between private land mobile services and similar common carrier services under disparate regulatory regimes. For instance, in 1989 we granted American Mobile Data Communications, Inc., a wholly-owned subsidiary of RAM Broadcasting Corporation, waivers and other relief to permit construction of a nationwide two-way mobile data communications network using novel digital technology on frequencies in the 900 MHz band allocated to the SMR Service.[10] Two years later, in 1991, we authorized Fleet Call, Inc. (now Nextel Corp.) to develop an SMR system that it claimed would offer wide-area, digital voice and data service comparable or superior to cellular radio in quality.[11] The liberalization of the PCP rules made private paging and common carrier paging similar as well. Because common carriers were subject to greater degrees of federal and state regulation than private carriers, common carriers argued that treating wide-area SMRs and PCPs as private carriers placed competing services at a regulatory disadvantage. In 1992, this debate was given new urgency by the Commission's proposal to allocate spectrum to personal communications services (PCS).[12] When it proposed PCS, the Commission indicated it was considering whether it should be a

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[8] *See* Interconnection of Private Land Mobile Systems with the Public Switched Telephone Network in the Bands 806-821 and 851-866 MHz, Docket No. 20846, Memorandum Opinion and Order, 93 FCC 2d 1111 (1983).

[9] *See* Amendment of Part 90, Subparts M and S of the Commission's Rules, PR Docket No. 86-404, Report and Order, 3 FCC Rcd 1838 (1988), *clarified*, 4 FCC Rcd 356 (1989); Amendment of the Commission's Rules to Permit Private Carrier Paging Licenses To Provide Service to Individuals, PR Docket No. 93-38, Report and Order, 8 FCC Rcd 4822 (1993).

[10] American Mobile Data Communications, Inc., *Memorandum Opinion and Order*, 4 FCC Rcd 3802 (1989).

[11] *See* Fleet Call, Inc., Memorandum Opinion and Order, 6 FCC Rcd 1533, *recon. dismissed*, 6 FCC Rcd 6989 (1991).

[12] Amendment of the Commission's Rules to Establish New Personal Communications Services, GEN Docket No. 90-314, ET Docket No. 92-100, Notice of Proposed Rule Making and Tentative Decision, 7 FCC Rcd 5676 (1992).

common carrier service, a private carrier service, or a combination of both.[13] This raised the prospect that a new generation of mobile services could be exempt from common carrier regulation.

From 1993 to the Present

In 1993 Congress enacted Section 6002(b) of the Budget Act to revise Section 332 of the Communications Act. Congress replaced the common carrier and private radio definitions in old Section 332 with two newly defined categories of mobile services: commercial mobile radio service (CMRS) and private mobile radio service (PMRS). CMRS is defined as "any mobile service (as defined in section 3(n)) that is provided for profit and makes interconnected service available (A) to the public or (B) to such classes of eligible users as to be effectively available to a substantial portion of the public."[14] PMRS is defined as "any mobile service (as defined in section 3(n)) that is not a commercial mobile service or the functional equivalent of a commercial mobile service."[15] By its action, Congress replaced traditional regulation of mobile services with an approach that brings all mobile service providers under a comprehensive, consistent regulatory framework and gives the Commission flexibility to establish appropriate levels of regulation for mobile radio services providers.[16]

Ensure Spectrum Is Put To Most Efficient Use

Commercial Services

There are more subscriber-based commercial mobile services available and becoming available than ever before. Where there are mutually exclusive licenses, spectrum for such services is now assigned by way of auctions.[17] This approach seeks to ensure that those who value the spectrum the most get access to it, and that assignments in cases of mutually exclusive applicants are made as quickly and efficiently as possible. The users of PLMRS are generally not subject to auctions and

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[13] *Id.* at 5712-14.

[14] Communications Act, § 332(d)(1), 47 U.S.C. § 332(d)(1).

[15] *Id.*, § 332(d)(2), 47 U.S.C. § 332(d)(2).

[16] Implementation of Sections 3(n) and 332 of the Communications Act -- Regulatory Treatment of Mobile Services, GN Docket No. 93-252, Second Report and Order, 9 FCC Rcd 1411, ¶ 12 (1994).

[17] Commercial providers who obtained their licenses before the FCC had auction authority did not pay any type of up front fee for their spectrum. These include original cellular licensees, paging services, specialized mobile radio, and licensees operating in the 220 MHz band. In the future, applicants in all these services are likely to will have to obtain their spectrum though auctions.

do not pay any similar up-front fee.[18] In addition, private wireless spectrum is most often shared between a number of users or even different services; commercial providers who win auctions receive exclusive access to the frequencies they bid on in a given area, subject to any rights of incumbent licensees. This comparison, in light of current concern for recovering the value for the spectrum for the public, often leads to questions about whether the public should be compensated for the value of this spectrum, and whether private land mobile entities can or should use subscription commercial services for some or all of their internal communications needs.

The implementation of auctions in the world of telecommunications has implications beyond resolving mutual exclusivity. It is an indicator that the traditional interpretation of what is in the public interest, convenience and necessity under the Communications Act has also undergone an evolution. Now, in addition to considering whether a radio service is meritorious, or whether the underlying services for which a business entity has an internal communications need warrant special attention by the FCC, there is also the consideration of whether the public is getting value for the spectrum used. This raises the question of the right context for treating spectrum made available only to private businesses rather than to the general public.

Value can be conceived in many ways, but is still an evolving concept. Spectrum can be valued on a monetary basis. Auctions clearly assign value to spectrum. Fees tied to the use of specific frequencies by a individual user or users may be another way to recover value. However, the value of the spectrum could also be based on its social or public worth. There may be cases, public safety for example, in which the value to the public comes in the services rendered by the user. Private users argue that the value to the public of their use of the spectrum--the benefit of private wireless spectrum generally--comes in the efficiency, competitive, and safety benefits private systems make possible. However it is defined, the value of spectrum is a significant component of the public interest standard today.

Exclusive Use

Concomitantly with these evolutions in technology and regulation, the Commission's methods for resolving mutually exclusive applications have also evolved. Because private land mobile radio frequencies are generally shared below 470 MHz, this evolution has had little immediate impact on most private users. And above 800 MHz, the "first come, first served" nature of the application process and the formation of SMR waiting lists as a way to satisfy the *Ashbacker* doctrine delayed the effect of this evolution until just recently. Initially, the Commission's only option to resolve mutually exclusive applications was to conduct a hearing. Then, the

[18] As of November 1996, the Congress had not yet given the Commission authority either to auction private radio service spectrum or to assess any type of spectrum fees. Interactive Video and Data Service licenses, however, have been auctioned.

Commission was given authority to conduct lotteries. Most mutually exclusive cellular applications were resolved by lottery.

Then, Congress gave the Commission the authority to use auctions to resolve mutually exclusive applications for radio services available on a subscription basis. As a result, mutually exclusive applications for subscription-based radio services are now generally resolved by auction. Sections 309(j)(1) and 309(j)(2) of the Communications Act[19] permit auctions where mutually exclusive applications for initial licenses or construction permits are accepted for filing by the Commission and where the principal use of the spectrum will involve, or is reasonably likely to involve, the receipt by the licensee of compensation from subscribers in return for enabling those subscribers to receive or transmit communications signals.[20] In addition, Section 309(j)(2)(B) requires the Commission, before it may adopt the use of auctions to award licenses, to determine that use of competitive bidding will promote the objectives described in Sections 1 and 309(j)(3) of the Communications Act.

Section 309(j)(3) of the Communications Act sets forth Congress's four objectives for competitive bidding, as follows:[21]

(A) the development and rapid deployment of new technologies, products, and services for the benefit of the public, including those residing in rural areas, without administrative or judicial delays;

(B) promoting economic opportunity and competition and ensuring that new and innovative technologies are readily accessible to the American people by avoiding excessive concentration of licenses and by disseminating licenses among a wide variety of applicants, including small businesses, rural telephone companies, and businesses owned by members of minority groups and women;

(C) recovery for the public of a portion of the value of the public spectrum made available for commercial use and avoidance of unjust enrichment through the methods employed to award uses of that resource; and

(D) efficient and intensive use of the electromagnetic spectrum.

Private Shared Use -- Community Repeaters/Multiple Licensing

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[19] 47 U.S.C §§ 309(j)(1), 309(j)(2).

[20] *See generally* Allocation of Spectrum Below 5 GHz Transferred from Federal Government Use, *Second Report and Order,* ET Docket No. 94-32, 11 FCC Rcd 624, ¶¶ 38 and 43 (1995).

[21] *See* 47 C.F.R. § 309(j)(3).

Traditional non-trunked systems operating on frequencies below 800 MHz that operated on shared channels experienced an evolution of their own. As private land mobile radio users migrated to higher frequency bands, line-of-sight considerations became more important because the higher the antenna, the greater the range of the system. Use of repeaters on mountaintops or on towers became more commonplace. However, there are a limited number of such choice sites.

With a need for base station sites at high locations, and a desire to repeat signals at other high locations, licensees sought and received regulatory relief from the FCC. An individual licensee was permitted to make use of its facilities available to other eligible private land mobile entities on a non-profit cost-shared cooperative basis. Multiple licensees were permitted to each use the same equipment for their respective systems. This was called "multiple licensing."[22] Licensees could also put up their own antennas and equipment at a shared site.

With the advent of multiple licensing, it became more and more common for third-party entrepreneurs to provide a single set of facilities at a particular site for the use of all the multiple licensees at that site. The third-party entrepreneur was not an FCC licensee, and in fact was not regulated by the FCC at all. Each of the multiple licensees remained separately responsible for its individual station, even though they all used a common site or common facilities. Alternatively, a licensee could opt for nonprofit or for-profit sharing of its facilities, where a single licensee is responsible for the entire system.[23]

Before 1993, for those private providers who chose to provide interconnected service, concerns arose about exactly how and where the interconnection should be offered. A private radio licensee offering a bundled service package that included interconnection to the PSTN could be construed as reselling common carrier services, causing the private radio licensee to cross that bright line and become a common carrier. One set of solutions to this was to carefully craft the location and type of interconnection to the PSTN. The simpler solution was to obtain the interconnection from a third-party entrepreneur, an answering service, or third-party dispatcher, one step removed from the private radio service itself.

Upon Congress' enactment of the changes to the Act in 1993, the Commission expressly reevaluated PLMR sharing and multiple licensing arrangements to determine whether they are CMRS in light of the new provisions of the Act.[24] PLMR

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[22] *See* 47 C.F.R. § 90.185.

[23] *See* 47 C.F.R. § 90.179.

[24] Implementation of Sections 3(n) and 332 of the Communications Act -- Regulatory Treatment of Mobile Services, GN Docket No. 93-252, Second Report and Order, *supra*, ¶¶ 47-49 (1994).

licensees may enter into shared-use arrangements on a not-for-profit basis and not be deemed CMRS, provided that they comply with Section 90.179 of the Rules.[25] Use of managers to operate multiple-licensed systems ("community repeaters"), considered typically small systems in which all system users are individually licensed, was also not deemed CMRS.[26] For-profit sharing under Section 90.179 that also includes interconnection and an offering to the public or a substantial portion of the public, to the contrary, is considered CMRS.

The Commission noted that if it is demonstrated that a licensee is operating a putatively not-for-profit or cost-shared system instead as a *de facto* for-profit service in competition with CMRS providers, that licensee would be in violation of Section 90.179, subject to enforcement action, and reclassified as CMRS.[27] The Commission also stated that it would closely monitor the use of multiple licensing arrangements to ensure that unlicensed managers do not attempt to provide for-profit service as *de facto* licensees.[28]

Evolution of Frequency Assignment and Licensing Mechanisms

As technology advanced and spectrum became more congested, the rules and regulations governing the assignment of licenses to PLMRS users evolved as well. In general, acquiring a license to operate a private land mobile system is a two-part process. First an applicant must apply for a frequency on which to operate a service, and then the applicant must be issued a license by the Commission. The applicant goes through a frequency coordinator in applying for the frequency. Today, private land mobile users are licensed in one of two ways, generally depending on the frequencies involved. First, an applicant may be licensed to share a given frequency along with other users in the same or different services. Second, an applicant may be granted exclusive use of a frequency.

Shared Frequencies

The PLMRS frequencies below 470 MHz, representing the majority of the frequencies allocated to the private radio services, are licensed on a shared, non-exclusive basis among the different services; different classes of users share frequencies in the same geographic area. The power, petroleum, forest products, airline, telephone maintenance, and manufacturing industries, for example, share

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[25] 47 C.F.R. § 90.179.

[26] Implementation of Sections 3(n) and 332 of the Communications Act -- Regulatory Treatment of Mobile Services, GN Docket No. 93-252, Second Report and Order, *supra*, ¶¶ 48 (1994).

[27] *Id.*, ¶ 47.

[28] *Id.*, ¶ 49.

frequencies in the 450-470 MHz band There are also some shared channels in the 470-512, 800, and 900 MHz bands.

Sharing allows multiple users with different coverage and capacity requirements to effectively use the same frequencies and increases the amount of frequency reuse that is possible compared to set distance separations--new entrants are often "squeezed in" to specific areas.[29] A sharing-oriented approach means that private system users must be able to tolerate interference and manage potential blocked access to channels. This is significantly different from most CMRS, which are generally licensed on an exclusive basis--no other user in a local area shares the same frequency. The shared use of frequencies also means that users and systems have to be coordinated in order to minimize interference and allow as many systems as possible to use the band--there are no defined geographic service/license areas or minimum separation distances between systems.[30]

An important element in enhancing the sharing of private wireless frequencies is the ability of users to be licensed on frequencies that are allocated to and controlled by other PLMR services; a process known as inter-service sharing.[31] For example, if a user needs spectrum in a given area, but no frequencies are available within its own radio service, that user can ask to use a frequency allocated to another PLMR service. This allows otherwise underutilized spectrum to be put to productive use. The extent of inter-service sharing that takes place varies depending on the services involved. Some services, which may have more available frequencies, participate more than those services that are congested. The willingness of frequency coordinators to recommend frequencies for applicants outside their normal purview also varies. The concept of inter-service sharing will change dramatically as a result of changes instituted as part of the Refarming (consolidation--see below) proceeding.

The Evolution of Frequency Coordination[32]

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[29] Comments of the International Taxicab and Livery Association, prepared by BIA Consulting, Inc., May 10, 1996.

[30] There are adjacent channel mileage restrictions in the 150 MHz band, see 47 C.F.R. 90.175(a)(1).

[31] Interservice sharing of frequencies in the 150-174 and 450-470 MHz bands pursuant to Section 90.176 of the Commission's Rules, 47 C.F.R. § 90.176, is different from, and should be distinguished from, inter-category sharing of 800 MHz frequencies pursuant to Section 90.621(e) of the Commission's Rules, 47 C.F.R. § 90.621(e). On April 5, 1995, a freeze was placed on the filing of new applications for inter-category sharing on all private mobile radio service frequencies in the 806-821 and 851-866 MHz frequency bands. This freeze is still in effect.

[32] Much of the information in this section is attributable to *Policies and Practices in the Regulation of Private Radio Communications Systems* (1994), by Frederick J. Day, Jr., at 5-1 through 5-6.

Frequency coordination for a new system involves selecting a frequency that will most effectively meet the applicant's needs while minimizing interference to licensees already using a given frequency band. To identify the most appropriate frequency in the area, private land mobile applicants rely on frequency "coordinators," also known as "frequency coordinating committees."[33] These frequency coordination entities are certified by the FCC. A list of currently certified frequency coordinators is included as Appendix C.

The coordination process for PLMRS frequencies has evolved over time from a very informal arrangement among radio users to a more formal system recognized in law and overseen by the FCC. Before 1958, the FCC's rules required applicants and licensees in the private land mobile services to cooperate with each other in the selection and use of frequencies in order to minimize the possibility of interference. Over time, groups of private radio licensees established frequency coordinating committees to bring order to the frequency assignment process.

In 1958 the Commission amended its rules to formally recognize the role of these frequency coordinating committees and establish principles to govern their operations.[34] With the exception of certain Business Radio frequencies, the Commission required applicants for new stations in the private land mobile radio services to provide evidence of frequency coordination when filing their applications. This could be accomplished in one of two ways. First, the applicant could conduct a "field study" and submit a report indicating the degree of probable interference to existing stations. This option allowed the applicant to select their own frequency rather than relying on a frequency coordinator. Alternatively, the applicant could provide a statement from a frequency advisory committee recommending the specific frequency that would result in the "least amount of interference" to existing stations.[35]

In 1986, responding to Congressional and industry concerns, the Commission abolished the alternative of "field studies" to satisfy an applicant's coordination requirements.[36] This meant that every application for a private land mobile radio station to operate on a shared frequency had to be submitted to a frequency

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[33] An applicant will, on occasion, request particular from a frequency coordinator, and when doing so, generally submits information in support of such a request. The coordinator must determine, however, whether those frequencies are the most appropriate for that applicant's use in that particular geographic area.

[34] Amendment of the Commission's Rules Governing the Industrial Radio Services to Delete, Modify and Create Services and Effect Changes in the Availability of Frequencies, *First Report and Order*, Docket No. 11991, 23 Fed. Reg. 4784 (1958).

[35] *Id.* at 4793-4794.

[36] *Report and Order*, PR Docket No. 83-737, 103 FCC 2d at 1125-26.

coordinator for that coordinator's recommendation of the best available frequency for the applicant's operation in the relevant area. The Commission decided that there would be only one frequency coordinator recognized for each individual radio service, and certified each respective coordinator in its 1986 decision.[37] Multiple coordinators were established for the SMR General Category Pool. The frequency coordination process survives in this form to the present day, although consolidation of the private radio services (see Refarming discussion below) could alter the coordination process. An abbreviated discussion of the frequency coordination process is found in Figure 1.

Id. at Appendix B (unpublished).

Figure 1: FCC's Private Land Mobile Radio Service Licensing Process

The 25-50 MHz, 150-174 MHz, and 450-470 MHz Bands

Step 1: Applicants may obtain **Form 600** (application for PLMRS) by toll-free phone (800) 418-3676 (FORM); by mail, FCC, Forms Distribution Center, 9300 E. Hampton Dr., Capital Heights, MD 20743; through fax on demand, call (202) 418-0177; or on the Internet (http://www.fcc.gov). The **WTB Fee Filing Guide** may be obtained by calling the Consumer Assistance Branch (800) 322-1117. Applicants who want to electronically file their application may obtain an FCC-provided software package from the Internet or the FCC Bulletin Board Service (For instructions, obtain Public Notice 61960 available on the WTB home page).

Step 2: Applicant completes Form 600.

Step 3: Applicant selects the appropriate frequency coordinator (FCC Fact Sheet PR 5000 #301, which is available on the Internet, contains a list of FCC-certified Part 90 frequency coordinators). The frequency coordinator that the user contacts will depend on the nature, size and purpose of the user's radio service.

Step 4: Applicant submits application, along with a check payable to the FCC for processing, and, if applicable, a check for the frequency coordination fee, to the frequency coordinator. The frequency coordinator will select the best available frequency based on the nature, size, and purpose of the radio systems already authorized on the frequency.

Step 5: Upon choosing the best available frequency, the frequency coordinator forwards the application and the check covering the FCC's fee to the FCC's lockbox bank facility in Pittsburgh, PA, and notifies the applicant of its recommendation.

Step 6: FCC's lockbox bank facility forwards the application package to the Licensing Division (LD) of the WTB in Gettysburg, PA.

Step 7: LD reviews application to confirm that a frequency was selected, coordinated, and approved by the frequency coordinator; ensures that application meets all applicable FCC rules; and performs any international coordination required. If the application involves a fee waiver, the Technical Branch of the LD reviews the request for fee waiver.

Step 8: Upon grant of the application, the FCC mails the license to the applicant and a copy to the appropriate frequency coordinator.

Exclusive Licensing

The Commission may assign spectrum in the bands 470-512 MHz, 806-824/851-869 MHz and 896-901/935-940 MHz for the exclusive use of a single entity. Exclusivity is only granted for conventional (non-trunked), single-channel systems if an applicant or licensee plans to operate 70 or more mobile units.[38] Otherwise, a channel may still be shared until that level is reached. Frequency coordination is required for all non-trunked SMR applicants. The coordination process is different for these frequency bands. There are specific coordination criteria set forth in the rules. Generally, these criteria provide for 70 mile separation between private land mobile stations using the same frequency in the 800 and 900 MHz bands. There are established exceptions in the rules for lesser separations if certain "short-spacing" criteria are met.[39] Non-SMR applicants submit their applications to their respective frequency coordinators, and typically do not ask for a particular frequency assignment, but seek the assistance of the coordinator in finding (a) channel(s) that meet the criteria. SMR applicants for SMR Pool frequencies, however, submit their applications directly to the Commission and do not employ the services of frequency coordinators, unless they file applications for channels in the General Category. SMR applications do not specify requested frequencies. Instead, the Commission determines the best available SMR channel(s) based upon whether the proposed station would cause harmful interference to previously licensed stations or stations that may be licensed as a result of previously pending applications.

Unlike subscriber-based services, PLMR licensees apply for only those channels needed to satisfy reasonably their own foreseeable communication requirements. A communications service provider, in contrast, acquires spectrum in the hope that users will be found. The provider has no need to justify system capacity.

Site-Based Licensing for PLMR Services

Generally, an applicant for a private land mobile radio license first chooses the site (location) at which the applicant intends to operate the base and/or mobile relay station (the "fixed" portion of the base-to-mobile operation). For shared frequencies below 470 MHz, the applicant then must employ the services of a frequency coordinator to determine the best frequency(ies) available in the service for which the applicant is applying at that site. For frequencies above 470 MHz that are not

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[38] 47 C.F.R. § 90.625(a).

[39] Both the standard co-channel separation criteria and the criteria for "short-spacing" are contained in 47 CFR § 90.621.

shared, but exclusive (other than the General Category at 800 MHz), the FCC determines whether frequencies are available and, if so, assigns the frequency(ies) at the requested site. Thus, from its inception to the present day, the majority of private land mobile radio applications and assignments are site-based.

Prior to 1993, SMRs and for-profit private carriers in the private land mobile bands were site-based. As a result of the Omnibus Budget Reconciliation Act of 1993, however, together with authorization for auctions to resolve mutually exclusive applications, a new paradigm evolved within Part 90 frequencies for commercial authorizations. Cellular entities were not typically authorized as site-based licensees, but rather were authorized to serve particular geographic areas. Once the Commission was required to treat all commercial entities in a similar fashion, it proposed to license SMRs and some for-profit private carriers operating in private land mobile bands on a geographic basis as well.

The practical effects upon private land mobile radio are that the private frequencies allocated to the SMR pool above 800 MHz are being reallocated from private land mobile radio to commercial radio; although some SMR providers are choosing to remain private. For the newly-commercial SMRs, new application and assignment rules either have been adopted or are currently under consideration. We have adopted geographic licensing for the upper 200 contiguous 800 MHz SMR Category channels. Geographic licensing proposals for the lower 80 SMR Category channels, as well as General Category channels, are still pending. In both cases, there are some incumbent non-commercial site-based private land mobile radio licensees that will be affected because they are present on the frequencies in those pools that will have the overlay auctions. In the SMR pool, they exist as a result of intercategory sharing. In the General Category, they exist because those frequencies were formerly only available for non-trunked conventional systems, to which many non-commercial systems originally gravitated.

Similar proposals are currently being advanced for other Part 90 private land mobile spectrum, including the outstanding Notice of Proposed Rule Making concerning 220 MHz spectrum.[40] Remaining Part 90 Private Land Mobile Radio spectrum, throughout its shared and exclusive-use bands, contains substantial numbers of both private and commercial site-based licensees.

General Technical Standards

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[40] Amendment of Part 90 of the Commission's Rules To Provide for the Use of the 220-222 MHz Band by the Private Land Mobile Radio Service, PR Docket No. 89-552, Implementation of Sections 3(n) and 332 of the Communications Act--Regulatory Treatment of Mobile Services, GN Docket No. 93-252, and Implementation of Section 309(j) of the Communications Act--Competitive Bidding, 220-222 MHz, PP Docket No. 93-253, *Second Memorandum Opinion and Order and Third Notice of Proposed Rulemaking*, 11 FCC Rcd 188 (1995) (*Third Notice*).

The Commission's PLMRS regulations include certain technical standards.[41] These requirements include standards for acceptability of equipment, frequency stability, modulation, emissions, power, and bandwidths.

The Commission periodically publishes a list of equipment entitled "Radio Equipment List, Equipment Acceptable for Licensing."[42] A licensee can only use a transmitter that appears on this list as "type accepted." Any manufacturer of radio transmitting equipment to be used for PLMRS may request type acceptance for such equipment.

Applicants for PLMRS licenses must request and use no more power than the actual power necessary for satisfactory operation.[43] The Commission's regulations specify the maximum power that will be authorized for particular bands. For instance, under 25 MHz the maximum transmitter peak envelope for single sideband operations is 1000 watts. For the bands between 25 and 50 MHz, the maximum transmitter output power is 300 watts, and between 72 and 76 MHz the maximum effective radiated power for stations operating on fixed frequencies is 300 watts.

The Commission's regulations set forth types of emissions that are permitted for PLMRS.[44] Each authorization issued to a station licensed under Part 90 shows an emission designator representing the class of emission authorized.[45] The designator is prefixed by a specified necessary bandwidth. This number, however, does not necessarily indicate the bandwidth occupied by the emission at any particular instant. In addition, radio services governed by Part 90 must comply with specified emission masks[46] and must meet certain minimum frequency stability requirements.[47]

In addition to the above requirements, private radio systems--like all FCC licensees--are also subject to the Commission's guidelines regarding radiofrequency emissions. The Commission recently released new guidelines that limit the amount of radiofrequency emissions to which both workers and the general public can be

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[41] 47 C.F.R. Part 90, Subpart I.

[42] 47 C.F.R. § 90.203.

[43] 47 C.F.R. § 90.205.

[44] 47 C.F.R. § 90.207.

[45] 47 C.F.R. § 90.209.

[46] 47 C.F.R. § 90.210.

[47] 47 C.F.R. § 90.213.

exposed.[48] The new regulations cover both emissions from portable radios and base station transmitting antennas. Under the new rules, all private carriers are expected to comply with the new limits, but most (except some part 90 paging operations) are categorically exempt from having to perform routine measurements to demonstrate their compliance.

Operating Requirements

The Commission's PLMRS regulations include certain operating requirements. These requirements include: station operating procedures, points of communication, permissible communications, methods of station identification, control requirements, and station record keeping requirements.[49]

In general, PLMRS licensees are held directly responsible for the proper operation and use of each transmitter for which they are licensed. The Commission's rules specifically state that licensed facilities must be used only for permissible purposes, in a permissible manner and only by persons with authority to use and operate the licensed equipment.[50] Licensees may not, through written or oral agreements or otherwise, relieve themselves of any duty or obligation imposed upon them, by law, as licensees. Each licensee must restrict all transmissions to the minimum practical transmission time and must employ an efficient operating procedure designed to maximize the utilization of the spectrum. Communications involving the imminent safety-of-life or property are to be afforded priority by all licensees.

Licensees must take reasonable precautions to avoid causing harmful interference.[51] This includes monitoring the transmitting frequency for communications in progress and such other measures as may be necessary to minimize the potential for causing interference. Except for some particular situations, stations may not continuously radiate an unmodulated carrier. The radiations of a transmitter must be suspended immediately upon detection or notification of a deviation from the technical requirements of the station authorization and until such deviation is corrected.

PLMRS licensees may only transmit communications related directly to the imminent safety-of-life or property, or communications directly related and necessary

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[48] Guidelines for Evaluating The Environmental Effects of Radiofrequency Radiation, *Report and Order*, ET Docket 93-62, released August 1, 1996.

[49] 47 C.F.R. Part 90, Subpart N.

[50] 47 C.F.R. § 90.403(a).

[51] 47 C.F.R. § 90.403(e).

to those activities for which they are licensed.[52] Licensees may not transmit broadcast programming or offer a common carrier service.[53] Normally, operations licensed under Part 90 are intended to provide intrastation mobile communications. For example, a base station is intended to communicate with its associated mobile stations and mobile stations are intended to communicate between associated mobile stations and associated base stations of the licensee. Operations between base stations at fixed locations are permitted only in particular situations.[54]

A licensee is not required to have an operator license or permit for the operation, maintenance, or repair of licensed stations.[55] The station licensee is responsible for the proper operation of the station at all times and is expected to provide observations, servicing and maintenance as often as may be necessary to ensure proper operation. The current original authorization for each station must be retained as a permanent part of the station records, but does not have to be posted.[56]

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[52] 47 C.F.R. § 90.405.

[53] 47 C.F.R. § 90.415.

[54] 47 C.F.R. § 90.419.

[55] 47 C.F.R. § 90.433.

[56] 47 C.F.R. § 90.437(a).