



Chapter 1

Introduction to Land Mobile Radio

The mobile wireless communications industry easily ranks as one of the most dynamic and fast-growing— if not the fastest growing—industries of today. Driving its popularity and growth are the wide variety of services it provides and the tremendous benefits it offers. Around the globe, convenience, improved efficiency, and enhanced productivity have become its trademarks.

Conventional Land Mobile Radio (Two-Way)

Conventional systems dedicate a single radio channel to a specific group of users who share it. As such, privacy is limited. It is possible for a company using a channel to be overheard by other users on the same channel. Some of these listeners might even be competitors! Conventional systems, by limiting a group of users to a specific channel, also limit the total number of customers who can be served by the system. Moreover, because radios on conventional systems transmit and receive on a single channel, the user must wait if the channel is occupied by another conversation. For these reasons, conventional systems are considered spectrally inefficient when compared to trunking systems. Figure 1.1 shows a block diagram of a conventional land mobile radio system.

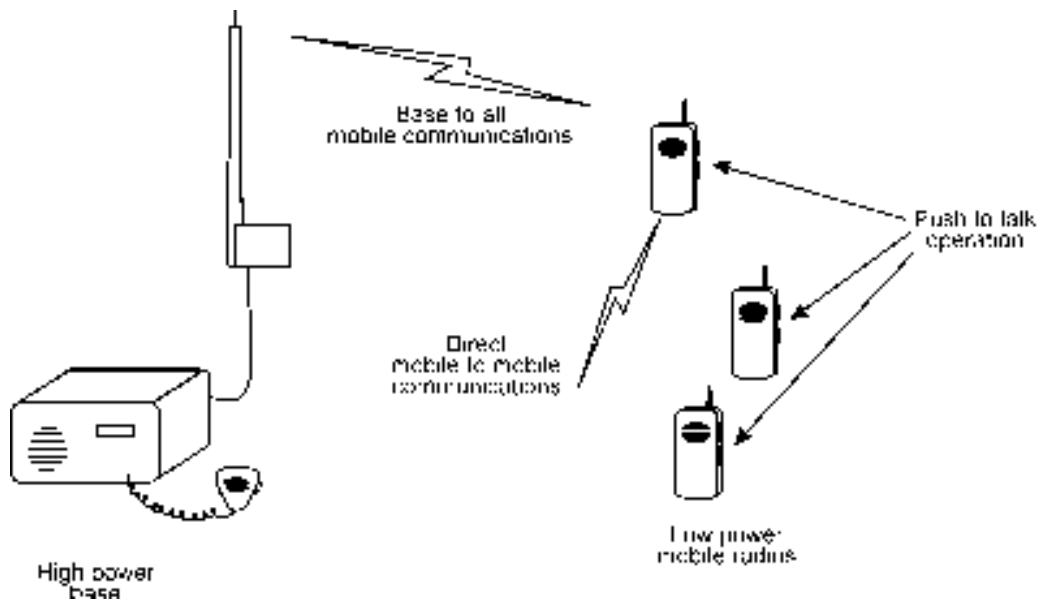


Figure 1.1, Conventional Land Mobile Radio System

Trunked Radio

Trunking systems, using frequency-trunked technology, were developed to use radio spectrum more efficiently, while offering companies a more sophisticated, private, and efficient way of communicating with their mobile workforce. Trunking systems are more expensive than conventional systems, but they also offer significant benefits and improvements in spectral-efficiency.

Unlike conventional technology, trunking allows for the automatic sharing of multiple radio channels. This means that a group of channels is assigned to a group of users who then share the channels. The advantage of this arrangement is that when a user attempts to make a call with the radio, a trunked system searches for an available channel and assigns it to the call. A different radio channel may be assigned each time the customer uses the radio; it may even switch during the same conversation. Either way, users are unaware of the swap. In the event the system is fully loaded and all channels are in use, the user either receives a busy signal or calls are "queued" until a channel is free. After the channel is selected, users have private use of the channel, which reduces interference and eavesdropping.

Trunking is considered much more spectrally efficient because switching between multiple radio channels allows less blocking and provides service to more radios per channel. Consider that on a 20-channel conventional system, roughly 700-1,000 users can be served. In contrast, those 20 channels on a trunked, dispatch-type system can service between 2,000 and 2,500 users!

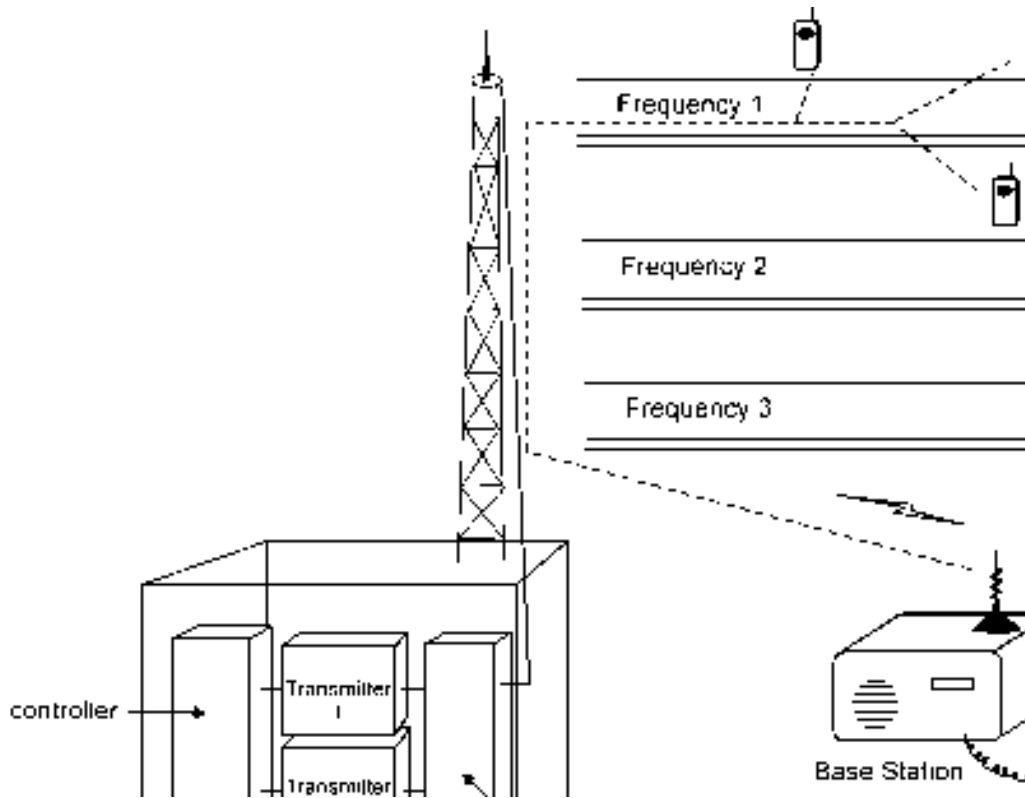
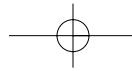


Figure 1.2, Trunked Land Mobile Radio System

Trunked systems also offer customers wider coverage areas through 1) interconnection with the public switched telephone network (PSTN), which allows trunked radio users to communicate with any user of the wireline telephone network; and 2) interconnection with other trunked systems, which may or may not be assigned to that user. Figure 1.2 shows a trunked land mobile radio system.

Commercial Trunked Radio

One relatively small, but significant, segment of the overall mobile wireless industry is commercial trunked radio, which has only recently begun to receive worldwide attention. This is because commercial trunked radio systems usually serve a very specific user group, rather than the public at large, and the major growth of the industry has occurred only within the last five years.



Today, a wide range of commercial trunked radio users exist as well as a variety of technologies and services to meet their needs. As word spreads about the industry and regulators allow for it to exist, we will see commercial trunked radio systems being introduced in country after country with increasing opportunities.

The term “commercial trunked radio” was created by the International Mobile Telecommunications Association (IMTA) in an attempt to create a universal definition encompassing the many names for the industry and to identify a specific kind of service.

As mentioned above, this small segment of the wireless communications industry has experienced rapid growth primarily outside the United States within the last five years. As the industry is created in each country, there are an increasing number of names and classifications governments use to identify the service. For example, commercial trunked radio is known as Specialized Mobile Radio (“SMR”) in the United States and is typically referred to as Trunked Radio Systems (“TRS”) in Asia and Public Access Mobile Radio (“PAMR”) in Europe. Figure 1.3 shows a commercial land mobile radio system.

Because the service is subject to different regulations in each country, it is difficult to create a single “name” for the service without first creating a definition. So, the following was developed.

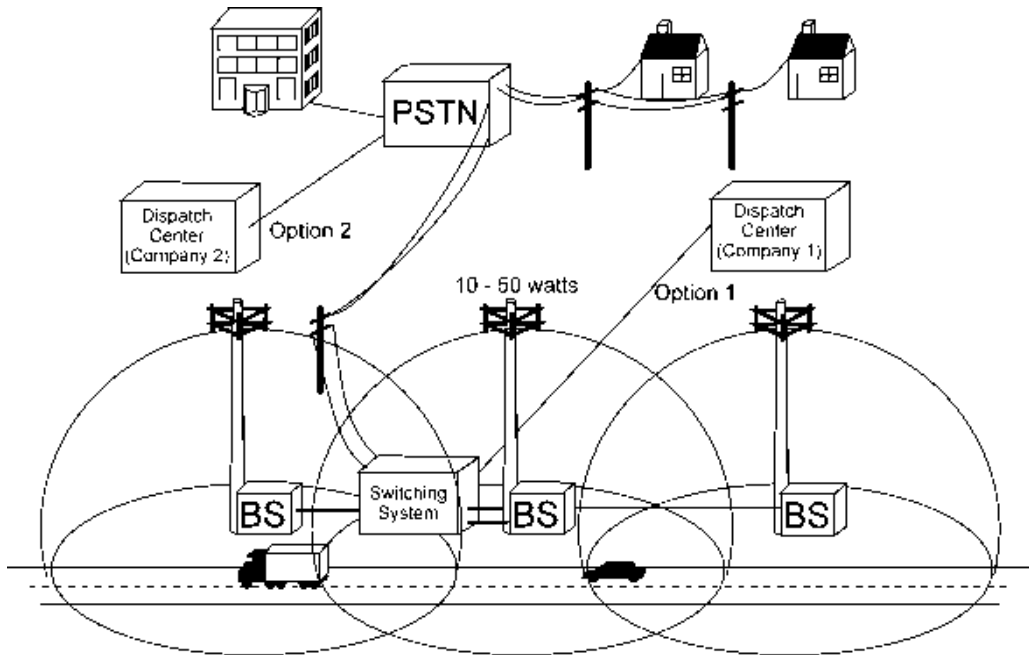
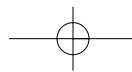


Figure 1.3, Commercial Land Mobile Radio System



The commercial trunked radio industry consists of wireless radio communications systems which employ either conventional or frequency-trunked technology to achieve two-way mobile radio communications. Most conventional and traditional trunked systems are analog systems, but several manufacturers have developed sophisticated digital technology aimed at dramatically increasing system capacity.

Commercial trunked radio systems generally provide one-to-many and many-to-one mobile wireless voice communications services, often called mobile dispatch services. Commercial trunked radio systems were developed to serve entities with a particular need for one-to-many and many-to-one mobile communications because they require the ability to communicate with large or small groups of employees on the road, especially those in fleet, sales and service operations.

Historically, commercial trunked radio technology can enable a company to simultaneously communicate with all units in a mobile and/or portable fleet or to direct transmissions to a single radio or subgroup of radios. For example, a customer can configure his trunked radio system to allow him to press a button and talk with one individual, press the same button and talk with one or more groups of people, and then press that same button again and talk with everyone on the entire network. This allows a company to operate with increased flexibility and efficiency.

Although commercial trunked radio systems are traditionally characterized by this ability to offer one-to-many and many-to-one voice communications, today they offer much more, including data capacity and full access to the PSTN. Many systems also offer integrated services such as voice mail, data messages, faxes or data transfer.

Commercial trunked radio systems are operated mostly by commercial entities, commonly called "service providers," who supply and resell their services to other entities for a profit. Commercial trunked radio systems are operated by commercial entities whose sole purpose is to provide a competitive business communications service. This is in contrast to trunked radio systems owned and operated by government agencies or by private companies for their own internal use. As more and more regulators allow entrepreneurs and businesses to operate commercial trunked radio systems, they allow a viable new marketplace to be created within their borders, with services tailored to meet the needs of particular user groups and reduced cost through competition.



Figure 1.4, Traditional Land Mobile Radio
Source: Motorola

The Need for Land Mobile Radio

The basic need for land mobile radio (LMR) is to allow independent two-way radio operation for private users of two-way radio services. Land mobile radio systems traditionally are used by organizations that have the need for instant communication such as taxi service, retail, construction, hospitality, conventioners, police and fire departments. The users of these rugged communication devices, as shown in Figure 1.4, belong to a pre-designated group of other users on the same account. All the radios, or a sub-group of radios can receive an instant communication by any party in the group. A push-to-talk method is used during the dispatch call or reply. This push-to-talk, radio-to-radio communication efficiently utilizes the airwaves because of the bursty nature of the information.

Locations of Commercial Trunked Radio Systems

Since 1990, changes in regulation and increased demand have led the commercial trunked radio industry to be introduced in a number of new markets throughout the world. At the end of 1997, it is estimated that there were commercial trunked radio systems in at least 55 countries, particularly in Europe, Latin America and the Asia-Pacific region, serving an estimated 6.8 million users. The rapid growth trend is predicted to last at least until the year 2015.

North America

In North America, the first country to introduce the commercial trunked radio industry in 1974 was the United States. It was at this time that the U.S. Federal Communications Commission (FCC), the primary telecommunications authority, recognized the need for greater and more efficient mobile communications. The FCC formulated two new types of mobile services, cellular and Specialized Mobile Radio (SMR), the U.S. term for commercial trunked radio. The FCC created separate rules and regulations for the two industries, expecting each to attract a unique group of users. SMRs were classified as “private carriers” and, as such, were not subject to “common carrier” regulations at either the state or federal levels. Cellular services, on the other hand, were classified as “common carriers” due to their expected appeal to the public.



The FCC also provided, and continues to provide, discreet spectrum for private, internal-use trunked systems.

The first U.S. commercial trunked radio network was launched in 1977. A decade later found approximately 3,000 operators with 628,000 units in service. By the end of 1997, the number of subscribers exceeded 2.68 million. The largest operator in the world was found in the United States: Nextel Communications. This company had more than 2.2 million subscribers at the beginning of 1999.

The constant growth of the U.S. industry is attributable to the growing importance of wireless communications, favorable economic conditions, the affordable price of most commercial trunked radio services and, most importantly, a positive regulatory environment. Continued growth is expected as enhanced services are introduced and more spectrally efficient technologies are implemented.

In Mexico, the government has been taking steps to deregulate the telecommunications sector to allow for private investment and to improve the quantity and quality of communications services. The deregulation process began in the late 1980s and, as new regulations were implemented, the market for commercial trunked radio, cellular, and paging was opened to private investment. By the end of 1996, 45 companies were operating commercial trunked systems in Mexico with an estimated 73,000 units in service.

The commercial trunked radio industry has been active in Canada since 1984. It is estimated that there are more than 50 and perhaps even hundreds of companies operating such systems today. The Canadian Wireless Telecommunications Association estimates that the total number of subscribers on these systems is 200,000. Some consolidation has occurred in the industry recently, which has left it with about three large operators and many small operators throughout Canada.



Europe/Eurasia

Until the late 1980s, most two-way radio systems in Europe were private networks owned and operated by utility companies, taxi companies, public safety groups, private companies, and government entities. At that time, deregulation in Europe, coupled with the desire among many telecommunications companies to offer new services, led to the introduction of the commercial trunked radio industry in the region. The first system was introduced in 1987 in the United Kingdom. In 1990, the French government issued its first commercial trunked radio licenses, and systems following soon after, known as "Chekker networks," appeared in Germany. Many other countries soon followed suit.

For those European and Eurasian countries that gained independence in the late 1980s/early 1990s, an inadequate public telephone infrastructure and the desire of the new regimes to privatize the communications sector led to liberalization and the immediate introduction of commercial trunked radio services in many markets.

Today, more than 175 companies are operating commercial trunked radio systems in Belarus, Belgium, the Czech Republic, Estonia, Finland, France, Germany, Latvia, Lithuania, Moldova, Poland, Portugal, Romania, Russia, Spain, Sweden, Tajikistan, Turkey, Ukraine and the United Kingdom. The largest markets are found in France, Germany and the United Kingdom.

In some of these countries, such as the United Kingdom and Germany, there may be hundreds of additional smaller systems in operation—just how many is unknown. In other European countries—including Bulgaria, Denmark, Hungary, Italy, Luxembourg, the Netherlands, Norway, and Switzerland—government agencies still control the trunked radio systems in operation. However, in many of these countries, regulators are investigating ways to introduce commercial trunked radio services in their markets over the next few years.

Although there were fewer than 100,000 commercial trunked radio subscribers in Europe in 1992, that number topped 567,000 in 1997 and is expected to increase to 1 million by 2000.

Central and South America and the Caribbean



The commercial trunked radio industry has seen increased growth in Latin America particularly in the last five years. This growth can be attributed to the region's high demand for reliable two-way voice communications and for business tools that improve productivity and efficiency. This demand has been able to be met due to the decision among many governments to privatize certain telecommunications services. This has opened a variety of telecommunications services to competition, including commercial trunked radio. Today, about 250 companies have licenses to operate these systems in Argentina, Brazil, Chile, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Peru, Trinidad & Tobago, and Venezuela.

Given that the commercial trunked radio industry has only been active in Latin America for a short time, the number of licenses that have been issued is significant. However, it should be noted that not all of these licensees are operating systems. In fact, in 1995 it was estimated that only 200,000 units were in service in these countries. With such high demand for service, the Latin American market is severely untapped. As more systems are fully implemented and others emerge over the next decade, we can expect to see increased industry growth.

The largest markets in the regions are Argentina, Brazil, Chile, Colombia and Venezuela, each with more than 10,000 total subscribers. The smaller markets have anywhere from a few hundred to a few thousand subscribers. However, competition is heating up in each market. Evidence of consolidation has appeared in Argentina, Brazil and Colombia, where operators are banding together to capture a larger market share. Many operators also are implementing larger systems to obtain larger capacities to serve the growing demand for these services.

Asia-Pacific



The commercial trunked radio industry has existed in Asia-Pacific since 1982, when the first system went into operation in New Zealand. Soon thereafter systems were also introduced in Japan and Australia. In most other countries in the region, however, the service was either relatively unknown or offered only by government agencies. In the last five years, many Asian-Pacific countries have experienced high economic growth, which has prompted demand for sophisticated business communications services. As governments have liberalized the telecommunications sector, commercial trunked radio has been able to meet this demand. Today, more than 250 companies have licenses to operate these systems in Australia, Cambodia,

China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore, Sri Lanka, Taiwan and Thailand.

Considering the industry's recent debut in the region, the number of licensees is significant. It seems safe to say that the industry has yet to experience its major growth spurt. In fact, licenses were issued for the first time in 1996 in major markets, such as India and South Korea. Operators anticipate a huge demand for services in these countries as well as several other Asian markets at least over the next five years. However, one factor that may limit commercial trunked radio growth in the region is the prohibition of operators to provide interconnect service. This restriction is found in several Asian countries. It is hoped that this restriction will eventually be lifted or relaxed as operators and associations such as IMTA continue to pressure governments to adopt flexible regulatory policies.



Africa/Middle East

The commercial trunked radio industry has also appeared in several countries in Africa and the Middle East in the last few years, although growth in these two regions has not been as extensive.

While many countries in Africa are in need of reliable two-way communications systems, many governments are currently focusing on industry development and unification rather than creating a thriving telecommunications sector. While some radio systems are in operation, they are commonly operated by government entities or United Nations forces rather than private companies. The key exceptions are the Ivory Coast, South Africa and Uganda.

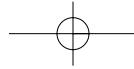
In the Middle East, demand for voice communications as well as business communications tools are in demand. Highly centralized governments have been hesitant to release radio frequencies to the private sector, although some are now considering doing so. The exceptions are in Turkey, where nine companies operate commercial trunked radio systems; Lebanon, where 67 companies operate these systems; and Jordan, where the government recently issued the first tender for commercial trunked radio systems.

As countries in these regions stabilize and open their telecommunications markets, the commercial trunked radio industry will have many opportunities for expansion and growth.

Commercial Trunked Radio Services

Commercial trunked radio systems were created to provide mobile dispatch voice services via analog systems. As demand for commercial trunked radio services has increased, so has the demand for more enhanced and diversified services. To meet this demand, technologies have been developed that expand and improve analog services. For example, trunking technology improved analog service by allowing more privacy, channel capacity and spectrum efficiency.

While service rules vary from country to country, additional enhanced and diversified services have evolved such as interconnection to the PSTN, networking between sites, messaging, and the ability to transmit and store various forms of data.



Conventional systems ordinarily provide:

- on-site direct radio to radio communications;
- wide-area coverage in remote areas;
- more efficient utilization of frequencies;
- enhanced dispatch capabilities;
- increased radio coverage.

As briefly explained above, trunked systems offer additional capabilities, including:

- improved system access;
- call privacy;
- user priority levels for system access;
- more efficient frequency utilization;
- flexibility in assigning multiple talk group levels;
- enhanced dispatch capabilities;
- system management capability.

The differences between analog and digital technology are substantial. For instance, operators who use digital technology claim that this technology is able to provide end users with the following:

- increased communications reliability;
- increased capacity to handle more calls;
- greater call privacy;
- reduced exposure to fraud;
- easier multiplexing;
- easier encryption;
- better monitorability of performance;
- integration of switching and transmission;
- opportunities for data and voice services, such as paging, messaging, and voice mail.

Voice

The most well known application for land mobile radio is wireless voice communications. Voice communication can be basic telephony or two-way voice (radio-to-radio). The service rates charged for land mobile radio voice services are normally lower than service usage charges for cellular systems. For private systems where the radio license permits private radio operation to be owned by a company, there are usually no service fees aside from the equipment maintenance costs. When LMR operators provide service for public use (such as for a taxi cab company), a flat monthly fee is charged and there is no usage fee. When the land mobile radio system offers telephony service, a fee is commonly charged for connection to the public telephone network since an operator must pay for the wired telephone line (and sometimes the usage of the line). When LMR systems provide voice services that interconnect with a public telephone network, they ordinarily charge per minute usage fees for both two-way voice and basic telephone service.

Dispatch

Dispatch radio service normally involves the coordination of a fleet of users via a dispatcher. All mobile units and the dispatcher can usually hear all the conversations between users in a dispatch group. Dispatch operation involves push-to-talk operation. Common dispatch service rates are shown below.

The commonality between dispatch service and mobile telephony is that communication occurs for brief periods. There is usually no charge for the airtime usage for SMR systems, but ESMR systems commonly charge usage fees for dispatch service.

Paging and Messaging

Paging and messaging services allow users to send and receive text messages up to approximately 200 characters per message. Messages can be cascaded to allow the sending of longer messages.

Depending on the type of system, the charge for unassisted messaging services varies from “no cost” when bundled with other services (such as voice) up to 50 cents per message. The cost per message ordinarily comes from operator assisted messaging.

Data

One of the fastest growing areas for land mobile radio is data service. Data services transfer information between computers and data terminals. Examples of data devices used in land mobile radio systems include computers used in police cars and digital dispatch terminals used in taxi cabs and delivery trucks.

A new type of operator console and service has been created to take advantage of data services on LMR systems. This service is called computer aided dispatch (CAD). CAD systems are a computerized communication system that can coordinate and/or track mobile vehicles. CAD systems can comprise various degrees of complexity, from automated messaging devices to complex computer systems that display maps and vehicle positions on a computer monitor.

Similar to the messaging fee structure for LMR service, the fees charged for data services range from “no charge” to over 10 cents per kilobyte.

Commercial Trunked Radio Standards

Although several standards/protocols have been developed, there is not one universal standard for commercial trunked radio systems. Within the industry, there are a mixture of key protocol standards that have been developed by manufacturers in the United States and Europe.

Analog Systems

In the United States, where the FCC has not promoted or created a standard, there are three analog protocols, each of which was developed by a manufacturer in the mid-1970s: E.F. Johnson Co., Ericsson Inc., and Motorola Inc. These manufacturers and many others, such as Kenwood and Uniden, supply equipment to commercial trunked radio operators throughout the world.

In the case of the United States, while market forces have dictated industry development and created a diverse and robust industry, the absence of a standard has led to the production of equipment that is incompatible with dissimilar systems. Over the last ten years, the emergence of multiple vendors for the Johnson LTR® protocol has been critical. The adoption of this protocol by so many vendors has led to what some consider a “de-facto standard.” Furthermore, groups of operators in the U.S. are now creating wide-area networks through consolidation, purchases of trunked systems or roaming agreements with other operators.

In Europe, the MPT 1327 protocol for analog trunked systems was pioneered by several manufacturers and first published in 1985. The first MPT systems went into operation in 1989, and MPT standard equipment is widely used throughout Europe and in many other countries. Many variations of the standard have been adopted. One example is Autonet, a Finnish standard based on MPT 1327. Many European operators and policy makers believe that, while creating a standard has contained market development, it has also helped the industry grow by creating flexibility while retaining competition.

Other companies, such as SmartLink Development L.P. and ComSpace Corp., are producing enhanced new technologies for commercial trunked radio systems. SmartLink’s SMRLink® technology is geared toward wide area networking and Unique’s DCMA technology is aimed at increasing system capacity without obtaining additional channels.

Digital Systems

To meet the growing need for advanced services and to lower system equipment costs, the land mobile radio industry is migrating to digital radio technology. Two digital mobile radio standards are being developed by association organizations in the U.S. and Europe. Other proprietary digital protocols have been developed by private companies. The first, Terrestrial Trunked Radio (TETRA) is being developed by the European Telecommunications Standards Institute (ETSI), and the second, APCO-25, is under development by the U.S. Association of Public Safety Communications Officers (APCO).

TETRA is seen as a replacement for the analog trunked MPT 1327 systems and large conventional analog systems. It is structured similar to MPT 1327 trunked analog products, in that interfaces are standard. However, within the infrastructure, each vendor will implement different interfaces to meet the different needs of end users. Forty-six organizations worldwide have signed a Memorandum of Understanding to support TETRA. To date, several TETRA systems are already in operation throughout Europe and several operators, such as Motorola and Nokia, have reported additional system orders.

APCO-25 is targeted specifically for the public safety and security sectors. Because these sectors usually are served by government operated or private systems, it probably will not be used for commercial trunked radio services.

While only two standards for digital radio technology are being developed, several companies have developed digital technology for this new and growing market. Some examples are EDACS® by Ericsson Inc. and iDEN® by Motorola Inc. Ericsson reports that more than 350 EDACS® systems are in operation worldwide, including Brazil, Canada, Hungary, Italy and the United States. Motorola reports that eight iDEN® systems are in operation worldwide in, Argentina, Canada, Colombia, Israel, Japan, Singapore, and the United States. In addition, the company currently is installing additional systems in Argentina, Brazil, China, Korea, Mexico, and the Philippines. The new generations of land mobile radio handsets have similar features to cellular telephones along with advanced traditional LMR features (e.g., dispatch).

Trunked Mobile Radio Equipment

Commercial trunked radio units are either hand-held portable radios or mobile radios installed in a vehicle. Many newer units look exactly like cellular phones and others look more like telephone handsets. Some units look like traditional land mobile radios. However, end-user equipment is changing rapidly. New generations of both analog and digital trunked radio units offer built-in paging, messaging, phone directories, voice mail, data, and more. These units offer advanced ergonomic designs created for more consumer appeal.

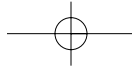
Commercial Trunked Radio Users

The most common customers of commercial trunked radio systems are those with a need for one-to-many and many-to-one radio communications with mobile workers. With the introduction of more sophisticated technology and the development of enhanced and diversified services, a broad spectrum of end-users now exists. Following is a partial list:

- Electrical Suppliers and Distributors;
- Gas and Water Distributors;
- Bus Companies;
- Airport Authorities;
- Railways;
- Courier Services;
- Emergency Services;
- Construction Companies;
- Trucking and Fleet Management Companies;
- Agriculture Industry;
- Health Services;
- Dispatch Companies;
- Taxi and Limousine Companies;
- Manufacturing Industry;
- Petroleum Industry;
- Service Technicians;
- Insurance Agents and Adjusters;
- Government Agencies;
- Real Estate;
- Security Services;
- Plumbing & Electrical Contractors;
- Concrete and Asphalt Companies.

Commercial Trunked Radio Equipment Suppliers

There are far fewer equipment suppliers worldwide than there are system operators. Designing and manufacturing equipment requires a lot of time, money and a skilled workforce. In many countries, the licensing mechanism is put into place before local companies have the time and the financial resources to design their own systems, so operators entering the market tend to purchase equipment from established suppliers. Examples of major equipment suppliers



are Alcatel, Celwave, E.F. Johnson, Ericsson, IDA Corp., Kenwood, King Communications, Motorola, Nokia, Simoco, Securicor, SmartLink, Standard, Tait, Uniden, Yaesu and Zetron.

Many additional companies manufacture terminals, rather than system equipment. In addition to the companies listed above, examples of major terminal equipment suppliers are: AEP, Aiko, Alinco, Andrew, Aselsan, Bendix, Cleartone, DeTeWe, Icom, Kavicom, Key, Maxon, Rohde & Schwarz, Sinclair, Talco and Teltronics.

Trunked Radio Competition

Because commercial trunked radio was designed to offer one-to-many and many-to-one communications to the business community, it represents a unique and specifically targeted industry segment without direct competition. There are, however, three mobile wireless technologies that provide similar services and may seem to be competitors: cellular telephony, paging and personal communication services (PCS).

Cellular telephony is not yet a direct competitor to commercial trunked radio because it does not provide the same kind of communication and is designed to meet the needs of a different end-user group. Cellular telephony, in contrast to commercial trunked radio, was developed as an outgrowth of the PSTN to serve the public by providing one-to-one communications. Using this system, a mobile unit can call another mobile unit or a wired telephone through interconnection with the PSTN and vice versa. Cellular systems are beginning to offer dispatch services (e.g., the group call feature of the GSM system). However, most cellular system infrastructure equipment is unfriendly to one-to-many dispatching needs. Many countries also limit the ability of commercial trunked radio systems to compete with local telephone service by prohibiting them from interconnecting with the local telephone network.

As commercial trunked radio develops worldwide and appropriate regulations are implemented, there is some overlap with cellular service. For example, when interconnection is allowed, commercial trunked radio systems allow for one-to-one communication with users of the wired telephone network. For this reason, some consider it similar to cellular. But commercial trunked radio offers its customers much more. Personal communications service (PCS) is similar to cellular service in that it is toward two-way personal communications.

Paging is another form of wireless communications that is not directly competitive to commercial trunked radio. Paging serves individuals and businesses and allows data messages to be sent instantly to a mobile unit. Because the message traditionally delivered to the pager is a one-way numeric or alphanumeric message, the person carrying the pager can respond only by using a telephone. As a result, paging is less convenient than instantaneous two-way voice mobile communications and offers neither one-to-many nor many-to-one services but regularly acts as an adjunct to either cellular or commercial trunked radio. The newer land mobile radio systems do offer the ability to send short messages directly to the handset. This allows land mobile radio systems to better compete with paging systems.

Radio Spectrum Regulation

Because radio spectrum is a finite resource, rules and regulations must be in place to manage its allocation and to ensure that it is being used efficiently. At the same time, these regulations often determine the availability and types of services that can be offered in any given market and can decide whether commercial trunked radio will flourish or stagnate in a given country.

Spectrum regulation occurs on an international level and on a national/local level. At the international level, the regulatory body charged with allocating spectrum is the International Telecommunications Union (ITU), created as part of the United Nations. The ITU constitution states that it will

- a) affect allocation of bands of the radio frequency spectrum, the allotment of radio frequencies and the registration of radio-frequency assignments in order to avoid harmful interference between radio stations of different countries;
- b) coordinate efforts to eliminate harmful interference between radio stations of different countries and to improve the use made of the radio-frequency spectrum [ITU Constitution, Article 1, Section 2].

In carrying out these tasks, the ITU allocates frequencies to the broadest extent possible so that national governments have the flexibility to make more specific allocations that are appropriate for their markets. For example, the ITU allocates frequencies for “land mobile communications” rather than “trunked radio” so that each national or local regulatory body can allocate specific frequencies to industries and services that fall under the category of “land mobile communications.” While specific allocations rest with the national/local governments, allocating widely accepted frequencies is beneficial because it promotes the growth of similar services in various countries.

Membership in the ITU is voluntary, as is participation in its meetings and complying with its recommendations. However, the ITU does serve a very significant purpose in that it is a forum at which national telecommunications authorities and other interested parties can convene to discuss agreements and/or disagreements regarding telecommunications issues.

Specific frequency allocation and the creation of rules and regulations associated with the licensing and operation of systems are left to the telecommunications authorities in individual countries, which may be national or local in scope. Regulatory bodies may be government-run ministries of telecommunications, semi-independent organizations, totally independent, or self-funded organizations. In many countries, the regulator is also still the operator of telecommunications services. However, many countries have separated these functions.

Frequency spectrum allocations for commercial trunked radio vary from country to country. Figure 1.5 shows the division of frequency use in the United States in 1998 for private radio users.

Developing rules and regulations is critical and necessary to ensure spectrum efficiency and the protection of users. Toward this end, national or local telecommunications authorities have numerous decisions to make regarding license allocation methods, application procedures, fees, license requirements, etc. Each decision influences the way in which the industry will mature. For example, if a government does not establish appropriate regulations requiring licensees to build and operate their systems, companies can receive a license but never build the system or provide service to the public. This can potentially keep sincere operators out of the market and

limit the industry's ability to grow and develop. Moreover, it prevents the business community from using the beneficial services that commercial trunked radio provides. In addition, some countries require licensees to pay such high licensing and annual fees that they often do not have enough money to implement the system and provide the service. When entering a new market it is essential to consider the range of regulations for trunked radio service in the target country. Everything from loading and construction rules, equipment standard requirements and interconnection regulations, may have a significant impact on a commercial trunked radio business.

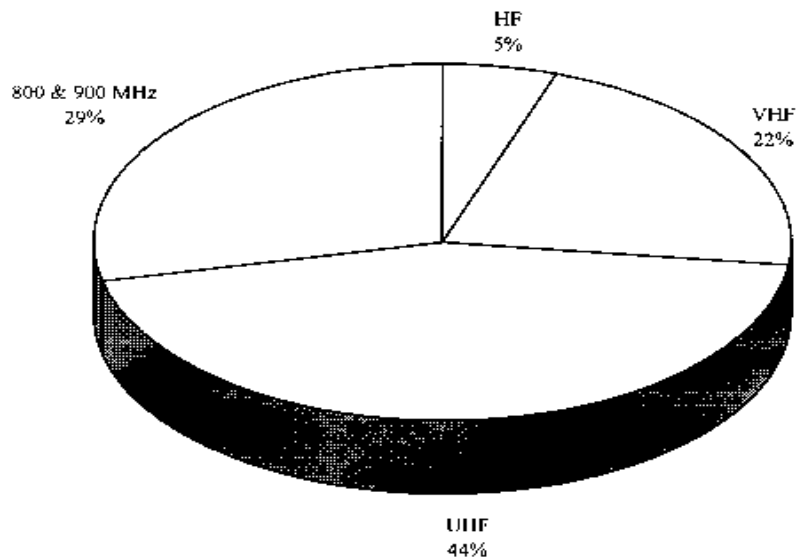


Figure 1.5, Division of Frequency use in the United States in 1998 for Private Mobile Radio
Source: Strategis Group, Washington D.C.

Summary

The commercial trunked radio industry has achieved tremendous growth within the last five years. As countries throughout the world continue to open their markets, numerous opportunities for further expansion abound. The diversity of markets, regulatory environments and customer needs throughout the world create an interesting and challenging landscape for the industry. Indeed, the prevailing trend toward liberalization and competition should prove to give the industry an ideal environment in which to flourish.