3

Radio Communications Spectrum and Telecommunications Players

The purpose of this chapter is to explore the various factors that are considered in utilizing a wireless solution with which to provide telecommunications services and some of the key issues associated with the use of the radiocommunications spectrum. In order to achieve this, it provides an overview of the advantages and disadvantages of using a wireline versus a wireless network for telecommunications services. This chapter then delves into the major participants involved in the spectrum forums, including telecommunications operators and users and equipment manufacturers. Ultimately, it provides an additional basis for understanding many of the issues raised in subsequent chapters, including access and use of the radiocommunications spectrum resource.

Wireless versus wireline network solutions

Wireline and wireless telecommunications networks both have certain advantages and disadvantages, both in general and when examined as technical solutions for the provision of specific telecommunications services.

In this section, and as outlined in Tables 3.1 and 3.2, we examine the general advantages and disadvantages of both types of telecommunications networks.[1]

The advantages associated with wireless networks include:

- *Mobility.* Unlike with the fixed network, wireless technologies provide the user with the ability to be mobile while using wireless telecommunications devices [1].

- *Geographic reach.* The ability to reach large numbers of people and cover large geographic distances (including into outer space) with limited infrastructure.

- *Lower costs due to less network equipment.* In many cases, communications services that utilize the radiocommunications spectrum are lower in cost than landline services because of the less resource-intensive network deployment [1].

- *In many cases, the ability to avoid large up-front payments for network building.* With regard to nonsatellite-based networks, wireless service providers are able to build out their networks with less investment. This is because nonsatellite-based wireless networks can start with a smaller coverage area that can be easily and quickly expanded as the network grows. This is in contrast to the wireline network, which requires close to full-scale buildout on day one of operations. Satellite systems, however, are more akin to wireline services, because of the large up-front investment required in the satellite itself [1].

- *Quick deployment.* Wireless networks can generally be deployed on a fast basis because of the limited network requirements (i.e., no extensive wiring). For example, in emergency situations, wireless networks are easily brought to the required service area and deployed. A good example of this were the emergency networks that were deployed on September 11, 2001, to help during the

1. However, it is important to bear in mind that a separate analysis on the benefits or disadvantages of any specific solution would need to be service and technology specific.

Table 3.1
Advantages and Disadvantages of Wireless Networks

Advantages	Disadvantages
Mobility	Propagation concerns
Geographic reach	Interference potential
Lower costs	Expense of regulatory fees
Avoidance of large up-front payments	At times, reliance on wireline network
Quick deployment	
Anytime, anywhere communications	
Less anticompetitive concerns	
Less regulation	
Ability to supplement wireline network	

Table 3.2
Advantages and Disadvantages of Wireline Networks

Advantages	Disadvantages
Reliable communications	Need for imbedded infrastructure
Elimination of interference concerns	Fixed service only
Decrease in network cost as use increases	Slow deployment

emergencies at the World Trade Center, where the landline network was severely damaged [2].

- *Anytime, anywhere communications.* Wireless networks provide the ability to have anytime, anywhere communications with minimal infrastructure. For example, services into remote regions, such as the Amazon, are often provided via wireless networks through technologies such as satellite [3].

- *In some cases, fewer anticompetitive concerns.* Generally many of the anticompetitive issues that arise with wireline service do not exist with wireless services. This is because the most popular wireless services, such as paging and mobile telephony, were generally deployed in a competitive environment and are provided in a competitive service market. Of course, there are exceptions to this, such as when

governments impose spectrum caps on the amount of spectrum in which a single operator may have access to operate.

- *Less regulation may mean pricing advantage.* In many cases, wireless service operators have been able to escape having imposed on them the types of regulations that have burdened traditional wireline service providers, such as a universal service requirement or requiring specified accounting safeguards to be imposed. While wireless networks may face the imposition of increased regulation over the next decade, in cases where this has not yet occurred, wireless service providers may have an artificial price advantage over competing wireline service providers.

However, wireless services and networks are far from the perfect solution. There are many disadvantages with their use, including:

- *Propagation concerns.* Problems associated with the propagation characteristics of the radiocommunications spectrum, including rain fade, penetration into buildings, and the need for line of sight for clear communications often impact the availability and quality of a frequency band to a specific service.

- *Potential for interference.* Interference issues associated with nonconforming uses in a relevant spectrum band or from cofrequency services are always a risk. Wireline networks do not face this concern, as there should be no interference issues in almost all cases.

- *Difficulties in obtaining roof rights.* In order to obtain full coverage, extensive buildout is often required, especially with regard to terrestrial wireless services. This may be difficult to achieve because of the need for easements and access to rooftops and other rights of way in order to build towers, antennas, and other transmit/receive equipment.

- *Expense of regulatory fees.* Because the radiocommunications spectrum resource appears to be scarce, countries have begun charging more and more money for its use and setting fees based on market-based auctions. Hence, the regulatory fees associated with obtaining access to the radiocommunications spectrum may be onerous and

negatively impact the ability of the service provider to meet its business plan [4].

- *In some cases, being reliant on the wireline network.* Many wireless systems are reliant, at least in part, on the wireline network. Accordingly, the success of wireless networks is often dependent on the extent of the cost to access this network and its availability in locations where it needs access.

Similarly, there are many benefits associated with the utilization of a wireline network. These include:

- *Reliable communications.* Wireline networks boast generally reliable communications services, without concerns about propagation characteristics, and they are less likely to face severe propagation delay problems. In most developed countries, for example, the availability of a wireline network is well above 99.95%, while wireless network availability is generally significantly below this percentage.

- *Eliminates interference concerns.* Because the communication travels via a wireline mechanism, the interference concerns associated with spectrum-based services is eliminated.

- *Network cost decrease as use increases.* Although an expensive network is required, once in place, the cost of the network decreases dramatically as usage increases.

In addition, in any evaluation of wireline versus wireless communications services, the disadvantages of the wireline network must also be considered. These disadvantages include:

- *The need for an imbedded infrastructure.* Service can only be required once an expensive imbedded infrastructure is put into place.

- *Fixed service only possible.* On a solely wireline network, service can only be provided to fixed points on an existing infrastructure.

- *Deployment may be slow.* Deployment of new services may be slow where the existing wireline infrastructure does not exist or is insufficient to support the relevant use. A good example of this is the

rolling out of high-speed Internet services by cable companies. In many cases, cable companies have had to rewire existing infrastructure to upgrade the infrastructure to support the bandwidth demands of this new service.

At the end of the day, the benefits and disadvantages of both types of services are evaluated by the service provider in determining the type of service they wish to provide and what type of technology they wish to use. In certain cases, such as in service to remote locations, wireless technology may be the only solution. However, if a service provider is able to rely in part on the existing wireline network, they may be able to decrease the cost of service provision by using a network made up of wireless and wireline components.

The key participants

As discussed, another driver in the consideration of the type of network to utilize is the point of view of the user. This section focuses on four key constituents, the types of uses they make of the spectrum, and some of the major issues that they are facing in the increasingly competitive search for spectrum.

The domestic government as user of the spectrum resource

In any country, one of the largest users of the radiocommunications spectrum resource is the government itself. Often, government users include the civilian defense ministries, scientific and educational uses, and public safety and distress uses. In most countries, however, the largest governmental user of the spectrum is the military. Like all assignments of the spectrum resource, the spectrum assigned to government uses is often under attack by advocates looking to use it for their own benefit. The next section discusses such efforts and also explores the issue of government self-regulation of spectrum use.

Self-regulation scenarios

In many countries, the government has no effective mechanism for controlling the efforts of government entities, including the military, from obtaining access to the radiocommunications spectrum, even for inefficient uses. Often, such use is purely a significantly less expensive alternative for these agencies in which to operate their communications. In these environments, the government entity may easily be able to access a desired frequency band, possibly even at the expense of other government users or

private industry users. Further, governmental use that is unchecked may be inefficient and wasteful. A lack of a regulatory process for governmental use of the spectrum may mean that private operations are not provided access to portions of the radiocommunications spectrum that may be best utilized to provide widespread commercial applications.

In response, a few countries have either put into place or have proposed mechanisms for the self regulation of the government's use of the radiocommunications spectrum resource. A good example of such an approach is the bifurcation of the regulation of the spectrum resource in the United States. The FCC and the NTIA have split jurisdiction over the spectrum resource in the United States. Specifically, the FCC controls the use of the spectrum for commercial uses, while NTIA has that role for government use [5]. The FCC and NTIA coordinate continuously on such efforts, and both adopt and implement regulations that spectrum users under their jurisdiction must adhere. However, due to the pressure by commercial interests to free up spectrum that is currently used by the government, the U.S. Congress has recently been actively involved in ordering NTIA to identify government spectrum that can be freed up for commercial users.

A more novel approach that has recently been proposed is that contained in the recent U.K. Spectrum Review. Within that process, advocates have argued that government entities should be subject to economic forces just like other spectrum users [6]. For example, this proposed approach provides that government users should be allowed to trade their spectrum to the commercial sector and keep the funds earned from such trading as initiative to surrender unutilized or underutilized spectrum. This approach is very interesting but may end up handicapping the private sector in some instances by allowing the government to continue to hoard spectrum in the hope of being able to resell it later at a higher price.

Government use

Most of the spectrum that is utilized for nonmilitary government uses is for public safety and distress uses. Such uses can include police protection, safety-at-sea uses, aeronautical uses, and other similar uses. Many of these uses rely on spectrum-based services because of the nature of the communication. For example, aviation administrations utilize spectrum-based services for air-to-ground communications because it is impossible to use wireline facilities to complete the communication between air traffic control and airplanes.

The spectrum for such uses was generally assigned in the early days of telecommunications regulation and is generally seen as untouchable by commercial users of the spectrum. The reason the use of such spectrum is seen in this light is because of its public importance (i.e., it is politically difficult to argue that a commercial use of the spectrum, such as mobile telephony, is more important than air traffic control uses). However, this does not foreclose such efforts from occurring. To the contrary, if industry sets its sights on such spectrum, it may argue, for instance, that too much spectrum is assigned for such a use because a new technology has made more efficient operations possible or that the use is no longer valid because a new use has taken its place. Accordingly, the private sector could argue that it would be a more efficient use of the spectrum to allow a new use in these bands. Although such battles are often contentious, resource intensive, and time consuming, they sometimes result in a win for industry with the opening up of frequency bands for use by the private sector.

Spectrum that is used for nonpublic safety and distress or nonmilitary uses is often more likely to be sought for use by private industry because the political issues associated with such use are not likely to be as fierce. In some cases, governments may be willing to reassign such spectrum in exchange for private industry providing some of the functions that government has in the past. For example, some governments have allowed private industry to utilize spectrum traditionally assigned for education uses for private use, if they also provide educational services for free or for a nominal charge.

As discussed, one of the largest spectrum users in any country is the military. In most countries, the military is able to obtain and retain usage of key frequency bands because of its powerful and integral role in the government [7]. Accordingly, in examining most country's domestic frequency allocation and use tables, one would find that some of what industry would coin the most valuable or attractive portions of the radiocommunications spectrum resource assigned to the military.

Needless to say, as the telecommunications industry has grown, and as spectrum-based telecommunications systems have become more in demand by consumers, private industry has begun to challenge an increasingly large amount of this use [8]. Global industry believes in many cases that the military underutilizes the spectrum that has been assigned to it or uses it in a manner that is technically inefficient. In response, the military often argues that this is a flawed argument and works to entrench itself in

the relevant frequency band. In other cases, the government flexes its muscle within other branches of the government to avoid even discussing this issue.

This conflict between the military and private industry is becoming even more common as the most attractive portions of the spectrum become more and more congested, and companies look to previously unusable bands for deployment of services.

However, it is a hard, uphill battle for industry to obtain access to military spectrum for several reasons. First, the military often operates under the cloak of confidentiality. Accordingly, in many cases, the military is able to block a wide inquiry into its use of a specified frequency band because of the confidentiality or security of its operations. Second, the military in most countries is extremely powerful politically. Accordingly, such battles often are fierce and reach into the highest rungs of the government for resolution. In this regard, only well-financed and politically well-positioned opponents stand a chance in such a battle. Third, in many cases the advocates of the proposed spectrum usage are vendors to the military. In this case, these advocates may not want to threaten their ability to retain the military as their customer.

In the late 1990s and early 2000s, prior to the events of September 11, 2001, it began to appear that the private sector was going to be successful in many countries in its efforts to obtain an increasingly large amount of spectrum traditionally assigned to the military. However, after these tragic events, and since the initiation of the global war on terrorism, the private sector's success in its efforts is less than certain, especially in the United States and European Union member states [7].

Telecommunications service providers and broadcasters

One of the largest spectrum constituents is the telecommunications service providers and broadcasters. Telecommunications service providers are the operators of telecommunications networks, such as Telefonica de Espana in Spain, AT&T Wireless in the United States, and Korea Telecom in South Korea. These service providers may provide a wide range of services or a single telecommunications service and may utilize the resources of network operators, such as PanAmSat, to provide services. Broadcasters, on the other hand, may include entities such as the powerful U.S. networks for NBC, ABC, or CBS, or the United Kingdom's BBC, or more local broadcasters.

Telecommunications service providers

Providers of wireless telecommunications services have become increasingly aggressive in the market as they recognize that "radio spectrum is the key 'asphalt' for the latest generation of the Information Highway, wireless Internet" [9]. In addition, many service providers today operate in more than one country.

In order to operate their telecommunications systems, these service providers must obtain authorizations and assignments from individual governments for each proposed use, which also specifies the frequency band, geographical area of service, and any technical rules with which the provider must comply. Accordingly, a company that wants to provide mobile telephony in Paris and London must obtain individual regulatory authorizations from the relevant regulator in France and the relevant regulator in the United Kingdom for such service. Further, if that same operator wants to also operate a wireless cable service in London, it must obtain a separate authorization for that operation from the United Kingdom regulator that would have the authority to allow such use.

In today's telecommunications world, usage of the radiocommunications spectrum resource has become increasingly important to telecommunications service providers as a method of providing services both directly (as in mobile telephony) and indirectly (as an adjunct to existing services, such as providing a last-mile connection to the home through point-to-point microwave services). Accordingly, many companies hold multiple authorizations for multiple uses in the same country or even geographical area.

In some cases, private industry may be closely aligned in obtaining spectrum. For example, when seeking an allocation of an individual frequency band to a specific service or identifying a frequency band for a specific use, several telecommunications service providers who support such a cause may band together in support into either a formal or informal association. As discussed in Chapter 8, such joint action often adds credence to the advocate's efforts and provides additional political pressure on the regulator to act in a specific manner.

There are also cases where industry is diametrically opposed. For example, once a frequency band is allocated to a specific service and identified for a set use, companies that were formerly allies may now be seeking assignments of the same spectrum. In this situation, a fierce battle in the authorization and assignment process may occur. For example, although many wireless mobile service providers worked together jointly at WRC

2000 in order to obtain access to a common frequency band for 3G services, they were often fierce competitors as they bid on regulatory authorizations to provide 3G services around the world.

Further, industry is often in an adversarial position toward one another when an advocate of a new use seeks to utilize spectrum that is already being used by another service provider for an existing service. In such cases, the incumbent user will often fight a fierce battle to preserve its ability to use the spectrum where it is currently operating. A good example of such a battle was the successful effort of the MMDS community in the United States to keep the 3G service providers from utilizing the 2.5-GHz band for their services.

In some cases, the incumbent user or new entrant may be part of a former government monopoly and have continuing, although indirect, ties to the government, which provides it with certain political advantages in a fight. Good examples of this are NTT in Japan, which was part of the Japanese Ministry of Posts and Telecommunications, and British Telecommunications, which was formerly a part of the agency that was also the spectrum manager in the United Kingdom. These entities may be looked at more favorably by the regulator than an unknown entity because of the past relationship.

If such a battle looks like a loss, the incumbent user may compromise and seek relocation (and corresponding payment from the new user) to another frequency band where it can also operate. This was the case in the United States when Teledesic sought interference-free operation in the 18-GHz band from point-to-multipoint operators. Ultimately, the parties, working with the government, formed a consensus solution that satisfied the needs of all parties. This resulted in the relocation of the point-to-multipoint operators to a different but acceptable frequency band. In many cases, this type of compromise requires the new use to pay for the relocation of the existing use to a different frequency band.

In more liberalized telecommunications markets, success on the part of a telecommunications operator in obtaining new spectrum or retaining old spectrum for use often depends on many factors. These factors may include, among others:

- The political power of the advocate;
- The amount of resources the advocate is willing to expend to fight to utilize the relevant frequency band;

- The public-interest benefits of the service that can be demonstrated by the service provider to the government;
- The types of services to be provided and consumer demand for such services;
- What sort of commitments the service provider is willing to make in order to be able to offer its proposed services;
- The lasting power of the participant, as spectrum battles quite often take years to resolve.

However, the factors used to evaluate such success in less competitive or closed telecommunications markets are less certain. In such cases, the political will of the government is often key to any success.

Broadcasters

Another important category of spectrum users is the television and radiocommunications broadcasters. National broadcasters, especially, such as the United Kingdom's BBC, hold access to vast spectrum assets and have significant political clout because of their reach into the general population. Often, in large part because of their public-service mandate and far reach, broadcasters are considered a specialized service and are not regulated as part of the rest of the radiocommunications spectrum. Accordingly, many governments have established separate agencies to regulate the broadcasters. A good example of this is in Nigeria, where the government is setting up three different spectrum-management agencies: one for government spectrum, one for broadcasters, and one for the nonbroadcast private sector. By arranging a spectrum bureaucracy in such a manner, the government may be able to further protect access to the broadcast spectrum by other members of the private sector.

Telecommunications equipment manufacturers

Another key constituent group with regard to the radiocommunications spectrum is telecommunications equipment manufacturers. For the purposes of this book, telecommunications equipment manufacturers refer to manufacturers of backbone equipment (e.g., large antennas, switches, and satellites) as well as the manufacturers of consumer end products (e.g., mobile telephony handsets). Examples of some equipment manufacturers who are very active and powerful in the area of radiocommunications

devices include Nokia from Finland, Nortel from Canada, Alcatel from France, Samsung from South Korea, and the U.S. manufacturers Lucent and Hughes.

The prime motivator behind the intense activities of the equipment manufacturers in the field of radiocommunications is sales. Quite simply, they want to ensure that their customers, both the telecommunications service providers and the end users, have access to the portions of the radiocommunications spectrum that their devices can operate in and that this spectrum is allocated for use by the relevant services and allows technically their operation. Accordingly, both domestically and internationally, the equipment manufacturers are active in ensuring the availability of spectrum for the uses that they are most interested in manufacturing equipment in which to operate.

A good example of such activities by equipment manufacturers is the efforts made by the 3G equipment manufacturers at WRC 2000, at its preparatory meetings, and in accompanying domestic proceedings. In this regard, equipment manufacturers such as Nokia and Motorola actively sought out sufficient spectrum for the operation of 3G services in the frequency bands in which they felt it was optimal for their equipment to operate. In many cases, the equipment manufacturers, more so than even the telecommunications service providers, led these efforts because of the direct financial impact on these manufacturers. Another reason for this is the lag of the technical market. This results in a dynamic whereby equipment manufacturers are often ahead of the service providers in planning for new services. Accordingly, before manufacturing the relevant equipment, these entities will look for certainty.

An interesting trend that has been occurring in recent years is the growing desire on the part of equipment manufacturers for global allocations of a single frequency band for an individual service and identification for use of an individual frequency band for specified use. This trend has been most prominent in Europe and Asia, where manufacturers feel that set standards make the manufacturing process easier to work with, as a single piece of equipment will work anywhere. The United States has consistently pushed against such an approach, believing instead that the marketplace should be the ultimate arbiter of technology. It is likely that as telecommunications markets become increasingly global and as uses continue their trend towards transborder usage, countries will work in a more coordinated effort in designating or identifying spectrum for specific

applications. Failure to do so may result in a patchwork of equipment devices that will not work in all countries, ultimately leaving the consumer unconnected.

In all cases, however, it must be remembered that new technology is not a spontaneous occurrence. With regard to radiocommunications equipment especially, research and development is based on both market demands and the regulatory climate. Accordingly, there must be not only a need for such equipment, but the regulatory regime governing the proposed technology must allow for it or be changed to allow for it. This is somewhat different than what happens in other high-technology fields, where often the best technologies are created without transparency and then released without advance notice.

Accordingly, manufacturers are often largely constrained by the amount of regulation to which telecommunications technology is subject. In some countries, such as the United States, freedom of technology by service providers is authorized and a desired end result. The U.S. philosophy is to let the market decide what technologies will be utilized in a particular frequency band to offer the desired telecommunications service. However, as discussed, many countries, including those of the European Union and Japan, feel that technologies should be dictated by governments and adhered to. What these countries fail to recognize, however, is that by picking technical winners and losers, they are inhibiting technical innovation.

Consumers

In general, all consumers have the same general goal: to obtain reasonably priced high-quality telecommunications services. However, divergent interests exist between the different groups of consumers. In this regard, consumers can be broken into two different groups:

- *High-end users:* large and medium enterprise consumers, such as multinational corporations or hotel chains, and high-profile users (such as celebrities or corporate executives);
- *General consumer users:* residential or small business consumers.

High-end users are generally looking for the most reliable means of transmitting their communications information to all their operations at the most reasonable rates. Of course, different types of high-end users

may also have additional needs. For example, for a large global bank like Citibank, the security of the transmission may be of increased importance, whereas an airline, like United, may require service-level guarantees of 100% reliability because of safety concerns. General consumer users, however, are often willing to accept lower quality services in order to obtain better prices.

The interests of these groups directly impacts what frequency band telecommunications service providers may be willing to operate in and what accompanying technical rules may be acceptable. For example, a service provider that is primarily looking to serve residential services may be willing to operate in a frequency band with a slight potential for interference. However, a service provider who is looking to provide the highest quality of service possible to demanding multinational companies may not be willing to operate in the same frequency band or with the same technical constraints on operation.

In addition, the ability for both high-end and general consumer users to utilize their communications equipment internationally is also important. Accordingly, a substantial amount of time and effort has been invested in the ITU and other forums in establishing a regime that allows wireless communications devices, such as mobile telephony handsets, to be freely brought into other countries. Under the agreements that have been reached on this issue, such as the ITU's Memorandum of Understanding on Global Mobile Personal Communications Devices, companies that abide by the technical standards established in the agreement are able to produce equipment that is freely transportable by consumers into multiple countries without obtaining additional nationalistic-type approval of the equipment.

General consumer users are actively involved in the spectrum arena battles generally only when they need a service and are trying to preserve an existing service's availability or trying to influence a proposed change that will directly impact them. In such cases, consumers may work on their own, with other consumers, or with other participants to obtain a satisfactory resolution.

Factors impacting the use of the spectrum resource

Now that a firm understanding of the major participants in the spectrum arena has been established, it is helpful to understand the significant

primarily nontechnical factors that directly impact the use of the spectrum resource. These factors include:

- The government regulator and the accompanying regulatory regime;
- Market demand for the service;
- Amount of spectrum available for the same or similar use;
- The cost of obtaining access to the spectrum (including regulatory fees, research and development, and equipment) and the impact on the business case;
- The ability and cost to use terrestrial landline networks for the same service;
- The ability to obtain access to rights of way for network buildout.

Each of these factors is addressed in more detail in the following sections.

The government regulator and the accompanying regulatory regime

No discussion of the radiocommunications spectrum would be complete without focusing on the domestic government in its role of regulator of the spectrum. Each constituent group is directly dependent on the regulator or regulators of the radiocommunications spectrum to allocate and assign spectrum. While the spectrum allocation and assignment process will be the subject of more in-depth discussion in Chapter 5, it is important to have a broad understanding of the role of the regulator and the governing regulatory regime at this point.

The role of each domestic regulator of the spectrum resource generally includes:[2]

1. Allocating individual frequency bands of the radiocommunications spectrum domestically to specific services (in accordance with international obligations);
2. Authorizing specific uses of the radiocommunications spectrum within individual frequency bands;

2. In this context, when the term domestic regulator is used, it is in reference to the reulator or regulators governing both public and governmental use of the radiocommunications spectrum resource.

3. Assigning the radiocommunications spectrum resource to individual users or operators for a limited term and under specified terms and conditions.

Accordingly, it is the domestic regulator that ultimately determines what use will be made of a specified frequency band, who will be able to operate and use that frequency band, and what limits will be placed on operations. As discussed subsequently, the processes that the domestic regulator(s) utilize to make each of these determinations directly impacts the availability of spectrum for a particular use, the ability to utilize that spectrum for that use by an individual operator or user, and the cost to obtain access to that spectrum. In many cases, as outlined in subsequent portions of this book, in order to obtain access to a specific portion of the spectrum resource, operators and other users will launch extremely resource-intensive efforts to gain or retain access to the spectrum resource for their specified usage. Often, such efforts are the equivalent to outright battles, which are also known as spectrum wars. The efforts of the 3G providers to obtain access to additional spectrum at WRC 2000 and in domestic arenas since then and the efforts of Teledesic to obtain spectrum both globally and on individual domestic basis for its NGSO satellite system have been among the most notable of these battles in the recent past.

Of course, the process that is utilized for each of these responsibilities is dependent on the specific regulatory regime. In a closed market or one with limited competition, it is unlikely that the private sector will have much of a role in establishing the rules governing the allocation, assignment, and designation or identification of the spectrum resource. However, in more competitive markets, and especially in countries that have adopted the regulatory principles encased in the World Trade Organization's Basic Agreement on Trade in Telecommunications Services (WTO Agreement), it is extremely likely that private industry will play a direct role in developing each of these issues.

The WTO Agreement is the cornerstone treaty on the free trade of telecommunications services. The WTO Agreement sets out a framework for market liberalization of telecommunications services, which includes:

- Market access and national treatment;
- Foreign investment;
- An international dispute settlement mechanism for failure to meet commitments.

In addition, it addresses the imposition of certain regulatory principles, including [10]:

- Transparency in the process;
- The creation of an independent regulator;
- The implementation of competitive safeguards;
- Fair and nondiscriminatory interconnection.

Accordingly, a firm understanding of each government's regulator and regulatory regime is imperative for the constituent to understand how to best obtain its goals.

Market demand for the service

In any evaluation of the use of the radiocommunications spectrum, it is imperative that an understanding of the market demand for the service be evaluated by taking into account the actual cost of the service to the end user and the technical characteristics of the service. An inability to understand this dynamic may lead to failure on the part of the service provider from an economic perspective.

Unfortunately, it is often difficult to obtain a good understanding of market demand for a new, unproven wireless telecommunications service. An excellent example of where such market demand was misunderstood involved the Iridium satellite system. The initial concept for the Iridium satellite system was the deployment of a 66-NGSO satellite constellation to provide mobile services to high-end consumers. Use of the satellite system would cost approximately $10 per minute for phone service, and the handset cost well over $1,000. To minimize the phone service cost, however, the handset was multiband, which allowed it to switch to terrestrial mobile service when such service existed. This would lower the price of the service in such cases to be comparable with existing mobile telephony service.

Unfortunately, Iridium overestimated its consumer attractiveness. First, consumers found the service expensive to use, especially because its deployment began around the time that mobile telephone prices first began to drop dramatically. Second, Iridium overestimated the demand for "anywhere" type of phone service. At the end of the day, the number of customers who needed to be reached anywhere in the world was dramatically less than estimated. In addition, early usage of the Iridium service

demonstrated a less than perfect system, with early users facing technical problems. Further, the handsets that were created were large and cumbersome. Finally, and perhaps most importantly, failure can be traced to the timing of the release of the Iridium system. By the time the Iridium system was ready for service, mobile telecommunications service through nonsatellite means was virtually ubiquitous through roaming agreements and national buildout. All of these factors led to the bankruptcy of Iridium. However, through scaling back its service plan and revising its business case, today Iridium has emerged from bankruptcy and is currently providing service.

Accordingly, to avoid similar results, many companies expend substantial resources evaluating the market demand of the proposed service. Of course, estimating the demand of a new service is always difficult, especially when you are depending on global customers. Therefore, with new and innovative wireless services, there is often an inherent risk in such deployment.

Amount of spectrum available for the same or similar use

Another key consideration is the amount of spectrum that is available for the same or similar uses. This consideration ties in directly with correctly understanding the market demand for service. In general, it is important to understand whether there will be a tremendous influx of the same or similar service providers with which the provider will have to compete. Because of the large geographic reach of spectrum-based services, it is generally more cost-efficient to have a broader service area, in terms of population coverage, and no competitors or only one competitor. However, whether such limited competition serves consumers is questionable—because they will only have limited choice in service providers. Service providers, in response to such an approach, argue that unlimited or increased competition will only result in increased prices to consumers because the providers will have substantially less market share with which to finance their telecommunications system.

Another spectrum consideration is the value of the spectrum to the applicant or user. For example, if there are only two assignments available for a specific use and more applicants, then the amount of resources (e.g., money or time) that the proposed user will expend increases substantially. This is dramatically different if there are more assignments or a similar number of assignments available than there are interested users.

The costs of obtaining access to the spectrum and the impact on the business case

Probably one of the largest drivers of the use of the radiocommunications spectrum resource is overall cost of access. These costs can include:

- Regulatory and other fees, which include any licensing fees, taxes, or other regulatory fees that are required to obtain and retain use of the spectrum (in some cases, instead of working directly through the regulatory process, the service provider can obtain spectrum through the secondary market that is beginning to develop for access to the spectrum resource);
- Costs involved in any regulatory actions that are required to ensure that use of the planned frequency band is available for the relevant use;
- The costs associated with research and development of the telecommunications service and accompanying equipment;
- The costs of obtaining easements and other rights of way in order to build out infrastructure;
- The cost of equipment to provide the telecommunications service;
- The cost of consumer equipment.

Each of these costs is critical in developing the telecommunications service provider's business case. Failure to account for such costs in a realistic manner can result in overly optimistic rates of return. This is likely what happened in the European 3G bid auctions, after licensees paid substantially larger than expected auction fees for the 3G spectrum and then faced huge financial pressures during the buildout of their systems, in some cases calling into question their continued viability.

The availability of terrestrial wireline infrastructure

In some cases, it may not always be cost-effective to provide all of a wireless service on a wireless basis or it may be technically necessary to operate a wireless and wireline network together. For example, many mobile telephony networks use wireline networks to carry the traffic from some of their cell sites to their switching station. Accordingly, any analysis must include an examination of the availability of the terrestrial wireline infrastructure for use and the costs, benefits, and disadvantages of utilizing such a

network with the wireless network. In many cases, as discussed, such an analysis may result in a determination that a combined wireline and wireless network would be the most efficient solution to provide the proposed use.

Conclusion

This chapter has provided an overview of the advantages and disadvantages of wireless telecommunications services and networks (in contrast to wireline services and networks), an introduction to the interests involved in spectrum battles, and an exploration of the key considerations involved in deploying a wireless telecommunications network and providing service. This provides a firm basis for the exploration of the domestic and international processes and structures that govern the radiocommunications spectrum, which are discussed in Chapters 4, 5, and 6.

Endnotes

[1] Geier, Jim, "Benefits of Wireless Networks," August 2000, available at http://www.wireless-nets.com/articles/whitepaper_wireless_benefits.htm.

[2] Kant, Eric, "Wireless GIS Solutions Aim WTC Rescue Efforts," 2002, available at http://www.esri.com/news/arcuser/0102/wtc1of3.html.

[3] Intelsat in Africa, available at http://www.intelsat.com/news/mediakit/press_ex/intelsatsfrica.asp.

[4] However, over time, some governments are lifting spectrum caps; see Mosquera, Mary, "Feds Lift Spectrum Caps on Wireless Providers," *Internet Week,* November 6, 2001, available at http://www.internetwk.com/story/INW20011109S001; see also Glasner, Joanna, "How Spectrum Caps Turned Sour," *Wired,* March 5, 2002, available at http://www.wired.com/news/wireless/0,1382,50782,00.html.

[5] Roosa, Paul Jr., "Who Regulates the Spectrum," *Federal Spectrum Management: A Guide to NTIA Process*, NTIA Special Publication 91-25, August 1992, available at http://www.ntia.doc.gov/osmhome/roosa4.html.

[6] http://www.spectrumreview.radio.gov.uk.

[7] Rucker, Teri, "The Military's Spectrum Pitch: Our Calls Must Go Through," *Technology Daily*, April 23, 2002, available at http://www.govexec.com/dailyfed/0402/042302td1.htm.

[8] See Mosquera, Mary, "Spectrum Search Puts Military in the Hot Seat," *Internet Week,* July 25, 2001, available at http://www.teledotcom.com/article/TEL20010725S0002.

[9] Industry questions and answers at http://www.wow-com.com/indstry/policy/congaffairs/articles.cfm?ID=437, June 7, 2001.

[10] See "Reference Paper to Basic Agreement on Telecommunications," available at http://www.wto.org.