

Spectrum Management

Part 2

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Particular situation, interests, goals and views

National spectrum management began in the early 1920s with record keeping – logging out frequencies to applicants essentially on a first come, first served basis. The 1947 Atlantic City Radio Conference made foundations for today's international spectrum management by copying, to some degree, the United States national spectrum management system of the time.

Today, the concept of spectrum management embraces all activities related to regulations, planning, allocation, assignment, use, and control of the radio-frequency spectrum and the satellite orbits. To be effective, any spectrum management system should embrace sound spectrum engineering, monitoring and enforcement mechanisms.

Three objectives shape any spectrum management system: conveying policy goals, apportioning scarcity, and avoiding conflicts, with due regard to social, political, economic, ecological, and other aspects. The society is composed of various groups, each with its particular situation, interests, goals and views.

As a consequence of spectrum scarcity, conflicts arise between those who have access to the spectrum resource and those without it. Conflicts also arise between the proponents of competing uses of the spectrum as well as between those who manage the spectrum and those who use it. These conflicts may be of various natures: commercial, political, physical interference, and so on.

For those whose needs have already been satisfied, spectrum management should assure the continuation of the existing status. Any modification would threaten their acquired benefits. On the other hand, the newcomers have no access to the spectrum they need. For them, the principal aim of spectrum management is to change the way the spectrum is assigned and to eliminate obstacles that prevent them from entering the competition. What is seen as the best for one group is not necessarily good for the other. Since the very beginning, spectrum management rules and regulations have tended to reflect the relative balance of powers of the competing interest groups.

Dual approach

Traditionally, the uses made of the spectrum/orbit resources have been based on frequency allocation principles, as given in the Table of Frequency Allocations of the Radio Regulations. Allocation means the distribution of a frequency band to a wireless service, allotment – to a country or area, and assignment – to an individual radio station. Some allocations are worldwide, others are regional, i.e. uniform throughout a particular region.

A country can make an assignment to an individual station or to a group of stations when needed. This is the so called *ad hoc* coordination or frequency distribution method. The alternative is known as *a priori* frequency distribution, or planning. For services subject to *a priori* planning, an assignment in accordance with the plan receives protection from any other assignment. In the case of *ad hoc* managed services, the protection is given in accordance with the priority of registration dates – a system frequently described as first come, first served.

International frequency plans are agreed at competent radio conferences for specific applications, geographic regions, and frequency bands that are subject to *a priori* frequency planning. A frequency plan is a table, or more generally, a function that assigns appropriate characteristics to each radio station (or group of stations) at hand.

The name "frequency planning" is a remnant of the early days of radio, when only the operating frequency of a radio station and its geographic location could vary. International plans are general and contain a minimal number of details. In contrast, design and operational frequency plans include all the details necessary to operate the station.

In *a priori* frequency plans, specific frequency bands and associated service areas are reserved for particular application well in advance of their real use. The distribution of the spectrum resource is made on the basis of the expected or declared needs of the parties interested. That approach was used, for instance, by the 1997 World Radiocommunication Conference (WRC-97) that established another plan for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz in Region 3 and 11.7-12.5 GHz in Region 1 and a plan for feeder links for the broadcasting-satellite service in the fixed-satellite service in the frequency bands 14.5-14.8 and 17.3-18.1 GHz in Regions 1 and 3. Both plans are annexed to the Radio Regulations.

Advocates of the *a priori* approach indicate that the *ad hoc* method is not fair because it transfers all the burden to latecomers who must accommodate their requirements with those of the existing users. Opponents, on the other hand, point out that *a priori* planning freezes the technological progress and leads to "warehousing" the resources. Here, warehousing means not using but keeping in reserve. However, when not used, no resource can offer benefits.

Although all usable frequency bands have been allocated to services, only a small portion of them is subject to international *a priori* planning. In this connection, many countries currently lacking the necessary financial resources are afraid that they will never have access to unplanned frequency bands or positions on the geostationary satellite orbit. These bands and positions might already be occupied when the countries will be ready to use them.

Critics of a priori planning indicate also that it is impossible to predict future requirements with a degree of accuracy, and any plan based on unrealistic requirements has no practical value. Instead, it blocks frequencies and freezes development.

Indeed, technological progress is very fast, and the plan may become outdated before it is implemented. We have to note that in fact, the *a priori* and *ad hoc* approaches differ only in the time horizon taken into account. Finally, one may argue that access to services does not require the ownership of, or control over, the spectrum/orbit resources.

What is important is that there is no mechanism to limit the requirements, as the spectrum/orbit resource is available at no cost at international planning conferences.

Although the ITU Convention calls for minimizing the use of spectrum resources: "... each country has an incentive to overstate its requirements, and there are few accepted or objective criteria for evaluat-

ing each country's stated need. In fact, the individual country itself may have only the dimmest perception of its needs over the time period for which the plan is to be constructed. ... Under these circumstances, it is easy to make a case that allotment plans are not only difficult to construct, but when constructed will lead to a waste of resources as frequencies and orbit positions are "warehoused" to meet future, indeterminate needs ... ".^①

These remarks, however, do not concern the frequency planning at the design stage of wireless systems, when all requirements are "real" and "immediate".

Trends

The current spectrum management policies and practices are inherited from the times when radio was mainly under State monopoly and access to spectrum resources was free. However, the world has changed in the meantime and the role of governments is still changing. State monopoly is being abandoned in many countries and the importance of the private sector and non-governmental international corporations is increasing. A single market is being created and a competitive worldwide market economy is developing.

New satellite constellations and stratospheric stations are being planned. New wide-band spread-spectrum systems based on a new concept of spectrum sharing are becoming more and more popular. Digital signal processing offers new possibilities for the integration of services, which are not yet fully exploited.

New satellite and stratospheric station technologies are being planned. All of this does not fit well into the framework of the present Radio Regulations. Redistribution, and better use of radio waves, is felt necessary by many.

Although the present spectrum management system has been criticized almost from its introduction, nothing better has been agreed. Developing countries are afraid that there will be no spectrum to satisfy their future needs. They would also like to exploit their old equipment for as long as it works. Developed countries are afraid that they cannot implement new technologies and develop new applications because of warehousing and regulatory barriers.

In the past, all the Radio Regulations were criticized as being too complicated and excessively rigid. The new regulations, which provisionally came into force on 1 January 1999, were expected to solve the problem, but it is too early to assess the results and we have to wait and see to what degree these expectations were justified.

Every radio conference makes the participants equally unhappy with the results achieved. But, this equal dissatisfaction of all parties involved indicates in fact that the best compromise possible has been reached; otherwise some parties would be more satisfied than others! Over the years, various improvements have been proposed, but few have been implemented and the fundamental rules remain unchanged.

One of the reasons of slow adaptation of the ITU process to the changing environment is fragmentation and disparity among the Member States, their needs and their interests. In spite of large differences between, say, China, representing a billion people, and that of Tonga, representing a hundred thousand people, the ITU Constitution warrants a single vote to each of them, as to any other Member country. Similar disparity exists in the telecommunication infrastructure.

^① Robinson G. O.: *Regulating international airwaves: the 1979 WARC, Spectrum Management and Engineering*, IEEE Press (1985), pages 43-69.

Another reason is the national sovereignty and consensus-based decision process – the two most sacred principles in ITU. These principles imply that common decisions are possible only if acceptable to the weakest and most conservative Members. Still, another reason is the separation of the decision-making process from economic mechanisms.

The financial contribution of each Member State to the Union's common budget is voluntary and without any correlation to the number of radio stations or satellites that that Member State uses. Consumers or users, service providers and equipment manufacturers are represented by governments in ITU's decision-making process.

The experience gained in dealing with other resources indicates that economic incentives could be used as an instrument to rationalize the use of scarce resources. As mentioned earlier, most countries have introduced a fee system for access to spectrum/orbit resources at the national level.

If introduced internationally, "spectrum occupation fees" could limit excessive demand and free the frequencies and orbital positions that are now "warehoused". The income could be used to develop telecommunication infrastructure where needed. Such an idea was formally proposed (among others by this author), but did not receive substantial support at WRC-97. The majority of ITU Member countries have preferred to continue with the administrative "due diligence" approach that focuses on bureaucratic aspects.

The concept of spectrum management through market forces, put forward in some countries, has found as many supporters as opponents. The idea is to replace the regulatory and fee system by a competitive market economy mechanism. For the time being, that action has been limited to a few countries and to selected frequency bands.

Its advocates indicate that market forces automatically match the demand to the available resource capacity and that the market-based management is inexpensive. Moreover, relying upon administrative decision-making is inferior to relying on market forces because decisions are arbitrary and often mistaken in determining what is the best interest of users. However, market forces could make wireless applications more expensive and influence the existing balance between the further developments of wired and wireless communication services.

The spectrum-market concept was implemented in a few countries, but the real breakthrough was the series of spectrum auctions conducted by the United States Federal Communications Commission (FCC) in 1994 and 1995. Earlier, licences to use radio frequency to offer wireless communication services were awarded on a "first come, first served" basis, by lottery, or by comparative hearings ("beauty contests"), almost for free.

Now the FCC is granting the licences to the highest bidders. The first auction in the United States (held in 1994) ended with the assignment of three bands of 1 MHz around 900 MHz for a total of about USD 650 million. In 1995, two pairs of bands of 15 MHz around 1900 MHz for personal communication services were assigned for a total of USD 7.74 thousand million^②.

On top of this, the successful bidders have to pay expenses for relocating thousands of microwave transmission facilities that were already using that portion of the spectrum. These numbers, however, should not be generalized as the price depends on the demand and supply. Spectrum in the centre of New York or Tokyo will cost much more than somewhere in the middle of a desert. However, one thing is clear: the consumers will pay the final bill.

^② Bell T. E.: *Main event: spectrum auctions. IEEE Spectrum, January 1996, page 28.*

It should be noted here that the creation of an international spectrum market would be the next logical step after the introduction of national spectrum markets. It would be a real revolution and – in view of a large inertia of the ITU mechanism and many open questions – it seems improbable that it will happen soon.

No evidence has been published that selling the spectrum on the global market will solve the scarcity problem in a way acceptable to all parties involved. The market approach, combined with sovereignty, still an indisputable principle in ITU, may increase further the existing fragmentation in spectrum management.

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