FACTA UNIVERSITATIS (NIŠ)
Series: Electronics and Energetics vol. 12, No.2 (1999), 45-65

UDC 621.396.74

CHALLENGES TO THE INTERNATIONAL RADIO REGULATORY ARRANGEMENT IN AN ENVIRONMENT OF DECREASING DIFFERENTIATION BETWEEN THE TRADITIONALLY DEFINED RADIOCOMMUNICATION SERVICES

This paper is dedicated to Prof. Ilija Stojanović on the occasion of his 75^{th} birthday and the 50^{th} anniversary of his scientific work

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Abstract. The radiofrequency spectrum and the geostationary satellite orbit, being limited natural resources, must be used rationally, efficiently and economically. They are subject to detailed international regulation included in the International Telecommunication Constitution and Convention and in the administrative regulations (Radio Regulations and Telecommunication Regulations) attached thereto. The basic purpose of these instruments, that have international treaty status , is to ensure equitable access to these natural resources by countries and groups of countries and to provide means for harmonized development and efficient operation of telecommunication services. These regulations have been established within the International Telecommunications Union and are under permanent review to respond to the rapidly changing telecommunication environment.

The primary goal of the international radio regulations is to establish useful and cost-effective ways of coordinating the planning and managing the implementation of services. The Radio Regulations and associated Recommendations are intended to assure the necessary performance and quality, while seeking to conserve spectrum and flexibility for future expansion and new requirements.

To this end, the international Radio Regulations address many different aspects relating to the assignment and use of frequencies (allocated frequency bands, mandatory sub-allocations, authorized classes of emission, power limits, and many other technical characteristics such as frequency tolerances,

Manuscript received June 23, 1993. This paper reflects the personal views of the author which are not necessarily those of the ITU.

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maximum permitted spurious emission power level, equipment characteristics). It also specifies the substantive procedural aspects (such as advance publication, coordination procedure, updating of plans, notification and recording) that lead to international recognition of the use of frequencies.

Radiocommunication services are currently undergoing major transformations due to the rapidly advancing technology and the convergence of media, telecommunications and computing. The traditional concepts for international management of the spectrum/orbit resource, in an environment of decreasing differentiation between the traditionally defined radiocommunication services, do not follow this pace of change. It is imperative that a substantive review be undertaken of the current concepts of international frequency management so as to establish a regulatory arrangement capable of responding to the challenges of the rapidly changing technological environment.

1. Management of the radiocommunication services in an increasingly changing environment: limits of international regulations

1.1 New developments in telecommunication and information technologies have resulted in highly sophisticated applications in both terrestrial and satellite telecommunication systems. Such applications have increased the access to communication channels and created the basis for new concepts like personal communications networks and "information superhighways". Furthermore, the convergence of the media, telecommunications and computing has resulted in the creation of the concept of a Global Information Infrastructure. The implementation of this concept requires appropriate international regulations that should be flexible, highly effective and responsive to the ever-accelerating pace of technological changes.

1.2 Radiocommunication services are an essential component of current telecommunication structures and one of the pillars of the Global Information Infrastructure. Based on the use of radio frequencies and satellite orbits (both geostationary and non-geostationary), radiocommunication services require a regulatory framework which will permit the use of the spectrum in a highly rational, efficient and economic manner, while providing flexible access to it by new technologies. This is necessary since, despite technological developments, the demand for spectrum is ever- increasing. In this connection the basic question which arises is: what uses of spectrum need to be regulated, and to what extent, bearing in mind that over-regulation may become a constraint for the development of radiocommunication systems, while the *laissez-faire* approach may lead to a chaotic situation.

1.3 The current radio regulatory arrangement, as contained in the Radio Regulations of the International Telecommunication Union (ITU), certainly aims to achieve the main regulatory objective, i.e., to provide the most useful and cost-effective ways of coordinating the planning and managing the implementation of services so as to ensure that they give the necessary performance and quality, while conserving spectrum and flexibility for future expansion and new requirements. Two main concepts are used in this connection:

- The concept of frequency block allocations that are intended for use by defined radio services (the Table of Frequency Allocations as contained in the current Article S5 of the Radio Regulations). This concept generally provides common frequency allocations to mutually compatible services operating with similar technical characteristics in specific parts of the spectrum. It also provides a stable planning environment for administrations, equipment manufacturers and users.
- The concept of voluntary or obligatory regulatory procedures for coordination, notification and recording that are tailored to the allocation structure.

1.4 In applying these concepts at various world radiocommunication conferences, Member States of the ITU have defined many radio services, with many derivations (sub-services), and appropriate specific procedures. This approach has been needed to ensure that quite specific requirements, and quite specific applications, are properly taken into account in the agreements reached at radiocommunication conferences or in planning. However, new technological developments, which offer practically unlimited choices for all kinds of digitization, coding, processing and switching of signals, are challenging the current rigid schemes. For instance, some highly complex multi- function systems nowadays offer a very wide ranges of applications but, at the same time, they put into question the appropriateness of the current definitions of single-purpose services. On the other hand, many of the services have become very similar and distinctions needed earlier are now not as important with current technologies and usage. In such an environment, it is legitimate to ask whether the principles of the current allocation structure and the associated regulatory framework are still able to respond adequately to the requirements of the rapidly advancing technology.

2. Allocation structures: basis for the planning and implementation of services

2.1 The allocation structure and the associated principles represent a basis for the planning and implementation of radiocommunication services. The current approach is based on a block allocation methodology with footnotes. The regulated frequency band (9 kHz – 400 GHz) is segmented into smaller bands and allocated to over 40 defined radiocommunication services in the Table of Frequency Allocations. The radio services are identified as primary or secondary (the latter shall cause no harmful interference to, nor claim protection from, the former) and footnotes are used to further specify how the frequencies are to be assigned or used. The Table is organized into three regions of the world and is supplemented by assignment and allotment plans for some bands and services. This approach has been maintained for a considerable period of time (since 1947) due to the several advantages it holds:

- it provides a stable planning environment for administrations,
- it provides stability for equipment manufacturers and users,
- it is accompanied by regulatory procedures adapted to block allocation methodology.

2.2 Two types of allocation are made:

(1) *exclusive allocations*, which are favoured in cases that involve broad international use of equipment and practices which imply the need to harmonize relevant operational procedures and technical material in a larger international context; the regulatory procedures which govern the use of bands that are allocated to only one radiocommunication service are adapted to the service concerned, also taking into account the relevant radiowave propagation mechanisms, and

(2) *shared frequency allocations*, which are applied to maximize the usage of the available spectrum when two or more radiocommunication services can effectively utilize the same frequency band. Any sharing of the spectrum should provide for continued (non- disturbed) operation of the existing or planned service after the introduction of a new service. It often happens that an existing or planned service, in an area of sparse radio usage, has enjoyed more than the necessary protection and has given a useful service beyond the specified coverage. The introduction of a new service may result in degradation of this "over-privileged" situation, while maintaining the conditions for optimal operation. The regulatory procedures which govern the use of bands that are allocated to several radiocommunication services, on a shared basis, are much more complicated: in addition to the radiowave propagation mechanisms applicable to the bands concerned, they are based on the use of technical criteria (usually threshold values) which are intended to identify the countries with which the coordination is to be effected to obtain

an acceptable sharing arrangement.

2.3 With shared allocations, it is essential that the sharing arrangement is acceptable to all parties concerned and that it allows sufficient quality and strength of signal for all of the involved services to be operated in a satisfactory manner. A solution is usually arrived at by separating different services by some combination of frequency, physical distance or time (frequency sharing, geographical sharing, time sharing).

2.4 However, the ever-increasing need for spectrum and the decreasing differentiation between the traditionally defined services has made many elements of this approach obsolete. Currently, there are many cases where the present distinction between the traditionally defined services is hazy and the block allocation structure may not be appropriate.

2.4.1 As an example, lets consider the broadcasting-satellite service (BSS) and the fixed-satellite service (FSS) from technical viewpoint. When the BSS and FSS services were originally defined as separate services there were considerable differences in the technical and operational standards of these services. FSS was considered to be mainly for point-to-point communications, using antennas of 15-30 meters, while the BSS was considered to be a point-to-multipoint service, using antennas of 50-60 cm. However FSS systems now use 1.5-2 m antennas in a point-to-multipoint mode similar to the BSS. FSS satellites now provide direct-to-home (DTH) service for computer connections using 60-70 cm antenna, but also a direct-to-home television in plain format, for direct reception by the general public. On the other hand, some transmissions in the BSS are totally encrypted, contrary to the definition of the broadcasting service which is defined as being intended for direct reception by the general public. In technical terms, there is little difference between a digital DTH service for computers (FSS) and a digital DTH TV service (BSS). This implies that DTH systems may be implemented in any bands allocated to the FSS and the BSS. As a consequence, one could hardly justify separate allocations for the FSS and BSS.

2.4.2 As another example, lets consider applications like FWA (fixed wireless access; sometimes referred as WLL - wireless local loop) and the cellular type mobile systems (sometimes referred to as MWA - mobile wireless access). As an extension to the fixed network, FWA is considered as part of the fixed service and it is normally implemented in the frequency bands allocated to the fixed service. However, from an operational point of view, FWA systems are point-to-multipoint systems, like the MWA systems. In many cases, FWA systems are designed to operate in the same frequency band as MWA systems, using the same technology. As a consequence, MWA systems operating in the bands allocated for mobile services may include FWA applications[1]. With such a convergence between the FWA and MWA systems (and many other applications, like multi-point distribution systems and radio local area networks), it is really a question of how long the difference between the fixed service and the land mobile services can be maintained. The only problem is finding a name for such a service, which integrates not only voice and data, but also audio and video transmissions.

2.4.3 As a further example, lets consider the adaptive HF communication networks. The systems used in these networks have real-time frequency management capabilities. Although initially conceived for use in the maritime mobile services, their architecture is consistent with any application in the fixed and mobile services. Consequently, they are being introduced in both fixed and mobile services. In view of the inherent advantages of these systems (very short call set-up time, efficient traffic handling, etc.), their channel occupancy is sometimes not even observed by the other users. As such systems can be implemented in any frequency band, with no detriment to other users, while ensuring effective throughput of their own transmissions, a question arises as to the adequacy of the rigid frequency block allocation scheme in this regard.

2.4.4 Similar questions are being asked in the context of the use of spread-spectrum CDMA systems. These systems could be used simultaneously for several applications, e.g., for point-to-point operations (in the fixed services) or for personal communication networks (in the land mobile service). In view of their features (e.g., the spreading of the energy of the transmitted signal over a bandwidth which is much wider than the information bandwidth) the conventional allocation techniques would require a wide frequency allocation block for both fixed and land mobile service. However, it is questionable whether such an allocation is required at all. Firstly, as spread spectrum systems have considerable resistance to interference, they could use many frequency bands jointly with other conventional systems without any need for a formal allocation (no need for increased protection of the spread-spectrum systems from conventional systems). Secondly, as the resulting transmitted signal of the spread spectrum systems is a wideband low power-density signal which resembles noise, such systems can be implemented on a non-interference basis with respect to the conventional systems that have allocations in the band concerned.

2.4.5 In other cases, the definitions of the service (Article S1 of the Radio Regulations) and the Table of Frequency Allocations to services (Article S5 of

[1] For more details see Recommendation ITU-R F.757-1

the Radio Regulations) do not seem to be consistent. For instance, Article S1 (provision No. S1.23) contains the definition of the space operation service, indicating that the functions of the space operation service (space tracking, space telemetry, space telecommand) will normally be provided within the service in which the space service is operating (e.g., fixed-satellite service, broadcasting-satellite service, mobile-satellite service). On the other hand, Article S5 contains several separate allocations to the space operation service and to other satellite services in the same frequency band (e.g., around 137 MHz, in 400.15 – 402 MHz, in 1525 – 1535 MHz, etc). Thus, in some cases there is an implicit allocation made, while in other case there is a redundancy: an allocation is made explicitly for the space operation service and there is an implicit allocation made through the allocation of the main space service.

2.5 In view of the above developments, the international community now tends to favour making allocations which are based on generic services. This became evident at the World Radiocommunication Conference in 1997 (WRC-97), where a considerable breakthrough was achieved by allocating some parts of the spectrum to the generic mobile-satellite service, a result which was obtained after 12 years of intensive negotiation. Similarly, the same Conference decided, *inter alia*, (1) to allocate some frequency bands for bi-directional use (Earth-to-space, space-to-Earth), and (2) to allocate some frequency bands for common operation by systems using the geostationary satellite orbit (GSO) and by systems using non-GSO; this kind of decision would have been unthinkable some 10 years ago. Certainly, such decisions on allocations were accompanied by other decisions on the conditions for use of the bands by the services concerned. To this end, some new concepts were introduced, e.g., fractional degradation in performance[2], equivalent power-flux density limits[3], aggregate power-flux density limits[4], etc.

2.6 In conclusion, in an environment of constantly decreasing differenti-

[2] A fractional degradation in perfomance (FDP) is used to evaluate the impact of a constellation of space stations in the mobille-satellite service using the non geostationary-satellite orbit on terrestrial stations in the fixed service using digital modulation; for details see paragraph 1.2.2 of Annex 1 to Appendix S5 (Radio Regulations, vol. 2, ITU, Geneva, 1998)

[3] The concept of equivalent pfd limit is used to evaluate the impact of a constellation of space stations in a satellite system using a non geostationary-satellite orbit on Earth stations in a service using the geostationary-satellite orbit;for details see Resolution 130 (WRC-97), (Radio Regulations, vol. 3, ITU, Geneva, 1998)

[4] The concept of aggregate pfd limit is used to evaluate the impact of all earth stations in a satellite system using a non geostationary-satellite orbit on a space station in the geostationary-satellite orbit; for details see Resolution 130 (WRC-97), (Radio Regulations, vol. 3, ITU, Geneva, 1998)

ation between the traditionally defined radiocommunication services, there are many reasons to question the appropriateness of the frequency block allocation methodology to distinctive radiocommunication services, *based on the traditional definitions of the single-purpose radiocommunication services.* With many radical changes in the operational practices, the old administrative concepts, such as service type, mobility and content, which served as a basis for differentiating various radio services, are now inoperative and obsolete. However, from an international perspective, an international table of frequency allocations is still required because it provides for stability of usage and for the possibility of international planning. Such a Table may only be useful in the context of a re- definition of the radiocommunication services, based on broader service definitions, in a way which provides improved flexibility and adaptability in meeting new or unforeseen requirements.

3. Radio regulatory procedures: uniforms which do not suit

3.1 The rights and obligations of the Member States of the ITU in the domain of international frequency management of the spectrum/orbit resource are incorporated in the International Telecommunication Constitution and Convention and in the Radio Regulations that are annexed to them. Article 44 of the Constitution (Geneva-1992, as amended by the Plenipotentiary Conference, 1994[5])stipulates that the radio frequencies and the geostationary-satellite orbit are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the Radio Regulations, so that countries and groups of countries may have equitable access to both. The specific procedures providing the means to achieve interference-free radiocommunications have been established by world radiocommunication conferences on the basis of the above principles.

3.2 Various mechanisms or procedures have been established to safeguard the rights of administrations when they comply with these obligations. These mechanisms or procedures subsequently lead to ensuring international recognition of the frequencies used. The principal mechanisms applicable to different bands/services are one or more of the following:

- selection and assignment of frequencies by each country to its own stations;
- coordination of frequencies, where appropriate, prior to their notification to the Radiocommunication Bureau of the ITU and their bringing

[5] The Constitution and Convention were further amended by the Plenipotentionary Conference, 1998; the modofied provisions will enter into force on 1 January 2000.

into use;

- notification of frequency assignments by the national administration to the Radiocommunication Bureau of the ITU, examination and recording, by the Bureau, in an international frequency register;
- use of frequencies according to a pre-established frequency plan and notification to the Radiocommunication Bureau of the ITU of the bringing into use of the frequency assignments of an allotment plan (HF aeronautical and maritime mobile services, fixed- satellite service) or of an assignment plan (broadcasting plans in the LF/MF and VHF/UHF bands, aeronautical and maritime radionavigation, maritime mobile, satellite-broadcasting and feeder-link plans);
- use of frequency assignments according to seasonal schedules that are established twice a year (HF broadcasting service).

3.3 The current system of regulations is based on provisions established in the time of HF communications and subsequently amended to take into account new services and new techniques, including space communications. Through the successive amendments, however, the regulations have become extremely complex and very difficult to manage. Even the recent simplification (in 1995 and in 1997) was a rather conservative one, as all the major features of the former procedures, such as advance publication (for space networks), prior coordination, plan modification, notification and the recording of frequency assignments in a "Master International Frequency Register", have been kept in one form or another.

3.4 The fact that the Constitution and Convention of the International Telecommunication Union and the Radio Regulations annexed to them are intergovernmental treaties ratified by governments, means that these governments undertake: (1) to apply the provisions in their countries and (2) to adopt adequate national legislation which includes, as the basic minimum, the essential provisions of this international treaty. However, the international radio regulations are oriented mainly towards those matters that have a global or Regional character, and in many areas there is a place for making special arrangements on a bilateral or multilateral basis. These arrangements can be Regional Agreements or Special Agreements and may deal with the settlement of policy or operational issues, with coordination on the establishment of radiocommunication systems and with many other items of mutual interest concerning the use of the radio frequency spectrum. In this connection the ITU Member States have concluded various Regional Agreements and many special agreements. Such special agreements (e.g., the Vienna-93 Agreement on the coordination of frequencies for the fixed and land mobile service in the bands between 29.7 MHz and 960 MHz; the Wiesbaden-95 Agreement concerning the introduction of digital audio broadcasting, and the Chester-97 agreement on the introduction of terrestrial digital video broadcasting in the VHF/UHF bands), shift the frequency coordination activities from the ITU to different regional bodies. This tendency may indicate that the rigid procedures of the ITU are not suitable for dealing with those applications which require fast responses.

4. A-priori planning of the frequency bands: successful and missed opportunities

4.1 From the very early days of the establishment of the international radio regulatory arrangement, the international community opted for frequency allotment or frequency assignment plans as a means of preserving the rights of all Member States in the context of equitable access to the limited radio resources (the frequency spectrum and the geostationary satellite orbit). Following the establishment of the Frequency Allocation Table in 1947, the ITU invested considerable efforts in establishing appropriate frequency allotment or frequency assignment plans for various radiocommunication services and in various frequency bands. Some plans (e.g., for the maritime mobile service in the HF bands reserved for duplex radiotelephony, for the aeronautical mobile (off- route) service in the HF bands, for the aeronautical mobile (route) service in the HF bands) were adopted as early as 1951. These plans (currently contained in Appendices S25, S26 and S27 of the Radio Regulations) were subsequently revised several times, so as to take account of the new technological advances (e.g., the introduction of the single-sideband modulation) or of the requirements of newly independent countries. They are still valuable instruments for an orderly use of the frequencies in the relevant bands. The associated plan modification and notification procedures provide for satisfaction of particular operational requirements which are not met by the Plans, while preserving the integrity of the Plans themselves.

4.2 The international community has not always been successful in establishing the appropriate Plans, despite enormous efforts invested. A very illustrative case in this regard is the broadcasting service in the HF bands. Since 1947, there have been several international Conferences and many planning exercises attempting to establish an acceptable Plan, but without any success. The failure was always due to the excessive number of requirements expressed by the Member States which could not be accommodated in the available spectrum. This failure was repeated even after the considerable extension of the allocated frequency bands. On the other hand, an excessive number of requirements in some other services did not prevent the completion of the relevant activities. For instance, the revision of the Appendix S25 Plan was performed by the ITU Secretariat, after WARC-87 (i.e., outside a planning Conference), in an environment of considerable excess of the initial requirements. The successful revision of the Plan in this case was possible because the Conference gave clear instructions to the Secretariat as to the treatment of the requirements which could not be satisfied through the standard plan-establishment procedure. The failure to establish the plan for HF broadcasting (i.e., for an international broadcasting service intended to cover territories of other countries) was primarily due to non-technical considerations which ITU Member States never articulated in plain language.

4.3 In other cases, the plans, although established after a long process of negotiation, were never really used. A very interesting case in this regard is the Plan for the broadcasting-satellite service in the 12 GHz band, accompanied with the associated feeder-links plans. These plans were adopted by the world conferences in 1977, 1985 and 1988, subsequently revised in 1997, and are still on the agenda of another world conference to be held in the year 2000. However, the use of these bands, by the broadcasting-satellite service (BSS) is well below the expected level. At the same time, some other bands which are not allocated to the broadcasting-satellite service are now extensively used for the so-called "direct-to-home" transmissions in the fixed-satellite service (FSS) which, by nature, are very similar to BSS transmissions.

4.4 In some other cases, where the international community opted for automated plan-establishment procedures as a neutral tool for dealing with the differing requirements of the Member States, the *a-priori* planning approach demonstrated additional shortcomings, which are illustrated with the following examples:

4.4.1 At a planning conference in 1985, the administrations belonging to Region 1, as defined in ITU instruments[6], established a frequency assignment plan for stations in the maritime mobile service in the bands around 500 kHz and 2 MHz as well as for stations in the aeronautical radionavigation service (radiobeacons) in the bands around 500 kHz. The participating administrations agreed that the selection of frequencies for the relevant stations would be based on an automated algorithm and that the other parameters (e.g., the transmitter power and the effective monopole

[6] See Nos. S5.3 to S5.9 of the Radio Regulations, vol. 1, ITU, Geneva, 1998; Region 1 corresponds approximately to Europe and Africa

radiated power) were to be derived from the minimum field strength to be protected at the edge of the coverage area. However, the determination of the basic planning parameter (the minimum field strength to be protected at the edge of the coverage area) was based on an administrative decision (e.g., 37 $dB(\mu\text{V/m})$ and 57 $dB(\mu\text{V/m})$, for single sideband telephony with suppressed carrier, in the bands around 2 GHz, depending whether the station is situated north of parallel 30° North, or south of that parallel) which resulted in very unrealistic parameters later on. For instance, some coast stations in the area north of parallel 30° N, were entered in the Plan with unrealistically low levels (e.g., Norddeich Radio, Germany, for F1B operation on 1611.5 kHz, with a transmitter power of -11 dBW), which are well below the values normally used in the maritime mobile service (typically 30 dBW). On the other hand, some coast stations in the area south of parallel 30° N were entered in the Plan with extremely high levels (e.g., Mombasa Radio, Kenya, for J3E operation on 1708.4 kHz with a transmitter power of 45 dBW), even above the maximum authorized value of 40 dBW. Similarly, some frequencies which were selected for simultaneous operation by the same coast station were too close to each other to be used (e.g., assignment of frequencies 437 kHz and 438 kHz for the coast station Durban, Republic of South Africa, for F1B operation). As this approach was applied in planning the maritime radionavigation service (radiobacons), in the European Maritime Area in 1985, similar unrealistic parameters were obtained (e.g., the radiobeacon station Zeebruggephare, Belgium, was entered in the plan with an e.m.r.p value of -26 dBW). In the practical implementation of these plans, some administrations preferred to notify the real operating characteristics of their transmitters, which resulted in their losing the advantages of being in conformity with the plan. However, the majority of the administrations preferred to ignore these deficiencies and continued to notify their assignments as if they were operating in accordance with the planned characteristics, as unrealistic as they may be.

4.4.2 In 1997, during the revision of the plan for the broadcasting-satellite service in the 12 GHz band for countries of Regions 1 and 3, several satellite systems were entered in the Plan with negative overall equivalent protection margin (OEPM). For instance, the satellite system *Europsat 1*, proposed by France , was entered in the Plan on position 29° E, despite the fact that the respective OEPMs were situated in the range between -7.87 dB and -2.84 dB, with an equivalent protection margin (EPM) as low as -29.62 dB for the feeder link, which makes the operation of this system theoretically impossible. This approach, which was followed by other systems as well, was justified by the fact that the calculated interference from other systems comes mainly from "paper systems" which would not be put into operation in the foreseeable future.

4.5 Despite the apparent success of the *a-priori* planning approach in many cases (e.g., the Stockholm-61 Plan dealing with the broadcasting (television) service in the VHF/UHF bands in the European broadcasting Area, which still proves to be adequate, with the associated plan modification procedures, almost 40 years after its establishment), other examples demonstrated many shortcomings of the plan-establishment procedure, putting into question the applicability of *a- priori* planning.

4.5.1 In most cases the severe restrictions imposed on the planned service in the planned bands (e.g., to the BSS in the 12 GHz band) has resulted in a migration of that service to other bands which are not subject to planning and where such restrictions do not exist. Although some restrictions on the planned service are unavoidable, a question arises as to the scope of such restrictions, because too severe restrictions may inhibit the implementation of the planned service. In such a case the *a-priori* planning is counter productive: instead of guaranteeing the right of any Member State to access the spectrum/orbit resource at the time when it requires such an access, it results in denying the right to almost every Member State to the spectrum/orbit resource because of the insurmountable obstacles to implementing a viable system in accordance with the too severe restrictions.

4.5.2 In other cases, the loose distinction between the planned (e.g., BSS) and some of the non- planned services (e.g., FSS) has resulted in migration of an application (DTH television) from one service to another. Such a migration was certainly motivated by the fact that the regulatory arrangement for the FSS is more flexible than that for the BSS, thus bypassing the more stringent regulatory provisions applicable to the BSS. In this context it is again worthwhile asking whether there is still a need to govern two similar services by different regulatory procedures ?

4.6 Against this background, we can conclude that *a-priori* planning does provide for some benefits for those *specific* services where the likely operating parameters are well known at the time of the planning endeavour and where the equity of rights in accessing the spectrum/orbit resource does not mean equal shares in the relevant part of the spectrum. The value of such plans may be further increased by developing supporting procedures to ensure flexibility to meet changing requirements and developments in technology. On the other hand, when the likely operating parameters are not sufficiently known, or where the equity of rights in accessing the spectrum/orbit resource is understood as equal shares to the relevant part of the spectrum, *a-priori* planning may easily fail, which may result in unnecessary wasting of the spectrum/orbit resource if it remains unused for long periods. In an environment of diminishing differentiation between the traditionally defined services and increased commonalties between their system designs, *a-priori* planning may seem an obsolete concept, rather than a viable tool for the management of the spectrum/orbit resource.

5. Coordination procedures: unnecessary burden or promising opportunities ?

5.1 One of the main purposes of the international radio regulatory procedures is to enable implementation of new radiocommunication systems while avoiding harmful interference with the other existing and planned users. For this reason the procedure for coordinating the use of frequencies in the non-planned bands represents the basic element of the international radio regulatory arrangement. In essence, coordination is a bilateral or multilateral process conducted between administrations which consists of:

- identification of the administrations whose assignments are likely to be affected and with which prior coordination must be sought or agreement obtained;
- use of standardized methods for calculating the potential for interference;
- application of standardized steps of a well-defined and transparent procedure comprising, *inter alia*, the exchange of a sufficient number of data elements in a prescribed format, communicating comments within a prescribed period, and publication of the results of the coordination procedure in the Weekly Circular of the ITU/BR.

5.2 The coordination procedures were largely considered as a means of dynamic planning of the spectrum/orbit resource, allowing more efficient use and without unnecessary freezing of the resource, as compared with *a-priori* planning. This process worked reasonably well during the period of a highly regulated environment, where the global telecommunication systems represented a common endeavour of the whole telecommunication community. However, in an environment of exploding demand for telecommunication services, which are very often motivated by profit-making considerations, these procedures have tended to become a means of reserving the resource without actually using it. In reserving this resource, the intention has been to gain some advantage at a later date by offering the already coordinated system, through an auction process or through another mechanism, to the user offering the highest bid. As a consequence, the coordination process has became inoperative in terms of the number of cases to be handled. Figure 1 shows the evolution of the number of submissions relating to space networks received by the BR for processing (capture, technical/regulatory examination and publication[7]), showing that, in 1998, the number of networks handled for advance publication and coordination in space networks alone was about 1 764. Those administrations starting the coordination procedure have to take into account the previously submitted requests for coordination, although some of them may be related to "paper requirements", i.e., requirements which are not intended to be brought into use, for various reasons, but which effectively block the implementation of real systems.

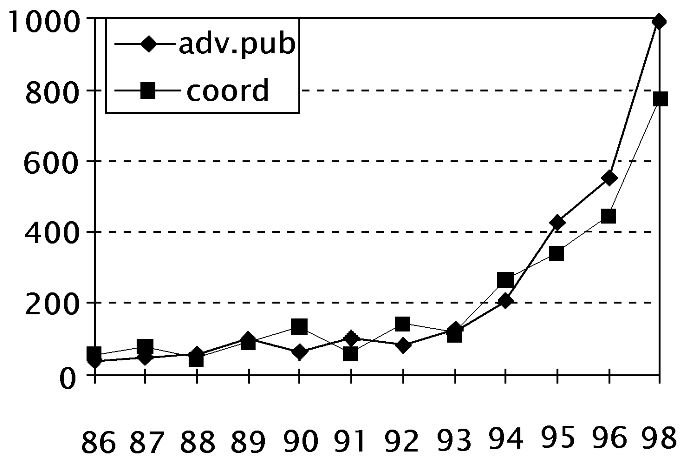

Fig. 1. Evolucion of the number of space networks (submission received for AR11/RS46)

5.3 In practice, the coordination process itself became rather an unworkable process. Several reasons for this are listed below:

- the coordination requests are normally submitted for *broader parameters* in order to cover not only the likely parameters of the services which will be implemented, but also unforeseen changes in demand which may occur due to changing market requirements (e.g., MSS instead of FSS). To this end, the coordination process is usually initiated for a multitude of applications involving a multi-service platform. While broad parameters may be necessary for protecting the option of alternative future applications, the coordination process tends to be more difficult

[7] Source: Report on the activity of the ITU in 1998, document C99/35, ITU Council, Geneva, 1999

and conservative than coordination for the known parameters of a single purpose application. This approach has the potential of blocking other real requirements which could have been achieved if the coordination process were conducted for a single purpose application;

- the coordination requests are normally submitted for *multiple orbital locations*, or more spectrum than is actually required. This is done to ensure that the resources which are actually needed are obtained at the end of a difficult coordination process, or to preserve the flexibility for gradual growth of the system, should it demonstrate commercial success. As all of these multiple positions have to undergo the whole coordination process, the coordination is more difficult than coordination for the limited number of orbital positions which are actually needed in the implementation phase. This approach has a detrimental impact on other real requirements which could have been achieved if the coordination process were conducted for a limited number of orbital positions;
- in some cases the coordination requests are initiated by administrations which have no serious intent to make early use of this resource. Their real intent is to block the projects of other administrations, thus preserving the rights of their national operators in an era of increasing competition. In other cases the coordination requests are submitted by administrations which do not intend to really implement a system, but which instead are interested in a subsequent transfer of the acquired rights to other administrations, or in selling/leasing of the coordinated resource to any operator, thus becoming an administration of convenience for any operator which is ready to adopt such an approach.

5.4 The defects in the regulatory process, which have been identified on various occasions and which have resulted in an increasing number of uncoordinated uses of the spectrum/orbit resource, have been the subject of an in-depth review since 1994, in pursuance to Resolution 18 of the ITU Plenipotentiary Conference (Kyoto, 1994)[8] . As a result of these studies, the World Radiocommunication Conference in 1997 (WRC-97) approved some measures which are intended to improve the situation. Amongst these measures, the most promising are the new obligations of the Member States to make a timely submission of specific evidence to demonstrate the serious intent to proceed with the project under coordination. Such a procedure, referred to as "due diligence" requests the coordinating administration to submit, before the end of the coordination period (normally 5 years) verifiable infor-

[8]Final Acts of the Plenipotentiary Conference, Kyoto, 1994, ITU, Geneva, 1995, pp. 154-156

mation on the spacecraft manufacturer and launch services provider. The non-submission of the relevant due diligence information, within a specified period, would result in deletion of the coordination information for the concerned network.

5.5 From the above considerations one can conclude that the frequency coordination process does represent a viable tool for orderly access to the spectrum/orbit resource as long as the size and the complexity of the submissions remain manageable and the coordination process is initiated and conducted in a good faith. However, with the increasing complexity of the technical parameters of the systems and the emphasis on the commercial aspects of frequency/orbit use, the coordination procedures have became a real burden for administrations and for operators. This has resulted in a considerable number of failures in coordination and an increasing practice of bringing systems into operation for which the coordination could not be completed in accordance with the relevant provisions of the Radio Regulations. The newly introduced measures in this respect (i.e., the procedure of administrative due diligence), which excludes systems that are not based on a serious intent of use, have yet to prove their value. However, in the absence of other measures (e.g., financial deposits for the proposed system, with all or part of the deposit returnable when the system is brought into operation) it is hard to expect any noticeable improvement of the coordination process in the near future. In the absence of more promising mechanisms to manage the spectrum/orbit resource in a satisfactory manner for all participants, the ITU coordination process, based on the application of mandatory procedures as stipulated in the Radio Regulations, risks collapsing and being replaced by a voluntary coordination between the operators, outside the ITU.

6. Notification and registration procedures: the utility of the dead wood

6.1 With the establishment of the Table of Frequency Allocations, whose observance was made obligatory in 1947, and with the introduction of the relevant procedure for notification of the use of the radio frequency spectrum to the ITU, the Master International Frequency Register (MIFR), in which all usage notified to the ITU was recorded, became one of the pillars of the international radio regulatory arrangement. As frequency assignments, when recorded in the MIFR, were accorded the appropriate status (e.g., right to protection from harmful interference) after very careful examinations by the International Frequency Registration Board (IFRB), an independent collegiate body, national administrations used to pay particular attention to the notification process and to the accuracy of the submitted data, bearing in mind that the accuracy of data was easily verifiable by many monitoring centers. Consequently, the MIFR remained, for many years, a very relevant frequency management tool which was regularly consulted before selecting a frequency for any new user.

6.2 Although the radio regulatory arrangement did not operate with a concept of a lifetime of an assignment, the right to international protection from harmful interference, accorded to some categories of frequency assignments, was subject to periodical examination, in which the notifying administration was expected to confirm whether the frequency was used with the same notified characteristics, or to submit a notice of change. In the case of a change of the transmission characteristics, the modified frequency assignment was subject to re-examination so as to evaluate whether the new characteristics increase the potential of harmful interference to the assignments already recorded in the MIFR and which are subject to protection. Should the result of examinations show an increase of the potential of harmful interference (e.g., by more than 2 dB), the modified assignment received a lower status for a trial period (2 or 6 years, depending on the frequency band). After the expiry of the trial period, the modified assignment was further examined with a view to determine its final status. In view of the above, many administrations adopted a pragmatic approach in respect to the periodic consultations, by which they consistently used to declare no change in the characteristics of the recorded assignments, so as to preserve their status, which implied some notion of priority. Such a course of action resulted in a kind of "dead wood", where the MIFR contained a considerable number of frequency assignments supposed to be in use, although many of them were not in use or were used with different characteristics. As the majority of these assignments preserved their priority rights with respect to any new assignment, the new uses were almost systematically given unfavourable findings and were returned to administrations. Although the notification procedure contained other elements which allowed the administrations to record such incompatible assignments (albeit with a lower status for a prescribed period of time), many administrations opted for a simpler approach - to continue with the use of the proposed incompatible assignment without any notification to the ITU. Such an approach, in conjunction with the approach of not updating the recorded assignments, led to a situation in which the value of MIFR was substantially compromised. Despite several measures (e.g., the possibility of updating the assignments in the MIFR so as to reflect the real use, without examination of the probability of harmful interference) the situation did not improve and the international community, in 1995, finally decided to take a radical decision by which it suppressed the category of assignments subject to protection from harmful interference, together with the related procedure concerning the examination of the probability of harmful interference.

6.3 In the current circumstances, the MIFR represents only an approximate summary of the frequency usage, as notified by the national administrations at their own discretion. In fact, the administrations are expected to notify only those frequency assignments that may have international implications, although the administrations are free to notify any frequency use they wish to be reflected in the MIFR. In many cases administrations have the option of notifying typical stations, thus supplying only the basic characteristics of a typical station which represents the frequency use of a large number of stations within a given geographical area of operation. In other cases, where assignments involve specific frequencies which are prescribed for common use by many stations of a given service (e.g., calling frequencies in the maritime mobile service), the frequency use is represented by a common entry in the MIFR. Although many administrations do follow the relevant recommendations in respect to the notification of frequencies, many others consider the MIFR as if it were their national frequency register and notify any licensed frequency, irrespective of its relevance to international frequency management. At the extreme, many administrations completely disregard their obligations to notify frequency uses that may have international implications, thus depriving such uses from an international recognition, but also making difficult the identification of sources of harmful interference. Finally, with the growing use of intelligent frequency-agile systems, or spread-spectrum systems, the notification of a considerable number of representative discrete frequencies, intended to cover as much operational situations as possible, does not seem to provide any useful purpose and many administrations fail to notify such systems.

6.4 With a similar tendency in the domain of space services, the MIFR may soon become an irrelevant spectrum/orbit management tool. In order to maintain its usefulness, several measures are being considered, some of them based on financial incentives. The introduction of a registration fee, which would be payable as long as the frequency assignment (of a satellite network) is recorded in the MIFR, may discourage the notification of "paper satellites" but does not guarantee an absolute accuracy of the MIFR: some users may be willing to pay a fee for a "paper satellite" if the fee is negligible; on the other hand, some users may decline to pay a fee for recording if the fee represents a financial burden.

6.5 Against this background one can conclude that the current regulatory arrangement, based on voluntary notification of the frequency usage, with all its consequential deficiencies, does not seem to respond adequately to the requirements of the international community for a viable and accurate spectrum/orbit management tool. This is especially evident in those cases where the recording in the Master Register does not result in any special priority: in such cases there is no interest notifying accurate and up-to-date data. On the other hand, where registration provides some priority the situation is also unworkable as administrations tend to keep the status-quo to retain that priority, even at the expense of the accuracy of the recorded data. In addition, the notification procedure, based on the obsolete concepts of single-purpose services, no longer seems to be appropriate for the present multi-purpose applications.

7. Conclusion: time for a change

Radiocommunication services are currently undergoing major transformations due to the rapidly advancing technology and the convergence of media, telecommunications and computing. The current radio regulatory arrangement, which is essentially based on well-differentiated single- purpose services, is far from being responsive to the challenges of many new multi-function systems which offer a very wide ranges of applications and which are hardly differentiable in terms of traditionally defined services. In order to respond to these new realities, the international radio regulatory arrangement has to be reviewed with a view to substantially re-defining many of the current inadequate concepts (such as "mobility"), which would lead to more flexible band allocation schemes. "A-priori" planning, when used, should be related to flexible operating parameters, accompanied with a plan modification procedure able to meet changing requirements of the Member States and developments in technology. The coordination process should be further refined, with the addition of other measures (such as financial deposits), so as to maintain its relevance; without additional mechanisms this process may collapse. The concept of notification and recording should be radically reviewed to maintain a database which is relevant for the international management of the spectrum/orbit resources; in order to ensure its accuracy, additional mechanisms may be needed (such as registration fees). Failure to implement such changes may result in the ITU regulatory framework becoming completely irrelevant and being replaced by alternative procedures outside the ITU.

Acknowledgments

This paper is dedicated to Prof. Dr. Ilija Stojanovic, an outstanding contributor to the development of the international radio regulatory arrangement since 1951. I am thankful to him for all guidance and advice which I have been received from him since 1973, including the suggestions for preparation of this paper. My thanks also go to Messrs. W. H Bellchambers and M. Harbi, former Members of the International Frequency Registration Board, and to Messrs. M. Sant and G. Kovacs, former Heads of Department in the IFRB/BR, for their precious guidance in respect to the matters treated in this paper. Finally, I would like to thank Mr. Y. Utsumi, Secretary General of the ITU and Mr. R. W. Jones, Director of the Radiocommunication Bureau, for their permission to submit this paper, as well as Mr. M. R. Giroux, Head of Department in BR, for his encouragement in the course of the preparation of this paper.