Annex

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INTERNATIONAL TELECOMMUNICATION UNION

IFRB
International
Frequency
Registration Board

CCIR
International
Radio Consultative
Committee

DRAFT

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ON NATIONAL FREQUENCY
MANAGEMENT

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PREFACE

Resolution No. 7 of the World Administrative Radio Conference, Geneva, 1979 (referred to hereafter as WARC-79), made provision for meetings to be organized between representatives of the International Frequency Registration Board (IFRB) and of the International Radio Consultative Committee (CCIR) and personnel involved in frequency management matters from administrations of developing and developed countries to discuss questions relating to the establishment and operation of frequency management units, taking into account the particular needs of the developing countries, to design possible standard structures for such units, and to identify the means required to satisfy those needs.

The first meeting on the development of national radio frequency management was held in Geneva from 24 to 28 October 1983, and 140 participants from 75 administrations attended. The report of this meeting was published by the Secretary-General of the ITU in his Circular-letter No. 13 of 22 March 1984.

In the time available the meeting could not deal with the question of standard structures of the frequency management units or with the means required to permit developing countries to set up these units. Need for a second meeting was identified with a view to completing the tasks outlined in Resolution No. 7. In this respect the meeting defined the work to be carried out by the administrations, the IFRB and the CCIR in the period preceding this second meeting.

One of the main goals identified in Resolution No. 7 is to define standard structures or models of national frequency management units for developing countries, and the first meeting adopted the principle of preparing a questionnaire to be sent to all administrations in order to assemble information on the current practices of administrations in this context. The questionnaire was distributed to administrations under IFRB Circular-letter No. 585 dated 30 July 1984. A consolidated report on the replies received was used as a basis for discussion at the second meeting. The report regarding standard structures for frequency management units was distributed through IFRB Circular-letter No. 677 of 14 November 1986. The second meeting took place in Geneva from 8 to 11 September 1987 and 76 participants from 34 administrations attended.

The first meeting concluded that it would be useful to the developing countries if the IFRB and the CCIR prepared a booklet describing the most basic functions, tasks and daily operations proper to a frequency management unit.

Following the recommendations made at the second meeting, the IFRB and the CCIR have collaborated in this revised version of the booklet, which it is hoped will be of assistance to administrations when establishing or developing their national frequency management units.

The booklet includes an annex which is a glossary of terms used in the text that have a particular meaning in the context of frequency management: when such a term appears for the first time in the text it is set in *italics*. The glossary also includes a selection of terms which, although not appearing in the booklet, are frequently encountered in the same context.

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CHAPTER 1

FREQUENCY MANAGEMENT IN GENERAL

1.1 BACKGROUND

Frequency management can be defined as the administrative and technical procedures necessary to ensure the operation of radio *stations* of different *radiocommunication services* at any given time without causing or receiving *harmful interference*.

Owing to the extensive use being made of the radio frequency spectrum it is now very difficult to allocate bands of interference-free frequencies to individual radio services: the requirements can be met only on a basis of sharing time, space and frequency.

This means that simple *assignment* procedures applied in the past and simple network plans for the use of frequencies may not always be satisfactory in the short or in the long term and are inadequate in congested areas. It is necessary to make *electromagnetic compatibility (EMC)* analyses before frequencies are assigned. The bulk of technical and administrative work involved requires detailed knowledge not only of the equipment characteristics used but also of the physical characteristics of propagation over the whole radio frequency spectrum. These activities need to be set within an organizational framework.

The administrative and regulatory procedures relevant in the international context are described in detail in the *IFRB* Handbook on Radio Regulatory Procedures. *CCIR* Recommendations, Reports and Handbooks provide a basis for the technical aspects.

The regulatory procedures adopted for internal application within a country are a matter to be decided by the country concerned, but they should embody the provisions contained in the International Telecommunication Convention and the Radio Regulations because the *telecommunication* administration of a country, as a Member of the ITU, has undertaken to apply them within the national territory as well as in its relations with other Member countries.

The principles of the technical procedures relevant in varying degrees to both national and international spectrum management, and general guidance based on these principles, are explained in general terms in the CCIR Handbook on Spectrum Management and Computer-Aided Techniques, and the CCIR Handbook for Monitoring Stations, and are documented in the relevant texts of CCIR Recommendations and Reports.

The present booklet sets forth the principles underlying the establishment and operation of a national spectrum management unit. It is based on official texts of the IFRB and the CCIR.

1.2 USE OF TERMS

In all documentation of the ITU relating to the use of the radio frequency spectrum the terms defined in RR17-19 are applied strictly in accordance with their definitions. These definitions are listed in the glossary in the annex to this booklet but in view of their importance in frequency management they are reproduced below.

RR17: *Allocation* (of a frequency band): Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more *terrestrial* or *space radiocommunication* services or the *radio astronomy* service under specified conditions. This term shall also be applied to the frequency band concerned.

RR18: *Allotment* (of a radio frequency or radio-frequency channel): Entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more *administrations* for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions.

RR19: Assignment (of a radio frequency or radio-frequency channel): Authorization given by an administration for a radio station to use a radio frequency or radio-frequency channel under specified conditions.

It follows from these three definitions that allocations (of frequency bands to services) are made by appropriately authorized world administrative radio conferences of the ITU. Allotments (of frequencies to geographical areas) are made by appropriately authorized world administrative radio conferences which may also adopt a procedure for updating such allotments. The assignment of a frequency (to a station) is normally made by an administration, through the licensing process, but a world-wide, regional or sub-regional planning conference may adopt a frequency assignment plan indicating frequencies that an administration may assign to specific stations and the associated characteristics.

CHAPTER 2

THE OBLIGATIONS OF AN ADMINISTRATION IN THE CONTEXT OF FREQUENCY MANAGEMENT

2.1 PURPOSE OF AND NEED FOR INTERNATIONAL REGULATIONS

The radio frequency spectrum and the geostationary-satellite orbit are two limited natural resources available to all mankind. Each of these resources has the unique property of being conserved if it is used properly, and wasted if it is not used properly.

Radio waves propagate in space with no regard for political frontiers: thus, of three users who may be in the same country or two or three different countries, user A communicating with user B on a particular frequency may very well cause *interference* to the services of user C. There must therefore be some regulation in the use of the frequency spectrum. Moreover, since several countries may be involved in ensuring the interference-free use of a frequency by any station, that regulation must take the form of an international agreement, defining all the conditions of such use.

The first essential requirement for the orderly use of the frequency spectrum is the division of that spectrum into separate parts (referred to as bands), each of which can be utilized by one or more radiocommunication services.

The second essential step is the division of the world into three distinct Regions called Region 1, Region 2 and Region 3. These divisions find expression in the Table of Frequency Allocations in Article 8 of the Radio Regulations.

The next essential requirement is the application of pre-established regulatory procedures for the use of frequencies by stations in the same service or in different services in such a way that interference between different countries is avoided: appropriate procedures have been developed, and these too are prescribed in the Radio Regulations.

2.2 INTERNATIONAL REGULATIONS

The first international regulations in the field of telecommunications were adopted at a conference in 1865 in Paris, thereby creating the International Telegraph Union.

Owing to rapid developments in the field of telecommunications, revision and updating of the first regulations were continuously needed. This need has been met by successive conferences held under the aegis of the International Telegraph Union, subsequently renamed the International Telecommunication Union. With the advent of space technology and the need to regulate the use of space radiocommunications, and particularly the geostationary-satellite orbit, new provisions have been adopted in the Radio Regulations.

Today these regulations are contained in the International Telecommunication Convention (Nairobi, 1982), and the Administrative Regulations annexed thereto. The Radio Regulations are part of the Administrative Regulations which are annexed to the Convention. The Convention and the Regulations are binding upon those governments which have signed and ratified or have acceded to them. The underlying principle upon which the effectiveness of the Convention and the Regulations is based is the voluntary undertaking by each signatory to comply and ensure international cooperation.

2.3 THE RADIO REGULATIONS

2.3.1 Generally speaking, the Radio Regulations define the rules to be applied in using the spectrum and the orbit, as well as the rights and obligations resulting from this use. Successive radio conferences have refined these rules to adapt them to technological advances. The principles developed by the radio conferences can be categorized under five general headings:

a) the allocation of frequency bands to specific services;

b) the requirements to obtain prior agreement in cases where allocations are made to meet the specific requirements of a country or a group of countries;

c) the adoption of plans where practicable;

d) the prior coordination in some cases of the proposed utilization of frequencies in shared bands; and

e) the adoption of procedures for notification and registration of frequency assignments in the planned and unplanned frequency bands.

2.3.2 Chapter III of the Radio Regulations, Geneva, 1979, edition of 1982, revised 1988, constitutes a <u>basic agreement</u> and comprises

- general rules for the assignment and use of frequencies, Article 6
- provisions for special agreements, Article 7
- allocation of frequency bands among defined radio services, Article 8
- special rules for the assignment and use of frequencies, Article 9

The special rules relating to particular radio services are to be found in Part B of the Radio Regulations, Chapters VIII, X, XI and XII. Many of these special rules concern the <u>use</u> of frequencies and are <u>obligatory</u> in character.

2.3.3 The Radio Regulations are completed by 44 Appendices, most of them containing detailed provisions, some in tabular form, which cannot be included conveniently in the body of the Regulations. The Appendices have the same status as the other provisions of the Radio Regulations.

In addition to provisions of the Radio Regulations, a world administrative radio conference may adopt resolutions and recommendations. In its application of the Radio Regulations, the Board considers that when references to these resolutions or recommendations are made in a provision of the Radio Regulations (for example Resolution No. 500 in RR458 and Recommendation No. 504 in RR480), they become obligatory under that provision.

2.4 THE PROCEDURES IN THE RADIO REGULATIONS

2.4.1 In accordance with the provisions of the Radio Regulations, any frequency assignment, with certain specified exceptions, shall be notified to the IFRB:

a) if the use of the frequency is capable of causing harmful interference to any service of another administration;

b) if the frequency is to be used for international radiocommunication; or

c) if it is desired to obtain international recognition of the use of the frequency.

2.4.2 The procedures governing notification and registration of frequency assignments in the *Master International Frequency Register (MIFR)* may be broadly subdivided into the acts of coordination, notification, examination and registration.

Prior to 1947, the procedures for the selection and publication of frequencies, together with the procedures for the resolution of harmful interference problems, were not of a detailed nature and all negotiations concerning the use of the spectrum, including the resolution of harmful interference, were carried out entirely between the administrations concerned.

In 1947, with the rapidly expanding use of radiocommunication, the administrations found it necessary to develop more sophisticated, mandatory procedures governing the use of the spectrum. The intent of these procedures was in effect to permit a more coordinated use of the spectrum prior to the actual use of frequencies by administrations, thus reducing the probability of harmful interference. In the late 1950s and 1960s, with the widespread use of more advanced terrestrial systems (radio relay links) and with the advent of space radiocommunications, there was a need to develop procedures for increased prior coordination of the use of frequencies and even more complex technical criteria.

2.4.3 So far as the problem of harmful interference is concerned, each administration wishing to put into service a new station, likely to cause interference outside the territory of the country in which it is located, is under obligation to send a notice of its intentions to the IFRB, giving the technical characteristics of the station concerned. The Board examines the notice for its conformity with the Table of Frequency Allocations and the other provisions of the Radio Regulations and then assesses the extent to which the use of the frequency, under the notified conditions, could cause interference to stations of any other administration recorded in the Master International

Frequency Register. If the Board finds that there is a probability of such interference, the notice is returned to the notifying administration which then, normally, searches for an alternative frequency or modifies the characteristics of the station in such a way as to obviate the probable harmful interference. If the Board finds that there is little or no probability of harmful interference with existing entries of other administrations in the Master Register, the notices will normally receive a favourable finding. The particulars of the assignment are entered in the Master Register, accompanied by all relevant remarks, which establishes the legal status of the assignment vis-à-vis other existing and future assignments.

2.5 THE INTERNATIONAL FREQUENCY REGISTRATION BOARD

The IFRB was created at the Atlantic City Plenipotentiary Conference, 1947. Although its composition, duties and working methods have undergone some changes since then, it remains a collegiate body possessing through its members a thorough knowledge of radiocommunications and the problems of their use in various regions throughout the world. The Convention specifies that members of the Board shall serve, not as representing their respective countries, or a region, but as custodians of an international public trust, and requires Members of the ITU to respect the international character of the Board and the duties of the Board members, and to refrain from any attempt to influence them in the exercise of these duties.

The Board at present comprises five Members elected at the Plenipotentiary Conference of the ITU, and is assisted by a specialized secretariat of about 150 persons working under the direction of the Board.

The composition and essential duties of the IFRB are defined in Articles 10 and 57 of the Convention. These may be summarized as follows:

- to effect an orderly recording of frequency assignments made by the different countries;
- to effect an orderly recording of the orbital positions assigned by countries to geostationary satellites;
- to advise countries on efficient utilization of the spectrum and the geostationary-satellite orbit;
- to follow the procedures laid down in the Radio Regulations or by Administrative Conferences;
- to provide technical assistance in organizing and preparing for radio conferences in consultation with the other permanent organs of the Union, and to assist developing countries in their preparations for such conferences; and
- to maintain the records essential for the performance of its duties.

Article 10 of the Radio Regulations (Geneva, 1979, edition of 1982, revised 1988) gives a detailed description of the Board's duties and working methods, which may be summarized as follows:

- the processing of frequency assignment notices, including information about orbital locations of geostationary satellites, received from administrations for recording in the Master International Frequency Register (MIFR);
- the processing of information received in application of the procedures of the Radio Regulations (advance publication, coordination, notification, etc.);
- the processing and coordination of seasonal *HF* broadcasting schedules;
- the periodic compilation of the *International Frequency List (IFL)* reflecting the data recorded in the MIFR;
- the review and updating of the MIFR;
- the study, on a long-term basis, of spectrum utilization with a view to ensuring maximum efficiency;
- the investigation of cases of harmful interference;
- the provision of assistance to administrations in the field of radio spectrum utilization and the training of senior staff;
- the collection of the results of monitoring observations;
- the development of technical standards and rules of procedure for internal use by the Board.

The Board examines all frequency assignment notices submitted to it by administrations, and formulates in respect of each notice what the Radio Regulations term a "finding". Each finding is a statement of a juridical nature based on regulatory and technical grounds: it results in a decision either to record the assignment in the MIFR in accordance with the Radio Regulations or to return the notice to the notifying administration because of its nonconformity with one or more relevant provisions.

The procedures to be followed by the administrations and by the Board in the processing of notifications and the recording of assignments are prescribed in Chapter IV of the Radio Regulations and are described in detail in the IFRB Handbook on Radio Regulatory Procedures. The Board ensures uniformity in application of these procedures by establishing objective technical standards and rules of procedure, which are published in loose-leaf form as they appear (see IFRB Circular-letter No. 692 of 18 May 1987).

2.6 THE INTERNATIONAL RADIO CONSULTATIVE COMMITTEE

The International Radio Consultative Committee (CCIR) is the permanent organ of the International Telecommunication Union whose duties under the International Telecommunication Convention are "to study technical and operating questions relating specifically to radiocommunication without limit of frequency range, and to issue recommendations on them" (International Telecommunication Convention, Nairobi, 1982, First Part, Chapter I, Article 11, No. 83).

The objectives of the CCIR are in particular:

a) to provide the technical bases for use by administrative radio conferences and radiocommunication services for efficient utilization of the radio-frequency spectrum and the geostationary-satellite orbit, bearing in mind the needs of the various radio services;

b) to recommend performance standards for radio systems and technical arrangements which assure their effective and compatible interworking in international telecommunications;

c) to collect, exchange, analyse and disseminate technical information resulting from studies by the CCIR, and other information available, for the development, planning and operation of radio systems, including any necessary special measures required to facilitate the use of such information in developing countries.

The CCIR works through the medium of a number of Study Groups, each dealing with a particular aspect of radiocommunication (see Table 2.1). The Study Groups prepare draft Reports and Recommendations which are considered by the Plenary Assembly (which meets usually every four years), and many of those adopted form the basis for revision of the Radio Regulations at world administrative radio conferences. The approved Reports and Recommendations of the CCIR are not of themselves obligatory in the same context as the Radio Regulations, but serve as standards for use by the world's telecommunication community. They may be incorporated on a national basis within national legislation and through special procedures adopted by ITU Member countries as obligatory in certain cases, e.g. space services coordination.

An Interim Working Party (IWP) may be set up by a Study Group (or jointly by more than one Study Group) if it is necessary to expedite work on a particular study: for example, IWP 1/2 (set up by Study Group 1) is responsible for study of computer-aided techniques in frequency management, and IWP 1/5 (also set up by Study Group 1) is responsible for updating the CCIR Handbook for Monitoring Stations.

The Recommendations and Reports adopted by the Plenary Assemblies are published on a four-year cycle, in a set of volumes covering the subject matter of each Study Group (see Bibliography).

The CCIR may also be invited to participate in the preparatory work prior to an administrative radio conference, with the main objective of preparing a report on the technical and operational topics relevant to the agenda of the conference concerned.

In 1978 the CCIR Plenary Assembly recognized that with the increasing complexity of spectrum management it may be practicable to employ computer-assisted techniques to achieve more efficient spectrum utilization. Consequently, it decided to create an Interim Working Party (IWP 1/2) to prepare a special Handbook. According to Recommendation No. 31 of the World Administrative Radio Conference (WARC-79) the Handbook describes various aspects of radio frequency management as well as providing guidelines for various levels of practical application of computer techniques to this goal. This Handbook was published in 1983 and revised in 1986 (see section 5.3 and the Bibliography).

The CCIR Handbook for Monitoring Stations contains the essential information for the establishment, staffing and operation of a monitoring system. This Handbook was first published in 1968 and its updated version is in preparation.

TABLE 2.1

CCIR Study Groups

Basic technical

1 - Spectrum utilization and monitoring

5 - Propagation in non-ionized media

6 - Ionospheric propagation

Radiocommunication services

2 - Space research and radio astronomy

3 - Fixed service at frequencies below about 30 MHz

4 - Fixed-satellite service

7 - Standard frequencies and time signals

8 - Mobile services

9 - Fixed service using radio relay systems

10 - Broadcasting service - sound

11 - Broadcasting service - television

Joint CCIR/CCITT Study Groups administered by CCIR

CMV - Vocabulary

CMTT - Transmission of sound broadcasting and television signals over long distances

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CHAPTER 3

THE OBJECTIVES AND FUNCTIONS OF AN ADMINISTRATION IN THE CONTEXT OF NATIONAL FREQUENCY MANAGEMENT

3.1 GENERAL OBJECTIVES OF NATIONAL FREQUENCY MANAGEMENT

3.1.1 The fact that the International Telecommunication Convention and the Radio Regulations annexed to that Convention are intergovernmental treaties, which have to be ratified and accepted by the governments of the countries Members of the ITU, means that the governments undertake to apply the provisions of the International Telecommunication Convention and the Radio Regulations in their countries as well as in the other geographical areas under their jurisdiction.

This also means that the governments of the Member countries of the ITU have to adopt national legislations that include, as the basic minimum, the essential provisions of the Convention and the Radio Regulations, which must apply to the radiocommunication services including those relating to national defence and national security (military, police, intelligence services, etc.).

3.1.2 The prime objectives of national frequency management are to permit a country to regulate the use of the radio frequency spectrum and the geostationary-satellite orbit, to ensure the availability of radio frequencies and orbit locations for the orderly use and development of radio services of the country, and to permit the country to fulfil its international obligations. To this effect, a country has to adopt national legislation (including means of enforcement) enabling its frequency management organization:

- to develop national policy and national regulations for the effective use of the spectrum on the basis of the internal priorities of the country;
- to identify the spectrum requirements to satisfy the needs of the country;
- to record and process users' requests, to coordinate them with other users nationally and with administrations of other countries and to authorize the use of radiocommunications by issuing licences in appropriate cases;
- to develop technical standards and engineering analysis models;
- to monitor and detect any operational or technical irregularities and take corrective action;
- to resolve cases of harmful interference;
- to promote and safeguard national interests relating to radiocommunications in international conferences and meetings.

3.1.3 To carry out these essential tasks and to implement the provisions of the Convention, the Radio Regulations, and bilateral or multilateral treaties as appropriate with neighbouring countries, there is a need for an identifiable frequency management authority in each country having the necessary powers and an appropriate supporting unit. It will be responsible for the planning and coordination of the use of radio frequencies by individuals, organizations and services in the country with particular regard to national security, safety of human life, public telecommunication, mass media (such as broadcasting and television), services for the public (such as transportation, supplies, health services, industries), scientific and technical research and development, and even the application of radiocommunication to personal hobbies of individuals. Contributing as it does to the social and economic development and well-being of the country, the planned and coordinated use of radio frequencies through a national frequency management authority deserves a high priority in each nation's considerations.

3.1.4 Each country should therefore establish a frequency management authority according to its particular requirements and available resources and adopt for it the organizational structure best suited for carrying out its tasks. The structure may differ from one country to another, but it is its essential duty to meet the objectives listed in section 3.1.2 and thus ensure that the radio frequency spectrum and geostationary-satellite orbit are rationally and properly used.

Recognizing that the international and national functions of frequency management are very closely interlinked, most countries have found it appropriate to set up a single authority whose responsibilities cover both aspects. This authority is the "administration" (defined in RR3) for the country concerned.

3.2 THE BASIC FUNCTIONS TO BE PERFORMED BY A NATIONAL FREQUENCY MANAGEMENT UNIT

The basic functions of a frequency management unit in support of the national authority can be identified as:

- long-term spectrum management policy and planning;
- establishment of a table of national frequency allocations and national regulations;
- assignment of frequencies;
- licensing and authorization of the use of radiocommunications;
- international relations in the context of spectrum management;
- establishment of technical standards and engineering support facilities;
- record keeping;
- inspection of installations;
- monitoring the use of the spectrum.

These functions are discussed individually in sections 3.2.1 - 3.2.9 below. More detailed information can be obtained from the CCIR Handbook on Spectrum Management and Computer-Aided Techniques.

3.2.1 Long-term spectrum management policy and planning

On the basis of social, economic and political requirements a national policy for management of the spectrum and long-term plans reflecting that policy have to be developed and kept under review. Such plans will be reflected in the national table of frequency allocations and supported by appropriate national regulations.

The primary goals of this function are to determine and periodically update the existing and future requirements for the various radiocommunication services on the basis of which a long-term national policy can be established, bearing in mind the national priorities, and to conduct necessary studies in this field.

3.2.2 Establishment of a table of national frequency allocations and national regulations

A table of national frequency allocations has to be established in accordance with the national priorities: this table has to be in conformity with the internationally adopted allocations prescribed in Article 8 of the Radio Regulations (see RR342), but may be more detailed - for example, a frequency band allocated internationally to the fixed and mobile services might be subdivided and allocated in accordance with the national priorities partly to the fixed service and partly to the mobile service, each on an exclusive basis. Further subdivision is possible: a band allocated nationally to the land mobile service might be split so that defined portions are allocated to particular categories of user such as the fire or ambulance services, services used by the public, or government services.

Figure 3.1 shows an extract from the International Frequency Allocation Table, taken from Article 8 of the Radio Regulations.

Figure 3.2 shows as an example the corresponding extract from a national allocation table which might be adopted by a country in Region 2. This example does not represent any particular or recommended national allocations or presentation.

Once the national frequency allocation table has been established, it must be kept under review to ensure that all national requirements can be met, and must be supported by appropriate national legislation and regulations prescribing the operating conditions applicable to the various services and frequency bands - for example power limitations, or prescribed areas of use - which will be reflected in the terms of the licence.

3.2.3 Assignment of frequencies

The frequency assignment function is responsible for ensuring the electromagnetic compatibility of all proposed or requested assignments with regard to existing assignments on a national or international basis, as appropriate. It will include the analysis of requirements for proposed radio services together with any relevant studies, and the assignment of the frequencies to be used in accordance with the national plan, and it may be responsible for the coordination and notification to the IFRB of assignments requiring to be so coordinated and notified in accordance with the Radio Regulations. It may also be responsible for related actions necessary to protect the country's radiocommunication systems from potential interference from another country's assignments published in the latest edition of the International Frequency List (IFL), List I, and in the weekly Circulars published thereafter by the IFRB.

Once a frequency has been assigned to a transmitting or a receiving station, all the technical and operating data indicating the spectrum space occupied by this assignment should be entered in the national frequency register. This register not only serves as a reference when subsequently selecting other usable frequencies but also provides the basic material for taking effective measures required to adapt national planning to the real requirements of the various users. The greatest care should be taken in compiling the national register and keeping it up to date; it must have room for recording a sufficient number of assignments and for all the information needed for the clear and complete description of each of them. If the size of the register and its use so require, it may be very useful to employ modern computer processing and recording techniques.

3.2.4 Licensing and authorization of the use of radiocommunications

Licensing is the process of conferring the legal authority to operate a radio station under conditions specified in the national regulations.

The Radio Regulations stipulate that no transmitting station may be established without a licence issued by the government of the administration to which the station belongs (RR2020). In some countries the right to use a radio receiving installation is also subjected to licensing under the rules adopted nationally.

Administrations may charge users of the spectrum a fee for their licences and the licensing function may be responsible for collection of these fees. The fee may reflect the degree to which the spectrum is used and the economic benefit derived by the user, as well as the administrative costs incurred by the administration.

Licensing thus plays a major role in any well-structured spectrum management system. This implies application of the national legislation and the regulations governing radiocommunications. Licensing activities may include:

- serving as the main interface between the frequency management authority and the general public;
- conducting an examination of licence applications and related documents to determine:

  - the licensing eligibility of the applicant from a legal and regulatory point of view
  - the technical acceptability of the radio equipment to be used
  - whether other types of communication services would better suit the need of the applicant
  - whether the frequencies requested are in a band allocated to the type of service involved and would be in keeping with national policy and planning requirements
  - that the proposed system has been well designed, would not use excessive power, and would use the minimum number of frequencies necessary to provide a reliable service
  - whether antenna mast or site clearance action is necessary (for example in connection with aircraft warning lights, or amenity considerations)
- forwarding approved submissions for the assignment of a frequency;
- ensuring that the information required for the production of licences is accurately recorded nationally;
- ensuring that relevant international service documents are updated;
- issuing licences to stations and, as relevant, to operators (see Articles 44 and 55 of the Radio Regulations) and collecting fees; and
- renewing and cancelling licences as appropriate.

3.2.5 International relationships in the context of spectrum management

In order to promote and preserve the national interests, participation in world and regional administrative radio conferences of the ITU and other meetings (such as those of the CCIR) dealing with radio matters is important: such meetings require a great deal of preparatory work. To participate effectively, each country should set up national Working Groups (in which the views of different users may be considered) in order to develop proposals and positions on the key issues of national importance and present these views in due course at the international conferences and meetings. Following a particular conference or meeting, the decisions taken need to be analysed and, if appropriate, the concluded Final Acts need to be ratified. Subsequently the decisions relevant to the country need to be implemented. The same considerations apply in the context of bilateral agreements with neighbouring countries to settle policy or operational issues, for the purpose of coordinating the establishment of radiocommunication systems, and for other items of mutual interest in the use of the radio frequency spectrum.

3.2.6 Establishment of technical standards and engineering support facilities

Technical standards have to be developed and applied nationally:

- to ensure that radio systems will meet the required national and international overall performance requirements (planning standards);
- to ensure that radio equipment will function satisfactorily under the relevant conditions (performance standards): these performance standards will be applicable to equipment used in the country concerned whether manufactured locally or imported from abroad. Testing is commonly carried out on representative samples of the equipment concerned (type approval);
- to ensure that equipment that generates RF energy (e.g. industrial, scientific and medical equipment) which might cause interference to radiocommunication systems performs satisfactorily in that respect (see RR1814, RR1815): the relevant standards may be those established by the ITU/CCIR, *IEC* and *CISPR*.

The technical standards concerned should take into account the latest developments in radio technology, and should be aimed at providing solutions to problems of radio interference and supporting timely policy formulation for the establishment of national frequency plans.

The provision of engineering support facilities, e.g. a radio laboratory or workshop, and expertise in the technical analysis of radio engineering and electromagnetic compatibility problems will greatly facilitate the development and application of technical standards, and will be a source of advice to sub-units carrying out other functions of the frequency management unit on technical matters.

3.2.7 Record keeping

Record-keeping activities are involved in almost all functions of a frequency management unit.

Accurate and up-to-date records are of utmost importance for effective national and international coordination, licensing and enforcement activities, policy formulation, interference investigations and resolution, and financial considerations. Depending on the amount of the data to be handled and the available resources, these records may be maintained either manually or by computer. Whichever method is used, the information is stored or filed in a data base in such a way that it can be consulted, extracted or amended in a manner which should reflect the importance of the data, how frequently it is to be consulted or modified, and the economics of collecting and storing it. In the development of a data base it is important to use compatible definitions, formats and codes for the data elements commonly used by more than one organization (for example, notified data should conform to the IFRB practice). It is also necessary to make generous allowance for expansion and provision for reliable and frequent updating of the information the data base contains.

To the extent practicable, it is helpful to centralize and integrate the data bases to eliminate duplication of records, as well as to facilitate the updating of the information. Extended considerations on data acquisition, maintenance and retrieval can be found in Chapter 4 of the CCIR Handbook on Spectrum Management and Computer-Aided Techniques.

To carry out the essential functions of national frequency management a number of manual or computerized data files may be established and maintained, covering, for example:

- frequency allocation data;
- frequency assignment and notification data;
- licence holder data;
- additional equipment characteristics data;
- monitoring data;
- other (e.g. administrative and financial) data.

Most of these data files are essentially interrelated, and therefore updating of them needs to be synchronized.

Frequency allocation data

In its simplest form the frequency allocation data file is derived from the Table of Frequency Allocations in Article 8 of the Radio Regulations, after adaptation to the national environment, and thus serves as the national frequency allocation table.

Frequency assignment and notification data

In general, the frequency assignment and notification data base contains all the information necessary to undertake a frequency assignment, and notify it to the IFRB if appropriate. Typical data elements contained in this data base would include:

- *assigned frequency*;
- transmitting and receiving station particulars;
- power;
- emission designation (comprises necessary bandwidth and class of emission);
- certain equipment and antenna characteristics;
- nature of service.

This data base serves as the national frequency register, and would contain information recorded in the same format as the IFL (see IFRB Circular-letter No. 583 of 6 July 1984) on all national assignments made, whether or not they have been notified to the IFRB. It will serve as the basic reference for other files such as the licensing data and monitoring data files, and should be correlated to these files.

Licence holder data

The licence holder data file contains all the data relevant to the licence holder (name, address, telephone/telex number, etc.), and could usefully contain information on licence application and renewal dates, and fees.

Additional equipment characteristics

The frequency assignment data file will contain certain items of information which are relevant to the equipment in the particular context of a given assignment: other, more general characteristics of the equipment, such as transmitter emission spectrum and receiver selectivity, may be recorded in the equipment characteristics file. Such data may include reference to relevant CCIR Recommendations and Reports.

Monitoring data

As a result of the functions outlined in section 3.2.9, monitoring and spectrum occupancy information will be generated, and may be stored in a dedicated data base.

Other data

Further files may be set up containing information on a wide range of subjects, such as planning standards, propagation, and topographical data. Such information will be useful in the planning of new radio stations and networks, and in EMC studies. Other subjects which might be covered include terrain roughness, ground conductivity, coastlines, building density in metropolitan areas etc., and the administrative and financial records necessary for spectrum management purposes.

Section 2.6.6 and Chapter 4 of the CCIR Handbook on Spectrum Management and Computer-Aided Techniques address the subject of record keeping/data *storage* in detail: although these texts may be particularly relevant in the context of computer assistance and automated data bases, they are perfectly valid in the context of manual data bases, or information files, and deserve careful study and consideration.

3.2.8 Inspection of installations

In connection with its responsibilities for issuing licences on behalf of the government, the national frequency management authority must be able to confirm that stations comply with the relevant provisions of the Radio Regulations, specifically RR312, and those of the national legislation which are indicated in the terms of the licence. For that purpose it must have the staff and equipment necessary for conducting inspections of stations and checking their operation on the spot; it is assumed that the authority is able to check emissions from a distance with the monitoring facilities at its disposal.

These various checks apply not only to non-mobile stations but also to mobile stations, that is to say to ship stations, aircraft stations and land mobile stations. In the case of mobile stations, the Radio Regulations stipulate that, when they are in the territory under the jurisdiction of an administration other than that by which the licence was issued, the stations may be inspected for the purpose of examining the licence, observing any irregularities in the equipment or its operation, and reporting them to the competent authorities of the licensing administration (see Articles 46 and 57 of the Radio Regulations). In the case of aircraft and ship stations, inspection also covers examination of the operator's certificates.

3.2.9 Monitoring the use of the spectrum

The frequency management unit should have access to monitoring facilities to check the emissions of radio stations and their technical characteristics, and to ensure that they are operated in conformity with the standards and various conditions on the basis of which their licences were issued. This would include ensuring compliance by stations with RR312 in the event that national priorities have supported sufficient monitoring capability.

An adequate monitoring service using fixed and/or mobile monitoring stations can be of great assistance in solving problems of harmful interference and in finding suitable frequencies not subject to such interference.

The monitoring service should be primarily designed to meet domestic needs. However, the stations of the monitoring service of an administration should be prepared to cooperate with other administrations as well as with the IFRB and the international monitoring system (see Article 20 of the Radio Regulations). They should then conform with the standards of performance prescribed by the CCIR. The CCIR Handbook for Monitoring Stations provides the guidance needed for administrations to establish priorities for monitoring resources; to site, construct and adequately equip monitoring facilities; and to appropriately carry out monitoring responsibilities of both a national and an international nature. It is noted that a monitoring system may have a great range of capabilities while still participating in the international monitoring system established under Article 20 of the Radio Regulations, depending upon the resources available. In practice, every administration may participate in the international monitoring system and contribute to the monitoring programmes organized by the IFRB, even with the most rudimentary system. An effective monitoring network, of whatever scale used, needs an accessible data base of nationally licensed stations, as well as the International Frequency List.

In essence, monitoring provides information needed for regulatory and enforcement purposes on the operation of radio stations, and may also provide statistical information on spectrum occupancy or propagation, which may be useful for:

- investigation of interference complaints;
- identification of usable frequencies;
- determination of the service area of a transmitting station;
- investigation of illegal operations and operations not in keeping with the terms of radio station licences;
- collection of information for prosecution cases and assistance to law enforcement agencies in carrying out the processes of the law;
- ensurance of compliance by radio station operators with national and international statutory and regulatory requirements.

3.3 THE POSITION OF THE FREQUENCY MANAGEMENT AUTHORITY WITHIN THE NATIONAL ADMINISTRATIVE STRUCTURE

The position occupied by the frequency management authority and its supporting unit within the national government depends on the nature of the administrative structure in the country concerned. Extended liaison between the frequency management authority and policy-making bodies is essential. The working relationships between the authority and other organizations inside or outside the country concerned will in a majority of cases be those shown in simplified form in Figure 3.3.

In determining the position of the authority within the national administrative structure the following considerations are relevant:

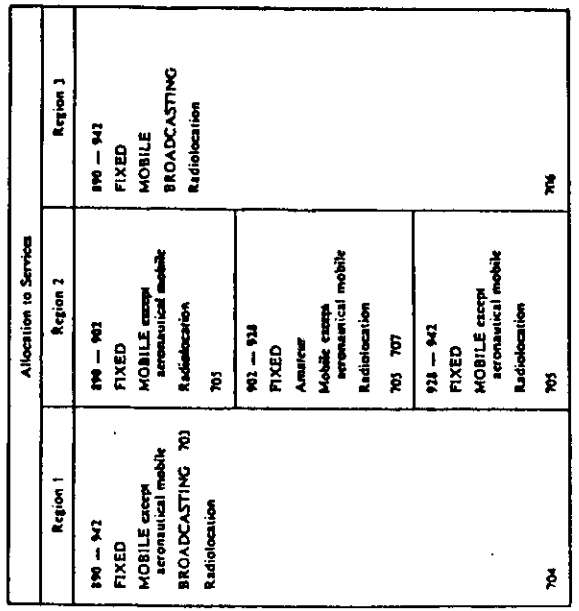
- the development of telecommunications is recognized to be closely linked to the economic development of a country, so the frequency management authority deserves a prominent position in the administrative structure because of its responsibility in the use of the radio frequency spectrum and the geostationary-satellite orbit;
- the frequency management authority maintains regular contact with:
  - the national legislature;
  - all users and potential users of the radio spectrum in the country, whether they are government, public or private organizations, or individuals;
  - the IFRB; and

- its own counterparts in other countries directly, or through the IFRB or by other means;

- whether it is appropriate for the frequency management authority itself to be a user or potential user of the radio spectrum;

- whether any element(s) of the authority's responsibilities should be delegated to particular groups of users or potential users of the spectrum, e.g. the armed services, or civil authorities such as the fire and ambulance services;

- whether the frequency management authority should be given responsibility for coordinating and conveying the country's views on allied matters not directly concerned with frequency management as such, for example by participating in CCIR activities.



Allocation to Services		
Region 1	Region 2	Region 3
890 — 942 FIXED MOBILE except aeronautical mobile BROADCASTING 703 Radiolocation	890 — 902 FIXED MOBILE except aeronautical mobile Radiolocation 703	890 — 942 FIXED MOBILE BROADCASTING Radiolocation
	902 — 928 FIXED Amateur Mobile except aeronautical mobile Radiolocation 703 707	
	928 — 942 FIXED MOBILE except aeronautical mobile Radiolocation 705	
704		706

703 In Region 1, in the band 862 — 960 MHz, stations of the broadcasting service shall be operated only in the African Broadcasting Area (see Nos. 480 to 483) excluding Algeria, Egypt, Libya and Morocco. Such operations shall be in accordance with the Final Acts of the African VHF/UHF Broadcasting Conference, Geneva, 1963.

704 *Additional allocation:* in Bulgaria, Hungary, Mongolia, Poland, the German Democratic Republic, Roumania, Czechoslovakia and the U.S.S.R., the band 862 — 960 MHz is also allocated to the aeronautical radionavigation service on a permitted basis until 1 January 1998. Up to this date, the aeronautical radionavigation service may use the band, subject to agreement obtained under the procedure set forth in Article 14. After this date, the aeronautical radionavigation service may continue to operate on a secondary basis.

705 *Different category of service:* in the United States, the allocation of the band 890 — 942 MHz to the radiolocation service is on a primary basis (see No. 425) and subject to agreement obtained under the procedure set forth in Article 14.

706 *Different category of service:* in Australia, the allocation of the band 890 — 942 MHz to the radiolocation service is on a primary basis (see No. 425).

707 In Region 2, the band 902 — 928 MHz (centre frequency 915 MHz) is designated for industrial, scientific and medical (ISM) applications. Radiocommunication services operating within this band must accept harmful interference which may be caused by these applications. ISM equipment operating in this band is subject to the provisions of No. 1815.

FIGURE 3.1

Extract from the Table of Frequency Allocations, Article 8 of the Radio Regulations, 1979

INTERNATIONAL ALLOCATION			NATIONAL ALLOCATION				
Allocation to services : MHz			Band MHz	National provisions	Government Allocation	Non-Governmental Allocation	Remarks
Region 1	Region 2	Region 3					
890 — 942 FIXED MOBILE except aeronautical mobile BROADCASTING 703 Radiolocation 704	890 — 902 FIXED MOBILE except aeronautical mobile Radiolocation 705 902 — 928 FIXED Amateur Mobile except aeronautical mobile Radiolocation 703 707 928 — 942 FIXED MOBILE except aeronautical mobile Radiolocation 705	890 — 942 FIXED MOBILE BROADCASTING Radiolocation 706	890-902	AA	BB	LAND MOBILE CC	
			902-928	AA	RADIOLOCATION BB		DD
			928-929	AA		FIXED	
			929-942	AA		LAND MOBILE CC	DD

AA : Footnotes relevant to the national provisions for the band concerned, and references to relevant footnotes in the International Table.
BB : Footnotes relevant to government allocations.
CC : Footnotes relevant to non-government allocations.
DD : Remarks in amplification of allocations and/or other footnotes.

FIGURE 3.2

Sample extract from the national frequency allocation table of a country in Region 2 for the same frequency bands as in Figure 3.1

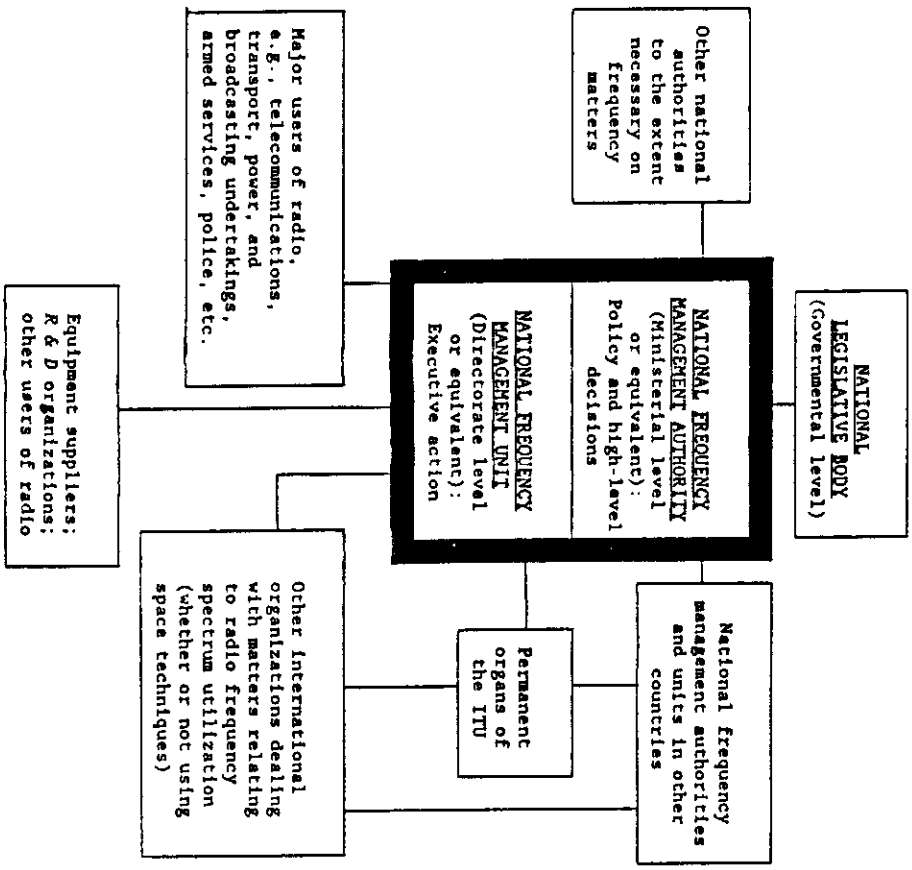


FIGURE 3.3

Principal working relationships of a national frequency management authority

CHAPTER 4

ESSENTIAL ELEMENTS OF A NATIONAL FREQUENCY MANAGEMENT UNIT

4.1 TASKS TO BE PERFORMED

The basic functions of a national frequency management unit in carrying out its mandate are described in section 3.2. The specific tasks arising therefrom are:

a) planning, coordinating, regulating and administering the use of radio frequencies within the country;

b) establishing regulations, technical parameters and standards governing the use of each frequency band or specific frequency by stations of different services, having regard to current international regulations and agreements;

c) optimizing the use of the radio spectrum and the geostationary-satellite orbit, ensuring the harmonious operation of the different services which use them;

d) allocating frequency bands in accordance with international regulations and the national priorities and assigning specific frequencies as appropriate;

e) authorizing the installation and operation of radio stations, assigning call signs, and granting appropriate licences;

f) updating all information on authorized radiocommunication systems such as frequencies, the location of stations, powers, call signs, etc., and their notification to the IFRB if necessary;

g) appropriate notification of information required for inclusion in the publications and service documents of the ITU;

h) representing, establishing relations, coordinating and issuing technical opinions concerning the use of frequencies in international forums;

i) measuring the technical parameters of the emissions of radiocommunication stations as appropriate;

j) conducting systematic inspections of radiocommunication stations to check that they meet the technical standards and parameters for which their equipment and operation were authorized;

k) participating, so far as the use of frequencies is concerned, in the development plans and projects of all radiocommunication services, ensuring that those plans are in accordance with current international and national regulations;

l) preparing for participation in international conferences convened by the ITU, participating in such conferences and implementing any decisions adopted;

m) conducting negotiations in connection with frequency spectrum management and related problems with other countries and international organizations;

n) providing a national technical forum for work relating to the Study Groups and Working Groups of the CCIR, preparing for the participation of specialists in meetings of the CCIR and participating therein;

o) constituting the national body for relations with international organizations other than the ITU on technical, regulatory and administrative matters, technical cooperation and other subjects related to utilization of the radio frequency spectrum and the geostationary-satellite orbit.

4.2 ORGANIZATION

4.2.1 A national frequency management unit capable of carrying out the tasks listed in section 4.1 may be organized in many different ways according to the requirements and resources of the country concerned: there is therefore no single ideal arrangement. However, Figure 4.1 illustrates the sub-units essential in a fully developed national frequency management unit. The role of each sub-unit is discussed in sections 4.2.2 - 4.2.7 below.

4.2.2 Policy and Regulations

The Policy and Regulations sub-unit is typically responsible for the ongoing development of national regulations relating to the use of the radio frequency spectrum, taking into account advances in technology as well as social, economic and political realities. Ministerial regulations and regulations requiring approval at a higher level are drafted by this sub-unit.

In addition this sub-unit may be responsible for developing and updating manuals for procedures and practices to be followed by other sub-units.

National telecommunication policy aspects are commonly associated with regulation development because of their close relationship. Accordingly it might also be a primary function of this sub-unit to conduct studies to determine existing and future telecommunication needs of the country and to develop policies to ensure that the best combination of radio, wire line and cable systems is employed in meeting the identified needs.

Such policies must take into account the needs for telecommunications established by the authorities responsible for national security, national defence, industry and commerce. In addressing these matters, the sub-unit gives consideration to the type of agency and operation which would best suit the communication needs of the country.

The resulting national radio regulatory policies and regulations must be fully documented and must be in line with the Radio Regulations of the ITU and particularly the Table of Frequency Allocations.

This sub-unit could also function as the secretariat for any interdepartmental policy committee set up in response to particular needs, such as the development of long-term national policies and the preparation for international conferences.

4.2.3 Coordination of International Conferences and Meetings

World and regional administrative radio conferences of the ITU and other types of conferences and meetings can require a great deal of advance preparation depending on the level of participation desired by the administration and the issues under consideration. In order to participate effectively at such gatherings an administration may set up working groups to develop national positions on the key issues of interest, and this may be done under a coordinating sub-unit, which would work closely with the Policy and Regulations sub-unit, the Engineering Support sub-unit and users as necessary.

This sub-unit could also be responsible for the development of bilateral agreements with neighbouring countries to settle policy or operational issues for the purpose of coordinating the establishment of communication systems and other items of mutual interest in the radio field.

4.2.4 Coordination, Assignment, Licensing and Notification

The Coordination, Assignment, Licensing and Notification sub-unit could be organized as two interrelated sections:

Frequency assignment section

The frequency assignment section is responsible for conducting electromagnetic compatibility analyses, and for assigning appropriate frequencies to radiocommunication systems. It may also initiate requests to the Inspection and Monitoring sub-unit for the monitoring of specific frequencies or frequency bands to facilitate the engineering analysis of required assignments.

This section is also responsible for coordinating all proposed assignments with regard to existing assignments on a national, regional or international basis. It notifies frequency assignments to the IFRB as required under the Radio Regulations. It also carries out coordination and related actions on request to protect the country's radiocommunication systems from interference or when information on assignments notified by other administrations appears in the weekly Circular published by the IFRB.

Licensing section

The licensing section plays a major role in any well-structured spectrum management unit. This section applies the national legislation, regulations, policies and procedures governing radiocommunications. It also exercises control over the operation of stations and the use of frequencies by:

- examination of licence applications and related documents to determine the licensing eligibility of the applicant from a legal and regulatory point of view and the technical acceptability of the radio equipment proposed;
- granting authorization to entities which may not require a licence, such as government agencies;
- assigning call signs to individual stations;
- issuing licences and collecting fees, if appropriate;
- renewing and cancelling licences as appropriate;
- conducting examinations of operator competence and issuing operator certificates; and
- serving as the main information bureau to the general public.

4.2.5 Engineering Support

The role of the Engineering Support sub-unit is vital and central to the full development of a national frequency management unit because the management of the radio frequency spectrum is becoming increasingly dependent on technical support. These demands come about not only from the need to find technical solutions to the problems of radio interference and congestion but also from the rapid changes in communication techniques and technology and the consequent need for effective, timely and appropriate spectrum planning. Hence the Engineering Support sub-unit must not only keep abreast of the latest technical developments but should, as far as possible, actively participate in the formulation of technical recommendations and standards for performance and compatibility by internationally recognized bodies such as the CCIR. Effectiveness in these tasks may be dependent on expertise in other areas such as radio system design, technical performance objectives, techniques for the development of engineering models (propagation, power, antennas, statistical analysis of performance, optimization techniques, etc.).

The functions of the Engineering Support sub-unit can be carried out by three sections, as follows.

Spectrum planning section

The spectrum planning section develops standard radio system plans using current engineering and radio system planning practices. The purpose is to ensure the most effective use of the spectrum by radiocommunication services, taking into account the technical and operational factors applicable to each service.

Standards and specifications section

The standards and specifications section is responsible for the development of procedures for the approval of radio equipment, and radio standards specifications (documents which set forth the minimum performance standards required for the type approval of radio transmitters and receivers and other equipment).

Spectrum engineering section

The spectrum engineering section is an engineering support facility which typically provides the following services to frequency management operations as a whole:

- laboratory testing of transmitting and receiving equipment in keeping with prescribed type-approval procedures;
- maintenance and calibration of laboratory test equipment and other equipment used by the Inspection and Monitoring sub-unit;
- acceptance evaluation of equipment being purchased for inspection and monitoring purposes; and
- outfitting of special-purpose vehicles and calibration of equipment to be fitted in such vehicles.

4.2.6 Inspection and Monitoring

The Inspection and Monitoring sub-unit may be organized in two sections, which according to the size and requirements of the country concerned may be centralized or dispersed. Propagation conditions, particularly in the VHF and higher frequency bands, are such that inspection and monitoring cannot be carried out satisfactorily from a single site unless the country is very small: the use of multiple sites or appropriately equipped vehicles for these purposes then becomes essential.

Inspection section

The inspection section is provided with the inspection equipment and mobility needed to enforce the national and international statutory and regulatory requirements of frequency management. It works closely with the monitoring section and the Assignment and Licensing sub-unit in collecting information.

The functions of this section may include the following:

- to investigate interference complaints;
- to investigate radiation from industrial, scientific and medical appliances;
- to investigate illegal operations, and operations not in keeping with the terms of radio station licences;

- to collect information for prosecution cases and to assist law enforcement agencies in carrying out the processes of the law; and
- to ensure that radio station operators comply with national and international statutory and regulatory requirements.

Monitoring section

In the management of the frequency spectrum, the monitoring section has two basic responsibilities. One is to provide statistical information of a technical and operational nature on spectrum occupancy. The second is to obtain information for regulatory and enforcement purposes on the operation of individual radio stations.

The monitoring section also performs an important function in establishing the locations and identities of stations causing interference. Monitoring station capabilities may be employed in certain circumstances for basic research of a limited nature. If fixed, mobile or portable monitoring stations are advantageously located, propagation characteristics over specific paths can be measured and correlated to known influencing factors to enable synthesis of propagation prediction tables. Monitoring centres may also contribute to the development of new measurement techniques.

According to its resources a country may wish to participate in the international monitoring system which exists to assist, to the extent practicable, in the implementation of the Radio Regulations, in particular to ensure efficient and economical use of the spectrum, and to help in the prompt elimination of harmful interference (see Article 20 of the Radio Regulations, and the CCIR Handbook for Monitoring Stations).

4.2.7 Computer Support

The extent to which computer support facilities are available to and used by the frequency management authority depends on the resources, priorities, and particular requirements of the country concerned. In the early stages of its introduction, computer support may be limited to, say, licensing records or the more complex engineering calculations; ultimately the Computer Support sub-unit may assume responsibility for the development, provision and maintenance of support facilities for nearly all spectrum management activities, including record keeping, forecasting, and financial management related to licensing.

The CCIR Handbook on Spectrum Management and Computer-Aided Techniques addresses the use of computers in this context in considerable depth.

4.3 TRAINING OF PERSONNEL

In considering the needs and the possibilities for providing training of personnel for frequency management, the conditions of training have to be seen in relation to the structure of the frequency management unit in the country.

Whatever the size of the frequency management unit, it is considered necessary to have at least one person with suitable technical professional qualifications who, in addition, has knowledge of the relevant national legislation and of the Radio Regulations.

In the case of small units junior staff will mainly be trained on the job, and such training may be supplemented by various other methods, for example:

- international and regional seminars organized by the IFRB or by administrations;
- exchange of staff with other countries;
- bilateral contacts with other countries in which problems are analysed and mutually acceptable solutions are sought;
- "hands-on" operational experience in user departments within the administration;
- handbooks, manuals or similar texts provided by the administration or by another administration or by international organizations or their organs (e.g. IFRB, CCIR);
- individual training in another country;
- individual training in the IFRB.

Several years of experience may be necessary before a national frequency manager can deal with all aspects of national and international regulations. It is therefore vital that such experience should not be lost through frequent changes of staff: to the extent possible, administrations should take the necessary steps to recruit and retain personnel having the required qualifications and experience.

Although considerable efforts are necessary for initial training of personnel for frequency management, it must be borne in mind that the development of both radio techniques and administrative procedures necessitates constant updating of knowledge, and training will therefore be an ongoing process.

The CCIR, through the work of IWP 1/5, is developing the use of audio-visual cassettes as a companion training tool to the Handbook for Monitoring Stations. These cassettes will be obtainable separately from the ITU to provide detailed training in such specialized subjects as visual identification of situations (emissions) and how to use a spectrum analyser for complex measurements.

Information on further training possibilities in international and national training centres may be obtained from the Technical Cooperation Department of the ITU.

4.4 SPECTRUM MANAGEMENT IMPLEMENTATION STRATEGY

During the development of a spectrum management capability a number of key subjects need to be addressed. By addressing these subjects, an administration can follow a step-by-step process that will help it in its planning activities. The set of steps described below is fairly comprehensive but not necessarily exhaustive.

- Take action to get spectrum management recognized as an essential element in the development of an administration's telecommunication policy. This will help to ensure that requests for resources are given appropriate priority and that the spectrum management unit is represented in the policy development activities of an administration.
- Identify and prioritize the functions that the spectrum management unit will carry out. Consideration should be given to both national and international needs resulting from national legislations or obligations under the Radio Regulations.
- Size the process, taking into account the specified functions and the time phasing of this introduction. This will aid in identifying the resources necessary for implementation.
- Develop a time-phased functional implementation plan that recognizes both national and international obligations. The plan would identify short-term as well as long-term goals towards which the spectrum management unit is directed.
- Upon completion of sizing of the planning process, consideration should be given to the subject of automation support and a time frame for its introduction. This should encompass both data base and records, keeping technical and engineering support of appropriate monitoring capabilities.
- Establish detailed plans leading to the specification of *software* needs and support *hardware*. It is important that data base management software needs and specific design capabilities be established prior to the specification and purchase of hardware.
- Document a comprehensive time-phased implementation process that will involve both functional and automation aspects of the spectrum management planning activities. This can be used as a master plan, as a means to secure necessary resources, and as a means to periodically update and revise an administration's plans.

By following these basic steps, an administration can proceed towards the development of a spectrum management unit that will meet its immediate needs, be compatible with its available resources, and provide a guide for future growth towards more comprehensive and sophisticated capabilities.

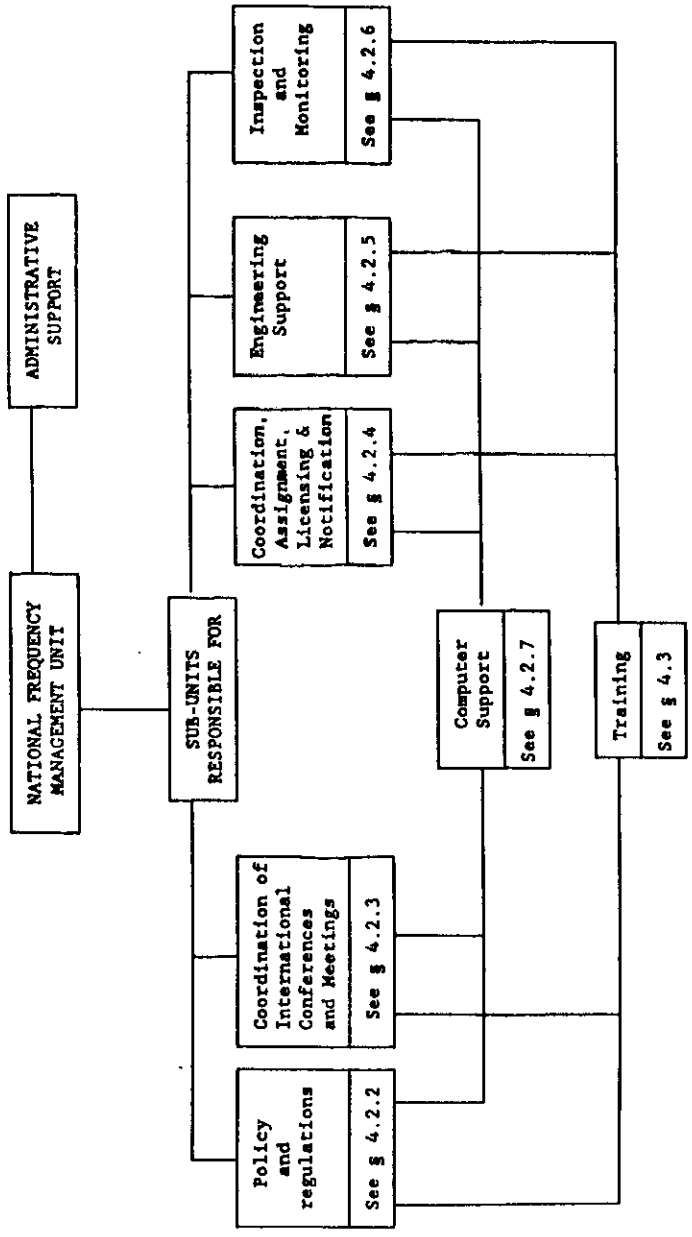


FIGURE 4.1

Sub-units in a national frequency management unit

CHAPTER 5

POTENTIAL SOURCES OF ASSISTANCE IN FREQUENCY MANAGEMENT MATTERS

As mentioned in section 4.3, personnel in a national frequency management unit need special training and experience suited to the prevailing conditions in the country. Since such training can only be provided in an active frequency management unit, administrations should encourage the staff concerned to approach their work with an innovative spirit, and seek external assistance only in cases which need an urgent solution.

The sources of assistance which an administration may find useful when such a need arises are described in the present Chapter.

The Chapter is divided into five sections, as follows:

5.1 - Assistance available from other administrations;

5.2 - Assistance available from the IFRB;

5.3 - Assistance available from the CCIR;

5.4 - Assistance available from the Technical Cooperation Department of the General Secretariat of the ITU;

5.5 - Assistance available from sources other than the ITU.

5.1 ASSISTANCE AVAILABLE FROM OTHER ADMINISTRATIONS

Discussions between administrations are helpful either in connection with the establishment and development of a frequency management unit, or in resolving particular problems of a technical or procedural nature in the operation of such a unit. Such discussions with neighbouring administrations might lead to bilateral or multilateral agreements which could simplify the treatment of any similar difficulties arising in the future (see also Article 7 of the Radio Regulations and RR1233). A short-term exchange of personnel between administrations can result in a mutual broadening of experience beneficial to both parties.

Several administrations have recently established formal training programmes in the fields of telecommunications and spectrum management. Others are under consideration in view of the demonstrated need for improved spectrum management on a global basis, and may be obtained directly from those administrations or via the Technical Cooperation Department of the ITU.

5.2 ASSISTANCE AVAILABLE FROM THE IFRB

5.2.1 General

RR999 specifies that the functions of the IFRB shall include

"the provision of assistance to administrations in the field of radio spectrum utilization, in particular to those administrations in need of special assistance, and the recommendation to administrations, where appropriate, of adjustments in their frequency assignments in order to obtain a better use of the radio spectrum."

5.2.2 Understanding the procedures of the Radio Regulations

In response to Resolution No. 6 of WARC-79 the IFRB has prepared the IFRB Handbook on Radio Regulatory Procedures. It is aimed at assisting administrations in the application of the procedures of the Radio Regulations. It contains many flowcharts which are to be inserted in the Radio Regulations as an aid to the understanding of the procedures.

5.2.3 Application of procedures of the Radio Regulations

The IFRB's Technical Standards and the Rules of Procedure are developed in accordance with RR1001 and distributed to administrations in accordance with RR1001.1.

Many provisions of the Radio Regulations specify that if difficulties arise in connection with a particular procedure the Board may be requested to provide assistance in applying the procedure concerned or assistance of a technical nature.

In particular RR1218 provides for the Board to assist in the selection of a frequency assignment to a station in the fixed service between 3 and 27.5 MHz.

5.2.4 Application of regional agreements

Certain regional agreements, such as the Regional LF/MF Broadcasting Agreement (Regions 1 and 3), Geneva, 1975, indicate assistance which may be provided by the IFRB in specified circumstances.

5.2.5 Pre- and post-conference activities

RR1003 prescribes that the IFRB shall provide technical assistance in the preparation for and organization of radio conferences in consultation, as appropriate, with the other permanent organs of the Union.

To fulfil this obligation the Board prepares appropriate documentation. In order to assist administrations in implementing conference decisions, or in order to provide clarification and advice on the interpretation and application of the Radio Regulations, the Board issues IFRB Circular-letters when appropriate: these are distributed to all administrations.

5.2.6 International monitoring

In accordance with RR1000 and RR1885 the IFRB records the results supplied by the monitoring stations participating in the international monitoring system, and periodically prepares summaries of the data it receives: the summaries are published by the Secretary-General and may be useful to a national frequency management unit in identifying less congested portions of the spectrum and/or sources of harmful interference. Special monitoring campaigns are initiated from time to time.

5.2.7 Cases of harmful interference

RR998 prescribes that at the request of one or more of the interested administrations the Board shall investigate cases of harmful interference and formulate recommendations with respect thereto: see Article 22 of the Radio Regulations, in particular RR1962-1966. The cases referred to the IFRB frequently include those in which communication between the administrations concerned is difficult: the IFRB acts as an intermediary in such cases, and tries to reach a satisfactory solution.

5.2.8 Training of personnel

RR1005 prescribes that at the request of an administration the Board shall provide assistance in the training of senior staff in the fields of spectrum management and utilization, particularly for those countries in special need: see section 4.3 in Chapter 4 of this booklet.

5.2.9 Publication of information of general interest

In compliance with the wishes of the first meeting on the development of national radio frequency management, from time to time the IFRB will arrange for publication in the ITU Telecommunication Journal of a short newsletter dealing with matters of interest to national frequency management authorities or units.

5.3 ASSISTANCE AVAILABLE FROM THE CCIR

5.3.1 Technical information

The main functions of the CCIR are listed in section 2.6. Administrations interested may find the information they need in existing CCIR texts (Recommendations, Reports, Handbooks and Documents).

The CCIR texts are published in the working languages of the ITU (English, French and Spanish). Relevant texts are contained in Volume I covering the activity of Study Group I, the CCIR Handbook on Spectrum Management and Computer-Aided Techniques and the CCIR Handbook for Monitoring Stations. Texts concerning specific services are contained in other Volumes (see Bibliography).

The Handbook on Spectrum Management and Computer-Aided Techniques describes engineering analysis techniques required for spectrum management, including frequency files, computer applications, and examples of automated aids for spectrum management. Examples are given of spectrum optimization techniques as well as indications where the data elements described in the Handbook are applied in the Radio Regulations.

The annexes contain a listing of frequency data files, computer models and data base management systems. There is a catalogue of data files and computer programs in use by various administrations and the ITU, with short descriptions.

The CCIR Handbook for Monitoring Stations describes, inter alia, various procedures and techniques used in monitoring stations. New subjects cover monitoring of the emissions from space stations and the use of computer techniques.

The publications entitled "CCIR Antenna Diagrams" (1978 and 1984) offer comprehensive information about various high frequency directional antennas, including technical and economic aspects.

5.3.2 Computer programs

There are computer programs available for carrying out technical calculations. One of them (NOISEY) predicts noise power and field strength at any frequency above 10 kHz for any geographic location and time, based on CCIR Reports 322 and 258. Programs WOMAP and MUFFY perform computations connected with ionospheric propagation. A package of antenna programs is dedicated to the calculation of the radiation pattern of a series of antennas of different types, from a single dipole to complex curtain antennas over imperfect ground.

The computer programs offered by various administrations and listed in the CCIR Handbook on Spectrum Management and Computer-Aided Techniques are being examined for their correctness, adequacy of documentation and program portability. It is expected that these programs will be made available through the CCIR when this examination has been completed.

The Telecommunication Journal publishes the information about computer software available through the CCIR. It is uneconomic to develop computer programs for radio-frequency management if they have been developed elsewhere. CCIR Resolution No. 88 invites administrations and other participants to exchange their own programs through the CCIR secretariat.

By submitting software for distribution under Resolution No. 88, the submitter grants permission to use the software free of charge. The submitted software and all subsequent copies (but not the physical media on which it is recorded) remain the property of the original submitter. The software (and documentation) is provided "as is", and some modifications may be required before the software can be utilized with specific computer hardware. Neither the submitter nor the CCIR makes any warranty or assurance as to its performance, and no liability is accepted for the content or applicability of the software and documentation, the results of using them, or their support and maintenance. The entire risk must be assumed by the user. The dissemination of the software by the CCIR secretariat does not imply any form of endorsement or recommendation. The CCIR secretariat copies the software (together with the accompanying documentation) at the request of interested parties and distributes it free of charge (except for the cost of material, processing, handling and postage), without necessarily reviewing it. In accordance with Resolution No. 88, CCIR Study Group 1, IWP 1/2 examines its portability, adequacy of documentation and correctness, and the results are published separately.

5.3.3 Studies of technical problems

If a specific problem of an administration is not covered by the existing CCIR texts, the administration may propose a special question, according to the provisions of No. 327 of the Convention. If the proposal is supported by at least twenty administrations the necessary studies are carried out by one of the CCIR Study Groups and the results are published as a CCIR text. The most detailed source of information on current studies carried out flows at the level of CCIR Working Parties and CCIR Study Groups, and thus active participation in their work is most beneficial for all those interested.

5.4 ASSISTANCE AVAILABLE FROM THE TECHNICAL COOPERATION DEPARTMENT OF THE GENERAL SECRETARIAT OF THE ITU

Within the framework of the United Nations Development Programme (UNDP), assistance can be provided to developing countries.

Generally, this type of assistance consists of the provision of a frequency management expert, who can take up an assignment for an appropriate period in the requesting country in order to assist the administration in any matters related to frequency management and monitoring. Alternatively, or in addition, fellowships can be granted to staff members of the requesting administration. These are usually arranged in the frequency management and monitoring services of other member administrations.

As a regular activity of the ITU and in accordance with Resolution No. 22 of the Convention (Nairobi, 1982), the ITU can also provide specialist advice and short missions of up to four weeks by specialists to assist the requesting administration on specific problems in the field of frequency management and monitoring.

5.5 ASSISTANCE AVAILABLE FROM SOURCES OTHER THAN THE ITU

An administration may be able to obtain assistance in the context of frequency management from several sources outside the ITU. A few of these sources are mentioned in this section.

5.5.1 Assistance from handbooks or works of reference

Handbooks, conference proceedings, manuals, or other works of reference are helpful sources of information which can range from the very general to the extremely detailed in both subject matter and treatment.

The bibliography presented at the end of this booklet may serve as a starting point for study, which might be augmented by text books appropriate to the subject concerned, be it technical (in the context of radio engineering) or administrative (in the context of business management). It may be noted that several of the sources listed in the bibliography contain further references to allied subject matter.

Handbooks or manuals produced by certain countries for their own use may be made available to other countries.

5.5.2 Assistance in radio matters from other specialized organizations

Although not directly concerned with frequency management activities as discussed in this booklet, assistance in the field of radiocommunication may be derived from discussions with, or the documents of, such organizations as the CISPR, *ICAO*, IEC, *IMO* and *ISO*, as well as from radio equipment manufacturers, suppliers, or *R & D* organizations.

Regional and multinational organizations such as *ATU*, *EBU*, *IEE*, *IEEE* and *URSI* offer seminars and technical forums from time to time for examination of new techniques and on new strategies applicable to frequency management on all levels, from the most simple to the most complex.

BIBLIOGRAPHY

ITU REFERENCE DOCUMENTS FOR NATIONAL FREQUENCY MANAGEMENT

The bibliography contains a list of texts which administrations may find useful when establishing or developing a national frequency management unit.

Items carrying the comment "Basic reference" are considered to be essential documents which should be available within the unit for consultation.

Documents	Comments
International Telecommunication Convention, Nairobi, 1982	Basic reference
Radio Regulations, Geneva, 1979, edition of 1982, revised 1988 (together with Appendices 26 and 27 Aer2 which are published separately)	Basic reference
Regional Agreements applicable to specific services, frequency bands and countries concerned (e.g. Regional MF Broadcasting Agreements, Geneva, 1975 (for Regions 1 and 3), and Rio de Janeiro, 1981 (for Region 2))	Basic references
Texts of the CCIR as adopted by its most recent Plenary Assembly	Basic references
VOLUME I	Spectrum utilization and monitoring (Study Group 1)
VOLUME II	Space research and radioastronomy (Study Group 2)
VOLUME III	Fixed service at frequencies below about 30 MHz (Study Group 3)
VOLUME IV-1	Fixed-satellite service (Study Group 4)
VOLUME IV/IX-2	Frequency sharing and coordination between systems in the fixed-satellite service and radio-relay systems (Study Groups 4 and 9)
VOLUME V	Propagation in non-ionized media (Study Group 5)
VOLUME VI	Propagation in ionized media (Study Group 6)
VOLUME VII	Standard frequencies and time signal services (Study Group 7)
VOLUME VIII-1	Land mobile service (terrestrial) (Study Group 8)
VOLUME VIII-2	Maritime mobile service (terrestrial), amateur and amateur satellite service (Study Group 8)
VOLUME VIII-3	All mobile satellite services and aeronautical mobile service (terrestrial) (Study Group 8)
VOLUME IX-1	Fixed service using radio-relay systems (Study Group 9)
VOLUME X-1	Broadcasting service (sound) (Study Group 10)
VOLUME X/XI-2	Broadcasting-satellite service (sound and television) (Study Groups 10 and 11)
VOLUME X/XI-3	Recording (sound and television) (Study Groups 10 and 11)
VOLUME XI-1	Broadcasting service (television) (Study Group 11)
VOLUME XII	Transmission of sound broadcasting and television signals over long distances (CMTT)
VOLUME XIII	Vocabulary (CMV)

Documents	Comments
Supplement to CCIR Report 252-2	Second CCIR computer-based interim method for estimating sky-wave field strength and transmission loss at frequencies between 2 and 30 MHz
CCIR Report 322-3	Characteristics and application of atmosphere radio noise data
The International Frequency List (IFL)	Basic reference: the IFL is List I of the Service Documents - see Appendix 9 to the Radio Regulations
The weekly Circular (of the IFRB)	Basic reference: see RR1455, RR1456 and RR1583
Service Documents other than List I	Selected according to requirements: see Appendix 9 to the Radio Regulations
IFRB Handbook on recommended techniques for better utilization and reduction of congestion of the high frequency radio spectrum (1973)	-
IFRB Handbook on Radio Regulatory Procedures	Handbook (2 volumes) published in 1984 with subsequent revisions
CCIR Handbook on Spectrum Management and Computer-Aided Techniques	Latest version published in 1987: includes many references to CCIR and other published texts
CCIR Handbook for Monitoring Stations	Handbook published in 1968 and at present under revision
CCIR Antenna Diagrams (1978 and 1984)	-
CCIR Handbook on Broadcasting-Satellite Systems, Geneva, 1983	-
CCIR Handbook on Satellite Communications (fixed-satellite service), Geneva, 1985	-
IFRB Circular-letters	Basic references, issued when appropriate: contain information on particular matters relating to frequency management.

Documents	Comments
Economic and Technical Impact of Implementing a Regional Satellite Network, GAS 8, CCITT, Geneva, 1983	-
Documents of the first and second meetings on the development of national radio frequency management, Geneva (24 to 28 October 1983/8 to 11 September 1987) (Note 1)	-
Documents of the regular IFRB Seminar on frequency management and the use of the radio frequency spectrum and the geostationary-satellite orbit - Geneva, 4 to 11 March 1988 (or later versions thereof) (Note 1)	-
Documents on frequency management matters of ICAO, IMO, INTELSAT, INTERSPUTNIK and similar international organizations	-

Note 1 - Several of the documents referred to mention further reference material.

ANNEX

GLOSSARY OF TERMS

This glossary explains terms which are used in this booklet and often encountered in the field of frequency management. Terms defined in Article 1 of the Radio Regulations have been so identified.

Administration	Any governmental department or service responsible for discharging the obligations undertaken in the Convention of the International Telecommunication Union and the Regulations (RR3).
Allocation (of a frequency band)	Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned (RR17).
Allotment (of a radio frequency or radio-frequency channel)	Entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions (RR18).
Assigned frequency	The centre of the frequency band assigned to a station (RR142).
Assigned frequency band	The frequency band within which the emission of a station is authorized; the width of the band equals the necessary bandwidth plus twice the absolute value of the frequency tolerance. Where space stations are concerned, the assigned frequency band includes twice the maximum Doppler shift that may occur in relation to any point of the Earth's surface (RR141).
Assignment (of a radio frequency or radio-frequency channel)	Authorization given by an administration for a radio station to use a radio frequency or radio-frequency channel under specified conditions (RR19).
ATU	Arab Telecommunications Union
CCIR	International Radio Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee
CISPR	International Special Committee on Radio Interference (this Committee works under the IEC).
e.i.r.p.	Equivalent isotropically radiated power; the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain) (RR155).
Electromagnetic compatibility (EMC)	EMC is the condition which prevails when telecommunications equipment is performing its individually designed function in a common electromagnetic environment without causing or suffering unacceptable degradation due to unintentional electromagnetic interference to or from other equipment in the same environment.
EBU	European Broadcasting Union
Frequency tolerance	The maximum permissible departure by the centre frequency of the frequency band occupied by an emission from the assigned frequency, or by the characteristic frequency of an emission from the reference frequency. The frequency tolerance is expressed in parts per million or in hertz (RR145).
Hardware	Physical equipment used in data processing as opposed to computer programs, procedures, rules and associated documentation.
Harmful interference	Interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with the Radio Regulations (RR163).
HF	High-frequency (decametric waves) (see RR208).
ICAO	International Civil Aviation Organization

IEC	International Electro-technical Commission
IEE	Institution of Electrical Engineers
IEEE	Institute of Electrical and Electronics Engineers
IFL	International Frequency List
IFRB	International Frequency Registration Board
IMO	International Maritime Organization
ISO	International Organization for Standardization
Industrial, Scientific and Medical (ISM) Applications (of radio frequency energy)	Operation of equipment or appliances designed to generate and use locally radio frequency energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of telecommunications (RR16).
Interference	The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy (RR160 - see "Harmful interference", above).
MF	Medium frequency (hectometric waves) (see RR208).
MIFR	Master International Frequency Register.
Necessary bandwidth	For a given class of emission, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions (RR146).
pfd	Power flux-density.
Protection ratio	The minimum value of the wanted-to-unwanted signal ratio, usually expressed in decibels, at the receiver input determined under specified conditions such that a specified reception quality of the wanted signal is achieved at the receiver output (RR164).

R & D	Research and development.
Radio astronomy	Astronomy based on the reception of radio waves of cosmic origin (RR14).
Radiocommunication	Telecommunication by means of radio waves (RR7).
Radiocommunication service	A service as defined in Section III of Article 1 of the Radio Regulations involving the transmission, emission and/or reception of radio waves for specific telecommunication purposes (RR20). In the Radio Regulations, unless otherwise stated, any radiocommunication service relates to terrestrial radiocommunication.
Radio waves or Hertzian waves	Electromagnetic waves of frequencies arbitrarily lower than 3 000 GHz, propagated in space without artificial guide (RR6).
RR...	Reference to a provision of the Radio Regulations.
SHF	Super high frequency (centimetric waves) (see RR208).
S/I	Signal-to-interference ratio.
S/N	Signal-to-noise ratio.
Software	Computer programs, procedures, rules and any associated documentation concerned with the operation of a data processing system.
Space radiocommunication	Any radiocommunication involving the use of one or more space stations or the use of one or more reflecting satellites or other objects in space (RR9).
Spurious emission	Emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions (RR139).

Station	One or more transmitters or receivers or a combination of transmitters and receivers, including the accessory equipment, necessary at one location for carrying on a radiocommunication service, or the radio astronomy service. Each station shall be classified by the service in which it operates permanently or temporarily (RR58).
Storage (device)	A functional unit into which data can be placed, in which they can be retained, and from which they can be retrieved.
Telecommunication	Any transmission, emission or reception of signs, signals, writing, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems (RR4).
Terrestrial radiocommunication	Any radiocommunication other than space radiocommunication or radio astronomy (RR8).
UHF	Ultra-high frequency (decimetric waves) (see RR208).
URSI	International Union of Radio Science
VHF	Very high frequency (metric waves) (see RR208).