Guide to Participation in Radio-frequency Coordination

2015 edition

World Meteorological Organization

Weather • Climate • Water

WMO-No. 1159

Guide to Participation in Radio-frequency Coordination

2015 edition

World Meteorological Organization

Weather · Climate · Water

WMO-No. 1159

EDITORIAL NOTE

METEOTERM, the WMO terminology database, may be consulted at http://www.wmo.int/pages/prog/lsp/meteoterm_wmo_en.html. Acronyms may also be found at http://www.wmo.int/pages/themes/acronyms/index_en.html.

WMO-No. 1159

Chairperson, Publications Board
World Meteorological Organization (WMO)
7 bis, avenue de la Paix
P.O. Box 2300
CH-1211 Geneva 2, Switzerland
Tel.: +41 (0) 22 730 84 03
Fax: +41 (0) 22 730 80 40
E-mail: publications@wmo.int
ISBN 978-92-63-11159-3

NOTE

The designations employed in WMO publications and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of WMO concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The mention of specific companies or products does not imply that they are endorsed or recommended by WMO in preference to others of a similar nature which are not mentioned or advertised.

The findings, interpretations and conclusions expressed in WMO publications with named authors are those of the authors alone and do not necessarily reflect those of WMO or its Members.

PUBLICATION REVISION TRACK RECORD

Date	*Part/chapter/section*	*Purpose of amendment*	*Proposed by*	*Approved by*

CONTENTS

Page

PREFACE

Purpose of this Guide

1. The *Guide to Participation in Radio-frequency Coordination* has been prepared to assist WMO Members in addressing the requirements of Resolution 4 (Cg-XV) – Radio frequencies for meteorological and related environmental activities[1] adopted by the Fifteenth World Meteorological Congress. The International Telecommunication Union (ITU), in particular its Radiocommunication Sector (ITU-R), has the global responsibility for facilitating the worldwide management of the radio-frequency spectrum and satellite orbits.

2. This Guide provides the general description of the main ITU processes related to radio-frequency coordination, regional structure and regulatory framework that govern the use of the radio-frequency spectrum globally[2] and guide the national management of the radio-frequency spectrum as well as management of satellite orbits. More detailed information on which frequencies are important to meteorology and related activities is available in the joint WMO/ITU publication entitled *Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction*.[3]

3. Resolution 4 (Cg-XV) and Resolution 11 (EC-64) – Radio frequencies for meteorological and related environmental activities,[4] adopted by the Executive Council at its sixty-fourth session, highlight the importance of radio frequencies for meteorological and related environmental activities. They urge all WMO Members to do their utmost to ensure the availability and protection of suitable radio-frequency bands required for meteorological and related environmental operations and research, and in particular urges them:

(a) To ensure that their national radiocommunication administrations are fully aware of the importance of and requirements for radio frequencies for meteorological and related activities, and to seek their support in the ITU World Radiocommunication Conferences (WRCs) and Radiocommunication Sector activities;

(b) To participate actively in the national, regional and international activities on relevant radiocommunication regulatory issues and, in particular, to involve experts from their National Meteorological and Hydrological Services (NMHSs) in the work of relevant regional radiocommunication organizations and of ITU-R, especially ITU-R Study Group 7 on Science Services;

(c) To register adequately with their national radiocommunication administrations all radiocommunication stations and radio frequencies used for meteorological and related environmental operations and research.

---

[1] Resolution 4 (Cg-XV) – http://www.wmo.int/pages/prog/www/TEM/WMO_RFC/Res4_en.html.

[2] Further details on the development and modification of the radio-frequency management framework on a worldwide basis are provided in the document "WMO Strategy on Radio-Frequency Protection for Meteorology" (http://wis.wmo.int/file=1029).

[3] *Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction*, http://www.itu.int/en/publications/ITU-R/pages/publications.aspx?parent=R-HDB-45-2008&media=electronic.

[4] Resolution 11 (EC-64) – http://library.wmo.int/opac/index.php?lvl=notice_display&id=12753#.VczC_CyqpBc.

Regulatory structure of the International Telecommunication Union

4. The ITU Radiocommunication Sector maintains its regulation framework that consists of agreed regulations, procedures, rules, international standards (designated as ITU-R Recommendations in ITU terminology) and other documents relating to the management of the radio-frequency spectrum and satellite orbits. The main part of this framework is the ITU Radio Regulations (RR). The Radio Regulations, like WMO Technical Regulations, is an international treaty. The regulated frequency range (8.3 KHz to 3 000 GHz) is segmented into smaller bands that are allocated to over 40 defined radio services. The most relevant radio services to WMO include the meteorological aids service (MetAids), meteorological-satellite service (MetSat), Earth exploration-satellite service (EESS) and radiolocation service (RLS); see 2.2 below. For a radio system or application to seek protection from interference from other systems or applications, it must be attributed to a known radio service.

5. Article 5 of the Radio Regulations contains the international Table of Frequency Allocations for all frequencies between 8.3 KHz and 3 000 GHz based on one row for each band divided into one to three columns. There is one column for each of the three ITU Regions (see Figure 3). ITU Region 1 incorporates WMO Regions I (Africa) and VI (Europe) plus the northern parts of Region II (Asia). ITU Region 2 incorporates WMO Regions III (South America) and IV (North America, Central America and the Caribbean) plus Greenland. ITU Region 3 covers the southern half of WMO Region II and most of Region V (South-West Pacific).

6. Allocations to the radio services are made at World Radiocommunication Conferences, which are held every three to four years. Allocations are made either on a PRIMARY or secondary basis, where services operating on secondary allocations shall cause no harmful interference to, nor claim protection from, services operating in the PRIMARY allocations. Where multiple services are operating in the same PRIMARY allocation, the stations of these services must coordinate with each other to ensure that they do not cause harmful interference to each other. When documenting allocations in the RR tables, PRIMARY allocations are always entered in UPPER CASE, while secondary allocations are written in normal sentence (lower) case.

7. The ITU Radiocommunication Sector also carries out studies and approves international standards on radiocommunication matters (standards designated as ITU-R Recommendations in ITU terminology). It works through world and regional radiocommunication conferences, the Radio Regulations Board, Radiocommunication Assemblies, Radiocommunication Study Groups and the Radiocommunication Bureau. The Bureau, in cooperation with administrations, implements coordination and recording procedures for space and terrestrial wireless systems, networks and stations.

8. The Member States of ITU have established six regional telecommunication organizations that formally are not part of the regulatory development process but play a significant role in world and regional preparation for World Radiocommunication Conferences. These regional telecommunication organizations coordinate and prepare common proposals related to different aspects of spectrum management including proposals on worldwide and regional allocations for consideration at World Radiocommunication Conferences. The organizations are as follows:

(a) African Telecommunications Union (ATU);

(b) Arab Spectrum Management Group (ASMG);

(c) Asia-Pacific Telecommunity (APT);

(d) European Conference of Postal and Telecommunications Administrations (CEPT);

(e) Inter-American Telecommunication Commission (CITEL);

(f) Regional Commonwealth in the field of Communications (RCC).

9. The Member States of ITU have voting rights in the World Radiocommunication Conferences, but these regional organizations have no such rights. Nevertheless, they carry a great deal of weight in the decision-making process. It is essential that national and regional bodies are fully aware of the impact of decisions on Earth observations and other WMO activities.

10. Coordination of frequency assignments of radiocommunication systems, stations and applications belonging to terrestrial and space radio services is one of the most important methods providing the way for the effective operations of all radio systems and the optimal use of the radio-frequency spectrum and satellite orbits. Coordination of a system/station/application in many cases is not only mandatory in accordance with national and international regulations and rules but also necessary for obtaining national or international recognition. As a result, coordination will also offer protection from harmful interference from frequency assignments of the existing and future stations/systems that will support successful operation of this system/station/application in particular and the WMO Integrated Global Observing System (WIGOS) in general.

WMO involvement in the ITU Radiocommunication Sector

11. WMO is an observer in ITU-R and, through the work of the WMO Commission for Basic Systems (CBS) Steering Group on Radio-frequency Coordination (SG-RFC) members, is a regular contributor to ITU-R Study Groups in WRC processes. The WMO input is well respected within the ITU-R technical activities. Unfortunately, WMO does not have voting rights on WRC decisions. Members of the SG-RFC also represent WMO requirements when registered as WMO representatives or as a part of their national delegations at many of the ITU meetings and at some meetings of the six regional groups. This is important for ensuring that meteorological-related requirements are taken into consideration in the establishment of new, or modification of existing, RR provisions. Similarly, some SG-RFC members have an input through their own administrations and organizations to national radio-frequency coordination and management processes.

12. Although ITU has Sector Members such as telecommunication companies, operators and equipment manufacturers, WRC decisions on changes to the Radio Regulations are made by ITU Member States. However, many of these Member States include industry representatives in their delegations as well as representatives from their regulatory bodies. In this way, unlike within the WMO infrastructure, industry has a very direct and effective influence on WRC decisions.

13. National Meteorological and Hydrological Services are encouraged to use this Guide to better understand the organization and processes that make up radio-frequency coordination and management. The aim is for NMHSs to take advantage of CBS and regional frequency coordination expertise to become more effective in ensuring that the radio-frequency services on which their present and future basic observations and systems depend are able to be protected from interference that has a negative impact on their functioning. This Guide should be used in conjunction with the WMO/ITU Handbook entitled *Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction*.[5]

[5] *Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Predictio*n, http://www.itu.int/en/publications/ITU-R/pages/publications.aspx?parent=R-HDB-45-2008&media=electronic.

1. INTRODUCTION

1.1 The radio-frequency spectrum and satellite orbits are valuable and limited natural resources employed by different radio-based systems, which provide tremendous opportunities for social development of modern society. Technological progress has continually opened doors to a variety of new radio applications that have spurred interest in, and demand for, spectrum. Dependence on radio communications in one form or another has grown dramatically in recent years, and the growth in the number and variety of applications – many of them bandwidth hungry – and the huge expansion in user expectations place ever-increasing demands on the radio spectrum.

1.2 Many services, systems and applications make extensive use of the radio spectrum. These include fixed and mobile radiocommunication systems, broadcasting, aviation, railway and maritime transport, defence, medical electronics, emergency services, remote control and monitoring, radio astronomy, Earth exploration and space research systems, as well as many other applications.

1.3 The access to the spectrum is extremely important for Earth observations, weather forecasting, climate monitoring and climate change prediction. Certain frequencies are unique to particular environmental elements and can be monitored passively, provided the signals are not overwhelmed by emissions of other radio-frequency users operating in or around that band. Similarly, active sensors based on the use of a certain radio frequency are also subject to interference from other radio systems, rendering them unusable in some circumstances.

1.4 However, almost no radio-frequency spectrum is absolutely free in populated areas. Different types of radio stations use the same frequencies and, in order to operate efficiently, technical parameters of these stations should be selected and tuned in such a way that their emissions would not create interference above the specified level. Otherwise, this may lead to the situation in which no station is operating in accordance with technical requirements and none would be able to implement the required function.

1.5 That is why there is a need to properly regulate usage of the radio-frequency spectrum by different systems or applications (including meteorological) in order to avoid harmful interference and to implement relevant procedures for the effective use of the spectrum. International and regional agreements, national laws, other documents, procedures and activities related to the effective use of the radio-frequency spectrum and satellite orbits form the spectrum management system. Radio-frequency coordination activities are part of the processes carried out in the framework of the spectrum management system.

1.6 The meteorological community also makes extensive use of the radio-frequency spectrum by meteorological radio-based systems and applications that obtain environmental information employed for weather forecasting, environment monitoring, detection and early warning of hazards and prevention and mitigation of natural disasters, and for planning and management of disaster relief operations. Technical details on the use of the spectrum for environmental monitoring are available in the joint WMO/ITU Handbook entitled *Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction*.[6]

1.7 This Guide describes the basic concepts of the radio-frequency coordination process at the international, regional and national levels that is necessary for effective noninterference operation of different kinds of radio equipment including meteorological systems and applications. It includes a suggested approach for NMHSs to improve their own effectiveness in

---

[6] *Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction*, http://www.itu.int/en/publications/ITU-R/pages/publications.aspx?parent=R-HDB-45-2008&media=electronic.

influencing spectrum management at the national and international levels but could be used as guidelines by any of the meteorological community.

1.8 This Guide has been developed by the Steering Group on Radio-Frequency Coordination[7] working within the framework of the Commission for Basic Systems.

---

[7] See http://www.wmo.int/pages/prog/www/TEM/WMO_RFC/meetings-en.html.

2. WHAT IS FREQUENCY ASSIGNMENT COORDINATION AND WHY IS IT NECESSARY?

2.1 FREQUENCY COORDINATION

2.1.1 There is no definition of the term coordination in the main international agreement regulating the use of the radio-frequency spectrum and satellite orbits – the Radio Regulations[8] developed and maintained by ITU.[9] However, coordination should be understood as a process followed by users of the radio-frequency spectrum in order to avoid potential harmful interference between new and existing wireless systems, stations or applications.

2.1.2 When is coordination necessary? The main purposes of coordination are the following:

(a) To allow effective operation of already existing radio stations or systems as well as any new station;

(b) To provide recognition of this new station or system in the future. Practically, this means that protection would be provided from harmful interference[10] of stations or systems that could be brought into use in the future.

2.1.3 The coordination process involves:

(a) The exchange of technical and operational data of existing and earlier submitted (usually data of the existing and earlier assignments are obtained from the relevant national and/or international databases) and new frequency assignment(s) of radio stations or systems;

(b) Studies of potential interference effects between existing and new frequency assignment(s);

(c) Correspondence between spectrum management authorities (national and/or international, depending on the case) and spectrum users, and between users themselves regarding new proposals;

(d) As necessary, adjustment of technical parameters and/or re-design of proposed systems or applications in order to allow effective operation of new and existing radio systems or applications.

2.1.4 Before starting the coordination process, it is essential to select proper technical or operational characteristics or parameters and avoid serious mistakes that may prevent successful coordination from the beginning. The working technical or operational characteristics or parameters of a future station or system should be consistent with international and/or national spectrum management regulations or rules. For example:

(a) Selected working frequencies of a new station or system shall be allocated (at the international and/or national levels) to the radiocommunication service in which this new station or system should operate;

---

[8] See http://www.itu.int/pub/R-REG-RR/en (*hereafter all references made to the Radio Regulations, Edition of 2012).*

[9] See http://www.itu.int.

[10] RR No. 1.169 defines harmful interference as follows:

"*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 Radio Regulations..."

(RR No. ***1.169*** *refers to provision number* ***1.169*** *of the Radio Regulations. This format will be used for further references to the relevant RR provisions).*

(b) Technical characteristics of the future station or system shall respect international and/or national regulatory limitations specified in the relevant regulations or rules, for example, output power, antenna characteristics and out-of-band emission level.

2.1.5 If technical or operational characteristics or parameters of a station or system are not in accordance with international and/or national regulations or rules, it is not possible to coordinate such a station or system.

2.1.6 A simplified general description of the coordination process is provided in Figure 1.

2.1.7 If the coordination process is completed successfully, then according to the Radio Regulations, the frequency assignment(s) belonging to the new stations or systems obtains the right to international recognition (RR No. 8.3) and should be recorded in the Master International Frequency Register (MIFR):

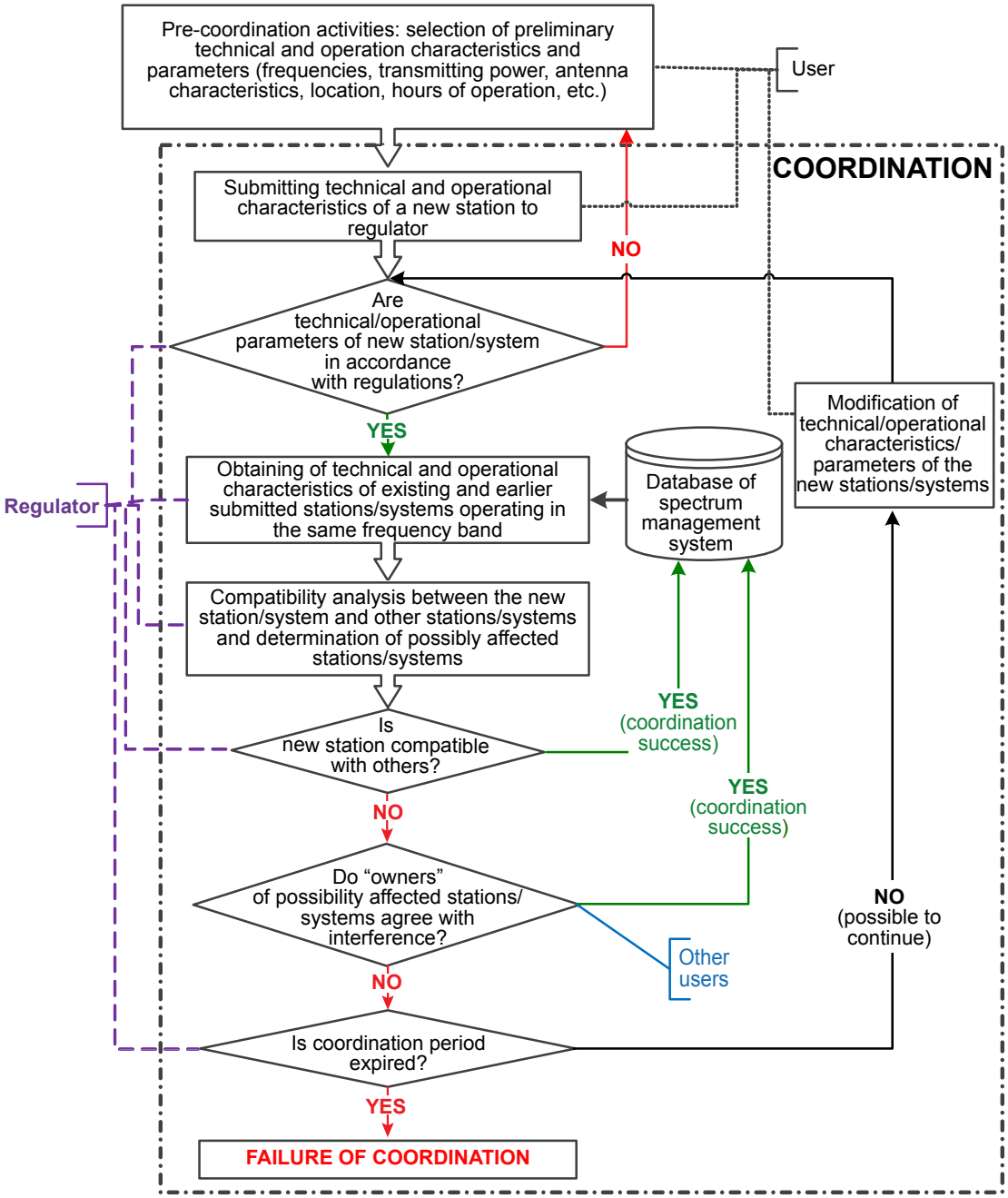

Figure 1. Simplified description of the radio-frequency assignment coordination process

(a) Any frequency assignment recorded in the MIFR with a favourable finding (meaning successfully coordinated) with respect to the Table of Frequency Allocations and other RR provisions shall have the right to international recognition;

(b) This right signifies that other administrations shall take it into account when making their own assignments, in order to avoid harmful interference.

2.1.8 Similar or exactly the same rights are in general also applied according to national regulations, not only for internationally recognized assignments but also for assignments recorded in the national frequency register (or database of the national spectrum management system).

2.1.9 Formally, coordination has been completed after all involved parties have reached an agreement. However, it is extremely important to notify the coordinated frequency assignments and their parameters to the relevant spectrum management authority (national and/or international) so that they can be recorded into the relevant database to be taken into account in the future.

2.1.10 The general description of the international coordination, notification and recording of frequency assignments through the ITU Radiocommunication Bureau is shown in Figure 2.

2.1.11 The time limit for satellite network coordination as specified in the Radio Regulations is seven years. This is a clear indication of the complexity of the coordination process.

2.1.12 Descriptions of different elements of the radio-frequency coordination process are provided in 2.2 to 2.10 below.

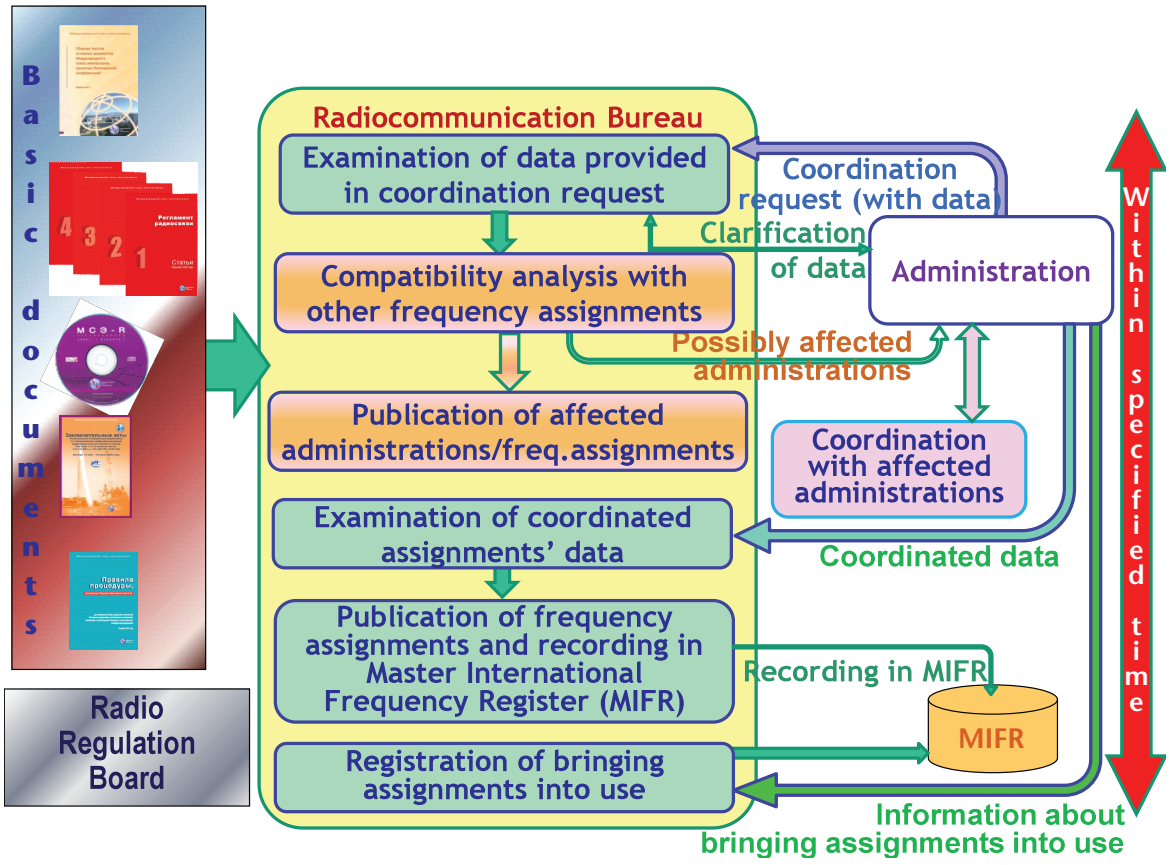

Figure 2. General description of international coordination, notification and recording of frequency assignments

2.2 RADIO SERVICES

2.2.1 Article 1 of the Radio Regulations contains definitions of over 40 different radio services; most, but not all, are radiocommunication services. For example, the radio astronomy service is a radio service, not a radiocommunication service.

2.2.2 A radiocommunication service is defined in the Radio Regulations as follows: "A service as defined in this Section involving the transmission, *emission* and/or reception of *radio waves* for specific *telecommunication* purposes." *(RR No. 1.19 in Section III – Radio Services of Article 1).*

2.2.3 Among these radio services, there are five radiocommunication services of prime interest or concern for meteorology. The definition of those services and samples of applications operating are shown in Table 1.

2.2.4 It is also worth mentioning that the fixed-satellite service systems, through commercial payloads in the C-band (3 400–4 200 MHz) and the Ku Band (10 700–11 700 MHz), are used globally to disseminate meteorological, hydrological, climatological and water-related information, including disaster warnings to meteorological agencies and user communities.

2.2.5 National spectrum management systems, in most cases, use the same classification of radio services as ITU. However, it is necessary to check whether a national spectrum management system applies the same classification or if there is a difference at least for some services.

2.3 FREQUENCY ALLOCATIONS AND THE TABLE OF FREQUENCY ALLOCATIONS

2.3.1 *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 *(RR No. 1.16).*

2.3.2 An allocation of a portion of the radio-frequency spectrum could be made to one or several radiocommunication services.

2.3.3 An allocation could have different rights and obligations, as follows:

(a) *PRIMARY allocations* grant to specific services priority in using the allocated spectrum. When there are multiple primary services within a frequency band, they all have equal rights. A station, however, has the right to be protected from any others that start operation at a later date;

(b) *Secondary allocations* are made for services that must protect all PRIMARY allocations in the same band. Services operating in secondary allocations must not cause harmful interference to, and must accept interference from, primary service stations. All secondary service stations have equal rights among themselves in the same frequency band.

2.3.4 An allocation usually does not combine together services that use high and lower power systems (such as terrestrial broadcasting stations and meteorological aids stations, for example, radiosondes).

2.3.5 Tables of frequency allocations to different radio services and technical or operational limitations rights, obligations and responsibilities of users or operators and regulators, and so forth, are normally incorporated in the national and international regulations and/or rules.

Table 1. Radio services of interest for meteorology and environmental observations

Provision numbers and definitions of radio services in the Radio Regulations (Edition of 2012)	*Acronym*	*Samples of applications*[a]
RR No. 1.51 *Earth exploration-satellite service:* A *radiocommunication service* between *earth stations* and one or more *space stations*, which may include links between *space stations*, in which: – information relating to the characteristics of the Earth and its natural phenomena, including data relating to the state of the environment, is obtained from *active sensors* or *passive sensors* on Earth *satellites;* – similar information is collected from airborne or Earth-based platforms; – such information may be distributed to *earth stations* within the system concerned; – platform interrogation may be included. This service may also include *feeder links* necessary for its operation.	EESS	space-borne sensors (active and passive) for environmental monitoring of the Earth's surface and atmosphere, for example, soil moisture, sea-surface temperature, ice extent, snow cover, water vapour content and concentration in atmosphere, different gases content, altitude of the Earth's ocean, wind direction, wind speed and precipitation rate over the ocean surface
RR No. 1.50 *meteorological aids service:* A *radiocommunication service* used for meteorological, including hydrological, observations and exploration.	MetAids	radiosondes, dropsondes, rocketsondes for atmospheric in situ measurements with high vertical resolution (relative humidity, temperature and wind speed); lightning detection systems
RR No. 1.52 *meteorological-satellite service:* An *earth exploration-satellite service* for meteorological purposes.	MetSat	meteorological-satellite systems (geostationary and non-geostationary) for collection of data with visible and infrared images, passive and active sensors and disseminating these data
RR No. 1.48 *radiolocation service:* A *radiodetermination service* for the purpose of *radiolocation*. *Related definitions:* **RR No. 1.40** *radiodetermination service:* A *radiocommunication service* for the purpose of *radiodetermination*. **RR No. 1.9** *radiodetermination:* The determination of the position, velocity and/or other characteristics of an object, or the obtaining of information relating to these parameters, by means of the propagation properties of *radio waves*.	RLS	meteorological radars: weather radars, wind-profiler radars for surface-based observations such as precipitation and wind measurements that also play a crucial role in the immediate alert processes and disaster warning (flash flood or severe storm events, etc.)
RR No. 1.55 *space research service*: A *radiocommunication service* in which *spacecraft* or other objects in space are used for scientific or technological research purposes.	SRS	space weather observation system for monitoring the physical processes occurring in the space environment, driven by the Sun and Earth's upper atmosphere (the solar wind, flow of solar wind plasma which carries the Sun's embedded magnetic field and releases energy, such as flares of electromagnetic radiation (radio waves, IR, visible, UV, X-rays), energetic particles (electron, protons and heavy ions), and high-speed plasma through coronal mass ejections)

SRS = Space radiocommunication service

[a] See also the Handbook *Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction* at www.itu.int/ITU-R/go/R-HDB-45-2008.

2.3.6 The Radio Regulations contain the international Table of Frequency Allocations (included in Article 5 of the Radio Regulations), which is based on a block allocation method with "footnotes". The regulated frequency band (8.3 kHz–3 000 GHz) is segmented into smaller bands and allocated to over 40 defined radio services. Allocations to the radio services are made either on a PRIMARY or a secondary basis (the latter shall cause no harmful interference to, nor claim protection from, the former). Footnotes are used to further specify how the frequency ranges are to be assigned or used.

2.4 ITU REGIONS

2.4.1 For the allocation of frequencies, ITU has divided the world into three Regions, as shown in Figure 3. Descriptions of these ITU Regions are provided in RR Nos. 5.3, 5.4 and 5.5.

> **5.3** *Region 1:* Region 1 includes the area limited on the east by line A (lines A, B and C are defined [in Figure 3]) and on the west by line B, excluding any of the territory of the Islamic Republic of Iran which lies between these limits. It also includes the whole of the territory of Armenia, Azerbaijan, the Russian Federation, Georgia, Kazakhstan, Mongolia, Uzbekistan, Kyrgyzstan, Tajikistan, Turkmenistan, Turkey and Ukraine and the area to the north of the Russian Federation which lies between lines A and C.
>
> **5.4** *Region 2:* Region 2 includes the area limited on the east by line B and on the west by line C.
>
> **5.5** *Region 3:* Region 3 includes the area limited on the east by line C and on the west by line A, except any of the territory of Armenia, Azerbaijan, the Russian Federation, Georgia, Kazakhstan, Mongolia, Uzbekistan, Kyrgyzstan, Tajikistan, Turkmenistan, Turkey and Ukraine and the area to the north of the Russian Federation. It also includes that part of the territory of the Islamic Republic of Iran lying outside of those limits.

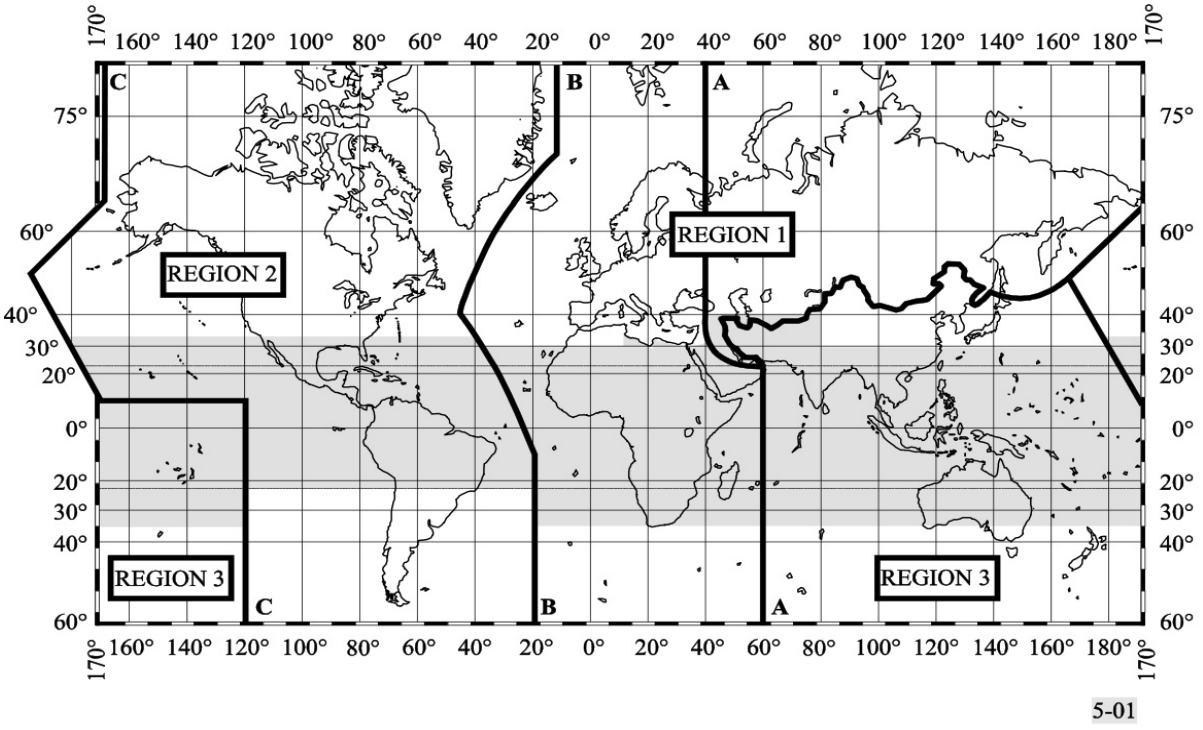

Figure 3. ITU radiocommunication Regions

2.4.2 An extract from the Table of Frequency Allocations in Article 5 of the Radio Regulations is shown in Table 2. Capital letters indicate PRIMARY allocations and lower case letters are used to indicate secondary allocations. Numbers are used for provisions employed for specifying conditions, additional and alternative allocations and descriptions of special uses. For example, RR No. 5.341:

> **5.341** In the bands 1 400–1 727 MHz, 101–120 GHz and 197–220 GHz, passive research is being conducted by some countries in a programme for the search for intentional emissions of extraterrestrial origin.

2.4.3 Each column in the Table of Frequency Allocations corresponds to one of the ITU Regions. An allocation that occupies the whole width of the table is a worldwide allocation, whereas one that occupies one or two of the three columns is a regional allocation (see Table 2).

2.4.4 As ITU Regions may have different allocations, sometimes done by footnote to the table, in addition to checking the table itself, it is also necessary to check provisions included in each row, because sometimes they contain additional allocations. For example, the 15.4–18.4 GHz part of the Table of Frequency Allocations (see Table 3) does not contain allocations to the meteorological-satellite service, but RR No. 5.519 at the bottom of both the 17.8–18.1 GHz entry in the Region 2 column and the 18.1–18.4 GHz entry in the global column provides additional allocation to MetSat for geostationary satellites as follows:

> **5.519** *Additional allocation:* the bands 18–18.3 GHz in Region 2 and 18.1–18.4 GHz in Regions 1 and 3 are also allocated to the meteorological-satellite service (space-to-Earth) on a primary basis. Their use is limited to geostationary satellites. (WRC-07)

Table 2. Extract from the Table of Frequency Allocations in Article 5 of the ITU Radio Regulations

<table>
<tr><td colspan="3">Allocation to services</td></tr>
<tr><td>Region 1</td><td>Region 2</td><td>Region 3</td></tr>
<tr><td>1 670–1 675</td><td colspan="2">METEOROLOGICAL AIDS
FIXED
METEOROLOGICAL-SATELLITE (space-to-Earth)
MOBILE
MOBILE-SATELLITE (Earth-to-space) 5.351A 5.379B
5.341 5.379D 5.379E 5.380A</td></tr>
<tr><td>1 675–1 690</td><td colspan="2">METEOROLOGICAL AIDS
FIXED
METEOROLOGICAL-SATELLITE (space-to-Earth)
MOBILE except aeronautical mobile
5.341</td></tr>
<tr><td>1 690–1 700
METEOROLOGICAL AIDS
METEOROLOGICAL-SATELLITE
(space-to-Earth)
Fixed
Mobile except aeronautical mobile
5.289 5.341 5.382</td><td colspan="2">1 690-1 700
METEOROLOGICAL AIDS
METEOROLOGICAL-SATELLITE (space-to-Earth)
5.289 5.341 5.381</td></tr>
<tr><td colspan="2">1 700–1 710
FIXED
METEOROLOGICAL-SATELLITE (space-to-Earth)
MOBILE except aeronautical mobile
5.289 5.341</td><td>1 700–1 710
FIXED
METEOROLOGICAL-
SATELLITE (space-to-Earth)
MOBILE except aeronautical
mobile
5.289 5.341 5.384</td></tr>
</table>

Table 3. Fragment of the 15.4–18.4 GHz portion of the Table of Frequency Allocations in Article 5 of the ITU Radio Regulations

<table>
<tr><td colspan="3">Allocation to services</td></tr>
<tr><td>Region 1</td><td>Region 2</td><td>Region 3</td></tr>
<tr><td colspan="3">…</td></tr>
<tr><td>17.3–17.7
FIXED-SATELLITE
(Earth-to-space) 5.516
(space-to-Earth) 5.516A 5.516B
Radiolocation

5.514</td><td>17.3–17.7
FIXED-SATELLITE
(Earth-to-space) 5.516
BROADCASTING-SATELLITE
Radiolocation

5.514 5.515</td><td>17.3–17.7
FIXED-SATELLITE
(Earth-to-space) 5.516
Radiolocation

5.514</td></tr>
<tr><td rowspan="2">17.7–18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
(Earth-to-space) 5.516
MOBILE</td><td>17.7–17.8
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.517
(Earth-to-space) 5.516
BROADCASTING-SATELLITE
Mobile
5.515</td><td rowspan="2">17.7–18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
(Earth-to-space) 5.516
MOBILE</td></tr>
<tr><td>17.8–18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A
(Earth-to-space) 5.516
MOBILE
5.519</td></tr>
<tr><td>18.1–18.4</td><td colspan="2">FIXED
FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B
(Earth-to-space) 5.520
MOBILE
5.519 5.521</td></tr>
</table>

2.5 REGIONAL TELECOMMUNICATION ORGANIZATIONS

2.5.1 The Member States of ITU have established six regional telecommunication organizations that formally are not part of the regulatory development process but play a significant role in world and regional preparation for World Radiocommunication Conferences. These regional telecommunication organizations coordinate and develop common proposals related to different aspects of spectrum management including proposals on worldwide and regional allocations for consideration at World Radiocommunication Conferences. The organizations are as follows:

(a) African Telecommunications Union (ATU);

(b) Arab Spectrum Management Group (ASMG);

(c) Asia-Pacific Telecommunity (APT);

(d) European Conference of Postal and Telecommunications Administrations (CEPT);

(e) Inter-American Telecommunication Commission (CITEL);

(f) Regional Commonwealth in the field of Communications (RCC).

2.5.2 The Member States of ITU have voting rights in the World Radiocommunication Conferences, but these regional organizations have no such rights. Nevertheless, they carry a great deal of weight in the decision-making process. It is essential that national and regional bodies are fully aware of the impact of decisions on Earth observations and other WMO activities.

2.6 NATIONAL FREQUENCY ALLOCATIONS

2.6.1 Although most countries follow the ITU allocations to a great degree, it is still possible for a country to deviate from the international allocations, to a limited degree, to satisfy specific national requirements. That is why many regulators develop national frequency allocation tables.

2.6.2 National frequency allocation tables, sometimes called plans or otherwise, are usually published on the web pages of national regulators (see 2.10 below). Some provide national frequency allocation tables in a more transparent and clear manner using a graphical format.[11] A fragment of such a graphical presentation is shown in Figure 4.

2.7 TECHNICAL AND OPERATIONAL LIMITATIONS

Frequencies are assigned and used with due account of any restrictions on their use, stipulated by international and national regulations. Some countries may place local limitations on the use of specified frequency bands for individual radio services. These can be restrictions on the utilization of some frequencies by particular users, on the radiated power in specific radio services operating in a specified frequency band, or in certain geographical areas.

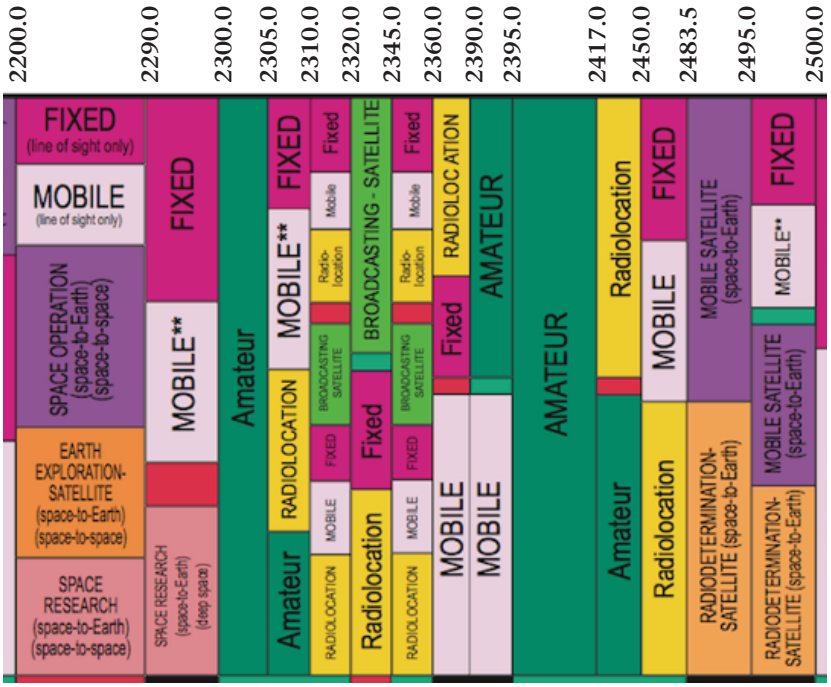

Figure 4. Extract from a national frequency allocation table for the frequency range 2 200–2 500 MHz

[11] See examples at www.acma.gov.au/webwr/radcomm/frequency_planning/spectrum_plan/arsp-wc.pdf, www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/2014_Canadian_Radio_Spectrum_Chart.pdf/$file/2014_Canadian_Radio_Spectrum_Chart.pdf, www.fab.gov.pk/images/spectrumchart.jpg and www.icta.mu//images/spectrum.jpg.

2.8 TECHNICAL AND/OR OPERATIONAL CONDITIONS AND LIMITATIONS CONTAINED IN THE INTERNATIONAL AND NATIONAL AGREEMENTS, LAW, REGULATIONS AND RULES

2.8.1 The following ITU documents are to be used when an assignment needs international recognition:

(a) The ITU Radio Regulations (mainly Article 5, Article 21 – for assignments belonging to the terrestrial services, and Article 22 – for assignments belonging to the space services). Radio Regulations contain the complete texts as adopted by the World Radiocommunication Conference (Geneva, 1995) (WRC-95) and subsequently revised and adopted by World Radiocommunication Conferences, including all Appendices, Resolutions, Recommendations and ITU-R Recommendations incorporated by reference; available free of charge at http://www.itu.int/en/publications/ITU-R/pages/publications.aspx?parent=R-REG-RR-2012&media=electronic;

(b) The Rules of Procedure, approved by the Radio Regulations Board, for the application by the Radiocommunication Bureau of the provisions of the Radio Regulations, Regional Agreements and Resolutions and Recommendations of World and Regional Radiocommunication Conferences; available free of charge at https://www.itu.int/en/publications/ITU-R/pages/publications.aspx?parent=R-REG-ROP-2012&media=electronic;

(c) Recommendations of the ITU Radiocommunication Sector; available free of charge at http://www.itu.int/pub/R-REC.

2.8.2 Article 5 of the Radio Regulations contains some provisions specifying conditions of the use for some stations or systems. Two samples (RR Nos. 5.54A and 5.549A) are shown below.

> **5.54A** Use of the 8.3–11.3 kHz frequency band by stations in the meteorological aids service is limited to passive use only. In the band 9–11.3 kHz, meteorological aids stations shall not claim protection from stations of the radionavigation service submitted for notification to the Bureau prior to 1 January 2013. For sharing between stations of the meteorological aids service and stations in the radionavigation service submitted for notification after this date, the most recent version of Recommendation ITU-R RS.1881 should be applied. (WRC-12)

> **5.549A** In the band 35.5–36.0 GHz, the mean power flux-density at the Earth's surface, generated by any spaceborne sensor in the Earth exploration-satellite service (active) or space research service (active), for any angle greater than 0.8° from the beam centre shall not exceed –73.3 dB(W/m$^{2)}$ in this band. (WRC-03)

2.8.3 Similarly, RR Articles 21 and 22 contain technical limitations applied to stations of different space services including those of interest to the meteorological community. Two samples are provided below.

> **22.4 §3** In the frequency band 29.95–30 GHz space stations in the Earth exploration-satellite service on board geostationary satellites and operating with space stations in the same service on board non-geostationary satellites shall have the following restriction:
>
> Whenever the emissions from the geostationary satellites are directed towards the geostationary-satellite orbit and cause unacceptable interference to any geostationary-satellite space system in the fixed-satellite service, these emissions shall be reduced to a level at or less than accepted interference.

> **22.5 §4** In the frequency band 8 025–8 400 MHz, which the Earth exploration-satellite service using non-geostationary satellites shares with the fixed-satellite service (Earth-to-space) or the meteorological-satellite service (Earth-to-space), the maximum power flux-density produced at the

geostationary-satellite orbit by any Earth exploration-satellite service space station shall not exceed –174 dB(W/m^2) in any 4 kHz band.

2.8.4 National operational and technical conditions or limitations on the use of certain frequency bands by stations, systems and applications belonging to the specific services in different frequency bands are described in national regulations or rules that are usually published on the web pages of national regulators (see 2.10 below).

2.9 ANALYSIS OF ELECTROMAGNETIC COMPATIBILITY BETWEEN EXISTING AND NEWLY SUBMITTED STATIONS OR SYSTEMS

2.9.1 The analyses of electromagnetic compatibility of stations or systems using the same frequency band and the analyses of interfering effects of out-of-band emissions spilling in the adjacent bands are very complicated engineering tasks. Such analyses require sophisticated software and significant computing resources. Fortunately, ITU-R processes identify and agree on standard methods so different projects can arrive at consistent solutions. As such, methods, criteria and algorithms to be employed for electromagnetic compatibility analysis between stations or systems belonging to different radio services at the international level are specified in Appendix 5 of the Radio Regulations – Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9.

2.9.2 The national approaches, methods and algorithms to electromagnetic compatibility analysis applicable at the national level are usually provided in the relevant national regulations or rules published on the web pages of regulators (see 2.10 below).

2.9.3 The complexity of the problem is reflected in Figure 5 for a new geostationary satellite.

2.9.4 Another important factor is the amount of frequency assignments to be considered in compatibility analysis. The ITU Master International Frequency Register, the database of radio stations operating around the world, is constantly updated by the ITU Radiocommunication Bureau.

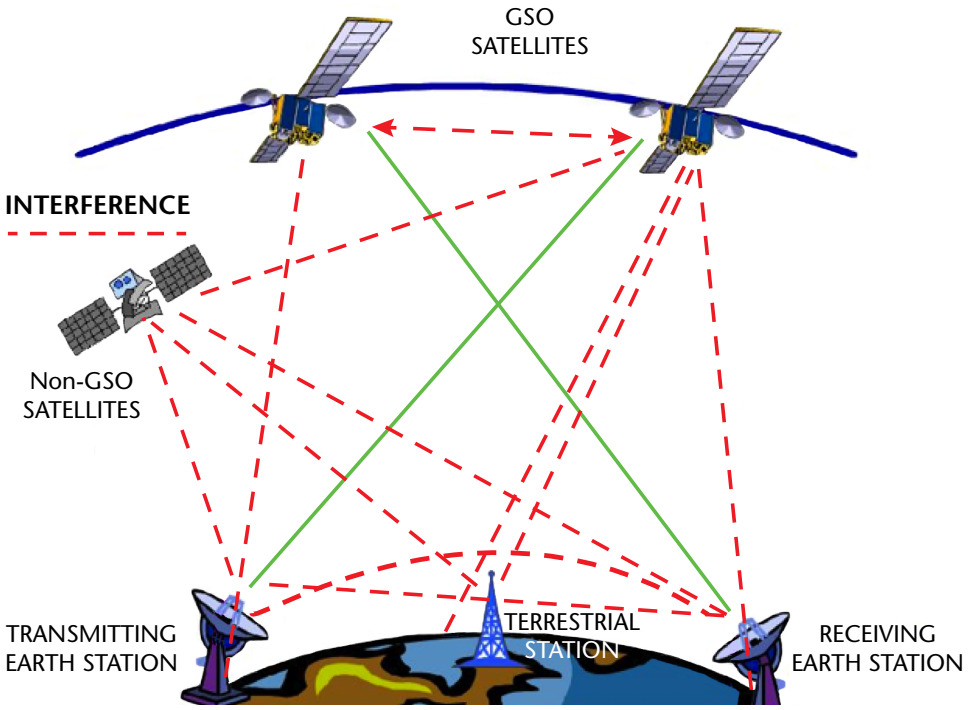

Figure 5. Types of interfering sources to be considered during electromagnetic compatibility analysis of a new geostationary satellite system

It contains more than 2 million frequency assignments for terrestrial services and more than 1.1 million assignments to space services. Every year the Bureau handles more than 120 000 notices for stations of terrestrial services and about 1 300 filings of satellite networks, covering some 0.5 million frequency assignments and 300 Earth stations and radioastronomy stations.

2.10 INTERNATIONAL AND NATIONAL REGULATORS

2.10.1 The global management of the radio-frequency spectrum and satellite orbits is provided by ITU. Established in 1865, ITU is the specialized agency of the United Nations for telecommunications and information and communication technologies.

2.10.2 According to Article 1 of the Constitution of ITU (see http://www.itu.int/net/about/basic-texts/constitution/chapterii.aspx):[12]

> "... the Union shall in particular:
>
> 11 PP-98 a) effect allocation of bands of the radio-frequency spectrum, the allotment of radio frequencies and the registration of radio-frequency assignments and, for space services, of any associated orbital position in the geostationary-satellite orbit or of any associated characteristics of satellites in other orbits, in order to avoid harmful interference between radio stations of different countries;
>
> 12 PP-98 b) coordinate efforts to eliminate harmful interference between radio stations of different countries and to improve the use made of the radio-frequency spectrum for radiocommunication services and of the geostationary-satellite and other satellite orbits;"

2.10.3 The ITU Radiocommunication Sector is the international steward of the radio-frequency spectrum and satellite orbits. Through World Radiocommunication Conferences, the Radiocommunication Sector allocates the necessary radio-frequency spectrum to allow the effective operation of different radio-based systems and applications (terrestrial and space) used for different purposes including climate monitoring and prediction, weather forecasting and disaster early warning and detection. It also carries out studies and approves international standards on radiocommunication matters (designated as ITU-R Recommendations in ITU terminology).

2.10.4 The ITU Radiocommunication Sector works through world and regional radiocommunication conferences, the Radio Regulations Board, Radiocommunication Assemblies, Radiocommunication Study Groups and the Radiocommunication Bureau. The Bureau implements coordination and recording procedures for space and terrestrial wireless systems, networks and stations.

2.10.5 At World Radiocommunication Conferences, usually held every three or four years, the texts of the Radio Regulations (see Figure 6) are revised. These have the status of international treaty, covering and regulating the use of the radio-frequency spectrum and satellite orbits by systems and stations of radio services. The main goal of the Radio Regulations is to ensure that reliable radio services are available everywhere and at every moment, enabling people to live and travel safely and enjoy high-performance radiocommunications. For further relations between the ITU and the WMO activities, see the "WMO Strategy on Radio-Frequency Protection for Meteorology".

---

[12] The collection of the basic texts of the International Telecommunication Union, including the ITU Constitution, Convention and other texts, is available free of charge at http://www.itu.int/pub/S-CONF-PLEN-2011.

Figure 6. ITU Radio Regulations (about 2 000 pages in four volumes)

2.10.6 The ability of each country to take full advantage of the spectrum resource depends heavily on spectrum management activities that facilitate the implementation of radio systems and ensure minimum interference. National spectrum management consists of the structures, procedures and regulations whereby an administration controls the use of the radio spectrum within its geographical boundaries. Effective management of the spectrum resource encompasses major directives that establish the responsibility of the national authority. This authority regulates the spectrum use as well as all related processes. Although no two administrations would manage the spectrum in exactly the same manner, the basic processes are essential to all national approaches.

2.10.7 Usually the national radiocommunication law delegates the authority and responsibility to manage spectrum use to one or more government bodies. Many countries establish their national frequency coordination procedures. Frequency coordination is the process of obtaining agreement between existing spectrum users and a prospective spectrum user when there is some potential spectrum conflict. Coordination at the national level may involve technical, administrative, legal or other considerations. Frequency coordination at the national level is essential, because the same frequency band typically is shared by radio systems that belong to different users. For example, some microwave links may be operated by different governmental agencies, others by national or local carriers, and some by one or more private companies – all using the same frequency allocations. The process of coordination is regulated by appropriate national rules. All users potentially affected by a new radio system under consideration are obliged to examine the possibility of interference with that assignment.

2.10.8 How is it determined which ministry, organization or commission is in charge of the spectrum regulations? It is possible to do so through the ITU Global Directory published and maintained at http://www.itu.int/GlobalDirectory/search.html. The Global Directory contains the basic information on ITU membership, including information concerning national regulators. Clicking on the ITU Member States entry under Main Lists of the Global Directory results in the list of the ITU Member States as shown in Figure 7.

2.10.9 Then it is necessary to click on the country of interest, for example, Bangladesh (People's Republic of). The next screen will present the detailed administrative information related to this ITU Member State, including information about the regulation authorities, as shown in Figure 8.

2.10.10 Going further and clicking on the name in the row containing the regulator indicator, it is possible to obtain the necessary information concerning the relevant national regulator (address, phone numbers and URL), as presented in Figure 9.

ITU Global Directory

TIES Main Page | FAQ | Email | GD Map Tue Jun 23 12:31:33 CEST 2015

Search the ITU Global Directory

[ITU Member States] display totals? map?

Designation in English	Administrative Region [?]	Ctry Symbol	Domain Name	Date of Entry
Afghanistan	E	AFG	.af	1928/04/12
Albania (Republic of)	C	ALB	.al	1922/06/02
Algeria (People's Democratic Republic of)	D	ALG	.dz	1963/05/03
Andorra (Principality of)	B	AND	.ad	1993/11/12
Angola (Republic of)	D	AGL	.ao	1976/10/13
Antigua and Barbuda	A	ATG	.ag	1987/02/04
Argentine Republic	A	ARG	.ar	1889/01/01
Armenia (Republic of)	C	ARM	.am	1992/06/30
Australia	E	AUS	.au	1878/05/27
Austria	B	AUT	.at	1866/01/01
Azerbaijan (Republic of)	C	AZE	.az	1992/04/10
Bahamas (Commonwealth of the)	A	BAH	.bs	1974/08/19
Bahrain (Kingdom of)	E	BHR	.bh	1975/01/01
Bangladesh (People's Republic of)	E	BGD	.bd	1973/09/05
Barbados	A	BRB	.bb	1967/08/16
Belarus (Republic of)	C	BLR	.by	1947/05/07

Figure 7. Extract from the list of ITU Member States

Name	ITU-R	ITU-T	ITU-D	Categories (?)
Bangladesh - Bangladesh - Bangladesh				
Ministry of Posts, Telecommunications and Information Technology , Government of the People's Republic of Bangladesh , DHAKA	MINISTRY			
Bangladesh Telecommunication Regulatory Commission (BTRC) , , Ramna, DHAKA	ADMIN / REGULATOR			
National Broadcasting Authority , Directorate General , DHAKA	ADMIN RELATED			
Banglalink Digital Communications Ltd. , DHAKA			X	ROA
Grameenphone (GP) Limited , DHAKA			X	ROA
Robi Axiata Limited , DHAKA			ASSOCIATE SG1	ROA

Figure 8. Part of administrative information concerning an ITU Member State – Bangladesh

Address details:

Category: ADMIN / REGULATOR

Bangladesh Telecommunication Regulatory Commission (BTRC)

IEB Bhaban
Ramna, DHAKA 1000
Bangladesh

Tf +880 27162277
Fax +880 29556677
URL www.btrc.gov.bd

TIES:TIES FocalPoint + TIES users

Figure 9. Information concerning the regulation authority of Bangladesh

3. STEP-BY-STEP COORDINATION GUIDELINE

The step-by-step guideline of coordination of radio frequencies within ITU is shown in Figure 10. How an NMHS should become engaged in this process is described in section 4 below. Formally speaking, steps 8 to 10 in Figure 10 are not part of the coordination process; however, they are essential for protection of the coordinated assignments (system/station/application) from harmful interference of future systems, stations or applications.

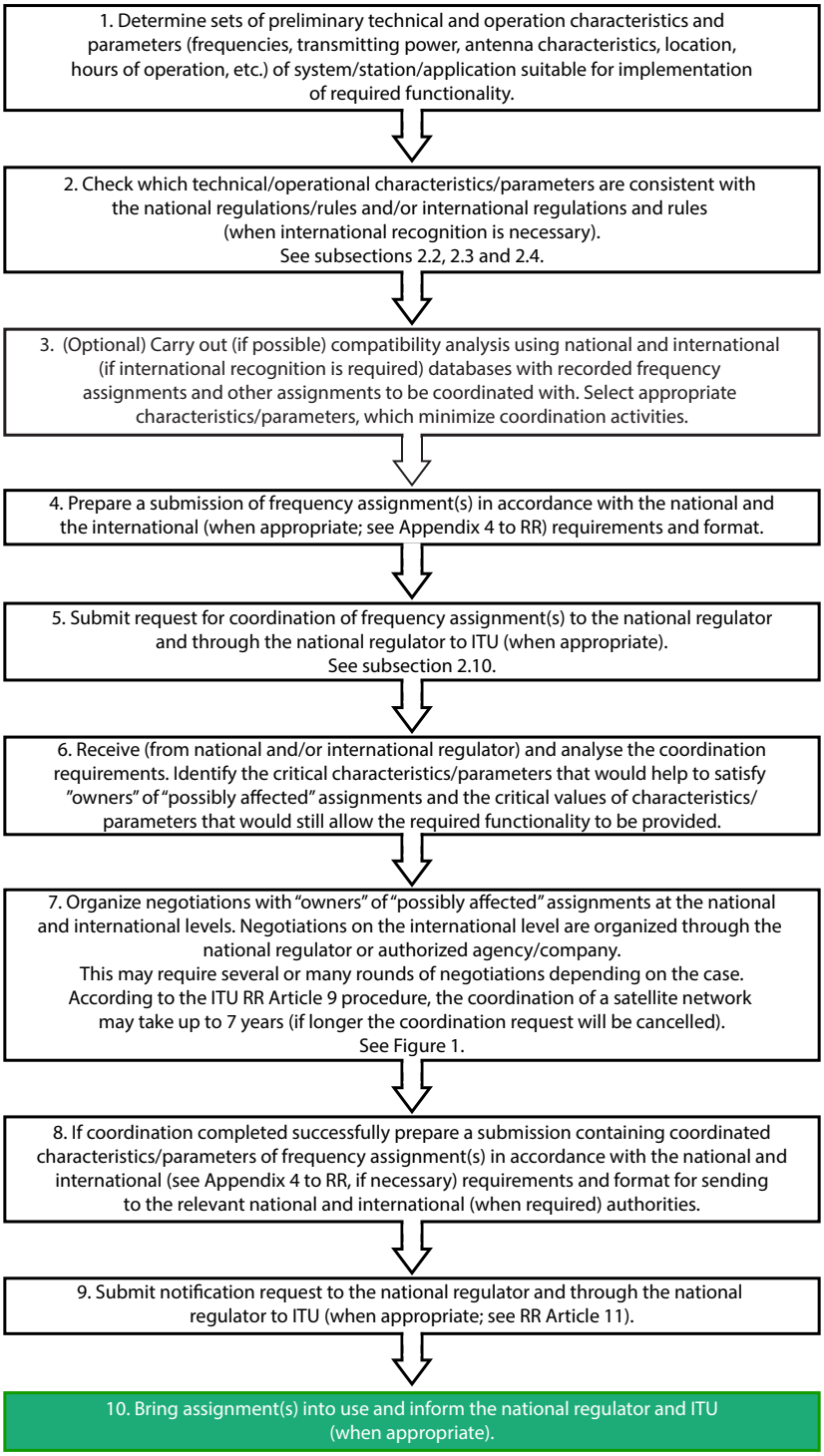

Figure 10. Step-by-step guideline of coordination of radio frequencies within ITU

4. HOW TO ENGAGE A NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICE IN ITU FREQUENCY MANAGEMENT AND COORDINATION

4.1 The purpose of this Guide is primarily to assist the heads of NMHSs to understand the ITU process that supports radio-frequency coordination, and what they should do to engage in their national, regional and global coordination. The following summarizes some common elements of approaches that NMHSs have found to be successful.

4.2 In order to engage in radio-frequency coordination, there are two high-level objectives. The main objective is to be effective in influencing frequency management decision-makers. The second high-level objective is to use the wider WMO expertise to ensure that decisions taken by frequency regulators relative to the meteorological requirements are scientifically and technically strong. The nature of radio-frequency coordination activities means that input needs to be provided at the national, regional and global forums.

4.3 An effective approach used by some NMHSs in achieving the first objective has been to identify which agencies or departments are the frequency regulators and to convince the regulatory body and its parent ministry of the importance of meteorology to national priorities. This opens the way to emphasize meteorology's dependence on frequencies. Having ministers, or at least departmental heads, buy in is an important element that will ensure a sustainable relationship. Once achieved, the aim is then to become involved in the national, regional and global processes, including NMHS representation on relevant delegations.

4.4 The above is described in more detail in the annex, which identifies some tools to assist in achieving these objectives. The CBS Steering Group on Radio-frequency Coordination, the relevant infrastructure working groups of the WMO regional associations and the WMO Secretariat are important sources of support for these activities. As such, NMHSs are encouraged to participate through registering their national focal point or experts in the Steering Group or regional groups, and to encourage them to participate actively.

5. CONCLUSION

5.1 The purpose of this Guide is primarily to assist the heads of NMHSs to understand the ITU process that supports radio-frequency coordination, and what they should do to engage in their national, regional and global coordination.

5.2 Coordination of frequency assignments of terrestrial and space radiocommunication systems, stations and applications belonging to terrestrial and space radio services is one of the most important methods facilitating the effective operations of all radio systems and the optimal use of the radio-frequency spectrum and satellite orbits.

5.3 In many instances, coordination of a system, station or application is not only mandatory in accordance with national and international regulations and rules but also necessary for obtaining national or international recognition. It also provides protection from harmful interference from frequency assignments of existing and future stations or systems that will support the successful operation of this system, station or application in particular and the WMO Integrated Global Observing System (see Figure 11) in general.

5.4 Coordination is all the more essential considering the limited financial resources of the NMHSs and the regional and national organizations involved in meteorological activities, as well as WMO. These simply cannot afford improper implementation of national regulations and regional and international agreements on the use of the radio-frequency spectrum and satellite orbits.

Figure 11. WMO Integrated Global Observing System

ANNEX. POSSIBLE ACTION PLAN

High-level objectives	*Approach*	*Tools*
1. Influence decision-making		
(a) Obtain ministerial/ departmental head support from: (i) NMHS parent body (ii) Regulatory department and its parent body. (b) To become involved in regulatory processes: (i) National (ii) Regional (iii) ITU-R/WRC bodies	(i) Use available guidance to brief relevant minister and department on the importance of RF to meteorological and related services (ii) Identify national priorities (e.g. emergency response and disaster risk reduction) and define their dependence on NMHS' services (iii) Identify radio-frequency spectrum regulator and arrange meetings between departmental heads (iv) Obtain NMHS representative on regulatory agency's frequency management steering committee or its equivalent (i.e. Board level participation). (v) Aim to place NMHS technical expert on national delegations to relevant ITU-R regional and global meetings	• *Guide to Participation in Radio-frequency Coordination* • The Handbook *Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction* • Government policy documents defining national priorities • ITU-R list of regulatory agencies[a] • SG-RFC/WMO Secretariat for identifying: – Relevant regional groups – Relevant ITU working groups and committees • SG-RFC membership and terms of reference
2. Ensure sound scientific and technical input to frequency management		
(a) Become involved in WMO RFC activities: (i) National (ii) Regional (iii) Global	(i) *National* Identify a national focal point on radio-frequency matters, most likely from observations or engineering staff (ii) *Regional* • At a minimum, register focal point and relevant experts with regional WIGOS/ infrastructure working group • Support participation of focal point/experts in regional WIGOS radio-frequency coordination activities (iii) *Global* • Register the focal point and experts as associated members of SG-RFC • Support participation of NMHS representative in national delegations to SG-RFC and relevant ITU-R/ WRC related meetings	• Report on regional association sessions and subsequent terms of reference of working groups and bodies • SG-RFC/WMO Secretariat for identifying relevant: – Regional groups – ITU working groups and committees • SG-RFC membership and terms of reference • ITU-R list of meetings and registration pages

[a] ITU Global Directory published and maintained at http://www.itu.int/en/membership/Pages/default.aspx.

For more information, please contact:
World Meteorological Organization

7 bis, avenue de la Paix – P.O. Box 2300 – CH 1211 Geneva 2 – Switzerland
Communications and Public Affairs Office

Tel.: +41 (0) 22 730 83 14/15 – Fax: +41 (0) 22 730 80 27

E-mail: cpa@wmo.int
www.wmo.int

JN 151276