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Information and coordination in international spectrum policy: Implications for Thailand

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Abstract

The Radio Regulations (RR) is an international treaty with which the International Telecommunication Union (ITU) Member States comply when managing the spectrum to avoid harmful interference. The RR is the outcome of the World Radiocommunication Conference (WRC) and is based on Member State contributions and negotiations.

Member States must implement the RR provisions carefully. However, national interpretations of the provisions are typically complex, leading to conflicts. Improved knowledge of the rationale behind the provisions would reduce tensions between Member States. Unfortunately, the ITU archives contain only the final input and output documents of the WRC proceedings and RR versions, nothing on the informal deliberations that form the rationale and missing information.

The purpose of this study is to understand the information needs of spectrum policy setting, including the relevant ITU processes and archives (WRC proceedings and RR versions). The study also proposes possible solutions to handling the missing information from the ITU archives in this policy setting.

To address the purpose, the study explores the contents of the ITU archives in terms of the WRC and RR developments. The author attended several meetings to document observations on meeting dynamics. Meeting observations were conducted through national and regional preparatory meetings and the WRC-12 on Agenda Items 1.19 and 1.22. The observations identify the particular form and nature of the information missing from the archives. An analysis of WRC-12 Agenda Items 1.2 and 1.19 from Thailand's perspective illustrates the gains that would accrue if this information were to be made available.

The main study results are the WRC and RR developments, including key definitions, important provisions, frequency bands in specified services, and the WRC preparatory process. These processes include the agenda-setting and study processes (national and regional activities). Many aspects of these processes are not documented. Using the institutional analysis and development (IAD) framework to understand the decision-making process inside the WRC activities yields a broad list of questions. This list includes questions about action situations. Much of the information that has not yet been documented could improve the resolutions.

To improve the archive resources, the study proposes that an information record form with webcast archives, minutes of meeting below the level of plenary session, and full use of a SharePoint website be completed and lodged with the archives. Member State networking would also provide an option to reduce the information deficit and compensate for Member States that do not attend the relevant meetings.

Enhanced archives and Member State networking would assist Low Income countries and Member States that are unable to participate in meetings due to resource constraints by providing argumentations and issue summaries. Augmented archives and networking would provide a stronger basis for understanding such RR provision changes. Moreover, for issues continuing to the next WRC, Member States would have a basis on which to develop further argumentations.

Keywords: Radio Regulations (RR), World Radiocommunication Conference (WRC), institutional analysis and development (IAD) framework, decision situation, participant observation, interaction

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Chapter 1 Introduction

This study is about the nature of information needs and coordination in the telecommunication sector between stakeholders: administrators, regulators, operators, manufactures, and end-users. However, the study only focuses on the information needs and coordination within the decision-making process of the International Telecommunication Union (ITU) Member States via the World Radiocommunication Conference (WRC).

1.1 Background

Communication has the purpose of connecting people. Basic communication begins with talking with each other at the same venue. When one party is distanced from others, telecommunication technology is introduced.

Telecommunication technology has developed from telegraph to radiotelegraph, from fixed telephone to mobile telephone, and from terrestrial services to satellite services. The transmission mediums are wire and wireless. Wire is developed from copper (twisted pair) and coaxial to fiber optics. Messages or information is converted into electric or light signals before being sent from transmitters via a transmission line to receivers.

What is spectrum?

Conversely, wireless uses radio (spectrum, radio waves, radio frequency, or frequency) as the medium. An electromagnetic wave up to 3,000 GHz (RR2012) carries messages through the air or free space without artificial guides. The radio propagation characteristics vary by frequency. Higher frequencies have a greater carrying capacity but a shorter communication range. Lower frequencies have a lower carrying capacity but a longer communication range.

Spectrum is a non-depletable resource. It can be reused by dividing it into frequencies, time, angle of arrival, polarization, geography, and uses. Due to its nature, transmissions will propagate across country borders until the power runs out.

Why manage spectrum?

In terms of technical aspects, the spectrum is similar to roads carrying traffic. It needs rules or regulations to control the use of each application and prevent disorder and harmful interference. Proper spectrum management can maximize its use by allowing for the maximum number of users, while keeping interference and congestion manageable.

In terms of social aspects, in some countries, such as Thailand, spectrum is a national resource of public interest. As stated in the Constitution of Thailand (2007), there must be an independent regulatory body with the duty of distributing frequency and supervising its use. There shall be regard for maximum public benefit at national and local levels in education, culture, state security, other public interests, and fair and free competition, including encouraging the public to participate in the management of public mass communication.

One of the WTO's declarations is to urge WTO members to liberalize basic telecommunication service. This requires the establishment of a regulatory authority. Such an

authority is denoted by law, i.e., administrator, national regulatory authority (NRA), or regulator.

In terms of economics, spectrum is a scarce resource and limited by its frequency band, time, and place. The spectrum can be used for different purposes or services. The different services of the spectrum make it similar to other goods that follow supply and demand. Demand for spectrum is created by the users, and supply of spectrum is provided by the regulator. A particular aspect of spectrum, from an economic point of view, is that it is non-excludable, non-depletable, and subject to congestion problems. It therefore has some properties that are similar to public goods, though it is not purely public goods.

How is spectrum managed?

With regard to the propagation of spectrum, there are three levels of spectrum management: allocation, allotment, and assignment. Allocation and allotment are designed at international level, while assignment is the responsibility of national agencies. Management at international level is by ITU, a United Nations specialized agency, through the issuing of the Radio Regulations (RR) via WRC to harmonize the allocation of frequency bands with radiocommunication services. The RR is the international treaty for radiocommunication managing the spectrum internationally without causing harmful interference.

Harmonization can also be regional. Active regional organizations are the African Telecommunications Union (ATU), Arab Spectrum Management Group (ASMG), Asia Pacific Telecommunity (APT), European Conference of Postal and Telecommunications Administrations (CEPT), Inter-American Telecommunication Commission (CITEL), and Regional Commonwealth in the Field of Communications (RCC). They help to consolidate and compromise on different ideas within and across regions.

National assignment and modes of assignment vary by country. Spectrum may be assigned by an administrator, NRA, or relevant ministry, depending on the laws of the country. Before the spectrum is assigned, the NRA normally checks the availability of spectrum, existing users, related regulations (national and international), and suitable technical characteristics imposed on the use of spectrum and radiocommunication equipment.

All obligations imposed by the authority must comply with the RR to avoid harmful interference between countries and maintain priority on claims to use the spectrum. The regulators have the right to manage the spectrum within their territories but not to interfere with neighboring countries. They set up coordination and cooperation with neighboring countries to help manage interference. For example, Thailand and Malaysia established the Joint Technical Committee (JTC) for frequency coordination on the Thailand-Malaysia border to avoid harmful interference. The coordination includes frequency planning and technical specifications for several services, such as mobile phone, television, and sound broadcasting.

What is spectrum allocation?

Spectrum allocation means giving specific frequency bands to radiocommunication services, i.e., for the purpose of frequency use, with both regional and global scope.

The allocation is presented in a so-called Table of Frequency Allocation (TFA), which shows the services that are allowed to be used by frequency band. The TFA is divided into three regions (Regions 1-3). The services can be either so-called primary or secondary. In the TFA, primary services are spelled out in capital letters while secondary services are in lower case. The reason for this division is to avoid harmful interference, with primary services always taking priority over secondary services by way of station (network and device) construction. This allocation is by WRC.

For example, the TFA of the RR2012, 472-479 kHz, is a global allocation to maritime mobile service on a primary basis, and amateur and aeronautical radionavigation services on a secondary basis. The 38.25-39 MHz band is allocated to fixed and mobile services in Region 1 on a primary basis. The 38.25-39.986 MHz band is allocated to fixed and mobile services in Region 2 on a primary basis. The 38.25-39.5 MHz band is allocated to fixed and mobile services in Region 3 on a primary basis. The 41.015-42 MHz band is allocated to fixed and mobile services on a global and primary basis.

What is spectrum allotment?

Spectrum allotment means designating specific frequency bands to at least one ITU Member State in a specified service (terrestrial or space). For example, Appendix 25 of the RR provides the allotment plan for coast radiotelephone stations in maritime mobile service between 4 000 kHz and 27 500 kHz (e.g., the 4 358.4 kHz band is allotted for South Africa, Australia, Chile, and Cuba). Appendix 30, Article 10 provides an allotment plan for broadcasting-satellite service in the 12.2-12.7 GHz band in Region 2, such as Beam SPMFRAN3 (channels 1, 5, 9, 13, and 17 are allotted to Germany, Denmark, Iceland, Norway, and Sweden).

What is spectrum assignment?

Spectrum assignment means giving a specific frequency band to users: providers, operators, or end-users. For example, the 897.5-915 and 942.5-960 MHz bands are assigned to Operator A for mobile service.

Spectrum assignment policy is limited to wireless or radiocommunication in a national territory. Each country has its own sovereignty. Spectrum assignment is a subset of spectrum management. Spectrum assignment is one of most important functions of spectrum management, beside other functions such as planning and regulation, financing, allocation and allotment, national liaison and consultation, international and regional cooperation, standards, specifications and equipment authorization, monitoring, and enforcement (ITU, 2005).

Spectrum management policy is a subset of telecommunications policy. Telecommunications policy includes technical, economic, and social aspects. It overlaps the natural sciences (technical) and social science (economics and society). Telecommunications policy often, but not always, deals with an institutional analysis. This is an analysis of an institutional arrangement or set of rules governing the number of decision-makers, allowable actions or strategies, authorized results, transformation from internal to decision situations, and linkages

between decision situations (Kiser & Ostrom, 1982). Telecommunications policy also includes economic analysis of, for example, the social value or value to private players of the spectrum. The regulator may impose conditions on spectrum to make it excludable, which in turn makes frequency use a specific right for a designated entity or person.

In the language of telecommunication planning, the regulator has the right to assign frequency to assignees. If the frequency is assigned to specific entities, i.e., individuals and legal persons, it is called licensed frequency, in short, licensed. The entities that obtain this assigned frequency are named licensees. If the frequency is not assigned to specific entities, in other words, assigned to the general public, it is called unlicensed frequency or, in short, unlicensed. A characteristic of licensees is that they have the exclusive right to use frequency. The unlicensed frequency does not carry this right however.

International relationship

Thailand became an ITU Member State in 1883 (formerly the International Telegraph Union and Siam). Thailand complied with the 1906 and 1912 International Telegraph Convention as its national regulation. Thailand's first Table of Frequency Allocation was brought into force in 1999 according to the RR1997. The Thailand's current Table of Frequency Allocation is the 2011 version according to the RR2008.

WRC is the forum for the decision-making process among Member States that reviews and revises the RR. The RR and WRC are administered by ITU. However, the ITU archives only contain the input and output documents of the WRC proceedings and the RR versions; they exclude the rationale underlying any such RR changes.

International differences

Member States have different income levels: High, Upper Middle, Lower Middle, and Low (World Bank income classification). This difference limits opportunities to participate in the ITU activities, including meetings and proposal preparation for the relevant conferences such as WRC (Hudson, 1997). As a consequence, the Member States that do not participate in the archival meetings may have a different understanding of the RR implementation.

Furthermore, Member States have different concerns and benefits with regard to the RR and ITU meetings. The concerns and benefits depend on their national interests and priorities. For example, manufacturing-based countries have concerns about global frequency allocations. They can produce and sell products globally. Conversely, the non-manufacturing-based or importing countries have concerns about standard compatibilities. They can use compatible standards with which interference is manageable.

The Member States' concerns and interests directly influence the WRC agenda items, including the number of delegates and relevant issues. For example, when issues directly connect to their benefit or interest, Member States might send several delegates to ensure outcomes that are favorable to them and protect their interest. On the other hand, when there is no issue on a specific agenda item, Member States might send a delegate to follow the argument or not attend such meetings.

ITU challenges

ITU administers WRC to revise the RR and facilitate the meetings. One concern for ITU is to balance the benefit between developed and developing Member States. Each Member State has a different background and concerns regarding the RR, in both regulatory and technical respects. The developed countries revise the RR to correspond with the rapid growth in technological development. Conversely, the developing countries might focus on technology and standard compatibilities due to the different technological adoption rates.

For example, in the maritime mobile service, a new technology, i.e., Global Maritime Distress and Safety System (GMDSS), is introduced by developed countries. Ships at sea are required to install GMDSS equipment under the Safety of Life at Sea (SOALS) Convention of the International Maritime Organization (IMO). Consequently, the relevant RR provisions must be revised for GMDSS, especially the deletion of Appendix 13 of the RR. Appendix 13 is about distress and safety communications, including the use of distress signals, calls, and messages when distress incidents happen at sea.

Conversely, in developing countries, there are many fishing boats (non-GMDSS vessels) that continue to use distress communication. The developing countries propose retaining the use of distress communication under the RR to safeguard their fishing boats. A compromise is therefore reached between Member States to keep the distress communication for non-GMDSS vessels and to implement GMDSS equipment for ships under the SOLAS Convention.

The other concern for ITU is the consequences of the rapid growth of technology necessitating changes in the ITU structure and RR provisions. In the beginning, ITU was in charge of the international telegraph and developed telecommunication, including wire and wireless technology, in both terrestrial and space services. Importantly, the RR was developed from a specific scope of regulation for maritime service and expanded to a general scope of regulation to govern several services.

Specific scope of regulation means that one regulation governs one application, technology, or service. Generic scope of regulation means that one regulation governs more than one application, technology, or service.

For example, in the space service, there are both generic and specific scopes of regulations, namely, unplanned and planned bands, respectively (Hudson, 1990, 1997). Unplanned bands originate from a first come, first served basis by the notification and coordination process to the Master of International Frequency Registration (MIFR) administered by ITU in order to provide satellite services, both domestic and international. Planned bands began after an unplanned plan to allot the frequency bands with an orbital slot for all Member States to have equal access to the resources for broadcasting-satellite service (BSS). However, coordination between these two schemes must be implemented in order to keep harmful interference manageable, not burden the development of satellite technology, and ensure equal access to the resources (a frequency and satellite orbit). Unplanned bands are supported by developed countries that have funding and technology to develop and operate satellite services. Planned

bands are supported by developing countries that seek support for funding and technology to deploy their domestic satellite services.

1.2 Motivation and problem

The motivation for this study originated from observing ITU members (Members States and Sector Members) using the RR as spectrum management guidelines to avoid interference between country transmission and reception.

Table 1 shows the ITU nomenclature used throughout the study. The "Term" column represents frequently used text used in the RR and mentioned in this study. The "Meaning" column provides a short definition of the relevant text.

Table 1. ITU nomenclature

Term	Meaning	Enforceability
Provisions	General term for all regulations in the RR, such as articles, appendices, WRC resolution and recommendation, ITU-R recommendation incorporated by reference	Binding/ Not binding
Final Act	Outcome of WRC containing the RR revisions	Binding
WRC resolution, e.g., Resolution xxx (WRC-xx)	Resolution approved by WRC	Binding
Resolution xxx (Rev. WRC-xx)	Resolution revised and approved by WRC	Binding
WRC recommendation, e.g., Recommendation xxx (WRC-xx)	Recommendation approved by WRC	Not binding
Recommendation xxx (Rev. WRC-xx)	Recommendation revised and approved by WRC	Not binding
ITU-R resolution	Resolution approved by the Radiocommunication Assembly (RA)	Not binding
ITU-R recommendation	Recommendation approved by the RA	Not binding
ITU-R recommendation incorporated by reference	Recommendation approved by the RA and adopted by WRC to be included in the RR	Binding
Recommendation ITU-R SM	ITU-R recommendation in spectrum management	Not binding
Recommendation ITU-R M	ITU-R recommendation in mobile, radiodeterminations, amateur, and related satellite services	Not binding
Recommendation ITU-R F	ITU-R recommendation in fixed service	Not binding
CPM report	Report prepared by the ITU-R study group for the Conference Preparatory Meeting (CPM) to be included as information for Member States to decide on at WRC	Not binding
ADD	Add or create new provisions	-
SUP	Delete the provisions	-
MOD	Modify, revise, or change the existing provisions	-
NOC	No change to the existing provisions	-

The "Enforceability" column represents the level of the RR implementation. "Binding" means that Member States must comply with this provision and that its implementation is

mandatory. “Not binding” means that Member States may implement this provision on a voluntary basis.

The RR2012 contains provisions that can be divided into four volumes, i.e., Volume 1 – Articles, Volume 2 – Appendices, Volume 3 – Resolutions and Recommendations, and Volume 4 – ITU-R Recommendations incorporated by reference.

Volume 1 – Articles contains nine chapters that include terminology and technical characteristics; frequencies; coordination, notification, and recording of frequency assignment and plan modifications; interferences; administrative provisions, provisions for services and stations; distress and safety communications; aeronautical services; and maritime services.

Volume 2 – Appendices provides 23 appendices, for example, Appendix 1 – Classification of emissions and necessary bandwidth, Appendix 9 – Report of an irregularity or infringement, and Appendix 18 – Table of transmitting frequencies in the VHF maritime mobile band.

Volume 3 – Resolutions and Recommendations comprises 148 resolutions and 23 recommendations, for example, Resolution 729 (Rev. WRC-07) – Use of frequency adaptive systems in the MF and HF bands, and Recommendation 7 (Rev. WRC-97) – Adoption of standard forms for ship station and ship earth station licences and aircraft station and aircraft earth station licences.

Volume 4 – ITU-R Recommendations incorporated by reference includes 38 recommendations, such as Recommendation ITU-R SM. 1138-1 – Determination of necessary bandwidths including examples for their calculation and associated examples for the designation of emissions, Recommendation ITU-R M.1583 – Interference calculations between non-geostationary mobile-satellite service or radionavigation-satellite service systems and radio astronomy telescope sites, and Recommendation ITU-R F.1613 – Operational and deployment requirements for fixed wireless access systems in the fixed service in Region 3 to ensure the protection of systems in the Earth exploration-satellite service (active) and the space research service (active) in the band 5 250-5 350 MHz.

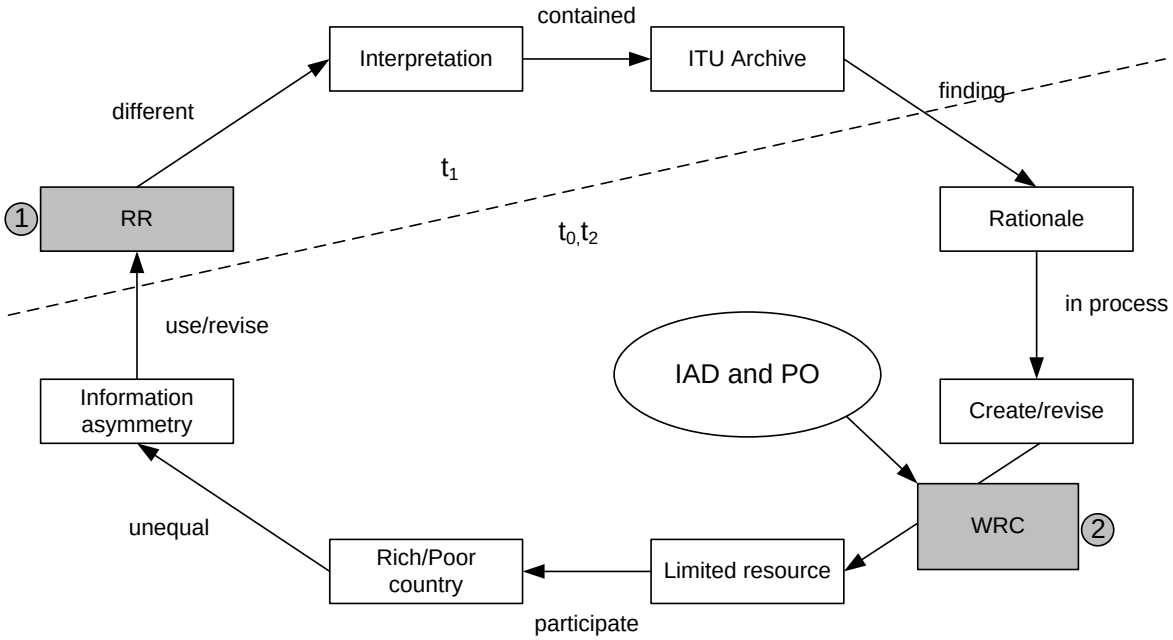


Figure 1. Overview of the RR processes

Figure 1 presents an overview of the main steps of the RR processes. The time t_1 represents when the RR becomes available in the ITU archives. The time t_0 represents when the RR is reviewed and revised during WRC. The time t_2 represents the next WRC.

In Figure 1, circle 1 denotes the starting point for the RR to be revised or implemented. Different actors: Member States and Sector Members have different interpretations of the reason for the RR changes or implementations, with some countries relying primarily on the ITU archives. The archives only provide the final input and output of the WRC proceedings or RR revisions and do not have the rationale of RR changes. The rationale for changing the RR is contained in the RR revision process at WRC (see circle 2). For this study, the institutional analysis and development (IAD) framework and participant observation (PO) are used to analyze WRC in order to capture the rationale behind it. However, since countries have varying resources in terms of participating in WRC, there is information asymmetry between attending and non-attending countries, or rich and poor countries. This information asymmetry influences the use and revision of the RR for the next round of RR revisions (circle 1).

The study uses the missing information and information asymmetry in the following:

When Member States or Sector Members implement the RR provisions, some of the provisions are not self-explanatory or have ambiguities. Such provisions need further interpretation. The interpretation varies and depends on who makes it. To understand the rationale of such provisions, further exploration of the ITU archives is required. However, the ITU archives only contain the final input and output documents of the WRC proceedings and RR versions. The rationale can be captured during the discussion at the relevant WRC. Only

attending Member States have this information, which is missing for non-attending Member States.

This missing information is not documented in the archives. Member States that use the ITU archives therefore have incomplete information, because the archives lack the rationale underlying the RR provisions, as it is left out. The study shares the view of incomplete information with institutional economics that, in the real world, the decision-maker has incomplete information, which imposes constraints on human interaction (North, 1992), such as buyers having incomplete information about the product compared with the information that sellers have. In the WRC context, Member States and Sector Members that only rely on the ITU archives have incomplete information regarding the missing information.

Consequently, the difference in availability of information between attending and non-attending Member States at the relevant meetings represents information asymmetry. The study shares the idea of information asymmetry with the principal-agent approach that the principal delegates responsibility for selecting and implementing an action to the agent (Thompson & McKee, 2011, p. 160). The level of understanding of information therefore differs between the principal and the agent and becomes information asymmetry. However, the study only applies the information asymmetry to the case between attending and non-attending Member States at the relevant meetings. Only the attending Member States have information on the underlying discussion and rationale.

At WRC, the Conference represents action situations for reviewing and revising the RR. The review is conducted through a formalized agenda with carefully numbered items. One agenda item may have several issues. Table 2 provides an overview of the main formal agenda items in this study for the WRC-2012.

Table 2. WRC-12 agenda items for this study

Agenda item	Detail
1.2	taking into account the ITU-R studies carried out in accordance with Resolution 951 (Rev. WRC-07), to take appropriate action with a view to enhancing the international regulatory framework
1.19	to consider regulatory measures and their relevance, in order to enable the introduction of software-defined radio and cognitive radio systems, based on the results of ITU-R studies, in accordance with Resolution 956 (WRC-07)
1.22	to examine the effect of emissions from short-range devices on radiocommunication services, in accordance with Resolution 953 (WRC-07)

Source Resolution 805 (WRC-07) – Agenda for the 2011 World Radiocommunication Conference adopted by the CC08 Resolution 1291 (MOD) – Place, dates and agenda of the World Radiocommunication Conference (WRC-12).

The reason why these agenda items are of interest because agenda items 1.19 and 1.22 study technologies and application regarding spectrum commons providing non-exclusive use of frequency. Spectrum commons increases the spectrum efficiency and flexibility of use. Moreover, agenda item 1.2 introduces the studies for convergence technologies between fixed

and mobile services, and fixed-satellite and mobile-satellite services allowing the RR responses to the rapid change of technology.

Selection from the IAD framework

The school of economic thinking shifts from classical to institutional: from commodities and individuals to transactions and working rules of collective actions. Its classical theories are a relation of man to nature, but institutional theories are a relation of man to man (Commons, 1931).

Commons (1931) also provides the definition of "institution" as collective actions in control, liberation, and expansion of individual actions. The individual actions are transactions instead of either individual behavior or the exchange of commodities (Commons, 1931, pp. 651-652). The transaction serves as the smallest unit of activity with its participants. The major activities are bargaining, managerial, and rationing transactions (Commons, 1931).

However, the early development of institutional economics or old institutional economics (OIE) provides imaginative insights, perceptive description, quantitative measurement, not a theory (North, 1992, p. 3). The new institutional economics (NIE) builds on the assumption of scarcity and competition and attempts to incorporate an institution into economics. In the real world, human beings have incomplete information and limited mental capacity to process information by imposing constraints on interaction with structural exchange. The information is costly and asymmetrical to exchange between parties. Institutions are formed to reduce uncertainty in human exchange (North, 1992).

Moreover, North (1992) provides the definition of institutions as the rules of the games of society or humanly devised constraints structuring human interaction. Furthermore, he defines the organization as the player or groups of individuals bounded by a common purpose to achieve objectives.

NIE has been developed in different areas, such as property rights economics, public choice, and the theory of the firm. The IAD framework has been developed by Ostrom and her colleagues at the workshop in political theory and policy analysis in order to understand the institution, especially the common-pool resources, which are part of the property rights economics. The IAD framework has been developed since 1982, providing the world of actions with a systematic approach to the decision-making process.

The IAD framework provides a systematic approach to the decision-making process in terms of exogenous and endogenous variables. The exogenous variables are bio/physical condition, attribute of community, and rules-in-use, representing the external parameter that influences the decision situation. Endogenous variables represent the connection between the action situation and the rules-in-use, and they are represented by seven rules: boundary, position, choice, information, payoff, aggregation, and scope.

Moreover, the interconnection between the world of actions or level of analysis and outcome: operational, collective-choice, constitutional, and metaconstitutional situations, is presented in the interaction between level and feedback as influencing the decision-making at the lower

level. The four levels of analysis and outcome by Ostrom are similar to the four levels of the economics of institutions by Williamson (2000). However, Williamson does not provide the detail of the action situation at each level.

The IAD framework enhances the understanding of the decision-making process in several fields, especially agriculture such as fishery, forestry, farming, water, and river basin. Table 3 shows some of the IAD literature on applications in the field. Most of them concentrate on common-pool resources, especially in the fishery field.

Table 3. IAD literature

Literature	**Introduction to the use of the IAD framework**	**Action situation**
Ho and Gao (2013)	Analyzing collective action problems in building management	4-housing
Chadsey, Trainer, and Leschine (2012)	Identifying key success factors of the Olympic Region Harmful Algal Bloom (ORHAB) partnership with harmful algal blooms (HABs)	4-marine
Fidelman et al. (2012)	Highlighting the diverse contextual factors that challenge the governance of large-scale marine commons, using the Coral Triangle Initiative as an example	4, (2)-marine
Ghorbani, Dignum, and Dijkema (2012)	Modeling agent-based systems based on the IAD framework (MAID: Modeling Agent-based systems based on Institutional Analysis)	Other-modeling
Mulazzani et al. (2012)	Describing the anchovy fisheries of Croatia and Italy, and France and Spain	4-fishery
Reiners (2012)	Examining how and why on-the-ground decisions and outcomes differ	4-wildfires/forest
Asquer (2011)	Analyzing the liberalization and regulatory reforms of network industries in Italy	Other-regulatory
Beitl (2011)	Examining the relationship between collective action and environment to sustainable mangrove fisheries in coastal Ecuador	4-fishery
Bushouse (2011)	Identifying six governance structures in the for-profit and nonprofit sectors for childcare service	1-club goods
Heikkila, Schlager, and Davis (2011)	Identifying the 14 interstate river basin systems and applying common-pool resource (CPR) design principles	4-water CPR management
Henry and Diet (2011)	Understanding the trust in variables-belief system and networks-influence trust	Other-trust
Li and Li (2011)	Analyzing the multifunctional agriculture (MFA) in Chongqing, China	4-agriculture
McGinnis (2011)	Providing a systematic approach to elaborating on a complex policy network with overlapping sets of actors influencing the rules of interactions in Maine lobster fisheries, international development assistance, and faith-based organizations for USA welfare policy	4-fishery Other-coordination, welfare
Mehring et al. (2011)	Structuring the forest management in Central Sulawesi, Indonesia, by considered rules, participants, and conservation outcomes	4-forest
Mokhtar, Torman, and Hossain (2010); Mokhtar et al. (2011); and Toriman et al. (2012)	Identifying institutional challenges associated with Integrated River Basin Management (IRBM) implementation in Langat River basin, Malaysia	4-water
Oakerson and Parks (2011)	Explaining local variations in public organizations as a function of the geo-physical diversity of localities in Yellowstone and Adirondack Park	4-forest
Thiele et al. (2011)	Understanding the multi-stakeholder platforms for potato-based value chains in Bolivia, Peru, and Ecuador	4-farmers

Literature	Introduction to the use of the IAD framework	Action situation
Wasike, Kahi, and Peters (2011)	Identifying the missing actor in action situations for animal-recording activities	4-animal farm
Akinola (2010)	Providing polycentric planning, self-governance, and adaptive development strategies to resolve the socio-economic and political crisis in the Niger Delta	2-public sphere
Hardy and Koontz (2010)	Evaluating the transaction costs and environmental, social, and policy outputs of two watersheds: urban and rural	4-water
Ostrom and Cox (2010)	Enabling a finer understanding of biodiversity loss, climate change, pollution, and natural resource degradation systems, and providing a basis for comparisons for policy prescriptions	2-environment
Andersson (2009)	Analyzing the contextual factors that affect the actors' motivation to engage in collaborative learning activities for SIDA	Other-collaboration
Coleman and Steed (2009)	Examining theoretical determinants of monitoring and sanctioning at local community level and external government agents from the International Forestry Resources and Institutions (IFRI) research program	4-forest
Dong et al. (2009)	Examining the effectiveness of institutional development at the local and national levels in mitigating the problems facing sustainable rangeland management in Nepal	4-rangelands
Hardy and Koontz (2009)	Illuminating how the operational rules produced by different types of partnerships result in outputs that impact three watershed management systems	4-water
Laing et al. (2009)	Understanding partnerships between protected area agencies and the tourism industry	Other-partnership success
Martinez (2009)	Identifying and examining the structure and relationships between the different actors involved in the tobacco control policies in health care organizations	2-tobacco policy in hospital
Schlager and Heikkila (2009)	Identifying the conditions under which interstate river compacts are likely to address conflict and solutions	4-water
Clement and Amezaga (2008)	Examining land use changes in Vietnam that national policy interfered with, with local factors leading to a complex course of decision-making and action	4-forest, land
Klass (2008)	Identifying the institutional roots of the crisis in Côte d'lvoire, and suggestions	Other
Yandle (2008)	Examining the development, strengths, and weaknesses of New Zealand's fisheries co-management, commercial stakeholder organizations (CSOs)	4-fishery
Blackstock and Carter (2007)	Providing sufficient incentives to make the transition from traditional science to sustainability science for the implementation of the Water Framework Directive (WFD)	4-water
Hill and Hupe (2006)	Illustrating the IAD framework assisting the English health and education policy analysis that are inter-related or nested	2-health
Imperial and Yandle (2005)	Examining competing institutional arrangements used to manage fisheries: bureaucracy, markets, community, and co-management to understand critical issues related to institutional analysis	4-fishery
Koontz (2005)	Examining collective decision-making related to natural resources for farmland preservation planning in Ohio, USA.	4-farmland
Flinkman (2004)	Evaluating the effectiveness and credibility of exchanges in the wood construction supply chain in Dar es Salaam and Mwanza	4-wood
Rudd (2004)	Facilitating critical examinations of important cross-cutting issues by a modified IAD framework providing a platform for ecosystem-based fisheries management policy, experiment, design, and monitoring	4-fishery
Sobeck (2003)	Examining an early stage of policy development emphasizing group membership and participation	Other-collaboration

Literature	Introduction to the use of the IAD framework	Action situation
Leach and Pelkey (2001)	Reviewing the conflict resolution in watershed partnerships on collaborative resource management	4-water
Sekher (2001)	Analyzing the process of organized participatory resource management in community forestry practices in India	4-forest
Carlsson (2000)	Incorporating the policy network approach to an analytical framework, e.g., the IAD framework	Other-analytical framework
Imprerial (1999a)	Examining the structure and performance of the institutional arrangement used to implement the Salt Ponds, a special area management (SAM) plan, Rhode Island	4-ecosystem-based management
Imperial(1999b)	Understanding the institutional arrangement used to implement an ecosystem-based management program	4-natural resource management
Piipponen (1999)	Examining the institutional setting for the forest sector in the Republic of Karelia, Russia	4-forest

Note: 1: Buyers and sellers exchanging goods (services) in a market
2: Legislators making legislative decisions about future laws
3: Powerful politicians bargaining over the allocation of public support
4: Users of a common-pool resource withdrawing resource units (such as fish, water, or timber)
5: Heads of state negotiating an international treaty
Other: excluded from five categories

WRC as an action situation represents the negotiation of RR revisions as an international treaty. Ostrom (2005b) pointed out that this action situation can be described and analyzed using a common set of variables, that is, the variables of an action situation inside the IAD framework. However, Ostrom did not provide the IAD application on a negotiation of an international treaty.

The author is familiar with the IAD framework from the previous work to understand the bundle rights of frequency use on frequency assignment approaches: command-and-control, market-based, and spectrum commons (Ard-paru, 2010). The element of the IAD framework helps in understanding the different bundles of rights for frequency use in each frequency assignment approach at the operational and collective-choice level.

It is a challenge to the author to apply the IAD framework at the constitutional level where the regulations or rules for collective-choice and operational level are revised. In the field of spectrum management, WRC is the forum for international negotiations of the RR revisions as the action situation at the constitutional level. At WRC, the dynamic situation of international negotiations between Member States can be analyzed and described systematically by the element of the IAD framework. The discussion at WRC contains the rationale of the RR revisions that is missing from the ITU archives. The IAD framework therefore allows the limitation of the ITU archives and meeting observation to be identified. This IAD framework applicability to WRC as the international negotiation is the original work of the author.

To conclude, the study selects the IAD framework, because the IAD framework has the ability to systematize the action situation and explain the dynamic situation of the decision-making process at WRC as the international negotiations. This study also contributes to the

first application of the IAD framework in the context of WRC as the international negotiations or an action situation.

Furthermore, in order to understand the rationale behind such discussions, the IAD framework provides a list of questions that should be asked during the decision-making process (WRC). However, the IAD framework does not provide the content or a detailed discussion. Participant observation (PO) or attending such relevant meetings captures the argument that represents the rationale behind it. This information is only available for attending the delegation and is never documented. This missing information from the ITU archives becomes crucial when the particular revision of the RR is not finished at the relevant WRC. The missing information then becomes critical input to influence the decision-making process at the next WRC, since the archives are incomplete. The attending Member States benefit from the information gathered by participant observations. This information enables them to develop further arguments or options during WRC or fully develop contributions for the next or future WRCs.

At WRC, Member States also have their own priority for each WRC agenda item, depending on their national interests. There are many meeting forms running in parallel after the plenary session. Member States that have limited resources (number of delegations, time, and budget) cannot attend all meetings.

The number of delegates among the Member States shows the gap between High, Upper Middle, Lower Middle, and Low Income countries. Moreover, the number of delegates illustrates the unequal access to the WRC meetings as information asymmetry. This number of delegates highlights the information asymmetry between them. It is highly likely that the High and Upper Middle Income countries, which have more delegates, will allow full (or almost full) participation at all relevant meetings, compared with the Lower Middle and Low Income countries. The study attempts to fill in the missing information as a contribution. A detailed discussion follows.

Problem with RR interpretation

Member States must understand the RR in order to operate national and international markets under the constraints of the provisions. Occasionally, when implementing RR provisions, the ambiguity of text can cause interpretation problems among Member States.

For instance, the text considering b) and c) of Resolution ITU-R 58 – Studies on the implementation and use of cognitive radio system (CRS) is the issue in Agenda Item 1.19 of the WRC-12. [1,2,3] The text is as follows:

“b) that studies on regulatory measures related to the implementation of CRS are outside the scope of this ITU-R Resolution;

[1] The Resolution ITU-R 58 is approved by the Radiocommunication Assembly (RA) to facilitate further studies on CRS implementation.
[2] The CRS is an enabling technology allowing the operating parameters to be changed automatically by software to obtain knowledge from the environment and improve performance.
[3] The ITU-R resolution is the resolution adopted by the RA. The RA is convened prior to WRC. The RA also approves recommendations and reports from the ITU-R study group (SG).

"c) that any radio system implementing CRS technology needs to operate in accordance with provisions of the Radio Regulations;"

The issue of WRC-12 Agenda Item 1.19 is whether regulatory measures are outside the scope of Resolution ITU-R 58. Some Member States interpret the above provisions as a need to have regulation in place. Another interpretation is that there is no need to have an additional regulation as "c)" already indicated that CRS technology should be operated under the relevant RR provisions.

Generally, when there is a problem of interpretation, Member States submit requests for an official interpretation to the Radiocommunication Bureau (BR) for clarification. The BR prepares relevant documents for submission to the Radio Regulations Board (RRB) for approval. After the RRB ruling, the resulting interpretation is published as the Rules of Procedure.[4]

To understand the RR provisions, the rationale of the provisions is required. Unfortunately, the rationale for RR provisions is not clearly stated in the RR. Member States must search relevant documents in the ITU archives. The WRC proceedings are also available in the ITU archives for this purpose.

To understand how and why such changes to the RR occurred, this study explored the ITU archives, as the RR development is contained in them.

ITU archives

The ITU archives contain the input and output documents of the WRC proceedings in the form of the RR revisions. However, the archives do not contain the rationale of the decision. The WRC proceedings only contain input documents (written documents from Member States) and output documents (RR revisions). The WRC proceedings also include only minutes of plenary meetings, not all meetings containing the rationale of RR revision. Verbal comments made during WRC meetings are not documented and discussions outside the meetings are completely unrecorded. Such argumentations contain the underlying rationale for RR revisions. Importantly, only participating Member States have this information, which is missing from the archives.

RR revisions

When there are new radio technologies, applications, and services, Member States may need to change the RR provisions to accommodate them. Moreover, any RR ambiguity should be corrected, and new national and regional concerns about the RR provisions addressed. These requirements necessitate RR revisions, which are performed during WRCs every three to four years, an important process for international and domestic policies concerning spectrum management.

[4] See Chapter 4 for details on the ITU structure development.

In order to review and revise the RR, the WRC agenda must be prepared four to six years in advance and approved by the Council (CC) according to the ITU Convention.[5]

Underlying issues of RR revisions

The underlying issues of RR revisions are conflict between existing services or current users and new technologies, applications, and services. Existing services and current users are normally always aware of the introduction of new services, technologies, or applications when they share (use the same or adjacent) frequencies. The main concern is the risk of interference to their existing users. When the new WRC agenda items propose a new or additional allocation for new services in the TFA, the issues of possible interference with the existing service and compatibility studies for sharing the same frequency are raised by the existing service to ensure that the new allocation does not cause harmful interference to existing users. Some examples of conflicts between existing services and new technologies follow:

(1) At the WRC-03, there was conflict between GMDSS and non-GMDSS vessels (Agenda Item 1.14). GMDSS is the new technology to replace the old technology for distress communication in the 2 182 kHz band. The non-GMDSS vessels, such as small local fishing boats in the developing countries, insisted on retaining the use of the 2 182 kHz band. Member States compromised by revising WRC Resolution 331 for non-GMDSS vessels for distress communication.

(2) At the WRC-03, there was conflict between ARS, amateur-satellite (ARSS), and broadcasting service (BS) in the 7 MHz band (Agenda Item 1.23). The conflict was about a global reallocation of ARS in the 7 MHz band. This conflict occurred after the World Administrative Radio Conference 1992 (WARC-92). Member States compromised by removing BS in Region 1 and Region 3 in the 7 100-7 200 kHz band and adding the new ARS global allocation in the 7 100-7 200 kHz band.

(3) At the WRC-12, there was conflict between existing services and the new applications or technologies addressed in Agenda 1.2 on whether the current RR has any flexibility to govern the rapid development of technology. This issue has been ongoing since the WRC-03 (Louis, 2011). However, the outcome of the WRC-12 on this issue needs further study on reviewing the definitions of fixed service, fixed station, and mobile station (during the WRC-15 study period) and further action will be taken at the WRC-15.

(4) At the WRC-12, there was conflict between maritime mobile service (MMS) and amateur service (ARS) for a frequency allocation in the 495-505 kHz band (Agenda Items 1.10 and 1.23).[6]

The proposal for MMS was for a primary allocation in the 495-505 kHz band on a global basis. However, the proposal for ARS was for a secondary global allocation of a 15 kHz

[5] See Chapters 4 and 3 for details on the ITU structure development and the WRC preparatory process.

[6] Council Resolution 1291 (MOD), Place, dates, and agenda of the World Radiocommunication Conference (WRC-12), provides Agenda Items 1.10 and 1.23 as follows:
1.10 to examine the frequency allocation requirements with regard to operation of safety systems for ships and ports and associated regulatory provisions, in accordance with Resolution 357 (WRC-07); and
1.23 to consider an allocation of about 15 kHz in parts of the band 415-526.5 kHz to the amateur service on a secondary basis, taking into account the need to protect existing services.

bandwidth. The original proposal was to allocate ARS in the 415-526.5 kHz band. During the discussion, the proposal was reduced to the 495-510 kHz band (The National Association of Amateur Radio, 2012).

The conflict between the MMS and ARS proposals was in the 495-505 kHz and 495-510 kHz bands. During the Member State discussion, a compromise was reached, i.e., MMS was given a global allocation in the 495-505 kHz band on a primary basis and ARS an allocation in the 472-479 kHz band on a secondary basis.

(5) WRC-12 Agenda Item 1.22 is about the use of short-range devices (SRD), especially Radio Frequency Identification (RFID) devices, in the extended C-band that may interfere with satellite receivers. The existing satellite operator conducted the studies and found that RFID devices caused harmful interference to its satellite receivers. Consequently, the satellite operators proposed recognizing the use of SRD in the satellite bands as an option for WRC Agenda Item 1.22, in order to make a clear discussion and decision regarding the SRD, in the view of the potential harmful interference.

Harmful interference from SRD also raised concerns from international organizations: the International Civil Aviation Organization (ICAO), International Maritime Organization (IMO), and World Meteorological Organization (WMO). They expressed their objections to sharing frequency with SRDs within their current frequency bands.

Form of RR revisions

The form of the RR revisions represents the scope of the RR provisions to be applied to a particular area: application, technology, or service, namely, a specific regulation, or to be applied to a broad or more than one area, namely, a generic regulation.

The specific and generic regulations are similar to the posterior and priori approaches explained by Codding and Rutkowski (1982). The posterior approach uses a case-by-case method that relies on coordination between interested parties or on a notice and recordation procedure (Codding & Rutkowski, 1982, p. 252). The posterior approach is likely to be a first-come, first-served method to allocate the right to use radio resources. Compared with this study, the generic regulation is similar to a posterior approach.

The priori approach is a principled approach, usually relying on a negotiated plan based on a general formula or criteria for seeking equity among all the parties (Codding & Rutkowski, 1982, p. 252). Compared with this study, the specific regulation is similar to a priori approach.

Examples of posterior and priori approaches include unplanned and planned bands for orbital satellite filling, respectively. The posterior approach uses existing rules to register the use of satellite orbits and frequencies at the MIFR. The registration record helps to notify and coordinate interested parties administered by the BR on a case-by-case basis. The existing rules are applied as a generic regulation. The posterior approach has greater flexibility to capture the rapid change of telecommunication technology than a priori approach (Codding & Rutkowski, 1982).

Conversely, the priori approach provides equality to access the satellite orbit and frequency with an allotment for each Member State, such as the BSS planned band. However, the detailed specifications and inflexible constraints unnecessarily impede the implementation of new technology (Codding & Rutkowski, 1982, p. 253). The priori approach provides a specific regulation by service.

In 1906, the RR was part of the Berlin Convention (International Radiotelegaph Convention). The Convention was regulated only by communication between the ship and coast stations in MMS. However, over time, the development of radiocommunication technology necessitated additional services. The Berlin Convention had to expand its scope to cover additional services, such as definitions for stations and services. The mix between a generic and specific regulation was unavoidable. Some additional examples of the regulation form follow:

(1) The RR2012 contains both generic and specific regulations. The generic regulation governs more than one service. The specific regulation provides practical guidelines for such technologies or applications, within either a specified frequency band or service. For example, Article 1 of the RR provides terms and definitions that can be used for all services. Article 5 of the RR provides the TFA by frequency band. The TFA specifies the services in each frequency band with footnotes (containing the specific constraint of use).

(2) In WRC-12 Agenda Item 1.19, the issue of CRS and SDR technologies raised the question of the form of the regulation. Some Member States viewed the current RR as allowing the use of these two technologies to be governed and that there was therefore no need to have a specific regulation (WRC resolution). Some Member States argued that the current RR did not provide a practical guidance when there was harmful interference. Thus, a specific regulation was required to provide Member States with practical guidelines.

Member States that consider the current RR to be sufficient to govern the SDR and CRS technologies are concerned about specific practical guidelines for new technologies. If WRC agrees with the specific guidelines for new technologies, every new technology will need to have its own guidelines or regulations in the future. There would then be many specific regulations in the future.

The debate was settled by a compromise between the Member States, and the WRC recommendation to encourage Member States to participate in the further CRS study and decision on regulatory matters, if necessary, will be taken at the WRC-15.

Limitations of the ITU archives

The ITU archives provide official but incomplete documentation on the RR and WRC proceedings. Member States that do not attend WRC meetings must rely on the ITU archives as their primary information source. The following examples demonstrate the limitations of the ITU archives.

The definition of “telecommunication” has developed over time. The ITU archives capture changes in meanings via the RR versions, i.e., 1932, 1947, and 1982. The ITU archives also capture changes from the codified input documents submitted by the Member States, however, non-codified verbal comments are not recorded. The rationale as to why changes

have occurred is therefore not documented. This "missing" information would be valuable if changes to the "telecommunication" definition are proposed at future WRCs.

Another crucial construct is the notion of frequency band. Frequency bands for MMS were first allocated in 1927. The first frequency band was 125-150 kHz. However, at the International Radiotelegraph Conference in Atlantic City in 1947, this band was terminated. The ITU archives are mute on the reason for this decision.

The study covers the development of selected RR provisions and frequency bands for specified services by identifying differences across the RRs, but the archives only contain the output documents, i.e., how and what they change.

Relevance and limitations of the IAD framework

The IAD framework is a valuable tool as it guides identification of the likely form of any missing information. The output obtained by applying the IAD framework to a decision-making process is the list of issues that would have been addressed during the meetings as an institutional arrangement. The missing information would vary by the WRC meeting forms. The IAD framework proposes a general form for missing information by posing the questions: What issues are debated?; Who raised the issues?; Who starts, who supports, who opposes the issues (position rules)?; How do issues flow inside meetings (information rules)?; How do Member States control their stances (aggregation rules)?; What are Member States' stances (support, oppose, neutral) (choice rules)?; What are the costs and benefits of choice (evaluative criteria and payoff rules)?; and What are the consequences of individual choice (outcome and scope rules)?

Clearly, the IAD approach only provides the questions, not their detailed content. Importantly, the detailed content varies with the form of the meetings, while the issues are case specific. To obtain details of the negotiations, participant observations by attending meetings are required.

Limitations of participant observations

Potentially, participant observation or attending meetings could provide the information missing from the archives. However, such information can only be provided for current situations.

At the WRC meetings, the number of delegates varies by the agenda item. Moreover, there are many meeting forms[7] (plenary, committee [COM], working group [WG], sub-working group [SWG], informal group [IG], and drafting group [DG]). To be specific, the maximum number of parallel sessions at the WRC-12 is twelve. However, as there are 32 agenda items for the WRC-12, this would require a delegation of 32 persons to allow full coverage of all the WRC meetings.

[7] The various meeting forms will be further explained in Chapter 2.

Table 4 lists the delegates attending the WRC-12, grouped by the World Bank income classification. Table 4 also indicates that Low Income countries have fewer delegates and therefore depend more on archived material for their future decision-making on issues that continue to the next WRC.

Table 4. WRC-12, national delegates by World Bank income classification

High	No.	Upper Middle	No.	Lower Middle	No.	Low	No.
Andorra	2	Albania	9	Angola	18	Afghanistan	5
Australia	38	Algeria	47	Armenia	9	Bangladesh	6
Austria	10	Argentina	18	Bhutan	2	Benin	13
Bahrain	4	Azerbaijan	5	Cameroon	18	Burkina Faso	7
Barbados	3	Belarus	22	Congo, Rep.	6	Burundi	4
Belgium	6	Bosnia and Herzegovina	15	Côte d'Ivoire	29	Cambodia	1
Brunei Darussalam	4	Botswana	9	Djibouti	9	Central African Rep.	4
Canada	43	Brazil	29	Egypt	11	Chad	14
Croatia	9	Bulgaria	16	El Salvador	6	Congo, Dem. Rep.	9
Cyprus	9	Chile	7	Georgia	2	Gambia, The	6
Czech Republic	9	China	116	Ghana	22	Guinea	9
Denmark	9	Colombia	21	Guatemala	3	Guinea-Bissau	2
Estonia	6	Costa Rica	14	Guyana	1	Haiti	1
Finland	16	Cuba	9	Honduras	5	Kenya	17
France	103	Dominican Rep.	4	India	36	Korea, Dem. Rep.	4
Germany	45	Ecuador	7	Indonesia	55	Kyrgyz Rep.	4
Greece	19	Gabon	11	Iraq	13	Liberia	2
Hungary	13	Grenada	1	Lao PDR	4	Madagascar	8
Iceland	2	Iran, Islamic Rep.	41	Lesotho	5	Malawi	4
Ireland	6	Jamaica	6	Mauritania	5	Mali	11
Israel	20	Jordan	9	Moldova	9	Mozambique	12
Italy	52	Kazakhstan	15	Mongolia	7	Myanmar	7
Japan	71	Latvia	11	Morocco	22	Niger	6
Korea, Rep.	60	Lebanon	12	Nicaragua	1	Rwanda	9
Kuwait	14	Libya	19	Nigeria	68	Sierra Leone	6
Liechtenstein	4	Lithuania	12	Pakistan	21	Somalia	1
Luxembourg	14	Macedonia, FYR	9	PNG	11	Tajikistan	2
Malta	3	Malaysia	30	Paraguay	13	Tanzania	14
Monaco	6	Mauritius	7	Philippines	8	Togo	14
Netherlands	19	Mexico	31	Senegal	16	Uganda	14
New Zealand	7	Montenegro	9	South Sudan	3	Zimbabwe	13
Norway	12	Namibia	12	Sri Lanka	9		
Oman	23	Panama	4	Sudan	15		
Poland	24	Romania	28	Swaziland	3		
Portugal	7	Russian Fed.	74	Syrian Rep.	7		
Qatar	13	Serbia	13	Ukraine	43		
San Marino	2	South Africa	35	Uzbekistan	7		
Saudi Arabia	51	Suriname	3	Vietnam	19		
Singapore	13	Thailand	22	Yemen, Rep.	3		
Slovak Rep.	11	Tunisia	16	Zambia	8		
Slovenia	9	Turkey	84				
Spain	36	Uruguay	7				
Sweden	27	Venezuela, RB	8				
Switzerland	11						
Trinidad and Tobago	7						
UAE	48						
United Kingdom	50						
United States	138						
Mean	**23.08**		**20.4**		**13.8**		**7.39**

Information asymmetry thus exists between High Income and Upper Middle Income countries, which have enough delegates attending all (or most) meetings, and Lower Middle Income and Low Income countries.

Event timeline

Table 5 presents the RR provision implementation at times t_0 and t_1. WRC is held at t_0. t_1 is the time when the archives are "completed."

Table 5. Timeline of RR provisions implementation

Provisions	**WRC at t_0 (past)**	**Archives at t_1 (current time)**
No ambiguous text	Not attending	Self-contained
	PO	No additional information
With ambiguous text	Not attending	Not self-contained and rationale is needed
	PO	Additional rationale apart from archives

When Member States implement the RR provisions, these provisions are understandable within the RR itself (no ambiguous text). The RR, as part of the ITU archives, is then self-contained. Attendance of the relevant WRCs or participant observations (PO) are therefore not necessary. In other words, meeting attendance does not provide additional information other than the archives.

Conversely, when such provisions contain ambiguous text, interpretations of the texts will vary between Member States. Further exploration of the ITU archives is then required to obtain the underlying rationales. Unfortunately, the ITU archives do not document such rationales. Participation in the relevant WRCs is therefore crucial to understanding such provisions. Only attending Member States have the information that is behind such provisions. Consequently, the ambiguous text may render issues for the RR revisions.

The possibilities for the RR revisions are represented by the WRC agenda items. Each agenda item contains at least one issue. For example, WRC-12 Agenda Item 1.19 contains two issues: software-defined radio (SDR) and CRS.

Table 6 shows the timeline of WRC issues. WRC is held at t_0. t_1 is the time when the archives are "completed." t_2 is the time when the next WRC meeting will be held.

Table 6. Timeline of WRC issues

Issues	**WRC at t_0 (past)**	**Archives at t_1 (current time)**	**Next WRC at t_2 (future)**
Settled	Not attending	Self-contained	No issues carried forward
	PO	No additional information	
Ongoing	Not attending	Lack rationale	Issues brought forward
	PO	Provide rationale	

At WRC, when the WRC agenda items have been solved or settled, the Final Act is the output of the discussions contained in the ITU archives as the WRC proceedings. In other words, the issues have been settled during the Member State negotiations at WRC. Only resolved issues move forward for approval as possible RR revisions. Other information, including the discussion of issues during the debates, is lost. The Final Act only contains the discussion settlement, not the details of the discussion of such issues. Non-attending Member States will

be better off because the issues are settled and no remaining issues are carried forward to the next WRC.

Conversely, when the issues are controversial or debatable and cannot be settled in that WRC, they are carried forward to the next WRC for further consideration. Only Member States attending the relevant WRC meetings will then have a clear understanding of these issues. The discussion is not documented anywhere. Unfortunately, Member States not attending the meetings will not know the rationale behind these issues, which is crucial information to develop further argumentation.

To sum up, in cases without ambiguous text or settled issues, participation in the meeting does not provide non-attending Member States with any additional information. The archives are therefore self-contained, providing an understanding of the RR provisions and settled issues as RR revisions.

However, in the case of RR with ambiguous text, the archives are not self-contained, because they lack the rationale behind the provisions. Only attending Member States will have this information to complement the archives. This information provides the full understanding of these ambiguous texts.

In the case of ongoing issues, the archives are not self-contained and, as such, do not provide an understanding of the rationale behind the issues. It is therefore vital for the Member State to attend the relevant meetings to capture these arguments, as they provide a strong basis on which the attending Member State can develop further documents for the next WRC or relevant meetings.

Incomplete information

Member States that only rely on the ITU archives have incomplete information, because the ITU archives do not document the rationale or missing information. Only Member States that attend the relevant meetings have this information. There is therefore information asymmetry between attending and non-attending Member States.

The following example demonstrates the practical importance of “missing” archive information to a developing country.

Thailand is an Upper Middle Income country (see Table 4) that sent 22 delegates to the WRC-12. However, only six delegates attended for the entire period of the WRC-12 (four weeks). Each delegate was required to contribute to several agenda items. The maximum number of parallel meetings at the WRC-12 was twelve. It was therefore impossible for the Thai delegates to attend all the meetings. Each delegate prioritized his/her agenda items and meetings. When issues outside the scope of the agenda continued to the next or future WRCs, Thailand did not have a strong basis on which to develop further argumentation. Moreover, if the issues are part of the RR provisions, Thailand has limited understanding of the provisions because of the missing information.

Does the missing information matter?

The missing information matters to Member States that would benefit from it. Not all Member States give WRC agenda items the same priority. Missing information from an agenda item may be valuable to some Member States and not to others.

The priority of WRC agenda items varies by country and depends on the benefit to the country. For example, countries that have a manufacturing, standard setting, or research and development base benefit from a global allocation of services. However, countries that only import radiocommunication equipment benefit from standard compatibility. They therefore have a choice of many compatible standards.

For example, for WRC-07 Agenda Item 1.14 regarding GMDSS, Thailand has many small fishing boats that are non-GMDSS vessels. The local fishermen cannot afford GMDSS equipment but still use the 2 182 kHz for distress communication. This evidence as background information renders concerns about this agenda item. Thailand must therefore protect its interest (local fishermen) by supporting the retention of the 2 182 kHz for non-GMDSS vessels for distress communication in WRC Resolution 331.

For WRC-12 Agenda Item 1.22 regarding the emission of SRD, Thailand has an existing satellite service with potential interference from SRD emissions to satellite receivers. Thailand must therefore protect its existing satellite service. Thailand submitted a proposal to the APG2012-4, indicating that the satellite receiver needed protection criteria from SRD emissions (Method C or D). However, at the APG2012-5, the satellite operator changed its views and did not submit Thailand's proposal further. Only a verbal statement in a drafting group mentioned that Thailand retained its previous position. The result of the APG2012-5 was a compromise with APT member countries that preferred to modify the existing ITU-R resolution to study harmonization of SRD further with adequate constraints to ensure there was no harmful interference to existing services.

For WRC-12 Agenda Item 1.2 regarding the enhancement of the international regulatory framework for fixed and mobile convergence, Thailand did not have a delegate to attend at drafting group level, as this may not have had any effect on Thailand at the end of the WRC-12. Thailand therefore lacked argumentation on the possibilities of changing the definitions of "fixed service" (FS), "fixed station," and "mobile station." Unfortunately, this issue will continue to the next WRC-15, and it may raise the impact on the existing fixed and mobile services, because they are the main services in Thailand. Thailand must therefore prepare itself by following the activities on this matter and evaluate the current situation on whether the change will be made at the WRC-15 or a Thai reservation as a country footnote will be necessary.[8]

The following example illustrates the importance of missing information on WRC-12 Agenda Item 1.2 to Thailand.

[8] The use and role of footnotes will be further explained in Chapter 2.

Agenda Item 1.2 concerns, in particular, the technological convergence of FS and mobile service (MS), and fixed-satellite service (FSS) and mobile-satellite service (MSS).[9] While there is general acceptance that the technology is converging, technological convergence allows the merger between FS and MS, allowing FS and MS to share the same frequency. One service can have at least one application. An example of an FS application is a microwave link between point-to-point and point-to-multipoint. Examples of MS applications include mobile phones, trunk radios, and walkie-talkies (push to talk). The implication of technological convergence for the implementation of the RR is whether the current RR will be able to govern the convergence or will need to be reviewed and revised.

Two main approaches were captured from the CPM report to revise the RR in terms of the scope of the RR implementation, namely: (1) specific scope and (2) general scope.

The specific scope is to implement the RR in a limited way, i.e., a particular service or application. The goal is to have a specific regulation for a service, such as a resolution or footnotes. In this case, the specific regulation is for fixed and mobile convergence service.

The general scope is to implement the RR over several services. In this case, the general scope approach is for the possibility of convergence between FSS and MSS, but the consequences apply to all allocations of frequency bands of the TFA.

The specific scope was proposed by the ITU-R study group (SG) that studied FS and MS (terrestrial service) convergence. The study proposed four options: (1) no change being made to the RR; (2) modifying the FS, fixed, mobile, and land station definitions contained in Article 1 and modifying Appendix 4; (3) modifying the FS and fixed station definitions, and modifying Article 11 and Appendix 4; or (4) modifying Appendix 4.

Alternatively, the general scope was to study FSS and MSS (space service) convergence. This study proposed two options: (1) no change being made to the RR and (2) adding FSS and MSS to the WRC resolution (Principle Allocation of Frequency Bands).

The Member States made some 25 submissions on Agenda Item 1.2 at the WRC-12, while Sector Members submitted 7 documents. The WRC-12 outcomes are contained in the Final Act: WRC Resolution 957 [PLEN/1] (WRC-12) – Studies Towards Review of the Definition of Fixed Service, Fixed Station and Mobile Station. Another WRC-12 output concerning this agenda item is the modified WRC Recommendation 34 – Principle for the Allocation of Frequency Bands. Figure 2 shows the Agenda Item 1.2 meetings and the document flow.

[9] Council Resolution 1291 (MOD), Place, dates and agenda of the World Radiocommunication Conference (WRC-12), provides Agenda item 1.2 as follows:
1.2 taking into account the ITU-R studies carried out in accordance with Resolution 951 (Rev.WRC-07), to take appropriate action with a view to enhancing the international regulatory framework.

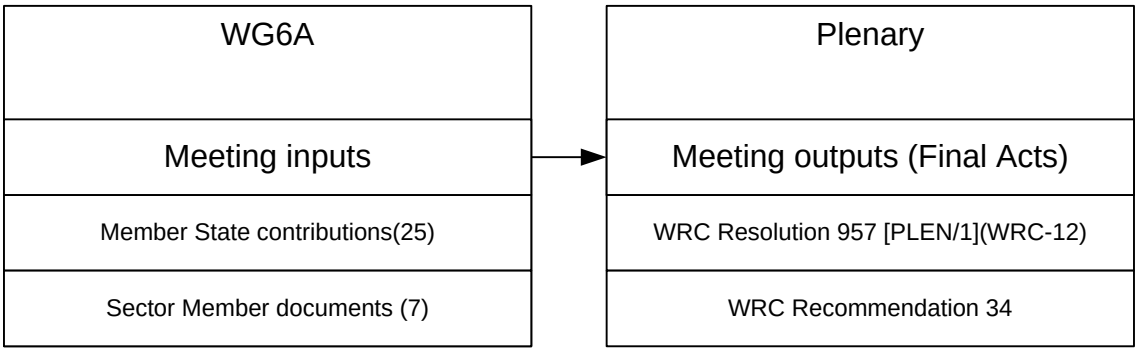


Figure 2. Agenda Item 1.2 meetings and document flow

The input (CPM report and submissions by Member States and Sector Members) and output documents (the Final Act) of WRC are contained in the ITU archives. However, the development of issues from four proposed options of the CPM report (FS and MS) to the WRC resolution and from two options (FSS and MSS) to the WRC recommendation are not documented in the archives. Only Member States that attended the meetings have knowledge of how and why the change occurred. Thailand did not have enough delegates to be able to attend the SWG and IG on Agenda Item 1.2. The ongoing Agenda Item 1.2 argumentation is therefore not available for Thailand to consider when developing further proposals on the matter.

WRC Recommendation 34, as a WRC-12 outcome in the form of an implementation guideline, is not mandatory for Thailand to implement because it is not binding. The recommendation suggests that a service allocation be a broadly defined service, provide on a global basis, require minimum footnotes, and take into account the relevant CPM report, and ITU-R recommendations and reports.[10]

However, WRC Resolution 957 mandates further study of the FS, fixed station, and mobile station definitions. Should the new definitions merge FS and MS into a single service, other provisions such as notification and coordination will need to be revised. This potential revision is important to Thailand because FS and MS are the two most allocated services in terms of the number of frequency bands used and the volume of their bandwidths. The majority of radiocommunication usage in Thailand is FS and MS applications. For example, FS and MS are used to provide a fixed microwave link and mobile phone. In terms of subscriber numbers and transmission, these are the dominating services in Thailand.

The ITU-R SG will study the possibility of modifications to the FS, fixed station, and mobile station definitions. The results of the study will be reported as information to Member States to make further decisions at the WRC-15.

Importantly, the change in these definitions, especially the merger between FS and MS, may influence a (almost entirely) national telecommunications regulation review. It includes a global as well as Thai TFA, FS and MS regulations, National Frequency Master Plan, frequency assignment scheme and criteria, licensing conditions, national law

[10] Footnotes inside the TFA can represent the different categories of additional or alternative allocation apart from the TFA. Moreover, Member States can use the footnotes to reserve their rights to use different services or not comply with such provisions.

(radiocommunication, telecommunication and broadcasting), station technical characteristics, and the notification and coordination process (national and international).

For example, when the modification of the definitions for FS, fixed station, and mobile station allows the merger between FS and MS (allowing the FS and MS to use the same frequency), the entire TFA must be reviewed and revised by the relevant frequency bands with priority. For example, MS can operate in the frequency bands that have FS allocation. The TFA must review and make the required changes for FS and MS convergence.

Furthermore, irrespective of the band allocation, a compatibility study must be conducted to ensure there is no harmful interference between the existing FS and MS, and new services. Moreover, the existing notification and coordination record must be reviewed to accommodate the RR revisions.

In the border area, Thailand and its neighboring countries have set up the JTC to coordinate the use of frequencies, e.g., mobile phone and broadcasting service. The JTC helps to set up the channel allocation plan and relieve harmful interference across the border.

Consequently, the existing FS and MS registry of station characteristics must be reviewed for the FS and MS convergence, especially stations that require international recognition (such as stations located on the country border). The JTC Thailand-Laos, Thailand-Cambodia, and Thailand-Malaysia must review the notification procedures.

The review of the FS, fixed station, and mobile station definitions is continuing during the WRC-15 study period. The goal is to allow convergence between FS and MS under the definition revisions. This review of definitions provides Thailand with a forum in which to develop proposals to protect its national interests. The possible merging of FS and MS, in particular, requires a sufficient period to allow existing services to gradually migrate to fixed and mobile convergence services, where appropriate. In the RR, a worst case scenario is that Member States reserve the right to use different services, apart from the services indicated in the TFA, by adding a country footnote. In the case of FS and MS convergence, Thailand may submit a country footnote for reservation to exempt it from being bound by the FS and MS convergence. This is the worst case scenario, because Thailand would not comply with this provision of the RR by having the Thai footnote exemption. Consequently, Thailand would not have the benefit of global harmonization in terms of economy of scale (low price of equipment) and this would delay the benefits of innovations.

Moreover, the review of the definitions for convergence between FS and MS provides Thailand with an opportunity to evaluate the current use of FS and MS and measure the impact of the RR revisions.

Finally, the missing information matters to non-attending Member States (i.e., Thailand) in the case of WRC-12 Agenda Item 1.2 for further study on the FS, fixed station, and mobile station definitions. This missing information provides a strong basis for Thailand to evaluate its own situation and prepare further argumentation for relevant meetings.

The archives should be complete in order to create information equality between Member States, providing equal opportunities during the decision-making process.

1.3 Purpose and limitations

The purpose of the study is to understand the information needs and coordination in the international spectrum policy setting, including the relevant ITU processes and archives (WRC proceedings and RR versions). The study also proposes the possibility of alleviating the problem of missing information in this policy setting.

The study limits the international spectrum policy setting as a decision-making process for international spectrum management to only inside WRC and its relevant ITU and regional group preparatory works. The stakeholders of WRC are defined as the ITU memberships, e.g., Member States and Sector Members.

1.4 Research question(s)

To fulfill the purpose of the study, the main research question is: **How is the international spectrum policy developed and affected by the lack of detailed documentation?** In order to answer this research question, the four sub-research questions are as follows:

1. What is the international spectrum policy setting in terms of the ITU structure, WRC, and RR, and how did they develop?
2. What information would be more useful for making the decision?
3. How does the missing information affect international spectrum policy?
4. How can the existing ITU archives be improved or completed?

Sub-research question 1: What is the international spectrum policy setting in terms of the ITU structure, WRC, and RR, and how did they develop?

The relevant literature and ITU archives have been explored to understand the development of ITU, WRC, and the RR.

The results of the exploration present the development of ITU, WRC, and the RR in terms of the ITU structure, RR provisions, and WRC process. The RR provisions include key definitions, important provisions, and the TFA in specified services. The key definitions comprise telecommunication, radiocommunication, radio waves, and radio. The important provisions are choice of apparatus, frequency assignment, licences, allocation, allotment and assignment, priority of services, radiocommunication services, and radiocommunication stations. The specified services for the development of TFA are maritime mobile service (MMS), maritime mobile-satellite service (MMSS), broadcasting service (BS), broadcasting-satellite service (BSS), fixed service (FS), fixed-satellite service (FSS), mobile service (MS), mobile-satellite service (MSS), space research service (SRS), and earth exploration-satellite service (EESS). The key definitions are selected based on the foundation of the RR. Important provisions are selected on the basis of usage. The TFA is selected because it contains an

overview of how to use each frequency band. The TFA works as a map and links relevant provisions. The specified services and their satellite part are selected according to the first allocated service (MMS), most influential service for the public (BS), two most allocated services in terms of number of usage bandwidths and frequency bands (FS and MS), and space science service (SRS and EESS).

Hence, the first sub-research question addresses how the existing ITU archives have developed. However, the rationale behind the RR provision is missing as the reason they changed, and this is the topic of the second sub-research question.

Sub-research question 2: What information would be more useful for making the decision?

In order to identify useful information for making the decision or the missing information, the study selects the WRC-12 as the study object for the standard process of WRC, including the WRC agenda-setting and preparatory work by ITU (WRC study process). The WRC standard process uses WRC-12 agenda-setting and the preparatory work for WRC-12 Agenda Items 1.19 and 1.22. WRC agenda-setting is the process for including the issues of RR revisions into the WRC agenda items. ITU's preparatory work process is used to study and provide decision options on each agenda item. The output of the preparatory work is the CPM report, as information for Member States to decide on at WRC. WRC-12 Agenda Item 1.19 is about the implementation of SDR and CRS. WRC-12 Agenda Item 1.22 is about the consequences of short-range device (SRD) emission.[11] These two agenda items are interesting to investigate, because they are relevant to the spectrum commons scheme. Spectrum commons increases spectrum use and encourages innovations. These two agenda items also contain controversial issues at both regional and international level.

To explore the WRC process, the IAD framework provides a list of questions to be considered during negotiations at relevant meetings. The meeting discussions represent the missing information that is not documented. Only the results of the discussions are carried forward to the next or higher meetings. However, the IAD framework only provides a broad view, not a detailed document. By attending the meetings, the author was able to capture the dynamic discussions inside them.

In order to capture these discussions, the author attended the relevant meetings, including Project Team A (PT A-9), the CEPT Conference Preparatory Group (CPG-12), the Asia-Pacific Telecommunity (APT) Conference Preparatory Group for the WRC 2012-5 (APG-2012-5), and the WRC-12.

The missing information is the detailed discussions during the negotiations inside the WRC meetings. This information provides the rationale behind the change in the RR provision and serves as a strong basis on which Member States can develop fully the argumentation to protect their interests in the relevant WRC meetings.

[11] Council Resolution 1291 (MOD), Place, dates and agenda of the World Radiocommunication Conference (WRC-12), provides the relevant agenda items as follows:
1.19 to consider regulatory measures and their relevance, in order to enable the introduction of software-defined radio and cognitive radio systems, based on the results of ITU-R studies, in accordance with Resolution 956 (WRC-07);
1.22 to examine the effect of emissions from short-range devices on radiocommunication services, in accordance with Resolution 953 (WRC-07).

Sub-research question 3: How does the missing information affect international spectrum policy?

The study responds by illustrating the importance of the missing information for WRC-12 Agenda Item 1.2 in the case of Thailand. As a consequence of its limited resources, Thailand did not have sufficient delegates to follow the whole discussion at the SWG and IG levels. Thailand has no information regarding its argumentation. At the WRC-12, the unsettled issue of Agenda Item 1.2, including the possibility of a revision of FS, fixed station, and mobile station, is continuing to the WRC-15.

WRC-12 Agenda 1.2 is about the convergence between FS and MS, and FSS and MSS. The remaining issues carried forward to the WRC-15 are possibilities of modifying the FS, fixed station, and mobile station definitions.

The study also demonstrates the missing information regarding WRC-12 Agenda Item 1.19 during the discussion at the SWG and IG levels. The output from the SWG and IG levels is the results of the discussions, excluding all available options at the meetings. Only the agreed options are forwarded to the next or higher level of meetings, the rest of the information is omitted and not documented in the ITU archives.

The study therefore demonstrates how important WRC-12 Agenda Items 1.2 and 1.19 are to Thailand, in the response to this sub-research question.

Sub-research question 4: How can the existing ITU archives be improved or completed?

In order to add the missing information to the incomplete ITU archives, the study proposes the meeting record form with webcast archives, full utilization of the SharePoint website, and Member State networking, as policy suggestions. The study also provides the potential costs and benefits, in terms of advantages and disadvantages, for each option, as information for policymakers.

Finally, the main research question is answered by the four sub-research questions that the missing information from the ITU archives has affected the international spectrum policy at WRC. Member States attending relevant meetings understand the rationale and benefit from it. The improved or completed ITU archives would benefit the non-attending Member States, especially the Low Income countries.

The study contributes original work on the IAD application to the international negotiations between the Member States at WRC. The study also contributes original work on spectrum policy setting at the spectrum allocation level, especially the development of the TFA by specified services in Appendices A, B, C, D, E, F, G, H, I, and J. These appendices provide the starting point to further explore why they change over time.

The contribution by this study also highlights the information missing from the ITU archives, i.e., the lack of rationale behind the provisions, by demonstrating WRC-12 Agenda Items 1.2 and 1.19. Use of the ITU archives (RR versions and WRC proceedings) should therefore bear this limitation in mind.

1.5 Structure of study

The study consists of ten chapters, starting with an introduction in Chapter 1, which includes the background and research questions. Chapter 2 provides the theoretical framework for this study. Chapter 3 deals with the methodology. The ITU history is provided in Chapter 4. The RR history and frequency band development are presented in Chapter 5 and Appendices A, B, C, D, E, F, G, H, I, and J. Chapter 6 describes the WRC preparatory process. Chapter 7 reports on the preparatory work or WRC study process on WRC-12 Agenda Items 1.19 and 1.22, including observations on national and regional preparatory work. The participant observations of the WRC-12 meetings are illustrated in Chapter 8. The study analyses and policy recommendation are provided in Chapter 9. Finally, the summary and findings are presented in Chapter 10. Figure 3 shows an overview of the study, including the contents in brief of each chapter.

Chapter 1 Introduction	Study background, motivation and problem, purpose and limitation, and research questions
Chapter 2 Theoretical framework	A theoretical framework, including the background to the RR, the IAD framework, background to WRC, and application of the IAD framework to the WRC context
Chapter 3 Methodology	Available data, mode of data collection, and methods used in data analysis
Chapter 4 History of ITU	History of ITU as the development of ITU's structure
Chapter 5 RR history	History of WRC as the RR provisions development: key definitions, important provisions, the TFA, and Appendices A, B, C, D, E, F, G, H, I, and J.
Chapter 6 WRC preparatory process	The WRC-12 preparatory work as the WRC agenda-setting and its assessment, and the national (Sweden and Thailand) and regional preparatory works (CPG and APG) for WRC
Chapter 7 Preparatory work on WRC-12 Agenda Items 1.19 and .122	The WRC study process and Thailand's spectrum management development as well as the importance of WRC-12 Agenda Items 1.19 and 1.22
Chapter 8 Participation in the WRC-12 and the issue of WRC-15	Reviews of the WRC preparatory materials based on WRC-12 Agenda Items 1.19 and 1.22, as a demonstration of the missing information and the importance of WRC-12 Agenda Item 1.2 to Thailand and the preparatory work toward the WRC-15.
Chapter 9 Analysis and policy recommendation	Analyses: the IAD framework applied to the justification of the WRC-12 IG6A2-1.19 and an illustration of the missing information for WRC-12 Agenda Item 1.19 with the policy recommendation
Chapter 10 Summary and findings	The study synthesis, results, responses to research question(s), general policy implications and recommendations, recommendations for Thailand, and recommendations for future research

Figure 3. Structure of the study

Chapter 2 Theoretical framework

This chapter provides a theoretical framework for the study, including the background to the RR, the IAD framework, background to WRC, and application of the IAD framework to the WRC context.

2.1 RR background

The RR has been developed in stages since 1865, initially as part of the International Telegraph Convention, Annex to the International Radiotelegraph Convention, and the RR. The forum for revision of the RR has included the International Telegraph Conference, the International Radiotelegraph Conference, the World Administrative Radio Conference, and WRC.

Following the Additional Plenipotentiary Conference 1992 (APP1992), each WRC has its own agenda, i.e., points or issues of the RR to be reviewed and revised. The agenda comprises several items, each of which contains issues that will become the RR revisions when adopted. All the agenda items deal with spectrum allocation and relevant technical and regulatory aspects on efficient use and interference.

ITU uses the RR as a tool to manage spectrum internationally. ITU allocates spectrum to radiocommunication services with particular frequency bands. Radiocommunication services, in short, services, represent the purpose of frequency uses. There are more than 40 services currently in use in the RR2012. The individual frequency bands are defined by the start and stop frequencies. The start and stop frequencies represent the allowable edges of the frequency to be used for specified services. Details of the development of the services and frequency bands are elaborated on in Chapter 5 and Appendices A, B, C, D, E, F, G, H, and I.

The RR is revised every three to four years via WRC. The current RR is the RR2012, which was revised by the WRC-12. The RR2012 defines usable frequency up to 3,000 GHz and divides the frequency use into services, including terrestrial and space services such as broadcasting, mobile, satellite, maritime, aeronautical, fixed, and earth exploration. All the services can share frequency bands; however, sharing requires services to be designated as primary or secondary. The TFA contains both primary (capitalized) and secondary (lower case) services. Secondary services must not interfere with primary services and cannot claim protection from interference by primary service transmission and reception.[12]

The RR divides the world into three regions. Region 1 covers the European and African continents, Region 2 covers North America and South America, and Region 3 covers Asia and Australasia. The RR2012 regions are shown in Figure 4.[13]

The frequency allocated in one region can be used in others: reuse of frequency. For example, frequency band A is allocated to Region 3 but can be reused in Region 1 or 2 for the same or different services.

[12] 5.23-5.32, Article 5, Radio Regulations
[13] Information obtained from 5.2-5.9, Article 5, Radio Regulations (2012)

Reuse of frequency has an indirect relationship with coverage area. A large coverage area has a low reuse of frequency, while a small coverage area has a high reuse of frequency. Spectrum reuse characteristics vary by service, frequency, location, time, and transmitting power.

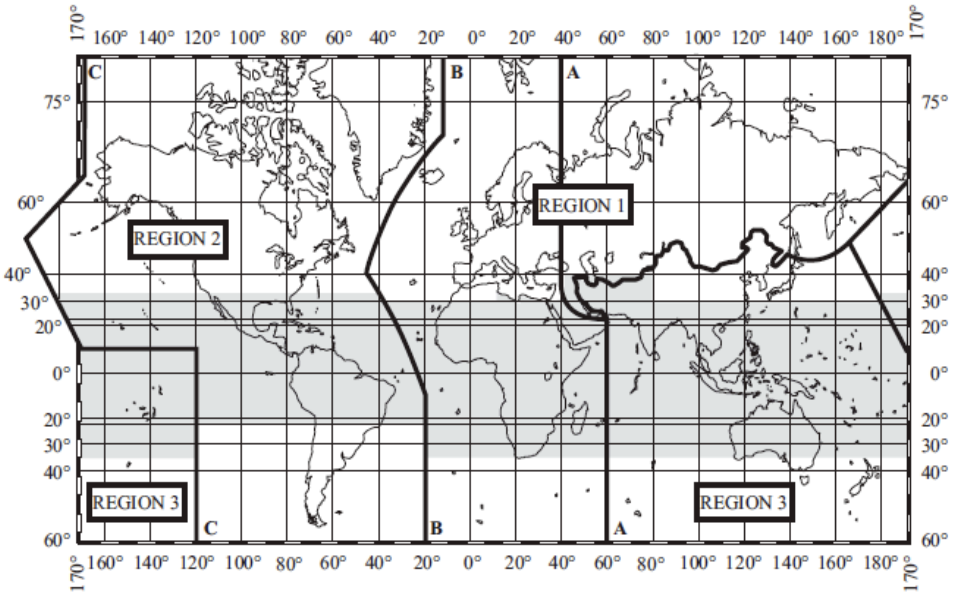


Figure 4. Regions in Radio Regulations 2012

The frequencies are further divided into bands. A wavelength equals its speed of propagation (normally that of light) divided by its frequency ($\lambda = c/f$). Each frequency band has its own propagation characteristics, such as sea-surface communication, stratospheric scattering, and long-range communication. Table 7 shows propagations by frequency band.

Table 7. Radio frequency propagation

Band	Frequency	Range	Uses	Bandwidth	Interference
VLF	3-30 kHz	to 1000 km	Long-range radio navigation	Very narrow	Widespread
LF	30-300 kHz	to 1000 km	VLF strategic communications	Very narrow	Widespread
MF	0.3-3 MHz	2000-3000 km	VLF strategic communications	Moderate	Widespread
HF	3-30 MHz	to 1000 km	Global broadcast and point-to-point	Wide	Widespread
VHF	30-300 MHz	200-300 km	Broadcast, PCS, Mobile, WAN	Very wide	Confined
UHF	0.3-3 GHz	to 100 km	Broadcast, PCS, Mobile, WAN	Very wide	Confined
SHF	3-30 GHz	30-2000 km	Broadcast, PCS, Mobile, WAN, satellite communications	Very wide to 1 GHz	Confined
EHF	30-300 GHz	20-2000 km	Microcell, point-to-point, PCS, and satellite communications	Very wide to 10 GHz	Confined

Notes: Table obtained from http://www.ictregulationtoolkit.org/en/Section.2658.html. WAN is wide area network. PCS is personal communication services.

The “Band” column in Table 7 represents the short form of frequency bands, i.e., very low frequency (VLF), low frequency (LF), medium frequency (MF), high frequency (HF), very high frequency (VHF), ultra high frequency (UHF), super high frequency (SHF), and extremely high frequency (EHF).

The “Frequency” column represents the range of frequency (the start and stop frequencies) in each frequency band. These short forms with frequency bands and start and stop frequencies correspond to RR Article 2.1.

The “Range” column represents communication distances between transmitters and receivers. This range is directly relevant to the applications or “Uses” column. For example, the VHF band provides the suitable distance between transmitters and receivers for broadcasting and mobile services. The EHF band is suitable for very long distance service for satellite communications.

The “Bandwidth” column represents the amount of carrying capacity. As mentioned before, the higher frequency band has a larger carrying capacity. The lower frequency band has a lower carrying capacity. For example, the VHF and LF bands have very narrow bandwidths. Conversely, the UHF, SHF, and EHF bands have very wide or large bandwidths.

The last column “Interference” represents the level of interference in the case of operating in those bands. For example, interference from the VLF, LF, MF, and HF bands is widespread. This means that the interference affects a very wide area due to the propagation characteristics of these bands. On the other hand, the interference from the VHF, UHF, SHF, and EHF bands is confined. This means that the interference from these bands is contained in a limited area.

Table 7 shows the TFA for the 460-890 MHz band, the global as well as the regional allocations captured from the RR2012. The purpose of the TFA is to provide an overview of the use of frequency bands by service, with the relevant regulations, including services, frequency bands, and footnotes. The functions of the TFA are similar to a map that provides an overview of the RR.

Regions and frequency bands

Inside the TFA, the main components are regions, frequency bands, services, and footnotes. When a frequency allocation has the same frequency band (the same start and stop frequencies) for three regions, it is called a global or worldwide allocation. For example, Table 8 shows the frequency band 460-470 MHz, which is a global allocation. On the other hand, the frequency band 470-790 MHz is allocated to Region 1. The frequency band of 470-512 MHz is allocated to Region 2. The frequency band of 470-585 MHz is allocated to Region 3. These three allocations are regional allocations.

Services

Inside each frequency band, services are allocated as either primary or secondary. For example, in the band 460-470 MHz, the fixed and mobile services are allocated as primary

services. Conversely, the meteorological-satellite service is allocated as a secondary service. These three services are allocated on a global basis.

Table 8. Table of Frequency Allocation, 460-890 MHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>460-470</td><td colspan="2">FIXED
MOBILE 5.286AA
Meteorological-satellite (space-to-Earth)
5.287 5.288 5.289 5.290</td></tr>
<tr><td rowspan="5">470-790
BROADCASTING

5.149 5.291A 5.294 5.296 5.300 5.302 5.304 5.306 5.311A 5.312 5.312A</td><td>470-512
BROADCASTING
Fixed
Mobile
5.292 5.293</td><td rowspan="2">470-585
FIXED
MOBILE
BROADCASTING

5.291 5.298</td></tr>
<tr><td>512-608
BROADCASTING
5.297</td></tr>
<tr><td>608-614
RADIO ASTRONOMY
Mobile-satellite except aeronautical mobile-satellite (Earth-to-space)</td><td>585-610
FIXED
MOBILE
BROADCASTING
RADIONAVIGATION
5.149 5.305 5.306 5.307</td></tr>
<tr><td>614-698
BROADCASTING
Fixed
Mobile
5.293 5.309 5.311A</td><td rowspan="5">610-890
FIXED
MOBILE 5.313A 5.317A
BROADCASTING

5.149 5.305 5.306 5.307 5.311A 5.320</td></tr>
<tr><td rowspan="2">698-806
MOBILE 5.313B 5.317A
BROADCASTING
Fixed

5.293 5.309 5.311A</td></tr>
<tr><td rowspan="2">790-862
FIXED
MOBILE except aeronautical mobile 5.316B 5.317A
BROADCASTING
5.312 5.314 5.315 5.316 5.316A 5.319</td></tr>
<tr><td rowspan="2">806-890
FIXED
MOBILE .317A
BROADCASTING

5.317 5.318</td></tr>
<tr><td>862-890
FIXED
MOBILE except aeronautical mobile 5.317A
BROADCASTING 5.322

5.319 5.323</td></tr>
</table>

For the 470-890 MHz band in Region 1, there are three frequency bands: 470-790 (broadcasting), 790-862 (fixed, mobile except aeronautical mobile, and broadcasting), and 862-890 MHz (fixed, mobile, and broadcasting).

For the 470-890 MHz band in Region 2, there are six frequency bands: 470-512 (broadcasting, fixed, and mobile), 512-608 (broadcasting), 608-614 MHz (radio astronomy, and mobile-satellite except aeronautical mobile-satellite [Earth-to-space]), 614-698 (broadcasting, fixed, and mobile), 698-806 (mobile, broadcasting, and fixed), and 806-890 MHz (fixed, mobile, and broadcasting).

For the 470-890 MHz band in Region 3, there are three frequency bands: 470-585 (fixed, mobile, and broadcasting), 585-610 (fixed, mobile, broadcasting, and radionavigation), and 610-890 MHz (fixed, mobile, and broadcasting).

Footnotes

The footnotes contained in the TFA can be used in several situations, including for the status of services (on a primary or secondary basis), additional allocation, alternative allocation, and miscellaneous provisions.

Apart from capital and lower case letter inside the TFA, footnotes can indicate the priority of services. For example, footnote 5.290 indicates the use of meteorological-satellite service in the 460-470 MHz band on a primary basis in Afghanistan, Azerbaijan, Belarus, China, the Russian Federation, Japan, Mongolia, Kyrgyzstan, Slovakia, Tajikistan, Turkmenistan, and Ukraine.[14]

The additional allocation footnote has the same service as indicated in the TFA, but in an area smaller than the region. For instance, footnote 5.291 is allocated the 470-485 MHz band for space research and space operation services in China.[15]

The alternative allocation footnote replaces the service indicated in the TFA, but in an area smaller than the Region. For example, footnote 5.315 is allocated the 790-838 MHz band for broadcasting service on a primary basis in Greece, Italy, and Tunisia.[16]

The miscellaneous provision footnote represents specific operation constraints such as footnote 5.287 in the 460-470 MHz band that provides the condition of maritime mobile service operations in the relevant bands.[17]

[14] 5.290 Different category of service: in Afghanistan, Azerbaijan, Belarus, China, the Russian Federation, Japan, Mongolia, Kyrgyzstan, Slovakia, Tajikistan, Turkmenistan and Ukraine, the allocation of the band 460-470 MHz to the meteorological-satellite service (space-to-Earth) is on a primary basis (see No. 5.33), subject to agreement obtained under No. 9.21. (WRC-07)

[15] 5.291 *Additional allocation:* in China, the band 470-485 MHz is also allocated to the space research (space-to-Earth) and the space operation (space-to-Earth) services on a primary basis subject to agreement obtained under No. 9.21 and subject to not causing harmful interference to existing and planned broadcasting stations.

[16] 5.315 *Alternative allocation*: in Greece, Italy and Tunisia, the band 790-838 MHz is allocated to the broadcasting service on a primary basis. (WRC-2000)

[17] 5.287 In the maritime mobile service, the frequencies 457.525 MHz, 457.550 MHz, 457.575 MHz, 467.525 MHz, 467.550 MHz, and 467.575 MHz may be used by on-board communication stations. Where needed, equipment designed for 12.5 kHz channel spacing using also the additional frequencies 457.5375 MHz, 457.5625 MHz, 467.5375 MHz, and 467.5625 MHz may be introduced for on-board communications. The use of these frequencies in territorial waters may be subject to the national regulations of the administration concerned. The characteristics of the equipment used shall conform to those specified in Recommendation ITU-R M.1174-2 (WRC-07).

Footnotes can also be used for a particular service, in which case it is located next to the service, or the entire frequency band, when it is placed at the bottom of the band, as indicated in the TFA. The band footnote is applied to all services allocated in this band. For example, in the 460-470 MHz band, the use of mobile service has the specific footnote 5.286AA. The band footnotes are 5.287, 5.288, 5.289, and 5.290, and they apply to all services in this band, including fixed, mobile, and meteorological-satellite services.

In Region 1, the 790-862 MHz band has two specific footnotes for mobile, except aeronautical mobile service 5.316B and 5.317A (These two footnotes are modified by the WRC-12). However, in the 862-890 MHz band, 5.317A is a specific footnote for mobile service. The broadcasting service in the 862-890 MHz band has 5.322 as a specific footnote. In the 790-862 MHz band, six footnotes, 5.312, 5.314, 5.315, 5.316, 5.316A, and 5.319, are band footnotes. In the 470-790 MHz band, footnote 5.312A indicates the band footnote. This footnote was added at the WRC-12.

In Region 2, the 470-512 MHz band has two band footnotes: 5.292 and 5.293. In the 806-890 MHz band, the mobile service has 5.317A as a specific footnote.

In Region 3, the 610-890 MHz band has two particular footnotes for mobile service (5.313A and 5.317A). The band footnotes are 5.149, 5.305, 5.306, 5.307, 5.311A, and 5.320.

2.2 IAD framework

Ostrom, among others, developed the IAD framework. The details of the IAD framework are discussed below.

The IAD framework has its roots in classic political economy, neoclassical microeconomic theory, institutional economics, public choice theory, transaction-cost economics, and non-cooperative game theory (Ostrom, Gardner, & Walker, 1994, p. 25). The IAD framework orients the analyst to ask particular questions. The questions generated by the IAD framework are the most important contributions. These question are used to diagnose, explain, and prescribe (Ostrom et al., 1994).

The literature of the IAD framework was developed by Kiser and Ostrom (1982) and provides three worlds of action: the operational, collective choice, and constitutional choice levels. Field (1992) has a similar level of analysis but with different names, i.e., three economic institutions: the operational, institutional, and constitutional levels. Kiser and Ostrom (1982) provide a metatheoretical framework to explain the relationships between institutional arrangements and the individual in terms of the transformation of rules into individual behavior.

Institutional arrangements are rules used by individuals to determine who and what is included in decision situations, how information is structured, what actions can be taken and in what sequence, and how individual actions will be aggregated into a collective decision (Kiser & Ostrom, 1982, p. 179). In other words, this framework explains phenomena attributed to the aggregation of individual actions that they have decided to take or strategies (plans of action) based on situations and the individual. The situation depends on rules,

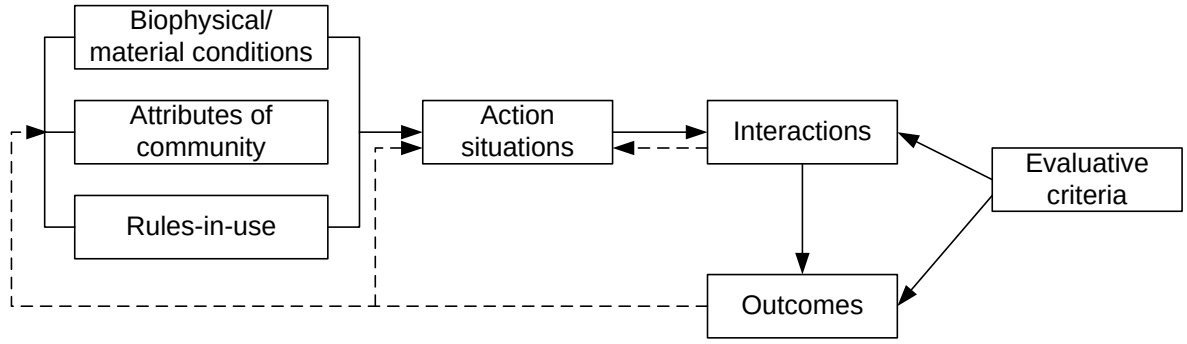
events, and the community. This framework also captures the dynamic situation through feedback from the phenomena that influence the community, situation, and individuals.

According to Kiser and Ostrom (1982), each world of action has five working parts in an institutional structure: the decision-maker or individual, the community, the event (or goods and services), the institutional arrangement, and the decision situation. The results of the institutional structure are individual actions or strategies, and the aggregation of individual actions.

Each level or world of action: metaconstitutional, constitutional, collective, and operation situations, comprises an IAD framework for an institutional analysis. The linkage between levels is in part the rules-in-use at each level (see Figure 7).

The three worlds of action were developed by Ostrom from 1982 to 2011 (Kiser & Ostrom, 1982; Ostrom, 2005a, 2005b, 2007, 2011). The differences between the old version from 1982 and the current version from 2011 are the consideration layers, the names of the elements, and the details of the internal rules.

The IAD framework provides consideration levels, or worlds of action, for the decision-making process, i.e., operational, collective-choice, constitutional, and metaconstitutional situations. Moreover, the IAD framework provides exogenous variables and an internal action situation at each situation level. The exogenous variables include biophysical/material condition, attributes of community, and rules-in-use. The internal action situation structure comprises boundary, position, choice, payoff, information, aggregation, and scope rules. Figure 5 shows the IAD framework.



Source Ostrom (2011, p. 10), Figure 1

Figure 5. Framework for an institutional analysis

Interaction (action and strategy)

When an individual wants to take action or implement a strategy, he or she must know the consequences of the action or strategy, or the outcome and value of the alternative actions or strategies. A tennis player makes a decision to charge at the net or wait for the ball to bounce and use a groundstroke: the outcome of the actions differs. In order to predict actions, a minimum of the following assumptions must be made: the level of information about the decision situations, the valuation of the potential outcomes, the alternative actions within the situation, and the process of calculation to act from alternative actions or strategies.

Action situations (or decision situation)

According to Kiser and Ostrom (1982), the decision situation is determined from interdependent relationships. Interdependent relationships depend on more than one input from the exogenous variables. The IAD framework separates the exogenous variables from the action arena or action situation. The exogenous variables include biophysical/material conditions, attributes of community, and rules-in-use.

Biophysical/material conditions

The biophysical/material conditions describe the type of goods. Goods can be further refined into four groups: private goods, toll goods, common-pool goods, and public goods. Each group has different characteristics, defined by the level of subtractability and the cost of exclusion (Kiser & Ostrom, 1982). Table 9 shows four categories of goods.

Table 9. Categories of goods

Level of subtractability / Cost of exclusion	High	Low
Low	Private goods	Toll goods
High	Common-pool goods	Public goods

Source Kiser and Ostrom (1982, p. 198), Table 7.1

The level of subtractability and cost of exclusion can also be explained in terms of four attributes of biophysical condition that individuals seek to produce and consume: jointness of use or consumption, exclusion, measurement, and degree of choice, in order to define private goods, tool goods, common-pool resources, and public goods.

Jointness of consumption explains separable and joint consumption goods. One individual consumes separable consumption goods, while more than one individual consume joint consumption goods. Joint consumption goods are defined as public goods that are non-subtractable, while separable consumption goods are private goods.

The exclusion attributes explain the difference between private and public goods. Public goods are non-excludable goods that an individual can consume without exclusion. Private goods are excludable goods that the individual can consume with exclusion.

The measurement is the degree of packaging and unitization. Public goods are hard to package and unitize in contrast to private goods. The calculation of private goods is more precise than that of public goods.

The degree of choice for the consumer differs between public and private goods. Public goods are non-subtractable and non-excludable, so there is not much choice, while private goods can produce many choices from subtractable and excludable goods.

The level of subtractability is defined by the characteristics of the goods that can be separated. Private goods can be separated by individual consumption, but public goods cannot. For example, rice can be consumed from a bowl by taking a spoon, as private goods. Air in the park is a public good. People can breathe, but no one can separate air for individual consumption.

Ostrom and Ostrom (1997) use the level of subtractability and the cost of exclusion to classify private goods, tool goods, common-pool resources, and public goods. Private goods, such as bread, milk, automobiles, and haircuts, have a low cost of exclusion and a high level of subtractability. Toll goods, for example, theaters, nightclubs, telephone service, cable TV, electric power, and libraries, have a low cost of exclusion and a low level of subtractability. World Cup football is tool goods at a low level of subtractability, because football players and spectators jointly benefit from football matches, whereas the cost of exclusion is low but managed by selling tickets to matches. Common-pool resources, e.g., water pumped from a ground basin, fish taken from an ocean, and crude oil extracted from an oil pool, have a high cost of exclusion and a high level of subtractability. Public goods, such as peace and security of a community, national defense, mosquito abatement, air pollution control, and weather forecasts, have a high cost of exclusion and a low level of subtractability.

Attributes of community

The attributes of community comprise levels of common understanding, common agreement, and distribution of resources. The common understanding between people in the action situation could be the norm, culture, or tradition in each community that has direct influence on the decision situation.

After setting the rules, the individual or member of the community must have a common understanding of them, i.e., the allowable actions and outcomes. Without a common understanding of the rules, they cannot be exercised.

Real actions must be evaluated with a common understanding of the rules. If community members obey the rules, allowable actions, and outcomes, the need for rule enforcement is low. If, on the other hand, the individual disagrees, the need for enforcement is high.

The distribution of the resource represents a situation in the market or community. If resources are distributed equally, a competitive environment arises. Otherwise, oligopoly or monopoly may arise.

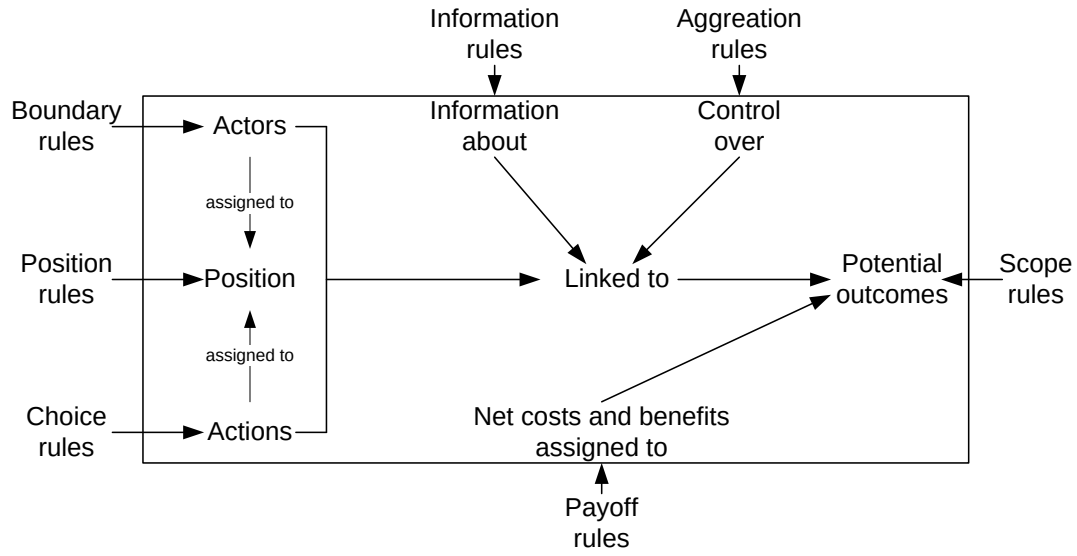
Rules-in-use

The rules-in-use provide an institutional arrangement in a decision-making situation, including boundary, position, choices, payoff, information, aggregation, and scope rules. Generally, rules-in-use can be thought of in terms of “do and don’t” rules, for example, when a new member of staff arrives at the office on the first day, the first thing he/she should ask his/her colleagues about is the “dos and don’ts” in the office. This is more important than the rules-in-form that are written down (Ostrom, 2007, pp. 36-37).

A detailed discussion with a connection to the action situations is provided below. These rules help to explain the action arena or action situation. Figure 6 shows the rules-in-use and the action situation.

Boundary rules: who is eligible to participate in a decision-making or action situation? These rules provide the list of participants or actors. For example, in the French Open, tennis players

with a higher rank automatically go to the first round, while newcomers have to win qualifying matches to enter the first round.



Source Ostrom (2011, p. 20), Figure 3

Figure 6. A rules-in-use and action situation

Position rules: what role does each participant perform in his/her position or what authority is given to each position? In each match, there are referees, line-persons, ball boys or girls, and two or four tennis players. Each position has its own task or responsibility to perform.

Choice rules: what actions should be taken? During the game, after one game of serving, the opponent has to strike back. There are many choices, e.g., whether to wait and hit a groundstroke or to go forward to volley. Even for the server, there are many choices when it comes to hitting the ball, e.g., to direct it to the corner, to the right, to the left, or to go for an ace on the first serve.

Payoff rules: what is the cost and benefit of the choice that is taken? During the game, if player A plays a drop shot at the net, player A expects player B to rush to the net to get the ball back.

Information rules: what information is available when making the decision? In the game, the information about players, weather conditions, changing to new balls or a new racket, medical breaks, and player injury are available to both players.

Aggregation rules: what level of control does the participant have in his/her action situation? During the game, the player has the ability to control his/her action to move forward, backward, to serve, or to hit the ball in order to win a point. Moreover, the player should control his/her performance to win the match in a normal game or a tiebreak.

Scope rules: what is the rule to delimit the potential outcome that is linked to a specific outcome? During the match, the winner has to win two out of three sets or three out of five sets. Both players can play a point in the specified court, including the height of the net, and the type and size of the court.

Outcomes

The term outcomes in Figure 5 and potential outcomes in Figure 6 describe the same concern. The outcomes are the result of actions or strategies by the decision-maker in a decision-making process. Moreover, the evaluative criteria in Figure 5 should be used to find the net costs and benefits of the outcomes in Figure 6.

Evaluative criteria

Ostrom (2011) also provides evaluative criteria, including economic efficiency, equity through fiscal equivalence, redistributional equity, accountability, conformance to the values of local actors, and sustainability.[18] The evaluative criteria are the possible outcomes under the alternative institutional arrangements (Ostrom, 2011, p. 15).

Levels or worlds of action

The IAD framework provides consideration levels, or worlds of action, for the decision-making process, i.e., operation, collective-choice, constitutional, and metaconstitutional situations. Figure 7 shows the level of analysis in the IAD framework.

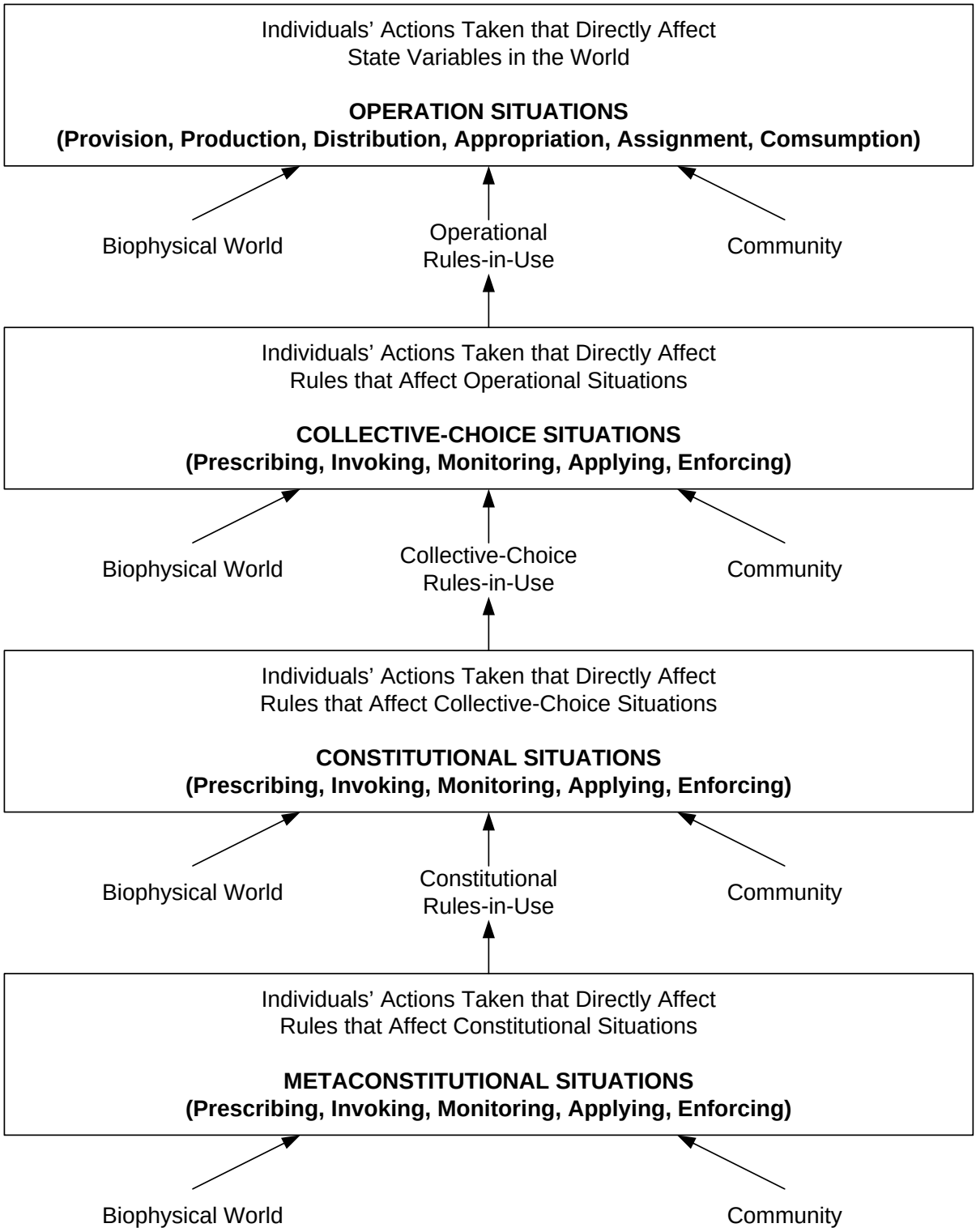
Each level or analysis comprises an internal action situation, as mentioned above. The seven parts of the IAD framework are contained in each level of the analysis. They are biophysical/material condition, attributes of community, rules-in-use, action situations, interactions, evaluative criteria, and outcomes.

At the operation level, the situation is affected by the operational rules of day-to-day decision-making by the participant. The decision is made according to the operational rules, which are defined at the collective-choice level. For example, in the State of Maine's lobster industry, the day-to-day work is to fish or obtain lobster from the inland shore. The fishermen have to fish with specified tools and a time slot.

At the collective-choice level, the collective-choice situation is affected by the operational rules to determine who is eligible, and it defines rules to change the operational rules. For example, if someone wants to change who can fish, and the tools and the time to fish lobster, they have to revise the operational rules at the collective-choice level.

At the constitutional-choice level, the situation is affected by the collective-choice rule of who is eligible and can change collective-choice rules, and it has consequences for the operational rules. For example, in the telecommunication industry, the national regulatory agency defines the set of rules allowing the use of Wi-Fi devices. The rules specify a frequency of 2.4-2.5 GHz with transmitting power up to 100 milliWatts. These rules work as constitutional-choice rules with room for the manufacturer or standard-setting agency to produce its technology and standards to fit these rules. The standard for Wi-Fi devices is set at the collective-choice level. After that, Wi-Fi devices are in the market and available to use. The user buys and uses Wi-Fi devices according to the standard.

[18] For more information, see Ostrom (2011, pp. 16-17).



Source Ostrom (2007, p. 45), Figure 2.2

Figure 7. Level of analysis and outcomes

As a constitutional decision-maker, Fédération Internationale de Football Association (FIFA) determines the rules of football at a high level. European or national football associations use FIFA's rules for their tournaments, such as EUROPA and the Premier League. Football teams must obey the rules to participate in tournaments.

At the metaconstitutional level, the situation is the deepest layer of analysis, underlying all

three of the above levels. The metaconstitutional level should contain the fundamental rules like customs, tradition, norms, and religion (Williamson, 2000).[19]

2.3 WRC-12 background

At WRC, the meeting forms that consider the RR revisions include the plenary, COM, WG, SWG, IG, DG, and ad hoc group.

At the WRC-12, there was a single plenary, seven COMs, nine WGs, and many SWGs, IGs, and DGs. The RR revision process starts by the plenary allocating selected input documents to particular COMs. Each COM forms WGs, and each WG forms SWGs to further consider individual input documents (documents submitted by Member States) and comments made at meetings. Each SWG can form IGs or DGs as required. Figure 8 shows the WRC meeting hierarchy.

COMs 1, 2, 3, and 7 are steering, credentials, budget control, and editorial committees, respectively. These committees facilitate the WRC meetings as administrative works. On the other hand, COMs 4, 5, and 6, are allocated specified agenda items in order to achieve the solution for WRC-12.

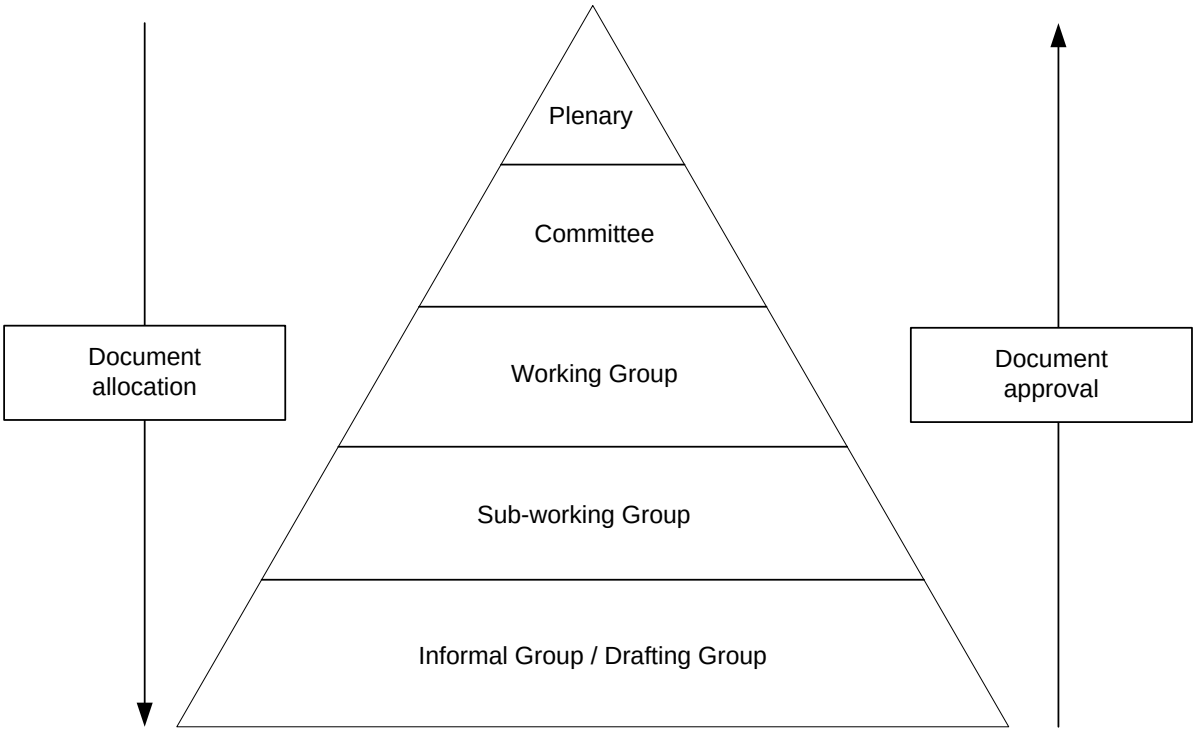


Figure 8. WRC-12 meeting hierarchy

The arrows in Figure 8 show the direction of the document flows. The input documents flow from plenary to COMs, to WGs, to SWGs, to IGs or DGs by agenda item. The arrow on the right-hand side presents the flow of approval documents from the bottom to the top of the pyramid.

[19] Williamson explains this as Level 1 (social theory), which is taken as given. Institutions at this level change very slowly: 100-1000 years.

At the WRC-12, Figure 9 shows, for example, the COM6 work program as an illustration of the process, including document allocations and approval.

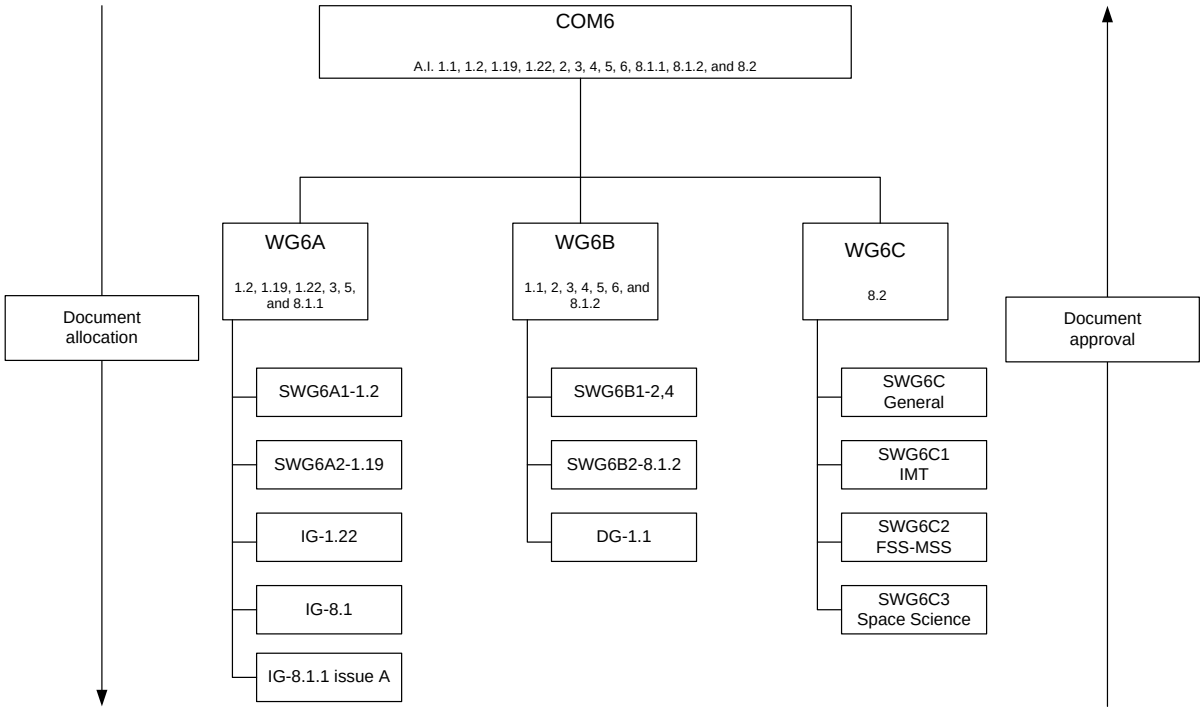


Figure 9. COM6 work program

COM6 is allocated Agenda Items 1.1, 1.2, 1.19, 1.22, 2, 3, 4, 5, 6, 8.1.1, 8.1.2, and 8.2 by the plenary. The items concern the related areas of fixed, mobile, and broadcasting issues, and future work programs.

The COM6 Chairman established three WGs, i.e., WG6A, WG6B, and WG6C. The WG6A is allocated Agenda Items 1.2, 1.19, 1.22, 3, 5, and 8.1.1. The WG6B is allocated Agenda Items 1.1, 2, 3, 4, 5, 6, and 8.1.2. The WG6C is allocated Agenda Item 8.2.

Furthermore, the WGs established their own SWGs, IGs, or DGs by agenda item. For example, the WG6A Chairman established two SWGs (SWG6A1-1.2 and SWG6A2-1.19), and three IGs (Agenda Items 1.22, 8.1, and 8.1.1 issue A). The WG6B formed two SWGs (SWG6B1-2. 4 and SWG6B2-8.1.2), and one DG (DG-1.1). The WG6C formed four SWGs (SWG6C-General, SWG6C-IMT, SWG6C-FSS-MSS, and SWG6C-Space Science).

COM4 and COM5 have similar structures to COM6, but they have different agenda items and the corresponding number of SWGs, IGs, or DGs.

At the SWG, IG, or DG level, detailed debates relating to the input documents are discussed to obtain consensus between the Member States. In terms of the IAD framework, this consensus approach is an attributes of community or common understanding between Member States (see Figure 5). The SWG, IG, or DG Chairman leads the discussions and attempts to achieve consensus on the issues.

When Member States reach consensus, the issue is resolved. However, only the result of the consensus moves forward (with possible forms of revision of relevant parts of the RR) to the next level for approval (e.g., SWG to WG), that is, all other information concerning the principles by which the matter is resolved is "left behind." This becomes the problem of the missing information.

Conversely, when consensus cannot be reached, a compromise solution may be achieved, the results of which "move forward" to the next meetings, that is, higher level meetings such as from SWG to WG, WG to COM, or COM to the plenary.

For example, on WRC-12 Agenda Item 1.22, the WG6A Chairman also presided over the IG 1.22. With no issue on the agenda item, the RA-12 approved ITU-R Resolution 54-1 to allow the study of a harmonized band for short-range devices (SRD) to proceed for further study in the WRC-15 study period (between the WRC-12 and WRC-15, and the results of the study to be presented at the WRC-15). The clarification required for ITU-R Resolution 54-1 concerned whether Member States needed to discuss the necessity of implementing the WRC resolution for SRD. Moreover, the RA-12 took place one week prior to the WRC-12, and the WRC-12 submission deadline was two weeks before the Conference. On the WRC-12 submission deadline, Member States submitting documents to the WRC-12 therefore had no information on the RA-12 approval. Further discussion on the approval of ITU-R Resolution 54-1 among Member States that had the WRC-12 submission for a WRC resolution was conducted. Accordingly, only confirmation from regional representatives was required for the IG Chairman to draft the IG output to the WG6A for approval: no change to the current RR was required.

The information on the IG subsequently moved to the WG without the missing information.

Conversely, the SWG6A2 was established at the WRC-12 in Agenda Item 1.19. The issue concerned whether a WRC resolution was required to use CRS. Both sides (the Member States who did and those who did not prefer to have a WRC resolution) provided arguments. The SWG6A2 created the IG to settle issues for a WRC resolution.

The IG meeting discussed issues about harmful interference, dynamic spectrum access, notification and coordination, and regulatory concerns for dynamic spectrum access. Details of these discussions are not included in the IG output. Accordingly, these unresolved issues now move forward to the SWG6A2, WG6A, and COM6. This is an example of the information loss that occurs during the process for IG Agenda Item 1.19, with seven possible options disappearing. Importantly, the omitted arguments are not documented, with only the three final options moving forward. Hence, this information is missing for those who did not participate.

The COM6 Chairman established an ad hoc group to consider the three options with the WG6A President. Ultimately, the SWG6A2 Chairman proposed a single option that Member States accepted.

Thus, valuable information was “lost” to Member States that did not participate at the meetings. This is because the debates below WG level are not documented. These arguments are only available to delegates in attendance at such meetings.

2.4 IAD framework in the WRC context

Occasionally, agenda items cannot be concluded within a WRC and must be carried forward to the next WRC. The discussions relating to the unsettled issues are not recorded, that is the abridged, not the final, output of the Final Act or the RR.

The RR and WRC archives provide a list of input (documents submitted by Member States) and output documents (RR revisions). However, the archives do not include the argumentations of the meetings. When issues are carried forward to the next WRC, only the delegates at the meetings know the arguments. This information, which may contain options for decision-makers, is missing from the archives of the RR and the WRC.

Accordingly, the archives do not provide a sound basis of arguments for decision-making on the issues. The administrations have no information regarding the arguments for the actions, limiting their understanding of the discussion and thereby their basis for developing full arguments for the next WRC.

This study contributes to the list of questions that should be considered during the action situation (decision-making process) inside the WRC meeting. A useful framework to address this information is the IAD framework developed by Ostrom (Kiser & Ostrom, 1982; Ostrom, 2005b, 2011). However, Ostrom has not applied the framework to international negotiations within WRC. This study will apply the IAD framework to identify questions that should be considered to show limitations of the archives. Moreover, this study uses three levels of analysis, i.e., operational, collective-choice, and constitutional choice.

Participant observation provides the information that is gained by delegates when they attend a meeting. Such information captures the dynamics of the meeting, i.e., arguments and rationale of the decision-making process. Attendance at a meeting corresponds to a list of questions obtained from the IAD framework. As such, attendance is an indicator of the limitations of the archives as an intrinsic area. However, participations at meetings from past event are not observed.

IAD application to WRC

The IAD framework provides a list of questions that should be considered during the decision-making process. The framework defines an action situation and decision-maker. An action situation is a situation in which decisions are made. The decision-maker is the person who makes the decision. The list of questions can be grouped into exogenous and endogenous variables.

Exogenous variables represent external influences on the action situation, which is comprised of biophysical/material conditions, attributes of community, and rules-in-use.

Biophysical/material conditions are the objects of the study. Normally, the study objectives can be categorized into four groups according to the level of subtractability and cost of exclusion, i.e., private, toll, common-pool, and public goods.

In this study, the biophysical/material condition inside WRC is a global spectrum, which has a low level of subtractability – it is easy to obtain, but the global spectrum has a high cost of exclusion. A global spectrum is therefore a public good.

Attributes of community are the common understanding of WRC, i.e., ITU and ITU members' cultures, traditions, and norms. This common understanding within a community or country directly influences the action situation of the meeting in terms of information constraints, e.g., it is common for Arab and European delegates to be outspoken during meetings.

Rules-in-use represent both a written and tacit form of rules, including "do" and "don't" rules during the action situations. Rules-in-use are comprised of boundary, position, choice, payoff, information, aggregation, and scope rules. The rules-in-use directly connect to the endogenous internal variables.

Endogenous variables are the action situations, such as interaction, outcome, and evaluative criteria, that can be linked by the rules-in-use. They provide actors, position, actions, net cost and benefit, and information about control and potential outcomes. The details of the rules-in-use of exogenous and endogenous variables are provided below.

The boundary rule defines who can participate in WRC (ITU membership). The ITU membership is clearly defined by the ITU Constitution (CS), the boundary rule for the regional preparatory meeting, i.e., PT A, CPG, and APG, and in its regulation. Participants have to be members of CEPT or APT or obtain endorsement from a member to receive observer status.

Inside the WRC-12, the boundary rule also includes access and withdrawal rights for the WRC documents, including the Wi-Fi access code, and a Telecommunication Information Exchange Service (TIES) account (defined by the BR as the WRC Secretariat).[20] Archive and participant observation can both capture this rule.

The position rule defines the delegate roles within the meeting. Formal roles are Head of Delegate (HoD), Deputy Head (DH), and Delegate (D). The original credentials need to be submitted to WRC for the right to vote and to sign the Final Act. However, the right to express views and information is available to all participants, including observers from the Sector Members. The Chairman and Secretary of each meeting also provide an extra role to conduct and facilitate the meetings, including the plenary, COM, WG, SWG, DG, and IG.

This rule can be captured from the archives and participant observations at the plenary and COM level. Below COM level, only participant observation can capture this role.

The regional preparatory meeting plays a major role in consolidating and coordinating the

[20] In order to participate in WRC, registration is done electronically by the designated focal point (DFP).

regional view during the WRC-12. Regional representatives from each regional preparatory meeting negotiate on behalf of their regional administrations. This process reduces lengthy discussion. This position rule for regional representatives can be only captured by participant observation.

The choice rule represents possible action that can be taken according to the position rule. The choice rule has direct influence on the interactions, including information, aggregation, payoff, scope rules, and evaluation criteria and outcomes.

For example, the final compromise recommendation was reached at the WRC-12-IG6A2 on Agenda Item 1.19. Delegates represent regional or individual administrations on whether to accept the final outcome. The choice of WRC recommendation influences the delegates' stance, including information, aggregation, payoff, scope rules, and evaluation criteria and outcomes of the negotiations. This choice is new information that is conveyed to their regional group to inform it of future decisions based on these evaluation criteria (or payoff rule) for their national or regional benefit. It also influences the stance of individual administrations, which either maintain or change their position (as the position and aggregate rules). The final decision can influence the scope rules as outcomes of the negotiation or interaction process.

According to the choice rule, this interaction can only be captured by delegate observation. The archives have no capacity to capture negotiations.

The payoff rule uses evaluation criteria and provides costs and benefits in the selection of actions based on national interests. The payoff rule and the evaluation criteria can both be derived from interactions between delegates. Interaction cannot be recorded even in the minutes of the meetings.

The information rule represents the flow of information inside the meeting, including written and verbal forms. Inside WRC, written and verbal contribution can be presented in terms of the information rule, which always happens inside and outside the meetings.

The archives can capture the input and output from previous documents. Current written and verbal communication can only be captured by participant observation.

The aggregation rule shows how to impose control on decision-making through the choice rule on outcome. The aggregation rule reflects the delegates' stance after making decisions by selecting a specific choice at the end of the discussions. The rule is only captured from delegate observations.

The scope rule is an outcome of the decision situation and provides the possibility for revision of the RR through no change, modification, addition, and suppression provisions. The rule is influenced by action situations and interactions. The scope rule provides an overview of possible revisions but lacks information from the detailed discussions and interactions.

The archives can capture this scope rule information from the previous event. However, WRC's current practices only allow participant observation to be made.

Table 10 shows the relationship between the IAD and the approaches of this study.

Table 10. IAD variable map, missing data, and observer activities

IAD variable	WRC	RR/WRC Archive	Participant observation	
			PTA, CPG, APG	WRC-12
Physical condition	Spectrum as public good	X	X	X
Community attribute	Norm, culture, and tradition		X	X
Rules-in-use				
Boundary	ITU membership	X	X	X
Position	HoD, Regional Rep., Chair, Secretary	X	X	X
Choice	Support, oppose, neutral		X	X
Payoff	Cost and benefit		X	X
Information	Public or informal information flow		X	X
Aggregate	Control over choice		X	X
Scope	ADD, MOD, SUP, NOC	X	X	X
Action situation	Negotiation		X	X
Interaction	Negotiation		X	X
Evaluation criteria	Link payoff rules		X	X
Outcome	Link RR revisions to scope rules	X	X	X

The list of questions that should be considered within the action situation (WRC meetings) is provided by the IAD framework and appears in the “IAD variable” column of Table 9. The “WRC” column identifies the corresponding IAD elements.

The “RR/WRC archives” column shows the IAD question that can be addressed from the RR and WRC archives. Cleary, only selected IAD questions can be considered with archived material. The RR and WRC archives therefore only provide partial information, lacking the dynamic interactions that occur inside meetings.

Conversely, participant observations can address all the IAD questions in the current situation. The interactions within meetings can be captured by the participant observations, which are only available to attending delegates. Such negotiations provide the argument and rationale concerning agenda items. When an issue is continued to the next WRC, it becomes important that information of this sort is not available to absent delegates. As it stands, the administration has no access to this information. There is therefore limited understanding of the debate and no basis on which to develop full arguments toward the next WRC.

However, the RR and WRC archives only provide incomplete records of proceedings, as demonstrated above. Therefore, the archives cannot be relied upon as a basis for understanding the past decision-making or basis on which to plan for future decisions when the issues continue to the next WRC. The information on the dynamics of the meeting will be valuable for an administration that has no representative at such meetings.

For example, the issue of WRC-12 Agenda Item 1.2 has continued to the next WRC-15, at which administrations are not represented. They have no basis for understanding the current

debate on this issue. There is therefore no strong basis on which to develop a full argument for the WRC-15.

Finally, this study identifies the limitations of the RR and WRC archives by implementing the IAD framework.

2.5 IAD framework and information matters

Ostrom (2005b) provides the perspective of complete and incomplete information in an action situation as follows. The complete information is an assumption that each participant could know the full structure of an action situation. When a participant has perfect information, he or she can know all other parties' actions before they take any further action. Incomplete information makes the action situation more complicated to model. Ostrom (2010) also points out that incomplete and imperfect information may influence the participant to make a mistake during the decision-making process. A couple of examples of the IAD framework with information asymmetry or imperfect information follows:

(1) Bushouse (2011) uses the information asymmetry to classify three categories of club goods: for-profit, nonprofit, and public providers. Bushouse also uses the information asymmetry to further explain the bio/physical condition as an exogenous variable in the IAD framework to identify six governance structures in the for-profit and nonprofit sectors.

(2) Wasike, Kahi, and Peters (2011) use the IAD framework with imperfect price information: input and output of the system to identify missing actors in the action arena, poor rule conformance and absence of rules in the animal recording system.

The study uses the IAD framework to identify the rationale behind the RR provisions as the missing information from the ITU archives. Consequently, Member States that only reply to the ITU archives have incomplete information. This missing information in the ITU archives renders the information asymmetry between attending and not-attending Member States at the relevant meetings. The missing information at SWG and IG influences the Member States' decision-making process at the higher level meetings, including the WG, COM, and plenary to make further decision on the RR.

The study demonstrates the missing information and its consequences in WRC-12 Agenda Items 1.2, 1.19, and 1.22, which will be discussed in a later chapter.

2.6 Summary

This chapter presents the background to the RR and WRC, including the spectrum propagation characteristics, TFA, WRC-12 work programs, and meeting forms. Moreover, the IAD framework is described together with the application of the IAD in the WRC context.

The study describes the background to the RR in terms of the technical characteristics of frequency propagation, which vary by frequency band, e.g., low frequencies can propagate above a sea surface and are suitable for maritime communication. Furthermore, the RR divides the Earth's geographic area into three regions: Region 1 (European, African, and Arab

countries, and Russia), Region 2 (North and South American countries), and Region 3 (Asian and Australasian countries). These regions construct the possibilities of frequency reuse, such as frequency band A allocated in Region 1 also being able to be reused or reallocated in Region 2 or Region 3.

The study also provides an overview of frequency use by explaining the TFA. The TFA works as a map. It usually divides a frequency allocation into global or regional. Inside the TFA, the services are allocated with either primary or secondary service. Moreover, the footnotes can be used for an additional or alternative allocation, or miscellaneous provisions for a particular service or entire frequency bands.

The study describes and prescribes the IAD framework in the WRC context. This is original work for the IAD framework application in the context of international negotiations.

The IAD framework helps to explain the action situation inside the international negotiations at WRC by posting a list of questions representing the institutional arrangements in terms of the exogenous and endogenous variables. The exogenous variables are the bio/physical material, the attribute of community, and rules-in-use. The endogenous variables are directly connected to the rules-in-use and comprise the seven rules: boundary, position, choice, payoff, information, aggregation, and scope.

At WRC, the world of action is in a constitutional situation, which represents the reviewing and revising of the international treaty: the RR via WRC.

The bio/physical material is the spectrum allocation that is treated as public goods. The attribute of community represents the common understanding between the ITU Member States, including ITU's and the Member States' cultures, traditions, and norms. The rules-in-use are represented in the endogenous variable by the seven rules.

At WRC, the boundary rule represents the ability to access the meetings, i.e., ITU membership. Each delegate performs in different roles at the meetings, including HoD, DH, D, or observer (as the position rule). However, only the Member States have a right to vote that is directly connected to the choice rule, which allows the action to be performed inside the meetings. The action to be taken is influenced by the information flow inside the meeting (as the information rule). Member States may change or retain their stances according to the availability of information (the aggregate rule). Member States have their own criteria to evaluate their action or decision in terms of cost and benefit analysis (the payoff rule and evaluative criteria) and consequences or outcomes of the action (the scope rule and outcome).

The missing information is contained in the rationale underlying the RR provisions and is not documented in the ITU archives. This missing information is only available to the attending Member States. The missing information may be treated as part of the information flow between Member States inside the meeting (the information rule), which directly influences the decision-making process and outcome.

Finally, the IAD framework provides the list of relevant questions as an institutional arrangement inside the decision-making process at WRC. However, the IAD framework does

not provide the detailed content of the meeting decision. Instead, participant observation captures the meeting argumentation inside the current event, not in past events.

Chapter 3 Methodology

This chapter concerns the available data, mode of data collection, and methods used in data analysis.

The primary data are sourced from observations made during the attendances at the selected PT A, CPG, APG, and WRC-12 meetings. Participating in meetings provides the rationale by which the complete archives should be understood.

Moreover, attending the PT A, CPG, APG, and WRC-12 meetings provides an enhanced understanding of the history of the differences between the current practice of the WRC-12 and previous practice from the archived document. Table 11 shows the details of the author's participation in the meetings.

Table 11. Meeting participation

Meeting	Date	Days	Venue	Participants
PT A-9	29-30 Mar 2011	2	Copenhagen, Denmark	53
CPG-12-7	27 Jun-1Jul 2011	5	Oxford, United Kingdom	181
APG2012-5	29 Aug-3 Sep 2011	6	Busan, Rep of Korea	385
WRC-12	23 Jan-17 Feb 2012	25	Geneva, Switzerland	>3000

The data are secondary and qualitative in nature. The secondary data are sourced from the ITU, CEPT, and APT archives. The secondary data archive approach is due to Rutkowski (2011). Rutkowski downloaded the principal data from the ITU History Portal. The data allowed examination of versions of the regulations to enable identification of key definitions and provisions by the RR versions. The analysis by Rutkoski enabled identification and links to detect any differences in the text. Rutkoski applied this method to cyber security and to find where such text amendments arose.

The benefit obtained from applying the Rutkowski approach is that the mapping of the WRC archives though time improves understanding of the context in which the regulations developed. However, the current study recognizes that the archives are only a record of the final input and output documents for particular regulations. That is, certain information is not recorded, i.e., argumentations during meetings.

To address this shortcoming the study employs the IAD framework to construct a list of questions that are probably considered in comprehensive meetings.

Complete archives would provide information on the context in which the final documents (archives) were developed and help to identify the shortcomings of the official archives.

Accordingly, the study is based on data obtained from archived documents and information derived from meeting attendance. The ITU archives include all the versions of the RR including 1906, 1912, 1927, 1932, 1938, 1947, 1959, 1968, 1971, 1976, 1982, 1986, 1990, 1994, 1996, 1998, 2001, 2004, 2008, and 2012. Conversion of the TFA for alternative versions of the RR into Excel sheets provides a record of the frequency bands by services and

band development. Moreover, the ITU structure development is based on the relevant literature and is cross-checked with the relevant Plenipotentiary Conferences (PP) document.

The WRC standard process is further explored through meeting documents from the WRC-12 agenda-setting and WRC-12 Agenda Items 1.19 and 1.22.

3.1 Data and data collection method

The primary data are obtained from participant observation and transcription of voice recordings from the meetings. Voice transcriptions provide the rationale of the argumentation and its resolution.

Such observations provide an internal view or meeting perspectives (Flick, 2009, pp. 226-233). However, Flick identifies the limitations of such observations, in particular, the difficulty of systematizing the status of meetings while maintaining distance. Moreover, observers must be limited only to what can be observed. Additional interviews of situations can help in understanding processes.

The secondary data are obtained from the ITU, CEPT, and APT archives outlining the timeline of RR changes by agenda item. In order to use documents as secondary data, Flick (2009) provides guidelines on how to select suitable analysis documents by the criteria: authenticity (applied to both primary and secondary data), credibility (official or personal), representativeness (typical or non-typical), and meaning (text clarity).

Document authenticity depends on the data source. If information is obtained from primary data sources and is documented by witnesses, then the authenticity is “high.” When the data are obtained from a secondary data source and are documented from primary data, the authenticity of the document is “medium” or “low.” Document credibility depends on the type of document. For official documents, credibility is “high.” Naturally, for personal documents, credibility is “low.” Representativeness is measured by document type. When documents are recorded for specific purposes, representativeness is non-typical. If the document is for general purposes, representativeness is typical. The documents’ meaning depends on its clarity.

Here, a brief summary of the data collection methods follow. To gain an appreciation of how the RR and WRC have developed over time, the ITU archives are the principal source of input and output documentation for all RR versions. These data are used to construct a database of the TFA to track changes to key definitions and the WRC process to alter the RR.

All ITU documents can be accessed through the ITU History Portal (http://www.itu.int/en/history/Pages/default.aspx) including the PP (Complete List of Plenipotentiary Conferences), Radiocommunications Collection (Complete List of Radiotelegraph & Radiocommunication Conferences), and RR (Complete List of Radio Regulations).

The ITU history in Chapter 4 is described from the relevant literature and double-checked against the PP documents. Each PP provides conference outcomes, a list of participants, and conference documents.

The RR history in Chapter 5 is described from the RR versions as final outcomes from WRC. The Radiotelegraph & Radiocommunication Conferences did not provide complete sets of conference outcomes (only a list of participants and conference documents). The study therefore uses the complete list of RRs to track the changes through the RR versions.

The keywords from the selected RR provisions help to identify the change from each RR version. However, each frequency band of the TFA must be converted into an Excel sheet in order to identify the change by service of how each frequency band developed over time. Each RR version has four tables, i.e., global, Region 1, Region 2, and Region 3. Each table is categorized by service, priority (primary and secondary services), and frequency band.

Finally, the manual comparison by service (MMS, MMSS, BS, BSS, FS, FSS, MS, MSS, SRS, and EESS) summarizes the frequency band development across RR versions and is described in Appendices A, B, C, D, E, F, G, H, I, and J. Each appendix is composed of eight allocation tables, including global, Region 1, Region 2, and Region 3 with primary and secondary services.

To sum up, primary data obtained from meetings are considered “participant observations” of the PT A, CPG, APG, and WRC-12 meetings. These observations provide insight, interaction, and dynamic and current practice of regional preparatory groups and WRC. The template constructed in Chapter 8 standardizes the participant observation recording process.

Secondary data obtained from the ITU, CEPT, and APT archives provide a high degree of authenticity and credibility. Furthermore, the representativeness of the documents depends on their purpose. The purpose may be general (typical) or specific (non-typical). In this study, the documents are specific. The representativeness of this study is also mainly non-typical. Furthermore, the meaning of the documents is measured by document clarity.

3.2 Data analysis

Data analysis explains action situations, i.e., how decisions are made at the WRC meetings. This study starts from a list of IAD questions that should be considered as a basis on which to analyze the ITU, CEPT, and APT archives, and guide participant observations.

The IAD framework provides three questions on exogenous variables and seven questions on endogenous variables. There are three exogenous questions: what is the study object (physical condition-spectrum)?; what are the community characteristics (community attribute)?; and what are the “do” and “don’t” rules (rules-in-use)? In essence, the exogenous variables help define the institutional framework within which the RR is considered. The seven endogenous questions relate to the operation of the “do” and “don’t” rules, in particular, a micro relationship such as who can participate; which roles participants can perform; in each role which action can be selected; which action can be decided on based on the criteria; how to

control action; how the information flows inside the action; and what the possible outcomes are of an action.

The ITU, CEPT, and APT archives provide input and output documentation from previous RR and WRCs. However, the archives cannot answer all the questions. For example, the WRC-07 archives can provide the study object, i.e., spectrum as a public good (physical condition), the details of ITU membership indicating who can join the WRC-07 (boundary rule) in which position (HoD, DH, and D) (position rule). The possible outcome is RR revisions, i.e., modification, addition, suppression, or no change to the RR (scope rule).

The archives also provide the development of input and output documentation since 1865. The use of keywords helps in tracking the development of provisions over time. However, the rationale for changes is not recorded in the archives.

Participant observations capture meeting interactions (action situations). For example, at the IG 1.19 (CRS), the information constraints were treated as attributes of community (which country speaks out or avoids speaking). The available options proposed by a Member State potentially influenced others (information rules). Options discussed by Member States were based on their criteria of whether to support, oppose, or keep neutral positions (choice, payoff, and aggregate rules). During debates, rationales were revealed but not documented. Only resolved issues moved forward to higher-level meetings for RR revision. If issues continued to the next or future WRCs, this rationale of arguments was more valuable to Member States that did not attend to fully develop such arguments for the next or future WRC.

Conversely, participation observations are limited to selected current meetings. For example, the discussion on issues of WRC-12 Agenda Items 1.2 and 1.19 convened at the same time in different meetings. If Member States have teams available to attend such meetings, they can exchange meeting notes. For Member States with limited resources, informal discussion can provide some understanding of the missing information.

3.3 Approach

The empirical work of the study is the exploration of the ITU, CPG, and APG archives. Together with relevant literature, the study presents the ITU structure development. Moreover, the exploration of the ITU archives provides the empirical work for the RR (key definitions, important provisions, and TFA) and WRC (agenda-setting process and preparatory work) development. The exploration of the CPG and APG archives, as the regional preparatory work, assists the ITU preparatory process.

The results of the empirical findings deduced from the exploration of the archives show that the ITU archives only contain the final input and output of the WRC proceedings and RR versions. The archives are incomplete because of the lack of rationale behind the RR provisions.

In order to obtain the rationale behind such provisions, the IAD framework by Ostrom (2011), as a key framework, provides a list of relevant questions during the interactions between the

stakeholders. The study applied the IAD framework to the WRC context as an action situation during the international negotiations. The list of relevant questions is deduced from the IAD framework, not the detailed content of the discussion.

The author's attendance or participant observations from the relevant meetings for WRC-12 Agenda Items 1.19 and 1.22 capture discussions that are missing from the archives. The study provides the missing information in the case of WRC-12 Agenda Item 1.19 as the result induced from the meetings.

To sum up, the study uses both the deductive IAD framework and the inductive participant observation approaches. The list of questions deduced from the IAD framework are probably considered during meetings. The results of the missing information are induced from the participant observations. As such, they provide a basis on which to analyze the archives and guide participant observations.

3.4 Summary

The study uses both primary and secondary data. Primary data come from the participant observations by attending the PT A, CPG, APG, and WRC-12 meetings. The secondary data come from the ITU, CEPT, and APT archives.

The study analyzes secondary data with questions provided by the IAD framework. The questions identify limitations of the ITU, CEPT, and APT archives. These gaps can be closed with information obtained from the participant observations. However, the participant observations are limited to the current meetings.

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Chapter 4 History of the International Telecommunication Union

This chapter presents the history of ITU (formerly, International Telegraph Union) since its establishment, in terms of the development of ITU's structure.[21]

ITU's structure has been established through a sequence of conferences, namely the International Telegraph Conference (1865-1932), International Telecommunication Conference (1947), and Plenipotentiary Conference (PP, 1952-2012). Administrative conferences, namely, the International Radiotelegraph Conference (Berlin, 1906), International Telegraph Conference (Paris, 1925), and International Radiotelegraph Conference (Washington, 1927), also focus on ITU's structure.

4.1 International Telegraph Conferences, 1865-1932

The first international telegraph activity occurred in 1849. Prussia and Austria-Hungary created the Austro-German Telegraph Union (Allison, 1993; Huurdeman, 2003). In 1850, Prussia, Austria-Hungary, Saxony, and Bavaria created the Austrian-German Telegraph Union in Dresden (Huurdeman, 2003; Rutkowski, 2011; Smith, 1976). The Dresden Treaty served as the first international telegraph convention.

Paris, 1865

The International Telegraph Conference was first held in Paris in 1865. The Conference created the international telegraph regulations (Rutkowski, 2011; White & Lauria, 1995). The Paris Convention had the signatory countries of France, Switzerland, Austria (Hungary), Bavaria, Belgium, Denmark, Spain, Greece, Hamburg, Hanover, Italy, Holland, Portugal, Prussia, Russia, Saxe, Sweden, Norway, Turkey, and Wurtenburg. The Convention contained the main text relating to the international telegraph operations with uniform transmission charges.[22]

Importantly, Mr. Kern (Swiss delegate) proposed that each country have one vote, irrespective of delegate numbers (Allison, 1993; ITU, 1965). This proposal had been approved by the Conference.

Vienna, 1868

The International Telegraph Conference had 23 signatory nations. The permanent secretariat was founded, namely, the International Bureau of Telegraph Administration in Berne, Switzerland (nee Berne Bureau). The Berne Bureau carried out administrative work and published a telegraphy journal (now *ITU news*), which was first published on 25 November 1869 (Codding, 1991; Glazer, 1962; Huurdeman, 2003; Lyall, 1997; Smith, 1976).

[21] This chapter is based on the History of the International Telecommunication Union (ITU), http://www.itu.int/en/history/Pages/default.aspx, accessed in May 2012, and relevant literature, but it is written in the author's own words.
[22] The Convention used French as the official language (Huurdeman, 2003; Lyall & Larsen, 2009).

Rome, 1871-1872

The International Telegraph Conferences included 19 countries and allowed private companies to attend as observers (as most telegraph cable is laid by private companies).

St. Petersburg, 1875

The Conference created the PP and Administrative Conferences. The PP produced the Convention text (principle), while the Administrative Conference provided the Annex (regulations) (Allison, 1993; Huurdeman, 2003).

Berlin, 1906

The International Radiotelegraph Conference transformed the International Telegraph Union into the International Radiotelegraph Union (Codding, 1991). This conference is an administrative conference with 30 delegate countries. The Conference amended the Annex (the RR) and appointed the Berne Bureau as the central registration office (Huurdeman, 2003; Smith, 1976).

Paris, 1925

In 1924, the International Telephone Consultative Committee (CCIF) was established for technical telephone study (Bellchamers, Francis, Hummel, & Nickelson, 1984).

The Conference founded the International Telegraph Consultative Committee (CCIT) to study technical aspect of telegraphy (Codding, 1991; Huurdeman, 2003; Lyall & Larsen, 2009). In 1956, the CCIF and CCIT were merged to form the International Telegraph and Telephone Consultative Committee (CCITT) (Codding, 1991; Huurdeman, 2003), which became the ITU-T in 1992 at the APP1992.

Washington D.C., 1927

Eighty countries attended the Conference. French was once again the official language, but the Conference allowed non-French speaking country delegates to converse in English (Smith, 1976).

Moreover, the Conference created the International Radio Consultative Committee (CCIR) as the technical committee for radio matters (Allison, 1993; Bellchamers et al., 1984; Codding, 1991; Glazer, 1962; Huurdeman, 2003; Lyall & Larsen, 2009). In 1992, the CCIR became the RA by the APP1992.

The Conference also established the Administrative Council to perform the tasks of the PP between conferences. Finally, private companies were given permission to contact the Berne Bureau directly (Allison, 1993).

Madrid, 1932

The PP merged the telegraph, telephone, and radio sectors into a single international union, ITU. The Madrid Convention developed the ITU Treaty as well as the Telegraph, Telephone,

and Radio Regulations. ITU became effective on 1 January 1934 (Allison, 1993; Codding, 1991, 1995).

4.2 International Telecommunication Conference, 1947

USSR, 1946

The Union of Soviet Socialist Republics (USSR) invited China, France, the UK, and the USA to attend a Moscow meeting on June 25. The USA viewed telecommunication as a private sector activity and declined the invitation. Accordingly, the USSR invited attendance from private enterprise (Glazer, 1962). The meeting proposed housing ITU within the United Nations (UN) and forming a permanent administrative council (Codding, 1991; Huurdeman, 2003; Smith, 1976).

Atlantic City, 1947

The PP adopted proposals from the Moscow meeting for ITU to become a UN special agency (Allison, 1993; Lyall & Larsen, 2009; Smith, 1976) and an administrative council to be established to supervise the Union (Allison, 1993; Codding, 1991, 1995; Huurdeman, 2003; Lyall & Larsen, 2009; Smith, 1976).[23] The PP also established the General Secretariat to replace the Berne Bureau, and moved the administration to Geneva (Allison, 1993; Codding, 1991; Huurdeman, 2003; Smith, 1976).

Moreover, the PP established the International Frequency Registration Board (IFRB) to operate between the International Radiotelegraph Conference meetings. The IFRB updated the Master of Frequency list and solved several international interference issues (Allison, 1993; Codding, 1991, 1995; Huurdeman, 2003; Lyall & Larsen, 2009; Smith, 1976). In 1992, the IFRB became the RRB by the APP1992.

The official ITU languages increased to five to include Chinese, English, French, Russian, and Spanish (Huurdeman, 2003).

4.3 Plenipotentiary Conferences, 1952-2012

Geneva, 1959

The launch of Sputnik in 1957 influenced the Geneva Conference to change the TFA (Glazer, 1962). The PP also separated the Administrative Conference into the Ordinary Administrative Conference (broad regulation) and Extraordinary Administrative Conference (specified agenda) (Smith, 1976).

Moreover, because of the technology change, the PP reviewed ITU's purpose (White & Lauria, 1995).

[23] There were initially 18 members of the Administrative Council.

Montreux, 1965

The PP reviewed the future of the IFRB after establishing the General Secretariat (Codding, 1991) and prepared a draft ITU Constitution for the next meeting (White & Lauria, 1995).

Malaga-Torremolinos, 1973

This PP divided the Convention into the Constitutional Charter (basic provision, purpose, and structure) and the Convention (general regulation) (White & Lauria, 1995).

Nairobi, 1982

During this meeting, the use of the Voluntary Fund and the International Commission (world-wide telecommunication development) were discussed (Codding, 1991, 1995). The PP prepared the text, or ITU's purpose, to be included in the Constitution (White & Lauria, 1995). A schedule of world and regional administrative conferences was also developed for 1983-1988 (Bellchamers et al., 1984).

Nice, 1989

The year 1989 saw the merger of telecommunications and information technology (computing) (Codding, 1991; White & Lauria, 1995), which required a reorganization of ITU's structure (Allison, 1993; Codding, 1995; Goddard, 1994; Lyall, 1997; Lyall & Larsen, 2009; Noll, 2001).

The PP also established the Telecom Development Bureau to replace the Technical Cooperation Department, which operated under the auspices of the General Secretariat (Codding, 1995). The PP also changed the IFRB from a full-time to a part-time working scheme (Codding, 1991, 1995) and reduced the number of CCs conducted (Allison, 1993).

Furthermore, the PP accelerated the speed of standard-making by the CCITT (Codding, 1991) and increased ITU membership (White & Lauria, 1995) by introducing the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), regional standards organizations, and the European Telecommunications Standards Institute (ETSI) in the CCITT and CCIR to the organization (Codding, 1991).

Finally, the PP completed the ITU CS and Convention (CV) (White & Lauria, 1995), and created the High Level Committee (HLC) to reorganize ITU's structure (Allison, 1993; Codding, 1991, 1995; Goddard, 1994; Lyall & Larsen, 2009; White & Lauria, 1995).

Additional Plenipotentiary, 1992

In Geneva, the HLC presented the new ITU structure. (Codding, 1995; Goddard, 1994; Huurdeman, 2003; Lyall, 1997; Lyall & Larsen, 2009; White & Lauria, 1995). The current ITU structure is the result of the APP1992 and its amendments. The amendments to this structure were made at Kyoto 1994, Minneapolis 1998, Marrakesh 2002, and Antalya 2006.

4.4 ITU Constitution

The result of this sequence of reorganizations is the current ITU structure, that is, ITU, an intergovernmental organization comprising Member States and Sector Members (Article 2, CS20). ITU promotes the extension of the benefits of new telecommunication technologies to the world's inhabitants (Article 1, CS6), harmonizes the actions of the Member States, and promotes fruitful and constructive cooperation and partnership between Member States and Sector Members in the attainment of these ends (Article 1, CS8).

The radio functions contained in Article 1 of the CS give ITU the power to: a) allocate radio-frequency spectrum band, allot radio frequencies, and register radiofrequency assignments for space services (any orbital position in geostationary-satellite orbit or any satellites in other orbits); b) coordinate efforts to eliminate intentional interference between radio stations and improve the use of radio-frequency spectrum (for radiocommunication services and of the geostationary-satellite and other satellite orbits); and c) facilitate the global standardization of telecommunications with a satisfactory quality of service.

The ITU Members' rights and obligations are contained in Article 3 of the CS. Furthermore, ITU activity is regulated by the CS, CV, International Telecommunication Regulations, and RR (Article 4 of the CS).

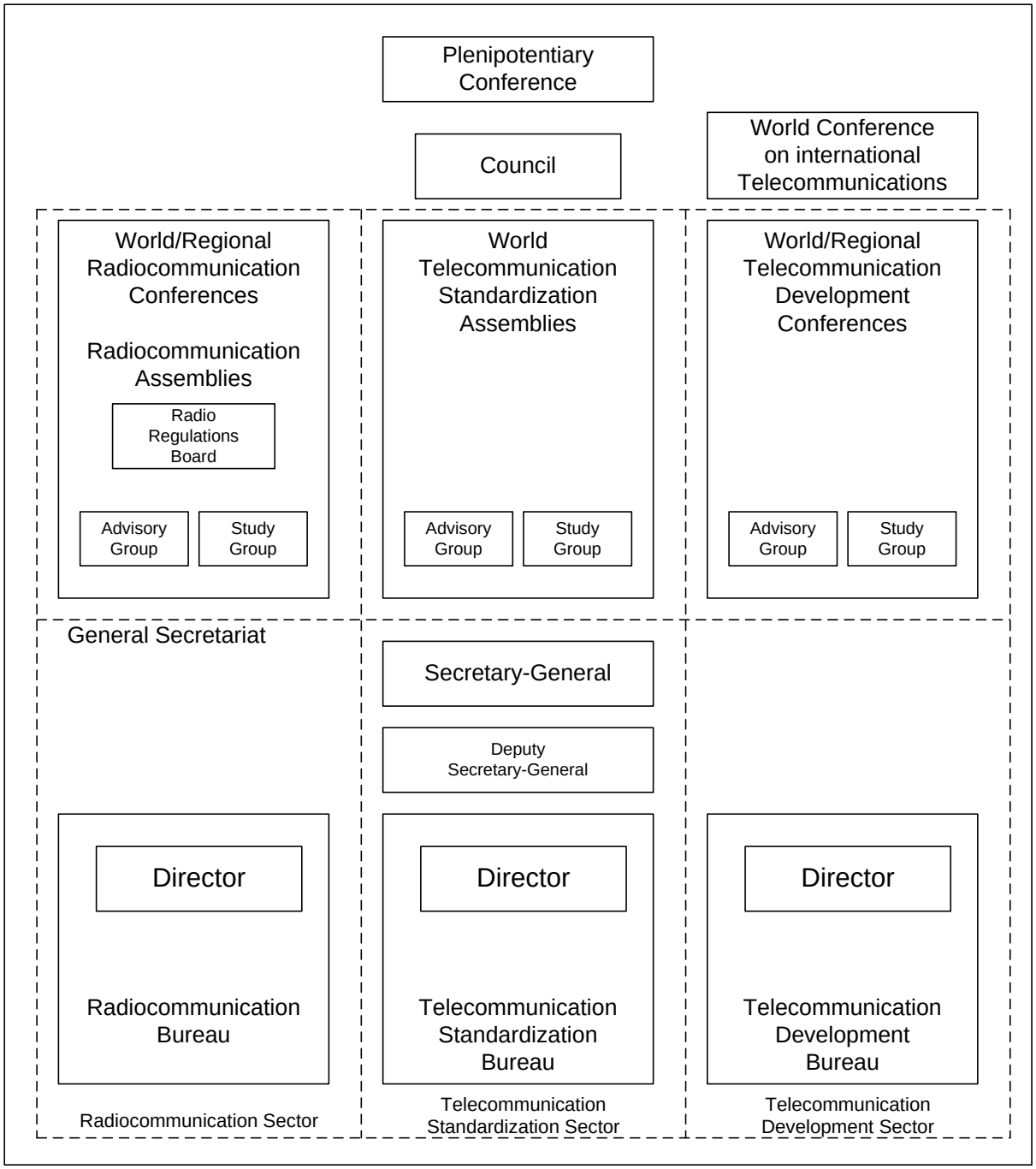
ITU's structure is contained in Article 7 of the CS and includes the PP; CC; World Conference on International Telecommunication; the Radiocommunication Sector: ITU-R (WRC and Regional Radiocommunication Conference, RA and RRB); the Telecommunication Standardization Sector: ITU-T (World Telecommunication Standardization Assemblies); the Telecommunication Development Sector: ITU-D (World and Regional Telecommunication Development Conferences); and the General Secretariat (CS-Article 7 a-g).

Figure 10 shows the internal structure of ITU, based on the *Collection of the Basic Texts of the International Telecommunication Union adopted by the Plenipotentiary Conference* (ITU, 2007a).

The PP is composed of Member States, and it convenes every four years to consider ITU matters, including policy and strategic plans, and budgetary matters, and it elects the members to the CC (Secretary-General, Deputy Secretary-General, Directors of the Sector Bureaux, and the RRB).

The CC is comprised of 48 Member States (25% of the Member States). The CC acts between PP meetings, but with limited power. The CC convenes annually and supervises the ITU Secretary-General.

The ITU-R is comprised of WRC and the Regional Radiocommunication Conferences, RA, RRB, Radio Advisory Group (RAG), and SG. The ITU-R office is the BR and is headed by an elected director.



Source: http://www.itu.int/aboutitu/structure/, Lee, K. (1996), and Hudson, H. E. (1997)

Figure 10. ITU's structure

The ITU-T includes the World Telecommunication Standardization Assemblies, Telecommunication Standardization Advisory Group, and SG. The ITU-T office is the Telecommunication Standardization Bureau and is headed by an elected director.

The ITU-D includes the World and Regional Telecommunication Development Conferences, Telecommunication Development Advisory Group, and SG. The ITU-D office is the Telecommunication Development Bureau and is headed by an elected director.

The APP1992 also changed the World Administrative Radio Conference (WARC to the WRC), CCIR (to the RA), IFRB (to the RRB), and CCITT (to the ITU-T), and required ITU to prepare the work for WRC.

4.5 Summary and discussion on research question

This chapter responds to sub-research question 1: *What is the international spectrum policy setting in terms of the ITU structure, WRC, and RR, and how did they develop?* The study illustrates the development of ITU's structure from 1865 to 1992 in terms of the International Telegraph Conference, International Telecommunication Conference, and Plenipotentiary Conference. The ITU Constitution (after the APP1992) also presents the current ITU structure.

The study explores the relevant literature regarding the ITU structure from available databases and websites. The keyword of the ITU structure and its timeline helps to illustrate the development of the ITU structure. The relevant literature provides the event of the ITU structure change and cross-checks it with the relevant convention. This output of the ITU structure is included in the Convention of the International Telegraph Conference, International Telecommunication Conference, and Plenipotentiary Conference. However, the reasons for the ITU structure change are not included. Some of the literature can complete this missing information from the ITU archives.

The ITU structure was developed from the International Telegraph Conference into the International Telecommunication Conference because of the development of technology from telegraph and radiotelegraph to telecommunication. The structure of ITU had to expand its scope to govern the growth of technology.

Most of the structure change concentrates on the supreme conference, i.e., the International Telegraph Conference, International Telecommunication Conference, and Plenipotentiary Conference. Changes are based on the input document from the Member States and discussions at the conferences.

During the initial stage, both the International Telegraph Conference and the International Telecommunication Conference responded to all matters (the Convention and Annex). The PP and administrative conferences were then separated. The PP now responds to the ITU structure as a main duty of the supreme body, and the administrative conferences take care of the regulations. Moreover, the PP separates the traditional International Telecommunication Convention into the ITU Constitution and the Convention. Here are the milestones of ITU's structure development:

(1) the Secretariat Unit developed from the Berne Bureau (1868) into the ITU General Secretariat (1934)

(2) the Administrative Council (1927) developed into the Councils (1992)

(3) the CCIF (1924) merged with the CCIT (1924) into the CCITT (1956) and developed into the ITU-T (1992)

(4) the CCIR (1927) developed into the ITU-R (1992)

(5) the IFRB (1947) developed into the RRB (1992)

(6) the Technical Cooperation Department developed into the Telecom Development Bureau (1989) and further into the ITU-D (1992)

The major reorganization of the ITU structure is the result of the HLC study (1989-1992). The APP1992 followed the result and approved the ITU structure. The current ITU structure is the result of the APP1992 and its amendments (1994, 1998, 2002, and 2006).

However, the reasons for the ITU structure change are not included in the ITU archives. Only the input and output of the conferences are provided.

This chapter illustrates the ITU structure development over time in order to respond to the first sub-research question: *What is the international spectrum policy setting in terms of the ITU structure, and how did it develop?*

Moreover, interesting changes to the ITU structure highlight the consequences of the rapid growth of telecommunication technologies. The rigid structure of the former ITU structure (before APP 1992) was not suitable for governing the dynamic situation of the rapid development in the telecommunication industry. However, the reason for the ITU structure changes did not explicitly show in the ITU archives. Only the Member States that attended have this missing information. Member States who rely on the ITU archives have incomplete information on the ITU structure change. The first sub-research question, *What is the international spectrum policy setting in terms of the ITU structure, and how did it develop?*, is therefore essential in terms of the ITU structure development to show that the ITU archives cannot capture the rationale underlying the ITU structure changes over time. This sub-research question is important to highlight the missing information as the conclusion of this chapter.

Chapter 5 History of the Radio Regulations

This chapter presents the history of WRC in terms of the RR development since the establishment of ITU (formerly the International Telegraph Union) in 1865. The study illustrates the RR development in terms of the RR provisions development, including key definitions, important provisions, the TFA, and Appendices A, B, C, D, E, F, G, H, I, and J. [24]

5.1 History of WRC

The study reviews the development of WRC, including the PP (International Telegraph Conference, 1865-1875), administrative conferences (International Radiotelegraph Conference, 1903-1947), Ordinary and Extraordinary World Administrative Radio Conference (1959-1992), and WRC (1993-2012).

5.1.1 International Telegraph Conferences, 1865-1875

The International Telegraph Conferences were convened in Paris (1865), Vienna (1868), Rome (1871-1872), and St. Petersburg (1875) to develop the ITU structure. WRC was embedded in the PP. The PP revised the Convention based on the contributions submitted by the Member States. The International Telegraph Conference output is the Convention.

Paris, 1865

The Convention developed general provisions, regulations, and effective dates. These elements are continuing (Codding, 1991; Smith, 1976). However, the Convention did not separate the general provisions (permanent text) from the operating manual (annex).

5.1.2 International Radiotelegraph Conferences, 1903-1947

In 1901, Marconi established coast stations in Belgium, Great Britain, Canada, Ireland, Italy, and Newfoundland. Operators were instructed only to exchange wireless signals between stations that had Marconi's equipment (Codding, 1991; Huurdeman, 2003).

Berlin, 1903

At the Berlin Conference, Wilhelm II called for the removal of Marconi's monopoly power on the radiotelegraph networks to allow distress communications with all ships. Austria, France, Germany, Great Britain, Hungary, Italy, Russia, Spain, and the United States made preliminary arrangements to cancel Marconi's monopoly (Allison, 1993; Glazer, 1962; Huurdeman, 2003; Smith, 1976).

Berlin, 1906

The Conference produced the document as the International Radiotelegraph Convention and the Annex. The Annex included frequency bands (wavelengths), service length of coast station, fees, telegram transmissions (Morse code and SOS distress signals), and the International Bureau.

[24] This chapter is based on the History of the International Telecommunication Union (ITU), http://www.itu.int/en/history/Pages/default.aspx, accessed in May 2012, and relevant literature, but it is written in the author's own words.

London, 1912

After the Titanic disaster (14 April 1912), the Conference mandated that SOS distress signals between coast stations and ships be allowed regardless of the brand of the equipment. This was the end of Marconi's monopoly (Huurdeman, 2003).

Washington D.C., 1927

The Conference canceled the use of high-power spark transmitters (greater than 150 Watts) and included the right to be protected from interference (Allison, 1993; Huurdeman, 2003).

Atlantic City, 1947

The Conference reviewed the entire TFA to meet World War II requirements (Glazer, 1962).

5.1.3 Ordinary and Extraordinary Administrative Radio Conferences, 1959-1992

In 1959, the Conference reviewed the entire RR provisions, including the TFA (including the allocation for space services), provisions, and footnotes (Glazer, 1962).

Table 12. List of Ordinary and Extraordinary Administrative Radio Conferences 1959-1992

Ordinary	**Title**	
	Administrative Radio Conference, Geneva, 1959	ARC-59
	World Administrative Radio Conference, Geneva, 1979	WARC-79
Extraordinary	**Topic**	
	Allocate frequency bands for space radiocommunication purposes, Geneva, 1963	Spa-63
	Prepare a revised allotment plan for the aeronautical mobile (R) service, Geneva, 1966	Aer-66
	Maritime mobile service, Geneva, 1967	Mar-67
	Space telecommunications, Geneva, 1971	WARC-71
	Maritime, Geneva, 1974	Mar-74
	Broadcasting-satellite, Geneva, 1977	HFBC-77
	Aeronautical mobile (R) service, Geneva, 1978	Aer-78
	Mobile services (1st session), Geneva, 1983	Mob-83
	Planning of HF bands allocated to broadcasting service (1st session), Geneva, 1984	HFBC-84
	Use of geostationary-satellite orbit and planning of space services utilizing it (1st session), Geneva, 1985	Orb-85
	Planning of HF bands allocated to broadcasting service (2nd session), Geneva, 1987	HFBC-87
	Mobile services (2nd Session), Geneva, 1987	Mob-87
	Use of geostationary-satellite orbit and planning of space services utilizing it (2nd session), Geneva, 1988	Orb-88
	Frequency allocations in certain parts of the spectrum, Málaga-Torremolinos, 1992	WARC-92

However, the fourteenth Extraordinary Administrative Conference only reviewed the RR according to a specified agenda. Table 12 shows the list of Ordinary and Extraordinary Administrative Conferences (1959-1992).

5.1.4 World Radiocommunication Conferences, 1993-2012

The APP1992 mandated the WRC-93 to prepare the WRC-95 and WRC-97 agendas. Initially, two years (WRC-95 and WRC-97) were used. After 1997, the WRC convened between the PPs (Article 3, CV24). The WRC preparatory work was done by the CPM as part of the ITU-R SG.

5.2 RR versions and WRC

The development of WRC can be captured through the RR revisions. Table 13 and Table 14 show the relation between WRCs and the RRs.

Table 13. RR versions and WRC, 1906-1994

Conference	RR versions by years																		
	06	12	27	32	38	47	59	68	71	76	78	79	81	82	85	86	88	90	94
Berlin, 1903																			
Berlin, 1906	x																		
London, 1912		x																	
Washington D.C., 1927			x																
Madrid, 1932				x															
Cairo, 1938					x														
Atlantic City, 1947						x													
ARC-59							x												
Spa-63								x	x	x		x	x	x					
Aer-66								x	x	x		x	x						
Mar-67								x	x	x		x	x						
WARC-71									x	x		x	x						
Mar-74										x		x	x						
HFBC-77												x	x						
Aer-78												x	x						
WARC-79													x	x					
Mob-83															x	x	x	x	x
HFBC-84																			
Orb-85																x	x	x	x
HFBC-87																	x	x	x
Mob-87																		x	x
Orb-88																		x	x
WARC-92																			x

Table 14. RR versions and WRC, 1993-2012

RR / Conferences	1996	1998	2001	2004	2008	2012
WRC-93						
WRC-95	x					
WRC-97		x				
WRC-2000			x			
WRC-03				X		
WRC-07					x	
WRC-12						x

5.3 RR definitions

5.3.1 Telecommunication

The definition of "telecommunication" first appeared at the Madrid Convention. The Conference merged telegraph, telephone, and radio into telecommunication. The definition appears in the Annex of "Definition of Terms," Madrid 1932 Convention, p. 25:

"Telecommunication: Any telegraphic or telephonic communication of signs, signals, writing, facsimiles and sounds of any kind, by wire, wireless or other systems or processes of electric signalling or visual signalling (semaphores)" (ITU, 1932b, p. 25). This definition was also used in Cairo (ITU, 1938, p. 1).

In 1947, the definition included "any transmission, emission, or reception" and is found in Chapter 1, Article 1, the RR, p. 1:

"Telecommunication: Any transmission, emission or reception of signs, signals, writing, images and sounds or intelligence of any nature by wire, radio, visual or other electromagnetic systems" (ITU, 1947, p. 1).[25]

The PP Malaga-Torremolinos changed the definition found in Chapter 1 (Article 1, RR, p. RR1-1):

"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" (ITU, 1982, pp. RR1-1).[26]

Table 15 shows the analysis of the "Telecommunication" definition of RR1932, RR1947 and RR1982 categorized by communication type, transmission object, and medium type.

[25] This definition was used at the following nine conferences:
1) The ARC-59 according to Chapter 1, Article 1, the RR, p. 3. (ITU, 1959)
2) The Spa-63 according to Chapter 1, Article 1, the RR, p. 5 (ITU, 1968)
3) The Aer-66 according to Chapter 1, Article 1, the RR, p. 5 (ITU, 1968)
4) The Mar-67 according to Chapter 1, Article 1, the RR, p. 5 (ITU, 1968)
5) The WARC-71 according to Chapter 1, Article 1, the RR, p. RR1-1 (ITU, 1971)
6) The Mar-74 according to Chapter 1, Article 1, the RR, p. RR1-1 (ITU, 1976)
7) The HFBC-77. There was no change in the RR edition of 1979 regarding the definition of "telecommunication" (ITU, 1979)
8) The Aer-78. There was no change in the RR edition of 1979 regarding the definition of "telecommunication" (ITU, 1979)
9) The WARC-79. There was no change in the RR edition of 1981 regarding the definition of "telecommunication" (ITU, 1981)

[26] This definition was used at the following 12 conferences and continues effectively until 2012:
1) The Mob-83. There was no change in the RR edition of 1985 regarding the definition of "telecommunication" (ITU, 1985)
2) The Orb-85 according to Chapter 1, Article 1, the RR, p. RR1-1 (ITU, 1986)
3) The HFBC-87. There was no change in the RR edition of 1988 regarding the definition of "telecommunication" (ITU, 1988)
4) The Mob-87 according to Chapter 1, Article 1, the RR, p. RR1-1 and 2 (ITU, 1990)
5) The Orb-88 according to Chapter 1, Article 1, the RR, p. RR1-1 and 2 (ITU, 1990)
6) The WARC-92 according to Chapter 1, Article 1, the RR, p. RR1-2 (ITU, 1994)
7) The WRC-95. There was no change in the RR edition of 1996 regarding the definition of "telecommunication" (ITU, 1996)
8) The WRC-97 according to Article S1.3, p. 7 of the RR edition of 1998 (ITU, 1998) and the Constitution (CS1012)
9) The WRC-2000 according to Article 1.3, p. 7 of the RR edition of 2001 (ITU, 2001) and the Constitution (CS1012)
10) The WRC-03 according to Article 1.3, p. 7 of the RR edition of 2004 (ITU, 2004) and the Constitution (CS1012)
11) The WRC-07 according to Article 1.3, p. 7 of the RR edition of 2008 (ITU, 2008) and the Constitution (CS1012)
12) The WRC-12 according to Article 1.3 of the RR edition of 2012 (ITU, 2012b)

Table 15. Telecommunication definition

Version	Communication	Transmission object	Medium
1932	Telegraphic or telephonic	Signs, signals, writing, facsimiles and sounds of any kind	Wire, wireless, or other systems or processes of electric signaling or visual signaling (semaphores)
1947	Transmission, emission, or reception	Signs, signals, writing, images, and sounds or intelligence of any nature	Wire, radio, visual, or other electromagnetic systems
1982	Transmission, emission, or reception	Signs, signals, writing, images, and sounds or intelligence of any nature	Wire, radio, optical, or other electromagnetic systems

Communication

The meaning of communication changed between the RR1932 and RR1947 (1982) because of the technology differences. The RR1932 provided telegraph and telephone. The RR1947 and RR1982 expanded into the general communication types: transmission, reception, and emission.

Transmission object

The RR1932 had “facsimiles,” but the RR1947 and RR1982 replaced “facsimiles” by “image” and extended the definition to “intelligence of any nature.”

Medium type

The RR1932 provided wireless, electric signaling, or visual signaling (semaphores). However, the RR1947 replaced “wireless” with “radio,” “electric signaling” with “electromagnetic system,” and “visual signaling (semaphores)” (the arm attached to a tower that sends visual signals between stations) with “visual.” However, visual is not the medium. The medium is the light that enables the sighting of an object.

The RR1982 replaced “visual” with “optical.” The optical communication includes optical cables and links.

The current “telecommunication” definition should be sufficient for future development because it expands “transmission” and “medium” to cover possible telecommunication technology.

5.3.2 Radiocommunication

The RR1932 provided the definition “radiocommunication” in the Annex of “Definition of Terms” on p. 25 of the Madrid Convention:

“Radiocommunication: Any telecommunication by means of Hertzian waves” (ITU, 1932b, p. 25).

This definition was used in Cairo (ITU, 1938, p. 1) and Atlantic City (ITU, 1947, p. 1).

The ARC-59 replaced “Hertzian waves” with “radio waves,” and it is found in Chapter 1 (Article 1, RR, p. 4):

"Radiocommunication: Telecommunication by means of radio waves" (ITU, 1959, p. 4).[27]

The differences between the RR1932 and RR1959 were "Hertzian" and "radio."

5.3.3 Radio waves

The definition of "Hertzian Waves" first appeared in Atlantic City and is found in the Annex to Chapter 1, Article 1, p. 1:

"Hertzian Waves: Electromagnetic waves of frequencies between 10 kc/s and 3 000 000 Mc/s" (ITU, 1947, p. 1).

The ARC-59 changed the definition found in Chapter 1, Article 1, the RR, p. 4:

"Radio Waves (or Hertzian Waves): Electromagnetic waves of frequencies lower than 3 000 Gc/s, propagated in space without artificial guide" (ITU, 1959, p. 4).[28]

The differences were "radio waves" and "propagated in space without artificial guide."

The Mar-74 changed the definition found in Chapter 1 (Article 1, RR, p. RR1-2 from c/s to Hz):

"Radio Waves (or Hertzian Waves): Electromagnetic waves of frequencies lower than 3 000 GHz, propagated in space without artificial guide" (ITU, 1976, pp. RR1-2).[29]

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[27] This definition was used at the following 21 conferences and continues effectively until 2012:
1) The Spa-63 according to Chapter 1, Article 1, the RR, p. 6 (ITU, 1968)
2) The Aer-66 according to Chapter 1, Article 1, the RR, p. 6 (ITU, 1968)
3) The Mar-67 according to Chapter 1, Article 1, the RR, p. 6 (ITU, 1968)
4) The WARC-71 according to Chapter 1, Article 1, the RR, p. RR1-2 (ITU, 1971)
5) The Mar-74 according to Chapter 1, Article 1, the RR, p. RR1-2 (ITU, 1976)
6) The HFBC-77. There was no change in the RR edition of 1979 regarding the definition of "radiocommunication" (ITU, 1979)
7) The Aer-78. There was no change in the RR edition of 1979 regarding the definition of "radiocommunication" (ITU, 1979)
8) The WARC-79. There was no change in the RR edition of 1981 regarding the definition of "radiocommunication" (ITU, 1981)
9) The PP Malaga-Torremolinos 1973 Convention used the same definition as ARC-59 (ITU, 1982, pp. RR1-1 and 2)
10) The Mob-83. There was no change in the RR edition of 1985 regarding the definition of "radiocommunication" (ITU, 1985)
11) The Orb-85 according to Chapter 1, Article 1, the RR, p. RR1-1 and 2 (ITU, 1986)
12) The HFBC-87. There was no change in the RR edition of 1988 regarding the definition of "radiocommunication" (ITU, 1988)
13) The Mob-87 according to Chapter 1, Article 1, the RR, p. RR1-1 and 2 (ITU, 1990)
14) The Orb-88 according to Chapter 1, Article 1, the RR, p. RR1-1 and 2 (ITU, 1990)
15) The WARC-92 according to Chapter 1, Article 1, the RR, p. RR1-2 (ITU, 1994)
16) The WRC-95. There was no change in the RR edition of 1996 regarding the definition of "radiocommunication" (ITU, 1996)
17) The WRC-97 according to Article S1.6, p. 7 of the RR edition of 1998 (ITU, 1998), the Constitution (CS1009), and the Convention (1005)
18) The WRC-2000 according to Article 1.6, p. 7 of the RR edition of 2001 (ITU, 2001) and the Constitution (CS1009), and the Convention (1005)
19) The WRC-03 according to Article 1.6, p. 7 of the RR edition of 2004 (ITU, 2004) and the Constitution (CS1009), and the Convention (1005)
20) The WRC-07 was also the same as the RR of the ARC-59 according to Article 1.6, p. 7 of the RR edition of 2008 (ITU, 2008), the Constitution (CS1009), and the Convention (1005)
21) The WRC-12 according to Article 1.3 of the RR edition of 2012 (ITU, 2012b)

[28] This definition was used at the four following conferences:
1) The Spa-63 according to Chapter 1, Article 1, the RR, p. 6 (ITU, 1968)
2) The Aer-66 according to Chapter 1, Article 1, the RR, p. 6 (ITU, 1968)
3) The Mar-67 according to Chapter 1, Article 1, the RR, p. 6 (ITU, 1968)
4) The WARC-71 according to Chapter 1, Article 1, the RR, p. RR1-2 (ITU, 1971)

[29] This definition was used at the three following conferences:
1) The HFBC-77. There was no change in the RR edition of 1979 regarding the definition of "radio waves" (ITU, 1979)
2) The Aer-78. There was no change in the RR edition of 1979 regarding the definition of "radio waves" (ITU, 1979)
3) The definition of "radio waves" in WARC-79 was also the same as the RR of the Mar-74, edition of 1976. There was no change in the RR edition of 1981 regarding definition of "radio waves" (ITU, 1981)

PP Malaga-Torremolinos changed the definition, which is found in Chapter 1 (Article 1, RR, p. RR1-1):

"Radio Waves or Hertzian Waves: Electromagnetic waves of frequencies arbitrarily lower than 3 000 GHz, propagated in space without artificial guide" (ITU, 1982, pp. RR1-1).[30]

The differences were the deletion of parenthesis "()" and the addition of "arbitrarily." The "arbitrarily" represents unspecified frequency lower than 3 000 GHz.

Table 16 presents the analysis of "radio waves" of the RR1947, RR1959, RR1976, and RR1982.

Table 16. Radio wave definition

Version	Heading	Medium	Text	Frequency unit	Propagation mode
1947	Hertzian Waves	Electromagnetic waves of frequencies	Between 10 kc/s and 3 000 000	Mc/s	None
1959	Radio Waves (or Hertzian Waves)	Electromagnetic waves of frequencies	Lower than 3 000	Gc/s	Propagated in space without any artificial guide
1976	Radio Waves (or Hertzian Waves)	Electromagnetic waves of frequencies	Lower than 3 000	GHz	Propagated in space without any artificial guide
1982	Radio Waves or Hertzian Waves	Electromagnetic waves of frequencies	Arbitrarily lower than 3 000	GHz	Propagated in space without any artificial guide

The RR1947 introduced "Hertzian waves" and replaced it with "Radio waves or Hertzian wave" in the RR1959, RR1976, and RR1982.

The propagation mode is inserted to differentiate between waves travelling in free space and with a waveguide. Only waves that travel in free space without any artificial guide need to be regulated.

The RR1982 added "arbitrarily" to include all unspecified frequency.

5.3.4 Radio

The definition of "Radio" first appeared in Atlantic City and is found in the Annex, Chapter 1, Article 1, p. 2:

"Radio: A general term applied to the use of Hertzian waves" (ITU, 1947, p. 2).

[30] This definition was used in the following 12 conferences and continues effectively until 2012:
1) The Mob-83. There was no change in the RR edition of 1985 regarding the definition of "radio waves" (ITU, 1985)
2) The Orb-85 according to Chapter 1, Article 1, the RR, p. RR1-1 (ITU, 1986)
3) The HFBC-87. There was no change in the RR edition of 1988 regarding the definition of "radio waves" (ITU, 1988)
4) The Mob-87 according to Chapter 1, Article 1, the RR, p. RR1-1 and 2 (ITU, 1990)
5) The Orb-88 according to Chapter 1, Article 1, the RR, p. RR1-1 and 2 (ITU, 1990)
6) The WARC-92 according to Chapter 1, Article 1, the RR, p. RR1-2 (ITU, 1994)
7) The WRC-95. There was no change in the RR edition of 1996 regarding the definition of "radio waves" (ITU, 1996)
8) The WRC-97 according to Article S1.5, p. 7 of the RR edition of 1998 (ITU, 1998)
9) The WRC-2000 according to Article 1.5, p. 7 of the RR edition of 2001 (ITU, 2001)
10) The WRC-03 according to Article 1.5, p. 7 of the RR edition of 2004 (ITU, 2004)
11) The WRC-07 according to Article 1.5, p. 7 of the RR edition of 2008 (ITU, 2008)
12) The WRC-12 according to Article 1.3 of the RR edition of 2012(ITU, 2012b)

The ARC-59 changed the definitions and again they are found in Chapter 1, Article 1, the RR, p. 4:

"Radio: A general term applied to the use of radio waves" (ITU, 1959, p. 4).[31]

The RR1959 replaced "Hertzian" with "Radio" in line with the "Radio Wave" definition.

5.4 RR provisions

The development of selected RR provisions, including choice of apparatus, services, stations, licenses, frequency assignment in general, and allocation, allotment, and assignment definition, are examined below.

5.4.1 Choice of apparatus

The Berlin 1906 Conference first revised the Choice of Apparatus provision to allow all communication between coast stations and ships at sea, regardless of the brand of equipment. The provision is contained in Article I of the Rule of Services of the Annex to the Berlin 1906 Convention:

"Le choix des appareils et des dispositifs radiotélégraphiques à employer par les stations côtières et les stations de' bord est libre. L'installation de ces stations doit répondre, autant que possible, aux progrès scientifiques et techniques" (ITU, 1906b, p. 361).

The choice of radiotelegraphy apparatus and devices to be used by the coastal stations and on-board stations is free. The installation of these stations must, as far as possible, match scientific and technical progress (English translation).

Marconi thus did not follow the Convention until the tragedy of the Titanic. Only then did Marconi allow his coast stations to communicate with all ships at sea.

The London Conference did not change the provision. Article 1 of the Detailed Service Regulations appended to the London 1912 Convention state that:

[31] This definition was used in the following 21 conferences and continues effectively until 2012:
1) The Spa-63 according to Chapter 1, Article 1, the RR, p. 6 (ITU, 1968)
2) The Aer-66 according to Chapter 1, Article 1, the RR, p. 6 (ITU, 1968)
3) The Mar-67 according to Chapter 1, Article 1, the RR, p. 6 (ITU, 1968)
4) The WARC-71 according to Chapter 1, Article 1, the RR, p. RR1-2 (ITU, 1971)
5) The Mar-74 according to Chapter 1, Article 1, the RR, p. RR1-2 (ITU, 1976)
6) The HFBC-77. There was no change in the RR edition of 1979 regarding the definition of "radio" (ITU, 1979)
7) The Aer-78. There was no change in the RR edition of 1979 regarding the definition of "radio" (ITU, 1979)
8) The WARC-79. There was no change in the RR edition of 1981 regarding the definition of "radio" (ITU, 1981)
9) The PP Malaga-Torremolinos 1973 Convention also used the same definition as ARC-59 (ITU, 1982, pp. RR1-1 and 2)
10) The Mob-83. There was no change in the RR edition of 1985 regarding the definition of "radio" (ITU, 1985)
11) The Orb-85 according to Chapter 1, Article 1, the RR, p. RR1-1 and 2 (ITU, 1986)
12) The HFBC-87. There was no change in the RR edition of 1988 regarding the definition of "radio" (ITU, 1988)
13) The Mob-87 according to Chapter 1, Article 1, the RR, p. RR1-1 and 2 (ITU, 1990)
14) The Orb-88 according to Chapter 1, Article 1, the RR, p. RR1-1 and 2 (ITU, 1990)
15) The WARC-92 according to Chapter 1, Article 1, the RR, p. RR1-2 (ITU, 1994)
16) The WRC-95. There was no change in the RR edition of 1996 regarding the definition of "radio" (ITU, 1996)
17) The WRC-97 according to Article S1.4, p. 7 of the RR edition of 1998 (ITU, 1998)
18) The WRC-2000 according to Article 1.4, p. 7 of the RR edition of 2001 (ITU, 2001)
19) The WRC-03 according to Article 1.4, p. 7 of the RR edition of 2004 (ITU, 2004)
20) The WRC-07 according to Article 1.4, p. 7 of the RR edition of 2008 (ITU, 2008)
21) The WRC-12 according to Article 1.3 of the RR edition of 2012 (ITU, 2012b)

"The choice of radiotelegraph apparatus and devices to be used by coast stations and ship stations is free. The installation of these stations must, as far as possible, be in keeping with scientific and technical progress" (ITU, 1912a, p. 187).

The Washington D.C. Conference revised the provisions. In Article 3, Choice of Calibration of Apparatus, General Regulations Annexed to the Washington D.C. 1927 Convention:

"The choice of the radioelectric apparatus and devices to be used by a station is free, provided that the waves emitted are in conformity with the provisions of these Regulations" (ITU, 1927, p. 32).[32]

The Conference clarified "scientific and technical progress" by adding "conformity with the provision of these Regulations."

The Atlantic City Conference deleted "radioelectric, free" and added "unrestricted." In Article 16, Choice of Apparatus, 395 § 1 of the RR, which is annexed to the Atlantic City 1947 Convention:

"The choice of apparatus and devices to be used in a station shall be unrestricted, provided that the performance thereof and the emissions therefrom satisfy the provisions of these Regulations" (ITU, 1947, p. 87).

In Geneva, the Conference changed "choice of apparatus" to "technical characteristics of station" in Article 12 (Technical characteristic of equipment and emission, 667 § 1, RR1959):

"The choice and performance of equipment to be used in a station and any emissions therefrom shall satisfy the provisions of these Regulations" (ITU, 1959, p. 144).[33]

Table 17 shows the "Choice of apparatus" provisions.

Choices

The RR1906-1947 uses "choice of apparatus" as equipment and devices. The RR1959 changed "apparatus and devices" to "performance of equipment."

Location

The RR1906 and RR1912 limit the location of apparatus to coast and ship stations. The RR1927 revised the provision to be able to use "choice of apparatus" by any station.

[32] This provision was used in the two following RR:

1) General Radiocommunication Regulations annexed to the International Telecommunication Convention, Madrid 1932, Article 4, the RR, p. 8, [37] §1 of the RR (ITU, 1932a) . The difference was "these" and "present"
2) General Radiocommunication Regulations annexed to the International Telecommunication Convention, Cairo 1938, Article 4, the RR, p. 6, 52§1 of the RR (ITU, 1938)

[33] This provision was used in the ten following RR and has continued until 2012:

1) Article 12, Technical Characteristics of Equipment and Emission, 667 § 1. (1) of the RR (ITU, 1968, 1976)
2) Article 5, Technical Characteristics of Stations, 299 § 1. (1) of the RR (ITU, 1982, 1990, 1994)
3) Article S3, Technical Characteristics of Stations, S3.1, of the RR (ITU, 1998)
4) Article 3, Technical Characteristics of Stations, 3.1 of the RR (ITU, 2001, 2004, 2008, 2012b)

General Provision

The RR1906 and RR1912 did not define the scope of "choice of apparatus;" however, the RR1927 limited the scope of "choice of apparatus" to the RR provisions.

Table 17. Choice of apparatus provision

Version	Choice	Location	General provision
1906	Apparatus and radio departments	Coast stations and the stations and ship station	Installations should respond, if possible, to scientific and technical progress
1912	Radiotelegraph apparatus and devices	Coast stations and ship stations	Installations must, as far as possible, be in keeping with scientific and technical progress
1927	Radioelectric apparatus and devices	Any station	Waves emitted conform to the provisions of the Regulations
1947	Apparatus and devices	Any station	Performance thereof and emissions therefrom satisfy the provisions of the Regulations
1959	Equipment and its performance	Any station and emission therefrom	Satisfy the provisions of the Regulations

5.4.2 Frequency assignment

The frequency assignment provision is initiated at the Washington D.C. Convention, Article 5 (Distribution and use of frequencies [wave lengths] and types of emission, §1):

"The administrations of the contracting governments may assign any frequency and any type of wave to any radioelectric station under their authority upon the sole condition that no interference with any service of another country results therefrom" (ITU, 1927, p. 35).

The Madrid Conference revised the provision (see General Radiocommunication Regulation, Article 7, Distribution and use of frequencies [wavelengths] and type of emission, ["] § 1):

"Subject to the provisions of section (5) of § 5 below, the Administrations of the contracting countries may assign any frequency and any type of wave to any radioelectric station under their authority, upon the sole condition that no interference with any service of another country results therefrom" (ITU, 1932a, p. 11).[34]

The Atlantic City Conference revised the provision. The provision is contained in the Annex to the Atlantic City 1947 Convention, Article 3, General rules for the assignment and use of frequencies, 86§1:

"The countries, members of the Union, adhering to these Regulations, agree that in assigning frequencies to stations which, by their very nature, are capable of causing harmful interference to the services rendered by the stations of another country, they will make such

[34] This provision was used in Cairo 1938 with slight changes to the relevant provision in the General Radiocommunication Regulation, Article 7, Distribution and use of frequencies (wavelengths) and type of emission, 79§1, p. 8 of the RR (ITU, 1938).

assignments in accordance with the table of frequency allocations and other provisions of this chapter" (ITU, 1947, p. 16).

The RR1959, RR1968, and RR1976, revised the provision (Article 3 General rules for the assignment and use of frequencies, 113 §1):

"The Members and Associate Members of the Union agree that in assigning frequencies to stations, which are capable of causing harmful interference to the services rendered by the stations of another country, such assignments are to be made in accordance with the Table of Frequency Allocations and other provisions of these Regulations" (ITU, 1959, p. 21, 1968, pp. RR3-1, 1976, pp. RR3-1).

The RR1982 revised the provision in Article 6 General rules for the assignment and use of frequencies, 340 § 2 of the RR:

"Members undertake that in assigning frequencies to stations which are capable of causing harmful interference to the services rendered by the stations of another country, such assignments are to be made in accordance with the Table of Frequency allocation and other provisions of these Regulations" (ITU, 1982, pp. RR6-1).[35]

Table 18. Frequency assignment provisions

Version	Authority	Harmful interference	General provision
1927	Administration of contracting governments	Assign any frequency and wave to any radioelectric station under their authority on the condition that there is no interference with other country services	None
1932	Administration of contracting countries	Assign any frequency and wave to any radioelectric station under their authority on the condition that there is no interference with other country services	Section (5) of § 5
1947	Countries, ITU Members, adhering to the Regulations	Recognize that assigning frequencies to stations can cause harmful interference to other country services	Assignments accord with the Table of Frequency Allocations and other provisions
1976	ITU Members and Associate Members of the Union	Recognize that assigning frequencies to stations can cause harmful interference to other country services	Assignments accord with the Table of Frequency Allocations and other provisions of the Regulations
1982	Members	Recognize that assigning frequencies to stations can cause harmful interference to other country services	Assignments accord with the Table of Frequency Allocations and other provisions of the Regulations

[35] This provision was used in seven of the following RR and continued to be in use until 2012:
1) Article 6 General rules for the assignment and use of frequencies, 340 § 2 of the RR (ITU, 1990, 1994)
2) Article S4, Assignment and use of frequencies, Section I General rules, S4.2 of the RR (ITU, 1998)
3) Article 4, Assignment and use of frequencies, Section I General rules, 4.2 of the RR (ITU, 2001, 2004, 2008, 2012b)

Table 18 shows the development of the “frequency assignment” provision. Three concepts have been developed: authority, harmful interference, and general provision.

Authority

The provision developed from “Administration of the Contracting Government or Countries,” “Countries, members of Union,” “Members and Associated Members,” to “Members.” The “Members” is defined as the ITU Members.

Harmful interference

While RR1927, RR1932, RR1947, RR1976, and RR1982 revised the provision, the concept of “not causing harmful interference” remained.

General provisions

The RR1932 established the specific provision (Section (5) of § 5). However, the RR1947, RR1976, and RR1982 revised the provision by referring to the TFA and RR provisions.

5.4.3 Licences

Licenses are tools that control devices and frequencies. The Berlin Conference established the provision contained in Article 6 (§ 1 of the Rule of Services Annexed to the Berlin 1906 Convention):

“Aucune station de bord ne peut être établie ou exploitée par une entreprise privée sans autorisation du Gouvernement dont dépend le navire. Cette autorisation fait l’objet d’une licence délivrée par ce Gouvernement” (ITU, 1906b, p. 362).

No on-board station may be established or operated by a private enterprise without authorisation from the government to which the ship belongs. This authorisation is the subject of a licence issued by this government (English translation).

The London Conference revised the provision via Article 9 (1 of Detailed Service Regulations appended to the London 1912 Convention):

“No ship station may be established or worked by private enterprise without licence issued by the Government to which ship is subject” (ITU, 1912a, p. 190).

Later, the Washington Conference further revised the provision via Article 2§1 (General Regulations, Annexed to Washington 1927 Convention):

“No radioelectric sending station shall be established or worked by an individual person or by a private enterprise without a special licence issued by the Government of the country to which the station in question is subject” (ITU, 1927, p. 31).

A Madrid revision is in Article 3, ["] § 1- (1) (General Radiocommunication Regulation, Madrid 1932 Convention):

“No sending station shall be established or worked by an individual person, or by any enterprise, without a special licence issued by the Government to which the station in question is subject” (ITU, 1932a, p. 7).

The differences between the RR1927 and RR1932 are in the deletion of “radioelectric” and “private,” but the “private” was reinserted at the RR1938.

Additionally, the Cairo Conference added “of the country” in Article 3 (47 § 1. (l), General Radiocommunication Regulation, Cairo 1938 Convention):

“No sending station may be established or worked by a private person, or by any enterprise, without a special licence issued by the Government of the country to which the station in question is subject” (ITU, 1938, p. 5).

Furthermore, the Atlantic City Conference changed from “sending” to “transmitting” in Article 22 (Choice of Apparatus, 488 § 1 (1) of RR annexed to the Atlantic City 1947 Convention):

“No transmitting station may be established or operated by a private person or by any enterprise without a licence issued by the government of the country to which the station in question is subject” (ITU, 1947, p. 105).[36]

The RR1982 revised the provision by also adding “conformity with the provision” in Article 24 (Licences, § 1. (1) of RR1982):

“No transmitting station may be established or operated by a private person or by any enterprise without a licence issued in an appropriate form and in conformity with the provision of these Regulation by the government of the country to which the station in question is subject” (However, see Nos. 2021, 2027 and 2030)” (ITU, 1982, pp. RR24-21).[37]

Finally, the WRC-98 added “or on behalf of” in order to include other parties that act on behalf of the administration. The revision is found in Article S18 (Licences, S18.1 § 1, 1) of RR1998):

“No transmitting station may be established or operated by a private person or by any enterprise without a licence issued in an appropriate form and in conformity with the provisions of these Regulations by or on behalf of the government of the country to which the station in question is subject (however, see Nos. S18.2, S18.8 and S18.11)” (ITU, 1998, p. 202).[38]

Table 19 shows the development of the “Licences” provision.

[36] This provision was used in four of the following RR with a slightly changed relevant provision in RR:
1) Article 18, Licences, 725§1 of the RR (ITU, 1959)
2) Article 18, Licences, 18§1 (1) of the RR (ITU, 1968, 1971, 1976)

[37] This provision was used in two of the following RR in Article 24, Licences, §1(1) of the RR (ITU, 1990, 1994).

[38] This provision was used in four consequent RRs with slight changes to the relevant provision in RR, Article 18, Licences, 18.1§1 (1) of the RR (ITU, 2001, 2004, 2008, 2012b).

Table 19. Licence provisions

Version	Station	Operator	Licences	Authority
1906	Ship	Private company	Government permission	Government
1912	Ship	Private enterprise	Licence issue	Government
1927	Radioelectric sending station	Individual person or private enterprise	Special licence issue	Government
1932	Sending station	Individual person or private enterprise	Special licence issue	Government
1938	Sending station	Private person or enterprise	Special licence issue	Government
1947	Transmitting station	Private person or enterprise	Licence issue	Government
1982	Transmitting station	Private person or enterprise	Licence issue that conforms with regulations	Government
1998	Transmitting station	Private person or enterprise	Licence issue that conforms with regulations	By or on behalf of the Government

Station

The concept of stations developed from “ship stations,” “radioelectric sending station” to “transmitting station.”

Operator

Operators that control the use of radiocommunication stations developed from “private company,” “private enterprise,” “individual person,” to “private person and any enterprise.”

Licenses

Permission to use radiocommunication stations developed from “ship station,” “special licences” to “licences.” The RR1982 provision limited the use of licenses to those specified by the Regulations.

Authority

The concept of authority initially focused on the Government (RR1906, RR1912, RR1927, RR1932, RR1938, RR1947, and RR1982), but is later extended to those acts on behalf of the Government (RR1998).

5.4.4 Allocation, allotment, and assignment

The initial definition of allocation, allotment, and assignment is provided in the RR1982 and remains unchanged.

The definitions are contained in Section II – Specific terms related to frequency management (2.1, 2.2, and 2.3 of the RR1982):

“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.

“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.

“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” (ITU, 1982, pp. RR1-3).

These definitions are also found in the RR1990 and RR1994 (ITU, 1990, 1994). The provision numbers were changed to S1.16, S1.17, and S1.18 at the RR1998 (ITU, 1998). However, the provision numbers reverted to 1.16, 1.17, and 1.18, respectively in the RR2001, RR2004, RR2008, and RR2012 (ITU, 2001, 2004, 2008, 2012b).

5.4.5 Service priority

The service priority indicates an ability to claim protection from interference.

In 1906 and 1912, services were allocated through a paragraph describing the use of frequency or wavelength.

The RR1927 provides the initial TFA. However, RR1927, RR1938, and RR1947 do not indicate any service priority, namely, all services have the same priority.

In Geneva in 1959, the service priority was officially established, i.e., primary, permitted, and secondary services. However, primary and permitted services have the same priority. Importantly, permitted services have a lower priority than primary services in the allocation of frequency bands.

The secondary services are not permitted to cause any interference. Nor can a secondary service claim protection from primary and permitted services.

Primary, permitted, and secondary services are found in Article 5 (Section II. Categories of Services and Allocations, Primary Services, Permitted Services, and Secondary Services, 137-141, of the RR1959) (ITU, 1959, pp. 26-27).[39]

[39] This provision was used in the RR editions of 1968, 1971, and 1976 (ITU, 1968, 1971, 1976),
“137 Where, in a box of the Table in Section IV of this Article, a band is indicated as allocated to more than one service, either on a world-wide or Regional basis, such services are listed in the following order:
a) services, the names of which are printed in ‘small capitals’ (example: FIXED); these services are called ‘primary’ services ;
b) services, the names of which are printed in ‘grotesque light’ (example: Radiolocation); these are ‘permitted’ services (see No. 138);
c) services, the names of which are printed in ‘italics’ (example: *Mobile)*; these are ‘secondary’ services (see No. 139).
138 Permitted and primary services have equal rights, except that, in the preparation of frequency plans, the primary service, as compared with the permitted service, shall have prior choice of frequencies.
139 Stations of a secondary service:
a) shall not cause harmful interference to stations of primary or permitted services to which frequencies are already assigned or to which frequencies may be assigned at a later date;

In the TFA, the font formats “grotesque light” and “italics” indicate permitted and secondary services, respectively. A new format was proposed in the RR1982.

The RR1982 revision added remarks in Article 8 (Section II – Categories of Services and Allocations, primary, permitted and secondary services, 413-425 of RR1982) (ITU, 1982, pp. RR8-5 to 6).[40]

Primary and permitted services are given the same priority. RR1996 revised the priority by removing permitted services from the TFA in Article S5 (Section II – Categories of services and allocations, primary and secondary services, S5.23-S5.33 of the RR1996) (ITU, 1996, pp. RRS5-5 to 7).[41] The RR2001 removed the prefix “S” from the provision numbers used in the four RR editions of 2001, 2004, 2008, and 2012 in Article 5, Section II – Categories of services and allocations, 5.23-5.33 (ITU, 2001, 2004, 2008, 2012b).

Table 20 shows the evolution of the “Categories of service and allocation” provision.

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b) cannot claim protection from harmful interference from stations of a primary or permitted service to which frequencies are already assigned or may be assigned at a later date;
c) can claim protection, however, from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date.
140 Where a band is indicated in a footnote to the Table as allocated to a service ‘on a secondary basis’ in an area smaller than a Region, or in a particular country, this is a secondary service (see No. 139).
141 Where a band is indicated in a footnote to the Table as allocated to a service ‘on a primary basis’, or ‘on a permitted basis’ in an area smaller than a Region, or in a particular country, this is a primary service or a permitted service only in that area or country (see No. 138).”

[40] This provision was used in the RR editions of 1990 and 1994, (ITU, 1990, 1994):
“413 Primary, Permitted and Secondary Services
414 § 8. (1) Where, in a box of the Table in Section IV of this Article, a band is indicated as allocated to more than one service, either on a worldwide or Regional basis, such services are listed in the following order:
415 a) services the names of which are printed in ‘capitals’ (example: FIXED); these are called ‘primary’ services;
416 b) services the names of which are printed in ‘capitals between oblique strokes’ (example: /RADIOLOCATION/); these are called ‘permitted’ services (see No. 419);
417 c) services the names of which are printed in ‘normal characters’ (example: Mobile); these are called ‘secondary’ services (see Nos. 420 to 423).
418 (2) Additional remarks shall be printed in normal characters (example: MOBILE except aeronautical mobile).
419 (3) Permitted and primary services have equal rights, except that, in the preparation of frequency plans, the primary service, as compared with the permitted service, shall have prior choice of frequencies.
420 (4) Stations of a secondary service:
421 a) shall not cause harmful interference to stations of primary or permitted services to which frequencies are already assigned or to which frequencies may be assigned at a later date;
422 b) cannot claim protection from harmful interference from stations of a primary or permitted service to which frequencies are already assigned or may be assigned at a later date;
423 c) can claim protection, however, from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date.
424 (5) Where a band is indicated in a footnote of the Table as allocated to a service ‘on a secondary basis’ in an area smaller than a Region, or in a particular country, this is a secondary service (see Nos. 420 to 423).
425 (6) Where a band is indicated in a footnote of the Table as allocated to a service ‘on a primary basis’, or ‘on a permitted basis’ in an area smaller than a Region, or in a particular country, this is a primary service or a permitted service only in that area or country (see No. 419).”

[41] This provision was used in the RR edition of 1998 (ITU, 1998):
“S5.23 Primary and Secondary Services
S5.24 (1) Where, in a box of the Table in Section IV of this Article, a band is indicated as allocated to more than one service, either on a worldwide or Regional basis, such services are listed in the following order:
S5.25 a) services the names of which are printed in ‘capitals’ (example: FIXED); these are called ‘primary’ services;
S5.26 b) services the names of which are printed in ‘normal characters’ (example: Mobile); these are called ‘secondary’ services (see Nos. S5.28 to S5.31).
S5.27 (2) Additional remarks shall be printed in normal characters (example: MOBILE except aeronautical mobile).
S5.28 (3) Stations of a secondary service:
S5.29 a) shall not cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date;
S5.30 b) cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date;
S5.31 c) can claim protection, however, from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date.
S5.32 (4) Where a band is indicated in a footnote of the Table as allocated to a service ‘on a secondary basis’ in an area smaller than a Region, or in a particular country, this is a secondary service (see Nos. S5.28 to S5.31).
S5.33 (5) Where a band is indicated in a footnote of the Table as allocated to a service ‘on a primary basis’, in an area smaller than a Region, or in a particular country, this is a primary service only in that area or country.”

Table 20. Category of service and allocation provision

Version	Primary	Permitted	Secondary	Additional remarks
1959	Small capitals, e.g., FIXED	Grotesque light, e.g., Radiolocation	Italic, e.g., *Mobile*	None
1982	Capitals, e.g., FIXED	Capitals between oblique strokes, e.g., /RADIOLOCATION/	Normal characters, e.g., Mobile	Normal characters, e.g., MOBILE except aeronautical mobile
1996	Capitals, e.g., FIXED	None	Normal characters, e.g., Mobile	Normal characters, e.g., MOBILE except aeronautical mobile

5.4.6 Radiocommunication service

The frequency is allocated within the TFA to enable the provision of services.[42] The definition of "Services" has developed over time. The initial service was considered "Maritime Mobile Service" (formerly "Maritime Service") in 1906. From 1906 to 2012, 41 services were added and 20 services removed from the TFA.

Table 21 shows the current service designation at the RR2012. Table 22 provides a list of terminated services. Table 23 shows the development of the "Service" category from 1906 to 1990.

[42] *Radiocommunication service:* A service as defined in this section involving the transmission, *emission* and/or reception of *radio waves* for specific *telecommunication* purposes. This definition is captured from Article 1. Section III–Radio services, 1.19 of the RR edition 2012 (ITU, 2012b).

Table 21. RR2012 services

Service	Abbreviation	Provision	RR
Fixed	FS	1.20	1927
Fixed-satellite	FSS	1.21	1971
Inter-satellite	ISS	1.22	1971
Space operation	SOS	1.23	1971
Mobile	MS	1.24	1927
Mobile-satellite	MSS	1.25	1971
Land mobile	LMS	1.26	1947
Land mobile-satellite	LMSS	1.27	1971
Maritime mobile	MMS	1.28	1906
Maritime mobile-satellite	MMSS	1.29	1971
Port operation	POS	1.30	1959
Ship movement	SMS	1.31	1976
Aeronautical mobile, route, off-route	AMS	1.32, 1.33, 1.34	1932
Aeronautical mobile-satellite, route, off-route	AMSS	1.35, 1.36, 1.37	1971
Broadcasting	BS	1.38	1927
Broadcasting-satellite	BSS	1.39	1968
Radiodetermination	RDS	1.40	1959
Radiodetermination-satellite	RDSS	1.41	1971
Radionavigation	RNS	1.42	1947
Radionavigation-satellite	RNSS	1.43	1968
Maritime radionavigation	MRNS	1.44	1947
Maritime radionavigation-satellite	MRNSS	1.45	1971
Aeronautical radionavigation	ARNS	1.46	1947
Aeronautical radionavigation-satellite	ARNSS	1.47	1971
Radiolocation	RLS	1.48	1947
Radiolocation-satellite	RLSS	1.49	1994
Meteorological aids	MetAids	1.50	1938
Earth exploration-satellite	EESS	1.51	1971
Meteorological-satellite	MetSat	1.52	1968
Standard frequency and time signal	SFTSS	1.53	1982
Standard frequency and time signal-satellite	SFTSSS	1.54	1982
Space research	SRS	1.55	1968
Amateur	ARS	1.56	1927
Amateur-satellite	ARSS	1.57	1971
Radioastronomy	RAS	1.58	1959
Safety	Safety	1.59	1959
Special	Special	1.60	1927

Most terminated services are merged with existing services. However, “Low-power Station” is merged with the industrial science and medical application (ISM) footnote. “Space,” “Earth,” “Terrestrial,” and “Communication-satellite” services have been moved to specific terrestrial or satellite services such as BS, FSS, MSS, and BSS. “Facsimile” has also been removed because it is an application not a service.

Radiobeacon and experiment services have been transferred to the radiocommunication “Stations” category.

Table 22. Terminated services, 1927-1976

Services	RR version		Note
	First	Last	
Air	1927	1927	Merged with AMS (communication to airplane)
Radiobeacon	1927	1938	Moved to station
Experiment	1927	1938	Moved to station
Telephone broadcasting	1932	1932	Merged with BS
Visual broadcasting	1932	1932	Merged with BS
Not open to public	1932	1938	Merged with AM(OR)S
Sound broadcasting	1938	1938	Merged with BS
Television	1938	1938	Merged with BS
Facsimile	1938	1938	Disappeared because it is an application*
Radiosounding	1938	1938	Merged with MetAids
Ionosphere measurement	1938	1938	Merged with MetAids
Low power station	1938	1938	Merged with an ISM applications
Standard frequency	1947	1976	Merged with SFTSS
Time signal	1959	1976	Merged with SFTSS
Space	1959	1968	Transformed into other satellite service
Earth	1959	1959	Transformed into other satellite service
Terrestrial	1968	1976	Transformed into other terrestrial service
Communication-satellite	1968	1968	Transformed into other satellite service
Standard frequency-satellite	1971	1976	Merged with SFTSSS
Time signal-satellite	1971	1976	Merged with SFTSSS

*Normally, one service can have at least one application using the frequency.

Table 23. Service category, 1906-1994

Year	Additional services
1906	MMS
1927	FS, MS, BS, ARS, Special
1932	AMS
1947	LMS, RNS, MRNS, ARNS, RLS, MetAids
1959	POS, RDS, RAS, Safety
1968	BSS, RNSS, MetSats, SRS
1971	FSS, ISS, SOS, MSS, LMSS, MMSS, AMSS, RDSS, MRNSS, ARNSS, EESS, ARSS
1976	SMS
1982	SFTSS, SFTSSS
1990	AM(R)S, AM(OR)S, AMS(R)S, AMS(OR)S
1994	RLSS

5.4.7 Radiocommunication stations

A radiocommunication "Station" has at least one transmitter or receiver.[43] Several "Station" classifications were developed from 1906 to 2012. Thirty-eight "Station" classifications are currently used, while seventeen "Station" classifications have been removed since 1932. Table 24 shows "Station" classifications added during the period 1906 to 1990. Table 25 shows a list of removed "Station" classifications.

Table 24. Station classification added 1906-1998

Year	Station
1906	Coast, ship
1927	Mobile, land, aeronautical, aircraft, broadcasting, radiodirection-finding, radiobeacon
1932	Fixed, amateur
1947	Base, land mobile, radionavigation mobile, radionavigation land, experiment
1959	Earth, space, survival craft, radiodetermination, radiolocation mobile, radiolocation land
1968	Terrestrial, port, emergency position-indicating radiobeacon, radio astronomy
1976	Ship Earth, on-board communication
1982	Mobile Earth, coast Earth, aeronautical Earth, aircraft Earth, standard frequency and time signal
1990	Land Earth, base Earth, land mobile, satellite-emergency position-indicating radiobeacon
1998	High-altitude platform

Table 25. Terminated station classification since 1932

Station	RR version		Changed/Merged station classification
	First	Last	
Aeronautical fixed	1947	1994	Merged with "Fixed"
Standard frequency	1947	1976	Merged with "Standard frequency and time signal"
Private experimental	1927	1938	Merged with "Experiment"
Station on board	1932	1938	Merged with "On-board communication"
Telephone broadcasting	1932	1932	Merged with "Broadcasting"
Visual broadcasting	1932	1932	Merged with "Broadcasting"
Private radiocommunication	1932	1938	Changed with specified station
Portable	1938	1938	Merged with "Mobile"
Communication-satellite Earth	1968	1968	Merged with "Earth"
Communication-satellite space	1968	1968	Merged with "Space"
Radiolocation	1947	1947	Changed with specified station
Radionavigation	1947	1947	Changed with specified station
SRS Earth	1968	1968	Merged with "Earth"
SRS space	1968	1968	Merged with "Space"
RNSS Earth	1968	1968	Merged with "Earth"
RNSS space	1968	1968	Merged with "Space"
MetSat Earth	1968	1968	Merged with "Earth"

[43] *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*. This definition is captured from Article 1. Section IV – Radio stations and systems, 1.61 of the RR edition 2012 (ITU, 2012b).

Table 26 shows the current stations in the RR2012.[44]

Table 26. RR2012 station classification

Station	Provision	RR
Terrestrial	1.62	1968
Earth	1.63	1959
Space	1.64	1959
Survival craft	1.65	1959
Fixed	1.66	1932
HAP	1.66A	1998
Mobile	1.67	1927
Mobile Earth	1.68	1982
Land	1.69	1927
Land Earth	1.70	1990
Base	1.71	1947
Base Earth	1.72	1990
Land mobile	1.73	1947
Land mobile Earth	1.74	1990
Coast	1.75	1906
Coast Earth	1.76	1982
Ship	1.77	1906
Ship Earth	1.78	1976
On-board communication	1.79	1976
Port	1.80	1968
Aeronautical	1.81	1927
Aeronautical Earth	1.82	1982
Aircraft	1.83	1927
Aircraft Earth	1.84	1982
Broadcasting	1.85	1927
Radiodetermination	1.86	1959
Radionavigation mobile	1.87	1947
Radionavigation land	1.88	1947
Radiolocation mobile	1.89	1959
Radiolocation land	1.90	1959
Radio direction-finding	1.91	1927
Radiobeacon	1.92	1927
Emergency position-indicating radiobeacon	1.93	1968
Satellite emergency position-indicating radiobeacon	1.94	1990
Standard frequency and time signal	1.95	1982
Amateur	1.96	1932
Radio astronomy	1.97	1968
Experiment	1.98	1947

[44] The definition of radiocommunication services was not changed in the Provisional Final Act, World Radiocommunication Conference (WRC-12) (ITU, 2012a) and RR2012 (ITU, 2012b).

5.5 Table of Frequency Allocation

The TFA is a function map that relates frequency bands to services and footnotes. Footnotes refer to constraints on frequency use.

Frequency bands inside the TFA are explored to explain the evolution of frequency band allocation within the TFA.[45]

Service allocation developments are considered next. In particular, the analysis considers the early allocations prior to the establishment of the TFA; an overview of the TFA developments from 1927 to 2012; and a detailed analysis of the MMS, MMSS, BS, BSS, FS, FSS MS, MSS, SRS, and EESS classification from the RR1927-2012. The service level analysis is contained in Appendices A, B, C, D, E, F, G, H, I, and J to the chapter.

5.5.1 Pre-TFA allocations

The RR1906 and RR1912 are part of the Annex of International Radiotelegraph Convention (Annex to the Berlin Convention 1906 and Detailed Service Regulation appended to the London 1912 Convention). These provide the wavelengths allowed between ships and coast stations.

In the RR1906 and RR1912, global allocations are provided for maritime service communications between ships and coast stations.

Annex to the 1906 Berlin Convention

The frequencies 188 kHz, 500 kHz, and 1000 kHz are allocated to the maritime service. However, in the Berlin Annex, they are defined as the corresponding aerial lengths of wavelengths of 1600, 600, and 300 meters, respectively.

Table 27 shows the wavelengths contained in the Annex to the Berlin 1906 Convention (ITU, 1906b, p. 361).

Table 27. Wavelength from the Annex to the Berlin 1906 Convention

Frequency (kHz)	**Wavelength (meters)**	**Maritime service**	**Purpose**
1000	300	Ship, coast station	General public
500	600	Ship, coast station	General public
to 188, >500	to 600, > 1600	Coast station	Long-range or other
> 1000	to 300	Ship station	Small vessel

The 500 kHz and 1000 kHz frequencies (wavelength 300 meters and 600 meters, respectively) are allocated to public services. Frequencies below 188 kHz (wavelength greater than 1600 meters) or higher than 500 kHz (wavelength shorter than 600 meters) are allocated to long-distance communications from ship to coast station and other services. The non-public services are military and naval (Huurdeman, 2003; Lyall & Larsen, 2009).

[45] The analysis of footnotes is not considered in this study.

Detailed Service Regulation appended to the London 1912 Convention

The London Conference cancelled the allocations for wavelengths of less than 300 meters for small vessels. The Conference also added two frequencies of 167 kHz and above 2 MHz for radiotelegrams and radiobeacons (Huurdeman, 2003). Meteorological information (time signal and weather report) is included in a radiotelegram service (Huurdeman, 2003; Lyall & Larsen, 2009).

Table 28. Wavelength of Detailed Service Regulation appended to the London 1912 Convention

Frequency (kHz)	Wavelength (meters)	Maritime service	Purpose
1000	300	Ship, coast station	General public
500	600	Ship, coast station	General public
167	1800	Ship, coast station	Radiotelegrams
to 188 >500	to 600 > 1600	Coast station	Long-range or other service
> 2000	to 150	Ship, coast station	Ship positioning

Table 28 shows the wavelength of the Detailed Service Regulation appended to the London 1912 Convention (Article 2 and 3) (ITU, 1912a).

5.5.2 TFA Overview

The Washington 1927 Conference provided the initial TFA global allocation. Both frequency bands and wavelengths are allocated to specific services. Particular services received an exclusive right to use a specified frequency band.

In Madrid 1932, the TFA was allocated to the European and other geographic regions. The TFA therefore made global allocations and allocations to the EU and other regions.

The Cairo 1938 Conference added an American region (Appendix 4 of the General Radiocommunication Regulation) (ITU, 1938).

The other regions were spitted to America and Asia-Pacific at the Atlantic City Conference. The Conference introduced the A, B, and C lines to separate Region 1 (EU Region), Region 2 (American Region), and Region 3 (Asia-Pacific Region) (Article 5, TFA of Atlantic City 1947 Convention) (ITU, 1947, pp. 18-20). The lines are still in effect (Article 5, Section I-Regions and areas, 5.2-5.22 of the RR) (ITU, 2012b, pp. 37-39).

TFA frequency limits

Table 29 reports the TFA frequency limits for the period 1927 to 2012.

An example of the TFA lower limit change to the global allocation occurs separately from 10 to 9 kHz and 9 to 8.3 kHz. The upper limit change occurs from 60 to 30 MHz, 30MHz to 10.5 GHz, 10 to 40 GHz, 40 to 275 GHz, 275 to 400 GHz, 400 to 1000 GHz, and 1000 to 3000 GHz.

The lower limit changes are less frequent because the minimum sampling frequency of human voice is 8 kHz (digital modulation). The upper limit changes are more frequent because of the need for new services.

Table 29. TFA frequency limits

RR	Global		Region 1		Region 2		Region 3	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
1927	10 kHz	60 MHz						
1932	10 kHz	60 MHz	160 kHz	2 MHz			160 kHz	2 MHz
1938	10 kHz	30 MHz	160 kHz	200 MHz	25 MHz	300 MHz	160 kHz	60 MHz
1947	10 kHz	10.5 GHz	70 kHz	10.5 GHz	70 kHz	5.925 GHz	70 kHz	5.925 GHz
1959	10 kHz	40 GHz	70 kHz	10.55 GHz	70 kHz	10.55 GHz	70 kHz	10.55 GHz
1968	10 kHz	40 GHz	70 kHz	33.4 GHz	70 kHz	33.4 GHz	70 kHz	33.4 GHz
1971	10 kHz	275 GHz	70 kHz	33.4 GHz	70 kHz	33.4 GHz	70 kHz	33.4 GHz
1976	10 kHz	275 GHz	70 kHz	33.4 GHz	70 kHz	33.4 GHz	70 kHz	33.4 GHz
1982	9 kHz	400 GHz	70 kHz	31.8 GHz	70 kHz	31.8 GHz	70 kHz	31.8 GHz
1986	9 kHz	400 GHz	70 kHz	31.8 GHz	70 kHz	31.8 GHz	70 kHz	31.8 GHz
1990	9 kHz	400 GHz	70 kHz	31.8 GHz	70 kHz	31.8 GHz	70 kHz	31.8 GHz
1994	9 kHz	400 GHz	70 kHz	31.8 GHz	70 kHz	31.8 GHz	70 kHz	31.8 GHz
1996	9 kHz	400 GHz	70 kHz	31.8 GHz	70 kHz	31.8 GHz	70 kHz	31.8 GHz
1998	9 kHz	400 GHz	70 kHz	42.5 GHz	70 kHz	42.5 GHz	70 kHz	42.5 GHz
2001	9 kHz	400 GHz	70 kHz	41 GHz	70 kHz	41 GHz	70 kHz	41 GHz
2004	9 kHz	1000 GHz	70 kHz	50.2 GHz	70 kHz	50.2 GHz	70 kHz	50.2 GHz
2008	9 kHz	1000 GHz	70 kHz	50.2 GHz	70 kHz	50.2 GHz	70 kHz	50.2 GHz
2012	8.3 kHz	3000 GHz	70 kHz	50.2 GHz	70 kHz	50.2 GHz	70 kHz	50.2 GHz

TFA number of frequency bands

Table 30. Global and regional frequency bands

RR	Global	Region 1	Region 2	Region 3
1906	5			
1912	6			
1927	59			
1932	51	16		10
1938	52	71	34	24
1947	102	57	47	50
1959	146	75	62	68
1968	181	88	76	82
1971	237	95	84	90
1976	237	95	84	90
1982	304	98	103	96
1985	304	98	103	96
1986	304	98	103	96
1990	307	101	106	99
1994	337	119	124	116
1996	343	123	128	120
1998	350	118	123	115
2001	360	118	123	115
2004	369	125	128	120
2008	372	128	132	124
2012	375	151	152	147

Table 30 shows global and regional frequency bands for the period 1906 to 2012.

After the RR1938, the number of frequency bands, global and regional allocation, increased steadily. This growth in frequency bands was driven by the introduction of new services. However, more frequency bands added complexity to the management of the TFA. Furthermore, the underlying growth in the demand for services meant increased use of the frequencies.

Regional allocations lead to increased frequency utilization. To avoid interference, a set of complex coordination provisions must be addressed. In particular, frequency band harmonization (regional to global) aims to reduce interference, but it reduces frequency use.

TFA bandwidth

The bandwidth is the quantity of frequency allocated to a service. A frequency band can be allocated to several services (either on a primary or secondary basis), increasing frequency utilization.

The RR1927, RR1938, and RR1947 introduced the practice of allocation between exclusive and shared bandwidth. However, the quantities were not substantial.

From the RR1947 to RR1968, the total bandwidth increased from 13 to 63 GHz. This period coincided with the relabeling of “exclusive” as “primary”, and “shared” as “secondary” services. From the RR1971 (410 GHz) to RR2012 (1062 GHz), allocations increased threefold (see Figure 11).

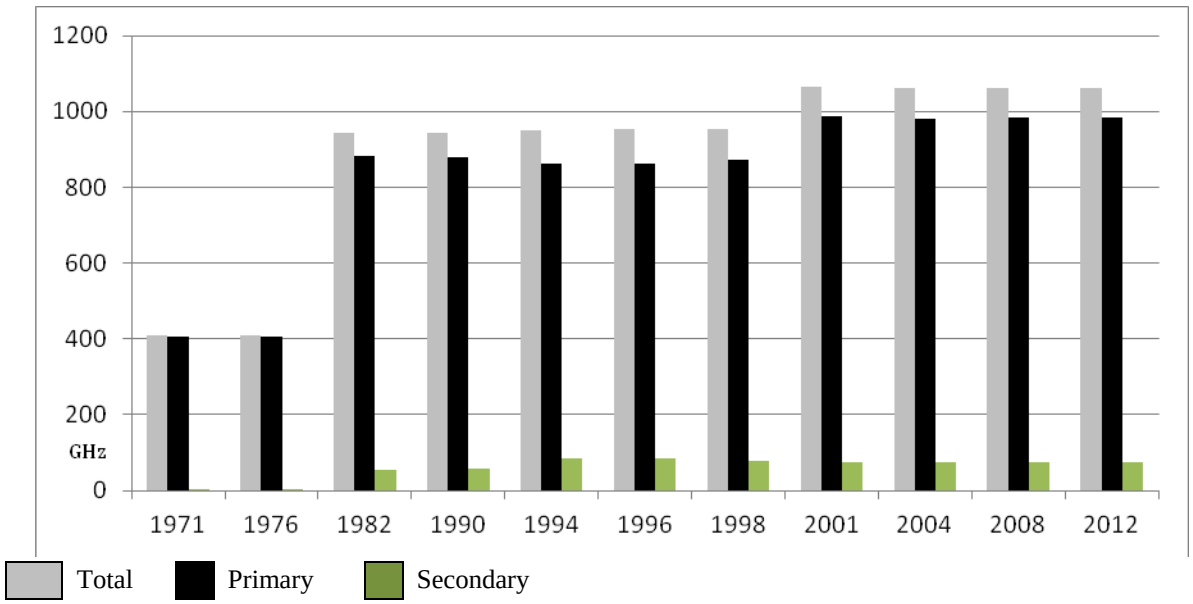

Figure 11. Global bandwidth allocations, 1971-2012

Figure 12 shows the bandwidth allocation for Region 1 (1932-2012). Prior to the RR1938, allocations were made to the EU Region. Figure 13 depicts Region 1 allocations for primary and secondary services.

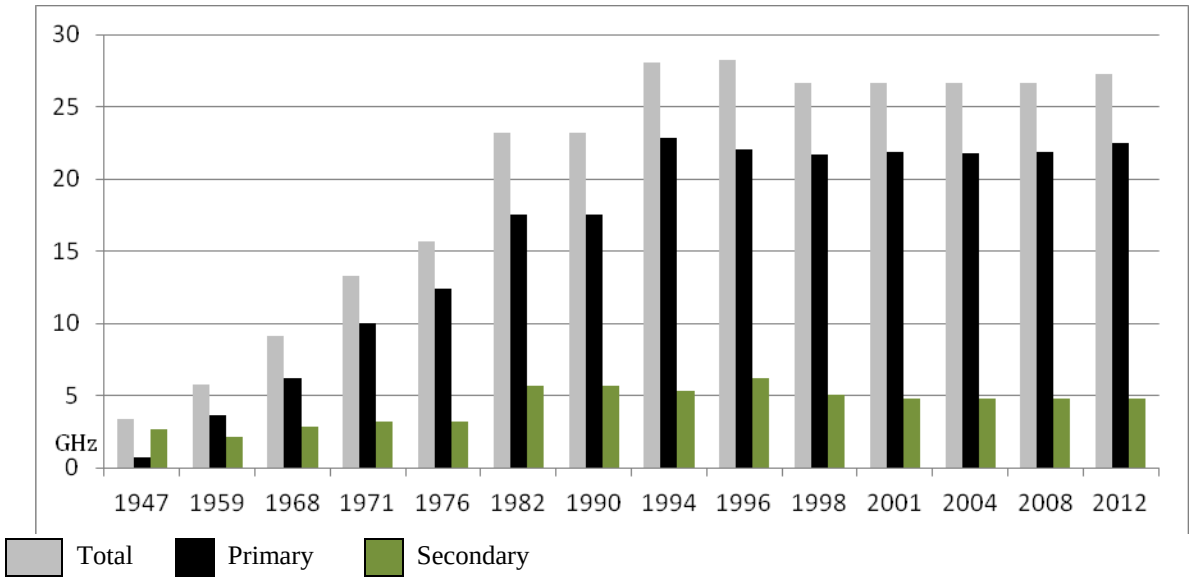

Figure 12. Region 1 bandwidth allocations, 1947-2012

Similarly, Figure 13 depicts Region 2 bandwidth allocations since 1947.

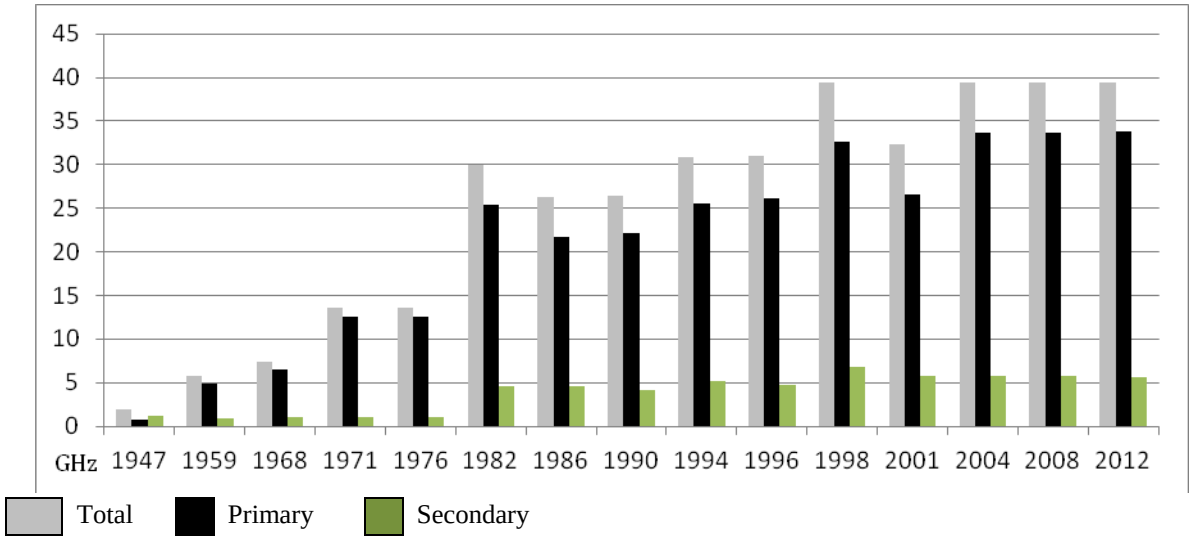

Figure 13. Region 2 bandwidth allocations, 1947-2012

Finally, Figure 14 shows Region 3 bandwidth allocations since 1947.

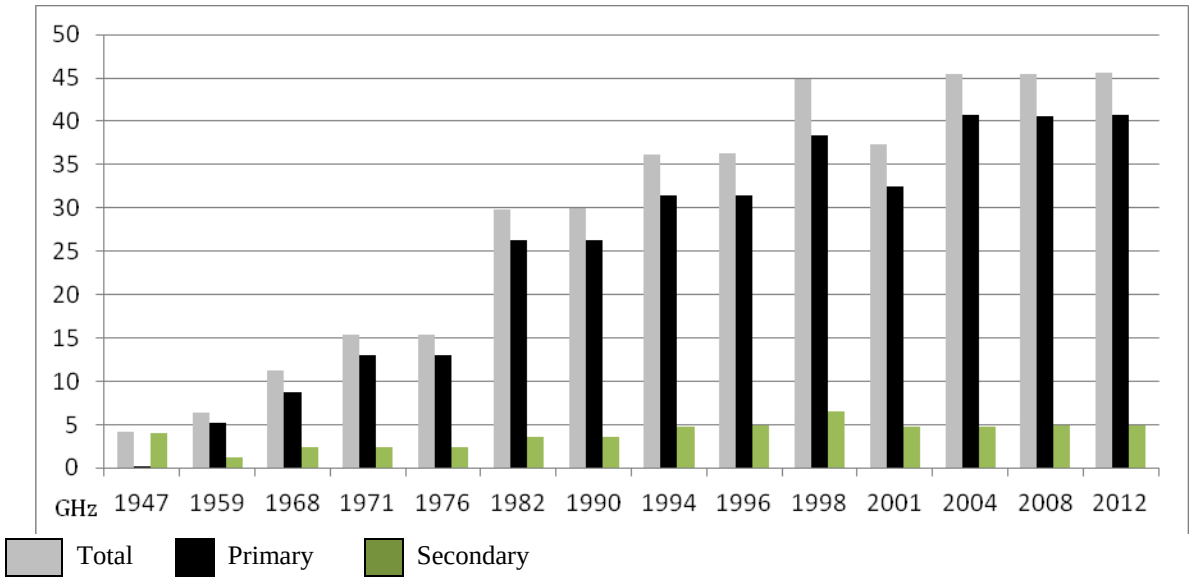

Figure 14. Region 3 bandwidth allocations, 1947-2012

5.5.3 Frequency band development and archived material

Appendices A, B, C, D, E, F, G, H, I, and J illustrate frequency band developments for MMS, MMSS, BS, BSS, FS, FSS, MS, MSS, SRS, and EESS. The following example of the BS in the 550-1705 kHz band is extracted from the relevant tables in Appendix C to show how to use the appendices.

The BS frequency band developments are illustrated in Appendix C. From Appendix C, the BS allocations in the 550-1705 kHz band are listed in Table 31.

Table 31. Broadcasting service 550-1705 kHz frequency band development

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	RR removal	Allocation/priority
1927	550	1300	1932	Global/Primary
1959	535	1605	1982	Global/Primary
1932	550	1500	1947	Global/Secondary
1947	525	535	1982	Region 1/Primary
1982-2012	526.5	1606.5		Region 1/Primary
1959-2012	525	535		Region 2/Primary
1982-2012	535	1605		Region 2/Primary
1982-2012	1605	1625		Region 2/Primary
1982-2012	1625	1705		Region 2/Primary
1959	525	535	1982	Region 3/Primary
1982-2012	526.5	535		Region 3/Primary
1982-2012	535	1606.5		Region 3/Primary

From 1927 to 1932, the BS global allocation was on a primary basis for the 550-1300 kHz band. In 1959, the global allocation (on a primary basis) expanded to spectrum to cover the 535-1605 kHz band. However, this allocation band was terminated in 1982.

The treatment of the BS was altered during the period 1932-1947, and the 550-1500 kHz band was allocated on a secondary basis.

From 1947, some allocations were based on a regional table. For instance, in 1947, the 525-535 kHz band was allocated to BS Region 1 on a primary basis but it was terminated in 1982.

By 1982, there were regional allocations (on a primary basis) for Region 1, Region 2, and Region 3. The 526.5-1606.5 kHz band was allocated to Region 1. The three frequency bands 535-1605, 1605-1625, and 1625-1705 kHz were allocated to Region 2. Finally, the two frequency bands 526.5-535 and 535-1606.5 kHz were allocated to Region 3.

The above information is obtained from the RR versions housed in the ITU archives. However, the reasons for the changes are not illustrated in the archives. Importantly, the rationale underneath the document is not documented. Only delegates that attended the meetings have this (missing) information.

5.6 Summary and discussion on research question

This chapter responds to sub-research question 1: *What is the international spectrum policy setting in terms of the ITU structure, WRC, and RR, and how did they develop?*

The study illustrates the development of WRC (International Telegraph Conference, International Radiotelegraph Conference, Ordinary/Extraordinary Administrative Radio Conference and WRC), the evolving relationship between WRC and the RR, and changes to the RR definitions (telecommunication, radiocommunication, radio waves and radio) and the RR provisions (choice of apparatus, frequency assignment, licenses, allocation, allotment and assignment, priority of services, services, and stations). Alterations to the TFA (MMS, MMSS, BS, BSS, FS, FSS, MS, MSS, SRS, and EESS in Appendices A, B, C, D, E, F, G, H, I, and J) are also reviewed.

The study explored the relevant literature and found that no literature was relevant to the RR development, especially the TFA development in terms of frequency band development. The study limits the exploration and explanation of the RR to several interesting RR provisions. The selection of the RR provision is based on the importance of such provisions. Some of the literature provides interesting keywords such as the definition of “telecommunication.”

The study applies Rutkoski’s approach to download all RR versions, including the Convention, Annex to the Convention, and the RR from the ITU History Portal. The study further explores each RR in depth by the keywords to trace the relevant provision and constructs in the personal database in an Excel file.

The keywords are key definitions, important provisions, and frequency bands by services. These keywords represent the sampling point of the RR development.

Key definitions and important provisions provide a starting point by searching each version of the RR and building up the personal database containing the changes to such provisions. The exploration will end when the changes match the current version (RR2012). The study analyzes the differences between versions by explaining different elements or concepts that have been developed over time. However, the RR versions provide the output from the WRC discussions, not the reasons why and how it changes.

Frequency band development is the output from the conversion of the TFA for each RR version into the Excel file. The study converted each frequency allocation, including for global, Region 1, Region 2, and Region 3, of each RR version into the table of the Excel sheet. The study sorts the TFA by service and manually keeps track of each frequency band across RR versions until it meets the current frequency band (RR2012). The table presents the output of the manual sorting that is illustrated in Appendices A, B, C, D, E, F, G, H, I, and J. Each appendix contains the global, Region 1, Region 2, and Region 3 allocations with separated primary and secondary services.

The table provides the starting point to further investigate the rationale underlying the frequency band development of RR versions.

The frequency band development is original work that the study contributes to the international spectrum policy setting as a mind map to further explore the rationale underlying the change to the TFA. The TFA is sorted by frequency band up to 3 000 GHz. The study changes the view of the TFA into the service-oriented one that has provided the additional information to the TFA on the service perspective. Appendices A, B, C, D, E, F, G, H, I, and J cover the majority of services in terms of bandwidth allocation and number of frequency bands.

However, the empirical findings from the exploration of the ITU archives only provide what they have developed over time in terms of the output of WRC as the RR revisions. The RR revisions are the consequences of the WRC agenda-setting and WRC study process and will be discussed in a later chapter.

The study illustrates the RR development by presenting the key definitions, important provisions, and frequency band development responding to one part of the first sub-research question: *What is the international spectrum policy setting in terms of the WRC and RR development?*

Furthermore, this part of the first sub-research question strengthens the fact that Member States that rely on the ITU archives have incomplete information that lack the reason changes occur. The study results provide RR development over time as the output for analyzing the personal database with manual sorting. The sub-research question *What is the international spectrum policy setting in terms of the WRC and RR development?* is therefore important in terms of the exploration of the existing situation of the ITU archives that lack the reason behind it. This sub-research question reflects on and supports the argument of incomplete information in the international policy setting in the summary of this chapter.

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Chapter 6 WRC preparatory process

This chapter illustrates the WRC-12 preparatory work by ITU, including the agenda-setting and its assessment. The national (Sweden and Thailand) and regional preparatory works (CPG and APG) for WRC are also included. The WRC preparatory processes by ITU, regional, and national preparatory meetings are part of the RR development to prepare possible RR revision options for Member States to decide on at WRC.

6.1 Background

The study focuses on the preparatory work after the APP 1992, because there was a mandate from the APP 1992 requesting the preparatory work for WRC. Before the APP1992, the revision of the RR was based purely on Member State contributions with no advance preparatory WRC agenda. The Chairman conducted the meeting with consideration for the existing RR from the beginning to the end together with the Member State contributions.

After the APP 1992, the systematic structure of the preparatory work was introduced. The RA-93 began the process to establish an SG to undertake preparatory work for the WRC-95 and WRC-97. The WRC-95 agenda was finalized at the WRC-93 and approved by the CC. The initial preparatory process has continued to be used until now, with some modifications, such as the WRC cycle. Figure 15 presents the current WRC preparatory process for the WRC-12.[46]

The CPM-1 begins when the current WRC finalizes the next WRC agenda. The agenda is an input to the CPM-1 (according to Resolution ITU-R 2-5).

The CPM-1 distributes work programs according to the WRC agenda to the SGs. Currently, there are six SGs, i.e., SG1-spectrum management, SG3-radiowave propagation, SG4-satellite service, SG5-terrestrial services, SG6-broadcasting service, and SG7-science services. Each SG has a duty to prepare a draft CPM text after studying the assigned issue from the WRC agenda (according to Resolution ITU-R 4-5). To complete their tasks, the SGs can form working parties (WPs).

Moreover, the issues relating to regulatory and procedural study must pass to the Special Committee on regulatory/procedural matters (SC) (see Resolution ITU-R 38-3).

The CPM-1 is held immediately after WRC. Based on documents submitted by ITU Members, this CPM-1 produces the input for the SGs and SC through the distribution of work programs, including a chapter outline for the CPM report.[47]

Based on the documents submitted by the ITU Members, the SGs produce a draft CPM text along the lines specified in the WRC agenda to the CPM chapter rapporteurs. Rapporteurs consolidate the text from the SGs into the chapter contained in the draft CPM report. This report is published on the ITU-R website prior to the second CPM session. At the same time,

[46] Source: The figure is adapted from Figure I-1 Organization of the ITU-R conference preparatory work, CPM report to WRC-12
[47] The ITU membership comprises Member States, Sector Members, Associates, and Academia.

the SGs submit the draft CPM text to the SC on issues relevant to regulatory and procedural matters.

At the CPM-2, a final report based on the draft CPM text, SC output, and ITU Members' document, the CPM report, is finalized.

Member States and Sector Members can submit documents to the RA. However, only Member States can submit documents (including joint, multiple, and common proposals) to WRC.

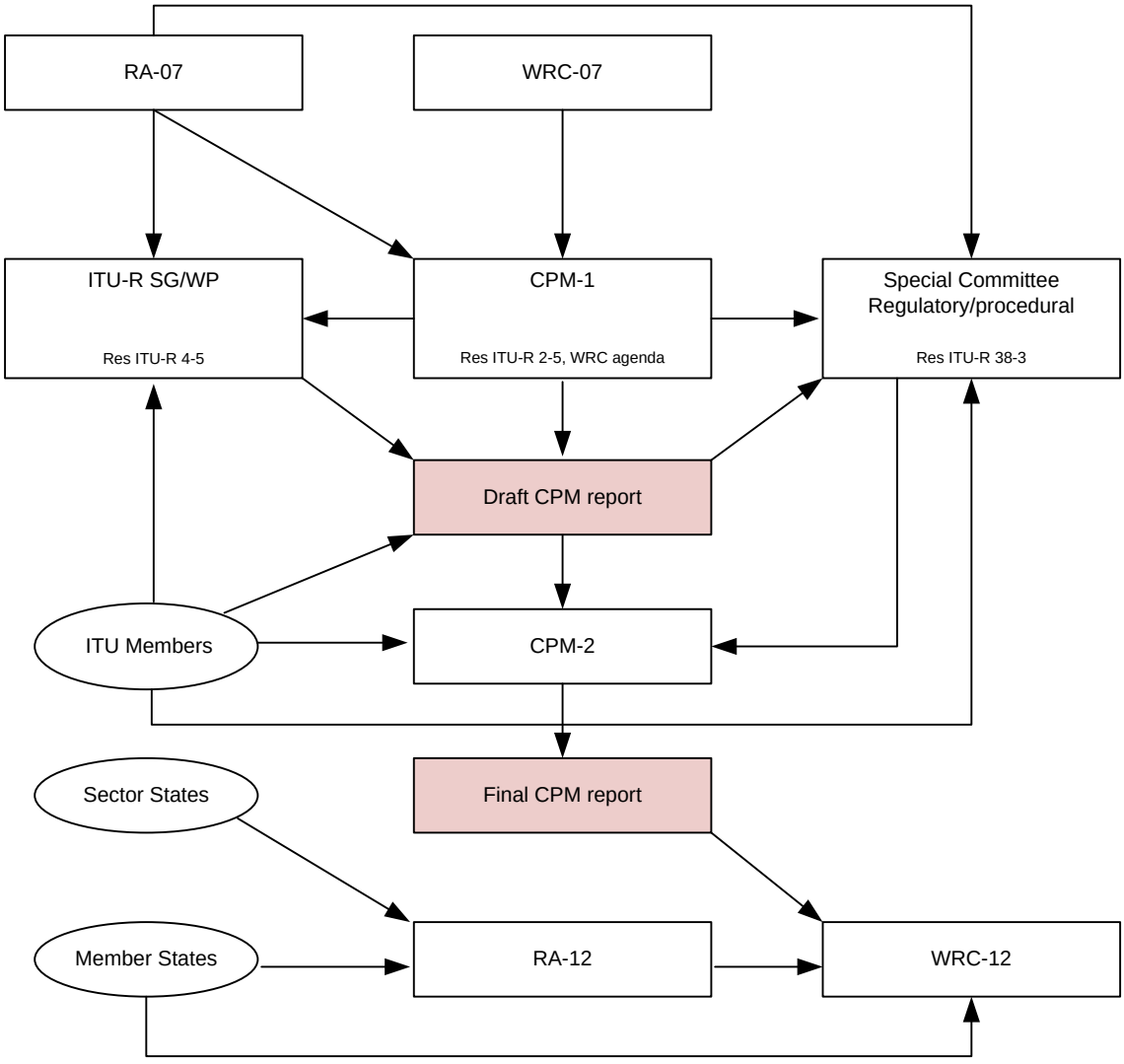

Figure 15. WRC-12 preparatory process

6.2 Agenda-setting

The WRC agenda contains issues that arise when new radio technologies, applications, or services are introduced and are of concern to Member States. Such concerns identify the need to revise the current RR. Consequently, conflict between existing services and new technologies is often unavoidable.

RR revisions to the TFA (frequency bands, services, and footnotes), or elsewhere, may be required. Frequency bands include both the "start" and "stop" frequencies. The service provision is the objective of frequency allocation (see Article 1 of the RR). Footnotes contain constraints on both frequency bands and services in terms of their technical characteristics, specific band allocations, and duration.

For instance, WRC-03 Agenda Item 1.23 considered the need to reallocate ARS to the global allocation table across three regions within the 7 MHz band. This agenda item moved the 7000-7100 kHz and 7100-7200 kHz band TFA allocation to an ARS global allocation (with relevant footnotes).

During the period in which new radio technologies and applications are developed, the developers must identify both the radio frequency and check the TFA (see Article 5 of the RR) to determine whether a new frequency or regulation is required.

For example, at the WRC-07, the replacement of analog by digital television occurred in the European countries (or digital dividend). The consequence of this transition is that the 790-862 MHz band is now available for new services and applications, especially MS (system beyond IMT-2000). In the RR2004, the Region 1 TFA has no 790-862 MHz band or footnote for MS allocation. Thus, an MS allocation in the 790-862 MHz band in Region 1 is required.

Consequently, developers must evaluate whether a change in the current RR within the WRC agenda is needed. To change the current RR within the WRC agenda, developers must request their Member States submit contributions to WRC at least 14 days before the Conference.

For example, to change the RR2008 provisions contained within the WRC-12 agenda, developers request their Member States to submit documents (within the specified WRC-12 agenda) at least 14 days prior to the WRC-12 (9 January 2012). Moreover, the WRC-12 attendance is required to ensure the change is accepted.

Accordingly, to prepare the WRC agenda, WRC and the SG must prepare a report. The WRC process spans four weeks while the SG process requires four years to complete.

The WRC agenda has both permanent and specified agenda items. Future RR provision changes are specified by agenda item for the next WRC agenda (contained in the permanent agenda). For example, in the WRC-12 agenda, the next WRC agenda (WRC-15) and future WRC agenda (WRC-18) are included within the permanent Agenda Item 8.2:

"8.2 recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences" (WRC-12 agenda).

However, ITU Members can submit proposals directly to the SGs via the CPM reports for the next and future WRC agendas. This process requires eight years (two WRC cycles for inclusion of the WRC agenda in the CPM report). For example, the WRC-15 agenda will be included in "the future WRC agenda" in the CPM report from the WRC-07 and the "next WRC agenda" in the CPM report from WRC-12.

WRC agenda-setting, 1993 to 2015

During the period 1993-1997, WRC had a two-year cycle (WRC-93, WRC-95, and WRC-97) of preparatory activities. After 1997, the average WRC cycle increased to a four-year period. Table 32 shows the number of WRC agenda items specified from 1993 to 2015.

Table 32. WRC agenda items, 1993-2015

Conference	CC	Agenda		Dropped	Merged	F to N (%)	N to C (%)
		Next	Future				
WRC-93	0	0	0	0	0	0	0
WRC-95	9	9	0	0	0	0	100.0
WRC-97	20	11	12	1	0	91.7	55.0
WRC-2000	25	1	4	3	0	25.0	4.0
WRC-03	42	11	19	8	0	57.9	26.2
WRC-07	20	5	15	7	3	33.3	25.0
WRC-12	24	3	7	3	1	42.9	12.5
WRC-15	20	2	1	0	0	100	10
Total	**160**	**42**	**58**	**22**	**4**	**72.4**	**26.3**

The column “CC” indicates the WRC agenda items finalized by WRC and approved by the CC. The columns labeled “Next” and “Future” show the next and future WRC agenda items in the CPM report. The column “Dropped” reports differences in the future and next WRC agendas. The next column shows the number of next and future agenda items that are merged. The column “F to N” shows the percentage of the future to next WRC agenda items. The column “N to C” indicates the percentage of the next approved agenda items.

The percentages of “F to N” and “N to C” fell over time. Only the WRC-15 agenda in row “WRC-15,” column “F to N” shows that the future WRC agenda was included in the next WRC agenda. These agenda items, in the future and next WRC agendas, prepared by the CPM, are not guaranteed to be contained in the final WRC agenda.

In Figure 16, the “non-service” category includes uncategorized service and general provisions such as the new radio applications, SDR, CRS, SRD, unmanned aircraft systems, and regulatory issues (transition from a broad international regulatory framework to a national framework).

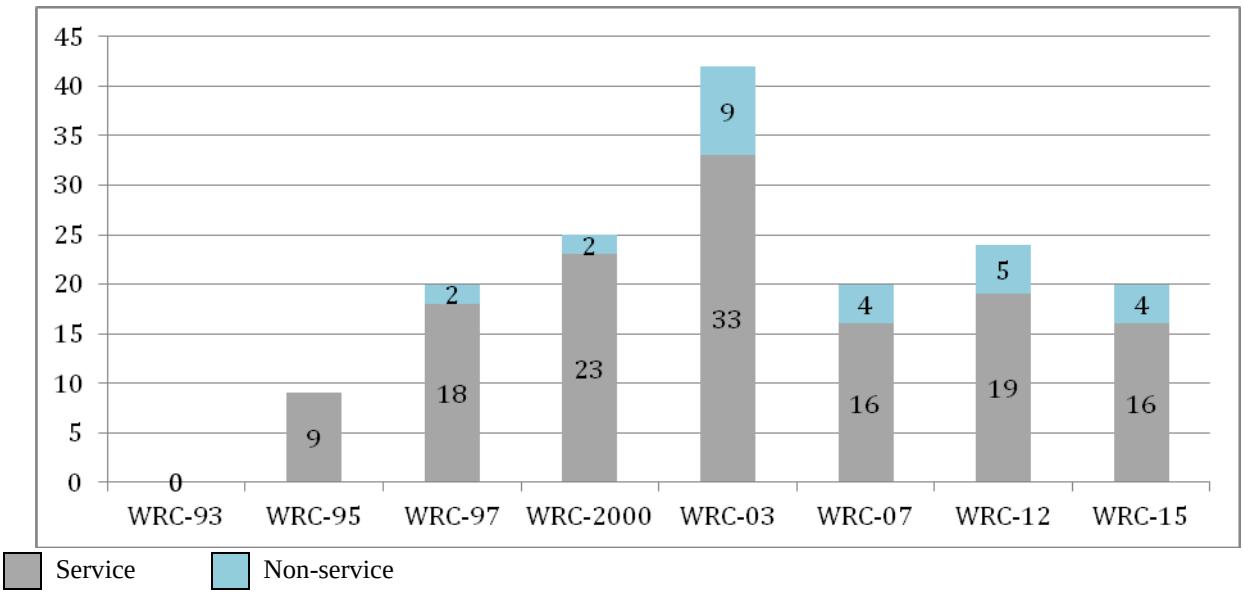

Figure 16. Specified WRC agenda items, 1993-2015

The “service” category represents the WRC agenda item with specified services. It varies over time. For example, from WRC-95 to WRC-03, the trend of WRC agenda items with specified services increases, however, it is dropped at the WRC-07 and fluctuates until the WRC-15.

Table 33 shows the distribution of specified WRC agenda items by service from 1993 to 2015. The service abbreviations are found in Table 21, except TS (terrestrial service) and SS (space service).

Table 33. Specified WRC agenda items by service, 1993-2015

Service	WRC								Total
	1993	1995	1997	2000	2003	2007	2012	2015	
Non-service	0	0	2	2	9	4	5	4	**26**
FSS	0	1	1	6	6	2	0	5	**21**
MSS	0	4	1	5	5	2	1	1	**19**
EESS	0	1	4	2	3	3	0	2	**15**
MMS	0	0	4	2	3	1	2	2	**14**
BSS	0	0	1	5	4	2	1	0	**13**
FS	0	0	1	3	3	0	3	0	**10**
SS	0	2	2	2	2	2	0	0	**10**
MS	0	0	1	2	1	1	3	2	**10**
BS	0	1	2	0	3	2	1	0	**9**
SRS	0	1	1	1	1	3	1	1	**9**
MMSS	0	0	4	0	1	1	0	1	**7**
RLS	0	0	0	0	2	1	3	1	**7**
RNSS	0	0	0	3	2	0	1	0	**6**
AM(R)S	0	0	1	1	1	1	1	0	**5**
AMS	0	0	0	0	3	1	1	0	**5**
TS	0	0	1	2	0	1	1	0	**5**
ARS	0	0	0	0	1	1	1	1	**4**
RAS	0	0	0	2	1	1	0	0	**4**
AMSS	0	0	0	0	3	0	0	0	**3**
MetSat	0	0	1	0	0	1	1	0	**3**
MetAids	0	0	1	0	0	0	1	0	**2**
AMS(R)S	0	0	0	0	0	0	1	0	**1**
ARSS	0	0	0	0	1	0	0	0	**1**
ARNS	0	0	0	0	1	0	0	0	**1**
SOS	0	1	0	0	0	0	0	0	**1**
Total	**0**	**11**	**28**	**38**	**56**	**30**	**28**	**20**	**211**

From 1993 to 2012, the most specified WRC agenda items are non-service (26), followed by FSS (21). The non-service may lead to revised service definitions to ensure service neutrality.

The number of specified WRC agenda items and services differs because a specified agenda may evolve through a single or several services. For example, WRC-12 Agenda Item 1.5 relates to FS, BS, and MS. The majority of specified WRC agenda items concerns MS: MSS, MMS, MMSS, AM(R)S, AMS(R)S, ARNS, and ARNSS.

6.3 Assessment of the WRC agenda-setting process

The ITU Convention (CV118) mandates preparation of the WRC agenda items or WRC agenda-setting four to six years in advance. The WRC agenda-setting process takes two WRC cycles to prepare the future and next WRC agendas. In order to assess the lengthy process of WRC agenda-setting, the IAD framework is discussed as follows.

In this case, the physical condition or study object is the WRC agenda-setting, and the issue is the RR revisions, both the technical and regulatory aspects.

The attribute of community is ITU and its membership environment, including its membership culture and traditions, with a common understanding of why the issues should be included in the WRC agenda and how to precede this matter in the ITU context.

The rules-in-use, as an action situation, reflect the discussions within the relevant meetings, including the relevant CPM, SG, and WRC.

The boundary rule, which determines who is allowed to participate in the relevant meetings, is ITU membership during the CPM and SG. However, only Member States can vote during WRC.

The position rule is directly relevant to the boundary rule: which role each delegate should perform during the discussions in an action situation and which option they have as the choice rule.

The actions to be taken will have been evaluated with consequences and possible outcomes (scope rule) by criteria such as the payoff rule. The dynamic discussion provides the information exchange within the meetings (information rule) and directly influences the choice and payoff rules in the meeting. The stances of the Member States represent their choices and how they control their decisions as the aggregate rule.

Table 31 shows the trend of agenda items prepared in the CPM report for the next and future WRCs decreasing over time. It may be that the Member States realize the importance of each forum for drafting and finalizing WRC agenda items. For example, the agenda items included in the future WRC in the CPM report are not guaranteed inclusion in the final version of the WRC agenda.

Conversely, the meeting to finalize the next WRC agenda items is crucial. For example, at the WRC-12, the WRC-15 agenda items were finalized under COM6 by the WG6C. Seventy-two documents were submitted by Member States containing 210 proposals for possible WRC-15 agenda items. The final version of the WRC-15 agenda included 20 issues. There were many discussions and compromises between the Member States to reach consensus.

During the discussion, the WG6C Chairman attempted to find similar issues among the possible WRC-15 agenda items to be grouped and nominated by the DG Chairman. The DG Chairman consolidated the views of the Member States' documents and discussions to

provide either a consensus or compromise text, if applicable. Once consensus was reached on the text, the final approval at the plenary of WRC-12 was quick.

Conversely, when conflict between Member States arises during discussions, either at the DG, WG, COM, or plenary level, a lengthy approval time is expected. The debate among the Member States represents information exchange, choices, consequences of decisions, and control over their stances as a decision situation captured by the IAD framework.

Finally, compromise must be reached on the Member State conflicts over the WRC agenda items for selection in order for them to be finalized and approved by the plenary.

The study therefore reveals that the WRC agenda-setting is lengthy in the preparatory process by ITU via the CPM, SG, and WRC, as it takes two WRC cycles or eight years. It provides several forums for discussing possible WRC agenda items; however, it does not guarantee inclusion of the outcome in the WRC agenda at the final stage of approval. Member States that have limited resources should pay attention to the final WRC in order to finalize the WRC agenda items for the next conference, such as the WRC-12, which was finalized in the WRC-15 agenda. When Member States realize the importance of having issues as agenda items to be included at the next WRC, they must submit documents to and actively participate in the relevant meetings at such WRCs in order to ensure inclusion of their proposed agenda items.

6.4 Preparatory process

WRC-12 Agenda Items 1.19 and 1.22 are identified as subjects of study, following the national, regional preparatory, and WRC-12 processes. The review leads to an identification of differences between submission processes and outcomes (relationship between them).

National preparatory meeting process

Sweden and Thailand are interesting to review, as they have different preparatory processes for their regional and WRC meetings. Both countries can submit to the regional and WRC-12 meetings.

Regional preparatory meeting process

The PT A, CPG, and APG are observed, as the processes and outcomes concern Agenda Items 1.19 and 1.22. The regional meeting is a forum that obtains a common view from its members on selected issues. The outcomes of regional meetings are regional proposals for the WRC-12.

Figure 17 presents the relationship between individual country delegations, regional meetings, and WRC processes. For example, Thailand can submit proposals directly to the WRC-12 or the APG-2012 to form common proposals (PACPs) prior to submission to the WRC-12.

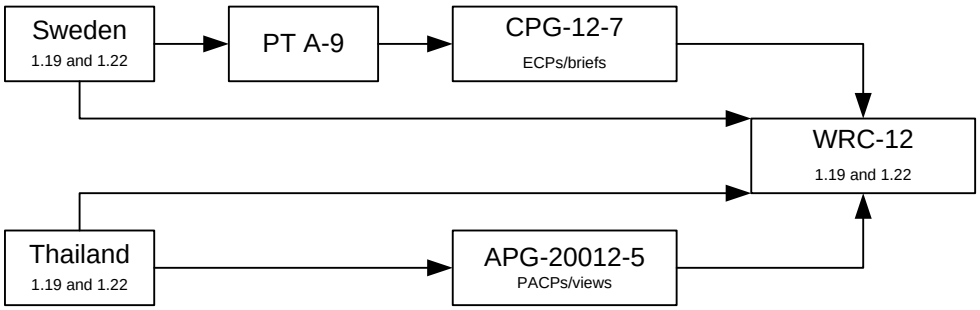

Figure 17. Regional preparatory and WRC-12 meeting processes

Differences between Sweden's and Thailand's preparatory processes are observed in an examination of preparatory material before the regional meetings, during the meetings, and in the meeting outputs.

The regional meetings help to reduce the number of issues as well as the proposals submitted to WRC. Countries with few delegates may use the regional meetings to protect their interests via common proposals and regional coordinators.

Participation at meetings provides an insight into the tabled issues and delegate position on Agenda Items 1.19 and 1.22 in a European and an Asia-Pacific context. Moreover, the ongoing discussion at the WRC-12 is observed to identify the issues that may potentially be missing from the archives.

6.5 National preparatory process

Sweden

The Swedish Post and Telecom Authority (PTS), as the Swedish national regulatory authority, prepared the Swedish position for meetings, including the PT, CPG, ITU-R SG/CPM, RA, and WRC.

The PTS has a mailing to distribute information to stakeholders, including meeting and venue, and submission and participant confirmation dates. E-mails are normally sent out the week prior to an activity. For example, for the CPG-12-7, the Swedish preparatory meeting was conducted in the week prior to the CPG-12-7.

During the preparatory meeting, the discussion on input documents from stakeholders helps to shape the Swedish position and prepare the document for submission to the relevant meetings.

Thailand

The Ministry of Information and Communication Technology (MICT) arranged a meeting prior to the APG2012-5 to establish a preparatory committee. The National Broadcasting and Telecommunications Commission (NBTC) (broadcasting and telecommunication regulator) is

a member of the committee. Dedicated staff prepared responses to the agenda items. These responses to the MICT process are in parts.

There were no proposals from Thailand for WRC-12 Agenda Items 1.19 and 1.22 at the APG2012-5. However, Thailand maintained its previous position (Method C or D) on WRC-12 Agenda Item 1.22 at the DG meeting. However, the change in position was discussed with the Head of the Thai delegation during the APG2012-5.

At the APG2012-5 and WRC-12, the Thai delegation's meeting between the staff responsible and the Head of the Thai Delegation depended on new information and possibilities to retain or change Thailand's position. The update status on each agenda item must be communicated directly via e-mail or discussion.

6.6 Regional meetings and observer attendance

At the WRC-12, there were 24 specified and 8 permanent agenda items to be reviewed. If all the Member States submitted only one document per issue for an agenda item, the minimum contribution to the WRC-12 would be more than 5,000 documents. However, Member States can submit many documents to the WRC-12.

To reduce this potentially large flow of documentation, the regional preparatory meetings act as a forum to discuss and negotiate common regional interests on the WRC agenda items. This forum helps to consolidate member views and develop common proposals for WRC.

ITU recognizes six regional preparatory meetings, i.e., APT, ASMG, ATU, CEPT, CITEL, and RCC.[48]

To be able to attend a regional preparatory meeting (boundary rules), a delegate observer requires permission from a regional preparatory meeting member.

The CEPT had CPG prepare a common proposal for WRC. As Sweden is a CEPT member country, the PTS allowed the author to be a CPG-PT A-9 and CPG-12-7 meeting observer.

The APT had APG as a regional forum to negotiate and prepare common proposals for submission to WRC. The NBTC, Thailand, allowed the author to be included in a preparatory team for the WRC-12 and attendance at the APG2012-5 and WRC-12 meeting as a Thai delegate.

The CPG process

The CPG is a forum for CEPT members to prepare common views for submission to WRC, the RA, and relevant ITU-R meetings, e.g., the SG and CC. The outputs of the CPG are the European Common Proposals (ECPs) and CEPT briefs (summary of discussion) for submission to WRC and the RA.

The CPG-12 has five PTs, i.e., PT A, B, C, D, and E. Each PT has several WRC-12 agenda items. WRC-12 Agenda Items 1.19 and 1.22 are included under the PT A.

[48] Some RCC member countries are also members of CEPT (e.g., the Russian Federation, Ukraine, and Belarus).

The PT and CPG meet separately. The PT is a function, as a WP provides a common view in the form of ECPs and briefs based on the documents submitted by CEPT members (including member countries and companies).

The CEPT Coordinator, as Chairman of the WG, drafts ECPs and briefs by agenda item. The WG can run two parallel meetings. The CEPT coordinator finalizes the draft ECPs and briefs for submission to the PT for approval. Each PT can have several meetings. The PT outputs are ECPs and briefs for CPG approval.

The CPG is an approval forum for the ECPs and briefs by agenda item. The CPG convenes meetings in a plenary manner (without parallel sessions). The CPG Chairman requests approval of the ECPs and briefs by agenda item. The right to vote on ECPs belongs to the CEPT Member Countries. The available positions are support, abstain, or oppose. Individual Members have a right to veto ECP proposals. After voting, formal signatory arrangements are conducted before submission to WRC.

The CPG met eight times and the PT A ten times to complete the ECPs and briefs for the WRC-12 and RA-12.

The APG process

The APG is a regional forum for APT members to formulate common views for submission to WRC, the RA, CPM, and SC to promote common benefits for the Asia-Pacific Region. The APG output takes the form of a common proposal submitted to WRC, the RA, CPM, and SC.

The APG-2012 has six WPs according to the CPM report. Each WP has several agenda items. WRC-12 Agenda Item 1.19 was included in the WP6, and Agenda Item 1.22 was contained in WP3.

The WP and APG convene at the same time. The APG conducts the plenary session chaired by the APG Chairman. Normally, the plenary is conducted on the first and last day of the APG. The first meeting introduces the working method, and the second meeting is intended to approve the WP output document.

The WP is conducted in two parallel sessions. Each WP has several agenda items. Each agenda item has a DG Chairman. The DG Chairman is the coordinator at WRC. Based on the document submitted by the APT Members and the discussion at the DG meeting, the DG Chairman drafts a preliminary view and the Asia-Pacific Common Proposal (PACP) by agenda item. The document is subsequently discussed at the DG and WP meetings.

The DGs are conducted via seven parallel sessions (from APG2012-5), each one lasting 90 minutes. If APT Members have insufficient delegate members attending a DG, the WP is the last forum to review and revise the draft preliminary view and PACP, prior to approval by the APG plenary. After finalizing the draft preliminary view and PACP on an agenda item, they are submitted to the WP for approval.

At the WP, the draft preliminary view and PACP are discussed and concluded for final approval by the APG plenary. Sometimes the debate at the WP is rigorous and the WP Chairman splits the meeting into smaller groups for discussion and compromises.

At the APG plenary session, all the draft preliminary views and PACPs are approved.

The APG2012 met five times to prepare the preliminary views and PACPs for the WRC-12. The last APG2012-5 meeting was held 29 September-3 August 2011, in Busan, the Republic of Korea.

CPG and APG comparisons

The processes

The CPG and APG have similar hierarchical work allocation structures to prepare common proposals for WRC. The plenary meetings approve the ECPs/PACPs and briefs/preliminary views on agenda items. The CPG and APG have the PT and WP, respectively, as DG pre-approval outputs. Similarly, the CPG and APG have the CEPT Coordinators and DG Chairmen to prepare the draft briefs/preliminary views and ECPs/PACPs on agenda items. Moreover, the CEPT Coordinators and DG Chairmen negotiate with other regional representatives at WRC.

The APG and CPG processes differ in the number of meetings held. The PT can arrange meetings until the work program is complete. However, the APG and WP have limited time to provide the preliminary views and PACPs.

The institutions

The IAD bio/physical condition indicates the nature of regional preparatory meetings. The CPG and APG have a similar objective, namely to formulate the common proposals for the WRC-12.

The IAD attributes of community concern the culture between the EU and Asia-Pacific Regions, for example, the ways in which views are presented in the plenary session. Most Asian countries are reluctant to express their views in English, when not mandated to do so, and prefer to converse in a small group.

The APG and CPG have similar IAD boundary rules (who can join the meeting), i.e., CEPT Members and APT Members. Members must endorse meeting delegates and their stated delegate or observer. These conditions indicate the position rules. There is a written rule for both APG and CPG.

The APG and CPG must approve common proposals via voting rules. Only the APT and CEPT Member Countries are able to vote. However, the CPG has a formal procedure with the options: support, abstain, or oppose.

There is no voting at the APG, but the WP Chairman seeks APG members' approval. The official support is indicated by an official signatory. When there is more than 25% APT Member support, a common proposal is made on behalf of the APT.

Conversely, in the CPG, when any CEPT member opposes the propositions, no common proposal is obtained for the agenda item.

The APG and CPG both use English as the common language to communicate. However, the local discussions are in their national languages.

The position of the APT and CEPT Members at the DG (WG) meeting is crucial when taking a new decision and position. For example, at APG2012-5, the DG meeting on Agenda Item 1.22 of WRC-12, when the DG Chairman sought the option to be drafted as the PACP, the majority indicated Method A. A decision was determined within the first five minutes of the meeting.

The draft PACP identified Method A with the WRC resolution (including an emission mask for SRD and modification of ITU-R Resolution 54).

The APG2012-5 meeting preferred the ITU Resolution for the CRS. The PACPs therefore made the following contributions: (1) draft ITU Resolution to the RA-12, and (2) no RR change with the suppression of Resolution 956 and the WRC resolution to the WRC-12. When the RA-12 approved the modified ITU-R 54, the APT withdrew the WRC resolution from the WRC-12.

Interactions

At the PT A-9, WRC-12 Agenda Item 1.19, one view expressed was that the WRC resolution was preferable. This concern was raised during a WG meeting chaired by a CEPT coordinator. This proposal was included in the PT A-9 minutes. However, the majority supported the ITU-R resolution.

The same view was repeated at the CPG-12-7. Due to this continued opposition, there was no ECP on this agenda item. Other solutions must be considered via multi-country proposals for the ITU-R resolution.

At the APG2012-5, with regard to WRC-12 Agenda Item 1.22, an APT Member proposed that the list of recommendations be included in the WRC resolution (SRD harmonization band and emission mask) at the DG meeting.

At the DG meeting, the majority supported the draft PACP Method A with no RR change. After the argument concerning whether the WRC resolution should be modified by adding the list of recommendations, the meeting decided that the ITU-R Resolution 54 modification be accepted as a compromise.

Finally, the DG meeting could not agree whether the list to ITU-R Resolution 54 should be kept or deleted, and the DG Chairman placed it in square brackets and moved the issues forward to the WP3 for further consideration.

At the WP3, further arguments considered the removal of the square brackets, however, no support for the proposition was received. The WP3 Chairman's final resolution was to remove this text from the resolution.

The APG and CPG discussions both show, via the aggregate rule, that the stances were held to the end of the process.

6.7 Summary and discussion on research questions

This chapter responds to one part of sub-research question 1: *How did they develop?;* sub-research question 2: *What information would be more useful for making the decision?;* and sub-research question 4: *How can the existing ITU archives be improved or completed?*

The study provides an illustrated WRC preparatory process for agenda-setting by ITU to respond to how to review and revise the RR in terms of the WRC agenda-setting process. The WRC agenda-setting process is used to identify which issues should be considered at WRC as possible RR revisions.

The WRC agenda-setting process provides a standard procedure for ITU to prepare the WRC agenda for the next and future WRCs in the CPM report. The study explores the CPM reports contained in the preparatory work for the next and future WRC agenda after the APP1992. The study also constructs a table to show the number of the next and future agenda items on each CPM report in order to understand the WRC agenda-setting process and identify the critical point in the process.

The empirical finding of the study showed that the WRC agenda-setting process carried out by ITU has two study cycles for the preparation in terms of the next and future WRC agenda in the CPM report. It takes eight years for the whole WRC agenda-setting process.

However, the study also reveals that the last WRC is a crucial forum for approving the next WRC agenda before the CC approval. The numbers "F to N" and "N to C" in Table 32 are falling over time. This evidence supports the last WRC being the crucial forum, which means that the agenda items, including those in the CPM report, for the next and the future WRC agendas are not guaranteed inclusion in the final version of the WRC agenda by the last WRC approval. Interested Member States with limited resources should pay attention to the last WRC that is finalized in the next WRC agenda.

The results of the exploration of the WRC agenda-setting process respond to one part of the first sub-research question, *How did they change?,* in terms of the creation of agenda items, as the point or issues will be discussed in the RR revisions. This sub-research question is important to show the process of RR revision, and it confirms that the ITU archives lack the rationale behind the RR revision, because the CPM report contains only the output of the discussion, not the underlying issues.

Moreover, the study provides the national and regional preparatory works that assist in the WRC preparatory process before WRC. The study elaborates on the national and regional preparatory processes in terms of Thailand and Sweden, as a national preparatory process, and

the APG and CPG, as a regional preparatory process. The exploration of the APT and CEPT archives helps provide an understanding of the issues and clarify the regional preparatory processes.

With regard to the second sub-research question, the study provides an inside view of the PT A, CPG, and APG on WRC-12 Agenda Items 1.19 and 1.22 via the attendance of the author. The record of the meeting discussions reveals the rationale behind the ultimate resolutions not contained in the archives. This information provides a more complete basis for understanding the state the issue has revealed and for the development of further arguments at relevant meetings.

During the discussion, the rationale of how it changes, as the missing information, is available to an attending Member State. The author's participation in both national and regional preparatory meetings provides the missing information apart from the archives.

The CPG and APG, as the regional forums, allow discussions on regional interests and preparation of common proposals for WRC. The process reduces the volume of submitted documents. Moreover, regional coordinators act as regional representatives and negotiate and report to regional coordination meetings. Highlights of the agenda items in the regional preparatory meeting include the following:

At the CPG, WRC-12 Agenda Item 1.19, the ITU-R and WRC resolutions on the CRS discussion rendered no ECP for the WRC-12 because of an objection from one Member State.

At the APG, WRC-12 Agenda Item 1.22, a resolution on the SRD issue is achieved through APT Member compromise. The proposal is submitted to the RA-12 and WRC-12. When the RA-12 approves the ITU-R resolution, the WRC-12 contribution is withdrawn.

The author's attendances at the national and regional preparatory meetings (PT A, CPG, and APG) illustrate the preparatory process and capture the missing information during the discussion inside the meetings. The second sub-research question highlights the importance of the missing information in the regional preparatory meetings by providing the rationale for the discussion of the meeting as the insight view missing from the archives.

Furthermore, national and regional preparatory meetings represent a forum for negotiation between stakeholder at national and regional level. The connection between stakeholders is formed during networking to exchange information before, during, and after the meeting. This networking also helps in understanding the rationale of the discussion, which is omitted from the archives. The networking is another possible solution to improve the ITU archives as the fourth sub-research question.

The fourth sub-research question is important for the study to identify the possibility to fulfill the limitation of the archives that lack the rationale underlying the RR provision. This rationale is not documented in the archives.

Finally, the study provides the RR development in terms of the WRC agenda-setting process to respond to one part of the first sub-research question. Furthermore, the study elaborates on

the national and regional preparatory meeting process, as the preparatory work before WRC. The study also demonstrates the missing information in the national and regional preparatory meeting and addresses the rationale underlying the preparatory process of WRC. In addition, the study highlights the appointment of national and regional stakeholders representing the networking for information exchange before, after, and during the meeting. This may be a possible solution to improve the limitation of the archives.

This chapter responds to the first sub-research question: *How did they develop?*; the second sub-research question: *What information would be more useful for making the decision?*; and the fourth sub-research question: *How can the existing ITU archives be improved or completed?* as a conclusion.

Chapter 7 Preparatory work on WRC-12 Agenda Items 1.19 and 1.22

The chapter provides preparatory work for WRC-12 Agenda Items 1.19 and 1.22 as the WRC study process and its assessment, including agenda item background, process, issues, and results from the SG, CPM, and RA-12. The study also covers the importance of WRC-12 Agenda Items 1.19 and 1.22 to Thailand as the basic information for analyzing how the missing information affects international spectrum policy.

7.1 Importance to Thailand

The study uses Thailand to illustrate spectrum management development and the importance of WRC-12 Agenda Items 1.19 and 1.22.

Thai regulatory profile

Thailand has a long history of spectrum management, dating back to 1875. Telecommunications developed from wire to wireless communication: from telegraph, telephone over a telegraph infrastructure, and radiotelegraph for ship-to-shore communication, to radiocommunication for both broadcasting and telecommunication. At the initial stage (without regulations), the use of radiocommunication devices was limited to government agencies, especially the Navy and the Army. Frequency assignment was initially made by His Majesty the King of Thailand. After 10 December 1932, this authority was transferred to the Prime Minister. The King delegated his authority to the responsible ministry. The ministry used the command-and-control approach on a first come, first served basis to authorize the use of radiocommunication devices. Thailand also endorsed the International Telegraph Convention 1906 and 1912 (ITU, 1906a, 1912b) as a national regulation. Most of the users were government agencies. There was little other usage and low demand, so there was no congestion of the use of radiocommunication.

After the Radio Act was enacted in 1914, all radiocommunication activities were prohibited, except with authorization granted by the authority, in terms of radiocommunication licenses. The authority was the Post and Telegraph Department (PTD), and it still used the command-and-control approach on a first come, first served basis to authorize the use of radiocommunication devices. However, the PTD functioned only for radiocommunication licences in technical respects and did not take into consideration the growing demand for the use of radiocommunication devices until congestion led to harmful interference.

The government realized that “good” spectrum management of frequencies would provide efficient national allocations. On 26 March 1974, the National Frequency Management Board (NFMB) was established to determine the national technical standard; control, assign, and register frequency; examine the standard of radiocommunication devices; create an efficient procedure; evaluate radiocommunication stations; and coordinate all radiocommunication users. The NFMB comprised several representatives from government agencies, and it was chaired by the Minister of Transport (the NFMB came into force in 1975). The NFMB acted as the approval board before the PTD issued radiocommunication licenses. The NFMB

operated until 2002, while the PTD was transferred and became part of the Ministry of Information and Communication Technology (MICT).

After the Act on Establishment of the National Broadcasting Commission (NBC) and the National Telecommunications Commission (NTC) were enacted in 2000, the NTC was established on 1 October 2004, and the PTD was dissolved by law to become the Office of the NTC on 1 January 2005. A new era of telecommunication with an independent regulator, the NTC, was founded in order to change the authorization process into a licensing process. Not only the technical aspects, but also social and economic aspects, were included in the licensing process.

On 7 October 2011, the National Broadcasting and Telecommunications Commission (NBTC) was established, according to the Thai Constitution 2007 and the Act on Organization to Assign Radio Frequency and to Regulate the Broadcasting and Telecommunications Service 2010. The Office of the NTC (ONTC) was transferred to the Office of the NBTC (ONBTC) from 20 December 2010. The NBTC responds to the broadcasting and telecommunication industry and ensures the transition from authorization to the licensing process.

Figure 18 shows the Thai spectrum management development profile: administrator, regulator, secretariat (an administrative unit), and operator.

	Administrator	Regulator	Secretariat	Operator
Before 1975	PTD			
1975-2002	PTD	NFMB	PTD	PTD/TOT/CAT
2002-2004	PTD		PTD	TOT/CAT
2004-2011	MICT	NTC	ONTC	TOT/CAT +licensees
2011-now	MICT	NBTC	ONBTC	TOT/CAT +licensees

Figure 18. Thailand's spectrum management profile

The administrator represents the Thai government as the Thai delegation to international activities, such as international conferences, conventions, treaties, negotiations, and cooperations. The regulator acts as the NRA for frequency management. The secretariat is the regulator's administrative office. The operator provides the services after obtaining the frequency and licenses from the regulator (TOT and CAT are state-owned companies).

Before 1975, the 1914 Radio Act authorized only the PTD to assign frequency to users. The PTD acted as the administrator, regulator, and operator.

To separate it from the PTD, the NFMB worked as regulator to assign frequency to users until 2002 and was dissolved by the MICT.

During 2002-2004, there was no regulator to assign new frequency (according to the provision of the Act on Establishment of the NBC and NTC 2000).

The transition period from the monopoly by state enterprise (or currently state-owned company) to market economies by licensees started with the NTC.

The NTC was founded in 2004 with the establishment of the licensing scheme for the Thai telecom sector. The NBC was never founded however. The NTC did not have full authority to form the Joint Committee between the NTC and the NBC to approve the National Table of Frequency Allocation or National Master Plan. The reason for the Supreme Administrative Court on 23 September 2010 was not to provide the NTC with any right to pursue the 3G auction until the establishment of the NBTC.

The NBTC was established on 7 October 2011 to combine broadcasting and telecommunication into a single regulator with full authority to assign new frequency. The 3G frequency assignment or auction will be able to be carried out after approval of the National Table of Frequency Allocation or National Master Plan.

Table 34 summarizes the important events in Thailand's spectrum assignment profile.

Table 34. Thailand's frequency assignment profile

Frequency transfer (alienation right)	NFMB in 1998 NTC in 2009
Auction	NFMB initiated in 1997 NTC attempted in 2010 NBTC in 2012
Spectrum commons	Authorization since 1974 Unlicensed since 2004

Thai telecommunication industry

The telecommunication industry in Thailand began with command-and-control and developed for the market economy that originated from the government-provided telecommunication service, state enterprise, and state-owned company to licensees.

The right to use frequency by command-and-control assignment has shifted to auction in order to provide licensees with exclusive rights to use frequency during a defined period of time. Two auction attempts were made by the NTC and NBTC during 2010-2012.

Thailand is not a telecommunication-manufacturing-based or research development country. Most telecommunication devices are imported, including telecommunication network infrastructure and end-user terminals. In order to take advantage of telecommunication development, Thailand must ensure that the regulatory regime facilitates the growth of the telecommunication industry by allowing frequencies to be used with compatible standards. For example, Thailand allows the 1900-1906 MHz to be used for personal cordless telephones, Digital Enhanced Cordless Telecommunication (DECT) as well as Personal

Handyphone System (PHS) technologies. The right to select standards and technologies should belong to the operators.

Importance of spectrum commons

Spectrum commons provides non-ownership of spectrum by sharing the use of frequency equally and having non-exclusive rights to use frequency. This increases spectrum efficiency. It was initiated in 1974 and became unlicensed for the general public in 2004.

The success story of Wi-Fi-enabled devices in Thailand confirms the appropriated regulatory regime. For example, Thailand has allowed the 2.4 GHz band to be used for Wireless LAN with relevant radiocommunication licenses since 1996, and it became unlicensed for all Wi-Fi-enables devices in 2004.

The global allocation of the 2.4 GHz band for spectrum commons is in accordance with the 5.150 ISM footnote of the RR. It allows manufacturers to reach mass production. When economy of scale is achieved, the price of devices becomes affordable to users.

In order to benefit from spectrum commons, the global frequency must be allocated either in the footnotes or in the relevant services of the RR. Thailand must therefore follow the relevant agenda items in terms of Thailand's position preparation and to evaluate the consequences of the RR revisions.

Importance of WRC-12 Agenda Items 1.19 and 1.22

At the WRC-12, there are two agenda items that are relevant to spectrum commons, i.e., Agenda Items 1.19 and 1.22. Agenda Item 1.19 is about the use of SDR and CRS. Agenda Item 1.22 is about the emission of SRD.

SDR and CRS are enabling technologies for spectrum commons. SDR is the technology that allows the operating parameter to be changed automatically via software. CRS is the technology that enables the operating parameter to be changed automatically via software, learning the environment from previous operations, and improving operating performance.

With these two enabling technologies, the use of spectrum commons can be shared with existing services, avoid harmful interference, and increase spectrum efficiency.

SRD is an example of a spectrum commons application or device that is mostly used under the ISM footnotes, for example, Wi-Fi-enabled devices in mobile phones, cameras, printers, Wi-Fi access points, garage door openers, RFID tags, and credit cards.

Thailand's situation

Comparing three frequency assignment approaches: command-and-control, market-based (auction), and spectrum commons, command-and-control still dominates in terms of legacy or existing assignments. However, the auction and unlicensed devices are introduced in different processes. For example, the 3G frequency auction is expected to be completed in 2012, but unlicensed devices have been initiated since 2004.

The development of radiocommunication technology enables sharing between radiocommunication services. An exclusive right to use frequency may not be necessary when the advancement of technology enables communication in any frequency without causing harmful interference between services. Consequently, a spectrum commons regime may be appropriated to prepare for future situations.

It is important for Thailand, as an importing country, to follow spectrum commons issues at the WRC-12 on Agenda Items 1.19 and 1.22 for its position on preparation and to evaluate the consequences for Thailand.

7.2 Background to WRC-12 Agenda Items 1.19 and 1.22

The WRC-12 agenda first appeared in the future WRC agenda contained in the CPM report for the WRC-03. The second appearance of the agenda was in the next WRC agenda contained in the CPM report for the WRC-07. The CPM-06-2 added the new proposals from the ITU Member documents and removed previous text when no support was received for the proposals.

WRC-12 Agenda Items 1.19 and 1.22 are not contained in the CPM reports of the future WRC or the next WRC agendas. These issues were introduced by the WRC-07 Member State documents. This treatment is consistent with the argument in Chapter 6 that most WRC agenda items are introduced by the last WRC.

Twenty-six documents concerning 80 issues were sent to the WRC-07 as WRC-12 agenda items. Seven remaining issues from the CPM report were not finalized or sent to the WRC-07. The WRC-07 established an ad hoc plenary 7.2 to finalize 24 issues through Member State negotiation. The WRC-12 agenda was approved by the plenary meeting. The plenary approved the first and second reading at the same time. The duration of the preparatory process for the WRC-12 agenda is therefore eight years (two CPM reports), and three plenary meetings (two ad hoc and one plenary meeting) during the WRC-07.

Of the 24 issues, WRC-12 Agenda Items 1.19 and 1.22 concern spectrum commons issues. Spectrum commons allows non-exclusive use of frequency, that is, when the frequency is being used, it is temporarily occupied, but later released. The shared used of frequency is intended to increase spectrum utilization.

WRC-12 Agenda Item 1.19 is about the use of SDR and CRS, and whether RR revisions are required. SDR is an enabling technology that allows radio-operation parameters to vary dynamically and autonomously by software. The CRS technology is comprised of obtaining knowledge about frequency use, dynamically changing radio-operating parameters via software, and learning from operational experiences to improve performance.[49]

[49] This section is based on the 2nd session of the Conference preparatory meeting for the WRC-12-CPM report on technical, operational, and regulatory/procedural matters to be considered by the 2012 World Radiocommunication Conference (ITU, 2011). The document is available on http://www.itu.int/md/R07-CPM11.02-R-0001/en
SDR is based on a working document towards a preliminary new draft Report ITU-R [LMS.CRS](ITU, 2010).
CRS is based on Report ITU-R M.2117 (ITU, 2007b).

Issues related to these agenda items concern the definition, regulations, and technical matters. The main concern is whether SDR and CRS are classified as technologies or services. As there are several ITU definitions, a single definition is needed for clarity.

WRC-12 Agenda Item 1.22 examines the effect of SRD emissions on existing services. SRDs use an ISM frequency band, but SRDs are not ISM applications, as they contain a transceiver to send and receive information.

The issue is whether the SRD should be handled nationally or internationally. While SRD is local, SRD circulation renders it an international issue. Most SRD is unlicensed and transportable between countries. However, SRD authorization is local (national) by Member States. When one country allows SRD but another does not, the emissions can interfere with existing services.

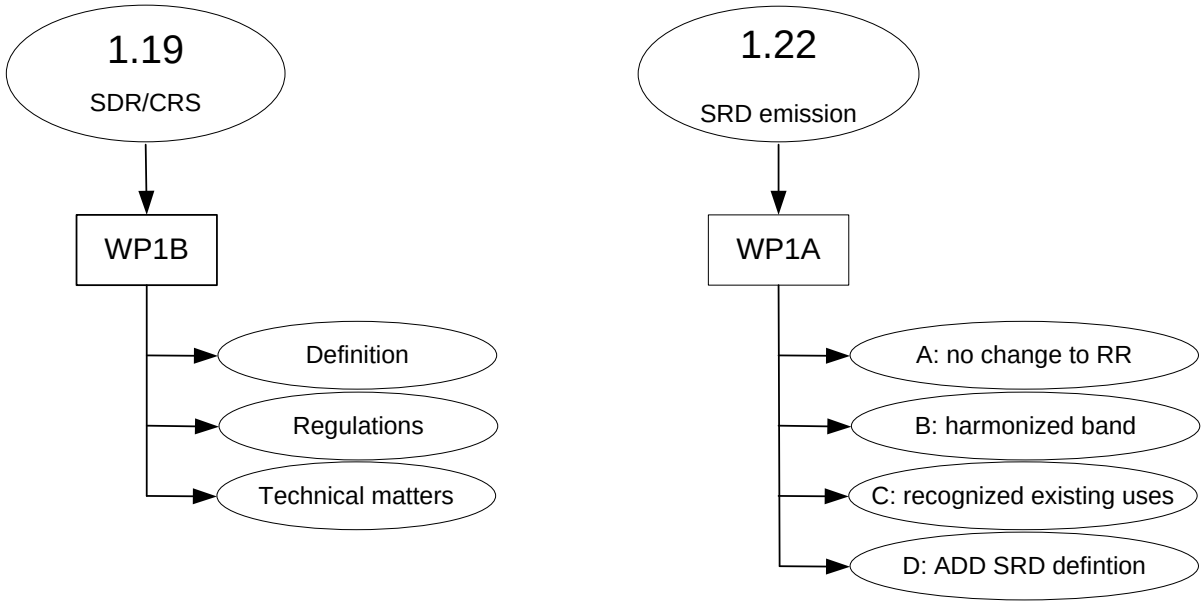

Figure 19. Agenda Items 1.19 and 1.22 and related issues

Figure 19 relates Agenda Items 1.19 and 1.22 to particular issues.

SDR and CRS are spectrum commons-enabling technologies that allow users to occupy spectrum frequencies temporarily, then later release them.

SRDs are local unlicensed applications. There are therefore no exclusive rights to use SRD frequency. SDR and CRS are both enabling technologies for SRD applications, such as Wi-Fi-enabled devices contained in computers, mobile phones, printers, and cameras.

7.3 Challenges to CRS and SDR

CRS and SDR are enabling technologies. SDR is an enabling technology for CRS that is able to change operating parameters automatically and dynamically via software.

CRS and SDR can be deployed in any services and applications, such as satellite and mobile services. These two technologies help to avoid harmful interference during transmission. Importantly, CRS and SDR abilities, i.e., to change operating parameters dynamically and

automatically via software, to learn from experiences and the environment, and to improve system performance, enable the transmission frequencies to be changed between the transmitter and receiver to avoid harmful interference.

The challenges faced by the Member States are how to facilitate and reduce the burden of the use of technologies, for example, the Member States may consider whether the existing regulatory scheme is appropriate or if there is a need for new regulation. Consequently, the impact of using this technology for portable devices may migrate national to international matter such as SRDs.

The telecommunication providers are challenged on how to introduce the new devices under the existing regulation, especially the use of new devices, which must not cause harmful interference.

7.4 Preparatory process

After finalization of the WRC-12 agenda by the WRC-07 (and approval by the CC2008), the CPM-11-1 organized and distributed preparatory work to relevant SGs/WPs. In particular, WRC-12 Agenda Items 1.19 and 1.22 are allocated to the SG1/WP1B and SG1/WP1A, respectively.

The SG1 meeting is a forum to approve the WP1B and WP1A report, prior to submission to the RA-12. The SG1 convenes annually. Figure 20 and Figure 21 show the preparatory process for Agenda Items 1.19 and 1.22.

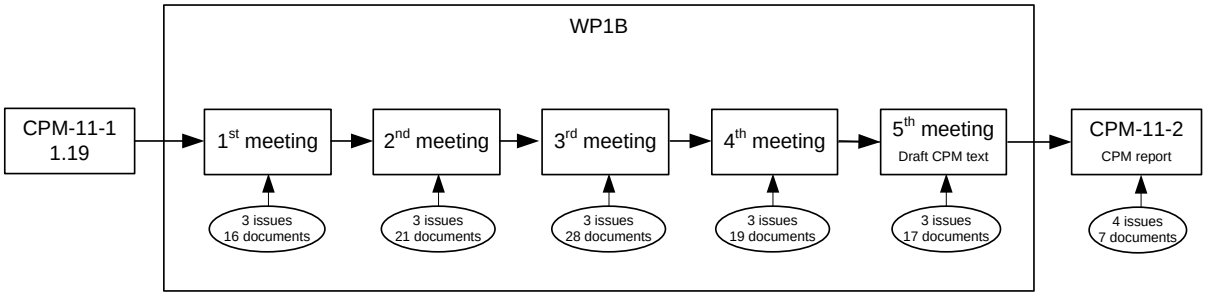

Figure 20. WRC-12 process for Agenda Item 1.19

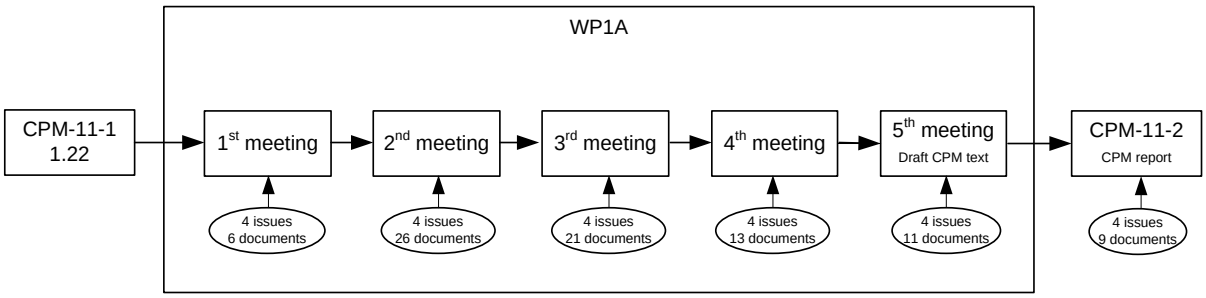

Figure 21. WRC-12 process for Agenda Item 1.22

The WP1B and WP1A met five times between the first and second session of the CPM. They studied and prepared the draft CPM text for inclusion in the CPM report, as the possible RR revision options for Member States to make a decision at WRC.

7.5 Assessment of the WRC agenda study process

The WRC study process is similar to the WRC preparatory process (WRC agenda-setting process), Chapter 6. The study process is only one WRC study cycle, but the WRC agenda-setting is two WRC cycles.

The study process is mandated by the RA and the relevant ITU-R resolution as mentioned in Figure 16 in Chapter 6. The study is conducted by the relevant SGs. The objective of the study process is to prepare the possible options for RR revisions on each agenda item as the CPM report. The CPM report provides the information required by Member States to consider the RR revisions during WRC.

The study by SGs takes time between WRCs. This is normally about four years. However, the study must be finished and be ready as the draft CPM text to be included as the CPM report at the CPM-2. For example, the draft CPM report for the WRC-12 was available on 5 August 2010. The SGs must study and prepare the text to be included around June 2010. The study time is around two years and seven months (after CPM-11-1 in November 2007 to the last meeting of the SGs in June 2010 before the draft CPM report was available). At the WRC-15, the study time is shorter. In order to assess the study process, the IAD framework is discussed as follows.

The study object is the study of each agenda item. The results of the study provide the options with the advantages and disadvantages of each agenda item for possible RR revisions.

The attribute of community is the same as the WRC agenda-setting environment because the study is conducted under ITU and its membership environment.

The rules-in-use as an action situation reflects the discussion within the relevant meetings, including the relevant CPMs and SGs.

The boundary rule that determines who is allowed to participate in the relevant meetings is ITU membership during the CPMs and SGs, including Member States, Sector Members, and Academia.

The position rule is directly relevant to the boundary rule, which role each participant will perform during the discussion in an action situation, and which options each has as the choice rule.

The actions to be taken have been evaluated with consequences and possible outcomes (scope rule) using evaluative criteria as the payoff rule. The dynamic discussion provides the information exchange in the meetings (information rule) and directly influences the choice and payoff rules of the meeting. Participant stances represent their choice and how to control their decision as the aggregate rule.

Figures 20 and 21 show the study process of the WP1B and WP1A for WRC-12 Agenda Items 1.19 and 1.22. There were five meetings on each agenda item to study and prepare the text to be included in the draft CPM report. The results of the study are based on the

document from the ITU members and the relevant results of the ITU-R study group in terms of the report, recommendations, and handbook.

The discussion, as an action situation inside the SGs, is less controversial when compared with WRC. The main discussion concentrates on the possible options to revise the RR according to the results of the relevant study and documents submitted by the ITU members. However, not all of the Member States attend and submit document to the SGs.

The results of the study, as stated in the CPM report, therefore represent the view of the relevant SGs and participants concerned. It may not include all possible concerns on each agenda item. The report serves as the basic text and possible options for Member States to consider the RR revisions on each agenda item.

7.6 Agenda item issues

WRC-12 Agenda Item 1.19

The principal concerns are issues related to the SDR and CRS. According to the RR, the status of SDR and CRS is unclear with regard to whether they should be treated as a service or technology. If they are a designated as a service, the SDR and CRS definitions should be added to Article 1. Consequently, their service priority would need to be identified as either primary or secondary within the TFA (Article 5). However, this treatment is not appropriate, as the WP1B identified the SDR and CRS as techniques to communicate and, as such, they are best treated as a technology.

Next, the WP1B Chairman sends a liaison statement to the relevant ITU/SG/WPs, where other current ITU definitions are in place; the Recommendation ITU-R M.1797 is identified.

Based on the definition contained in Recommendation ITU-R M.1797, a WP1B subgroup (corresponding group) is charged with developing a final definition.

ITU Members submit documents, including information concerning liaison statements, working methods, SDR and CRS definitions, and views on a proposed service or technology classification.

The SDR and CRS definitions were concluded in the CPM draft at the second meeting. The SDR and CRS are both determined technologies.

Other issues to be resolved concerning regulatory and technical matters were identified and inserted in the background of the CPM draft.

The SDR technology, in particular, is used to provide many services, especially in the LMS. The SDR is already subjected to an ITU recommendation and report. There is no need for new SDR regulation or RR revisions.

The CRS technology has three main functions: (1) the ability to change radio operating parameters dynamically and automatically via software (SDR is the enabling technology), (2)

the ability to use knowledge of the working environment, and (3) the ability to improve performance based on this knowledge.

As for CRS environmental knowledge and performance, the adjustment functions are in their infancy. However, unlike SDR technology, there is insufficient knowledge to make any decision on regulatory and technical matters on CSR. The RR revision is therefore not necessary at this stage, and further study of CRS matters is required.

At the final WP1B meeting, the draft CPM text (covering the background and issues considered) was submitted to the CPM chapter rapporteur. The CPM chapter rapporteur consolidated the draft CPM text into the draft CPM report, which is to be finalized at the CPM-11-2.

CPM report to the WRC-12 on Agenda Item 1.19

The CPM report contains two responses to the SDR and CRS issues. The response to the SDR issue is that there is no change to the RR. With respect to the CRS issues, there are three options: (1) no change to the RR (Method B1 option 1); (2) no change to the RR, with the ITU-R resolution for CRS requiring further study (Method B1 option 2); (3) no change to the RR, with the WRC resolution for CRS requiring further study (Method B2). The RA approved the ITU-R resolution, whereas the WRC resolution was approved by WRC. Importantly, the WRC resolution is mandatory for Member States, but the ITU-R resolution is voluntary.

WRC-12 Agenda Item 1.22

The prospect of SRD emissions interfering with existing services lies at the heart of the conflict between existing and new users. Providers of existing services do not want new services or applications to interfere with service transmission, especially satellites with highly sensitive receivers.

The reason SRD technology has created international interference, in particular, is that SRD encompasses the low-power devices (normally unlicensed) that are transportable internationally. Local SRD authorization by Member States is covered by national regulations. However, because of international circulation, there may be a need for international SRD regulations. For example, if Country A allows unlicensed SRD use in Band A but it is not allowed in Country B, then cross-border travel can lead to interference with existing services in Country B, thus requiring RR revisions.

In addressing emission issues, the WP1A is unable to consider a wide range of SRD applications; it therefore focuses specifically on Radio Frequency Identification (RFID) applications such as tags, barcodes, access cards, and credit cards.

The WP1A Chairman submitted liaison statements, establishing a subgroup (correspondence group) to consider documents from ITU Members to prepare the draft CPM text.

The report considered two main issues concerning whether the RR revisions were required: (1) if SRD was a truly national issue, there would be no need to revise the current RR; and (2) if global interference from SRD was considered a serious problem. It provided three options, depending on the severity of the problem.

The first proposal was that an SRD harmonization band be introduced to reduce interference from emissions. This band would not be restrictive to service transmission and would allow sufficient growth for the economy of scale to be raised (a lower price). TheWP1A therefore proposed the WRC resolution for further study of SRD to be accepted.

The second proposal recognized that existing SRD use could be constrained (emission mask) to ensure there was no further interference to existing services, especially satellite receivers. An SRD footnote providing for proper constraints was therefore proposed. This footnote was drafted in a similar manner to the ISM footnote.

The final proposal was that the new SRD definition be strengthened by inclusion in Article 1 and that SRD be a priority service. SRD could then claim protection from existing services.

At the last WP1A meeting, the draft CPM text (covering the background and the issues considered) was submitted to the CPM chapter rapporteur. The CPM chapter rapporteur consolidated the draft CPM text into the draft CPM report, which is due to be finalized at the CPM-11-2.

CPM report to WRC-12 on Agenda Item 1.22

The CPM report contains four options: (1) no RR change (existing RR and ITU recommendations and reports can govern SRD) (Method A), (2) a WRC resolution (further study on global and regional harmonized frequency bands for SRD) (Method B), (3) a footnote similar to the ISM footnote (recognize existing SRD use, ensuring no harmful interference to existing services) (Method C),and (4) a new SRD definition under Article 1 (Method D).

7.7 RA-12 proposals for WRC-12 Agenda Items 1.19 and 1.22

For WRC-12 Agenda Items 1.19 and 1.22, the ITU-R resolutions developed were Resolution 58 and Resolution 54-1, respectively. Resolution 58 deals with proposed further study of technical CRS issues, whereas Resolution 54-1 is concerned with the study of the harmonization of short-range devices.

Based on the ITU Members' submitted documents, contributions were introduced in Resolution 58 (five proposals) and Resolution 54-1 (four proposals).

The RA-12 also resolved, through ITU-R Resolution 58, to conduct further study of technical CRS issues for WRC-12 Agenda Item 1.19.

The RA-12 modified ITU-R Resolution 54 to require further study of the harmonization of short-range devices. This RA-12 output is contained in ITU-R Resolution 54-1 for WRC-12 Agenda Item 1.22.

7.8 Summary and discussion on research questions

This chapter responds to one part of sub-research question 1: *How did they develop?* and sub-research question 3: *How does the missing information affect international spectrum policy?*

The study explores the ITU archives for the WRC study process for WRC-12 Agenda Items 1.19 and 1.22. The WRC study process provides the output of the discussion from the ITU SG and the issues of these agenda items. The WP1B and WP1A of SG1 are in charge of WRC-12 Agenda Items 1.19 and 1.22, respectively. The study explores the input and output documents of the ITU members' contributions to both study groups. The illustration of study output is presented as follows.

The output from the WP1B provides one option for SDR and three options for CRS in the CPM report for WRC-12 Agenda Item 1.19. The SDR issue is that there is no change to the RR. For the CRS issues, there are three options: (1) no change to the RR (Method B1 option 1), (2) no change to the RR with the ITU-R resolution for CRS requiring further study (Method B1 option 2), and (3) no change to the RR with the WRC resolution for CRS requiring further study (Method B2).

The output from the WP1A provides four options in the CPM report for WRC-12 Agenda Item 1.22: (1) no RR change (existing RR and ITU recommendations and reports can govern the SRD) (Method A), (2) a WRC resolution (further study of a global and regional harmonized SRD frequency band) (Method B), (3) a footnote similar to the ISM footnote (recognize existing SRD use ensuring no harmful interference to existing services) (Method C), and (4) a new SRD definition in Article 1 (Method D).

Moreover, the output from the RA-12 provides two ITU-R resolutions for WRC-12 Agenda Items 1.19 and 1.22: ITU-R Resolution 54-1 and ITU-R Resolution 58, respectively.

The output of the SG is presented in the CPM report as the options for Member States to decide on at the WRC-12. Moreover, the output from the RA-12 provides additional information regarding these two agenda items (ITU-R Resolutions 58 and 54-1). However, the missing information in terms of the reasons for such options being developed has been omitted from the ITU archives.

The study illustrates the WRC study process as the preparatory work for WRC, which is contained in the CPM report and the RA report to WRC. This chapter responds to one part of the first sub-research question, *How did they develop?*, in terms of the issue content that is the output from the ITU-SG study to provide possible options for Member States to decide on at WRC.

This sub-research question is important to the study in order to understand the content of WRC-12 Agenda Items 1.19 and 1.22 in depth. The information forms the decision options for Member States, including the background to issues and possible options, with the advantages and disadvantages in the CPM report. This information includes the output from the ITU SG study and the RA report to WRC. However, the rationale of the issues is not

included in the ITU archives, only the conclusion of the study is presented. The results of this sub-research also strengthens the missing information from the archives.

Furthermore, the study explores the history of Thailand's spectrum management from the relevant literature, including the development from the monarchy to the democracy era and from the PTD, MICT, and NTC to the NBTC.

The study also analyzes the development of the Thai telecommunication industry that has gradually developed from a command-and-control to a market economy, as the transition from authorization to licensing scheme.

The study also illustrates challenges of CRS and SDR facing Thailand's perspective: how do these technologies influence Thailand's spectrum management? Thailand's spectrum management profile and background are also presented as Thailand's environment.

The importance of WRC-12 Agenda Items 1.19 and 1.22 influences Thailand's priority on the WRC agenda items. The priority can either be an amplifier or attenuator of the missing information during the decision-making process at WRC. The importance of WRC-12 Agenda Items 1.19 and 1.22 therefore forms the basis of the information to analyze the effects of the missing information on international spectrum policy.

CRS and SDR are enabling technologies for frequency sharing between radiocommunication services. The exclusive right to use frequency may not be necessary when the advancement of technology enables communication in any frequency without causing harmful interference between services. Consequently, a spectrum commons regime may be appropriated to prepare for future situations.

Thailand is an importing country in the telecommunication sector. It is important for Thailand to follow spectrum commons issues at WRC-12 on Agenda Items 1.19 and 1.22 in terms of Thailand's position on the preparation and its evaluation.

The study looks at the challenges and importance of WRC-12 Agenda Items 1.19 and 1.22 from Thailand's perspective, responding to one part of the third sub-research question, *How does the missing information affect international spectrum policy?*, in terms of the existing situation in Thailand as an impact background for further analysis of the impact level when Thailand faces the missing information on this matter.

The third sub-research question is crucial to preparing the impact background for the analysis of the missing information affecting the international spectrum policy from Thailand's perspective.

To conclude, this chapter illustrates the RR development as part of the WRC study process by ITU in the CPM report and the RA-12 output for WRC-12 Agenda Items 1.19 and 1.22. The study also underlines the limitations of the archives, which lack the underlying rationale, corresponding to one part of the first sub-research question: *How did they develop?*

Moreover, the study also illustrates the challenge and importance of WRC-12 Agenda Items 1.19 and 1.22 from the perspective of Thailand as the basic information to analyze the effects of the missing information on Thailand's spectrum management policy, responding to the third sub-research question: *How does the missing information affect international spectrum policy?*

Chapter 8 Participation in the WRC-12 meetings and the issue of the WRC-15

This chapter reviews the WRC preparatory materials based on the observations and outcomes of WRC-12 Agenda Items 1.19 and 1.22. The WRC-12 organization, documents, and observations are also provided. The informal channel of communication during the WRC-12 is acknowledged, and the importance of the missing information is restated. This chapter also presents the ongoing issues of the WRC-12 Agenda Item 1.2, including the existing situation in Thailand and the preparatory work toward the WRC-15.

8.1 WRC-12 organization

The WRC-12 was convened at the Centre International de Conférences Genève (CICG) and the ITU buildings, Geneva, Switzerland, 23 January-17 February 2012.

More than 3,000 participants from 165 Member States and Sector Members attended. A hard copy of the Conference documentation was provided to Member States on request.[50] The electronic means facilitated meetings: website, webcast, SharePoint (working document), and mobile applications (e.g., meeting schedules) were employed.[51]

Six languages (i.e., Arabic, Chinese, English, French, Russian, and Spanish) were officially supported by simultaneous interpretations. Documentation was also available during the plenary, COMs, and WGs for all the supported languages. However, SWGs, DGs, and IGs were only conducted in English.

Six meeting sessions were scheduled: two in the morning, afternoon, and evening. No offer meetings could take place when the plenary was in session. At all other times, at least two parallel COM, WG, SWG, and IG meetings must be held.

The official Conference session times were 9.00-12.00, 14.00-17.00, and 17.00-22.00 (Monday to Thursday), and 9.00-12.00, 14.30-17.30, and 17.30-22.00 on Friday. Weekend time slots were also available on request.

The Chairman and Secretary scheduled the meeting rooms. Room sizes varied from a capacity of 12 to 2,200 delegates at the CICG and ITU buildings (Tower and Monbrillant). For example, at the plenary, Rooms 1+2+3+4 of the CICG accommodated more than 3,000 delegates. When there was no vacant seating, webcast was available during the plenary, COM, and WG. Moreover, Rooms 1, 2, 3, 4 at CICG, and Popov at the ITU Tower, had webcast archives, which were available through the TIES system.

8.2 WRC-12 documents

Delegates obtained Conference information though the TIES (temporary TIES) system. Documents could be uploaded via a SharePoint website. The LAN and Wi-Fi connections

[50] The hard copy is provided at the WRC before each session begins.
[51] The WRC document is only available for participants because of its confidentiality. The conference provides press release for public. Webcasting is a voice streaming delivering the conference live broadcasting. SharePoint is a website providing the space for delegates to upload and download working document. There is no presentation on screen during the plenary session because there are six languages document.

were the Conference Internet access mediums. For their Wi-Fi connections, the delegates were provided with passwords obtained at the registration desk.

The Conference access rules (Internet and TIES systems) were an IAD boundary rule determining resource access (Internet and documentation).

The submission deadline to the WRC-12 was two weeks prior to the Conference and in a defined format. The submission deadline and formatting requirement were also an IAD boundary rule.

8.3 WRC-12 observation documentation

The author attended 79 sessions of the Conference; only 37 of these were relevant to WRC-12 Agenda Items 1.19 and 1.22.[52] Table 35 and Table 36 report the sessions relevant to the WRC-12 during the period 23 January-17 February 2012.

The "1.19" and "1.22" show meetings that were relevant to the agenda items.

Table 35. WRC-12 attendance 23 January-3 February 2012

Meeting	Jan 24	Jan 25	Jan 26	Jan 27	Jan 30	Jan 31	Feb 1	Feb 2	Feb 3
APT			1.19						
APT			1.22						
Plenary									1.19
COM6						1.19		1.19	
COM6						1.22		1.22	
WG6A	1.19	1.22		1.22			1.19		1.19
WG6A	1.22						1.22		
SWG6A2		1.19	1.19			1.19		1.19	
Informal6A2				1.19	1.19				
Informal6A2					1.19				
Informal6A			1.22						
Total	**2**	**2**	**4**	**2**	**2**	**3**	**2**	**3**	**2**

Table 36. WRC-12 attendance 6-17 February 2012

Meeting	Feb 6	Feb 7	Feb 8	Feb 9	Feb 10	Feb 13	Feb 14	Feb17
APT				1.19				
Plenary			1.22		1.22		1.19	1.19
Plenary							1.22	1.22
Plenary							1.19	
COM6		1.19	1.19	1.19		1.19		
WG6A	1.19							
Informal6A2					1.19			
AdHocCOM6-1.19			1.19					
Total	**1**	**1**	**3**	**2**	**2**	**1**	**3**	**2**

[52] The author did not participate in the meetings for agenda item 1.2 because it was known at the time that this agenda item would not be resolved until WRC-15, and the focus of the participant observation related to the agenda items related to spectrum commons, 1.19 and 1.22.

A template or meeting summary recorded the author's observations in the development for the WRC-12 meetings. The template that was developed allowed issues concerning Agenda Items 1.19 and 1.22 to be captured. The core elements of the document were Item 4 (Arguments) and Item 5 (Solving the argument). These Items correspond to "interaction" with the IAD framework. It was these data that were not recorded, and therefore not lodged in the ITU archives. Figure 22 shows the WRC-12 meeting summary document (observation template).[53]

Observation Report

Meeting: **Date:** **Time:** **Room**

Opening	**Plenary**	**Committee**	**WG**	**SWG**	**HoD**	**APT**	**Lobby**

Chairman (Head) Chairman

Objectives (agenda in focus/documents) ___

Was the aim achieved (following the schedule until): YES NO (_____YES_____)

Number of participants: _____ Involved:

1	2	3 - 7	8-12	more

Check (for PhD-related documents, recordings, etc.) _____

1. Comments on what the meeting was like (Rank 1 to 5: 3 is normal, 1 is very bad, 5 is very good)
   climate
   chairman mastery
   breadth
   depth
   attention
   openness
   responsiveness
   difficulties
2. Comments on objectives
3. Method(s) of dealing with the objectives (per issue, e.g., how the Chairman and party achieve the objectives. Voting?)
4. Arguments (in relation to)?
5. Solving the arguments?
6. Involved (form and extent of participation, country, etc.):
7. Other (on the next page):

Figure 22. Meeting template

[53] However, some IGs allowed the non-voice recording of meeting notes. The author took note in an electronic form.

The ITU meetings had an agenda to meet pre-determined objectives. Before commencement of the meeting, the agenda was approved. The approval of the agenda provided clear guidelines for the way the Chairman could best conduct the meeting. In forming a draft resolution from the meeting or conclusion concerning an issue, the Chairman requested any observations from the delegates. In closing the meeting, any final conclusion could only be adopted when any objection had been resolved.

Summary notes were recorded by the authors on a daily basis to keep track of WRC-12 Agenda Items 1.19 and 1.22 developments at the relevant meetings, details of any arguments, and mapping of Item 4 and Item 5 into the IAD framework process.

8.4 Observed interaction

During the WRC-12, all discussion concerning the agenda items had to be conducted through a parallel session. During the first week of the Conference, the plenary considers documents submitted by Member States. After reviewing these documents, work programs were allocated to the COMs. The directions to the COMs included a list of agenda items to be considered with the durations for such deliberations, in particular, WRC-12 Agenda Item 1.1 on a country footnote deletion, which was allocated to COM6.

Moreover, during the first two weeks, most SWGs and WGs must submit recommendations for approval to the COMs. In the final week, the COMs submitted a proposal to the plenary for approval (first and second reading prior to inclusion in the Final Act). The WRC Chairman could arrange the plenary night sessions on 15-16 February to consider any unresolved issues by the COMs.

At the WRC-03 and WRC-07, the overnight sessions were held on Thursday night and Friday morning. However, at the WRC-12, the overnight sessions were held on a Wednesday. The meeting schedules were therefore acted on by the WRC Chairman.

Agenda Item 1.19

Figure 23 illustrates the document flow of WRC-12 Agenda Item 1.22. The process of advancement required 26 meetings: COM6 (6), plenary (5), IG6A2 (4), SWG6A2 (4), WG6A (4), APT (2), and ad hoc COM6 (1) meetings.

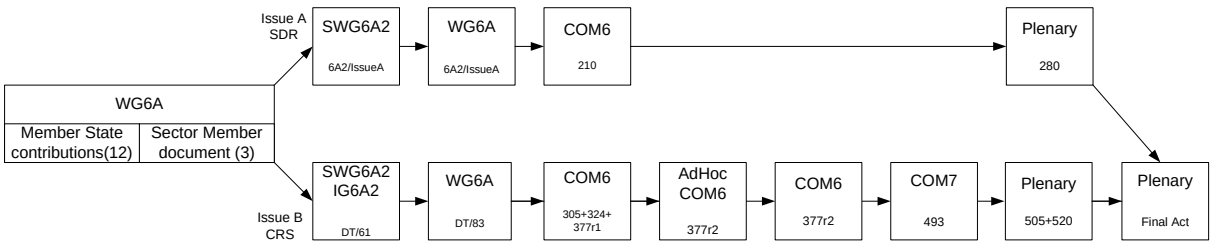

Figure 23. Agenda Item 1.19 meeting and document flow

Figure 24 shows the issues involving the nature of the CRS (Agenda Item 1.19).

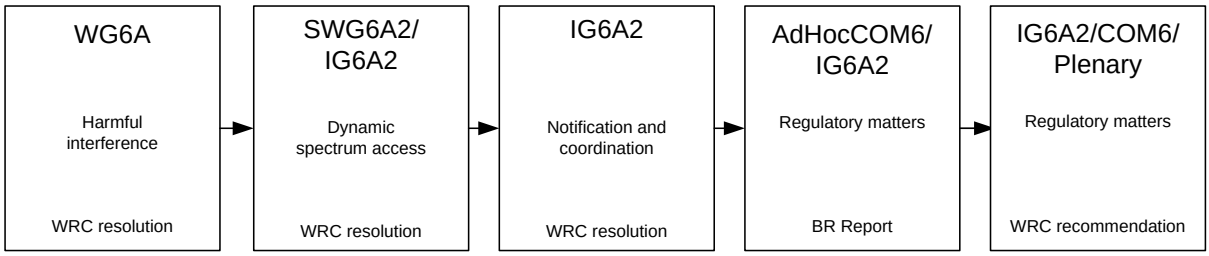

Figure 24. Agenda Item 1.19 issue development

Two views on the CRS issues were presented at the first WG6A meeting. The meeting discussed whether a WRC resolution should be made. The meeting proposed that to avoid harmful interference with the CRS system, a WRC resolution was required. Subsequently, the SWG6A2/IG6A2 changed the topic to dynamic spectrum access. The IG6A2 meeting progressed the resolution further by notifying the MIFR database of an international recognition and coordination between neighboring countries (bilateral and multi-lateral) for the CRS station's operating characteristic, e.g., location, transmitted power, and frequency bands. Furthermore, the issue moved on to regulatory matters (during ITU-R Resolution 58 on the CRS study) that will be reported at the next WRC via the BR Directors' report. The final outcome of the process was a WRC recommendation (a compromise solution between Member States).

The lengthy discussion process through several meetings provides an example of the Chairman's leadership and ability to facilitate a consensus outcome.

Table 37 shows approximate delegate numbers and discussion themes for Agenda Item 1.19. The corresponding meeting dates and locations are provided.

Table 37. Agenda Item 1.19 meeting organization

Meeting	Date	Room	Delegates	Discussion themes
WG6A	24 January	1, CICG	200	> 12
SWG6A2	25 January	A, ITU Tower	70	> 12
SWG6A2	26 January	A, ITU Tower	80	> 12
APT	26 January	5+6, CICG	120	> 12
Informal 6A2	27 January	T103, ITU Tower	16	> 12
Informal 6A2	30 January	T103, ITU Tower	24	> 12
Informal 6A2	30 January	T103, ITU Tower	8	3-7
COM6	31 January	1, CICG	300	> 12
SWG6A2	31 January	C1, ITU Tower	80	8-12
WG6A	1 February	1, CICG	200	> 12
COM6	2 February	1, CICG	300	> 12
SWG6A2	2 February	H, Monbrillant	50	8-12
WG6A	3 February	3+4, CICG	200	8-12
Plenary	3 February	1, CICG	500	> 12
WG6A	6 February	2, CICG	300	> 12
COM6	7 February	1, CICG	500	> 12
COM6	8 February	1, CICG	500	> 12
AdHocCOM6	8 February	A, ITU Tower	50	> 12
COM6	9 February	1, CICG	500	> 12
APT	9 February	3+4, CICG	200	> 12
Informal 6A2	10 February	17, CICG	8	3-7
COM6	13 February	1, CICG	500	> 12
Plenary	14 February	1+2+3+4, CICG	1500	> 12
Plenary	14 February	1+2+3+4, CICG	1500	> 12
Plenary	15 February	1+2+3+4, CICG	1500	> 12
Plenary	17 February	1+2+3+4, CICG	1000	> 12

Agenda Item 1.22

Figure 25 illustrates the document flow of theWRC-12 for Agenda Item 1.22. The process of advancement required 12 meetings: plenary (4), COM6 (2), WG6A (4), APT (1), and IG6A (1).

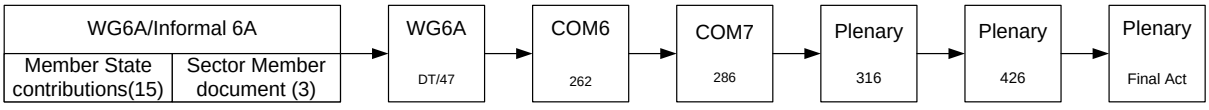

Figure 25. Agenda Item 1.22 meeting and document flow

Table 38 shows the approximate numbers of delegates and discussion themes for WRC-12 Agenda Item 1.22. The corresponding dates and locations are also recorded.

Table 38. WRC-12 Agenda Item 1.22 meeting organization

Meeting	Date	Room	Delegates	Discussion themes
WG6A	24 January	1, CICG	200	> 12
WG6A	25 January	Popov, ITU Tower	200	3-7
APT	26 January	5+6, CICG	120	> 12
Informal 6A	26 January	15, CICG	40	> 12
WG6A	27 January	1, CICG	200	> 12
COM6	31 January	1, CICG	300	> 12
WG6A	1 February	1, CICG	200	> 12
COM6	2 February	1, CICG	300	> 12
Plenary	8 February	1, CICG	500	> 12
Plenary	10 February	1, CICG	400	> 12
Plenary	14 February	1+2+3+4, CICG	1500	> 12
Plenary	17 February	1+2+3+4, CICG	1000	> 12

The discussions among the delegates were information exchanges. Within the meetings, these exchanges included a particular stance on agenda items, Member State justifications for that stance, alternative positions in the face of resistance to a particular stance, the form of the proposed recommendation, and the cost/benefit for the proposing Member States. Such interactions represented the position, choice, aggregation, payoff, scope, and information rules contained within the IAD framework.

For example, the Country A delegation saw that ITU-R Resolution 54-1 covered the content of the WRC resolution and that there was therefore no need for a new WRC resolution. This view showed Country A's position with regard to the IAD payoff (cost/benefit), choice, aggregate (control of the stance), information (flow of information exchange), and scope (possible outcome) rules. Consequently, the Country A delegation's statement influenced other parties at the meeting (representing information exchange). Each Member State reacted to Country A's stance by considering its own position.

8.5 Actual dynamic situation of the CRS issue

WRC-12 Agenda Item 1.19 concerns SDR and CRS technologies (see Chapter 7). Here, the focus is on the CRS, because there are currently subject proposals and counter-proposals.

The "Document" column in Table 39 identifies the Member States' positions on the CRS issues. For example, "5 A19" refers to document number 5 Annex 19. "SUP" means suppression of Resolution 956 (i.e., it is an instruction to delete the resolution from the RR). "ADD" means the addition of a WRC resolution (i.e., it is an instruction to add the WRC resolution to the RR). "WRC rec" is a WRC recommendation.

Table 39. WRC Agenda Item 1.19 document positioning

Member States	Input				Output
	Document	RR change	Resolution 956	WRC resolution	Final Act
CEPT	5 A19	No	SUP		WRC rec [COM6/1]
RCC	6 A19	No	SUP	ADD	
USA	9 A19	No	SUP		
CITEL	10 A19	No	SUP		
Cameroon	15 A15	No	SUP	ADD	
ATU	17 A19	No	SUP	ADD	
Multi-country*	19	No	SUP	ADD	
ASMG	25 A19	No	SUP		
APT	26 A19	No	SUP		
China	45 A19	No	SUP		
Colombia	90				
Multi-country*	97 A19	No	SUP	ADD	

*Angola (Republic of), Botswana (Republic of), Democratic Republic of the Congo, Lesotho (Kingdom of), Madagascar (Republic of), Malawi, Mauritius (Republic of), Mozambique (Republic of), Namibia (Republic of), Seychelles (Republic of), South Africa (Republic of), Swaziland (Kingdom of), Tanzania (United Republic of), Zambia (Republic of), Zimbabwe (Republic of)

While Table 39 records all relevant input and output documents for Agenda Item 1.19 contained in the ITU archives, the development issue that led from a WRC resolution to a WRC recommendation has been omitted.

Table 39 provides Member State positions captured from their documents submitted to the WRC-12. There are two groups: with and without a WRC resolution.[54] The Member States that do not support a WRC resolution are CEPT, the USA, CITEL, ASMG, APT, China, and Colombia. The Member States that support a WRC resolution are RCC, Cameroon, ATU, and a multi-country proposal from the South African countries.

The actual dynamic situation was captured from the meetings on Agenda Item 1.19. The summary of the debate is presented anonymously below.

ITU-R Resolution 58 on CRS was adopted at the RA-12 after the Member States submitted their documents to the WRC-12. ITU-R Resolution 58 is new information that Member States should consider with a view to whether to review their positions.

Group A represents countries that do not support a WRC resolution. Group A expressed its concern that the current RR could govern the use of CRS. There was therefore no need for a WRC resolution. If the use of CRS requires a WRC resolution, when the new application or technology emerges, there will be a WRC resolution for every single new application or technology. This would be unacceptable for Group A.

Group B represents countries supporting a WRC resolution, considering the new information for ITU-R Resolution 58. Group B compared ITU-R Resolution 58 with its proposal for a WRC resolution. The result was that ITU-R Resolution 58 included all the concerns from a WRC resolution. Consequently, Group B developed its new position to support Group A, because there was no need for a WRC resolution regarding the adoption of ITU-R Resolution 58 at the RA-12.

[54] WRC resolution is a practical guidance to implement the CRS which Member States are obliged to implement. However, some Member States argue that the current RR can govern the use of CRS. Thus, the WRC resolution is not necessary in their opinion.

Group C represented countries supported a WRC resolution. Group C insisted on having a WRC resolution with its views that ITU-R Resolution 58 does not include the regulatory aspect while using the CRS. Moreover, its concern over the possibility of harmful CRS interference may need the provisional regulatory framework as a WRC resolution.

Group A and Group B asked Group C to clarify the real issues or concerns regarding harmful interference. Group C expressed its concerns in more detail during the discussion. Consequently, Group A and Group B pointed out that each concern could be governed by the current RR.

Group C's issue developed from harmful interference, dynamic spectrum access, notification and coordination to regulatory matters (see Figure 24).[55]

However, Group C insisted on having a WRC resolution at the end. Two Member States from Groups A and B formally opposed a WRC resolution at the COM6 meeting. The COM6 Chairman therefore established the ad hoc group to find a compromise between Group A, Group B, and Group C.

During the ad hoc group meeting, the Chairman of the COM6 ad hoc group proposed the compromised text as the minutes of the plenary. However, Group C proposed a WRC recommendation as an alternative.

After the meeting, one Member State from Group A arranged an informal meeting between the regional representatives of Group A, Group B, and Group C. The purpose of this meeting was to compromise on all the concerns as a WRC recommendation with agreed text between the Member States. Finally, a compromise was reached at the COM6 with a WRC recommendation.[56]

It was a lengthy debate from the first day of the WRC-12, however, the spirit of consensus and compromise encouraged Member States to find an acceptable solution as the ITU tradition.

8.6 Informal channel at WRC-12

Besides the formal meetings in Tables 36 and 37, there were some informal channels for delegates to communicate during the WRC-12. The informal channels increased the participation level between the Member States in terms of the stakeholders on such issues.

The informal channel serves as an important way to encourage the discussion to be settled either as a compromise or consensus.

The informal channel forms that could be observed during the WRC-12 were a discussion and e-mail. The informal discussion was almost observed in parallel with formal meetings. For

[55] Group C is concerned about the possibilities of harmful interference from the use of CRS, however, there is no ITU evidence or study that supports these concerns.
[56] This WRC recommendation encourages Member States to participate in further studies on CRS by the ITU SG. Member States are not mandated to implement this WRC recommendation but it is voluntary.

example, while the Chairman conducted the meetings, the informal discussions between the delegation and the regional groups always happened to exchange the information and prepare to express their positions. This conversation sometimes continued outside the meeting room, during break, lunch, or dinner. When the Chairman experienced a lengthy discussion, the meeting intermission took place with a small group discussion on issues.

Secondly, the informal e-mails between the stakeholders expressed their concerns, clarified issues, and updated a status or stance. These e-mails mostly originated from the meeting chairmen. Only notified Member States were included on this mailing list. This mailing list also notified remaining issues, further discussion issues, and details of meeting discussions.

8.7 Role of Sector Members

The sector Members include recognized operating agencies (e.g., Algérie Télécom SPA, China Mobile Communications Corporation [CMCC], and SOFTBANK MOBILE Corp.), scientific and industrial organizations (e.g., Free TV Australia Ltd., ZTE Corporation, and Nokia Corporation), other entities dealing with telecommunication matters (e.g., Autorité de Régulation de la Poste et des Télécommunications [ARPT], and the Telecommunications Authority of Trinidad and Tobago [TATT]), and regional and other international organizations (e.g., the Arab States Broadcasting Union, Broadcast Networks Europe, and the International Amateur Radio Union). Some of the Sector Members are part of the Member States delegation. They can perform both roles inside WRC.

Sector Members are allowed to attend WRC as observers. They are allowed to express their views and clarify their document to the meeting. However, they do not have the right to vote.

For example, at the plenary, the Chairman allowed the Sector Members to present their document and clarify their concerns. During the WRC-12 Agenda Item 1.19 discussions, one of the Sector Members expressed its view on the meeting discussions that issues went back and forth and proposed a new option to settle this debate.

8.8 Importance of missing information

The rationale underlying the RR provision was contained during the discussion, which is missing from the ITU archives. The discussion of issues and information inside an informal e-mail is only available to attending Member States. This information is missing for non-attending Member States and not documented in the ITU archives. When such issues affect the interests of the non-attending Member States, they become a matter for them to follow and seek missing information on for their understanding. This missing information is essential to them to develop further proposals to protect their interest when the issues continue to the next or future WRCs.

For example, WRC-12 Agenda Item 1.2, at which no Thai delegation attended the discussion, is crucial to Thailand to evaluate and prepare its position regarding possible consequences of the RR revisions on this agenda item at the WRC-15.

8.9 WRC-12 Agenda Item 1.2 ongoing to WRC-15

At WRC-12 Agenda Item 1.2, Thailand did not have a delegate to attend the SWG and IG meetings. Thailand therefore has no information regarding the discussion at the SWG and IG meeting, which covered the underlying issues or rationale of the discussion. The ITU archives only contain the final input and output of the WRC proceedings and RR version. The input document is from the contributions by the Member States and Sector Members. The Member States made some 25 submissions on Agenda Item 1.2 at the WRC-12, while Sector Members submitted 7 documents. During the discussion, the underlying issue of FS and MS convergence under WRC-12 Agenda Item 1.2 is missing from the archives. The outputs of the discussion are found in the Final Act WRC-12, including WRC Resolution 957 [PLEN/1] (WRC-12) – Studies Towards Review of the Definition of Fixed Service, Fixed Station and Mobile Station, and the modified WRC Recommendation 34 – Principle for the Allocation of Frequency Bands. Figure 26 shows the Agenda Item 1.2 meeting and document flow.

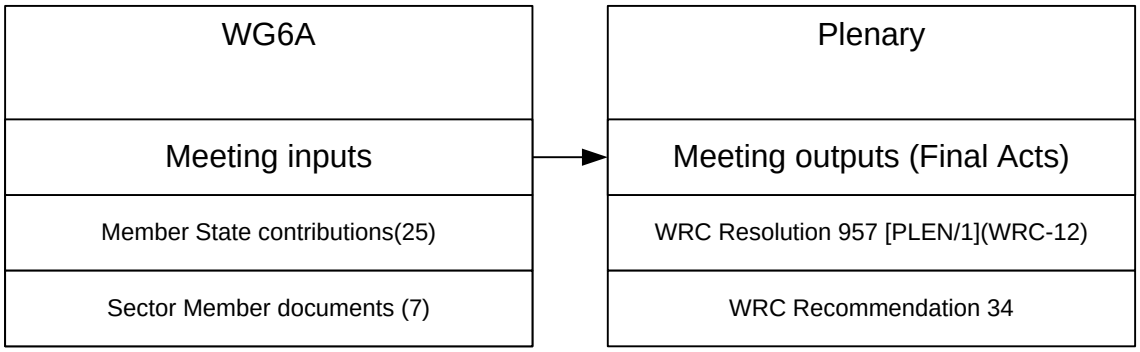

Figure 26. Agenda Item 1.2 meetings and document flow (c.f. Figure 2, Chapter 1)

Normally, the input (CPM report and submission by Member States and Sector Members) and output documents (the Final Act) of WRC are contained in the ITU archives. However, the development of issues from the four proposed options of the CPM report (FS and MS)[57] to the WRC resolution, and from two options (FSS and MSS)[58] to the WRC recommendation are not documented in the archives. Only Member States that attended the meetings have knowledge of how and why the change occurred. Thailand did not have enough delegates to be able to attend the SWG and IG on Agenda Item 1.2. The ongoing Agenda Item 1.2 argumentation is therefore not available to Thailand to consider when developing a further proposal on the matter.

Only WRC Resolution 957 is going on to WRC-15 for further decision on the possibilities of definition of the revision of the FS, fixed station, and mobile station.

Thailand's concern is the ongoing issue to the WRC-15 that Thailand has no information regarding the underlying issues of the FS and MS convergence. The only available

[57] The CPM report proposed four options for WRC-12 Agenda Item 1.2 for FS and MS: (1) no change be made to the RR; (2) modify the FS, fixed, mobile, and land station definitions contained in Article 1 and modify Appendix 4; (3) modify the FS and fixed station definition and modify Article 11 and Appendix 4; or (4) modify Appendix 4.
[58] The CPM report proposed two options for WRC-12 Agenda Item 1.2 for FSS and MSS: (1) no change to be made to the RR and (2) to add FSS and MSS to the WRC resolution (Principle Allocation of Frequency Bands).

information is WRC Resolution 957 that allows further study on the possibility of a revision of the definition.

In order to prepare Thailand's position for the WRC-15 and understand how the missing information on WRC-12 Agenda Item 1.2 impacts Thailand, the existing situation, both allocation and assignment, for the FS, MS, FSS, and MSS are explored.

Current allocation FS, MS, FSS, and MSS

Thailand can use the TFA for FS, MS, FSS, and MSS, both a global and Region 3 allocation. Table 40 shows the summary of the relevant appendices and tables from this study for Thailand.

Table 40. List of tables for Thailand TFA on FS, FSS, MS, and MSS

Service	Appendix	Global allocation		Region3 allocation	
		Primary	Secondary	Primary	Secondary
FS	E	74, 76, 78	79, 80	93, 95, 96	97, 98
FSS	F	99, 101	-	104	-
MS	G	106, 108, 110	111, 112	124, 126, 127	128, 129
MSS	H	130	131	136	137

Table 40 represents the IAD scope rule for Thailand to allocate a frequency for the FS, FSS, MS, and MSS captured from the RR2012.

Table 41 and Table 42 show the number of frequency bands, bandwidth, and percentage of occupied bandwidth for the FS, FSS, MS, and MSS for a global and Region 3 allocation.

Table 41. Number of frequency band on FS, FSS, MS, and MSS for Thailand

Service	Global allocation		Region 3 allocation		Total	
	Primary	Secondary	Primary	Secondary	Primary	Secondary
FS	175	12	105	6	280	18
FSS	53	0	24	0	77	0
MS	148	19	81	9	229	28
MSS	28	9	10	8	38	17

Comparing the total frequency band in Table 28, Chapter 5, the total numbers of frequency bands for a global and Region 3 allocation are 375 and 147, respectively.

Almost 50% of the frequency band belongs to the FS for global allocation. Moreover, 75% of the frequency bands in Region 3 are allocated for the FS.

As for the MS, 45% of the frequency bands are allocated for the MS for a global allocation. In addition, 61% of the frequency bands are allocated for the MS in Region 3.

The majority of frequency bands available for Thailand to allocate are therefore FS and MS. The figure for the frequency band in Table 40 provides the scope of allocation for Thailand.

Table 42 presents the occupied bandwidth with percentages for FS, FSS, MS, and MSS for global and Region 3 allocation.

Table 42. Occupied bandwidth (kHz) with percentages for FS, FSS, MS, and MSS

Service	Global allocation		Region 3 allocation	
	Primary	Secondary	Primary	Secondary
FS	151168442.9	213920	11567937	305012.6
	(15.36)	(0.27)	(28.44)	(6.27)
FSS	83600000	0	9095000	0
	(8.50)	(0)	(22.36)	(0)
MS	157016553	1517657	10861500	1010279
	(15.96)	(1.92)	(26.70)	(20.78)
MSS	53226925	1406325	91900	912800
	(5.41)	(1.78)	(0.23)	(2.24)

In terms of the occupied bandwidth, FS and MS are the most occupied bandwidths for both global and regional allocation.

Table 41 and Table 42 provide the upper limit or scope for Thailand to allocate frequency bands to the FS and MS.

Table 43 illustrates the utilization bandwidth captured from Thailand's utilization chart in 2012.

Table 43. Thailand's 2012 utilization bandwidth for FS, FSS, MS, and MSS

Service	Bandwidth (kHz)	Occupied percentage
FS	12203456	13.56
FSS	6600000	7.33
MS	321975	0.36
MSS	144500	0.16

The percentage of occupied bandwidth is calculated from the total amount of bandwidth of 90 GHz. In Thailand, the FS is the most occupied bandwidth.

The impact of the RR revisions on FS and MS convergence will therefore affect the existing use of FS and MS in Thailand due to the majority use in terms of frequency bands, occupied bandwidths, and number of subscribers. Furthermore, consideration must be given to changing or merging the existing database that separates the FS and MS.

Consequently, the change in FS and MS convergence may influence a (almost entirely) national telecommunications regulation review. The review includes the allocation of global and Thai TFA, FS and MS regulations, the National Frequency Master Plan, frequency assignment scheme and criteria, licensing conditions, national laws (radiocommunication, telecommunication, and broadcasting), station technical characteristics, and notification and coordination process (national and international).

The possibility of the RR revision of the definition of FS, fixed station, and mobile station is conducted under the SG during the WRC-15 study cycle. The study output will be available in the CPM report for the WRC-15 to make a further decision on the RR revisions.

8.10 Preparatory work on the definitions of FS, fixed station, and mobile station for the WRC-15

The study demonstrates that the ITU archives are incomplete and cannot provide the rationale behind the RR provisions. The following example illustrates the use of this study as the starting point or basic information to further explore the ITU archives in depth.

The issue of WRC-12 Agenda Item 1.2 left over for consideration by the WRC-15 was the possibility of reviewing and revising the definition of FS, fixed station, and mobile station. Further study of WRC-12 Agenda Item 1.2 is continuing to the WRC-15 under the WP1B. The study takes into account the convergence between the FS and MS by these three definitions.

The result of this study provides the starting point to further explore Table 19, Table 22, and Table 23, Chapter 5. The specified version of the RR has shown the original point of exploration for further exploration of the relevant RR versions. The exploration is finished when the definition is matched with the current version (RR2012).

Fixed service

The definition of “fixed service” first appeared in the General Regulations annexed to the Washington D.C. 1927 Convention, Article 1, Definition, p. 30:

“A service effecting radioelectric communications of any kind between fixed points, but does not include the broadcasting service or special services”(ITU, 1927, p. 30).

In 1932, the Madrid Convention changed the definition slightly by deleting “effecting,” changing “any” to “all,” and “not include” to “with the exception of”:

“A service of radioelectric communications of all kinds between fixed points, with the exception of broadcasting services and special services” (ITU, 1932a, p. 6).

In Cairo 1938, the definition changed “radioelectic communication” to “radiocommunication”:

“A radiocommunication service of any kind between fixed points, with the exception of broadcasting services and special services” (ITU, 1938, p. 2).

The RR1947 changed the definition to “service of radiocommunication”:

“A service of radiocommunication between specified fixed points” (ITU, 1947, pp. 3-E) and continued to use it in the RR1959, RR1968, and RR1976.

In the RR1982, the definition changed back to “radiocommunication service”:

“A radiocommunication service between specified fixed points” (ITU, 1982, pp. RR1-3), which continued being used in the RR2008, Provisional of Final Act WRC-12, and RR2012.

Table 44 shows the development of the “fixed service” definition.

Table 44. Fixed service definition

RR	Service	Medium	Location	Exception
1927	Service	Radioelectric	Fixed points	Broadcasting or special services
1932	Service	Radioelectric	Fixed points	Broadcasting or special services
1938	Radiocommunication service	-	Fixed points	Broadcasting or special services
1947	Service of radiocommunication	-	Specified fixed points	-
1982	Radiocommunication service	-	Specified fixed points	-

The development of the “fixed service” definition does not have a significant change through time. The main concept of radiocommunication service between specified fixed points represents the main characteristic of the FS.

Fixed station

The development of the “fixed station” definition started in Madrid 1932, General Radiocommunication Regulation Annexed to the Madrid 1932 Convention:

“A station not capable of moving which communicates, by means of radiocommunication, with one or more stations similarly established” (ITU, 1932a, p. 6).

In the RR1947, the final development was shortened and appeared as follows:

“A station in the fixed service” (ITU, 1947, pp. 4-E). This definition continued being used in the RR2008, Provisional of Final Act WRC-12, and RR2012.

Table 45 shows the development of the “fixed station” definition.

Table 45. Fixed station definition

RR	Characteristics	Means	Location	Scope
1932	not capable of moving	radiocommunication	one or more stations	-
1947	-	-	-	A station in the fixed service

The concept changes from a specific detail of station and narrows to the scope of station that is already mentioned in the FS definition.

Mobile station

The definition of "mobile station" first appeared in the General Regulations annexed to the Washington D.C. 1927 Convention, Article 1, Definition:

"Any mobile station whatever; all mobile stations wherever they are" (ITU, 1927, p. 29).

The new definition was developed and contained in the General Radiocommunication Regulation Annexed to the Madrid 1932 Convention, Article 1, definition:

"A station capable of moving which ordinarily does move" (ITU, 1932a, p. 5).

In Cairo 1938, the definition changed slightly from "ordinarily" to "usually":

"A station capable of moving which is usually moving" (ITU, 1938, p. 4).

The final version of the definition was adopted in Atlantic City 1947 with an explanatory clause for location both in motion and during halts:

"A station in a mobile service intended to be used while in motion or during halts at unspecified points" (ITU, 1947, pp. 5-E) and continued being used in RR2008, Provisional of Final Act WRC-12, and RR2012.

Table 46 shows the development of the "mobile service" definition.

Table 46. Mobile station definition

RR	Characteristics	Location	Scope
1927	whatever	wherever	-
1932	moving which ordinarily does move	-	-
1938	moving which is usually moving	-	-
1947	in motion or during halts	at unspecified points	A station in a mobile service

The concept of the mobile station definition gradually changes from "any mobile station" to "moving station" to "station in motion or during halts." The location of the mobile station is unspecified by nature. Finally, the scope of the mobile station is specified according to the MS.

8.11 Summary and discussion on research questions

This chapter responds to sub-research question 2: *What information would be more useful for making the decision?* and sub-research question 3: *How does the missing information affect international spectrum policy?*

The study describes the WRC-12 environment in terms of the organization and document. Moreover, at the WRC-12, the study illustrates WRC-12 Agenda Items 1.19 and 1.22 activities by participant observations. The observation demonstrates the document flow from the plenary to the SWG or IG, the approval process from the SWG or IG to the plenary, the

negotiation among Member States on the issues, and the issue development on WRC-12 Agenda Items 1.19 and 1.22.

The study explores the WRC-12 meeting documents: the input from the Member States and the Sector Members as well as the administrative document by the ITU BR for preparation and facilitation at the WRC-12 meetings.

The study also addresses the missing information during the discussion of WRC-12 Agenda Items 1.19 and 1.22. This missing information can be captured at the SWG and IG levels. The author attended the relevant WRC-12 Agenda Items 1.19 and 1.22 meetings to illustrate the missing information from the ITU archives, which is the rationale underlying the discussion and available only to attending participants.

The study illustrates how the missing information affects the decision-making during the Member States' negotiations in the case of WRC-12 Agenda Item 1.19. The summary of WRC-12 Agenda Items 1.19 and 1.22 follows.

The CRS or WRC-12 Agenda Item 1.19 is a controversial issue. The issue is gradually developed at several IG meetings. The development of the argument is from the harmful interference to dynamic spectrum access issue. Consequently, the argument moves to MIFR notification and coordination. Finally, regulatory matters (during ITU-R Resolution 58 on CRS study) are reported to the next WRC via the BR Director's report. The final outcome is the WRC recommendation as a compromise solution between the Member States.

Additionally, the SRD or WRC-12 Agenda Item 1.22 is solved at the RA-12 with ITU-R Resolution 54-1 (further studies on harmonization of short-range devices). Consequently, there are no more issues for discussion: only the documentation of the approval process is required to complete the matters.

The missing information during the discussion in an informal meeting creates an information asymmetry between the attending and non-attending Member States. Moreover, the missing information at the SWG and IG meetings is not documented in the ITU archives, and Member States that use the ITU archives have incomplete information. The information is a matter when the issue may change outcomes or propose new options. When such an issue continues to the next or future WRC, the information is a matter for non-attending Member States to prepare and develop their position on relevant meetings if the issue has a strong effect on their interest.

The demonstration of WRC-12 Agenda Items 1.19 and 1.22 fulfills the second and third sub-research question to identify the missing information from the ITU archives in terms of the discussion by the Member States at the SWG and IG meetings. This discussion contains the rationale underlying the RR revisions. Moreover, the demonstration of the missing information on WRC-12 Agenda Item 1.19 provides the effects of the international spectrum policy at the higher level, such as at the WG, COM, and plenary.

Sub-research questions 2 and 3 are important for the study to investigate the missing information and the effect of the missing information in the context of WRC-12 Agenda Items

1.19 and 1.22. The result displays the missing information, leaving the Member States that use the ITU archives with incomplete information. The missing information cannot be documented during the negotiations by the Member States at the SWG and IG meetings. Moreover, the missing information is only available to attending Member States. The missing information therefore creates an information asymmetry between attending and non-attending Member States.

Moreover, the study provides the background to the definition of the FS, fixed station, and mobile station for the ongoing WRC-12 Agenda Item 1.2 to the WRC-15.

The study also explores the ITU archives with the relevant RR provisions, including the development of the FS, fixed station, and mobile station definition.

Moreover, the study elaborates on how Thailand is affected by the missing information on WRC-12 Agenda Item 1.2 in terms of reviewing the current situation on the FS and MS and the preparatory work toward the WRC-15.

The review of the current status of the FS and MS in Thailand provides the basic information to analyze the effect of the FS and MS convergence. The availability of frequency allocation and occupied bandwidth is presented. The preparatory work for the WRC-12 on reviewing the FS, fixed station, and mobile station is also reported.

The exploration of the ITU archives provides the background to the FS, fixed station, and mobile station definition development. The existing situation of frequency allocation and frequency utilization for FS and MS in Thailand also provides critical information to analyze the impact or consequences of the RR revisions. This information serves as the basis to analyze the effect of Thailand's spectrum management policy corresponding to the third sub-research question: *How does the missing information affect international spectrum policy?*

The third sub-research question is crucial to the study to reflect on the consequences of the missing information for the international spectrum policy. Moreover, it helps to understand how the missing information affects attending as well as non-attending Member States in their decision-making process at WRC.

To conclude, this chapter illustrates the useful information as the missing WRC-12 Agenda Items 1.19 and 1.22 responding to the second sub-research question. Moreover, the study also demonstrates how this missing information affects the decision-making process at the WRC-12, corresponding to the third sub-research question. Furthermore, the importance of WRC-12 Agenda Item 1.2 raises concern for Thailand's response to the FS and MS situation and preparatory work for the WRC-15 corresponding to the third sub-research question.

Chapter 9 Analysis and policy recommendation

This chapter provides analyses on the IAD framework applied to the justification of the WRC-12 IG6A2-1.19. WRC-12 Agenda Item 1.19 is used to illustrate the nature of the missing information from the ITU archives and potential usefulness of the data. Finally, the policy recommendation to relieve the missing information at WRC is presented with advantages and disadvantages.

9.1 Statement of problem

The study addresses problems of missing information in an international spectrum policy setting within WRC in terms of the RR provision interpretation by observing Member States and Sector Members implementing the RR. Interpretations vary because stakeholders have views that are linked to their own conflicting interests. With this context in mind, the ITU archives are explored to isolate the rationales behind such RR provisions. Unfortunately, the ITU archives are incomplete. Only the input and output documents of the WRC proceedings and RR versions are included in the archives.

Accordingly, this study proposes the IAD framework as a vehicle to capture delegate interactions during meetings, including the position, payoff, choice, information, and aggregate rules. However, the IAD framework provides only the general list of missing data, not detailed content of the discussion.

Consequently, observations by the author from attending the meetings are a means to obtain interaction details from the discussions. The observations provide the insight views expressed at meetings. Importantly, such observations can only be obtained for the current situations, not past events, that is, the information for past events is permanently lost.

Member States that are unable to attend meetings have no information about the nature of the discussions. This missing information (from the ITU archives) becomes an issue or serious matter for Member States that prioritize issues based on their interest. When issues carry over to the next or future WRCs, these Member States are in a weak position to develop further arguments. Most Low Income countries cannot attend all the meetings. This income difference has led to the information asymmetry arising between High and Low Income countries. Thus, poor countries can only rely on the ITU archives as a source of information.

The study proposes that the reporting of interaction information is recorded. Such information would benefit everyone, especially poor countries (see Chapter 1 and Chapter 2). This study also proposes that Member States network as an alternative solution, especially, in connection with a regional representative in charge of the WRC agenda items.

9.2 Application of the IAD framework to the WRC negotiations

The study applies the IAD framework to analyze WRC negotiations conducted at various meetings addressing potential RR revisions. The framework elements are presented in Table 47.

Table 47. IAD variable map, missing data, and observer activities (c.f. Table 10, Chapter 2)

IAD variable	WRC	RR/WRC Archive	Participant observation	
			PTA, CPG, APG	WRC-12
Physical condition	Spectrum as public good	X	X	X
Community attribute	Norm, culture, and tradition		X	X
Rules-in-use				
Boundary	ITU membership	X	X	X
Position	HoD, Regional Rep., Chair, Secretary	X	X	X
Choice	Support, oppose, neutral		X	X
Payoff	Cost and benefit		X	X
Information	Public or informal information flow		X	X
Aggregate	Control over choice		X	X
Scope	ADD, MOD, SUP, NOC	X	X	X
Action situation	Negotiation		X	X
Interaction	Negotiation		X	X
Evaluation criteria	Link payoff rules		X	X
Outcome	Link RR revisions to scope rules	X	X	X

Table 47 records the mapping of IAD variables to the WRC context. In doing so, the broad classes of missing data are also identified, as in an observer activity.

The above IAD-WRC mappings are next applied to the particular IG6A2-1.19 meeting for a WRC recommendation.

Physical conditions are the object of the study. In the context of Agenda Item 1.19, consider whether a WRC recommendation is required for CRS spectrum use as a non-exclusive scheme (public goods).

Community attributes or attributes of community is a basic understanding of the IG6A2-1.19 issue within the meeting. At the meeting, delegates clearly require an understanding of the meetings' objective for the issue to progress. The Chairman's role is to encourage compromise between Member States to accept a WRC recommendation. Meeting compromises and consensus are a tradition within the ITU process.

Rules-in-use can be represented by the following rules:

At the meeting, a delegate's role is as an individual or regional representative (boundary and position rules) to provide views. Individual and regional representatives have different contexts in which their views are formed and expressed.

When a chairman calls for any further modification to a WRC recommendation, the representatives offer their opinions. Subsequently, other delegates review any proposal change (based on their national or regional interest – the payoff rule and associated criteria) and consider whether to support, oppose, or remain in a neutral position on the issues (choice rules). Information exchange flows from proposals and counter-proposals (information rule), the role of the chairman is to distil the debate and suggest compromise propositions for

consideration. The information rule also influences individual and regional stances (aggregate rule), and meeting outcomes (scope rule and outcomes). Finally, the IG6A2-1.19 output document containing the WRC recommendation is agreed between the Member States.

This process illustrates the IAD framework applied to the IG6A2-1.19 meeting. However, the IAD framework only provides a general guideline for the source of missing data, not the detailed discussion elements. Only an observer has the ability to obtain detailed information or meeting negotiations. The current ITU archive procedure cannot be documented meeting interactions. That is, only input documents submitted by Member States and output of a WRC recommendation are recorded.

9.3 Agenda Item 1.19 missing information cost

WRC-12 Agenda Item 1.19 is not contained in the WRC-03 and WRC-07 CPM reports. However, this agenda item is introduced through documents submitted by Member States for the WRC-07. At the WRC-07, it was finalized and included in WRC-12 agenda items.

WRC-12 Agenda Item 1.19 concerns SDR and CRS technologies (see Chapter 8). Here, the focus is on CRS, because there are currently subject proposals and counter-proposals.

The "Document" column in Table 48 identifies the Member States' positions on the CRS issues. For example, "5 A19" refers to document number 5 Annex 19. "SUP" means suppression of Resolution 956 (i.e., it is an instruction to delete the resolution from the RR). "ADD" means the addition of the WRC resolution (i.e., it is an instruction to add a WRC resolution to the RR). "WRC rec" is a WRC recommendation.

Table 48. WRC Agenda Item 1.19 document positioning (c.f. Table 39, Chapter 8)

Member States	Input				Output
	Document	RR change	Resolution 956	WRC resolution	Final Act
CEPT	5 A19	No	SUP		WRC rec [COM6/1]
RCC	6 A19	No	SUP	ADD	
USA	9 A19	No	SUP		
CITEL	10 A19	No	SUP		
Cameroon	15 A15	No	SUP	ADD	
ATU	17 A19	No	SUP	ADD	
Multi-country*	19	No	SUP	ADD	
ASMG	25 A19	No	SUP		
APT	26 A19	No	SUP		
China	45 A19	No	SUP		
Colombia	90				
Multi-country*	97 A19	No	SUP	ADD	

*Angola (Republic of), Botswana (Republic of), Democratic Republic of the Congo, Lesotho (Kingdom of), Madagascar (Republic of), Malawi, Mauritius (Republic of), Mozambique (Republic of), Namibia (Republic of), Seychelles (Republic of), South Africa (Republic of), Swaziland (Kingdom of), Tanzania (United Republic of), Zambia (Republic of), Zimbabwe (Republic of).

While Table 48 records all relevant input and output documents for Agenda Item 1.19 contained in the ITU archives, the development issue that led from a WRC resolution to a WRC recommendation has been omitted.

The Member States that do not attend meetings have no access to information on how and why issues developed as they did. When final documents are submitted to the plenary for approval, such Member States must accept negotiated outcomes with limited clarity.

Missing information

With regard to the plenary through the IG, WRC-12 Agenda Item 1.19 is considered via 26 meetings. The CRS issues were initially developed at the SWG and IG meetings. The WRC resolution proposal is developed from the impact of CRS considering harmful interference to other services and, in particular, issues related to dynamic spectrum access. With dynamic access deemed not to be the core problem, the focus of the alternative moved to notification and coordination and, finally, to regulatory matters. The final format of the regulation developed from a WRC resolution, a BR Directors' report, to a WRC recommendation. This final recommendation is contained in the Final Act. The Final Act is an archived document.

Figure 27 depicts the CRS issue development.

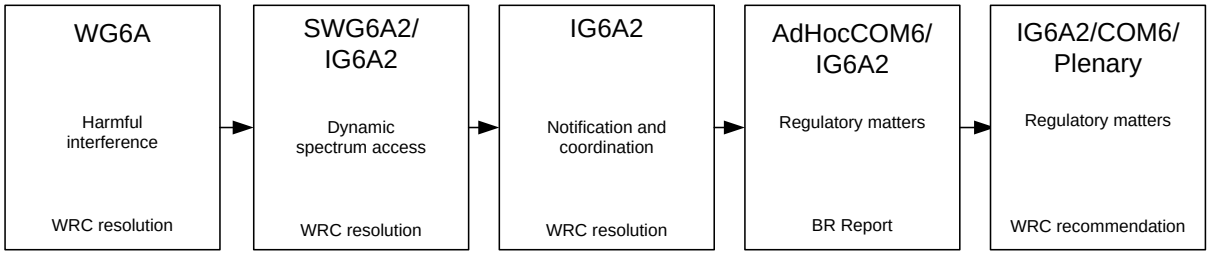

Figure 27. Agenda Item 1.19 issue development (c.f. Figure 24, Chapter 8)

Information not contained in the archives includes the options proposed at the IG meetings by the SWG6A2 Chairman, in particular, because the IG6A2 meeting was deadlocked on whether CRS required an additional regulation and the form of that regulation. At the IG6A2, the Chairman proposed the following compromise proposals: (1) that no RR change be made and that WRC Resolution 956 be suppressed; (2) that no RR change be made and WRC Resolution 956 be suppressed with additional text with no additional regulation required; (3) that no RR change be made and that WRC Resolution 956 be suppressed with an additional text included in the BR Directors' report to the next WRC to explain the RR difficulties or inconsistencies; 4) that no RR change be made and WRC Resolution 956 be suppressed with an additional text included in the RA report to the WRC via the BR Directors' report; (5) that a cross-border coordination handbook be developed in the WP5A and WP5C; (6) that a list of questions be submitted to ITU-R for further study on issues related to the sharing of MS and FSS in the 3400-4200 MHz band; and (7) that no RR change be made, the WRC Resolution 956 be suppressed, and an additional WRC resolution be made.

The SWG6A2 discussed the Chairman's seven proposals. The meeting agreed that Proposal (1), Proposal (3), and Proposal (7) move forward for further consideration at the WG6A.

The final outcome was contained in a WRC recommendation of the Final Act with Proposal (3) (see Chapter 8).

Usefulness of missing information

Member States that did not have delegates in attendance at the SWG and IG meetings have no information in relation to the "lost" proposal, namely, Proposal (2), Proposal (4), Proposal (5), and Proposal (6).

Consequently, when WRC-12 Agenda Item 1.19 CRS issues are studies further via ITU-R Resolution 58, the focus of the study is Proposal (3). The SGs report to the RA-15, which sends an approval to the WRC-15.

The WRC-15 will consider the report on the CRS agenda item. The input document includes the study report form SG concerning Proposal (3). The report is housed in the ITU archives, which give all Member States an equal opportunity to review the status quo of the issues.

However, the deliberations concerning Proposal 2, 4, 5, and 6 are effectively "lost" to Member States that did not send delegates to the WRC-12. The practical importance of this state is that the trajectory of future debates and resolution is path-dependent on the information received from the archives.

The nature and form of these data are effectively framed by delegates in attendance at the WRC-12. That is, they frame future debates.

9.4 Policy recommendation

The ITU archives are incomplete (see the illustration of the development of the WRC and RR provisions contained in Chapter 5 and Appendices A, B, C, D, E, F, G, H, I, and J). The archives only provide the WRC proceedings and RR versions, excluding the rationale issue development that underlies RR provisions and their changes.

The IAD questions provide an outline that enables the capture of interactions between Member States at meetings, but not the detailed discussions.

The study proposes three possibilities to solve the missing information as follows:

1) An information record form developed for implementation by the BR. The form would be completed by a BR officer designated by the Chair. The records would form part of the ITU archives for inclusion together with the ITU webcast archives.

Table 49 shows the format of the proposed document.

Table 49. Information recording form

Meeting:	Room:	Date:	Time:
Issues	Party with reason		
	Initiating	Supporting	Opposing
e.g., CRS 1.19			
Dynamic spectrum access	Country A	Country B	Country C, D, E
Notification and coordination	Country A	Country B	Country C, D, E
Regulatory matters during the ITU-R study	Country A	Country B	Country C, D, E

Table 49 presents an example of a completion of Agenda Item 1.19 CRS concerning the otherwise missing information. This information shows issue developments with the parties concerned: initiating, supporting, and opposing. When this information becomes available, all

Member States have information equality, and information asymmetry between the attending and non-attending Member States is minimized.

The form would act as a guide to propose the ITU webcasts also contained in the archives. The form should be completed for all meetings, especially the SWG and IG meetings, with the corresponding webcast.

Advantages

-The missing information is available to all Member States.

Disadvantages

-The extra budget for the recording system in every room should be implemented.

-As the meeting secretary, the BR officer should fill in the form (same as the log book). It may impose some extra work on the meeting secretary.

2) Minutes of meeting, at WRC only plenary session has the minutes of meeting. Most of plenary minutes summarize the approval of document. The COM, WG, SWG, DG, IG meeting do not have minutes of meeting. The minutes of meeting below the level of plenary session contain the rationale of RR revision. Such minutes of meeting can be summarized the discussion or debate by meeting chairman or secretary. The implementation of minutes of meeting at all meeting forms will capture the reason behind RR revision.

Advantages

-The missing information is available to all Member States.

Disadvantages

-The extra work for the meeting secretary and chairman summarizing meeting discussion should be considered.

3) Discussion forum during WRC, at the WRC-12 the SharePoint site is introduced to facilitate shared folders for Member States to exchange informal documents during meetings.[59] The WRC-12 SharePoint site requires a TIES system for access. Moreover, inside the SharePoint, the functions “Announcement” and “Tags & Notes” provide an additional communication channel. However, no one is interesting in using it. It is an opportunity to fully use the SharePoint site as a discussion forum during WRC. The BR should inform Member States of this function. More information could be added from the existing “SharePoint Sites Information” regarding the discussion forum.

Advantages

-Additional channel to communicate, obtain the missing information and follow up the discussion

[59] The SharePoint Site is the website provided by the BR during the WRC-12. This website is used for Member States to upload and download the working document during the WRC-12. To access this website, the TIES user is required.

-No extra cost for implementing the software development

Disadvantages

-Additional work on guidelines on using the discussion forum (BR officers).

-Additional work for the meeting between the Chairman and secretary, and stakeholders who post the files and comments must be aware of a response time (need immediate response)

4) Member States Networking (regional representatives): The connection between Member States and Sector Members becomes more important before, during, and after WRC. In order to exchange information, including the position and rationale behind it, and a formal or informal discussion establishes the connection. However, the content of the issues varies for each agenda item.

For Low Income countries, it is difficult to send a delegate to the relevant meetings, apart from WRC. Even for WRC, there are limited resources. Member States should prioritize the WRC agenda items based on their national interest or benefit.

During the national preparatory work for WRC, Member States should identify the coordinator on each agenda item to be a contact or focal point and follow the relevant activities at both national and international meetings. The preliminary views on each agenda item should be prepared in order to initiate the discussion in the meeting.

Consequently, the contact point should follow the relevant activities in order to find the regional representative or coordinator on each agenda item at the regional preparatory meeting either from participation or electronic communication. The coordinators prepare the common views as a regional position to WRC. The discussion or communication with coordinators provides the information and rationale between stakeholders.

When the national position is in line with the regional positions, the regional proposals can be supported. The communication with the coordinator will update the discussion on this issue.

When the national and regional positions are in conflict, the regional proposals cannot be supported. Frequent communication with the coordinator will provide an insight position between the Member States that can be used to form the multi-countries proposal, if necessary.

Advantages

Obtain information from a regional representative when Member States cannot participate in the meetings.

Disadvantages

Take time and money to build up Member States networking, i.e., attending relevant meetings (local, regional, and global).

9.5 Summary and discussion on research questions

This chapter responds to sub-research question 2: *What information would be more useful for making the decision?*; sub-research question 3: *How does the missing information affect international spectrum policy?;* and sub-research question 4: *How can the existing ITU archives be improved or completed?*

The study describes and prescribes the IAD framework in order to understand and apply the framework to the WRC context. The IAD framework helps to differentiate the capability between the ITU archives and observation, and to identify the limitation of the ITU archives and the observations.

The results of the IAD analysis identifies the ITU archives as incomplete because they lack the rationale underlying the RR provisions. The study further expands the element of the IAD framework to fulfill the missing information: the interaction or discussion comprising the attribute of community (common understanding between participants at the meetings), choice rule (the options that are available at the meetings), payoff rule and evaluative criteria (the evaluation of the option according to the choice rule), information rule (the information exchange inside the meetings), aggregate rule (the control of the Member States' stance at the meetings), action situation and interaction (discussion at the meeting).

The study also explains the limitation of the ITU archives that can be fulfilled by the participant observation via the meeting attendances. However, the observation is only available in the current situations.

Moreover, the study demonstrates the application of the IAD framework to the IG6A2 1.19 at the WRC-12 to show the missing information from the ITU archives.

The analysis of the IAD framework in the WRC context reveals the type of the missing information as the IAD element responding to the second sub-research question: *What information would be more useful for making the decision?*

The second sub-research question is crucial to identifying the type of missing information or rationale that is not documented in the ITU archives. Moreover, the second sub-research question reveals the fact that the ITU archives are incomplete, and it raises awareness of the Member States that use these ITU archives with caution that the ITU archives do not contain the rationale of the RR provision, only the input and output of the WRC proceeding and RR version are available.

The study uses the observation of WRC-12 Agenda Item 1.19 at the SWG meeting to demonstrate the missing information. Furthermore, the effects or consequences of the missing information on the decision-making process at the higher-level meetings and the usefulness of the missing information are prescribed.

At the SWG6A2 1.19, the seven proposals from the Chairman were put forward, however, the meeting decided to select only three options to forward to the next meetings. This meant that the other four options were left out. These options were not documented. Only the attending

participants have this missing information. When this information becomes available to other Member States, especially non-attending Member States, the missing information becomes a possible option for Member States to make a decision.

The study demonstrates the usefulness of the missing information in the case of SWG6A2 to respond to the third sub-research question: *How does missing information affect the international spectrum policy?* The third sub-research question is important to enlighten the cruciality of the missing information in the international spectrum policy as WRC to the Member States that do not attend such meetings. When the missing information is available, the Member States can have additional information to decide on at WRC.

In order to improve the missing information in the ITU archives, the study also proposes three possible methods as policy recommendations to improve them: (1) a meeting record form with webcast archives, (2) minutes of meeting below the level of plenary session, (3) the enhancement of the SharePoint Site in the discussion forum, and (4) Member States networking for a regional representative connection. Moreover, the study also provides the advantages and disadvantages of each option, responding to the fourth sub-research question: *How can the existing ITU archives be improved or completed?*

The fourth sub-research question is the final output of this study to manage the missing information in the ITU archives. This sub-research question is crucial to the study to complete the whole process from the exploration of the ITU archives, identification of the missing information, analysis of the effects of the missing information, and improvement of the ITU archives.

To conclude, the study applies the IAD framework as the guidelines to identify the missing information from the ITU archives. Moreover, the study demonstrates how the missing information affects the international policy setting in the case of WRC-12 Agenda Item 1.19. Finally, possible solutions to reduce the missing information are proposed: (1) a meeting summary record form with the webcast archives, (2) minutes of meeting below the level of plenary session containing a meeting discussion summary, (3) full utilization of the SharePoint Site, and (4) Member States networking, especially a regional representative on the WRC agenda items.

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Chapter 10 Summary and findings

This chapter provides an overview and findings of the study. The explicit answer to the research question is also illustrated.

10.1 Synthesis

Looking back at the complex issues associated with the RR processes, the author provides a summary below.

Problem

An RR interpretation problem always arises when Member States and Sector Members implement changes to the RR provisions. Interpretations can vary because stakeholders have very different views about the RR that are linked to their own interests, leading to conflict. The ITU archives are explored by the Member States to obtain a rationale that underlies such provision changes. However, the ITU archives only contain the final form of the input and output documents of the WRC proceedings, along with the RR versions (Chapter 1).

The study has the main research question: *How is international spectrum policy developed and affected by the lack of detailed documentation?* In order to respond to the main research question, the study has four sub-research questions as follows:

1. What is the international spectrum policy setting in terms of the ITU structure, WRC, and RR, and how did they develop?
2. What information would be more useful for making the decision?
3. How does the missing information affect international spectrum policy?
4. How can the existing ITU archives be improved or completed?

Purpose

The purpose of the study is to understand the information needs and coordination in the international spectrum policy setting, including the processes and archives relevant to the ITU (WRC proceedings and RR versions). The study also proposes a possible way to alleviate the missing information in this policy setting.

The study attempts to explore and explain the WRC and RR developments. Moreover, the author observed the PT A, CPG, APG, and WRC-12 meetings with a view to obtaining insights into the nature of and substance information lost through adequate archiving. In particular, the study illustrates the preparatory processes of the WRC-12 Agenda Items 1.19 and 1.22 at both national and regional meetings. WRC-12 Agenda Item 1.19 is the focus for demonstrating the valuable nature of the lost information. Furthermore, the importance of WRC-12 Agenda Item 1.2 to Thailand is illustrated. The study proposes that the missing information (corresponding to the IAD framework analysis) be completed along with webcasts. Together, these initiations would directly address the situations of information asymmetry between rich and poor countries. The full utilization of the SharePoint Site

provides an additional opportunity for communication between the Member States during WRC. Furthermore, Member State networking in terms of connection with the regional representatives on the WRC agenda items helps the non-participating Member States fill in the missing information.

Method

The study uses both inductive and deductive approaches, and primary and secondary data. The primary data are obtained from observations made during the meeting negotiations at the PT A, CPG, APG, and WRC-12. The secondary data are obtained from the ITU, CEPT, and APT archives. The keyword mapping helps to track the relevant provisions across the RR versions.

The IAD framework provides a "concerned question" list to capture the rationale driving the negotiations.

Participant observations at meetings allow for more complete meeting documentation. A limitation of such observations is that they can only be conducted for current situations, not past events. Accordingly, the process is one of demonstration, with full implementation requiring complete documentation at meetings, which is subsequently included.

10.2 Result

The results of the study are as follows:

(1) ITU structure development (Chapter 4)

The study provides the ITU structure development since 1865, from the International Telegraph Union to ITU via the International Telegraph Conference, International Telecommunication Conference, and Plenipotentiary Conference. The major change to the ITU structure is a result of the study by the High Level Committee during 1989-1992. The current ITU structure is the decision of the APP1992 and its amendments (1994, 1998, 2002, and 2006).

(2) RR development (Chapter 5) and Appendices A, B, C, D, E, F, G, H, I, and J

The study provides a review of the WRC and RR developments in terms of: (1) key definitions (telecommunication, radiocommunication, and radio waves), (2) important provisions (choice of apparatus, frequency assignment provision, licenses, allocation, allotment and assignment, priority of services, radiocommunication services, and radiocommunication station), and (3) frequency band developments (MMS, MMSS, BS, BSS, FS, FSS, MS, MSS, SRS, and EESS).

(3) WRC preparatory work

3.1) WRC agenda-setting process (Chapter 6)

The WRC agenda-setting process provides a standard for ITU to prepare the WRC agendas for the next and future WRC in the CPM report. The WRC agenda-setting has two study

cycles for preparation, i.e., the next and future WRC agendas in the CPM report. The whole WRC agenda-setting process takes eight years.

However, the last WRC is a crucial forum in which to approve the next WRC agenda before CC approval. This means that the agenda items, including the CPM report, for the next and future WRCs are not guaranteed inclusion in the final version of the WRC agenda by the last WRC approval. Interested Member States with limited resources should pay attention to the last WRC that is finalized in the next WRC agenda.

3.2) WRC study process (Chapter 7)

The WRC study process for WRC-12 Agenda Items 1.19 and 1.22 provides the output of the discussion from the ITU SG and the issues of these agenda items that use one WRC study cycle. The output from the SG is presented in the CPM report as the options for Member States to decide on at the WRC-12. Moreover, the output from the RA-12 provides additional information for Member States to consider at the WRC-12

3.3) National and regional preparatory meeting (Chapter 6)

The national and regional preparatory work assists the WRC preparatory process before WRC. The study elaborates on Thailand and Sweden as national preparatory processes and the APG and CPG as regional preparatory processes.

The study provides an inside view of the PT A, CPG, and APG on WRC-12 Agenda Items 1.19 and 1.22 via attendance by the author. The record of the meeting discussions reveals the rationale behind the ultimate resolutions not contained in the archives. This information provides a more complete basis for understanding the state of the issue and the development of further arguments at the relevant meetings.

During the discussion, the rationale on how it changes, as the missing information, is available to an attending Member State. The author participated in the national and regional preparatory meetings, providing the missing information apart from the archives.

The CPG and APG, as the regional forums, allow discussion of regional interests and preparation of common proposals for WRC. The process reduces the volume of submitted documents. Moreover, regional coordinators, as regional representatives, negotiate and report to the regional coordination meetings.

Furthermore, national and regional preparatory meetings represent the forums in which the stakeholders can negotiate at national and regional level. The connections between the stakeholders form the networking to exchange information before, during, and after the meeting. This networking also helps them understand the rationale of the discussion, which is omitted from the archives. Networking is also a possible solution to improve the ITU archives as the fourth sub-research question.

(4) WRC-12 Agenda Items 1.19 and 1.22 (Chapters 7 and 8)

The WP1B and WP1A of SG1 are in charge of WRC-12 Agenda Items 1.19 and 1.22, respectively. The study explores the input and output documents of the ITU members' contribution for both WPs. The illustration of the study output is presented as follows.

The output of the WP1B provides one option for the SDR and three options for the CRS in the CPM report for WRC-12 Agenda Item 1.19. The SDR issue is that there is no change to the RR. There are three options for the CRS issues: (1) no change to the RR (Method B1 option 1), (2) no change to the RR with the ITU-R resolution for CRS requiring further study (Method B1 option 2), (3) and no change to the RR with the WRC resolution for CRS requiring further study (Method B2).

The output of the WP1A provides four options in the CPM report for WRC-12 Agenda Item 1.22: (1) no RR change (existing RR and ITU recommendations and reports can govern the SRD) (Method A), (2) a WRC resolution (further study on SRD global and regional harmonized frequency bands) (Method B), (3) a footnote similar to the ISM footnote (recognize existing SRD use ensuring no harmful interference to existing services) (Method C), and (4) a new SRD definition under in the Article 1 (Method D).

Moreover, the output from the RA-12 provides two ITU-R resolutions for WRC-12 Agenda Items 1.19 and 1.22: ITU-R Resolution 54-1 and ITU-R Resolution 58, respectively.

The study also addresses the missing information during the discussion of WRC-12 Agenda Items 1.19 and 1.22. This missing information can be captured at the SWG and IG levels. The author attended the relevant meetings on WRC-12 Agenda Items 1.19 and 1.22 to illustrate the missing information from the ITU archives, which is the rationale underlying the discussion and is available only to attending participants.

The study illustrates how the missing information affects the decision-making during the negotiations by the Member States in the case of WRC-12 Agenda Item 1.19. A summary of WRC-12 Agenda Items 1.19 and 1.22 follows.

The CRS or WRC-12 Agenda Item 1.19 is a controversial issue. The issue is gradually developed at several IG meetings. The development of the argument stems from the issue of harmful interference to dynamic spectrum access. Consequently, the argument moves to MIFR notification and coordination. Finally, regulatory matters (during ITU-R Resolution 58 in the CRS study) are then reported to the next WRC via the BR Director's report. The final outcome is the WRC recommendation, as a compromise solution between the Member States.

The SRD or WRC-12 Agenda Item 1.22 is solved at the RA-12 with ITU-R Resolution 54-1 (further studies on the harmonization of short-range devices). Consequently, there are no more issues for discussion; only the documentation on the approval process is required to complete the matter.

The missing information during the discussion in an informal meeting creates information asymmetry between attending and non-attending Member States. Moreover, the missing

information at the SWG and IG meetings is not documented in the ITU archives. The information matters when the issue could change outcomes or propose new options. When such an issue continues to the next or future WRCs, the information matters to non-attending Member States that need it to prepare and develop their position at the relevant meetings if the issue has a strong effect on their interests.

The demonstration of WRC-12 Agenda Items 1.19 and 1.22 fulfills the ITU archives in terms of the Member States' discussions at the SWG and IG meetings. These discussions contain the rationale underlying the RR revisions. Moreover, the demonstration of the missing information for WRC-12 Agenda Item 1.19 also provides the effects to the international spectrum policy at a higher level, such as at the WG, COM, and plenary.

(5) IAD application to the WRC context (Chapters 2 and 9)

The results of the IAD analysis identify that the ITU archives are incomplete, because they lack the rationale underlying the RR provisions. The study further expands the element of the IAD framework to complete the missing information: the interaction or discussion comprising the attribute of community (common understanding between participants at the meetings), choice rule (the options that are available at the meetings), payoff rule and evaluative criteria (the evaluation of the option according to the choice rule), information rule (the information exchange inside the meetings), aggregate rule (the control of the Member States' stance at the meetings), and action situation and interaction (discussion at the meeting).

The study also explains the limitation of the ITU archives that can be fulfilled by participant observation via meeting attendances. However, the observation is only available in the current situations.

The study also demonstrates the application of the IAD framework to the IG6A2 1.19 at the WRC-12 to show the missing information from the ITU archives.

(6) Demonstration of the missing information effects on Thailand (Chapters 1, 7, 8, and 9)

The study demonstrates the effects on Thailand of the missing information on WRC-12 Agenda Items 1.2 and 1.19 in terms of its importance as basic information to analyze its impact at the meeting and for ongoing issues to the next or future WRC.

Moreover, the demonstration of the missing information on WRC-12 Agenda Item 1.19 at the SWG meeting influences non-attending Member States, as it is additional information to decide on at the WRC-12.

The missing information represents the rationale of the RR revisions or the issues at the meeting and provides an understanding for Member States to develop further argumentation at the relevant meeting for ongoing debates or implementations, such as the RR provisions.

(7) Policy recommendation (Chapter 9)

The study also proposes three possible methods as a policy recommendation to improve the ITU archives: 1) a meeting record form with webcast archives, 2) minutes of meeting below

the level of plenary session, 3) enhancement of the SharePoint Site in a discussion forum, and 4) Member State networking for a regional representative connection. The study also provides the advantages and disadvantages of each option.

10.3 Responses to research questions

The study summarizes the responses to the sub-research questions in Table 50. Table 50 presents the responses to the sub-research questions related to the content of the study.

Table 50. Responses to the sub-research questions related to the chapters of the study

RQ		Chapter								
		4	5	6	6	7	7	8	8	9
1	ITU structure development	X								
1	RR development		X							
1	How did they develop			X		X				
2	Missing information				X			X		X
3	Effects on international policy setting						X	X	X	X
4	Improvement of the ITU archives				X					X
	Detailed content		Appendices A, B, C, D, E, F, G, H, I, and J	WRC agenda-setting	National, APG& CPG	WRC study process	Importance 1.19 & 1.22	Missing info 1.19 & 1.22	Importance 1.2	Analysis, missing info 1.19

The study contains the main research, i.e., *How is international spectrum policy developed and affected by the lack of more detailed documentation?* To fulfill the main research question, four sub-research questions are posed.

Sub-research question 1: *What is the international spectrum policy setting in terms of the ITU structure, WRC, and RR, and how did they develop?*

The study responds to the first sub-research question in four parts: (1) ITU structure development; (2) RR development; (3) WRC agenda-setting; and (4) WRC study process.

The study explores the relevant literature and cross-checks it with the ITU Convention to provide the ITU structure development in Chapter 4. The revision of the ITU structure is based on the Member States' contributions.

The study further explores the ITU archives, including the input and output of the WRC proceedings and RR versions, to construct its own database. The keywords are used to keep track of the RR provisions, and the TFA provides the RR developments in Chapter 5 and

Appendices A, B, C, D, E, F, G, H, I, and J. The results of the exploration also confirm that the ITU archives are incomplete: lack the rationale behind the RR provisions.

Furthermore, the study explores the ITU archives to explain the process of RR revision, including the WRC agenda-setting and WRC study process. The study also illustrates the WRC-12 preparatory process as the WRC standard process. The results of the WRC agenda-setting process and WRC study process are presented in Chapters 6 and 7, respectively.

Sub-research question 2: *What information would be more useful for making the decision?*

The study responds to the second sub-research question, which has three parts: (1) the IAD framework application in the WRC context, (2) the national and regional preparatory meeting for WRC, and (3) WRC-12 Agenda Item 1.19.

The study proposes the use of the IAD framework as the outline for a question inside the action situation: WRC and relevant meetings. The justification for the IAD framework is also described and prescribed in Chapters 2 and 9. The results of the IAD framework application, indicating the limitation of the ITU archives, lacks the dynamic situation or discussion inside the meetings.

However, the IAD framework provides only a list of relevant questions, not the detailed contents of the discussion. The participant observations by the author are pursued to capture the debate inside the meetings, as the missing information was left out of the ITU archives.

The study also presents the missing information for WRC-12 Agenda Items 1.19 and 1.22 during the regional preparatory meetings: the CPG, APG, and WRC-12 in Chapters 6, 8, and 9.

Sub-research question 3: *How does the missing information affect international spectrum policy?*

The study responds to the third sub-research question and has two parts: (1) the importance of WRC-12 Agenda Items 1.2, 1.19 and 1.22 and (2) a demonstration of the effects on international spectrum policy.

The study also presents the importance of the missing information on WRC-12 Agenda Item 1.2 from Thailand's perspective in order to illustrate how the missing information affects Thailand's position to further develop the argument for this agenda item in Chapters 1 and 8.

Moreover, the current situation of the FS and MS in Thailand is also provided as basic information to analyze the impacts or consequences on the FS and MS convergence. The background to the definition development of FS, fixed station, and mobile station for the ongoing issue to the WRC-15 is also presented in Chapter 8.

The study presents the importance of WRC-12 Agenda Items 1.19 and 1.22 to Thailand as basic information to analyze the effects or consequences of the RR revisions in Chapter 7. It also considers the usefulness of the missing information in terms of WRC-12 Agenda Item

1.19 to demonstrate the valuable information to non-attending Member States that prioritize this agenda item in Chapter 9.

Sub-research question 4: *How can the existing ITU archives be improved or completed?*

The study responds to the fourth sub-research question and has two parts: (1) national and regional preparatory networking and (2) policy recommendations.

The study proposes three possibilities to complete the missing information in the ITU archives: (1) the meeting record form together with the webcast archives, (2) minutes of meeting below the level of plenary session, (3) full utilization of the SharePoint Site during WRC, and (4) connection with a regional representative on each WRC agenda item as Member State networking.

The proposals do not complete the ITU archives; however, they offer possible ways to reduce the missing information in the ITU archives and the information asymmetry between High and Low Income countries, or attending and non-attending Member States. The study presents the results in Chapters 6 and 9.

10.4 General policy implications and recommendations

The study proposes three possible solutions to reduce the amount of missing information in the ITU archives: (1) completing and lodging an information record form in the ITU archives along with corresponding webcast archives of all meetings, (2) implementing minutes of meeting below the level of plenary session by summarizing meeting discussion (3) making full use of the SharePoint Site to provide an additional opportunity for communication between Member States during WRC, and (4) Member State networking in terms of connections with regional representatives on the WRC agenda items to help non-attending Member States fill in the missing information.

The study illustrates that the ITU archives are incomplete because they lack the rationale underlying the RR provisions. The Member States and Sector Members must therefore implement the RR provisions carefully and be aware of the missing information from the ITU archives.

10.5 Implications for Thailand

The study contributes original work on the RR development including key definitions, important provisions, frequency bands in specified services, and the WRC preparatory process.

Basic understanding of the RR development

Thailand could use the RR development from the study contributions to understand the basic concept of the RR, especially the way the RR is reviewed and revised by WRC.

The development of the RR for key definitions, important provisions, and frequency bands in specified services provides the basic information for Thailand to further investigate the

relevant RR for detailed information. The study provides a starting point as a mind map to further explore the ITU archives.

Moreover, the database compiled by the author can serve as a resource for the TFA development since no one collects and compares all the TFA in the RR versions. The database could represent a starting point for further exploration of the TFA issues

RR implementation and caution

The study confirms that the ITU archives lack the rationale behind the RR provisions. The rationale can be captured during the meeting discussions. In order to implement the RR, Thailand should be aware of this limitation, and it may consider participating in the ITU activities to obtain missing information or rationale that matters to Thailand. Thailand may start to consider the priority of the WRC agenda items in the case of limitation of resources and identify the relevant ITU activities to attend in the WRC preparatory process.

WRC preparatory process

The study illustrates the WRC preparatory process, the WRC agenda-setting and the WRC study process. The WRC agenda-setting takes two WRC cycles to complete for the next and future WRC agendas in the CPM report. However, the crucial forum is the final WRC, which finalizes the WRC agenda.

The study explores the WRC agenda-setting process from 1993 to 2012. The results of the approval of the WRC agenda items at the finalized WRC reveal that the majority of WRC agenda items comes from the contributions at the finalized WRC. Moreover, the WRC agenda prepared by the CPM in the CPM report for next and future WRC agenda items is reducing over time.

Thailand should therefore concentrate on the finalized WRC by submitting contributions to and participating in this WRC to ensure the inclusion of WRC agenda items if necessary.

With regard to the WRC study cycle by ITU SG, after the WRC agenda item prioritization, Thailand should participate in the relevant activities by the relevant SGs and submit contributions (if necessary) to ensure preferable options are included in the CPM report. ITU SG/WP will usually convene approximately three times each year (from the previous meetings of SG1, WP1A, and WP1B).

Regional preparatory meeting (APG)

The study also elaborates on the role of the regional preparatory meeting, especially the APG, as the regional preparatory meeting in the Asia-Pacific regions by the APT. Moreover, ITU recognizes the importance of the six regional preparatory meetings as the regional forum for consolidation and negotiation among Member States represented by the commons or regional proposal. Furthermore, the regional coordinator or representative represents its own region to negotiate and report back to their regional meeting during WRC. The commons proposal and

regional representative both help to reduce the number of documents and discussions at WRC and encourage consensus or compromise between Member States.

The author was part of the Thai team preparing Thailand's position on WRC-12 Agenda Items 1.19 and 1.22. During the meeting discussions at the APG2012-5, the author observed the dynamic meeting situation between APT members in order to understand the issue of these two agenda items and the APG preparatory process for the APT common proposal to the WRC-12. The discussions varied between agenda items depending on the APT members' standpoints (based on their interests). When a consensus or compromise was reached, the APT common proposal was submitted to the WRC-12.

Thailand should create a connection between stakeholders at national and regional level through participation in national and regional preparatory meetings. The connection between stakeholders enables information exchange and improves understanding of the issues or situations of the WRC agenda items in order to prepare Thailand's position and protect its national interest.

The stakeholder connection, especially Member State networking, may help to relieve the issue of the missing information from the ITU archives and the information asymmetry between attending and non-attending Member States. The follow-up discussion with relevant Member States will enhance understanding of the issues, as the crucial information for improving Thailand's decision-making process at the relevant meetings.

WRC-12 Agenda Items 1.2, 1.19, and 1.22

The study demonstrates the effects of the missing information on WRC-12 Agenda Items 1.2, 1.19, and 1.22 from Thailand's perspective. The demonstration shows the strong impact this has on Thailand. It is important for Thailand to prepare for the rapid growth of new technology, especially the spectrum commons and FS and MS convergence.

In order to prepare for the convergence technology, an evaluation of the current situation of both FS and MS is necessary: an up-to-date database. A review of the current status of FS and MS usage should be conducted and the existing database updated. The initial phase may begin with FS and MS and apply to all services at a later stage.

To prepare for the relevant issues on spectrum commons, Thailand might consider participating in all relevant meetings, including the ITU SG, WP, CPM, SC, RA, and WRC parts of the WRC preparatory processes (WRC agenda-setting and WRC study process) to update the information and prepare Thailand's position in order to take advantage of the advancement of technology.

10.6 Recommendations for future research

Further studies on FS and MS convergence following the ITU activities for reviewing and revising the definition of FS, fixed station, and mobile station during the WRC-15 study cycle may be considered. It is a long process for WRC to make the RR more flexible to govern the new technology.

Further studies relevant to spectrum commons may be encouraged to follow: (1) the study on frequency harmonization of SRD according to ITU-R Resolution 54-1 and (2) further study on the CRS according to ITU-R Resolution 58. Both of these studies are conducted by the ITU SG in the WRC-15 study cycle.

From a theoretical point of view, the IAD framework by Ostrom assumes that all decision-makers in an action situation have complete information in order to reduce complexity to model the outcome. The study does not reformulate the theoretical part of the IAD framework; however, the study demonstrates and applies the IAD framework to the real action situation at the WRC-12 meetings, which contains the elements of incomplete information situation, as shown in the thesis. From a theoretical point of view, it may be of interest to conduct future research on the IAD framework by modifying the assumption to model the outcome in the case of incomplete information.

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List of abbreviations

General

ADD	Addition
APG	Asia-Pacific Telecommunity conference preparatory group for WRC
APP1992	Additional Plenipotentiary conference 1992
ARC	Administrative Radio Conference
CC	The Council
CICG	Centre International de Conférences Genève
CRS	Cognitive radio system
CPG	CEPT conference preparatory group
COM	Committee
CPM	Conference Preparatory Meeting
CS	The ITU Constitution
CV	The ITU Convention
D	Delegate
DECT	Digital enhanced cordless telecommunication
DFP	Designated focal point
DH	Deputy head
DG	Drafting group
DT	Temporary document
ECP	European common proposal
GHz	Giga Hertz
HF	High frequency
HoD	Head of delegate
Hz	Hertz
IAD	Institutional Analysis and Development
IFIC	International Frequency Information Circular
IG	Informal group
IMT-2000	International Mobile Telecommunication-2000
ISM	Industrial science and medical application
LAN	Local area network
LF	Low frequency
MF	Medium frequency
MHz	Mega Hertz
MIFR	Master International Frequency Registration
MOD	Modification
NOC	No change
PACP	Asia-Pacific common proposal
PCS	Personal communication system
PHS	Personal handyphone system
PO	Participant observation
PP	Plenipotentiary conference
PT A	Project team A
RA	Radiocommunication Assembly
Rev	Revision
RFID	Radio-frequency identification
RR	Radio Regulations
SDR	Software defined-radio
SC	Special Committee on regulatory and procedural matter
SG	Study group
SHF	Super high frequency
SRD	Short-range devices
SUP	Suppression
SWG	Sub-working group

TFA	Table of frequency allocation
TIES	Telecommunication Information Exchange Service
UHF	Ultra high frequency
VLF	Very low frequency
VHF	Very high frequency
WAN	Wide area network
WARC	World Administrative Radio Conference
Wi-Fi	Wireless fidelity
WG	Working group
WP	Working party
WRC	World Radiocommunication Conference

Administration and organization

APT	Asia-Pacific Telecommunity
ASMG	Arab Spectrum Management Group
ATU	African Telecommunications Union
BR	Radiocommunication Bureau
CCIF	International Telephone Consultative Committee
CCIR	International Radio Consultative Committee
CCIT	International Telegraph Consultative Committee
CCITT	International Telegraph and Telephone Consultative
CEPT	European Conference of Postal and Telecommunications administrations
CISPR	Special committee of the international electrotechnical commission for interference
CITEL	Inter-American Telecommunication Commission
CPG	CEPT conference preparatory group
ETSI	European Telecommunications Standards Institute
HLC	High level committee
ICAO	International Civil Aviation Organization
IEC	International Electrotechnical Commission
IFRB	International Frequency Registration Board
IMO	International Maritime Organization
ISO	International Organization for Standard
ITU	International Telecommunication Union
ITU-D	Telecommunication development sector
ITU-R	Radiocommunication sector
ITU-T	Telecommunication standardization sector
MICT	Ministry of Information and Communication Technology
NBC	National Broadcasting Commission
NBTC	National Broadcasting and Telecommunications Commission
NFMB	National Frequency Management Board
NRA	National regulatory authority
NTC	National Telecommunications Commission
ONBTC	Office of the NBTC
ONTC	Office of the NTC
PTD	Post and Telegraph Department
PTS	Swedish Post and Telecom Authority
RAG	Radiocommunication Advisory Group
RCC	Regional Commonwealth in the Field of Communications
RRB	Radio Regulations Board
UK	United Kingdom
UN	United Nations
USA	United States of America
USSR	Union of Soviet Socialist Republic
WMO	World Meteorological Organization

Radiocommunication service	
ARNS	Aeronautical radionavigation service
ARNSS	Aeronautical radionavigation-satellite service
AMSS	Aeronautical mobile-satellite service
AM(R)S	Aeronautical mobile (route) service
AM(OR)S	Aeronautical mobile (off-route) service
AMS(R)S	Aeronautical mobile-satellite (route) service
AMS(OR)S	Aeronautical mobile-satellite (off-route) service
ARS	Amateur service
ARSS	Amateur-satellite service
BS	Broadcasting service
BSS	Broadcasting-satellite service
EESS	Earth-exploration satellite service
FS	Fixed service
FSS	Fixed-satellite service
LMS	Land mobile service
LMSS	Land mobile-satellite service
ISS	Inter-satellite service
MetAids	Meteorological aids services
MetSat	Meteorological-satellite service
MMS	Maritime mobile service
MMSS	Maritime mobile-satellite service
MRNS	Maritime radionavigation service
MRNSS	Maritime radionavigation-satellite service
MS	Mobile service
MSS	Mobile-satellite service
POS	Port operation service
RAS	Radio astronomy service
RDS	Radiodeterminatio service
RDSS	Radiodetermination-satellite service
RLS	Radiolocation service
RLSS	Radiolocation-satellite service
RNS	Radionavigation service
RNSS	Radionaviation-satellite service
SOS	Space operation service
SRS	Space research service
SFTSS	Standard frequency and time signal service
SFTSSS	Standard frequency and time signal-satellite service
SS	Space service
TS	Terrestrial service

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Appendix A Maritime mobile service geographic frequency allocations

Table 51. MMS Global allocation for exclusive/primary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1927	125	150	25	1947
1947	16460	17360	900	1982
1947	22000	22720	720	1982
1947	12330	13200	870	1982
1959	415	490	75	1982
1959	25070	25110	40	1982
1959-2012	14	19.95	5.95	
1959-2012	20.05	70	49.95	
2012	472	479	7	
1982-2012	2170	2173.5	3.5	
1982-2012	2190.5	2194	3.5	
1982-2012	4000	4063	63	
1947-2012	4063	4438	375	
1947-2012	6200	6525	325	
1982-2012	8100	8195	95	
1947-2012	8195	8815	620	
1982-2012	12230	13200	970	
1982-2012	16360	17410	1050	
1982-2012	18780	18900	120	
1982-2012	19680	19800	120	
1982-2012	22000	22855	855	
1982-2012	25070	25210	140	
1982-2012	26100	26175	75	
Initial RR	**Lower frequency (MHz)**	**Upper frequency (MHz)**	**Bandwidth (MHz)**	**RR removal**
1982	156.7625	156.8375	75	2012
2008-2012	156.4875	156.5625	75	
2012	156.7875	156.8125	25	

Table 52. MMS Global allocation for shared/secondary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1927	1300	1500	200	1947
1947	14	70	56	1959
1947	90	110	20	1959
1982	90	110	20	2012

Table 53. MMS EU region/Region 1 allocation for exclusive/primary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1932	1670	1715	45	1938
1932	290	315	25	1947
1932	315	320	5	1947
1932	1630	1670	40	1947
1938	1600	1630	30	1947
1938	2900	2925	25	1947
1938	32000	32500	500	1947
1947	130	150	20	1982
1959	90	110	20	1982
1959	115	126	11	1982
1959	150	160	10	1982
1959	255	285	30	1982
1959	510	525	15	1982
1982	130	148.5	18.5	2008
1982	435	495	60	2012
1959-2012	72	84	12	
1959-2012	86	90	4	
1959-2012	110	112	2	
1982-2012	117.6	126	8.4	
1959-2012	129	130	1	
2008-2012	130	135.7	5.7	
2008-2012	135.7	137.8	2.1	
2008-2012	137.8	148.5	10.7	
1982-2012	415	435	20	
2012	435	472	37	
2012	479	495	16	
1982-2012	505	526.5	21.5	
1982-2012	1606.5	1625	18.5	
1982-2012	1635	1800	165	
1982-2012	2045	2160	115	
1959-2012	2625	2650	25	
Initial RR	**Lower frequency (MHz)**	**Upper frequency (MHz)**	**Bandwidth (MHz)**	**RR removal**
2012	156.7625	156.7875	25	
2012	156.8125	156.8375	25	

Table 54. MMS EU region/Region 1 allocation for shared/secondary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1932	1925	2000	75	1959
1938	1715	1925	210	1959
1938	2000	2050	50	1959
1938	2070	2330	260	1959
1938	2360	2635	275	1959
1947	70	90	20	1959
1947	110	130	20	1959
1947	150	160	10	1959
1947	255	285	30	1959
1947	510	525	15	1959
1947	2625	2650	25	1959
1982-2012	115	117.6	2.6	

Table 55. MMS American region/Region 2 allocation for exclusive/primary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1947	2065	2105	40	1959
1959	130	150	20	1982
1959	150	160	10	1982
1982	130	160	30	2008
1982	415	495	80	2012
1959-2012	70	90	20	
1959-2012	110	130	20	
2008-2012	130	135.7	5.7	
2008-2012	135.7	137.8	2.1	
2008-2012	137.8	160	22.2	
2012	415	472	57	
2012	479	495	16	
1982-2008	505	510	5	
2012	510	525	15	
1959-2012	2065	2107	42	
Initial RR	**Lower frequency (MHz)**	**Upper frequency (MHz)**	**Bandwidth (MHz)**	**RR removal**
2012	156.7625	156.7875	25	
2012	156.8125	156.8375	25	
2012	161.9625	161.9875	25	
2012	162.0125	162.0375	25	
1982-2012	21.6	22	4000	

Table 56. MMS American region/Region 2 allocation for shared/secondary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1947	70	90	20	1959
1947	110	130	20	1959
1947	130	150	20	1959
1947	150	160	10	1959
1959	90	110	20	1982

Table 57. MMS Other regions/Region 3 allocation for exclusive/primary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1938	290	315	25	1947
1947	2065	2105	40	1959
1959	70	90	20	1982
1959	90	110	20	1982
1959	110	130	20	1982
1959	130	150	20	1982
1959	150	160	10	1982
1959	510	525	15	1982
1982	130	160	30	2008
1982	415	495	80	2012
1982-2012	72	84	12	
1982-2012	86	90	4	
1982-2012	110	112	2	
1982-2012	117.6	126	8.4	
1982-2012	129	130	1	
2008-2012	130	135.7	5.7	
2008-2012	135.7	137.8	2.1	
2008-2012	137.8	160	22.2	
2012	415	472	57	
2012	479	495	16	
1982-2012	505	526.5	21.5	
1959-2012	2065	2107	42	
Initial RR	**Lower frequency (MHz)**	**Upper frequency (MHz)**	**Bandwidth (MHz)**	**RR removal**
2012	156.7625	156.7875	25	
2012	156.8125	156.8375	25	
2012	161.9625	161.9875	25	
2012	162.0125	162.0375	25	

Table 58. MMS Other regions/Region 3 allocation for shared/secondary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1938	285	290	5	1947
1947	70	90	20	1959
1947	110	130	20	1959
1947	130	150	20	1959
1947	150	160	10	1959
1982-2012	70	72	2	
1982-2012	84	86	2	
1982-2012	112	117.6	5.6	
1982-2012	126	129	3	

Appendix B Maritime mobile-satellite service geographic frequency allocations

Table 59. MMSS Global allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	1535	1542.5	7.5	1982
1971	1542.5	1543.5	1	1982
1971	1636.5	1644	7.5	1982
1971	1644	1645	1	1982
1982	1626.5	1645.5	19	1994
1982	1535	1544	9	1998
1994	1631.5	1634.5	3	1998
1994	1634.5	1645.5	11	1998
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1971	43	48	5	1982
1971	66	71	5	1982
1971	95	101	6	1982
1971	142	150	8	1982
1971	190	200	10	1982
1971	250	265	15	1982

Table 60. MMSS Region 1 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1982	1530	1535	5	1994
1994	1525	1530	5	1998
1994	1530	1533	3	1998
1994	1533	1535	2	1998
1994	1626.5	1631.5	5	1998

Table 61. MMSS Region 2 and 3 allocations for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1982	1530	1535	5	1998

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Appendix C Broadcasting service geographic frequency allocations

Table 62. BS Global allocation for exclusive/primary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1927	550	1300	750	1932
1927	6000	6150	150	1938
1927	9500	9600	100	1938
1927	17750	17800	50	1938
1927	21450	21550	100	1938
1938	6000	6200	200	1947
1938	9500	9700	200	1947
1927	11700	11900	200	1947
1927	15100	15350	250	1947
1938	17750	17850	100	1947
1932	25600	26600	1000	1947
1947	9500	9775	275	1982
1947	11700	11975	275	1982
1947	15100	15450	350	1982
1947	17700	17900	200	1982
1938	21450	21750	300	1982
1947	25600	26100	500	1982
1959	535	1605	1070	1982
1994	7300	7350	50	2004
1959-2012	3200	3230	30	
1959-2012	3230	3400	170	
1959-2012	4850	4995	145	
1959-2012	5005	5060	55	
1994-2012	5900	5950	50	
1947-2012	5950	6200	250	
2004-2012	7300	7400	100	
1994-2012	9400	9500	100	
1982-2012	9500	9900	400	
1994-2012	11600	11650	50	
1982-2012	11650	12050	400	
1994-2012	12050	12100	50	
1994-2012	13570	13600	30	
1982-2012	13600	13800	200	
1994-2012	13800	13870	70	
1982-2012	15100	15600	500	
1994-2012	15600	15800	200	
1994-2012	17480	17550	70	
1982-2012	17550	17900	350	
1994-2012	18900	19020	120	
1982-2012	21450	21850	400	
1982-2012	25670	26100	430	

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1947	88	100	12	1959
1947	470	585	115	1959
1947	610	940	330	1959
1982-2012	100	108	8	

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1959	11.7	12.7	1	1971
1982	40.5	42.5	2	1998
1982	84	86	2	2001
2001-2012	41	42.5	1.5	
2001-2012	74	76	2	

Table 63. BS Global allocation for share/secondary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1927	160	194	34	1932
1927	194	285	91	1932
1927	1300	1500	200	1932
1932	550	1500	950	1947
1938	7200	7300	100	1947
1947	3200	3230	30	1959
1947	3230	3400	170	1959
1947	4850	4995	145	1959
1947	5005	5060	55	1959

Table 64. BS EU region/Region 1 allocation for exclusive/primary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1932	160	240	80	1947
1938	415	460	45	1947
1938	1500	1560	60	1947
1938	64000	70500	6500	1947
1938	85000	94000	9000	1947
1938	170000	200000	30000	1947
1947	7150	7300	150	1959
1959	150	160	10	1982
1947	160	255	95	1982
1959	255	285	30	1982
1947	525	535	10	1982
1959	7100	7300	200	2004
1982-2012	148.5	255	106.5	
1982-2012	255	283.5	28.5	
1982-2012	526.5	1606.5	1080	
1959-2012	2300	2498	198	
1959-2012	3950	4000	50	
1959-2012	4750	4850	100	
2004-2012	7200	7300	100	
2004-2012	7400	7450	50	

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1947	41	68	27	1959
1947	87.5	88	0.5	1959
1947	940	960	20	1959
1947	10000	10500	500	1959
1959	41	47	6	1982
1947	174	216	42	1982
1959	216	223	7	1982
1959	470	582	112	1982
1959	582	606	24	1982
1959	606	790	184	1982
1959	790	890	100	1982
1959-2012	47	68	21	
1959-2012	87.5	100	12.5	
1982-2012	174	223	49	
1982-2012	223	230	7	
1982-2012	470	790	320	
1982-2012	790	862	72	
1982-2012	862	890	28	
1959-2012	890	942	52	
1959-2012	942	960	18	
1994-2012	1452	1492	40	

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1998	40.5	42.5	2	2001
1976-2012	11.7	12.5	0.8	
2001-2012	40.5	41	0.5	

Table 65. BS EU region/Region 1 allocation for shared/secondary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1932	240	255	15	1947
1932	255	265	10	1947
1938	40500	56000	15500	1947
1938	56000	58500	2500	1947
1938	58500	60000	1500	1947
1947	150	160	10	1959
1947	255	285	30	1959
1947	2300	2498	198	1959
1947	3950	4000	50	1959
1947	4750	4850	100	1959
1947	7100	7150	50	1959

Table 66. BS American region/Region 2 allocation for exclusive/primary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1938	25000	25600	600	1947
1938	26600	27000	400	1947
1938	41000	44000	3000	1947
1938	44000	56000	12000	1947
1938	66000	72000	6000	1947
1938	78000	90000	12000	1947
1938	96000	108000	12000	1947
1938	156000	168000	12000	1947
1938	180000	192000	12000	1947
1938	204000	216000	12000	1947
1938	234000	246000	12000	1947
1938	258000	270000	12000	1947
1938	282000	294000	12000	1947
1959-2012	525	535	10	
1982-2012	535	1605	1070	
1982-2012	1605	1625	20	
1982-2012	1625	1705	80	
1959-2012	2300	2495	195	
1959-2012	4750	4850	100	
Initial RR	**Lower frequency (MHz)**	**Upper frequency (MHz)**	**Bandwidth (MHz)**	**RR removal**
1947	585	610	25	1959
1959	68	74.6	6.6	1968
1968	68	73	5	1982
1959	75.4	88	12.6	1982
1947	100	108	8	1982
1968	470	890	420	1982
1959-2012	54	68	14	
1982-2012	68	72	4	
1982-2012	76	88	12	
1959-2012	88	100	12	
1959-2012	174	216	42	
1982-2012	470	512	42	
1982-2012	512	608	96	
1982-2012	614	806	192	
1982-2012	806	890	84	
1994-2012	1452	1492	40	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1971	11.7	12.2	0.5	1982
1971	12.2	12.5	0.3	1982
1982	12.1	12.3	0.2	1986
1982	12.3	12.7	0.4	1990
1998	40.5	42.5	2	2001
1990-2012	12.2	12.7	0.5	
2001-2012	40.5	41	0.5	

Table 67. BS American region/Region 2 allocation for shared/secondary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1947	2300	2495	195	1959
1947	4750	4850	100	1959
Initial RR	**Lower frequency (MHz)**	**Upper frequency (MHz)**	**Bandwidth (MHz)**	**RR removal**
1947	44	50	6	1959
1947	54	72	18	1959
1947	76	88	12	1959
1947	174	216	42	1959

Table 68. BS Other regions/Region 3 allocation for exclusive/primary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1947	7150	7300	150	1959
1959	525	535	10	1982
1959	7100	7300	200	2004
1982-2012	526.5	535	8.5	
1982-2012	535	1606.5	1071.5	
1959-2012	2300	2495	195	
1959-2012	3900	3950	50	
1959-2012	3950	4000	50	
1959-2012	4750	4850	100	
2004-2012	7200	7300	100	
2004-2012	7400	7450	50	
Initial RR	**Lower frequency (MHz)**	**Upper frequency (MHz)**	**Bandwidth (MHz)**	**RR removal**
1947	87	88	1	1959
1947	940	960	20	1959
1959	44	50	6	1982
1947	100	108	8	1982
1959	170	174	4	1982
1959	174	216	42	1982
1982-2012	47	50	3	
1959-2012	54	68	14	
1959-2012	87	100	13	
1982-2012	174	223	49	
1982-2012	223	230	7	
1982-2012	470	585	115	
1982-2012	585	610	25	
1959-2012	610	890	280	
1959-2012	890	942	52	
1959-2012	942	960	18	
1994-2012	1452	1492	40	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1998	40.5	42.5	2	2001
1971-2012	11.7	12.2	0.5	
1971-2012	12.2	12.5	0.3	
2001-2012	40.5	41	0.5	

Table 69. BS Other regions/Region 3 allocation for shared/secondary services

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1938	1500	1600	100	1947
1938	2300	2500	200	1947
1938	3300	3500	200	1947
1938	4770	4965	195	1947
1947	2300	2495	195	1959
1947	3900	3950	50	1959
1947	3950	4000	50	1959
1947	4750	4850	100	1959
1947	7100	7150	50	1959
Initial RR	**Lower frequency (MHz)**	**Upper frequency (MHz)**	**Bandwidth (MHz)**	**RR removal**
1947	44	50	6	1959
1947	54	68	14	1959
1947	170	200	30	1959

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Appendix D Broadcasting-satellite service geographic frequency allocations

Table 70. BSS Global allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	2550	2655	105	1982
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1971	41	43	2	1982
1982	40.5	42.5	2	1998
1971	84	86	2	2001
2001-2012	41	42.5	1.5	
2001-2012	74	76	2	

Table 71. BSS Region 1 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	2500	2550	50	1990
1990	2500	2655	155	1994
1971	2655	2690	35	1994
1994-2012	1452	1492	40	
1994-2012	2520	2655	135	
1994-2012	2655	2670	15	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1998	40.5	42.5	2	2001
1971-2012	11.7	12.5	0.8	
1994-2012	21.4	22	0.6	
2001-2012	40.5	41	0.5	

Table 72. BSS Region 2 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	2500	2535	35	1982
1971	2535	2550	15	1982
1982	2500	2655	155	1994
1971	2655	2690	35	1994
1994-2012	1452	1492	40	
1994-2012	2520	2655	135	
1994-2012	2655	2670	15	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1971	11.7	12.2	0.5	1982
1982	12.1	12.3	0.2	1986
1982	12.3	12.7	0.4	1986
1982	22.5	22.55	0.5	1994
1982	22.55	23	0.45	1994
1998	40.5	42.5	2	2001
1986-2012	12.2	12.7	0.5	
1994-2012	17.3	17.7	0.4	
1994-2012	17.7	17.8	0.1	
2001-2012	40.5	41	0.5	

Table 73. BSS Region 3 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	2500	2535	35	1994
1971	2535	2550	15	1994
1971	2655	2690	35	1994
1994-2012	1452	1492	40	
1994-2012	2520	2535	15	
1994-2012	2535	2655	120	
1994-2012	2655	2670	15	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1971	22.5	23	0.5	1982
1982	22.5	22.55	0.05	1994
1982	22.55	23	0.45	1994
1998	40.5	42.5	2	2001
1971-2012	11.7	12.2	0.5	
1982-2012	12.5	12.75	0.25	
1994-2012	21.4	22	0.6	
2001-2012	40.5	41	0.5	

Appendix E Fixed service geographic frequency allocations

Table 74. FS Global allocation for exclusive/primary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1927	2750	2850	100	1932
1927	9600	11000	1400	1938
1927	17800	21450	3650	1938
1932	26600	28000	1400	1938
1927	10	100	90	1947
1927	5700	6000	300	1947
1927	6675	7000	325	1947
1927	7300	8200	900	1947
1927	8900	9500	600	1947
1938	9700	11000	1300	1947
1927	11900	12300	400	1947
1927	13350	14000	650	1947
1927	14400	15100	700	1947
1927	15350	16400	1050	1947
1938	17850	21450	3600	1947
1938	26600	27500	900	1947
1947	15450	16460	1010	1968
1947	18030	19990	1960	1968
1968	18030	18036	6	1971
1968	18036	19990	1954	1971
1947	5730	5950	220	1982
1947	7300	8195	895	1982
1947	9775	9995	220	1982
1947	10100	11175	1075	1982
1927	11400	11700	300	1982
1947	11975	12330	355	1982
1947	13360	14000	640	1982
1968	15450	15762	312	1982
1968	15762	15768	6	1982
1968	15768	16460	692	1982
1947	17360	17700	340	1982
1971	18068	19990	1922	1982
1947	21750	21850	100	1982
1947	22720	23200	480	1982
1959	23350	24990	1640	1982
1968	25110	25600	490	1982
1968	26100	27500	1400	1982
1982	7300	8100	800	1994
1947	9040	9500	460	1994
1982	11400	11650	250	1994
1982	12050	12230	180	1994
1982	13410	13600	190	1994
1982	13800	14000	200	1994
1982	15600	16360	760	1994
1982	17410	17550	140	1994
1982	18900	19680	780	1994
1994	7350	8100	750	2004
1982	5250	5450	200	2012
1994	13410	13570	160	2012
1994	15800	16360	560	2012
1982	24000	24890	890	2012
1982	26175	27500	1325	2012

Table 75. FS Global allocation for primary service-2

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1959-2012	14	19.95	5.95	
1959-2012	20.05	70	49.95	
1959-2012	3155	3200	45	
1959-2012	3200	3230	30	
1959-2012	3230	3400	170	
1959-2012	4000	4063	63	
1959-2012	4850	4995	145	
1959-2012	5005	5060	55	
1947-2012	5060	5250	190	
2012	5275	5450	175	
1947-2012	6765	7000	235	
2004-2012	7450	8100	650	
1982-2012	8100	8195	95	
1994-2012	9040	9400	360	
1982-2012	9900	9995	95	
1982-2012	10100	10150	50	
1982-2012	10150	11175	1025	
1994-2012	11400	11600	200	
1994-2012	12100	12230	130	
1982-2012	13360	13410	50	
2012	13410	13450	40	
2012	13550	13570	20	
1994-2012	13870	14000	130	
1947-2012	14350	14990	640	
2012	15800	16100	300	
2012	16200	16360	160	
1994-2012	17410	17480	70	
1971-2012	18030	18052	22	
1971-2012	18052	18068	16	
1982-2012	18168	18780	612	
1994-2012	19020	19680	660	
1982-2012	19800	19990	190	
1947-2012	20010	21000	990	
1982-2012	21850	21870	20	
1996-2012	21870	21924	54	
1982-2012	22855	23000	145	
1982-2012	23000	23200	200	
1996-2012	23200	23350	150	
1982-2012	23350	24000	650	
2012	24000	24450	450	
1968-2012	25010	25070	60	
1982-2012	25210	25550	340	
2012	26175	26200	25	

Table 76. FS Global allocation for primary service-3

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1959	29.7	41	11.3	1968
1959	136	137	1	1968
1959	235	328.6	93.6	1968
1959	335.4	400	64.6	1968
1959	450	470	20	1968
1959	1660	1700	40	1968
1959	2550	2700	150	1968
1959	4400	5000	600	1968
1959	5925	8400	2475	1968
1959	8400	8500	100	1968
1959	406	420	14	1971
1968	2550	2690	140	1971
1968	7300	7750	450	1971
1968	8025	8400	375	1971
1968	30.01	37.75	7.74	1982
1968	37.75	38.25	0.5	1982
1968	38.25	41	2.75	1982
1968	273	328.6	55.6	1982
1971	2550	2655	105	1982
1968	4400	4700	300	1982
1968	4700	4990	290	1982
1968	5925	6425	500	1982
1968	6425	7250	825	1982
1982	273	322	49	1994
1968	335.4	399.9	64.5	1994
1968	1670	1690	20	1994
1968	7900	7975	75	1994
1982	7975	8025	50	1994
1968	450	460	10	1996
1982	5925	7075	1150	1996
1968	7750	7900	150	1998
1994	2010	2025	15	2004
1982	7075	7250	175	2004
1982	41.015	44	2.985	2012
1998	7750	7850	100	2012
1998	7850	7900	50	2012

Table 77. FS Global allocation for primary service-4

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1982-2012	27.5	28	0.5	
1968-2012	29.7	30.005	0.305	
1968-2012	30.005	30.01	0.005	
1982-2012	30.01	37.5	7.49	
1982-2012	37.5	38.25	0.75	
1982-2012	38.25	39.986	1.736	
1982-2012	39.986	40.02	0.034	
1982-2012	40.02	40.98	0.96	
1982-2012	40.98	41.015	0.035	
2012	41.015	42	0.985	
2012	42.5	44	1.5	
1982-2012	44	47	3	
1968-2012	235	267	32	
1968-2012	267	272	5	
1968-2012	272	273	1	
1994-2012	273	312	39	
1994-2012	312	315	3	
1994-2012	315	322	7	
1982-2012	322	328.6	6.6	
1994-2012	335.4	387	51.6	
1994-2012	387	390	3	
1994-2012	390	399.9	9.9	
1971-2012	406.1	410	3.9	
1971-2012	410	420	10	
1982-2012	420	430	10	
1982-2012	440	450	10	
1996-2012	450	455	5	
1996-2012	456	459	3	
1968-2012	460	470	10	
1959-2012	1427	1429	2	
1982-2012	1668.4	1670	1.6	
1994-2012	1670	1675	5	
2004-2012	1675	1690	15	
1994-2012	1710	1930	220	
1998-2012	1970	1980	10	
1994-2012	1980	2010	30	
1994-2012	2025	2110	85	
1994-2012	2110	2120	10	
1994-2012	2170	2200	30	
1994-2012	2200	2290	90	
1994-2012	2290	2300	10	
1982-2012	4400	4500	100	
1982-2012	4500	4800	300	
1982-2012	4800	4990	190	
1982-2012	4990	5000	10	
1996-2012	5925	6700	775	
1996-2012	6700	7075	375	
2004-2012	7075	7145	70	
2004-2012	7145	7235	90	
2004-2012	7235	7250	15	
1982-2012	7250	7300	50	
1971-2012	7300	7450	150	
1971-2012	7450	7550	100	
1971-2012	7550	7750	200	
2012	7750	7900	150	
1994-2012	7900	8025	125	

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1998-2012	8025	8175	150	
1998-2012	8175	8215	40	
1998-2012	8215	8400	185	
1971-2012	8400	8500	100	

Table 78. FS Global allocation for primary service-5

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1959	10.55	10.7	0.15	1968
1959	14.4	15.15	0.75	1968
1959	15.25	15.4	0.15	1968
1959	17.7	21	3.3	1968
1959	25.25	31.5	6.25	1968
1968	10.55	10.68	0.13	1971
1959	10.7	11.7	1	1971
1959	11.7	12.7	1	1971
1959	12.7	13.25	0.55	1971
1968	14.4	15.25	0.85	1971
1968	17.7	19.3	0.16	1971
1968	19.4	21	0.16	1971
1959	22	23	1	1971
1968	25.25	31	5.75	1971
1971	10.7	10.95	0.25	1982
1971	11.2	11.45	0.25	1982
1971	11.45	11.7	0.25	1982
1971	14.4	14.5	0.1	1982
1971	14.5	15.35	0.85	1982
1971	17.7	19.7	2	1982
1971	21.2	22	0.8	1982
1971	22	22.5	0.5	1982
1971	23	23.6	0.6	1982
1971	25.25	27.5	2.25	1982
1959	36	40	4	1982
1982	18.1	18.6	0.5	1994
1982	21.4	22	0.6	1994
1982	25.25	27	0.175	1994
1971	27.5	29.5	2	1994
1982	37.5	39.5	2	1994
1982	39.5	40.5	1	1994
1982	151	164	13	1994
1982	17.7	18.1	0.40	1994
1982	18.8	19.7	0.9	1996
1994	28.5	29.5	1	1996
1982	116	126	10	1996
1994	22.55	23	0.45	1998
1982	23	23.55	0.55	1998
1982	54.25	58.2	3.95	1998
1982	59	64	5	1998
1982	92	95	3	1998
1982	74	75.5	1.5	2001
1982	100	102	2	2001
1996	116	119.98	3.98	2001
1996	119.98	120.02	0.04	2001
1996	120.02	126	5.98	2001
1982	126	134	8	2001
1982	149	150	1	2001
1982	150	151	1	2001
1994	151	156	5	2001
1994	156	158	2	2001
1994	158	164	6	2001
1982	168	170	2	2001
1982	170	174.5	4.5	2001
1982	174.5	176.5	2	2001
1982	176.5	182	5.5	2001

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1982	185	190	5	2001
1982	200	202	2	2001
1982	202	217	15	2001
1982	231	235	4	2001
1982	235	238	3	2001
1982	238	241	3	2001
1982	47.2	50.2	3	2004
1982	50.2	50.4	0.2	2004
1998	22.55	23.55	1	2012

Table 79. FS Global allocation for primary service-6

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1971-2012	10.55	10.6	0.05	
1971-2012	10.6	10.68	0.08	
1971-2012	12.75	13.25	0.5	
1982-2012	14.4	14.47	0.07	
1982-2012	14.47	14.5	0.03	
1982-2012	14.5	14.8	0.3	
1982-2012	14.8	15.35	0.55	
1994-2012	18.1	18.4	0.3	
1994-2012	18.4	18.6	0.2	
1996-2012	18.8	19.3	0.5	
1996-2012	19.3	19.7	0.4	
1982-2012	21.2	21.4	0.2	
1982-2012	22	22.21	0.21	
1982-2012	22.21	22.5	0.29	
1994-2012	22.5	22.55	0.05	
2012	22.55	23.15	0.6	
2012	23.15	23.55	0.4	
1982-2012	23.55	23.6	0.05	
1994-2012	25.25	25.5	0.25	
1994-2012	25.5	27	1.5	
1994-2012	27.5	28.5	1	
1996-2012	28.5	29.1	0.6	
1996-2012	29.1	29.5	0.4	
1998-2012	31	31.3	0.3	
1998-2012	31.8	32	0.2	
1998-2012	32	32.3	0.3	
1998-2012	32.3	33	0.7	
1998-2012	33	33.4	0.4	
1982-2012	36	37	1	
1982-2012	37	37.5	0.5	
1994-2012	37.5	38	0.5	
1994-2012	38	39.5	1.5	
1994-2012	39.5	40	0.5	
1994-2012	40	40.5	0.5	
2001-2012	41	42.5	1.5	
1982-2012	42.5	43.5	1	
2004-2012	47.2	47.5	0.3	
2004-2012	47.9	48.2	0.3	
1982-2012	50.4	51.4	1	
1998-2012	51.4	52.6	1.2	
1998-2012	55.78	56.9	1.12	
1998-2012	56.9	57	0.1	
1998-2012	57	58.2	1.2	
1998-2012	58.2	59	0.8	
1998-2012	59	59.3	0.3	
1998-2012	59.3	64	4.7	
1998-2012	64	65	1	
1998-2012	65	66	1	
1982-2012	71	74	3	
2001-2012	74	76	2	
1982-2012	81	84	3	
1982-2012	84	86	2	
1998-2012	92	94	2	
1998-2012	94.1	95	0.9	
2001-2012	95	100	5	
1982-2012	102	105	3	

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
2001-2012	105	109.5	4.5	
2001-2012	111.8	114.25	2.45	
2001-2012	122.25	123	0.75	
2001-2012	130	134	4	
2001-2012	141	148.5	7.5	
2001-2012	151.5	155.5	4	
2001-2012	155.5	158.5	3	
2001-2012	158.5	164	5.5	
2001-2012	167	174.5	7.5	
2001-2012	174.5	174.8	0.3	
2001-2012	191.8	200	8.2	
2001-2012	209	217	8	
2001-2012	217	226	9	
2001-2012	231.5	232	0.5	
2001-2012	232	235	3	
2001-2012	238	240	2	
2001-2012	240	241	1	
2004-2012	252	265	13	
1982-2012	265	275	10	

Table 80. FS Global allocation for shared/secondary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1927	160	194	34	1932
1927	194	285	91	1932
1927	1715	2000	285	1932
1927	2000	2250	250	1932
1927	2850	3500	650	1932
1927	22300	23000	700	1932
1932	2000	3500	1500	1938
1927	3500	4000	500	1938
1927	100	110	10	1947
1927	4000	5500	1500	1947
1927	8550	8900	350	1947
1927	12825	13350	525	1947
1927	17100	17750	650	1947
1932	22300	24600	2300	1947
1947	14	70	56	1959
1947	90	110	20	1959
1947	3155	3200	45	1959
1947	3200	3230	30	1959
1947	3230	3400	170	1959
1947	4000	4063	63	1959
1947	4850	4995	145	1959
1947	5005	5060	55	1959
1947	21850	22000	150	1959
1947	23200	23350	150	1959
1947	23350	24990	1640	1959
1947	25010	25600	590	1959
1947	26100	27500	1400	1959
1982-2012	90	110	20	

Table 81. FS Global allocation for shared/secondary services-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1947	235	328.6	93.6	1959
1947	335.4	420	84.6	1959
1947	460	470	10	1959
1947	1700	2300	600	1959
1947	2450	2700	250	1959
1947	3900	4200	300	1959
1947	4400	5000	600	1959
1947	5925	8500	2575	1959
1959	401	406	5	1968
1968	402	406	4	1971
1982	137	138	1	1994
1982	136	137	1	1998
1982	1660.5	1668.4	7.9	2004
1947	9800	10000	200	2008
1994-2012	137	137.025	0.025	
1994-2012	137.025	137.175	0.0150	
1994-2012	137.175	137.825	0.0650	
1994-2012	137.825	138	0.0175	
1968-2012	401	402	1	
1971-2012	402	403	1	
1971-2012	403	406	3	
2004-2012	1660.5	1668	7.5	
2004-2012	1668	1668.4	0.4	
2008-2012	9800	9900	100	
2008-2012	9900	10000	100	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1959	15.15	15.25	0.1	1968
1959	31.5	31.8	0.3	1968
1982	40.5	42.5	2	1998
1982	65	66	1	1998

Table 82. FS EU region/Region 1 allocation for exclusive/primary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1938	26600	27500	900	1947
1959	115	126	11	1982
1959	130	150	20	1982
1959	1605	2000	395	1982
1959	2000	2045	45	1982
1959	2045	2065	20	1982
1959	2065	2170	105	1982
1959	5250	5430	180	1982
1959	5430	5480	50	1982
1982	5730	5950	220	1994
1982	130	148.5	18.5	2008
1959	90	110	20	2012
1947	4438	4650	212	2012
1959-2012	72	84	12	
1959-2012	86	90	4	
1959-2012	110	112	2	
1982-2012	117.6	126	8.4	
1959-2012	129	130	1	
2008-2012	130	135.7	5.7	
2008-2012	135.7	137.8	2.1	
2008-2012	137.8	148.5	10.7	
1982-2012	1606.5	1625	18,5	
1982-2012	1635	1800	165	
1982-2012	1850	2000	150	
1982-2012	2000	2025	25	
1982-2012	2025	2045	20	
1982-2012	2045	2160	115	
1959-2012	2194	2300	106	
1959-2012	2300	2498	198	
1959-2012	2502	2625	123	
1959-2012	2650	2850	200	
1959-2012	3500	3800	300	
1959-2012	3800	3900	100	
1959-2012	3950	4000	50	
2012	4438	4488	50	
2012	4488	4650	162	
1959-2012	4750	4850	100	
2012	5250	5275	25	
1982-2012	5450	5480	30	
1994-2012	5730	5900	170	
2012	9040	9305	265	
2012	9305	9355	50	
2012	9355	9400	45	
2012	13450	13550	100	
2012	16100	16200	100	
2012	24450	24600	150	
2012	24600	24890	290	
2012	26200	26350	150	
2012	26350	27500	1150	

Table 83. FS Region 1 allocation for primary service-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1959	146	151	5	1968
1959	1429	1535	106	1968
1959	1710	2290	580	1968
1959	151	154	3	1971
1959	2450	2550	100	1971
1968	8400	8500	100	1971
1968	150.05	151	0.95	1982
1971	151	153	2	1982
1959	154	156	2	1982
1959	156	174	18	1982
1959	420	430	10	1982
1959	440	450	10	1982
1959	790	890	100	1982
1968	1525	1535	10	1982
1968	1710	1770	60	1982
1968	1770	1790	20	1982
1968	1790	2290	500	1982
1971	2500	2550	50	1982
1971	4990	5000	10	1982
1971	2450	2500	50	1990
1968	146	149.9	3.9	1994
1968	136	137	1	1994
1968	1429	1525	96	1994
1982	1710	2290	580	1994
1959	2290	2300	10	1994
1982	2500	2655	155	1994
1971	2655	2690	35	1994
1994	2120	2160	40	1996
1971	8025	8175	150	1998
1971	8175	8215	40	1998
1971	8215	8400	185	1998
1994	1492	1525	33	2004
1994	1675	1690	15	2004
1994	1970	1980	10	2004
1982	154	156.7625	2.7625	2008
1982	156.8375	174	17.1625	2012

Table 84. FS Region 1 allocation for primary service-3

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
2012	38.25	39	0.75	
2012	39	39.5	0.5	
2012	39.5	39.986	0.486	
2012	39.986	40.02	0.034	
2012	42	42.5	0.5	
1959-2012	68	74.8	6.8	
1959-2012	75.2	87.5	12.3	
1994-2012	146	148	2	
1994-2012	148	149.9	1.9	
1982-2012	150.05	153	2.95	
1971-2012	153	154	1	
2008-2012	154	156.4875	2.4875	
2008-2012	156.5625	156.7625	0.2	
2012	156.8375	161.9625	5.125	
2012	161.9625	161.9875	0.025	
2012	161.9875	162.0125	0.025	
2012	162.0125	162.0375	0.025	
2012	162.0375	174	11.9625	
1982-2012	230	235	5	
1996-2012	455	456	1	
1996-2012	459	460	1	
1982-2012	790	862	72	
1982-2012	862	890	28	
1959-2012	890	942	52	
1959-2012	942	960	18	
1959-2012	1350	1400	50	
1994-2012	1429	1452	23	
1994-2012	1452	1492	40	
2004-2012	1492	1518	26	
2004-2012	1518	1525	7	
1982-2012	1525	1530	5	
1959-2012	1700	1710	10	
1994-2012	1930	1970	40	
1996-2012	2010	2025	15	
1996-2012	2120	2160	40	
1994-2012	2160	2170	10	
1959-2012	2300	2450	150	
1990-2012	2450	2483.5	33.5	
1990-2012	2483.5	2500	16.5	
1994-2012	2500	2520	20	
1994-2012	2520	2655	135	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
1959-2012	3400	3600	200	
1959-2012	3600	4200	600	
1959-2012	5850	5925	75	

Table 85. FS Region 1 allocation primary service-4

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1959	10.5	10.55	0.05	1982
1971	10.95	11.2	0.25	1982
1971	22.5	23	0.5	1982
1982	22.5	22.55	0.05	1994
1982	22.55	23	0.45	1994
1998	40.5	42.5	2	2001
1982-2012	10	10.45	0.45	
1982-2012	10.5	10.55	0.05	
1982-2012	10.7	11.7	1	
1976-2012	11.7	12.5	0.8	
1982-2012	14.3	14.4	0.1	
1994-2012	17.7	18.1	0.4	
1982-2012	18.6	18.8	0.2	
1994-2012	21.4	22	0.6	
1994-2012	24.25	24.45	0.2	
1994-2012	24.45	24.65	0.2	
1994-2012	24.65	24.75	0.1	
1994-2012	24.75	25.25	0.5	
1982-2012	27	27.5	0.5	
2001-2012	40.5	41	0.5	
2004-2012	47.5	47.9	0.4	
2004-2012	48.2	48.54	0.34	
2004-2012	48.54	49.44	0.9	
2004-2012	49.44	50.2	0.76	

Table 86. FS EU region/Region 1 allocation for shared/secondary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1932	1500	1530	30	1938
1938	1600	1630	30	1947
1932	1715	1925	210	1947
1938	2000	2050	50	1947
1938	2070	2330	260	1947
1938	2360	2635	275	1947
1938	2660	2810	150	1947
1938	2860	2900	40	1947
1938	2930	3065	135	1947
1938	3095	3245	150	1947
1938	3305	3500	195	1947
1938	3500	3635	135	1947
1938	3685	3950	265	1947
1938	4000	4480	480	1947
1938	4530	5500	970	1947
1938	40000	40500	500	1947
1947	70	90	20	1959
1947	110	130	20	1959
1947	1605	2000	395	1959
1947	2000	2045	45	1959
1947	2065	2300	235	1959
1947	2300	2498	198	1959
1947	2502	2625	123	1959
1947	2650	2850	200	1959
1947	3500	3800	300	1959
1947	3800	3900	100	1959
1947	3950	4000	50	1959
1947	4750	4850	100	1959
1947	5250	5430	180	1959
1947	5430	5480	50	1959
1982-2012	115	117.6	2.6	

Table 87. FS Region 1 allocation for shared/secondary services-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1947	31.7	41	9.3	1959
1947	70	72.8	2.8	1959
1947	75.2	78	2.8	1959
1947	80	83	3	1959
1947	85	87.5	2.5	1959
1947	156	174	18	1959
1947	1300	1600	300	1959
1947	3300	3900	600	1959
1947	5850	5925	75	1959
1959	41	47	6	1982
1959	223	235	12	1990
1982	1530	1535	5	1990
1990	1530	1533	3	1998
1990	1533	1535	2	1998
1990-2012	223	230	7	
1998-2012	1530	1535	5	
1968-2012	1690	1700	10	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1968-2012	31.5	31.8	0.3	

Table 88. FS Region 2 allocation for exclusive/primary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1947	940	960	20000	1959
1959	130	150	20	1982
1959	150	160	10	1982
1947	160	200	40	1982
1959	1605	1800	195	1982
1959	1800	2000	200	1982
1959	2505	2625	120	1982
1959	2625	2850	225	1982
1959	3500	4000	500	1982
1959	5250	5450	200	1994
1982	130	160	30	2008
1959	4438	4650	212	2012
1959-2012	70	90	20	
1959-2012	110	130	20	
2008-2012	130	135.7	5.7	
2008-2012	135.7	137.8	2.1	
2008-2012	137.8	160	22.2	
1982-2012	160	190	30	
1982-2012	1625	1705	80	
1982-2012	1705	1800	95	
1982-2012	1850	2000	150	
1959-2012	2000	2065	65	
1959-2012	2107	2170	63	
1959-2012	2194	2300	106	
1959-2012	2300	2495	195	
1982-2012	2505	2850	345	
1982-2012	3750	4000	250	
2012	4438	4488	50	
2012	4488	4650	162	
1959-2012	4750	4850	100	
2012	5250	5275	25	
1994-2012	5730	5900	170	
2004-2012	7400	7450	50	
2012	9040	9400	360	
2012	13450	13550	100	
2012	16100	16200	100	
2012	24450	24650	200	
2012	24650	24890	240	
2012	26200	26420	220	
2012	26420	27500	1080	

Table 89. FS Region 2 allocation for primary service-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1959	68	74.6	6.6	1968
1959	137	144	7	1968
1959	148	174	26	1968
1959	1700	1710	10	1968
1959	1710	2290	580	1968
1959	2290	2300	10	1968
1959	2450	2550	100	1971
1959	132	136	4	1971
1959	27.5	28	0.5	1982
1959	41	50	9	1982
1959	54	68	14	1982
1968	68	73	5	1982
1959	75.4	88	12.6	1982
1968	150.05	174	23.95	1982
1959	174	216	42	1982
1959	225	235	10	1982
1959	890	942	52	1982
1968	1710	1770	60	1982
1968	1770	1790	20	1982
1968	1790	2290	500	1982
1971	2500	2535	35	1982
1971	2535	2550	15	1982
1959	1429	1435	6	1990
1971	2450	2500	50	1990
1990	1429	1525	96	1994
1982	1710	2290	580	1994
1971	2290	2300	10	1994
1982	2500	2655	155	1994
1971	2655	2690	35	1994
1994	2120	2160	40	1996
1994	1970	1980	10	1998
1971	8025	8175	150	1998
1971	8175	8215	40	1998
1971	8215	8400	185	1998
1994	1492	1525	33	2004
1994	1675	1690	15	2004
1982	150.05	156.7625	6.7125	2008
2008	150.05	156.4875	6.4375	2012
1982	156.8375	174	1.71625	2012

Table 90. FS Region 2 allocation for primary service-3

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
2012	38.25	39.986	1.736	
2012	39.986	40.02	0.034	
2012	42	42.5	0.5	
1982-2012	47	50	3	
1982-2012	72	73	1	
1982-2012	74.6	74.8	0.2	
1982-2012	75.2	75.4	0.2	
1982-2012	75.4	76	0.6	
1968-2012	138	143.6	5.6	
1968-2012	143.6	143.65	0.05	
1968-2012	143.65	144	0.35	
1968-2012	148	149.9	1.9	
2012	150.05	154	3.95	
2012	154	156.4875	2.4875	
2008-2012	156.5625	156.7625	0.2	
2012	156.8375	161.9625	5.125	
2012	161.9875	162.0125	0.025	
2012	162.0375	174	11.962.	
1959-2012	216	220	4	
1982-2012	220	225	5	
1982-2012	225	235	10	
1996-2012	455	456	1	
1996-2012	459	460	1	
1982-2012	806	890	84	
1982-2012	890	902	12	
1982-2012	902	928	26	
1982-2012	928	942	14	
1959-2012	942	960	18	
1994-2012	1429	1452	23	
1994-2012	1452	1492	40	
2004-2012	1492	1518	26	
2004-2012	1518	1525	7	
1971-2012	1700	1710	10	
1994-2012	1930	1970	40	
1996-2012	2010	2025	15	
1996-2012	2120	2160	40	
1994-2012	2160	2170	10	
1990-2012	2300	2450	150	
1990-2012	2450	2483.5	33.5	
1990-2012	2483.5	2500	16.5	
1994-2012	2500	2520	20	
1994-2012	2520	2655	135	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
1982-2012	3400	3500	100	
1959-2012	3500	3700	200	
1959-2012	3700	4200	500	
1982-2012	5850	5925	75	

Table 91. FS Region 2 allocation for primary service-4

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1971	10.95	11.2	0.25	1982
1971	11.7	12.2	0.5	1982
1971	12.2	12.5	0.3	1982
1971	12.5	12.75	0.25	1982
1971	22.5	23	0.5	1982
1982	12.1	12.3	0.2	1986
1982	12.3	12.7	0.4	1986
1982	22.5	22.55	0.05	1994
1982	22.55	23	0.45	1994
1998	40.5	42.5	2	2001
1982-2012	10.5	10.55	0.05	
1982-2012	10.7	11.7	1	
1982-2012	11.7	12.1	0.4	
1986-2012	12.2	12.7	0.5	
1986-2012	12.7	12.75	0.05	
1994-2012	17.7	17.8	0.1	
1994-2012	17.8	18.1	0.3	
1994-2012	18.6	18.8	0.2	
1994-2012	21.4	22	0.6	
1982-2012	27	27.5	0.5	
2001-2012	40.5	41	0.5	
2004-2012	47.5	47.9	0.4	
2004-2012	48.2	50.2	2	

Table 92. FS American region/Region 2 allocation for shared/secondary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1938	27000	27500	500	1947
1938	30000	41000	11000	1947
1938	60000	66000	6000	1947
1938	72000	78000	6000	1947
1938	90000	96000	6000	1947
1938	108000	112000	4000	1947
1938	118000	123000	5000	1947
1938	132000	156000	24000	1947
1938	168000	180000	12000	1947
1938	192000	204000	12000	1947
1938	216000	224000	8000	1947
1938	230000	234000	4000	1947
1938	246000	258000	12000	1947
1938	270000	282000	12000	1947
1938	294000	300000	6000	1947
1947	70	90	20	1959
1947	110	130	20	1959
1947	130	150	20	1959
1947	150	160	10	1959
1947	1605	1800	195	1959
1947	1800	2000	200	1959
1947	2000	2065	65	1959
1947	2105	2300	195	1959
1947	2300	2495	195	1959
1947	2505	2850	345	1959
1947	3500	4000	500	1959
1947	4438	4650	212	1959
1947	4750	4850	100	1959
1947	5250	5450	200	1959
1938	27500	28000	500	1959
1959	90	110	20	1982

Table 93. FS Region 2 allocation shared/secondary services-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1947	29.7	44	14.3	1959
1947	44	50	6	1959
1947	54	72	18	1959
1947	72	76	4	1959
1947	76	88	12	1959
1947	132	144	12	1959
1947	148	174	26	1959
1947	174	216	42	1959
1947	216	220	4	1959
1947	225	235	10	1959
1947	450	460	10	1959
1947	3500	3900	400	1959
1959	1435	1535	100	1968
1968	1525	1535	10	1982
1982	1530	1535	5	1990
1959	2300	2450	150	1990
1968	1435	1525	90	1990
1990	1530	1533	3	1998
1990	1533	1535	2	1998
1982	614	806	192	2012
1982-2012	54	68	14	
1982-2012	68	72	4	
1982-2012	76	88	12	
1982-2012	174	216	42	
1982-2012	470	512	42	
2012	614	698	84	
2012	698	806	108	
1982-2012	1525	1530	5	
1982-2012	1530	1535	5	
1982-2012	3300	3400	100	

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1994	21.4	22	0.6	1996

Table 94. FS Region 3 allocation for primary service-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1959	70	90	20	1982
1959	90	110	20	1982
1959	110	130	20	1982
1959	130	150	20	1982
1959	150	160	10	1982
1947	160	200	40	1982
1959	1605	1800	195	1982
1959	2505	2625	120	1982
1959	2625	2850	225	1982
1959	5250	5430	180	1982
1959	5430	5480	50	1982
1982	5730	5950	220	1994
1982	130	160	30	2008
1959	4438	4650	212	2012
1982-2012	72	84	12	
1982-2012	86	90	4	
1982-2012	110	112	2	
1982-2012	117.6	126	8.4	
1982-2012	129	130	1	
2008-2012	130	135.7	5.7	
2008-2012	135.7	137.8	2,1	
2008-2012	137.8	160	22.2	
1982-2012	160	190	30	
1982-2012	1606.5	1800	193.5	
1959-2012	1800	2000	200	
1959-2012	2000	2065	65	
1959-2012	2107	2170	63	
1959-2012	2194	2300	106	
1959-2012	2300	2495	195	
1982-2012	2505	2850	345	
1959-2012	3500	3900	400	
1959-2012	3950	4000	50	
2012	4438	4488	50	
2012	4488	4650	162	
1959-2012	4750	4850	100	
2012	5250	5275	25	
1982-2012	5450	5480	30	
1994-2012	5730	5900	170	
2012	9040	9305	265	
2012	9305	9355	50	
2012	9355	9400	45	
2012	13450	13550	100	
2012	16100	16200	100	
2012	24450	24600	150	
2012	24600	24890	290	
2012	26200	26350	150	
2012	26350	27500	1150	

Table 95. FS Region 3 allocation for primary service-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1959	137	144	7	1968
1959	148	170	22	1968
1959	1429	1535	106	1968
1959	1710	2290	580	1968
1959	5850	5925	75	1968
1959	132	136	4	1971
1968	136	137	1	1971
1959	2450	2550	100	1971
1968	5850	6425	575	1971
1968	8400	8500	0.1	1971
1959	27.5	28	0.5	1982
1959	41	44	3	1982
1959	44	50	6	1982
1959	68	70	2	1982
1959	70	74.6	4.6	1982
1959	75.4	78	2.6	1982
1959	78	80	2	1982
1959	80	87	7	1982
1968	150.05	170	19.95	1982
1959	170	174	4	1982
1959	174	216	42	1982
1959	225	235	10	1982
1968	1525	1535	10	1982
1968	1710	1770	60	1982
1968	1770	1790	20	1982
1968	1790	2290	500	1982
1971	2535	2550	15	1982
1968	4990	5000	10	1982
1971	2450	2500	50	1990
1968	1429	1525	96	1994
1982	1710	2290	580	1994
1959	2290	2300	10	1994
1971	2500	2535	35	1994
1971	2655	2690	35	1994
1994	2120	2160	40	1996
1994	1970	1980	10	1998
1971	8025	8175	150	1998
1971	8175	8215	40	1998
1971	8215	8400	185	1998
1994	1492	1525	33	2004
1994	1675	1690	15	2004
1982	150.05	156.7625	6.7125	2008
1982	3500	3700	200	2008
2008	150.05	156.4875	6.4375	2012
1982	156.8375	174	17.1625	2012

Table 96. FS Region 3 allocation for primary service-3

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
2012	38.25	39.5	1.25	
2012	39.5	39.986	0.486	
2012	39.986	40	0.014	
2012	40	40.02	0.02	
2012	42	42.5	0.5	
1982-2012	47	50	3	
1959-2012	54	68	14	
1982-2012	68	74.8	6.8	
1982-2012	75.2	75.4	0.2	
1982-2012	75.4	87	11.6	
1959-2012	87	100	13	
1968-2012	138	143.6	5.6	
1968-2012	143.6	143.65	0.05	
1968-2012	143.65	144	0.35	
1982-2012	146	148	2	
1968-2012	148	149.9	1.9	
2012	150.05	154	3.95	
2012	154	156.4875	2.4875	
2008-2012	156.5625	156.7625	0.2	
2012	161.9875	162.0125	25	
2012	162.0375	174	11.9625	
1982-2012	174	223	49	
1982-2012	223	230	7	
1982-2012	230	235	5	
1996-2012	455	456	1	
1996-2012	459	460	1	
1982-2012	470	585	115	
1982-2012	585	610	25	
1959-2012	610	890	280	
1959-2012	890	942	52	
1959-2012	942	960	18	
1994-2012	1429	1452	23	
1994-2012	1452	1492	40	
2004-2012	1492	1518	26	
2004-2012	1518	1525	7	
1982-2012	1525	1530	5	
1959-2012	1700	1710	10	
1994-2012	1930	1970	40	
1996-2012	2010	2025	15	
1996-2012	2120	2160	40	
1994-2012	2160	2170	10	
1982-2012	2300	2450	150	
1990-2012	2450	2483.5	33.5	
1990-2012	2483.5	2500	16.5	
1994-2012	2500	2520	20	
1994-2012	2520	2535	15	
1982-2012	2535	2655	120	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
1982-2012	3400	3500	100	
2008-2012	3500	3600	100	
2008-2012	3600	3700	100	
1959-2012	3700	4200	500	
1971-2012	5850	5925	75	

Table 97. FS Region 3 allocation for primary service-4

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1971	10.95	11.2	0.25	1982
1971	22.5	23	0.5	1982
1982	22.5	22.55	0.05	1994
1982	22.55	23	0.45	1994
1998	40.5	42.5	2	2001
1982-2012	10	10.45	0.45	
1982-2012	10.5	10.55	0.05	
1982-2012	10.7	11.7	1	
1971-2012	11.7	12.2	0.5	
1971-2012	12.2	12.5	0.3	
1971-2012	12.5	12.75	0.25	
1982-2012	14.3	14.4	0.1	
1994-2012	17.7	18.1	0.4	
1982-2012	18.6	18.8	0.2	
1994-2012	21.4	22	0.6	
1994-2012	24.25	24.45	0.2	
1994-2012	24.45	24.65	0.2	
1994-2012	24.65	24.75	0.1	
1994-2012	24.75	25.25	0.5	
1982-2012	27	27.5	0.5	
2001-2012	40.5	41	0.5	
2004-2012	47.5	47.9	0.4	
2004-2012	48.2	50.2	2	

Table 98. FS Other regions/Region 3 allocation for shared/secondary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1932	160	194	34	1938
1932	194	285	91	1938
1932	1500	1715	215	1938
1938	160	200	40	1947
1938	1500	1600	100	1947
1938	1600	1715	115	1947
1932	1715	2000	285	1947
1938	2000	2300	300	1947
1938	2300	2500	200	1947
1938	2500	3300	800	1947
1938	3300	3500	200	1947
1938	3500	4000	500	1947
1938	4000	4770	770	1947
1938	4770	4965	195	1947
1938	4965	5500	535	1947
1947	70	90	20	1959
1947	110	130	20	1959
1947	130	150	20	1959
1947	150	160	10	1959
1947	1605	1800	195	1959
1947	1800	2000	200	1959
1947	2000	2065	65	1959
1947	2105	2300	195	1959
1947	2300	2495	195	1959
1947	2505	2850	345	1959
1947	3500	3900	400	1959
1947	3950	4000	50	1959
1947	4438	4650	212	1959
1947	4750	4850	100	1959
1947	5250	5430	180	1959
1947	5430	5480	50	1959
1947	27500	28000	500	1959
1982-2012	70	72	2	
1982-2012	84	86	2	
1982-2012	112	117.6	5.6	
1982-2012	126	129	3	

Table 99. FS Region 3 allocation for secondary service-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1947	29.7	31.7	2	1959
1947	31.7	44	12.3	1959
1947	44	50	6	1959
1947	54	68	14	1959
1947	70	78	8	1959
1947	80	87	7	1959
1947	132	144	12	1959
1947	148	170	22	1959
1947	170	200	30	1959
1947	1300	1700	400	1959
1947	3300	3900	600	1959
1947	5850	5925	75	1959
1959	2300	2450	150	1982
1959	3500	3700	200	1982
1982	1530	1535	5	1990
1990	1530	1533	3	1998
1990	1533	1535	2	1998
1998-2012	1530	1535	5	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1968-2012	31.5	31.8	0.3	

Appendix F Fixed-satellite service geographic frequency allocations

Table 100. FSS Global allocation for primary service-1

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	4400	4700	300	1982
1971	5925	6425	500	1982
1982	5925	7075	1150	1996
1976	7900	7975	75	2001
1971	7975	8025	50	2001
1982-2012	4500	4800	300	
1996-2012	5150	5250	100	
1996-2012	5925	6700	775	
1996-2012	6700	7075	375	
1971-2012	7250	7300	50	
1971-2012	7300	7450	150	
1971-2012	7450	7550	100	
1971-2012	7550	7750	200	
2001-2012	7900	8025	125	
1998-2012	8025	8175	150	
1998-2012	8175	8215	40	
1998-2012	8215	8400	185	

Table 101. FSS Global allocation for primary service-2

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1971	11.45	11.7	0.25	1982
1971	14	14.3	0.3	1982
1971	14.3	14.4	0.1	1982
1971	14.4	14.5	0.1	1982
1971	17.7	19.7	2	1982
1971	19.7	21.2	1.5	1982
1971	29.5	31	1.5	1982
1971	40	41	1	1982
1971	50	51	1	1982
1971	140	142	2	1982
1971	150	152	2	1982
1971	220	230	10	1982
1982	17.3	17.7	0.4	1994
1982	18.1	18.6	0.5	1994
1982	19.7	20.2	0.5	1994
1971	27.5	29.5	2	1994
1982	29.5	30	0.5	1994
1982	37.5	39.5	2	1994
1982	39.5	40.5	1	1994
1982	151	164	13	1994
1982	17.7	18.1	0.4	1996
1982	18.8	19.7	0.9	1996
1994	28.5	29.5	1	1996
1996	15.4	15.7	0.3	1998
1982	74	75.5	1.5	2001
1971	92	95	3	2001
1971	102	105	3	2001
1982	149	150	1	2001
1982	150	151	1	2001
1994	151	156	5	2001
1994	156	158	2	2001
1994	158	164	6	2001
1982	202	217	15	2001
1982	231	235	4	2001
1982	238	241	3	2001
1982	47.2	50.2	3	2004

Table 102. FSS Global allocation for primary service-3

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1982-2012	12.75	13.25	0.5	
1994-2012	13.75	14	0.25	
1982-2012	14	14.25	0.25	
1982-2012	14.25	14.3	0.05	
1982-2012	14.4	14.47	0.07	
1982-2012	14.47	14.5	0.03	
1982-2012	14.5	14.8	0.3	
2001-2012	15.43	15.63	0.2	
1994-2012	18.1	18.4	0.3	
1994-2012	18.4	18.6	0.2	
1996-2012	18.8	19.3	0.5	
1996-2012	19.3	19.7	0.4	
1994-2012	20.1	20.2	0.1	
1982-2012	20.2	21.2	0.1	
1994-2012	27.5	28.5	1	
1996-2012	28.5	29.1	0.6	
1996-2012	29.1	29.5	0.4	
1994-2012	29.9	30	0.1	
1982-2012	30	31	1	
1994-2012	37.5	38	0.5	
1994-2012	38	39.5	1.5	
1994-2012	39.5	40	0.5	
1996-2012	40	40.5	0.5	
2004-2012	41	42.5	0.15	
1982-2012	42.5	43.5	1	
2004-2012	47.2	47.5	0.3	
2004-2012	47.9	48.2	0.3	
1982-2012	50.4	51.4	1	
1982-2012	71	74	3	
2001-2012	74	76	2	
1982-2012	81	84	3	
2001-2012	84	86	2	
2001-2012	123	130	7	
2001-2012	158.5	164	5.5	
2001-2012	167	174.5	7.5	
2001-2012	209	217	8	
2001-2012	217	226	9	
2001-2012	232	235	3	
1982-2012	235	238	3	
2001-2012	238	240	2	
1971-2012	265	275	10	

Table 103. FSS Region 1 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	5725	5850	125	1996
1971	8025	8175	150	1996
1971	8175	8215	40	1996
1971	8215	8400	185	1996
1971-2012	3400	3600	200	
1971-2012	3600	4200	600	
1996-2012	5725	5830	105	
1996-2012	5830	5850	20	
1971-2012	5850	5925	75	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1971	10.95	11.2	0.25	1982
1982-2012	10.7	11.7	1	
1971-2012	12.5	12.75	0.25	
1982-2012	14.3	14.4	0.1	
1994-2012	17.3	17.7	0.4	
1994-2012	17.7	18.1	0.4	
1982-2012	18.6	18.8	0.2	
1994-2012	19.7	20.1	0.4	
2012	24.65	24.75	0.1	
2012	24.75	25.25	0.5	
1994-2012	29.5	29.9	0.4	
2001-2012	40.5	41	0.5	
2004-2012	47.5	47.9	0.4	
2004-2012	48.2	48.54	0.34	
2004-2012	48.54	49.44	0.9	
2004-2012	49.44	50.2	0.76	

Table 104. FSS Region 2 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	2500	2535	35	1982
1971	2655	2690	35	1994
1971	8025	8175	150	1998
1971	8175	8215	40	1998
1971	8215	8400	185	1998
1994-2012	2500	2520	20	
1982-2012	2500	2655	155	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
1994-2012	3400	3500	100	
1971-2012	3500	3700	200	
1971-2012	3700	4200	500	
1982-2012	5850	5925	75	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1971	10.95	11.2	0.25	1982
1971	11.7	12.2	0.5	1982
1971	12.5	12.75	0.25	1982
1982	12.1	12.3	0.2	1986
1998	40.5	42.5	0.2	2001
1982-2012	10.7	11.7	1	
1982-2012	11.7	12.1	0.4	
1986-2012	12.1	12.2	0.1	
1982-2012	12.7	12.75	0.05	
1982-2012	14.3	14.4	0.1	
1994-2012	17.3	17.7	0.4	
1994-2012	17.7	17.8	0.1	
1994-2012	17.8	18.1	0.3	
1982-2012	18.6	18.8	0.2	
1994-2012	19.7	20.1	0.4	
1994-2012	24.75	25.25	0.5	
1982-2012	27	27.5	0.5	
1994-2012	29.5	29.9	0.4	
2001-2012	40.5	41	0.5	
2004-2012	47.5	47.9	0.4	
2004-2012	48.2	50.2	2	

Table 105. FSS Region 3 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	2500	2535	35	1994
1971	2655	2690	35	1994
1971	8025	8175	150	1998
1971	8175	8215	40	1998
1971	8215	8400	185	1998
1971	3500	3700	200	2008
1994-2012	2500	2520	20	
1994-2012	2520	2535	15	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
1971-2012	3400	3500	100	
2008-2012	3500	3600	100	
2008-2012	3600	3700	100	
1971-2012	3700	4200	500	
1971-2012	5850	5925	75	

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1971	10.95	11.2	0.25	1982
1998	40.5	42.5	2	2001
1982-2012	10.7	11.7	1	
2004-2012	12.2	12.5	0.3	
1971-2012	12.5	12.75	0.25	
1982-2012	14.3	14.4	0.1	
1994-2012	17.3	17.7	0.4	
1994-2012	17.7	18.1	0.4	
1982-2012	18.6	18.8	0.2	
1994-2012	19.7	20.1	0.4	
2012	24.65	24.75	0.1	
1994-2012	24.75	25.25	0.5	
1982-2012	27	27.5	0.5	
1994-2012	29.5	29.9	0.4	
2001-2012	40.5	41	0.5	
2004-2012	47.5	47.9	0.4	
2004-2012	48.2	50.2	2	

Appendix G Mobile service geographic frequency allocations

Table 106. MS Global allocation for exclusive/primary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1927	315	350	35	1932
1927	350	360	10	1932
1927	390	460	70	1932
1927	485	515	30	1932
1927	515	550	35	1932
1927	1500	1715	215	1932
1927	2250	2750	500	1932
1927	5500	5700	200	1938
1927	6150	6675	525	1938
1932	24600	25600	1000	1938
1927	110	125	15	1947
1927	150	160	10	1947
1932	400	460	60	1947
1927	460	485	25	1947
1932	485	515	30	1947
1938	5500	5640	140	1947
1938	6200	6675	475	1947
1927	8200	8550	350	1947
1927	11000	11400	400	1947
1927	12300	12825	525	1947
1927	16400	17100	700	1947
1927	21550	22300	750	1947
1938	24600	25000	400	1947
1938	25000	25600	600	1947
1947	490	510	20	1982
1959	2170	2194	24	1982
1959	25110	25600	490	1990
1959	26100	27500	1400	1990
1982	495	505	10	2012
1982	5250	5450	200	2012
1990	26175	27500	1325	2012

Table 107. MS Global allocation for primary service-2

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
2012	479	505	26	
1982-2012	2173.5	2190.5	17	
1959-2012	3155	3200	45	
1959-2012	3200	3230	30	
1959-2012	3230	3400	170	
2012	5275	5450	175	
2004-2012	6765	7000	235	
1982-2012	23350	24000	650	
2004-2012	23350	24000	650	
1959-2012	25010	25070	60	
1990-2012	25210	25550	340	
2012	26175	26200	25	

Table 108. MS Global allocation for primary service-3

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1959	29.7	41	11.3	1968
1959	136	137	1	1968
1959	235	328.6	93.6	1968
1959	335.4	400	64.6	1968
1959	450	470	20	1968
1959	1660	1700	40	1968
1959	2550	2700	150	1968
1959	4400	5000	600	1968
1959	5925	8400	2475	1968
1959	8400	8500	100	1968
1959	406	420	14	1971
1968	2550	2690	140	1971
1968	7300	7750	450	1971
1968	7750	7900	150	1971
1968	8025	8400	375	1971
1968	30.01	37.75	7.74	1982
1968	38,25	41	2.75	1982
1968	273	328.6	55.6	1982
1971	2550	2655	105	1982
1968	4400	4700	300	1982
1968	4700	4990	290	1982
1968	5925	6425	500	1982
1968	6425	7250	825	1982
1968	37.75	38.25	0.5	1990
1982	273	322	49	1994
1968	335.4	399.9	64.5	1994
1968	1670	1690	20	1994
1968	7900	7975	75	1994
1982	7975	8025	50	1994
1968	450	460	10	1996
1994	2010	2025	15	1996
1982	5925	7075	1150	1996
1971	7750	7900	150	1998
1982	7075	7250	175	2004
1982	41.015	44	2.985	2012
1998	7750	7850	100	2012
1998	7850	7900	50	2012

Table 109. MS Global allocation for primary service-4

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1982-2012	27.5	28	0.5	
1968-2012	29.7	30.005	0.305	
1968-2012	30.005	30.01	0.05	
1982-2012	30.01	37.5	7.49	
1990-2012	37.5	38.25	0.75	
1982-2012	38.25	39.986	1.736	
1982-2012	39.986	40.02	0.034	
1982-2012	40.02	40.98	0.96	
1982-2012	40.98	41.015	0.035	
2012	41.015	42	0.985	
2012	42.5	44	1.5	
1982-2012	44	47	3	
1968-2012	235	267	32	
1968-2012	267	272	5	
1968-2012	272	273	1	
1994-2012	273	312	39	
1994-2012	312	315	3	
1994-2012	315	322	7	
1982-2012	322	328.6	6.6	
1994-2012	335.4	387	51.6	
1994-2012	387	390	3	
1994-2012	390	399.9	9.9	
1971-2012	406.1	410	3.9	
1971-2012	410	420	10	
1982-2012	420	430	10	
1982-2012	440	450	10	
1996-2012	450	455	5	
1996-2012	456	459	3	
1968-2012	460	470	10	
1959-2012	1427	1429	2	
1982-2012	1668.4	1670	1.6	
1994-2012	1670	1675	5	
2004-2012	1675	1690	15	
1994-2012	1710	1930	220	
1998-2012	1970	1980	10	
1994-2012	1980	2010	30	
1994-2012	2025	2110	85	
1994-2012	2110	2120	10	
1994-2012	2170	2200	30	
1994-2012	2200	2290	90	
1994-2012	2290	2300	10	
1982-2012	4400	4500	100	
1982-2012	4500	4800	300	
1982-2012	4800	4990	190	
1982-2012	4990	5000	10	
2004-2012	5150	5250	100	
2004-2012	5250	5255	5	
2004-2012	5255	5350	95	
2004-2012	5470	5570	100	
2004-2012	5570	5650	80	
2004-2012	5650	5725	75	
1996-2012	5925	6700	775	
1996-2012	6700	7075	375	
2004-2012	7075	7145	70	
2004-2012	7145	7235	90	
2004-2012	7235	7250	15	

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1982-2012	7250	7300	50	
1971-2012	7300	7450	150	
1971-2012	7450	7550	100	
1971-2012	7550	7750	200	
2012	7750	7900	150	
1994-2012	7900	8025	125	
2001-2012	8025	8175	150	
2001-2012	8175	8215	40	
2001-2012	8215	8400	185	
1971-2012	8400	8500	100	

Table 110. MS Global allocation for primary service-5

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1959	10.55	10.7	0.15	1968
1959	14.4	15.15	0.75	1968
1959	15.25	15.4	0.15	1968
1959	17.7	21	3.3	1968
1959	25.25	31.5	6.25	1968
1968	10.55	10.68	0.13	1971
1959	10.7	11.7	1	1971
1959	11.7	12.7	1	1971
1959	12.7	13.25	0.55	1971
1968	14.4	15.25	0.85	1971
1968	17.7	19.3	1.6	1971
1968	19.4	21	1.6	1971
1959	22	23	1	1971
1968	25.25	31	5.75	1971
1971	10.7	10.95	0.25	1982
1971	11.2	11.45	0.25	1982
1971	11.45	11.7	0.25	1982
1971	14.4	14.5	0.1	1982
1971	14.5	15.35	0.85	1982
1971	17.7	19.7	2	1982
1971	21.2	22	0.8	1982
1971	22	22.5	0.5	1982
1971	23	23.6	0.6	1982
1971	25.25	27.5	2.25	1982
1959	36	40	4	1982
1982	17.7	18.1	0.4	1994
1982	18.1	18.6	0.5	1994
1982	21.4	22	0.6	1994
1982	25.25	27	1.75	1994
1971	27.5	29.5	2	1994
1982	37.5	39.5	2	1994
1982	151	164	13	1994
1982	18.8	19.7	0.9	1996
1994	28.5	29.5	1	1996
1982	116	126	10	1996
1994	22.55	23	0.45	1998
1982	23	23.55	0.55	1998
1982	50.2	50.4	0.2	1998
1982	54.25	58.2	3.95	1998
1982	59	64	5	1998
1982	92	95	3	1998
1982	74	75.5	1.5	2001
1996	116	119.98	3.98	2001
1996	119.98	120.02	0.04	2001
1996	120.02	126	5.98	2001
1982	126	134	8	2001
1982	134	142	8	2001
1982	149	150	1	2001
1982	150	151	1	2001
1994	151	156	5	2001
1994	156	158	2	2001
1994	158	164	6	2001
1982	168	170	2	2001
1982	170	174.5	4.5	2001
1982	174.5	176.5	2	2001
1982	176.5	182	5.5	2001

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1982	185	190	5	2001
1982	190	200	10	2001
1982	200	202	2	2001
1982	202	217	15	2001
1982	231	235	4	2001
1982	235	238	3	2001
1982	238	241	3	2001
1982	100	102	2	2001
1982	47.2	50.2	3	2004
1998	22.55	23.55	1	2012

Table 111. MS Global allocation for primary service-6

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1971-2012	10.55	10.6	0.05	
1971-2012	10.6	10.68	0.08	
1971-2012	12.75	13.25	0.5	
1982-2012	14.4	14.47	0.07	
1982-2012	14.47	14.5	0.03	
1982-2012	14.5	14.8	0.3	
1982-2012	14.8	15.35	0.55	
1994-2012	18.1	18.4	0.3	
1994-2012	18.4	18.6	0.2	
1996-2012	18.8	19.3	0.5	
1996-2012	19.3	19.7	0.4	
1982-2012	21.2	21.4	0.2	
1982-2012	22	22.21	0.21	
1982-2012	22.21	22.5	0.29	
1994-2012	22.5	22.55	0.05	
2012	22.55	23.15	0.6	
2012	23.15	23.55	0.4	
1982-2012	23.55	23.6	0.05	
1994-2012	25.25	25.5	0.25	
1994-2012	25.5	27	1.5	
1994-2012	27.5	28.5	1	
1996-2012	28.5	29.1	0.6	
1996-2012	29.1	29.5	0.4	
1968-2012	31	31.3	0.3	
1982-2012	36	37	1	
1982-2012	37	37.5	0.5	
1994-2012	37.5	38	0.5	
1994-2012	38	39.5	1.5	
1994-2012	39.5	40	0.5	
1982-2012	40	40.5	0.5	
1982-2012	42.5	43.5	1	
1982-2012	43.5	47	3.5	
2004-2012	47.2	47.5	0.3	
2004-2012	47.9	48.2	0.3	
1982-2012	50.4	51.4	1	
1998-2012	51.4	52.6	1.2	
1998-2012	55.78	56.9	1.12	
1998-2012	56.9	57	0.1	
1998-2012	57	58.2	1.2	
1998-2012	58.2	59	0.80	
1998-2012	59	59.3	0.3	
1998-2012	59.3	64	4.7	
1998-2012	64	65	1	
1998-2012	65	66	1	
1982-2012	66	71	5	
1982-2012	71	74	3	
2001-2012	74	76	2	
1982-2012	81	84	3	
1982-2012	84	86	2	
1998-2012	92	94	2	
1998-2012	94.1	95	0.9	
1982-2012	95	100	5	
1982-2012	102	105	3	
2001-2012	105	109.5	4.5	
2001-2012	111.8	114.25	2.45	
2001-2012	122.25	123	0.75	

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
2001-2012	130	134	4	
2001-2012	141	148.5	7.5	
2001-2012	151.5	155.5	4	
2001-2012	155.5	158.5	3	
2001-2012	158.5	164	5.5	
2001-2012	167	174.5	7.5	
2001-2012	174.5	174.8	0.3	
2001-2012	191.8	200	8.2	
2001-2012	209	217	8	
2001-2012	217	226	9	
2001-2012	231.5	232	0.5	
2001-2012	232	235	3	
2001-2012	238	240	2	
2001-2012	240	241	1	
1982-2012	252	265	13	
1982-2012	265	275	10	

Table 112. MS Global allocation for share/secondary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1927	160	194	34	1932
1927	194	285	91	1932
1927	360	390	30	1932
1927	1715	2000	285	1932
1927	2000	2250	250	1932
1927	2850	3500	650	1932
1927	22300	23000	700	1932
1932	365	385	20	1938
1932	2000	3500	1500	1938
1927	3500	4000	500	1938
1927	100	110	10	1947
1938	365	380	15	1947
1932	550	1500	950	1947
1927	4000	5500	1500	1947
1927	8550	8900	350	1947
1927	12825	13350	525	1947
1927	17100	17750	650	1947
1932	22300	24600	2300	1947
1947	3155	3200	45	1959
1947	3200	3230	30	1959
1947	3230	3400	170	1959
1947	4850	4995	145	1959
1947	23350	24990	1640	1959
1947	25010	25600	590	1959
1947	26100	27500	1400	1959
1982	13410	13600	190	1994
1982	13800	14000	200	1994
1994	13410	13570	160	2012
1982-2012	5060	5250	190	
1982-2012	10150	11175	1025	
2012	13410	13450	40	
2012	13550	13570	20	
1994-2012	13870	14000	130	
1982-2012	14350	14990	640	
1994-2012	18168	18780	612	
1982-2012	20010	21000	990	
1982-2012	23000	23200	200	

Table 113. MS Global allocation for share/secondary services-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1947	235	328.6	93.6	1959
1947	335.4	420	84.6	1959
1947	460	470	10	1959
1947	1700	2300	600	1959
1947	2450	2700	250	1959
1947	3900	4200	300	1959
1947	4400	5000	600	1959
1947	5925	8500	2575	1959
1959	401	406	5	1968
1968	402	406	4	1971
1982	137	138	1	1994
1982	136	137	1	2001
1982	1660.5	1668.4	7.9	2004
1994-2012	137	137.025	0.025	
1994-2012	137.025	137.175	0.015	
1994-2012	137.175	137.825	0.65	
1994-2012	137.825	138	0.175	
1968-2012	401	402	1	
1971-2012	402	403	1	
1971-2012	403	406	3	
2004-2012	1660.5	1668	7.5	
2004-2012	1668	1668.4	0.4	

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1959	15.15	15.25	0.1	1968
1959	31.5	31.8	0.3	1968
1982	40.5	42.5	0.2	1998
1982	65	66	1	1998
2001-2012	41	42.5	1.5	

Table 114. MS EU region/Region 1 allocation for exclusive/primary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1932	1530	1630	100	1938
1938	1560	1600	40	1947
1938	1670	1715	45	1947
1938	25000	25600	600	1947
1938	157000	162000	5000	1947
1959	405	415	10	1982
1959	1605	2000	395	1982
1959	2000	2045	45	1982
1959	2045	2065	20	1982
1959	2065	2170	105	1982
1959	4438	4650	212	2012
1982-2012	1850	2000	150	
1982-2012	2000	2025	25	
1982-2012	2025	2045	20	
1959-2012	2194	2300	106	
1959-2012	2300	2498	198	
1959-2012	2502	2625	123	
1959-2012	2650	2850	200	
1959-2012	3500	3800	300	
2012	4438	4488	50	
2012	4488	4650	162	
2012	5250	5275	25	
2012	26200	26350	150	
2012	26350	27500	1150	

Table 115. MS Region 1 allocation for primary service-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1959	146	151	5	1968
1959	1429	1535	106	1968
1968	136	137	1	1971
1959	2450	2550	100	1971
1968	8400	8500	100	1971
1959	151	154	3	1976
1947	100	108	8	1982
1968	150.05	151	0.95	1982
1976	151	153	2	1982
1976	153	154	1	1982
1959	154	156	2	1982
1959	156	174	18	1982
1959	420	430	10	1982
1959	440	450	10	1982
1971	2500	2550	50	1982
1959	3400	3600	200	1982
1968	4990	5000	10	1982
1971	2450	2500	50	1990
1968	146	149.9	3.9	1994
1968	1429	1525	96	1994
1982	2500	2655	155	1994
1971	2655	2690	35	1994
1994	1970	1980	10	1998
1971	8025	8175	150	1998
1971	8175	8215	40	1998
1971	8215	8400	185	1998
1994	1492	1525	33	2004
1994	1675	1690	15	2004
1982	154	156.7625	2.7625	2008
1982	156.8375	174	17.1625	2012
2012	38.25	39	0.75	
2012	39	39.5	0.5	
2012	39.5	39.986	0.486	
2012	39.986	40.02	0.034	
2012	42	42.5	0.5	
1959-2012	68	74.8	6.8	
1959-2012	75.2	87.5	12.3	
1994-2012	146	148	2	
1994-2012	148	149.9	1.9	
1982-2012	150.05	153	2.95	
1982-2012	153	154	1	
2008-2012	154	156.4875	2.4875	
2008-2012	156.5625	156.7625	0.2	
2012	156.8375	161.9625	5.125	
2012	161.9625	161.9875	0.025	
2012	161.9875	162.0125	0.025	
2012	162.0125	162.0375	0.025	
2012	162.0375	174	11.9625	
1982-2012	230	235	5	
1996-2012	455	456	1	
1996-2012	459	460	1	
2008-2012	790	862	72	
1982-2012	862	890	28	
1982-2012	890	942	52	
1982-2012	942	960	18	
1959-2012	1350	1400	50	
1994-2012	1429	1452	23	

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1994-2012	1452	1492	40	
2004-2012	1492	1518	26	
2004-2012	1518	1525	7	
1994-2012	1700	1710	10	
1994-2012	1930	1970	40	
1996-2012	2010	2025	15	
1994-2012	2120	2160	40	
1994-2012	2160	2170	10	
1994-2012	2300	2450	150	
1990-2012	2450	2483.5	33.5	
1990-2012	2483.5	2500	16.5	
1994-2012	2500	2520	20	
1994-2012	2520	2655	135	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
1959-2012	5850	5925	75	

Table 116. MS Region 1 allocation for primary service-3

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1971	10.95	11.2	0.25	1982
1976	11.7	12.5	0.8	1982
1971	22.5	23	0.5	1982
1982	22.5	22.55	0.05	1994
1982	22.55	23	0.45	1994
1994	11.7	12.5	0.8	1996
1982-2012	10	10.45	0.45	
1959-2012	10.5	10.55	0.05	
1982-2012	10.7	11.7	1	
1998-2012	11.7	12.5	0.8	
1982-2012	14.3	14.4	0.1	
1994-2012	17.7	18.1	0.4	
1982-2012	18.6	18.8	0.2	
1994-2012	21.4	22	0.6	
1982-2012	27	27.5	0.5	
2004-2012	47.5	47.9	0.4	
2004-2012	48.2	48.54	0.34	
2004-2012	48.54	49.44	0.9	
2004-2012	49.44	50.2	0.76	

Table 117. MS EU region/Region 1 allocation for share/secondary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1932	1500	1530	30	1938
1932	1715	1925	210	1938
1938	2660	2810	150	1947
1938	2860	2900	40	1947
1938	2930	3065	135	1947
1938	3095	3245	150	1947
1938	3305	3500	195	1947
1938	3500	3635	135	1947
1938	3685	3950	265	1947
1938	4000	4480	480	1947
1938	4530	5500	970	1947
1938	40000	40500	500	1947
1947	1605	2000	395	1959
1947	2000	2045	45	1959
1947	2065	2300	235	1959
1947	2300	2498	198	1959
1947	2502	2625	123	1959
1947	2650	2850	200	1959
1947	3500	3800	300	1959
1947	3800	3900	100	1959
1947	4750	4850	100	1959
1947	5250	5430	180	1959
1947	5430	5480	50	1959
2012	13450	13550	100	

Table 118. MS Region 1 allocation for share/secondary services-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1947	31.7	41	9.3	1959
1947	70	72.8	2.8	1959
1947	75.2	78	2.8	1959
1947	80	83	3	1959
1947	85	87.5	2.5	1959
1947	156	174	18	1959
1947	1300	1600	300	1959
1947	3300	3900	600	1959
1947	5850	5925	75	1959
1959	1710	2290	580	1968
1959	41	47	6	1982
1959	223	235	12	1982
1968	1525	1535	10	1982
1968	1710	1770	60	1982
1968	1770	1790	20	1982
1968	1790	2290	500	1982
1982	1530	1535	5	1990
1959	1700	1710	10	1994
1982	1710	2290	580	1994
1959	2290	2300	10	1994
1959	2300	2450	150	1994
1990	1530	1533	3	2001
1990	1533	1535	2	2001
1982-2012	223	230	7	
1982-2012	1525	1530	5	
2001-2012	1530	1535	5	
1968-2012	1690	1700	10	
1982-2012	3400	3600	200	
1959-2012	3600	4200	600	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1982	11.7	12.5	0.8	1994
1996	11.7	12.5	0.8	1998
1998	40.5	42.5	2	2001
1968-2012	31.5	31.8	0.3	
2001-2012	40.5	41	0.5	

Table 119. MS Region 2 allocation for exclusive/primary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1947	525	535	10	1982
1959	1605	1800	195	1982
1959	1800	2000	200	1982
1959	2505	2625	120	1982
1959	2625	2850	225	1982
1959	3500	4000	500	1982
1982	5730	5950	220	1994
1947	510	525	15	2012
1959	4438	4650	212	2012
1982-2012	1625	1705	80	
1982-2012	1705	1800	95	
1982-2012	1850	2000	150	
1959-2012	2000	2065	65	
1959-2012	2107	2170	63	
1959-2012	2194	2300	106	
1959-2012	2300	2495	195	
1982-2012	2505	2850	345	
1982-2012	3750	4000	250	
2012	4438	4488	50	
2012	4488	4650	162	
1982-2012	4750	4850	100	
2012	5250	5275	25	
1994-2012	5730	5900	170	
2004-2012	7400	7450	50	
2012	26200	26420	220	
2012	26420	27500	1080	

Table 120. MS Region 2 allocation for primary service-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1959	68	74.6	6.6	1968
1959	137	144	7	1968
1959	148	174	26	1968
1959	1435	1535	100	1968
1959	1700	1710	10	1968
1959	1710	2290	580	1968
1959	2290	2300	10	1968
1959	132	136	4	1971
1959	2450	2550	100	1971
1959	27.5	28	0.5	1982
1959	41	50	9	1982
1959	54	68	14	1982
1968	68	73	5	1982
1959	75.4	88	12.6	1982
1968	150.05	174	23.95	1982
1959	174	216	42	1982
1959	216	220	4	1982
1968	1710	1770	60	1982
1968	1770	1790	20	1982
1968	1790	2290	500	1982
1971	2500	2535	35	1982
1971	2535	2550	15	1982
1959	1429	1435	6	1990
1968	1435	1525	90	1990
1971	2450	2500	50	1990
1990	1429	1525	96	1994
1982	1710	2290	580	1994
1971	2290	2300	10	1994
1982	2500	2655	155	1994
1971	2655	2690	35	1994
1994	1970	1980	10	1998
1971	8025	8175	150	1998
1971	8175	8215	40	1998
1971	8215	8400	185	1998
1994	1492	1525	33	2004
1994	1675	1690	15	2004
1982	150.05	156.7625	6.7125	2008
2008	150.05	156.4875	6.4375	2012
1982	156.8375	174	17.1625	2012

Table 121. MS Region 2 allocation for primary service-3

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
2012	38.25	39.986	1.736	
2012	39.986	40.02	0.034	
2012	42	42.5	0.5	
1982-2012	47	50	3	
1982-2012	72	73	1	
1982-2012	74.6	74.8	0.2	
1982-2012	75.2	75.4	0.2	
1982-2012	75.4	76	0.6	
1968-2012	138	143.6	5.6	
1968-2012	143.6	143.65	0.05	
1968-2012	143.65	144	0.35	
1968-2012	148	149.9	1.9	
2012	150.05	154	3.95	
2012	154	156.4875	2.4875	
2008-2012	156.5625	156.7625	0.2	
2012	156.8375	161.9625	5.125	
2012	161.9875	162.0125	0.25	
2012	162.0375	174	11.9625	
1982-2012	220	225	5	
1959-2012	225	235	10	
1996-2012	455	456	1	
1996-2012	459	460	1	
2012	698	806	108	
1982-2012	806	890	84	
1982-2012	890	902	12	
1982-2012	928	942	14	
1994-2012	942	960	18	
1994-2012	1429	1452	23	
1994-2012	1452	1492	40	
2004-2012	1492	1518	26	
2004-2012	1518	1525	7	
1971-2012	1700	1710	10	
1994-2012	1930	1970	40	
1996-2012	2010	2025	15	
1994-2012	2120	2160	40	
1994-2012	2160	2170	10	
1990-2012	2300	2450	150	
1990-2012	2450	2483.5	33.5	
1990-2012	2483.5	2500	16.5	
1994-2012	2500	2520	20	
1994-2012	2520	2655	135	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
1959-2012	3500	3700	200	
1959-2012	3700	4200	500	
1982-2012	5850	5925	75	

Table 122. MS Region 2 allocation for primary service-4

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1971	10.95	11.2	0.25	1982
1971	11.7	12.2	0.5	1982
1971	12.2	12.5	0.3	1982
1971	12.5	12.75	0.25	1982
1971	22.5	23	0.5	1982
1982	12.1	12.3	0.2	1986
1982	12.3	12.7	0.4	1986
1982	22.5	22.55	0.05	1994
1982	22.55	23	0.45	1994
1982-2012	10.5	10.55	0.05	
1982-2012	10.7	11.7	1	
1986-2012	12.2	12.7	0.5	
1982-2012	12.7	12.75	0.05	
1994-2012	17.8	18.1	0.3	
1982-2012	18.6	18.8	0.2	
1996-2012	21.4	22	0.6	
1982-2012	27	27.5	0.5	
2004-2012	47.5	47.9	0.4	
2004-2012	48.2	50.2	2	

Table 123. American Region/MS Region 2 allocation for share/secondary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1938	27000	27500	500	1947
1938	30000	41000	11000	1947
1938	60000	66000	6000	1947
1938	72000	78000	6000	1947
1938	90000	96000	6000	1947
1938	108000	112000	4000	1947
1938	118000	123000	5000	1947
1938	132000	156000	24000	1947
1938	168000	180000	12000	1947
1938	192000	204000	12000	1947
1938	216000	224000	8000	1947
1938	230000	234000	4000	1947
1938	246000	258000	12000	1947
1938	270000	282000	12000	1947
1938	294000	300000	6000	1947
1947	2505	2850	345	1959
1947	3500	4000	500	1959
1947	4438	4650	212	1959
1947	5250	5450	200	1959
1938	27500	28000	500	1959
2012	13450	13550	100	

Table 124. MS Region 2 allocation for share/secondary services-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1947	29.7	44	14.3	1959
1947	44	50	6	1959
1947	54	72	18	1959
1947	72	76	4	1959
1947	76	88	12	1959
1947	132	144	12	1959
1947	148	174	26	1959
1947	174	216	42	1959
1947	216	220	4	1959
1947	225	235	10	1959
1947	450	460	10	1959
1947	3500	3900	400	1959
1968	1525	1535	10	1982
1982	1530	1535	5	1990
1959	2300	2450	150	1990
1982	942	960	18	1994
1990	1530	1533	3	1998
1990	1533	1535	2	1998
1982	614	806	192	2008
2008	698	806	108	2012
1982-2012	54	68	14	
1982-2012	68	72	4	
1982-2012	76	88	12	
1982-2012	174	216	42	
1982-2012	470	512	42	
2008-2012	614	698	84	
1982-2012	902	928	26	
1982-2012	1525	1530	5	
1998-2012	1530	1535	5	
1982-2012	3300	3400	100	
1982-2012	3400	3500	100	

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1998	40.5	42.5	2	2001
1982-2012	11.7	12.1	0.4	
1994-2012	17.7	17.8	0.1	
2001-2012	40.5	41	0.5	

Table 125. MS Other regions/Region 3 allocation for exclusive/primary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1932	385	400	15	1938
1938	400	415	15	1947
1947	405	415	10	1959
1947	510	525	15	1959
1947	525	535	10	1982
1959	1605	1800	195	1982
1959	2505	2625	120	1982
1959	2625	2850	225	1982
1959	4438	4650	212	2012
1982-2012	1606.5	1800	193.5	
1959-2012	1800	2000	200	
1959-2012	2000	2065	65	
1959-2012	2107	2170	63	
1959-2012	2194	2300	106	
1959-2012	2300	2495	195	
1982-2012	2505	2850	345	
1959-2012	3500	3900	400	
2012	4438	4488	50	
2012	4488	4650	162	
2012	5250	5275	25	
2012	26200	26350	150	
2012	26350	27500	1150	

Table 126. MS Region 3 allocation for primary service-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1959	137	144	7	1968
1959	148	170	22	1968
1959	1429	1535	106	1968
1959	1710	2290	580	1968
1959	5850	5925	75	1968
1959	132	136	4	1971
1968	136	137	1	1971
1959	2450	2550	100	1971
1968	5850	6425	575	1971
1968	8400	8500	100	1971
1959	27.5	28	0.5	1982
1959	41	44	3	1982
1959	44	50	6	1982
1959	68	70	2	1982
1959	70	74.6	4.6	1982
1959	75.4	78	2.6	1982
1959	78	80	2	1982
1959	80	87	7	1982
1968	150.05	170	19.95	1982
1959	170	174	4	1982
1959	174	216	42	1982
1959	225	235	10	1982
1968	1710	1770	60	1982
1968	1770	1790	20	1982
1968	1790	2290	500	1982
1971	2535	2550	15	1982
1968	4990	5000	10	1982
1971	2450	2500	50	1990
1968	1429	1525	96	1994
1982	1710	2290	580	1994
1959	2290	2300	10	1994
1971	2500	2535	35	1994
1971	2655	2690	35	1994
1994	1970	1980	10	1998
1971	8025	8175	150	1998
1971	8175	8215	40	1998
1971	8215	8400	185	1998
1994	1492	1525	33	2004
1994	1675	1690	15	2004
1982	150.05	156.7625	6.7125	2008
2008	150.05	156.4875	6.4375	2012
1982	156.8375	174	17.1625	2012

Table 127. MS Region 3 allocation for primary service-3

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
2012	38.25	39.5	1.25	
2012	39.5	39.986	0.486	
2012	39.986	40	0.014	
2012	40	40.02	0.02	
2012	42	42.5	0.5	
1982-2012	47	50	3	
1959-2012	54	68	14	
1982-2012	68	74.8	6.8	
1982-2012	75.2	75.4	0.2	
1982-2012	75.4	87	11.6	
1959-2012	87	100	13	
1968-2012	138	143.6	5.6	
1968-2012	143.6	143.65	0.05	
1968-2012	143.65	144	0.35	
1982-2012	146	148	2	
1968-2012	148	149.9	1.9	
2012	150.05	154	3.95	
2012	154	156.4875	2.4875	
2008-2012	156.5625	156.7625	0.2	
2012	161.9875	162.0125	0.025	
2012	162.0375	174	11.9625	
1982-2012	174	223	49	
1982-2012	223	230	7	
1982-2012	230	235	5	
1996-2012	455	456	1	
1996-2012	459	460	1	
1982-2012	470	585	115	
1982-2012	585	610	25	
1959-2012	610	890	280	
1959-2012	890	942	52	
1959-2012	942	960	18	
1994-2012	1429	1452	23	
1994-2012	1452	1492	40	
2004-2012	1492	1518	26	
2004-2012	1518	1525	7	
1959-2012	1700	1710	10	
1994-2012	1930	1970	40	
1996-2012	2010	2025	15	
1994-2012	2120	2160	40	
1994-2012	2160	2170	10	
1982-2012	2300	2450	150	
1990-2012	2450	2483.5	33.5	
1990-2012	2483.5	2500	16.5	
1994-2012	2500	2520	20	
1994-2012	2520	2535	15	
1982-2012	2535	2655	120	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
1982-2012	3500	3700	200	
1959-2012	3700	4200	500	
1971-2012	5850	5925	75	

Table 128. MS Region 3 allocation for primary service-4

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1971	10.95	11.2	0.25	1982
1971	22.5	23	0.5	1982
1982	22.5	22.55	0.05	1994
1982	22.55	23	0.45	1994
1982-2012	10	10.45	0.45	
1982-2012	10.5	10.55	0.05	
1982-2012	10.7	11.7	1	
1971-2012	11.7	12.2	0.5	
1971-2012	12.2	12.5	0.3	
1971-2012	12.5	12.75	0.25	
1982-2012	14.3	14.4	0.1	
1994-2012	17.7	18.1	0.4	
1982-2012	18.6	18.8	0.2	
1994-2012	21.4	22	0.6	
1994-2012	24.25	24.45	0.2	
1994-2012	24.45	24.65	0.2	
1994-2012	24.65	24.75	0.1	
1994-2012	24.75	25.25	0.5	
1982-2012	27	27.5	0.5	
2004-2012	47.5	47.9	0.4	
2004-2012	48.2	50.2	2	

Table 129. MS Other regions/Region 3 allocation for share/secondary services-1

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1932	160	194	34	1938
1932	194	285	91	1938
1932	1500	1715	215	1938
1938	160	200	40	1947
1938	200	285	85	1947
1932	320	325	5	1947
1932	345	365	20	1947
1938	380	385	5	1947
1938	385	395	10	1947
1938	395	400	5	1947
1938	1500	1600	100	1947
1938	1600	1715	115	1947
1932	1715	2000	285	1947
1938	2000	2300	300	1947
1938	2300	2500	200	1947
1938	2500	3300	800	1947
1938	3300	3500	200	1947
1938	3500	4000	500	1947
1938	4000	4770	770	1947
1938	4770	4965	195	1947
1938	4965	5500	535	1947
1947	1605	1800	195	1959
1947	1800	2000	200	1959
1947	2000	2065	65	1959
1947	2105	2300	195	1959
1947	2300	2495	195	1959
1947	2505	2850	345	1959
1947	3500	3900	400	1959
1947	4438	4650	212	1959
1947	5250	5430	180	1959
1947	5430	5480	50	1959
1947	27500	28000	500	1959
1982	5730	5950	220	1994
1982-2012	526.5	535	8.5	
1994-2012	5730	5900	170	
2012-2012	13450	13550	100	

Table 130. MS Region 3 allocation for share/secondary services-2

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1947	29.7	31.7	2	1959
1947	31.7	44	12.3	1959
1947	44	50	6	1959
1947	54	68	14	1959
1947	70	78	8	1959
1947	80	87	7	1959
1947	132	144	12	1959
1947	148	170	22	1959
1947	170	200	30	1959
1947	1300	1700	400	1959
1947	3300	3900	600	1959
1947	5850	5925	75	1959
1968	1525	1535	10	1982
1959	2300	2450	150	1982
1959	3500	3700	200	1982
1982	1530	1535	5	1990
1990	1530	1533	3	2001
1990	1533	1535	2	2001
1982-2012	1525	1530	5	
2001-2012	1530	1535	5	
1982-2012	3400	3500	100	
2012	3500	3600	100	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1998	40.5	42.5	2	2001
1968-2012	31.5	31.8	0.3	
2001-2012	40.5	41	0.5	

Appendix H Mobile-satellite service geographic frequency allocations

Table 131. MSS Global allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1982	1544	1545	1	1998
1982	1645.5	1646.5	1	1998
1994-2012	137	137.025	0.025	
1994-2012	137.175	137.825	0.65	
1998-2012	149.9	150.05	0.15	
1998-2012	399.9	400.05	0.15	
1994-2012	400.15	401	0.85	
1971-2012	406	406.1	0.1	
1998-2012	1535	1559	24	
1998-2012	1626.5	1660	33.5	
1998-2012	1660	1660.5	0.5	
2004-2012	1668	1668.4	0.4	
2004-2012	1668.4	1670	1.6	
2004-2012	1670	1675	5	
1994-2012	1980	2010	30	
1994-2012	2170	2200	30	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1982	39.5	40.5	1	1994
1982	95	100	5	2001
1982	134	142	8	2001
1982	190	200	10	2001
1994-2012	20.1	20.2	0.1	
1982-2012	20.2	21.2	1	
1994-2012	29.9	30	0.1	
1982-2012	30	31	1	
1994-2012	39.5	40	0.5	
1994-2012	40	40.5	0.5	
1982-2012	43.5	47	3.5	
1982-2012	66	71	5	
1982-2012	71	74	3	
1982-2012	81	84	3	
2001-2012	123	130	7	
2001-2012	158.5	164	5.5	
2001-2012	191.8	200	8.2	
1982-2012	252	265	13	

Table 132. MSS Global allocation for secondary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1994-2012	137.025	137.175	0.15	
1994-2012	137.825	138	0.175	
1994-2012	312	315	3	
1994-2012	387	390	3	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1982-2012	19.7	20.2	0.5	1994
1982-2012	29.5	30	0.5	1994
1998-2012	14	14.25	0.25	
1998-2012	14.25	14.3	0.05	
1998-2012	14.4	14.47	0.07	
1998-2012	14.47	14.5	0.03	
1982-2012	50.4	51.4	1	

Table 133. MSS Region 1 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1994	2500	2520	20	2008
1994	2670	2690	20	2008
1994-2012	148	149.9	1.9	
2004-2012	1518	1525	7	
1998-2012	1525	1530	5	
1998-2012	1530	1535	5	
1994-2012	1610	1610.6	0.6	
1994-2012	1610.6	1613.8	3.2	
1994-2012	1613.8	1626.5	12.7	
1994-2012	2483.5	2500	16.5	

Table 134. MSS Region 1 allocation for secondary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
2012	156.7625	156.7875	0.025	
2012	156.8125	156.8375	0.025	
2012	161.9625	161.9875	0.025	
2012	162.0125	162.0375	0.025	
1994-2012	1613.8	1626.5	12.7	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1998-2012	14.3	14.4	0.1	
1994-2012	19.7	20.1	0.4	
1994-2012	29.5	29.9	0.4	

Table 135. MSS Region 2 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1994	1970	1980	10	1996
1994	1626.5	1631.5	5	1998
1994	1675	1690	15	2004
1994	1690	1700	10	2004
1994	1700	1710	10	2004
1994	2500	2520	20	2008
1994	2670	2690	20	2008
1996-2012	148	149.9	1.9	
2012	156.7625	156.7875	0.025	
2012	156.8125	156.8375	0.025	
2012	161.9625	161.9875	0.025	
2012	162.0125	162.0375	0.025	
1996-2012	455	456	1	
1996-2012	459	460	1	
1994-2012	1492	1525	33	
1994-2012	1525	1530	5	
1998-2012	1530	1535	5	
1994-2012	1610	1610.6	0.6	
1994-2012	1610.6	1613.8	3.2	
1994-2012	1613.8	1626.5	12.7	
1996-2012	2010	2025	15	
1994-2012	2160	2170	10	
1994-2012	2483.5	2500	16.5	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1994-2012	19.7	20.1	0.4	
1994-2012	29.5	29.9	0.4	

Table 136. MSS Region 2 allocation for secondary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1982-2012	608	614	6	
1994-2012	1613.8	1626.5	12.7	
1994-2012	1930	1970	40	
1994-2012	2120	2160	40	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1998-2012	14.3	14.4	0.1	
2001-2012	40.5	41	0.5	

Table 137. MSS Region 3 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1994	1626.5	1631.5	5	1998
1996-2012	148	149.9	1.9	
2004-2012	1518	1525	7	
1994-2012	1525	1530	5	
1998-2012	1530	1535	5	
1994-2012	1610	1610.6	0.6	
1994-2012	1610.6	1613.8	3.2	
1994-2012	1613.8	1626.5	12.7	
1994-2012	2483.5	2500	16.5	
1994-2012	2500	2520	20	
1994-2012	2670	2690	20	

Table 138. MSS Region 3 allocation for secondary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
2012	156.7625	156.7875	0.025	
2012	156.8125	156.8375	0.025	
2012	161.9625	161.9875	0.025	
2012	162.0125	162.0375	0.025	
1994-2012	1613.8	1626.5	12.7	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1998-2012	14.3	14.4	0.1	
1994-2012	19.7	20.1	0.4	
1994-2012	29.5	29.9	0.4	

Appendix I Space research service geographic frequency allocations

Table 139. SRS Global allocation for primary service-1

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1968	400.05	401	0.95	1971
1968	5250	5255	5	1971
1971	136	137	1	1982
1968	137	138	1	1994
1982	1660.5	1668.4	7.9	2004
1998	1240	1260	20	2008
1998	1260	1300	40	2008
1968-2012	30.005	30.01	0.005	
1994-2012	137	137.025	0.025	
1994-2012	137.025	137.175	0.15	
1994-2012	137.175	137.825	0.65	
1994-2012	137.825	138	0.175	
1971-2012	400.15	401	0.85	
1998-2012	410	420	10	
1998-2012	1215	1240	25	
2008-2012	1240	1300	60	
1982-2012	1400	1427	27	
2004-2012	1660.5	1668	7.5	
2004-2012	1668	1668.4	0.4	
1994-2012	2025	2110	85	
1994-2012	2110	2120	10	
1994-2012	2200	2290	90	
1994-2012	2290	2300	10	
1982-2001	2690	2700	10	
1998-2001	5250	5255	5	
1998-2001	5255	5350	95	
2004-2012	5350	5460	110	
2004-2012	5460	5470	10	
2004-2012	5470	5570	100	
2004-2012	7145	7235	90	
1971-2012	8400	8500	100	
1998-2012	8550	8650	100	
2008-2012	9300	9500	200	
1998-2012	9500	9800	300	

Table 140. SRS Global allocation for primary service-2

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1968	15.25	15.35	0.1	1971
1971	51	52	1	1982
1971	52	54.25	2.25	1982
1971	130	140	10	1982
1971	182	185	3	1982
1971	230	240	10	1982
1982	116	126	10	1996
1982	51.4	54.25	2.85	1998
1982	54.25	58.2	3.95	1998
1971	64	65	1	1998
1982	105	116	11	2001
1996	119.98	120.02	0.04	2001
1996	120.02	126	5.98	2001
1982	150	151	1	2001
1982	164	168	4	2001
1982	174.5	176.5	2	2001
1982	217	231	14	2001
1982-2012	10.6	10.68	0.08	
1982-2012	10.68	10.7	0.02	
1998-2012	13.25	13.4	0.15	
1998-2012	13.4	13.75	0.35	
1982-2012	15.35	15.4	0.05	
1998-2012	17.2	17.3	0.1	
1982-2012	21.2	21.4	0.02	
1982-2012	22.21	22.5	0.29	
2012	22.55	23.15	0.60	
1982-2012	23.6	24	0.4	
2004-2012	25.5	27	1.5	
1982-2012	31.3	31.5	0.2	
1994-2012	31.8	32	0.2	
1994-2012	32	32.3	0.3	
1994-2012	34.2	34.7	0.5	
1998-2012	35.5	36	0.5	
1982-2012	36	37	1	
1996-2012	37	37.5	0.5	
1994-2012	37.5	38	0.5	
1994-2012	40	40.5	0.5	
1982-2012	50.2	50.4	0.2	
1998-2012	52.6	54.25	1.65	
1998-2012	54.25	55.78	1.53	
1998-2012	55.78	56.9	1.12	
1998-2012	56.9	57	0.1	
1998-2012	57	58.2	1.2	
1971-2012	58.2	59	0.8	
1998-2012	59	59.3	0.3	
1971-2012	65	66	1	
1971-2012	86	92	6	
1998-2012	94	94.1	0.1	
1971-2012	101	102	1	
2001-2012	105	109.5	4.5	
2001-2012	109.5	111.8	2.3	
2001-2012	111.8	114.25	2.45	
2001-2012	114.25	116	1.75	
1996-2012	116	119.98	3.98	
2001-2012	119.98	122.25	2.27	
2001-2012	148.5	151.5	3	

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
2001-2012	155.5	158.5	3	
2001-2012	164	167	3	
2001-2012	174.8	182	7.2	
1982-2012	182	185	3	
2001-2012	185	190	5	
2001-2012	190	191.8	1.8	
1982-2012	200	202	2	
2001-2012	202	209	7	
2001-2012	217	226	9	
2001-2012	226	231.5	5.5	
1982-2012	235	238	3	
1982-2012	250	252	2	

Table 141. SRS Global allocation for secondary service

Initial RR	Lower frequency (kHz)	Upper frequency (kHz)	Bandwidth (kHz)	RR removal
1968	15762	15768	6	1971
1968	18030	18036	6	1971
1982-2012	2501	2502	1	
1994-2012	5003	5005	2	
1982-2012	10003	10005	2	
1982-2012	15005	15010	5	
1971-2012	18052	18068	16	
1982-2012	19990	19995	5	
1982-2012	25005	25010	5	
Initial RR	**Lower frequency (MHz)**	**Upper frequency (MHz)**	**Bandwidth (MHz)**	**RR removal**
1994	410	420	10	1998
1971	5250	5255	5	1998
1982	39.986	40.02	0.034	2012
1982-2012	40.98	41.015	0.035	
1998-2012	3100	3300	200	
1982-2012	4990	5000	10	
1968-2012	5670	5725	55	
2008-2012	9800	9900	100	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1968	31.8	32.3	0.5	1982
1982	13.4	14	0.6	1994
1982	31.8	32	0.2	1994
1982	32	32.3	0.3	1994
1968	34.2	35.2	1	1994
1994	13.4	13.75	0.35	1998
1982	17.2	17.3	0.1	2001
1994	74	75.5	1.5	2001
1994	75.5	76	0.5	2001
1994	76	81	5	2001
1982-2012	12.75	13.25	0.5	
1994-2012	13.75	14	0.25	
1982-2012	14	14.25	0.25	
1982-2012	14.25	14.3	0.05	
1982-2012	14.4	14.47	0.07	
1982-2012	14.5	14.8	0.3	
1982-2012	14.8	15.35	0.55	
1982-2012	16.6	17.1	0.5	
1968-2012	31	31.3	0.3	
1994-2012	34.7	35.2	0.5	
2001-2012	74	76	2	
2001-2012	76	77.5	1.5	
2001-2012	77.5	78	0.5	
2001-2012	78	79	1	
2001-2012	79	81	2	
1994-2012	81	84	3	

Table 142. SRS Region 1 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1968	136	137	1	1971
1968	8400	8500	100	1971
1968	1700	1710	10	1982
1968	2290	2300	10	1994
1968-2012	143.6	143.65	0.05	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1968-2012	31.5	31.8	0.3	

Table 143. SRS Region 1 allocation for secondary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1982	2655	2690	35	1994
2012	39.986	40.02	0.034	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1982-2012	18.6	18.8	0.2	

Table 144. SRS Region 2 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1968	136	137	1	1971
1968	8400	8500	100	1971
1968	1700	1710	10	1982
1968	2290	2300	10	1994
1968-2012	143.6	143.65	0.05	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1982-2012	18.6	18.8	0.2	
1968-2012	31.5	31.8	0.3	

Table 145. SRS Region 2 allocation for secondary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1986	2655	2690	35	1994
2012	39.986	40.02	0.034	
1971-2012	138	143.6	5.6	
1971-2012	143.65	144	0.35	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	

Table 146. SRS Region 3 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1968	136	137	1	1971
1968	8400	8500	100	1971
1968	1700	1710	10	1982
1968	2290	2300	10	1994
1968-2012	143.6	143.65	0.05	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1968-2012	31.5	31.8	0.3	

Table 147. SRS Region 3 allocation for secondary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1982	2655	2690	35	1994
2012	39.986	40	0.014	
2012	40	40.02	0.02	
1971-2012	138	143.6	5.6	
1971-2012	143.65	144	0.35	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1982-2012	18.6	18.8	0.2	

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Appendix J Earth exploration-satellite service geographic frequency allocations

Table 148. EESS Global allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1998	1240	1260	20	2004
1998	1260	1300	40	2004
1998-2012	401	402	1	
1998-2012	402	403	1	
1998-2012	1215	1240	25	
2004-2012	1240	1300	60	
1982-2012	1400	1427	27	
1994-2012	2025	2110	85	
1994-2012	2200	2290	90	
1982-2012	2690	2700	10	
1998-2012	5250	5255	5	
1998-2012	5255	5350	95	
1998-2012	5350	5460	110	
2004-2012	5460	5470	10	
2004-2012	5470	5570	100	
1998-2012	8025	8175	150	
1998-2012	8175	8215	40	
1998-2012	8215	8400	185	
1998-2012	8550	8650	100	
2008-2012	9300	9500	200	
1998-2012	9500	9800	300	

Table 149. EESS Global allocation for primary service

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
1971	21.2	22	0.8	1982
1971	51	52	1	1982
1982	231	235	4	1990
1982	116	126	10	1996
1982	54.25	58.2	3.95	1998
1982	64	65	1	1998
1982	105	116	11	2001
1996	119.98	120.02	0.04	2001
1996	120.02	126	5.98	2001
1982	150	151	1	2001
1994	156	158	2	2001
1982	164	168	4	2001
1982	174.5	176.5	2	2001
1982	217	231	14	2001
1982-2012	10.6	10.68	0.8	
1982-2012	10.68	10.7	0.02	
1998-2012	13.25	13.4	0.15	
1998-2012	13.4	13.75	0.35	
1982-2012	15.35	15.4	0.05	
1998-2012	17.2	17.3	0.1	
1982-2012	21.2	21.4	0.2	
1982-2012	22.21	22.5	0.29	
1982-2012	23.6	24	0.4	
1998-2012	25.5	27	1.5	
1982-2012	31.3	31.5	0.2	
1998-2012	35.5	36	0.5	
1982-2012	36	37	1	
1994-2012	40	40.5	0.5	
1982-2012	50.2	50.4	0.2	
1982-2012	51.4	54.25	2.85	
1998-2012	54.25	55.78	1.53	
1998-2012	55.78	56.9	1.12	
1998-2012	56.9	57	0.1	
1998-2012	57	58.2	1.2	
1982-2012	58.2	59	0.8	
1998-2012	59	59.3	0.3	
1971-2012	65	66	1	
1982-2012	86	92	6	
1998-2012	94	94.1	0.1	
1982-2012	100	102	2	
2001-2012	109.5	111.8	2.3	
2001-2012	114.25	116	1.75	
1996-2012	116	119.98	3.98	
2001-2012	119.98	122.25	2.27	
2001-2012	130	134	4	
2001-2012	148.5	151.5	3	
2001-2012	155.5	158.5	3	
2001-2012	164	167	3	
2001-2012	174.8	182	7.2	
1982-2012	182	185	3	
2001-2012	185	190	5	
2001-2012	190	191.8	1.8	
1982-2012	200	202	2	
2001-2012	202	209	7	
2001-2012	226	231.5	5.5	
1982-2012	235	238	3	

1982-2012	250	252	2	

Table 150. EESS Global allocation for secondary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1982	401	402	1	1998
1982	402	403	1	1998
1998-2012	3100	3300	200	
2008-2012	9800	9900	100	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1994	28.5	29.5	1	1996
1982	17.2	17.3	0.1	1998
1982	25.25	27	1.75	1998
2004-2012	13.75	14	0.25	
1982-20112	24.05	24.25	0.2	
1996-2012	28.5	29.1	0.6	
1996-2012	29.1	29.5	0.4	
1994-2012	29.9	30	0.1	
1994-2012	37.5	38	0.5	
1994-2012	38	39.5	1.5	
1994-2012	39.5	40	0.5	
1994-2012	40	40.5	0.5	

Table 151. EESS Region 1 allocation for primary service

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
2001-2012	18.6	18.8	0.2	
1982-2012	31.5	31.8	0.3	

Table 152. EESS Region 1 allocation for secondary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	1525	1535	10	1982
1982	1530	1535	5	1990
1982	2655	2690	35	1994
1990	1530	1533	3	1998
1990	1533	1535	2	1998
1971	8025	8175	150	1998
1971	8175	8215	40	1998
1971	8215	8400	185	1998
2004-2012	432	438	6	
1982-2012	1525	1530	5	
1998-2012	1530	1535	5	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1982	27	27.5	0.5	1994
1982	18.6	18.8	0.2	2001
1994-2012	29.5	29.9	0.4	

Table 153. EESS Region 2 allocation for primary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	8025	8175	150	1998
1971	8175	8215	40	1998
1971	8215	8400	185	1998
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1982-2012	18.6	18.8	0.2	
1982-2012	31.5	31.8	0.3	

Table 154. EESS Region 2 allocation for secondary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	1525	1535	10	1982
1982	1530	1535	5	1990
1982	2655	2690	35	1994
1990	1530	1533	3	1998
1990	1533	1535	2	1998
2004-2012	432	438	6	
1982-2012	1525	1530	5	
1998-2012	1530	1535	5	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1982	27	27.5	0.5	1994
1994-2012	29.5	29.9	0.4	

Table 155. EESS Region 3 allocation for primary service

Initial RR	Lower frequency (GHz)	Upper frequency (GHz)	Bandwidth (GHz)	RR removal
2001-2012	18.6	18.8	0.2	
1982-2012	31.5	31.8	0.3	

Table 156. EESS Region 3 allocation for secondary service

Initial RR	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth (MHz)	RR removal
1971	1525	1535	10	1982
1982	1530	1535	5	1990
1982	2655	2690	35	1994
1990	1530	1533	3	1998
1990	1533	1535	2	1998
1971	8025	8175	150	1998
1971	8175	8215	40	1998
1971	8215	8400	185	1998
2004-2012	432	438	6	
1982-2012	1525	1530	5	
1998-2012	1530	1535	5	
1994-2012	2655	2670	15	
1994-2012	2670	2690	20	
Initial RR	**Lower frequency (GHz)**	**Upper frequency (GHz)**	**Bandwidth (GHz)**	**RR removal**
1982	27	27.5	0.5	1994
1982	18.6	18.8	0.2	2001
1994-2012	29.5	29.9	0.4	