The ITU structure and the ITU Study Groups

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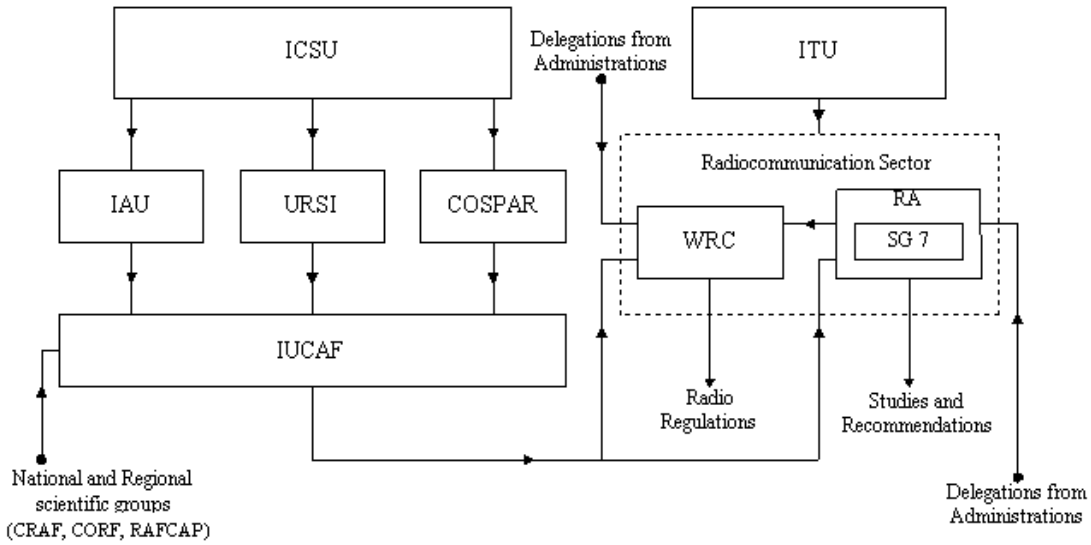
1. The Radiocommunication Sector and World Radiocommunication Conferences of the ITU

This document is concerned principally with aspects of radio astronomy that are relevant to frequency coordination, that is, the usage of the radio spectrum in a manner regulated to avoid interference by mutual agreement between the radio services. On an international scale, the regulation of spectrum usage is organized through the International Telecommunication Union (ITU), whose web page is at http://www.itu.int/). The ITU is a specialized agency of the United Nations Organization.

Fig. 1: Inter-relationships between international agencies involved in frequency coordination for the radio astronomy service.



where (in alphabetical order):

CORF	Committee on Radio Frequencies
COSPAR	Committee on Space Research
CRAF	Committee on Radio Astronomy Frequencies
IAU	International Astronomical Union
ICSU	International Council of Scientific Unions
ITU	International Telecommunication Union
IUCAF	Inter-Union Commission for the Allocation of Frequencies for Radio Astronomy and Space Science
RA	Radiocommunication Assembly
RAFCAP	Radio Astronomy Frequency Committee in the Asia-Pacific region
SG 7	Study Group 7
URSI	International Union of Radio Science
WRC	World Radiocommunication Conference

The Radiocommunication Sector (ITU-R; http://www.itu.int/ITU-R/), which is a part of the ITU, was created on 1 March 1993 to implement the new ITU structure. Other parts of the ITU are the ITU-T (Telecom Standardization Sector) and the ITU-D (Telecom Development Sector). The Radiocommunication Sector includes World and Regional Radiocommunication Conferences, Radiocommunication Assemblies, the Radio Regulations Board, Radiocommunication Study Groups, the Radiocommunication Advisory Group and the Radiocommunication Bureau headed by the elected Director. The Radiocommunication Assembly and the Radiocommunication Bureau replaced the former International Consultative Committee on Radio (CCIR) and its Secretariat, which performed similar functions.

The ITU Radio Regulations, which provide the basis for the planned usage of the spectrum, are the result of World Radiocommunication Conferences (WRCs) that are held at intervals of a few years. At such conferences, the aim is to introduce new requirements for spectrum usage in a form, which is as far as possible, mutually acceptable to the representatives of participating countries. The results of each WRC take the form of a treaty to which the participating administrations are signatories. As in most areas of international law, the enforcement of the regulations is difficult, and depends largely upon the goodwill of the participants.

Radiocommunication Study Groups are set up by a Radiocommunication Assembly. They study questions and prepare draft recommendations on the technical, operational, and regulatory/procedural aspects of radiocommunications. These ITU-R Study Groups address such issues as the preferred frequency bands for the various services, the threshold levels of unacceptable interference, sharing between services, the desired limits on emissions, etc. These groups are further organised into Working Parties and Task Groups, which deal with specific aspects of Study Group work. As of 2002, the ITU-R Study Groups and associated Working Parties are as follows:

Study Group 1	Spectrum management
WP 1A	Spectrum engineering techniques
WP 1B	Spectrum management methodologies
WP 1C	Spectrum monitoring
TG 1/7	**Protection of passive service bands from unwanted emissions**

JTG 1-6-8-9 Multimedia applications (Resolution 737 (WRC-2000))

Study Group 3	Radio wave propagation
WP 3J	Propagation fundamentals
WP 3K	Point-to-area propagation
WP 3L	Ionospheric propagation
WP 3M	Point-to-point and Earth-space propagation
Study Group 4	Fixed-satellite service
WP 4A	Efficient orbit/spectrum utilization
WP 4B	Systems, performance, availability and maintenance of FSS, Satellite news gathering (SNG) and outside broadcast via satellite
JWP 4-9S	Frequency sharing, between the FSS and the FS
JTG 4-7-8	Sharing in the band 13.75 – 14 GHz (Resolution 733 (WRC-2000))
JTG 4-7-8-9	5 GHz band allocations (Resolution 736 (WRC-2000))

Study Group 6	Broadcasting service (terrestrial and satellite)
WP 6A	Programme assembling and formatting
WP 6E	Terrestrial delivery
WP 6M	Interactive and multimedia broadcasting
WP 6P	Content production / postproduction
WP 6Q	Performance assessment and quality control
WP 6R	Recording for production, archival and play-out; film for television
WP 6S	Satellite delivery
TG 6/6	Recommendation for a digital broadcasting standard below 30 MHz
TG 6/7	Planning parameters for digital broadcasting at frequencies below 30 MHz
TG 6/8	Preparation for the Regional Radiocommunication Conference 2004 (RRC-04)
TG 6/9	Digital cinema

Study Group 7	**Science services**
WP 7A	Time signals and frequency standard emissions
WP 7B	Space radio systems
WP 7C	Earth-exploration satellite systems and meteorological elements
WP 7D	**Radioastronomy**

	WP 7E	Inter-service sharing and compatibility
Study Group 8		Mobile, radiodetermination, amateur and related satellite services
	WP 8A	Land mobile service excluding IMT-2000
	WP 8B	Maritime mobile service including Global Maritime Distress and Safety System (GDMSS); aeronautical mobile service and radiodetermination service
	WP 8D	All mobile-satellite services and radiodetermination-satellite service
	WP 8F	International Mobile Telecommunications – 2000 and systems beyond IMT-2000
	JRG 8A-9B	Wireless access systems
Study Group 9		Fixed service
	WP 9A	Performance and availability, interference objectives and analysis, effects of propagation and terminology
	WP 9B	Radio-frequency channel arrangements, radio system characteristics, interconnection, maintenance and various applications
	WP 9C	Systems below 30 MHz (HF and others)
	WP 9D	Sharing with other services (except for the FSS)
	JRG 6S-9D	Frequency sharing between the FS and BSS (sound)
SC		Special Committee on Regulatory / Procedural Matters
CCV		Coordination Committee for Vocabulary
CPM		Conference Preparatory Meeting

Radio astronomy (WP 7D) falls within ITU-R Study Group 7, Science Services, which also includes space sciences, time signals and frequency standards. In the work of the Study Group, the search for extraterrestrial intelligence (SETI), radar astronomy as practiced from the surface of the Earth, and space-based radio astronomy are usually included with radio astronomy.

International meetings of the **Study Groups** and **Working Parties** occur at approximately two-year intervals, and are attended by delegations from many countries. The **Task Groups** are usually set up for a limited period of time to carry out specific tasks, and meet at intervals according to their needs.

Appropriate **Questions** are assigned to the Study Groups, which provide responses, generally in the form of **ITU-R Recommendations. The ITU-R Recommendations provide a body of technical, operational, and regulatory/procedural information that has been agreed upon by the participating administrations.** This information is used to provide technical inputs to WRCs, and many of the results of the work of the Study Groups are thereby incorporated into the Radio Regulations. Aside from

this, the ITU-R Recommendations and Reports are, in themselves, generally regarded as authoritative guidelines for spectrum users. This is particularly true of the ITU-R Recommendations, which are widely followed, and are revised and published on a four-year cycle by the ITU.

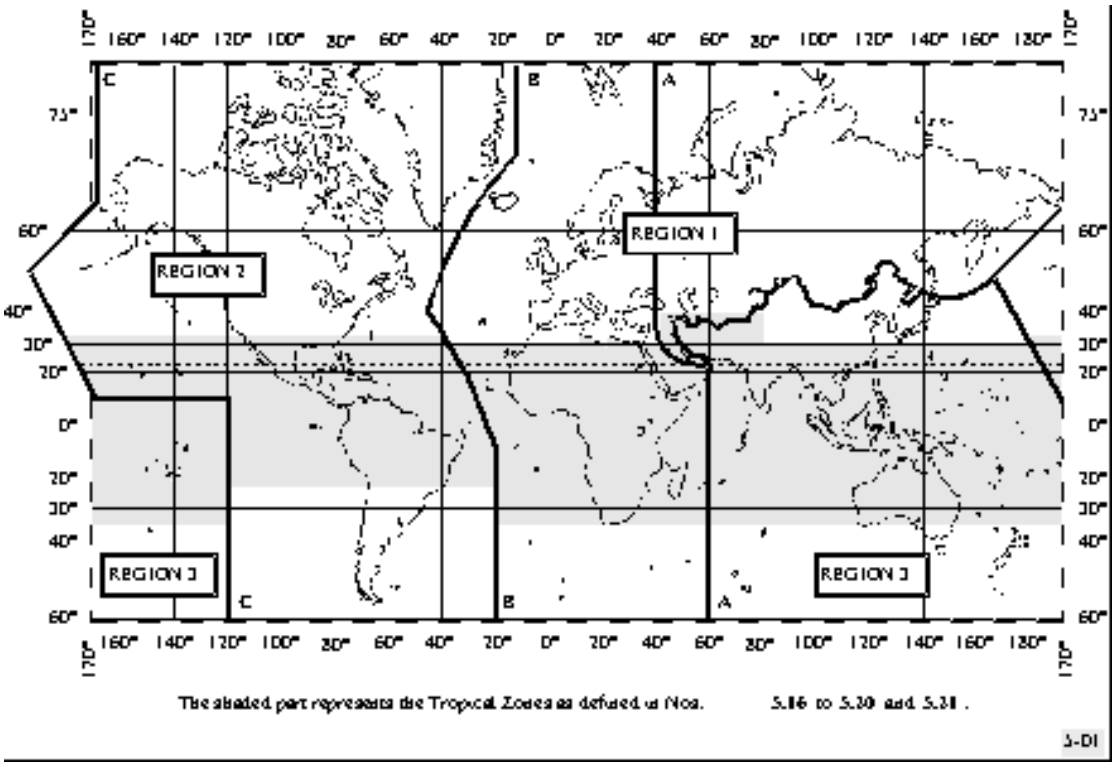


Fig. 2: The Three ITU Regions of the World.

2. The Radio Regulations and frequency allocations

International frequency allocations are carried out at WRCs, which are attended by representatives of more than 180 administrations from all over the world. For the purpose of allocation, the world is divided into three regions (see 5. 2 through 5.22 of the RR): **Region 1** includes Europe, Africa and northern Asia; **Region 2** includes North America and South America; **Region 3** includes southern Asia and Australasia. For any particular frequency band, the allocations may be different in different regions. Bands are often shared between two or more services. Generally speaking, the allocations are primary or secondary. A service with a secondary allocation is not permitted to cause interference to a service with a primary allocation in the same band. **The frequency allocations are contained in Article 5 of the Radio Regulations. Most are shown in a table of allocations; however, additional allocations are contained in numbered footnotes to the table.**

Within individual countries, spectral-allocation matters are handled by government agencies. The agencies vary greatly from one administration to another. In many countries, the administration of the radio spectrum is part of the work of a larger agency, which may also administer other items such as postal and telephone services, transportation, commerce, etc. Such agencies play major roles in the preparation of the national positions that are advocated at WRCs. Administrations participating in the WRC treaties retain sovereign rights over the spectrum within their national

boundaries, and can deviate from the international regulations to the extent that this does not cause harmful interference within the territories of other administrations. In the setting up of the Radio Regulations, many administrations have claimed exceptions in certain bands in order to cover particular national requirements.

3. Frequency allocations and related issued with radio astronomy

In Article 1, Section 1 of the Radio Regulations, **radio astronomy is defined as astronomy based on the reception of radio waves of cosmic origin.** In the table of frequency allocations, frequency bands which offer the greatest protection to radio astronomy are those for which the radio astronomy service has a **primary allocation** that is shared only with other passive (non-transmitting) services. Next in degree of protection are the bands for which radio astronomy has a primary allocation while it shares this status with one or more active (transmitting) services. Less protection is afforded where bands are allocated to radio astronomy on a **secondary basis.**

The following footnotes are related to primary and secondary allocations:

5.23 *Primary and secondary services*

5.24 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:

5.25 *a)* services the names of which are printed in "capitals" (example: FIXED); these are called "primary" services;

5.26 *b)* services the names of which are printed in "normal characters" (example: Mobile); these are called "secondary" services (see Nos **5.28** to **5.31**).

5.27 2) Additional remarks shall be printed in normal characters (example: MOBILE except aeronautical mobile).

5.28 3) Stations of a secondary service:

5.29 *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;

5.30 *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;

5.31 *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.

5.32 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 **5.28** to **5.31**).

5.33 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.

For many frequency bands, the protection is by footnote rather than by direct table listing. The footnotes are of several types. For an exclusive band allocated only to passive services, the footnote points out that all emissions are prohibited in the band

(see **5.340**). Other footnotes are used when radio astronomy has an allocation in only part of the band appearing in the table (see for example, **5.149**). A different form of footnote is used for bands or parts of bands which are not allocated to radio astronomy, but which are nevertheless used for astrophysically important observations. It urges administrations to take all practicable steps to protect radio astronomy, when making frequency assignments to other services. Although such footnotes provide no legal protection, they have often proven valuable to radio astronomy, when coordination with other services is required.

5.149 In making assignments to stations of other services to which the bands:

13 360-13 410 kHz,	4 990-5 000 MHz,	94.1-100 GHz,
25 550-25 670 kHz,	6 650-6 675.2 MHz,	102-109.5 GHz,
37.5-38.25 MHz,	10.6-10.68 GHz,	111.8-114.25 GHz,
73-74.6 MHz in Regions 1 & 3	14.47-14.5 GHz,	128.33-128.59 GHz,
150.05-153 MHz in Region 1	22.01-22.21 GHz,	129.23-129.49 GHz,
322-328.6 MHz,	22.21-22.5 GHz,	130-134 GHz,
406.1-410 MHz,	22.81-22.86 GHz,	136-148.5 GHz,
608-614 MHz in Regions 1 & 3	23.07-23.12 GHz,	151.5-158.5 GHz,
1 330-1 400 MHz,	31.2-31.3 GHz,	168.59-168.93 GHz,
1 610.6-1 613.8 MHz,	31.5-31.8 GHz in Regions 1 & 3	171.11-171.45 GHz,
1 660-1 670 MHz,	36.43-36.5 GHz,	172.31-172.65 GHz,
1 718.8-1 722.2 MHz,	42.5-43.5 GHz,	173.52-173.85 GHz,
2 655-2 690 MHz,	42.77-42.87 GHz,	195.75-196.15 GHz,
3 260-3 267 MHz,	43.07-43.17 GHz,	209-226 GHz,
3 332-3 339 MHz,	43.37-43.47 GHz,	241-250 GHz,
3 345.8-3 352.5 MHz,	48.94-49.04 GHz,	252-275 GHz
4 825-4 835 MHz,	76-86 GHz,	
4 950-4 990 MHz,	92-94 GHz,	

are allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from spaceborne or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos **4.5** and **4.6** and Article **29**) (WRC-2000).

5.208A In making assignments to space stations in the mobile-satellite service in the bands 137-138 MHz, 387-390 MHz and 400.15-401 MHz, administrations shall take all practicable steps to protect the radio astronomy service in the bands 150.05-153 MHz, 322-328.6 MHz, 406.1-410 MHz and 608-614 MHz from harmful interference from unwanted emissions. The threshold levels of interference detrimental to the radio astronomy service are shown in Table 1 of Recommendation ITU-R RA.769-1 (WRC-97).

5.225 *Additional allocation:* in Australia and India, the band 150.05-153 MHz is also allocated to the radio astronomy service on a primary basis.

5.250 *Additional allocation*: in China, the band 225-235 MHz is also allocated to the radio astronomy service on a secondary basis.

5.304 *Additional allocation:* in the African Broadcasting Area (see Nos **5.10** to **5.13**), the band 606-614 MHz is also allocated to the radio astronomy service on a primary basis.

5.305 *Additional allocation:* in China, the band 606-614 MHz is also allocated to the radio astronomy service on a primary basis.

5.306 *Additional allocation:* in Region 1, except in the African Broadcasting Area (see Nos **5.10** to **5.13**), and in Region 3, the band 608-614 MHz is also allocated to the radio astronomy service on a secondary basis.

5.307 *Additional allocation:* in India, the band 608-614 MHz is also allocated to the radio astronomy service on a primary basis.

5.340 All emissions are prohibited in the following bands:

1 400-1 427 MHz,	
2 690-2 700 MHz,	except those provided for by Nos **5.421** and **5.422**,
10.68-10.7 GHz,	except those provided for by No **5.483**,
15.35-15.4 GHz,	except those provided for by No **5.511**,
23.6-24 GHz,	
31.3-31.5 GHz,	
31.5-31.8 GHz,	in Region 2,
48.94-49.04 GHz,	from airborne stations,
50.2-50.4 GHz[2],	except those provided for by No **5.555A**,
52.6-54.25 GHz,	
86-92 GHz,	
100-102 GHz,	
109.5-111.8 GHz,	
114.25-116 GHz,	
148.5-151.5 GHz,	
164-167 GHz,	
182-185 GHz,	except those provided for by No **5.563**,
190-191.8 GHz,	
200-209 GHz,	
226-231.5 GHz,	
250-252 GHz.	

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

5.372 Harmful interference shall not be caused to stations of the radio astronomy service using the band 1 610.6-1 613.8 MHz by stations of the radiodetermination-satellite and mobile-satellite services (No **29.13** applies).

5.376A Mobile earth stations operating in the band 1 660-1 660.5 MHz shall not cause harmful interference to stations in the radio astronomy service (WRC-97).

5.379A Administrations are urged to give all practicable protection in the band 1 660.5-1 668.4 MHz for future research in radio astronomy, particularly by eliminating air-to-ground transmissions in the meteorological aids service in the band 1 664.4-1 668.4 MHz as soon as practicable.

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[2] **5.340.1** The allocation to the Earth exploration-satellite service (passive) and the space research service (passive) in the band 50.2-50.4 GHz should not impose undue constraints on the use of the adjacent bands by the primary allocated services in those bands (WRC-97).

5.385 *Additional allocation:* the band 1 718.8-1 722.2 MHz is also allocated to the radio astronomy service on a secondary basis for spectral-line observations (WRC-2000).

5.402 The use of the band 2 483.5-2 500 MHz by the mobile-satellite and the radiodetermination-satellite services is subject to the coordination under No **9.11A.** Administrations are urged to take all practicable steps to prevent harmful interference to the radio astronomy service from emissions in the 2 483.5-2 500 MHz band, especially those caused by second-harmonic radiation that would fall into the 4 990-5 000 MHz band allocated to the radio astronomy service worldwide.

5.413 In the design of systems in the broadcasting-satellite service in the bands between 2 500 MHz and 2 690 MHz, administrations are urged to take all necessary steps to protect the radio astronomy service in the band 2 690-2 700 MHz.

5.443 *Different category of service:* in Argentina, Australia and Canada, the allocation of the bands 4 825-4 835 MHz and 4 950-4 990 MHz to the radio astronomy service is on a primary basis (see No **5.33**).

5.443B *Additional allocation:* The band 5 010-5 030 MHz is also allocated to the radionavigation-satellite service (space-to-Earth) (space-to-space) on a primary basis. In order not to cause harmful interference to the microwave landing system operating above 5 030 MHz, the aggregate power flux-density produced at the Earth's surface in the band 5 030-5 150 MHz by all the space stations within any radionavigation-satellite service system (space-to-Earth) operating in the band 5 010-5 030 MHz shall not exceed –124.5 dB (W/m^2) in a 150 kHz band. In order not to cause harmful interference to the radio astronomy service in the band 4 990-5 000 MHz, the aggregate power flux-density produced in the 4 990-5 000 MHz band by all the space stations within any radionavigation-satellite service (space-to-Earth) system operating in the 5 010-5 030 MHz band shall not exceed the provisional value of –171 dB (W/m^2) in a 10 MHz band at any radio astronomy observatory site for more than 2% of the time. For the use of this band, Resolution **604** (WRC-2000) applies (WRC-2000).

5.458A In making assignments in the band 6 700-7 075 MHz to space stations of the fixed-satellite service, administrations are urged to take all practicable steps to protect spectral-line observations of the radio astronomy service in the band 6 650-6 675.2 MHz from harmful interference from unwanted emissions.

5.511A The band 15.43-15.63 GHz is also allocated to the fixed-satellite service (space-to-Earth) on a primary basis. Use of the band 15.43-15.63 GHz by the fixed-satellite service (space-to-Earth and Earth-to-space) is limited to feeder links of non-geostationary systems in the mobile-satellite service, subject to coordination under No **9.11A.** The use of the frequency band 15.43-15.63 GHz by the fixed-satellite service (space-to-Earth) is limited to feeder links of non-geostationary systems in the mobile-satellite service for which advance publication information has been received by the Bureau prior to 2 June 2000. In the space-to-Earth direction, the minimum Earth station elevation angle above and gain towards the local horizontal plane and the minimum coordination distances to protect an Earth station from harmful interference shall be in accordance with Recommendation ITU-R S.1341. In order to protect the radio astronomy service in the band 15.35-15.4 GHz, the aggregate power flux-density radiated in the 15.35-15.4 GHz band by all the space stations within any feeder-link of a non-geostationary system in the mobile-satellite service (space-to-Earth) operating in the 15.43-15.63 GHz band shall not exceed the level of –156 dB(W/m^2) in a 50 MHz bandwidth, into any radio astronomy observatory site for more than 2% of the time (WRC-2000).

5.551G In order to protect the radio astronomy service in the band 42.5-43.5 GHz, the aggregate power flux-density in the 42.5-43.5 GHz band produced by all the space stations in any non-geostationary-satellite system in the fixed-satellite service (space-to-Earth) or in the broadcasting-satellite service (space-to-Earth) system operating in the 41.5-42.5 GHz band shall not exceed –167 dB (W/m^2) in any 1 MHz band at the site of a radio astronomy station for more that 2% of the time. The power flux-density in the band 42.5-43.5 GHz produced by any geostationary station in the fixed-satellite service (space-to-Earth) or in the broadcasting-satellite service (space-to-Earth) operating in the band 42-42.5 GHz shall not exceed –167 dB (W/m^2) in any 1 MHz band at the site of a radio astronomy station. These limits are provisional and will be reviewed in accordance with Resolution **128** (Rev.WRC-2000) (WRC-2000).

5.555 *Additional allocation:* the band 48.94-49.04 GHz is also allocated to the radio astronomy service on a primary basis (WRC-2000).

5.556 In the bands 51.4-54.25 GHz, 58.2-59 GHz and 64-65 GHz, radio astronomy observations may be carried out under national arrangements (WRC-2000).

5.562A In the bands 94-94.1 GHz and 130-134 GHz, transmissions from space stations of the Earth exploration-satellite service (active) that are directed into the main beam of a radio astronomy antenna have the potential to damage some radio astronomy receivers. Space agencies operating the transmitters and the radio astronomy stations concerned should mutually plan their operations so as to avoid such occurrences to the maximum extent possible (WRC-2000).

5.562B In the bands 105-109.5 GHz, 111.8-114.25 GHz, 155.5-158.5 GHz and 217-226 GHz, the use of this allocation is limited to space-based radio astronomy only (WRC-2000).

5.562D *Additional allocation*: In Korea (Rep. of), the bands 128-130 GHz, 171-171.6 GHz, 172.2-172.8 GHz and 173.3-174 GHz are also allocated to the radio astronomy service on a primary basis until 2015 (WRC-2000).

5.565 The frequency band 275-1 000 GHz may be used by administrations for experimentation with, and development of, various active and passive services. In this band a need has been identified for the following spectral-line measurements for passive services:

- radio astronomy service: 275-323 GHz, 327-371 GHz, 388-424 GHz, 426-442 GHz, 453-510 GHz, 623-711 GHz, 795-909 GHz and 926-945 GHz;
- Earth exploration-satellite service (passive) and space research service (passive): 275-277 GHz, 294-306 GHz, 316-334 GHz, 342-349 GHz, 363-365 GHz, 371-389 GHz, 416-434 GHz, 442-444 GHz, 496-506 GHz, 546-568 GHz, 624-629 GHz, 634-654 GHz, 659-661 GHz, 684-692 GHz, 730-732 GHz, 851-853 GHz and 951-956 GHz.

Future research in this largely unexplored spectral region may yield additional spectral lines and continuum bands of interest to the passive services. Administrations are urged to take all practicable steps to protect these passive services from harmful interference until the date when the allocation Table is established in the above-mentioned frequency band (WRC-2000).