

## RADIO ASTRONOMY AT WRC-03<sup>1)</sup>

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### ABSTRACT

Most radio astronomy issues at WRC-03 (World Radiocommunication Conference-03) revolved around satellite downlink allocations, particularly to NGSO (Non-Geostationary Satellite Orbit) satellite systems, in bands adjacent to or close to a radio astronomy frequency band.

Out of a total of 50 agenda items, ten were of interest to radio astronomers. This paper provides some details about the important outcome of the radio astronomy related issues at the WRC-03.

*Keywords* : frequency allocation, active service, passive service, radio astronomy

### 1. INTRODUCTION

International uses of the radio spectrum are regulated by the International Telecommunication Union (ITU), an organ of the United Nations, through the Radio Regulations (RR). Changes to the RR, an International Treaty, are adopted at World Radiocommunication Conferences (WRCs), held every 2-3 or 3-4 years.

The International Table of Allocations is part of the RR (Article 5). Within the current practices of the ITU, Radiocommunication is considered to encompass the spectrum below 3,000 GHz, but at present spectrum allocations cover only up to 275 GHz. ITU-R Recommendations (non-mandatory) are debated and/or adopted within the Radiocommunication Study Groups. Study Groups also elaborate technical bases for WRC action.

WRC-03 was held between 9 June and 4 July 2003 in Geneva, Switzerland. Over 2,200 delegates, the largest number ever, from 138 ITU Member States attended the Conference. The delegates considered some 2,500 proposals, and over 900 numbered documents related to 50 agenda items. The final output of the Conference consists of 527 pages of new and revised text of the Radio Regulations.

Out of a total of 50 agenda items, ten were of interest to radio

astronomers. Most of these involved allocations<sup>1)</sup> to satellite downlinks, adjacent or close to radio astronomy allocations.

20 radio astronomers participated in the Conference, either as members of their national delegations, or as representatives of IUCAF or CRAF, and in some cases as both. Some stayed for a limited time only, others were present for the entire four weeks of the Conference. Radio astronomers in attendance were: W. Baan (The Netherlands), H.S. Chung, Duk-Gyoo Rho, Hyo-Ryoung Kim, Do-Heung Je (Korea), J. Cohen (UK), D. Emerson (IUCAF), T. Gergely (USA), Y. Gupta (IUCAF), M. Lewis (IUCAF), S. Lioubtchenko (Russian Federation and IUCAF), H. Liszt (IUCAF), D. Morris (CRAF), M. Ohishi (Japan), K. Ruf (Germany and IUCAF), T. Spoelstra (The Netherlands), T. Tzioumis (Australia and IUCAF), W. van Driel (France and IUCAF), M. Venkatasubramani (India and IUCAF) and G. Wannberg (IUCAF).

This paper provides some details about the outcome of the radio astronomy related issues at the Conference. It is divided into three part: a) Agenda items (AIs) on which work was completed, and for which there is no further work requirement within the ITU-R (AIs 1.11, 1.13, 1.15, 1.25 and 1.31), b) Agenda items

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that require further study, either in preparation for a future WRC, or within the ITU-R (AIs 1.8.2, 1.16, 1.32 and 7.2) and c) some other actions taken by WRC-03, related to radio astronomy. Relevant extracts from the Final Acts of WRC-03 are given in the Appendix, in order of increasing WRC-03 AI number.

## 2. Final Acts of WRC-03

### 2.1. WRC-03 Agenda Items that require no further ITU-R studies

#### 2.1.1 Agenda Item 1.11

This agenda is to consider possible extension of the allocation to the mobile-satellite service (Earth-to-space) on a secondary basis in the band 14-14.5 GHz to permit operation of the as stipulated in Resolution 216 (Rev.WRC-03).

Following an Inter-American proposal, WRC-03 broadened the existing 14.0-14.5 GHz secondary mobile satellite (Earth-to-space) allocation, to include aeronautical(R) use, which was explicitly excluded prior to WRC-03. The new allocation impacts the 14.47-14.5 GHz secondary radio astronomy allocation, used for observations of the 14.488 GHz formaldehyde line. **Recommendation ITU-R M.1643, Part C, Annex 1** details protection measures to be implemented by aeronautical mobile-satellite service(R) [AMSS(R)] stations to protect radio astronomy stations that observe in this band. This **Recommendation**, along with national arrangements, was deemed to be sufficient by most administrations to protect radio astronomy observations in the 14.47-14.5 GHz band. Spain, France, India, Italy, the United Kingdom and South Africa demanded and received stronger protection, through a new footnote (**5.504B**), that makes mandatory the application of the radio astronomy related provisions of **Recommendation ITU-R M.1643** in the territory of those administrations.

#### 2.1.2 Agenda Item 1.13

This agenda is to consider regulatory provisions and possible identification of existing frequency allocations for services which may be used by high altitude platform stations (HAPS), taking into account No. **5.543A** and the results of the ITU-R studies conducted in accordance with **Resolutions 122 (Rev.WRC-2000)** and **734 (WRC-2000)**.

Prior to WRC-03, footnote **5.543A** allowed use the 31-31.3 GHz band by HAPS (in the ground-to-HAPS direction) in some

Region 3 countries, on condition that, *inter alia*, they do not cause harmful interference to passive services that have a primary allocation in the adjacent 31.3-31.8 GHz band. Several Region 3 countries, as well as one region 1 (Russian Federation) country were added at WRC-03 to the list of those that allow HAPS operations in the 31.0-31.3 GHz band. The strong protection of radio astronomy observations, already in place before WRC-03, was reaffirmed through a slight modification to footnote **5.543A**, which now requires taking into account the relevant **Recommendation ITU-R RA.769** protection level.

Radio astronomers should follow HAPS related developments carefully, as HAPS use of the 31-31.3 GHz band may expand to include other countries in the regions where such use is already authorized, and in Region 2 countries as well, under the terms of **Resolution 145 (WRC-03)**. Further compatibility studies of HAPS services in the 31.0-31.3 GHz and neighboring bands may be conducted (but are not required) under **Resolution 145 (WRC-03)**. These studies are to be reviewed at the next WRC.

#### 2.1.3 Agenda Item 1.15

This agenda is to review the results of studies concerning the radionavigation-satellite service in accordance with **Resolutions 604 (WRC-2000)**, **605 (WRC-2000)** and **606 (WRC-2000)**.

WRC-00 allocated the 5010-5030 MHz band to the Radionavigation Satellite Service (RNSS). The band is to be used by the European Galileo system. WRC-00 sought to protect the 4990 - 5000 MHz radio astronomy band through the adoption of footnote **5.443B**. Footnote **5.443B** mandated a provisional limit on unwanted emissions of the RNSS, consistent with the threshold level in **Recommendation ITU-R RA.769** for this band, to apply at radio astronomy sites. **Resolution 604 (WRC-00)** invited WRC-03 to review the limit, in light of studies conducted within the ITU-R. WRC-03 modified footnote **5.443B** to read: "In order not to cause harmful interference to the radio astronomy service in the band 4 990-5 000 MHz, radionavigation-satellite service systems operating in the band 5 010-5 030 MHz shall comply with the limits in the band 4 990-5 000 MHz defined in **Resolution 741 (WRC03)**. **Resolution 741** directs compliance with per satellite pfd limits for GSO networks and per-system epfd limits for Non-GSO systems, consistent with the pfd threshold value in **Recommendation ITU-R RA.769**.

No. 5.443B modified to direct RNSS stations in 5010-5030 Hz

#### 2.1.4. Agenda Item 1.25

This agenda is to consider, with a view to global harmonization to the greatest extent possible, having due regard to not constraining the development of other services, and in particular of the fixed service and the broadcasting-satellite service, regulatory provisions and possible identification of spectrum for high-density systems in the fixed-satellite service above 17.3 GHz, focusing particularly on frequency bands above 19.7 GHz.

WRC-03 allocated the 48.2-48.54 and 49.44-50.2 GHz bands to the FSS in Region 1 under this Agenda Item. In order to protect the 48.94-49.04 GHz radio astronomy allocation (footnote 5.555), that is used for observations of the 48.991 GHz CS line, the Conference also adopted footnote 5.555A, that imposes mandatory unwanted emission limits from the new FSS allocations into the radio astronomy band. The limit in footnote 5.555A is consistent with the detrimental interference levels in **Recommendation ITU-R RA.769**.

#### 2.1.5. Agenda Item 1.31

This agenda is to consider additional allocations to the mobile-satellite service in the 1-3 GHz band, in accordance with **Resolutions 226 (WRC-2000)** and **227 (WRC-2000)**.

Under pressure from INMARSAT, and with the strong support of the Arab bloc and some European countries, the WRC allocated the 1668-1675 MHz band to the Mobile Satellite Service (Earth-to-space) (MSS), for uplinks by Mobile Earth Stations (MES). Radio astronomy stations that observe in the 1668-1670 MHz band were protected to the appropriate **Recommendation ITU-R RA.769** continuum and spectral line protection levels through a new footnote (5.379C), from in-band transmissions of MES. It should be emphasized that such protection may be provided only to radio astronomy sites that are recorded in the Master International Frequency Register (MIFR) as operating in the 1668-1670 MHz band. No protection was afforded to radio astronomy from unwanted emissions of MES operating in the 1670-1675 MHz portion of the new allocation. Such unwanted emissions may represent a serious problem for observations of the 1665 MHz and particularly the 1668 MHz OH line, if and when the new uplink allocation is implemented.

## 2.2 WRC-03 Agenda Items that require further ITU-R studies

### 2.2.1. Agenda Item 1.8.2

This agenda is about that the consideration of the results of studies, and proposal of any regulatory measures regarding the protection of passive services from unwanted emissions, in particular from space service transmissions, in response to *recommends* 5 and 6 of **Recommendation 66 (Rev.WRC2000)**.

This was one of the most controversial Agenda Items at WRC-03. Studies were carried out within ITU-R TG 1/7 for the last three years; the results of these studies are summarized in **Recommendation ITU-R SM.1633**. While **Recommendation ITU-R SM.1633** represents some minor progress towards the protection of passive services from unwanted emissions, it can hardly be seen as a solution to the problem, even in those band pairs that were specifically studied and are dealt with in the **Recommendation**.

All proposals dealing with this Agenda Item 1.8.2 fell into one of the following groups:

- o **Mandatory limits on unwanted emissions in the Radio Regulations**

This outcome was favored by astronomers, and was supported by most of the European and Asia-Pacific administrations in CEPT and the APT, respectively, at least in certain specific bands. Mandatory regulation was opposed by the U.S.A., Canada, the Russian Federation, the Arab countries and some others.

- o **Mandatory coordination between Administrations, triggered when unwanted emissions by stations of an active service operating in a band adjacent or nearby to a specific passive band exceeds a threshold level in the passive band.**

This approach was favored in the later stages of the Conference, as a compromise by CEPT and the APT, at least in some specific band pairs, but was also opposed by the same countries that opposed mandatory limits.

- o **Resolution, calling for coordination when unwanted emissions by stations of an active service operating in a band adjacent or nearby to a specific passive band exceeds a threshold level in that passive band.**

This approach, that is the closest to the final outcome on this Agenda Item, was favored by Canada.

- o **No regulatory changes, adopt mitigation techniques (if**

**and when problems arise)**

This approach was favored by the U.S.A and a few other Administrations.

The Conference adopted a new footnote (**5.347A**), that calls for the application of **Resolution 739 (WRC-03)** in the 1452-1492 MHz, 1525-1559 MHz, 1613.8-1626.5 MHz, 2655-2670 MHz, 2670-2690 MHz and 21.4-22.0 GHz bands.

**Resolution 739 (WRC-03)**, in turn, calls for consultations between concerned administrations, if unwanted emissions of a satellite system that operates in one of the above bands exceeds the **Recommendation ITU-R RA.769** protection level in the 1400-1427 MHz, 1610.6-1613.8 MHz, 2690-2700 MHz or 22.21-22.5 GHz radio astronomy bands. The **Resolution** establishes the satellite systems, radio observatories, specific band pairs and other circumstances to which the consultation procedure applies. It calls for the initiation of consultation when threshold unwanted emission levels are exceeded either during construction or following launch of a satellite, and states that the objective of the consultation is a mutually acceptable solution. The procedure is not mandatory, does not involve the BR and sets up no enforcement procedure.

**Resolution 740 (WRC-03)** calls for further studies of the threshold levels in the band pairs included in **Resolution 739 (WRC-03)** and also includes the band pairs referenced by footnote **5.208A**. Finally, it calls for the consideration of those studies by WRC-07, with a view of updating the threshold levels in **Resolution 739 (WRC-03)**.

### 2.2.2. *Agenda Item 1.16*

This agenda is to consider allocations on a worldwide basis for feeder links in bands around 1.4 GHz to the non-GSO MSS with service links operating below 1 GHz, taking into account the results of ITU-R studies conducted in response to **Resolution 127 (Rev.WRC-2000)**, provided that due recognition is given to the passive services, taking into account No. **5.340**.

WRC-03 allocated the bands 1 390-1 392 MHz and 1 430-1 432 MHz to the fixed-satellite service, in the Earth-to-space and space-to-Earth directions, respectively, for nongeostationary-satellite networks in the mobile-satellite service with service links below 1 GHz, on a secondary basis and subject to **Resolution 745**

(**WRC-03**). **Resolution 745 (WRC-03)** denies use of the allocation until sharing studies are completed with the other services to which the 1390-1392 and 1430-1432 MHz bands are allocated as well as with passive services in the 1400-1427 MHz band, and the results of these studies are reviewed by WRC-07. This allocation therefore cannot be used until 2007.

### 2.2.3. *Agenda Item 1.32*

This agenda is to consider technical and regulatory provisions concerning the band 37.5-43.5 GHz, in accordance with **Resolutions 128 (Rev.WRC-2000)** and **84 (WRC-2000)**.

Radio astronomy concerns focused on **Resolution 128 (WRC-00)**, that urged ITU-R studies to review the validity of the detrimental threshold level in footnote **5.551G**, adopted at WRC-00 for the protection of radio astronomy observations in the 42.5-43.5 GHz band from unwanted emissions of FSS systems operating in the 40.5-42.5 GHz (an allocation that was first made at WRC-97). WRC-03 reviewed and adjusted the levels in the footnote, to conform to the **Recommendation ITU-R RA.769** detrimental levels for this band. New footnotes **5.551H** and **5.551I** cover the protection of radio astronomy observations in the 42.5-43.5 GHz band from unwanted emissions by non-geostationary (**5.551H**) and geostationary (**5.551I**) FSS and BSS systems, respectively. Satellite interests resisted mandatory protection of the 42.5-43.5 GHz radio astronomy band to the lower band edge and, as a result, in Region 2 mandatory protection applies only to the 42.77-43.5 GHz band. In addition, application of the 2% data loss criterion (**Recommendation ITU-R RA.1513**), that for geostationary satellites results in 0% time interference into the radio astronomy band was not adopted for Region 2, under pressure from satellite interests. The Region 2 exceptions to the protection of the radio astronomy service in the 42.5-43.5 GHz band are detailed in **Resolution 743 (WRC-03)**. This **Resolution** also invites the ITU-R to conduct studies and develop **Recommendations** to establish the appropriate balance between the percentage of time that GSO satellites operating in the 42-42.5 GHz band exceed the single-dish values in No. **5.551I** at the site of a radio astronomy station and the associated impact on radio astronomy observations.

### 2.2.4. *Agenda Item 7.2*

This agenda is to 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, taking into account **Resolution 801 (WRC-2000)**.

#### 2.2.5. WRC-07 Agenda Items

WRC-07 review studies of compatibility between active space services and radio astronomy and update tables of levels and review studies of compatibility between radio astronomy (1400-1427 MHz) and satellite up and downlinks nearby.

Agenda Item 1.17 is to consider the results of ITU-R studies on compatibility between the fixed-satellite service and other services around 1.4 GHz, in accordance with **Resolution 745 (WRC03)**.

Agenda Item 1.21 is to consider the results of studies regarding the compatibility between the radio astronomy service and the active space services in accordance with **Resolution 740 (Rev.WRC03)**, in order to review and update, if appropriate, the tables of threshold levels used for consultation that appear in the **Annex to Resolution 739 (WRC03)**.

Both agenda items continue studies (or, in one case, lack of studies) conducted in preparation for WRC-03; studies invited under **Resolution 745 (WRC03)** (AI 1.17) continue and extend those conducted under **Resolution 127 (WRC-00)**, and studies invited under **Resolution 740 (Rev.WRC03)** (AI 1.21) continue those carried out in TG 1/7, albeit with a much narrower focus.

The preliminary agenda for WRC-10 (**Resolution 803 (WRC-03)**) under AI 2.2 calls for consideration of frequency allocations between 275 GHz and 3 000 GHz, taking into account the result of ITU-R studies, in accordance with **Resolution 950 (WRC03)**. The **Resolution** also allows administrations to submit details of systems which operate between 275 and 3 000 GHz, for inclusion in the Master International Frequency Register (MIFR) and instructs the Radiocommunication Bureau to accept such filings, for inclusion in the MIFR, for information purposes. Finally, agenda item 2.7 in **Resolution 803 (WRC-03)** calls for consideration of the progress of ITU-R studies concerning the technical and regulatory issues relative to the fixed service in the 8186 and 92-100 GHz frequency bands, taking into account **Resolution 731 (WRC2000)**, on sharing between active and passive services above 71 GHz.

A number of other items on the preliminary agendas for WRC-07 and WRC-10, e.g. dealing with expansion of HAPS related

services (WRC-07 preliminary agenda item 1.8) may have a large impact on radio astronomy, and several agenda items will have to be followed carefully by the radio astronomy community.

#### 2.3 Some other actions taken by WRC-03

WRC-03 took some additional actions related to radio astronomy: Under AI 1.30, it added two data elements to the registration of radio astronomy stations:

- 1) The type of radio astronomy station: Single-dish (S) telescope used for spectral-line or continuum observations using single-dishes or closely connected arrays, or very long baseline interferometry (VLBI) (V) station used only for VLBI observations should be specified.
- 2) The minimum elevation angle  $\bullet_{min}$  at which the radio astronomy station conducts single-dish or VLBI observations in the frequency band.

These data elements will have to be submitted to the Bureau, for those stations already registered, and will need to be added in future submissions.

In addition, as proposed by Syria, it revised Article 29.12 § 9 of the Radio Regulations, to read: "In applying the measures outlined in this Section, administrations *should* bear in mind that the radio astronomy service is extremely susceptible to interference from space and airborne transmitters (for further information, see the most recent version of Recommendation ITU-R RA.769)". Previously, administrations were "*urged* to bear in mind..."

### APPENDICES New Regulations and Recommendations Referencing Radio Astronomy

#### Appendix 1. Agenda Item 1.8.2

##### 5. 347A In the bands:

1 452-1 492 MHz,  
1 525-1 559 MHz,  
1 613.8-1 626.5 MHz,  
2 655-2 670 MHz,  
2 670-2 690 MHz,  
21.4-22.0 GHz

**Resolution 740 (WRC03)** applies. (WRC03)

### RESOLUTION 739 (WRC03)

#### Compatibility between the radio astronomy service and the active space services in certain adjacent and nearby frequency bands

The World Radiocommunication Conference (Geneva, 2003),

##### *considering*

- a)* that adjacent or nearby primary service allocations have been made to the radio astronomy service, and to various space services, such as the fixed satellite service (FSS), radionavigation satellite service (RNSS), mobile satellite service (MSS) and broadcasting satellite service (BSS), hereafter referred to as “active space services”;
- b)* that, in many cases, the frequencies used by the radio astronomy service (RAS) are chosen to study natural phenomena producing radio emissions at frequencies fixed by the laws of nature, so shifting frequency to avoid or mitigate interference problems may not be possible;
- c)* that **Recommendation** ITU-R SM.1633 provides a methodology for conducting, and a framework for documenting the results of, compatibility studies between active space service and passive service band-pairs;
- d)* that **Recommendation** ITU-R SM.1633 also provides the results of compatibility studies between a passive service and an active space service in certain adjacent and nearby bands;
- e)* that appropriate consultation between administrations has the potential to lead to the development of innovative solutions and to the rapid deployment of systems;
- f)* that, for technical or operational reasons, more stringent spurious emission limits than the general limits in **Appendix 3** may be required to protect the RAS from active services in specific bands,

##### *noting*

- a)* that the additional burden of undertaking any technical examination should not be placed on the Radiocommunication Bureau;
- b)* that a consultation procedure, as contained in this **Resolution**, would not place an additional burden on the

Radiocommunication Bureau;

- c)* that **Recommendation** ITU-R M.1583 provides a methodology based on the equivalent power flux-density (epfd) concept for calculation of interference resulting from unwanted emissions from non-geostationary (non-GSO) satellite systems of the MSS or RNSS into radio astronomy stations;
- d)* that **Recommendation** ITU-R S.1586 provides a methodology based on the epfd concept for calculation of interference resulting from unwanted emissions from non-GSO systems of the FSS into radio astronomy stations;
- e)* that **Recommendation** ITU-R RA.1631 provides antenna patterns to be used for compatibility analyses between non GSO systems and RAS stations, based on the epfd concept;
- f)* that **Recommendation** ITU-R RA.1513 provides acceptable levels of data loss to radio astronomy observations, stating in particular that the percentage of data loss caused by any system should be lower than 2%;
- g)* that some of the results documented in **Recommendation** ITU-R SM.1633 may be used as threshold levels to initiate the consultation procedure;
- h)* that the results of successful consultation between concerned administrations would ensure that the interests of both the active and passive services are considered;
- i)* that measures taken by active space services to protect radio astronomy stations from interference may result in increased costs and/or reduced capabilities for those services;
- j)* that conversely, not taking such measures may result in additional operating costs and reduced operational effectiveness for the radio astronomy stations concerned;
- k)* that the implementation of additional interference mitigation measures at the radio astronomy station may increase operating costs and reduce observational effectiveness;
- l)* that conversely, not implementing such measures may impose upon the active space services an additional cost burden and reduction in service capability;
- m)* that studies for some of the band-pairs listed in **Recommendation** ITU-R SM.1633 are still in progress,

##### *recognizing*

- a)* that unwanted emissions produced by stations of the active space services may cause unacceptable interference to stations of the RAS;
- b)* that, although some unwanted emissions from transmitters on

space stations can be controlled through careful design methods and appropriate testing procedures, other unwanted emissions, such as narrowband spurious emissions, generated by uncontrollable and/or unpredictable physical mechanisms, may only be detected after the spacecraft is launched;

c) that there is an uncertainty in the pre-launch assessment of the levels of unwanted emissions;

d) that it is necessary to ensure an equitable sharing of burden for achieving compatibility between the active space services and the RAS;

e) that for those cases where difficulties are encountered in meeting the values in the Annex, a consultation procedure could be used to resolve the difficulties,

*resolves*

1 that an administration takes all reasonable steps to ensure that space stations being designed and constructed to operate in the bands in the Annex meet the values given therein at any radio astronomy station operating in the corresponding bands identified in the Annex;

2 that in the event that during construction and prior to launch it is determined that, after having considered all reasonable means, the unwanted emissions from the space station cannot meet the values given in the Annex, the administration that notified the space station contacts, as soon as possible, the administration operating the radio astronomy station:

a) to confirm that *resolves* 1 has been fulfilled; and

b) the concerned administrations enter into a consultation process in order to identify all practicable steps with a view to achieving a mutually acceptable solution;

3 that in the event, following the space station launch, an administration operating a radio astronomy station determines that, due to unexpected circumstances, a space station does not meet the values for unwanted emissions given in the Annex to this **Resolution** at that radio astronomy station, it contacts the administration that notified the space station, so that:

a) the administration that notified the space station confirms that *resolves* 1 has been fulfilled; and

b) the concerned administrations enter into a consultation process in order to identify further steps with a view to achieving a mutually acceptable solution;

4 that the radio astronomy stations to be taken into account in

applying *resolves* 1, 2 and 3 are those which are operating in the frequency band(s) identified in the Annex to this **Resolution** and which are notified before the date of reception of the advance publication information of the space station to which this **Resolution** applies;

5 that the space stations to be considered in the application of the above *resolves* are those designed to operate in the space service frequency bands listed in the Annex for which advance publication information is received by the Radiocommunication Bureau following the entry into force of the Final Acts of this conference;

6 that the objective of the consultation process in *resolves* 1, 2 and 3 is to achieve a mutually acceptable solution, using as guidance **Recommendation** ITU-R SM.1633 and any other ITU-R **Recommendations** deemed relevant by the concerned administrations;

7 that the Radiocommunication Bureau shall make no examination or finding with respect to this **Resolution** under either Article 9 or 11,

*invites administrations*

1 to take all appropriate and practicable steps, from the design phase onward, to ensure that unwanted emissions are minimized from space stations that are planned to operate in one or more space service allocations, in order to avoid exceeding the threshold levels of unwanted emissions identified in the Annex to this **Resolution** at any radio astronomy station;

2 to take all practicable steps, from the design phase onward, to minimize the sensitivity of radio astronomy stations to interference and to take into account the need to implement interference mitigation measures.

ANNEX TO RESOLUTION 739 (WRC-03)

**Unwanted emission threshold levels**

The unwanted emission threshold levels applicable to geostationary space stations are given in Table 1 in terms of power flux-density (pfd) in a reference bandwidth produced at a radio astronomy station.

In Table 1 the unwanted emission threshold levels given in the fourth, sixth and eighth columns (associated with the reference bandwidth contained in the adjacent columns) should be met by space stations operating in the bands indicated in the second

**Table 1.** pfd thresholds for unwanted emissions from geostationary space stations at a radio astronomy station

Space service	Space service Band	Radio Astronomy Band	Single dish, continuum observations		Single dish, spectral line observations		VLBI <sup>(1)</sup>
			pfd <sup>(2)</sup>	Reference bandwidth	pfd <sup>(2)</sup>	Reference bandwidth	pfd <sup>(2)</sup>
	MHz	MHz	dB(W/m <sup>2</sup> )	MHz	dB(W/m <sup>2</sup> )	kHz	dB(W/m <sup>2</sup> )
<b>BSS (s-to-E)</b> <b>MSS (s-to-E)</b>	1 452-1 492 1 525-1 559	1 400-1 427	-180	27	-196	20	-166
<b>MSS (s-to-E)</b> <b>MSS (s-to-E)</b>	1 525-1 559 1 613.8- 1 626.5	1 610.6- 1 613.8	NA	NA	-194	20	-166
<b>BSS (s-to-E) FSS (s-to-E)</b>	2 655-2 670	2 690-2 700	-177	10	SI	25	-161
<b>FSS (s-to-E)</b>	2 670-2 690	2 690-2 700 (in Regions 1 and 3)	-177	10	SI	20	-161
	GHz	GHz					
<b>BSS (s-to-E)</b>	21.4-22.0	22.21-22.5	SI	SI	SI	250	-128
NA: Not applicable, measurements of this type are not made in this band.							
NR: No result available.							
<sup>(1)</sup> The reference bandwidth used for spectral line observations has also been used as reference bandwidth for very long baseline interferometry (VLBI) observations. In VLBI bands, where no spectral line observations are conducted, the reference bandwidth for VLBI observations has been determined using the assumption of Recommendation ITU-R RA.769 for a typical spectrometer channel (3 km/s)							
<sup>(2)</sup> Integrated over the reference bandwidth with an integration time of 2,000 s.							

column at the radio astronomy station operating in the band mentioned in the third column.

The unwanted emission threshold levels applicable to space stations of non-geostationary systems are given in Table 2 in terms of the equivalent power flux-density (epfd), produced at a radio astronomy station in a reference bandwidth, not to be exceeded during a given percentage of time, over the whole sky.

In Table 2 the epfd value given in the fourth, sixth and eighth columns (associated with the reference bandwidths contained in the adjacent column) should be met by space stations operating in the bands indicated in the second column at the radio astronomy station operating in the band mentioned in the third column. The epfd value at a given radio astronomy station shall be evaluated by using the antenna pattern and the RAS maximum antenna gain given in **Recommendation ITU-R RA.1631**. Guidance on the calculation of epfd can be found in **Recommendations ITU-R S.1586** and **ITU-R M.1583**. The elevation angles of the radio astronomy stations to be taken into

account in the epfd calculation are those higher than the minimum elevation angle  $\theta_{min}$  of the radio telescope. In the absence of such information a value of 5° shall be taken. The percentage of time during which the epfd level shall not be exceeded is mentioned in Note <sup>(1)</sup> of Table 2.

#### RESOLUTION 740 (WRC-03)

##### Future compatibility analyses between the radio astronomy service and active space services in certain adjacent and nearby frequency bands

The World Radiocommunication Conference (Geneva, 2003),

*considering*

a) that adjacent or nearby primary service allocations have been made to the radio astronomy service (RAS), and to various space services, such as the fixed-satellite service (FSS), mobile-satellite



**Table 2** epfd thresholds<sup>(1)</sup> for unwanted emissions from non-GSO satellite systems  
at a radio astronomy station

Space service	Space service Band	Radio Astronomy Band	Single dish, continuum observations		Single dish, spectral line observations		VLBI <sup>(2)</sup>
			epfd <sup>(3)</sup>	Reference bandwidth	epfd <sup>(3)</sup>	Reference bandwidth	epfd <sup>(3)</sup>
	MHz	MHz	dB(W/m <sup>2</sup> )	MHz	dB(W/m <sup>2</sup> )	kHz	dB(W/m <sup>2</sup> )
<b>MSS (s-to-E)</b>	1 613.8- 1 626.5	1 610.6- 1 613.8	NA	NA	-258	20	-230
NA: Not applicable, measurements of this type are not made in this band. (1) These epfd thresholds should not be exceeded for more than 2% of time. (2) The reference bandwidth used for spectral line observations has also been used as reference bandwidth for VLBI observations. In VLBI bands, where no spectral line observations are conducted, the reference bandwidth for VLBI observations has been determined using the assumption of Recommendation ITU-R RA.769 for a typical spectrometer channel (3 km/s). (3) Integrated over the reference bandwidth with an integration time of 2 000 s.							

service (MSS), broadcasting-satellite service (BSS) and radionavigation satellite service (RNSS), hereafter referred to as “active space services”;

*b)* that unwanted emissions from active space services may cause unacceptable interference to the RAS;

*c)* that, for technical or operational reasons, the general limits in Appendix 3 may be insufficient in protecting the RAS in specific bands;

*d)* that, in many cases, the frequencies used by the RAS are chosen to study natural phenomena producing radio emissions at frequencies fixed by the laws of nature, and therefore shifting frequency to avoid or mitigate interference problems may not be possible;

*e)* that **Recommendation** ITU-R SM.1633 provides a list of band-pairs and a methodology for conducting, and a framework for documenting the results of, the compatibility studies between certain active and passive services operating in specific adjacent and nearby band-pairs;

*f)* that it is necessary to ensure an equitable burden sharing for achieving compatibility between active and passive services,

*recognizing*

*a)* that **Recommendation** ITU-R SM.1633 addresses the compatibility between the RAS and the active space services in specific band-pairs;

*b)* that the relevant annexes in **Recommendation** ITU-R SM.1633 need further refinement;

*c)* that measures beyond the general unwanted emission limits in Appendix 3 may be required to protect the RAS from unwanted emissions of active space services for the band-pairs listed in the Table 3,

*resolves*

1 to invite ITU-R to study the compatibility between the RAS and the corresponding active space services as listed in the Table only, with a view to updating or developing ITU-R **Recommendations**, if appropriate;

2 that WRC-07 should consider the results of the studies as identified in *resolves* 1, in order to review and update, if appropriate, the tables of threshold levels for consultation in the Annex to **Resolution 739 (WRC-03)**,

*invites administrations*

to actively participate in the ITU-R studies identified in *resolves* 1 and to provide, where practicable, the relevant characteristics of active and passive service systems operating in the bands identified in the Table 3 to this **Resolution**, as well as to indicate the impact on all concerned services of implementing or not implementing the compatibility solutions.

**Appendix 2. Agenda Item 1.11**

**5.504B** Aircraft earth stations operating in the aeronautical mobile-satellite service in the band 14-14.5 GHz shall comply

Table 3. Band-pairs to be considered for further studies

Space service band	Space service	Radio astronomy service band
MHz		MHz
137-138	MSS (space-to-Earth)	150.05-153.0 (No. 5.208A)
387-390	MSS (space-to-Earth)	322-328.6 (No. 5.208A)
400.15-401	MSS (space-to-Earth)	406.1-410 (No. 5.208A)
620-790 (No. 5.311) see Resolution 545 (WRC-03)	BSS (space-to-Earth)	608-614
1 452-1 492	BSS (space-to-Earth) (non-GSO systems only)	1 400-1 427
1 525-1 559	MSS (space-to-Earth) (non-GSO systems only)	1 400-1 427
1 525-1 559	MSS (space-to-Earth) (non-GSO systems only)	1 610.6-1 613.8
1 559-1 610	RNSS (space-to-Earth)	1 610.6-1 613.8
2 655-2 670	BSS (space-to-Earth)	2 690-2 700
2 655-2 670	FSS (space-to-Earth) (Region 2)	2 690-2 700
2 670-2 690	FSS (space-to-Earth) (Region 2)	2 690-2 700
GHz		GHz
10.7-10.95	FSS (space-to-Earth)	10.6-10.7
21.4-22.0	BSS (space-to-Earth)	22.21-22.5

with the provisions of Annex 1, Part C of **Recommendation ITU-R M.1643**, with respect to any radio astronomy station performing observations in the 14.47-14.5 GHz band located on the territory of Spain, France, India, Italy, the United Kingdom and South Africa. (WRC-03)

#### RECOMMENDATION ITU-R M.1643

**Technical and operational requirements for aircraft earth stations of aeronautical mobile-satellite service including those using fixed-satellite service network transponders in the band 14-14.5 GHz (Earth-to-space)**

(2003)

The ITU Radiocommunication Assembly,

*considering*

a) that various technically and operationally different aeronautical mobile-satellite service (AMSS) networks have been

designed to commence operation in the near future;

b) that these planned AMSS networks may provide access to a variety of broadband communication applications (Internet, email, internal corporate networks) to and from aircraft on a global basis;

c) that the aircraft earth station (AES) will operate on national and international airlines around the world;

d) that circulation of AES is usually a subject of a number of national and international rules and regulations including satisfactory conformance to a mutually agreed technical standard and operational requirements;

e) that there is a need for identifying the technical and operational requirements for the conformance testing of AES;

f) that the identification of technical and operational requirements for AES would provide a common technical basis for facilitating conformance testing of AES by various national and international authorities and the development of mutual recognition arrangements for conformance of AES;

g) that the technical and operational requirements need to achieve an acceptable balance between radio equipment complexity and the need for effective use of the radio-frequency,

*considering also*

- a) that in the frequency band 14-14.5 GHz there are allocations to the FSS (Earth-to-space), radionavigation, fixed and mobile (except aeronautical mobile) services on a primary basis; that secondary services allocated in the band 14-14.5 GHz or in parts of the band include mobile-satellite (except aeronautical mobile-satellite) service (Earth-to-space), space research service, radio astronomy service, and radionavigation-satellite service;
- b) that there is a requirement to fully protect all primary services and pre-existing systems of secondary services in the band 14-14.5 GHz;
- c) that results of the studies conducted in accordance with **Resolution 216** (Rev.WRC-2000) showed the feasibility of using the band 14-14.5 GHz by AMSS (Earth-to-space) on a secondary basis under certain conditions and arrangements<sup>1</sup>;
- d) that the identification by ITU-R of technical and operational requirements for AES operating in the band 14-14.5 GHz could assist administrations to prevent harmful and/or unacceptable interference to other services;
- e) that technical and operational characteristics should be continuously and accurately measurable and controllable,

*recommends*

1 that the technical and operational requirements for aircraft earth stations of AMSS networks operating in the band 14-14.5 GHz given in Annexes 1 and 2 be used by administrations as a guideline for:

- a) establishing conformance requirements for AES;
- b) facilitating AES operations.

## ANNEX 1

### Part C

#### Essential requirements related to sharing with the radio astronomy service

In order to protect the radio astronomy in the band 14.47-14.5 GHz, AMSS earth stations should comply with both following measures:

#### *AMSS channels in the 14.47-14.5 GHz band*

- AMSS stations do not transmit in the 14.47-14.5 GHz band within line-of-sight of radio astronomy stations operating within this band;

or,

- if an AMSS operator intends to operate co-frequency within the visibility of the radio astronomy station, a specific agreement with the radio astronomy station will be needed to ensure that AMSS AES will meet the requirements of **Recommendations** ITU-R RA.769 and ITU-R RA.1513 within the 14.47-14.5 GHz band during observations. Where practicable, this may include advance information to AMSS operators regarding observation schedules.

#### *AMSS channels in the 14-14.47 GHz band*

All AES transmitters on channels in the 14-14.47 GHz band within line-of-sight of radio astronomy stations during radio astronomy observations have emissions in the band 14.47-14.5 GHz such that they meet the levels and percentage of data loss given in **Recommendations** ITU-R RA.769 and ITU-R RA.1513. Results from studies show that the following AES pfd levels (dB(W/(m<sup>2</sup> • 150 kHz))) in the band 14.47-14.5 GHz are sufficient, with some margin, to meet the radio astronomy pfd levels in **Recommendation** ITU-R RA.769 and the percentage of data loss given in **Recommendation** ITU-R RA.1513, i.e.:

$$-190 + 0.5 \cdot \theta \quad \text{dB(W/(m}^2 \cdot 150 \text{ kHz)) for } \theta \leq 10^\circ$$

$$-185 \text{ dB(W/(m}^2 \cdot 150 \text{ kHz)) for } 10^\circ < \theta \leq 90^\circ$$

where  $\theta$  is the angle of arrival of the radio-frequency wave (degrees above the horizontal).

Such AES pfd levels in the band 14.47-14.5 GHz may be achieved by the AMSS operators through a combination of reduced AES signal power, sharp filtering, maintaining adequate frequency separation, or better AES antenna performance.

#### Appendix 3. Agenda Item 1.13

**5.543A** In Bhutan, Korea (Rep. of), the Russian Federation, Indonesia, Iran (Islamic Republic of), Japan, Kazakhstan,

Lesotho, Malaysia, Maldives, Mongolia, Myanmar, Uzbekistan, Pakistan, Philippines, Kyrgyzstan, the Dem. People's Rep. of Korea, Sri Lanka, Thailand and Viet Nam, the allocation to the fixed service in the band 31-31.3 GHz may also be used by systems using high altitude platform stations (HAPS) in the ground-to-HAPS direction. The use of the band 31-31.3 GHz by systems using HAPS is limited to the territory of the countries listed above and shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems, systems in the mobile service and systems operated under No. 5.545. Furthermore, the development of these services shall not be constrained by HAPS. Systems using HAPS in the band 31-31.3 GHz shall not cause harmful interference to the radio astronomy service having a primary allocation in the band 31.3-31.8 GHz, taking into account the protection criterion as given in Recommendation ITU-R RA.769. In order to ensure the protection of satellite passive services, the level of unwanted power density into a HAPS ground station antenna in the band 31.3-31.8 GHz shall be limited to -106 dB(W/MHz) under clear-sky conditions, and may be increased up to -100 dB(W/MHz) under rainy conditions to take account of rain attenuation, provided the effective impact on the passive satellite does not exceed the impact under clear-sky conditions as given above. See Resolution 145 (WRC-03).

#### RESOLUTION 145 (WRC-03)

##### Potential use of the bands 27.5-28.35 GHz and 31-31.3 GHz by high altitude platform stations (HAPS) in the fixed service

The World Radiocommunication Conference (Geneva, 2003),

*considering*

- a) that WRC-97 made provision for the operation of HAPS, also known as stratospheric repeaters, within a  $2 \times 300$  MHz portion of the fixed-service allocation in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;
- b) that WRC-97 adopted No. 4.15A specifying that transmissions to or from HAPS shall be limited to the bands specifically identified in Article 5;
- c) that at WRC-2000, several countries in Region 3 and one country in Region 1 expressed a need for a lower frequency band for HAPS due to the excessive rain attenuation that occurs at

47 GHz in these countries;

- d) that at the present Conference, countries in Region 2 also expressed an interest in using a frequency range lower than those referred to in *considering a*);
- e) that, in order to accommodate the need expressed by the countries referred to in *considering c*), WRC-2000 adopted Nos. 5.537A and 5.543A, which were modified at this Conference to permit the use of HAPS in the fixed service within 300 MHz of spectrum in the band 27.5-28.35 GHz and in the band 31-31.3 GHz in certain Region 3 countries and in one Region 1 country on a non-harmful interference, non-protection basis;
- f) that the bands 27.5-28.35 GHz and 31-31.3 GHz are already heavily used or planned to be used by a number of different services and a number of other types of applications in the fixed service;
- g) that while the decision to deploy HAPS can be taken on a national basis, such deployment may affect neighboring administrations, particularly in small countries;
- h) that the 31.3-31.8 GHz band is allocated to the radio astronomy, Earth exploration-satellite (passive) and space research (passive) services, and that this Conference amended No. 5.543A to specify signal levels that would protect satellite passive services and radio astronomy stations;
- i) that ITU-R has conducted studies dealing with sharing between systems using HAPS in the fixed service and other types of systems in the fixed service in the bands 27.5-28.35 GHz and 31-31.3 GHz leading to Recommendation ITU-R F.1609;
- j) that results of some ITU-R studies indicate that, in the bands 27.5-28.35 GHz and 31-31.3 GHz, sharing between fixed-service systems using HAPS and other conventional fixed-service systems in the same area will require appropriate interference mitigation techniques to be developed and implemented;
- k) that ITU-R has conducted studies dealing with compatibility between systems using HAPS and the passive services in the 31.3-31.8 GHz band leading to Recommendations ITU-R F.1570 and ITU-R F.1612;
- l) that ITU-R has produced Recommendation ITU-R SF.1601 containing a methodology for evaluating interference from the fixed-service system using HAPS into GSO FSS systems in the band 27.5-28.35 GHz in order to facilitate further studies;
- m) that HAPS technical and regulatory issues should continue to be studied in order to determine appropriate measures for

protecting the fixed service and other co-primary services in the band 27.5-28.35 GHz;

n) that pending the completion of studies, administrations in Region 2 may wish to consider deployment of HAPS systems in the fixed service within 300 MHz of spectrum at 27.5-28.35 GHz and in 300 MHz of spectrum at 31-31.3 GHz and to have some provisional means by which to authorize such use of HAPS in their territories,

*noting*

that systems using HAPS may operate in the bands 27.5-28.35 GHz and 31-31.3 GHz under No. 4.4,

*resolves*

1 to invite WRC-07 to review the results of the studies specified below and consider appropriate refinement of the regulatory provisions for the use of HAPS within the bands 27.5-28.35 GHz and 31-31.3 GHz;

2 that, notwithstanding No. 4.15A, in Region 2 the use of HAPS within the fixed-service allocations within the 27.5-28.35 GHz and 31-31.3 GHz bands shall be limited, pending the completion of the studies specified in *invites ITU-R 1* below, to 300 MHz in each band, that such use shall not cause harmful interference to, nor claim protection from, other stations of services operating in accordance with the Table of Frequency Allocations of Article 5, and, further, that the development of these other services shall proceed without constraints by HAPS operating pursuant to this resolution;

3 that, pursuant to *resolves 2* above, any use by HAPS of the fixed-service allocation at 27.5-28.35 GHz shall be limited to operation in the HAPS-to-ground direction, and that any use by HAPS of the fixed-service allocation at 31-31.3 GHz shall be limited to operation in the ground-to-HAPS direction;

4 that, on a provisional basis, the administrations listed in Nos. 5.537A and 5.543A and those administrations in Region 2 which intend to implement systems using HAPS in the fixed service in the bands 27.5-28.35 GHz and 31-31.3 GHz shall seek explicit agreement of concerned administrations with regard to their primary services to ensure that the conditions in Nos. 5.537A, 5.543A, *resolves 2* and *resolves 5* are met;

5 that systems using HAPS in the band 31-31.3 GHz, in accordance with *resolves 2* above, shall not cause harmful interference to the radio astronomy service having a primary allocation in the band 31.3-31.8 GHz, taking into account the

protection criterion given in **Recommendation ITU-R RA.769**. In order to ensure the protection of satellite passive services, the level of unwanted power density into the HAPS ground station antenna in the band 31.3-31.8 GHz shall be limited to -106 dB(W/MHz) under clear-sky conditions and may be increased up to -100 dB(W/MHz) under rainy conditions to take account of rain attenuation, provided that effective impact on the passive satellite does not exceed the impact under clear-sky conditions as given above,

*invites ITU-R*

1 to continue to conduct studies, as a matter of urgency, and taking into account the requirements of other fixed-service systems and other services, on the feasibility of identifying a suitable and preferably a common 300 MHz segment of the band 27.5-28.35 GHz paired with the 300 MHz band at 31-31.3 GHz, for use by HAPS in the countries listed in Nos. 5.537A and 5.543A or countries in Region 2 planning provisional operation;

2 to develop, one or more ITU-R **Recommendations**, technical sharing criteria or HAPS system design conditions that are necessary to ensure that HAPS applications in the fixed service operate successfully on a non-harmful interference, non-protected basis in the bands 27.5-28.35 GHz and 31-31.3 GHz;

3 to complete studies on the interference criteria and methodology for evaluating interference from the downlink (HAPS-to-ground direction) of systems using HAPS to the uplink of the GSO satellite networks in the FSS within the band 27.5-28.35 GHz, taking into account **Recommendation ITU-R SF.1601** for the situations referred to in *considering l*);

4 to study the regulatory provisions that might be needed in order to address those cases where the deployment of HAPS in the fixed service in the bands 27.5-28.35 GHz and 31-31.3 GHz in the territory of one administration may affect other administrations;

5 to continue to carry out studies on the appropriate interference mitigation techniques for the situations referred to in *considering j*),

*invites administrations*

to advise the Radiocommunication Bureau of their intention to implement HAPS systems within the band 27.5-28.35 GHz and in the band 31-31.3 GHz, whether in countries listed in Nos. 5.537A and 5.543A or in accordance with *resolves 2*, and to

specify the frequency bands (up to 300 MHz each within the 27.5-28.35 GHz and 31-31.3 GHz bands) they intend to use for such systems,

*instructs the Director of the Radiocommunication Bureau*

to publish in the International Frequency Information Circular (BR IFIC) a list of administrations who have so advised, and to publish the information on HAPS implementation received from administrations which intend to implement systems using HAPS in the fixed service in the bands 27.5-28.35 GHz and 31-31.3 GHz.

#### Appendix 4. Agenda Item 1.15

**5.443B** 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<sup>2</sup>) 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, radionavigation-satellite service systems operating in the band 5 010-5 030 MHz shall comply with the limits in the band 4 990-5 000 MHz defined in **Resolution 741 (WRC-03)**.

#### RESOLUTION 741(WRC-03)

##### **Protection of the radio astronomy service in the band 4 990-5 000 MHz from unwanted emissions of the radionavigation-satellite service (space-to-Earth) operating in the frequency band 5 010-5 030 MHz**

The World Radiocommunication Conference (Geneva, 2003),

*considering*

a) that unwanted emissions from space stations of the radionavigation-satellite service (RNSS) operating in the frequency band 5 010-5 030 MHz may cause interference to the radio astronomy service (RAS) in the band 4 990-5 000 MHz;

b) that WRC-2000 decided to introduce a provisional power flux-density (pfd) limit in the band 4 990-5 000 MHz to protect the RAS, and invited ITU-R to conduct studies to review this limit;

c) that protection requirements for the RAS are given in **Recommendations** ITU-R RA.769 and ITU-R RA.1513, and are different for geostationary (GSO) and non-geostationary (non-GSO) satellite systems,

*noting*

a) that **Recommendation** ITU-R M.1583 provides a methodology based on the equivalent pfd (epfd) concept for calculation of interference resulting from unwanted emissions from non-GSO systems of the mobile-satellite or radionavigation-satellite services into radio astronomy stations;

b) that **Recommendation** ITU-R RA.1631 provides antenna patterns and maximum antenna gain to be used for compatibility analyses between non-GSO systems and RAS stations based on the epfd concept;

c) that **Recommendation** ITU-R RA.1513 recommends acceptable levels of data loss to radio astronomy observations, stating in particular that the percentage of data loss caused by any system should be lower than 2%,

*resolves*

1 that in order not to cause harmful interference to the radio astronomy service in the band 4 990-5 000 MHz, the pfd produced in this band by any GSO RNSS network operating in the 5 010-5 030 MHz band shall not exceed  $-171$  dB(W/m<sup>2</sup>) in a 10 MHz band at any radio astronomy station;

2 that in order not to cause harmful interference to the radio astronomy service in the band 4 990-5 000 MHz, over the whole sky, for elevations higher than the minimum operating elevation angle  $\gamma_{min}$  specified for the radio telescope, the epfd produced in this band by all space stations within any non-GSO RNSS system operating in the 5 010-5 030 MHz band shall not exceed  $-245$  dB(W/m<sup>2</sup>) in a 10 MHz band at any radio astronomy station for more than 2% of the time, using the methodology in **Recommendation** ITU-R M.1583 and a reference antenna with a radiation pattern and maximum antenna gain given in **Recommendation** ITU-R RA.1631;

3 that the limits referred to in *resolves* 1 and 2 shall apply to RNSS systems as from 3 June 2000;

4 that administrations planning to operate a GSO or a non-GSO

RNSS system in the band 5 010-5 030 MHz, for which complete coordination or notification information, as appropriate, has been received by the Bureau after 2 June 2000, shall send to the Radiocommunication Bureau the value of the maximum level of pfd as referred to in *resolves* 1 or the value of the maximum level of epfd as referred to in *resolves* 2, as appropriate,

*instructs the Radiocommunication Bureau*  
as from the end of WRC-03, to review all RNSS systems for which complete coordination or notification information, as appropriate, has been received by the Bureau before the end of WRC-03 for the band 5 010-5 030 MHz, and, if appropriate, to revise its findings regarding compliance with No. **5.443B**, taking into account additional information received under *resolves* 4.

#### Appendix 5. Agenda Item 1.16

**5.339A** *Additional allocation:* the band 1 390-1 392 MHz is also allocated to the fixed-satellite service (Earth-to-space) on a secondary basis and the band 1 430-1 432 MHz is also allocated to the fixed-satellite service (space-to-Earth) on a secondary basis. These allocations are limited to use for feeder links for non-geostationary-satellite networks in the mobile-satellite service with service links below 1 GHz, and **Resolution 745 (WRC-03)** applies.

#### RESOLUTION 745 (WRC-03)

##### Protection of existing services in all Regions from non-geostationary-satellite networks in the fixed-satellite service using the frequency bands around 1.4 GHz on a secondary basis

The World Radiocommunication Conference (Geneva, 2003),

*considering*

*a)* that the agenda of this Conference included consideration of the adoption of allocations for feeder links for the non-geostationary (non-GSO) systems in the mobile-satellite service (MSS) around 1.4 GHz;

*b)* that the band 1 350-1 400 MHz is allocated on a primary basis to the radiolocation, fixed and mobile services in Region 1 and to

the radiolocation service in Regions 2 and 3;

*c)* that Nos. **5.149**, **5.338** and **5.339** also apply to the band 1 350-1 400 MHz;

*d)* that the band 1 400-1 427 MHz is allocated to the Earth exploration-satellite service (EESS) (passive), radio astronomy and space research (passive) services on a primary basis in all Regions;

*e)* that No. **5.340** also applies to the band 1 400-1 427 MHz;

*f)* that the band 1 427-1 429 MHz is allocated in all Regions to the space operation (Earth-to-space), fixed and mobile (except aeronautical mobile) services on a primary basis;

*g)* that No. **5.341** also applies to the band 1 400-1 452 MHz;

*h)* that the band 1 429-1 452 MHz is allocated on a primary basis to the fixed service in all Regions, to the mobile service (except aeronautical mobile) in Region 1 and to the mobile service in Regions 2 and 3;

*I)* that No. **5.342** also applies to the band 1 429-1 452 MHz in Region 1;

*j)* that the Report of the 2002 Conference Preparatory Meeting (CPM-02) indicated that there were significant technical challenges to be overcome in some areas if existing services, particularly passive services, were to be protected from harmful interference from the operation of feeder links around 1.4 GHz;

*k)* that the Report of CPM-02 also indicated that studies in ITU-R were incomplete for the radio astronomy, EESS (passive), space research, aeronautical mobile (aeronautical mobile telemetry (AMT)) and radiolocation services,

*recognizing*

that secondary allocations around 1.4 GHz to the fixed-satellite service (FSS) for feeder links for non-GSO satellite systems in the MSS with service links below 1 GHz may support the development of new services on a global basis,

*resolves*

1 that the additional allocations for the FSS on a secondary basis in the bands 1 390-1 392 MHz and 1 430-1 432 MHz for feeder links in the (Earth-to space) and (space-to-Earth) directions, respectively, for non-GSO satellite systems in the MSS with service links operating below 1 GHz, shall not be used until the completion of ITU-R studies on all identified compatibility issues as shown in Annex 1 to this **Resolution** and the results of these studies shall be reported to WRC-07 and the decisions should be taken by WRC-07 accordingly;

2 to recommend that decisions taken by WRC-07, including any provisions for the protection of other services to which the bands in *resolves* 1 are allocated, and of passive services in the adjacent band, apply to all non-GSO FSS systems in these bands filed to the Bureau after 5 July 2003,

*further resolves to invite ITU-R, as a matter of urgency*

1 to continue studies, and to carry out tests and demonstrations to validate the studies on operational and technical means to facilitate sharing around 1.4 GHz, including the frequency band 1 390-1 392 MHz, between existing and currently planned services and FSS feeder links (Earth-to-space) for use by non-GSO satellite systems in the MSS with service links operating below 1 GHz;

2 to conduct studies and carry out tests and demonstrations to validate the studies on operational and technical means to facilitate sharing around 1.4 GHz, including the frequency band 1 430-1 432 MHz, between existing and currently planned services and FSS feeder links (space-to-Earth) for use by nonGSO satellite systems in the MSS with service links operating below 1 GHz;

3 to carry out studies, including the measurement of emissions

to validate that the systems meet all requirements for the protection of passive services in the band 1 400-1 427 MHz from unwanted emissions from FSS feeder links around 1.4 GHz for non-GSO satellite systems in the MSS with service links operating below 1 GHz;

4 to study the power flux-density (pfd) values required to protect sensors of the EESS (passive) operating in the band 1 400-1 427 MHz.

#### Appendix 6. Agenda Item 1.25

**5.555A** The power flux-density in the band 48.94-49.04 GHz produced by any geostationary space station in the fixed-satellite service (space-to-Earth) operating in the bands 48.2-48.54 GHz and 49.44-50.2 GHz shall not exceed  $-151.8$  dB (W/m<sup>2</sup>) in any 500 kHz band at the site of any radio astronomy station. (WRC-03)

#### ANNEX 1 Compatibility issues Earth-to-space

Service	Parameter of concern	1 350-1 400 MHz	1 400-1 427 MHz
Fixed service		Note 1	Note 2
Mobile service		Note 1	Note 2
Radiolocation	pfd limits	Note 1	Note 2
EESS (passive) (secondary) (No. 5.339)	e.i.r.p. limits	Note 1	Note 2
Radio astronomy	pfd limits, separation distances	Note 1	Note 1
EESS (passive)	unwanted emission limits; limited filter rejection	Note 2	Note 1
Space research (passive)	pfd limits	Note 2	No issue

from equipment that would be employed in operational systems,

#### Appendix 7. Agenda Item 1.31



## space-to-Earth

Service	Parameter of concern	1 350-1 400 MHz	1 400-1 427 MHz	1 429-1 452 MHz
Fixed service	pdf limits	Note 1	Note 2	Note 1
Mobile service	pdf limits; FSS shall not cause harmful interference	Note 1	Note 2	Note 1
Aeronautical mobile (AMT)	pdf limits	Note 2	Note 2	Note 1
Radio astronomy	epfd limits; issue % of time	Notes 1 and 2	Note 1	Note 2
EESS (passive)	unwanted emission limits; limited filter rejection	Note 2	Note 1	Note 2
Space research (passive)	pdf limits	Note 2	Note 1	Note 2

NOTE 1 – study considered in this **Resolution**

NOTE 2 – no allocation (for radio astronomy: No. **5.149** applies to the band 1 350-1 400 MHz)

**5.379C** In order to protect the radio astronomy service in the band 1 668-1 670 MHz, the aggregate power flux-density (pdf) values produced by mobile earth stations in a network of the mobile-satellite service operating in this band shall not exceed 181 dB(W/m<sup>2</sup>) in 10 MHz and 194 dB(W/m<sup>2</sup>) in any 20 kHz at any radio astronomy station recorded in the Master International Frequency Register, for more than 2% of integration periods of 2 000 s. (**WRC-03**)

#### Appendix 8. Agenda Item 1.32

**5.551H** The equivalent power flux-density (epfd) produced in the band 42.5-43.5 GHz by all 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) operating in the 42-42.5 GHz band, shall not exceed the following values at the site of any radio astronomy station for more than 2% of the time:

-230 dB(W/m<sup>2</sup>) in 1 GHz and -246 dB(W/m<sup>2</sup>) in any 500 kHz of the 42.5-43.5 GHz band at the site of any

radio astronomy station registered as a single-dish telescope; and

-209 dB(W/m<sup>2</sup>) in any 500 kHz of the 42.5-43.5 GHz band at the site of any radio astronomy station registered as a very long baseline interferometry station.

These epfd values shall be evaluated using the methodology given in **Recommendation ITU-R S.1586** and the reference antenna pattern and the maximum gain of an antenna in the radio astronomy service given in **Recommendation ITU-R RA.1631** and shall apply over the whole sky and for elevation angles higher than the minimum operating angle  $\theta_{min}$  of the radiotelescope (for which a default value of 5° should be adopted in the absence of notified information).

These values shall apply at any radio astronomy station that either:

- was in operation prior to the end of WRC-03 and has been notified to ITU before 4 January 2004; or
- was notified before the date of receipt of the complete Appendix 4 information for coordination or notification, as appropriate, for the space station to which the limits apply.

Other radio astronomy stations notified after these dates may

seek an agreement with administrations that have authorized the space stations. In Region 2, **Resolution 743 (WRC-03)** shall apply. The limits in this footnote may be exceeded at the site of a radio astronomy station of any country whose administration so agreed. (WRC-03)

**5.551I** The power flux-density in the band 42.5-43.5 GHz produced by any geostationary space station in the fixed-satellite service (space-to-Earth), or the broadcasting-satellite service (space-to-Earth) operating in the 42-42.5 GHz band, shall not exceed the following values at the site of any radio astronomy station:

- 137 dB(W/m<sup>2</sup>) in 1 GHz and -153 dB(W/m<sup>2</sup>) in any 500 kHz of the 42.5-43.5 GHz band at the site of any radio astronomy station registered as a single-dish telescope; and
- 116 dB(W/m<sup>2</sup>) in any 500 kHz of the 42.5-43.5 GHz band at the site of any radio astronomy station registered as a very long baseline interferometry station.

These values shall apply at the site of any radio astronomy station that either:

- was in operation prior to the end of WRC-03 and has been notified to ITU before 4 January 2004; or
- was notified before the date of receipt of the complete Appendix 4 information for coordination or notification, as appropriate, for the space station to which the limits apply.

Other radio astronomy stations notified after these dates may seek an agreement with administrations that have authorized the space stations. In Region 2, **Resolution 743 (WRC-03)** shall apply. The limits in this footnote may be exceeded at the site of a radio astronomy station of any country whose administration so agreed. (WRC-03)

#### RESOLUTION 743 (WRC-03)

##### Protection of single-dish radio astronomy stations in Region 2 in the 42.5-43.5 GHz band

The World Radiocommunication Conference (Geneva, 2003),

*considering*

*a)* that the band 42.5-43.5 GHz is allocated to the radio astronomy service (RAS) on a primary basis, and that both continuum and spectral line observations are conducted in this band;

*b)* that there are primary allocations to the fixed-satellite service (FSS) (space-to-Earth) and to the broadcasting-satellite service (BSS) in the 42-42.5 GHz band;

*c)* that a geostationary (GSO) FSS or BSS satellite operating in the 42-42.5 GHz band could encounter great difficulty in meeting the values given in No. **5.BC05** for single-dish radio telescope observations in the 42.5-43.5 GHz band for 100% of the time;

*d)* that an FSS or BSS satellite or system operating in the 42-42.5 GHz band would encounter great difficulty in meeting the power flux-density (pfd) level of -153 dB(W/m<sup>2</sup>) in any 500 kHz for GSO satellites or the equivalent power-flux density (epfd) level of -246 dB(W/m<sup>2</sup>) in any 500 kHz for any non-GSO system for single-dish radio telescope spectral-line observations near the 42.5 GHz band edge of the 42.5-43.5 GHz band, even when all practicable technical or operational measures to reduce the potential for interference detrimental to the RAS stations are employed;

*e)* that because there are relatively few RAS stations operating single-dish telescopes in the band 42.5-43.5 GHz, and because there are expected to be relatively few FSS or BSS earth stations operating in the 42-42.5 GHz band, it may be feasible for both services to employ technical or operational measures, including but not limited to such interference mitigation techniques as geographical isolation, time sharing, etc., in order to reduce the potential for interference detrimental to the RAS stations operating in this band;

*f)* that, taking into account the above *considerings*, it should be feasible to rely on arrangements between concerned RAS and FSS/BSS administrations to ensure that the unwanted emissions from FSS or BSS satellites and systems in the 42-42.5 GHz band do not cause interference detrimental to RAS stations in Region 2 conducting spectral-line observations in the 42.5-42.77 GHz band,

*resolves*

1 that a GSO FSS or BSS satellite in the band 42-42.5 GHz shall not exceed the values given in No. **5.BC05** for more than 2% of the time at any radio astronomy station in Region 2 registered as a single-dish radio telescope in the 42.5-43.5 GHz band;

2 that an administration that plans to operate a GSO FSS or BSS satellite or a non-GSO FSS or BSS system in the 42-42.5 GHz band shall take all practicable steps to avoid exceeding the pfd value of -153 dB(W/m<sup>2</sup>) in any 500 kHz for a GSO satellite, and the epfd value of -246 dB(W/m<sup>2</sup>) in any 500 kHz for any non-GSO system in the 42.5-42.77 GHz band, for more than 2% of the time, at the site of a radio astronomy station registered as a single-dish radio telescope in Region 2;

3 that in the event that an administration planning to operate a GSO FSS or BSS satellite or a non-GSO FSS or BSS system in the band 42-42.5 GHz has taken all practicable steps to avoid exceeding the values and percentage of time criterion in *resolves 2* in the 42.5-42.77 GHz band, but that nevertheless would not meet them, the administration planning to operate such a satellite or systems shall enter into discussions with the administration operating the affected radio astronomy station in Region 2 to arrive at a mutually satisfactory arrangement with respect to the unwanted emissions produced into the band 42.5-42.77 GHz;

4 that *resolves 1, 2 and 3* shall apply with respect to any radio astronomy station in Region 2 registered as a single-dish radio telescope in the band 42.5-43.5 GHz that was in operation prior to the end of WRC-03 and that has been notified to ITU before 4 January 2004, or that was notified before the date of receipt of the complete Appendix 4 information for coordination or notification, as appropriate, for an FSS or BSS satellite or system to which this **Resolution** applies (see Note 1);

5 that an administration notifying a radio astronomy station in Region 2 as a single-dish radio telescope after the dates provided in *resolves 4* may seek an agreement with administrations that have authorized FSS or BSS satellites or systems to which this **Resolution** applies,

*invites ITU-R*

to conduct studies and develop **Recommendations** to establish the appropriate balance between the percentage of time that GSO satellites operating in the 42-42.5 GHz band exceed the single-dish values in No. **5.551I** at the site of a radio astronomy station and the associated impact on radio astronomy observations.

NOTE 1 – For purposes of No. **5.551H**, No. **5.551I** and *resolves 4* of this **Resolution**, the radio astronomy stations currently under construction in Sierra Negra, Mexico, 18° 59' N/97° 18' W (station Volcan Sierra Negra) and San Pedro

de Atacama, Chile, 23° 20' S/67° 44' W (station Atacama Large Millimeter Array) to conduct observations in the 42.5-43.5 GHz band, shall be considered to have been in operation prior to the end of WRC-03 if they are notified to the Bureau before 1 January 2005.

## Appendix 9. Agenda Item 7.2

### RESOLUTION 802 (WRC-03)

#### Agenda for the 2007 World Radiocommunication Conference

The World Radiocommunication Conference (Geneva, 2003),

*considering*

a) that, in accordance with No. 118 of the Convention, the general scope of the agenda for a world radiocommunication conference should be established four to six years in advance and a final agenda shall be established by the Council two years before the conference;

b) Article 13 of the Constitution relating to the competence and scheduling of world radiocommunication conferences and Article 7 of the Convention relating to their agendas;

c) the relevant **Resolutions** and **Recommendations** of previous world administrative radio conferences (WARCs) and world radiocommunication conferences (WRCs),

*recognizing*

a) that this Conference has identified a number of urgent issues requiring further examination by WRC-07;

b) that, in preparing this agenda, many items proposed by administrations could not be included and have had to be deferred to future conference agendas,

*resolves*

to recommend to the Council that a world radiocommunication conference be held in 2007 for a period of four weeks, with the following agenda:

1 on the basis of proposals from administrations, taking account of the results of WRC-03 and the Report of the Conference Preparatory Meeting, and with due regard to the requirements of existing and future services in the bands under consideration, to consider and take appropriate action with respect to the

following items:

1.1 requests from administrations to delete their country footnotes or to have their country name deleted from footnotes, if no longer required, in accordance with **Resolution 26 (Rev.WRC-97)**;

1.2 to consider allocations and regulatory issues related to the Earth exploration-satellite (passive) service, space research (passive) service and the meteorological satellite service in accordance with **Resolutions 746 (WRC-03)** and **742 (WRC-03)**;

1.3 in accordance with **Resolution 747 (WRC-03)**, consider upgrading the radiolocation service to primary allocation status in the bands 9 000-9 200 MHz and 9 300-9 500 MHz and extending by up to 200 MHz the existing primary allocations to the Earth exploration-satellite service (active) and the space research service (active) in the band 9 500-9 800 MHz without placing undue constraint on the services to which the bands are allocated;

1.4 to consider frequency-related matters for the future development of IMT-2000 and systems beyond IMT-2000 taking into account the results of ITU-R studies in accordance with **Resolution 228 (Rev.WRC-03)**;

1.5 to consider spectrum requirements and possible additional spectrum allocations for aeronautical telecommand and high bit-rate aeronautical telemetry, in accordance with **Resolution 230 (WRC-03)**;

1.6 to consider additional allocations for the aeronautical mobile (R) service in parts of the bands between 108 MHz and 6 GHz, in accordance with **Resolution 414 (WRC-03)** and, to study current satellite frequency allocations, that will support the modernization of civil aviation telecommunication systems, taking into account **Resolution 415 (WRC-03)**;

1.7 to consider the results of ITU-R studies regarding sharing between the mobile-satellite service and the space research service (passive) in the band 1 668-1 668.4 MHz, and between the mobile-satellite service and the mobile service in the band 1 668.4-1 675 MHz in accordance with **Resolution 744 (WRC-03)**;

1.8 to consider the results of ITU-R studies on technical sharing and regulatory provisions for the application of high altitude platform stations operating in the bands 27.5-28.35 GHz and 3131.3 GHz in response to **Resolution 145 (WRC-03)**, and for high altitude platform stations operating in the bands 47.2-

47.5 GHz and 47.9-48.2 GHz in response to **Resolution 122 (Rev.WRC-03)**;

1.9 to review the technical, operational and regulatory provisions applicable to the use of the band 2 500-2 690 MHz by space services in order to facilitate sharing with current and future terrestrial services without placing undue constraint on the services to which the band is allocated;

1.10 to review the regulatory procedures and associated technical criteria of Appendix 30B without any action on the allotments, the existing systems or the assignments in the List of Appendix 30B;

1.11 to review sharing criteria and regulatory provisions for protection of terrestrial services, in particular terrestrial television broadcasting services, in the band 620-790 MHz from BSS networks and systems, in accordance with **Resolution 545 (WRC-03)**;

1.12 to consider possible changes in response to **Resolution 86 (Rev. Marrakesh, 2002)** of the Plenipotentiary Conference: "Coordination and notification procedures for satellite networks" in accordance with **Resolution 86 (WRC-03)**;

1.13 taking into account **Resolutions 729 (WRC-97)**, **351 (WRC-03)** and **544 (WRC-03)**, to review the allocations to all services in the HF bands between 4 MHz and 10 MHz, excluding those allocations to services in the frequency range 7 000-7 200 kHz and those bands whose allotment plans are in Appendices 25, 26 and 27 and whose channeling arrangements are in Appendix 17, taking account of the impact of new modulation techniques, adaptive control techniques and the spectrum requirements for HF broadcasting;

1.14 to review the operational procedures and requirements of the Global Maritime Distress and Safety System (GMDSS) and other related provisions of the Radio Regulations, taking into account **Resolutions 331 (Rev.WRC-03)** and **342 (Rev.WRC-2000)** and the continued transition to the GMDSS, the experience since its introduction, and the needs of all classes of ships;

1.15 to consider a secondary allocation to the amateur service in the frequency band 135.7137.8 kHz;

1.16 to consider the regulatory and operational provisions for Maritime Mobile Service Identities (MMSIs) for equipment other than shipborne mobile equipment, taking into account **Resolutions 344 (Rev.WRC-03)** and **353 (WRC-03)**;

1.17 to consider the results of ITU-R studies on compatibility

between the fixed-satellite service and other services around 1.4 GHz, in accordance with **Resolution 745 (WRC-03)**;

1.18 to review pfd limits in the band 17.7-19.7 GHz for satellite systems using highly inclined orbits, in accordance with **Resolution 141 (WRC-03)**;

1.19 to consider the results of the ITU-R studies regarding spectrum requirement for global broadband satellite systems in order to identify possible global harmonized FSS frequency bands for the use of Internet applications, and consider the appropriate regulatory/technical provisions, taking also into account No. **5.BC03** of the Radio Regulations;

1.20 to consider the results of studies, and proposals for regulatory measures regarding the protection of the Earth exploration-satellite service (passive) from unwanted emissions of active services in accordance with **Resolution 738 (WRC-03)**;

1.21 to consider the results of studies regarding the compatibility between the radio astronomy service and the active space services in accordance with **Resolution 740 (Rev.WRC-03)**, in order to review and update, if appropriate, the tables of threshold levels used for consultation that appear in the Annex to **Resolution 739 (WRC-03)**;

2 to examine the revised ITU-R **Recommendations** incorporated by reference in the Radio Regulations communicated by the Radiocommunication Assembly, in accordance with **Resolution 28 (Rev.WRC-03)**, and to decide whether or not to update the corresponding references in the Radio Regulations, in accordance with principles contained in the Annex to **Resolution 27 (Rev.WRC-03)**;

3 to consider such consequential changes and amendments to the Radio Regulations as may be necessitated by the decisions of the Conference;

4 in accordance with **Resolution 95 (Rev.WRC-03)**, to review the **Resolutions** and **Recommendations** of previous conferences with a view to their possible revision, replacement or abrogation;

5 to review, and take appropriate action on, the Report from the Radiocommunication Assembly submitted in accordance with Nos. 135 and 136 of the Convention;

6 to identify those items requiring urgent action by the Radiocommunication Study Groups in preparation for the next world radiocommunication conference;

7 in accordance with Article 7 of the Convention:

7.1 to consider and approve the Report of the Director of the

Radiocommunication Bureau:

- on the activities of the Radiocommunication Sector since WRC-03;

- on any difficulties or inconsistencies encountered in the application of the Radio Regulations; and

- on action in response to **Resolution 80 (Rev.WRC-2000)**;

7.2 to 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, taking into account **Resolution 803 (WRC-03)**,

*further resolves*

to activate the Conference Preparatory Meeting and the Special Committee on Regulatory/Procedural Matters,

*invites the Council*

to finalize the agenda and arrange for the convening of WRC-07, and to initiate as soon as possible the necessary consultations with Member States,

*instructs the Director of the Radiocommunication Bureau*

to make the necessary arrangements to convene meetings of the Conference Preparatory Meeting and to prepare a report to WRC-07,

*instructs the Secretary-General*

to communicate this **Resolution** to international and regional organizations concerned.

## RESOLUTION 803 (WRC-03)

### Preliminary agenda for the 2010 World Radiocommunication Conference

The World Radiocommunication Conference (Geneva, 2003),

*considering*

a) that, in accordance with No. 118 of the ITU Convention, the general scope of the agenda for WRC-10 should be established four to six years in advance;

b) Article 13 of the Constitution relating to the competence and

scheduling of world radiocommunication conferences and Article 7 of the ITU Convention relating to their agendas;

c) the relevant **Resolutions** and **Recommendations** of previous world administrative radio conferences (WARCs) and world radiocommunication conferences (WRCs),

*resolves to give the view*

that the following items should be included in the preliminary agenda for WRC-10:

1 to take appropriate action in respect of those urgent issues that were specifically requested by WRC-07;

2 on the basis of proposals from administrations and the Report of the Conference Preparatory Meeting, and taking account of the results of WRC-07, to consider and take appropriate action in respect of the following items:

2.1 requests from administrations to delete their country footnotes or to have their country name deleted from footnotes, if no longer required, taking into account **Resolution 26 (Rev.WRC-97)**;

2.2 to consider frequency allocations between 275 GHz and 3 000 GHz taking into account the result of ITU-R studies in accordance with **Resolution 950(WRC-03)**;

2.3 to consider results of ITU-R studies in accordance with **Resolution 222 (WRC-2000)** to ensure spectrum availability and protection for the aeronautical mobile-satellite (R) service, and to take appropriate action on this subject, while retaining the generic allocation for the mobile-satellite service;

2.4 to consider allocations to the mobile service in the band 806-862 MHz in Region 1, following the transition of analogue to digital TV;

2.5 to consider the results of studies related to **Resolution 136 (Rev.WRC-03)** dealing with sharing between nonGSO and GSO systems;

2.6 to consider the need to modify the provisional protection ratio values in the Annex to **Resolution 543 (WRC-03)**, taking into account the experience of the coordination of seasonal scheduling of the HF bands allocated to the broadcasting service and relevant studies conducted by ITU-R since WRC-03;

2.7 to consider the progress of ITU-R studies concerning the technical and regulatory issues relative to the fixed service in the 8186 and 92-100 GHz frequency bands, taking into account **Resolutions 731 (WRC-2000)** and **732 (WRC-2000)**;

2.8 to consider the progress of the ITU-R studies concerning the

development and regulatory requirements of terrestrial wireless interactive multimedia applications, in accordance with **Recommendation 722 (WRC-03)** and to take any appropriate action on this subject;

3 to consider the results of the studies related to the following, with a view to considering them for inclusion in the agendas of future conferences:

3.1 to review the use of the band 5 091-5 150 MHz by the fixed-satellite service (Earth-to-space) (limited to feeder links of the non-GSO mobile-satellite service) in accordance with **Resolution 114 (Rev.WRC-03)**;

4 to examine the revised ITU-R **Recommendations** incorporated by reference in the Radio Regulations communicated by the Radiocommunication Assembly, in accordance with **Resolution 28 (Rev.WRC-03)**, and to decide whether or not to update the corresponding references in the Radio Regulations, in accordance with the principles contained in Annex 1 to **Resolution 27 (Rev.WRC-03)**;

5 to consider such consequential changes and amendments to the Radio Regulations as may be necessitated by the decisions of the Conference;

6 in accordance with **Resolution 95 (Rev.WRC-03)**, to review the **Resolutions** and **Recommendations** of previous conferences with a view to their possible revision, replacement or abrogation;

7 to review, and take appropriate action on, the Report from the Radiocommunication Assembly submitted in accordance with Nos. 135 and 136 of the Convention;

8 to identify those items requiring urgent action by the Radiocommunication Study Groups;

9 in accordance with Article 7 of the Convention:

9.1 to consider and approve the Report of the Director of the Radiocommunication Bureau on the activities of the Radiocommunication Sector since WRC-07;

9.2 to recommend to the Council items for inclusion in the agenda for the following world radiocommunication conference,

*invites the Council*

to consider the views given in this **Resolution**,

*instructs the Director of the Radiocommunication Bureau*

to make the necessary arrangements to convene meetings of the Conference Preparatory Meeting and to prepare a report to WRC-10,

*instructs the Secretary-General*

to communicate this **Resolution** to international and regional organizations concerned.

## RESOLUTION 950 (WRC-03)

### Consideration of the use of the frequencies between 275 and 3 000 GHz

The World Radiocommunication Conference (Geneva, 2003),

*considering*

- a) that, in the Table of Frequency Allocations, frequency bands above 275 GHz are not allocated;
- b) that, notwithstanding *considering a)*, No. **5.565** makes provision for the use of the frequency band 275-1 000 GHz for the development of various passive services and all other services and recognizes the need to conduct further experimentation and research;
- c) that No. **5.565** also makes provision for the protection of passive services until such time as the Table of Frequency Allocations may be extended;
- d) that, in addition to the spectral lines identified by No. **5.565**, research activities in the bands above 275 GHz may yield other spectral lines of interest, such as those listed in **Recommendation ITU-R RA.314**;
- e) that within various ITU-R study groups, studies on systems between 275 and 3 000 GHz, including system characteristics of suitable applications, are being considered;
- f) that the present use of the bands between 275 and 3 000 GHz is mainly related to the passive services, however, with anticipated technology development, the bands may become increasingly important for suitable active service applications;
- g) that sharing studies in ITU-R among passive services and all other services operating in frequencies between 275 and 3 000 GHz have not been completed,

*recognizing*

- a) that propagation characteristics at frequencies above 275 GHz, such as atmospheric absorption and scattering, have a significant impact on the performance of both active and passive systems and need to be studied;

- b) that it is necessary to investigate further the potential uses of the bands between 275 and 3 000 GHz by suitable applications,

*noting*

- a) that significant infrastructure investments are being made under international collaboration for the use of these bands between 275 and 3 000 GHz, for example, the Atacama Large Millimetre Array (ALMA), a facility under construction that will provide new insights on the structure of the universe;
- b) that BR Circular Letter CR/137 identified additional information for the Radiocommunication Bureau to record characteristics of active and passive sensors for EESS and SRS satellites, in frequency bands below 275 GHz,

*further noting*

- a) that a process and format similar to that provided in *noting b)* could be used to record systems operating in the 275 to 3 000 GHz band;
- b) that recording active and passive systems operating in the 275 to 3 000 GHz band will provide information until the date when it is determined that changes to the Radio Regulations are needed,

*resolves*

- 1 to consider at WRC-10 frequency allocations between 275 GHz and 3 000 GHz taking into account the result of the ITU-R studies;
- 2 that administrations may submit for inclusion in the Master International Frequency Register details on systems which operate between 275 and 3 000 GHz and which may be recorded by the Radiocommunication Bureau under Nos. **8.4**, **11.8** and **11.12**,

*invites ITU-R*

to conduct the necessary studies in time for consideration by WRC-10 with a view to the modification of No. **5.565** or the possible extension of the Table of Frequency Allocations above 275 GHz, including advice on the applications suitable for such bands,

*instructs the Director of the Radiocommunication Bureau*

to accept submissions referred to in *resolves 2*, and to record them in the Master International Frequency Register.