

A year or two or three or sixty of IUCAF

SCIENTIFIC COMMITTEE ON FREQUENCY ALLOCATIONS UCAF FOR RADIO ASTRONOMY AND SPACE SCIENCE



Harvey Liszt NRAO & North American ALMA Science Center Charlottesville, VA & Chair, IUCAF

$I_{\text{nternational}} \ S_{\text{cience}} \ C_{\text{ouncil}} \ \& \ IUCAF$

Overview



International Science Council

Research Programmes

Data and Information

Committee on Data for Science and Technology (CODATA)

World Data System (WDS)

INASP

Frequencies for Radio Astronomy & Space Science (IUCAF) The International Science Council (ISC) is a nongovernmental organization with a unique global membership that brings together 40 international scientific Unions and Associations and over 140 national and regional scientific organizations including Academies and Research Councils.

The ISC was created in 2018 as the result of a merger between the International Council for Science (ICSU) and the International Social Science Council (ISSC).

The Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science (IUCAF) is an international committee (set up in 1960 by URSI, IAU, and COSPAR) that works in the field of spectrum management on behalf of the passive radio sciences, like radio astronomy, remote sensing, space research, and meteorological remote sensing.

IAU, URSI & COSPAR Provide Budget URSI Oversees IUCAF Finances

Radio Science Bulleti

RADIO SCIENCE

INTERNATIONAL.

UNION OF

UNION RADIO-SCIENTIFIQUE INTERNATIONALE





01/17/07 22-	csz eme-12 n	Same a		
	2	1	1	
- C	1	2		5
		3	10	0211
1			10-	
19 00			100	3
1	and the second	12	d.	
Nit int	and and	1		

Rapport CROWNCOM 2016	123		
Report on IEEE Radio and Antenna Days of the Indian Ocean	124		
Report on ISAP2016	125		
IUCAF 2016 Annual Report	129		
URSI Conference Calendar	132		
Information for Authors	133		
Become An Individual Member of URSI134			

Cover: (Upper figure) The steps used to create the volume conductor models used for the paper. The MRI data were first segmented, and then the surfaces obtained were used to voxelize the segmented model. See the paper by Marko Mikkonen and likka Laakso in the special section on "The Best Papers from the EMTS 2016 Young Scientist Awards", pp. 13-18.

(Lower figure) Passive microwave imagery from the NASA TRMM satellite, depicting the eyewall replacement cycle in Hurricane Dean on August 17, 2007, at 2254 UTC. All images are from the 85 GHz channel, in which ice scattering reveals areas of deep convection displayed in the red shades (image courtesy of the Naval Research Laboratory, NRL). See the paper by Michel Parrot in the special section on "Radio Science for Humanity: URSI-France 2017 Workshop", pp. 75-79.

No 360 March 2017

URSI, c/o Ghent University (INTEC) St.-Pietersnieuwstraat 41, B-9000 Gent (Belgium)

eting Washington May 2018



IUCAF Chairs 1960 - now



Darrel Emerson 2000-2002



Wim van Driel 2003-2009



Masatoshi Ohishi 2009-2015



Harvey Liszt 2015-

Figure 1 The six chairmen of IUCAF. *Top*: J-F. Denisse (1960–1964), F.G. Smith (1964–1975). *Middle*: J.P. Hagen (1975–1981), J.W. Findlay (1981–1987). *Bottom*: B.J. Robinson (1987–1995), W.A. Baan (1995–1999). In March 1999 Klaus Ruf Became chairman.

What is IUCAF?



The IUCAF brief is to study and coordinate the requirements for radio frequency allocations established by the afore-mentioned sciences and to make these requirements known to the national and internationl bodies responsible for frequency allocations. IUCAF has official standing as a non-voting organization at the ITU, the International Telecommunication Union, located in Geneva, Switzerland; it is a Sector Member of ITU-R.

IUCAF takes action aimed at ensuring that disruptive emissions do not interfere with the above sciences (when operating within allocated bands) by other radio services. IUCAF is particularly concerned about radio transmissions from aircraft, space vehicles, and land-based telecom services.

What can IUCAF do?

Conference Preparatory Meeting (CPM)

YOU ARE HERE HOME > ITU-R > STUDY GROUPS > CPM



What did IUCAF do?

IUCAF provided radio astronomy's input to the CPM

ITU-R CPM19.02 C

ITU-R CPM19.02

Second Session of the Conference Preparatory Meeting for WRC-19

Results: 248 total items.

[25]	Proposed modification to the draft CPM text Chapter 5 - Agenda items 1.8 (Issue B), 1.9.1, 1.9.2	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science
[24]	Proposed modifications to the draft CPM text Chapter 4 - Agenda item 1.7	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science
[23]	Proposed modifications to the draft CPM text Chapter 3 - Agenda items 1.6 and 9.1.9	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science
[22]	Proposed modifications to the draft CPM text Chapter 2 - Agenda item 1.13	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science
[21]	Proposed modifications to the draft CPM text Chapter 1 - Agenda items 1.11, 1.14 and 1.15	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science
[20]	IUCAF views on WRC-19 agenda items of concern to Radio Astronomy	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science

What did IUCAF do?

IUCAF provided radio astronomy's input to the CPM Important to distinguish Agenda Items with regulatory consequences and those that more reflect burgeoning technology in existing allocations Quantity has a quality all its own Just because an allocation is shared does not mean the co-primary services within are compatible

No new spectrum proposed, concentration on 5.8 GHz

Which AI will have most long term impact?

- The SUBJECT of AI 1.6(issue 1) matters, the AI less so
 - FSS space-Earth at 37 42.5 GHz; E-s ~ 52 GHz
 - Stronger consequences for GSO operators & EESS
 - Spectrum already allocated
 - Footnotes RR. 5.551H,I put hard limits on RFI into our band
 - Some difference if the downlink stops at 42 not 42.5
 - US table allocates FSS s-E only up to 42.0 GHz
 - Boeing, SpaceX asked FCC to launch multi-kilo satellites
 - Only a toy study for RAS, owing to lack of characteristics

Which AI will have most long term impact?

- The SUBJECT of AI 1.6(issue 1) matters, the AI less so
 - FSS space-Earth at 37 42.5 GHz; E-s ~ 52 GHz
 - Stronger consequences for GSO operators & EESS
 - Spectrum already allocated
 - Footnotes RR. 5.551H,I put hard limits on RFI into our band
 - Some difference if the downlink stops at 42 not 42.5
 - US table allocates FSS s-E only up to 42.0 GHz
 - Boeing, SpaceX asked FCC to launch multi-kilo satellites
 - Only a toy study for RAS, owing to lack of characteristics

US has mobile up to 42.5 GHz, RAS alone in 42.5 - 43.5 In the end, IMT will just use whatever FSS leaves on the table

1.20 *fixed service: A radiocommunication service* between specified fixed points.

1.66 *fixed station:* A *station* in the *fixed service*.

1.66A *high altitude platform station:* A *station* located on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth.



Report ITU-R F.2439-0 (11/2018)



A platform at 20 km is visible for 510 km at 0 elevation and a full buildout of HAPS would put 81 platforms above the horizon





A platform at 20 km is visible for 510 km at 0 elevation and a full buildout of HAPS would put 81 platforms above the horizon





A platform at 20 km is visible for 510 km at 0 elevation and a full buildout of HAPS would put 81 platforms above the horizon

Report ITU-R F.2439-0 (11/2018)



A platform at 20 km is visible for 510 km at 0 elevation and a full buildout of HAPS would put 81 platforms above the horizon

- In May 2018 WP 5C's draft pfd limits for HAPS were calculated as for the GSO case in RA.769
 - Using 15dBi RAS gain allows RAS to point within 5°
 - RA. 769 limits are strengthened by 15 dB
 - Still much more than 2% data loss from sky blockage

Now-ridiculous verbiage in RA. 769 that the GSO belt doesn't block the same portion of sky at every observatory so the data loss can be recovered

> You just use the other billion-dollar observatory you happen to have constructed somewhere else

- In May 2018 WP 5C's draft pfd limits for HAPS were calculated as for the GSO case in RA.769
 - Using 15dBi RAS gain allows RAS to point within 5°
 - RA. 769 limits are strengthened by 15 dB
 - Still much more than 2% data loss from sky blockage

- In May 2018 WP 5C's draft pfd limits for HAPS were calculated as for the GSO case in RA.769
 - Using 15dBi RAS gain allows RAS to point within 5°
 - RA. 769 limits are strengthened by 15 dB
 - Still much more than 2% data loss from sky blockage
 - Draft pfd limits for HAPS implied >> 2% data loss
 - Studies were in shambles, an incoherent mess
 - Different methodologies, thresholds, characteristic
 - Studies were thrown out after IUCAF pointed out their manifest "inadequacies"

HAPS

- IUCAF provided a set of guidelines for studies
 - HAPS downlink pfd calculated for 30 dBi RAS gain
 - A 3° cone of avoidance for us about each of 81 platforms
 - Pfd limit for downlinks in the direction of RAS stations
 - RAS and HAPS must know where the other is
 - Puts premium on notification of RAS sites, mandatory for HAPS
 - Implemented Nov 2018 after CPM text drafted
 - Retrofitted at CPM-2

Uncertain flight path of HAPS platform gives this whole process an Alice in Wonderland quality

• Draft Methods all had a 2020 sunset date for protection

4 that *resolves* 3 above applies at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

• Draft Methods all had a 2020 sunset date for protection

4 that *resolves* 3 above applies at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

Can be reasonable in a case where a new co-primary system comes into service sharing spectrum with incumbents

• Draft Methods all had a 2020 sunset date for protection

4 that *resolves* 3 above applies at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

Can be reasonable in a case where a new co-primary system comes into service sharing spectrum with incumbents

That isn't what's happening with HAPS which will roll out piecemeal and operate in adjacent band spectrum, and should not interfere with RAS in its bands

• Draft Methods all had a 2020 sunset date for protection

4 that *resolves* 3 above applies at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

• Changes had to be worked in many places in CPM text

4 that *resolves* 3 shall apply above applies at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020, or at any radio astronomy station that was notified before the date of receipt of the complete Appendix 4 information for coordination or notification, as appropriate, for the HAPS system to which *resolves* 3 applies. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

• Draft Methods all had a 2020 sunset date for protection

4 that *resolves* 3 above applies at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

• Changes had to be worked in many places in CPM text

4 that *resolves* 3 shall apply above applies at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020, or at any radio astronomy station that was notified before the date of receipt of the complete Appendix 4 information for coordination or notification, as appropriate, for the HAPS system to which *resolves* 3 applies. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

We need to identify & register some core ngVLA stations

- Are the cones avoidance real? (Copernican?)
 - For the HAPS proponents, cones of avoidance were just a mathematical device to set their pfd limit
 - They didn't think RAS operators would avoid HAPS
 - For RAS operators they are likely to be real
 - RFI from a HAPS platform observed with full RAS gain would be quite strong (30 dBi vs 80+ dBi gain)
 - The 60 dB stronger HAPS in-band signal will also be in our receiver passband
 - A main beam encounter at the edge of a HAPS service area would damage an RAS receiver

- Are STRAPS HAPS or merely HAP-less?
 - STRAPS proponents (Lockheed + Elefante Group)
 - Elefante noted 65,000' stratospheric minimum
 - 65,000′ = 19.8 km
 - Therefore if 19.8 <> 20, STRAPS <> HAPS
 - Their own documents show STRAPS operating above 20 km
 - Petitioned FCC for early relief with prepackaged rules
 - Trying to evade CPM-2 and WRC-19 rules
 - Using 20 dBi RAS gain
- STRAPS proponents will carry HAPS issues past WRC-19
- STRAPS & other HAPS may have platform end user links, much messier

Above 95 GHz – special experimental licenses

- FCC allowed
 - 10 yrs cloaked experimental use of passive bands
 - marketing/sale of devices illegal under RR. 5.340
 - ITU-R RRB deprecates use of RR. 5.340 bands under a banner of non-interfering use (RR. 4.4)
- FCC acted in the context of criticism of spectrum devoted to passive services
 - A trespass against norms
 - NRAO filed a ferocious response on the eve of release

ftp://ftp.cv.nrao.edu/NRAO-staff/hliszt/NRAOReplyToFCCDraftAbove95GHz.docx

Above 95 GHz – special experimental licenses

- An important difference between arguing with private industry and arguing with FCC:
 - Industry claims we don't understand what *they* do
 - FCC claims we also don't understand what we do
- FCC persists in stating:
 - High directivity of large RAS antennas mitigates RFI
 - RFI only arises near the boresight of the antenna
 - Fictional sidelobes at large boresight angles reject RFI

Immediate IUCAF work program

- May June 2019
 - WP 1A to finish studies for AI 1.15, 275 450 GHz
 - WP 4C to finish studies for AI 1.8, Iridium as GMDSS
 - Meet in Geneva to start coordination for WRC-19
 - CRAF, SKA participation not clear
- July September
 - Prepare IUCAF white paper w/ RAS views for WRC-19
 - Other input to WRC-19 not allowed from IUCAF
- September 23-27, 2019
 - RFI2019, Toulouse (CNES)
- October November 2019
 - WRC-19 Sharm al-Sheik

Also on the table at ITU-R

Radiocommunication Study Groups



Document 7D/145-E 23 April 2018 English only

C

Director, Radiocommunication Bureau

RECONSIDERATION OF RR ARTICLE No. 4.6

Taking into account the note received from Working Party 7D (Doc. 7D/119 Annex 1), the Director of Radiocommunication Bureau has brought the issue detailed in Document 7D/106 to the attention of the 77th meeting of the Radio Regulations Board (19-23 March 2018), which has concluded as follows:

"In considering the proposed modification to RR No. 4.6 in Document RRB18-1/2(Add.1)(Rev.1), the Board concluded that such a modification to the Regulations is outside its purview. The Board instructed the Director to include this matter in the Report to WRC-19."

Also on the table at ITU-R

3.1.1 Article 4 of the Radio Regulations

3.1.1.1 RR No. 4.6

RR No. **4.6** stipulates that: "For the purpose of resolving cases of harmful interference, the radio astronomy service shall be treated as a radiocommunication service. However, protection from services in other bands shall be afforded the radio astronomy service only to the extent that such services are afforded protection from each other".

In a Note dated 2 November 2017 to the Director of the Radiocommunication Bureau, ITU-R Working Party (WP) 7D indicated that at its October 2017 meeting, it had received input Document 7D/106 addressing issues with No. **4.6** of the Radio Regulations. This document discusses the origin of No. **4.6** of the Radio Regulations, noting its contradictory nature and inconsistency with the Radio Regulations at large. Such inconsistencies have often resulted in protracted arguments at ITU-R meetings.

WP 7D respectfully requested that the Radiocommunication Bureau Director considers these issues and takes appropriate action for their resolution.

These issues were brought to the attention of the RRB at its 77th meeting on 19-23 March 2018, where the Board concluded that the requested modification to the Regulations is outside its purview. It instructed the Director to include this matter in the Report to WRC-19.