A year of IUCAF; WRC-19 , COVID-19 edition

SCIENTIFIC COMMITTEE ON FREQUENCY ALLOCATIONS FOR RADIO ASTRONOMY AND SPACE SCIENCE

IUCAF

Harvey Liszt

NRAO & North American ALMA Science Center

Charlottesville, VA

&

Chair, IUCAF

www.iucaf.org

International Science Council charters IUCAF

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)

Overview

The International Science Council (ISC) is a non-governmental 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).

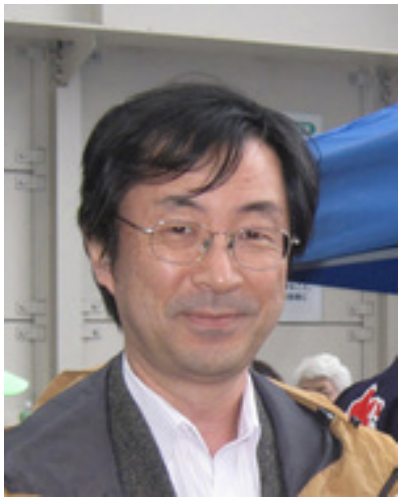
The Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science (IUCAF) is an international committee (set up in 1960 by URSI, IAU, and COSPAR) that works in the field of spectrum management on behalf of the passive radio sciences, like radio astronomy, remote sensing, space research,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

www.iucaf.org

IUCAF Chairs 1960 - now

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.

Darrel Emerson 2000-2002



Masatoshi Ohishi 2009-2015

Wim van Driel 2003-2009

Harvey Liszt 2015-2021

Some history

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I.U.C.A.F AND FREQUENCIES FOR RADIO ASTRONOMY

JOHN W. FINDLAY
Senior Scientist at the National Radio Astronomy Observatory until retirement in 1985

International Astronomical Union Colloquium No. 112

https://tinyurl.com/sygkq7c

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More history

Annu. Rev. Astron. Astrophys. 1999. 37:65–96

FREQUENCY ALLOCATION: The First Forty Years

Brian Robinson
Research Fellow Emeritus, Australia Telescope National Facility, Epping, N.S.W. 2121 Australia; e-mail: brobinso@ozemail.com.au

Key Words Frequency management, IUCAF, world radio conferences, radio interference, mobile satellites, radio astronomy

■ **Abstract** In 1960 ICSU set up an Inter-Union Commission (IUCAF) on the Allocation of Frequencies for Space Research and Radio Astronomy, to keep key parts of the radio spectrum clear for passive, scientific use. IUCAF represents URSI, IAU and COSPAR at World Radio Conferences (WRCs) convened by the International Telecommunications Union (ITU) in Geneva; the WRCs establish the international law which governs users of the radio spectrum. This review recounts many serious threats posed to passive scientific research by commercial and military operations, particularly those involving radio emissions from aircraft and spacecraft. The continual conflict between commercial greed and scientific curiosity has often put the future of radio astronomy, space research, and earth exploration in jeopardy. The conflict increases as we move into the Information Age.

https://tinyurl.com/yxyheela

IUCAF mainly works at the ITU-R but also does this

5th International IUCAF Spectrum Management School for Radio Astronomy
Stellenbosch, South Africa 2 – 6 March 2020

SCIENTIFIC COMMITTEE
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IUCAF FOR
RADIO ASTRONOMY
AND
SPACE SCIENCE

- Supported by IUCAF, SARAO, RadioNet http://www.iucaf.org/sms2020/
  - No registration or banquet fee!
- Previous schools 2002 (USA), 2005 (Italy), 2010 (Japan), 2014 (Chile)

“RFI is what happens when spectrum management fails”

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- Radio scientists also deal directly with received RFI
  - Regular RAS RFI meetings have broadened to incorporate remote sensing, occur more often

Blue?

PARTNERS

URSI
CESBIO
cnes
comet
COMmunity of Experts
IEEE
ASTRON
CSIRO
esa
GRSS
NASA
NRAO

"RFI is what happens when spectrum management fails"

- But this *also* happens when spectrum management fails:

Tacoma, WA, Dec 2017
3 dead for lack of train control on maiden run of this new train line, operator took a 25 mph curve at 78 mph

Harper's Ferry, WVa Dec 2019
Appalachian trail closed

WRC-19 and its fallout

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- Summary for 12/19 URSI Commission J Newsletter
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RRB20-2/1-E

WRC-19 decision	Date of application	Reasons for a new Rule of Procedure	RRB Meeting
ADD **5.564A** For the operation of fixed and land mobile service applications in frequency bands in the range 275-450 GHz: The frequency bands 275-296 GHz, 306-313 GHz, 318-333 GHz and 356-450 GHz are identified for use by administrations for the implementation of land mobile and fixed service applications, where no specific conditions are necessary to protect Earth exploration-satellite service (passive) applications. The frequency bands 296-306 GHz, 313-318 GHz and 333-356 GHz may only be used by fixed and land mobile service applications when specific conditions to ensure the protection of Earth exploration-satellite service (passive) applications are determined in accordance with Resolution **731 (Rev.WRC-19)**. In those portions of the frequency range 275-450 GHz where radio astronomy applications are used, specific conditions (e.g. minimum separation distances and/or avoidance angles) may be necessary to ensure protection of radio astronomy sites from land mobile and/or fixed service applications, on a case-by-case basis in accordance with Resolution **731 (Rev.WRC-19)**.	**01.01.2021**	**Reasons:** To suspend processing of potential notifications to stations in the land mobile and fixed service in the frequency bands above 275 GHz until the studies under Resolution **731 (Rev. WRC-19)** on the conditions of using the frequency band are complete.	**TBD**

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- Revision of Radio Regulations No. 4.6

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4.6 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.

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Iridium persistently argues that RAS is not entitled to protection on the basis of RR No. 4.6

Notwithstanding the limited protection which No. 4.6 grants to the RAS from active services, this HIBLEO-2 satellite operator has undertaken, in conjunction with the United States administration, to reduce the impact of unwanted emissions on radio astronomy observatories.

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4.6 Pour le règlement des cas de brouillages préjudiciables, le service de radioastronomie est traité comme un service de radiocommunication. Cependant, vis-à-vis des émissions des services fonctionnant dans d'autres bandes, il bénéficie du même degré de protection que celui dont bénéficient ces services les uns vis-à-vis des autres.

WRC-19 and its fallout

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- Revision of Radio Regulations No. 4.6
- English language version of 4.6 referred for examination
  - IUCAF had shown that the 2nd sentence was an historical relic
  - Well-supported Japan input to WR-19 proposed removing it
  - The US reacted harshly and blocked the Japanese proposal
  - The outcome will only be known when RR 2020 are released

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- Iridium immediately reneged on RAS protection

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Iridium document
CEPT SE40(19)40, 12/19

- System performance examined
  - When we applied second stage RASP restrictions in May 2019, they created unsustainable service impacts
  - Safety-critical nature of end-users requires minimum baseline performance
  - Hence necessary to reduce RASP restrictions while investigating the results

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- Leeheim filed an interference complaint at FCC
  - Iridium soon replied promising better behavior in future

Thanks for inviting me

Why are we here?

- Access to spectrum is eroding for all of science

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  - New active systems are prodigious spectrum users

ECC Report 271

Table 19: Frequency Bands Used by the SpaceX System

Type of Link and Transmission Direction	Frequency Ranges	RAS band affected
User Downlink Satellite-to-User Terminal	10.7–12.7 GHz	10.6–10.7 GHz (10.68-10.7 passive)
Gateway Downlink Satellite to Gateway	17.8–18.6 GHz 18.8–19.3 GHz	
User Uplink User Terminal to Satellite	14.0–14.5 GHz	14.47–14.5 GHz
Gateway Uplink Gateway to Satellite	27.5–29.1 GHz 29.5–30.0 GHz	
TT&C Downlink	12.15–12.25 GHz 18.55–18.60 GHz	
TT&C Uplink	13.85–14.00 GHz	

SpaceX, OneWeb

- *5G at WRC-15*
  - ***450-470,1427-1452,1492-1518,1710-1885,1885-2025,2110-2200, 300-2400,2500-2690,3400-3600 MHz***

HAPS

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

Deployment and technical characteristics of broadband high altitude platform stations in the fixed service in the frequency bands 6 440-6 520 MHz, 21.4-22.0 GHz, 24.25-27.5 GHz, 27.9-28.2 GHz, 31.0-31.3 GHz, 38.0-39.5 GHz, 47.2-47.5 GHz and 47.9-48.2 GHz used in sharing and compatibility studies

WRC-23:

1.2 to consider identification of the frequency bands
- **3 600-3 800 MHz and 3 300-3 400 MHz** (Region 2);
- **3 300-3 400 MHz** (amend footnote in Region 1);
- **7 025-7 125 MHz** (globally);
- **6 425-7 025 MHz** (Region 1);
- **10 000-10 500 MHz** (Region 2),

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    - None below 1GHz & radio astronomy has none* at 32-86 GHz

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    - FCC order (ET Docket No. 18-21), experimental licenses for transmission, sale, marketing **in passive bands above 95 GHz**
    - ECC sanctioning CEPT SE sharing studies in passive bands

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  - **Less unoccupied spectrum**
  - **More unwanted emissions**
  - **Weakening of spectrum protections in passive bands**
  - **Increasing blurring, mixed use**
    - **Earth stations (FS, FSS, MSS) in motion, airborne (+UAV)**
    - **Inter-satellite links, cubesat downlinks in MSS spectrum**
    - **HIBS - 5G base stations on HAPS (WRC-23 AI 1.4)**

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  - Orbital debris
  - Desecration of the dark night sky

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*"Two things fill the mind ...: **the starry heavens above me and the moral law within me."***

Immanuel Kant, Critique of Practical Reason