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The Role of Working Party 7D Radio Astronomy

CSIRO Astronomy and Space Science
Tasso Tzioumis, March 2020
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How do we protect Radio astronomy

• Self protection

- Robust designs – receivers and filters
- **RFI mitigation**
 - Excision → active compensation (becoming more critical...)

• Regulation

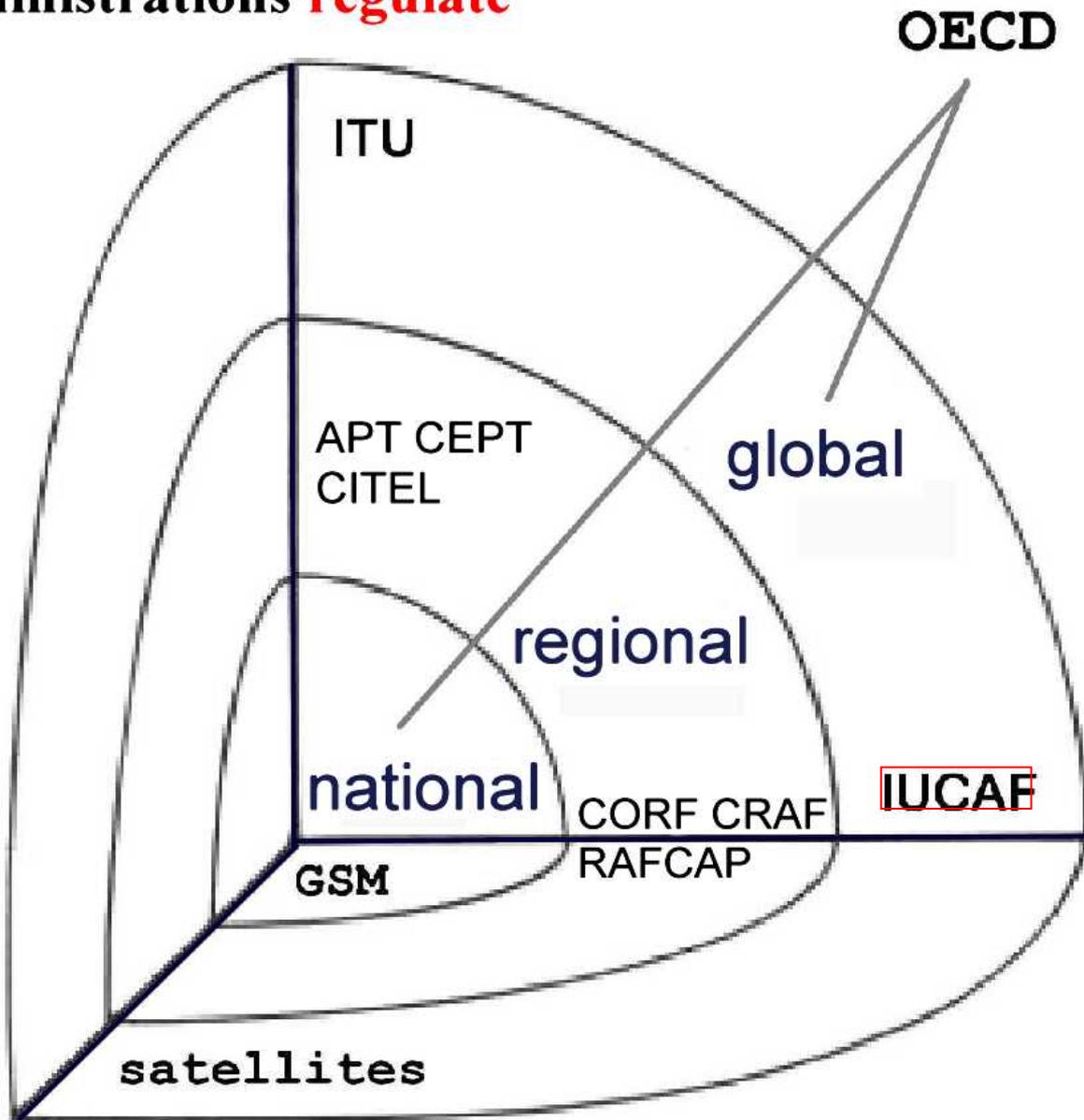
- International (ITU-R)
- Regional (CEPT, CITELE, **APT**) - 3 ITU regions
- National (**administrations**)

• Advocacy

- International – **IUCAF** (for **URSI**, **IAU**, COSPAR), OECD..
- Regional – CRAF, CORF, **RAFCAP**
- National – Astronomy institutes, Academies,...

The spectrum management problem space

Administrations **regulate**



"passive" services
(radio astronomy)
receive

"active" services
emit

International Telecommunications Union (ITU)

- ITU is the United Nations specialized agency for information and communication technologies – ICTs.
 - Allocates global radio spectrum and satellite orbits,
 - Develops the technical standards that ensure networks and technologies seamlessly interconnect,
 - Strives to improve access to ICTs to underserved communities worldwide.
 - Members: 193 countries;
 - + private-sector entities and academic institutions. ~800
 - ITU Sectors:
 - **Radiocommunications ITU-R**
 - Standardization ITU-T
 - Development ITU-D

ITU-R structures

- **Technical studies**

- Study Groups & associated Working Parties

- Study Group 1 (SG 1) Spectrum management
- Study Group 3 (SG 3) Radiowave propagation
- Study Group 4 (SG 4) Satellite services
- Study Group 5 (SG 5) Terrestrial services
- Study Group 6 (SG 6) Broadcasting service
- Study Group 7 (SG 7) Science services

- **SG7**

- **WP7A**: Time signals and frequency standard emissions
- **WP7B** : Space radio systems
- **WP7C**: Earth-exploration satellite systems and meteorological elements
- **WP7D: Radio Astronomy** (Chair: Tzioumis)

Regulatory instruments

- **World Radiocommunications Conference (WRC)**
 - 3-4 years study cycle; Agenda Items (AI) predefined at previous WRC
 - WRC Conference Preparatory Meeting (CPM) → WRC options
 - Radiocommunications Assembly (RA) – defines working rules
- **Radio Regulations (RR) – from WRC**
 - An **international treaty**!! – enforceable
 - **Allocations** to services (Primary, Secondary)
 - Also allocations via **Footnotes**.
 - Rules on sharing and protection
- **Recommendations, Reports, Handbooks...**
 - Technical analyses and guidelines – from SGs & RA
 - Only enforceable if incorporated into RR – most are NOT!

RA allocated bands ?

Frequency Bands(MHz)	Frequency Bands(GHz)
13.360 - 13.410	10.6 - 10.7
25.550 - 25.670	14.47 – 14.50 (H ₂ CO)
37.5 - 38.25	15.35 - 15.4
73 - 74.6	22.21- 22.50 (H ₂ O)
150.05 - 153	23.6 - 24.0 (NH ₃)
322 - 328.6	31.3 - 31.8
406.1 - 410	42.5 - 43.5 (SiO)
608 - 614	76 - 116
1 400 - 1 427 (HI)	123 - 158.5
1 610.6 - 1 613.8 (OH)	164 - 167
1 660 - 1 670 (OH)	200 - 231.5
2 655 - 2 700	241 - 275
4 800 - 5 000 (H ₂ CO)	

RAS Allocation Summary

- **< 30 GHz:**

- 1.3% primary exclusive for passive frequency use
- 1.2% primary shared allocations
- 0.5% secondary allocations

- **30 - 275 GHz:**

- 16.8% primary exclusive for passive frequency use
- 38.3% primary shared allocations
- 5.1% secondary allocations

- **Important footnotes**

- **5.340** All emissions are prohibited in exclusive passive bands
- **5.149** Urged to take all practicable steps to protect the radio astronomy from RFI in other (non-allocated) bands.

**** RAS protection in ITU only for ALLOCATED bands!**

Radio Quiet Zones

- Modern radio telescopes operate way beyond RAS allocated bands!!
 - eVLA 1-50 GHz continuous
 - ATCA – most of 1-110 GHz (some gaps)
 - Next generation radio telescope – SKA
 - 50 MHz to 25 GHz
 - Need means of protecting radio astronomy observations over whole spectrum!
→ Radio Quiet Zone (RQZ)
 - Reference: Report ITU-R RA.2259
- ** RQZs defined and administered nationally.**

WP7D role – Technical studies

- WP7D is the responsible party for RAS issues in ITU
 - Issues for Studies defined via Questions & approved by SG7.
 - Produce New Recommendations & Reports
 - Revise Recommendations and Reports in a timely manner.
 - Invite inputs and comments from other WPs as appropriate.
 - Provide Liaisons with comments for studies affecting RAS conducted by other WPs
 - Accept Formal Inputs to studies from ITU members
 - Primary mechanism for new inputs.
 - Maintain and Update the RAS Handbook- major undertaking
 - ALL Recs/Reports/Handbooks must be approved via SG7
- * **Details of Recs/Reports/Handbook in separate lectures**

WP7D Role – Protection criteria for RAS

- Recommendation ITU-R RA.769
 - Most important for Radio Astronomy
 - Protection criteria and thresholds
 - Tables for continuum, spectral-line and VLBI
- Provides **Methodology** for thresholds
 - Sound technical base
 - All assumptions mentioned and justified
 - Can be used to determine RA thresholds for any band
 - e.g. for eVLA & SKA bands not allocated to RAS
- RAS Handbook provide even more technical details on RA.769 methodology.

WP7D role – WRC Agenda Items

• WRC Agenda Items & Studies

- Each WRC defines the Agenda Items for the next WRC
- About 15-30 AIs are approved each 3-4 year study cycle
- Responsibility for each AI is assigned to a WP
 - Coordinate studies for production of CPM text
 - Other WPs may be assigned as contributing or concerned.
- RAS is affected by most AIs
 - WP7D contributing or concerned in many (most) AIs
 - Must keep close watch and contribute as necessary to studies
 - Sharing and compatibility studies – Reports in ITU literature
 - CPM summary of studies & proposed Methods – 1 year before WRC
- WRC AIs & CPM preparation highest **priority!!**
 - Focus of WP7D work...

WP7D meetings and participation

- WP7D meets 2 times a year for ~1 week duration
- SG7 meets once a year adjacent to the WPs
- WP outputs usually take at least 2 meetings to consider and review & then approved via SG7
 - More than a year before approval of new work!!
 - Heavy reliance on timely inputs from contributors
- Possible to continue work between meetings via formal Correspondence groups
- Participation only via official delegations!
 - Administrations; Sector members; IUCAF; SKAO...
- Interested parties from other Sectors can & do participate in WP7D...
- Need TIES access for ITU meeting documents
 - Obtain via national administrations

WP7D role - Summary

- WP7D guardian of RAS interests in ITU
 - Primary conduit for RAS inputs to the ITU
- Only mechanism to “have a seat at the table”
 - Awareness of emerging issues
 - Potential to influence direction & protect RAS
- Critical link in the WRC cyclical process
- Responsible for technical literature and protection criteria.
- Participation is essential and critical
 - liaise and get support from your national administrations

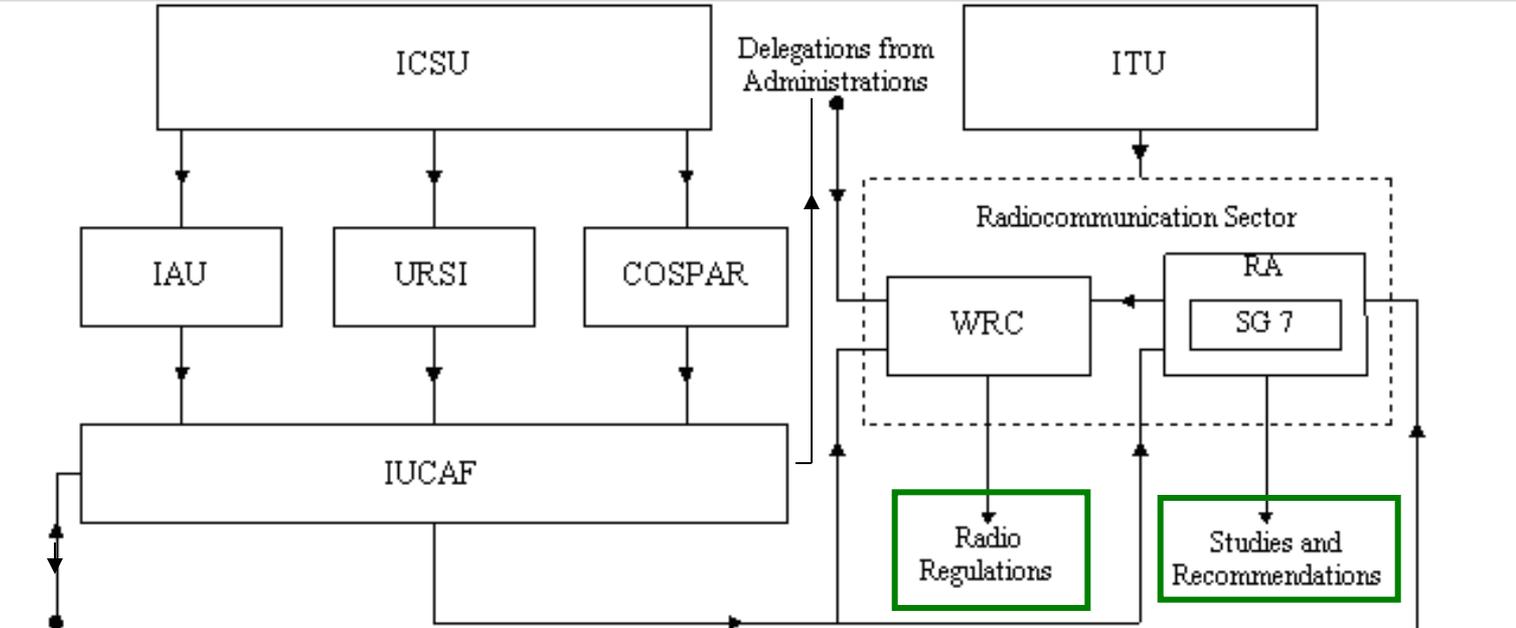
**** Need new (& younger) participants !!!**



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The worldwide spectrum management circus – RAS perspective



National and Regional scientific groups (CRAF, CORF, RAFCAP)

- COSPAR** Committee on Space Research
- IAU** International Astronomical Union
- URSI** International Union of Radio Science
- IUCAF.** Scientific Committee on Frequency allocations for astronomy and space sciences
- CORF** Committee on Radio Frequencies (USA)
- CRAF** Committee on Radio Astronomical Frequencies (EUR)
- RAFCAP** Radio Astronomy Frequency Committee in the Asia-Pacific Region
- ICSU** International Council of Scientific Unions
- ITU** International Telecommunication Union
- RA** Radiocommunication Assembly
- SG 7** Radiocommunication Study Group7
- WRC** World Radiocommunication Conference