International
& national
Spectrum Management
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What is it, exactly?
• ‘Everyone’ knows that there is heavy demand on the finite resources of the RF spectrum
• So, use of the spectrum is heavily regulated
• Making the regulations work/making new regulations is called “spectrum management”
• The lowliest job at any observatory
• There are far more “spectrum managers” than astronomers (in the real world, that is)

What is interference?
• Interference happens when SM FAILS
• Unwanted extraneous signal detected
-----IN A RADIO ASTRONOMY BAND-----
• Outside the radio astronomy bands you are quite likely seeing intentional radiation which is legally someone else’s SIGNAL and THIS ISN’T INTERFERENCE
• Inside a RA band, unwanted signal is quite likely to be generated by the observatory

What is the Radio Astronomy Service?
• Few services (official uses) are “passive”
  – Radio astronomy is a radio communication service only when interfered with
  – Earth Exploration Satellite Service (passive)
• Concept of “use” for passive services somewhat elusive
  – FCC considers spectrum “unused” just where RAS works best

Did you say “international”?

On the other bank …
The ITU-R

- A UN agency in Geneva

International Alphabet Soup

- IUCAF
  - ICSU-chartered for IAU, COSPAR, URSI
  - Historically, the vehicle for RAS representation
  - Now being pressured to be more interdisciplinary
- Regional groups
  - 1: Committee European Post Telegraph (CEPT)
    - Committee Radio Astronomy Frequencies (CRAF)
  - 2: CITEL (organ of OAS)
    - Committee on Radio Frequencies (CORF) of NAS in US
  - 3: Asia Pacific Tel. APT shadowed by RAFCAP

ITU Regions

Entire ITU-R structure mirrored in US
USWP7A,B,C,D
What’s a WRC?

- World Radio Conference (WRC97, 00, 03, 08)
  - Crafts INTERNATIONAL TREATY
  - Ratified by individual administrations (nations)
    - Nations are allowed their sovereignty
  - Considers agenda items which result in
    - Recommendations (such as RA-769)
    - Regulations (the rules including frequency tables)
    - Resolutions and questions for future WRC

Agenda item, WRC07

- 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 730 (WRC-03).

- 740 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 1 to Resolution 730 (WRC-03).

Part of the frequency table

ITU-R defines ‘radio’ as extending up to 3000 GHZ!

Allocations now extend up to 275 GHZ

US74

- In the bands 25.5-25.67, 73-76-74, 406-410.0, 688-694, 1400-1402, 1000.5-1670.0, 2690-2550, and 4900-5000 MHz, and in the bands 10.68-10.7, 15.35-15.4, 23.6-24.0, 31.3-31.5, 86-92 100-102, 109.5-111.8, 114.25-116, 148.5-151.5, 164-167, 206-208, and 250-252 GHz, the radio astronomy service shall be protected from external radiation only to the extent that such radiation exceeds the level which would be present if the offending station were operating in compliance with the technical standards or criteria applicable to the service in which it operates. Radio astronomy observations in these bands are performed at the locations listed in US311.

- FCC now considering cell phones on planes
- 1st harmonic in protected OH band @ 1665
- Harmonic isn’t heavily regulated, nor need it be
- But once pigs can fly …
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**WRC07 Agenda items**

- **1.5** to consider spectrum requirements and possible additional spectrum allocations for aeronautical telecommand and high bit-rate aeronautical telemetry
  - Will likely be in band 4800-4940
- **1.17** to consider the results of ITU-R studies on compatibility between the fixed-satellite service and other services around 1.4 GHz …
  - 1390-1392 (up), 1430-1432 MHz feeder links
  - Loathed by passive services, DoD (bad for awacs)

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**What’s hot now**

- Broadband over Power Lines (BPL) Q218, 221
- CloudSat radar at 94.05 GHz
  - From the evil twin (active) branch of a sister passive service EESS (passive)
- Compatibility studies for ultrawideband
  - Vehicular radar at 24, 76 GHz
  - Unlicensed portable devices
    - FCC mask 3.1-10.6 GHz

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**What commenters said**

**Q:** Would it be possible to achieve sufficient isolation between radio astronomy and UWB through practical methods of physical separation?

**Responses:** The responses were broadly polarized between the radio astronomy community and all other respondents:

- Many thought that it would be possible to achieve sufficient isolation, given that most UWB devices would be indoors and most radio astronomy antennas would be pointing predominantly upwards. They noted that astronomy sites already protected themselves against out-of-band and spurious interference, and that UWB would be little different from this. Some provided specifications showing, e.g., that WLAN spurious emissions were higher than proposed UWB emissions.
- One respondent noted that in the case of MDLIN and Multihop line studies in the 6500-9500 MHz band, such studies are typically performed at night with narrow channel bandwidths, significantly reducing the effects of wideband or ultra-wideband emissions because of pulse desensitization effects. As a result, they thought a pointless license restriction would be acceptable.
- One respondent recommended a small levy on each UWB device sold which would be used to provide the astronomy community with funds to mitigate the interference.

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**What’s wrong with this picture?**

- One respondent noted that protecting astronomy at low elevation angles was probably the least thing given that, somewhere in the world, there would be an observatory able to monitor the same part of the sky with a high elevation angle.
- Many noted that if the protection requirements stated were real, then “radio astronomy would already be impossible” due to the spurious emissions from other devices.
- The astronomy community said that relocation would be impractical and that permanent fences would not provide sufficient isolation. They claimed that restricting observations to night-time would destroy the scientific nature of their research.

**Reaction:** On the balance of evidence provided there seems a strong likelihood that a means could be found whereby sufficient isolation could be achieved. This might be through the combination of a perimeter fence and a recognition that certain measurements could be performed differently in the case of interference. We will consider further studies to confirm whether this is the case.

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**What can RAS have in the near future?**

- **Allocations above 275 GHz**
  - Spectrum 275-1000 GHz will open next
  - ITU-R is considering extending definition of radio above 3000 GHz
- **Consideration of radio quiet zones**
  - Presently exist in US, Chile, India
  - Lesser coordination zones elsewhere
  - SKA will need a quiet zone
  - US couldn’t provide one, dropped out as host

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**It’s a long way from here to Geneva**

- **How do things appear on the WRC agenda?**
  - Services like radio astronomy may foster issues
    - RAS procured mm-wave allocations at WRC00
    - Now sponsoring ITU consideration of Quiet Zones
  - Countries/blocks may tout initiatives
    - Europe’s Galileo RNSS (GPS competitor)
    - At WRC03 US pushed
      - Ku-band links for airborne mobile broadband
      - Increased 5 GHz allocation for WiFI
      - Primary status for L-band feeder links, HAPS

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**Inside the US**

- **Unusual parallel structure**
  - FCC for commercial (non-government)
  - NTIA for government + shared
    - NTIA does the testing and is supposed to be the president’s technical expert advisor
- **FCC has been dominant in technology**
  - Industry proposes to FCC, FCC orders NTIA to show everything is OK, NTIA complies
  - Dept of State uses FCC to control WRC access

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**Inside the US**

- FCC under Michael Powell frequently infuriated both industry and public interests and lost some big court cases
  - Immediately after Powell’s resignation the FCC pulled back on many of its wackier initiatives
  - Present realignment of FCC ongoing
  - FCC won two big cases very recently
    - Cable access not regulated
      - Services are data, not telecommunications

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**Recent NRAO FCC Filings**

- ESV (Ku band links on ships for broadband)
- Interference temperature
- Cognitive radio
- Unlicensed use of TV broadcast bands
- Airborne use of cellular telephones
- Airborne mobile Ku band satellite links
- Comments on draft US WRC position on L-band feeder links
Problematic:

- Observing outside protected bands
- Bandwidths far exceed width of protected bands (at lower frequencies)
- No amount of geographic separation protects against satellites, planes, HAPS etc.
- Perhaps best viewed as a gradual process of deracination, isolation & marginalization
  (think of QZ as reservations)