National Science Foundation

Preparations for WRC-12 and Update from NSF
Presentation to the CORF
May 16, 2011

Tomas E. Gergely

tgergely@nsf.gov

National Science Foundation

World Radiocommunication Conference -12

- 23 January – 17 February 2012 (4 weeks)
- Location: Geneva, Switzerland
- 33 Agenda Items, many include several sub-items
  - Compare to 28 Agenda Items at WRC-07
- ~ 15 of (at least some) interest to science
- CPM Report provides possible outcomes
- US Head of Delegation designated (Mr. Decker Anstrom, ex-President of the Weather Channel)
- US Delegation to be named: June- Sept., 2011
- US proposals mostly ready to be submitted

National Science Foundation

The Agenda Item Most Directly Relevant to Radio Astronomy (AI 1.6)

Two parts:

a) (Res. 950) Revision of Footnote RR 5.565

a) revise the listing of bands currently in the footnote, in the 275 - 1000 GHz range,

b) Extend the range up to 3000 GHz

" The frequency band 275 – 1000 GHz may be used by administrations for experimentation with, and development of, various active and passive services. In this band a need has been identified for the following spectral line measurements for passive services:

Radio astronomy service: 275-323 GHz, 327-371 GHz, 388-424 GHz, 426- 442 GHz, 453-510 GHz, 623-711 GHz, 795-909 GHz and 926-945 GHz;

Earth exploration-satellite service: ……

- Future research in this largely unexplored spectral region may yield additional spectral lines and continuum bands of interest to the passive services. Administrations are urged to take all practicable steps to protect these passive services from harmful interference until the date when the allocation Table is established in the above-mentioned frequency band.

National Science Foundation

Proposal

Coordinated with the European and Asia-Pacific area radio astronomers

- List of radio astronomy bands in the 275-1000 GHz range:

  No change - Existing list includes all atmospheric windows within range

"The use of the range 275-1 000 GHz by the passive services does not preclude use of this range by active services. Administrations wishing to make frequencies in the 275-1 000 GHz range available for active service applications are urged to take all practicable steps to protect these passive services from harmful interference until the date when the Table of Frequency Allocations is established in the above-mentioned 275-1 000 GHz frequency range. "

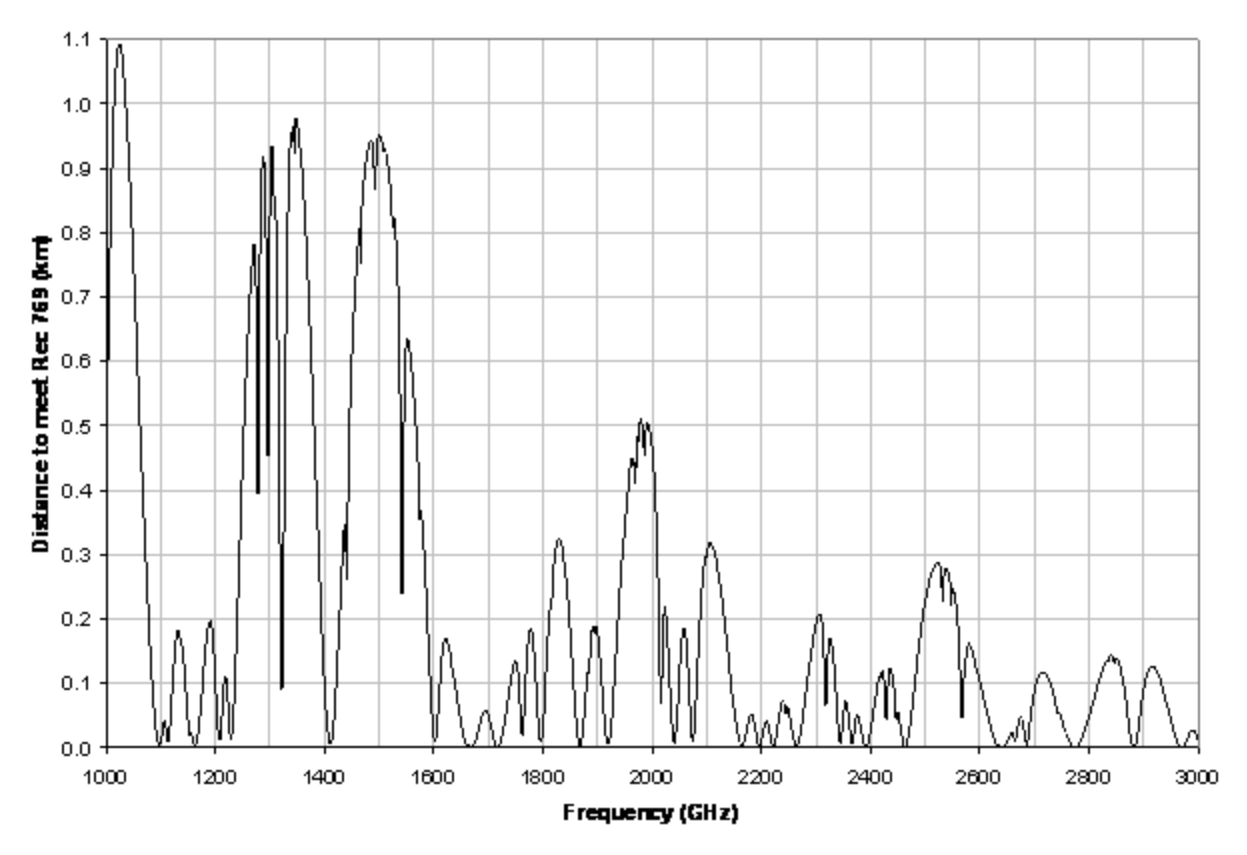
- The 1000-3000 GHz range can be used by both passive and active services without restrictions (and minimal risk of interference)

"All frequencies in the range 1 000-3 000 GHz may be used by both active and passive services. "

No controversy expected at the WRC

National Science Foundation

Distance beyond which a transmitted signal, using maximum achievable RF power and transmitting through a 30 cm diameter antenna pointed directly at a radio telescope, would reach levels that would not be detrimental to the radio astronomy service. The calculations assume free space loss and atmospheric attenuation at 3000 m altitude with a total of 2 cm precipitable WVP, scale height of 2 km and 50% atmospheric humidity at sea level, and are based upon radio astronomy interference objectives extrapolated from those in Rec. ITU-R RA.769



National Science Foundation

AI 1.6

- b) (Res. 955): Consider possible regulatory procedures for free-space optical links, based on ITU-R studies
- An attempt to introduce regulation at optical frequencies
- CPM Report provides only one possible outcome: no change in the radio regulations, meaning no regulations at optical frequencies; delete associated Resolution (Res. 955)

National Science Foundation

HF Oceanographic Radar (AI 1.15)

- Primary allocations sought in the 3-50 MHz range for oceanographic radars, to measure wave heights, currents, track large objects (e.g. tsunamis), etc.
- Radars operating on NIB basis since 1970s. Improved regulatory status sought, for firm availability of operational capabilities in case of disasters, aid with climate studies, etc.
- Development of radar system included among objectives of the National Ocean Policy
- Allocations desired near 4.5 MHz, 9 MHz,13 MHz, 16 MHz (2x 25-100 kHz), 26 MHz (2x100-150 kHz) and 43 MHz (2x150-500 kHz)

National Science Foundation

HF Oceanographic Radar (AI 1.15)-2

- Agreement reached recently among government agencies, after lengthy discussions, but no buy-in from FCC yet
- Primary allocations at ~ 3.2, 4.5, 5.3, *13.4,* 14.5, *25.5*, 26.3, 41.5 and 43.5 MHz
- US proposed footnote nullifies primary status
- Peak power (e.i.r.p.) restricted to 25 dBW
- Some other restrictions, to avoid interference to fixed and mobile stations
- Most controversy within US, little controversy expected at WRC-12

National Science Foundation

Other WRC-12 Agenda Items

AIs That May Impact the 4990-5000 MHz Band

- **AI 1.4. "….to consider, …. further regulatory measures to facilitate introduction of new aeronautical mobile (R) service (AM(R)S) systems in the bands …5 000-5 030 MHz"**
  - **Issue: airborne transmitters operating next to the widely used primary 4990-5000 MHz radio astronomy band**
    - ***Allocation to be used by surface LAN's at airports only, using very low power levels***
- ***Regulatory text would be included in a Resolution, if allocation is made***
- ***Example (as per the CPM Report):***

Resolves

that if the separation distance for AM(R)S stations operating in the band 5 000-5 010 MHz with respect to stations in the RAS operating in the band 4 990-5 000 MHz is less than 150 km, site-specific compatibility studies including local conditions shall be undertaken in order to ensure that RAS is protected (*Arecibo, Jodrell Bank)*

National Science Foundation

Other WRC-12 Agenda Items

AIs That May Impact the 4990-5000 MHz Band (2)

- AI 1.18"… extending the existing …radiodetermination-satellite service (space-to-Earth) allocations in the band 2 483.5-2 500 MHz in order to make a global primary allocation, and determine the necessary regulatory provisions…."
- Issue: 2nd harmonic of downlink falls on 4990-5000 MHz RA band, currently subject to footnote RR 5.402, that urges protection of RA
- CPM report: suggests no changes to RR 5.402, that applies already in all three ITU Regions.
- RR 5.402 should be maintained (or strengthened) if a worldwide primary allocation is made to the RDSS

National Science Foundation

Other WRC-12 Agenda Items

AI That May Impact the 15.35-15.4 GHz passive band

- AI 1.21. "to consider a primary allocation to the radiolocation service in the band 15.4-15.7 GHz…"
- Issue: Strong, possibly airborne transmitters operating next to the 15.35-15.4 GHz passive band
- CPM Report provides four different alternatives:
  - Addition of primary RLS allocation in 15.4-15.7 GHz band, footnote including hard limits, protecting RA in 15.35-15.4 GHz band
  - Addition of RLS in 15.5-15.7 GHz, coupled with Resolution protecting RA
  - Addition of primary RLS allocation in the 15.55-15.7 GHz band, coupled with Resolution protecting RA
  - NOC to the RR
- Will require vigilance at WRC

National Science Foundation

Other WRC-12 Agenda Items

AI That May Impact the various passive bands

- 1.25 to consider possible additional allocations to the mobile-satellite service, in accordance with Res 231 (WRC-07);
- Bands that could be considered: 10.5-10.6 GHz(MSS s-E); 15.43-15.63 GHz (MSS E-s)
- 10.5-10.6 GHz CPM Report gives two alternatives:
  - NOC
  - Primary allocation. "Measures for protection of the RAS in the adjacent band, 10.6-10.7 GHz, may be required. This could be through use of Recommendation ITU-R RA.769, pfd limits, or pfd threshold levels for consultation."
- 15.43-15.63 GHz CPM Report – three alternatives:
  - NOC
  - Primary allocation in 15.43-15.63 GHz band
  - Primary allocation in 15.43-15.63 GHz band, subject to RR 9.21 coordntn

  Under the last two options: "Measures for protection of the RAS in the nearby band, 15.35-15.4 GHz, may be required."

National Science Foundation

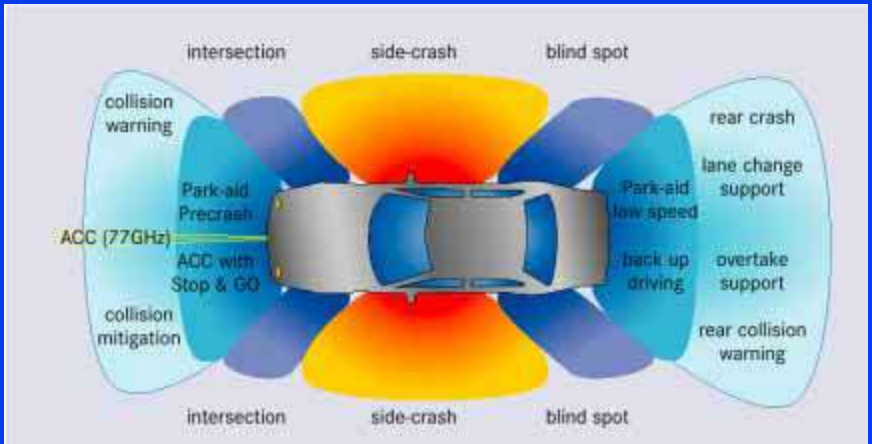
AIs of interest (but likely limited impact) to radio astronomy

- AI 1.3 "…to consider spectrum requirements and possible regulatory actions, including allocations, in order to support the safe operation of unmanned aircraft systems (UAS)…"
- AI 1.5 "to consider worldwide/regional harmonization of spectrum for electronic news gathering (ENG).."
- AI 1.8 " to consider the progress of ITU-R studies concerning the technical and regulatory issues relative to the fixed service in the bands between 71 GHz and 238 GHz…"
- AI 1.13 " to ….decide on the spectrum usage of the 21.4-22 GHz band for the broadcasting-satellite service and the associated feeder-link bands in Regions 1 and 3"
- AI 1.20 "spectrum identification for gateway links for high altitude platform stations (HAPS) in the range 5 850-7 075 MHz in order to support operations in the fixed and mobile services"

National Science Foundation

76-81 GHz Issues

- **SRR Vehicular Radars**



- **Satellites**

National Science Foundation

Short Range Vehicular Radars (SRR)

- Vehicles increasingly manufactured with two kinds of radars:
  - Long Range (LRR) – adaptive cruise control, collision avoidance
  - Short Range (SRR) – blind spot detection, backup warning, etc.
- LRRs operate at 76-77 GHz ; 1 GHz bandwidth
  - Europe: 55 dBm (~316 W) peak; 50 dBM (100 W) average power
  - US : 48.3 dBm (60 W) average (in motion-forward); 45.3 dBm average (in motion- side/rear) ; 23.5 dBm (02.W)average (standing)
- SRRs operate at 23.6-24.0 GHz, in Europe/Japan moving to 77-81 GHz (ECC Decision 19 March, 2004) – 24 GHz radars phased out in 2013, predicted penetration of 79 GHz radars complete by 2020
- NSF approached by representatives of car industry (Bosch GmbH) to discuss impact of such a move in USA on radio astronomy installations – petition to FCC expected later this year
- Proposed eirp mean: 24 dBm (25W); peak: 55 dBm (316 W); mean psd: -3 dBM/MHz ; possible bumper attenuation: 6dB

National Science Foundation

Short Range Vehicular Radars (SRR) -2

- ITU-R Rec. RA.769 threshold level of interference reached by single interferor at 65-130 km, depending on atmospheric conditions (dry air att. 0.135 dB/km; most air att. 0.35 dB/km)
- Automobile industry modelling also yields high levels of aggregate interference, requiring mitigation
- Potential mitigation methods:
  - Fence around observatories- impractical, would require fence 150 m high at 700 m from telescope
  - Beacon to signal switch off requirement near radio astronomy sites
  - GPS based switch-off near radio astronomy sites
- However, according to car industry, no on/off switch is contemplated.

National Science Foundation

WP 7D

- SG 7 (Science Services)
  - WP 7A (Time and Frequency Standards)
  - WP 7B (Space Radiocommunication Systems)
  - WP 7C (Remote Sensing Systems)
  - WP 7D (Radio Astronomy)
- WP 7D Chair: Tasso Tzoumis, Australia (CSIRO, ATNF)
- If you want to participate in WP 7D activities please e-mail:

tgergely@nsf.gov
or aclegg@nsf.gov

National Science Foundation

76 GHz Satellites

- NSF recently contacted by USAF
- FSS system desired 71-76 GHz Downlink
  > 81-86 GHz uplink
- First step: operation of a beacon for ~ 6 months
- Schedule: 2015 or before
- Spot beam antenna: 1 degree 3 dB BW
- Bandwidth in the kHz range ; Peak power 56 dBW
- Possibly could turn off beacon (on/off switch)
- Bottom Line: USAF desires to coordinate activities with radio astronomy community

National Science Foundation

WP 7D Activity

Recommendations approved by SG 7 and available on the ITU website:

- **Rec. ITU-R RA.1860 "Preferred Frequency Bands for Radio Astronomy in the 1-3 THz Range" (A. Clegg)**
- **Rec. ITU-R RA.1237 "Protection of the Radio Astronomy Service from Unwanted Emissions Resulting from the Applications of Wideband Modulation" – (T. Gergely) Revision**
- **Rec. ITU-R RA.1417 "A radio quiet zone in the vicinity of the L_2 Sun- Earth Lagrange point" (H. Liszt) Revision approved by WP 7D, approved by SG 7 after editorial change, subsequently rejected by Japan and returned to WP 7D**
- **Minimize interference to radio astronomy observations (or other space missions? (or other space science missions)**

National Science Foundation

WP 7D Activity – Reports & Handbook

- Reports (New)
  - > Radio Quiet Zones – C. Wilson (Australia) Intended to be mostly descriptive of what exists and common characteristics. Still being written
  - > The essential role and global importance of radio spectrum use for Earth observations and for related applications – Ch van Diepenbeek (The Netherlands)
- Revision/update needed: Mitigation Methods in Radio Astronomy (S. Ellingson/M. Lewis)
- WP 7D will work on a new version of the Radio Astronomy Handbook, portions of which are now obsolete.

National Science Foundation

CubeSats

- **CubeSats :**
  - "miniaturized satellite for space research that has a volume of exactly one liter (10 cm cube), weighs no more than one kilogram, and typically uses commercial off-the-shelf electronics components".
  - Cost ~ $ 100K ; Can piggyback on launches, or launch many at one launch.
- **NSF program to use CubeSats for science missions, dedicated to space weather and atmospheric research**
- **First deadline for proposals: May, 2008; annually in February, thereafter (3-6 awards) .**
- **Problem: No specific band designated for data transmissions**
- **CubeSats have been using the amateur bands for data transmission, but this cannot be done indefinitely**
- **Spectrum will be needed for CubeSats (Micro Sats) - An ITU-R Question has been introduced (WP 7B), to explore the options and conduct studies**

National Science Foundation

Third Summer School in Spectrum Management for Radio Astronomy

Held May 31- June 6, 2010 , Mitaka, Japan

Presentations at: http://www.iucaf.org/SSS2010/