Science Outcomes of WRC-12
Presentation to the CORF
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World Radiocommunication Conference-12 (WRC-12)

- 23 January- 17 February, 2012 Geneva, Switzerland
- NSF on US delegation: A. Clegg, T. Gergely
- Science Related Agenda Items:
  - ✓ Update of footnote on spectrum use of passive services above 275 GHz
  - ✓ Allocation in the band adjacent to 15.35-15.4 GHz passive band
  - ✓ Allocations for Oceanographic Radar
  - ✓ Allocation for Lightning Research
  - ✓ Future agenda items: WRC-15 and WRC-18

Winter Delights
Geneva
Sunday, Feb 12, 2012

Update of footnote 5.565 (AI 1.6)

(Spectrum Use of Passive Services Above 275 GHz)

- **The spectrum is not allocated above 275 GHz, but footnote 5.565 lists the bands used by the passive services (remote sensing and radio astronomy) between 275 and 1000 GHz.**
  - **-No need to update bands used by radio astronomy (essentially all atmospheric windows in the 275-1000 range are already included in the list)**
  - **- List of bands used by Earth Remote Sensing updated**
  - **- Extended the range of the footnote, noting that passive services use the spectrum up to 3 THz**
    - **Frequencies between 1 and 3 THz can be shared by active and passive services, with minimal risk of interference**
- **Extensively pre-coordinated internationally and between the EESS/RAS (WP 7C/7D) before the Conference, easily adopted during the first week of the WRC**
- **Second part of the agenda item: Regulation of Optical Links – WRC Decision: No Regulation Needed**

The other “radio astronomy” issue

- Allocation in 15.4-15.7 GHz band, adjacent to the 15.35-15.4 GHz passive band
- Prior to WRC, three possibilities, under different agenda items:
  - Satellite downlink allocation – little or no support (AI 1.25)
  - Band allocated for use of unmanned aerial vehicles – favored by Europe (xc Russia) - AI 1.3
  - Band allocated to radars (possibly airborne) AI 1.21 Favored by US, rest of the world
- One of the highest priority AIs for the US! Highly contentious, resolved only during the last days of the WRC!
- Radars the best of three (all pretty bad) options for passive services – Passive band protected by footnote, includes hard limit for unwanted emissions.
- Radio astronomy protection played a large part in resolving the issue

Competing Proposals

- **CITEL**

  15.4-15.7 GHz Primary Radiolocation Allocation

  Footnote: In order to protect the radio astronomy service in the band 15.35-15.4 GHz, radiolocation stations operating in the 15.4-15.7 GHz band shall not exceed the power flux-density level of −156 dB(W/m^2) in a 50 MHz bandwidth into the 15.35-15.4 GHz, at any radio astronomy observatory site for more than 2 per cent of the time.

- **CEPT**

  15.4-15.5 GHz Primary Aeronautical Mobile (R) Service Allocation

  Footnote: The use of the band 15.4-15.5 GHz by the aeronautical mobile (R) service is limited to systems operated in accordance with recognized international aeronautical standards. In order to protect the radio astronomy in the band 15.35-15.4 GHz, the e.i.r.p. density of any AM(R)S station shall not exceed −68 dBW/50 MHz in the band 15.35-15.4 GHz.

  15.5-15.7 GHz Primary Radiolocation Allocation

  No additional protection of passive band

HF Oceanographic Radar (AI 1.15)

- Primary allocations sought in the 3-50 MHz range, to measure wave height, currents, track large objects (e.g. tsunamis), streamline rescue operations, etc.
- Radars operating for over 30 years, but better regulatory status sought, to improve operational capabilities in case of disasters, aid with climate studies, etc.
- Development of radar system included among the objectives of the National Ocean Policy, to be operated for coastal oceanographic networks

Region 1	Region 2	Region 3
	kHz	
4 438-4 488 (s)*	**4 438-4 488 (P)***	**4 438-4 488 (s)**
5 250- 5275 (s)	**5 250- 5275 (P)**	**5 250- 5275 (s)**
9 305- 9 355 (s)		**9 305- 9 355 (s)**
13 450-13 550 (s)	**13 450-13 550 (s)**	**13 450-13 550 (s)**
16 100-16 200 (s)	**16 100-16 200(P)**	**16 100-16 200 (s)**
24 450-24 650 (s)	**24 450-24 600 (P)**	**24 450-24 650 (s)**
26 200-26 350 (s)	**26 200-26 420 (P)**	**26 200-26 350 (s)**
	MHz	
39-39.5(s)	41.015-41.665 (P US)	**39.5-40 (P)**
42-42.5 (s)	43.35-44.0 (P-US)	
***Denotes Primary (P) or secondary (s) allocation**		

HF Oceanographic Radar (AI 1.15)-2

- There are numerous country-by-country exceptions (subtractions and addition) to this Table.
- Most allocations secondary. When primary, a footnote effectively nullifies primary status
- More detailed “rules of the road” are spelled out in Resolution 612 (Rev. WRC-12)
- Extremely contentious agenda item (unexpected!)
- Group chaired by Andy Clegg, took many hours of discussions to reach conclusion

Lightning Research (AI 1.16)

- 8.3-11.3 kHz band allocated to the Meteorological Aids service, for passive observations (lightning research) only.

- Limited or no protection from stations in the radionavigation service

- Somewhat controversial because prior to WRC-12 spectrum below 9 kHz unallocated

The Future: WRC-15/18

- WRC-15 to be held in Geneva, 4 weeks, end of 2015
- Conference preparatory meeting: February 2015?
- Agenda to be found in Resolution 807 (WRC-12)
  - > ~ 25 substantive + 10 standard items
  - > Many Items relevant to science interests:

    1.1 Additional primary allocations to the mobile service (IMT) to facilitate development of broadband mobile telecommunications

    Undefined spectrum requirements and range, to be developed by WP 5D

    Joint Task Group 4-5-6-7 established to deal with sharing issues

    WP 7D should develop input text for CPM Report

    High Importance to the USA (jobs!) –Likely to be contentious

WRC-15 Agenda Items of Interest to CORF

- 1.6 Additional Primary Allocations to the FSS

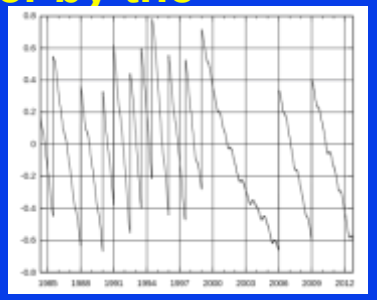
  250 MHz in the 10-17 GHz range - in Region 1

  300 MHz in the 13-17 GHz range - in Regions 2 and 3

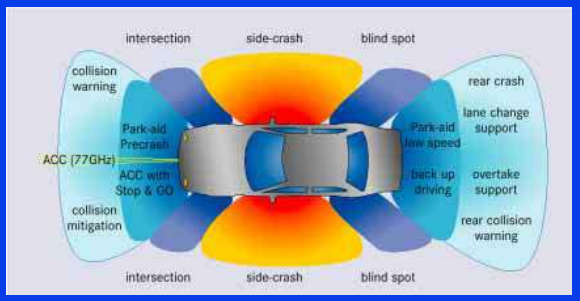
  Review the regulatory provisions related to the FSS in each of these ranges
- 1.9 Review the provisions related to Earth Stations on Vessels – (may impact 14.47-14.5 GHz band).
- 1.10 Additional allocations for MSS up and downlinks, including satellite applications for IMT broadband applications in the 22-26 GHz range (Res 234)
- 1.17 Spectrum requirements and regulatory actions for Intra-avionics wireless communications (WAIC)

Future Agenda Items of Interest to CORF at WRC-15/18

- **1.14 UTC - Leap Seconds** "consider the feasibility of achieving a continuous reference time-scale, whether by the modification of coordinated universal time (UTC) or some other method"



- **1.18 Vehicular Radars at 77.5-78 GHz** primary allocation to the radiolocation service for automotive applications in the 77.5-78.0 GHz frequency band, in accordance with Resolution 654



- **CubeSats – WRC-18**

UTC- Leap Seconds

- Leap seconds keep mean solar time and civil time in sync – inserted (or not) once or twice a year, according to need.
- Inconvenient for many applications –e.g. positioning satellites, cell phones
- ITU-R Working Party 7A (Time and Freq. Standards) proposes to eliminate leap seconds, in 4-5 years. Studies performed 2005-2012
- Issue was to be decided at Radiocommunication Assembly (RA), held just before the WRC No agreement reached: US, France, Italy, others in favor of suppression; Canada, China, U.K. opposed; others: more studies needed
- IAU Commission on time: leap seconds unnecessary, AAS study: no problem with suppression; some astronomers vehemently opposed
- Pushed onto the Agenda of WRC-15, for further "studies"
- Excellent, up-to-date article in wikipedia: http://en.wikipedia.org/wiki/Leap_second

Short Range Vehicular Radars (SRR)

- Vehicles increasingly outfitted with radars:
  - Long Range (LRR) – adaptive cruise control, collision avoidance
  - Short Range (SRR) – blind spot detection, backup warning, parking, etc.
    - LRRs operate at 76-77 GHz ; 1 GHz bandwidth
    - SRRs operate at 23.6-24.0 GHz, in Europe/Japan moving to 77-81 GHz
- Tests conducted at U of Arizona jointly with car industry representatives (Bosch GmbH and Toyota) conclusively show interference to radio astronomy installations from prototype SRRs

  See: http://www.gb.nrao.edu/electronics/edtn/edtn219.pdf
- Automobile industry modeling also yields high levels of aggregate interference, requiring mitigation
- Potential mitigation through GPS based on-off switch, allows/forces deactivation of radar near radio astronomy sites.

Short Range Vehicular Radars (SRR) -2

- SRRs require 4 GHz bandwidth for adequate resolution.
- The 76-77.5 GHz and 78-81 GHz bands are allocated to radars (the radiolocation service); while the 77.5-78 GHz band is not allocated for radar use
- It is questionable why an allocation would be needed if SRRs (and LRRs) (will) operate on an unlicensed basis?
- Germany, representing car radar manufacturers' interests, proposed AI, allocating the 77.5-78 GHz band to radiolocation, specifically for vehicular
- Studies in preparation for Agenda Item to include impact on neighboring bands (compatibility studies)
- WP 7D - Radio astronomers to participate in the studies

CubeSats

- **CubeSats :**
  - **Definition: "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 ~ $ 1 M ; Can piggyback; launch many at same time**
- **NSF CubeSats program established 2008: CubeSat-based Science Missions for Geospace and Atmospheric Research**
- **Current solicitation at:**
- **http://www.nsf.gov/publications/pub_summ.jsp?WT.z_pims_id=503172&ods_key=nsf12536**
  - **One or two CubeSats expected to be launched per year**
- **NASA: 3rd CubeSat Launch Initiative (CSLI), Feb. 2012, see:**
  http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html
  33 projects selected for 2013-14 period
- **Issues:**
  - **No specific band designated for command, control and data transmissions**
  - **License approval (regulatory process) takes a very long time, compared to time scale desired for CubeSats (2-3 years from award to completion)**

CubeSats: Spectrum Issues

- **NSF tried, (unsuccessfully), to propose this as a future WRC item**
- **ITU Question, put together by NSF:**
  1. **What are the distinctive characteristics of nano and pico satellites and satellite systems in terms of their use of the radio spectrum as defined by data rates, transmissions time and bandwidths?**
  2. **Taking into account such distinctive characteristics, what are the specific spectrum requirements for nano and pico satellite systems?**
  3. **Under which radiocommunication services can nano and pico satellites and systems composed of those satellites, operate?**
- **Approved at recent SG 7 meeting (8 May) – should be completed in time for RA-15**
- **Expected to result in ITU Recommendation(s)**
- **May force some WRC action – if timely results!**

CubeSats: Regulatory Issues

- **Proposed at the WRC by the Netherlands and promptly supported by CEPT and other Administrations (but not the US) as a future Agenda Item.**
- **On Agenda of WRC-18, but easily bumped if no action taken:**

resolves to invite WRC-18

to consider whether modifications to the regulatory procedures for notifying satellite networks are needed to facilitate the deployment and operation of nano- and picosatellites, and to take the appropriate actions,

invites ITU-R

to examine the procedures for notifying space networks and consider possible modifications to enable the deployment and operation of nano- and picosatellites, taking into account the short development time, short mission time and unique orbital characteristics

- **Not clear at present where work is to be performed:**

WP 4A (satellites), Special Committee(SC), WP 7B ?

Back-up Slides

HAPS at 6 GHz

- **5.A120 In Australia, Burkina Faso, Cote d'Ivoire, Mali and Nigeria, the allocation to the fixed service in the bands 6 440-6 520 MHz (HAPS-to-ground direction) and 6 560-6 640 MHz (ground-to-HAPS direction) may also be used by gateway links for high-altitude platform stations (HAPS) within the territory of these countries. Such use is limited to operation in HAPS gateway links and shall not cause harmful interference to, and shall not claim protection from, existing services, and shall be in compliance with Resolution COM5/3 (WRC-12). Existing services shall not be constrained in future development by HAPS gateway links. The use of HAPS gateway links in these bands requires explicit agreement with other administrations whose territories are located within 1 000 kilometres from the border of an administration intending to use the HAPS gateway links.**
- **RR 5.149 covers the 6 650-6 675.2 MHz Methanol line**