National Science Foundation

Spectrum Management - Update

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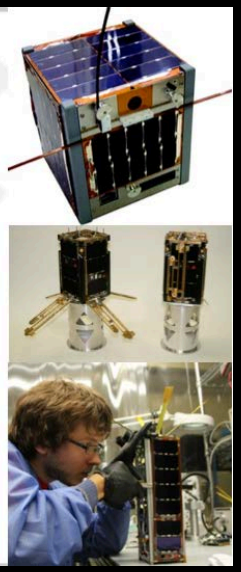
NSF-funded research increasingly relies on access to radio spectrum

Astronomy, ocean science and polar studies, atmospheric science, space weather, wireless communication and networks…
Future of facilities: AST and AGS portfolio reviews; NRC cubesats for science study

NSF Cubesat Program since 2008

- Geospace & atmospheric science and education
- 5 competitions with >80 unique missions proposed
- 12 (15) projects funded
- Grants $900,000 total cost and 3 year duration



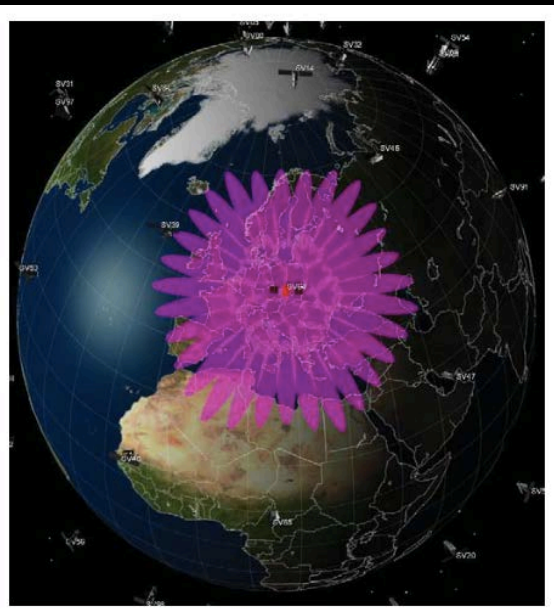
In 2013, a Presidential Memorandum to guide expanding America's leadership in wireless innovation.

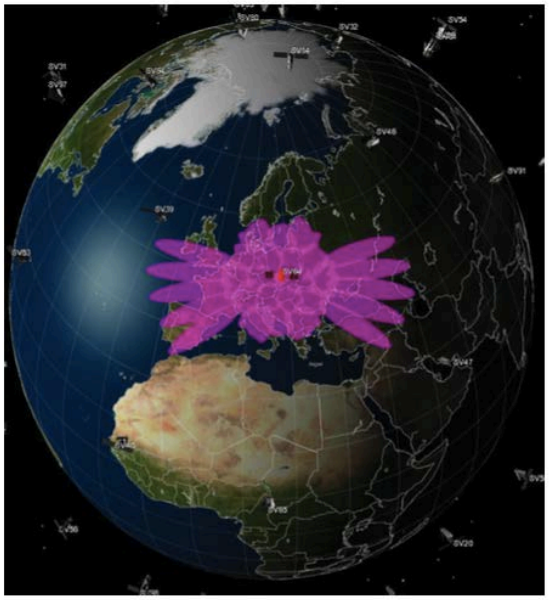
"Companies bid over $40 billion .. for six blocks of airwaves, totaling 65 MHz of the EM spectrum"
-CNET , Jan 2015

RA has to coexist with satellites …

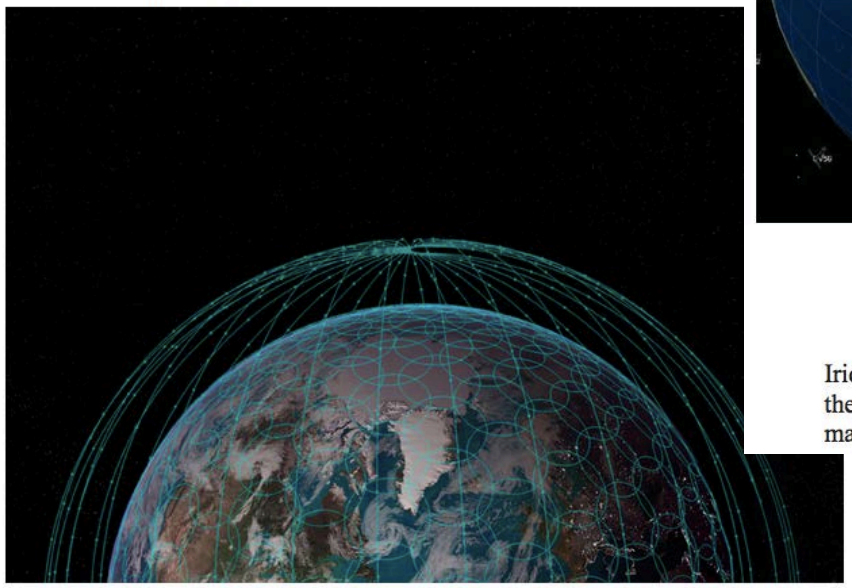
Table 4.11.1: Identified VLA RFI Between 1 and 4 GHz					
Frequency (MHz)	Source	Comment	**Frequency (MHz)**	Source	Comment
1025–1150	Aircraft navigation	Very strong	1564–1584	GPS L1	Very strong
1200.0	VLA modem		1598–1609	GLONASS L1	
1217–1237	GPS L2	Very strong	1618–1627	IRIDIUM satellites	
1243–1251	GLONASS L2		1642	2nd harmonic VLA radios	Sporadic
1254	Aeronautical radar		1683–1687	GOES weather satellite	
1268	Aeronautical radar		1689–1693	GOES weather satellite	
1268	COMPASS E6		1700–1702	NOAA weather satellite	
1310	Aeronautical radar		1705–1709	NOAA weather satellite	
1317	Aeronautical radar		1930–1990	PCS cell phone base stations	
1330	Aeronautical radar		2178–2195	Satellite Downlink	Very strong*
1337	Aeronautical radar		2320–2350	Sirius/XM Satellite radio	Very strong*
1376–1386	GPS L3	Intermittent	3700–4200	Satellite Downlinks	Very strong*
1525–1564	INMARSAT satellites				

… Constellations of satellites – big and small, now and Iridium NEXT





Press Release From: OneWeb
Posted: Thursday, April 28, 2016



Today, OneWeb filed an application with the Federal Communications Commission seeking access to the U.S. market for its planned low earth orbit satellite system.

3) New network management software

Iridium NEXT features new network management software that enables Iridium to optimize both the satellite hardware and the traffic distribution to maximize the protection of RAS sites, while maintaining traffic capacity and supporting growth.

Automotive radar studies will go on …

RESOLUTION B4

Protection of Radio Astronomy Observations in the Frequency Range 76 - 81 GHz from Interference Caused by Automobile Radars.

Proposed by IAU Commission 40 (Radio Astronomy)

The XXIX General Assembly of the International Astronomical Union,

Resolves

1. to request that WRC-15 take all possible steps to protect radio astronomy observations in the range 76 – 81 GHz from interference caused by automobile radars,

2. to express the view that the most effective protection of radio astronomy observations would be through geographical separation,

3. to send a copy of this resolution to administrations that operate or host radio astronomy observations in the frequency range 76 – 81 GHz, and where automobile radars are operating or plan to operate in the same frequency range,

4. to encourage astronomers, particularly those in countries that fall under Resolves 3, to work proactively in protecting radio astronomy observations in the frequency range 76 – 81 GHz.

ITU World Radiocommunication Conference approves spectrum for automotive radar

Anti-collision mechanism to improve road safety

Near miss

Crash

- Resolution **759 (WRC-15)** invited studies to assist administrations in ensuring compatibility between RAS and radiolocation service applications in 76-81 GHz…
- WP 7D correspondence group set up in April 2016

ITU-R continues to debate RAS protection criteria for RR 5.340 bands

Annex 3 to Working Party 7D Chairman's Report (April 2016): PRELIMINARY DRAFT NEW RECOMMENDATION ITU-R RA.[PASSIVEBANDPROTECTION]

Scope

This Recommendation clarifies the protection criteria to be applied to radio astronomy use of frequency bands covered by RR No. **5.340** with regard to unwanted emissions of active services falling into those bands.

…

considering

a) that a number of frequency bands are allocated for exclusive use by passive services (radio astronomy service, earth exploration-satellite service (passive) and/or space research service (passive));

b) that these frequency bands are the subject of RR No. **5.340**, which states that all emissions are prohibited in those bands; …

recommends

[…]

WRC-15 and WRC-19

- 2015 World Radiocommunication Conference (WRC-15) took place in Geneva, 2-27 Nov. 2015; the next, WRC-19, is to be held in Nov. 2019
  - Over 160 International Telecommunication Union members participated in treaty-based modifications to the ITU Radio Regulations
- Technical for the next WRC is in preparation; reconciliation of regulations from previous WRC's are done in the ITU Radiocommunication Sector Study Groups
- Conference Preparatory Meeting (CPM) for WRC-19: The report contained approaches (Methods) for satisfying each agenda item (technical basis upon which Administration proposals are made)
- US Regulators oversee conference preparations by Federal Government (NTIA) and private sector (FCC)

ITU Meeting April 3 to 12

- This was Working party 7D (Radio Astronomy)
  - Also Study Group 7 (WP 7B, C and D)
  - A total of 89 delegates
  - The US Delegation for 7D had 7 members, H. Liszt represented IUCAF (Scientific Committee for the Allocation of Frequencies for Radio Astronomy)

SG 7 Opening Session

Preparation for ITU

- The US Delegation can propose items
  - The delegation discusses these in telecons and decides unanimously what items to put forward
  - Once this is decided, the items are fixed.
  - These are then proposed in Geneva at the Working Party 7D (Radio Astronomy)
  - These are then further discussed at the Study Group 7 (science) and put forth at World Radio Conference 2019

WP7D Overview as of April 2017

- US delegation had 29 items received, 3 liaison statements, and produced 14 documents. WP7D proposed the items:
  - RAS above 275 GHz to 400 GHz: new question on the technical and operational characteristics of radio astronomy applications. This is now ITU R226/7
  - Revision of Question ITU R226-1/7, which as to be above 70 GHz, to be now in the range 67 to 275 GHz. This was submitted as ITU R146/7 (old Action Item 1.13)
  - ITU-R 145-2/7 (older, was 70 GHz and above); this was suppressed
  - Also: Information paper on Airport Scanners (20 GHz to 40 GHz)
  - Not treated was the long-standing question of how to reconcile Footnote 5.534 and ITU Rec. 769.

A sample of the documents produced

Radiocommunication Study Groups

Annex 2 to
Document 7D/89-E
24 April 2017
English only

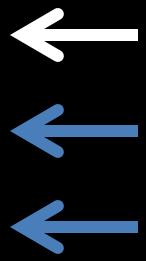
Annex 2 to Working Party 7D Chairman's Report

LIST OF OUTPUT (TEMP) DOCUMENTS

(Documents 7D/TEMP/22 – 7D/TEMP/35)

Doc. 7D/TEMP/	Source	Title
[22]	WP 7D	Draft new Question ITU-R [RAS ABOVE 275 GHz]/7 – Technical and operational characteristics of radio astronomy applications operating above 275 GHz
[23]	WP 7D	[Draft] Liaison statement to Working Party 1B (copy to Working Parties 1A, 5B, 5C, 6A and 7A for information) – Studies on "Wireless Power Transmission (WPT)"
[24]	WP 7D	Draft revision of Question ITU-R 226-1/7 – Frequency sharing between the radio astronomy service and other services in bands between 67-275 GHz
[25]	WP 7D	Draft editorial revision to Recommendation ITU-R RA.1630 – Technical and operational characteristics of ground-based astronomy systems for use in sharing studies with active services between 10 THz and 1 000 THz
[26]	WP 7D	Draft editorial revision to Recommendation ITU-R RA.1513-2 – Levels of data loss to radio astronomy observations and percentage-of-time criteria resulting from degradation by interference for frequency bands allocated to the radio astronomy service on a primary basis
[27]	WP 7D	[Draft] revision of Question ITU-R 145-2/7 – Technical factors involved in the protection of radioastronomical observations
[28]	WP 7D	Draft editorial revision to Recommendation ITU-R RA.479-5 – Protection of frequencies for radioastronomical measurements in the shielded zone of the Moon
[29]	WP 7D	Draft liaison statement to Working Party 1A (copy to Working Party 5C for information) – Technical and operational characteristics of radio astronomy systems in the spectrum band 275-450 GHz
[30]	WP 7D	Liaison statement to Working Party 1A – Proposed modification to the working document towards a preliminary draft new Report ITU-R SM.[SHARING-METHODS] – Methods for sharing between radiocommunication services
[31]	WP 7D	Draft editorial revision to Recommendation ITU-R RA.611-4 – Protection of the radio astronomy service from spurious emissions
[32]	WP 7D	Draft editorial revision to Recommendation ITU-R RA.1750 – Mutual planning between the Earth exploration-satellite service (active) and the radio astronomy service in the 94 GHz and 130 GHz bands

Doc. 7D/TEMP/	Source	Title
[33]	WP 7D	Working document towards a preliminary draft new Report ITU-R RA.[COEXISTENCE] – Coexistence between radio astronomy service and radiolocation service applications in the frequency band 76-81 GHz
[34]	WP 7D	Draft editorial revision to Recommendation ITU-R RA.1031-2 – Protection of the radio astronomy service in frequency bands shared with other services
[35]	WP 7D	Draft editorial revision to Recommendation ITU-R RA.1237-2 – Protection of the radio astronomy service from unwanted emissions resulting from applications of wideband digital modulation



Issues for WRC-19

- New allocations in the millimeter wave range
- New satellite constellations
- Automotive radars
- New generations of mobile phones

RFI issues need scientists' attention

- FCC filings and comments
- International WP 7D and US WP 7D participation