NASA Spectrum Management Update: WRC-11 Issues and Objectives and Domestic Concerns

CORF Spring Meeting

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Agenda

- Overview
- WRC-11 Issues of Primary Interest to NASA
- WRC-11 Issues of Primary Concern to NASA
- WRC-11 Issues of Secondary Concern to NASA
- Domestic Concerns
- Summary
- Discussion/Questions?

Overview

- 2011 World Radiocommunication Conference (WRC-11) to take place in Geneva, SW, [January 2012]
  - 192 International Telecommunication Union members will decide treaty-based modifications to the ITU Radio Regulations
- Technical preparatory work done in the ITU Radiocommunication Sector Study Groups
- Conference Preparatory Meeting (CPM) Report to contain approaches for satisfying each agenda item (basis upon which Administration proposals are made)
- US Regulators oversee conference preparations by Federal Government (NTIA) and private sector (FCC)

WRC-11 Issues of Primary Interest to NASA

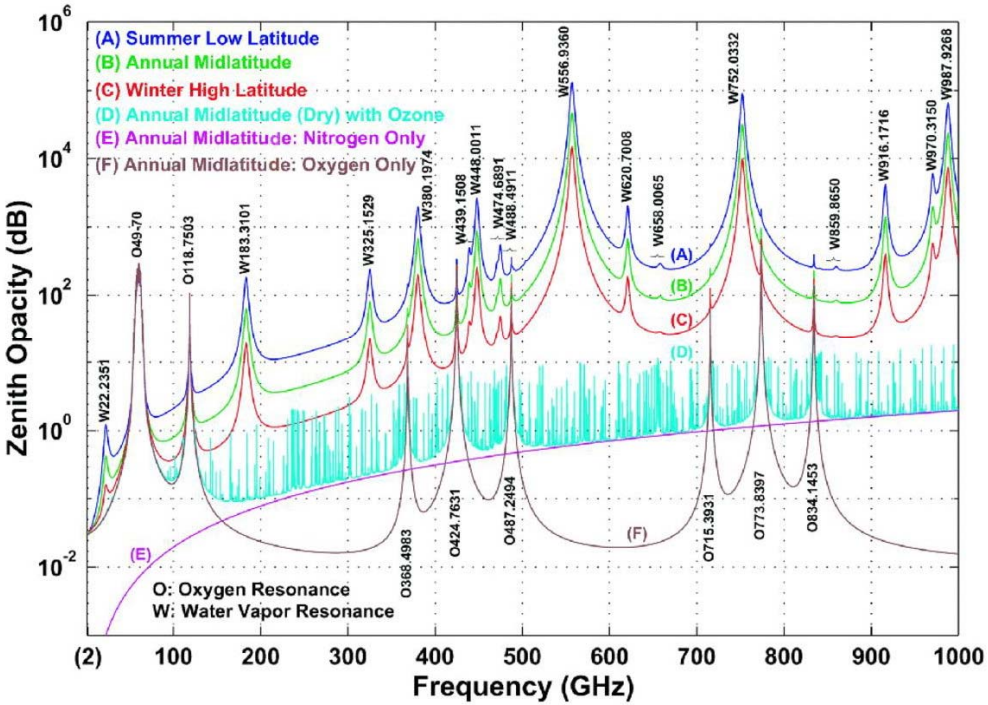
- 1.6 (Resolution 950) deals with passive uses of the spectrum from 275-3000 GHz
- 1.11 considers a new primary allocation to the space research service (Earth-to-space) in the band 22.55-23.15 GHz
- 1.12 considers protection of primary services (including space research (space-to-Earth)) in the band 37-38 GHz from interference from aeronautical mobile service operations

WRC-11 Issues of Primary Interest to NASA (continued)

- 8.1.1 (Issue C) deals with improving the recognition of the essential role and global importance of Earth observation radiocommunication applications and their societal benefits
- 8.2 considers future WRC agenda items for the 2015 WRC and beyond

AI 1.6: (Res 950) Review No. 5.565 of the Radio Regulations in order to update the spectrum use by the passive services between 275 and 3000 GHz

- While there are no allocations above 275 GHz, footnote 5.565 currently notes the bands used by the passive services (remote sensing and radio astronomy) between 275 and 1000 GHz. Due to scientific advances, more information is available on the bands between 275 and 3000 GHz that are or will be used by the passive services and the footnote should be updated.



AI 1.6 (Res 950): Continued

NASA Objectives

- Protect future uses of 275-3000 GHz frequency range for remote sensing and radio astronomy applications
- Modify footnote **5.565** accordingly to continue protection of this spectral region

US Status:

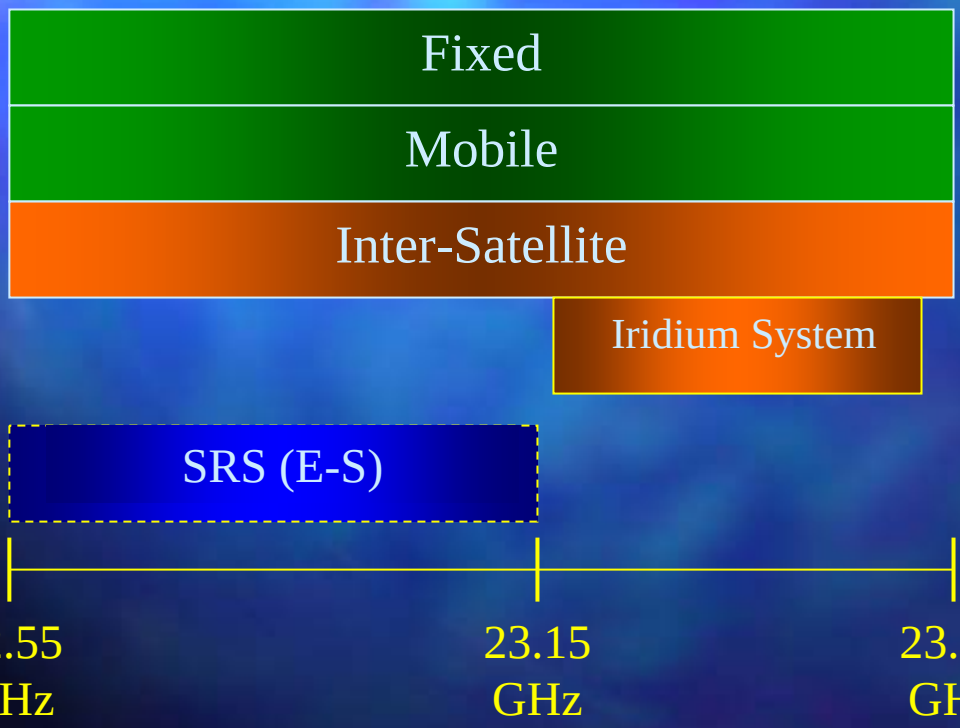
- RCS/IRAC Preliminary View (PV) authored by NASA and NSF and has been reconciled with the FCC to state that any modifications to the footnote do not preclude the use of these bands in the future by active services.
- US PV to go to CITEL meeting in June

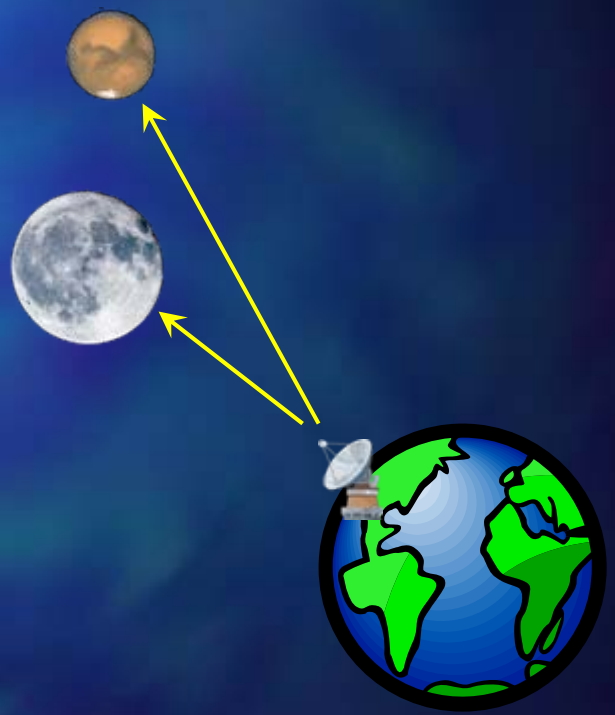
International Status:

- Studies on passive use nearing completion in WP7C and 7D and draft CPM text is maturing
- CEPT favors modifying footnote 5.565 to point to new WRC Resolutions that provide details on the passive use of the spectrum in this frequency range

AI 1.11: Consider a primary allocation to the space research service (Earth-to-space) in the 22.55-23.15 GHz band

- Required SRS uplink envisioned for Constellation future use for Moon and Mars exploration communications





AI 1.11: Continued

NASA Objectives

- Obtain primary allocation of at least 500 MHz within the 22.55-23.15 GHz band for the space research service (E-s) for Constellation use

US Status:

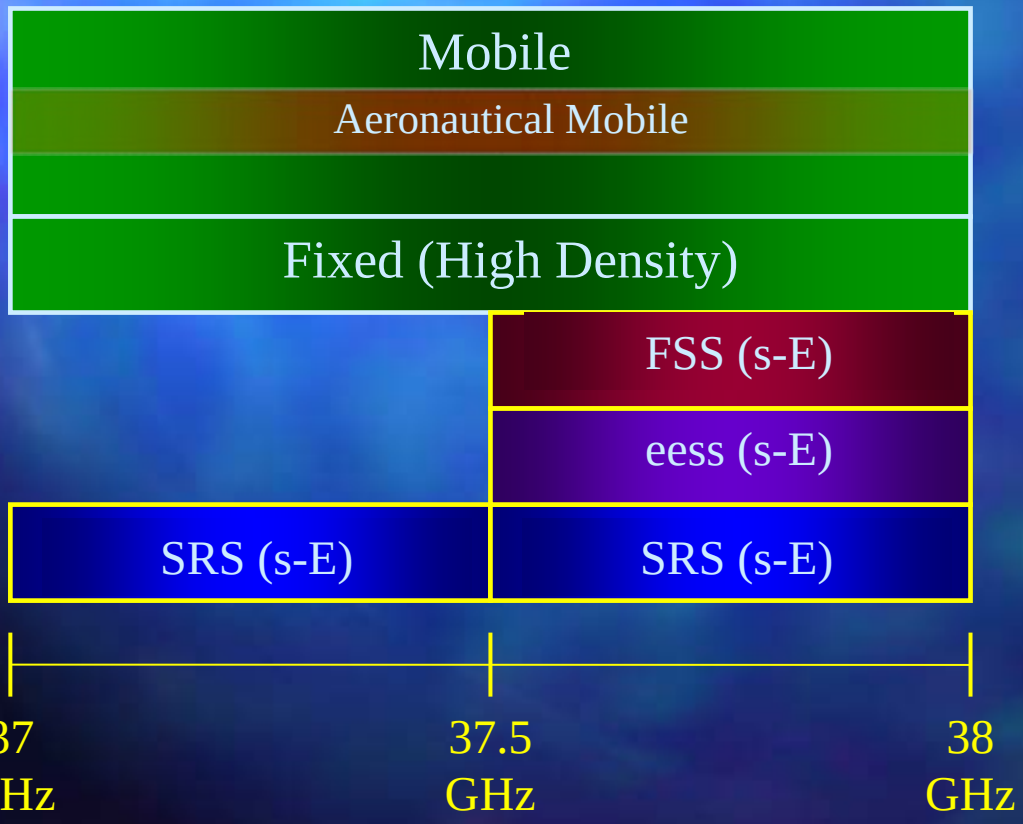
- RCS/IRAC Preliminary View supports allocation pending positive study results
- FCC/WAC Preliminary View driven by Iridium and makes support for allocation difficult

International Status:

- Studies underway within WP 7B with generally positive results to date
- Iridium making things difficult by seeking additional studies outside of the agenda item (out-of-band considerations)

AI 1.12: Protection of primary services in the 37-38 GHz band from interference from aeronautical mobile applications

- Within the 37-38 GHz band, aeronautical mobile applications would cause interference to the space research service (s-E) uses of the band



Note: SFCG Rec 14-2R5 reflects agreements on the use of the 37-37.5 GHz band vis-à-vis the 37.5-38 GHz band

AI 1.12: Continued

NASA Objectives

- Protection of the space research downlinks in the 37-38 GHz band

US Status:

- US Preliminary View supports protection of primary services in band from interference by aeronautical mobile uses
- Boeing would like to keep allocation available for communications within and in close proximity of the airframe for aicraft sensors

International Status:

- Studies proceeding within WP 7B
- CEPT generally supportive of studies and of removal of aeronautical mobile from existing mobile allocation
- France wants to eliminate all aircraft transmissions in the band.

AI 8.1.1 (Issue C): The essential role and global importance of Earth observation systems and their societal benefits

- Resolution 673 calls for studies to improve the recognition of the essential role and global importance of Earth observation radiocommunication applications and the knowledge and understanding of administrations regarding the utilization and benefits of these applications

Examples of Earth Observation Frequencies

438 MHz	6750 MHz	21.4 GHz	54-60 GHz
1260 MHz	9500 MHz	23.8 GHz	86-92 GHz
1413 MHz	10.65 GHz	31.5 GHz	118 GHz
3200 MHz	14.5 GHz	36.5 GHz	150 GHz
5350 MHz	18.7 GHz	50.3 GHz	183 GHz

AI 8.1.1 (Issue C): Continued

NASA Objectives

- Increase the visibility of Earth observation radiocommunication applications
- Encourage protection of frequency bands for Earth observation applications, especially by developing countries

US Status:

- No Preliminary Views to date

International Status:

- Europeans introduced Preliminary Report within ITU-R on the essential role of Earth observation applications & other science apps
- US introduced new Recommendation on use of remote sensing in disaster management and other applications
- US leading effort on drafting EESS Handbook in ITU-R which includes information on societal benefits

AI 8.2: Future Conference AI's of Interest

NASA is considering two possible agenda items for WRC-15

- Possible need for wideband deep-space space research (space-to-Earth) allocation below 40 GHz
- Possible need for designated band in S-band for emergency communications for human spaceflight missions in Constellation program

Status

- Studies have been initiated in support of both requirements
- Too early for proposals

WRC-11 Issues of Primary Concern to NASA

- AI 1.5 – ENG Harmonization
- AI 1.8 – Fixed Service Use between 71 and 238 GHz
- AI 1.19 – Software Defined Radio (SDR) and Cognitive Radio Systems (CRS)
- AI 1.22 – Short-Range Devices (SRD)
- AI 1.25 – Mobile-satellite service (MSS) in the 4-16 GHz Range

AI 1.5 – ENG Harmonization

- *to consider worldwide/regional harmonization of spectrum for electronic news gathering (ENG)*
- Concern: ENG frequency harmonization will impact NASA uses of the space research service in S-band

AI 1.8 – Fixed Service Use between 71 and 238 GHz

- *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*
- Concern: FS activities in this frequency range could impact passive remote sensing operations
  - Passive bands: 86-92 GHz, 100-102 GHz, 109.5-111.8 GHz, 114.25-122.25 GHz, 148.5-151.5 GHz, 164-167 GHz, 174.8-191.8 GHz, 200-209 GHz, 226-231.5 GHz, and 235-238 GHz

AI 1.19 – SDR and CRS

- *to consider regulatory measures and their relevance, in order to enable the introduction of software-defined radio and cognitive radio systems*
- Concern:
  - ensure possible use of SDR and CRS technologies in space applications
  - ensure protection of existing uses of the spectrum such as the space research service and passive remote sensing

AI 1.22 – Short-Range Devices

- *to examine the effect of emissions from short-range devices on radiocommunication services*
- Concern:
  - SRDs could affect sensitive NASA operations such as GPS, deep-space communications and passive remote sensing.
    - RFID devices are an example of such systems

AI 1.25 – MSS between 4 and 16 GHz

- *to consider possible additional allocations to the mobile-satellite service (with particular focus on the range 4 GHz to 16 GHz)*
- Concern: new MSS allocations in this frequency range will impact NASA operations.
  - NASA makes use of many frequency bands within this range for data communications (both direct to ground and via TDRSS) and remote sensing applications.

WRC-11 Issues of Secondary Concern to NASA

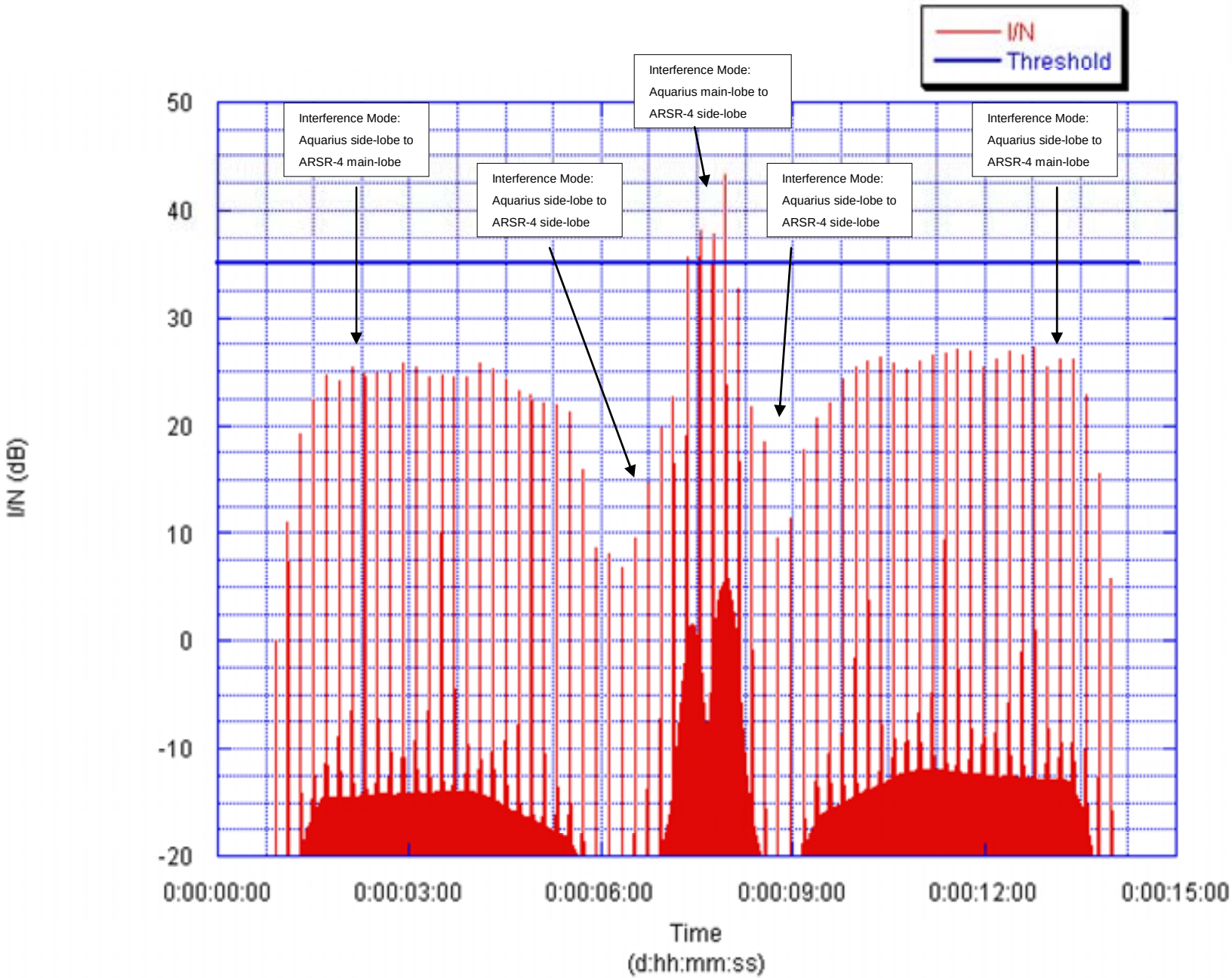
AI	Description	NASA Concern
1.2	Considers enhancing the regulatory framework	Protection of NASA operations and use of spectrum
1.3	Consider spectrum/regulations for safe operation of UAS	Protection of NASA operations and use of spectrum
1.4	Possible AM(R)S use of 960-1164 MHz and 5000-5030 MHz	Protection of NASA operations and use of spectrum
1.6 (Res 955)	Possible procedures for free-space optical links	Ensure NASA optical communications & sensors are not adversely affected
1.7	AM(R)S and MSS in 1 525-1559 MHz and 1626.5-1660.5 MHz	Protection of GPS L1 frequencies
1.20	HAPS in 5850-7075 MHz	Possible impact on passive sensing in 6700-7075 MHz
1.21	Allocation to radiolocation in 15.4-15.7 GHz	Protection of NASA operations and use of spectrum in near by bands

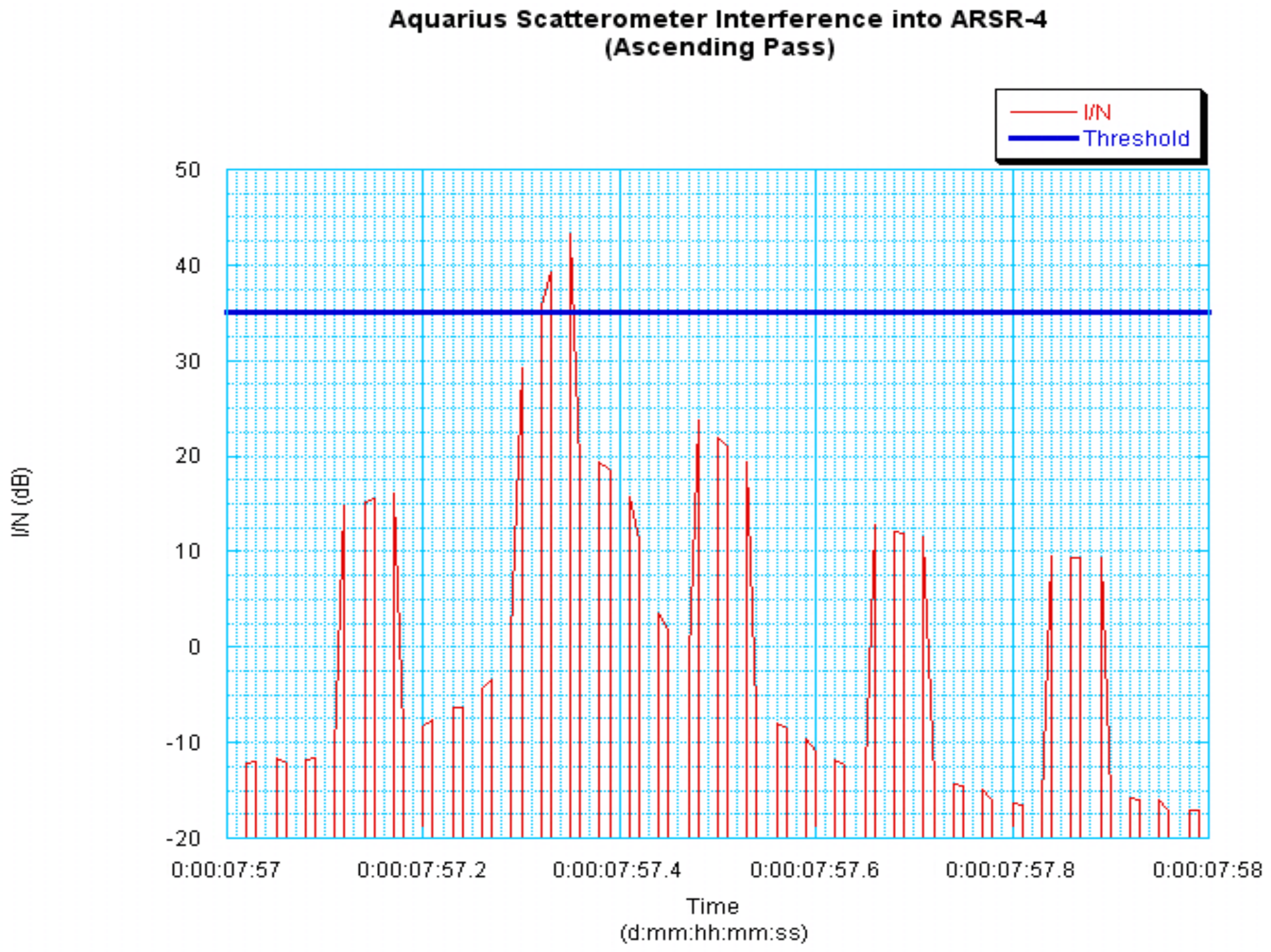
Domestic Issues

- Three upcoming NASA remote sensing missions will use the 1215-1300 MHz band for active sensing applications
  - Aquarius, whose primary focus is on measuring ocean salinity, will use a scatterometer
  - SMAP, whose primary focus is on measuring soil moisture content, will use a somewhat different scatterometer
  - DesDynI, whose primary focus is measuring surface and ice sheet deformation, will us a synthetic aperture radar (SAR)
- FAA and AF operate important air surveillance radars in this band and these active sensing instruments could potentially cause harmful interference to these radars (currently being studied)

Aquarius/ARSR-4 Study

- Aquarius scatterometer is flown on a sun-synchronous spacecraft having a 98^0 inclination, an equatorial altitude of 657 km and a 6:00 pm Ascending Node equatorial crossing
- Ground track repeat interval of the spacecraft is 7 days (103 orbits)
- Aquarius is scheduled to be launched in 2010 and have a lifetime of about 3 years


Aquarius Scatterometer Interference into ARSR-4
(Ascending Pass)
I/N
Threshold
Interference Mode:
Aquarius side-lobe to
ARSR-4 main-lobe
Interference Mode:
Aquarius main-lobe to
ARSR-4 side-lobe
Interference Mode:
Aquarius side-lobe to
ARSR-4 side-lobe
Interference Mode:
Aquarius side-lobe to
ARSR-4 side-lobe
Interference Mode:
Aquarius side-lobe to
ARSR-4 main-lobe
I/N (dB)
50
40
30
20
10
0
-10
-20
0:00:00:00
0:00:03:00
0:00:06:00
0:00:09:00
0:00:12:00
0:00:15:00
Time
(d:hh:mm:ss)


Aquarius Scatterometer Interference into ARSR-4
(Ascending Pass)
I/N
Threshold
50
40
30
20
10
0
-10
-20
I/N (dB)
0:00:07:57
0:00:07:57.2
0:00:07:57.4
0:00:07:57.6
0:00:07:57.8
0:00:07:58
Time
(d:mm:hh:mm:ss)

Aquarius/ARSR-4 Study Conclusions

- Satellite orbital geometry precludes main-beam to main-beam coupling between the ARSR-4 and Aquarius scatterometer antennas
- Interference only possible when the Aquarius main-lobe intersects the side-lobe/back-lobe of the ARSR-4 antenna
- The azimuth scanning rotation of the ARSR-4 antenna results in the potential of the maximum interference to last for a total of 60 msec per ARSR-4 revolution. However, during this time, the scatterometer beam, by design, fires four 1 msec pulses, resulting in a maximum 4 msec of possible interference time during such 60 msec event.

Aquarius/ARSR-4 Study Conclusions

- Short duration simulations indicate that there could be a series of short periods of interference.
- For the simulations run, the interference event durations were periods of 0.05 seconds or less
- A long duration simulation of 28 days indicated 20 interference events, lasting 0.05 seconds or less, separated by long periods with no interference.
- Based on these results from the dynamic analyses, and given the ARSR-4 interference criteria, the simulation results indicate that the Aquarius scatterometer can operate compatibly with the ARSR-4 radars.

Summary

- NASA has total reliance on continued spectrum availability and a predictable spectrum environment
  - Spectrum for safety services and scientific research is public good that requires continued Federal regulatory protection
- All agency missions are important facets of our national space and aeronautics infrastructure
- NASA/NTIA/FCC/DOS must collaborate closely to protect vital spectrum and create opportunities for successful introduction of new technologies
- NASA has long history of success at World Radiocommunication Conferences since 1959

Questions???