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# NASA Spectrum Management Issues Presentation to CORF

17- May- 2012



# NASA Spectrum Management Update: Review of WRC-12 Results and Current Domestic Concerns

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# WRC-12 Background



- 2012 World Radiocommunication Conference (WRC-12) took place in Geneva, Switzerland 23-January-17-February 2012 – international treaty negotiation
- Over 3000 delegates from 165 Member States and numerous sector member organizations participated in WRC-12 out of 193 total Member States
- Technical preparatory work done in the ITU Radiocommunication Sector (ITU-R) Study Groups
- Conference Preparatory Meeting (CPM) Report contains approaches for satisfying each agenda item (basis upon which proposals are made from Member States)
- U.S. Regulators oversee conference preparations by Federal Government (NTIA) and private sector (FCC)
- U.S. Head of Delegation – Ambassador Decker Anstrom



# 2012 World Radiocommunication Conference







# A view of WRC-12





# Regional Influence at WRCs



- CITELE is a subgroup in Organization of American States (OAS)– proposals to Conference called Inter-American Proposals (IAP)
- CEPT is group of all European countries – proposals to Conferences called European Common Proposals (ECP)
- Asian Pacific Telecommunity (APT) is made up of all Asian and Pacific Rim countries including Australia and New Zealand - proposals to Conferences called APT Common Proposals (ASP)
- Regional Commonwealth in the Field of Communications (RCC) is group of Russia and former Soviet states – common proposals to Conference noted as RCC
- African Telecommunications Union is group of African countries – common proposals to Conference noted as ATU
- Arab Spectrum Management Group (ASMG) is comprised of Arab countries – Arab States common proposals noted as ARB





# WRC-12 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
- **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

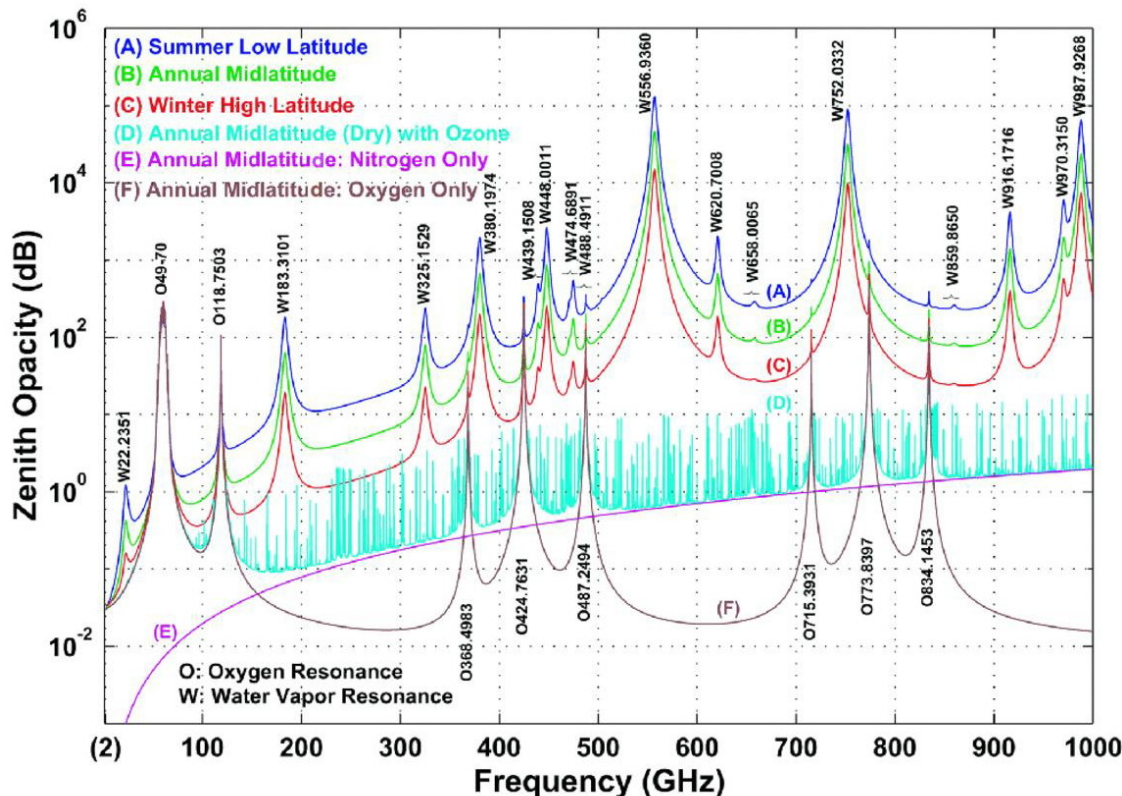




# AI 1.6: (Res 950) deals with passive uses of the spectrum from 275-3000 GHz



- 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

- Update frequencies used for passive remote sensing between 275 and 1,000 GHz in footnote 5.565 and provide for possible uses of the spectrum between 1 and 3 THz
- Protect future uses of 275-3000 GHz frequency range for remote sensing and radio astronomy applications

## WRC-12 Results:

- The frequency bands above 275 GHz identified by the Earth observation experts as needed for remote passive sensing in the future are now also identified in the ITU Radio Regulations.
- Results directly in line with NASA objectives.

**5.565** The following frequency bands in the range 275-1 000 GHz are identified for use by administrations for passive service applications:

- 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 (passive) and space research service (passive): 275-286 GHz, 296-306 GHz, 313-356 GHz, 361-365 GHz, 369-392 GHz, 397-399 GHz, 409-411 GHz, 416-434 GHz, 439-467 GHz, 477-502 GHz, 523-527 GHz, 538-581 GHz, 611-630 GHz, 634-654 GHz, 657-692 GHz, 713-718 GHz, 729-733 GHz, 750-754 GHz, 771-776 GHz, 823-846 GHz, 850-854 GHz, 857-862 GHz, 866-882 GHz, 905-928 GHz, 951-956 GHz, 968-973 GHz and 985-990 GHz.

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.

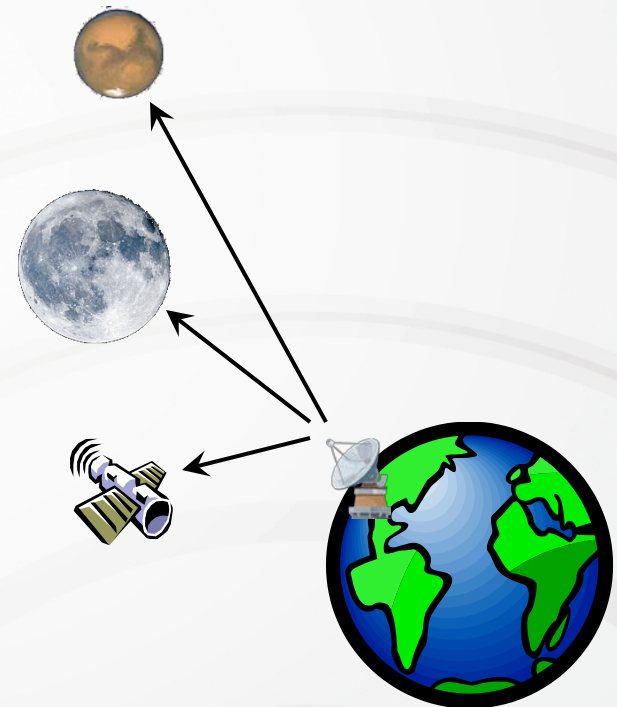
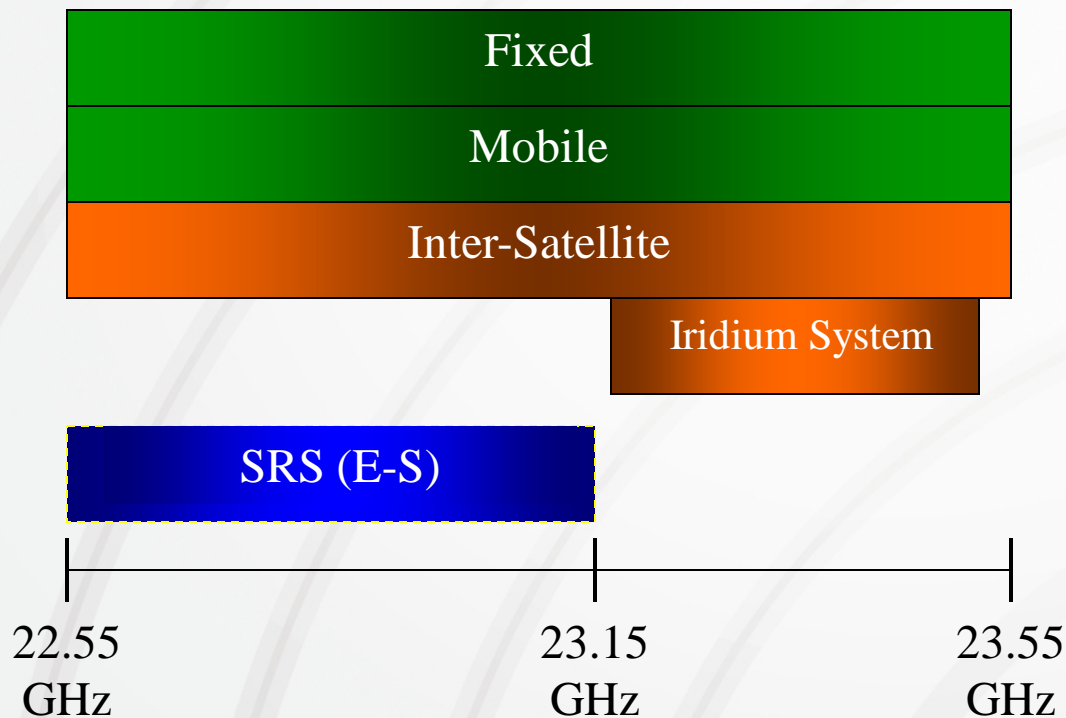
All frequencies in the range 1 000-3 000 GHz may be used by both active and passive services. (WRC-12)



# AI 1.11: Considers a new primary allocation for wideband space research uplinks in 22.55-23.15 GHz



- Required SRS uplink envisioned for future exploration missions to the L2 point, the Moon and Mars for communications







# AI 1.11: Continued



## NASA Objectives

- Obtain primary allocation of 600 MHz in the 22.55-23.15 GHz band for the space research service (E-s) for future space research mission support

## WRC-12 Results:

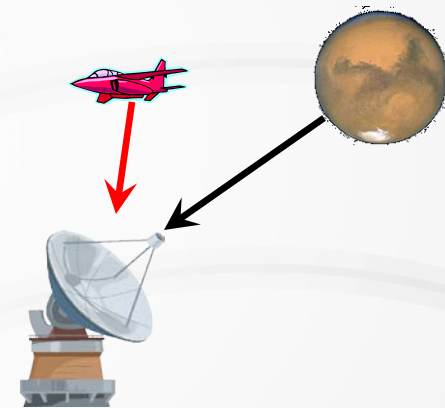
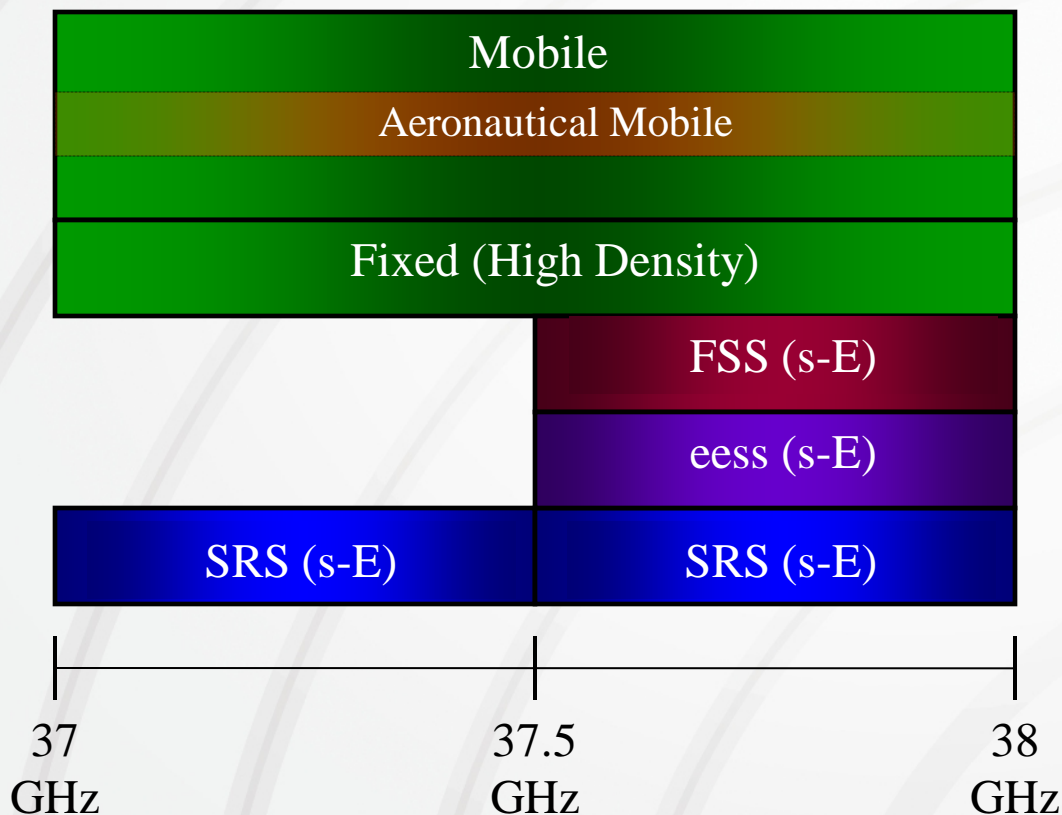
- The primary SRS allocation in 22.55-23.15 GHz was eventually achieved, despite a strong initial opposition by the Arab countries (linked to a new proposed AI for WRC-15).
- Results directly in line with NASA objectives.



## AI 1.12: Protection of services in 37-38 GHz 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 either through pfd limit or removal of aeronautical mobile

## WRC-12 Results:

- This Agenda Item was closed with the exclusion of the aeronautical mobile systems from the allocation in the band.
- This will allow using this band for space science future missions.
- Result directly in line with NASA objectives.





## AI 8.1.1 (Issue C): Essential role and importance of Earth observation systems and 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

### Some Examples of Both Active and Passive Earth Observation Frequencies

438 MHz	6750 MHz	21.4 GHz	54-60 GHz
1260 MHz	9600 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 and raise visibility of such uses, especially by developing countries

## WRC-12 Results:

- WRC-12 generated a revised Resolution stressing the fundamental role that Earth Observation plays in the areas of weather prediction, climate change studies, disasters prevention/monitoring/ mitigation, etc.... This Resolution is referred to in Article 29A of the Radio Regulations.
- The WRC-12 result is somewhat better than the US proposal given the pointer to the Resolution in a new Article in the Radio Regulations.

## ARTICLE 29A

### Radio services related to Earth observation

**29A.1** 1 Radio services related to Earth observations include the Earth exploration-satellite service (EESS), meteorological-satellite service (MetSat), meteorological aids service (MetAids) and specific applications of the radiolocation service (e.g., meteorological or oceanographic radars, wind profiler radars). In this respect, see Resolution **673 (Rev.WRC-12)**.



# AI 8.2: Future Conference Agenda

## Items of Interest to NASA



- Nearly all proposals for new WRC-15 Agenda items were accepted.
- A number of them are of generic in nature and encompass key bands used by NASA.
- CPM inputs for WRC-15 must be ready by July 2014, i.e. we have only 2 years to complete studies.
- Items directly related to science services:
  - **AI 1.11** - Need for Earth-exploration satellite (Earth-to-space) allocation in 7-8 GHz (initial emphasis on 7145-7235 MHz) – Concerns over 7145-7190 MHz
  - **AI 1.12** - Germany has identified a need for expanding the current EESS (active) allocation from 9300-9900 MHz by an additional 600 MHz. – Concerns over possible OOB interference to 8400-8500 MHz SRS downlinks as well as radio astronomy systems operating throughout the range of expansion
  - **AI 1.13** - Need to revise RR No. 5.268 to allow broader use of the 410-420 MHz band for SRS applications in the vicinity of Earth-orbiting manned space vehicles (ISS) – NASA initiated in supports of COTS





# WRC-12 Issues of Primary Concern to NASA



- [AI 1.2](#) deals with flexible regulatory framework
- [AI 1.5](#) deals with ENG Harmonization
- [AI 1.8](#) deals with fixed service use between 71 and 238 GHz
- [AI 1.19](#) deals with possible regulatory measures for Software Defined Radio (SDR) and Cognitive Radio Systems (CRS)
- [AI 1.22](#) deals with emissions from Short-Range Devices (SRD)
- [AI 1.25](#) deals with mobile-satellite service (MSS) in the ~4-16 GHz Range



# AI 1.2 – Regulatory Framework



- *take appropriate action with a view to enhancing the international regulatory framework*

## **Concern:**

- NASA is mainly concerned about the notion of convergence of services, especially fixed and mobile services which share bands with EESS and SRS operations. Changes to the regulatory framework could adversely affect NASA operations

## **WRC-12 Results:**

- WRC-12 didn't agree to modify the definition of fixed service as asked by a number of countries. This would have created potential difficulties for the coordination of all our earth stations, since the coordination with terrestrial systems is possible only if their location is fixed and known. It is to be noted though that this point is still on the agenda for the next WRC.



# AI 1.5 – ENG Harmonization



➤ *to consider worldwide/regional harmonization of spectrum for electronic news gathering (ENG)*

## **Concern:**

ENG frequency harmonization may impact NASA uses of the space research service in S-band (2 GHz)

## **WRC-12 Results:**

- The bands proposed for ENG spectrum harmonization included, amongst others, the S-band frequencies used for controlling most of the space science satellites.
- Fortunately WRC-12 didn't accept this international harmonization.





# AI 1.8 – Fixed Service Use 71-238 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

## **WRC-12 Results:**

- Europe introduced unwanted emission limits that will protect the satellite passive remote sensing in the band 86-92 GHz.
- Despite the strong opposition to any limits by many administrations (the U.S. among them), eventually it was agreed to have these limits introduced in the Radio Regulations, although only as “recommended”.



# 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 science applications
- Ensure protection of existing uses of the spectrum such as the space research service and passive remote sensing

## **WRC-12 Results:**

- WRC-12 agreed that no regulatory changes were required in association with the SDR and CRS systems.
- 2012 Radiocommunication Assembly also agreed to a Resolution indicating that under no circumstances can a CRS system can operate outside the Radio Regulations.



# AI 1.22 – Short-Range Devices



➤ *to examine the effect of emissions from short-range devices (SRD) on radiocommunication services*

## **Concern:**

- SRDs could affect sensitive NASA operations such as deep-space communications, passive remote sensing and use of GPS on spacecraft
- RFID devices are an example of such systems

## **WRC-12 Results:**

- WRC-12 decided not to make any changes to the Radio Regulations



# AI 1.25 – MSS from 4 to 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 may impact NASA operations

- NASA had particular concern regarding the 7145-7235 MHz and 8400-8500 MHz space research service bands used heavily for deep space and near-Earth missions.
- Operational coordination procedures identified by MSS proponents would have put an unacceptable burden and risk on SRS operators.

**WRC-12 Results:**

- All inputs on this Agenda Item were for no-change
- Consequently, no new allocation was given to MSS, in line with NASA's position.
- However, a new WRC-15 agenda item will look at the 22-26 GHz band for MSS allocations which is also of concern to NASA





# WRC-12 Issues of Secondary Concern to NASA



AI	Description	WRC-12 Results
1.3	Consider spectrum/regulations for safe operation of UAS	5030-5091 MHz identified for UAS LOS command and control. Use of FSS spectrum for BLOS kicked to WRC-15
1.6 (Res 955)	Possible procedures for free-space optical links	NOC – in line with NASA/US objectives
1.7	AM(R)S and MSS in 1 525-1559 MHz and 1626.5-1660.5 MHz	GPS L1 frequencies were protected
1.20	HAPS in 5850-7075 MHz	Limited country footnote allocation with specific protection of EESS (passive)

# **DOMESTIC ISSUES**



# U.S. Broadband Initiatives



- U.S. Broadband initiatives all seek to enhance the broadband (i.e., high-speed) access to the Internet
- All of these actions will require additional spectrum access for wireless broadband service providers in private sector, generally below 5-6 GHz and particularly below 3.5 GHz (eventually may go up to 10 GHz)
- Risk to NASA spectrum use either through taking spectrum from space research and Earth exploration-satellite frequency bands or from moving other users into frequency bands used by NASA.
- Current emphasis is on the 1755-1850 MHz band or portions thereof
- While NASA's use of this band is minimal, moving all of the other government users out of the band could impact NASA in other bands, primarily 2025-2100 MHz and 2200-2290 MHz



# Congressional Spectrum Legislation



- Numerous Bills are before the 112<sup>th</sup> US Congress addressing issues relating to the radio spectrum. They are at varying stages of deliberation.
- In general the Bills are focused on either an inclusive spectrum inventory, public safety or funding for Federal Agencies which may require moving to other bands.
- One piece of Legislation concerning radio spectrum has been approved by Congress and signed by the President
  - Middle Class tax Relief and Job Creation Act of 2012





# Middle Class Tax Relief and Job Creation Act of 2012



- So far in the 112<sup>th</sup> US Congress, this is the only spectrum legislation that has reached law status
- NTIA to conduct a study evaluating known and proposed spectrum-sharing technologies and the risk to Federal users if unlicensed U-NII devices (WiFi, WiMAX) were allowed to operate in the 5350-5470 MHz band and in the 5850-5925 MHz band.
  - 5350-5470 MHz band in 8 months and 5850-5925 MHz band in 18 months
- The FCC is to auction the following bands within 3 years:
  - 1915 MHz - 1920 MHz
  - 1995 MHz - 2000 MHz
  - 15 MHz between 1675 MHz - 1710 MHz
  - 2155 MHz - 2180 MHz
  - 15 MHz of contiguous spectrum to be identified by the Commission (this is a Wildcard)



# DISH Network Mobile Service



- NASA has an existing agreement with a satellite company, ICO, for their use of the 2180-2190 MHz band for the deployment of terrestrial mobile service as an Ancillary Terrestrial Component (ATC) of their mobile-satellite service (MSS) system
- Terrestar wants to use the 2190-2200 MHz band for the terrestrial mobile component of their MSS system
- Both ICO and Terrestar were acquired by DISH Network this year
- DISH Network wants to use the entire 2180-2200 MHz band for deployment of a terrestrial mobile system with a national deployment with some 40,000 mobile base stations
- NASA's concern is that these terrestrial base stations located in the vicinity of our earth stations operating in the adjacent 2200-2290 MHz band will cause harmful interference to NASA operations
- NASA and other federal agencies are currently in discussions with DISH Network trying to negotiate a new agreement that will protect NASA operations.



# Summary



- WRC-12 agenda items of interest to NASA all were resolved in a positive manner
- WRC-12 agenda items of concern for NASA were generally resolved to NASA's satisfaction but some related WRC-15 agenda items may prove difficult for the next Conference
- National Broadband efforts will likely impact NASA spectrum use within next 5-10 years in some manner
- DISH Network system may cause interference into NASA operations at S-band; discussions continue to mitigate this problem
- Congressional spectrum legislation continues to be of concern to NASA and other federal agencies and is being monitored

**QUESTIONS???**



# Acronym List

**AM(R)S** – Aeronautical Mobile (Route) Service

**APT** – Asia Pacific Telecommunity

**ASMG** – Arab Spectrum Management Group

**ATU** – African Telecommunications Union

**CEPT** - European Conference of Postal and  
Telecommunications Administrations

**CITEL** – Inter-American Telecommunication  
Commission

**CRS** – Cognitive Radio Systems

**EESS** – Earth exploration-satellite service

**ENG** – Electronic News Gathering

**FCC** – Federal Communications Commission

**FS** – Fixed Service

**HAPS** – High Altitude Platform Systems

**IRAC** – Interdepartmental Radio Advisory Committee

**ISS** – International Space Station

**ITU-R** - International Telecommunication Union –  
Radiocommunication Sector

**MSS** – Mobile satellite service

**NOC** – NO Change

**NTIA** – National Telecommunications and  
Information Administration

**RCC** – Regional Commonwealth in the field of  
Communications

**RR** – Radio Regulations

**SDR** – Software Defined Radio

**SRD** – Short Range Device

**SFCG** – Space Frequency Coordination Group

**SRD** – Short Range Device

**SRS** – Space Research Service

**TDRSS** – Tracking and Data Relay Satellite System

**UAS** – Unmanned Aircraft Systems

**UWB** – Ultra Wide-Band

**WAC** – (FCC) WRC-12 Advisory Committee

**WAIC** – Wireless avionics intra-communications