National Aeronautics and Space Administration

NASA Spectrum Management Issues Presentation to CORF

16- May- 2011

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NASA Spectrum Management Update: Status of WRC-12 Issues and Current Domestic Concerns

CORF Spring 2011 Meeting

16-May-2011

John Zuzek, NASA

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WRC-12 Background

- 2012 World Radiocommunication Conference (WRC-12) to take place in Geneva, Switzerland 23-January-17-February 2012 – international treaty negotiation
- 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 contains approaches for satisfying each agenda item (basis upon which proposals are made from Member States)
- US Regulators oversee conference preparations by Federal Government (NTIA) and private sector (FCC)
- U.S. Head of Delegation named – Mr. Decker Anstrom

A view of CPM-10

NASA Representation

Regional Influence at WRCs

- CITEL 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

Overview CITEL Update

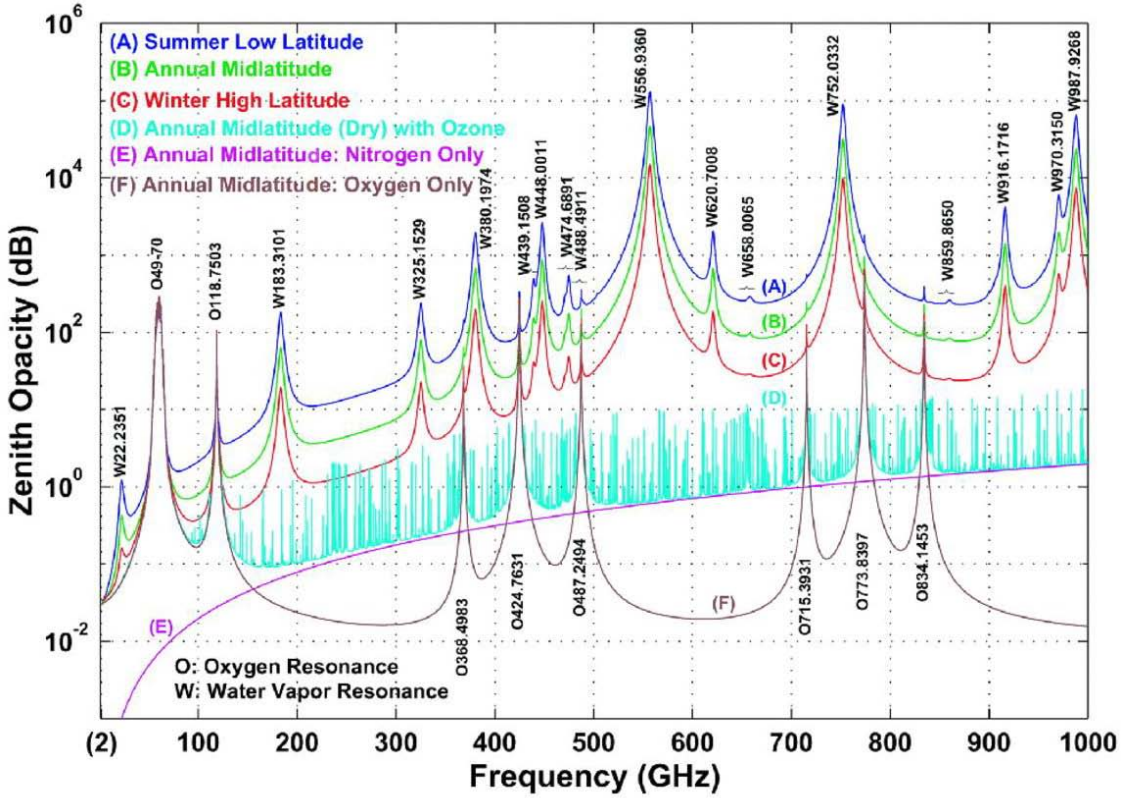
- Last Meeting of CITEL Prep Group 29 November – 2 December 2010 in Bogota, Colombia
  - Inter-American Proposals (IAPs) approved on AIs of interest or concern to NASA: 1.5, 1.6 (Res 950), 1.6 (Res 955), 1.11, 1.12, 1.19, 1.20, 1.22.
- Next CITEL Prep Group meeting to be held in Santo Domingo, Dominican Republic 17-20 May, 2011
- Final CITEL Prep Group meeting to be held in Puerto Rico in November 2011

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:

- 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:

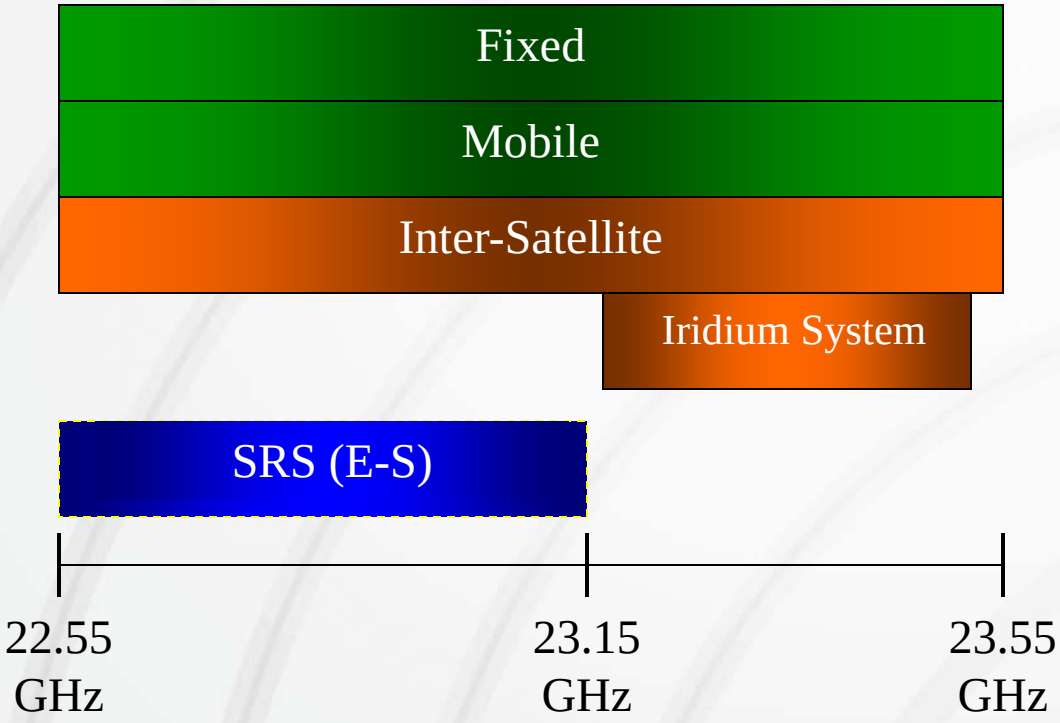
- US proposal in agreement with NASA objectives; CITEL IAP in agreement with US proposal.

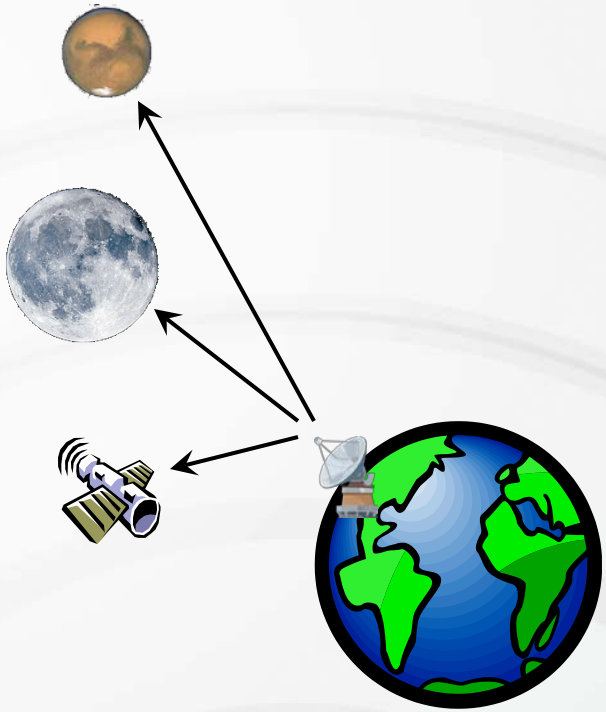
International Status:

- CPM text contains only one method to satisfy the agenda item: modify footnote 5.565 to update bands of interest and noting possibilities for sharing with active transmitters
- CEPT draft proposal agrees with US/CITEL proposals
- APT, RCC, ASMG, ATU agree in principle

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 at least 500 MHz within the 22.55-23.15 GHz band for the space research service (E-s) to support future exploration missions

US Status:

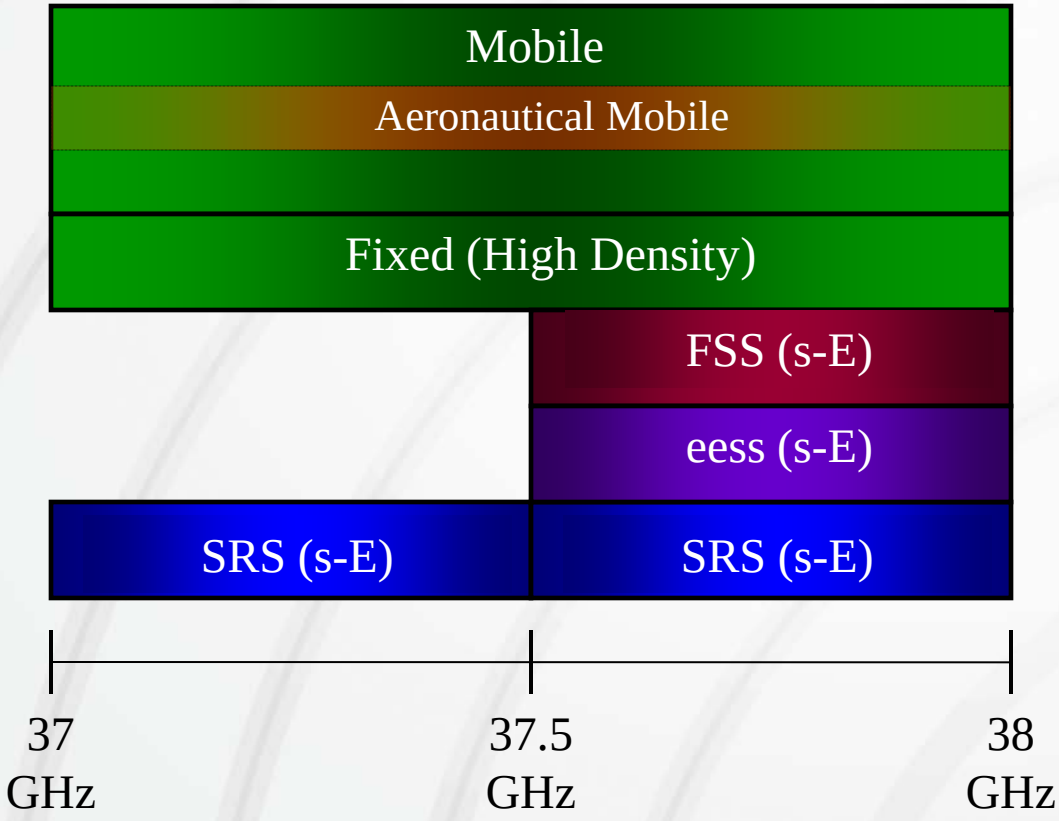
- Agreement between NASA and Iridium has seemed to resolve this issue
- US Proposal in agreement with NASA objectives

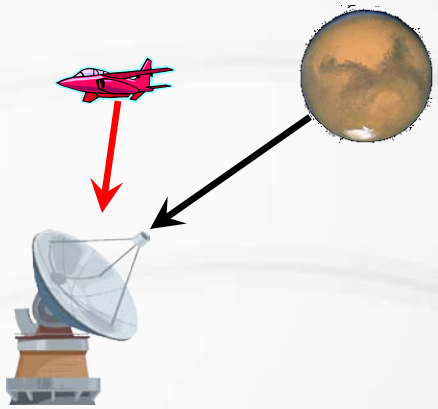
International Status:

- Single method in CPM Report supporting SRS allocation in 22.55-23.15 GHz without significant restrictions
- IAP adopted in November in agreement with US Proposal
- CEPT, RCC and APT are expected to support CPM method

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

US Status:

- Simplest solution is remove aeronautical mobile from mobile allocation
- However, Boeing would like to keep allocation available for communications within and in close proximity of the airframe for aircraft sensors
- US Proposal for footnote with PFD limits in band to protect SRS downlinks

International Status:

- Two methods in CPM Report, both would protect NASA systems
- IAP adopted in November in line US Proposal supporting NASA objective and Boeing desires
- CEPT, APT, ATU, and ASMG support removal of aeronautical mobile from existing mobile allocation

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 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 knowledge and understanding of administrations regarding the utilization and benefits of Earth observation applications
- Encourage protection of frequency bands for Earth observation applications, especially by developing countries

US Status:

- US Proposal to modify existing Resolution 673 to reflect completion of studies in ITU-R recognizing importance of Earth observation systems

International Status:

- Report ITU-R RS.2178 "The essential role and global importance of radio spectrum use for Earth observations and for related applications" adopted October 2011
- Recommendation ITU-R RS.1859, "Use of remote sensing systems for data collection to be used in the event of natural disasters and similar emergencies" approved January 2010
- Recommendation ITU-R RS.1883, "Use of remote sensing systems in the study of climate change and the effects thereof" approved February 2011
- EESS Handbook in publication in ITU-R which includes information on societal benefits (to be published in summer 2011)
- CEPT draft proposal modifies Resolution 673 and ties it to a new provision in Article 4 of Radio Regulations

AI 8.2: Future Conference Agenda Items of Interest to NASA

NASA has proposed two Agenda items for WRC-15:

- Need for Earth-exploration satellite (space-to-Earth) allocation in 7190-7235 MHz
- 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)

Status:

- Studies have been initiated in support of both requirements; preliminary studies nearing completion
- 7 GHz EESS proposal has been adopted as a U.S. proposal, the 410-420 MHz proposal is still pending

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
- FCC currently is pushing its "National Broadband Plan" and is making this agenda item part of its efforts in this area

Status:

- US Proposal is for "no change" (NOC) and suppression of Res 951
- No regional group has yet to decide on position – very contentious agenda item

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)

Status:

- US Proposal is for the ITU to maintain a global database of ENG frequencies used throughout the world which is acceptable to NASA
- Australia pushing for ENG harmonization in 2200-2290 MHz which NASA strongly opposes

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

Status:

- US Proposal is NOC
- CEPT appears to support OOB protection for 86-92 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 science applications
- ensure protection of existing uses of the spectrum such as the space research service and passive remote sensing

Status:

- US Proposal is NOC
- Most regions seem to support no regulatory action

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

Status:

- US Proposal is NOC
- Some regions considering identification of bands for SRD use for purpose of harmonization

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

- 6 candidate bands for MSS allocations in this frequency range identified in the CPM Report
- List of bands for MSS contains 7145-7235 MHz deep space SRS band for downlinks and 8400-8500 MHz deep space SRS band for uplinks as well as 13.25-13.4 GHz active sensing band for downlinks

Status:

- US Proposal is for NOC with respect to ALL bands under consideration
- General opposition to MSS allocations except for UK and UAE

WRC-12 Issues of Secondary Concern to NASA

AI	Description	NASA Concern
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 from HAPS gateways
1.21	Allocation to radiolocation in 15.4-15.7 GHz	Protection of NASA operations and use of spectrum in nearby bands

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)
- White House Broadband Initiative
  - Administration driven initiative to help formulate and guide national Broadband Policy
- FCC Broadband Plan and associated Notices
  - Identified some commercial and some Federal spectrum for reallocation and methods to facilitate such reallocation
  - Seeks up to 500 MHz of spectrum from both public sector and private sector in next 10 years
- 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.

GPS Protection Issues

- A company called “LightSquared” has petitioned the FCC to allow it to operate high-powered terrestrial transmitters (~1.5 kW) in densely populated urban areas in a frequency band adjacent to the band used by GPS.
- LightSquared intends to provide wireless broadband coverage through ubiquitous satellite coverage and a “complementary” ground segment.
- The nationwide LightSquared network, consisting of approximately 40,000 cellular base stations, is intended to cover 92 percent of the U.S. population by 2015
- Concern is with this ground segment and possible interference into GPS receivers in the adjacent band.
- Current GPS receivers were not designed to filter out such high-powered signals.

Active Sensing Issues

- Three upcoming NASA remote sensing missions will use the 1215-1300 MHz band for active sensing applications
  - Aquarius (June launch?), 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 Earth 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 (recent tests in Oklahoma City currently being evaluated by FAA, NTIA)
  - SMAP scatterometer design has been adjusted to help mitigate interference to air surveillance radars
- GPS also operates in this frequency band and space-based radars need to protect operation of GPS receivers
  - JPL tested various active radar signals into some GPS receivers and results were fairly positive although still being evaluated

Summary

- WRC-12 agenda items of interest to NASA all have US proposals supporting NASA objectives
- WRC-12 agenda items of concern for NASA have generally proceeded well, but AI 1.2 (framework) and AI 1.25 (MSS) may be difficult at Conference
- National Broadband efforts will likely impact NASA spectrum use within next 5-10 years in some manner
- LightSquared system may cause severe interference into GPS receivers
- Future L-band active sensing missions require careful coordination with FAA and DoD to avoid interference to/from existing systems

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