SEMINAR ON SCIENCE SERVICES IN PREPARATION FOR WORLD RADIO CONFERENCE 2027 (WRC-27)

9-10/12/2025 Cyberjaya, Malaysia

Session 9: Space Frequency Coordination Group (SFCG) Overview



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SFCG – Purpose and objective



Space Frequency Coordination Group (SFCG): created in 1980

- provide a less formal and more flexible environment for the solution of frequency management problems encountered by member space agencies;
- effective use and management of those radio frequency bands that are allocated by the ITU Radio Regulations to the Space Research, Space Operations, Earth Exploration Satellite, and Meteorological Satellite service;
 - > also interested in with feeder links and data relay satellites operated in connection with these services, and with satellite-borne radio astronomy (including radar astronomy);
- Develop international informal agreement among participating space agencies concerning assignment of specific frequencies, and related technical issues, to complement the framework of the Radio Regulations
- Provides a forum for cooperation:
 - facilitate contributions to regional bodies (e.g. APT, CEPT, CITEL), ITU-R Study Groups; or encourage their national administrations to make proposals to ITU WRCs;
 - closely cooperate in the area of frequency management with other space agencies as well as with commercial or research users of frequency bands of interest;
 - maintain strong ties with other international bodies with related objectives.

SFCG – Terms of Reference



RES SFCG A6-1R2 (2000)

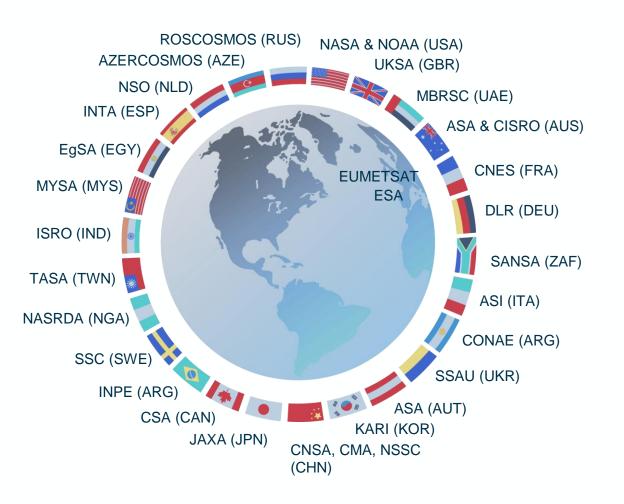
SFCG provides a forum for multilateral discussion and coordination of spectrum matters of mutual interest concerning, in particular, the following space radiocommunication services, as defined in the ITU Radio Regulations:

- Space research
- Space operations
- Earth exploration-satellite
- Meteorological-satellite
- Inter-satellite
- Radionavigation-satellite
- Radio astronomy and radar astronomy, to the extent that they are relevant to spacecraft missions,

The agreed upon results of SFCG work will be expressed in the form of Resolutions, Recommendations, Reports, or whatever form may be appropriate for the case. SFCG members will attempt to ensure that findings of SFCG are taken into account by their agencies.

SFCG Membership





Observer Organizations:

- Consultative Committee on Space Data Standards (CCSDS)
- Committee on Earth Observation Satellites (CEOS)
- Coordination Group for Meteorological Satellites (CGMS)
- Committee in Radio Astronomy Frequencies (CRAF)
- European Meteorological Network (EUMETNET)
- Institute of Electrical and Electronics Engineering (IEEE)
 Geoscience and Remote Sensing Society (GRSS)
- Interagency Operations Advisory Group (IAOG)
- ITU-R Study Group 7
- International TVOS/ATOVS Working Group
- Scientific Committee on the Frequency Allocations for Radio Astronomy and Space Science (IUCAF)
- Square Kilometer Array Observatory (SKAO)
- World Meteorological Organization (WMO)

SFCG – Structure and operation



SFCG meets at approximately one-year intervals:

- Meeting Chair: provided by the host agency;
- Executive Secretary: ESA
- SFCG website host and administrator: NASA

SWG 1
ITU Matters
and
Preparation of
WRCs

SWG 2
General
Frequency
Management

SWG 3
Sensors and
Meteorological
Satellites

SWG 4
Databases and mission coordination

LMSG
Lunar Martian
Spectrum
Group

Activities mainly driven by Action Items agreed from the previous meeting Inter-sessional activities performed for LMSG and, occasionally for the SWGs

SFCG - Deliverables

The principal outputs of SFCG meetings is documented in Resolutions and Recommendations which express technical and administrative agreements. These agreements may be used by space agencies to make best use of allocated bands and to avoid interference.

- Administrative Resolutions, governing the function and operation of the SFCG,
- Resolutions, for actions to be taken within SFCG on technical topics,
- Recommendations, for action proposed by SFCG to be taken by member agencies or other outside bodies,

 The effectiveness of SFCG Recommendations depends **upon voluntary acceptance and use by member agencies**. There is no formal process by which agencies formally agree to accept and be bound by SFCG recommendations.
- Reports, based on outputs from Action Items, for providing detailed information on issues of concern to the SFCG,
- > **Decisions** (internal), for documenting the results of deliberations, e.g. on requests for waivers to SFCG Recommendation

SFCG Resolutions and Recommendations - objectives



Their **primary objectives are** to:

- Provide guidelines and requirements for the design of SRS and EESS missions in order to promote an efficient use of the bands allocated to these services.
- ➤ Provides guidelines to facilitate the frequency coordination between space missions operating in frequency bands allocated to SOS, SRS, EESS and the MetSat service.

In addition, SFCG also adopted Resolutions and Recommendations in order to:

- Identify preferred frequencies and guidelines for space missions operating in the Lunar and Mars Regions.
- Provides guidelines for the implementation of Data Relay Systems.
- Establish sound technical rationale for updates to ITU-R Recommendations/Reports to achieve effective utilization of bands used by space science missions.
- Develop guidelines and procedures to complement the Radio Regulations for the operation and coordination of active sensors.
- > Collect information on the requirements, protection criteria and technical characteristics of EESS (passive) sensors to be used as basis for the development or the update of relevant ITU-R Recommendations/Reports.

General guidelines applicable to EESS and SRS (near Earth) missions



Guidelines for the design of EESS and SRS (near Earth) missions		
REC SFCG 6-2R2	Transponder Turnaround Frequency Ratios for Space Research, Category A and EESS (2017)	Define the Turnaround Ratios for SRS (near Earth) and EESS in the S and X bands
Efficient Spectrum Utilisation for Space Research Service (Category A) and Earth Exploration- Satellite Service on Space-to-Earth Links (2022)		Guidance on the implementation of the relevant modulation schemes and requirements for spectral emissions masks in the S, X and Ka band (space-to-Earth)
REC SFCG 21-3R1	Use of Sub-Carriers for Space Science Services on Space-to-Earth Links; Category A (2002)	sub-carrier modulation shall not be used except where absolutely required and then only for symbol rates below or equal to 60 ks/s

Guidelines for the frequency coordination of SOS/SRS/EESS in the S-band

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Guidelines applicable for the efficient use and the frequency coordination of the bands 2025-2110 and 2200-2290 MHz		
REC SFCG 4-3R3	Utilisation of the 2 GHz Bands for Space Operations (1998)	Avoid using these bands for the TT&C of NGSO satellites of services other than the space science services. Requirements for the TT&C of GSO satellites of services other than the space science services.
RES SFCG 24-1R2	Interference Mitigation Techniques for an Optimised Use of the 2200-2290 MHz Band (2023)	Basis for Recommendation ITU-R SA.2155 and SA.2156. Mitigation techniques include: - No transmission when beyond view of their cooperating
RES SFCG 27-1R1	Interference Mitigation Techniques for an Optimized Use of the 2025-2110 MHz Band (2024) stations, - Limits on the operational bandy MHz for E-s.	
REC SFCG 6-1R5	Interference from Space-to-Space Links between Non-Geostationary Satellites to Other Space Systems in the 2025-2110 and 2200-2290 MHz Bands (2005)	Techniques to reduce the power spectral density of space-to-space links between NGSO satellites
REC SFCG 12-5R3	Limitations on Earth-Space Link Power Levels in the 2025-2110 MHz Band (2023)	Proposed techniques to limit the EIRP of Earth-space links (e.g. antenna diameter, antenna pattern, adjustment of output power).

Guidelines applicable for the coordination in Earth-to-space for SRS (near Earth) and EESS at 7 GHz



Guidelines for the use of the band 7190-7235 for SRS (Earth-to-space) and the band		
7190-7250 MHz for EESS (Earth-to-space)		
REC SFCG 32-3	Protection Criteria for GSO Space Research Satellites in the 7 GHz Band (2013)	GSO SRS system uplinks in the 7190-7235 MHz band do not claim protection from lunar, Lagrange and other near Earth mission uplinks in this band
REC SFCG 39-1	Interference mitigation techniques for future systems planning to operate in the SRS 7190-7235 MHz and EESS 7190-7250 MHz bands (2020)	Requirements for the implementation of EESS include: - No transmission when beyond view of their cooperating stations, - Limits on the necessary bandwidth: 4 MHz per link.
REC SFCG 39-2	Limitations on earth-space link power levels in the SRS 7190-7235 MHz and EESS 7190-7250 MHz bands (2020)	Proposed techniques to limit the EIRP of Earth- space links (e.g. antenna diameter, antenna pattern, adjustment of output power).

Guidelines for the use of the band 8025-8400 MHz by EESS and the band 8450-8500 MHz by SRS (near Earth) mission



Guidelines for the coordination of the band 8025-8400 MHz between EESS missions and for the use of th
band 8450-8500 MHz by SRS (near Earth) mission

Dand 6450-6500 Minz by SKS (near Earth) mission		
REC SFCG 14- 3R10	Use of the 8025-8400 MHz Band by Earth Exploration Satellites (2016)	Provides a set of techniques to reduce interference between EESS missions, including: - Radiation only when transmitting data to earth stations, - Limitations of PFD levels at the Earth surface, - Use of efficient modulation and coding techniques, - Consideration on orbital parameters and earth station receiving antennas - Protection of SRS (deep space) in adjacent band.
REC SFCG 5- 1R7	Use of the 8450-8500 MHz band for Space Research, Category A (2024)	Limitation on the occupied bandwidth: 10 MHz per mission.

Guidelines for the use of the band 25.5-27 GHz by EESS and SRS

Guidelines for the efficient use of the band 25.5-27 GHz by EESS and SRS space-to-Earth links

RES SFCG 19-1	Efficient Use of Spectrum in the 25.5-27 and 37-38 GHz Bands (1999)	Use of bandwidth efficient modulation techniques whenever practicable for high data rate space-to-Earth applications.
REC_SFCG_29-1R2	Efficient sharing of the 25.5-27 GHz band between EESS(s-E) and SRS (s- E) (2025)	Consistent with ITU-R Recommendation SA.1862 with additional provisions for the coordination between GSO networks and Lagrange and Lunar SRS missions. This updated (R2) version "Provides minimum antenna gain (30 dBi) for onboard LEO high data rate transmitting EESS satellites ";
REC SFCG 30-2	Efficient use of the 25.5-27 GHz frequency band by future Earth Exploration satellite systems (2011)	Recommends: - the implementation of variable or adaptative coding and modulation for high data rate EESS and SRS space-Earth links - the implementation of higher elevation tracking methods, for high data rate SRS space-to-Earth links

Guidelines applicable for the frequency coordination for the MetSat service



Guidelines for the efficient and shared use of the frequency bands allocated to the Meteorological- satellite service		
RES SFCG 19- 7R4	Use of the 7750-7900 MHz Band by non-GSO Meteorological Satellites (2014)	Procedures for efficient use of the 7750-7900 MHz band by MetSat and proposed interference mitigation techniques.
RES SECG 30-1		coordinated use of Data Collection Systems (DCS) operated on MetSat and EESS in 401-403
REC SFCG 11- 1R4 Use of the Band 1670-1710 MHz for Meteorological Satellite Services within 1		Partitioning of the band between various types of MetSat uses: GSO within 1670-1698 MHz, NGSO within 1698-1710 MHz (with possibility to extend down to 1695 MHz)

Guidelines for the implementation of data relay systems



Guidelines for the implementation of Data Relay systems in Ka-band		
REC SFCG 13- 3R3	Data Relay Satellite Channel Plans for the 23/26 GHz Bands (2011)	Channel plan for DRS in the 22.55 - 23.55 GHz (Forward link) and the 25.25 - 27.50 GHz (Return link bands)
REC SFCG 15- 2R4 Use of the Band 25.25-27.5 GHz for Inter-Satellite (DRS and Proximity Links) in the		Guidance for the implementation of proximity operation communication links in the 25.25-27.5 GHz band
RES SFCG 14- 1R2Use of the Inter-Satellite Service (ISS) 23 GHz Band (2005)administrations to avoid using 22.55 - 23.55 GHz for ISS link		SFCG members urge their administrations to avoid using the band 22.55 - 23.55 GHz for ISS links other than for DRS systems

Procedures and guidelines related to the operation and coordination of active sensors

Guidelines and procedures to complement the Radio Regulations for the operation of active sensors		
RES SFCG 43-2	Coordination of active sensors (2024)	Procedure to coordinate operations of EESS (active) or SRS (active) sensors: - potential mutual interference between EESS (active) or SRS (active) sensors; - coordination of EESS (active) sensors or SRS (active) is mandatory in the RR; - protect receivers from other services from aggregate from remote sensors interference.
RES SFCG 23-2R1	Use of synthetic aperture radars in the band 5250-5570 MHz (2013)	Identifies actions towards national administrations to safeguard the current and future operations of active sensors in 5250-5570 MHz from potential interferences.
RES SFCG 23-3	Use of the allocation for EESS (Active) in the band 432-438 MHz (2003)	Provides some guidelines and procedures for the implementation of EESS active sensors in 432-438 MHz: - means to comply with the regulatory requirements set up in RR No.5.279A and Recommendation ITU-R RS.1260-2, - coordination procedure to ensure the protection of launch command and destruct communications.
RES SFCG 24-2	Use of the allocation for EESS (active) in the band 94-94.1 GHz (2004)	Provides some guidelines and procedures for the implementation of EESS active sensors in 94-94.1 GHz: - means to comply with the regulatory requirements set up in RR No.5.562A for the protection of the Radio Astronomy, - mutual planning procedure for EESS (active) cloud radar operations with radio astronomy service observations, including the publication of relevant information on the SFCG website.

Requirements, protection criteria and technical characteristics of EESS (passive)



Information on the requirements, protection criteria and technical characteristics of EESS (passive) sensors		
RES SFCG 21-2R5	Requirements, Performance, and Protection Criteria for EESS (Passive) Sensors (2025)	Initially developed in 2001, served as basis for the ITU-R Recommendation RS.2017
RES SFCG 29-1	Passive sensing above 275 GHz (2009)	Served as a basis for the development of ITU-R Reports RS.2194 and RS.2431

General guidelines applicable to SRS (deep space missions)

Guidelines applicable to the design and the frequency coordination of SRS (deep Space) missions		
REC SFCG 23-1R5	Efficient Spectrum Utilisation for Space Research Service, Deep Space (Category B), in the Space- to-Earth link (2025)	Guidance on the implementation of the relevant modulation schemes for the X and Ka bands and requirements for maximum occupied bandwidths in the X band
REC SFCG 27-1R1	Efficient spectrum utilization for Space Research Service deep-space (Category B), in the space-to earth 31.8-32.3 GHz band (2011)	Recommends the use of bandwidth efficient modulations for links with telemetry symbol rates of 20 Msps or more
REC SFCG 7-1R6	Transponder Turnaround Frequency Ratios and Radio Frequency Channel Plans for Space ; Research, Category B (2019)	Define the Turnaround Ratios for SRS (deep space) in the S, X and Ka bands and recommends the use of the Deep Space Network channel plans.
REC SFCG 23-2	Assignment of Differential One-Way Ranging Tone Frequencies for Category B Missions (2003)	Guidelines for the assignment of DOR tone frequencies
REC SFCG 30-1	Use of Differential One Way Ranging Tones in the 8400-8450 MHz Band for Category B SRS Missions (2011)	Specific requirements for the implementation of DOR in the X-band in order to minimize DOR tone interference

Preferred frequencies and guidelines for space missions operating in the Mars region



Guidelines	tor	Mars	missions	

(in addition to the Recommendations applicable to SRS (deep space) missions)

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REC SFCG 22-1R4	Frequency assignment guidelines for communications in the Mars region (2021)	Reference Recommendation on the preferred frequencies and operational requirements for communication links in the Mars region			
REC SFCG 24-1R1	Frequency Assignment Guidelines for Active Remote Sensing in the Mars Region (2009)	Preferred frequencies for the implementation of active sensors in the Mars region.			
RES SFCG A21-1R4	Assistance in the Assignment of Frequencies to Deep Space Missions (Category B)	SFCG membership recognized the benefits of early technical coordination to promote maximum compatibility, minimize interference and enhance mission; this Administrative Resolution offers assistance of frequency channel selection and interference analysis to member agencies and non-SFCG organizations.			

Preferred frequencies and guidelines for space missions operating in the Lunar region



	Guidelines for Lunar missions					
REC SFCG 32-2R6 Communication and Positioning, Navigation, and Timing Frequency Allocations and Sharing in the Lunar Region (2025)		Reference Recommendation on frequency assignment guidelines for all communications links and PNT in the Lunar Region				
REC SFCG 29-2R1	Frequency Assignment Guidelines for Active Remote Sensing in the Lunar Region (2025)	Preferred frequencies for the implementation of active sensors in the Lunar region. To be reviewed taking into account the protection of the shielded zone of the Moon.				
RES SFCG 23-5R2	Protection of Future Radio Astronomy Observatories in the Shielded Zone of the Moon (2024)	Procedures for cooperation between SFCG Member Agencies and the Radio Astronomy community for the protection of radio astronomy observations in the shielded zone of the Moon				
REC SFCG 14-2R5	Use of the 37-38 GHz Space Research Service Allocation (2004)	Use of the 37-38 GHz planned for Lunar missions.				
REC SFCG 41-1	Efficient Spectrum Utilization for Space Research Systems in the Lunar Region (2023)	Guidelines for the implementation of in-situ lunar links, Earth-space links and space-Earth links for lunar missions, including spectral emission masks for in-situ lunar links.				
REC SFCG 42-1	; Frequency channel plan for in-situ lunar data relay satellites (2024)	Channel plan to support interoperability for the operation of lunar data relay services in the S-band and the Ka-band				
REC SFCG 43-1	Protection of in-situ lunar region PNT services in the 2 483.5 – 2 500 MHz frequency band from unwanted emissions from lunar surface communications systems (2025)	Defines a limit for the aggregate unwanted emissions from each lunar surface wireless system into the frequency range 2483.5 – 2500 MHz for the protection of PNT receivers				
RES SFCG A40-1	Assistance in the Assignment of Frequencies to Missions in the Lunar Region (2022)	SFCG membership recognized the benefits of early technical coordination to promote maximum compatibility and mission success based on the SFCG internal coordination; this Administrative Resolution offers assistance of frequency selection to member agencies and non-SFCG organizations (upon request through the NASA Lunar Spectrum Management Portal (LSMP).				

LSM Portal



The LSM Portal is a hub for information about the LSM and the Lunar Pre-Coordination Process

Key Functions

- Track status on missions under pre-coordination with the LSM
- View summary information about known lunar missions
- Find information about spectrum planning in the lunar region

Key Resources

- Overview of relevant regulations and policies, and other government documents
- Summary information about known lunar region missions
- Overview of LSM role and Pre-Coordination Process
- Downloadable Lunar Frequency Selection Input Form to initiate Lunar Pre-Coordination Process
 - Permissions-based approach to control sharing of all information, including proprietary details



www.nasalsmp.org

For more information about the Portal, contact Karen Clothier, LSMP Data Manager



Thank you!

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