Spectrum Usage Guidance for Proposal and Concept Study Report (CSR) Teams Responding to Science Mission Directorate (SMD) Announcements of Opportunity (AOs)

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Notice to Proposers

This document is provided for informational purposes as supplemental guidance for Science Mission Directorate (SMD) mission proposers. It does not establish binding or definitive NASA policy. Because Radio Frequency (RF) spectrum regulations are subject to update, the contents herein may not reflect recent policy changes. This document should not be used as a final authoritative source. For definitive and up-to-date guidance, proposers are strongly advised to consult directly with an authorized spectrum manager or the SCaN Point of Contact (POC) designated in the applicable Announcement of Opportunity (AO).

1 Spectrum Management Background

All NASA missions that plan to use the Radio Frequency (RF) spectrum are required to follow the U.S. spectrum regulatory rules and processes as referenced in the relevant NASA Policy Directives (NPDs) and NASA Procedural Requirements (NPRs). NPD 2570.5 sets forth NASA policy and responsibilities for obtaining approval for the use of the spectrum for any NASA mission, project, or other activity. NPR 2570.1 sets forth the requirements for establishing and governing NASA's RF usage.

2 Key Spectrum Usage Guidance

- Missions may have to operate with reduced link margins and duty cycles to meet international limits on interference among RF spectrum users. Users in S-band and X-band will be affected more than Ka-band users because these lower-frequency bands have more congestion[1]. These impacts will generally be the greatest at heavily used ground stations. (See Section 6)
- Missions seeking access to RF spectrum resources in federal allocations will receive NASA spectrum management support. Missions seeking non-federal allocations will bear additional responsibilities related to spectrum authorization. (See Section 5.1 and Appendix C)
- The process for a mission to obtain approval for spectrum usage may be lengthy (i.e., over 12 months in duration). Any changes during the spectrum approval process to the frequency, bandwidth, signal characteristics, transmission power, hardware, orbital characteristics, ground station antennas, or ground station locations may significantly delay the process. Furthermore, these changes may trigger re-initiation of the approval process or invalidate an existing authorization. (See Section 4)
- Missions with primary services must coordinate with other users having the same status and will benefit from regulatory protection from interference by missions having secondary services. Missions using secondary services must not cause degraded performance to any

[1] Frequency bands are defined in Appendix D.

users using primary services in that specific frequency band and must accept possible interference from them. (See Appendix A)

- Missions that rely on private telecommunication services to meet their mission needs are still required to comply with spectrum regulations. Every mission that plans to access the spectrum resource must have a Radio Frequency Authorization (RFA). The availability of bandwidth from a private vendor system (e.g., a ground station network) does not imply availability of the spectrum resource to access such a private system. (See Section 5.2)
- Proposal teams and Concept Study Report (CSR) teams are encouraged to contact the Space Communications and Navigation (SCaN) Program to inquire about spectrum considerations for their missions. (See Section 3)

3 SCaN Support During Proposal and CSR Development

SCaN interacts with proposal teams as early in their development process as possible to begin pre-mission planning and analysis. SCaN assists missions in procuring RF services from other non-SCaN network entities and partners, including but not limited to other NASA organizations, other government agencies, commercial partners, commercial service providers, and international partners. Proposal teams responding to a Science Mission Directorate (SMD) Announcement of Opportunity (AO) may contact the spectrum officials identified in the Communication Services presentation from the pre-proposal conference. CSR teams may contact the spectrum officials identified in the Communication Services presentation from the Phase A Kickoff. Proposal teams and CSR teams may send their questions, concerns, or services requests to the SCaN POC identified in the AO.

4 Radio Frequency Authorization Schedule

NPR 2570.1 C requires all projects to submit requests for RF spectrum certification as early in the acquisition and procurement cycles as possible to ensure that missions receive the necessary authorizations and certifications to operate. All projects are also required to consider their spectrum requirements at each life cycle review. The process to obtain an RFA to operate a telecommunication system or an instrument may take more than 18 months. The authorizations given to a project are specific to frequency, bandwidth, signal characteristics, transmission power, transmitter location (orbital characteristics), ground station location(s), transmission angle, and other restrictions listed in the license. Changes to any of these specifications may cause significant delays in the authorization process. These changes may also result in repeated analyses, and a repeated request for spectrum authorization.

5 Frequency Utilization

All NASA missions using the RF spectrum are required to operate in frequency bands consistent with the allocations in the National Telecommunications and Information Administration (NTIA) *Manual of Regulations and Procedures for Federal Radio Frequency Management* as defined in

Appendix B. Table 1 specifies the frequency bands for telecommunication systems. Table 2 specifies the frequency bands for active sensors. Table 3 specifies the frequency bands for passive sensors. Each of these tables specifies the permitted usages of each band for federal and non-federal users. Key constraints on maximum channel bandwidth or additional notes on restrictions are included in the table. To comply with NPR 2570.1, missions must use the radio spectrum as efficiently as possible.

While requirements related to some of the information in these tables may be deferred by some AOs, mission teams are encouraged to consider all the information in these tables as the mission concept is being defined starting in pre-Phase A. Proposals should be compliant with any policies for deferred requirements that are defined in the AO, Questions and Answers (Q&A), and pre-proposal conference.

5.1 Federal or Non-Federal Allocations

Most NASA-sponsored and funded missions are required to follow the NASA/NTIA processes that coordinate the frequency request within the operations community. Some missions may pursue RF spectrum approval in a non-federal allocation. Missions that wish to obtain an RF allocation as a non-federal user through the Federal Communications Commission (FCC) are encouraged to contact NASA spectrum management support (See Section 3) to ensure the approach is consistent with all relevant NASA policies. Missions that obtain spectrum approval in a non-Federal allocation may not receive the level of support described in Appendix C.

5.2 Applicability of Radio Frequency Authorization (RFA)

Every mission that plans to access RF spectrum resources must have an RFA. The use of commercial services does not forgo the regulatory requirement for NASA missions to be certified by a regulatory agency. An NTIA authorization or an FCC license is needed prior to any transmission.

A letter of commitment from SCaN or a commercial provider does not constitute an authorization for a spacecraft telecommunication system or a spacecraft instrument to operate. Private vendors do not have authority nor visibility over the spectrum space. Commitments from private vendors refer to the compatibility, capacity, and availability of the private resources. These commitments do not guarantee availability of the spectrum resource. Regulatory access to RF spectrum resources is still a requirement through the FCC or the NTIA prior to any transmission.

6 Impacts of Frequency Selection on Concept of Operations (CONOPS)

Radio frequencies for new missions are selected based on an RF compatibility analysis between the new and incumbent or already planned systems at the frequencies and geographical regions of interest. The new systems must not cause degraded performance or interference to existing systems. If necessary, the new system must accept reduced performance at the accepted frequencies. As part of the NASA federal frequency assignment process, spectrum analysts run compatibility analyses for all frequencies within the allocation and artificially introduce duty cycles to the transmission to achieve compliance with limits on interference. These analyses allow the spectrum analysts to find a channel and duty cycle combination where the new mission does not cause degraded performance to existing or planned missions that exceeds permissible interference thresholds.

The paragraph above assumes the NTIA process. This analysis is not generally provided for FCC licensure by either NASA or the FCC.

The results of the compatibility analyses may lead the spectrum analyst to propose limitations on the mission at one or more of the requested ground stations. A mission may choose to reject the analyst's proposed solution if the project can achieve compliance with the International Telecommunication Union's (ITU's) thresholds through redesign or changes in mission CONOPS.

To date, these limitations have included reduced duty cycles at ground stations, reduced link margin, reduced data rates, and prohibitions on using certain ground stations. For example, missions have had the duty cycle at a single ground station reduced by up to 85%, while other missions have had the link signal margin to a single ground station reduced by 4.5 dB. Mission design decisions early in the project can determine the level of impact the spectrum management process will have on the CONOPS.

6.1 Mission Design Considerations to Minimize Impacts to the CONOPS

The process of RF spectrum coordination and RFA can result in significant impacts to the CONOPS. These impacts can be reduced by considering the need to share the RF spectrum and coexist with other spectrum users. Integrating these considerations into the early design process can result in timely approval at the lowest cost.

1. RF system design: The characteristics of the RF components included in the system design will determine the system's compatibility with other systems. For example, using directional antennas to focus the signal where it is needed can minimize interference with other users.
2. Spectrum Allocation and Service: Frequency bands are allocated for specific services, such as Space Research Service (SRS) or Earth Exploration-Satellite Service (EESS). Projects must select frequencies within the appropriate service and ensure the system operates within the designated bands to avoid interference with other systems.
3. Bandwidth: The bandwidth necessary to meet mission objectives must be considered during RF system design. Some bands have regulatory limits on the bandwidth available per user. Some bands are not restricted by regulation. Wider bandwidths may overlap with a larger userbase, increasing the possibility of operational restrictions. To comply with NPR 2570.1, missions must use the radio spectrum as efficiently as possible.
4. Geographical Location: Restrictions on the use of RF channels can vary based on the geographical area. Ground stations in densely populated or high-priority areas may have

limited access. The location and the number of ground stations available to the mission may affect the total available data downlink time.

5. Other technical considerations: Impacts to CONOPS may be minimized by considering modern techniques of interference management such as modulation schemes, adaptive interference-nulling techniques, and dynamic spectrum access during RF system design.

Appendix A: Spectrum Related Definitions

Terminology related to the three tables in Appendix B is fully defined in Chapter 6 of the *Manual of Regulations and Procedures for Federal Radio Frequency Management*. The definitions in this section provide summaries of the portions of these definitions that are most relevant for respondents to SMD AOs.

Radiocommunication Service

A service involving the transmission, emission, and/or reception of radio waves for specific telecommunication purposes.

Earth Exploration-Satellite Service (EESS)

The EESS is a radiocommunication service in which information relating to the characteristics of the Earth and its natural phenomena, including data relating to the state of the environment, is obtained from sensors on satellites. The sensors onboard the spacecraft obtain data on the Earth's land, sea, and atmosphere for the purpose of studying and monitoring the Earth's climate, weather, geology, oceans, or environment. These data may be applied to many related scientific applications. Similar information is often collected from airborne or Earth-based sensing platforms This service operates between one or more ground station(s) and one or more spacecraft. This service may also include feeder links necessary for its operation.

Telemetry, Tracking, and Command (TT&C)

TT&C functions will normally be provided within the service in which the spacecraft is operating. For example, an EESS satellite could use an EESS allocation for both its science data as well as its TT&C link. Missions that want to user the Space Operations Service (SOS) are encouraged to contact spectrum management support (See Section 3) to ensure the approach is consistent with all relevant NASA policies and the allocations in the *Manual of Regulations and Procedures for Federal Radio Frequency Management*.

Space Research Service (SRS)

The SRS is a radiocommunication service in which spacecraft or other objects in space are used for scientific or technological research purposes. Missions that study solar-terrestrial interaction as well as studies of the Sun, solar activities, and its influence on the Earth are included in SRS rather than EESS. For the purposes of using the tables in Appendix B to respond to an SMD AO, any radiocommunication other than EESS will be subject to the SRS allocations. Missions that plan to use services other than EESS and SRS are encouraged to contact spectrum management support (See Section 3) to ensure the approach is consistent with all relevant NASA policies and the allocations in the *Manual of Regulations and Procedures for Federal Radio Frequency Management.*

Passive Sensor

A passive sensor is a measuring instrument in the EESS or in the SRS by means of which information is obtained by reception of radio waves of natural origin.

Active Sensor

An active sensor is a measuring instrument in the EESS or in the SRS by means of which information is obtained by transmission and reception of reflected radio waves.

Primary and secondary services

Primary services receive priority access or status in using a particular swathe of allocated spectrum. A spacecraft, sensor, or ground station operating as a primary service has the right to be protected from non-primary services. A spacecraft, sensor, or ground station operating as a primary service has the right to be protected from primary services that start operation at a later date.

Secondary services must protect all primary allocations in a particular band. Services operating in secondary allocations must not cause harmful interference to primary users. Secondary services must accept interference from primary users. Secondary services can claim protection from harmful interference from a secondary service spacecraft, sensor, or ground station to which frequencies may be assigned at a later date.

Space Telecommand

Space telecommand is the use of radiocommunication for the transmission of signals to a spacecraft to initiate, modify, or terminate functions of equipment on an associated space object, including the spacecraft itself. Examples of Space Telecommand include sending individual, stream, or file-based commands to elements of the spacecraft; sending data files such as calibration constants; and uploading software.

Space Telemetry

Space telemetry is the use of telemetry for the transmission from a spacecraft of results of measurements made in a spacecraft, including those relating to the functioning of the spacecraft. Examples of Space Telemetry include scientific data from sensors, health and welfare data from elements of the spacecraft, and flight or instrument computer downloads.

Space Station

One or more transmitters or receivers or a combination of transmitters and receivers, including the accessory equipment, operating outside of the Earth and its atmosphere. Examples of a space station include the spacecraft telecommunication subsystem, an active sensor on a spacecraft, and a passive sensor on a spacecraft.

Earth Station

One or more transmitters or receivers or a combination of transmitters and receivers, including the accessory equipment, operating on the Earth or in its atmosphere. Examples of Earth stations include ground stations.

Permissible Interference

Observed or predicted interference which complies with quantitative interference and sharing criteria contained in the NTIA regulations or in International Telecommunication Union - Radiocommunication Section (ITU-R) recommendations or in special agreements as provided for in the NTIA regulations.

Appendix B: Table of Frequency Allocations

Table 1. Frequency allocations and usage parameters for SOS, EESS, and SRS through 50 GHz. Upper case denotes primary service usage while lower case denotes secondary service usage. The usage column reflects current NASA accommodations through the Near

Frequency Bands (MHz)	Federal Allocation	Non-Federal Allocation	Transmitter Power and Bandwidth Restrictions	Typical Usage
1628 -- 1708			Power restriction for space stations.	Space Telemetry
1761 – 1850	SPACE OPERATION (Earth-to-space)		Power restriction for earth stations.	
2025 – 2110	SPACE OPERATION (Earth-to-space) (space-to-space) EARTH EXPLORATION-SATELLITE (Earth-to-space) (space-to-space) SPACE RESEARCH (Earth-to-space) (space-to-space)		Power restriction for earth stations and space stations. Power flux density restrictions at the Earth's surface. The maximum channel bandwidth is 5 MHz.	Space Telecommand
2110 – 2120	SPACE RESEARCH (deep space) (Earth-to-space)			Space Telecommand
2200 – 2290	SPACE OPERATION (space-to-Earth) (space-to-space) EARTH EXPLORATION-SATELLITE (space-to-Earth) (space-to-space) SPACE RESEARCH (space-to-Earth) (space-to-space)	Space operation (space-to-Earth)	Power restriction for space stations. Band is channelized for multiple users which will affect frequency selection. The maximum channel bandwidth is 5 MHz.	Space Telemetry
2290 – 2300	SPACE RESEARCH (deep space) (space-to-Earth)		Power restriction for space stations.	
	SPACE RESEARCH (deep space) (Earth-to-space)	Space research (deep space) (Earth-to-space)		Space Telecommand
7190 – 7235	EARTH EXPLORATION-SATELLITE (Earth-to-space) SPACE RESEARCH (Earth-to-space)			Space Telecommand
7235 – 7250	EARTH EXPLORATION-SATELLITE (Earth-to-space)		Power restriction for space stations.	
8025 – 8400	EARTH EXPLORATION-SATELLITE (space-to-Earth)		Power restriction for earth stations and space stations.	Space Telemetry
8400 – 8450	SPACE RESEARCH (deep space) (space-to-Earth)	Space research (deep space) (space-to-Earth)	Power restriction for space stations. The maximum channel bandwidth is 12 MHz (8 MHz for Mars).	Space Telemetry
8450 – 8500	SPACE RESEARCH (space-to-Earth)		The maximum channel bandwidth is 10 MHz.	
13750 – 14000	Space research	Space research		Space Telemetry
14000 – 14250	Space research			
14500 – 14750	Space research			
14800 – 15350	SPACE RESEARCH			
16600 – 17100	Space research (deep space) (Earth-to-space)			
22550 – 23150	SPACE RESEARCH (Earth-to-space)		Power restriction for space stations.	Space Telecommand
25500 – 27000	EARTH EXPLORATION-SATELLITE (space-to-Earth) SPACE RESEARCH (space-to-Earth)	SPACE RESEARCH (space-to-Earth)	Power restriction for space stations.	Space Telemetry
31800 – 32300	SPACE RESEARCH (deep space) (space-to-Earth)		The maximum channel bandwidth is 60 MHz.	Space Telemetry
34200 – 34700	SPACE RESEARCH (deep space) (Earth-to-space)	Space research (deep space) (Earth-to-space)		Space Telecommand
37000 – 38000	SPACE RESEARCH (space-to-Earth)			
40000 – 40500	EARTH EXPLORATION-SATELLITE (Earth-to-space) SPACE RESEARCH (Earth-to-space)	Earth exploration-satellite (space-to-Earth)		

Table 2. Frequency allocations and usage parameters for active sensors on satellite systems (through 50 GHz).

Frequency Bands (MHz)	Federal Allocation	Non-Federal Allocation
1240 – 1300	EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active)	Earth exploration-satellite (active) Space research (active)
3100 – 3300	Earth exploration-satellite (active) Space research (active)	
5250 – 5350	EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active)	Earth exploration-satellite (active) Space research (active)
5350 – 5460	EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active)	Earth exploration-satellite (active) Space research (active)
5460 – 5470	EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active)	Earth exploration-satellite (active) Space research (active)
5470 – 5570	EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active)	Earth exploration-satellite (active) Space research (active)
8550 – 8650	EARTH EXPLORATION-SATELLITE (active)	Earth exploration-satellite (active)
9300 – 9500	EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active)	Earth exploration-satellite (active) Space research (active)
9500 – 9800	EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active)	Earth exploration-satellite (active) Space research (active)
9800 – 9900	Earth exploration-satellite (active) Space research (active)	
13250 – 13400	EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active)	Earth exploration-satellite (active) Space research (active)
13400 – 13650	EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active)	Earth exploration-satellite (active) Space research (active)
17200 – 17300	EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active)	Earth exploration-satellite (active) Space research (active)
24050 – 24250	Earth exploration-satellite (active)	
35500 – 36000	EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active)	Earth exploration-satellite (active) Space research (active)

Unless otherwise noted, users have access to the entire band listed on each row by the regulations. Upper case denotes primary service usage while lower case denotes secondary service usage. There may be specific restrictions that will require coordination in practice.

Table 3.Frequency allocations and usage parameters for passive sensors on satellite systems (through 50 GHz)

Unless otherwise noted, users have access to the entire band listed on each row by the regulations. Upper case denotes primary service usage while lower case denotes secondary service usage. There may be specific restrictions that will require coordination in practice.

Frequency Bands (MHz)	**Federal Allocation**	**Non-Federal Allocation**
1400 – 1427	EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive)	
1660.5 – 1668.4	SPACE RESEARCH (passive)	
2655 – 2690	Earth exploration-satellite (passive) Space research (passive)	
2690 – 2700	EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive)	
10600 – 10680	EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive)	
10680 – 10700	EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive)	
15350 –15400	EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive)	
18600 – 18800	EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive)	
21200 – 21400	EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive)	
22210 – 22500	EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive)	
23600 – 24000	EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive)	
31300 – 31500	EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive)	
36000 – 37000	EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive)	

Appendix C: NASA Spectrum Management Support

All NASA missions that plan to use federal allocations through the NTIA process (See Section 5.1), will receive support from NASA Spectrum Managers (SMs). Missions that apply for a non-Federal Allocation through the FCC process, will not receive this level of support from the NASA Spectrum Management Team.

The SMs ensure that the mission has access to the necessary frequency bands while avoiding interference with other agencies or commercial entities. This process involves regular coordination with all the federal government agencies who share frequency access with NASA. The SM team will collaborate with international space agencies to ensure compatibility, prompt approval, and efficient global operations with missions flying over international space. The SM assigned to a project will ensure that the project obtains system certifications to enable the testing and operation of the RF system. SMs help renew licenses and help close licenses at the end of the mission.

The frequencies allocated for all missions (Federal and non-Federal Allocations) are selected based on channel availability within the allocation. These selections are made with the stipulation that the mission must satisfy interference threshold criteria specified in NTIA and FCC regulations. The *Manual of Regulations and Procedures for Federal Radio Frequency* Management defines permissible interference as observed or predicted interference which complies with quantitative interference and sharing criteria contained in these regulations or in ITU-R recommendations. The ITU-R interference threshold criteria are guidelines established by the ITU to ensure the proper functioning and protection of radio communications systems from harmful interference. These criteria are particularly important for the allocation of frequency bands and the management of radio spectrum use to maintain the quality of services across various communication systems. ITU interference threshold criteria are defined for various cases, and the applicability to specific missions is dependent on frequency, location, type of radio service, and other factors.

The criteria define specific limits on the field strength of signals and the level of interference that can be tolerated by systems operating in adjacent or overlapping frequency bands. These levels are designed to protect the integrity and functionality of existing services. The criteria define a percentage of time that a radio system can withstand interference before experiencing degradation in performance or significant disruption. For example, recommendation ITU-R SA.609 provides the interference criterion for Near-Earth Research Satellites. For uplink, the received interference level from all sources should not exceed -6 dB more than 0.1 % of the time. For downlink, the received interference level from all sources should not exceed -6 dB more than 0.1 % of the time. Recommendation ITU-R SA.1155 provides the protection criteria for Space-to-Space links (e.g. relay satellite forward and return). The received interference level from all sources for space-to-pace links should not exceed -10 dB more than 0.1 % of the time.

Missions that exceed interference thresholds during operations are required to make operational changes that result in compliance. Missions that are unable to comply with interference thresholds can be required to cease operations.

For missions applying for a Federal Allocation through the NTIA process, the NASA Spectrum Management team performs compatibility studies between new and incumbent systems to assess the potential for interference between systems at all possible frequencies within the allocation selected by a new project. The known designs and mission operations of existing systems, as well as the expected performance of the new RF system and the intended location of transmission are inputs to RF compatibility assessment. The characteristics of the RF system, such as the signal characteristics, RF power level, antenna beamwidth and sidelobes, filter bandpass and rejection ratio affect the result of these analyses. These analyses are also impacted by aspects of the mission's CONOPS such as the time and angles of transmission and the location and characteristics of the planned ground stations.

Appendix D: Frequency Band Designations

References to band designations in this document follow the Institute of Electrical and Electronics Engineers (IEEE) Standard Letter Designations for Radar Frequency Bands as specified in IEEE Std 521™-2019. The NTIA does not use letters or numbers to designate specific bands of frequencies.

Table 4. IEEE frequency band letter designations.

Band Designation	**Frequency Range (GHz)**
HF	0.003 to 0.03
VHF	0.03 to 0.3
UHF	0.3 to 1
L	1 to 2
S	2 to 4
C	4 to 8
X	8 to 12
Ku	12 to 18
K	18 to 27
Ka	27 to 40
V	40 to 75
W	75 to 110
mm	110 to 300
THz	300 to 1000

Appendix E: Acronyms

AO	Announcement of Opportunity
CONOPS	Concept of Operations
CSR	Concept Study Report
DSN	Deep Space Network
EESS	Earth Exploration-Satellite Service
FCC	Federal Communications Commission
IEEE	Institute of Electrical and Electronics Engineers
ISM	Industrial, Scientific, and Medical
ITU	International Telecommunications Union
ITU-R	International Telecommunications Union - Radiocommunication Section
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NSN	Near Space Network
NTIA	National Telecommunications and Information Administration
Q&A	Questions and Answers
RF	Radio Frequency
RFA	Radio Frequency Authorization
SCaN	Space Communications and Navigation
SM	Spectrum Manager
SMD	Science Mission Directorate
SOS	Space Operations Service
SRS	Space Research Service
TT&C	Telemetry, Tracking, and Command

Record of Revisions

Revision	Date	Description of changes
	April 2026	Initial release