NASA Procedural Requirements

NPR 2570.1
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COMPLIANCE IS MANDATORY

NASA Radio Frequency (RF) Spectrum Management Manual

Responsible Office: Space Operations Mission Directorate

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Appendix K. Acronyms

Preface

P.1 Purpose

a. This NASA Procedural Requirement (NPR) sets forth the procedures for the management requirements for controlling the use of radio frequencies by the National Aeronautics and Space Administration (NASA).

b. NPR 1000.3 assigns the authority for the management of radio frequencies for NASA to the Associate Administrator for Office of Space Flight (AA for OSF), NASA Headquarters.

c. Comments, suggestions, or questions concerning this NPG should be addressed to the Chief, Spectrum Management Office, Space Communications Office, Code 6140, NASA Glenn Research Center, Cleveland, Ohio 44135.

P.2 Applicability

This NPR applies to NASA Headquarters, all NASA Centers, including Component Facilities, and to the Jet Propulsion Laboratory (JPL) and other contractors to the extent specified in their contracts.

P.3 Authority

a. 47 U.S.C. 151 et seq. of the Telecommunications Act of 1996, P.L. 104-104.

b. 47 U.S.C. 901 et seq. of the Telecommunications Authorization Act of 1992, P. L. 102-538.

c. 47 U.S.C. 701 et seq. of the Communications Satellite Act of 1962, as amended.

d. 47 U.S.C. 151 et seq. of the Federal Communications Act of 1934, as amended.

e. 47 U.S.C. 305, note Executive Order 12046, Transfer of Telecommunications Functions, March 27, 1978.

f. Office of Management and Budget (OMB) Circular No. A-11, Section 34.1.

g. 47 CFR Part 300, Manual of Regulations and Procedures for Federal Radio and Frequency Management, National Telecommunications and Information Administration.

h. 47 CFR Part 100, Regulations of the Federal Communications Commission, Direct Broadcast Satellite Service.

i. Radio Regulations, International Telecommunication Union (ITU), published in Geneva, Switzerland.

P.4 References

a. NPR 1000.3, The NASA Organization.

b. NPD 2570.5, Radio Frequency Spectrum Management.

c. NPD 1440.6, NASA Records Management.

d. NPR 1441.1, NASA Records Retention Schedules.

e. NASA/ESA Frequency Coordination Manual.

f. NASA/NASDA Frequency Coordination Manual.

g. SSP 50423, International Space Station Radio Frequency Coordination Manual.

h. SFCG Resolutions and Recommendations.

i. NASA FAR Supplement, Subpart 1823.71 and Section 1852.223-71, Frequency Authorization.

j. "ANSI/IEEE C 95.1-1992, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Eletromagnetic Fields, 3 kHz to 300 GHz."

k. "ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)."

l. NASA Publication 530-RFIMM/Space Shuttle, Space Shuttle Program Radio Frequency Interference Management Manual (April 1994).

P.5 Cancellation

None.

/S/ William F. Readdy
Associate Administrator for Space Flight

Chapter 1: General

1.1 Purpose

1.1.1 This NPG provides guidance in the use of the RF spectrum for Agency communications links and remote sensing purposes. Procedures relating to Radio Frequency Interference (RFI) are also presented, and requirements are defined for the support of future NASA programs that may require long-lead-time spectrum management initiatives. Responsibilities of concerned NASA personnel are defined in chapter 2.

1.1.2 For the purpose of this NPG, the RF spectrum is defined as the set of radio frequencies below, arbitrarily, about 1000 GHz. Also several terms used frequently have very specific, technical connotations for those familiar with the RF spectrum management discipline. A glossary of these terms is provided in Appendix A.

1.2 Spectrum Management Policy Guidance

1.2.1 The U.S. policy, with regard to the use of properly authorized frequency bands, is stated in the Communications Act of 1934, as amended. In order to ensure compliance with the provisions of the Communications Act, OMB Circular No. A-11, Section 34.1, states that:

1.2.2 "A certification must be obtained by the National Telecommunications and Information Administration, Department of Commerce that the RF required is available before you submit estimates for the development or procurement of major electronics systems (including all systems employing space satellite techniques)." (see http://www.whitehouse.gov/omb/circulars/)

1.2.3 NASA policies to be adhered to by all Agency spectrum users are given in NASA Policy Directive (NPD) 2570.5B, (see http://nodis3.gsfc.nasa.gov/library/main_lib.html).

1.2.4 All NASA RF spectrum usage must be pursuant to specific assignments approved by the NASA Spectrum Manager, the AA for OSF, under the conditions specified in chapter 3, Section 3.7(c).

1.3 Regulatory Structure

1.3.1 Internationally, the RF spectrum is allocated by the International Telecommunication Union (ITU) (see http://www.itu.int/) to various classes of service according to different regions of the world (see Figure 1-1). Within the United States and its Possessions, the RF spectrum is further allocated to non-Government and Government users. The Federal Communications Commission (FCC), acting under the authority of Congress, is responsible for the allocation and assignment of frequencies to non-Government users (see http://www.fcc.gov). The National Telecommunications and Information Administration (NTIA), acting under the authority of the President, are responsible for the allocation and assignment of frequencies to departments and agencies of the U.S. Government (see http://www.ntia.doc.gov). Descriptions of international and national spectrum management structures are contained in Appendices B and C.

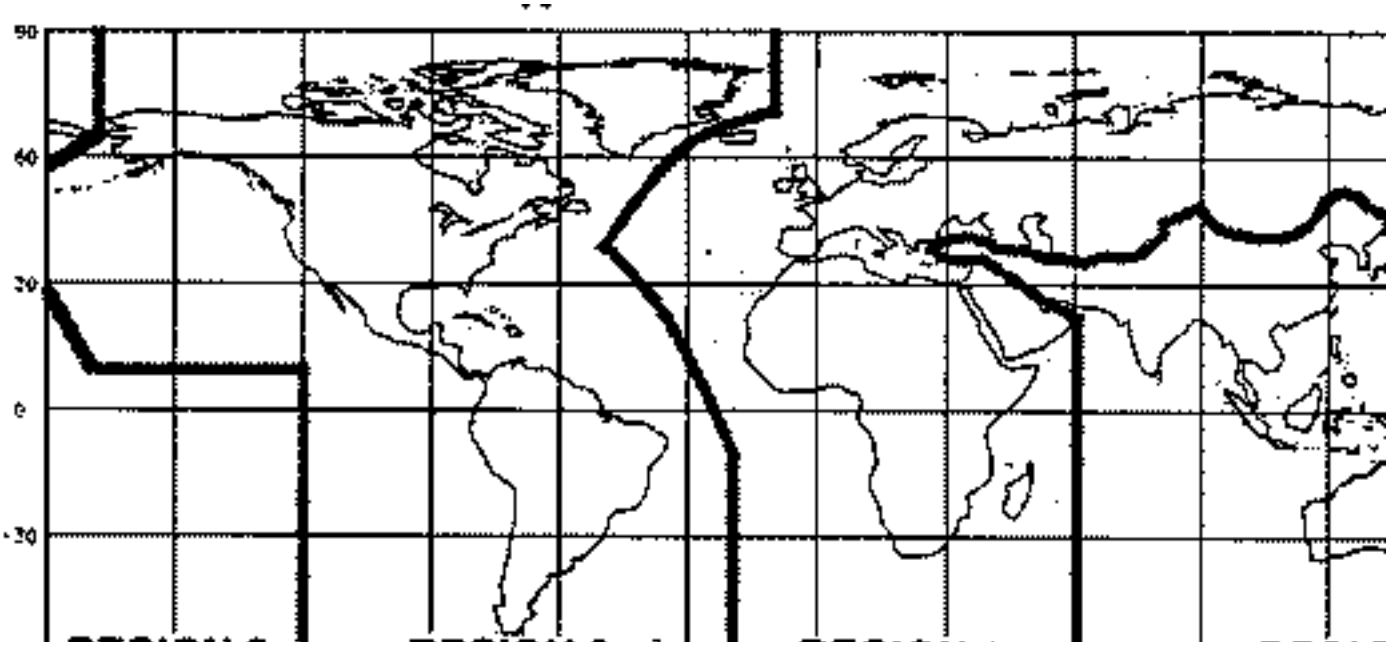
1.3.2 NTIA performs its functions through the assistance of the Interdepartment Radio Advisory

Committee (IRAC)[1] that is also responsible for maintaining the National Table of Frequency Allocations. [2] Coordination between non-Government and Government users of the RF spectrum is accomplished through joint meetings of the FCC and the NTIA.

1.3.3 NASA responsibility for acquiring frequency allocations and providing assignment of frequencies is delegated to the AA for OSF. Normally, all allocations and assignments are made through the AA for OSF and are issued to NASA RF spectrum users through NASA Center Spectrum Managers (for NASA spectrum management points of contact, see http://nasa-spectrum.grc.nasa.gov).

Figure 1-1

Geographic Regions for Frequency Allocation of the Spectrum

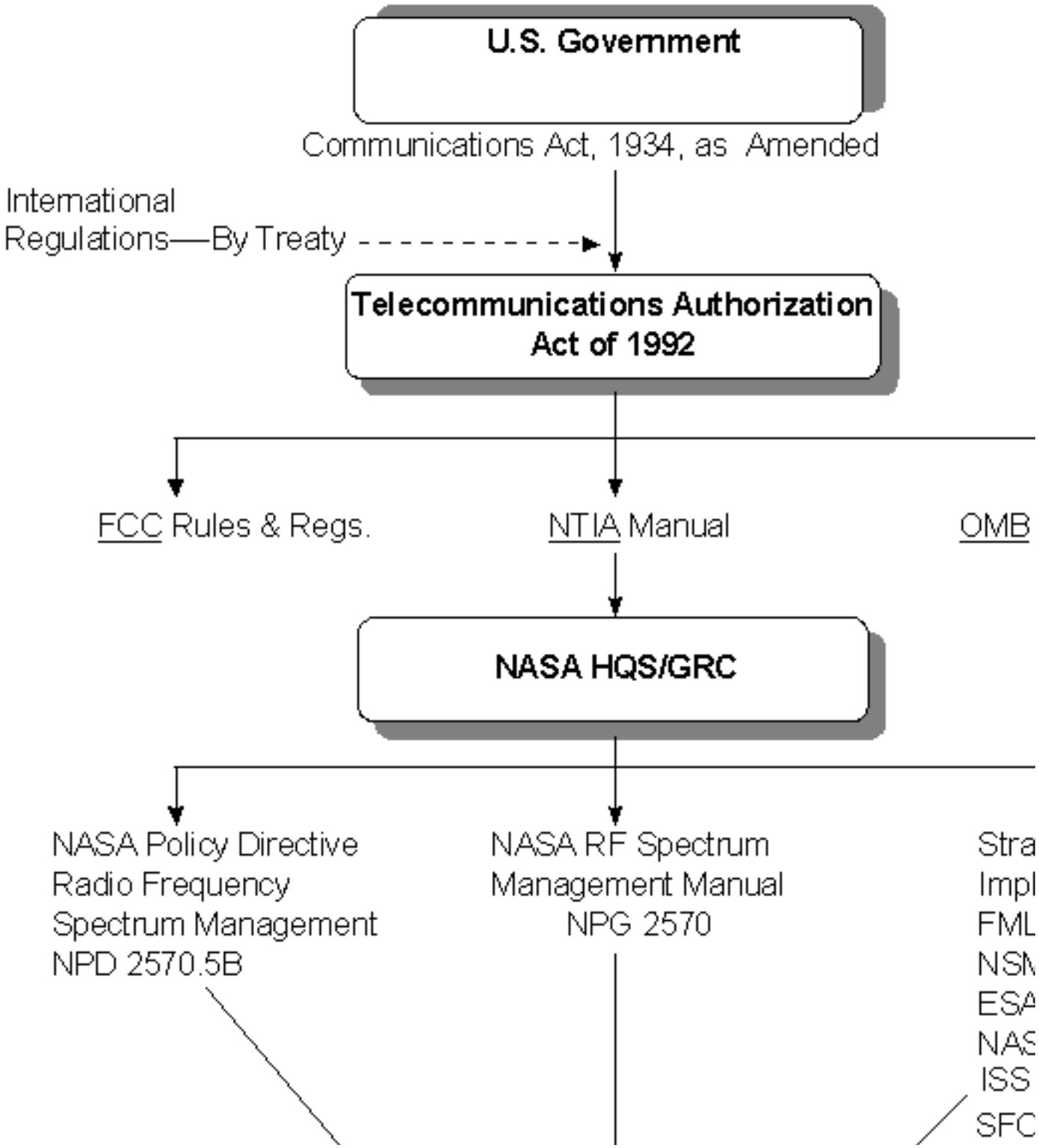


1.4 NASA Spectrum Management Program Documentation Tree

The Spectrum Management Program Documentation Tree is shown in Figure 1-2. The tree shows the linkages between NASA spectrum management documentation and national rules and regulations.

Figure 1-2

NASA Spectrum Management Program Documentation Tree



[1]The IRAC has been in constant session since 1922, NASA has been an active member since 1958.

[2] See Chapter 4 of Manual of Regulations and Procedures for Federal Radio Frequency Management.

Chapter 2:NASA Spectrum Management Program Roles and Responsibilities

2.1 Agency-Level Responsibilities

2.1.1 The AA for OSF is designated as the NASA Spectrum Manager and is responsible for ensuring compliance with pertinent international and national rules and regulations of all NASA RF spectrum users. The AA for OSF nominates the Chairperson of the United States Study Group 7 (ITU-R) under the U.S. National Committee, appoints the Agency IRAC representative, and designates NASA representatives to official spectrum management forums, both national and international.

2.1.2 The AA for OSF has delegated authority for the overall planning, policy and administration of the NASA Spectrum Management Program to the Agency Spectrum Policy and Planning Director within the OSF. The Agency Spectrum Policy and Planning Director also chairs and coordinates the Frequency Management Liaison Group (FMLG), which consists of representatives from the NASA Enterprises. The FMLG (see Appendix D) identifies new spectrum requirements needed to fulfill the missions of the Enterprises in a timely manner so that new spectrum allocations may be acquired.

2.1.3 The Glenn Research Center (GRC) has been designated the Lead Center for the Spectrum Management Program, and the Center Director for GRC has been assigned all programmatic implementation responsibilities for the program. The GRC Center Director has delegated responsibility for execution of the Spectrum Management Program implementation responsibilities to the Agency Spectrum Program Manager.

2.1.4 Specifically, the Agency Spectrum Policy and Planning Director establishes the policies, and the Agency Spectrum Program Manager implements the necessary procedures to:

a. Obtain adequate spectrum to support Agency programs.

b. Ensure Agency compliance with national and international rules and regulations.

c. Ensure timely processing of spectrum allocations and frequency assignment requests.

d. Ensure timely dissemination of technical and regulatory changes to the Center Spectrum Managers and the JPL Spectrum Manager.

e. Provide the means for NASA Mission Program Managers to obtain guidance on spectrum matters so that spectrum dependent devices are coordinated at the conceptual stage.

f. Ensure identification and mitigation of any RFI, which might be caused or suffered by Agency operational programs.

g. Provide planning and implementation of actions required to obtain new allocations or enhanced radio regulations through national and international organizations.

h. Provide spectrum planning and support to NASA's technology transfer mission.

i. Advocate rules and rule changes that support the lowest life-cycle cost technical solutions to NASA programs for meeting their communications needs.

2.1.5 The Agency Spectrum Program Manager, with advice and counsel of the Agency Spectrum Policy and Planning Director (NASA HQ/OSF), will provide civil servant staff for assisting the NASA Spectrum Manager in representing the Agency in national and international regulatory fora. Participation in these fora is required, or mandated, to advance and defend Agency spectrum allocation and regulatory needs in addition to securing all requisite license operating authority for flight and administrative programs. These fora include nationally, the NTIA IRAC and its subcommittees, and relevant entities established by NASA, the FCC, the NTIA and the U.S. Department of State to deal with national and international regulatory proceedings, and the ITU and its relevant sectors, study groups, and working parties.

2.1.6 Where appropriate, the Agency Spectrum Program Manager is supported in carrying out these responsibilities by the electromagnetic spectrum engineering services contract. Funding for this contract is provided to GRC through the Space Operations Management Office (SOMO). Additionally, the Agency Spectrum Program Manager will draw upon support from the NASA Centers when specific, specialized expertise is required.

2.1.7 The structure of the NASA Spectrum Management Program is shown in Figure 2-1. NASA and its relationship to the national spectrum management structure are presented in Figure 2-2.

2.1.8 Contact information regarding Agencywide spectrum management personnel is available at http://nasa-spectrum.grc.nasa.gov http://nasa-spectrum.grc.nasa.gov, a Web site which is maintained by the Spectrum Management Office, Code 6140, at GRC.

2.2 NASA Enterprises and Other Headquarters Offices' Responsibilities

2.2.1 NASA Enterprise and other Headquarters Offices are responsible for coordinating spectrum requirements with the Agency Spectrum Program Manager. The OSF has a unique role within the Agency that is authorized under the Communications Satellite Act of 1962, as amended. This role is to provide technical advocacy to U.S. industry in the research and development of advanced technology applied to commercial communications satellites. Additionally, at times within this program, there may be the requirement to transfer, to entities of U.S. industry, existing communications technology. To ensure adequate spectrum support for these programs, the Agency Spectrum Management Program must provide adequate coordination and representation to the FCC.

2.2.2 For future Agency missions, it is the responsibility of each NASA Enterprise, through the FMLG, to provide the latest conceptual spectrum requirements (communications, remote sensing, and any others) to the Agency Spectrum Program Manager with respect to programs and future mission concepts over which they may have cognizance.

Figure 2-1 NASA Spectrum Management Program

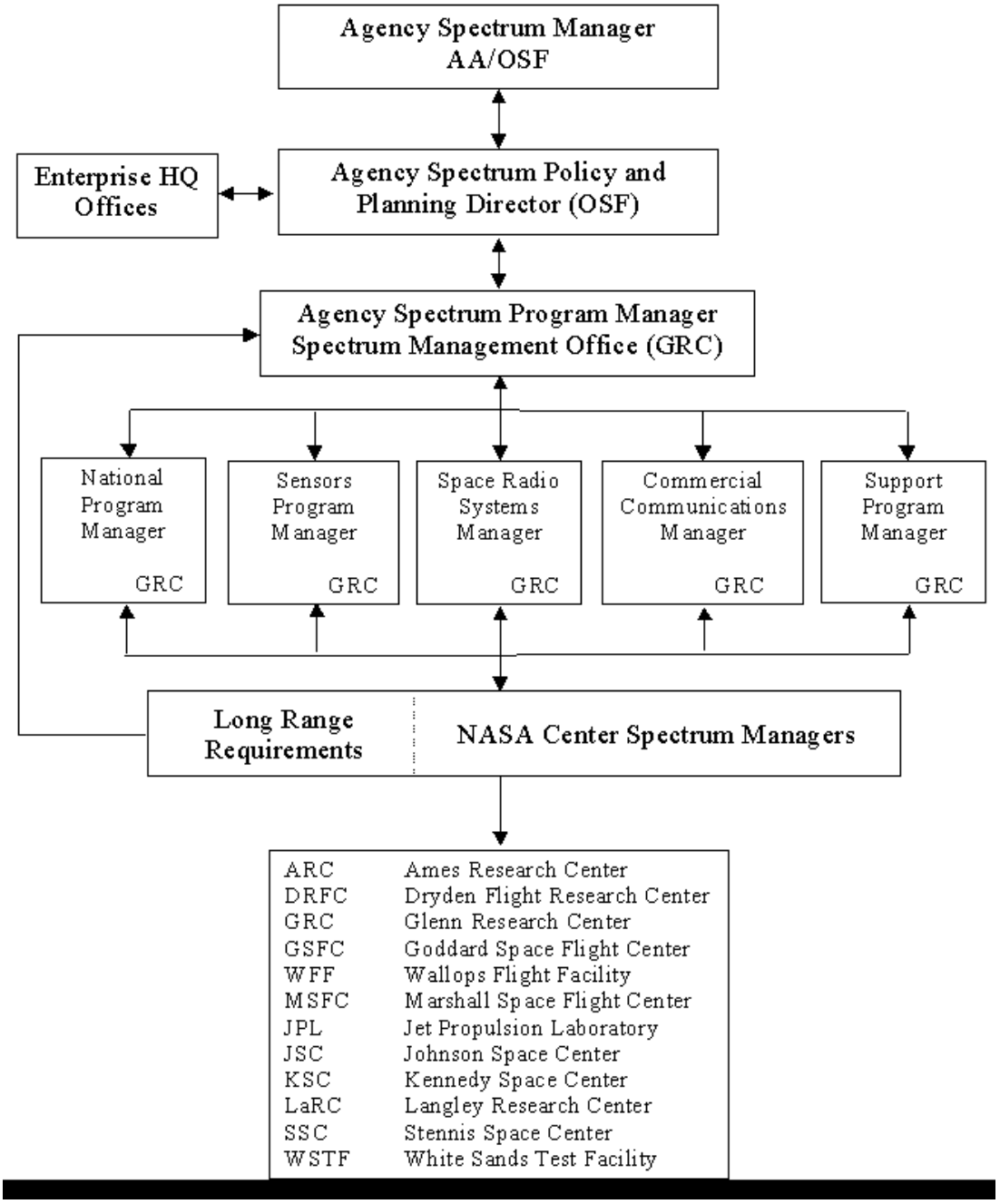
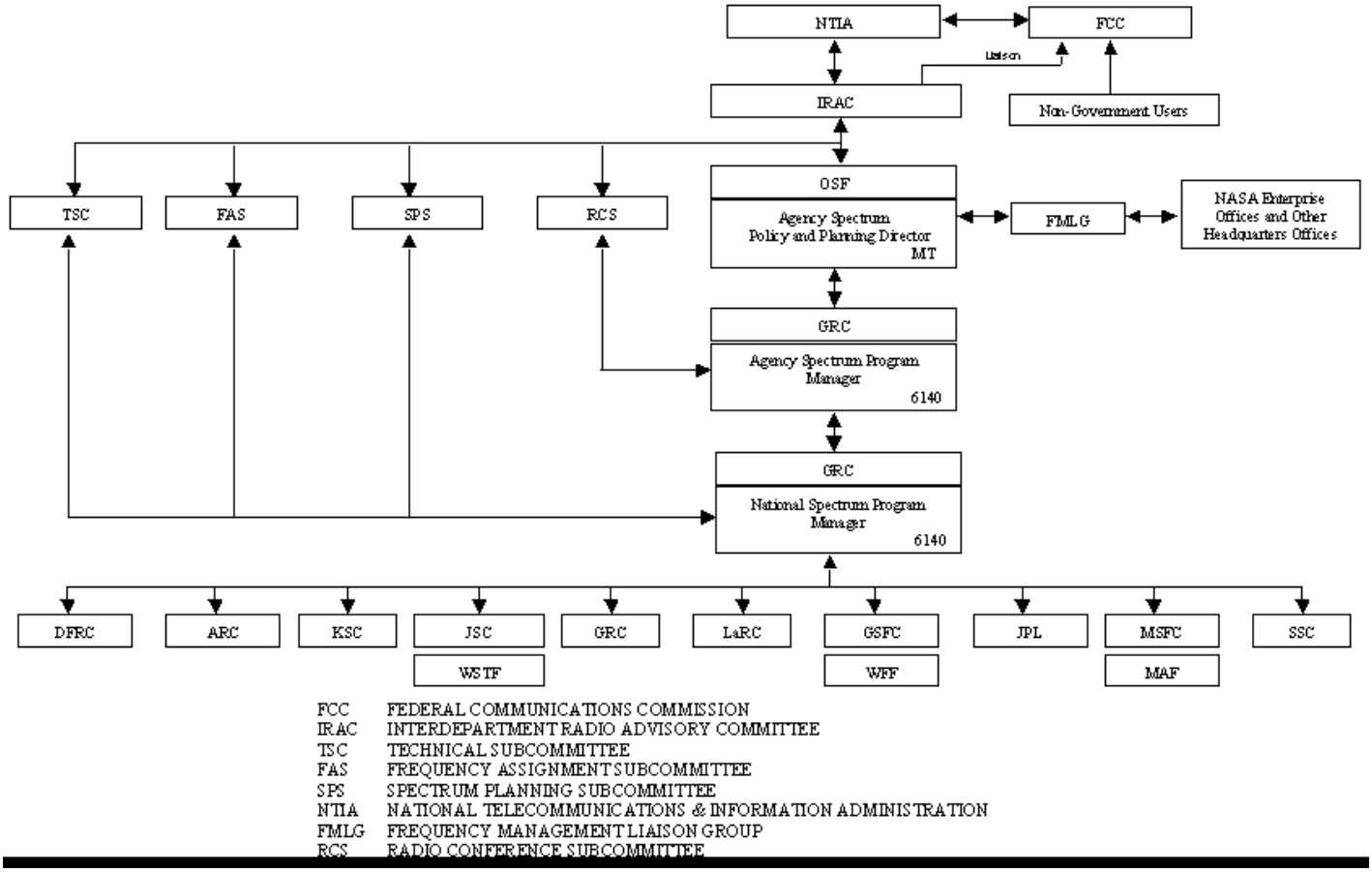


Figure 2-2 NASA/National Spectrum Management Structure



2.3 NASA Centers Responsibilities

2.3.1 Each Center Director is responsible for implementing the Agency spectrum policies and applicable procedures through the publication of Center Management Instructions and adherence to this NPG, and providing resources in support of the Center spectrum management function. Each Center Director will designate a qualified Center Spectrum Manager and a qualified alternate Center Spectrum Manager. The JPL[1], although not a Center, also provides a qualified JPL Spectrum Manager[2] and a qualified alternate JPL Spectrum Manager.

2.3.2 Each Center Spectrum Manager, JPL Spectrum Manager, and their alternates have the following responsibilities at their Center:

a. Coordinate RF spectrum requirements for the site including the licensing of all transmitters (whether for active remote sensing or communications use, and whether spaceborne or otherwise) and the registering of all radiometers or receivers (whether for passive sensing or communications use, and whether spaceborne or otherwise.

b. Maintain accurate records[3] of all frequency assignments in use at or by the Center and JPL

c. Maintain the electromagnetic integrity of the site and its flight missions through proper selection of RF equipment and electromagnetic compatibility (EMC) testing.

d. Ensure day-to-day interference-free operations at the site and by its flight missions

e. Identify communication and other RF spectrum requirements such as active and passive remote sensing requirements, of future missions proposed by the site, and report as early as possible to the Agency Spectrum Program Manager at GRC for inclusion in NASA long-range spectrum forecasts.

f. Prepare technical analyses required to support spectrum management submittals for site projects.

g. Participate in local, national, and international spectrum management coordination groups, as appropriate, and to provide representation and cognizance of the site's project requirements.

h. Coordinate the development and maintenance of Center/JPL instructions for spectrum management with the National Spectrum Program Manager to ensure Agencywide program consistency.

i. Serve as the representative for the Agency Spectrum Program Manager to the NASA programs/projects at their Centers and JPL.

j. Ensure that RF and electromagnetic field emissions conform to the latest requirements of ANSI/IEEE c95.1, Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields 3 kHz to 300 GHz and the ICNIRP Electromagnetic Field Standard, 1 Hz to 300 GHz.

k. Each Center Spectrum Manager has the responsibility to ensure coordination of RF spectrum requirements with the NASA Center Safety and Mission Assurance Office. All RF spectrum requirements will be coordinated with the Center Occupational Health Office. Based on the particular Center mission responsibilities, RF emissions shall be coordinated with other operations such as range safety, flight operations, operation safety, explosive safety, and propellant handlers.

l. Each Center Spectrum Manager and the JPL Spectrum Manager shall be included in their Center procurement process for all RF equipment in order that the above outlined responsibilities may be properly discharged.

m. The National Spectrum Program Manager chairs the NASA Spectrum Managers Group (NSMG) meeting, which meets at least annually to review issues pertinent to all Centers (see Appendix E).

[1] JPL is an operating division of the California Institute of Technology (Caltech) and a Federally Funded Research and Development Center under Caltech's contract with NASA, Contract NAS7-1407 . Under terms of this NASA prime contract, JPL performs a number of communication functions that support various projects and other functions carried out by JPL, including operational management of the Deep Space Network. This support requires access to and use of the RF spectrum.

[2] To ensure proper and adequate RF spectrum availability, the JPL Spectrum Manager interfaces with the Agency Spectrum Program Manager. Also, as necessary, the JPL Spectrum Manager interfaces with the NASA Spectrum Policy and Planning Director and in accordance with procedures outlined in this NPG to obtain the necessary spectrum for JPL requirements and to maintain JPL's RF spectrum utilization in accordance with NASA and NTIA policies and regulations.

[3]The guidelines in NPG 1441.1, NASA Records Retention Schedules, should be followed to maintain and safeguard these records. Records such as documents and reports can only be disposed of based on the retention periods in NPG 1441.1. If an item is not described in NPG 1441.1, an entry needs to be developed and added to the NPG. In this instance, contact your Center Records Manager for the procedures.

Chapter 3: RF Allocations and Assignments

3.1 General

3.1.1 In order to effectively implement the national and international spectrum management policy, NASA has adopted procedures for requesting frequency assignments and for obtaining new frequency allocations. These procedures allow for a coordinated process starting with identification of agency program/project needs and ending with national and international recognition of actual band usage.

3.1.2 For the purpose of this NPG, the following definitions are adopted from the ITU Radio Regulations (RR).

a. Frequency Allotment: Entry of a designated frequency channel in an agreed-upon plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specific conditions.

b. Frequency Allocation: Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more (terrestrial or space) radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned.

c. Frequency Assignment: Authorization given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions.

3.1.3 In general, the frequency assignment process takes the form outlined in Figure 3-1 and is initiated at the user NASA Center and ends with issuance of a Radio Frequency Authorization (RFA). If the use is not for a major terrestrial program or not for frequencies to be used for transmissions to and from space, the frequency assignment process is fairly simple as described in paragraph 3.3.2.2.

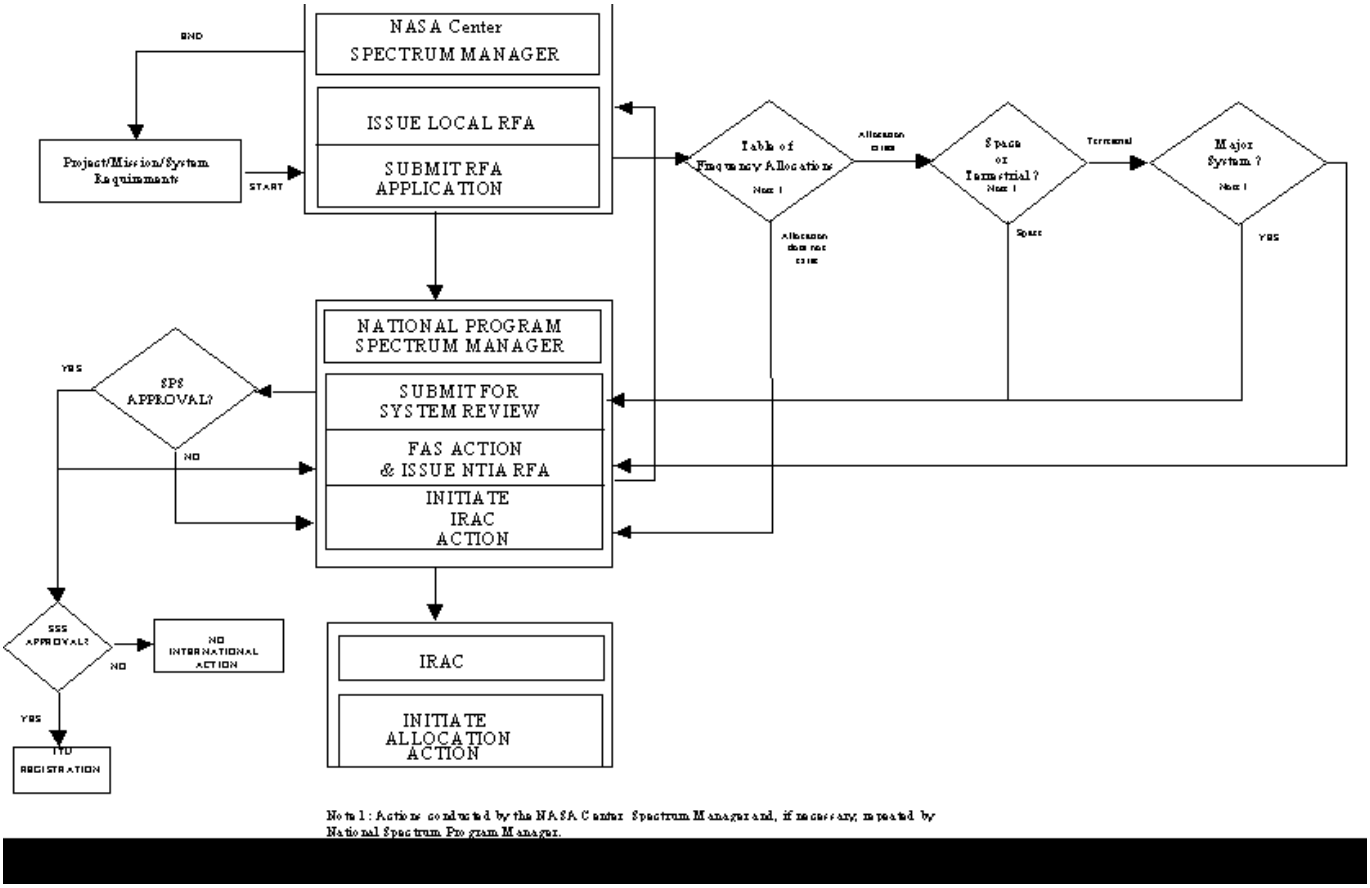
3.1.4 However, for major new programs or for programs involving spacecraft, NTIA has established a systems review process by which the use is coordinated within the United States and internationally. This process is described in Appendix F.

3.2 Frequency Allocations

3.2.1 In most cases, identification of RF spectrum support for Agency needs is focused on frequency bands currently allocated nationally and internationally for the particular radio service for which the Agency requires support. This includes both terrestrial use (in fixed and mobile allocations) and space use (in space services that support the U.S. space programs). However, in some cases, particularly as new scientific, technological, and commercial requirements emerge and bands lower in the RF spectrum become congested, it may be necessary to move Agency communication operations elsewhere in the RF spectrum where appropriate allocations do not currently exist within which to operate. As shown in Figure 3-1, the identification of the need for a new allocation may be made by reference to the Table of Frequency Allocations or as a result of the systems review process which includes a study of current frequency band occupancy.

3.2.2 In cases where new frequency allocations are deemed necessary, it is imperative that long-lead times be allowed for the national and international processes which are required for new allocations to be made. While ITU conferences, which are competent to reallocate portions of the RF spectrum occur on a periodic basis, NASA must be prepared to identify new requirements well in advance of these conferences so that supporting technical and regulatory arguments can be prepared and presented.

Figure 3-1 Frequency Authorization Process



3.3 Frequency Assignments

3.3.1 General

Specific procedures by which Agency users may be authorized to operate on a particular frequency depend upon the following factors:

a. Whether a frequency allocation exists or not;

b. Whether the system is terrestrial or spaceborne; and

c. Whether the system is considered a major telecommunications system, e.g., high investment.

3.3.2 Process for frequency selection prior to design commitment (See Figure 3.2)

3.3.2.1 Project Commitment (Funding Approved)

The dissemination of information of project commitment made at NASA Headquarters or within NASA Programs and Projects is key to the successful coordination of design decisions involving the selection of frequencies for systems requiring RF communications.

3.3.2.2 Initial Frequency Coordination Guidance

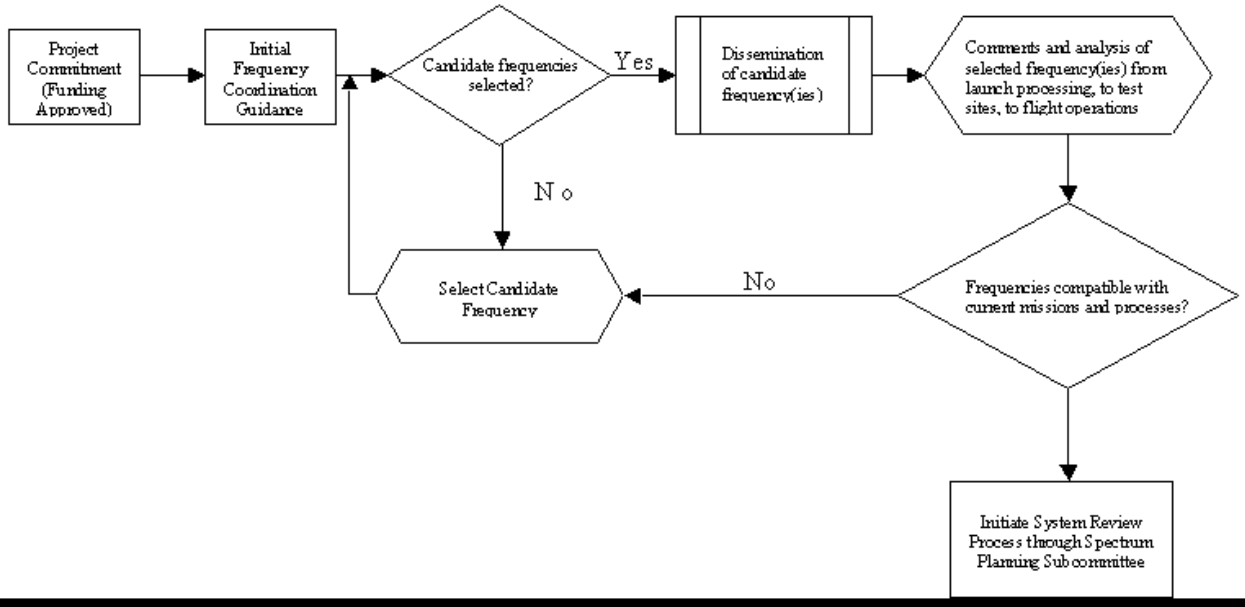
Due to the increasing complexity and usage of the RF spectrum, the availability of spectrum may actually drive the design requirements for future NASA missions. Each Center has a designated Radio Frequency Spectrum Manager who is responsible for obtaining, maintaining, and retiring the RFA for programs and projects at the Center, and for preventing or mitigating radio frequency interference at the Center or to the Center's programs to enable mission execution. The Center Radio Frequency Spectrum Manager, or Spectrum Manager, provides guidance on the selection of properly allocated frequency bands to fulfill mission requirements. Once candidate frequency bands and center frequencies are selected, the dissemination of the information is necessary to ensure that appropriate feedback is obtained to ensure timely resolution of problems from within NASA, as well as with other users of the spectrum.

3.2.3.3 Dissemination of Candidate Frequencies

The dissemination of candidate frequencies should include the relevant NASA Spectrum Managers at the Center level and the candidate Government or commercial launch sites that NASA may use in the future. In addition, the NASA National Spectrum Program Manager must be included on distribution to ensure that the NTIA's Spectrum Planning Subcommittee (SPS) concerns are

addressed before the submission of a Systems Review. Spectrum Managers may also provide additional insight into scheduling issues for frequencies in highly congested bands requiring ground station support.

Figure 3-2 Process for Frequency Selection



3.3.2.4 Comments and Analysis of Frequencies

Projects should employ an approach similar to the RF analysis of the candidate frequencies (see Figure 3-2). Therefore, projects should be prepared to fund an RF analysis that may need to be conducted to ensure electromagnetic compatibility with other users of the proposed frequency band(s) of operation. The results of such an analysis should provide better information for the selection of the best frequency for a particular mission and should be included in a submission to the NTIA for a Systems Review.

3.3.2.5 Initiate Spectrum Planning Subcommittee Process

The conceptual phase of a mission ends when the necessary analysis has determined the best frequency candidate for a particular mission. The planning phase then begins with an initial submission of a Systems Review (Stage 1 or 2) to the NTIA. The NTIA may provide further guidance or raise concerns regarding existing systems that may be incompatible with the particular mission. {See Appendix F of this NPG and chapter 10 of the NTIA Manual.}

3.3.3 Terrestrial Assignments

3.3.3.1 Some terrestrial systems may be classified as major telecommunications systems. These would be expected to include systems which, even though spectrum allocations currently exist, may be required to submit to NTIA for a systems review, for example, high bandwidth requirements, new modulation techniques, and novel applications. This systems review procedure is referred to in Appendix F of this NPG.

3.3.3.2 NASA users requiring assignments for radio frequencies for nonmajor terrestrial use should provide the specific technical information via electronic means for submission to NTIA via the Frequency Assignment Subcommittee (FAS) electronic agenda. This information should be submitted for all frequency assignment actions (new, renewal, and modifications) to the appropriate NASA Center Spectrum Manager for review and submission to the National Spectrum Program Manager in the proper NTIA computer mnemonic format, as described in Chapter 9 of the NTIA Manual.

3.3.3.3 The following procedures and notes will aid NASA spectrum users in the preparation of applications for frequency assignments, and facilitate the processing of the applications:

Step 1: From the operational requirements, determine the specific frequency or band of frequencies, together with alternate frequencies that would be acceptable if the desired frequencies are not available. Allow a lead-time of at least 30 work days for processing of typical land mobile radio operations and up to 180 work days for complex systems requiring pre-coordination with other Federal agencies. The time process commences when the application appears on the FAS electronic agenda.

Step 2: The Center Spectrum Manager will ensure that the frequencies are available and are in accordance with the National Table of Frequency Allocations. (Do not request "out-of-band" frequency assignments or allocations unless absolutely necessary and with writtenjustification). In cases where out-of-band frequencies must be used, allow the maximum lead-time possible.

Step 3: Refer to paragraph 3.4 to determine if coordination with other users of the spectrum is required. The type and amount of coordination that might be required varies with the specific frequencies involved. When such coordination is extensive, the user (applicant) must provide funds for such coordination, including the preparation of coordination contour charts.

Step 4: For each frequency assignment action required, submit the information to the NASA Center Spectrum Manager together with any other information that will aid in expediting the application. If necessary, refer to Appendices G and H for procedures to determine bandwidth and emissions designations and call signs.

3.3.3.4 NASA Center Spectrum Managers are responsible for processing the information into the proper NTIA computer mnemonic format. Submit this data directly to the National Spectrum Program Manager.

3.3.3.5 Submission of data or acknowledged receipt does not constitute an assignment or authorization regardless of any verbal agreements or understandings between the applicant and NASA spectrum management personnel. Do not attempt to operate on the frequency requested or to purchase equipment requiring such frequency support until authorized by formal RFA issued through the Center Spectrum Manager.

3.3.4 Space Assignments

3.3.4.1 Chapter 10 of the NTIA Manual entitled, "Procedures for the Review of Telecommunication Systems for Frequency Availability and Electromagnetic Compatibility (EMC)" states that for Government agencies the systems review process is applicable to certain systems and subsystems. The systems review is intended for:

a. New telecommunication systems or subsystems, and major modifications to existing systems or subsystems, involving the use of satellites or spacecraft.

b. New major terrestrial systems or subsystems, and major modifications to existing systems or subsystems.

c. Such systems or facilities as may be referred to the Spectrum Planning Subcommittee (SPS) on a case-by-case basis.

3.3.4.2 The systems review is a procedure used by the SPS to develop recommendations on behalf of the IRAC for the Deputy Associate Administrator, Office of Spectrum Management of NTIA, regarding certification of spectrum support for telecommunication systems or subsystems. This review provides an early awareness in the regulatory community and allows for either early support or early identification of potential problems in the future. A system can be reviewed at four stages as it matures into an operational status. These are:

Stage 1 Conceptual

Stage 2 Experimental

Stage 3 Developmental

Stage 4 Operational

3.3.4.3 This review process is mandatory for space systems except those that operate under Annex K of the NTIA Manual regarding low power nonlicensed devices. For those systems so designated, the Center Spectrum Manager will be required to coordinate with the NASA SPS representative throughout the review process.

3.3.4.4 Details of the systems review procedure can be found in Appendix F.

3.4 U.S. Coordination Requirements

3.4.1 NASA Components as Tenants at Other Government Agencies

The Centers having joint tenant status at other Government agencies will coordinate frequency requirements with the host Government agency as required. Applications are then forwarded to the NASA National Spectrum Program Manager reflecting the recommendations of the host Agency under whose jurisdiction the operation is proposed.

3.4.2 Joint Radio Frequency Coordination for National Test Ranges

3.4.2.1 The Department of Defense (DOD) has established a system of military interservice frequency coordination to minimize interference and to avoid conflict with or among radio and electronic operations at the DOD National Test Ranges. This system requires that certain frequencies must be coordinated with DOD Area Frequency Coordinators (AFC) prior to the issuance of assignments. In the interest of economy and compatibility of operations, this system of coordination is used by NASA, in accordance with the joint DOD-NASA Agreement of July 28, 1980.

3.4.2.2 The areas in which Military Interservice Frequency Coordination is required are shown in Figure 3-3 and further defined in Table 3-1. Table 3-1 also lists the DOD AFC responsible for coordination within each area.

3.4.2.3 DOD AFC maintain current records of frequencies that have been coordinated with them for use in their area of cognizance. Upon request for frequency coordination, they supply technical comments on the probability of harmful interference being caused

or received by the proposed operations.

3.4.2.4 All frequencies intended for use within the National Test Ranges (or within those areas delineated in Table 3-1) which are considered capable of causing harmful interference to operations at the specified test ranges, including any extended established "down-range" areas, are coordinated with the responsible DOD AFC. Area frequency coordination is accomplished by the Spectrum Manager of the NASA Center in accordance with the following procedures:

Step 1: When NASA operations require DOD range support and are to be conducted at sites under military cognizance, select the use of the frequencies required in coordination with the AFC of the range concerned. In the case of those military test facilities where there is no resident AFC, coordinate NASA frequency usage with the local Military Frequency Manager who will, in turn, effect the necessary coordination with the cognizant AFC.

Step 2: If the frequencies required are already assigned for use at the range concerned, the AFC (or local Military Frequency Manager) will effect local authorization and interference protection as necessary. When the frequencies required are not assigned to the range, the AFC will request assignment from the military department having cognizance of that range.

Step 3: Where NASA operations are to be conducted at sites not under military cognizance, but within the area defined in Table 3-1, coordinate the use with the AFC of the range concerned by providing system/emission characteristics for this purpose. The AFC will comment with due regard to all military frequency usage within the area involved.

Step 4: Forward system/emission characteristics in accordance with chapter 9 of the NTIA Manual to NASA GRC for coordination with other users and IRAC, as appropriate. Include a memorandum stating that coordination has been effected with the AFC involved. The National Spectrum Program Manager will apply for the assignments to cover these operations.

Step 5: Should a frequency conflict arise between DOD AFC and NASA Center Spectrum Managers that cannot be resolved satisfactorily through measures acceptable to the Center involved, forward a complete and detailed report to the National Spectrum Program Manager who will attempt to resolve the conflict at the national level.

Figure 3-3 Geographic Locations of National Ranges and National Radio Quiet Zone

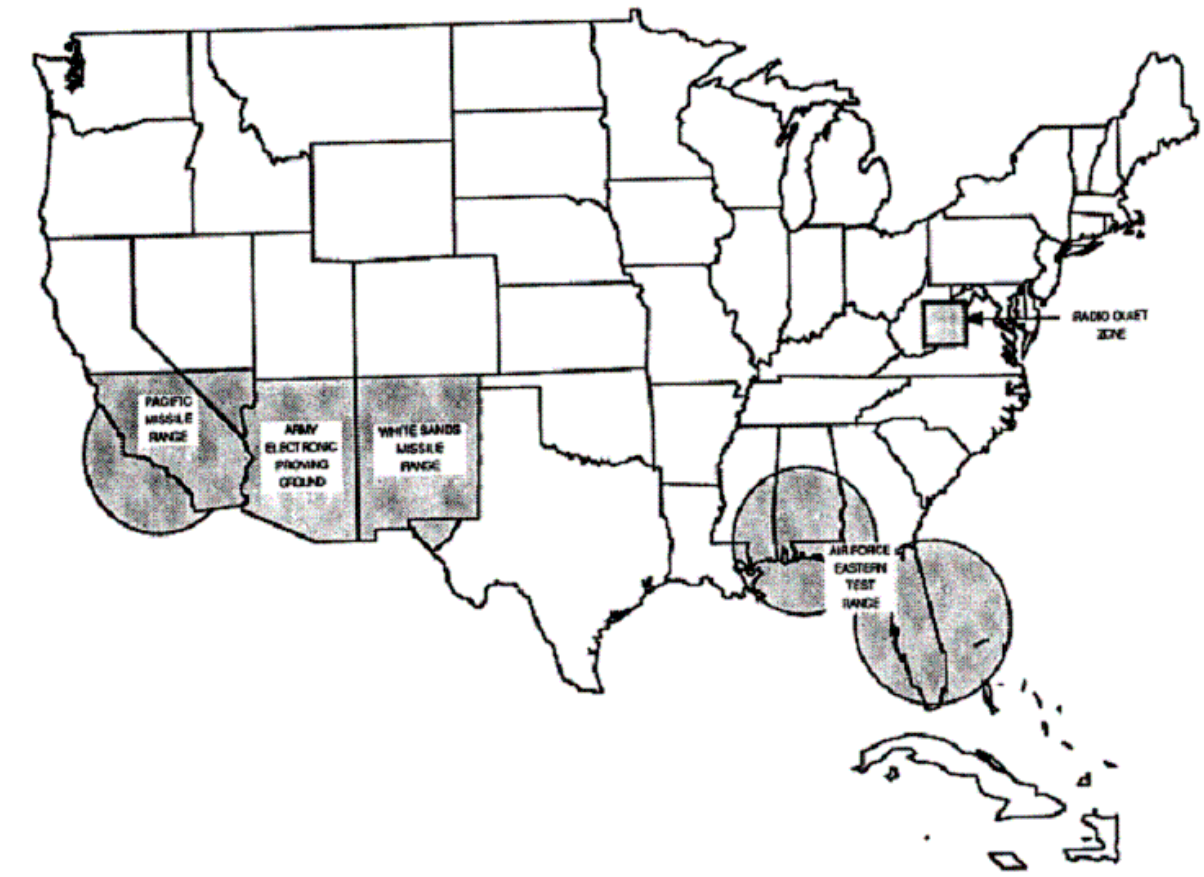


Table 3-1. Coordination Areas for National Test Ranges

Area	Responsibility
The entire State of Florida including Key West Area, as well as the area enclosed within a 200 mile radius of the Headquarters Building, Patrick Air Force Base, Florida; and the area enclosed within a 200-mile radius of Eglin Air Force Base, Florida.	Area Frequency Coordinator, Air Force Eastern Range (ER) Patrick Air Force Base, Florida.
The entire State of Arizona.	Area Frequency Coordinator, U.S. Army Electronic Proving Ground, Fort Huachuca, Arizona
The entire State of New Mexico and other U.S. Territories within a 150-mile radius of the Headquarters Building, White Sands Missile Range, Las Cruces, New Mexico.	Area Frequency Coordinator, White Sands Missile Range, Las Cruces, New Mexico.
The area enclosed within a 200-mile radius of the Headquarters Building, Pacific Missile Range, Point Mugu, California, plus the areas of Nevada and California that lie south of latitude 37° 30'N. This Area Frequency Coordinator will provide frequency coordination for the Naval Weapons Center, China Lake, California; and Edwards Air Force Base, California.	Area Frequency Coordinator, Pacific Missile Range, Point Mugu, California.

3.4.3 Coordination Procedures for the National Radio Quiet Zone (NRQZ)

3.4.3.1 The NRQZ is an area approximately 100 miles square set aside for radioastronomy observations. This area is bounded by 39°15'N on the North, 78°30'W on the East, 37°30'N on the South and 80°30'W on the West (Figure 3-3).

3.4.3.2 To protect the NRQZ from interference, the following criteria have been established for the maximum field strength limits:

a. 50 MHz to 1 GHz Less than 0.1 microvolt per meter

b. 1 GHz to 10 GHz Less than 1.0 microvolt per meter

c. 10 GHz to 100 GHz Less than 10.0 microvolts per meter

(Measured at 38°31' 16" N, 79°16' 36" W at 2,292 feet above mean sea level.)

3.4.3.3 All proposed frequency assignments to NASA radio stations within the NRQZ must be coordinated per the NTIA Manual Part 8.3.9, prior to authorization.

3.4.4 Coordination Procedures with the Aerospace and Flight Test Radio Coordinating Council (AFTRCC)

3.4.4.1 Coordination procedures are applicable for all frequency assignment actions for use of frequencies in the bands 1435-1535 MHz and 2310-2390[1] MHz by U.S. Government radio stations within the conterminous United States, and are implemented to minimize, through local selection of frequencies and effective coordination, the possibility of interference.

3.4.4.2 All frequency applications (proposed and renewal) for NASA radio stations must be accompanied by an AFTRCC concurrence letter submitted in accordance with the NTIA Manual Chapter 8.3.17 and Annex D of the NTIA Manual.

3.5 NASA Contractors (NASA FAR Supplement, Subpart 1823.71 and Section 1852.223-71)

3.5.1 Center Spectrum Manager

3.5.1.1The Center Spectrum Manager shall request the contracting officer to insert the clause from NASA FAR Supplement Section 1852.223-71, Frequency Authorization, in any contract which calls for the development, construction, or operation of a device for which an RFA is required.

3.5.1.2The Center Spectrum Manager shall provide to the contracting officer such technical assistance as may be required to enable the issuance of a radio frequency assignment.

3.5.2 NASA Contracting Officers

Commercial contractors, providing or operating RF equipment for NASA use, shall obtain RF spectrum authorization in accordance with the terms of the contract, through the NASA Contracting Officer.

3.6 Foreign Frequency Assignments

Foreign frequency assignments shall be obtained by the Senior NASA Official available at, or convenient to, the site of operations. Reports of all such actions will be made to the AA for OSF, National Aeronautics and Space Administration, Washington, DC 20546.

3.7 Conditions of Assignment

3.7.1 All Center activities will be assigned frequencies by NTIA through the National Spectrum Program Manager and will reflect full particulars of the assignment. The National Spectrum Program Manager will forward these assignments, using NTIA supplied RFA forms, to the appropriate Center Spectrum Manager upon completion of the frequency coordination process. Based on this authorization, Center Spectrum Managers may issue Center RFA's.

3.7.2 Annually, the National Spectrum Program Manager will provide, upon request, each Center Spectrum Manager with a current list of all NASA frequency assignments that have been approved by NTIA. Additionally, a copy of the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management will also be supplied to all Spectrum Managers. Supplements to the NTIA Manual will be furnished by GRC Spectrum Management Office, when published by NTIA.

3.7.3 All NASA frequency assignments are issued subject to the following conditions:

a. All frequencies assigned to NASA are issued subject to the conditions stated on the authorization.

b. Radio transmitters must be operated by adequately trained and designated personnel, and in a manner conforming to established and accepted procedures.

c. Transmitter operations must be conducted only on authorized frequencies.

d. Approved power, emissions, and conditions of assignments must be adhered to at all times.

e. All land mobile radio transmissions must be identified by the use of the authorized radio call signs, pursuant to Appendix H of this NPG.

f. Transmitter operations must be held within the prescribed tolerances outlined in chapter 5 of the NTIA Manual, unless otherwise authorized.

g. A copy of the current RFA for each fixed radio station should be posted or retained in some manner at the principal control point of each station.

h. An RF evaluation should be conducted to determine the effects on human health, including interference with personnel operations such as maintenance procedures. Evaluations must be handled at a local level and must be coordinated with the Center Spectrum Manager. Local procedures will vary at each site and as a minimum, follow ANSI C95.1, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields."

i. Chapter 7 paragraph 11 of the NTIA Manual outlines conditions under which specific frequency usage may be authorized without prior coordination with other Government agencies. The Center Spectrum Managers may issue local RFA's without referral to the National Spectrum Program Manager, to cover those operations that meet the criteria established in this chapter of the NTIA Manual for the particular frequency usage involved.

3.8 Emergency and Wartime Procedures

3.8.1 Emergency Procedures

3.8.1.1 Under a declared emergency condition, Center Spectrum Managers may use or assign to an operation under their direction, frequencies not otherwise authorized, provided that:

3.8.1.2 The nature and duration of the requirement is such that the normal frequency assignment procedures are impractical.

3.8.1.3 All reasonable measures are taken before such frequencies are used to ensure that harmful interference will not be caused to other users.

3.8.2 Wartime Procedures

3.8.2.1 In wartime, all radio frequencies, both Government and non-Government, will be under the centralized authority of NTIA. Normally, under such conditions, military operations will take precedence over nonmilitary operation. However, all priorities established by NTIA take into account all aspects of the President's communications requirements for the national defense in time of war.

3.8.2.2 NASA's role in providing support for these wartime procedures is established through NTIA by the Agency's Spectrum Policy and Planning Director, and will be implemented as required. The specific procedures are beyond the scope or intent of this NPG.

The bands 2305-2320 MHz and 2345-2360 MHz are allocated as Primary for Wireless Communication Services. The bands 2320-2345 MHz are allocated as Primary for Digital Audio Services via satellite and terrestrial means. Use of the whole band 2310-2390 MHz currently is allocated to Aeronautical Telemetry Service on a primary basis until the Wireless Communication Service and Digital Audio Radio begin service.

Chapter 4: Radio Frequency Interference Procedures

4.1 Radio Frequency Interference Reporting Procedures

4.1.1 The probability of harmful RFI increases as more and more demands for frequency assignments are placed in the RF spectrum. In an attempt to meet these demands and to optimize the use of the spectrum, the space between channels is minimized within the limitations imposed by the state-of-the-art development of electronic equipment. The same frequencies are often shared by users separated geographically, or the same frequencies may be assigned to two or more users on a time-share basis. Because of this, some interference can be expected (and even tolerated) since, ordinarily, clear channels are not available within the overcrowded RF spectrum.

4.1.2 Occurrences of interference are to be investigated initially at the lowest possible echelon of NASA spectrum management. Reports of harmful interference or jamming of NASA emitters should be distributed as follows:

a. At the impacted Center:

(1) Office of Safety and Mission Assurance

(2) Occupational Health Office

(3) Local Security Office

b. At NASA Headquarters:

(1) Office of Security Management and Safeguards (Code X)

(2) Office of Inspector General (Code W)

4.1.3 Consideration should also be given to including intentional interference as an information technology security incident, which needs to be reported to the NASA Incident Response Center (NASIRC) and the OIG Computer Crimes unit. Requests for the assignment of replacement frequencies will be made only if the interference is prolonged and disruptive and cannot be cleared through normal procedures.

4.2 RFI Control Procedures

4.2.1 Radio Frequency Users

4.2.1.1 Normally, the NASA frequency user will be the first to become aware of RFI, and a judgment must be made of how the observed RFI affects their operation.

4.2.1.2 If the interference is such that it cannot be tolerated, proceed in the following manner:

Step 1: Thoroughly check the affected equipment to ensure that the equipment is operating properly and the RFI is not being generated internally or on the site.

Step 2: If possible, identify by call sign (or other identification) the station causing the interference.

Step 3: Measure the frequency or band of frequencies causing the interference.

Step 4: If possible, determine the type of emission and the type of traffic being transmitted.

Step 5: If possible, measure the bandwidth of the interfering signal (highest and lowest frequencies) and note the type of equipment used for measurement.

Step 6: Measure the interference signal strength.

Step 7: Determine the nature or severity of the interference. Indicate the impact to operations including the severity of data loss or data degradation due to the interference.

Step 8: After the information in Steps 2 through 7 have been obtained, report this data to the Center Spectrum Manager together with a formal request to clear the interference.

Step 9: Supply the Center Spectrum Manager with any additional information that is necessary or may be useful in identifying and clearing the RFI (e.g., tape recordings or spectrum photographs).

4.2.2 Center Spectrum Managers

4.2.2.1 The Center Spectrum Manager will make every effort to clear the interference at the Center before requesting assistance from the National Spectrum Program Manager.

4.2.2.2 Follow the appropriate procedures listed below to clear cases of interference to Agency operations:

Step 1: Check the information supplied by the frequency user to ensure that it is as complete as possible. Request additional information from the user as required for filing the standard RFI report (See Step 6).

Step 2: If the station can be identified, contact the interfering station directly, and attempt to clear the interference through coordination with the station manager. If the interference originates from a foreign (non-U.S.) source, contact the National Spectrum Program Manager for further assistance (see paragraph 4.2 e (2) and (3)).

Step 3: If direct contact with the interfering station is unsuccessful and the interference appears to be from a non-Government station, request assistance from the nearest FCC monitoring station as required, to coordinate efforts to clear the interference.

Step 4: If the interference is encountered on or from a DOD Test Range, report the RFI to the Area Frequency Coordinator (see Table 3-1) in accordance with appropriate range communications instructions.

Step 5: If all attempts to clear the interference through local coordination fail, report the RFI

to the National Spectrum Program Manager in accordance with Steps 6 and 7 below.

Step 6: Forward a message directly to the National Spectrum Program Manager. Use the standard RFI reporting format shown in Figure 4-1 for listing the particulars of the interference.

Figure 4-1 Standard RFI Reporting Format

Report of Harmful Interference

Particulars Concerning the Station Causing the Interference:

A. Name or call sign and category of state.....

B. Frequency measured.....

C. Class of emission.....

D. Bandwidth.....

E. Field strength.....

F. Nature of interference.....

Particulars Concerning the Transmitting Station Interfered with:

G. Name or call sign and category of station.....

H. Frequency assigned.....

I. Frequency measured.....

J. Class of emission.....

K. Bandwidth.....

L. Field strength.....

Particulars Furnished by the Receiving Station Experiencing the Interference:

M. Name of station.....

N. Geographic location of station.....

O. Dates and times of occurrence of harmful interference.....

P. Other particulars.....

Q. Requested action.....

Note: For convenience and brevity, prepare reports in the format above, using the letters in

the order listed in place of the explanatory titles, and place an "X" after any such letter if no information on that particular item is reported.

Step 7: When practicable, forward a followup letter to the National Spectrum Program Manager. Reference the message by number, date, and time, and include the same information as the message together with a detailed report of local action taken to eliminate the interference.

4.2.2.3 The Center Spectrum Manager should cooperate fully with non-NASA spectrum users in resolving RFI that may be caused by emissions from within the local Center.

4.2.3 National Spectrum Program Manager

4.2.3.1 When an RFI problem cannot be resolved at the Center, the National Spectrum Program Manager must attempt to clear the interference through direct coordination with other Agencies, if the problem is a national one, or indirectly with the assistance of the FCC or the NTIA, if the problem is either international or the result of a non-Government system.

4.2.3.2 Follow the steps below as they apply to the particular situation:

Step 1: If the RFI is caused by a non-Government station operating in the United States and its Possessions, notify the FCC directly, and provide such information and assistance required to enable the FCC to clear the interference.

Step 2: If the RFI is caused by a station operated by another agency or department of the U.S. Government, refer the matter to the Interdepartment Radio Advisory Committee (IRAC), including a full report of the interference and a request for action or assistance, as required.

Step 3: If the RFI is caused by a station of another nation operating outside the United States and its Possessions, refer the matter to IRAC or to NTIA as appropriate. NTIA or the FCC will assume the coordination necessary to resolve the problem at the International level through the ITU, if required.

4.2.3.3 The National Spectrum Program Manager should cooperate fully with non-NASA spectrum users in resolving RFI that may be caused by emissions from within the local Center.

4.2.4 STS RFI Management

Procedures for RFI Management for the Space Transportation System (STS) are defined in NASA Publication 530-RFIMM/Space Shuttle, dated April 1994, and titled Space Shuttle Program Radio Frequency Interference Management Manual.[1]

4.2.5 Interference From Foreign (Non-U.S.) Sources

4.2.5.1 All other NASA flight projects shall follow the procedures for the management of RFI situations, outlined earlier in this paragraph, except when the interference is believed to originate from a foreign (non-U.S.) source.

4.2.5.2 In the case of interference from a foreign (non-U.S.) source, the National Spectrum Program Manager shall use the information supplied in the standard RFI report to apprise

appropriate spectrum administration offices (e.g., NTIA, FCC, U.S. Department of State) of the interference, its nature, source, and the need for cessation.

4.2.5.3 In the case where interference from a foreign (non-U.S.) source is jeopardizing the return of unique scientific data or the survival of a spacecraft (e.g., spacecraft emergency), the Agency Spectrum Program Manager shall contact appropriate Space Frequency Coordination Group (SFCG) members to try to secure cessation of the interfering transmission. This action is to be followed up with a formal report to the appropriate spectrum administration office (e.g., NTIA, FCC or U.S. Department of State).

4.2.6 NASA/ESA/NASDA RFI Coordination Procedures

Coordination of spectrum use between NASA, the European Space Agency (ESA) and the National Space Development Agency of Japan (NASDA) shall conform to the procedures outlined in the appropriate coordination manual.

4.2.7 Space Frequency Coordination Group (SFCG)

4.2.7.1 The SFCG was established to provide a less formal and more flexible environment, as compared with the formal structure of the International Telecommunication Union (ITU), for the solution of frequency management problems encountered by member space agencies. The Terms of Reference for SFCG are given in Appendix I.

4.2.7.2 The SFCG is concerned with the effective use and management of those radio frequency bands as allocated in the ITU RR for radio services within the scope of Radiocommunication Sector Study Group 7. In particular, the services of interest to the SFCG include space research, Earth-exploration satellites, meteorological satellites, space operations, data relay satellites, and radio astronomy (including radar astronomy) to the extent that they are relevant to spacecraft missions. Within the formal framework of the Radio Regulations, there is the need and opportunity for international informal agreement among participating space agencies concerning assignment of specific frequencies and related technical issues.

4.2.7.3 The principal result of SFCG meetings is the adoption of resolutions and recommendations that express technical and administrative agreements. These agreements may be used by space agencies to make best use of allocated bands and to avoid interference.

4.2.8 ISS Radio Frequency Coordination

Procedures for radio frequency coordination for the International Space Station (ISS) are defined in NASA publication SSP 50423, ISS Radio Frequency Coordination Manual.

[1] This document is available on the GSFC Web site: http://csoc-ddcs.csoconline.com/library/
http://csoc-ddcs.csoconline.com/library/project/sshuttle.asp .

Chapter 5: NASA Long-Range Spectrum Planning

5.1 Background

5.1.1 The NASA Spectrum Policy and Planning Director (NASA HQ/OSF) is responsible for the planning of long-term national and international spectrum management initiatives aimed at improving the spectrum management environment within which the Agency must operate. The Agency Spectrum Program Manager is responsible for implementation of these initiatives. For instance, in cases where new frequency allocations or changes to the national and international radio regulations are required, lead times of more than a decade may be necessary since periodic ITU conferences that are competent to make such changes are usually limited in scope. For this reason, and to permit the Agency to continue to operate in compliance with section 1.2 of this NPG, the Agency Spectrum Program Manager must be aware of new concepts, which may require spectrum support with sufficient time available to accomplish changes.

5.1.2 Considering typical design and construction periods, it is essential that appropriate spectrum be allocated a minimum of 5 years prior to anticipated launch dates for all Agency missions. Since new allocations may take as much as 10 years to realize, it is essential that the Agency Spectrum Program Manager be informed of new mission concepts as early as possible so that appropriate allocation initiatives may be identified.

5.2 Long-Range Planning

5.2.1 General

In light of potential long lead time requirements for some new mission concepts, the Spectrum Policy and Planning Director maintains a long-range spectrum forecast in order to identify needed spectrum management initiatives in a timely manner. All dates are driven, primarily, by the anticipated agendas of World Radiocommunications Conferences (WRCs) and projected launch dates of particular missions. NASA expects that many mission RF spectrum needs will be satisfied by existing allocations. However, for some missions, changes in international and national regulations may be required to support new and entirely unique operations in the future (such as operations on or in the vicinity of the far side of the moon or for radio links between a transatmospheric vehicle and the Earth). To this end, the long-range spectrum forecast attempts to identify dates at which consideration of these matters needs to be completed if NASA is to operate in an interference-free environment.

5.2.2 Enterprise Office Responsibilities

5.2.2.1 For future Agency missions, it is the responsibility of each NASA Enterprise Office through the FMLG to provide the latest conceptual communications requirements to the Agency Spectrum Program Manager in respect of programs and future mission concepts over which they may have cognizance. This information should be provided from the inception of the conceptual mission and updated as the program evolves.

5.2.2.2 The Agency Spectrum Program Manager will provide an assessment of the spectrum

requirements in consultation with the concerned program office with sufficient lead-time to allow appropriate regulatory action.

5.2.2.3 Each Headquarters Enterprise Office should provide updated mission concepts and new anticipated launch dates to the Agency Spectrum Program Manager via direct consultation or via the FMLG.

5.2.3 Center Responsibilities

5.2.3.1 For future Agency missions, it is the responsibility of each Center Spectrum Manager to provide the latest conceptual communications requirements to NASA GRC Spectrum Management Office, with respect to projects and future mission concepts over which the Center may have cognizance. This information should be provided from the inception of the conceptual mission and updated as the project evolves.

5.2.3.2 The Agency Spectrum Program Manager will provide an assessment of the spectrum requirements in consultation with the Center with sufficient lead time to permit appropriate regulatory action.

5.2.3.3 Each Center should provide updated mission concepts and new anticipated launch dates to the Agency Spectrum Program Manager via direct consultation or via the NASA Spectrum Managers Group annual meeting.

5.3 Support Program

5.3.1 The NASA Support Program effort was established to provide a mechanism whereby NASA could provide the necessary capability and expertise to help select required new spectrum, protect existing spectrum from encroachment by outside parties, and other related activities. The Terms of Reference is given in Appendix J.

5.3.2 The Support Program is concerned with the preservation of the spectrum that NASA currently uses to perform its critical mission. In particular, the services of interest to the Support Program effort are all those frequency bands that NASA uses to support its domestic and foreign programs.

5.3.3 The Support Program is also concerned about emerging NASA requirements for spectrum. As systems become more complex, there is a growing requirement for new spectrum to meet the mission needs. An example is the growing aerospace telemetry and video requirements.

Appendix A: Glossary of Commonly Used Terms Applicable to NASA RF Spectrum Management

A.1 General Terms

Experimental Station: A station utilizing radio waves in experiments with a view to the development of science or technique. This definition does not include amateur stations.

Facsimile: A system of telecommunication for the transmission of fixed images, with or without half-tones, with a view to their reproduction in a permanent form.

Frequency Allotment: Entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specific conditions.

Frequency Allocation: Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more (terrestrial or space) radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned.

Frequency Assignment: Authorization given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions.

Frequency Coordination: Procedures established to provide portions of the RF spectrum or specific frequencies to two or more users that best accommodate the services required by each.

Frequency Management (RF Spectrum Management): The control of radio frequency interference through the processes of frequency allocation and assignment, monitoring of equipment research and development, frequency records administration, engineering analysis, and international negotiations.

Frequency Support (Spectrum Support): The availability of authorized frequencies or portions of the RF spectrum to accommodate the operational requirements of particular electronic equipment.

Frequency-Shift Telegraphy: Telegraphy by frequency modulation in which the telegraph signal shifts the frequency of the carrier between predetermined values. There is phase continuity during the shift from one frequency to the other.

Harmful Interference: RF interference that endangers the functioning of a radio navigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radio communications service.

Noninterference Basis: Use of radio frequencies not in accordance with all applicable RR shall not cause harmful interference to, or claim protection from stations of, other services operating in accordance with the RR.

Radioastronomy: Astronomy based on the reception of RF waves of a cosmic origin.

Radio Waves: Electromagnetic waves of frequencies lower than 3000 GHz, propagated in space without artificial guides.

Radiocommunication: Telecommunication by means of radio signals.

Radiosonde: An automatic radio transmitter in the meteorological aids service usually carried on an aircraft, free balloon, kite or parachute, and which transmits meteorological data.

Radiotelemetering: Telemetering by means of radio signals.

Telecommunication: Any transmission, emission or reception of signs, signals, writing, images and sound or intelligence of any nature by wire, radio, visual or other systems.

Telegraphy: A system of telecommunication which is concerned in any process providing transmission and reproduction at a distance of documentary matter, such as written or printed matter or fixed images, or the reproduction at a distance of any kind of information in such a form.

Telemetering: The use of telecommunication for automatically indicating or recording measurements at a distance from the measuring instrument.

Telephony: A system of telecommunication set up for the transmission of speech or, in some cases, other sounds.

Television: A system of telecommunication for the transmission of transient images of fixed or moving objects.

Terrestrial Service: Any radio service other than a space service or the radioastronomy service.

Tropospheric Scatter: The propagation of radio waves by scattering as a result of irregularities or discontinuities in the physical properties of the troposphere.

A.2 Space Systems, Services, and Stations

Active Satellite: An Earth satellite carrying a station intended to transmit or retransmit radio signals either for communications or remote sensing purposes.

Active Sensing: The measurement on board a spacecraft of signals transmitted by the sensor and then reflected, refracted, or scattered by the Earth's or another planet's surface or its atmosphere.

Broadcasting-Satellite Service: A space service in which signals transmitted or re-transmitted by space stations, or transmitted by reflection from objects in orbit around the Earth, are intended for direct reception by the general public.

Earth Station: A station in the space service located either on the Earth's surface, including on board a ship, or on board an aircraft.

Earth Exploration Satellite Service: A radiocommunication service between Earth stations and one or more space stations, which may include links between space stations, 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 active sensors or passive sensors on Earth stations;
- Similar information is collected from airborne or Earth-based platforms;
- Such information may be distributed to Earth stations within the system concerned; and
- Platform interrogation may be included.

This service may also include feeder links necessary for its operations.

Fixed and Mobile Satellite Service: A space service (1) between Earth stations, when using active or passive satellites for the exchange of communications of the fixed or mobile service, or (2) between an Earth station and stations on active satellites for the exchange of communications of the mobile service, with a view to their retransmission to or from stations in the mobile service.

Fixed-Satellite Service: A radiocommunication service between Earth stations at specified fixed points when one or more satellites are used; in some cases this service includes satellite-to-satellite links, which may also be effected in the intersatellite service; the fixed-satellite service may also include feeder links for other space radiocommunication services.

Geostationary Satellite: A satellite, the circular orbit of which lies in the plane of the Earth's equator and which turns about the polar axis of the Earth in the same direction and with the same period as those of the Earth's rotation.

Maintenance Space Telemetering: Space telemetering relating exclusively to the electrical and mechanical condition of a spacecraft and its equipment together with the condition of the environment of the spacecraft.

Mobile Satellite Service: A radiocommunication service between mobile Earth stations and one or more space stations, or between space stations used by this service; or between mobile Earth stations by means of one or more space stations.

Passive Satellite: An Earth satellite which does not require a transmitter, such as one which reflects radiocommunications signals or observes emission from the Earth's or another planet's surface and constituents of its atmosphere.

Passive Sensing: The measurement on board of a spacecraft of the natural electromagnetic energy emitted and scattered by the Earth or another planet and constituents of its atmosphere.

Remote Semsing: The observation of the Earth and its atmosphere using active or passive sensing.

Satellite System: A space system using one or more artificial Earth satellites.

Space Research Service: A space service in which spacecraft or other objects in space are used for scientific or technological research purposes.

Space Service: A radiocommunication service (1) between Earth stations and space stations or (2) between space stations or (3) between Earth stations when the signals are retransmitted by space stations, or transmitted by reflection from objects in space, excluding reflection or scattering by the ionosphere or within the Earth's atmosphere.

Space Station: A station in the space service located on an object, which is beyond, is intended to go beyond, or has been beyond, the major portion of the Earth's atmosphere.

Space System: Any group of cooperating Earth and space stations providing a given space service and which, in certain cases, may use objects in space for the reflection of the radiocommunication signals.

Space Telecommand: The use of radiocommunication for the transmission of signals to a space station to initiate, modify, or terminate functions of the equipment on a space object, including the space station.

Space Telemetering: The use of telemetering for the transmission from a space station of results of measurements made in a spacecraft, including those relating to the functioning of the spacecraft.

Space Tracking: Determination of the orbit, velocity, or instantaneous position of an object in space by means of radiodetermination, excluding primary radar, for the purpose of following the movement of the object.

Spacecraft: Any type of space vehicle, including an Earth satellite or a deep-space probe, whether human-tended or robotic.

A.3 Space and Orbits of Spacecraft

Apogee: Altitude above the surface of the Earth of the point on a closed orbit where a satellite is at its maximum distance from the center of the Earth.

Deep Space: Space at distances from the Earth equal to or greater than 2×10^6 km.

Geosynchronous: A location in space where a satellite's period of revolution is equal to the period of rotation of the Earth about its axis.

Geostationary: A location in space where a satellite's circular and direct orbit lies in the plane of the Earth's equator and which thus remains fixed relative to the Earth. {This is a special case of geosynchronous where the orbit inclination is 0°.}

Inclination: The acute angle between the plane containing an orbit and the plane of the Earth's equator.

Nongeostationary: A location in space here a satellite's orbit is not necessarily in the plane of the Earth's equator and has a period of revolution other than 24 hours.

Orbit: The path in space described by the center of mass of a satellite or other object in space.

Perigee: Altitude above the surface of the Earth of the point on a closed orbit where a satellite is at its minimum distance from the center of the Earth.

Period: The time elapsing between two consecutive passages of an object in space through the same point on its closed orbit.

Sun-Synchronous: A orbit in which the angle between the Sun-Earth vector and the intersection of the plane of a satellite's orbit and the Earth's equator is a constant and does not change with the season.

A.4 Technical Characteristics

Assigned Frequency Band: The frequency band, the center of which coincides with the frequency assigned to the station and the width of which equals the necessary bandwidths plus twice the absolute value of the frequency tolerance.

Assigned Frequency: The center of the frequency band assigned to a station.

Carrier Power of a Radio Transmitter: The average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle under conditions of no modulation. This definition does not apply to pulse-modulated emissions.

Equivalent Isotropically Radiated Power: The equivalent isotropically radiated power of an emission is the product of the power supplied to the antenna for this emission and the antenna gain relative to

an isotropic antenna.

Frequency Tolerance: The maximum permissible departure by the center frequency of the frequency band occupied by an emission from the assigned frequency or, by the characteristic frequency of an emission from the reference frequency. The frequency tolerance is expressed in parts per million (ppm), or in percentage, or in Hz, kHz, or MHz, as applicable.

Gain on an Antenna: The ratio of the power required at the input of a reference antenna to the power supplied to the input of the given antenna to produce, in a given direction, the same field at the same distance. When not specified otherwise, the figure expressing the gain of an antenna refers to the gain in the direction of the radiation main lobe.

Harmful Interference: Any emission, radiation, or induction which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service operating in accordance with ITU RR.

Isotropic or Absolute Gain of an Antenna: The gain of an antenna in a given direction when the reference antenna is an isotropic antenna isolated in space.

Mean Power of a Radio Transmitter: The power supplied to the antenna transmission line by a transmitter during normal operation, averaged over a time sufficiently long compared with the period of the lowest frequency encountered in the modulation. A time of 1/10 second during which the mean power is greatest will be selected normally.

Necessary Bandwidth: For a given class of emission, the minimum value of the occupied bandwidth sufficient to ensure the transmission of information at the rate and with the quality required for the system employed, under specific conditions. Emissions useful for the good functioning of the receiving equipment as, for example, the emission corresponding to the carrier of reduced carrier systems, are included in the necessary bandwidth.

Peak Envelope Power of a Radio Transmitter: The average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle at the highest crest of the modulation envelope, taken under conditions of normal operation.

Relative Gain of an Antenna: The gain of an antenna in a given direction with reference to an antenna which is a half-wave, loss-free dipole isolated in space, and in the equatorial plane of which contains the given direction.

Appendix B: International Spectrum Management

Structure

The International Telecommunication Union (ITU) is recognized by the United States as the Agency for international telecommunications policy and regulations. Figure B-1 presents the ITU structure with its components as approved at the Additional Plenipotentiary Conference, Geneva 1992.

The structure of the Union comprises:

The Plenipotentiary Conference, which is the supreme organ of the Union;

The Council, which acts on behalf of the Plenipotentiary Conference;

World conferences on international telecommunications;

The Radiocommunication Sector, including world and regional radiocommunication conferences, radiocommunication assemblies, and the Radio Regulations Board;

The Telecommunications Standardization Sector, including World Telecommunications Standardization Conferences;

The Telecommunication Development Sector, including world and regional telecommunication development conferences; and

The General Secretariat.

The authority of the ITU is derived from its member nations and is contained in the Constitution and Convention of the ITU and is further complemented by the Administrative Regulations which are the International Telecommunication Regulations, and the RR, each of which holds treaty status.

B.1 Plenipotentiary Conference

The Plenipotentiary Conference meets every 4 years to determine the operational framework of the Union including:

Elect the Secretary-General and the Deputy Secretary-General;

Elect the ITU Council Members (43);

Elect the Directors of the Bureaus of the Sectors and the Radio Regulations Board Members;

Authorize any World or Regional Radiocommunications Conferences;

Approve any changes to the ITU Constitution or ITU Convention;

Determine the budget for the Union.

B.2 Administrative Council

The Council meets annually and is comprised of 43 members elected by the Plenipotentiary to serve until the next Plenipotentiary. The functions served by the ITU Council are:

To establish agendum and actual dates for upcoming conferences, and

To manage Union resources between Plenipotentiary meetings.

B.3 Radiocommunication Sector

The functions of the Radiocommunication Sector are to fulfill the purposes of the Union relating to radiocommunications:

By ensuring the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, and

By carrying out studies without limit of frequency range and adopting recommendations on radiocommunication matters.

The Radiocommunication Sector works through:

World and regional radiocommunication conferences;

The Radio Regulations Board;

Radiocommunication assemblies, which are associated with world radiocommunication conferences held once every 2-3 years;

Radiocommunication study groups and their associated working parties and task groups; and

The Radiocommunication Bureau, headed by the elected Director.

B.4 Telecommunications Standardization Sector

The functions of the Telecommunications Standardization Sector shall be to fulfill the purposes of the Union relating to telecommunication standardization:

By studying technical, operating and tariff questions; and

Adopting recommendations with a view to standardizing telecommunications on a worldwide basis.

The Telecommunications Standardization Sector works through:

World telecommunication standardization conferences;

Telecommunication standardization study groups; and

The Telecommunication Standardization Bureau headed by the elected Director.

B.5 Telecommunications Development Sector

The functions of the Telecommunications Development Sector shall be to fulfill the purposes of the Union relating to telecommunication development:

By promoting and offering technical assistance to countries in the field of telecommunications;

By promoting the mobilization of the material and financial resources needed for implementation; and

By promoting the extension of the benefits of the new telecommunication technologies to all the world's inhabitants.

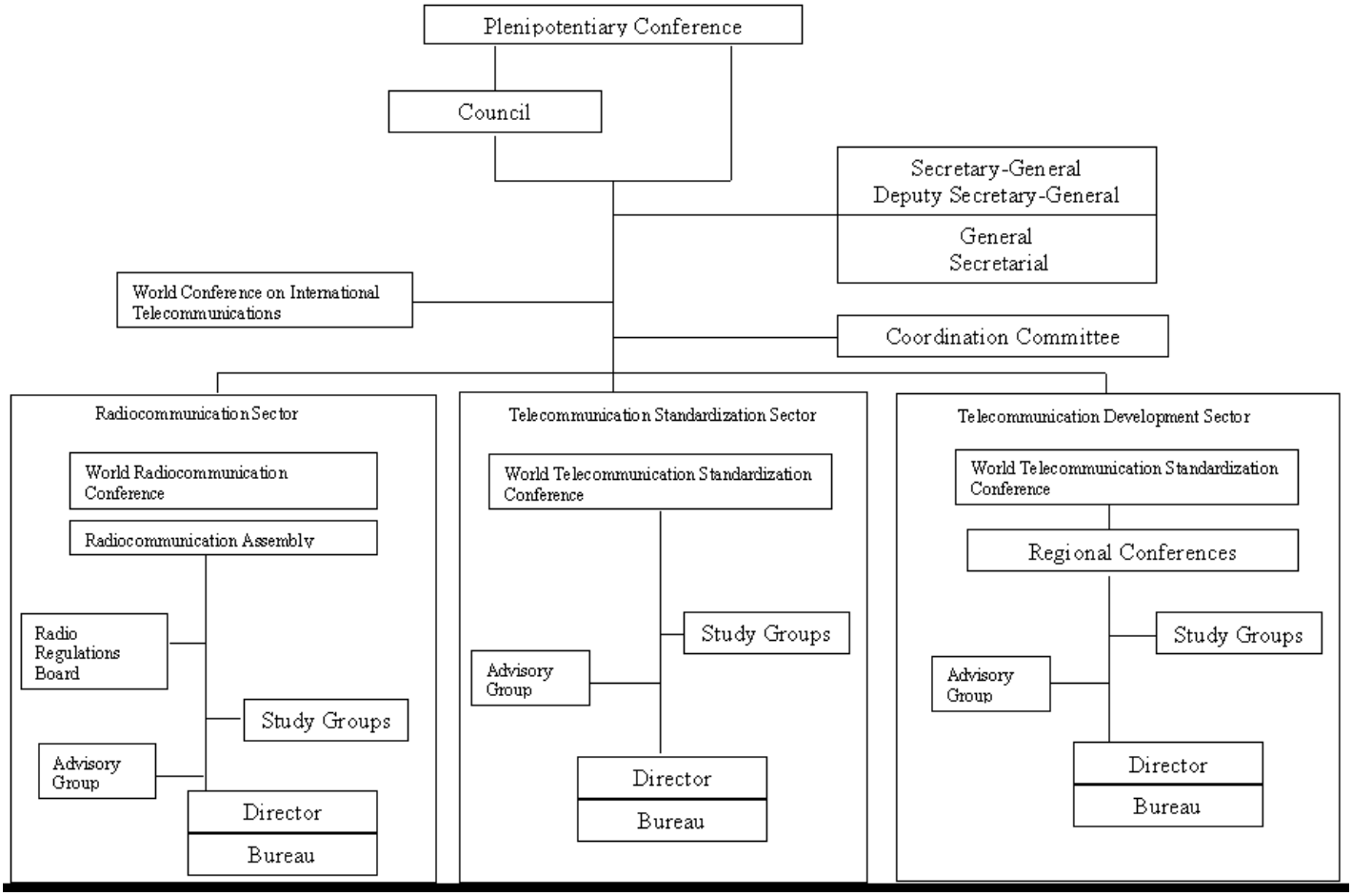
B.6 Radiocommunication Study Groups

The study groups of the Radiocommunication Sector are responsible for specific areas of technical interest as follows:

Study Group	Name of Group
1	Spectrum Management
3	Radiowave Propagation
4	Fixed-Satellite Service
6	Broadcasting Service (terrestrial and satellite)
7	Science Services
8	Mobile, Radiodetermination, and Amateur and Related Satellite Services
9	Fixed Service

The United States uses a similar structure for its National Radiocommunication Study Groups (see Appendix C, Figure C-1, and Figure C-2).

Figure B-1 Structure of the ITU



Appendix C: National and International Spectrum

Interfaces

The relationship between the U.S. and international spectrum management structures is shown as Figure C-1. The figure depicts two paths. One is the technical path where studies of radio matters are conducted; the other depicts the preparations within the United States leading to a Radiocommunication Conference.

Conference preparation follows the flow as shown in Figure C-1. NASA, as well as other Federal agencies, inputs proposals to the IRAC Radio Conference Subcommittee (RCS). Upon approval within the RCS, proposals are then coordinated with the FCC Advisory Committee for acceptance by the private sector. In a similar fashion private sector proposals are coordinated through the RCS for approval by the Government sector. Jointly approved proposals are then put on public notice for comment before going through the U.S. Department of State for submission to the conferences.

Significant technical interests for NASA are in the Study Group and its associated Working Parties concerned with the space science services (Study Group 7 and Working Party 7A, 7B, 7C, 7D and 7E), which support U.S. civil and commercial space programs (See Figure C-2). In general, technical studies of current interest are supplied to the United States Study Group or cognizant Working Party by member agencies. When approved by the Study Group, or Working Party, they are forwarded to the National Committee for national policy review prior to being submitted to Radiocommunication Assemblies or to a special conference preparation study group. The results of these studies provide the technical bases for Radiocommunication Conferences.

In addition to the space sciences services, NASA also contributes to the work of Study Group 3 (Radiowave Propagation), Study Group 4 (Fixed-Satellite Service), Study Group 6 (Broadcasting Services, Study Group 8 (Mobile, Radiodetermination, Amateur and Related Satellite Services), and Study Group 9 (Fixed Service) to assist the commercial industry in better meeting the long-term communications requirements of the Agency, as well as to protect and promote Agency use of allocated frequency bands.

Figure C-1 National and International Spectrum Interfaces

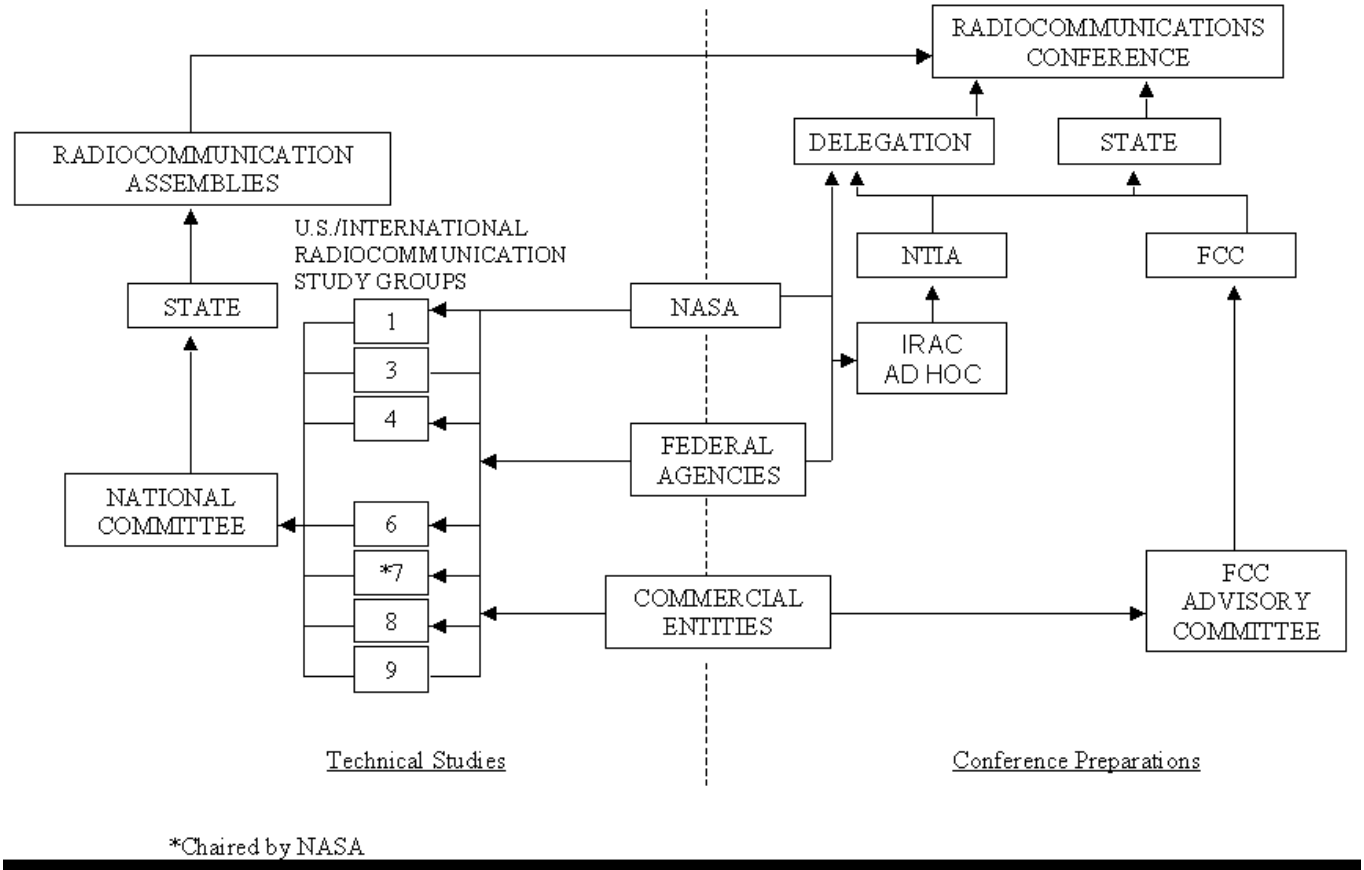
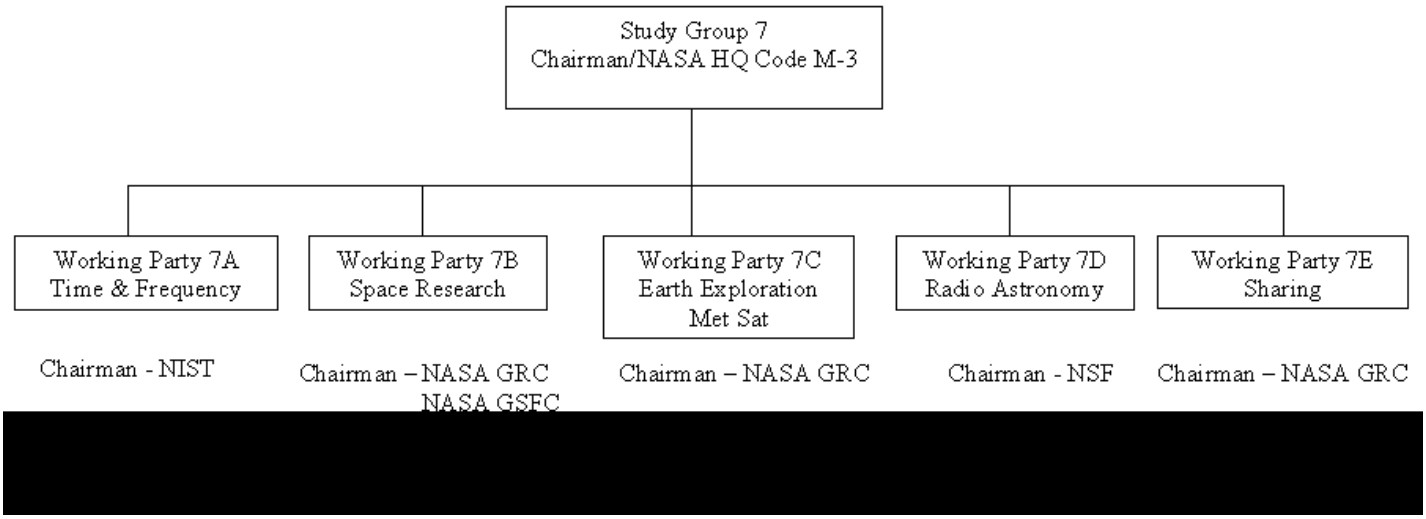


Figure C-2 National Radiocommunication Study Group 7 Structure


Study Group 7
Chairman/NASA HQ Code M-3
Working Party 7A
Time & Frequency
Working Party 7B
Space Research
Working Party 7C
Earth Exploration
Met Sat
Working Party 7D
Radio Astronomy
Working Party 7E
Sharing
Chairman - NIST
Chairman – NASA GRC
NASA GSFC
Chairman – NASA GRC
Chairman - NSF
Chairman – NASA GRC

Appendix D: Frequency Management Liaison Group (FMLG)

The FMLG is organized to provide a forum for the exchange of information on radio frequency spectrum management requirements, policies, and issues between all Enterprises of the Agency.

D.1 Purpose

The group is established to provide the means by which the AA for OSF ensures other Headquarters Offices of the Agency's compliance with Office of Management and Budget (OMB) Circular A-11, Section 34.4.

The group also provides the means of assuring spectrum compatibility between the different communications systems requirements, in support of each Enterprise's mission goals.

D.2 Objectives

The group provides a medium for each Enterprise to input the communications requirements of all current and future programs sponsored by that Enterprise to the Agency Spectrum Policy and Planning Director, in a timely manner, to ensure that spectrum support is available, as and when required by each program.

The group also provides the means for Headquarters Offices to review and comment on the status and progress of frequency spectrum support issues and activities in the national and international frequency spectrum arenas.

Additionally, the group provides assurance of intra-NASA compatibility by reviewing, for coordination purposes, spectrum support submissions prior to frequency assignment application.

D.3 Organization

The Agency Spectrum Policy and Planning Director, on behalf of the AA for OSF, chairs the group. The chairman is supported by the Agency Spectrum Program Manager at GRC. Meetings of the group are convened by the Chairperson, and meet as necessary, but not more than 90 days should elapse between meetings.

Each Enterprise provides to the group one representative, knowledgeable in the communications requirements of all current and future programs sponsored by that office. In addition, the Office of Safety and Mission Assurance (OSMA) will provide a representative to the Group.

The work of the group will be recorded by means of three documents:

1. Meeting Minutes[1], published after each meeting.

2. Action Item List, reviewed and updated at each meeting.

3. Calendar of Events for 1 year, updated monthly.

These documents, published by the Chairperson, will be distributed to all members.

[1] The guidelines in NPG 1441.1, NASA Records Retention Schedules, should be followed to maintain and safeguard these records. Records, documents, reports, etc. can only be disposed of based on the retention periods in NPG 1441.1. If an item is not described in NPG 1441.1, an entry needs to be developed and added to the NPG. In this instance, contact your Center Records Manager for the procedures.

Appendix E: NASA Spectrum Managers' Group (NSMG)

The NSMG is organized to provide a forum for the exchange of information on radio frequency spectrum management requirements, actions and issues among all Center Spectrum Managers.

E.1 Purpose

The group provides the assurance to NASA Headquarters of the Centers' compliance with NASA policy.

E.2 Objectives

The group provides a medium for each Center to input the communications requirements of all current and future projects undertaken by that Center to NASA, OSF, in a timely manner, to ensure that spectrum support is available, as and when required by each project.

The group also provides a means for Center Spectrum Managers to be kept informed on the status and progress of frequency spectrum support issues in the national and international frequency spectrum arenas.

Additionally, the group's meetings provide the opportunity for Centers to comment on proposed Agency and interagency frequency management issues.

E.3 Organization

The group is chaired by the National Spectrum Program Manager, from GRC, on behalf of the AA for OSF. The Chairperson convenes meetings of the group annually. Meeting locations vary to provide each Center Spectrum Manager the opportunity to host.

Each Center Spectrum Manager provides to the group one representative knowledgeable in the communications requirements of all current and future project activities in which the Center is involved. Additionally, the host Center Spectrum Manager will invite a local representative of the OSMA to the annual meeting at their host NASA Center.

The work of the group is recorded by means of three documents:

1. Meeting Minutes[1], published after each meeting.

2. Action Item List, reviewed and updated at each meeting.

3. Calendar of Events for 1 year, updated monthly.

These documents are distributed, upon request, to all members, in hardcopy format.

[1]The guidelines in NPG 1441.1, NASA Records Retention Schedules, should be followed to maintain and safeguard these records. Records, documents, reports, etc. can only be disposed of based on the retention periods in NPG 1441.1, If an item is not described in NPG 1441.1, an entry

needs to be developed and added to the NPG. In this instance, contact your Center Records Manager for the procedures.

Appendix F: NTIA Systems Review and NTIA Space Systems Subcommittee (SSS)

Details of the NTIA Systems Review process can be found in the NTIA Manual Chapter 10. Note also section 1.2 of this NPG. Briefly, the procedure consists of a four-stage review performed in the NTIA Spectrum Planning Subcommittee (SPS) Systems Review branch as described below. Note that this review process is mandatory for space systems except those that operate under Annex K of the NTIA Manual regarding low power nonlicensed devices.

All data must be submitted to the NASA SPS Representative in accordance with paragraph 10.7 and on the following forms found in chapter 10 of the NTIA Manual:

NTIA Form 33 Transmitter equipment characteristics;

NTIA Form 34 Receiver equipment characteristics; and

NTIA Form 35 Antenna equipment characteristics.

Stage 1 Conceptual

Here the initial planning effort has been completed, including proposed frequency bands and other available characteristics.

The Stage 1 Systems Review addresses the certification of spectrum support for telecommunication systems or subsystems and provides guidance on the feasibility of obtaining certification of spectrum support at subsequent stages. Those systems or subsystems that have a major impact on spectrum usage as defined by user agencies, IRAC, or NTIA, especially those that use new technological concepts or use existing technology in significant new ways, should be submitted. The guidance provided will indicate any modification, including more suitable frequency bands, necessary to ensure conformance with the Tables of Frequency Allocations and the provisions of chapter 5 {Spectrum Standards} of the NTIA Manual.

Because much of the system data will be estimated, in analyses performed by the SPS Systems Review Branch leading to certification of spectrum support, only gross calculations may be achievable for a general evaluation of spectrum impact and will be subject to adjustment during later stages. The system will be reviewed in conformance to International and National Allocation Tables. In addition, checks will be made against existing standards and sharing criteria, comparison will be made with known similar systems, and spectrum efficiency will be considered.

Note that with Stage 1 approval, the Agency, may not apply for a temporary frequency assignment. Temporary frequency assignments are available after Stage 2 SPS approvals and above.

Stage 2 Experimental

Here the preliminary design has been completed, and radiation, using test equipment or preliminary models, may be required.

Information identified in the Stage 1 Systems Review should be enhanced to make it current. Along with this, information required by Appendix S4 of the ITU RR shall be furnished to the SSS in accordance with the instructions in the current Manual of Instructions and Procedures for Notifying US Radio Frequency Assignment Data to the Radio Regulations Board (RRB). This data may be used in lieu of the data required for Stage 1 or 2 Systems Review request. The Appendix S4 data

shall be provided to the SSS at the same time as the request for Stage 2 Systems Review and shall not normally be transmitted to the RRB for advance publication until Stage 2 Certification of Spectrum Support has been granted.

The Advance Publication Information should be submitted not earlier than 6 years and preferably not later than 2 years before bringing the frequency assignments into use. There is no minimum time period but as a practical matter if coordination and/or agreement are required, the information should be submitted at least 2 years before bringing the frequency assignments into use.

The RR require information for each "satellite network," e.g., a satellite "system" or part thereof consisting of "only one satellite and the co-operating Earth station(s)" or in the case of inter-satellite links, "the associated satellite network." The information on a multi-satellite system should, where possible, be furnished to the RRB in separate parts, each corresponding to a satellite network.

In the case of a geostationary satellite system, there is no difficulty in singling out each network.

In the case of a nongeostationary satellite system, an operator may find it difficult to single out one satellite (and its cooperating Earth stations) from the system in order to assign an identity to the network. One system may be composed of two satellites, one of which is working while the other is idle. Another system may be composed of a large number of satellites operating simultaneously. Thus, according to the type of nongeostationary satellite system involved, it may be difficult or even impossible to draw a distinction between network and system. In order to distinguish between the different networks of such a nongeostationary satellite system, it is often necessary to specify factors such as the satellite's orbit, the nature of the service to be provided, the coverage area on the Earth's surface, and the daily hours of operation, which would lead to unwarranted complications.

Unless the Agency can easily break down the satellite system into separate networks, the identity of the entire nongeostationary satellite system should be entered and information on the whole system should be furnished.

Certification of spectrum support for telecommunication systems or subsystems at Stage 2 is a prerequisite for NTIA authorization of radiation in support of experimentation for space systems. It also provides guidance for ensuring certification of spectrum support at subsequent stages. Certification at Stage 2 may be requested for test equipment modified operational equipment or initial design models that can be used to determine which of several frequency bands or which of several proposed equipment configurations should be selected for continued investigation.

In the review leading to certification of spectrum support at Stage 2, an evaluation of the system conformance to NTIA Manual Chapter 5, Spectrum Standards, is performed along with an assessment of the system usage for war emergencies and verification that Appendix S4 of the ITU RR is satisfied. A general analysis will be applied by the SPS, where appropriate, with more specific Electromagnetic Compatibility (EMC) analysis, against a typical environment, being added where experimental testing of technically defined equipments is involved. Recommendations for changes to equipment characteristics and contemplated operational employment and deployment will be provided, when appropriate. Calculations required in connection with national and international space coordination procedures in accordance with the methods of Appendices 28 and 29 of the ITU RR will be performed to the extent practicable.

After the SPS Stage 2 review is approved, the Agency may forward a request to the FAS to obtain the necessary frequency assignment. See section 3.3 of this NPG. At this stage, the frequency assignment request should be for a trial assignment for the location at which the system will be tested. A planning assignment may also be applied for in anticipation of the operational {Stage 4} approval.

Stage 3 Developmental

Here the major design has been completed and radiation may be required during testing.

For the Stage 3 Systems Review, the Agency must update the information already provided and include as a minimum:

(1) For each Earth station transmitter and receiver site:

(a) Frequencies or frequency bands and satellites to be accessed;

(b) Coordinates;

(c) Emission designator for each frequency or frequency band;

(d) Maximum spectral power density and output power for each frequency or frequency band;

(e) Lowest equivalent satellite link noise temperature and associated value of transmission gain for each frequency or frequency band (geostationary satellites with simple frequency changing transponders only);

(f) Antenna gain and beamwidth;

(g) Minimum elevation angle of antenna main beam;

(h) Range of azimuth angles, and

(i) Lowest total receiver noise temperature (when (e) is not appropriate).

(2) For each space station transmitter and receiver:

(a) Frequency or frequency bands and cooperating Earth stations;

(b) Satellite orbital information;

(c) Emission designator for each frequency or frequency band;

(d) Peak power and spectral power density for each frequency or frequency band for transmitters;

(e) Receiver noise temperature, and

(f) Transmitter antenna patterns (only if power flux density limits are exceeded).

Following receipt of these data, the SPS will initiate the Stage 3 Systems Review. Certification of spectrum support for telecommunication systems or subsystems at Stage 3 is a prerequisite for NTIA authorization of radiation in support of developmental testing for systems that are subject to these procedures. It also provides guidelines for assuring certification of spectrum support at Stage 4. At this point, the intended frequency band will normally have been determined and certification at Stage 3 will be required for testing of proposed operational hardware and potential equipment configurations.

Detailed EMC analyses will be performed using test data and considering specific sites of equipment. A radiation hazard evaluation will be performed using Occupational Safety and Health Administration (OSHA) Operation of Exposure Limits ANSI-C95.1-1982 as the standard. Appropriate recommendations as to equipment characteristics or operational deployment will be developed. Calculations in connection with national and international space system coordination

procedures will be performed or updated as appropriate.

After the Stage 3 approval, the Agency, through the FAS representative, should apply for or upgrade a temporary frequency assignment. This also applies to any planning assignments extant.

Stage 4 Operational

Here development has been essentially completed, and final operating constraints or restrictions required to ensure compatibility needs to be identified.

When submitting for Stage 4 Systems Review, NASA must update all previous information provided.

Certification of spectrum support for telecommunication systems or subsystems at Stage 4 is a prerequisite for an NTIA RFA for a station with an operational station class (i.e., other than experimental) for systems that are subject to these procedures. Both the Stage 4 Certification of Spectrum Support and the RFA may provide restrictions on the operation of the system or subsystems as may be necessary to prevent harmful interference.

In analyses leading to certification of spectrum support at Stage 4, detailed EMC analyses will be updated by the submitting Center, as required, to include consideration of frequency assignments for specific system deployment. Appropriate recommendations as to equipment characteristics and/or operational limitations will be provided. Having completed the SPS review process, application may be made by the Agency, through the FAS Representative, for an operational frequency assignment.

NTIA Space Systems Subcommittee

The SSS of the IRAC will review the information provided by the Agency prior to initiating the international coordination and notification process through the ITU.

For unclassified space systems that have not been waived from the requirements of international registration, information must be prepared in specific formats and submitted to the SSS in accordance with instructions in the Manual of Instructions and Procedures for Notifying U.S. Radio Frequency Assignment Data to the Radio Regulations Board. These data, required by the SSS to satisfy the specifications in Appendix S4, Advanced Publication, and formerly Appendix 3, request for coordination and notification of the ITU Radio Regulations, shall be submitted at the same time as the Stage 3 Systems Review requests and may be used in lieu of the data required for Stage 3 and 4 Systems Review requests. Appendix 3 has been replaced by the newer requirements of Appendix S4.

In analyses leading to certification of spectrum support, an evaluation of the required submission of information according to Appendix S4 of the ITU Radio Regulations will be performed.

Submission of Information to the ITU

Notification of Frequency Assignments

Frequencies assigned to Government radio stations shall be notified to the International Frequency Registration Board (IFRB) in Geneva, Switzerland, as specified in the "Manual of Instructions for Notifying U.S. Radio Frequency Assignment Data to the BR (Radiocommunications Bureau), Geneva, Switzerland."

Provision of Information Regarding Satellite Networks in Planned Satellite Systems

In order to ensure compliance with the provisions of Section I, Articles 8, 11, 13 and 14 of the ITU RR, any Government agency intending to establish a satellite system shall provide to the SSS the details contained in Appendix S4 to the ITU RR for each satellite network within the planned satellite system, including changes in the technical characteristics and the employment and deployment of stations contained therein.

The information in Appendix S4 of the ITU RR shall be furnished to the SSS in accordance with the instructions appearing in Chapter 10 of the NTIA Manual. The information in Appendix S4 shall be furnished to the SSS in accordance with the instructions in the current Manual of Instructions for Notifying U.S. Radio Frequency Assignment Data to the IFRB.

The Appendix S4 data shall be provided to the SSS at the same time as the request for Stage 2 Systems Review under chapter 10 of the NTIA Manual and shall not normally be transmitted to the BR for advance publication until Stage 2 certification of Spectrum Support has been granted or earlier if sufficient information is available.

The information in Appendix S4 shall be furnished to the SSS in accordance with the instructions in the current Manual of Instructions for Notifying U.S. Radio Frequency Assignments Data to the IFRB. The Appendix S4 data shall be provided at the same time as the Stage 3 Systems Review approval request under chapter 10 of the NTIA Manual. After Stage 3 approval, the required coordination will be initiated. Notification of frequency assignments to the BR will be made after Stage 4 approval has been granted and any required coordination has been accomplished. Operational frequency assignments will not normally be granted until notification has been initiated.

Before Stage 2, 3, or 4 support is granted the SSS must indicate that the appropriate Appendix S4 data have been submitted and reviewed if required by the SPS. The SSS will review the information and:

(a) May notify the SPS that the required data are on file, and

(b) Submit data to the FCC.

It is recognized that the submission of information to the BR concerning Earth stations located outside the jurisdiction of the United States may be the responsibility of the country on whose territory the Earth station is located.

As a matter of policy, advance publication information and notices of frequency assignments relating to space systems shall be submitted to the BR. Exceptions to this policy will be made only by the NTIA on a case-by-case basis.

Appendix G: Determination Emissions and Bandwidths

G.1 Full Designation of Emission

The full designation of an emission consists of alphanumeric symbols for the classification of the emission preceded by a number indicating the necessary bandwidth in kilohertz as delineated in the NTIA Manual paragraph 9.8.2.16. The classification symbols are described in paragraph H.2 and the procedure for calculating the necessary bandwidth is given in paragraph H.3.

G.2 Classification of Emissions

Emissions are classified by alphanumeric symbols that represent the type of modulation of the carrier, type of transmission, and supplementary characteristics of the transmitting system. The basic emission designator consists of three symbols, and if desired, two optional additional symbols, as derived from Tables H-1 to H-5.

Table G-1. First Symbol-designates the type of modulation of the main carrier

Symbol..... Type of Emission

Unmodulated

N..... Emission of an unmodulated carrier.

Amplitude Modulated

Emission in which the main carrier is amplitude-modulated (including cases where sub-carriers are angle-modulated):

A..... Double sideband.

B..... Independent sidebands.

C..... Vestigial sideband.

H..... Single sideband, full carrier.

J..... Si-ngle sideband, suppressed carrier.

R..... Single sideband, reduced or variable level carrier.

Angle Modulated

Emission in which the main carrier is angle-modulated:

F..... Frequency modulation.

G..... Phase modulation.

Amplitude-Modulated and Angle modulated

D ..... Emission in which the main carrier is amplitude

modulated and angle-modulated either simultaneously or in a preestablished sequence.

Pulse

Emission of pulses:

(Emissions, where the main carrier is directly modulated by a signal which has been coded into quantized form (e.g., pulse code modulation), shall be designated as either an emission in which the main carrier is amplitude-modulated, or an emission in which the main carrier is angle-modulated).

P..... Sequence of unmodulated pulses.

Symbol..... Type of Emission

A sequence of pulses:

K..... Modulated in amplitude.

L..... Modulated in width or duration.

M..... Modulated in position or phase.

Q..... Carrier is angle-modulated during the period of the pulse.

V..... A combination of the foregoing or produced by other means.

Combination

W..... Cases not covered above, in which an emission consists

of the main carrier modulated, either simultaneously or in a combination of two or more of the following modes: amplitude, angle, pulse.

X[1]..... Cases not otherwise covered.

[1]A full explanation for the selection of the letter X shall be provided in the Supplementary Details (SUP) unless the application is for a nondirectional beacon in the bands 190-435 and 510-535 kHz.

Table G-2. Second Symbol-designates the nature of signal(s) modulating the main carrier

Symbol.....Type of Emission

0..... No modulating signal.

1..... A single channel* containing quantized or digital

signals without the use of a modulating subcarrier. (This excludes time division multi-plex.)

2..... A single channel* containing a quantized or a

digital signal with the use of modulating subcar-rier.

3..... A single channel* containing an analogue signal.

7..... Two or more channels* containing quantized or digital

signals.

8..... Two or more channels* containing analogue signals.

9..... A composite system with one or more channels*

containing quantized or digital signals, togeth-er with one or more channels containing analogue signals.

X[1]..... Cases not otherwise covered.

*In this context, the word "Channel(s)" refers to the radio frequency (RF) channel.

[1]A full explanation for the selection of the letter X shall be provided in the Supplementary Details (SUP) unless the application is for a nondirectional beacon in the bands 190-435 and 510-535 kHz

Table G-3. Third Symbol--designates the type of information to be transmitted (In this context the word "information" does not include information of a constant, unvarying nature such as provided by standard frequency emissions, continuous wave and pulse radars, etc.)

Symbol..... Type of Emission

N..... No information transmitted.

A..... Telegraphy--for aural reception.

B..... Telegraphy--for automatic reception.

C..... Facsimile.

D..... Data transmission, telemetry, telecommand;

(the symbol D indicates that data, telemetry, or telecommand information is being transmitted individually or, that any combination of the three are being transmitted simultaneously. If any combination *is* being transmitted simultaneously, one of the multi-channel symbols, 7, 8, or 9, must be used for the second symbol).

E..... Telephony (including sound broadcasting).

F..... Television (video).

W..... Combination of the above. (Use only for

multichannel systems having the capability of trans-mitting all informa-tion simultaneous-ly).

X[1]..... Cases not otherwise covered.

[1]A full explanation for the selection of the letter X shall be provided in the Supplemen-tary Details (SUP) unless the applica-tion is for a nondirectional beacon in the bands 190-435 and 510-535 kHz.

Table G-4. Fourth Symbol--designates the details of signal(s)

Symbol..... Type of Emission

A..... Two condition code with elements of differing

numbers and/or durations.

B..... -Two condition code with elements of the same

number and duration without error correction.

C..... Two condition code with elements of the same

number and duration with error cor-rection.

D..... Four condition code in which each condition

repre-sents a signal element (of one or more bits).

E..... Multicondition code in which each condition

repre-sents a signal element (of one or more bits).

F..... Multicondition code in which each condition

or combi-nation of conditions represents a char-acter.

G..... Sound of broadcasting quality (mono-phonic).

H..... Sound of broadcasting quality (stereo-phonic

or quadra-phonic).

J..... Sound of commercial quality (excluding

..... categories defined for symbols K and L below).

K..... Sound of commercial quality with the use of

frequen-cy inversion or band splitting.

L..... Sound of commercial quality with separate

frequ-ency- modulated signals to control the level of demodu-lated signal.

M..... Monochr-ome.

N..... Color.

W..... Combination of the above.

X..... Cases not otherwise covered.

Table G-5. Fifth Symbol--designates the nature of multiplexing

Symbol..... Type of Emission

N..... None.

C..... Code division multiplex (This includes band-

-width expansion tech-niques).

F..... Frequency division multiplex.

T..... Time division multiplex.

W..... Combination of frequency division multiplex and

time division multiplex.

X..... Other types of multiplexing.

Examples:

Designator Type of Emission

Non Continuous wave.

1K24F1B 1.24 kHz necessary bandwidth for frequency modulated single chan-nel telegraphy.

16KF3EJN 16 kHz necessary bandwidth for com-mer-cial telephony.

G.3 Determination of Necessary Bandwidths

1. The necessary bandwidth is the minimum value of bandwidth sufficient to ensure the transmission of information at the rate and with the quality required for the system employed. Emissions needed for satisfactory functioning of the receiving equipment (such as the carrier in reduced-carrier systems, or a vestigial sideband but not the effect of Doppler) are included in the necessary bandwidths.

2. When the full designation of an emission is required, the symbol for that emission (as given in paragraph H.2) is preceded by the number of Hertz, kHz or MHz (see examples) required for the necessary bandwidths. Bandwidths are generally expressed to a maximum of three significant digits with the third digit usually being a multiple of five.

3. To calculate the necessary bandwidths, refer to Annex J of the NTIA Manual. (This table also gives examples of the calculation of necessary bandwidths and full designation of corresponding emissions.) The necessary bandwidths can also be computed in accordance with ITU-R Recommendation SM.328. In cases in which computation is not practical, the necessary bandwidth can be obtained by measurement.

4. The value of necessary bandwidth determined by calculation or measurement should be used in designating the full emission. The necessary bandwidths so determined are not the only characteristic of an emission to be considered in evaluating the interference caused by that emission.

5. Further, more detailed, information on the method of calculation of necessary bandwidth is available in Annex J of the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management (current edition).

Appendix H: Call Signs

H.1 Call Signs Allocated to NASA Centers and the Jet Propulsion Laboratory (JPL)

Blocks of call signs are allotted to NASA Centers and JPL for assignment by the FCC through the NASA National Spectrum Program Manager who in turn allots them in groups to the Center or JPL Spectrum Manager. The Center Spectrum Manager assigns these call signs, as required, to all frequency users at the Center or JPL, including commercial contractors. The call signs allocated to each NASA Center and JPL are shown in Tables H-1 through H-3. For the assignment of additional call signs contact the National Spectrum Program Manager.

Table H-1. Allocation of Experimental Call Signs

Glenn Research Center	NA2XAA through NA2XGZ
Dryden Flight Research Center	NA2XHA through NA2XOZ
Langley Research Center	NA2XPA through NA2XZZ
Ames Research Center	NA3XAA through NA3XGZ
Goddard Space Flight Center	NA3XHA through NA3X0Z
NASA Headquarters	NA3XPA through NA3XRZ
Jet Propulsion Laboratory	NA3XSA through NA3XZZ
Marshall Space Flight Center	NA4XAA through NA4XEZ
Stennis Space Center	NA4XFA through NA4XJZ
Wallops Flight Facility	NA4XKA through NA4XUZ
Kennedy Space Center	NA4XVA through NA4XZZ
Johnson Space Center	NA5XAA through NA5XGZ

Table H-2. Allocation of HF Call Signs

Glenn Research Center	KHA940 through KHA944
Dryden Flight Research Center	KHA910 through KHA914
Langley Research Center	KHA935 through KHA939
Ames Research Center	KHA905 through KHA909
Goddard Space Flight Center	KHA915 through KHA919
NASA Headquarters	KHA900 through KHA904

Jet Propulsion Laboratory	KHA920 through KHA924
Marshall Space Flight Center	KHA945 through KHA949
Stennis Space Center	KHA950 through KHA954
Wallops Flight Facility	KHA955 through KHA959
Kennedy Space Center	KHA930 through KHA934
Johnson Space Center	KHA925 through KHA929
Spare Call Signs	KHA960 through KHA969

Applicable only to fixed operations.

Table H-3. Allocation of VHF-UHF Call Signs

Glenn Research Center	PBA320 through WPBA335
Dryden Flight Research Center	WPBA230 through WPBA244
Langley Research Center	WPBA305 through WPBA319
Ames Research Center	WPBA215 through WPBA229
Goddard Space Flight Center	WPBA245 through WPBA259
NASA Headquarters	WPBA200 through WPBA214
Jet Propulsion Laboratory	WPBA260 through WPBA274
Marshall Space Flight Center	WPBA336 through WPBA350
Stennis Space Center	WPBA351 through WPBA365
Wallops Flight Facility	WPBA366 through WPBA380
Kennedy Space Center	WPBA290 through WPBA304
Johnson Space Center	WPBA275 through WPBA289

Applicable only to land mobile radio systems operations, i.e. repeater operations.

H.2 Responsibility for Assignment

The NASA Center Spectrum Manager is responsible for the assignment of one or more of the call signs allocated to the Center to each specific operation requiring such an identifier.

H.3 Assignment Procedure

1. The Center or JPL Spectrum Manager exercises complete control of the assigned block of call signs and reserves the right to cancel or make changes as appropriate. The Center Spectrum Manager must maintain a complete and accurate record of all call sign assignments. Additional call signs may be made available by the National Spectrum Program Manager upon receipt of a request

supplemented by documentary proof that the call sign allocation cannot satisfy existing call sign requirements.

2. One or more call signs may be assigned by the Center or JPL Spectrum Manager to any operation remotely located from the Center where the spectrum manager exercises responsibility for the NASA Radio Frequency Assignment (NRFA) specifically issued to NASA representatives of commercial contractors, research institutes, colleges and universities under contractual jurisdiction of the activity.

3. Upon receipt of an NRFA, the Center or JPL Spectrum Manager will make all call sign assignments required by operations on such radio frequencies from the call sign block allocated to the Center or JPL, regardless of the organization or commercial activity conducting the operation.

4. Prior to the assignment of an initial radio call sign, the Center or JPL Spectrum Manager must first determine that a valid requirement exists and that no previous assignment of an experimental call sign has been made to this operation.

5. Upon receipt of a request for an additional call sign, the Center or JPL Spectrum Manager will review the requirement to determine the feasibility of expanding the initial call sign assignment in lieu of the assignment of an additional identifier.

6. Duplicate assignment of the same call sign to different operations is not authorized.

H.4 Expansion of NASA Call Signs

In consideration of special requirements or the shortage of basic call signs, any assigned basic call sign may be expanded by suffixing any letter (A through Z) or any number (including zero), and may consist of more than one digit.

H.5 Reporting of Call Sign Assignments

The Center or JPL Spectrum Manager will advise the National Spectrum Program Manager of each initial assignment of a call sign to an operation via the RFA 5-year review process.

Appendix I: Terms of Reference of the Space Frequency

Coordination Group (SFCG)

The 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 RR:

Space Research
Space Operations
Earth Exploration Satellite
Meteorological Satellite
Inter-satellite
Radionavigation Satellite
Radioastronomy 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, or whatever form may be appropriate for the case. SFCG members willattempt to ensure that findings of SFCG are taken into account by their agencies.

SFCG will:

Facilitate early understanding of present and future plans for space systems and services and of other systems affecting these;

Identify problem areas and coordination needs, and study potential solutions associated therewith;

Identify issues and policy matters relating to the future orderly use of the frequency bands allocated to respective space radiocommunication services;

Suggest courses of action to be taken by SFCG member agencies with regard to current and future frequency needs of the space radiocommunications services identified above,

Identify those matters for which member agencies should facilitate contributions to regional bodies (e.g. APT, CEPT, CITEL), ITU-R Study Groups; or to encourage their 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 allocated to the services identified above;

Consider any other items of technical, operational, or administrative nature which affect the interests of the Group, and

Maintain strong ties with other international bodies with related objectives.

Appendix J: Support Program

The NASA Support Program provides a forum for multiple discussions and efforts concerning the protection and preservation of NASA Spectrum, requirements, use and where necessary programmatic support.

The results of the Support Program are typically expressed in the form of a ruling by the IRAC, the FCC or other fora.

The Support Program will:

- Provide an advocacy effort in protecting and preservation of existing NASA spectrum.
- Provide an advocacy effort in gaining new NASA spectrum as appropriate.
- Work with NASA Enterprises and Centers to identify new Spectrum Requirements (Telemetry).
- Work with IRAC and its subcommittees and ad hoc working groups to protect NASA spectrum.
- Work with the private sector to build support groups for spectrum issues.
- Provide interface to the Spectrum Support Contractor for NASA.

Appendix K: Acronyms

AA	Associate Administrator
AFC	Area Frequency Coordinators
AFTRCC	Aerospace & Flight Test Radio Coordinating Council
ANSI	American National Standards Institute
ARC	Ames Research Center
AFC	Area Frequency Coordinator
BR	Radiocommunications Bureau
DFRC	Dryden Flight Research Center
DOD	Department of Defense
EMC	Electromagnetic Compatibility
ESA	European Space Agency
ETR	Eastern Test Range (Patrick AFB FL)
FAR	Federal Acquisition Regulation
FAS	Frequency Assignment Subcommittee
FCC	Federal Communications Commission
FMLG	Frequency Management Liaison Group
GHz	gigaHertz
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
HF	High Frequency
HQ	Headquarters
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEEE	Institute of Electrical and Electronics Engineers Inc.
IFRB	International Frequency Registration Board
IRAC	Interdepartment Radio Advisory Committee
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union - Radiocommunication Sector
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
kHz	kiloHertz
KSC	Kennedy Space Center
LaRC	Langley Research Center
MHz	MegaHertz
MSFC	Marshall Space Flight Center
NASDA	National Space Development Agency of Japan
NIST	National Institute of Standards and Technology

NMI	NASA Management Instruction
NPD	NASA Policy Directive
NPG	NASA Procedures and Guidelines
NRFA	NASA Radio Frequency Assignment
NRQZ	National Radio Quiet Zone
NSF	National Science Foundation
NSMG	NASA Spectrum Managers' Group
NTIA	National Telecommunications and Information Administration
NTIA Manual	Manual of Regulations and Procedures for Federal Radio Frequency Management
OMB	Office of Management and Budget
OSF	Office of Space Flight
OSMA	Office of Safety and Mission Assurance
RCS	Radio Conference Subcommittee
RF	Radio Frequency
RFA	Radio Frequency Authorization
RFI	Radio Frequency Interference
RR	Radio Regulations
SFCG	Space Frequency Coordination Group
SOMO	Space Operations Management Office
SPS	Spectrum Planning Subcommittee
SSC	Stennis Space Center
SSS	Space Systems Subcommittee
STGT	Second TDRS Ground Terminal
TDRS	Tracking and Data Relay Satellite
TSC	Technical Subcommittee
UHF	Ultra High Frequency
VHF	Very High Frequency
WFF	Wallops Flight Facility
WRC	World Radiocommunication Conference
WSTF	White Sands Test Facility