

Frequency Assignment Summary for 1.435 GHz - 2.5 GHz Band

**Leslie A. Berry
Francis K. Steele
William B. Grant**



**U.S. DEPARTMENT OF COMMERCE
Robert A. Mosbacher, Secretary**

Janice Obuchowski, Assistant Secretary
for Communications and Information

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PREFACE

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FREQUENCY ASSIGNMENT SUMMARY FOR 1.435 GHZ - 2.5 GHZ BAND

L. A. Berry,* F. K. Steele,* and W. B. Grant**

Allocations and assignments for frequencies in the United States between 1435 MHz and 2500 MHz are reviewed and summarized. The summarized data come from the FCC data base and the Government Master File.

Key words: service band allocations; UHF band assignments

1. INTRODUCTION: INTERNATIONAL AND NATIONAL ALLOCATIONS

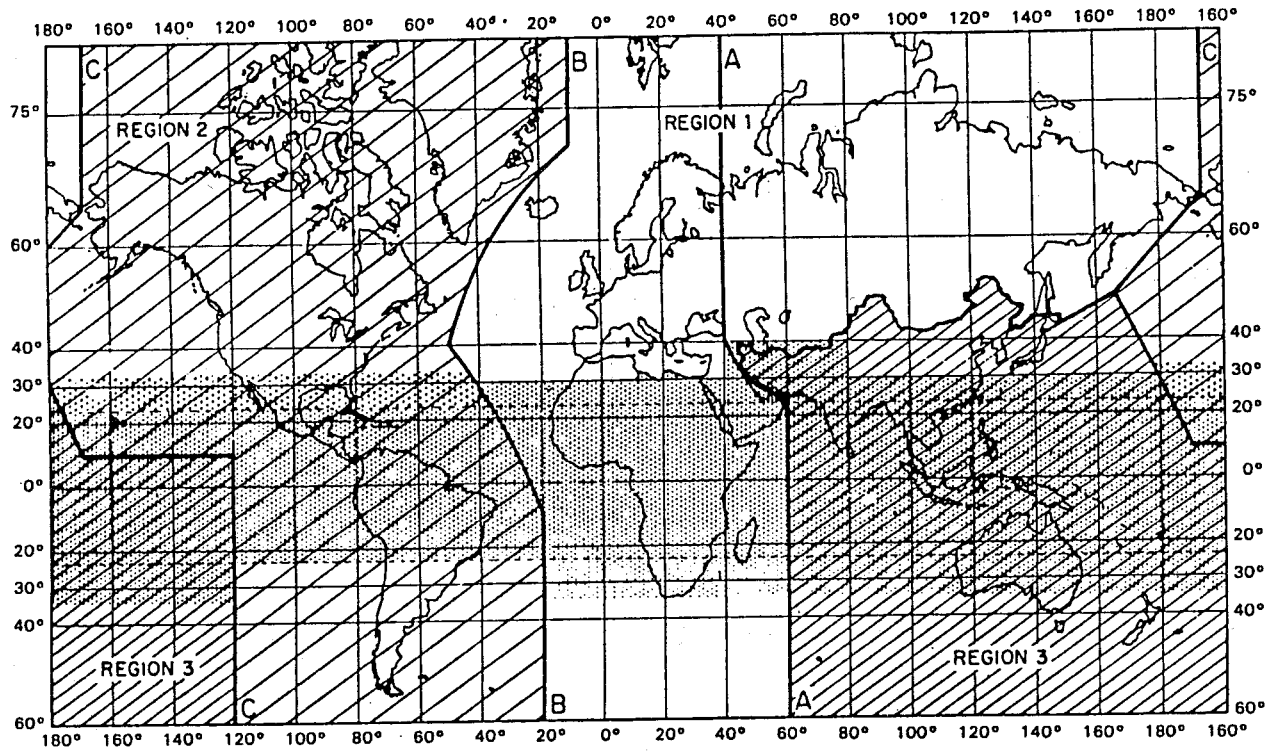
By international and national agreement, the radio frequency spectrum is divided into "service bands," which are discrete blocks of frequencies designated for use by particular spectrum-using "services." For historical reasons, "service" has specialized meaning for spectrum management. For example, making a connection between two telephone receivers for the purpose of conversation is a communications "service" to the layman. However, there is no single band of frequencies allocated to the "telephone service." Instead, that single communications service may use several different frequency bands, each of which may be a different service band. If one telephone set is in a car in Chicago and the other in an office in Munich, the link may use a mobile service band frequency to connect to the telephone network, a fixed service band to relay the message to an Earth station, and a satellite service band to carry it on to Europe. Usually a radio spectrum allocation implies not only a communications service, but also a particular type of radio system used to supply the service.

Designating a block of frequencies for a particular radio service is called "allocation." The International Table of Frequency Allocations is contained in the International Telecommunication Union (ITU) Radio Regulations. The allocations differ somewhat for three regions of the world. Figure 1 shows the three ITU regions of the world. Roughly speaking, Region 1 includes most of

* The authors are with the Institute for Telecommunication Sciences, National Telecommunications and Information Administration, U.S. Department of Commerce, Boulder, CO 80303.

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Europe, Northern Asia, and Africa, Region 2 is the Western Hemisphere, and Region 3 includes India, Southern Asia, and Australia. The United States is in Region 2.



The shaded part represents the Tropical Zone

Figure 1. Chart of regions of the world as defined by the International Telecommunications Union.

Within the U.S., spectrum is further divided between Federal Government users (designated as "Government") and all other users (designated as "non-Government"). The Federal Communications Commission (FCC) manages all non-Government use of the spectrum and the National Telecommunications and Information Administration (NTIA) manages the Federal Government use of the spectrum. Many service bands are shared by Government and non-Government users, requiring coordination between the FCC and the NTIA.

A block of frequencies may be allocated to more than one service, but the services may not have equal rights to frequencies in the block. Services may be designated as primary, permitted, and secondary. Primary and permitted services have priority over, and are protected from interference from, secondary services. In preparation of frequency plans, primary services have priority over permitted services. Secondary services must not cause harmful interference to the primary and permitted services, and cannot claim protection from interference from them.

Figure 2 shows the international and U.S. allocation table between 1300 MHz and 2500 MHz (extracted from a complete table in the NTIA Manual [NTIA, Chapter 4, 1989]). The international allocations for the three regions are shown left of the double vertical line in the table; the U. S. allocations are shown to the right. The frequency band limits in megahertz are shown in column 1 of the U.S. table. The column headed "National Provisions" shows the footnotes to the table that are applicable to both Government and non-Government users in this service band. The footnotes are contained in Appendix A.

Columns 3 and 4 of the U.S. table show the services to which the band is allocated. Services printed entirely in upper case letters are primary services. Services printed with the first letter upper case, and all other letters lower case are secondary services.

In general, the U.S. allocations conform to the International allocations, but with added detail. However, it should be noted that under ITU regulations, administrations (countries) "retain their entire freedom with regard to military radio installations," and that they may assign frequencies that do not conform to the ITU table on the condition that harmful interference shall not be caused to services operating in accordance with the table.

The intensity of usage in a service band is partially indicated by the number, nature, and location of the assignments. An "assignment" is the "...authorization...for a radio station to use a radio frequency...under specified conditions" (NTIA, Chapter 6, 1989). In some cases, an assignment may represent several (or many) transmitters. An assignment may be valid anywhere

INTERNATIONAL				UNITED STATES			
Region 1 MHz	Region 2 MHz	Region 3 MHz	Band MHz	National Provisions	Government Allocation	Non-Government Allocation	Remarks
1300-1350	AERONAUTICAL RADIONAVIGATION 717 Radiolocation 715 716 718		1300-1350	717 718	AERONAUTICAL RADIONAVIGATION Radiolocation G2	AERONAUTICAL RADIONAVIGATION	5
1350-1400 FIXED MOBILE RADIOLOCATION	1350-1400 RADIOLOCATION		1350-1400	US311 714 718 720	FIXED MOBILE RADIOLOCATION		
718 719 720	714 718 720				G2 G27 G114		
1400-1427	EARTH EXPLORATION-SATELLITE (Passive) RADIO ASTRONOMY SPACE RESEARCH (Passive) 721 722		1400-1427	US74 US246 722	RADIO ASTRONOMY EARTH EXPLORATION- SATELLITE (Passive) SPACE RESEARCH (Passive)	RADIO ASTRONOMY EARTH EXPLORATION- SATELLITE (Passive) SPACE RESEARCH (Passive)	
1427-1429	SPACE OPERATION (Earth-to-space) FIXED MOBILE except aeronautical mobile 722		1427-1429	722	FIXED MOBILE except aero- nautical mobile SPACE OPERATION (Earth-to-space) G30	SPACE OPERATION (Earth-to-space) Land Mobile (Telemetering and telecommand) Fixed (Telemetering)	
1429-1525 FIXED MOBILE except aero- nautical mobile	1429-1525 FIXED MOBILE 723		1429-1435	722	FIXED MOBILE G30	Land Mobile (Telemetering and Telecommand) Fixed (Telemetering)	
722	722		1435-1530	US78 722	MOBILE (Aeronautical telemetering)	MOBILE (Aeronautical telemetering)	

Figure 2. International and United States Service band allocations between 1429 MHz and 2500 MHz.

INTERNATIONAL				UNITED STATES			
Region 1 MHz	Region 2 MHz	Region 3 MHz	Band MHz	National Provisions	Government Allocation	Non-Government Allocation	Remarks
1525-1530 SPACE OPERATION (Space-to-Earth) FIXED Earth Exploration- Satellite Mobile except aero- nautical mobile 724	1525-1530 SPACE OPERATION (Space-to-Earth) Earth Exploration- Satellite Fixed Mobile 723	1525-1530 SPACE OPERATION (Space-to-Earth) FIXED Earth Exploration- Satellite Mobile 723 724					
722 725	722 723A	722					
1530-1533 SPACE OPERATION (Space-to-Earth) MARITIME MOBILE- SATELLITE (Space- to-Earth) LAND MOBILE-SATELLITE (Space-to-Earth) Earth Exploration-Satellite Fixed Mobile 723	1530-1533 SPACE OPERATION (Space-to-Earth) MARITIME MOBILE-SATELLITE (Space-to-Earth) LAND MOBILE-SATELLITE (Space-to-Earth) Earth Exploration-Satellite Fixed Mobile 723		1530-1535	US78 US272 722 726A	MARITIME MOBILE- SATELLITE (Space- to-Earth) Mobile (Aeronautical telemetering)	MARITIME MOBILE- SATELLITE (Space- to-Earth) Mobile (Aeronautical telemetering)	
722 726 726A	722 726 726A						
1533-1535 SPACE OPERATION (Space-to-Earth) MARITIME MOBILE- SATELLITE (Space- to-Earth) Earth Exploration- Satellite Fixed Mobile except aero- nautical mobile Land Mobile- Satellite (Space- to-Earth) 726B	1533-1535 SPACE OPERATION (Space-to-Earth) MARITIME MOBILE-SATELLITE (Space-to-Earth) Earth Exploration-Satellite Fixed Mobile 723 Land Mobile-Satellite (Space-to-Earth) 726B						
722 726 726A	722 726 726A						

Figure 2. Continued . . .

INTERNATIONAL				UNITED STATES				Remarks
Region 1 MHz	Region 2 MHz	Region 3 MHz	Band MHz	National Provisions	Government Allocation	Non-Government Allocation		
1535-1544	MARITIME MOBILE-SATELLITE (Space-to-Earth) Land Mobile-Satellite (Space-to-Earth) 726B 722 726A 727		1535-1544	722 726A	MARITIME MOBILE- SATELLITE (Space- to-Earth)	MARITIME MOBILE- SATELLITE (Space- to-Earth)	5	
1544-1545	MOBILE-SATELLITE (Space-to-Earth) 722 727 727A		1544-1545	722 727A	MOBILE-SATELLITE (Space-to-Earth)	MOBILE-SATELLITE (Space-to-Earth)		
1545-1555	AERONAUTICAL MOBILE-SATELLITE (R) (Space-to-Earth)		1545-1549.5	US308 US309 722 726A	AERONAUTICAL MOBILE-SATELLITE (R)(Space-to-Earth) Mobile-Satellite (Space-to-Earth)	AERONAUTICAL MOBILE-SATELLITE (R)(Space-to-Earth) Mobile-Satellite (Space-to-Earth)		
1555-1559	722 726A 727 729 729A 730 LAND MOBILE-SATELLITE (Space-to-Earth) 722 726A 727 730 730A		1549.5- 1558.5	US308 US309 722 726A	AERONAUTICAL MOBILE- SATELLITE (R) (Space-to-Earth) MOBILE-SATELLITE (Space-to-Earth)	AERONAUTICAL MOBILE- SATELLITE (R) (Space-to-Earth) MOBILE-SATELLITE (Space-to-Earth)		
1559-1610	AERONAUTICAL RADIONAVIGATION RADIONAVIGATION-SATELLITE (Space-to-Earth) 722 727 730 731 731A 731B 731C 731D		1558.5-1559	US308 US309 722 726A	AERONAUTICAL MOBILE- SATELLITE (R) (Space-to-Earth)	AERONAUTICAL MOBILE- SATELLITE (R) (Space-to-Earth)		
			1559-1610	US208 US260 722	AERONAUTICAL RADIONAVIGATION RADIONAVIGATION- SATELLITE (Space- to-Earth)	AERONAUTICAL RADIONAVIGATION RADIONAVIGATION- SATELLITE (Space- to-Earth)		
1610-1626.5	AERONAUTICAL RADIONAVIGATION RADIODETERMINATION- SATELLITE (Earth- to-space) 733A	1610-1626.5 AERONAUTICAL RADIONAVIGATION Radiodetermination- Satellite (Earth- to-space) 733A 733E	1610-1626.5	US208 US260 US306 722 732 733 734	AERONAUTICAL RADIONAVIGATION	AERONAUTICAL RADIONAVIGATION		
722 727 730 731 731A 731B 731D 732 733 733A 733B 733E 733F 734	722 731B 731C 732 733 733C 733D 734	722 727 730 731B 731C 732 733 733B 734						

Figure 2. Continued . . .

INTERNATIONAL				UNITED STATES			
Region 1 MHz	Region 2 MHz	Region 3 MHz	Band MHz	National Provisions 2	Government Allocation 3	Non-Government Allocation 4	Remarks 5
1626.5-1631.5	MARITIME MOBILE-SATELLITE (Earth-to-space) Land Mobile-Satellite (Earth-to-Space) 726B 722 726A 727 730			1626.5- 1645.5	722 726A	MARITIME MOBILE- SATELLITE (Earth- to-space)	MARITIME MOBILE- SATELLITE (Earth- to-space)
1631.5-1634.5	MARITIME MOBILE-SATELLITE (Earth-to-space) LAND MOBILE-SATELLITE (Earth-to-space) 722 726A 727 730 734A						
1634.5-1645.5	MARITIME MOBILE-SATELLITE (Earth-to-space) Land Mobile-Satellite (Earth-to-space) 726B 722 726A 727 730						
1645.5-1646.5	MOBILE-SATELLITE (Earth-to-space) 722 734B			1645.5- 1646.5	722 734B	MOBILE-SATELLITE (Earth-to-space)	MOBILE-SATELLITE (Earth-to-space)
1646.5-1656.5	AERONAUTICAL MOBILE-SATELLITE (R) (Earth-to-space)			1646.5-1651	US308 US309 722 726A	AERONAUTICAL MOBILE-SATELLITE (R) (Earth-to- space) Mobile-Satellite (Earth-to-space)	AERONAUTICAL MOBILE-SATELLITE (R) (Earth-to- space) Mobile-Satellite (Earth-to-space)
1656.5-1660	LAND MOBILE-SATELLITE (Earth-to-space) 722 726A 727 730 730A 734A			1651-1660	US308 US309 722 726A	AERONAUTICAL MOBILE- SATELLITE (R) (Earth-to-space) MOBILE-SATELLITE (Earth-to-space)	AERONAUTICAL MOBILE- SATELLITE (R) (Earth-to-space) MOBILE-SATELLITE (Earth-to-space)
1660-1660.5	LAND MOBILE-SATELLITE (Earth-to-space) RADIO ASTRONOMY 722 726A 730A 736			1660-1660.5	US309 722 726A 736	AERONAUTICAL MOBILE- SATELLITE (R) (Earth-to-space) RADIO ASTRONOMY	AERONAUTICAL MOBILE SATELLITE (R) (Earth-to-space) RADIO ASTRONOMY

Figure 2. Continued . . .

INTERNATIONAL				UNITED STATES			
Region 1 MHz	Region 2 MHz	Region 3 MHz	Band MHz	National Provisions	Government Allocation	Non-Government Allocation	Remarks
1660.5-1668.4	RADIO ASTRONOMY SPACE RESEARCH (Passive) Fixed Mobile except aeronautical mobile 722 736 737 738 739		1660.5- 1668.4	US74 US246 722	RADIO ASTRONOMY SPACE RESEARCH (Passive)	RADIO ASTRONOMY SPACE RESEARCH (Passive)	5
1668.4-1670	METEOROLOGICAL AIDS FIXED MOBILE except aeronautical mobile RADIO ASTRONOMY 722 736		1668.4-1670	US74 US99 722 736	METEOROLOGICAL AIDS (Radiosonde) RADIO ASTRONOMY	METEOROLOGICAL AIDS (Radiosonde) RADIO ASTRONOMY	
1670-1690	METEOROLOGICAL AIDS FIXED METEOROLOGICAL-SATELLITE (Space-to-Earth) MOBILE except aeronautical mobile 722		1670-1690	US211 722	METEOROLOGICAL AIDS (Radiosonde) METEOROLOGICAL- SATELLITE (Space- to-Earth)	METEOROLOGICAL AIDS (Radiosonde) METEOROLOGICAL- SATELLITE (Space- to-Earth)	
1690-1700	METEOROLOGICAL AIDS METEOROLOGICAL-SATELLITE (Space-to-Earth) Fixed Mobile except aero- nautical mobile 671 722 741	1690-1700 METEOROLOGICAL AIDS METEOROLOGICAL-SATELLITE (Space-to-Earth) 671 722 740 742	1690-1700	671 722	METEOROLOGICAL AIDS (Radiosonde) METEOROLOGICAL- SATELLITE (Space- to-Earth)	METEOROLOGICAL AIDS (Radiosonde) METEOROLOGICAL- SATELLITE (Space- to-Earth)	

Figure 2. Continued . . .

INTERNATIONAL				UNITED STATES			
Region 1 MHz	Region 2 MHz	Region 3 MHz	Band MHz	National Provisions 2	Government Allocation 3	Non-Government Allocation 4	Remarks 5
1700-1710 FIXED METEOROLOGICAL- SATELLITE (Space- to-Earth) Mobile except aero- nautical mobile 671 722 743A	1700-1710 FIXED METEOROLOGICAL-SATELLITE (Space-to-Earth) MOBILE except aeronautical mobile 671 722 743		1700-1710	671 722	FIXED METEOROLOGICAL- SATELLITE (Space- to-Earth) G118	Fixed METEOROLOGICAL- SATELLITE (Space- to-Earth)	
1710-2290 FIXED Mobile	1710-2290 FIXED MOBILE		1710-1850	US256 722	FIXED MOBILE G42		
			1850-1990			FIXED	
			1990-2200	US90 US111 US219 US222		MOBILE Fixed NG23 NG118	
722 743A 744 746 747 748 750	722 744 745 746 747 748 749 750		2200-2290	US303	FIXED (LOS* only) MOBILE (LOS only including aeronau- tical telemetering, but excluding flight testing of manned aircraft) SPACE RESEARCH (Space-to-Earth) (Space-to-space) G101		*Line of sight
2290-2300 FIXED SPACE RESEARCH (Deep Space) (Space-to-Earth) Mobile except aero- nautical mobile 743A	2290-2300 FIXED MOBILE except aeronautical mobile SPACE RESEARCH (Deep Space) (Space-to-Earth)		2290-2300		SPACE RESEARCH (Space-to-Earth) (Deep Space only) FIXED MOBILE except aero- nautical mobile	SPACE RESEARCH (Space-to-Earth) (Deep Space only)	

Figure 2. Continued . . .

INTERNATIONAL				UNITED STATES			
Region 1 MHz	Region 2 MHz	Region 3 MHz	Band MHz	National Provisions	Government Allocation	Non-Government Allocation	Remarks
			1	2	3	4	5
2300-2450 FIXED Amateur Mobile Radiolocation	2300-2450 FIXED MOBILE RADIOLOCATION Amateur		2300-2310	US253	RADIOLOCATION Fixed Mobile G2	Amateur	
			2310-2390	US276	RADIOLOCATION MOBILE Fixed G2 G120	MOBILE	
			2390-2450	664 752	RADIOLOCATION G2	Amateur	ISM 2450 ± 50 MHz
664 743A 752	664 751 752						
2450-2483.5 FIXED MOBILE Radiolocation 752 753	2450-2483.5 FIXED MOBILE RADIOLOCATION 752		2450-2483.5	US41 752		FIXED MOBILE Radiolocation	
2483.5-2500 FIXED MOBILE Radiolocation 733F 752 753A 753B 753C 753E	2483.5-2500 FIXED MOBILE RADIODETERMINATION- SATELLITE (Space- to-Earth) 753A RADIOLOCATION 752 753D	2483.5-2500 FIXED MOBILE RADIOLOCATION Radiodetermination- Satellite (Space- to-Earth) 753C 752 753C	2483.5-2500	US41 752		RADIODETERMINATION- SATELLITE (Space- to-Earth)	NG147

Figure 2. Continued . . .

in a large specified area. Receive-only stations (for satellite transmissions, for example) do not need assignments, but may represent much of the use of a band.

Each of the individual bands between 1435 and 2500 MHz shown in the U.S. table of allocations is discussed separately in Section 2 of this report.

2. BAND ALLOCATIONS AND ASSIGNMENTS, 1435 - 2500 MHZ

Each individual band identified in the Table of Allocations in Figure 2 is discussed separately in this section. It should be noted that a few experimental assignments that do not conform to the band allocation may exist in each band. Footnotes referenced can be found in the Appendix.

The number of Government assignments given in each band is from the 1990 Government Master File (GMF), unless otherwise noted. The non-Government assignment totals are derived from the 1987 FCC data base or the 1990 GMF.

2.1 The 1435 - 1530 MHz Band

2.1.1 Services Allocated

This band is shared by Government and non-Government users.

In Region 2, the primary service in this band is the Mobile service. In the U. S., the 1435 - 1530 MHz band is allocated exclusively to the Mobile (aeronautical telemetering) service on a primary basis for both the Federal Government and non-Government. U.S. Footnote US78 states that 1435 - 1485 MHz will be assigned primarily for flight testing of manned aircraft or major components thereof. The 1485 - 1535 MHz portion will be assigned primarily for flight testing of unmanned aircraft, missiles, or major components thereof. Telemetry associated with launching and reentry of space vehicles is a permissible usage between 1435 MHz and 1535 MHz. Flight testing telemetry is telemetry that supports research, development, testing and evaluation, but is not integral to the operational function of the system.

2.1.2 System Characteristics

Most of the systems in the band are used for aeronautical telemetry and telecommand. Emission bandwidths typically fall within 1, 3, or 5 MHz (Matos, 1984). Most transmitter powers are in the range 2-50 watts. A typical transmitter might have a nominal power output of 18 watts

and an FM carrier deviation of 600 kHz. A typical receiver has a noise figure of 4.5 dB and an IF bandwidth of 1.5 MHz. The data is usually pulse-code modulated at a rate up to 1 Mbps. Because the telemetering equipment is airborne, the operational radius for an assignment is typically 200 miles (320 km).

2.1.3 Assignments

In 1990, there are 817 Government assignments in this band. Some of the Government assignments represent 1-10 transmitters. Figure 3 shows the distribution of assignments within the band in 1984, when there were 725 assignments in the band (Matos, 1984). There are assignments every megahertz beginning at 1435.5 MHz.

Figure 4 shows the geographic distribution of the Government assignments. There are not 817 locations indicated in Figure 4 because many of the assignments are to the same location, for example, Yuma, Arizona. Government usage is heaviest in the southwestern U.S. Some Government assignments are authorized for use anywhere in the U.S. (hereafter referred to as USA assignments) and some are authorized for operation anywhere in the U.S. and its possessions (hereafter referred to as USP assignments).

The GMF shows 135 non-Government assignments in the 1435 - 1530 band. Usage in this band is coordinated by the Aerospace and Flight Testing Radio Coordinating Council (AFTRCC) whose comments to the FCC on General Docket No. 89-554 should be noted.

2.2 The 1530 - 1535 MHz Band

2.2.1 Services Allocated

This band is shared by Government and non-Government services.

The 1979 World Administrative Radio Conference (WARC-79) added the Maritime Mobile-Satellite (space-to-Earth) Service to the 1530 - 1535 MHz band and this change has been incorporated into the U.S. Table of Allocations. The Mobile service has been downgraded to secondary status in this band. These changes became effective January 1, 1990.

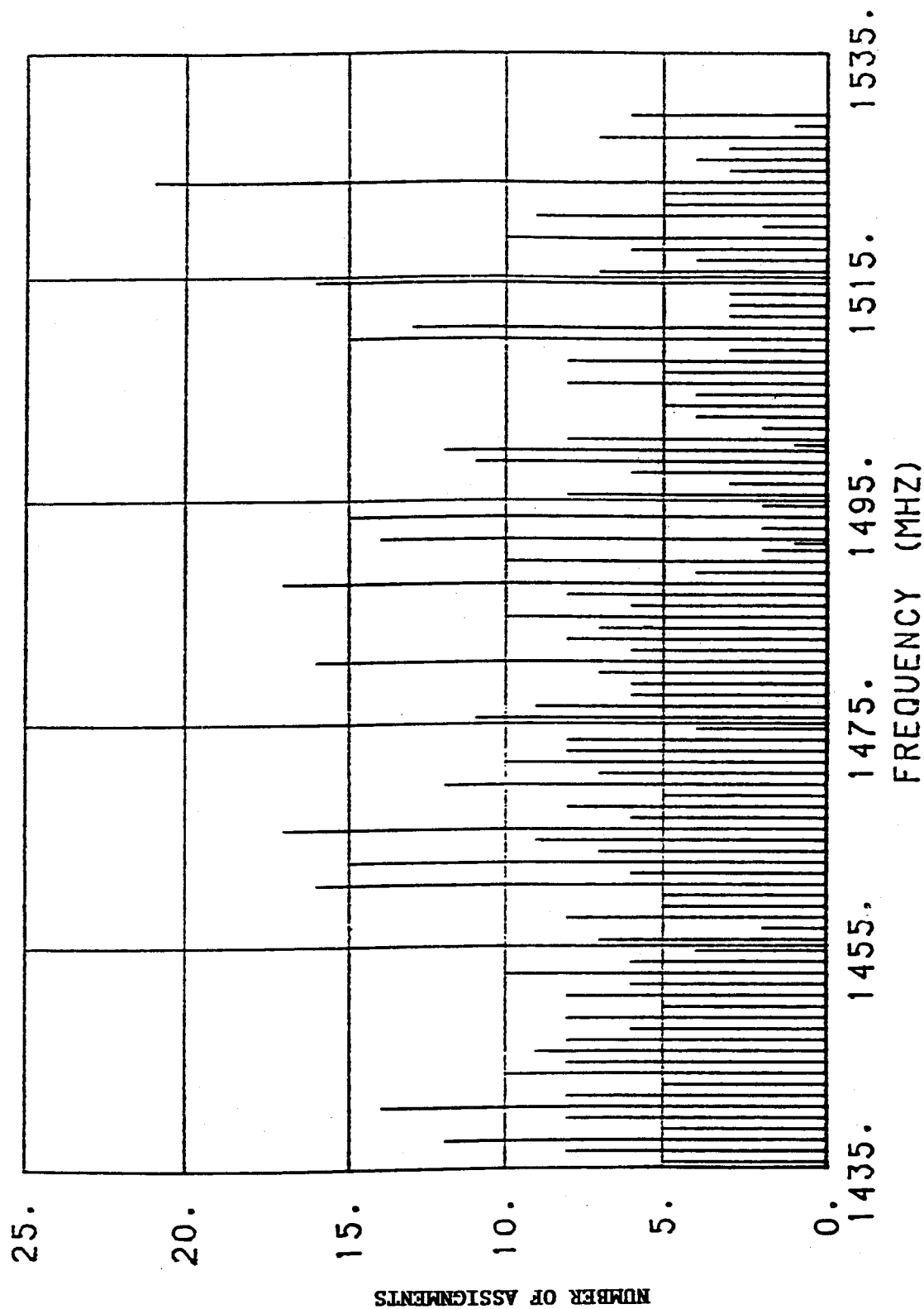


Figure 3. Federal Government frequency assignment distribution in the 1435 - 1530 MHz band in 1984 (Matos, 1984).

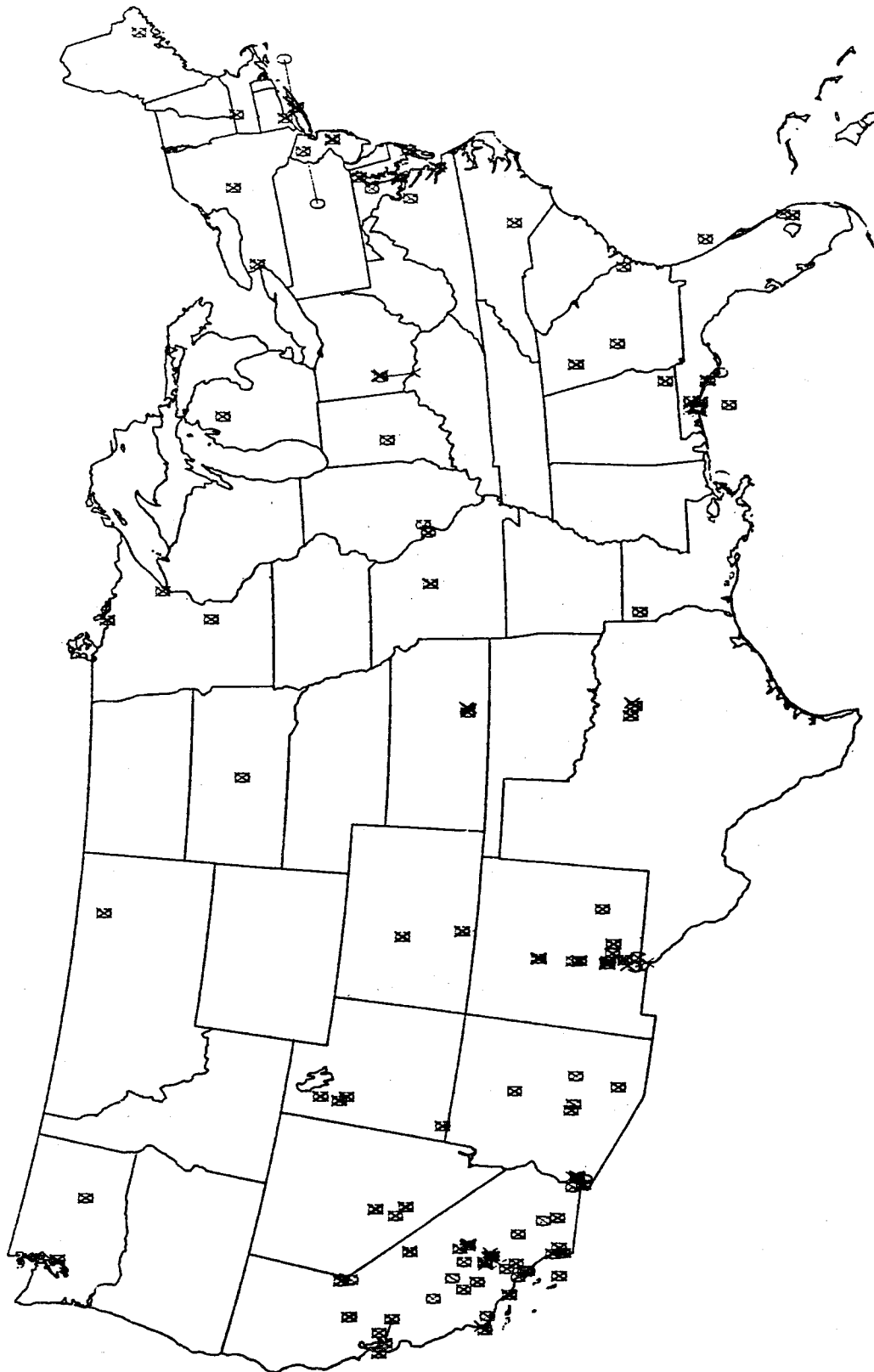


Figure 4. Geographic distribution of assignments in the 1435 - 1530 MHz band.

2.2.2 System Characteristics

There are still a number of aeronautical telemetry systems in this band on a secondary basis. These systems are similar to those in the band 1435 - 1530 MHz. They have 2-10 W power and operate in areas 80-320 km (50-200 mi) in radius.

2.2.3 Assignments

In 1990, there are 36 Government assignments in the 1530 - 1535 MHz band. The assignments represent 1-10 transmitters. The geographic distribution of the assignments is shown in Figure 5.

The 1987 FCC data base shows no non-Government assignments.

2.3 The 1535 - 1544 MHz Band

2.3.1 Services Allocated

The 1535 - 1544 MHz band is shared by Government and non-Government services.

This band is allocated worldwide to the Maritime Mobile-Satellite (space-to-Earth) service. The major use is for INMARSAT downlinks. Its use is part of the Global Maritime Distress and Safety System (GMDSS). This system is currently used by 12,000 ships worldwide. It is expected that, in 10 years, there will be 40,000 users.

2.3.2 System Characteristics

The systems are usually INMARSAT earth stations. Transmitters typically have 25 W power.

2.3.3 Assignments

The 1987 FCC data base shows six non-Government assignments in the 1535 - 1544 MHz band. The GMF shows twelve Government assignments in the band. The Government assignments may represent many stations, and are typically authorized to operate in the U.S., its possessions, or on the high seas. Thus, one assignment in the Government Master File may represent many INMARSAT stations. The INMARSAT satellites are licensed by the United Kingdom.

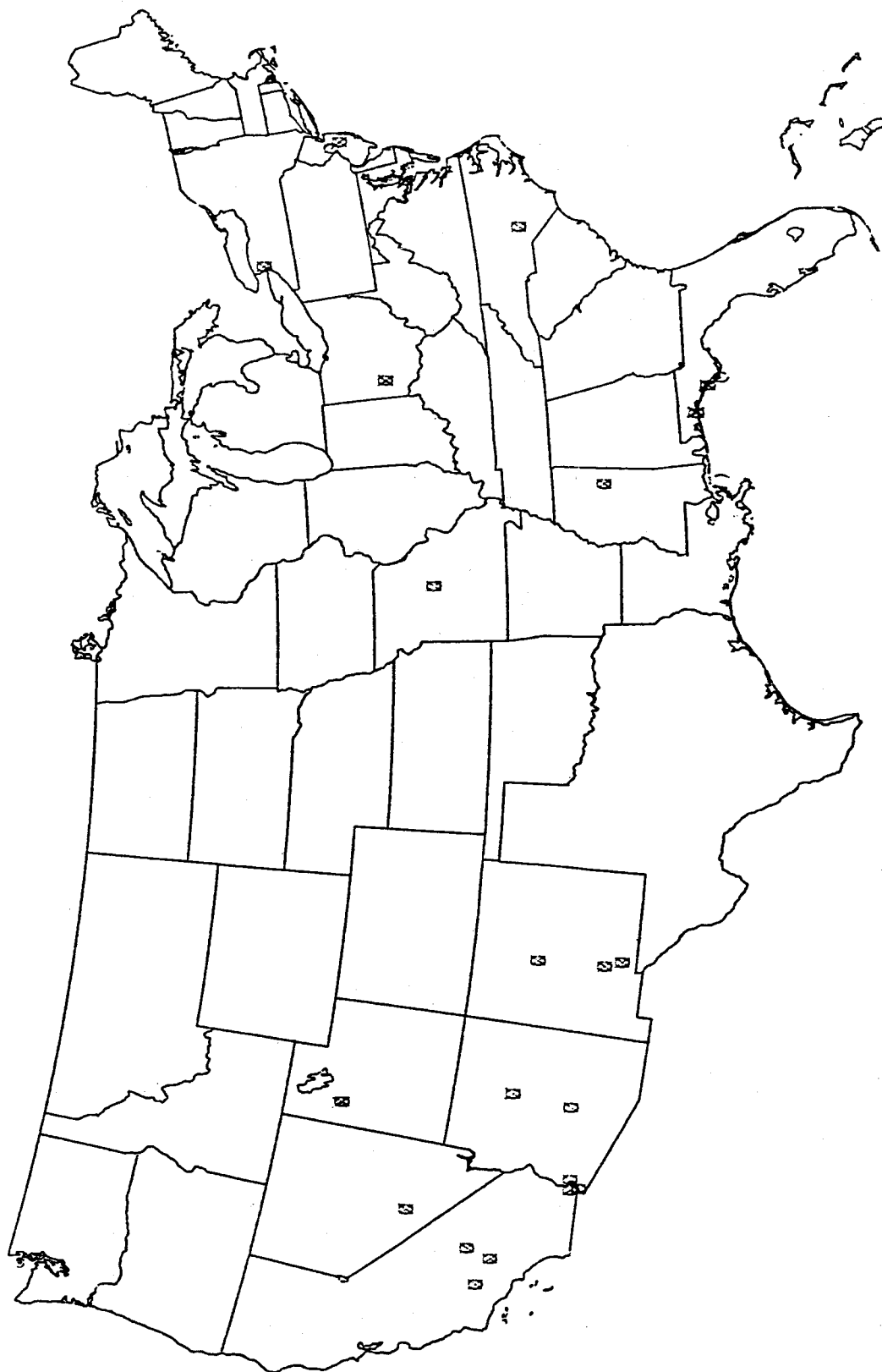


Figure 5. Geographic distribution of assignments in the 1530 - 1535 MHz band.

2.4 The 1544 - 1545 MHz Band

The 1544 - 1545 MHz band is allocated worldwide to the Mobile Satellite (space-to-Earth) service.

The data bases available to us showed no assignments in the 1544 - 1545 MHz band. The band is used by SARSAT to relay satellite EPIRB transmissions.

2.5 The 1545 - 1559 MHz Band

2.5.1 Services Allocated

The 1545 - 1559 MHz band is allocated worldwide to the Aeronautical Mobile-Satellite (R) (space-to-Earth) service. It will be used for the downlink for the nationwide mobile satellite system recently authorized by the FCC.

2.5.2 Assignments

The 1987 FCC data base shows three non-Government assignments in the 1545 - 1559 MHz band to the business and special emergency services. There are three Government assignments in the band. It is expected that the mobile satellite service will grow rapidly once it is deployed. Individual assignments for each station are not required.

2.6 The 1559 - 1610 MHz Band

2.6.1 Services Allocated

The 1559 - 1610 MHz band is allocated worldwide to Aeronautical Radionavigation and Radionavigation-Satellite (space-to-Earth) service. The Global Positioning System (GPS) downlinks are in this band.

2.6.2 System Characteristics

Most systems are assigned as earth stations for GPS. This is a multi-satellite system with thousands of users. The GPS stations typically are listed at 120 W. There are also some antenna test ranges, altimeters, and other miscellaneous experimental equipment.

2.6.3 Assignments

The 1987 FCC data base shows 19 non-Government assignments in the 1559 - 1610 MHz band, including some in the business, industrial, and public safety service categories. There are 53 Government assignments in the band, mostly related to GPS. All of an agency's GPS stations can be assigned under one authorization. The thousands of receivers do not require an assignment.

2.7 The 1610 - 1626.5 MHz Band

2.7.1 Services Allocated

The 1610 - 1626.5 MHz band is allocated worldwide to the Aeronautical Radionavigation service. Footnote US306 also allocates the band to the Radiodetermination Satellite service uplinks.

2.7.2 Assignments

There are 10 non-Government assignments in the 1610 - 1626.5 MHz band, including some in the broadcasting, public safety, and land transportation service categories. There are 16 Government assignments in the band, mostly experimental testing.

2.8 The 1626.5 - 1645.5 MHz Band

2.8.1 Services Allocated

The 1626.5 - 1645.5 MHz band is allocated worldwide to the Maritime Mobile-Satellite (Earth-to-space) service. It is used for the INMARSAT uplinks, paired with the downlinks at 1535 - 1544 MHz.

2.8.2 Assignments

There are 19 non-Government assignments in the 1626.5 - 1645.5 MHz band, including some to the industrial, public safety, and radio location service categories. There are 29 Government assignments in the band, including experimental testing, mobile satellite, and altimeters. As in the corresponding downlink band, a single entry in the GMF may represent many stations authorized to operate in USP or on the high seas. In fact, the system is used by 12,000 ships worldwide.

2.9 The 1645.5 - 1646.5 Band

2.9.1 Services Allocated

The 1645.5 - 1646.5 MHz band is allocated worldwide to the Mobile-Satellite (Earth-to-space) service.

2.9.2 Assignments

There are two non-Government assignments in the 1645.5 - 1646.5 MHz band to auxiliary broadcast services. There are no Government assignments in this band. Plans exist for relay of distress and safety signals between satellites.

2.10 The 1646.5 - 1660.5 MHz Band

2.10.1 Services Allocated

The 1646.5 - 1660.5 MHz band is allocated worldwide to the Aeronautical Mobile-Satellite (R) (Earth-to-space) service. It will be used for the uplink for the nationwide mobile satellite service authorized by the FCC. This service will be operated by the American Mobile Satellite Corporation.

The 1660.0 - 1660.5 MHz portion of this band is also used for passive radio astronomy observations.

2.10.2 Assignments

There are eight non-Government assignments in the 1646.5 - 1660 MHz band to industrial, public safety, and radio location users. There are six Government assignments in the band.

2.11 The 1660.5 - 1668.4 MHz Band

The 1660.5 - 1668.4 MHz band is allocated to the Radio Astronomy and (passive) Space Research services. No transmissions are authorized in the band.

2.12 The 1668.4 MHz - 1670 MHz Band

The 1668.4 - 1670 MHz band is allocated to Meteorological Aids (Radiosonde) and Radio Astronomy, both on a primary basis for Government and non-Government users.

There is one experimental Government assignment in this band.

2.13 The 1670 - 1690 MHz Band

2.13.1 Services Allocated

The 1670 - 1690 MHz band is shared by Government and non-Government users in the Meteorological Aids (Radiosonde) and Meteorological-Satellite (space-to-Earth) services.

2.13.2 System Characteristics

The radiosondes are typically balloon-borne with powers of 1 - 20 W and protected in an operational radius of 320 km (200 mi). The receivers for the GOES satellite downlinks are in this band.

2.13.3 Assignments

There are three non-Government assignments in the 1670 - 1690 MHz band to petroleum and experimental service categories. There are 312 Government assignments in the band, almost all are radiosondes. Each assignment represents 1 - 10 stations, and some assignments are authorized for use anywhere in the U.S. or its possessions.

Figure 6 shows that the assignments are distributed nearly uniformly across the U.S. Most of the meteorological satellite users are receive-only Earth stations that do not require licenses and are not necessarily recorded in the GMF.

2.14 The 1690 - 1700 MHz Band

2.14.1 Services Allocated

In the U.S., the 1690 - 1700 MHz band is shared by Government and non-Government users of the Meteorological Aids (Radiosonde) and Meteorological-Satellite (space-to-Earth) services.

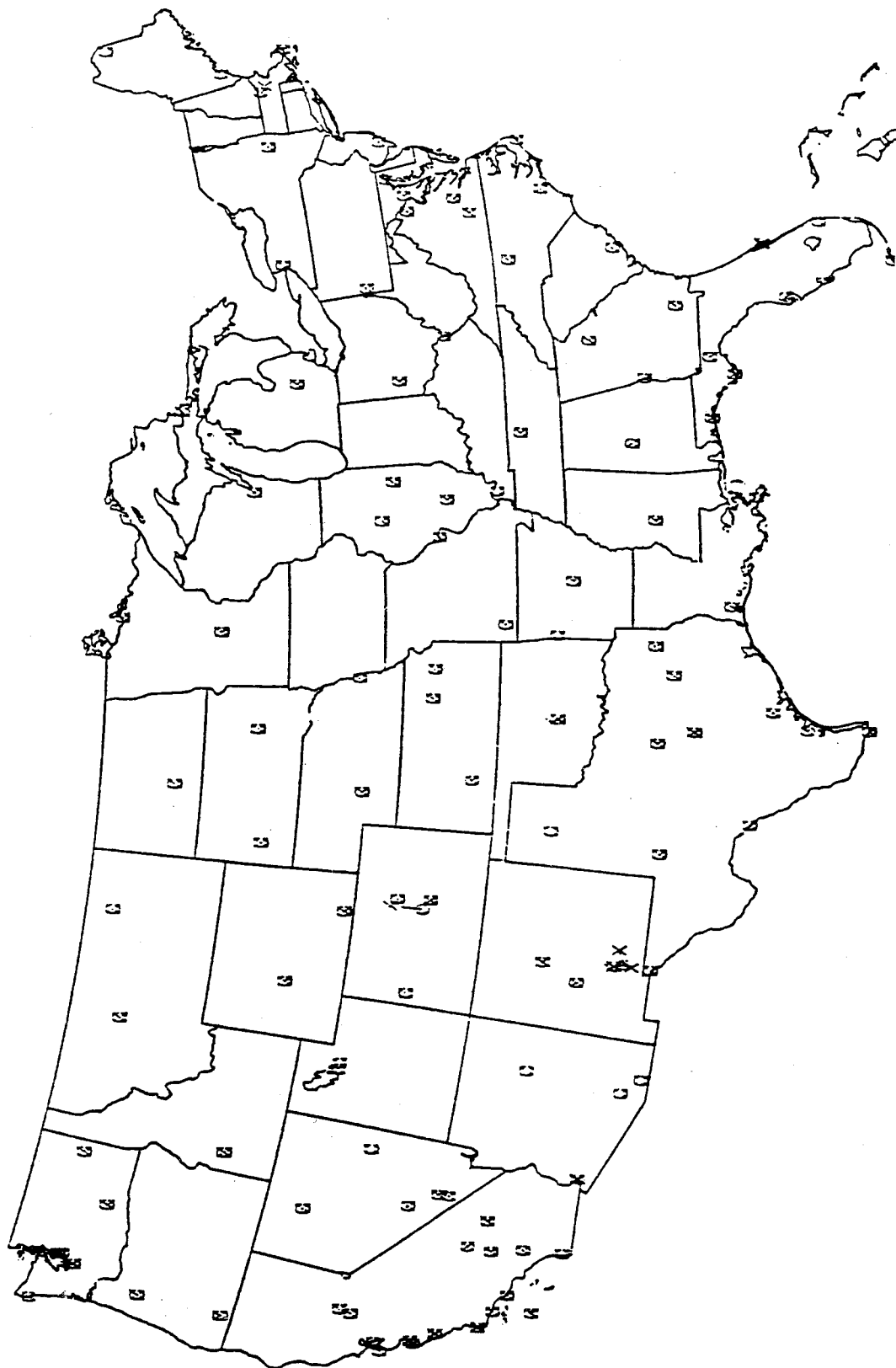


Figure 6. Geographic distribution of assignments in the 1670 - 1700 MHz band.

2.14.2 System Characteristics

Radiosondes in this band are similar to those in the previous band. In addition, The GOES and TIROS-N weather satellites operate in this band. Most of the assignments are to Earth stations that receive the satellite data.

2.14.3 Assignments

There are 39 Government assignments in this band to meteorological satellite stations, radiosondes, and experimental testing. However, the meteorological satellite assignments typically represent 20 - 30 receiving locations.

2.15 The 1700 - 1710 MHz Band

2.15.1 Services Allocated

In the U.S., the 1700 - 1710 MHz band is allocated on a shared primary basis to the Fixed service and the Meteorological-Satellite (space-to-Earth) services.

2.15.2 System Characteristics

This band contains the downlinks for the earth stations for the meteorological satellites mentioned in the previous band (TIROS-N). There are also a number of microwave links in the Fixed service.

2.15.3 Assignments

The 1987 FCC data base shows 11 non-Government assignments in the 1700 - 1710 MHz band to the petroleum service and to experimental stations. There are 35 Government assignments to meteorological satellite stations and the fixed service. The 14 satellite assignments each represent 20 - 30 receiving earth stations. There are also an unknown number of receivers that are not recorded.

2.16 The 1710 - 1850 MHz Band

2.16.1 Services Allocated

The U.S. allocation of the 1710 - 1850 MHz band is to the Federal Government on an exclusive basis.

The 1710 - 1850 MHz band is allocated to the Fixed and Mobile Services on a shared primary basis. Footnote G42 allows certain space command, control, range, and range rate systems in the band 1761 - 1842 MHz on a coequal basis.

2.16.2 System Characteristics

The 1710 - 1850 MHz band is the major Government band for accommodating medium-channel-capacity point-to-point microwave links. For multi-channel telephony, typical capacity varies from 24 to 600 channels with most necessary bandwidths being in the range from 0.5 to 10 MHz. Most of the assignments in the band are for such systems.

Other types of systems operating in this band include: military radio relay equipment for tactical and training use, air-to-ground and air-to-air video/data links for testing, training, and limited operational use, aeronautical mobile stations for telemetry, and space uplinks.

2.16.3 Assignments

In 1990, there are 5,775 Government assignments in the 1710 - 1850 band. In 1984 there were only 2,590 Government assignments.

Figure 7 shows the frequency distribution of the 1984 assignments (Grant and Chilton, 1984); the frequency distribution of the assignments in 1990 is probably similar, but with twice the total number. About 400 new Government assignments are being added to this band each year.

Figure 8 shows the geographic distribution of the assignments in the band in 1983 (Grant and Chilton, 1984). There is heavy usage in the Southwest and in the Northeast corridor. The 1990 geographic distribution is probably similar to that in 1983.

There are 30 non-Government assignments in this band, many to experimental systems, but a few to radio-location stations and special industrial services.

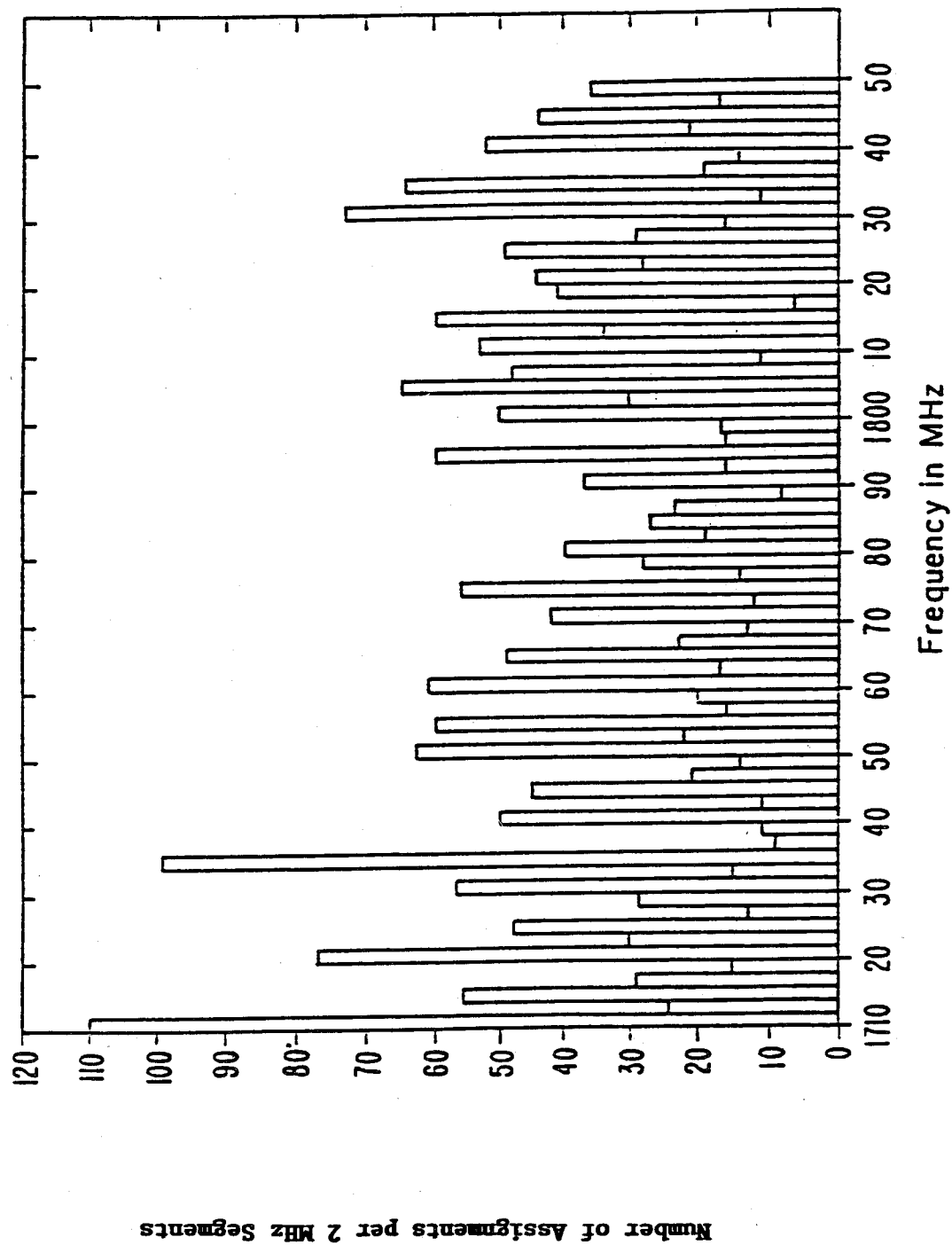


Figure 7. Frequency distribution of Government assignments in the 1710 - 1850 MHz band in 1984 (Grant and Chilton, 1984).

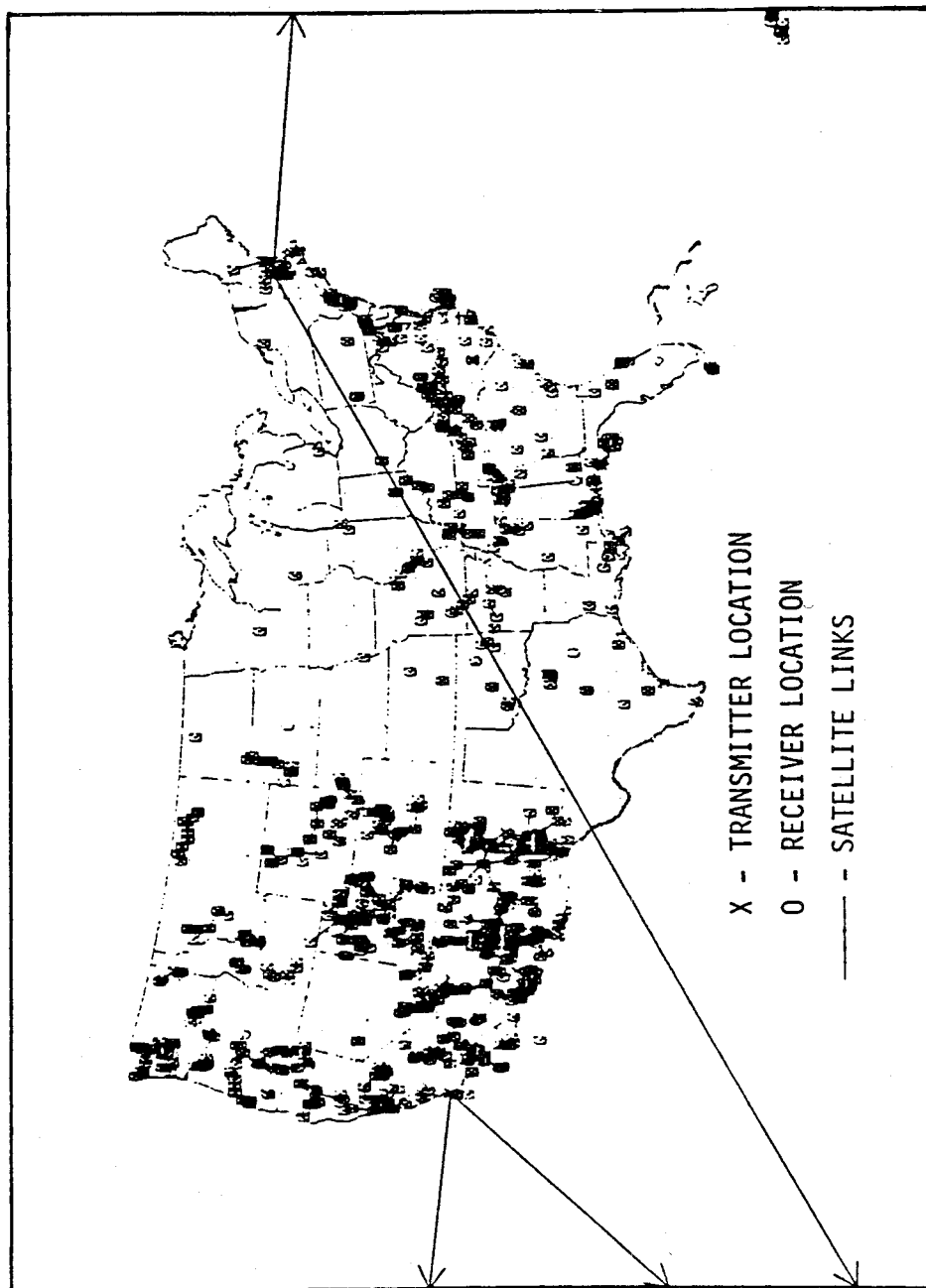


Figure 8: Geographic distribution of Government assignments in the 1710 - 1850 MHz band in 1983 (Grant and Chilton, 1984). The arrows are antenna pointing angles for Earth stations.

2.17 The 1850 - 1990 MHz Band

2.17.1 Services Allocated

In the U.S., the 1850 - 1990 MHz band is allocated exclusively to the non-Government Fixed service -- microwave line-of-sight links.

2.17.2 Assignments

In the 1987 FCC data base, there were 8,155 non-Government assignments in the 1850 - 1990 MHz band. These assignments are mostly in the power, petroleum, railroad, and local government service categories.

2.18 The 1990 - 2110 MHz Band

2.18.1 Services Allocated

In the U.S., the 1990 - 2110 MHz band is allocated to non-Government services and is shared by the Fixed and Mobile services. Footnotes US90, US111, US219, and US252 authorize use of the band from 2025 MHz to 2110 MHz for Earth exploration, space operations, and space research activities.

2.18.2 System Characteristics

The non-Government services assigned in the band are primarily auxiliary broadcasting, including remote pickup (mobile), TV translators, and inter-city relay of TV. This is NASA's major band for uplinks for its earth stations in its global ground network.

2.18.3 Assignments

There are about 5,700 non-Government assignments in the 1990 - 2100 MHz band, mostly to the auxiliary broadcast service category. There are 133 Government assignments, mainly uplinks to the TDRSS, GOES, Landsat, and other satellite and space research operations.

2.19 The 2110 - 2200 MHz Band

2.19.1 Services Allocated

In the U.S., the 2110 - 2200 MHz band is mostly non-Government, and is allocated to the Fixed service. This includes point-to-point microwave links for common carriers and private networks, and some multipoint distribution systems. Footnotes US111 and US252 authorize certain space research uses.

2.19.2 Assignments

There are 17,489 assignments in the 2100 - 2200 MHz band to common carriers. The assignments are mostly in the point-to-point microwave and domestic land mobile service categories.

There are 121 Government assignments in the band, primarily for Earth-to-space links for NASA's deep space network, but including some experimental systems.

2.20 The 2200 - 2290 MHz Band

2.20.1 Services Allocated

In the U.S., this band is allocated exclusively to the Federal Government.

The U.S. allocates the 2200 - 2290 MHz band to the Fixed service, the Mobile service, and the Space Research (space-to-Earth) service on a shared primary basis. The Fixed and Mobile services are restricted to line-of-sight propagation. The Mobile service includes aeronautical telemetry, but excludes telemetry from manned aircraft. The band is used primarily for terrestrial and space telemetry.

Footnote US303 allows non-Government space stations to transmit to the Tracking and Data Relay Satellite System (TDRSS) on a case-by-case basis. For more details see the relevant footnote.

2.20.2 System Characteristics

A wide variety of systems operate in the 2200 - 2290 Mhz band. Nearly one-half of the assignments are to mobile stations, mostly used for telemetering. There are some stations in the Fixed Service. Space applications include the TDRSS, and the Air Force Space Groundlink Subsystem. There are also some assignments to experimental stations.

2.20.3 Assignments

There are 2,475 Government assignments in the 2200 - 2290 MHz band. The assignments in the mobile service typically have powers from 1 - 20 W, represent 1 - 30 stations, and are protected in operational areas with radii of 80 - 320 km (50 - 200 mi). Some are authorized to operate anywhere in the U.S.

The frequency distribution of the assignments in this band in 1984 are shown in Figure 9 (Grant and Chilton, 1984). The geographic distribution in 1984 is shown in Figure 10. These distributions probably represent the current situation fairly well.

2.21 The 2290 - 2300 MHz Band

2.21.1 Services Allocated

The 2290 - 2300 MHz band is shared by Government and non-Government users. The Government allocation is to the Space Research (space-to-Earth, deep space only), Fixed, and Mobile (except aeronautical mobile services), all on a primary basis. The non-Government allocation is to the Space Research (space-to-Earth, deep space only) service. NOTE: "Deep Space" designates space craft operating outside of Earth orbit, e.g., probes to other planets.

2.21.2 System Characteristics

NASA uses this band for Deep Space Network space-to-Earth telemetry. The assignments support, or will support, Pioneers 6 through 12, Voyagers 1 and 2, MAGELLAN, GALILEO, and ULYSSES.

2.21.3 Assignments

There are 3 non-Government assignments in the 2290 - 2300 MHz band. There are 35 Government assignments in the band.

2.22 The 2300 - 2310 MHz Band

2.22.1 Services Allocated

The 2300 - 2310 MHz band is shared by Government and non-Government services. This restriction limits the use of aeronautical mobile service in this band.

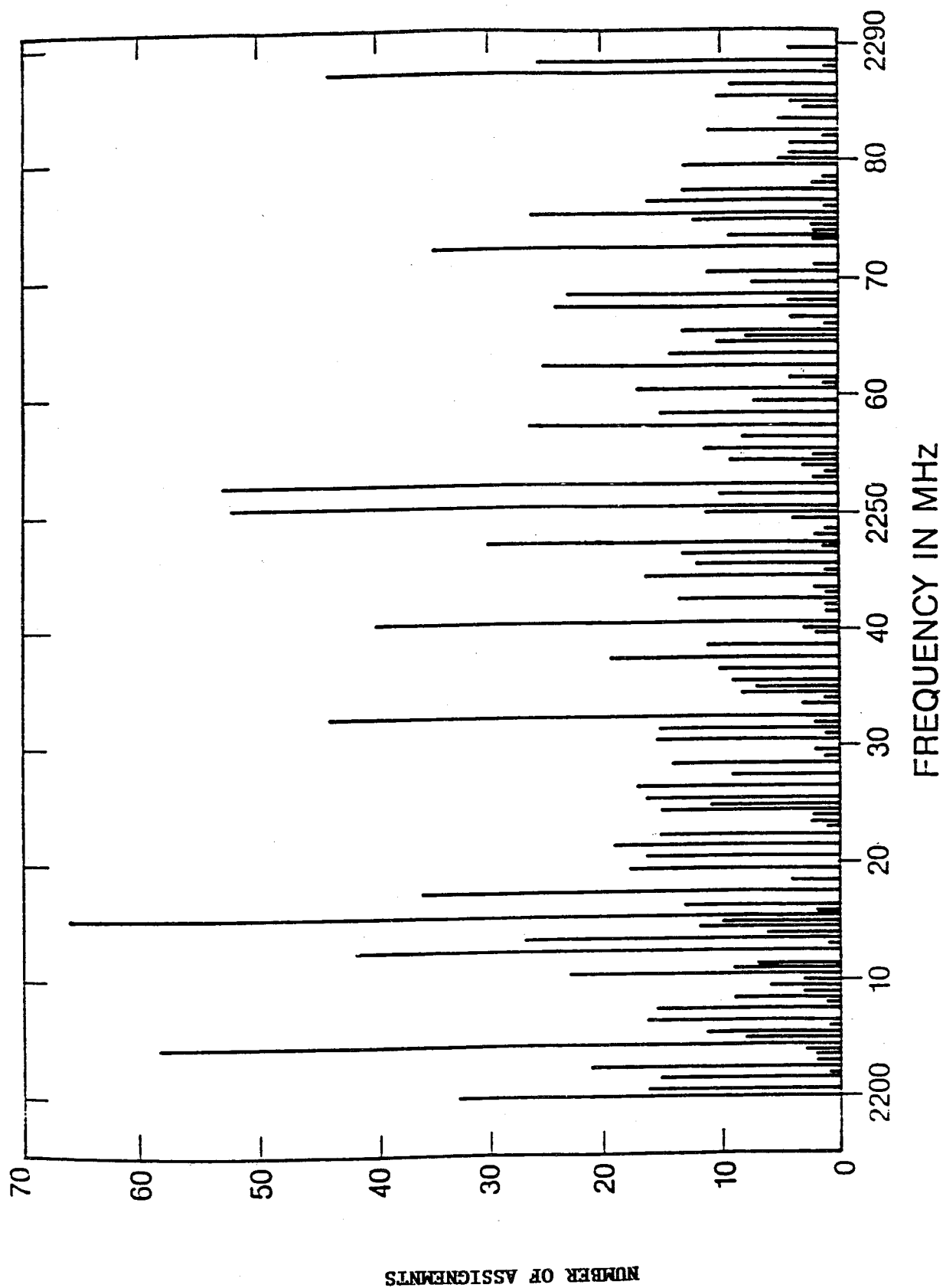


Figure 9. Frequency distribution of Government assignments in the 2200 - 2290 MHz band in 1984 (Grant and Chilton, 1984).

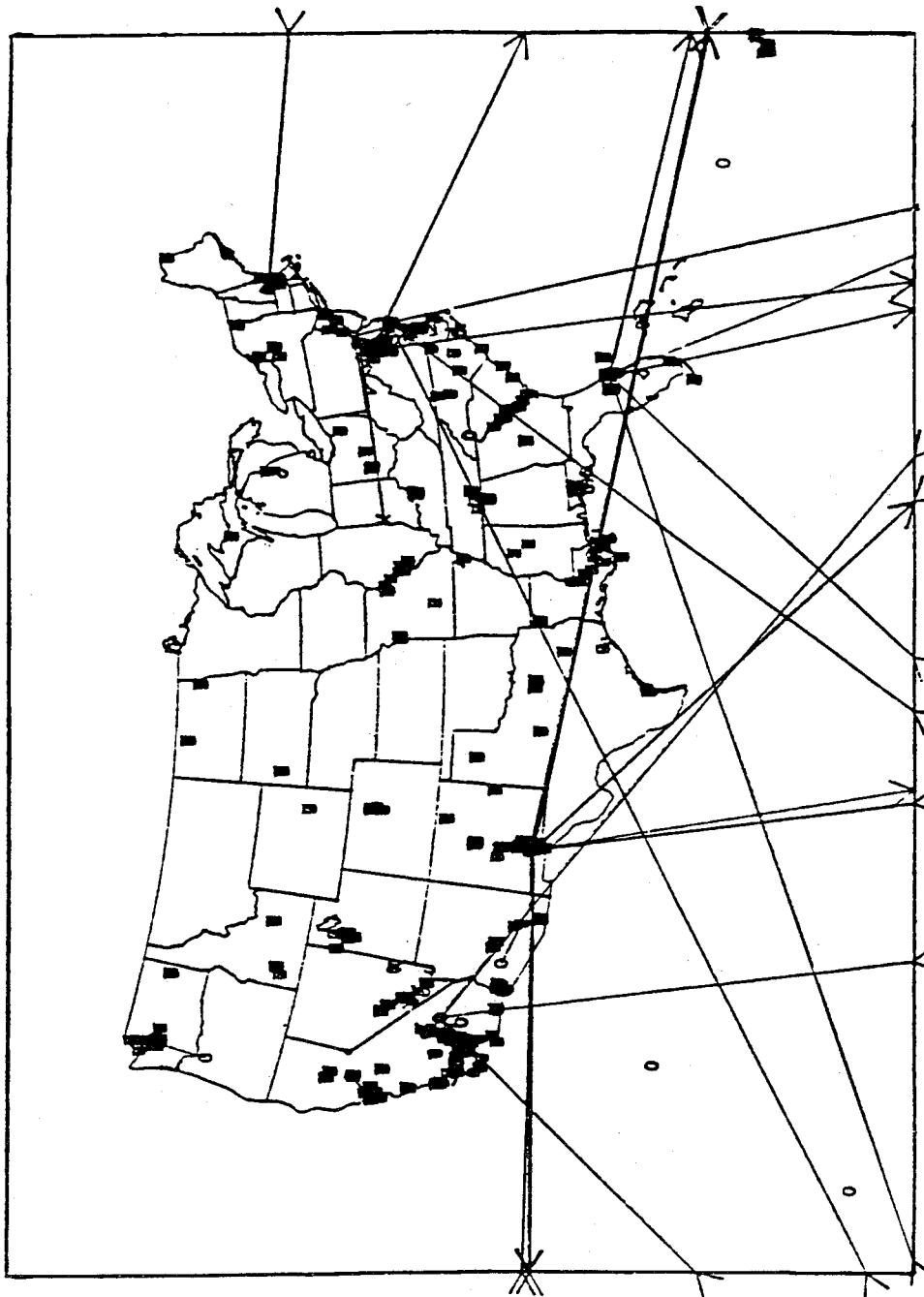


Figure 10. Geographic distribution of Government assignments in the 2200-2290 MHz Band in 1984 (Grant and Chilton, 1984). The arrows are antenna pointing angles for Earth stations.

The Government allocates this band to the Radiolocation service on a primary basis, and to the Fixed and Mobile services on a secondary basis. The band is allocated to the non-Government Amateur Service on a secondary basis. However, Footnote US253 states that "the fixed and mobile services shall not cause harmful interference to the amateur service."

2.22.2 System Characteristics

Government assignments in this band are to experimental equipment. Uses include antenna test ranges and mobile radionavigation. The nature of the Amateur equipment is unknown.

2.22.3 Assignments

There are 26 Government assignments in this band, mostly for experimental testing.

There are two non-Government assignments in the 2300 - 2310 MHz band.

2.23 The 2310 - 2390 MHz Band

2.23.1 Services Allocated

This band is shared by Government and non-Government services.

The Government allocates the 2310 - 2390 MHz band to the Radiolocation and Mobile services on a shared primary basis. However, in the Mobile service, only aeronautical telemetering and telecommand operations for flight testing of aircraft and missiles is primary, with all other uses secondary. The Government allocates this band to the Fixed service on a secondary basis.

The non-Government allocation is to the Mobile service. New FCC rules authorize use of telemetry from expendable launch vehicles.

2.23.2 System Characteristics

This band is used for aeronautical telemetry, high-power, long-range surveillance radar, air-traffic-control radar, and air/ground ranging systems. Powers range from 0.1 W to 1.6 MW.

2.23.3 Assignments

There are 141 Government assignments in the 2310 - 2390 MHz band. Some assignments are for several stations, and some authorize operations anywhere in the U.S., its possessions, and on the high seas.

The 1987 FCC data base shows no non-Government assignments in this band.

2.24 The 2390 - 2450 MHz Band

2.24.1 Services Allocated

The Government allocates this band to the Radiolocation service. The non-Government allocation is to the Amateur service. Footnote 752 states that the band 2400 - 2500 MHz is designated for industrial, scientific and medical (ISM) applications. Radio services operating in this band must accept any harmful interference that may be caused by ISM equipment.

2.24.2 Assignments

There are 51 non-Government assignments in the 2390 - 2450 MHz band. There are 61 Government assignments in the band, primarily to experimental systems. Note that ISM devices do not require an assignment. Microwave ovens are major ISM devices that use the 2400 - 2500 MHz band, and leakage from these ovens can be observed in most populated areas.

2.25 The 2450 - 2483.5 MHz Band

2.25.1 Services Allocated

The 2450 - 2483.5 MHz band is exclusively non-Government. It is allocated to the Fixed and Mobile services on a primary basis, and to the Radiolocation service on a secondary basis. Footnote US41 permits some Government radiolocation use.

2.25.2 Assignments

There are 560 non-Government assignments in the 2450 - 2483.5 MHz band, mostly to the auxiliary broadcast, petroleum, and radiolocation services. There are 12 Government assignments, including radars authorized to operate in the Pacific and the Atlantic, experimental systems, and some law enforcement radiolocation systems on a secondary basis.

2.26 The 2483.5 - 2500 MHz Band

2.26.1 Services Allocated

The 2483.5 - 2500 MHz band is exclusively non-Government. It is allocated to the Radiodetermination Satellite (space-to-Earth) service. Footnote NG147 authorizes continued operation of private radio services licensed prior to July 25, 1985 in the band.

2.26.2 Assignments

There are 150 assignments in the 2483.5 - 2500 MHz band, mostly to the petroleum service category.

3. DISCUSSION

This report has listed the services allocated to each service band between 1435 MHz and 2500 MHz, along with the footnotes authorizing other uses. The report describes the types of systems used in the bands, and some of the types of systems planned for the bands.

The report lists the number of assignments in each service band (derived from the Government Master File and the FCC data service available to us), and shows the geographic distribution of assignments in some heavily populated Government bands. However, the number of assignments, and the location of those that have locations listed, does not tell the whole story of band usage. In some services, a single authorization (assignment) is all that is necessary for all the stations an agency may have--for example, Earth stations for INMARSAT. Many Government assignments to a specific frequency may apply to a number of individual equipments. For example, in the Government Master File, one datum may indicate that the assignment applies to 1-10 stations, or to 11-30 stations, etc. But this data field is not required for all services, so there may be multiple users even when it is not shown. Thus, it is generally not possible to determine the number of stations in a band from the GMF.

It may also be impossible to determine the geographic location of all stations in a band. Some assignments in the GMF are authorized for use anywhere within a specified area, often, anywhere in the United States or its possessions, or anywhere on the high seas.

Some users do not require assignments or licenses. For example, low power [CFR 1990 , Title 47] ("Part 15") devices do not need to be licensed, and Industrial, Scientific, and Medical (ISM) [CFR 1990, Title 47] uses are authorized in the range from 2400 MHz to 2500 MHz.

However, most of the bands in the range 1435 - 2500 MHz are heavily populated. Some bands that are not now heavily populated, such as the Aeronautical Mobile Satellite band, have been allocated worldwide for new services, and are expected to be heavily used by these new services in the near future.

4. REFERENCES

- CFR (1990), Code of Federal Regulations, Telecommunications, Title 47, (U.S. Government Printing Office, Washington, DC).
- Grant, W. B., and C. J. Chilton (1984), Spectrum resource assessment of the fixed and mobile services in the 947 - 17,700 MHz band, Phase I, NTIA Report 84-161 (NTIS Order No. PB 85-128288).
- Matos, F. (1984), Spectrum resource assessment of the aeronautical mobile service between 400 MHz and 17.7 GHz, NTIA Report 84-162 (NTIS Order No. PB 85-125995).
- NTIA (1989, with May 1990 revisions), *Manual of Regulations and Procedures for Federal Radio Frequency Management*, National Telecommunications and Information Administration, SupDocs Stock No. 903-008-00000-8 (Superintendent of Documents, U.S. Government Printing Office, Washington, DC).

APPENDIX A: ALLOCATION TABLE FOOTNOTES

This appendix contains footnotes that are cited in the U.S. Table of Allocations for bands between 1435 MHz and 2500 MHz. The Table is shown as Figure 2 in the text of the Report.

A.1 International Footnotes

664 - In the bands 435-438 MHz, 1260-1270 MHz, 2400-2450 MHz, 3400-3410 MHz (in Regions 2 and 3 only) and 5650-5670 MHz, the amateur-satellite service may operate subject to not causing harmful interference to other services operating in accordance with the Table (see No. 435). Administrations authorizing such use shall ensure that any harmful interference caused by emissions from a station in the amateur-satellite service is immediately eliminated in accordance with the provisions of No. 2741. The use of the bands 1260-1270 MHz and 5650-5670 MHz by the amateur-satellite service is limited to the Earth-to-space direction.

671 - Earth exploration-satellite service applications, other than the meteorological-satellite service, may also be used in the bands 460-470 MHz and 1690-1710 MHz for space-to-Earth transmissions subject to not causing harmful interference to stations operating in accordance with the Table.

722 - In the bands 1400-1727 MHz, 101-120 GHz and 197-220 GHz, passive research is being conducted by some countries in a programme for the search for intentional emissions of extra-terrestrial origin.

728 - The use of the bands 1544-1545 MHz (space-to-Earth) and 1645.1-1646.5 MHz (Earth-to-space) by the mobile-satellite service is limited to distress and safety operations.

729 - Transmissions in the band 1545-1559 MHz from terrestrial aeronautical stations directly to aircraft stations, or between aircraft stations, in the aeronautical mobile (R) service are also authorized when such transmissions are used to extend or supplement the satellite-to-aircraft links.

732 - The band 1610-1626.5 MHz is reserved on a worldwide basis for the use and development of airborne electronic aids to air navigation and any directly associated ground-based or satellite-borne facilities. Such satellite use is subject to agreement obtained under the procedure set forth in Article 14.

733 - The bands 1610-1626.5 MHz, 5000-5250 MHz and 15.4-15.7 GHz are also allocated to the aeronautical mobile-satellite (R) service on a primary basis. Such use is subject to agreement obtained under the procedure set forth in Article 14.

734 - The band 1610.6-1613.8 MHz is also allocated to the radio astronomy service on a secondary basis for spectral line observations. In making assignments to stations of other services to which the band is allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 343 and 344 and Article 36).

735 - Transmissions in the band 1646.1-1660.5 MHz from aircraft stations in the aeronautical mobile (R) service directly to terrestrial aeronautical stations, or between aircraft stations, are also authorized when such transmissions are used to extend or supplement the aircraft-to-satellite links.

736 - In making assignments to stations of other services to which the band 1660-1670 MHz is allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 343 and 344 and Article 36).

752 - The band 2400-2500 MHz (center frequency 2450 MHz is designated for industrial, scientific and medical (ISM) applications. Radio Services operating within this band must accept harmful interference which may be caused by these applications. ISM equipment operating in this band is subject to the provisions of No. 1815.

A.2 U.S. Footnotes

US39 - Radio Altimeters are permitted to use the band 1600-1660 MHz only until such time as international standardization of other aeronautical radionavigation systems or devices requires the discontinuance of radio altimeters in this band.

US41 - The Government radiolocation service is permitted in the band 2450-2500 MHz on the condition that harmful interference is not caused to non-Government services.

US74 - In the bands 25/55-25.67, 73-74.6, 406.1-410, 608-614, 1400-1427, 1660.5-1670, 2690-2700, and 4990-5000 MHz and in the bands 10.68-10.7, 15.35-15.4, 23.6-24, 31.3-31.8, 86-92, 105-116, and 217-231 GHz, the radio astronomy service shall be protected from extra-band radiation only to the extent that such radiation exceeds the level which would be present if the offending station were operating in compliance with the technical standards or criteria applicable to the service in which it operates.

US78 - The frequencies between 1435-1535 MHz will be assigned for aeronautical telemetry and associated telecommand operations for flight testing of manned or unmanned aircraft and missiles, or their major components. Permissible usage includes telemetry associated with launching and reentry into the earth's atmosphere as well as any incidental orbiting prior to reentry of manned or unmanned objects undergoing flight tests. The following frequencies are shared with flight telemetering mobile stations: 1444.5, 1453.5, 1501.5, 1515.5, 1524.5 and 1525.5 MHz. In the band 1530-1535 MHz, the Maritime Mobile-satellite Service will be the only primary service after January 1, 1990.

US90 - In the band 2025-2110 MHz earth-to-space and space-to-space transmissions may be authorized in the space research and earth exploration-satellite services subject to such conditions as may be applied on a case-by-case basis. Such transmissions shall not cause harmful interference to non-Government stations operating in accordance with the Table of Frequency Allocations. All

space-to-space transmission reaching the earth's surface shall adhere to a power flux density of between -144 and -154 dbw/m²/4 kHz depending on the angle of arrival per ITU Radio Regulation 2557 and shall not cause harmful interference to the other space services.

US99 - In the band 1668.4-1670 MHz, the meteorological aids service (radiosonde) will avoid operations to the maximum extent practicable. Whenever it is necessary to operate radiosondes in the band 1668.4-1670 MHz within the United States, notification of the operations shall be sent as far in advance as possible to the Electromagnetic Spectrum Management Unit, National Science Foundation, Washington, D.C. 20550.

US111 - In the band 1990-2120 MHz, Government space research earth stations may be authorized to use specific frequencies at specific locations for the earth-to-space transmissions. Such authorizations shall be secondary to non-Government use of this band and subject to such other conditions as may be applied on a case-by-case basis.

Corpus Christi, Tex.,	27° 39' N 097° 23' W
Fairbanks, Alaska,	64° 59' N 147° 53' W
Goldstone, Calif.,	35° 18' N 116° 54' W
Greenbelt, MD.,	39° 00' N 076° 50' W
Guam, Marianas Is.,	13° 19' N 144° 44' E
Kauai, Hawaii,	22° 08' N 159° 40' W
Merrit Is., Fla.,	28° 29' N 080° 35' W
Rosman, N. C.,	35° 12' N 082° 52' W
Wallops Is., VA.,	37° 57' N 075° 28' W

US208 - Planning and use of the band 1559-1626.5 MHz necessitate the development of technical and/or operational sharing criteria to ensure the maximum degree of electromagnetic compatibility with existing and planned systems within the band.

US211 - In the bands 1670-1690, 5000-5250 MHz and 10.7-11.7, 15.1365-15.35, 15.4-15.7, 22.5-22.55, 24-24.05, 31.0-31.3, 31.8-32, 40.5-42.5, 84-86, 102-105, 116-126, 151-164, 176.5-182, 185-190, 231-235, 252-265 GHz, applicants for airborne or space station assignments are urged to take all practicable steps to protect observations in the adjacent exclusive radio astronomy bands from harmful interference; however, US74 applies.

US219 - In the band 2025-2120 MHz Government Earth Resources Satellite Earth Stations in the Earth Exploration-Satellite Service may be authorized to use the frequency 2106.4 MHz for earth-to-space transmissions for tracking, telemetry, and telecommand at the sites listed below. Such transmissions shall not cause harmful interference to non-Government operations:

Sioux Falls, S. D.,	43° 32' 03.1" N 96° 45' 42.8" W
Fairbanks, Alaska,	64° 58' 36.6" N 147° 30' 54.2" W

US222 - In the band 2025-2110 MHz Geostationary Operational Environmental Satellite Earth stations in the Space Research and Earth Exploration-Satellite Services may be authorized on a coequal basis to use the frequency band 2025-2035 MHz for earth-to-space transmissions for tracking, telemetry, and telecommand at the sites listed below:

Wallops IS., Va.,	37° 50' 48" N 75° 27' 33" W
Seattle, Wa.,	47° 34' 15" N 122° 33' 10" W
Honolulu, Ha.,	21° 21' 12" N 157° 52' 36" W

US246 - No stations will be authorized to transmit in the bands 608-614 MHz, 1400-1427 MHz, 1660.5-1668.4 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.3-31.8 GHz, 51.4-54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 100-102 GHz, 105-116 GHz, 164-168 GHz, 182-185 GHz and 217-231 GHz.

US252 - The bands 2110-2120 and 7145-7190 MHz, 34.2-34.7 GHz are also allocated for earth-to-space transmissions in the Space Research Service, limited to deep space communications at Goldstone, California.

US253 - In the band 2300-2310 MHz, the fixed and mobile services shall not cause harmful interference to the amateur service.

US256 - Radio Astronomy observations may be made in the band 1718.8-1722.2 MHz on an unprotected basis. Agencies providing other services in this band in the geographic areas listed below should bear in mind that their operations may affect those observations, and those agencies are encouraged to minimize potential interference to the observations insofar as it is practicable.

National Astronomy and and Ionosphere Center Arecibo, Puerto Rico	Rectangle between latitudes 17°30'N and 19°00'N and between longitudes 65°10'W and 68°00'W
Haystack Radio Observatory Tyngsboro, Massachusetts	Rectangle between latitudes 41°00'N and 43°00'N and between longitudes 71°00'W and 73°00'W
National Radio Astronomy Observatory Green Bank, West Virginia	Rectangle between latitudes 37°00'N and 39°15'N and between longitudes 78°30'W and 80°30'W
National Radio Astronomy Observatory Socorro, New Mexico	Rectangle between latitudes 32°30'N and 35°30'N and between longitudes 106°00'W and 109°00'W
Owens Valley Radio Observatory Big Pine, California	Two contiguous rectangles, one between latitudes 36°00'N and 37°00'N and between longitudes 117°40'W and 118°30'W and the second between latitudes 37°00'N

and 38°00'N and longitudes
118°00'W and 118°50'W

Hat Creek Observatory Rectangle between latitudes 40°00'N
Hat Creek, California and 42°00'N and between longitudes
120°15'W and 122°15'W

US260 - Aeronautical mobile communications which are an integral part of aeronautical radionavigation systems may be satisfied in the bands 1559-1626.5 MHz, 5000-5250 MHz and 15.4-15.7 GHz.

US272 - The allocation to the Maritime Mobile-Satellite Service in the band 1530-1535 MHz shall be effective from 1 January 1990. Up to that date the allocation to the Mobile Service will be on a primary basis.

US276 - Use of the band 2310-2390 MHz by the mobile service is limited to aeronautical telemetering and associated telecommand operations for flight testing of manned or unmanned aircraft, missiles or major components thereof. Exceptionally all other mobile telemetering uses shall be secondary.

US303 - In the band 2285-2290 MHz, non-Government space stations in the space research, space operations and earth exploration-satellite services may be authorized to transmit to the Tracking and Data Relay Satellite System subject to such conditions as may be applied on a case-by-case basis. Such transmissions shall not cause harmful interference to authorized Government stations. The power flux density at the Earth's surface from such non-Government stations shall not exceed -144 to -154 dBW/m²/4 kHz, depending on angle of arrival, in accordance with ITU Radio Regulation 2557.

US306 - The band 1610-1626.5 MHz is also allocated for use by the radiodetermination satellite service in the Earth-to-space direction.

US308 - In the frequency bands 1549.5-1558.5 MHz and 1651-1660 MHz, the Aeronautical Mobile-Satellite (R) requirements that cannot be accommodated in the 1545-1549.5 MHz, 1558.5-1559 MHz, 1646.5-1651 MHz and 1660-1660.5 MHz bands shall have priority access with real-time preemptive capability for communications in the mobile-satellite service. Systems not interoperable with the aeronautical mobile-satellite (R) service shall operate on a secondary basis. Account shall be taken of the priority of safety-related communications in the mobile-satellite service.

A.3 GOVERNMENT FOOTNOTES

G2 - In the bands 216-225, 420-450 (except as provided by US217), 890-902, 1300-1400, 2300-2450, 2700-2900, 5650-5925, and 9000-9200 MHz, the Government radiolocation is limited to the military services.

G30 - In the bands 138-144, 148-149.9, 150.05-150.8, 1427-1429 and 1429-1435 MHz, the fixed and mobile services are limited primarily to operations by the military services.

G42 - Space command, control, range and range rate systems for earth stations transmission only (including installations on certain Navy ships) may be accommodated on a co-equal basis with the fixed and mobile services in the band 1761-1842 MHz. Specific frequencies required to be used at any location will be satisfied on a coordinated case-by-case basis.

G101 - In the band 2200-2290 MHz, space operations (Space-to-Earth) and (Space-to-space), and earth exploration-satellite (Space-to-Earth) and (Space-to-space) services, may be accommodated on a co-equal basis with fixed, mobile and space research service.

G118 - Government fixed stations may be authorized in the band 1700-1710 MHz only if spectrum is not available in the band 1710-1850 Mhz.

G120 - Development of airborne primary radars in the band 2310-2390 MHz with peak transmitter power in excess of 250 watts for use in the United States is not permitted.

A.4 NON-GOVERNMENT FOOTNOTES

NG23 - Frequencies in the band 2100-2200 MHz may also be assigned to stations in the international fixed public radio service located south of 25°30' north latitude in the State of Florida and in U.S. Possessions in the Caribbean area, provided, however, no new assignments in the band 2150-2162 MHz will be made to such stations after February 25, 1974.

NG118 - Television translator relay stations may be authorized to use frequencies in this band on a secondary basis to stations operating in accordance with the Table of Frequency Allocations.

NG147 - Stations in the broadcast auxiliary service and private radio services licensed as of July 25, 1985, or on a subsequent date following as a result of submitting an application for license on or before July 25, 1985, may continue to operate on a primary basis with the radiodetermination satellite service.

BIBLIOGRAPHIC DATA SHEET

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