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PAGES
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Register Federal

highlights

SUNSHINE ACT MEETINGS..... 27713

BLOOD PRODUCTS
HEW/FDA sets additional standards for normal serum albumin (human) and plasma protein fraction (human); effective 8-29-77..... 27575

EDUCATION AND WORK GRANTS PROGRAM
HEW/NIE announces closing date of 7-7-77 for receipt of applications..... 27577
HEW proposes change in research topics funded; comments by 7-15-77..... 27626

INSURANCE
PBGC extends comment period to 6-17-77 on rules pertaining to allocation and valuation of plan assets (2 documents)..... 27615, 27616

METRIC CONVERSION
DOT/St. Lawrence Seaway Development Corporation amends regulations to coordinate and plan use of metric system; effective 5-31-77..... 27585

COMMUNITY FOOD AND NUTRITION
CSA issues interim rule providing for variety of needs of low-income groups; comments by 6-30-77..... 27593

AIR SAFETY
DOT/FAA requires domestic and flag air carriers adopt an approved system for obtaining forecasts and reports of adverse weather conditions that may affect safety of a flight while en route and at each airport to be used; effective 6-30-77; compliance date 12-31-77..... 27572

INDIAN AFFAIRS
Interior/BIA proposes establishment of term "Indian" in eligibility for preference in employment; comments by 7-15-77..... 27609

TRANSPORTATION AND CONSTRUCTION EQUIPMENT
EPA proposes noise emission standards (2 documents); comments by 6-30-77..... 27618, 27620

STATE PLANNING COMMISSIONS PROGRAM
HEW/OE proposes regulations on interstate postsecondary education planning; comments 7-15-77..... 27625

NEW MOTOR VEHICLE CERTIFICATION
EPA issues notice of intent to amend regulations for light-duty vehicles and trucks..... 27669

CONTINUED INSIDE

contents

AGENCY FOR INTERNATIONAL DEVELOPMENT	CUSTOMS SERVICE	Orange County, Calif. County Sanitation Districts Waste-water Management Program, Southern Kennebec Valley, Water Quality Management Plan, Maine..... 27674	FEDERAL DISASTER ASSISTANCE ADMINISTRATION	FOOD AND DRUG ADMINISTRATION
Rules	Rules	Meetings:	Notices	School b
Procurement; registrations, etc.... 27600	Personal declarations and exemptions; inspection, search and seizure:	State-Federal Water Programs Advisory Committee..... 27674	Disaster and emergency areas:	grams; ments
AGRICULTURAL MARKETING SERVICE	Merchandise seized to protect U.S. revenue; correction..... 27599	Pesticides programs:	Missouri..... 27678	ards, C
Rules	EDUCATION OFFICE	Diallate pesticides products containing; rebuttable presumption against registration and continued registration..... 27669	Oregon..... 27679	GEOLOGICAL SURVEY
Beef research information; referendum conduct procedure.... 27569	Proposed Rules		Washington (2 documents)..... 27679	Coal leas
Cherries (sweet) grown in Wash. 27567	State planning commissions program; interstate planning..... 27625	FARMERS HOME ADMINISTRATION	Drought impact; areas, emergency; various States..... 27678	Drug A
Oranges (Valencia) grown in Ark. and Calif..... 27568	Notices	Borrowers and grant recipients, supervision:	FEDERAL ENERGY ADMINISTRATION	Wyomih
Notices	Meetings:	Labor and rural rental housing projects; monthly rental rates; notice to tenants..... 27602	Notices	HEALTH, EDUCATION AND WELFARE
Meetings:	Bilingual Education National Advisory Council..... 27677	FEDERAL AVIATION ADMINISTRATION	Environmental statements; availability, etc.:	DEPAR
Flue-Cured Tobacco Advisory Committee..... 27685	EMERGENCY NATURAL GAS ACT OF 1977, ADMINISTRATOR	Rules	Georgia Power Co.; McManus Generating Station powerplants 1 and 2..... 27675	See Educ
AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE	Notices	Air carriers certification and operations:	FEDERAL POWER COMMISSION	Drug A
Rules	Emergency Natural Gas Act of 1977; emergency orders, etc.:	Weather information, additional..... 27572	Rules	Institut
Beef research and information; referendum conduct procedure, cross references..... 27566	El Paso Natural Gas Co..... 27665	Airworthiness directives:	Policy and interpretations:	See also
Tobacco (flue-cured); marketing quotas and acreage allotments. 27565	EMPLOYMENT AND TRAINING ADMINISTRATION	Canadaair; correction..... 27571	Electric rate schedule filings and filing of comparative rate information..... 27574	Notices
AGRICULTURE DEPARTMENT	Notices	McDonnell Douglas..... 27571	Notices	Committe
See Agricultural Marketing Service; Agricultural Stabilization and Conservation Service; Commodity Credit Corporation; Farmers Home Administration; Food and Nutrition Service; Soil Conservation Service.	Comprehensive Employment and Training Act programs:	Messerschmitt-Bolkow-Blomh..... 27574	Hearings, etc.:	Future
CIVIL AERONAUTICS BOARD	Funds allocation..... 27885	Transition areas..... 27574	Gas Research Institute..... 27675	INDIAN AFFAIRS
Notices	ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION	Proposed Rules	FEDERAL RAILROAD ADMINISTRATION	Proposed
Hearings, etc.:	Rules	Transition areas; extension of time..... 27603	Rules	Preference
Air Midwest, Inc., et al..... 27665	Procurement; mandatory pre-award audit; dollar level raised. 27600	Notices	Employee hours of service; Hours of Service Act; policy statement. 27594	Notices
International Air Transport Association (2 documents)..... 27666	Notices	Organization and functions:	Practice rules:	Distributio
CIVIL SERVICE COMMISSION	Americium-241, price increase; correction..... 27630	Engineering and Manufacturing District Office; moving to Oklahoma City, Okla..... 27704	Petitions for reconsideration..... 27593	Cold Sp
Rules	Awards and grants, Federal assistance manual; issuance..... 27630	Plight Standards District Office, Opa Locka, Fla.; rescinded... 27704	FEDERAL RESERVE SYSTEM	Minutes
Excepted service:	ENVIRONMENTAL PROTECTION AGENCY	FEDERAL COMMUNICATIONS COMMISSION	Rules	Truth-in-lending:
Defense Department..... 27599	Rules	Proposed Rules	Official staff interpretations..... 27570	INTERIOR
Notices	Air quality implementation plans; various States, etc.:	Citizens radio service:	FISH AND WILDLIFE SERVICE	See also F
Meetings:	Ohio..... 27588	Class D transmitters, spurious and harmonic emissions; operating rules; extension of time..... 27622	Rules	Geologic
Federal Employees Pay Council. 27687	Proposed Rules	Frequency allocations and radio treaty matters:	Fishing:	fairs B
COMMERCE DEPARTMENT	Air quality implementation plans; various States, etc.:	External radio frequency power amplifiers, amateur radio service; extension of time..... 27628	Rice Lake National Wildlife Refuge, Minn..... 27599	Service
See also National Oceanic and Atmospheric Administration.	California (4 documents)..... 27616-27618	Type acceptance of equipment requirement, amateur radio service; extension of time..... 27628	Notices	Financial
Rules	Noise abatement programs:	Television broadcast stations: VSP stations, adding in 100 markets; correction..... 27629	Endangered and threatened species permits; applications (5 documents)..... 27680-27684	Adams
Contract appeals, handling procedures; location change; correction..... 27574	Transportation equipment; trucks, medium and heavy..... 27620	Notices	FOOD AND DRUG ADMINISTRATION	Glass E
Notices	Notices	World Administrative Radio Conference..... 27758	Rules	Gregg, I
Technical Advisory Board..... 27687	Air pollution control, new motor vehicles and engines:		Biologics; normal serum albumin (human) and plasma protein fraction (human)..... 27575	Hunt, H
COMMODITY CREDIT CORPORATION	Light duty vehicles and trucks, certification; intent to develop rulemaking..... 27689		Proposed Rules	James, J
Rules	Air quality implementation plans:		Food for human consumption; Butylated hydroxytoluene; use restrictions..... 27603	Quigley, R
Export programs:	Vapor recovery, stage II, gas-line stations; certain final compliance dates, deferral..... 27674		Notices	Roifing,
Agricultural commodities; financing of sales from private stocks..... 27569	Environmental statements; availability, etc.:		Biological product license: Metabolic, Inc.; revocation; change of comment date.... 27678	INTERNAL SECURITY
COMMUNITY SERVICES ADMINISTRATION	Jackson wastewater treatment system, Wyo..... 27668		GRAS or prior-sanctioned ingredients; specification, manufacturing and use; inquiry..... 27676	Proposed
Rules			Meetings:	Income ta
Community Action Programs:			Gastrointestinal Drugs Advisory Committee; agenda change... 27677	Bonds, a
Food and nutrition program... 27593				INTERNATIONAL TRADE COMMISSION

Vol. 42
1977

CONTENTS

Notices	Northeast Nuclear Energy Co. et al..... 27782	SOIL CONSERVATION SERVICE	STATE DEPARTMENT
Marine mammal permit applications, etc.:	Pacific Gas & Electric Co..... 27782	Notices	Notices
Black Hills Marinefund, Inc..... 27687	Philadelphia Electric Co. et al..... 27783	Environmental statements on watershed projects; availability, etc.:	Meetings:
Hogle Zoological Garden..... 27687	Portland General Electric Co. et al..... 27783	Pinto Lake, Calif..... 27688	International Educational and Cultural Affairs, U.S. Advisory Commission..... 27704
Scarpand, Louis, Enterprises, Inc..... 27687	PENSION BENEFIT GUARANTY CORPORATION	STATE DEPARTMENT	Notices
NATIONAL PARK SERVICE	Proposed Rules	Meetings:	International Educational and Cultural Affairs, U.S. Advisory Commission..... 27704
Notices	Plan assets, allocation; extension of time..... 27616	TEXTILE AGREEMENTS IMPLEMENTATION COMMITTEE	Notices
Authority delegations:	Plan assets, valuation; extension of time..... 27616	Notices	Leather articles containing textiles; temporary suspension from restraints; extension of time..... 27668
North Atlantic Region, Superintendents, et al..... 27687	POSTAL SERVICE	TRANSPORTATION DEPARTMENT	See Federal Aviation Administration; Federal Railroad Administration; National Highway Traffic Safety Administration; Saint Lawrence Seaway Development Corporation.
Historic Places National Register; additions, and deletions, etc. 27687	Rules	See Federal Aviation Administration; Federal Railroad Administration; National Highway Traffic Safety Administration; Saint Lawrence Seaway Development Corporation.	
NATIONAL SCIENCE FOUNDATION	Procurement of property and services:		
Notices	Regional Contract and Supply Management Branch, Southern Region; address change... 27588		
Meetings:	SAINT LAWRENCE SEAWAY DEVELOPMENT CORPORATION		
Public Understanding of Science Advisory Panel..... 27700	Rules		
Science Education Projects Advisory Panel, Science for Children Public Service Science Residences and Internships Subpanel..... 27700	Sewage; metric system implementation..... 27545		
NUCLEAR REGULATORY COMMISSION	SECURITIES AND EXCHANGE COMMISSION		
Notices	Proposed Rules		
Environmental Standard Review Plans; availability of draft; inquiry..... 27702	Regulatory		

Vol. 42
1977

List of CFR parts c

The following numerical guide is a list of the parts of each title issued. A cumulative list of parts affected, covering the current to issue. A Cumulative List of CFR Sections Affected is published separately by documents published since the revision date of each title.

5 CFR	19 CFR
213..... 27599	162.....
7 CFR	21 CFR
210..... 27565	610.....
220..... 27565	620.....
Ch. VII..... 27565	630.....
725..... 27565	640.....
908..... 27565	650.....
910..... 27565	660.....
922..... 27567	PROPOSED RULES
1269..... 27569	127.....
1488..... 27569	128.....
	129.....
PROPOSED RULES:	27602.....
1803..... 27602	175.....
12 CFR	176.....
226..... 27570	177.....
14 CFR	178.....
39 (3 documents)..... 27571	180.....
71..... 27574	181.....
181..... 27574	182.....

FEDERAL COMMUNICATIONS COMMISSION

[Docket No. 20271; FCC 77-349]

INTERNATIONAL RADIO REGULATIONS

Fifth Notice of Inquiry¹

In the matter of an inquiry relative to preparation for a General World Administrative Radio Conference of the International Telecommunication Union to consider revision of the international Radio Regulations.

Adopted: May 20, 1977.

Released: May 23, 1977.

By the Commission: Commissioners Wiley, Chairman; and White concurring in part and dissenting in part and issuing a joint statement; Commissioner Fogarty concurring in part and dissenting in part and issuing a statement.

1. On November 24, 1976, the Commission adopted a Third Notice of Inquiry in the above entitled matter (FCC 76-1099, No. 43086). It was released on December 6, 1976 and appeared in the FEDERAL REGISTER on December 13, 1976 (41 FR 54309). The period for comments and reply comments has passed.

2. The primary purpose of the Third Notice was "to present a proposed International Frequency Allocations Table (Article 5) and to solicit comments there-to." The proposed Table represented the status, at that time, of the development of the United States proposal for revisions to Article 5 of the international Radio Regulations; it took into consideration the comments received in response to past notices, the reports of various advisory radio Service Working Groups (SWG), and spectrum requirements made known by Government agencies. The proposed Table was accompanied by a narrative which contained a rationale for its contents and which noted a number of issues that had to be resolved before the U.S. proposal could become final; the narrative solicited specific comments on these issues in order to obtain guidance from the public on resolution of them. In addition, the Third Notice solicited specific comments on a draft protocol concerning the communications of protected medical transports which was proposed for inclusion in the Geneva Convention and on methods proposed for specifying the allowable frequency tolerance of radio transmitters. The Notice further solicited comments on "any other matter relevant to preparation for the 1979 WARC."

3. The names of parties which filed comments and reply comments in response to the Third Notice are given in Appendix 1. Although the comments and reply comments have been considered and will continue to receive attention as this preparatory effort proceeds, they are not summarized herein. Instead, their substance will be treated in the discussion which follows. It is not our intent to dwell on areas where the public agreed with proposals presented in the Third Notice of Inquiry; the discussions

highlight those areas where the respondents felt their requirements were not being satisfied.

4. In reviewing the multitude of comments received in response to the Third Notice, it became apparent that many parties have misinterpreted the purpose and extent of this proceeding. This docket has been initiated for the purpose of preparing the U.S. proposals for the 1979 World Administrative Radio Conference, and it is the only issue that is involved. We recognize that in some cases it may be difficult to separate purely domestic issues from international matters; however, every attempt must be made to keep these issues distinct. As has been previously indicated in this docket, it is not a domestic Rule Making proceeding, but rather an Inquiry to determine the best U.S. proposals to modify the International Table of Frequency Allocations and associated Radio Regulations in order to meet future telecommunication needs. Since the international allocations table forms the framework of our domestic allocations table, the international table must have the flexibility built into it to accommodate national/regional needs as they arise. The table cannot remain static to accommodate only present on-the-air systems; it must be capable of accommodating future technological developments. Without this flexibility in the table, the ability of the U.S. to meet future requirements would be severely constrained. It is in this context that comments are solicited.

5. The agenda established by the Administrative Council of June 1976 of the International Telecommunication Union (ITU) for the 1979 G.W.A.R.C. was presented in paragraph 6 of the Third Notice, and that Agenda is still the guide for preparing U.S. proposals.

6. The Third Notice presented a draft protocol concerning communications for protected medical transports which was proposed for inclusion in the Convention on International Humanitarian Law applicable in armed conflict. Since no respondents commented on that draft protocol, we shall assume that the public favors it and we will proceed to take the appropriate action.

7. The Third Notice also solicited comments on methods for expressing frequency tolerances. That subject was further treated in the Fourth Notice of Inquiry in this docket along with discussions on small antenna earth stations, spacecraft stationkeeping, spacecraft antenna pointing error, Radio Regulation Appendices 3 and 4, and possible new emission designators.

8. This Fifth Notice of Inquiry in Docket 20271 includes discussions of articles in the Radio Regulations which deal with allocations, definitions, and technical and operational matters, and discussions of the Resolutions and Recommendations. We emphasize that we are presenting proposals for changes to these items. Depending on their further development, these proposals may or may not be submitted to the International Telecommunication Union; they may or

may not be accepted at the 1979 WARC. National implementation will require further action by us. The proposals and associated discussions represent the views of the United States preparatory structure as identified to date. As previously indicated, other requirements will continue to be treated as identified.

9. The primary purpose of this Notice is to present a revised proposal for the International Frequency Allocations Table (Article 5) and to solicit comments there-to. In the development of this proposal, we have considered the comments and reply comments received in response to the Third Notice, the intentions of the Federal Government and information available to the Commission. The proposed Table is attached as Appendix 2 to this Notice; a discussion of its contents is provided in the following paragraphs.

INTERNATIONAL RADIO REGULATIONS (ARTICLE 5)

SPECTRUM BETWEEN 10 KHZ AND 400 KHZ

10. Allocation table changes proposed in this frequency range in the Third Notice were the subject of numerous comments and reply comments from interested parties. Due consideration of the comments and continued evaluation of service requirements has led to several changes in the proposed Table of Allocations. In the following paragraphs we will discuss the proposed changes, as well as address the several areas of controversy developed in the public comments.

Amateur

11. The proposed changes in the Amateur allocation given in the Third Notice were generally well received by the amateur community. However, in the responses received from other services, notably the radiolocation service and the power line carrier system operators, there was repeated concern that the possibility of frequency coordination with the Amateur service is extremely remote due to the variable and unpredictable frequency usage of any given amateur radio operator. Therefore, it is felt that all services would benefit from the assignment of an exclusive allocation for the Amateur service wherever possible. This is what is generally proposed. This would have the additional effect of removing any unusual restrictions on amateur use in their exclusive channels, enabling more efficient use of a smaller allocation.

12. The need for an amateur allocation to be proposed by the U.S. to the 1979 WARC at 160-190 kHz has not been established. We have, however, proposed that Broadcasting be added in the 115-190 kHz range; this is treated in further detail in the Broadcast section.

13. Because of extensive national requirements, we have not been able to continue the proposal for Amateur shared use of the 1750-1800 kHz band. We have, however, maintained the proposal for exclusive Amateur use of the 1800-1900 kHz band. This proposal, if adopted by the 1979 WARC, should adequately provide for the Amateur service in this band. Because of the continuing

¹ 42 FR 11258.

need for LORAN in the 1900-2000 kHz band, we are proposing to maintain RADIONAVIGATION in this band, shared internationally with Amateur and other services.

14. At the 3500 kHz region, we are continuing the proposal for exclusive Amateur use of the 3500-3900 kHz band, but only on a Region 2 basis. Further, we are continuing the proposal for shared use of the 3900-4000 kHz band by the Amateur and other radio services.

Broadcast

15. Many comments were received regarding the proposed extension of the present AM broadcast allocation. In response to these comments, we are proposing international allocations that will provide for broadcasting between 115-190 kHz, and 1615-1800 kHz, noting that the international proposal for broadcast allocations between 525-535 kHz, and 1805-1615 kHz contained in the Third Notice have not been modified. We feel that the need for additional spectrum for the AM broadcasting service has been established. The present AM band, 535-1605 kHz, is used very efficiently in this country; however, the increasing complexity of applications and increasing cost of broadcasting antenna facilities necessary to protect existing stations greatly inhibits future development of this service. If the proposal is adopted internationally and implemented nationally, these channels could increase the diversity of programming choices available to listeners, and provide local broadcast services to communities presently denied service due to existing interference situations.

16. If the broadcast allocation between 115-190 kHz is adopted internationally, national requirements dictate that existing operations (including power line operations) would have to be accommodated. This would mean the "engineering-in" of broadcast frequencies. Since AM broadcast operations are already subject to extensive engineering studies, we foresee no great difficulty in this regard. Thus, existing national requirements would be taken into consideration when domestic implementation of the broadcast allocations were undertaken.

17. As mentioned earlier, we are proposing internationally an allocation for broadcasting at 1615-1800 kHz, to be shared with, among others, the Radiolocation service. We feel that the need for the proposed broadcasting allocation has been amply justified. Sharing difficulties, particularly with the Radiolocation service, will be treated under that service.

Mobile

18. Comments in response to the Third Notice on Land Mobile below 400 kHz were very limited in number. The Third Notice contained a proposal to add this service to the 1615-1750 kHz band, deleting the Mobile Service. At this time, and in light of other proposals, we are proposing Mobile at 1605-1800 kHz, which could provide for land mobile use of this band after appropriate national rule-making.

Radiolocation

19. Several comments were received regarding the present high interference levels being experienced in the shared band 1605-1800 kHz. As indicated earlier, we are proposing an allocation for Broadcast in Region 2 in this band. We solicit detailed parameters of present and foreseen systems for developing meaningful sharing criteria. In this regard, we are adding a proposed footnote 195B to provide for Radiolocation on a world-wide basis in the bands 1615-1800 kHz and 3230-3400 kHz. We fully recognize that if this proposal is adopted internationally, Radiolocation will have to continue to be satisfied on a national basis. Proposed footnote 195C, for the 1615-1800 kHz band, would assist in ensuring that Radiolocation would not receive harmful interference in the proximity of international boundaries. Notwithstanding this, we feel that Broadcasting and Radiolocation can share the band, and that Radiolocation requirements will be met. Further, we may be able to guarantee Radiolocation access to this band by setting aside nationally, and within the interior of the country, a certain number of frequencies in which no broadcasting signals in the periphery of the Radiolocation emission would be permitted to exceed a specified level. A frequency width of 6 kHz with no broadcasting signals exceeding 0.1 microvolt in the Radiolocation emission has been suggested, to satisfy one existing known national requirement. In addition, Radiolocation is being continued to be proposed in the 1900-2000 kHz band.

Radionavigation

20. As suggested in comments filed in response to the Third Notice, it is proposed to add Aeronautical Radionavigation in the 190-200 kHz band in Region 2. The fixed requirements remaining in this band would have to be accommodated. We are also proposing that the permitted status for Aeronautical Radionavigation in the 525-535 kHz band be restored. Further, we are proposing that this service be reinstated as previously allocated in all regions for the band 510-525 kHz.

21. The U.S. Maritime interests which commented on our proposal for an Aeronautical Radionavigation permitted allocation at 415-490 kHz, felt strongly that the present allocation for maritime services and this proposed allocation were incompatible. We have deleted the proposed Aeronautical Radionavigation allocation; however, we note that there is a continuing need to provide for navigation beacons in applications such as on off-shore platforms and at smaller airports. We solicit specific comments as to how that need can be accommodated.

22. We are proposing to delete Aeronautical Radionavigation from 1605-1800 kHz since no justification for retention has been received and further, to delete Radionavigation from 1800-1900 kHz. This latter proposal is predicated on the removal of LORAN operations in this band by 1980. Since the status of LORAN in the 1900-2000 kHz band is unclear, we have made no proposal to remove the

allocation from this band, noting that the secondary allocation proposed for Radiolocation is continued. We are, however, proposing a modification to footnote 198 and a new footnote 198A, which should provide for other use of this band once the LORAN system is disestablished.

SPECTRUM BETWEEN 4 MHz AND 27.5 MHz

Amateur

23. Comments were filed by the WARC Advisory Committee for Amateur Radio and the American Radio Relay League (ARRL); twenty-five amateur radio clubs; and thirty amateurs. While the comments varied, nearly all concerned one or more of the following: proposed allocation of additional bands at 10, 18, and 24 MHz; rearrangement of the proposed allocations at 21 MHz, which would cause expensive equipment modification; and correction of the interference at 7 MHz between the Amateur and international Broadcasting services.

24. In this Notice of Inquiry we are proposing an additional band at 25760-25860 kHz for the Amateur Service which could be considered as satisfying the request for a band at 24 MHz, but we are unable to propose bands at 10 and 18 MHz. The request for rearrangement of the 21 MHz allocation has been fulfilled since comments submitted by the Radio Technical Commission for Marine Services indicate that such a rearrangement would be acceptable. Removal of the interference at 7 MHz between Amateur and International Broadcasting has been difficult to accomplish because of the large demand for spectrum and the I.T.U. Region 1 and 3 allocation of 7100-7300 kHz to the Broadcasting service. The attached proposal provides the bands 6950-7000 and 7000-7250 kHz for the Amateur service on an exclusive worldwide basis and the bands 7250-7300 and 7300-7500 kHz for the Broadcasting service on a shared basis. We believe this proposal could be acceptable to international Broadcasters and would eliminate the sharing difficulties presently encountered by the amateur and the international Broadcasters.

Aeronautical Mobil (R)

25. Comments were filed by Aircraft Owners and Pilots Association (AOPA); Special Committee 129 of the Radio Technical Commission for Aeronautics; Aviation Service Working Group (ASWG); and jointly by Aeronautical Radio, Inc. (ARINC) and the Air Transport Association of America (ATA).

26. ARINC, ATA, AOPA and A-SWG supported the proposals for the bands between 4 and 27.5 MHz as set forth in the Third Notice and those proposals are unchanged in this Notice.

Fixed Service

27. As mentioned in the Third Notice, and affirmed by the comments of the American Telephone and Telegraph Co., a substantial part of common carrier and other operations using frequencies in the

NOTICES

Fixed Service at 4-27.5 MHz have been shifted to satellite and to cable systems. The table attached to this Notice proposes substantial reallocations of spectrum currently allocated to the Fixed

Service to other services. To alert the parties affected, we are listing below the proposed services and the portion of the spectrum proposed for reallocation to those services:

Present ITU band (kilohertz)	Existing service	Proposed ITU band (kilohertz)	Proposed new service
4438-4650	Fixed mobile except aeronautical mobile (R)	4438-4560	Maritime mobile.
5060-5250	Fixed	5200-5250	Do.
5250-5430	Fixed land mobile	5250-5300	Do.
6765-7000	Fixed	6950-7000	Amateur/amateur satellite.
7300-8195	do	8000-8195	Maritime mobile.
11975-12330	do	12130-12330	Do.
13360-14000	do	13360-13410	Radio astronomy.
13360-14000	do	13950-14000	Amateur.
14350-14990	do	14350-14400	Do.
15450-16460	do	16310-16460	Maritime mobile.
17360-17700	do	17360-17410	Do.
20010-21000	do	20010-20230	Do.
20010-21000	do	20950-21000	Amateur/amateur satellite.
22720-23200	do	22720-22855	Maritime mobile.

28. In addition to these proposed reallocations, this Notice contains proposals to add other services to bands now allocated exclusively to the Fixed service. As the fixed operations move from this part of the spectrum, those services can make more use of the vacated frequencies.

29. It is our intention to accommodate the fixed users that justify their operation in this part of the spectrum by reassigning the operations to suitable frequencies. To further reduce the impact on the Fixed users, we are considering proposing a footnote to the allocations table along the following lines:

On the condition that harmful interference is not caused to the Maritime Mobile Service, the frequencies 4438-4560 kHz, 5200-5300 kHz, 8000-8195 kHz, 12130-12330 kHz, 16310-16460 kHz, 17360-17410 kHz, 20010-20230 kHz, and 22720-22855 kHz may be used exceptionally by fixed stations communicating only within the boundary of the country in which they are located.

30. This note would be similar to the present Nos. 209 and 211. We are not now, however, proposing a power limit against the Fixed service using frequencies from within the maritime allocations. Comments on the proposed footnote, along with a power limit, if any, are requested.

Maritime Mobile

31. Comments on this portion of the spectrum were filed by Special Committee 69 of the Radio Technical Commission for Marine Services (Maritime Mobile Service Working Group, MM-SWG); American Telephone and Telegraph Company (AT&T); North Pacific Marine Radio Council (NPMRC); Mobile Marine Radio, Inc. (Mobile); Hoyt Haddock; and Arthur Thompson. Reply comments were filed by RTCM SC69 (MM-SWG) to the comments filed by Arthur Thompson.

32. RTCM (MM-SWG), AT&T, NPMRC, Mobile and H. Haddock strongly supported the proposed expansion of allocations to the Maritime Mobile service in the bands between 4 and 27.5 MHz. RTCM (MM-SWG) and AT&T urged that these allocations be further expanded. AT&T stated that the proposed Maritime Mobile allocations

were only 1/3 of that necessary to accommodate the service and noted that frequencies in this portion of the spectrum are required because satellite systems will be attractive only to vessels with large and special needs. The RTCM stated that the increased allocations proposed in the Third Notice would fall far short of accommodating needs and submitted additional statistics which would justify additional increases. It believes that the HF Fixed service should be further reduced. Arthur Thompson believes that HF should be put to use for services which have no other alternatives and noted that the Maritime Mobile service is lagging in the implementation of new techniques such as satellite communication. The RTCM replied that there is a growing number of small ships for which the costs of satellite communications could not be justified. In general, while there was generous support in favor, there was no substantial comment in opposition to expansion of allocations to Maritime Mobile service in the 4-27.5 MHz bands.

33. In the attached Table we are proposing the band changes between 20010 and 21850 kHz, as urged by the Amateur service and supported by the RTCM, which involves the proposed allocations for the Amateur, Amateur-Satellite, Mobile, Fixed, Maritime Mobile and Broadcasting Services. We cannot, at this time, propose the additional increases in spectrum which have been requested by the Maritime Mobile interests.

Mobile

34. Comments were filed on behalf of the Citizens Band service by the International CB Radio Operators Association (CBA). In their comments, CBA restated an earlier request by the Citizens Radio Advisory Service WARC Advisory Committee that one megacycle of spectrum be proposed for reallocation to the Citizens Band service between 26 and 28 MHz. However, the Consumer Electronics Group of the Electronic Industries Association was opposed to any expansion of the service at 27 MHz because it believes that the expansion would result in more TV interference. The Private Land Mobile SWG commended the Commission for retaining the allocations below 470 MHz which are

used by the Land Mobile services. The proposals contained in this Notice are unchanged from those contained in the Third Notice.

Radio Astronomy

35. The National Academy of Sciences supported the general plan of the proposed table, but concurred with the comments of the Radio Astronomy Service Working Group (RA-SWG). The RA-SWG commented that the proposed allocation at 13360-13410 kHz should be expanded from 50 to 100 kHz, and further, that the proposed allocation at 25850-26050 kHz would better meet the needs of the Radio Astronomy community if it were located at 25900-26100 kHz. Considering the needs of all services, we are unable to propose an expansion of the proposed allocation at 13 MHz from 50 to 100 kHz, and find it necessary to relocate the previously proposed allocation to Radio Astronomy from 25850-26050 to 25600-25760 kHz. The opposition to the allocation previously proposed at 25 MHz for Radio Astronomy, expressed by the Auxiliary Broadcast Service Working Group, is treated under the section headed Broadcast Auxiliary.

Broadcast Auxiliary

36. The National Broadcasting Company recommended that the frequency table continue to provide for the use of remote pickup broadcast base and mobile stations. These are currently provided in the band 25850-26100 kHz. The Auxiliary Broadcast Service Working Group opposed the proposed allocation to Radio Astronomy at 25850-26050 kHz on the basis that the allocation would substantially negate use of 25850-26100 kHz for remote pickup broadcasting. The F.C.C. rules currently locate remote pickup broadcasting within the international allocation (25600-26100 kHz) for Broadcasting. In this Notice we are proposing changes in allocations for Broadcasting and Radio Astronomy; these changes would not impede continuation of the past domestic practice of meeting the needs of remote pickup broadcast within the Broadcasting allocation, except perhaps for that portion of 25600-26100 kHz which we are proposing for reallocation to Radio Astronomy and Amateur use.

HF Broadcasting

37. Comments were filed by Trans World Radio, Trans World Radio Pacific, Far East Broadcasting Company, Inc., Family Stations, Inc., and the International Broadcasting Service Working Group. The comments urged the allocation of additional spectrum for International Broadcasting. Family Stations noted that there has already been a de-facto allocation of spectrum due to out-of-band operations conducted by some countries. The respondents generally believed that the Commission's treatment of their needs was inadequate and, perhaps, arbitrary. They noted that program hours is not a good measure of broadcast growth and pointed to channel hours as the relevant statistic

which should be used (the channel hours figure increases as the number of transmitters broadcasting a particular program grows). They also noted that the Panel of Experts established following the 1959 Ordinary Administrative Radio Conference had not recommended single sideband for broadcast emission, but had limited that recommendation to radio-telephony and telegraphy systems only.

38. The thrust of the comments was that interference between stations in the bands allocated to HF Broadcasting Service is so severe that additional spectrum must be allocated since the present HF broadcasting bands are overcrowded. The number of transmitters worldwide has since 1959 increased approximately four times. Extensive monitoring by many countries has established the extreme nature of the congestion beyond reasonable doubt. The basic questions are—why are the bands so crowded and can anything be done about the growing congestion?

39. The crowded condition of the bands is partially due to the fact that the HF broadcasting services have been confined to spectrum space allocated in 1947 at the Atlantic City Conference. Over 100 countries are using the bands either for international or domestic coverage, and many for both services. This growth in usage has led to the application of higher power installations and the use of more than one transmitter to cover the same service area.

40. The proposals contained in this Notice of Inquiry are aimed toward the long term alleviation of the congestion and a reduced need for higher and higher power. First, three new bands are proposed as follows: 4063–4123 KHz; 7250–7500 KHz; and 13,700–13,800 KHz. The 7 and 13 MHz bands should provide for greater frequency diversity permitting stations to operate under more optimum propagation conditions depending upon length of path to the area to be served thereby reducing the need for competing signals in the same band.

41. Secondly, this Notice proposes the expansion of three bands to alleviate crowding. These expansions are as follows: The 11,700–11,975 KHz band would be expanded downward to 11,600 KHz; the 15,100–15,450 KHz band would be expanded upwards to 15,550 KHz, and the 17,700–17,900 KHz band would be expanded downward to 17,600 KHz.

42. We feel that the above proposals will do much to treat the basic causes of congestion in the HF broadcasting service. However, there is a great need for technical and operational rules which could facilitate the shared use of spectrum and accommodate the future growth of HF Broadcasting.

43. The time between now and the 1979 Conference is probably insufficient to develop technical and operational rules. Certainly there will be insufficient time at the Conference to fully develop plans for High Frequency broadcasting and a subsequent specialized WARC will probably need to be held to deal only with that service. In this connection, because of the present uncertainty with

respect to the specific wording of certain items on the 1979 Conference agenda, there is some question as to whether Article 10 of the international Radio Regulations is to be included. Alternatively, it is possible that a resolution to hold a specialized High Frequency broadcasting conference may result. We are, therefore, requesting comments on either eventuality although the 32nd Administrative Council Session meeting in Geneva during the period May 23–June 10, 1977 may clarify the point.

44. As to the details to be taken up in such a specialized WARC we solicit comments. In this Notice we propose maximum power limits for HF Broadcasting. Should minimum power limits also be established? Compatible single side band transmissions have been suggested and offers have been made to undertake tests. A move in this direction could provide space for growth in the present bands and could result in a significant reduction in primary power requirements. Co-channel and adjacent channel protection ratios and minimum required field strength over a service area should be examined.

45. Further, Appendix 3 draws attention to proposals which among other matters would limit power, and stresses the need for consideration of compatible single side band which could improve spectrum efficiency considerably. While the conversion to CSSB would create difficulties at first in implementation, nevertheless we believe these proposals deserve intensive consideration.

46. Although requirements for HF Broadcasting have not yet been finalized, some allocations and technical changes are being proposed.

47–51. [Reserved.]

SPECTRUM BETWEEN 27.5 MHz AND 1215 MHz

52. Our Third Notice stated that this portion of the spectrum may be the most contentious portion to be considered in preparation for the 1979 WARC and at the WARC itself. We believe this is so because this range of frequencies is the most desirable for local broadcasting as well as non-broadcast communications. Frequencies between 450 MHz and 1 GHz are particularly suited for short-range mobile communications and will likely be the only area of the spectrum where short-range mobile communications growth can be expected to be accommodated into the longterm future. Frequencies between 470 and 890 MHz are also the range of spectrum where television broadcasters expect growth to occur. Comments and service working group reports received in response to our Notice confirm these observations. We summarize the nature and extent of the problem between 470 MHz and 890 MHz:

53. The international Radio Regulations provide exclusive frequency allocations between 470 and 890 MHz for the Broadcasting Service in Region 2.¹ Region 2 includes North and South Amer-

ica. In the United States the band 470 to 890 MHz provides for UHF TV channels 14 thru² 83 (70 UHF-TV channels, each 6 MHz wide). Commission decisions taken in Docket 18261 and 18262 respectively provide for Land Mobile access to the lower 7 channels (14–20) in 13 major urbanized areas and for reallocation of the upper 14 channels (70–83) to the Land Mobile services nationwide with existing TV translators on a secondary basis.

Statement of the Problem

54. Beyond Commission decisions taken in Dockets 18261 and 18262 there have been non-television requirements stated particularly for short-range mobile communications, which, by the year 2000, could amount to approximately 268 MHz in the band between 470 and 806 MHz.³ On the other hand, Broadcasting requirements for commercial and non-commercial UHF television stations have been stated which, by the year 2000 could require a full complement of frequencies between 470 and 806 MHz.

55. In reviewing the comments and the service working group reports we have found that projecting service requirements to the year 2000 is not an easy task for spectrum users. Justifying such projections is particularly difficult since the communications industry is growing and technology is changing so fast that requirements for frequencies so far into the future are subject to considerable uncertainty.

BAND 470–890 MHz

56. In this Fifth Notice of Inquiry, we are proposing that Region 2 of the International Table be modified along the following lines:

470–512 MHz BROADCASTING/MOBILE
512–608 MHz BROADCASTING
608–614 MHz RADIO ASTRONOMY
614–806 MHz BROADCASTING
806–890 MHz Broadcasting/MOBILE

57. This proposal, if adopted by the 1979 WARC, would bring the international allocation table into line with our current domestic table except in the band 806–890 MHz where it provides for international allocation for Mobile service primary and broadcasting secondary and a footnote for mobile-satellite service operation. In addition, national rules confine mobile operations in the bands 470–512 MHz and 806–890 MHz to the land mobile services; and for Broadcast operations, to TV translators on a secondary basis in the 806–890 MHz band.

58. The above allocation proposal would reduce the exclusive Broadcasting allocations in Region 2 and would not provide for all the exclusive Region 2 spectrum requested by the TV Service Working Group. Neither would it provide for spectrum between 584 and 614 MHz requested by the Aeronautical Services worldwide, or spectrum between 582

¹ Except that Footnote 332 provides for radio astronomy use of the band 608–614 MHz.

² Private Land Mobile 102 to 174 MHz; Aeronautical Mobile (R) 30 MHz; Maritime Mobile 18 MHz; Radioastronomy 6 MHz; FM Broadcast 24 MHz; B'Cast Sat. (Aural) 6 MHz; Personal Radio services 10 MHz.

NOTICES

and 606 MHz requested by the Maritime Services worldwide. It is argued that co-equal allocations would provide the flexibility requested by the land mobile community for a primary Broadcasting and Mobile allocation in Region 2 in the band between 512 and 806 MHz to meet potential need for between 102 and 174 MHz of spectrum in this band.

59. The Commission is not convinced that sufficient evidence has been introduced to justify a position other than that outlined in paragraph 56 for any of the services indicated. Proposals for the use of the band 470-890 MHz range all the way from exclusive television broadcasting to a total co-equal allocation of broadcasting and mobile across the band. The Commission finds that the various service working group reports and comments received do not adequately justify in terms of documented future growth, scientifically based studies and usage data, the requests for exclusive worldwide spectrum allocations for aeronautical and maritime services or the shared Region 2 international allocation requested by the land mobile community. Absent such documentation we see no compelling reasons, at this point, to provide for exclusive allocations or additional flexibility in the international table between 470 and 890 MHz beyond that described. Accordingly, we continue to solicit comments and supporting data to fully support retention of present allocations, as well as any changes in the allocations as proposed in paragraph 56. We also solicit further views regarding alternatives which may exist to satisfy requests for spectrum between 470 and 890 MHz.

60. It should be noted that the Commission created a Task Force on October 14, 1976, to obtain information and conduct studies to aid in developing policies concerning frequency allocations in the UHF television band (470-890 MHz). It is hoped that the interim results of its studies will be available early enough to assist the Commission in formulating a final U.S. position on UHF allocations for the 1979 World Administrative Radio Conference. One of the areas to be examined by the Task Force concerns the requests of the non-television services seeking the use of the 470-890 MHz spectrum. Time constraints of the WARC have limited the major focus of the group in this area to consideration of the international services requests. These are the Aeronautical and Maritime Services which seek, respectively, 30 and 18 MHz of the spectrum domestically allocated to the UHF television band. While much information has been developed on the present VHF operations of the Maritime Service and a lesser amount on the Aeronautical Service, additional specific data is needed for each service.

61. As technology progresses it is likely that improved methods of television transmissions will emerge providing a new generation of higher quality pictures and sound. It is questionable if such a new generation can be expected to emerge within the spectrum currently allocated to VHF, but may emerge in the

UHF band. It is also anticipated that lower power local origination television stations may also develop in the UHF frequencies. Further, the future needs of minorities and non-commercial operators may be heavily dependent on frequency availability in the UHF band. Additional comments, documenting as far as possible, future broadcast type needs in the UHF band are invited.

62. The Commission recognizes the complexity of issues found at this band both internationally and domestically, issues which relate to technology, growth of services, the need for flexibility, and the efficient use of spectrum. Comments are requested on these and other related issues.

63. [Reserved]

Aeronautical Mobile

64. The aeronautical community has withdrawn its proposal for a navigation requirement while stating the continuing need for operational control communications between 584 and 614 MHz. A flexible allocation is desirable for aviation services. Communications in the Aeronautical Service occur between aircraft of all nations and U.S. land stations as aircraft arrive and depart U.S. airports; aircraft are subject (functionally and technically) to compulsory equipment outfitting for safety resulting from international treaties, and international frequency planning is accepted practice. Moreover, the lead time required to plan an aeronautical conference, which is convened to consider planning for aviation only and does not consider any other service, necessitates that band limits for aeronautical operations be specified in advance. The aeronautical community believes that these factors warrant specific allocation proposals.

65. Comments were solicited in the Third Notice as to satisfying additional aeronautical requirements of 8 MHz for operational control. In the Third Notice, no proposal was made to satisfy this requirement between 136 and 150 MHz. In this Fifth Notice we are again unable to advance a proposed solution. While attempting to address the requirement, we have looked at the idea of satisfying a portion of the requirement in the mid-range future by adding a footnote to the band 136-138 MHz which would provide for gradual reduction of presently allocated services. This footnote could read along the following lines:

ADD 273C In the band 136-138 MHz no new transmitters are authorized the Space Research, Space Operation or Meteorological-Satellite services after 1-1-82. Operation by these services are on a primary basis until 1-1-87 and on a permitted Secondary non-interference basis to the primary service until 1-1-90. Operation by the above services is not permitted after 1-1-90. In this band the Aeronautical Mobile (R) Service is not authorized operation in this band until 1-1-82. During the period 1-1-82 until 1-1-87, operation by the Aeronautical Mobile (R) service will be on a secondary non-interference basis. After 1-1-87

the Aero Mob (R) Service is the primary service.

66. In looking at the present space users between 136-138 MHz, we find that there is a major capital investment of perhaps over 5 Billion dollars in the U.S., and a further substantial investment on a worldwide basis. In addition to present satellite systems in this band, i.e., GOES, ITOS, Timation Navigation, SOLRAD, and others, planned future activities indicate a continuing need for U.S. and foreign satellite operations. It thus becomes apparent that the satisfaction of aeronautical requirements in this band is not possible. Comments on other solutions to this problem are requested.

67. Notwithstanding the above, we note that our rules provide for 25 kHz channel spacing the band between 128-825 MHz and 132 MHz effectively doubling available frequencies to 128 for enroute (operational control) functions. While we recognize the limitations on the use of these frequencies due to international coordination, information is requested on an implementation schedule for their use and the effect which use of these 25 kHz channels will have upon (1) satisfying current and future needs of aviation for operational control, (2) the need for additional VHF spectrum, e.g., 136 MHz-138 MHz and (3) the need for UHF spectrum, e.g., 584 MHz-614 MHz. Comments are solicited on this approach and these questions, and further, how this requirement can be satisfied.

67A. In support of the effort discussed in paragraph 60, information is requested in the following areas of present spectrum usage for both network and off-network stations in busy locations in congested areas:

1. Peak-hour occupancy
2. Average-hour occupancy
3. Waiting time
4. Number of messages per day
5. Length and type of messages transmitted.

Amateur/Amateur-Satellite

68. The Amateur community generally supported proposals in our Notice with the exception of the introduction of the Mobile service in the band 220-225 MHz. Amateurs also request provision for Amateur-Satellite service in Region 2 for the band 902-928 MHz which in accordance with existing national policy is used on a primary basis for Radiolocation systems. We have made proposals for a secondary allocation for Amateur in this band. Due to national requirements, we have been unable to accommodate a proposal for Amateur-Satellite at 220-225 MHz. We have addressed the 220-225 MHz Mobile allocation elsewhere.

69. In addition, the National Astronomy and Ionosphere Center (NAIC) recommended that we propose a shift in the Amateur-Satellite allocation at 435-438 MHz to the top of the band (447-450 MHz). We believe that experience at 435-438 MHz has demonstrated that amateur satellites have little or no potential for interfering with other radio services which share the same allocation and that

reliable control of the emissions of an amateur satellite can be accomplished, further providing necessary protection to other services. Moreover, present sharing arrangements with Radiolocation has proved to be satisfactory. To shift Amateur-Satellite allocations to 447-450 MHz is likely to cause interference between Amateur stations since the band 442-450 MHz is available for amateur repeater stations. Thus, we propose to maintain the Amateur-Satellite allocation.

Broadcasting

70. The television industry stated that there has been no showing that it is necessary to revise the international table of allocations to accommodate either land mobile demand for UHF channels or any other nonbroadcast demand. Moreover, Broadcasters stated that the full complement of frequencies allocated to Broadcasting will be needed for local service, and that no feasible alternatives exist. Further, Broadcasters project that public television stations will grow from 160 presently to more than 420 by the year 2000 and expect similar growth and saturation for commercial UHF stations.

71. Thus, the television broadcasters recommended maintaining the exclusive international allocation to Broadcasting between 470 and 890 MHz. Our Third Notice in this proceeding proposed re-allocation of the band 806 to 890 MHz to the Mobile service in Region 2 to be consistent with Commission decisions taken in Docket No. 18262. However, broadcasters proposed that access to that band for UHF television translator stations be retained, which is presently provided for in our rules.

72. FM Broadcasters requested that a new FM service be proposed as originally suggested between 782 and 806 MHz. Such a service, as with other such proposals, is properly addressed in domestic rule making, provided, however, that the allocation for Broadcasting in Region 2 remains in the international table of allocations.

Land Mobile (Common Carrier)

73. The common carrier land mobile community supported our Third Notice with respect to existing allocations but noted that no provision was made for decisions taken in Docket No. 18261. In addition, our proposal for a Mobile allocation between 896-902 MHz and 941-947 MHz, which may be used for a worldwide air-ground public correspondence service, was supported by the common carrier land mobile community and AT&T because it has the necessary flexibility for possible future domestic inquiry and allocation. While the Aviation Service Working Group also supported the Mobile allocation, the Private Land Mobile Service Working Group opposed consideration of an air-ground service since reserve frequencies potentially available to private land mobile might be used. The Auxiliary Broadcast Service Working Group also objects to inclusion of an air-ground service since Broadcasters seek to restore use of the band 942-947 MHz

for Aural STL and Inter-City Relay services. We also note that sharing problems may exist with the Radiolocation service.

74. In this Fifth Notice we are proposing a secondary allocation for Radiolocation in the 896-902 and 941-942 MHz bands. Radars, mostly mobile, now operating in these bands and others, and projected during the future will have the following general parameters:

Power Peaks—1-3 Megawatts.
Pulse Repetition Rate—250-300 pps.
Duty Cycle—about 1%.
Beam Width (Horizontal)—1-3 degrees.

The distribution of platforms carrying these radars is relatively sparse on a worldwide basis.

75. We are continuing our proposal for a Mobile allocation at this time to be consistent with our goal of flexibility and to provide for future planning in accordance with long term needs and priorities. However, comments are invited from interested parties, particularly the general aviation community, with respect to the need for and scope of the worldwide public air-ground service, which might operate in the 896-902 and 941-947 MHz bands.

76. The Common Carrier Land Mobile and Aviation Service Working Groups have submitted substantial justification for this public air-ground service. This service is primarily intended to provide a radiotelephone link between the airplane and the ground telephone system to give passengers and crew a means of communicating for purposes in addition to those associated with the safety, control or origin of flight of the aircraft. This type of service is presently not permitted on frequencies allocated to the Aeronautical Mobile (R) Service. An existing system which operates in 450-460 MHz is inadequate for anticipated future expansion and is primarily limited by agreement with the scheduled airlines to General and Business Aviation uses. Any air-ground public telephone system which would cater to airlines as well as general and business aviation should have adequate frequencies to support world-wide needs. An ultimate public correspondence system should be able to communicate with an aircraft in flight anywhere and be able to connect it directly with the worldwide telephone network at or near its geographic position.

In summary such a system may consist of the following:

1. Provide public radiotelephone service to commercial aircraft and general aviation.
2. Provide a 0.98 probability of obtaining a channel.
3. Have geographic distribution of ground stations of between 77 and 154 miles.
4. Accommodate aircraft flying between 2,000 and 60,000 feet.
5. Provide up to 300 radio channels spaced between 25 and 40 kHz.

77. Further, we note that if an air-ground system is implemented at 896-902 and 941-947 MHz, it may in fact be too close to the Aeronautical Radionavigation band at 960-1215 MHz, causing unacceptable interference aboard the airframe. Comments on this issue are requested.

78. Finally, to what extent may the band 584-614 requested by the Aviation SWG for operational control communications satisfy the needs for a public air-ground system? As to the international nature of the proposed air-ground service, how could it be operated in conjunction with, while being distinguished from, the Aeronautical Mobile (R) service which provides for operational control and safety communications? Comments on these issues are requested.

Land-Mobile (Private)

79. The private land mobile community indicated that dramatic recent growth has been experienced in stations authorized, particularly in major urbanized areas, projected similar growth into the future, and identified new uses for communications beyond existing applications. It contends that growth would have to be met by recently made 900 MHz allocations, the 902-928 MHz band, the 952-960 MHz band, and some amount of spectrum (between 102 and 174 MHz) out of the remaining UHF-TV bands between 512 and 806 MHz. Therefore, the private land mobile community recommended a co-equal Mobile and Broadcasting allocation between 470 and 806 MHz to provide flexibility in the international table of allocations and to permit flexibility to leave domestic UHF-TV allocations intact to the degree that is necessary. Thus, domestic decisions would be made in accordance with our own needs and priorities.

80. With respect to the band 902-928 MHz, Hazletine Corporation opposed introduction of Amateur and Mobile services on the basis that such action could discourage development of the band for the primary Radiolocation service.⁶ A proposal of flexibility in the international table is the more important goal and future domestic rule making will address the specific services in accordance with long-term needs and priorities, if the proposal is adopted at the 1979 WARC. We further note that there are also national Radiolocation requirements, on a continuing basis, in this band on a primary basis.

81. The Private Land Mobile SWG supported our proposal to identify spectrum below 1 GHz to accommodate mobile satellite uses but opposed such use in the band 806-890 MHz which is the home for future terrestrial land mobile systems. AT&T opposed the proposal on the basis that no new unique service is proposed which could not be performed by Land, Aeronautical, or Maritime Mobile-Satellite services, for which there are already frequency allocations, and that fundamental sharing problems when one or both sharing services are mobile have not been addressed. General Electric and the Domestic Public Land Mobile SWG opposed the proposed footnote 329E and

⁶In this connection, national rules provide for Automatic Vehicle Monitoring (AVM) operations subject to not causing harmful interference to government stations and accepting interference from ISM devices and government stations authorized in the band.

stated that space radiocommunications in this band would limit spectrum use efficiency by the inability to re-use channels on a geographic basis to the same extent as terrestrial systems; thus, the objectives of Docket No. 18262 would not be realized. COMSAT General supported the footnote or specific allocations. We are proposing to keep the footnote at this time, to be consistent with our goal of flexibility and to provide for future planning. However, comments are invited from interested parties as to the nature of services which could be provided (e.g., is it confined to land mobile users or are small fixed stations or other mobile users to be served); why such services could not be accommodated in specific service allocations elsewhere, and if the footnote should be proposed in another frequency band, what band? Further, what practical coordination problems may exist with terrestrial users and how may these be minimized? Comments on these issues are requested.

Maritime Mobile

82. In the Third Notice we indicated that little hope existed to satisfy existing requirements on Appendix 18 frequencies and that inadequate spectrum is available for growth between 150 and 174 MHz. Comments received in response to our Third Notice confirm that long-term maritime requirements are such that they could not be satisfied on VHF frequencies even if all Appendix 18 frequencies were made available. However, the maritime community still requested deletion of those portions of footnote 287 which permit administrations to make assignments to other services, in order to provide full use of Appendix 18 frequencies to meet immediate maritime needs not presently satisfied and to conform with internationally agreed use. While comments provided by the American Association of Railroads strongly opposed deletion of footnote 287 on the basis that such action would have consequences endangering the operations and safety of the entire railroad industry, the Associated Public Safety Communications Officers, Inc. stated that if the Commission determines to recommend deletion of footnote 287 and if it is accepted by the WARC, then displacement of public safety licensees should be accomplished over a period of at least seven years from the effective date of the international decision. Only 4 frequencies representing less than 5 percent of police VHF frequencies are affected, as compared to 33 frequencies representing one-third of railroad VHF frequencies, and 13 frequencies representing one-third of highway maintenance VHF frequencies. In brief, since it appears that long-term growth for maritime services, particularly public correspondence communications, cannot be met by Appendix 18 frequencies, we question how immediate needs of maritime can be met except through domestic rule making which is outside the scope of this proceeding. It appears that future growth particularly for maritime pub-

lic correspondence will need to be satisfied at higher frequencies, i.e., above 400 MHz.

83. Although the maritime community agrees that the goal of flexibility in the international table is a desirable objective particularly for domestic services where control of allocations between domestic mobile services and broadcasting may be expected to be settled after WARC 79 through domestic rule making, it contends that its allocations are not necessarily controlled within the U.S. and that it is basic and essential that specific worldwide allocations be provided to permit future planning. Furthermore, specificity would preclude a situation where the U.S. is at variance with the rest of the world, a situation which presently exists on the Appendix 18 frequencies.

83A. Also in support of the effort discussed in paragraph 60 information is requested in the following areas: (1) Public coast stations operated by non-AT&T licensees are requested to furnish data concerning the following areas of their station's operation: (a) Channel occupancy during the busiest hour of an average day.

(b) Average message length (conversation time).

(c) Average set-up time (i.e., from the time the operator responds to a call, how long does it take to place the call).

(d) Number of messages handled each month for the years 1975 and 1976.

(2) In certain areas the UHF Task Force has noted that existing public correspondence channels are heavily used. In some areas it appears that assignment of additional channels could be accomplished, but have not been requested. What criteria are presently used to decide when and where to request assignment of additional channels.

(3) 1.5 MHz has been requested at UHF for on-board communications. These operations involve communications over short ranges for which higher frequencies could be substituted; however, we recognize there may be difficult technical problems associated with the development of hand-carried equipment above 1000 MHz. UHF is more useful for longer range communication with mobile units. Comments on the use of frequencies other than UHF to perform this function are needed.

(4) 3 MHz is requested for aeronautical-maritime coordinated communications. Specific data justifying this request is sought as it represents twice the VHF maritime spectrum currently allocated in the U.S.

(5) Use of maritime frequencies on board recreational craft is a national rather than an international concern. Many recreational boaters presently use Citizens Band (CB) equipment rather than VHF maritime equipment. Comments are requested recommending alternatives looking towards solution of the recreational boaters communication requirement with an allocation similar to CB but with consideration given to the distress function.

(6) Specific data should also be furnished to justify the spectrum requests

for vessel traffic services (0.2 MHz), ship-to-shore radiotelephony (0.75 MHz) and radiotelegraphy (0.6 MHz).

Mobile (Personal Radio)

84. In the Third Notice a Mobile allocation was proposed in the bands 220-225 MHz and 890-947 MHz, to provide future flexibility for the introduction of mobile operations.

85. Comments by Amateurs and the television industry opposed the Mobile allocation at 220-225 MHz, anticipating personal radio use in the band, and thus, intolerable interference to existing operations. Amateurs and the TV industry suggested that 900 MHz should be the future home for personal radio users.

86. We believe that it is premature at this point to discuss spectrum to be allocated to domestic mobile services since such discussions prejudice the outcome of the WARC-79 Conference and domestic allocation proceedings likely to occur after WARC-79. Flexibility to plan for future needs is the more important goal; thus, we are proposing to maintain the mobile allocations in Region 2.

Radioastronomy, ISM, Fixed

87. We are unable to propose an allocation for Radioastronomy use at 150-153 MHz, or to propose a shift in the Amateur Satellite allocation at 435-438 MHz to the 447-450 MHz band. Heavy land mobile use of the 150-153 MHz will continue to prevent any protection to radioastronomy at 150-153 MHz. The Amateur Satellite allocation is discussed elsewhere.

88. With respect to the ISM allocation at 915 MHz, the ISM Community supports the proposal to expand existing ISM bands worldwide by introducing footnote 340 into Regions 1 and 3.

89. The Private microwave community opposed our proposal to introduce the Mobile service into the band 952-960 MHz on the basis that microwave stations are expected to grow from 2600 at present to 6700 by the year 2000. We are proposing to maintain the co-equal Fixed and Mobile allocation to be consistent with our flexibility approach. If such a proposal is accepted by the 1979 WARC, domestic rulemaking would be required to determine which frequencies would be available and for what service or services.

SPECTRUM BETWEEN 1215 MHz AND 10.7 GHz

THE USE OF ISM FREQUENCIES AND WIRELESS TRANSMISSION OF POWER

90. Considerable information has been received concerning the expansion of industrial electronics. Several comments have suggested that the ISM bands be harmonically related and that the existing 5800 MHz allocation be changed. Study of this matter, however, suggests that this could be unreasonably disruptive of existing arrangements and our present thinking is, therefore, to retain existing bands.

91. With regard to the wireless transmission of power, this is seen as an entirely different problem, not in any way

related to ISM matters. One form of the wireless transmission of power is the concept of a Satellite Solar Power System (SSPS), and a footnote has been proposed looking toward the accommodation of such a system. Several parties have adversely commented on the proposed footnoted frequency allocation to the Solar Satellite Power System (SSPS) use. In view of its technical complexity, possible impact on other services, and significance of technological concepts, the following information is provided.

92. The operational SSPS has been proposed to contain a space station in the geostationary orbit where the solar energy will be converted to dc using either the photovoltaic effect of the silicon solar cell or a heat engine generating electricity. For an SSPS delivering about 5000 MW of dc power, two solar panels, each one having a dimension of 5.2 km by 4.33 km would be required. The maximum theoretical efficiency of silicon solar cells is about 20 percent while the efficiency practically obtained is about 11 percent. The currently expected lifetime, which is influenced by the environment, is about 10 years. Solar radiation damage causes a logarithmic decay of solar cell effectiveness. Research on radiation-resistant solar cells is in progress which is predicted to result in a life-expectancy of 30 years.

93. The dc generated at the space station is fed to a microwave generator whose design is based on the principle of either a cross-field amplifier (CFA) device or a klystron. The output of each individual tube could range from 2 to 5 kW. It has been projected that about 1 million or more tubes would be needed for each SSPS, and the total radiation contemplated is on the order of 5-10 gigawatts.

94. For a 1 km diameter transmitting phased array antenna having a gaussian distribution in the beam, the diameter of the receiving antenna would be about 7 km for interception of 90 percent of the transmitted energy. Depending on the design, the received microwave density levels could vary from about 100 mW/cm² at the center to about 0.1 mW/cm² at a distance of 13 km from the center of the received beam. The direction of the transmitted beam is proposed to be accurately controlled by a pilot signal transmitted from the center of the receiving area. The optimum frequency of operation is stated to be between 2 and 4 GHz, and fundamental frequencies of 2450 and 5800 MHz have been proposed for this service.

95. The receiving antenna would intercept, collect and rectify the microwave energy into dc which could be transmitted as dc or as ac after suitable

conversion. Distributed half-wave dipole antennas and Schottky barrier diodes are proposed to respectively receive and rectify the microwave energy. The receiving antenna element spacing is proposed to be 0.6 times the operating wavelength requiring a total of 14 billion elements.

96. As ninety percent of the SSPS energy will be confined to a beam of about 0.01 degree in diameter, an antenna pointing accuracy of about a tenth of the beam width or 0.001 degree could, then, be required. We consider it premature to speculate on the feasibility of practically achieving this order of antenna pointing accuracy.

97. The peak noise power of CFA is predicted to be 85 dB/MHz below the fundamental. The noise power can be reduced by introducing a filter between each generator and the antenna with a predicated 6 dB attenuation per octave (of 50 MHz) per section.

98. The U.S. International Radio Consultative Committee Study Group draft paper 2/302 states that a 5 cavity klystron envisaged for use with the SSPS would provide 120 db attenuation at a distance of 50 MHz from the center frequency, thereby providing a 26 db margin from a single SSPS above the ITU power flux density (PFD) limit of -154dBW/m²/4kHz, although this is still above the limit required for Radio Astronomy Service.

99. The energy from the different CFA tubes is additive at the operating frequency and is focused in the main beam of the phased array. However, we consider it premature to speculate on the performance of the phased array outside the operating band and at the harmonic frequencies. In addition to the modification of the footnote 357A proposed by AT&T, it could be specified that the radiation from the SSPS shall meet all the ITU PFD regulations outside the occupied bandwidth of the SSPS, and that the energy from the SSPS shall be attenuated by specified amounts outside the occupied bandwidth, and that the occupied bandwidth shall be 5 MHz.

100. The projected cost of SSPS power (5 gigawatt unit) at the bus bar, for an operational life of about 30 years, is estimated to be 2.7 cents per kWh. For an operational life of 10 years, the cost of SSPS power could increase to 8.1 cents per kWh. The projected costs of power from terrestrial solar plants (100-150 MWe) i.e. non-tracking flat plate, 2-D, brayton, steam, chemical, central receiver and photovoltaic are estimated to be 9.7, 8.6, 7.3, 5.5, 5.7, 4.6 and 8.6 cents per kWh respectively.

101. The optimistic launch data for an operational SSPS is 1995 although there are many technical uncertainties in the program.

102. There are several areas of concern as they relate to the possibility of interference or biological damage. For the present footnote 357A has been modified accordingly.

103. These problem areas are itemized below. (1) The possibility of interference associated with out-of-band radiation.

This consists of 3 principal components: (a) Harmonics of the fundamental frequency; (b) Noise spectrum associated with each component of (a); (c) Spurious signals.

(2) Scattering and other phenomena in the ionosphere and upper atmosphere which could possibly result in crossmodulation with other carriers, or wide-spread interference fields.

(3) Phase fluctuations on the received signals and its harmonics due to corresponding fluctuations in the refractive index. Such fluctuations could produce an intrinsic noise spectrum due to the associated phase modulation of the received signal.

(4) Area coverage problems associated with the severe pointing accuracy and side lobe requirements of the main beam. The U.S. International Radio Consultative Committee Study Group draft paper 2/302 indicates a sidelobe level of -25 dB (referred to the peak radiation) which represents a fundamental radiation density of about 0.3 mW/cm² at a distance of 7km from the center of the receiving antenna. We are not certain as to the practically achievable sidelobe level from a 1 km diameter phased array.

(5) Physical effects in the upper atmosphere which may be associated with such high flux densities and are ordinarily of no consequence but which may result in hitherto unsuspected sources of interference.

(6) Biological and ecological hazards due to the radiation levels contemplated both on the earth's surface and throughout the world's atmosphere, particularly relating to aircraft in flight.

104. We are soliciting detailed and explicit comments on each of the problem areas outlined above, so that appropriate allocations and guard bands can be structured.

Radio Astronomy

105. Two bands connected with radio astronomy remain as serious problem areas. The first of these is the band 1370-1400 MHz. The RA service views this band as one of its highest priorities since observations of the hydrogen line are related to critical studies of the universe. At present, RA use of this band is covered only by footnote 349A, and its importance is felt by RA to justify exclusive use of the band. At present this band is allocated in Region 2 to the Radiolocation Service, and is utilized to satisfy national requirements. At present, the request of the RA service is being intensively studied, however, a resolution has not been forthcoming at the time of writing.

106. The second problem area is in the 2670-2690 MHz band. The proposed exclusion of the Broadcasting Satellite Service from this band as suggested in the 3rd NOI was met with very strong opposition. The Broadcasting Satellite Service has severe demands for growth and urgently needs this spectrum. The RA group on the other hand, indicates that a CCIR limit for interference in this band has already been developed and should serve as a guide for sharing. However, this limit would certainly preclude

⁴ Solar Satellite Power System Concepts, Hearing before the Subcommittee on Space Science and Applications and the Subcommittee on Energy Research, Development and Demonstration of the Committee on Science and Technology, U.S. House of Representatives, Ninety Fourth Congress Second Session, February 20, 1976, (No. 87).

satellite service operating in real time since the limit is established by virtue of the integration time permissible with RA observations.

107. The RA service has pointed out that a 1 percent bandwidth is required for observation in the 3 GHz region, the 2670-2690 slot being the most promising choice. We have looked at other options in this region. However, the interference level to be expected from existing services would be too great, or the restrictions on these services necessary to obtain the required protection would be too great. We are therefore unable to resolve this dilemma without further suggestions from the parties concerned. These should resolve the following: (1) Is it possible for the Broadcasting Satellite Service to meet the required RA interference criteria or relinquish spectrum in areas where astronomers are making continuum observations. Alternatively, are there any possibilities whereby effective sharing criteria (time technology area, etc.), regardless of determinants, can be developed; (2) The band 3325-3355 MHz, where discrete observations are currently being made appears to be the next most obvious choice. The allocation of this portion of the spectrum to Radioastronomy was suggested by the PSSC in lieu of the present allocation at 2690-2700 MHz.

Continuum measurements require determination of interference and sharing criteria. What measures can be proposed by the services occupying this band so that effective use by the RA service can be obtained. We seek the ideas of all parties concerned, to solve this sharing problem. (3) Are there other alternatives which might be addressed which would permit the RA service to obtain a 1 percent continuum band for its observations, and share this effectively with other services.

108. Until this problem is resolved, we are proposing to maintain both the Broadcasting Satellite and Radio Astronomy Services in the band 2670-2690 MHz.

Fixed-Satellite Service

109. Since the 3rd NOI, considerable effort has gone into attempting to provide additional spectrum space for this service. Problems still remain formidable, and efforts continue to obtain bandwidths in spectrum also required for other national needs. Whatever decisions are finally made, it is evident that highly coordinated sharing criteria will pertain. The options still remain as outlined in the 3rd NOI.

110. We recognize that highly coordinated sharing criteria will need to be developed if the Fixed-Satellite Service is to successfully share the 3400-3700 MHz, 4400-4700 MHz, and 5725-5925 MHz bands with other services which are required to satisfy other national needs. In response to the Third Notice of Inquiry, several parties requested further details with respect to the proposed addition of Aeronautical Radionavigation in the band 3500-3700 MHz. This band is intended for use, inter alia, by ground based airport surveillance radars

and this addition would provide international recognition and protection of a service which has already been allocated domestically. There are probably similar questions regarding sharing in the other bands referenced above. Recognizing that any sort of meaningful evaluation of this problem would be impossible without a better understanding of the proposed uses for these bands, we have been provided with an independent analysis of the problems of sharing these bands between the Fixed-Satellite Service and the other services having requirements therein. This analysis is attached to this Notice of Inquiry as Appendix 5 and highlights the complexity and difficulties of sharing in these bands. (Appendix 5 supplied by the Executive Branch.)

111. The principal difficulty with the 6425-6925 MHz band occurs at the two ends; above 6875 MHz the band is used by the Auxiliary Broadcast (mobile) service; while from 6425-6575 MHz, it is used in a similar fashion by other mobile services. Sharing in these portions of the band, if actually possible, can only be accomplished under carefully defined conditions, and at this juncture there is not agreement on what these conditions should be. We therefore seek advice as to the definition of specific criteria for such sharing. The alternative would be, of course, to relinquish the top 50 MHz and the bottom 150 MHz of this spectrum.

112. The proposed companion band (down link) of 4400-4900 is a currently heavily used band, and again, sharing if feasible at all, would require special criteria. The more basic question then is this—if it is not possible to use the 4400-4900 band, what should be paired with the proposed 6425-6925 band? Alternatively, would it be preferable to dispense with this proposal, and aim rather toward expansion near the existing 4 and 6 GHz bands? The use of these bands has demonstrated the feasibility of sharing in already heavily congested portions of the spectrum. The fact that this has proven successful would seem to suggest that a combination of ingenuity and inventiveness might be used to develop criteria for those other portions of the spectrum under discussion here. In making such comments it is recognized that the nature of the services which have successfully shared these bands (existing at 4 and 6 GHz) lends them to such sharing. Much greater problems exist in other bands proposed due to different kinds of services already in occupancy, and in the case of mobile, there can be no doubt that sharing problems may be almost insurmountable. Nevertheless, we would urge both the present users of the various bands suggested, and also the Fixed-Satellite service, to view the total situation in terms of solutions rather than problems. The logical extensions of the 4 and 6 GHz bands would be in the 3.4-3.7 GHz, and 5.625-5.925 GHz bands as originally suggested in the Third NOI. At this juncture, the maximum bandwidths (in each of these bands) that appear feasible to share with existing services is quite limited. As yet it is not clear whether any part of the 4.4-4.9 GHz spectrum could readily be shared. The

questions are two fold: (1) are such small bandwidths of value, considering that difficult sharing criteria would certainly be necessary; and (2) can special criteria be established which could, as a practical matter, permit sharing more of the spectrum? The problems therefore resolve to the following:

(1) What are the real needs of the service in terms of continuous and contiguous bands?

(2) Is it possible, given conditions of use, geographical location, power, probability of service, power modulation, and/or any other criteria, that sharing criteria can be developed where they do not presently exist? We submit this is the critical question before all users. The many comments and reports in connection with this matter reflect the desperate need of all services. It is evident that partnerships previously considered impossible are going to have to evolve in order to bring any degree of satisfaction to all those who need and demand spectrum.

(3) What are the band options, in terms of preference, that the Fixed-Satellite service should address most vigorously, so that criteria can be developed in terms of priority?

113. In view of the foregoing comments, we have tentatively suggested the following: (1) The band 6425-6925 MHz be used for the up link, (as in the 3rd NOI) recognizing the need to develop explicit sharing criteria with the mobile services.

(2) The down link be split into two bands (a) 3400-3700 MHz and (b) 5725-5925 MHz recognizing the need to develop appropriate sharing criteria with existing services in these bands.

114. We solicit comments with respect to these choices, taking into account the foregoing statements. The problems inherent in these choices are formidable and are at present unresolved and we therefore seek information which will aid us in providing the Fixed-Satellite service with needed spectrum. It should be further pointed out that the Broadcasting-Satellite service has requested use of the 3400-3700 MHz band also, and this of course further exacerbates the sharing problem. This request for access to the 3400-3700 MHz band by the Broadcasting-Satellite Service was not known to the authors of the sharing analysis performed in Appendix 5 prior to its completion, and therefore no analysis is available with respect to the Broadcasting-Satellite Service. It can be assumed, however, that due to the special characteristics of the Broadcasting-Satellite Service, the sharing problems foreseen will be even more severe than for the Fixed-Satellite Service. We solicit comments as to how the Broadcasting-Satellite Service also might be accommodated in some useful fashion.

Broadcasting-Satellite Service

115. The Broadcasting-Satellite Service Working Group has asked for the retention of the 2500-2690 MHz band, as well as expansion into certain other bands. The 2670-2690 MHz portion of the above band was proposed, in the Third

Notice of Inquiry, for reallocation to the Radio Astronomy Service. However, in view of the strong opposition demonstrated by certain parties to this proceeding, as well as alternative proposals put forth, this question is still very much open for discussion. Until this problem is resolved, we are proposing to maintain both the Broadcasting-Satellite and Radio Astronomy Services in the band 2670-2690 MHz. Reference should be made to the section on Radio Astronomy for a more detailed discussion on this item.

116. The band 2300-2500 MHz has been suggested as an additional allocation to the Broadcasting-Satellite service. The proposed table does not reflect this service, but the problem must be addressed before the allocations can be finalized. Existing services have indicated serious opposition to this proposal. Attention should also be drawn to the fact that this band is also allocated for ISM use and we have proposed a footnote which would provide for the wireless transmission of power from space at 2450 MHz. However, the fact that the Broadcasting-Satellite Service is not shown in any part of this band in the current table is not intended to mean that consideration of its sharing in the band has been eliminated.

117. There has also been a request for Broadcasting-Satellite Service access to the 3400-3700 MHz band. Use of this band for satellite service has been discussed under the Fixed-Satellite Service, which is presently allocated internationally in this band. Conditions for the shared use by both the Broadcasting-Satellite and Fixed-Satellite Services, along with existing services, present serious problems and comments are solicited in this respect.

Aeronautical Mobile Satellite Service

118. In response to the Commission's request for comments on the general philosophy proposed by the Aviation SWG that space applications are merely extensions of the aeronautical terrestrial services, and thus should not be accorded separate status, COMSAT General states that the philosophy was rejected at the 1971 WARC and has not been advanced by other SWG's in preparing for the 1979 WARC. While we believe that the aviation philosophy may be useful in existing exclusive aeronautical terrestrial allocations, there are no compelling reasons to eliminate the specific allocations to Aeronautical Satellite Services in the bands 1542.5-1588.5 MHz and 1644-1660 MHz.

119. With respect to these allocations, the aviation community has requested maintaining them for aeronautical mobile-satellite (R) use. We note that no specific justification has been advanced to maintain 30 MHz for the exclusive use of the Aeronautical Mobile Satellite Service. There is a lack of U.S. air carrier interest in the experiment, hence, comments are requested as to whether or not the aviation requirements for 15 MHz in each direction, which were presented by the U.S. at the 1971 Space WARC, are still valid.

120. On the other hand, there is allocated a total of 15 MHz for the exclusive use of the Maritime Mobile Satellite Service and we have received extensive requirements of need for approximately 25 MHz beyond existing allocations. The Maritime SWG states that the operation of MARISAT has opened up new applications stemming from marine seismic and drilling communications requirements; that the potential airplane market is considerably less than the ship market for an international satellite system; that a convention and operating agreement on the INMARSAT Organization have been opened for signature and will likely provide a single international system during the next several years to serve ships and structures operating in the marine environment; and that if additional allocations are not provided, it is likely that service to some users may not be able to be offered. All of these factors imply more vigorous interest for the maritime satellite service and the need for a reallocation of the bands between 1535 and 1660 MHz to more accurately reflect the needs of the two services. In this connection, COMSAT General states that a portion of the 1558.5-1636.5 MHz band can be allocated to the Maritime Satellite Service since requirements of the new Aeronautical Radionavigation Satellite Service between 1595 and 1636.5 MHz can be satisfied in existing Aeronautical Mobile Satellite (R) Service frequency allocations intended to encompass domestic and international air traffic control as well as operational control. The Maritime SWG suggests expanding the 1 MHz shared Aeronautical/Maritime Mobile Satellite bands at 1542.5-1543.5 MHz and 1644-1645 MHz by 6 MHz each into the Aeronautical Mobile Satellite bands, thereby providing flexibility needed for development of either service or for a cooperative venture. Comments are requested as to which portions of the bands 1535 to 1660 MHz if any, should be reallocated for Maritime Satellite Service use or shared with Aeronautical Satellite Services. We address separately the frequency bands between earth stations at fixed points and satellites.

121. In considering the shared use of these allocations between the aviation and maritime communities, merit was seen in the possible shared use of these bands for coordinated distress and safety operations. Consequently, we propose the addition of a new footnote 352L which reads, "In the frequency bands 1542.5-1543.5 MHz and 1644-1645 MHz distress and safety operations of the Maritime-Mobile Satellite and the Aeronautical-Mobile Satellite Services shall be given priority".

Maritime Services

122. While spectrum within the existing 500 MHz of allocations in the Fixed Satellite Service (e.g., at 6/4 GHz and 15/11 GHz) will continue to be needed to meet estimated requirements for maritime communications between satellite and land, it appears that projected non-Maritime growth is expected to exceed

these allocations. Whether or not this occurs, existing spectrum and any additional allocations provided for the Fixed Satellite Service must include uplink and downlink provisions for maritime users (i.e., about 16 MHz uplink and 24 MHz downlink).

123. As the use of the maritime satellite service grows, it will become increasingly desirable to provide shore and satellite frequencies which do not have to be coordinated with the fixed satellite services. One way to accomplish this would be through the use of a footnote to existing allocations. One precedent for this was set by aeronautical interests with the addition of footnote 383B to the 5000 MHz to 5250 MHz band. However, it is noted that the bands 2900-3100 MHz and 5460-5600 MHz are extensively used by high power fixed and mobile radars for Radionavigation and Radiolocation functions. Furthermore, specifics concerning the use of frequencies within these bands by radar systems is not readily available due to established practice of granting band assignments. Therefore, considering the electromagnetic environment, the usefulness of the proposed footnote 367C is questionable unless the establishment of international regulatory changes concerning modification of existing radar systems and assignment processes are proposed and accepted. It may be preferable to find a more suitable band for the Fixed Satellite Service than to proceed with this approach. A footnote 367C for the required Maritime bands has been added and comments are requested. As an alternative, should the footnote be proposed for the band 5000 to 5250 MHz to provide for the maritime frequencies? Such proposal might provide flexibility needed for development of either mobile-satellite service or for a cooperative venture.

124. We have proposed use of the band 1710-1720 MHz from space stations to ship earth stations. However, comments indicate that communications needs will be greater in the ship to shore direction. Thus, we propose an additional allocation of the band 1970-1990 MHz for Maritime Mobile Satellite Service use.

125. The remainder of Maritime Mobile Satellite Service projected spectrum needs has not yet been satisfied. However, our Notice addresses this question under Aeronautical Satellite Service.

126. Provisions are proposed to be made for radar beacons and ship board transponders in the bands 2900-2920 MHz and 9300-9320 MHz and for Shipboard radars in the bands 2920-3100 MHz and 9320-9500 MHz, which were not addressed in the Commission's Third Notice. With respect to the provisions for the bands 9300-9320 MHz and 9320-9500 MHz comments are solicited concerning an appropriate mechanism to be used to accommodate maritime radar beacons and interrogator-transponders. For example, should the band be split into two portions, i.e., 9300-9320 MHz and 9320-9500 MHz? The band 9300-9320 MHz would be labelled, under Radionavigation, with "(Radar Beacons) (Shipboard

Transponders)". The band 9320-9500 MHz would be labelled, under Radio-navigation, with "(Shipboard radars)". One alternative would be to accommodate the above operations through the use of footnotes. A second alternative could be to place the 20 MHz allocation referenced above for "(Radar Beacons) (Shipboard Transponders)" at the upper end of the band, i.e., at 9480-9500 MHz, with the 9300-9480 MHz portion containing the "(Shipboard radars)" designation. A third alternative would be to accommodate the requirements for shipboard transponders by footnote in the band 9480-9500 MHz which is relatively unused and to provide for fixed frequency RACONS in the 9300-9320 MHz band. This last alternative would eliminate the possibility of co-channel interference between very low powered RACONS and relatively high powered shipboard transponders. Noting that RACONS are used to mark navigational hazards and, consequently, interference to these devices could result in the loss of life and property, and significant environmental damage. Separate allocation provisions for shipboard radars in the bands 2920-3100 MHz and 9320-9500 MHz may not be required as these bands already allocated to the Radio-navigation Service on a primary basis.

Additionally, it is important to note that frequency support for land/coast based radars used for maritime radio-navigation purposes in these bands is a continuing requirement and would be prohibited only if the use of shipboard radars is permitted. There also appears to be an inconsistency between the proposal for shipboard transponders in the 2900-2920 MHz band and the existing footnote 367A. Comments are requested concerning resolution of this problem. One final point to be considered is the fact that within the band 9300-9480 MHz, the frequencies 9345 MHz and 9375 MHz are extensively used for airborne weather radars.

127. Comments are requested concerning how to satisfy the recognized requirement for radar beacons and shipboard transponders in this frequency range.

128. We have received a request for the establishment of a new international footnote RR404c for the band 10.55-10.68 GHz, to read as follows: "Operations of the Maritime Mobile Service using this band for safety of shipmovement by telemetry, data exchange and telecommand systems shall be protected from harmful interference in areas of inland waterways, ports, and coastal zones." The proposed footnote RR404c, will clearly establish and provide regulatory protection against harmful interference for future maritime mobile telecommunications pertaining to safety of

* In the band 5000 to 5250 MHz frequencies between 5000.4 and 5020.1 MHz and between 5023.1 and 5033.1 MHz are planned to be used for Aerosat links from fixed stations to satellites; frequencies between 5232.2 and 5246.6 MHz and between 5309.3 and 5280.7 MHz are planned to be used from satellites to fixed stations.

ship movement. In addition, it provides for maritime communication systems needed to enhance the protection of life, property and the environment, e.g., future collision avoidance systems, tug-tow telemetry/telecommand systems and ship-shore interface communications for handling dangerous cargoes.

Amateur Service

129. In the 1215-1240 MHz band, the needs of the Radio Navigation Satellite Service, in view of its safety of life feature has been regarded as of paramount importance; consequently, amateur usage in this band has been proposed for deletion. With respect to the 10-10.5 GHz band, comments in response to the Third Notice of Inquiry expressed a desire to include Amateur Satellite Service in this band. We have carefully examined this request and have concluded that due to the extensive use and particular types of radars in this band, sharing with the Amateur-Satellite Service is impractical.

130. In the 2300-2400 MHz band, the Third Notice of Inquiry proposed allocating 10 MHz (2310-2320 MHz) for satellite service. This conflicts with mobile service requirements. Consequently, a band for Amateur Satellite use is proposed at the top end of this portion of the spectrum, 2390-2400 MHz. This should better serve amateur needs and should also be compatible with the other services making use of this part of the band.

Additional Requirements

131. Several bands have not been addressed specifically, but do require consideration. They are:

(1) 2025-2110 MHz: This band is currently used to meet mobile requirements, and is also used under footnotes 356AB and 356ABA for space applications. The proposal here is to upgrade these footnotes to a primary status in the Table. These footnotes allow operation by the Space Research and Earth Exploration Satellite Services, in the Earth-to-Space direction. Space-to-Space links are also contemplated in the Space Research Service. Space-to-Space transmissions are required by the international Radio Regulations to adhere to a power flux density limit for any transmission reaching the Earth's surface of between -144 and -154 dBW/m² per 4 kHz of bandwidth, depending upon the angle of arrival. No significant sharing problems are anticipated.

(2) 2110-2120 MHz: This band is also currently used to meet mobile requirements, and footnote 356ABA allows operation of the Space Research Service. It is proposed to give the Space Research Service (Earth-to-Space) (Deep Space only) a primary allocation in this band. No sharing problems with the terrestrial services are anticipated.

(3) Requirement of the Aviation services at 2300 MHz: The Aerospace Radio Flight Test Radio Coordinating Council (AFTRCC) and the Aviation Services

Working Group have pointed out that the frequency spectrum from 2310-2450 MHz could not be used completely inasmuch as footnote 357A designates 2450 MHz \pm 50 MHz for the wireless transmission of power. (This has since been changed to 2450 MHz \pm 10 MHz) They propose instead that the spectrum from 2300-2390 MHz be designated for aeronautical telemetry with Radiolocation, Amateur, Amateur-Satellite, Fixed, and Mobile accommodated in the band 2390-2450 MHz. We have in large part satisfied this requirement. We have proposed the upgrading of the Mobile allocation in the 2310-2390 MHz band and proposed footnote 349C to provide that the primary use of the mobile service in this band is to aeronautical mobile for telemetering purposes. It should be noted that we have retained the Radiolocation Service as a primary service. Experience has demonstrated that with the intensive scheduling which can be accomplished in the field, these two services can share the band on a co-equal, primary basis.

SPECTRUM ABOVE 10.7 GHz

Aeronautical Mobile/Aeronautical Mobile-Satellite

132. ARINC and ATA stated that "... the bands above 40 GHz allocated jointly to the Aeronautical and Maritime Services should be split into separate and distinct services * * *." They stated (1) that the Aeronautical Service is a safety service precluding sharing of common bands, (2) that there is a dissimilarity of disciplines between the Aeronautical and Maritime Services and (3) that the "provision of shared bands may well lead to the development of incompatible systems for aeronautical and maritime * * *." In the Frequency Allocations Table, RTCA separated the Aeronautical and the Maritime services. AOPA supported the submission of RTCA. However, RTCM supported the shared allocations.

133. There are various uncertainties in these frequency bands. The Aeronautical Mobile-Satellite (AEROSAT) experimental program is under development while the MARISAT has recently started providing operational service, both in the 1.5/1.6 GHz bands. No evidence has been submitted indicating that the development in the frequency bands above 40 GHz will take place in the foreseeable future. The requirements of the Aeronautical and the Maritime services are not known, making a logical apportionment of frequency bands between the two services difficult. It also appears that no irreparable harm will be done in retaining the shared allocations at the present time. Because of the Commission's participation in the RTCA and the RTCM it is unlikely as stated in the comments of ARINC, that "... the development of incompatible systems for aeronautical and maritime * * * services would take place. The bandwidth of each of the shared allocations is more than the combined identifiable needs of the Maritime and the Aeronautical Services. We believe that the fear of any incompatibility and

the thesis put forth by ARINC that each service " * * * would require the full shared allocation * * * " are, at present, unfounded. Considering all the factors, we are retaining the shared allocations to the Aeronautical and the Maritime Mobile Services above 40 GHz, except for the 190-200 GHz band as mentioned in the Third Notice of Inquiry.

134. ARINC, ATA and RTCA recommended that the Aeronautical Mobile-Satellite service should be deleted and a footnote should provide for the use of space techniques in the Aeronautical Mobile service because a separate Aeronautical Mobile-Satellite service (1) " * * * is unwieldy (sic) from the frequency management and operational view points", and (2) imposes constraints regarding the need to develop separate co-ordination and registration procedures as distinct from the terrestrial service. COPA supported the position of RTCA. COMSAT General opposed the proposal.

135. At present, there are many uncertainties surrounding the 1.5/1.6 GHz bands proposed for the AEROSAT experimental program. We are not aware of any terrestrial use of these frequency bands other than altimeters. Above 40 GHz, the frequencies are being allocated co-equally with the terrestrial and the satellite services providing flexibility of the use, if needed, of the same frequency for the terrestrial and space services. However, co-ordination with Maritime services would be required because the frequency bands are shared. Considering all the factors, we are proposing to retain the satellite services.

136. At the request of the proponents of the Aeronautical Mobile and the Aeronautical Mobile-Satellite services, the Route designator (R) was applied to the frequencies above 40 GHz allocated to them. In paragraph 113 of the Third Notice of Inquiry, the Commission specifically requested technical justification for the necessity of the Route or "R" designator. In the absence of any such justification, the "R" designator is being deleted.

Industrial, Scientific and Medical

137. Litton and Raytheon supported the proposals of the International Microwave Power Institute for ISM allocations which was provided through appropriate footnote; however, AT&T has opposed the proposal of footnote 410E, to permit the use of industrial, scientific and medical (ISM) radiators on 55 GHz±250 MHz because " * * * it would divide the breadth of contiguous bandwidth which makes the 54.25-58.2 GHz particularly attractive to common carriers."

This frequency band is attractive because, according to AT&T, it lies at the lower end of the 40-300 GHz range but is high enough to offer practically all the advantages of compactness of equipment, and because the technology developed now and in future for use of the band 59-64 GHz could be usable on it. AT&T suggested the use of a frequency near maximum oxygen resonance such as 60.2 GHz. The 25th harmonic of 2450 MHz,

the frequency proposed to be used for Solar Satellite Power System (SSPS), is 61.25 GHz. We are proposing to reallocate the ISM emission from 55 GHz to 61.25 GHz±250 MHz.

Amateur/Amateur Satellite

138. The Amateurs generally supported the proposed allocations; however, a number of respondents urged us to make the 48-50 GHz band available to the Amateur and Amateur Satellite services. This band has been allocated to "safety of life" services, due to a re-alignment of the Table of Allocations to accommodate additional spectrum required for the Fixed-Satellite and Mobile-Satellite Services. For this reason, we are proposing to allocate the 49.8-50 GHz band to the amateur services.

Broadcasting

139. The Television Broadcasting Service Working Group reiterated its belief " * * * that the Broadcasting allocation should be retained * * * " in the 11.7-12.2 GHz band. We discussed this topic and rejected this proposal in paragraph 117 of the Third Notice of Inquiry in this docket. Since no new arguments have been put forth, our proposal remains unchanged.

Intersatellite

140. At the request of COMSAT, which was supported by AT&T, we are proposing to allocate the 21.4-21.7 GHz band in addition to the 22.7-23 GHz band to the Inter-Satellite service for providing simultaneous communications link in both directions. In paragraph 129 of the Third Notice of Inquiry, we invited information as to how these Inter-Satellite bands would be used in conjunction with foreseeable systems and discussion as to the reason for these two specific frequency bands. If no such justification is received, then we may be pressed to make these frequencies available to other services, with the subsequent deletion of the Intersatellite service from the Table.

Broadcasting-Satellite

141. The City College of the City University of New York (CUNY), JCET and CPB have requested that the 12.2-12.5 GHz band be allocated to the Broadcasting Satellite service in Region 2.

142. We have not made any assumption " * * * of equal channel distribution among all Region 2 countries * * * " as attributed to us by CUNY. If all community reception channels are assumed, as suggested by JCET and CUNY, then 3528 channels are projected from the Joint Industry Government Committee (JI/GC) Group B report for a 75% Broadcasting-Satellite case satisfying 2450 TV channels "market estimate" submitted by the Broadcasting-Satellite service working group. Even for a 50% Broadcasting-Satellite case, 2358 community reception channels are projected by the JI/GC report. The Broadcasting-Satellite working group originally postulated a 25% Broadcasting-Satellite case providing 1188 community reception channels and 131 Fixed-Satellites. We believe that this apportionment of the orbital arc between the two services is

unrealistic because that number of satellites would provide an inordinately large number of channels, far in excess of foreseeable requirements in the 11.7-12.2 GHz band, for the Fixed-Satellite service. We used a cross-polarization system because that is more efficient and because its use was recommended by the JI/GC Group B.

143. No economic analysis has so far been submitted to us regarding the outlay and its sources for realizing the "market estimates" submitted. Because of the uncertainties associated with the forecasting of channels for social services, we are tentatively allocating the 12.2-12.5 GHz band to the Broadcasting-Satellite service provided the proponents of it submit reasonable criteria for sharing it with the Fixed and the Broadcasting Services.

144. Attention is also drawn to the proposal submitted for comment in the next section of this Notice (Fixed-Satellite). This allocation proposal shows the Broadcasting-Satellite Service as the only space service allocated in the 11.7-12.2 GHz band in Region 2. Several parties commented that the capacity estimates upon which additional spectrum was being requested for the Broadcasting-Satellite Service were based on a 25% use of the orbit by Broadcasting-Satellites as opposed to a 75% use by Fixed-Satellites. We do not necessarily agree with this analysis of the percentage of the orbit which would be consumed by each of these space services; however, comments are invited in two areas; 1) the feasibility and/or desirability of the allocation listed in the following section on Fixed-Satellites and 2) based on the various requirement estimates submitted, how much "exclusive" (only space service) spectrum in this range of the frequency spectrum is necessary to meet those requirements.

Fixed-Satellite

145. AT&T has objected to the proposed allocation of the 10.7-10.95 and 11.7-11.45 GHz bands to the Fixed-Satellite service. COMSAT General, COMSAT and RCA American Communications (RCA Americom) supported the proposal. COMSAT and RCA Americom stated that a contiguous frequency band entails economy. RCA Americom advocated the allocation of the 10.7-11.7 GHz band for domestic satellite system use also. (That portion of this band currently allocated to FX/SAT is limited to international systems by a domestic footnote. No such restriction exists in the international Table.)

146. Considering all the factors, we envision that the 10.7-11.7 GHz band will be confined to international use by the Fixed-Satellite Service with about half-a-dozen high density large diameter antenna earth stations located at places (such as Etam, Andover) away from the heavily populated areas of the United States. We would propose that these limitations be included in any future rulemaking proceeding. We believe that this allocation would provide flexibility to meet our future needs.

147. In the frequency bands 11.7-12.75, COMSAT, COMSAT General and Satellite Business System (SBS) raised several issues and submitted their proposals. COMSAT stated, and COMSAT General and SBS implied, that frequency division is more efficient than orbit division; this is contrary to technical recommendations* and the United States position represented in the just concluded 1977 World Broadcasting-Satellite Administrative Radio Conference (1977 WARC). The three parties recommended that 10.7-11.2 GHz bands should be allocated, in all Regions, to accommodate the earth-to-space requirements of the Broadcasting-Satellite service.

148. However, COMSAT and COMSAT General had already proposed the allocation of this 500 MHz band to accommodate the space-to-earth requirements of the Fixed-Satellite service. AT&T, in its reply comments has stated that "Bi-directional satellite operation is fraught with serious interference and other problems which are discussed in Report 557 of the International Radio Consultative Committee".

149. The proponents of these proposals have not submitted any analysis showing that the "bi-directional", as opposed to the "uni-directional", international Fixed-Satellite allocation provides more efficient use of orbit-spectrum. The space station of a Fixed-Satellite could use an earth coverage beam. What would the co-channel interference potential be from such a Fixed-Satellite space station to an adjacent Broadcasting-Satellite space station? Further, these proposals shift the frequency sharing of the earth-to-space transmission of the Fixed- and the Broadcasting-Satellite services in the 14.0-14.5 GHz band to the frequency sharing of the space-to-earth transmissions of the Fixed-Satellite service and the earth-to-space transmissions of the Broadcasting-Satellite service in the 10.7-11.2 GHz band. The proponents have not specifically identified, outside the presumption of the 14.0-14.5 GHz band, the frequency band of the earth-to-space transmissions of the additional 300 MHz of frequency of the Broadcasting Satellite service in Region 1.

150. SBS stated that the results of the 1977 WARC "... makes clear that the present allocations for use of the 12 and 14 GHz bands do not provide an adequate basis for the development of multiple fixed domestic satellite systems in these bands ...". When such analysis is submitted it will be carefully considered.

151. We are not persuaded by the arguments in making drastic changes in this portion of the Frequency Allocation Table, particularly in Regions 1 and 3. In view of the possibility of an "a priori" orbital plan for the Fixed-Satellite service in the 11.7-12.2 GHz band and in view of the uncertainties of the forthcoming Region 2 conference, we would like to know the benefits and disadvantages of the following Region 2 allocations, along the lines suggested by JCET.

* RAND Report-1463, May 1974; Santa Monica, California.

11.7-12.2 GHz..	Mobile (except aeronautical mobile). Broadcasting satellite.
12.2-12.5 GHz..	Fixed. Mobile (except aeronautical mobile). Broadcasting. Fixed satellite (space to Earth).
12.5-12.75 GHz..	Fixed. Mobile (except aeronautical mobile). Fixed satellite (space to Earth).

152. In the region between 13 and 15.5 GHz, we are not able to obtain a contiguous 1 GHz uplink. The 12.75-13.25 GHz was the only available frequency band for this purpose. We are further investigating this matter. The 250 MHz imbalance can be simply eliminated by allocating only 12.75-13.00 GHz for the Fixed-Satellite service. In practical life, earth-to-space and space-to-earth links are not as closely or simply related as some proponents would like. For example, the 14 GHz band of the INTELSAT-V satellite could be connected to either the 11 GHz or 4 GHz band.

153. We deleted the direction indicators from the Fixed and the Mobile-Satellite services above 40 GHz in the 3rd Notice of Inquiry. COMSAT General commented that "... the bands should be paired in an explicit manner in order to avoid utilization problems." We are now placing direction indicators on these two services. There is some imbalance, particularly at the higher portion of the spectrum, between the space-to-earth and the earth-to-space links. We are further studying this matter.

Standard Frequency Satellite

154. The following information on the Standard Frequency-Satellite Service is provided for information.

155. The National Bureau of Standards of the Department of Commerce (on behalf of the national laboratories including the Naval Observatory, Goddard Space Flight Center, Naval Research Laboratory, Johns Hopkins University and many universities and industry laboratories engaged in the research of precision frequency and time standards) has a need to exchange frequency and time to nanosecond precision at the present time and will require picoseconds precision within the time frame of the 1979 WARC. In addition, there is a demonstrated need for the international exchange of precise time and time intervals between laboratories to a higher order than presently achievable by the transporting of atomic clocks. In fact, there are a number of international standards laboratories, such as Australia, who now cannot contribute to the determination of the international second as determined by the Bureau International de l'Heure (BIH) in Paris due to the fact that flying a clock to make comparisons requires so long a period of time that the uncertainties in the clock being flown is greater than the variation between the two standards; the time scales presently associated with the reference standards between many adminis-

trations depart from uniformity by as little as 1 nanosecond in one day.

156. The 13.4-14.0 and 20.2-21.2 GHz bands have been identified in order to utilize existing hardware developments and present technology. The up and down links require an emission bandwidth of approximately 250 MHz and a coherently related integer functional frequency relation—the one selected here is 20/29. The proposed type of modulation will be a PRN digital code spread over approximately 250 MHz. The standard frequency community is proposing to utilize spread spectrum techniques using wide bandwidths to reduce the power levels of the satellite signals at the earth's surface to levels well below the levels of signals in the other services which share the band.

157. The 26 and 30 GHz bands have been identified for future development with a bandwidth requirement of about 1.2 GHz, a coherently related integer functional frequency relation of 22/25, and capable of achieving timing precision in the picosecond range.

Mobile Satellite and Fixed Satellite

158. AT&T inquired about the necessity of allocating frequencies to be shared by Mobile-Satellite and the Fixed-Satellite Services when separate allocations are already available in the Aeronautical Mobile-Satellite, Maritime Mobile-Satellite and Fixed-Satellite Services. There are intentions to use earth stations on maritime mobile vessels, on airborne platforms, and on land (with manpack equipment, with transportable systems, and at fixed points all at the same frequency. This kind of service, at present, cannot be provided by the existing allocations.

159. Both AT&T and COMSAT expressed doubts about the feasibility of sharing between the Mobile-Satellite Service and the Fixed-Satellite and the Fixed Services. AT&T recommended that any allocation to the Mobile-Satellite Service of frequencies used by a non-mobile service should be on a secondary basis.

160. The national requirement is for a primary allocation; as such, no secondary allocation is possible.

Several papers on this topic have been, and are being, submitted to the U.S. International Radio Consultative Committee Study Group 8C. The weakest communications link could be between two mobile low gain antenna, earth stations connected through a satellite. Geostationary satellites are expected to provide the mobile services with highly reliable communications links which could support a large volume of traffic. Critical needs of users are to be satisfied, although the orbit-spectrum efficiency, using traditional measures, could appear to be "low".

161. Some experimental work has been conducted above 20 GHz. Currently, an experimental/developmental system is operating in the 36-40 GHz band. Testing to date and the empirical analyses have shown the feasibility and desirability of operating satellite systems in the higher portions of the spectrum.

Currently, we have under evaluation and development a satellite system which will use as a basis the experimental/developmental system in the 36-40 GHz. Implementation of this follow-on system is planned in the 1980's, with a total investment of approximately \$1 billion. Accordingly, requirements include a Mobile Satellite allocation for the 20.2-21.2, 30-31, 40-41, 43-45, 76-79 and 81-84 GHz bands to accommodate the above and subsequent systems.

162. Considering all the factors, the shared allocations to the Mobile-Satellite and the Fixed-Satellite Services are proposed as indicated in the Table of Allocations. Following is a listing of current requirements for allocations to the shared Mobile-Satellite and Fixed-Satellite Services above 10.7 GHz. The requirement in the 102-106 GHz band is still under consideration.

GHz	GHz
20.2-21.2	50.4-51.4
30-31	76-79
40-41	81-84
43-45	102-106

Space Research/Earth Exploration Satellite

163. The following frequencies have been identified for the passive Space Research and Earth Exploration Satellite Services in order to permit remote environmental sensing operations.

GHz	GHz
10.6-10.7	86-92
15.2-15.4	100-102
17.7-17.9	108-126
19.7-19.9	150-151
21.2-21.44	164-168
22.21-22.5	174.5-176.5
23.6-24.0	182-185
31.3-31.8	200-201.5
36-37	225-240
50.2-50.4	250-252
51.4-59.0	275-277
64-85	

164. COMSAT and COMSAT General requested information on the characteristics, parameters and the potential impact of sharing of the Space Research and the Earth Exploration Satellite Services before they could comment on the shared allocations. The parameters of passive low-orbiting radiometers are listed in Tables 1A and 1B. In some cases geostationary satellites are envisioned, however, the radiometer bandwidth and the interference threshold would be identical with those of low orbiting satellites. The results of analyses performed by NASA to determine the feasibility of the passive services sharing with the Fixed and Fixed-Satellite Services are listed in Tables 2 and 3. The e.i.r.p.'s of the Mobile Service are the same as that of the Fixed Service, however a smaller size antenna is generally expected to be used by the Mobile Service. The frequency bands 21.2-21.4, 22.21-22.25, 36-37, 50.2-50.4, 54.25-58.2, 100-101, 116-126, 150-151,

164-168, 174.5-176.5, 200-201.5, 225-227, 250-252 and 275-277 GHz are included in the proposed Table of Frequency Allocations as we are assured that no restrictions would be placed on the active services sharing with the passive radiometer services. The allocations for passive radiometers in the bands above are predicated upon the assurance of non-restricted operation of the active services.

165. In the balance of the identified frequency bands, where sharing between

passive remote sensors and active services would exist, the following sharing criteria are proposed by NASA to prevent harmful interference to passive remote sensors.

166. In the band 10.6-10.7 GHz, the maximum equivalent isotropically radiated power of a station in the Fixed or Mobile service shall not exceed 35 dBW. The power delivered by a transmitter to the antenna of a station in the Fixed or Mobile service shall not exceed -3 dBW.

TABLE 1A
PASSIVE RADIOMETER PARAMETERS

FREQUENCY GHz	10.6 - 10.7	15.2 - 15.35	17.7 - 17.9	19.7 - 19.9	21.2 - 21.4	22.21- 22.5	36- 37
MEASURED PARAMETER	WATER, ICE, SNOW	WATER, RAIN	WATER	WATER SNOW, ICE	WATER	WATER VAPOR	RAIN, SNOW ICE
RANGE, DEGREES	-	-	-	-	-	-	-
SENSITIVITY K	1	0.2, 1	0.2	0.2, 1	0.2	0.4	1
RESOLUTION Km	1 to 20	2, 1	2	1 to 20	2	2	0.2 to 2.0
INTEGRATION TIME, SECOND	.05 to .06	0.2, 0.01	0.2	0.03 to 0.2	0.2	0.02	.02 to 0.2
BANDWIDTH, MHz	90, 120	180, 195	180	120 to 210	180	405	115 to 920
SENSOR INTERFERENCE THRESHOLD dBW	-150, -155	-160, -153	-160	-160 to -152	-160	-153	-155, -145
SPACECRAFT ALTITUDE, KM	500	500	500	500	500	500	500
SPACECRAFT INCLINATION, DEGREES	70-110	70-110	70-110	70-110	70-110	70-110	70-110
SPACECRAFT ANTENNA, m	15	5	5	5	4	4	4

TABLE 1B
PASSIVE RADIOMETER PARAMETERS

FREQUENCY GHz	50.2-50.4 54.25-58.2	100-102	116-126	150-151	164-168	174.5-176.5 200-201.5	225-227	250-252	275-277
MEASURED PARAMETER	ATMOSPHERIC TEMPERATURE	H ₂ O OZONE	ATMOSPHERIC TEMPERATURE	H ₂ O	CHLORINE OXIDE	H ₂ O	H ₂ O, CO OZONE	H ₂ O	H ₂ O
RANGE DEGREES	-70 to +30	-	-	-	-	-	-	-	-
SENSITIVITY K	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
RESOLUTION Km	2	2	2	2	2	2	1	1	1
INTEGRATION TIME, SECOND	1	1	1	1	1	1	1	1	1
BANDWIDTH, MHz	235	1850	1850	1850	1850	1850	1850	1850	1850
SENSOR INTERFERENCE THRESHOLD dBW	-157	-150	-150	-150	-150	-150	-150	-150	-150
SPACECRAFT ALTITUDE, km	300	500	500	500	500	500	500	500	500
SPACECRAFT INCLINATION, DEGREES	70-110	70-110	70-110	70-110	70-110	70-110	70-110	70-110	70-110
SPACECRAFT ANTENNA, m	2X6	1X4	0.75X3	0.5X2.5	0.5X2.5	0.5X2	0.4X1.5	0.4X1.5	0.4X1.5

NOTICES

TABLE 2A
SHARING ANALYSIS: FIXED SERVICE

FREQUENCY GHz	10.6 - 10.7	15.2 ANALOG	15.31 DIGITAL	17.7 - 17.9	19.7 - 19.9	21.2 - 21.4	22.21 - 22.5	36 - 37
TRANSMITTER POWER, dBW	0	13	-13	-13	-13	-13	-13	-6.5
FEEDER LOSS, dB	-	-	-4	-4	-4	-4	-4	-4
ANTENNA GAIN, dBi	30	45	43.5	43.5	43.5	43.5	43.5	43.5
e.i.r.p. dBW	30	58	26.5	26.5	26.5	26.5	26.5	33
TRANSMISSION BANDWIDTH, MHz			220	220	220	220	220	220
LINK LENGTH, Km		20	10	10	10	10	10	10
ATMOSPHERIC ABSORPTION, dB HORIZONTAL	--	5.6	5.6	9	17	30	+33	18
FADE MARGIN, dB	--		45	45	45	45	45	45
RADIOMETER ANTENNA SIDELobe EFFECTIVE AREA dBm ²	-56	-59	-59	-60	-61.4	-62	-62	-67
RECEIVED INTERFERENCE, dBW	-157	-145.6	-177.1	-181.5	-191.4	-204.5	-207.5	-191
INTERFERENCE RELATIVE TO THRESHOLD, dB	+1	+14	-18.1	-21.5	-31.4	-51.5	-54.5	-45
SHARING FEASIBILITY	YES	NO	YES	YES	YES	YES	YES	YES

TABLE 2B
SHARING ANALYSIS: FIXED SERVICE

FREQUENCY GHz	50.2 - 50.4	54.25 - 58.2	110 - 126	150 - 151	164 - 169	174.5 - 176.5	200 - 201.5	225 - 227
TRANSMITTER POWER, dBW	-7.34	-6.0	-3.0	-0.7	0.3	+1.67	3.8	6.13
FEEDER LOSS, dB								
ANTENNA GAIN, dBi	43.5	43.5	45	45	45	45	43.5	45
e.i.r.p. dBW	36.2	37.5	42	44.3	45.3	46.7	49.3	51.1
TRANSMISSION BANDWIDTH, MHz	220	220	220	220	220	220	220	220
LINK LENGTH, Km	1	1	1	1	1	1	1	1
ATMOSPHERIC ABSORPTION, dB HORIZONTAL	100	100	70-100	>100	>100	>100	>100	>100
FADE MARGIN, dB	45	45	45	45	45	45	45	45
RADIOMETER ANTENNA SIDELobe EFFECTIVE AREA dBm ²	-69.4	-70.8	+2.3 (main beam)	0 (main beam)	-1 (main beam)	-1.3 (main beam)	-2.5 (main beam)	-3.7 (main beam)
RECEIVED INTERFERENCE, dBW	-272.4	-270.8	-184.7	-194.7	-195	-193.6	-192.7	-191.5
INTERFERENCE RELATIVE TO THRESHOLD, dB	-114.4	-113.8	-14.7	-44.7	-45	-44	-42	-41.5
SHARING FEASIBILITY	YES	YES	YES	YES	YES	YES	YES	YES

Table 3

SHARING ANALYSIS: FIXED-SATELLITE SERVICE

FREQUENCY GHz	17.7-17.9	19.7-19.9	150-151	164-165	225-227		
e.i.r.p. dBW	73.4	73.4	88	88	105		
FLUX AT EARTH SURFACE dBW/m ²	-88.6	-88.6	-75.0	-75.0	-58		
REFLECTIVITY FACTOR, dB	-3	-3	-3	-3	-3		
REFLECTION FROM EARTH dBW/m ²	-91.6	-91.6	-78.0	-78.0	-61		
AREA WITHIN RADIO-METER MAINLOBE dBm ²	63	63	86.7	86.7	86.7		
REFLECTED e.i.r.p., dBW	-18.6	-18.6	8.7	8.7	25.7		
SPREADING LOSS dBm ⁻²	-125	-125	-139	-139	-139		
FLUX AT RADIO-METER ANTENNA dBW/m ²	-143.6	-143.6	-130.3	-130.3	-113.3		
RADIO-METER ANTENNA AREA dBm ²	+10.5	+9.6	-15.7	-16	-19.8		
RECEIVED INTER-FERENCE dBW	-133.1	-134	-146	-146.3	-133.1		

within the present power flux density limits.

177. The requirement in the 25.25-27.5 GHz band has been included in the proposed Table of Allocations. A new footnote 411A has been proposed in the Table to satisfy the requirements for space-to-space transmission in the 27.5-30 GHz band.

178. The requirements in the 17.9-19.7 and 27.5-30 GHz bands for radiocommunications between an earth station at a fixed point and a satellite can be satisfied by the existing allocations in Fixed-Satellite Service. For clarification, the Earth Exploration Satellite Service can be added to the other services listed as examples in the Radio Regulation 84 AG.

MOD Fixed-Satellite Service

84A G Spa2... 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 inter-satellite service; For connection between one or more earth stations at specified fixed points and satellites used for a service other than the fixed-satellite service (for example, the mobile-satellite service, broadcasting-satellite service, earth exploration-satellite service, etc.).

Radio Astronomy

179. The Radio Astronomy Service Working Group (RASWG) and the National Academy of Sciences commented on the Radio Astronomy service allocations. The RASWG requested sharing the band 14.5-15.35 GHz on a primary basis with Space Research. Footnote 408B provides for a secondary allocation to the Space Research service in the space-to-earth direction. Transmission is already planned by the Tracking and Data Relay Satellite in the major portion of this band ruling out any possibility of sharing it with the Radio Astronomy service. We are proposing to add the restriction "except aeronautical mobile" in the frequency bands 22.21-22.5 GHz and 217-230 GHz as requested by the RASWG. We are also proposing to add the footnote 412II in the 48-50 GHz, 95-101 GHz and 142-150 GHz bands as required by RASWG for observation of three carbon monosulfide lines. The footnote 412M is being modified, as requested by RASWG, to include the frequency 140.840 GHz for observation of the formaldehyde line, and we are deleting the footnote MOD 412J from the frequency bands 217-220 GHz and 220-221 GHz as it is inappropriate. The National Academy of Sciences considered the needs of the space research services, noted that "clear" bands allocated for use by passive sensors aid the Radio Astronomy service, and supported the proposals for such bands. Both the RASWG and the National Academy of Sciences noted the potential for problems of interference from adjacent bands and recommended that the harmful interference limits defined in CCIR report 224-3 be taken into account in planning for adjacent band usage.

167. In the band 15.1-15.4 GHz, the maximum equivalent isotropically radiated power of a station in the Fixed or Mobile service shall not exceed 35 dBW. The power delivered by a transmitter to the antenna of a station in the Fixed or Mobile service shall not exceed -3 dBW.

168. In the band 17.7-17.9 GHz, the maximum equivalent isotropically radiated power of a station in the fixed or mobile service shall not exceed 40 dBW. The power delivered by a transmitter to the antenna of a station in the Fixed or Mobile service shall not exceed -3 dBW. The power flux density at the Earth's surface produced by emissions from a fixed-satellite space station for all conditions shall not exceed -109 dBW/m² in a 200 MHz reference band for all angles of arrival.

169. In the frequency band 19.7-19.9 GHz, the power flux density at the Earth's surface produced by emissions from a fixed-satellite space station for all conditions shall not exceed -108 dBW/m² in a 200 MHz reference band for all angles of arrival.

170. ARINC has opposed the addition of Space Research Service in the 14-14.3 GHz band without stating any reason. COMSAT stated that it would not oppose the allocation of the 14.4-14.5 GHz band to the Space Research Service on a permitted or secondary basis. We are modifying the allocation proposal, for these two bands, to a secondary service, subject to further evaluation.

171. AT&T has objected to the suggestion of an unrestricted Power Flux Density (PFD) in the 17.9-17.95 GHz band. AT&T believes that this unrestricted PFD would cause an excessive and intolerable time level of interference into a fixed service system at 18 GHz, such as AT&T's DR-18 terrestrial radio-relay system.

Our proposal of unrestricted PFD in the 17.90-17.95 GHz band is withdrawn.

172. COMSAT commented on the inquiry about a definition of a "Space Radiolocation Station" in place of an "Active Sensor" designation. COMSAT stated that "... it would seem that active space-borne Radiolocation devices would require extensive coordination and/or frequency assignment control in order to operate under the same allocation with terrestrial Radiolocation device without causing such interference." At this time, we are opposed to changing the definition. The requirements of this service are satisfied by specific allocations as identified.

172A. The frequency band 17.9-18.7 GHz has been identified for read-out of telemetry from meteorological satellites.

173. The following frequencies have been identified for Earth Exploration Satellite telecommunications links. The 17.9-19.7 GHz band has been identified for the space-to-earth link from a data relay satellite to a central data acquisition earth station. A bandwidth of 1800 MHz is required to accommodate the data transmission requirements of a data relay satellite serving multiple low orbiting earth exploration satellites.

174. The 27.5-30 GHz band has been identified for the earth-to-space link from the central data acquisition earth station to a data relay satellite as well as for the forward link from a data relay satellite to the low orbiting earth exploration satellite.

175. The 25.25-27.5 GHz frequency band is proposed for data from low orbiting earth exploration satellites to a data relay satellite.

176. Signal levels at the Earth resulting from transmissions over all data links would produce power flux density levels

Fixed/Mobile (including Auxiliary Broadcast)

180. Referring to the frequency band 11.7-12.2 GHz, the Auxiliary Broadcasting Service Working Group (SWG) stated that "There is no need to reduce the Mobile Service to secondary status." The co-equal sharing of the Mobile, and the Broadcasting- and the Fixed-Satellite services in the same service area is practically impossible and we disagree with thesis put forward by the Auxiliary Broadcasting SWG.

181. The Auxiliary Broadcasting SWG stated that "It would be expected that 12.2-12.5 MHz (sic) could be shared on a secondary basis." This is a domestic issue. As we are not proposing deletion of the international allocations, the subject will not be discussed further.

182. The Auxiliary Broadcasting SWG opposed the proposed allocation of the 12.75-13.25 GHz band to the Fixed-Satellite service and stated that " . . . no other services be permitted to share the 12.70-13.25 GHz band with the Television Auxiliary Broadcasting Services". Since this particular band was the only one that appeared to be available to satisfy the Fixed-Satellite uplink requirement, we are unable to comply with this request. However, restrictions on the Fixed-Satellite service, similar to those mentioned in the Fixed-Satellite section for the 10.7-11.7 GHz band, would be considered if so proposed. In the 12.75-13.25 GHz band, it is not certain if the electronic news gathering transmissions would interfere with the space station receiver or not. The typical ranges of parameters of the mobile electronic news gathering system are as follows:

Maximum transmitter power, dBW, -20 to 0
Antenna diameters, 3' to 2'
Antenna gain, dBi, 20 to 35.5
Modulation, FM
BW, MHz, 25
Link, Length, miles, 0.5 to 5
Receiver Noise Figure, dB, 8
Sound Subcarrier(s), Two

183. Comments are invited on the sharing criteria between the electronic news gathering systems and the space stations, and on the level of the interference, if any, that would be introduced to the space stations by the current parameters of the electronic news gathering systems. Considering the answers to the above questions, along with any other pertinent information before us, we will carefully review the situation during domestic Rulemaking proceedings.

184. Referring to the frequency bands 17.7-19.7 GHz, 21.2-22, 22.4-23 GHz and 37-40 GHz, the Auxiliary Broadcasting SWG urged " . . . the Commission to permit no footnote to be associated with these bands which would preclude their use for Television Auxiliary Stations". If this SWG submits any analysis showing a particular footnote to be detrimental to the Television Auxiliary Stations, then we will consider those comments.

Radiation/Radiolocation

185. These services in the bands above 10.7 GHz were only nominally addressed

in the comments and reply comments to the Third Notice of Inquiry. Specific comments included the deletion of footnote 407A from the 13.25-13.4 GHz band, deletion of footnote 408A from the 14-14.3 GHz band, and support for addition of a new footnote 409CA in the band 15.7-16.6 GHz. In addition, the RTCA and ARINC supported the retention of the Radionavigation allocations at 31.8-32.3 GHz and 33-33.4 GHz.

186. The ARINC and RTCA request for suppression of of footnote 408A in the band 14-14.3 GHz has been opposed by COMSAT in its reply comments, "unless CCIR Recommendation 496 (concerning frequency sharing criteria) is incorporated in the International Radio Regulations". This band will be used by the INTELSAT system and by the SBS system for the uplink to their satellites. Such systems require huge investments and must be protected. We, therefore, cannot accept the deletion of footnote 408A at this time. We do, however, invite comment on the sharing criteria which could be adopted in lieu of footnote 408A, if such criteria are deemed preferable to footnote 408A.

187. ARINC proposed the deletion of the footnote 407A from 13.4-14.0 GHz band without giving any reason. The footnotes 407A and 408B are proposed to be deleted and the secondary Space Research Service is proposed to be allocated in the Table to meet our national requirements. Except for the 14.4-14.5 GHz band, the direction indicators for the Space Research Service, in this region of the spectrum, are deleted. Because of the secondary status of the proposed allocations to the Space Research Service, no interference is expected to be caused by it to the other services.

Above 40 GHz

188. COMSAT commented that we may desire to leave a large portion of the frequency band above 40 GHz unallocated at this time " . . . ". The private cated but request a conference in the late 1980s to make specific allocations. COMSAT General had previously recommended certain frequency bands above 40 GHz for the fixed-satellite service. COMSAT General proposed that " . . . no other allocations above 40 GHz be made at this time " . . . ". The private microwave advisory committee stated its belief that allocations above 100 GHz should be left "open" to insure future flexibility. AT&T recommended " . . . that the Commission continue to press for international allocations of the spectrum from 40 to 300 GHz to encourage experimentation and innovative development." Several arguments, any of which is persuasive, can be made for proposing specific allocations above 40 GHz. First, a large portion of the spectrum above 40 GHz is currently allocated; other Administrations may be expected to propose allocations for the frequency bands currently unallocated, and the United States should be prepared for that eventuality. Second, many spectral lines have been identified for the Radio Astronomy and Space Research services. Third, developments are currently in progress in

several frequency bands above 40 GHz. Fourth, the allocations table helps users to select the appropriate frequency for the development of a specific service, thus preventing waste of funds. Fifth, and perhaps most importantly, orderly spectrum development ensues. The last General World Administrative Radio Conference (GWARC) was held in 1959 and at that time the entire Article 5 was considered. The World Administrative Radio Conferences held between 1959 and the present were "specialized" in nature and devoted to specific services such as Space, Maritime, and Broadcasting-Satellite. We are not certain that another GWARC could be convened in the late 1980s as suggested by COMSAT. Considering all factors, we believe it prudent to prepare a specific Frequency Allocations Table extending up to 300 GHz.

189. Various lasers systems are currently being developed for radar, and for terrestrial and satellite communications. What, if any, allocations and technical regulation should be proposed for these frequencies?

International Radio Regulations and Appendices

190. Although the published Agenda for the 1979 WARC specifies Articles of the Radio Regulations which are to be considered, we are reviewing all Articles and Appendices in order to determine the appropriate actions to take in their regard. For purposes of discussion, we have divided the Articles and Appendices into those dealing with definition matters, technical matters, and operational matters. Some proposals pertaining to these matters were presented in the previous Notice; additional proposals arising to this time are presented in Appendix 3.

Definition Matters

191. We have identified a requirement for accommodating spaceborne radars such as docking and mapping radars used in space programs. We have considered modifying the definition of the Radiolocation Service to include spaceborne operations, however, at this time we are opposed to this subject and we may propose specific allocations in future to satisfy this requirement.

Technical Matters

192. Spectrum requirements are far beyond the ability of usage concepts to provide. There is simply not enough usable spectrum for exclusivity. To determine which services should be sacrificed at the expense of another, would, in most cases, be a difficult task. Initially at least, it must be assumed that, with few exceptions, all services must be regarded as coequal.

193. We ask all users to recognize the impossibility of obtaining all the spectrum requested and the virtual impossibility of exclusivity with perhaps several exceptions. We must develop conditions for cooperative use which go far beyond the concepts of sharing that presently prevail. Given that a band must be used by more than one justifiable service, our problem is to determine

the specific conditions or criteria, which can be applied to two or more services on mutually cooperative rather than mutually exclusive bases in order to achieve more effective use of the spectrum.

194. The need for cooperative use of the spectrum (as evidenced by the projected demands for existing services and expected growth of new services) is greater than ever envisaged before by more than an order of magnitude.

195. We ask that interested parties address themselves to the conditions under which they can cooperate with other services that must make use of the same portions of the spectrum.

196. A number of problem areas concerning cooperative use have been identified as being of great importance. We solicit comments on these problems (see Problem Areas) and we suggest that the replies take cognizance of the following key issues which underlie the development of increased sharing through "Cooperative and Mutual Usage" criteria:

Key Issues

(1) Is there a case for exclusivity as far as particular bands or frequencies are concerned?

(2) Is the need for the service in a requested band such that increased sharing through cooperative and mutual usage criteria should be developed, or would the service suffer serious harm by virtue of such usage?

(a) Exactly how does the service make us of the band (for which increased sharing through cooperative and mutual usage are to be developed)? The answer should be couched in terms of radiation patterns, size of markets, use as a function of population density, geographical location, time of day, expected physical coverage by radiated signal, frequency sharing, and any other related pertinent factors. In particular, consideration should be given to the probability statistics of use, and tolerable interference, since less than 100% uninterrupted service may be a necessary factor in the increased sharing through cooperative and mutual usage criteria.

(b) Which factors, specifically relevant to the above usage, would have to be addressed in order to develop increased sharing through cooperative and mutual usage criteria?

(3) Do the existing Radio Regulations concerning interference aid or interfere with the determination of increased sharing through cooperative and mutual usage criteria? If so, in what way, and what modifications would be helpful?

(4) Are there preferred technical and operating characteristics of a service, or of services for which it is necessary to develop increased sharing through cooperative and mutual usage criteria? For instance, would specific attention to such factors as antenna characteristics, transmitted power, flux density, type of emission, receiver characteristics, TASI, etc. for a given system, or equipment, not presently specified in detail, permit greater usage of the band by the several necessary services?

(5) Would cooperative use be enhanced by specific rules and regulations which do not presently exist, and what would such rules cover?

(6) In the event that special coordination procedures would be helpful for increased sharing through cooperative and mutual usage, what form would these take? Finally, what would such procedures be able to accomplish that cannot be accomplished under the present operating structure?

(7) Can requests for various segments of the bands be coordinated in some form of priority? For instance, if a service must be expanded, is greater priority to be given to new bands, or expansion of existing bands? If increased sharing through mutual and cooperative usage criteria must be employed, what other services are the most and the least desirable for mutual usage? Is a single wide band used in cooperation with other services, preferable to a number of smaller bands with perhaps less interference potential? Where is it contemplated that such bands should lie? Are other factors pertinent?

(8) In what way do modulation techniques, e.g. digital, FM, spread spectrum, etc., affect the increased sharing through cooperative and mutual usage?

197. We wish to approach this problem with the positive outlook that at least partial solutions are available if only we search diligently enough.

198. With these thoughts in mind, particular problems of band usage are here brought to the specific attention of those users who are involved. These matters are also addressed in the text of this Notice of Inquiry either in terms of service or spectrum bands or both. However, because they pose particularly severe difficulties as far as resolution is concerned, they are presented below. We request that the various users suggest criteria/conditions for increased sharing through cooperative usage, with particular reference to the preceding statements:

Problem Areas

(1) Usage of the 3.4-6.925 GHz band by the Broadcasting-Satellite Service, Fixed Satellite Service, and mobile users. (See Appendix 5.)

(2) Mutual usage by Mobile and Radiolocation Services in the 896-902, and 941-947 MHz bands. There are also potential problems with troposcatter and broadcasting. (Technical Parameters of Radiolocation Service are listed in the common carrier Land-Mobile Section, page 20.)

(3) Broadcasting and Radiolocation services in the 1615-1800 kHz band require consideration.

(4) Usage of the 4-30 MHz band by HF Broadcasting and Fixed/Mobile services, Maritime Mobile Service sharing with secondary Fixed Service in accordance with the Note described in the HF Fixed section, page 9.

(5) Usage of the 821-825 MHz and 866-870 MHz bands for Mobile Satellites—interference with TV, land mobile and other services requires consideration. (See footnote 329B.)

(6) Usage of 2300-2500 MHz band. Required for Broadcasting-Satellite Service, along with requirements of Aviation and Marine related services.

(7) A 1% bandwidth is requested for radio astronomy research in the 3 GHz region. At present it is not clear where this may be best provided. (See footnote 369A.)

Operational Matters

199. Operational matters are those which are left after the Table of Frequency Allocations, technical matters and notification provisions are excluded. Numerous topics which would fall within the purview of the operations committee which may be established at the 1979 WARC are treated in Appendices 3 and 4 of this document. In many instances where the intent of the proposed MOD or ADD is not self-evident, a tentative reason has been shown.

200. There is no intent to expand the agenda as presently adopted by the Administrative Council. These matters go beyond the scope of the draft agenda for the 1979 WARC already adopted pursuant to the provisions of the Convention. However, that Convention does provide for the amendment of draft agendas already established. Since there will be three meetings of the ITU Administrative Council prior to the Conference, and since the Council may initiate adjustment of, or expansion of, the agenda, we are here endeavoring to prepare should matters not now slated for consideration perhaps suddenly be added to the agenda. Were an expansion effected in, say, June of 1979, the Commission would not then have time, in all probability, to issue a notice of inquiry prior to the convening of the WARC on September 24, 1979.

201. Rather, noting the provisions of the Administrative Procedure Act, we would prefer to invite attention to these matters now while there is some time to benefit from public comment thereupon. It should also be noted that portions of these appendices were produced very late in the preparation of this notice and therefore have not been reviewed in their entirety by all appropriate elements in the preparatory structure. When that total review is effected, some may be altered or removed and others may be added as is true for all matters advanced herein. With this in mind, cogent comment upon the proposals advanced is requested with the hope that commenters will bear in mind that this is not a domestic proceeding, and that the scope of the proceeding extends well beyond 1977.

Resolutions and Recommendations

202. We are reviewing all Resolutions and Recommendations in order to determine the appropriate actions to take in their regard. The proposals arising to this time are presented in Appendix 4; additional proposals will be presented in future Notices. In some cases we are proposing no action. In other cases, the proposals will depend on the outcome of events at the 1979 WARC or in the period between today and the time of