

NASA Technical Memorandum 87285

Impact of the 1985 Space World Administrative Radio Conference on Frequency/Orbit Planning and Use

(NASA-TM-87285) IMPACT OF THE 1985 SPACE
WORLD ADMINISTRATIVE RADIO CONFERENCE ON
FREQUENCY/ORBIT PLANNING AND USE (NASA) 8 p
HC A02/MF A01 CSCL 17B

N86-24881

Unclas

G3/32 43360

Edward F. Miller
Lewis Research Center
Cleveland, Ohio

Prepared for the
11th Annual Communications Satellite Systems Conference
sponsored by the American Institute of Aeronautics and Astronautics
San Diego, California, March 16-20, 1986

NASA

IMPACT OF THE 1985 SPACE WORLD ADMINISTRATIVE RADIO CONFERENCE ON FREQUENCY/ORBIT PLANNING AND USE

Edward F. Miller
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio 44135

Abstract

The 1985 World Administrative Radio Conference (WARC-ORB-85) was held to determine which space radio services should be planned and which planning methods should be used. The second session of this Conference (WARC-ORB-88) will meet to develop the required plans. This paper presents the results of WARC-ORB-85, assesses the impact of those decisions, and identifies the intersessional work to be conducted by administrations and the CCIR (Consultative Committee on International Radio).

The major decisions of WARC-ORB-85 were. (1) the restriction of additional planning to the fixed satellite service at identified frequencies, (2) the selection of a planning method consisting of two parts (a) an allotment plan, and (b) improved procedures. The paper also discusses WARC-ORB-85 decisions relative to the Region 2 broadcast satellite service plans at 12 GHz, feederlink planning for Regions 1 and 3 broadcast satellites at 12 GHz, and sound broadcast satellite service.

Introduction

The International Telecommunications Union (ITU), consisting of more than 160 member administrations, is engaged in an effort expected to result in the planning of portions of the geostationary orbit and the frequency spectrum used for space services. The ITU established a two-phase World Administrative Radio Conference (WARC) to accomplish this planning. The first session, WARC-ORB-85, was to identify the frequency bands and the space services to be planned, and the second session, WARC-ORB-88, was to perform that planning. This paper presents the results and impacts of the 1985 Space World Administrative Radio Conference, and discusses the work being performed in the intersessional period.

Agenda for WARC-ORB-85

The agenda for the first session of the Space WARC was established by the Administrative Council of the ITU.

Major elements were:

- Review of the situation prevailing.
- Decision on which space services and frequencies should be planned.
- Establishment of the principles, technical parameters, and criteria for planning.
- Identification of frequency bands where sharing criteria are needed.

- Establishment of guidelines for regulatory procedures for bands and services not subject to planning.

- Consideration of other approaches that would provide flexibility with changing services and technology.

- Feederlink planning in ITU regions 1 and 3, for the broadcasting satellite service (BSS) at 12 GHz, as planned (downlink only) at WARC-77.

- Selection of frequency bands.

- Feederlink technical characteristics.

- Consideration of sound BSS and recommendations.

- Specification of intersessional work.

- Incorporation of the ITU Region 2 BSS plan into the Radio Regulations.

Preparatory Work for WARC-ORB-85

Preparations for the Space WARC in 1985 began more than two years prior to the Conference. International preparations culminated in the 1984 Conference Preparatory Meeting of the CCIR (Consultative Committee on International Radio). At this meeting, the relevant CCIR study groups developed the necessary technical information¹ to serve as the basis for WARC-85 decisions.

Individual administrations had also been engaged in preparations for the Space WARC. In the United States, government and industry advisory groups were formed to develop and assess technical information, evaluate alternatives, and establish formal positions prior to the Conference. In other countries the PTT's (Post, Telephone, and Telegraph organizations) played similar roles. Between and among administrations, bilateral and multilateral discussions were held to exchange views before the Conference.

In the final months before the Space WARC, the United States delegation was formed consisting of 56 representatives of government and industry. The delegation finalized technical and political positions, prepared formal United States proposals to the Conference, and reviewed the proposals of other administrations. In other countries, similar preparations were undertaken.

Conference Setting

The WARC-ORB-85 was held in Geneva, Switzerland with approximately 112 administrations in attendance. Twenty-three other organizations, such as INTELSAT, INTERSPUTNIK, EBU, and WMO, were present. More than 600 delegates were registered at the WARC-85.

The remainder of this paper presents the results and impacts of the 1985 Space WARC and discusses the intersessional work and preparations to be conducted by administrations and the CCIR for the 1988 Space WARC.

Results and Impacts of WARC-ORB-85

The agenda topics discussed earlier fall quite naturally into categories that might be termed "Routine Matters" and "New Directions."

Routine" Results

An important task of WARC-ORB-85 was to incorporate into the Radio Regulations the Final Acts of the 1983 Regional Administrative Radio Conference, which had established a plan for broadcasting satellites at 12 GHz in ITU Region 2 (the western hemisphere). After detailed technical discussions among administrations and the performance of additional computer analyses, the concerns of several European administrations were alleviated, and the Region 2 broadcasting satellite plan (both downlink and feederlink) was approved. The agreed upon plan is contained in the "Final Acts, WARC ORB-85".² These revisions to the Radio Regulations are scheduled to become effective on October 30, 1986.

Another task of the Conference was to deal with feederlink planning for the broadcasting satellite service (BSS) at 12 GHz in ITU Regions 1 and 3. The 1977 WARC had developed plans for BSS downlinks in these regions, but the corresponding feederlink plan had not yet been addressed in a WARC. The 1985 Space WARC decided that the frequency bands for Regions 1 and 3 feederlinks would be:

17.3 - 18.1 GHz (Preferred)

14.5 - 14.8 GHz (Outside Europe and for Malta)

The WARC-ORB-85 also defined the technical characteristics for the feederlinks to Region 1 and 3 broadcasting satellites. (See Reference 3, for specific values of the technical parameters.) It was decided that the International Frequency Registration Board (IFRB) would prepare the appropriate computer software to perform preliminary feederlink planning exercises prior to WARC-ORB-88. The '88 Conference would then develop and agree upon a feederlink assignment plan for Region 1 and 3 broadcasting satellites with 12 GHz downlinks.

The '85 WARC was also to consider the area of the sound BSS, and to make appropriate recommendations to the '88 WARC. Most administrations saw difficulty in accommodating a potential allocation for the sound BSS in the frequency range 0.5 to 2.0 GHz. Agreement was reached to study a number of technical parameters that would more readily permit the implementation of the sound BSS. (See Reference 3, Section 7.2.4 for a listing of the study areas.) One of the more contentious areas selected for study was the frequency of operation. Agreement was finally reached to study "frequencies outside but near the 0.5 - 2.0 GHz range where the possibilities for sharing or other

accommodations may be greater." The frequency allocation question for the sound BSS was referred to the '88 WARC.

"New Directions"

The more significant results of the WARC-ORB-85 are in those areas where entirely new decisions were made, specifically, the decisions to plan particular space services in identified frequency bands.

Results. From an examination of the situation prevailing, the Conference made a decision to limit its planning activities to the fixed satellite service (FSS). This decision was based upon the degree of use, the state of technical development, the demand for orbit and frequency assignments, and other factors. It was concluded that, at the present time, only the FSS has sufficiently high demand upon its resources and a sufficiently high level of technical development to warrant planning.

The question of which frequency bands were to be planned was more contentious, and was not settled until the end of the Conference. Early in the Conference, the administrations split into two groups: those who argued for planning all frequencies assigned to the FSS, up to 20 GHz, and those who supported minimal planning. Arguments were presented supporting both points of view, but by the fourth week of the Conference no decision had been made on which frequency bands were to be planned. This failure on the part of the planning committee of the Conference to reach a timely conclusion had a limiting effect on the work of the other committees. For example, the technical committee output was developed before the decision on frequencies and hence was quite general and not tailored to the specific frequency bands chosen for planning.

Eventually, on the last day of the Conference, the decision was reached on a planning method consisting of two parts: (a) an allotment plan and (b) improved procedures.

The allotment planning method described in Table 1 is associated with C and Ku band frequencies. However, the specific frequencies identified are in what are commonly termed as "the expansion bands" or "the WARC '79 bands." Thus, the C and Ku band frequencies, which are presently being used quite intensively for FSS communications, are not subject to allotment planning. The allotment planning method will determine the use of and access to frequencies that are presently little used in the fixed satellite service.

The method of planning by improved procedures, described in Table II and Fig. 1, includes most of the other frequencies that are allocated to the FSS. The heavily used C band frequencies (3700-4200 MHz downlink and 5925-6425 MHz feederlink) are included in the frequencies covered by improved procedures. The 7 and 8 GHz frequencies used by the military are not included under either planning method.

The WARC-ORB-85 also established planning principles to guide the development of both parts

of the planning method. These eleven planning principles are summarized below:

1. Guarantee of access and equitability - guarantee in practice for all countries equitable access to the geostationary satellite orbit and the frequency bands allocated to the space services utilizing it, taking into account the special needs of developing countries and the geographical situation of particular countries.

2. Sharing with other services - must not impose additional constraints on terrestrial and/or space services sharing the band on an equal basis.

3. Reservation of resources -

(a) The planning method should consider the full orbit/spectrum resource. Setting aside portions of the resources to accommodate unforeseen requirements and requirements of future members of the Union shall be considered after all requirements are satisfied.

(b) Administrations or groups of administrations are not entitled to permanent priority in the use of particular frequencies and GSO positions in such a way as to foreclose access by other administrations to the GSO and frequency bands allocated to space services.

4. The technical aspects of special geographical situations - should be taken into account.

5. Consideration of existing systems - take into account the existing systems. If necessary, these systems may be subjected to some adjustments to allow for the accommodation of new systems.

6. Provisions for multi-administration systems -

(a) shall take into account the requirements of administrations using multi-administration systems created by intergovernmental agreement and used collectively without affecting the rights of administrations with respect to national systems.

(b) shall take account of the specific characteristics of multi-administration systems in order to enable them to continue to meet the requirements of administrations for international services as well as, in many cases, for national services.

7. Flexibility - to accommodate unforeseen requirements and modification of requirements of administrations, and to accommodate advances in technology as well as to not prevent the use of technologies which are well proven and widely available.

8. Different planning solutions in different circumstances - as for different regions, frequency bands or orbital arcs shall not be excluded.

9. Efficiency - efficient and economical use of the geostationary orbit and frequency bands allocated to space services.

10. Provisions for multiservice and multiband networks - without imposing undue constraints to planning.

11. Administrative cost - for the development and application of the planning method to be as low as possible.

The difficult task of WARC-ORB-88 will be to develop the appropriate planning methods that will be judged to be consistent with these planning principles, which are likely to be differently understood by the different administrations present. The task will then be to forge agreement from what may initially be substantial disagreement.

Impacts. The near term impacts of the decisions of WARC-ORB-85 are (1) that a portion of the frequency bands allocated to the fixed satellite service will be subject to allotment planning, and (2) other FSS bands will benefit from improved procedures. These specific actions are scheduled to occur at WARC-ORB-88. Given a successful outcome of the 88 Space WARC, what will be the scenario for the affected bands in the fixed satellite service?

In the bands subject to allotment planning, each ITU member is targeted for a minimum of one allotment, with the full 800 MHz bandwidth. The achievability of this goal is a function of the technical parameters selected as the basis for planning. If characteristics are chosen that are representative of yesterday's technology, then full bandwidth allotments may not be possible for areas where there is a high density of ITU members per degree of longitude, as for Europe/Africa and the Caribbean/Central America. On the other hand, the use of current technology or advanced technology with improved performance would allow closer spacings of satellites in the geostationary orbit and would be more likely to provide one full bandwidth allotment per ITU member. Detailed analyses of different planning scenarios, under different technical assumptions, are required to fully examine the possibilities.

For the FSS bands subject to improved procedures, the likely outcome of WARC-ORB-88 is a simplification and improvement of the processes required to obtain frequency assignments. Two very strong factors are pushing toward this outcome.

(1) A sincere desire on the part of member administrations of the ITU to change and simplify the present processes.

(2) A wealth of experience with the difficulties and complexities of the current procedures.

The efforts of administrations to develop the concept of periodic multilateral planning meetings will likely produce agreed upon improvements to the current procedures for obtaining geostationary orbit/frequency assignments in the FSS.

Intersessional Work and Preparations for WARC-ORB-88

With the Space WARC being held in two sessions (1985 and 1988), there is a 3 year inter-sessional period in which to develop the necessary technical data and analyses and to establish the formal positions of the individual administrations. The intersessional technical work will be accomplished by administrations via the CCIR, and each administration will internally prepare its formal positions on the issues of WARC-ORB-88.

Possible Agenda Items for WARC-ORB-88

The first session of the Space WARC has recommended items for the agenda of the second session. The administrative council of the ITU will consider these items, previous resolutions and recommendations, and inputs from administrations, to arrive at a final agenda. Items likely to be on the WARC-ORB-88 agenda include:

- (1) Establishment of an allotment plan and regulatory procedures for the FSS.
- (2) Establishment of improved regulatory procedures.
- (3) Adoption of technical standards, parameters and criteria.
- (4) Establishment of a feederlink plan for ITU Regions 1 and 3, associated with the 12 GHz downlink plan for the BSS.
- (5) Consideration of allocations for sound BSS.
- (6) Consideration of a suitable frequency band for the BSS to accommodate high definition television.

The preparatory work being conducted by the several CCIR study groups and the administrations will touch upon all items of the WARC-ORB-88 agenda.

Preparatory Work

The intersessional work topics identified by the first session of the Space WARC include:

- Technical parameters of satellite systems, such as frequency band pairing, orbit sectorization, generalized parameters for planning, earth station antennas, polarization discrimination, and sharing criteria.
- Computer software development for planning.
- Bi-directional use of frequencies for satellite communications.
- Satellite sound broadcasting systems - technical parameters.
- High definition television transmissions by satellite - technical parameters, frequencies, and sharing aspects.

To accomplish this intersessional work the CCIR has proposed to use existing Interim Working Parties of the Study Groups and to organize a Joint Interim Working Party (JIWP) of the eight CCIR study groups concerned. This JIWP would meet in November 1986 and again in late 1987, with a Final Report available in February 1988.

The various administrations are also performing preparatory work during the intersessional period. In the United States, the Federal Communications Commission has maintained the Industry Advisory Committee to coordinate and collect the efforts of U.S. industry. On the government side, the Interagency Radio Advisory Committee (IRAC) has continued ad hoc committee 178 to similarly lead and coordinate the work. Also, the existing U.S. national CCIR structure is being used to channel technical inputs to the CCIR. In other administrations similar efforts are in progress.

Concluding Remarks

The 1985 Space WARC has made some fundamental decisions regarding the planning of space services. An allotment planning method has been identified for certain frequency bands in the fixed satellite service. Other frequency bands are subject to improved procedures for access by administrations. Between now and the next session of the Space WARC, there will be an intense period of preparatory work, during which technical studies will be conducted, planning software will be developed, and administrations will establish their positions on the issues. At the 1988 Space WARC, the FSS allotment plan will likely be developed and agreed upon, as will the improved procedures. The decade following the 1988 Conference will apply the test of history to the outputs of this two session Space WARC. In the year 2000, we will be able to look back and assess which of the planning methods used (allotment planning, improved procedures, or another method) has been the most effective in guaranteeing equitable access to the geostationary orbit by all countries.

References

1. Technical Bases for the World Administrative Radio Conference on the Use of the Geostationary-Satellite Orbit and the Planning of the Space Services Utilizing It (WARC-ORB (1)), Report of the CCIR Conference Preparatory Meeting (CPM), Joint Meeting, Study Groups 1,2,4,5,7,8,9,10 and 11, Geneva, June 25 - July 20, 1984, Parts I and II, International Telecommunications Union, Geneva, Switzerland, 1984.
2. Final Acts, WARC-ORB-85, International Telecommunications Union, Geneva, Switzerland, 1985.
3. Report to the Second Session of the Conference, and, Addendum to Report to the Second Session of the Conference, World Administrative Radio Conference on the Use of the Geostationary-Satellite Orbit and the Planning of Space Services Utilizing It, First Session, Geneva, 1985, International Telecommunications Union, Geneva, Switzerland, 1985.

TABLE I. - MAJOR CHARACTERISTICS OF THE ALLOTMENT PLANNING METHOD

Service		FSS
Frequencies	downlink feederlink	4500-4800 MHz 300 MHz in band 6425-7075 MHz
	downlink feederlink	10.70-10.95 GHz and 11.20-11.45 GHz 12.75-13.25 GHz
Total bandwidth		800 MHz
National systems, providing domestic service, with provision for sub-regional service		
Allotments		at least one per ITU member an orbital position in a predetermined arc 800 MHz bandwidth
Duration		10 years, minimum
Existing systems		to be included in the plan.
Procedures for converting an allotment into a assignment		to be determined by WARC-ORB-88

TABLE II. - MAJOR CHARACTERISTICS OF PLANNING BY IMPROVED PROCEDURES

Service		FSS
Frequencies	downlink feederlink	3700-4200 MHz 5850-6425 MHz
	downlink	10.95 to 11.20 GHz 11.45 to 11.70 GHz 11.70 to 12.20 GHz in Region 2 12.50 to 12.75 GHz in Regions 1 and 3
	feederlink	14.00 to 14.50 GHz
	downlink feederlink	18.10 to 20.20 GHz 27.00 to 30.00 GHz
Multilateral planning meetings		convened periodically provide access to GSO/spectrum resources simple matters of access or modification dealt with between adminis- trations new and separate procedure nature and status con- sidered by WARC-ORB-88
Possible approach		See flowchart (Fig. 1)

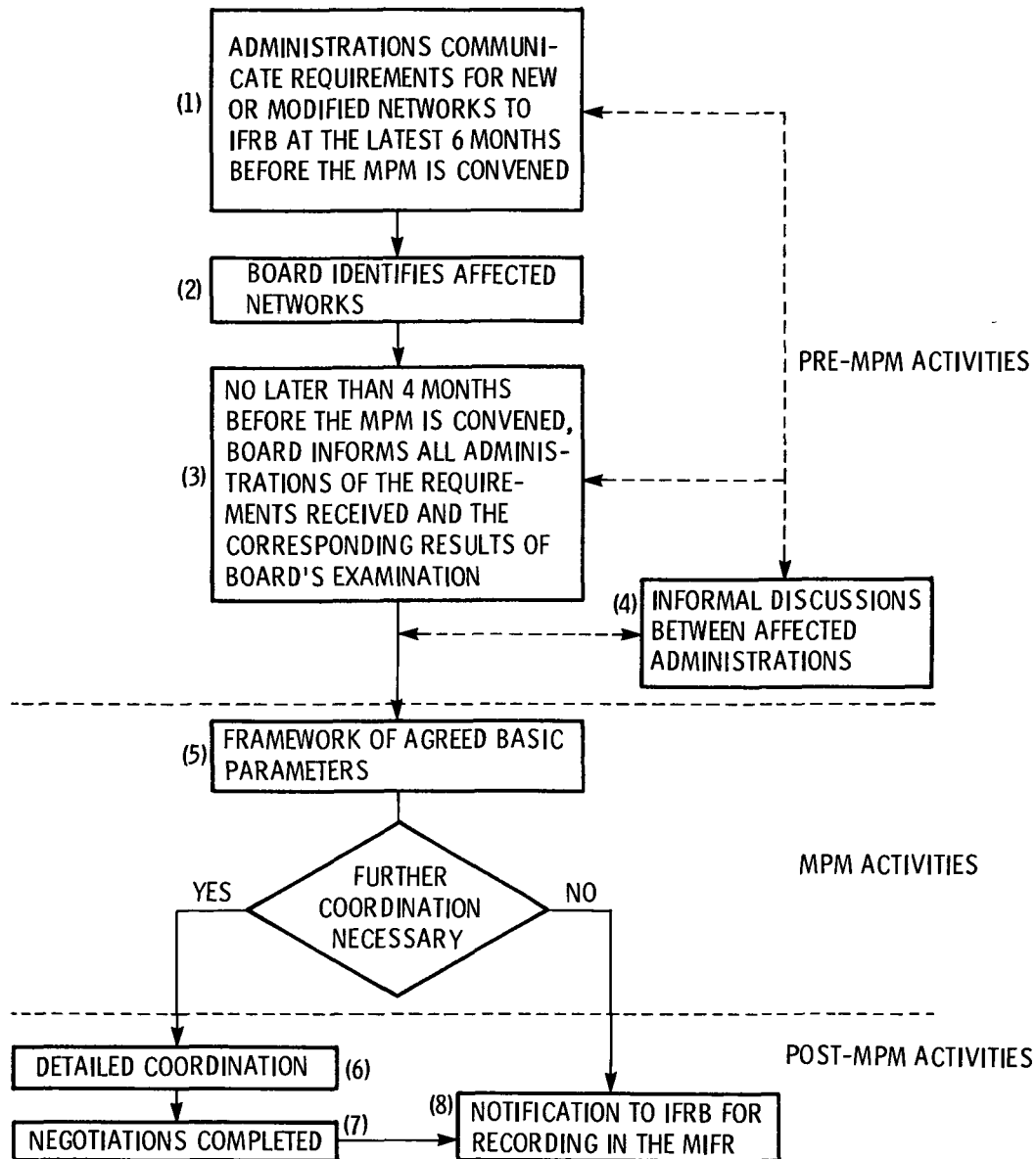


Figure 1. - Flowchart for a proposed approach to multi-lateral planning meetings (MPM's).

1 Report No NASA TM-87285		2 Government Accession No		3 Recipient's Catalog No	
4 Title and Subtitle Impact of the 1985 Space World Administrative Radio Conference on Frequency/Orbit Planning and Use				5 Report Date	
				6 Performing Organization Code 643-10-01	
7 Author(s) Edward F. Miller				8 Performing Organization Report No E-2976	
				10 Work Unit No	
9 Performing Organization Name and Address National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio 44135				11 Contract or Grant No	
				13 Type of Report and Period Covered Technical Memorandum	
12 Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546				14 Sponsoring Agency Code	
15 Supplementary Notes Prepared for the 11th Annual Communications Satellite Systems Conference sponsored by the American Institute of Aeronautics and Astronautics, San Diego, California, March 16-20, 1986.					
16 Abstract The 1985 World Administrative Radio Conference (WARC-ORB-85) was held to determine which space radio services should be planned and which planning methods should be used. The second session of this Conference (WARC-ORB-88) will meet to develop the required plans. This paper presents the results of WARC-ORB-85, assesses the impact of those decisions, and identifies the intersessional work to be conducted by administrations and the CCIR (Consultative Committee on International Radio). The major decisions of WARC-ORB-85 were: (1) the restriction of additional planning to the fixed satellite service at identified frequencies, (2) the selection of a planning method consisting of two parts (a) an allotment plan, and (b) improved procedures. The paper also discusses WARC-ORB-85 decisions relative to the Region 2 broadcast satellite service plans at 12 GHz, feederlink planning for Regions 1 and 3 broadcast satellites at 12 GHz, and sound broadcast satellite service.					
17 Key Words (Suggested by Author(s)) Communications satellites; Planning; Spectrum use; Geostationary orbit				18 Distribution Statement Unclassified - unlimited STAR Category 32	
19 Security Classif (of this report) Unclassified		20 Security Classif (of this page) Unclassified		21 No of pages	
				22 Price*	

National Aeronautics and
Space Administration

Lewis Research Center
Cleveland Ohio 44135

Official Business
Penalty for Private Use \$300

SECOND CLASS MAIL

ADDRESS CORRECTION REQUESTED



Postage and Fees Paid
National Aeronautics and
Space Administration
NASA-451

NASA
