INTERNATIONAL TELECOMMUNICATION UNION

Thirty-fifth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space

Booklet No. 44

Geneva 1996

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Thirty-fifth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space

Booklet No. 44

Geneva 1996
ISBN 92-61-06222-9

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THIRTY-FIFTH REPORT OF THE INTERNATIONAL TELECOMMUNICATION UNION ON TELECOMMUNICATION AND THE PEACEFUL USES OF OUTER SPACE

Introduction

This report provides information on the activities of the International Telecommunication Union (ITU) with regard to outer space since the submission of the thirty-fourth report in 1995.

It is submitted for the attention of the United Nations Committee on the Peaceful Uses of Outer Space (its Scientific and Technical Sub-Committee and its Legal Sub-Committee) and for information of Members of the Union.

1. International regulations for the use of orbit/spectrum resources

The Constitution and Convention of the International Telecommunication Union (Geneva, 1992), drawn up by the Additional Plenipotentiary Conference (Geneva, 1992) and amended by the Plenipotentiary Conference

(Kyoto, 1994) entered into force on 1 January 1996. These basic instruments of the Union contain the regulatory bases for the allocation of orbit/spectrum resources. One of the main principles in this regard is laid down in No. 196 of the ITU Constitution (Article 44), which stipulates that *"In using frequency bands for radio services, Members shall bear in mind that radio frequencies and the geostationary-satellite orbit are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulations, so that countries or groups of countries may have equitable access to both, taking into account the special needs of the developing countries and the geographical situation of particular countries"*. As indicated in the above provision, further detailed regulations and procedures governing orbit/spectrum use are contained in the Radio Regulations (RR), which is a binding international treaty (No. 31 of the ITU Constitution). The legal regime embodied in the Radio Regulations, which includes the rights and obligations of countries and procedures applicable for all radiocommunication services, has been established by major ITU world radiocommunication conferences (WARCs, WRCs).

The above-mentioned principles of efficient use of and equitable access to orbit/spectrum resources and the technical and regulatory mechanisms for the sharing of these resources have been the major concern of the ITU Member administrations in establishing the legal regime governing the use of the geostationary-satellite orbit. The regulatory framework which resulted from more than 30 years of continuous effort by the Member countries has been constantly adapted to changing circumstances.

For some time now, with the dramatic development in telecommunication services, increasing demand for spectrum/orbit usage for practically all space communication services has been observed. This development may prompt significant changes in spectrum/orbit allocation practices. The change is attributable to many factors. These include not only technological progress and the resulting increased use of space techniques in radiocommunications, but also political, social and structural changes around the world and their impact on the liberalization of telecommunication services, the introduction of non-GSO satellite systems for commercial communications, growing market orientation, increasing competition, the change in the way this widening market is shared between private and public service providers and the general globalization and commercialization of communication systems.

These elements led the Plenipotentiary Conference (Kyoto, 1994) to call, in its Resolution 18, for a new in-depth review of the ITU spectrum/orbit resource allocation procedures with the aim of:

— ensuring equitable access to spectrum/orbit resources;

— ensuring that coordination procedures meet the needs of administrations;

— examining advanced technologies;

— establishing linkage between procedures and commitments to take up notified networks.

As a first phase of this review, in 1995, ITU studies focused on identifying problem areas ("the issues") requiring further consideration and solution. The major aspects of these studies are described below.

The first and probably single most important issue is the reservation of capacity without actual use. Some administrations tend to initiate the coordination procedure for more orbital positions or more spectrum than really needed ("overfiling"), expecting that some of these positions will not survive by the end of the coordination process. In the existing procedures, administrations can also reserve orbital positions for later use, or which they themselves do not intend to implement but which might later be transferred to others. Although no one can legally claim ownership of a particular position on the geostationary-satellite orbit, which is a "common heritage" belonging to all mankind, it is also evident that the recognized right to use a specific orbital position may represent a monetary value. Access to orbital positions is, at present, free of charge in that there are no international filing, registration or licence fees. Yet market considerations will probably have an increasing influence in orbit/spectrum resource allocation as its perceived scarcity increases.

The second main issue identified is the uncoordinated use of spectrum and orbital resources. There is growing concern about cases of satellites launched or repositioned before the coordination process is properly concluded. Bilateral negotiations between administrations can be very difficult when faced with a *"fait accompli"* situation. On the other hand, it should be recognized that the time-frames in the regular coordination process may be inadequate for the coordination of cases involving rapid but temporary modifications.

The third issue that was identified is dispute resolution. The ITU regulatory processes for achieving equitable access to orbital resources are founded on the fundamental axiom of coordination conducted in a cooperative manner, applying practical, operational experience, with differences resolved by direct negotiation between the parties involved. However, it is felt that means of resolving disputes should be examined. The proliferation of complex satellite systems in an era of growing congestion, resulting in a nearly continuous series of intersystem coordinations, have placed a strain on ITU Member administrations' human and financial resources. Moreover, widespread privatization and deregulation provides an incentive for greater involvement of satellite system operators in intersystem coordination. These factors suggest that system operators might be given a larger role within the coordination process.

Another issue is efficient use of the orbit and spectrum resources. As far as theoretical overall capacity is concerned, calculations indicate that a higher number of transponders could be accommodated than are presently in orbit. Nevertheless, there are some regions with rapidly developing telecommunication sectors and particularly "valuable" orbital segments where real conflict situations are emerging due to the limited capacity of the spectrum/orbit resource. Ways of making more efficient use of these scarce resources need to be explored. Orbit capacity can be increased by applying advanced technologies such as the use of shaped antenna beams, steerable antennas, better earth station characteristics and smaller coverage areas with better frequency re-use. Other technical means such as digital compression and other modulation techniques could also help to increase the efficiency of spectrum utilization.

One of the most important issues is that of equitable access to orbit and spectrum resources. A large number of administrations consider that the principle of equitable access is mainly implemented through the establishment and use of "plans". However, the spectrum covered by the broadcasting-satellite and fixed-satellite plans is largely unused. This may be explained by the fact that the implementation procedures are, in some cases, difficult to apply and that certain technical and administrative constraints are placed on spectrum usage. This issue also indicates the need for an in-depth review of the ITU's planning and coordination practices.

The problem areas having been identified, the different bodies and organizations within the ITU will, in 1996, endeavour to find solutions. The Radiocommunication Bureau, the Radiocommunication Advisory Group, the Radio Regulations Board, the relevant ITU-R study groups, the Special Committee on Regulatory/Procedural Matters and the ITU Policy Forum will all contribute to a final report summarizing the results of the studies for submission to the 1997 World Radiocommunication Conference (WRC-97), with a view to deciding on ways of incorporating new procedures/mechanisms into the ITU legal regime in order to increase efficiency and equity in spectrum/orbit utilization.

2. World radiocommunication conferences of the ITU

2.1 *World Radiocommunication Conference, 1995 (WRC-95)*

The 1995 World Radiocommunication Conference (WRC-95), which took place in Geneva from 23 October to 17 November 1995, focused on the following topics:

— general simplification of the Radio Regulations;

— review of the mobile-satellite services (MSS) below 3 GHz and the provision of feeder links for the MSS in other frequency bands.

The simplification of the Radio Regulations was a major achievement, completing the work of years of effort by different ITU forums. The need to simplify the Radio Regulations was formally recognized at the ITU Plenipotentiary Conference held in Nice in 1989, and a Voluntary Group of Experts was set up to study the issues. The resulting report (VGE Report), after review by the Conference Preparatory Meeting, formed the basis for discussions at WRC-95. The changes in the Regulations responded not only to the need to modernize in the light of necessary technical developments, but also to make the Regulations more efficient and reflect global political changes. WRC-95 adopted simplified procedures which are now contained in the new Radio Regulations to come into force in 1998 (some specific parts, mainly related to frequency allocations to MSS and MSS feeder links, enter into force on 1 January 1997).

The question of mobile-satellite services, and in particular the use of constellations of non-geostationary (low-Earth orbit - LEO) satellites to offer mobile voice and data services, was at the centre of the discussions at two major ITU Conferences (WARC-92 and WRC-95). The resulting new generation of personal communications services (PCS) have the potential to become an important part of the global telecommunication infrastructure. In addition to amendments to the decisions of WARC-92 to facilitate use of the frequency bands already allocated for MSS, sufficient spectrum has been allocated to MSS feeder links. To provide these links, spectrum had to be shared with the fixed-satellite services by placing non-GSO use on an equal footing with GSO use in some frequency bands.

2.2 *Forthcoming world radiocommunication conferences of the ITU*

Based on the decisions of WRC-93, WRC-95 recommended the following main items for consideration by WRC-97:

— revision of Appendices 30 and 30A for Regions 1 and 3, taking into account the need to preserve the integrity of the Region 2 Plans and their associated provisions;

— review of the propagation information in Appendix 28 used for the determination of coordination areas in the frequency bands between 1 GHz and 40 GHz shared by space and terrestrial services;

— protection of space services in the bands 2 025-2 110/2 200-2 290 MHz;

— allocation of frequency bands for the Earth exploration-satellite service;

— allocation issues for other unplanned space services;

— spurious emissions, wind profiler radars, multiservice satellite networks;

— examination of the issue of the HF bands allocated to the broadcasting service;

— issues related to implementation of the Global Maritime Distress and Safety System (GMDSS);

— use of Appendix 18 (transmitting frequencies in the band 156-174 MHz for stations in the maritime mobile service).

WRC-95 also adopted a preliminary agenda for WRC-99.

3. Application of international regulations – International registration of frequency assignments for space radiocommunications and orbital positions of geostationary satellites

3.1 Since the publication of the thirty-fourth Report, the Radiocommunication Bureau has continued to apply the relevant provisions of the Radio Regulations annexed to the Constitution/Convention of the International Telecommunication Union. In accordance with these provisions, administrations:

a) send information concerning their planned satellite systems to the Radiocommunication Bureau and inform the Radiocommunication Bureau whether or not comments have been received as a result of the publication of that information and of the progress made, with other administrations, in resolving difficulties that may have arisen;

b) send information to the Radiocommunication Bureau, where necessary, concerning coordination of the use of their assignments to geostationary and non-geostationary systems, for publication in other special sections of the Weekly Circular;

c) notify their frequency assignments to the Radiocommunication Bureau for recording in the Master International Frequency Register (Master Register).

The publication, coordination, notification and registration procedures which are applicable are those prescribed in the Radio Regulations in force and in the resolutions of the World Administrative Radio Conferences (Geneva, 1979; Geneva, 1985; Geneva, 1987; Geneva, 1988; Malaga-Torremolinos, 1992) and the World Radiocommunication Conference (Geneva, 1995).

3.2 In 1995, the Radiocommunication Bureau published under the advance publication procedure information relating to 186 new satellite networks. This information was submitted by the following administrations (listed in French alphabetical order):

Notifying Administration	Satellite system	Service[1]
Germany (Federal Republic of)	DFS-II-1 (23.5°E) DFS-II-2 (28.5°E) DFS-II-3 (33.5°E)	Fixed-satellite service
	EQUATOR-S (NON-GEO)	Space research service
	GENESIS-1 (28°W) GENESIS-2 (18°E) GENESIS-3 (67°E) GENESIS-4 (37°W) GENESIS-5 (13°E) GENESIS-6 (63°E)	Fixed-satellite service Mobile-satellite service
Brazil	B-SAT-L (45°W) B-SAT-M (59°W) B-SAT-N (84°W) B-SAT-O (87°W)	Fixed-satellite service
Canada	CANSAT-KA1 (107.3°W) CANSAT-KA2 (111.1°W) CANSAT-KA3 (118.7°W)	Fixed-satellite service
	KA ADVANCED SATCOM (114.9°W)	Fixed-satellite service Mobile-satellite service
Chile	FASAT-ALFA (NON-GEO)	Mobile satellite service Space research service
China (People's Republic of)	CHINASAT-6 (110.5°E)	Fixed-satellite service
	CHINASAT-25 (117.5°E)	Fixed-satellite service Mobile-satellite service
	CHINASAT-31 (80°E) CHINASAT-32 (140°E) CHINASAT-33 (110.5°E)	Radiodetermination-satellite service
United Arab Emirates	EMARSAT-1A/M (24°E) EMARSAT-1B/M (54°E)	Fixed-satellite service Mobile-satellite service
	EMARSAT-1E (15.5°W)	Fixed-satellite service
	EMARSAT-1F (44°E) EMARSAT-1G (51.5°E) EMARSAT-1J (33.5°E) EMARSAT-1K (38.5°E) EMARSAT-1L (28.5°E)	Fixed-satellite service Mobile-satellite service

[1] For frequency ranges of the geostationary-satellite systems see Table 1 under paragraph 3.7.
For frequency ranges of the non-geostationary-satellite systems see Table 2 under paragraph 3.7.

Notifying Administration	Satellite system	Service[1)]
United States of America	CASSINI (NON-GEO) FORTE (NON-GEO)	Space research service Space operation service
	JBS-1 (30°E) JBS-2 (120°W) JBS-3 (90°E) JBS-4 (16.5°W) JBS-5 (68°W) JBS-6 (90°W) JBS-7 (150°E) JBS-8 (177.5°E) JBS-9 (4°E) JBS-10 (57°E) JBS-11 (60°E) JBS-12 (175°E) JBS-13 (180°E) JBS-14 (135°W) JBS-15 (130°W) JBS-16 (52.5°W) JBS-17 (12°W) LEOSAT-1 (NON-GEO)	Fixed-satellite service Mobile-satellite service
	LEWIS (NON-GEO)	Space research service Earth exploration-satellite service
	MARS-PATHFINDER (NON-GEO) MTI (NON-GEO) NEAR (NON-GEO) P92-3 (NON-GEO) P92-4 (NON-GEO) P92-5 (NON-GEO) P92-6 (NON-GEO)	Space research service Space operation service
	SURFSAT-1 (NON-GEO)	Space research service
	USABSS-3TTC (119.2°W) USABSS-4 (118.8°W)	Space operation service
	USASAT-28A (80°W) USASAT-28B (110°W)	Broadcasting-satellite service Fixed-satellite service
	USASAT-29A (101°W) USASAT-29B (99°W)	Fixed-satellite service Inter-satellite service

[1)] For frequency ranges of the geostationary-satellite systems see Table 1 under paragraph 3.7.
For frequency ranges of the non-geostationary-satellite systems see Table 2 under paragraph 3.7.

Notifying Administration	Satellite system	Service[1)]
United States of America *(cont.)*	USASAT-29C (50°W) USASAT-29D (25°E) USASAT-29E (110°E)	Fixed-satellite service Inter-satellite service
	USASAT-29F (175°E)	Fixed-satellite service
	USGON-1 (70°E) USGON-2 (8.50°E) USGON-3 (103°E) USGON-4 (165°W) USGON-5 (38°W) USGON-6 (145°E) USGON-7 (145°W)	Space research service Space operation service
France (On behalf of Member Administrations of the European Space Agency)	SPOT-4 ESBT (NON-GEO)	Inter-satellite service Space operation service
Ghana	AFRICOM-1 (14.6°E)	Fixed-satellite service Mobile-satellite service
India	INSAT-2E (74°E) INSAT-2E (82°E) INSAT-2E (83°E) INSAT-2E (93.5°E)	Fixed-satellite service
	IRS-P3 (NON-GEO)	Earth exploration-satellite service Space operation service
Indonesia	PALAPA-PAC-4 (135.5°E) PALAPA-PAC-5 (152°E)	Fixed-satellite service
	PALAPA-PAC1-CKU (134°E) PALAPA-PAC2-CKU (139°E) PALAPA-PAC3-CKU (144°E)	Fixed-satellite service Space operation service
Italy	SARIT-19W	Fixed-satellite service Space operation service
Japan	COMETS (120°E) KIKU-6 (NON-GEO)	Fixed-satellite service Mobile-satellite service

1) For frequency ranges of the geostationary-satellite systems see Table 1 under paragraph 3.7.
For frequency ranges of the non-geostationary-satellite systems see Table 2 under paragraph 3.7.

Notifying Administration	Satellite system	Service[1]
Japan *(cont.)*	LUNAR-A (NON-GEO) LUNAR-A PENETRATOR	Space research service Space operation service
	SUPERBIRD-A2 (158°E) SUPERBIRD-B2 (162°E)	Fixed-satellite service
Luxembourg	LUX-24.2°E LUX-26.2°E LUX-28.2°E LUX-31.5°E LUX-35.5°E LUX-37.5°E LUX-41.2°E LUX-43.2°E LUX-KA-19.0°E	Fixed-satellite service
Malaysia	MEASAT-4 (72°E) MEASAT-SA1 (5.7°E) MEASAT-SA2 (9°E) MEASAT-SA3 (37°E) MEASAT-SA4 (46°E)	Fixed-satellite service
Mexico	SOLIDARIDAD-2KU-127 (127°W)	Fixed-satellite service
Phillippines	AGILA-A4 (127°E) AGILA-A5 (137°E) AGILA-A6 (147°E)	Fixed-satellite service
United Kingdom	AFRISAT-1 (19°E) AFRISAT-2 (32°E) AFRISAT-3 (38°E) AFRISAT-4 (64.5°E)	Fixed-satellite service Space operation service
	ASIASAT-AKS (122°E) ASIASAT-BKS (116°E) ASIASAT-CKS (105.5°E) ASIASAT-DKS (77.5°E) ASIASAT-EKS (100.5°E)	Fixed-satellite service Broadcasting-satellite service
	ASIASAT-AKX (122°E) ASIASAT-BKX (116°E) ASIASAT-CKX (105.5°E) ASIASAT-EKX (100.5°E)	Fixed-satellite service

[1] For frequency ranges of the geostationary-satellite systems see Table 1 under paragraph 3.7.
For frequency ranges of the non-geostationary-satellite systems see Table 2 under paragraph 3.7.

Notifying Administration	Satellite system	Service[1)]
United Kingdom *(cont.)*	ICO-P (NON-GEO) AGRANI-1 (11.5°E) AGRANI-1A (29°E) AGRANI-2 (52°E) AGRANI-2A (46°E) AGRANI-3 (120°E) AGRANI-3A (80°E)	Fixed-satellite service Mobile-satellite service
	SAMSAT-1 (75°W) SAMSAT-2 (82°W) SAMSAT-3 (89°W)	Fixed-satellite service Space operation service
	SKYSAT-A1 (118.3°E) SKYSAT-A2 (121.5°E) SKYSAT-A3 (124.7°E) SKYSAT-B1 (133.2°E) SKYSAT-B2 (136.4°E) SKYSAT-B3 (139.6°E) SKYSAT-B4 (142.8°E) SKYSAT-C1 (80°E)	Fixed-satellite service
	SKYSAT-C2 (90°E) SKYSAT-C3 (101.5°E)	Fixed-satellite service Land mobile-satellite service
	SKYSAT-C4 (104.8°E) SKYSAT-C5 (169.2°E)	Fixed-satellite service
Russian Federation	MARAFON-8HE (NON-GEO) PROMETEI-1 (9°W) PROMETEI-2 (80°E)	Fixed-satellite service Mobile-satellite service
	STATSIONAR-M1 (170°W) STATSIONAR-M2 (3°W) STATSIONAR-M3 (1°E) STATSIONAR-M4 (5°E) STATSIONAR-M5 (8°E) STATSIONAR-M6 (12°E) STATSIONAR-M7 (15°E) STATSIONAR-M8 (23°E) STATSIONAR-M9 (35°E) STATSIONAR-M10 (45°E) STATSIONAR-M11 (49°E) STATSIONAR-M12 (70°E) STATSIONAR-M13 (85°E) STATSIONAR-M14 (128°E)	Fixed-satellite service

[1)] For frequency ranges of the geostationary-satellite systems see Table 1 under paragraph 3.7.
For frequency ranges of the non-geostationary-satellite systems see Table 2 under paragraph 3.7.

Notifying Administration	Satellite system	Service[1)]
Sweden	SIRIUS-2 (4.8°E)	Fixed-satellite service
Thailand	THAICOM-A2L (78.5°E) THAICOM-A3L (120°E)	Fixed-satellite service Mobile-satellite service
	THAICOM-A3B (120°E) THAICOM-A4B (142°E)	Fixed-satellite
Turkey	TURKSAT-1E (73.5°E) TURKSAT-KX (42°E)	Fixed-satellite service
Ukraine	UKRSAT2-C-3W UKRSAT2-KU-3W UKRSAT3-C-1E UKRSAT3-KU-1E UKRSAT-4X-64.5E	Fixed-satellite service
	UKRSAT-5X-38.2W	Fixed-satellite service Space operation service
	UKRSAT-4S-64.5E UKRSAT-4U-64.5E UKRSAT-5S-38.2W UKRSAT-5U-38.2W	Mobile-satellite service
	SITCH (NON-GEO)	Earth exploration-satellite service Space operation service

1) For frequency ranges of the geostationary-satellite systems see Table 1 under paragraph 3.7.
For frequency ranges of the non-geostationary-satellite systems see Table 2 under paragraph 3.7.

3.3 In 1995, the Bureau also received, but has not yet processed, requests from administrations for advance publication for 171 new satellite networks and requests for additional frequency bands for 54 previously published networks.

3.4 In addition, in 1995, the Radiocommunication Bureau published the relevant information concerning requests for coordination of space service assignments for geostationary-satellite and non-geostationary-satellite networks for which advance publication had already been made. Twenty-two administrations were provided assistance in dealing with 58 cases concerning coordination of frequency assignments to stations in the space radiocommunication services.

3.5 In 1995, the Radiocommunication Bureau processed and published 37 requests from various administrations for modifications to the Broadcasting-Satellite Service Plan (Appendix 30), and the Feeder-Link Plan (Appendix 30A) and under Resolution 42 (Rev. ORB-88). Also, the Bureau processed two notifications submitted under Article 5 of Appendices 30 and 30A. In application of various procedures of the Allotment Plan for the Fixed-Satellite Service (Appendix 30B) the Bureau received in 1995 requests from administrations for conversion of their allotments contained in Part A of the Plan into assignments, for the implementation of existing systems as contained in Part B of the Plan, or for the introduction of sub-regional systems and additional uses (Sections II and III of Article 6 of that Appendix).

3.6 In 1995, 25 083 frequency assignment notices for stations in the space radiocommunication services were submitted to the Radiocommunication Bureau for recording in the Master Register. These notices consisted of 16 102 frequency assignments relating to 153 space stations and 8 981 frequency assignments relating to 575 earth stations. During the same period, the Radiocommunication Bureau processed 7 783 frequency assignments in the above-mentioned services, of which 3 836 related to space stations and 3 947 related to earth stations.

3.7 The Radiocommunication Bureau has been publishing, on a quarterly basis, the Space Network List containing information on geostationary and non-geostationary space stations, communicated to the Bureau in application of the procedures of Articles 11 and 13, Resolutions 33 and 46 and Appendices 30, 30A and 30B. Part of the List, relating to the geostationary and non-geostationary space stations as submitted to the Bureau under Articles 11 and 13 of the Radio Regulations, is presented in the following tables:

Table 1

LIST OF GEOSTATIONARY SPACE STATIONS BY ORBITAL POSITION AND FREQUENCY BANDS (RR 1042, RR 1060, RR 1488-1491)

Orbital position	Space station		Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
177.00 W N	USA	FLTSATCOM-A W PAC	0						7	8												
177.00 W N	USA	FLTSATCOM-C W PAC2	C0		2				C7	C8									C20			C*
177.00 W C	USAIT	INTELSAT IBS 183E				4		6			11	12		14								
177.00 W N	USAIT	INTELSAT5 183E				4		6			11			14								
177.00 W C	USAIT	INTELSAT5A 183E				4		6			11			14								
177.00 W C	USAIT	INTELSAT7 183E				4	5	6			11	12	13	14								
177.00 W C	USAIT	INTELSAT8 183E				4	5	6			11	12	13	14								
175.00 W A	PNG	PACSTAR A-2		C1			5	6														
175.00 W C	PNG	PACSTAR-4				4		6				12		14								
174.00 W N	USA	ATDRS 174W			A2								A13		A15				20	A	30	
174.00 W N	USA	TDRS 174W			2								13		15							
174.00 W C	USA	USASAT-14E				4		6														
174.00 W A	USAIT	INTELSAT T 186E				4		6														
171.00 W N	USA	ATDRS 171W			A2								A13		A15				20	A	30	
171.00 W N	USA	TDRS WEST			2									14	15							
170.00 W A	RUS	ROSCOM-2				4	5	6			11			14					20		*	
170.00 W N	RUS	STATSIONAR-10				4	5	6														
170.00 W C	RUS	STATSIONAR-10A				4	5	6														
170.00 W A	RUS	STATSIONAR-M1									11			14								
170.00 W N	URS	GALS-4							7	8												
170.00 W N	URS	STATSIONAR-D2				4		6														
170.00 W N	URS	TOR-5															18	19	20			*
170.00 W N	URS	VOLNA-7	0	1																		
168.00 W N	RUS	FOTON-3				C4	C5	6														
168.00 W N	RUS	POTOK-3				C4	C5															
165.00 W A	G	USGON-4			2																	
165.00 W A	USA	USASAT-13L									11	12		14								
160.00 W N	RUS	ESDRN				C4	C5				11			14								
160.00 W C	RUS	MARAFON-4		1		4	5	6														
159.00 W N	URS	PROGNOZ-7			2	4																
155.00 W C	RUS	EXPRESS-12				4		6			11			14								
155.00 W N	URS	STATSIONAR-26				4	5	6														
148.00 W A	USA	MILSTAR-12	0		C2														C20			C*
145.00 W A	G	USGON-7			2																	
145.00 W A	MEX	MORELOS 4				4		6				12		14								
145.00 W N	USA	FLTSATCOM-C W PAC3	C0		2				7	8									20			*
144.00 W A	USA	P92-6			2																	
144.00 W N	USA	USLL-PAC																				*
141.00 W A	USA	P92-5			2																	
139.00 W A	USA	ACS-3K										12		14								
139.00 W A	USA	MCS-3		1																		
139.00 W N	USA	US SATCOM 1-R				4		6														

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Orbital position	Space station		Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
139.00 W C	USA	USASAT-22I				4		6														
138.00 W A	MEX	SOLIDARIDAD KU										12		14								
137.00 W C	USA	USASAT-22G				4		6														
136.00 W N	USA	USASAT-16D										12		14								
135.00 W N	USA	GOES WEST	0	1	2																	
135.00 W A	USA	GOES-J	0	1	2																	
135.00 W A	USA	JBS-14																	20		*	
135.00 W C	USA	USASAT-21A				4		6														
135.00 W N	USA	USGCSS PH2 E PAC							7	8												
135.00 W N	USA	USGCSS PH3 E PAC			2				7	8												
135.00 W N	USA	USGCSS PH3B E PAC			C2				7	8												
135.00 W A	USA	USGCSS PH4 E PAC-3			2														20			*
133.00 W N	USA	USASAT-11D				4		6														
133.00 W C	USA	USASAT-22A				4		6														
131.00 W C	USA	USASAT-22H				4		6														
131.00 W A	USA	USASAT-23B										12		14								
130.00 W A	USA	JBS-15																	20		*	
130.00 W A	USA	USGCSS PH2 E PAC-2							7	8												
130.00 W N	USA	USGCSS PH3 E PAC-2			2				7	8												
130.00 W A	USA	USGCSS PH3B E PAC-2			2				C7	C8												
130.00 W A	USA	USGCSS PH4 E PAC-2			2														20			*
130.00 W N	USA	USRDSS WEST		1	2		5	6														
129.00 W N	USA	ASC-1				4		6				12		14								
129.00 W C	USA	USASAT-24A				4		6				12		14								
127.00 W A	MEX	SOLIDARIDAD-2KU 127										12		14								
127.00 W A	USA	USASAT-21B				4		6														
126.00 W N	USA	USASAT-20A				4		6														
125.00 W A	F	SYRACUSE-3A							7	8									20	22		*
125.00 W C	USA	USASAT-22B				4		6														
125.00 W C	USA	USASAT-23E										12		14								
122.00 W N	USA	USASAT-10A										12		14								
121.00 W C	USA	USASAT-23C										12		14								
120.00 W A	TRD	CARIBSS-1						6														
120.00 W A	USA	JBS-2																	20		*	
120.00 W A	USA	MILSTAR-6	0		C2														C20			C*
120.00 W C	USA	SPACENET-1				4		6				12		14								
119.20 W A	USA	USABSS-3 TTC				4		6														
119.00 W A	USA	OMRDSS WEST		1	2		5	6														
118.80 W A	USA	USABSS-4				4	5	6														
118.70 W C	CAN	ANIK C-3										12		14								
118.70 W N	CAN	ANIK D-1				C4		C6														
118.70 W A	CAN	ANIK E-D				4		6				12		14								
118.70 W A	CAN	CANSAT KA-3									11	12	13	14			18	19	20	*	30	
116.80 W N	MEX	MORELOS 2				4		6				12		14								
116.00 W A	USA	USASAT-27D			2														20	29		
114.90 W C	CAN	ANIK C-1										12		14								
114.90 W N	CAN	ANIK D-2				4		6														
114.90 W A	CAN	ANIK E-C				4		6				12		14								
114.90 W A	CAN	Ka ADVANCED SATCOM										12		14					20	29	30	
113.00 W C	MEX	SOLIDARIDAD 2M		1								12		14								

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Orbital position	Space station		Frequency bands GHz 0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
113.00 W C	MEX	SOLIDARIDAD 2MA										12		14								
113.00 W N	MEX	SOLIDARIDAD-2				4		6				12		14								
111.10 W N	CAN	ANIK E-B				4		6				12		14								
111.10 W A	CAN	CANSAT KA-2									11	12	13	14			18	19	20	*	30	
110.00 W N	CAN	ANIK C-2										12		14								
110.00 W A	USA	USASAT-28B						6														
109.20 W C	MEX	SOLIDARIDAD 1M		1								12		14								
109.20 W C	MEX	SOLIDARIDAD 1MA										12		14								
109.20 W N	MEX	SOLIDARIDAD-1				4		6				12		14								
109.00 W C	USA	USGCSS PH4 E PAC-1			2														20			44
109.00 W C	VENASA	SIMON BOLIVAR-3				4		6														
107.30 W N	CAN	ANIK E-A				4		6				12		14								
107.30 W A	CAN	CANSAT KA-1									11	12	13	14			18	19	20	*	30	
106.50 W A	CAN	MSAT		C1	2						11	C12		C14								
106.50 W A	CAN	MSAT-1A		1	2							12		14								
106.00 W A	USA	MARISAT-CONUS		1		4		6														
106.00 W C	VENASA	SIMON BOLIVAR-1				4		6														
105.00 W N	USA	ATS-5	0	1																		
105.00 W N	USA	FLTSATCOM-A EAST PAC	C0						7	8												
105.00 W N	USA	FLTSATCOM-C E PAC1	C0		2				7	8									20			*
105.00 W C	USA	GSTAR-2										12		14								
103.00 W C	USA	GSTAR-1										12		14								
103.00 W C	USA	USASAT-24B				4		6				12		14								
103.00 W C	VENASA	SIMON BOLIVAR-2				4		6														
101.00 W A	USA	MCS-1		1																		
101.00 W A	USA	USASAT-27E			2																	
101.00 W A	USA	USASAT-29A														17	18	19	20	*	30	
101.00 W C	USA	USASAT-7D				4		6				12		14								
100.00 W C	USA	ACS-1		1																		
100.00 W N	USA	ACTS																19	20	*		
100.00 W N	USA	FLTSATCOM E PAC	0						7	8												
100.00 W N	USA	FLTSATCOM-B EAST PAC																	20			44
100.00 W N	USA	FLTSATCOM-C E PAC2	C0		2				7	8									20			*
100.00 W N	USA	USRDSS CENTRAL		1	2		5	6														
99.00 W C	USA	USASAT-24J				4		6				12		14								
99.00 W A	USA	USASAT-29B														17	18	19	20	*	30	
97.00 W A	CUBIK	LATAMSAT-2			2	C4	C5	C6			C11		C13	C14								
97.00 W N	USA	TELSTAR-3A				4		6														
97.00 W C	USA	USASAT-24D				4		6				12		14								
97.00 W N	USA	USASAT-6A										12		14								
96.00 W A	USA	USASAT-27C			2														20	29		
95.00 W N	USA	COMSTAR D-2				4		6														
95.00 W C	USA	USASAT-22D				4		6														
95.00 W C	USA	USASAT-24L				4		6				12		14								
95.00 W N	USA	USASAT-6C										12		14								
93.50 W N	USA	USASAT-12B				4		6														
92.00 W A	B	B-SAT-H									11	12	13	14								
92.00 W A	B	SBTS B4				4	5	6														
91.00 W C	USA	USASAT-24K				4		6				12		14								
91.00 W C	USA	USASAT-9A										12		14								

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			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
90.00 W C	G INM	INMARSAT GSO-2A		1	2	4		6														
90.00 W A	USA	JBS-6																	20		*	
90.00 W A	USA	MILSTAR-1	0		C2														C20			C*
90.00 W A	USA	USASAT-27A																19	20	29		
89.00 W A	G	SAMSAT-3				4	5	6	7	8						17	18	19	20	*	*	
89.00 W A	USA	OMRDSS EAST		1	2		5	6														
89.00 W C	USA	USASAT-24E				4		6				12		14								
88.50 W N	USA	SPACENET-3				4		6				12		14								
87.00 W A	B	B-SAT-G				4	5	6														
87.00 W A	B	B-SAT-K									11	12	13	14								
87.00 W A	B	B-SAT-O									11	12	13	14								
86.00 W N	USA	USASAT-3C				4		6														
85.00 W C	ARG	NAHUEL-B				4		6			11	12	13	14								
85.00 W C	USA	USASAT-9C										12		14								
84.00 W A	B	B-SAT-N									11	12	13	14								
83.00 W A	CUBIK	LATAMSAT-1			2	C4	C5	C6			C11		C13	C14								
83.00 W A	USA	USASAT-24C				4		6				12		14								
82.00 W A	B	B-SAT B		1		4	5	6			11											
82.00 W A	G	SAMSAT-2				4	5	6	7	8						17	18	19	20	*	*	
81.00 W C	USA	USASAT-22F				4		6														
81.00 W C	USA	USASAT-9D									11	12		14								
80.00 W C	ARG	NAHUEL-A				4		6			11	12	13	14								
80.00 W A	USA	USASAT-28A						6														
79.00 W N	USA	TDRS CENTRAL			2									14	15							
79.00 W N	USA	TDRS-C2			2								13	14	15							
79.00 W N	USA	USASAT-12A				4		6														
79.00 W C	USA	USASAT-24F				4		6				12		14								
77.50 W A	B	B-SAT A		1		4	5	6			11											
76.00 W A	ARG	NAHUEL-2				4		6				C12		C14								
76.00 W C	ARG	NAHUEL-D				4		6			11	12	13	14								
76.00 W C	USA	USASAT-12C				4		6														
76.00 W A	USA	USASAT-27B			2														20	29		
75.40 W A	CLM	COLOMBIA 1A				4		6														
75.00 W A	CLM	COLOMBIA 2				4		6														
75.00 W A	G	SAMSAT-1				4	5	6	7	8						17	18	19	20	*	*	
75.00 W N	USA	GOES EAST	0	1	2																	
75.00 W A	USA	GOES-I	0	1	2																	
74.00 W C	USA	USASAT-22E				4		6														
74.00 W C	USA	USASAT-7A				4		6														
73.00 W A	B	B-SAT C		1		4	5	6			11											
73.00 W C	USA	USASAT-18B										12		14								
72.00 W A	ARG	NAHUEL-1				4		6				C12		C14								
72.00 W C	ARG	NAHUEL-C									11	12	13	14								
72.00 W N	USA	USASAT-8B				4		6														
71.00 W C	USA	USASAT-18C										12		14								
70.00 W C	B	SATS-1				4		6														
70.00 W N	B	SBTS A1				4		6														
70.00 W A	B	SBTS B1				4		6														
70.00 W A	B	SBTS-C1									11	12	13	14								
70.00 W C	B	SISCOMIS-3							7	8												

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Orbital position	Space station		Frequency bands GHz 0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
70.00 W N	USA	USRDSS EAST		1	2		5	6														
69.00 W C	USA	USASAT-24H				4		6				12		14								
69.00 W C	USA	USASAT-7C				4		6				12		14								
68.00 W A	B	B-SAT-F				4	5	6														
68.00 W A	B	B-SAT-J									11	12	13	14								
68.00 W A	USA	JBS-5																	20		*	
68.00 W A	USA	MILSTAR-8	0		C2														C20			C*
65.00 W C	B	SATS-2				4		6														
65.00 W N	B	SBTS A2				4		6														
65.00 W A	B	SBTS B2				4	5	6														
65.00 W A	B	SBTS C2									11	12	13	14								
65.00 W C	B	SISCOMIS-2							7	8												
63.00 W A	B	B-SAT-E				4	5	6														
63.00 W A	B	B-SAT-I									11	12	13	14								
62.00 W A	USA	ACS-2A		1																		
62.00 W A	USA	ACS-2K										12		14								
62.00 W A	USA	MCS-2		1																		
62.00 W N	USA	TDRS 62W			2								13	14	15							
62.00 W C	USA	USASAT-15B										12		14								
61.00 W A	B	SBTS B3				4	5	6														
61.00 W A	B	SBTS C3									11	12	13	14								
61.00 W C	B	SISCOMIS-1							7	8												
60.00 W C	BEL	SATCOM PHASE-3B							7	8												
60.00 W C	USA	USASAT-25H				4		6														
60.00 W C	USA	USASAT-26H									11	12		14								
59.00 W C	ARG	NAHUEL-E				4		6			11	12	13	14								
59.00 W A	B	B-SAT-M									11	12	13	14								
58.00 W C	USA	USASAT-25G				4		6														
58.00 W C	USA	USASAT-26G									11	12		14								
56.00 W C	USA	USASAT-25F				4		6														
56.00 W C	USA	USASAT-26F									11	12		14								
56.00 W C	USAIT	INTELSAT IBS 304E				4		6			11	12		14								
56.00 W C	USAIT	INTELSAT5A 304E				4		6			11			14								
56.00 W C	USAIT	INTELSAT7 304E				4	5	6			11	12	13	14								
56.00 W C	USAIT	INTELSAT8 304E				4	5	6			11	12	13	14								
55.50 W C	F ESA	MARECS ATL4		1		4		6														
55.00 W C	G INM	INMARSAT GSO-2B		1	2	4		6														
55.00 W C	G INM	INMARSAT2 AOR-WEST		1		4		6														
55.00 W A	G INM	INMARSAT3 AOR-WEST		C1		C4		C6														
54.00 W A	G INM	INMARSAT2 AOR-WEST-2		1		4		6														
54.00 W A	G INM	INMARSAT3 AOR-WEST-2		C1		C4		C6														
53.00 W N	USAIT	INTELSAT IBS 307E				4		6			11	12		14								
53.00 W N	USAIT	INTELSAT5A CONT1				C4		C6			11			14								
53.00 W C	USAIT	INTELSAT7 307E				4	5	6			11	12	13	14								
53.00 W C	USAIT	INTELSAT8 307E				4	5	6			11	12		14								
52.50 W A	USA	JBS-16																	20		*	
52.50 W N	USA	USGCSS PH3 W ATL			2				7	8												
52.50 W A	USA	USGCSS PH3B W ATL			2				C7	C8												
52.50 W A	USA	USGCSS PH4 W ATL			2														20			*
50.00 W A	USA	USASAT-29C														17	18	19	20	*	30	

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50.00 W C	USAIT	INTELSAT MCS ATL A		1		4		6														
50.00 W N	USAIT	INTELSAT5A CONT2				C4		C6			C11			C14								
50.00 W N	USAIT	INTELSAT7 310E				C4	C5	C6			C11	C12	C13	14								
50.00 W A	USAIT	INTELSAT8 310E				C4	C5	C6			C11	C12	C13	C14								
48.00 W A	F	SYRACUSE-3B							7	8									20	22		*
47.00 W C	USA	USASAT-25E				4		6														
47.00 W C	USA	USASAT-26E									11	12		14								
46.00 W N	USA	ATDRS 46W			A2								A13		A15				20	A	30	
46.00 W N	USA	TDRS 46W			2								13	14								
45.00 W A	B	B-SAT-L									11	12	13	14								
45.00 W C	USA	USASAT-13F									11	12		14								
45.00 W C	USA	USASAT-13I				4		6														
45.00 W C	USA	USASAT-25D				4		6														
45.00 W C	USA	USASAT-26D									11	12		14								
44.00 W A	F ESA	EDRSS-W			2												18	19	20	*	30	
43.00 W C	USA	USASAT-25C				4		6														
43.00 W C	USA	USASAT-26C										12		14								
42.50 W C	USA	USGCSS PH3 MID-ATL			2				7	8												
42.50 W A	USA	USGCSS PH3B MID-ATL			2				7	8												
42.50 W C	USA	USGCSS PH4 ATL3			2														20			44
41.00 W N	USA	ATDRS 41W			2								13		15				20		30	
41.00 W N	USA	TDRS EAST			2									14	15							
41.00 W C	USA	USASAT-14A				4		6														
41.00 W C	USA	USASAT-25B				4		6														
41.00 W C	USA	USASAT-26B									11	12		14								
40.50 W N	USAIT	INTELSAT IBS 319.5E				4		6			11	12		14								
40.50 W C	USAIT	INTELSAT K 319.5E									11	12		14								
40.50 W N	USAIT	INTELSAT5A 319.5E				4		6			11			14								
40.50 W C	USAIT	INTELSAT7 319.5E				4	5	6			11	12	13	14								
40.50 W C	USAIT	INTELSAT8 319.5E				4	5	6			11	12	13	14								
39.00 W C	USA	USGCSS PH4 ATL2			2														20			44
38.20 W A	UKR	UKRSAT5 S 38.2W			2																	
38.20 W A	UKR	UKRSAT5 U 38.2W	0																			
38.20 W A	UKR	UKRSAT5 X 38.2W			2				7	8												
38.00 W A	G	USGON-5			2																	
37.50 W C	RUS	EXPRESS-1				4		6			11			14								
37.50 W C	URS	STATSIONAR-25				4	5	6														
37.50 W C	USA	USASAT-25A				4		6														
37.50 W C	USA	USASAT-26A									11	12		14								
37.00 W A	D	GENESIS-4	0						7	8									20			*
35.00 W C	USA	USGCSS PH4 ATL1			2														20			44
34.50 W N	USAIT	INTELSAT6 325.5E				4	5	6			11			14								
34.50 W C	USAIT	INTELSAT7 325.5E				4	5	6			11	12	13	14								
34.50 W C	USAIT	INTELSAT8 325.5E				4	5	6			11	12	13	14								
34.00 W C	G	SKYNET-4D	0						7	8												44
34.00 W A	G	SKYNET-4I																	20			*
32.50 W A	BLRIK	INTERSPUTNIK-32.5W			2	4	5	6				12	13	14								
32.00 W A	F ESA	EDRSS-WC			2												18	19	20	*	30	
32.00 W C	G INM	INMARSAT2 AOR-CL-2A		1		4		6														
32.00 W C	G INM	INMARSAT3 AOR-CL-2A		C1		C4		C6														

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			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
31.00 W N	G	BSB-1										12		14		C17						
31.00 W N	USAIT	INTELSAT5A ATL6				4		6			11			14								
31.00 W C	USAIT	INTELSAT7 329E				4	5	6			11	12	13	14								
31.00 W A	USAIT	INTELSAT8 329E				4	5	6			11	12		14								
30.00 W N	E	HISPASAT-1			2				7	8	11	12		14								
30.00 W C	E	HISPASAT-2A KU										12	13									
30.00 W A	E	HISPASAT-2B KU									C11		C13									
30.00 W A	E	HISPASAT-2C3 KU									11	12	13									
29.50 W A	USAIT	INTELSAT7 330.5E				C4	C5	C6			C11	C12	C13	C14								
29.50 W A	USAIT	INTELSAT8 330.5E				C4	C5	C6			C11	C12	C13	C14								
28.00 W A	D	GENESIS-1	0						7	8									20			*
27.50 W N	USAIT	INTELSAT5A ATL2				4		6			11			14								
27.50 W N	USAIT	INTELSAT6 332.5E				C4	C5	C6			11			14								
27.50 W C	USAIT	INTELSAT7 332.5E				4	5	6			11	12	13	14								
27.50 W C	USAIT	INTELSAT8 332.5E				4	5	6			11	12	13	14								
26.50 W A	RUS	MARAFON-6		1		4		6														
26.50 W C	RUS	STATSIONAR-17				4	5	6														
26.50 W N	URS	GALS-1							7	8												
26.50 W N	URS	STATSIONAR-D1				4		6														
26.50 W C	URS	TOR-1															18	19	20			*
26.50 W C	URS	VOLNA-13	0	1																		
26.00 W N	F ESA	MARECS ATL1	0	1		4		6														
25.00 W N	RUS	GALS-9							7	8												
25.00 W N	RUS	STATSIONAR-8				C4	C5															
25.00 W C	URS	VOLNA-1A	0	1																		
24.50 W N	USAIT	INTELSAT6 335.5E				C4	C5	C6			11			14								
24.50 W C	USAIT	INTELSAT7 335.5E				4	5	6			11	12	13	14								
24.50 W C	USAIT	INTELSAT8 335.5E				4	5	6			11	12	13	14								
24.00 W N	URS	PROGNOZ-1			2																	
23.00 W A	BLRIK	INTERSPUTNIK-23W			2	4	5	6				12	13	14								
23.00 W N	USA	FLTSATCOM ATL	0						7	8												
22.50 W N	USA	FLTSATCOM-B EAST ATL																	20			44
22.50 W N	USA	FLTSATCOM-C E ATL1	C0		2				C7	C8									C20			C*
22.00 W C	USAIT	INTELSAT6 338E				4	5	6			11			14								
22.00 W A	USAIT	INTELSAT7 338E				C4	C5	C6			C11	C12	C13	C14								
22.00 W A	USAIT	INTELSAT8 338E				C4	C5	C6			C11	C12	C13	C14								
21.50 W N	USAIT	INTELSAT K 338.5E									C11	12		C14								
21.50 W N	USAIT	INTELSAT MCS ATL C		C1		C4		C6														
21.50 W N	USAIT	INTELSAT5 ATL5				4		6			11			14								
21.50 W N	USAIT	INTELSAT5A 338.5E				4		6			11			14								
21.50 W C	USAIT	INTELSAT7 338.5E				4		6			11	12		14								
21.50 W C	USAIT	INTELSAT8 338.5E				4	5	6			11	12		14								
20.00 W C	USAIT	INTELSAT6 340E				4	5	6			11			14								
20.00 W A	USAIT	INTELSAT7 340E				C4	C5	C6			C11	C12	C13	C14								
20.00 W A	USAIT	INTELSAT8 340E				C4	C5	C6			C11	C12	C13	C14								
19.50 W A	RUS	YAMAL-W1				4	5	6														
19.00 W A	D	TV-SAT 2			C2							12				17						
19.00 W N	F	TDF-1			C2						11	12				17						
19.00 W A	F	TDF-2			C2						11	12				17						
19.00 W N	F ESA	L-SAT			2							12	13	14		17		19	20	28	30	

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Orbital position		Space station	Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
19.00 W A	I	SARIT			2												18	19	20	29	30	
18.00 W N	BEL	SATCOM PHASE-3							7	8												
18.00 W N	USAIT	INTELSAT IBS 342E				4		6			11	12		14								
18.00 W N	USAIT	INTELSAT5A 342E				4		6			11			14								
18.00 W C	USAIT	INTELSAT7 342E				4	5	6			11	12	13	14								
18.00 W C	USAIT	INTELSAT8 342E				4	5	6			11	12	13	14								
17.80 W C	BEL	SATCOM-4	0						7	8									20			44
17.00 W A	G INM	INMARSAT2 AOR-EAST-2		1		4		6														
17.00 W A	G INM	INMARSAT3 AOR-EAST-2		C1		C4		C6														
16.50 W A	USA	JBS-4																	20		*	
16.50 W C	USA	MILSTAR-3			2														20			44
16.00 W A	BLRIK	INTERSPUTNIK-16W			2	4	5	6				12	13	14								
16.00 W N	RUS	WSDRN				C4	C5				11			14								
16.00 W N	RUS	ZSSRD-2				C4	C5				11	12	13	14								
15.50 W C	G INM	INMARSAT GSO-2C		1	2	4		6														
15.50 W N	G INM	INMARSAT2 AOR-EAST		1		4		6														
15.50 W A	G INM	INMARSAT3 AOR-EAST		C1		C4		C6														
15.50 W A	UAE	EMARSAT-1E				4	5	6			11	12		14								
15.50 W N	USA	FLTSATCOM-C E ATL2	C0		2				C7	C8									C20			C*
15.00 W C	F ESA	MARECS ATL5		1		4		6														
15.00 W N	USA	FLTSATCOM A ATL	C0						7	8												
14.80 W A	F EUT	EUTELSAT-3 14.8W			2						11	12	13	14								
14.50 W A	RUS	ROSCOM-1				4	5	6			11			14					20		*	
14.50 W N	URS	GOMS-1M	0	1	2	4		6	7	8									20	29		
14.00 W C	RUS	EXPRESS-2				4		6			11			14								
14.00 W N	RUS	LOUTCH-1									C11			C14				A19		A28		
14.00 W C	URS	MORE-14		1		4		6														
14.00 W N	URS	VOLNA-2		1																		
14.00 W N	URSIK	STATSIONAR-4				C4		C6														
13.50 W N	RUS	FOTON-1				4	C5	6														
13.50 W C	RUS	MARAFON-5		1		4	5	6														
13.50 W N	RUS	POTOK-1				C4	C5															
13.50 W C	URS	FOTON-1				4																
13.00 W A	MLT	MELITASAT-1A										C12	13	C14								
13.00 W A	USA	P92-4			2																	
12.50 W A	F EUT	EUTELSAT-3 12.5W			2						11	12	13	14								
12.00 W N	F ESA	HIPPARCOS			2																	
12.00 W A	USA	AFRIBSS				4		6														
12.00 W A	USA	JBS-17																	20		*	
12.00 W A	USA	USASAT-14L									11	12		14								
12.00 W N	USA	USGCSS PH2 ATL							7	8												
12.00 W N	USA	USGCSS PH3 ATL			2				7	8												
12.00 W C	USA	USGCSS PH3B ATL			2				7	8												
12.00 W A	USA	USGCSS PH4 ATL-4			2														20			*
11.00 W N	F	F-SAT 2			C2							12		14					C20		C30	
11.00 W C	RUS	EXPRESS-3				4		6			11			14								
11.00 W C	URS	LOUTCH-6									11			14								
11.00 W N	URS	STATSIONAR-11				4		6														
11.00 W C	URS	VOLNA-11W		1		4		6														
10.00 W N	F ESA	METEOSAT S2			2																	

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Orbital position	Space station		0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
			Frequency bands GHz																			
10.00 W A	USA	P92-3			2																	
10.00 W N	USA	USLL-ATL																				
9.50 W C	RUS	KUPON-3									11			14								
9.00 W A	RUS	PROMETEY-1			2							12	13	14								
9.00 W A	USA	MILSTAR-2	0		C2														C20			C*
8.00 W A	F	SYRACUSE-3C							7	8									20	22		*
8.00 W N	F	TELECOM-1A			2	4		6	7	8		12		14								
8.00 W N	F	TELECOM-2A			C2	C4		C6	C7	C8		C12		C14								
8.00 W A	F	TELECOM-3A				4	5	6														
8.00 W A	F	VIDEOSAT-6			C2						C11	C12	13	C14								
8.00 W A	F	ZENON-A		1	2						11			14								
7.00 W A	F	RADIOSAT									11						18					
7.00 W A	F	SYRACUSE-3D							7	8									20	22		*
7.00 W A	F	TELECOM-3D				4	5	6														
7.00 W A	F	VIDEOSAT-5			C2						C11	C12	13	C14								
6.00 W A	BLRIK	INTERSPUTNIK-6W			2	4	5	6				12	13	14								
5.00 W A	F	SYRACUSE-3E							7	8									20	22		*
5.00 W N	F	TELECOM-1B			2	4		6	7	8		12		14								
5.00 W N	F	TELECOM-2B			C2	C4		C6	C7	C8		C12		C14								
5.00 W A	F	TELECOM-3B				4	5	6														
5.00 W A	F	VIDEOSAT-7			C2						C11	C12	13	C14								
4.00 W A	HNG	CERS-1									11			14								
4.00 W C	ISR	AMOS 1-B									11			14								
3.00 W A	BLRIK	INTERSPUTNIK-3W			2	4	5	6				12	13	14								
3.00 W A	RUS	STATSIONAR-M2									11			14								
3.00 W A	UKR	UKRSAT2 C 3W				4	5															
3.00 W A	UKR	UKRSAT2 KU 3W									11	12	13	14								
3.00 W C	URS	GALS-11							7	8												
3.00 W C	URS	TOR-11															18	19	20			*
1.00 W C	G	SKYNET-4A	0						7	8												44
1.00 W A	G	SKYNET-4F																	20			*
1.00 W N	USAIT	INTELSAT5A CONT4				4		6			11			14								
1.00 W N	USAIT	INTELSAT7 359E				C4	C5	C6			C11	12	C13	14								
1.00 W C	USAIT	INTELSAT8 359E				4	5	6			11	12	13	14								
0.80 W C	NOR	BIFROST												14								
0.00 E C	F	LOCSTAR OUEST		1	2		5	6														
0.00 E N	F ESA	METEOSAT	0	1	2																	
1.00 E N	RUS	STATSIONAR-22				C4	C5															
1.00 E A	UKR	UKRSAT-3 C 1E				4	5															
1.00 E A	UKR	UKRSAT-3 KU 1E			2						11	12	13	14								
1.00 E C	URS	GALS-15							7	8												
1.00 E C	URS	TOR-15															18	19	20			*
1.00 E C	URS	VOLNA-21	0																			
1.50 E C	ISR	AMOS 1-A									11			14								
3.00 E A	F	SYRACUSE-3F							7	8									20	22		*
3.00 E N	F	TELECOM-1C			2	4		6	7	8		12		14								
3.00 E N	F	TELECOM-2C			C2	C4		C6	C7	C8		C12		C14								
3.00 E A	F	TELECOM-3C				4	5	6														
3.00 E A	RUS	STATSIONAR-M3									11			14								
4.00 E C	F EUT	EUTELSAT 2-4E			2						11	12		14								

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Orbital position	Space station		0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
			Frequency bands GHz																			
4.00 E A	F EUT	EUTELSAT-3 4E			2						11	12	13	14								
4.00 E A	USA	JBS-9																	20		*	
4.00 E A	USA	MILSTAR-13	0		C2														C20			C*
4.80 E A	S	SIRIUS-2										12		14								
5.00 E A	ARSARB	ARABSAT-2D				4		6														
5.00 E N	F ESA	OTS	0								11			14								
5.00 E A	RUS	STATSIONAR-M4									11			14								
5.00 E N	S NOT	TELE-X			2							12		14		17						
5.00 E C	URS	TOR-19															18	19	20			*
5.70 E A	MLA	MEASAT-SA1				4		6			11	12	13	14								
6.00 E N	G	SKYNET-4B	0						7	8												44
6.00 E A	G	SKYNET-4G																	20			*
7.00 E N	F EUT	EUTELSAT 1-3									11	12		14								
7.00 E N	F EUT	EUTELSAT 2-7E		C1	2						C11	12		C14								
7.00 E A	F EUT	EUTELSAT 3-7E			2						11	12	13	14								
8.00 E C	RUS	STATSIONAR-18				4	5	6														
8.00 E A	RUS	STATSIONAR-M5									11			14								
8.00 E C	URS	GALS-7							7	8												
8.00 E C	URS	VOLNA-15	0	1																		
8.50 E A	G	USGON-2			2																	
9.00 E A	MLA	MEASAT-SA2				4		6			11	12	13	14								
10.00 E C	F	LOCSTAR CENTRE		1	2		5	6														
10.00 E C	F ESA	METEOSAT S1			2																	
10.00 E N	F EUT	EUTELSAT 2-10E		C1	2						C11	12		C14								
10.00 E N	F EUT	EUTELSAT-1	0								11	12		14								
10.00 E A	F EUT	EUTELSAT-3 10E			2						11	12	13	14								
10.20 E C	I	ITALSAT-10.2E		1	2							12		14			18	19	20	*		
11.50 E A	G	AGRANI-1		1	2	4	5	6			11	12	13	14								
12.00 E C	RUS	STATSIONAR-27				4	5	6														
12.00 E A	RUS	STATSIONAR-M6									11			14								
12.00 E C	URS	GALS-17							7	8												
12.00 E N	URS	PROGNOZ-2			2																	
12.00 E C	URS	TOR-18															18	19	20			*
12.00 E C	URS	VOLNA-27	0																			
13.00 E A	D	GENESIS-5	0						7	8									20			*
13.00 E N	F EUT	EUTELSAT 1-2	C0								C11	12		14								
13.00 E N	F EUT	EUTELSAT 2-13E		C1	2						C11	12		C14								
13.00 E A	F EUT	EUTELSAT-3 13E			2						11	12	13	14								
13.20 E N	I	ITALSAT			2													19	20	28	*	40
13.20 E C	I	ITALSAT-13.2E		1	2							12		14			18	19	20	*		
14.60 E A	GHA	AFRICOM-1		1		4		6														
15.00 E A	F	ZENON-B		1	2	4		6														
15.00 E C	RUS	STATSIONAR-23				4	5	6														
15.00 E A	RUS	STATSIONAR-M7									11			14								
15.00 E C	URS	GALS-12							7	8												
15.00 E C	URS	TOR-12															18	19	20			*
15.00 E C	URS	VOLNA-23	0																			
16.00 E N	F EUT	EUTELSAT 2-16E		C1	C2						C11	12		C14								
16.00 E A	F EUT	EUTELSAT-3 16E			2						11	12	13	14								
16.00 E C	I	SICRAL-1A			2																	

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				0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
16.20 E	A	I	SICRAL-2A	0		2				7	8		12		14					20			*
16.40 E	A	F ESA	ARTEMIS-16.4E DR			2												18	19	20	*	30	
16.40 E	A	F ESA	ARTEMIS-16.4E LM		1								12		14								
16.40 E	C	I	ITALSAT-16.4E		1	2							12		14			18	19	20	*		
17.00 E	A	ARS	SABS-1									11			14								
17.00 E	A	BLRIK	INTERSPUTNIK-17E			2	4	5	6				12	13	14								
17.00 E	A	UAE	EMARSAT-1C				4	5	6			11	12		14								
18.00 E	A	D	GENESIS-2	0						7	8									20			*
19.00 E	A	F	ZENON-C		1	2						11			14								
19.00 E	A	G	AFRISAT-1				4		6	7	8						17	18	19	20	*	*	
19.00 E	A	LUX	LUX-KA-19E															18	19	20	*	*	
19.00 E	A	URS	TOR-26															18	19	20			*
19.00 E	A	USA	MILSTAR-9	0		C2														C20			C*
19.20 E	N	LUX	GDL-6						C6			C11	A12	A13	C14								
19.20 E	C	LUX	GDL-7									11		13	14								
20.00 E	C	ARSARB	ARABSAT 1-D				4		6														
20.00 E	A	ARSARB	ARABSAT-2C				4		6														
20.00 E	C	G INM	INMARSAT4 GSO-2D		1	2	4		6														
20.10 E	A	ARS	SAUDI-FMSS-2		1	2																	
21.00 E	A	IRQ	BABYLONSAT-3									11	12	13	14								
21.50 E	A	F ESA	ARTEMIS-21.5E DR			2												18	19	20	*	30	
21.50 E	A	F ESA	ARTEMIS-21.5E LM		1								12		14								
21.50 E	N	F EUT	EUTELSAT 1-5	C0								11	12		14								
21.50 E	N	F EUT	EUTELSAT 2-21.5E			2						C11	C12		C14								
21.50 E	A	F EUT	EUTELSAT-3 21.5E			2						11	12	13	14								
21.80 E	A	I	SICRAL-2B	0		2				7	8		12		14					20			*
22.00 E	C	I	SICRAL-1B			2																	
22.50 E	C	F	LOCSTAR EST		1	2		5	6														
22.50 E	C	F ESA	MARECS MED-1		1		4		6														
23.00 E	A	RUS	ROSCOM-3				4	5	6			11			14					20		*	
23.00 E	C	RUS	STATSIONAR-19				4	5	6														
23.00 E	A	RUS	STATSIONAR-M8									11			14								
23.00 E	C	URS	GALS-8							7	8												
23.00 E	C	URS	VOLNA-17	0	1																		
23.50 E	A	D	DFS II-1				4	5	6			11	12	13	14								
23.50 E	N	D	DFS-1			2						11	12		14					20		30	
23.50 E	A	UKR	UKRSAT-1 C 23.5E				4	5	6														
23.50 E	A	UKR	UKRSAT-1 KU 23.5E									11		13	14								
23.50 E	A	UKR	UKRSAT-1 MOB 23.5E		1							11		13									
24.00 E	A	UAE	EMARSAT-1A				4	5	6			11	12		14								
24.00 E	A	UAE	EMARSAT-1A/M		1	2	4		6	7	8	11		13	14								
24.20 E	A	LUX	LUX-24.2E									11	12	13	14								
25.00 E	A	F	SYRACUSE-3G							7	8									20	22		*
25.00 E	A	G INM	INMARSAT3 IOR-WEST		1		4		6														
25.00 E	A	USA	USASAT-29D														17	18	19	20	*	30	
25.50 E	C	F EUT	EUTELSAT 1-8	0								11	12		14								
26.00 E	N	ARSARB	ARABSAT 1-B				C4		C6														
26.00 E	C	ARSARB	ARABSAT 2-B				4		6			11	12	13	14								
26.00 E	C	D	DFS-6			2						11	12		14					20	29		
26.00 E	N	IRN	ZOHREH-2									11			14								

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Orbital position	Space station		Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
26.20 E A	LUX	LUX-26.2E									11	12	13	14								
27.00 E A	BLRIK	INTERSPUTNIK-27E			2	4	5	6				12	13	14								
27.00 E C	URS	TOR-20															18	19	20			*
28.20 E A	LUX	LUX-28.2E									11	12	13	14								
28.50 E A	D	DFS II-2				4	5	6			11	12	13	14								
28.50 E N	D	DFS-2			2						11	12		14					20		30	
28.50 E A	D	KEPLER 1			2						11	12		14								
28.50 E A	UAE	EMARSAT-1L		1	2	4	5	6	7	8	11	12	13	14								
29.00 E C	ARS	STRATSAT-1								8												
29.00 E A	G	AGRANI-1A		1	2	4	5	6			11	12	13	14								
29.00 E N	USA	FLTSATCOM-C INDOC1	C0		2				C7	C8									C20			C*
30.00 E A	IRQ	BABYLONSAT-1									11	12	13	14								
30.00 E A	USA	JBS-1																	20		*	
30.00 E A	USA	MILSTAR-10	0		C2														C20			C*
30.50 E C	ARSARB	ARABSAT 2-A				4		6				12	13									
31.00 E N	ARSARB	ARABSAT 1-C				C4		C6														
31.00 E N	TUR	TURKSAT-1B									11			14								
31.00 E N	TUR	TURKSAT-K1									11			14								
31.50 E A	LUX	LUX-31.5E									11	12	13	14								
32.00 E C	F	VIDEOSAT-4			2							12		14								
32.00 E A	G	AFRISAT-2				4		6	7	8						17	18	19	20	*	*	
32.00 E C	URS	TOR-21															18	19	20			*
33.00 E N	F EUT	EUTELSAT 2-33E			2						C11	C12		C14								
33.00 E A	F EUT	EUTELSAT-3 33E			2						11	12	13	14								
33.00 E C	USAIT	INTELSAT5 33E				4		6			11			14								
33.00 E C	USAIT	INTELSAT7 33E				4	5	6			11	12	13	14								
33.00 E C	USAIT	INTELSAT8 33E				4	5	6			11	12	13	14								
33.50 E A	D	DFS II-3				4	5	6			11	12	13	14								
33.50 E C	D	DFS-5			2						11	12		14				19	20	29		
33.50 E A	UAE	EMARSAT-1J		1	2	4	5	6	7	8	11	12	13	14								
34.00 E N	IRN	ZOHREH-1									11			14								
35.00 E N	RUS	STATSIONAR-2				C4	C5	C6														
35.00 E A	RUS	STATSIONAR-M9									11			14								
35.00 E N	URS	GALS-6							7	8												
35.00 E N	URS	PROGNOZ-3			2	4																
35.00 E N	URS	STATSIONAR-D3				4		6														
35.00 E C	URS	TOR-2															18	19	20			*
35.00 E C	URS	VOLNA-11	0	1																		
35.50 E A	LUX	LUX-35.5E									11	12	13	14								
36.00 E C	F EUT	EUTELSAT 1-7	0								11	12		14								
36.00 E N	F EUT	EUTELSAT 2-36E		C1	2						C11	12		C14								
36.00 E A	F EUT	EUTELSAT-3 36E			2						11	12	13	14								
37.00 E A	MLA	MEASAT-SA3				4		6			11	12	13	14								
37.50 E A	LUX	LUX-37.5E									11	12	13	14								
37.50 E C	SEY	SEYSAT-2				4		6			11			14								
38.00 E A	G	AFRISAT-3				4		6	7	8						17	18	19	20	*	*	
38.00 E A	PAK	PAKSAT-1	0			4	5	6			11	12	13	14								
38.50 E A	UAE	EMARSAT-1K		1	2	4	5	6	7	8	11	12	13	14								
39.00 E C	GRC	HELLAS-SAT									11	12		14								
39.00 E C	ISR	AMOS 1-C									11			14								

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Orbital position		Space station		0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
40.00 E	C	RUS	EXPRESS-4				4		6			11			14								
40.00 E	C	RUS	MARAFON-1		1		4	5	6														
40.00 E	C	URS	LOUTCH-7									11			14								
40.00 E	N	URS	STATSIONAR-12				4	5	6														
40.00 E	C	URS	TOR-22															18	19	20			*
40.00 E	C	URS	VOLNA-40E		1		4		6														
41.00 E	C	ARS	STRATSAT-2								8												
41.00 E	C	IRN	ZOHREH-4		1							11			14								
41.00 E	A	PAK	PAKSAT-2	0			4	5	6			11	12	13	14								
41.20 E	A	LUX	LUX-41.2E									11	12	13	14								
42.00 E	N	TUR	TURKSAT-1A									11			14								
42.00 E	N	TUR	TURKSAT-K2									11			14								
42.00 E	A	TUR	TURKSAT-KX							7	8		12	13	14								
42.50 E	A	KAZ	KAZAKHSAT-42.5E				4		6			11			14								
42.50 E	C	SEY	SEYSAT-1				4		6			11			14								
43.00 E	A	D	EUROPE*STAR-2									C11	C12	13	C14								
43.20 E	A	LUX	LUX-43.2E									11	12	13	14								
44.00 E	A	F EUT	EUTELSAT E 44E	0		2						11	12		14								
44.00 E	A	F EUT	EUTELSAT-3 44E			2						11	12	13	14								
44.00 E	A	UAE	EMARSAT-1F		1	2	4	5	6	7	8	11	12	13	14								
45.00 E	A	D	EUROPE*STAR-1									C11	C12	13	C14								
45.00 E	N	RUS	STATSIONAR-9				4	5	6														
45.00 E	C	RUS	STATSIONAR-9A				4	5	6														
45.00 E	A	RUS	STATSIONAR-M10									11			14								
45.00 E	N	URS	GALS-2							7	8												
45.00 E	N	URS	STATSIONAR-D4				4		6														
45.00 E	N	URS	TOR-3															18	19	20			*
45.00 E	N	URS	VOLNA-3	0	1																		
45.50 E	A	MLT	MELITASAT-1B						6			11	12		14								
46.00 E	A	G	AGRANI-2A		1	2	4	5	6			11	12	13	14								
46.00 E	A	MLA	MEASAT-SA4				4		6			11	12	13	14								
47.00 E	A	F	SYRACUSE-3H							7	8									20	22		*
47.00 E	A	F ESA	EDRSS-EC			2												18	19	20	*	30	
47.00 E	N	IRN	ZOHREH-3									11			14								
47.50 E	A	D	EUROPE*STAR-3									C11	C12	13	C14								
48.00 E	A	F EUT	EUTELSAT E 48E	0		2						11	12		14								
48.00 E	A	F EUT	EUTELSAT-3 48E			2						11	12	13	14								
48.00 E	C	IND	INSAT-2 48E	0			4	5	6			11			14								
48.00 E	A	IND	INSAT-2M(48)			2	4		6														
48.00 E	A	IND	INSAT-2T(48)				4		6														
49.00 E	A	RUS	ROSCOM-4				4	5	6			11			14					20			
49.00 E	N	RUS	STATSIONAR-24				C4	C5	6														
49.00 E	A	RUS	STATSIONAR-M11									11			14								
49.00 E	C	URS	GALS-13							7	8												
49.00 E	C	URS	TOR-16															18	19	20			*
49.00 E	C	URS	VOLNA-25	0																			
50.00 E	C	TUR	TURKSAT-1C									11			14								
50.50 E	A	THA	THAICOM-C1				4	5	6			11	12	13	14								
51.00 E	A	IRQ	BABYLONSAT-2									11	12	13	14								
51.50 E	A	UAE	EMARSAT-1G		1	2	4	5	6	7	8	11	12	13	14								

Frequency bands GHz (columns 0 to >40)

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Orbital position		Space station		Frequency bands GHz																			
				0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
52.00 E	A	ARS	SAUDI-FMSS-1		1	2																	
52.00 E	A	G	AGRANI-2		1	2	4	5	6			11	12	13	14								
53.00 E	N	G	SKYNET-4C	0						7	8												44
53.00 E	A	G	SKYNET-4H																	20			*
53.00 E	C	RUS	EXPRESS-5				4		6			11			14								
53.00 E	N	URS	LOUTCH-2									C11			C14								
53.00 E	C	URS	MORE-53		1		4		6														
53.00 E	C	URS	TOR-23															18	19	20			*
53.00 E	N	URS	VOLNA-4		1																		
53.00 E	N	URSIK	STATSIONAR-5				4		6														
54.00 E	A	UAE	EMARSAT-1B				4	5	6			11	12		14								
54.00 E	A	UAE	EMARSAT-1B/M		1	2	4		6	7	8	11		13	14								
55.00 E	C	IND	INSAT-2 55E	0			4	5	6			11			14								
55.00 E	A	IND	INSAT-2M(55)			2	4		6														
55.00 E	A	IND	INSAT-2T(55)				4		6														
55.00 E	C	RUS	KUPON-1									11			14								
55.00 E	C	SNG	ST-1D				4	5	6			11	12		14								
55.00 E	A	USA	MILSTAR-4	0		C2														C20			C*
56.00 E	C	USA	USGCSS PH4 INDOC1			2														20			44
57.00 E	A	USA	JBS-10																	20		*	
57.00 E	C	USA	USGCSS PH2 INDOC2							7	8												
57.00 E	A	USA	USGCSS PH3 INDOC2			2				7	8												
57.00 E	A	USA	USGCSS PH3B INDOC2			2				7	8												
57.00 E	N	USAIT	INTELSAT5A INDOC2				C4		C6			C11			C14								
57.00 E	C	USAIT	INTELSAT7 57E				4	5	6			11	12	13	14								
57.00 E	C	USAIT	INTELSAT8 57E				4	5	6			11	12	13	14								
58.00 E	C	URS	TOR-13															18	19	20			*
59.00 E	A	F ESA	EDRSS-E			2												18	19	20	*	30	
59.00 E	A	IRN	ZOHREH-5		1							11			14								
59.50 E	A	BLRIK	INTERBELAR-1			C2	C4	C5	C6				C12	C13	14								
60.00 E	A	USA	JBS-11																	20		*	
60.00 E	N	USA	USGCSS PH2 INDOC							7	8												
60.00 E	N	USA	USGCSS PH3 INDOC			2				C7	C8												
60.00 E	A	USA	USGCSS PH3B INDOC			2				7	8												
60.00 E	C	USA	USGCSS PH4 INDOC2			2														20			44
60.00 E	N	USAIT	INTELSAT6 60E				4	5	6			11			14								
60.00 E	C	USAIT	INTELSAT7 60E				4	5	6			11	12	13	14								
60.00 E	C	USAIT	INTELSAT8 60E				4	5	6			11	12	13	14								
61.50 E	A	IRN	ZOHREH-6		1							11			14								
62.00 E	C	URS	TOR-24															18	19	20			*
62.00 E	C	USAIT	INTELSAT6 62E				4	5	6			11			14								
62.00 E	C	USAIT	INTELSAT7 62E				4	5	6			11	12	13	14								
62.00 E	C	USAIT	INTELSAT8 62E				4	5	6			11	12	13	14								
63.00 E	A	D	GENESIS-6	0						7	8									20			*
63.00 E	N	USAIT	INTELSAT MCS INDOC A		C1		C4		C6														
63.00 E	N	USAIT	INTELSAT5A INDOC3				4		6			11			14								
63.00 E	N	USAIT	INTELSAT6 63E				4	5	6			11			14								
63.00 E	C	USAIT	INTELSAT7 63E				4		6			11	12		14								
64.00 E	C	G INM	INMARSAT GSO-2E		1	2	4		6														
64.00 E	A	G INM	INMARSAT3 IOR-1		C1		C4		C6														

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Orbital position		Space station		Frequency bands GHz																			
				0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
64.00 E	C	USAIT	INTELSAT6 64E				4	5	6			11			14								
64.00 E	C	USAIT	INTELSAT7 64E				4	5	6			11	12	13	14								
64.00 E	C	USAIT	INTELSAT8 64E				4	5	6			11	12	13	14								
64.50 E	A	BLRIK	INTERSPUTNIK-64.5E			2	4	5	6				12	13	14								
64.50 E	A	G	AFRISAT-4				4		6	7	8						17	18	19	20	*	*	
64.50 E	N	G INM	INMARSAT2 IOR-1		1		4		6														
64.50 E	A	UKR	UKRSAT4 S 64.5E		1	2																	
64.50 E	A	UKR	UKRSAT4 U 64.5E	0																			
64.50 E	A	UKR	UKRSAT4 X 64.5E			2				7	8												
65.00 E	A	G INM	INMARSAT3 IOR-2		C1		C4		C6														
65.00 E	C	URS	TOR-25															18	19	20			*
66.00 E	N	USAIT	INTELSAT MCS INDOC D		C1		C4		C6														
66.00 E	N	USAIT	INTELSAT5 INDOC4				4		6			11			14								
66.00 E	N	USAIT	INTELSAT5A 66E				4		6			11			14								
66.00 E	N	USAIT	INTELSAT7 66E				C4	C5	C6			C11	12	C13	14								
66.00 E	C	USAIT	INTELSAT8 66E				4	5	6			11	12	13	14								
67.00 E	A	D	GENESIS-3	0						7	8									20			*
67.50 E	A	BLRIK	INTERSPUTNIK-67.5E			2	4	5	6				12	13	14								
68.00 E	C	SNG	ST-1E				4	5	6			11	12		14								
68.00 E	C	USA	USASAT-14I				4		6				12		14								
69.00 E	C	URS	GALS-14							7	8												
69.00 E	C	URS	TOR-14															18	19	20			*
69.00 E	C	USAIT	INTELSAT5 69E				4		6			11			14								
69.00 E	C	USAIT	INTELSAT7 69E				4	5	6			11	12	13	14								
69.00 E	C	USAIT	INTELSAT8 69E				4	5	6			11	12	13	14								
70.00 E	A	G	USGON-1			2																	
70.00 E	N	RUS	STATSIONAR-20				C4	C5	6														
70.00 E	A	RUS	STATSIONAR-M12									11			14								
70.00 E	C	SNG	ST-1F				4	5	6			11	12		14								
70.00 E	C	TON	TONGASAT-H70				4		6			11	12	13	14								
70.00 E	C	URS	GALS-16							7	8												
70.00 E	C	URS	TOR-17															18	19	20			*
70.00 E	C	URS	VOLNA-19	0																			
70.00 E	C	USA	USASAT-13N									11	12		14								
70.40 E	A	UAE	EMARSAT-1D					5	6			11	12		14								
70.50 E	C	F EUT	EUTELSAT E 70.5E			2						11	12		14								
70.50 E	A	F EUT	EUTELSAT-3 70.5E			2						11	12	13	14								
72.00 E	A	MLA	MEASAT-4				4		6			11		13	14								
72.00 E	A	USA	FLTSATCOM INDOC	0						7	8												
72.00 E	A	USA	FLTSATCOM-B INDOC																	20			44
72.00 E	N	USA	FLTSATCOM-C INDOC2	C0		2				C7	C8									C20			C*
72.00 E	C	USA	USASAT-14J				4		6				12		14								
72.50 E	N	USA	MARISAT-INDOC	0		2	4		6														
73.50 E	C	ARS	STRATSAT-3								8												
73.50 E	A	TUR	TURKSAT-1D									11	12		14								
73.50 E	A	TUR	TURKSAT-1E									11	12	13	14								
74.00 E	N	IND	INSAT-1B	0			4	5	6														
74.00 E	N	IND	INSAT-2 (74)	0			4	5	6														
74.00 E	A	IND	INSAT-2E (74)				4	5	6														
74.00 E	C	IND	INSAT-2K (74)									11			14								

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Orbital position	Space station		Frequency bands GHz 0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
74.00 E A	IND	INSAT-2M(74)			2	4		6														
74.00 E A	IND	INSAT-2T(74)				4		6														
75.00 E A	BLRIK	INTERBELAR-2			C2	C4	C5	C6				C12	13	14								
75.00 E A	RUS	YAMAL-E1				4	5	6														
75.00 E N	USA	FLTSATCOM INDOC	0						7	8												
75.00 E N	USA	FLTSATCOM-C INDOC3	C0		2				C7	C8									C20			C*
75.50 E A	CHN	CHINASAT-23	0			4		6														
76.00 E A	F EUT	EUTELSAT-3 76E			2						11	12	13	14								
76.00 E A	RUS	BUMERANG									11			14								
76.00 E A	RUS	COMINCOM-76E									11	12		14								
76.00 E C	RUS	CROSNA-1				4		6														
76.00 E N	RUS	GOMS-M	0	1	2	A4	A5	6	7	8									20	29		
77.00 E A	CHN	APSTAR-4				4		6				12		14								
77.00 E N	RUS	CSSRD-2				C4	C5				11	12	13	14								
77.00 E A	USA	FLTSATCOM-A INDOC	0						7	8												
77.50 E C	G	ASIASAT-D				4		6			11			14								
77.50 E C	G	ASIASAT-DK1										12		14								
77.50 E A	G	ASIASAT-DKS											13	14								
78.50 E C	THA	THAICOM-A2				4		6														
78.50 E A	THA	THAICOM-A2B				4	5	6			11	12	13	14								
78.50 E A	THA	THAICOM-A2L		1		4		6				12	13	14								
78.50 E C	THA	THAICOM-AK2										12		14								
80.00 E A	CHN	CHINASAT-31		1	2	4		6														
80.00 E A	G	AGRANI-3A		1	2	4	5	6			11	12	13	14								
80.00 E A	G	SKYSAT-C1							7	8	11	12				17	18	19	20	*	*	
80.00 E C	RUS	EXPRESS-6				4		6			11			14								
80.00 E N	RUS	FOTON-2				C4	C5	6														
80.00 E N	RUS	POTOK-2				C4	C5															
80.00 E N	RUS	PROGNOZ-4			C2																	
80.00 E A	RUS	PROMETEY-2			2							12	13	14								
80.00 E N	URS	LOUTCH-8									11			14								
80.00 E C	URS	PROGNOZ-4			2																	
80.00 E N	URS	STATSIONAR-1				4	5	6														
80.00 E N	URSIK	STATSIONAR-13				4		6														
80.50 E A	F EUT	EUTELSAT-3 80.5E			2						11	12	13	14								
80.50 E A	INS	GARUDA-4		1	2	4		6	7	8	11			14								
81.50 E A	THA	THAICOM-B1				4	5	6														
81.50 E A	THA	THAICOM-BK1										C12	13	C14								
82.00 E A	IND	INSAT-2E (82)				4	5	6														
83.00 E N	IND	INSAT-1D	0			4	5	6														
83.00 E N	IND	INSAT-2 (83)	0			4	5	6														
83.00 E A	IND	INSAT-2E (83)				4	5	6														
83.00 E C	IND	INSAT-2K (83)									11			14								
83.00 E A	IND	INSAT-2M(83)			2	4		6														
83.00 E A	IND	INSAT-2T(83)				4		6														
83.30 E A	TON	TONGASAT AP-KU-4				4		6			C11	C12	C13	C14								
83.50 E A	F EUT	EUTELSAT-3 83.5E			2						11	12	13	14								
84.50 E A	THA	THAICOM-B2				4	5	6														
84.50 E A	THA	THAICOM-BK2										C12	13	C14								
85.00 E C	RUS	COMINCOM 85E									11	12		14								

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85.00 E	A	RUS	MARAFON-7		1		4		6														
85.00 E	N	RUS	STATSIONAR-3				C4	C5	6														
85.00 E	A	RUS	STATSIONAR-M13									11			14								
85.00 E	N	URS	GALS-3							7	8												
85.00 E	N	URS	TOR-4															18	19	20			*
85.00 E	N	URS	VOLNA-5	0	1																		
85.00 E	N	USA	TDRS-85E			2								13	14	15							
85.00 E	C	USAIT	INTELSAT5 85E				4		6			11			14								
85.00 E	C	USAIT	INTELSAT7 85E				4	5	6			11	12	13	14								
85.00 E	C	USAIT	INTELSAT8 85E				4	5	6			11	12	13	14								
85.40 E	N	RUS	STATSIONAR-D5				4		6														
85.50 E	A	CHN	APSTAR-2 F1				4	5	6				12		14								
86.50 E	C	RUS	KUPON-4									11			14								
87.50 E	N	CHN	CHINASAT-1				4		6														
87.50 E	N	CHN	DFH-3-0C				4		6														
88.00 E	C	SNG	ST-1A		1		4	5	6			11	12		14								
88.50 E	A	F EUT	EUTELSAT-3 88.5E			2						11	12	13	14								
89.50 E	A	CHN	APSTAR-2 F2				4	5	6				12		14								
90.00 E	A	G	SKYSAT-C2			2				7	8						17	18	19	20	*	*	
90.00 E	C	RUS	EXPRESS-7				4		6			11			14								
90.00 E	N	URS	LOUTCH-3									11			14								
90.00 E	C	URS	MORE-90		1		4		6														
90.00 E	N	URS	STATSIONAR-6				4		6														
90.00 E	N	URS	VOLNA-8		1																		
90.00 E	A	USA	JBS-3																	20		*	
90.00 E	A	USA	MILSTAR-5	0		C2														C20			C*
90.50 E	C	RUS	MARAFON-2		1		4	5	6														
91.50 E	N	MLA	MEASAT-1				4		6			C11	12		C14								
91.50 E	A	MLA	MEASAT-1K 91.5										12	13	14								
91.50 E	C	USAIT	INTELSAT5A 91.5E				4		6			11			14								
91.50 E	C	USAIT	INTELSAT7 91.5E				4	5	6			11	12	13	14								
91.50 E	C	USAIT	INTELSAT8 91.5E				4	5	6			11	12	13	14								
91.75 E	C	RUS	KUPON-2									11			14								
93.00 E	A	CHN	APSTAR-3				4		6				12		14								
93.50 E	N	IND	INSAT-1C	0			4	5	6														
93.50 E	N	IND	INSAT-2 (93.5)	0			4	5	6														
93.50 E	A	IND	INSAT-2E (93.5)				4	5	6														
93.50 E	C	IND	INSAT-2K (93.5)									11			14								
93.50 E	A	IND	INSAT-2M(93.5)			2	4		6														
93.50 E	A	IND	INSAT-2T(93.5)				4		6														
95.00 E	A	MLA	MEASAT-1K 95										12	13	14								
95.00 E	C	MLA	MEASAT-3				4		6			11			14								
95.00 E	N	RUS	CSDRN				C4	C5				11			14								
95.00 E	C	USAIT	INTELSAT5A 95E				4		6			11			14								
95.00 E	C	USAIT	INTELSAT7 95E				4	5	6			11	12	13	14								
95.00 E	C	USAIT	INTELSAT8 95E				4	5	6			11	12	13	14								
96.50 E	C	RUS	EXPRESS-8				4		6			11			14								
96.50 E	N	RUS	STATSIONAR-14				C4		C6														
96.50 E	N	URS	LOUTCH-9									11			14								
98.00 E	A	CHN	CHINASAT-22	0			4		6														

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Orbital position		Space station		0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
				Frequency bands GHz																			
98.00 E	N	CHN	CHINASAT-3				4		6														
98.00 E	A	RUS	PROGNOZ-8			2																	
98.50 E	C	SNG	ST-1B		1		4	5	6			11	12		14								
99.00 E	C	RUS	EXPRESS-13				4		6			11			14								
99.00 E	N	URS	STATSIONAR-T						6														
99.00 E	N	URS	STATSIONAR-T2						6														
100.50 E	A	G	ASIASAT-DBA 2							7													
100.50 E	C	G	ASIASAT-E				4		6			11			14								
100.50 E	C	G	ASIASAT-EK1										12		14								
100.50 E	A	G	ASIASAT-EKS											13	14								
100.50 E	A	G	ASIASAT-EKX				4	5	6	7	8	11	12	13	14								
101.00 E	C	THA	THAICOM-A1				4		6														
101.00 E	C	THA	THAICOM-AK1										12		14								
101.50 E	A	CHN	CHINASAT-11									11			14								
101.50 E	A	G	SKYSAT-C3			2				7	8						17	18	19	20	*	*	
103.00 E	A	CHN	CHINASAT-21	0			4		6														
103.00 E	N	CHN	DFH-3-0B				4		6														
103.00 E	N	CHN	STW-2				4		6														
103.00 E	A	G	USGON-3			2																	
103.00 E	C	RUS	EXPRESS-9				4		6			11			14								
103.00 E	C	RUS	VOLNA-103E		1		4		6														
103.00 E	N	URS	LOUTCH-5									11			14								
103.00 E	N	URS	STATSIONAR-21				C4	5	C6														
104.80 E	A	G	SKYSAT-C4							7	8						17	18	19	20	*	*	
105.00 E	A	CHN	FY-2A	0	1	2	C4		C6														
105.50 E	A	CHN	CHINASAT-12									11			14								
105.50 E	N	G	ASIASAT-1				4		6														
105.50 E	C	G	ASIASAT-CK				4		6			11			14								
105.50 E	C	G	ASIASAT-CK1										12		14								
105.50 E	A	G	ASIASAT-CKS											13	14								
105.50 E	A	G	ASIASAT-CKX				4	5	6	7	8	11	12	13	14								
105.50 E	A	G	ASIASAT-DBA 1							7													
105.90 E	C	INS	INDOSTAR-3				4		6		8												
106.10 E	C	INS	INDOSTAR-1				4		6		8												
108.00 E	A	F	SYRACUSE-3I							7	8									20	22		*
108.00 E	N	INS	PALAPA-B1				4		6														
108.00 E	C	INS	PALAPA-C2				4		6			11		13	14								
109.85 E	C	J	BS-3N										12		14								
110.00 E	C	G INM	INMARSAT GSO-2F		1	2	4		6														
110.00 E	N	J	BS-3			2							12		14								
110.00 E	N	J	JMCS-2							7	8												
110.00 E	C	J	N-SAT-110										12		14								
110.00 E	C	SNG	ST-1C		1		4	5	6			11	12		14								
110.00 E	A	USA	USASAT-29E														17	18	19	20	*	30	
110.50 E	N	CHN	CHINASAT-2				4		6														
110.50 E	A	CHN	CHINASAT-33		1	2	4		6														
110.50 E	A	CHN	CHINASAT-6				4	5	6			11	12		14								
111.50 E	C	IND	INSAT-2 111.5E	0			4	5	6			11			14								
113.00 E	N	INS	PALAPA-B2				4		6														
113.00 E	C	INS	PALAPA-C1				4		6			11		13	14								

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Orbital position		Space station		0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
				Frequency bands GHz																			
113.00 E	N	KOR	KOREASAT-2										12		14								
114.50 E	A	BLRIK	INTERSPUTNIK-114.5E			2	4	5	6				12	13	14								
114.90 E	C	INS	INDOSTAR-4				4		6		8												
115.10 E	C	INS	INDOSTAR-2				4		6		8												
115.50 E	C	CHN	DFH-3-0D				4		6				12		14								
116.00 E	C	G	ASIASAT-B				4		6														
116.00 E	C	G	ASIASAT-BK				4		6			11			14								
116.00 E	C	G	ASIASAT-BK1										12		14								
116.00 E	A	G	ASIASAT-BKS											13	14								
116.00 E	A	G	ASIASAT-BKX				4		6	7	8	11	12	13	14								
116.00 E	N	KOR	KOREASAT-1										12		14								
117.50 E	A	CHN	CHINASAT-25	0			4		6														
118.00 E	A	INS	GARUDA-1		1	2	4		6	7	8	11			14								
118.00 E	N	INS	PALAPA B-3				4		6														
118.00 E	C	INS	PALAPA-C3				4		6			11		13	14								
118.30 E	A	G	SKYSAT-A1				4		6	7	8	11	12	13	14		17	18	19	20	*	*	
120.00 E	A	G	AGRANI-3		1	2	4	5	6			11	12	13	14								
120.00 E	N	J	GMS-120E	0	1	2																	
120.00 E	C	J	SJC-2										12		14								
120.00 E	C	THA	THAICOM-A3				4		6														
120.00 E	A	THA	THAICOM-A3B				4	5	6			11	12	13	14								
120.00 E	A	THA	THAICOM-A3L		1		4		6				12	13	14								
120.00 E	C	THA	THAICOM-AK3										12		14								
121.00 E	C	CHN	DFH-3-OE				4		6														
121.00 E	A	J	COMETS			2													19	20	*	30	*
121.50 E	A	G	SKYSAT-A2				4		6	7	8	11	12	13	14		17	18	19	20	*	*	
122.00 E	C	G	ASIASAT-A				4		6														
122.00 E	C	G	ASIASAT-AK				4		6			11			14								
122.00 E	C	G	ASIASAT-AK1										12		14								
122.00 E	A	G	ASIASAT-AKS											13	14								
122.00 E	A	G	ASIASAT-AKX				4		6	7	8	11	12	13	14								
123.00 E	A	INS	GARUDA-2		1	2	4		6	7	8	11			14								
124.00 E	A	J	JCSAT-3B				4		6				12	13	14								
124.00 E	C	J	SJC-1										12		14								
124.70 E	A	G	SKYSAT-A3				4		6	7	8	11	12	13	14		17	18	19	20	*	*	
125.00 E	N	CHN	DFH-3-0A				4		6														
125.00 E	N	CHN	STW-1				4		6														
125.00 E	A	G	ORIENT-1				4		6			11		13	14								
125.00 E	A	G	ORIENT-2				4		6			11			14								
126.00 E	A	THA	THAICOM-C2				4		6			11	12	13	14								
126.00 E	A	USA	USASAT-14M									11	12		14								
127.00 E	A	PHL	AGILA-A4				4		6			11	12	13	14								
127.50 E	A	CHN	CHINASAT-24	0			4		6														
128.00 E	N	J	JCSAT-3A				4		6				12	13	14								
128.00 E	C	J	N-SAT-128										12		14								
128.00 E	N	RUS	GALS-10							7	8												
128.00 E	N	RUS	STATSIONAR-15				C4	C5	6														
128.00 E	A	RUS	STATSIONAR-M14									11			14								
128.00 E	N	URS	STATSIONAR-D6				4		6														
128.00 E	C	URS	TOR-6															18	19	20			*

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Orbital position		Space station		0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
				Frequency bands GHz																			
128.00 E	C	URS	VOLNA-9	0	1																		
130.00 E	C	CHN	CHINASAT-4				4		6														
130.00 E	A	G INM	INMARSAT3 POR-WEST		1		4		6														
130.00 E	C	TON	TONGASAT AP-1				4		6														
130.00 E	N	TON	TONGASAT C/KU-1				C4		C6			C11	C12	C13	C14								
130.00 E	N	URS	GALS-5							7	8												
130.00 E	N	URS	PROGNOZ-5			2																	
131.00 E	C	CHN	APSTAR-1				4	5	6														
132.00 E	N	J	CS-3A			2	4		6								17	18	19		28		
132.00 E	N	J	N-STAR-A			2	4		6				12		14		17	18	19	20	*	30	
133.00 E	A	USA	MILSTAR-7	0		C2														C20			C*
133.20 E	A	G	SKYSAT-B1				4		6	7	8	11	12	13	14		17	18	19	20	*	*	
134.00 E	A	CHN	APSTAR-2				4		6				12		14								
134.00 E	A	INS	PALAPA PAC-1 CKU				4		6			11	12	13	14								
134.00 E	N	INS	PALAPA PACIFIC-1				4		6														
134.00 E	C	TON	TONGASAT AP-2				4		6														
134.00 E	N	TON	TONGASAT C/KU-2				C4		C6			C11	C12	C13	C14								
135.00 E	A	INS	GARUDA-3		1	2	4		6	7	8	11			14								
135.50 E	A	INS	PALAPA PACIFIC-4				4		6			11		13	14								
136.00 E	N	J	CS-3B			2	4		6								17	18	19		28		
136.00 E	C	J	N-STAR-B			2	4		6				12		14		17	18	19	20	*	30	
136.40 E	A	G	SKYSAT-B2				4		6	7	8	11	12	13	14		17	18	19	20	*	*	
137.00 E	A	PHL	AGILA-A5				4		6			11	12	13	14								
138.00 E	C	TON	TONGASAT AP-3				4		6														
138.00 E	N	TON	TONGASAT C/KU-3				A4	A5	6			11	12	13	14								
139.00 E	A	INS	PALAPA PAC-2 CKU				4		6			11	12	13	14								
139.00 E	C	INS	PALAPA PACIFIC-2				4		6														
139.00 E	A	USA	ORION-AP-1									11	12		14								
139.60 E	A	G	SKYSAT-B3				4		6	7	8	11	12	13	14		17	18	19	20	*	*	
140.00 E	A	CHN	CHINASAT-32		1	2	4		6														
140.00 E	N	J	GMS-140E	0	1	2																	
140.00 E	N	J	GMS-4	0	1	2																	
140.00 E	C	RUS	EXPRESS-10				4		6			11			14								
140.00 E	N	URS	LOUTCH-4									11			14								
140.00 E	C	URS	MORE-140		1		4		6														
140.00 E	N	URS	STATSIONAR-7				4		6														
140.00 E	N	URS	VOLNA-6		1																		
142.00 E	C	THA	THAICOM-A4				4		6														
142.00 E	A	THA	THAICOM-A4B				4	5	6			11	12	13	14								
142.00 E	C	THA	THAICOM-AK4									11			14								
142.50 E	C	TON	TONGASAT AP-4				4		6														
142.50 E	C	TON	TONGASAT C/KU-4				4		6			11	12	13	14								
142.80 E	A	G	SKYSAT-B4				4		6	7	8	11	12	13	14		17	18	19	20	*	*	
144.00 E	A	INS	PALAPA PAC-3 CKU				4		6			11	12	13	14								
144.00 E	C	INS	PALAPA PACIFIC-3				4		6														
144.00 E	N	J	JMCS-1							7	8												
144.00 E	A	J	SUPERBIRD-C				4		6			11	12	13	14								
144.00 E	A	USA	ORION-AP-2									11	12		14								
145.00 E	A	G	USGON-6			2																	
145.00 E	C	RUS	EXPRESS-11				4		6			11			14								

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Orbital position		Space station		Frequency bands GHz 0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
145.00 E	C	URS	LOUTCH-10									11			14								
145.00 E	N	URS	STATSIONAR-16				4		6														
145.50 E	C	RUS	MARAFON-3		1		4	5	6														
146.00 E	C	J	N-SAT-146										12		14								
147.00 E	A	PHL	AGILA-A6				4		6			11			14								
148.00 E	N	MLA	MEASAT-2				4		6			11			14								
150.00 E	N	J	ETS-5		1	2		5	6														
150.00 E	N	J	JCSAT-1										12		14								
150.00 E	A	J	JCSAT-1R				4	5	6				12	13	14								
150.00 E	A	USA	JBS-7																	20		*	
150.00 E	A	USA	MILSTAR-15	0		C2														C20			C*
150.50 E	C	INS	PALAPA C4				4		6			11		13	14								
151.00 E	A	PHL	AGILA-A3				4		6			11	12	13	14								
151.50 E	A	AUS	DBSTAR 151.5E				4		6	7													
152.00 E	N	AUS	AUSSAT A 152E										12		14								
152.00 E	C	AUS	AUSSAT A 152E PAC										12		14								
152.00 E	A	AUS	AUSSAT B 152E MOB		1								12		14								
152.00 E	A	AUS	AUSSAT B 152E MXL		1								12		14								
152.00 E	A	INS	PALAPA PACIFIC-5				4		6			11		13	14								
152.00 E	A	USA	MILSTAR-11	0		C2														C20			C*
152.50 E	A	THA	THAICOM-C3				4	5	6			11		13	14								
153.00 E	A	PHL	AGILA-A1				4		6			11	12	13	14								
153.50 E	A	BLRIK	INTERSPUTNIK-153.5E			2	4	5	6				12	13	14								
154.00 E	N	J	ETS-6-FS			C2	C4		C6								C17	C18	C19	C20	C*	C*	C43
154.00 E	N	J	ETS-6-FSM																	20	*		
154.00 E	C	J	ETS-6-IS			2															23	*	43
154.00 E	N	J	ETS-6-ISM																		*		
154.00 E	N	J	ETS-6-MSS			2																	
154.00 E	N	J	ETS-6-T			2																	
154.00 E	N	J	JCSAT-2										12		14								
154.00 E	A	J	JCSAT-2R				4	5	6				12	13	14								
155.00 E	C	USA	USGCSS PH4 W PAC-1			2														20			44
156.00 E	N	AUS	AUSSAT A 156E										12	13	14								
156.00 E	N	AUS	AUSSAT A 156E PAC										12		14								
156.00 E	N	AUS	AUSSAT B 156E										12		14								
156.00 E	N	AUS	AUSSAT B 156E MC										12		14								
156.00 E	C	AUS	AUSSAT B 156E MOB		1								12		14								
156.00 E	C	AUS	AUSSAT B 156E MXL		1								12		14								
156.00 E	N	AUS	AUSSAT B 156E NZ										12		14								
156.00 E	C	AUS	AUSSAT B 156E R		1								12		14								
156.00 E	N	AUS	AUSSAT B 156E S										12		14								
156.50 E	A	THA	THAICOM-C4				4	5	6			11		13	14								
157.00 E	C	USAIT	INTELSAT5A 157E				4		6			11			14								
157.00 E	A	USAIT	INTELSAT7 157E				C4	C5	C6			C11	C12	C13	C14								
157.00 E	C	USAIT	INTELSAT8 157E				4	5	6			11	12	13	14								
158.00 E	N	J	SUPERBIRD-A							7	8		C12		C14		C17	C18	C19		C*		
158.00 E	A	J	SUPERBIRD-A2				4	5	6			11	12	13	14								
160.00 E	A	AUS	ACSAT-1							7	8												
160.00 E	N	AUS	AUSSAT A 160E										12	13	14								
160.00 E	N	AUS	AUSSAT A 160E PAC										12		14								

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Orbital position	Space station		Frequency bands GHz 0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
160.00 E N	AUS	AUSSAT B 160E										12		14								
160.00 E N	AUS	AUSSAT B 160E MC										12		14								
160.00 E N	AUS	AUSSAT B 160E MOB		1								12		14								
160.00 E C	AUS	AUSSAT B 160E MXL		1								12		14								
160.00 E N	AUS	AUSSAT B 160E NZ										12		14								
160.00 E C	AUS	AUSSAT B 160E R		1								12										
160.00 E N	AUS	AUSSAT B 160E S										12										
160.00 E N	J	GMS-160E	0	1	2																	
161.00 E A	PHL	AGILA-A2				4		6			11	12	13	14								
162.00 E N	J	SUPERBIRD-B							7	8		12		14		17	18	19		*		
162.00 E A	J	SUPERBIRD-B2				4	5	6			11	12	13	14								
164.00 E A	AUS	ACSAT-2	0						7	8												
164.00 E N	AUS	AUSSAT A 164E										12	13	14								
164.00 E N	AUS	AUSSAT A 164E PAC										12		14								
164.00 E C	AUS	AUSSAT B 164E		1								12		14							30	
164.00 E C	AUS	AUSSAT B 164E MOB		1								12		14								
164.00 E C	AUS	AUSSAT B 164E MXL		1								12		14								
166.00 E N	RUS	GOMS-2M	0	1	2	4		6	7	8									20	29		
166.00 E N	URS	PROGNOZ-6			2																	
166.00 E C	USA	USASAT-14H				4		6				12		14								
167.00 E N	RUS	VSSRD-2				C4	C5				11	12	13	14								
167.45 E A	PNG	PACSTAR A-1		C1			5	6														
167.45 E C	PNG	PACSTAR-3				4		6				12		14								
169.00 E C	USA	USASAT-14G				4		6				12		14								
169.20 E A	G	SKYSAT-C5							7	8						17	18	19	20	*	*	
170.00 E C	USA	USASAT-13M										12		14								
170.75 E C	TON	TONGASAT C-1				4		6			11	12	13	14								
170.75 E A	TON	TONGASAT C-1-R				4		6			11	12	13	14								
172.00 E N	USA	FLTSATCOM W PAC	0						7	8												
172.00 E N	USA	FLTSATCOM-C W PAC1	C0		2				C7	C8									C20			C*
172.00 E C	USA	USASAT-14K				4		6				12		14								
174.00 E N	USAIT	INTELSAT5A PAC1				C4		C6			11			14								
174.00 E N	USAIT	INTELSAT7 174E				C4	C5	C6			C11	12	C13	14								
174.00 E C	USAIT	INTELSAT8 174E				4	5	6			11	12	13	14								
175.00 E A	USA	JBS-12																	20		*	
175.00 E A	USA	USASAT-29F														17	18	19	20	*	30	
175.00 E N	USA	USGCSS PH2 W PAC							7	8												
175.00 E N	USA	USGCSS PH3 W PAC			2				C7	C8												
175.00 E A	USA	USGCSS PH3B W PAC			2				C7	C8												
175.00 E A	USA	USGCSS PH4 W PAC-3			2														20			*
176.50 E N	USA	MARISAT-PAC	0	1		4		6														
177.00 E N	USAIT	INTELSAT5A PAC2				4		6			11			14								
177.00 E N	USAIT	INTELSAT7 177E				C4	C5	C6			C11	12	C13	14								
177.00 E C	USAIT	INTELSAT8 177E				4	5	6			11	12	13	14								
177.50 E A	USA	JBS-8																	20		*	
177.50 E A	USA	MILSTAR-14	0		C2														C20			C*
178.00 E N	F ESA	MARECS PAC1	0	1		4		6														
178.00 E C	G INM	INMARSAT2 POR-2		1		4		6														
178.00 E A	G INM	INMARSAT3 POR-2		C1		C4		C6														
179.00 E C	G INM	INMARSAT GSO-2G		1	2	4		6														

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Orbital position	Space station	Frequency bands GHz																			
		0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
179.00 E A	G INM INMARSAT3 POR-1		C1		C4		C6														
179.50 E C	G INM INMARSAT2 POR-1		1		4		6														
180.00 E A	USA JBS-13																	20		*	
180.00 E C	USA USGCSS PH2 W PAC-2							7	8												
180.00 E A	USA USGCSS PH3 W PAC-2			2				C7	C8												
180.00 E A	USA USGCSS PH3B W PAC-2			2				7	8												
180.00 E A	USA USGCSS PH4 W PAC-2			2														20			*
180.00 E N	USAIT INTELSAT MCS PAC A		C1		C4		C6														
180.00 E N	USAIT INTELSAT5 PAC3				4		6			11			14								
180.00 E C	USAIT INTELSAT7 180E				4	5	6			11	12	13	14								
180.00 E C	USAIT INTELSAT8 180E				4	5	6			11	12	13	14								

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Table 2

LIST OF NON-GEOSTATIONARY SPACE STATIONS BY ADMINISTRATION AND FREQUENCY BANDS (RR 1042, RR 1060, RR 1488-1491)

		Space station	Frequency bands GHz																						
			0	1	2	4	5	6	7	8	9	11	12	13	14	15	17	18	19	20	>20	>30	>40	>100	>200
A	AFS	GREENSAT-1			2					8															
A	AFS	GREENSENSE			2					8															
N	ARG	SAC-B			2																				
A	B	ECO-8 EQUATORIAL LEO		1	2		5	6																	
N	B	MECB-S1	0		2																				
A	BEL	MLMS	0																						
N	CAN	ISIS-1	0																						
N	CAN	ISIS-2	0																						
N	CAN	RADARSAT-1A			2		5			8															
A	CHL	CESAR-1 / AMSAT-CE	0	1	2																				
A	CHL	FASAT-ALFA	0																						
A	CHN	FY-1	0	1																					
A	D	EQUATOR-S			2																				
A	D	EXPRESS			2																				
A	D	LOOPUS ASIA EAST										11	12		14										
A	D	LOOPUS ASIA WEST										11	12		14										
A	D	LOOPUS EUROPE										11	12		14										
A	D	LOOPUS NA EAST										11	12		14										
A	D	LOOPUS NA WEST										11	12		14										
A	D	QUASIGEO-L1										11		13	14			18	19	20	*	*			
A	D	QUASIGEO-L2		1	2							11		13	14				19	20	*	30			
A	D	QUASIGEO-L3			2							11		13	14				19	20	*	30			
A	D	ROSAT			2																				
A	D	SAFIR	0																						
A	DNK	ORSTED			2																				
N	E	MINISAT 1			2																				
N	F	ARIANE	0		2																				
A	F	ARSENE	0		2																				
N	F	CAS-A	0																						
A	F	DORIS 1	0		2																				
A	F	F-SAT ICO															17	18	19	20	27	30			
A	F	F-SAT LEO															17	18	19	20	27	30			
A	F	GIOTTO			2					8															
N	F	S80-T	0																						
A	F	SARA	0																						
N	F	SPOT-1			2					8															
N	F	SPOT-2			A2					8															
N	F	SPOT-3	A0		A2					8															
A	F	SPOT-4	0	1	2					8															
A	F	SPOT-5			2					8															
A	F	SPOT-6			2																				
N	F ESA	CLUSTER 1-5			2																				

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	Space station		Frequency bands GHz																					
			0	1	2	4	5	6	7	8	9	11	12	13	14	15	17	18	19	20	>20	>30	>40	>100	>200
N	F ESA	ERS-1			2		5		7	8				13							A23	A36			
N	F ESA	EURECA			2													18			28				
N	F ESA	ISO			2																				
N	F ESA	ISPM ULYSSES			2					8															
N	F ESA	SOHO			2																				
	F ESA	SPOT-4 ESBT			2																				
A	G	ICO-P					5	6																	
A	G	STRV-1	0		2																				
A	G	UOSAT-3	0																						
A	G	UOSAT-4	0																						
A	G	UOSAT-B	0	1																					
A	HOL	PETALRING 30C-K										11		13					19	20	*	*			
A	HOL	PETALRING 30C-S			2							11		13	14										
A	HOL	PETALRING 60E-S										11			14										
A	I	ITAMSAT 1	0																						
N	I	SAX			2																				
N	I	TEMISAT	A0																						
N	IND	ASLV			2																				
A	IND	IRS	0		2																				
N	IND	IRS-1B			2					8															
A	IND	IRS-1C			2					8															
A	IND	IRS-1E	0		2																				
A	IND	IRS-P3			2																				
N	IND	PSLV			2																				
N	IND	SEO BHASKARA-1	0																						
N	IND	SEO BHASKARA-2	0																						
A	IND	SROSS-1	0		2																				
A	IND	SROSS-2	0		2																				
N	IND	SROSS-3	0		2																				
A	IND	SROSS-C2	0		2																				
N	J	ADEOS	0		2					8				13											
N	J	ASTRO-D			2					A8															
A	J	EXOS-C	0		2																				
N	J	EXOS-D			2																				
N	J	GEOTAIL			2					8															
N	J	JAS-1B	0																						
A	J	JAS-2	0																						
N	J	JERS-1		1	2					8															
A	J	KIKU-6			2	4		6									17	18	19	20	*	*			
A	J	LUNAR ORBITER			2																				
A	J	LUNAR-A			2																				
N	J	MOS-1	0		2					8															
N	J	MOS-1B	0		2					8															
N	J	MS-T5			2																				
A	J	MUSE-B			2										14	15									
N	J	SFU			2																				
N	J	SHINSEI	0																						
N	J	SOLAR-A			2					8															
N	KOR	KITSAT-1	0																						
N	KOR	KITSAT-2	0																						

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		Space station	Frequency bands GHz																						
			0	1	2	4	5	6	7	8	9	11	12	13	14	15	17	18	19	20	>20	>30	>40	>100	>200
A	PAK	BADAR-1	0																						
N	POR	POSAT-1	0																						
A	RUS	ELEKON-STIR					5	6																	
N	RUS	GEO-IK-2	0		2									13											
A	RUS	KOSKON	0																						
A	RUS	MARAFON-8HE		1		4	5	6																	
A	RUS	METEOR-3M	0	1																					
N	RUS	MIR-1													14	15									
A	RUS	NORD-FSS										11			14										
A	RUS	SIGNAL	0									11			14										
N	S	FREJA	0		2																				
N	S	KIRUNA ROCKET	0				5																		
A	S	VIKING			2																				
A	TON	TONGASAT-ELL-1	0		2	4		6				11		13	14				19	20	*	30			
A	TON	TONGASAT-LEO-10000	0		2	4		6				11		13	14				19	20	*	30			
A	TON	TONGASAT-LEO-1200	0		2	4		6				11		13	14				19	20	*	30			
A	TON	TONGASAT-LEO-1300	0		2	4		6				11		13	14				19	20	*	30			
A	TON	TONGASAT-RADIO/TV-8					5	6						13	14			18			*	30			
A	UGA	EYESAT-A	0																						
A	UKR	SITCH		1	2					8															
N	URS	1	0																						
N	URS	2	0																						
N	URS	3	0																						
N	URS	4	0																						
N	URS	GLONASS	0																						
A	URS	GLONASS-M		1																					
N	URS	KOSPAS	0																						
N	URS	METEOR-2	0																						
N	URS	MOLNIA-1				4		6																	
N	URS	MOLNIA-2				4	5	6																	
N	URS	MOLNIA-3				4		6																	
N	URS	RADIO-M	0																						
N	URS	RS	0																						
A	URS	SPEKTR-R								8															
N	URS	SSIPR	0							8															
A	URS	UOSAT-5	0																						
N	USA	ALEXIS			2																				
A	USA	AMRAD-OSCAR	0																						
A	USA	BLOCK 5D-3			2																				
N	USA	BLOCK 5D			2																				
A	USA	CASSINI			2				7	8				13											
N	USA	COBE			2																				
N	USA	COMET			2																				
N	USA	CRRES			2																				
A	USA	EDSAT	0																						
A	USA	EOS AM			2									13		15									
N	USA	ERBS			2																				
N	USA	EUVE			2																				
N	USA	FAST			2																				
A	USA	FORTE	0		2																				

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	Space station		Frequency bands GHz																					
			0	1	2	4	5	6	7	8	9	11	12	13	14	15	17	18	19	20	>20	>30	>40	>100	>200
N	USA	GALILEO			2				7	8															
N	USA	GRO			2																				
N	USA	GRO OMNI			2																				
N	USA	HELIOS-1			2																				
N	USA	HETE			2																				
A	USA	HIBLEO					5	6											19	20	*	30			
N	USA	IMP-J	0																						
A	USA	INT. SPACE STN. ACS			2																				
A	USA	INTNL SPACE STN SGS												13		15									
N	USA	ISTP POLAR			2																				
N	USA	ISTP WIND			2																				
N	USA	IUS			2																				
N	USA	LANDSAT-4			2					8				13		15									
A	USA	LANDSAT-6			2					8															
N	USA	LANDSAT1-2	0		2																				
A	USA	LEOSAT-1															17	18	19	20	*	30			
N	USA	LEOTELCOM-1	0																						
A	USA	LEWIS			2																				
N	USA	MAGELLAN			2				7	8															
N	USA	MARS OBSERVER								8												33			
A	USA	MARS PATHFINDER							7	8															
N	USA	MICROLAB-1			2																				
A	USA	MSSLEO-1																	19	20	27	30			
A	USA	MSSLEO-2																	19	20	27	30			
A	USA	MTI	0		2																				
N	USA	NAVSTAR GPS		1	2																				
A	USA	NEAR							7	8															
N	USA	NIMBUS-7			2																				
N	USA	NIMBUS-E	0																						
A	USA	ORBITAL TEST FLIGHT		1	2																				
N	USA	OSCAR-7	0																						
N	USA	OSCAR-8	0																						
N	USA	P78-1			2																				
N	USA	P78-2			2																				
N	USA	P80-1			2																				
N	USA	P91-1			2																				
N	USA	P92-1			2																				
N	USA	P92-2			A2																				
A	USA	PACSAT-OSCAR-14	0																						
A	USA	PACSAT-OSCAR-19	0																						
N	USA	PAM			2																				
A	USA	PANSAT	0																						
N	USA	PIONEER VENUS ORBITE			2					8															
N	USA	PIONEER-10			2																				
N	USA	PIONEER-11			2																				
N	USA	PIONEER-6			2																				
N	USA	PIONEER-7			2																				
N	USA	PIONEER-8			2																				
N	USA	PIONEER-9			2																				
N	USA	RAE-B	0																						

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	Space station		Frequency bands GHz																						
			0	1	2	4	5	6	7	8	9	11	12	13	14	15	17	18	19	20	>20	>30	>40	>100	>200
N	USA	SAMPEX			2																				
N	USA	SAR	0	1																					
A	USA	SEASTAR		1	2																				
N	USA	SPACE SHUTTLE	0		2									13		15									
N	USA	SPACE SHUTTLE EMU			2																				
N	USA	SRL-1		1			5				9														
N	USA	ST			2																				
N	USA	ST OMNI			2																				
N	USA	STEP MISSION-00			2																				
N	USA	STEP MISSION-01			2																				
N	USA	STEP MISSION-02			2																				
A	USA	STEP MISSION-03			2																				
A	USA	SURFSAT-1							7	8					14	15						32			
N	USA	SWAS			2																				
N	USA	TDE/TAP			2																				
N	USA	TIROS-N	0	1	2																				
N	USA	TOMS-EP			2																				
N	USA	TOPEX/POSEIDON	0	1	2		5							13			17				21	37			
N	USA	TRANSIT	0																						
A	USA	TRMM			2									13	14										
N	USA	UARS																					63	183	205
N	USA	USAPEX			2																				
A	USA	USASAT-30A	0							8															
N	USA	USLL-HEO																					*		
N	USA	USLL-LEO																					*		
N	USA	VIKING 1 LAND			2																				
N	USA	VIKING 1 ORB			2					8															
N	USA	VOYAGER-1			2					8															
N	USA	VOYAGER-2			2					8															
N	USA	WAKE SHIELD FACILITY			2																				
A	USA	WSC-OSCAR-16	0																						
A	USA	XTE			2																				

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4. Studies and standardization in the field of telecommunication

4.1 *Integration of telecommunication satellites in the general network (activities of the Telecommunication Standardization Sector (ITU-T))*

The fixed-satellite and mobile-satellite services, which form part of public service telecommunications, have evolved radically in recent years. Today, the fixed-satellite service is the most widely used of all the space services and, along with the mobile-satellite service, is probably undergoing the most rapid development.

To coordinate studies on satellite matters, an Intersector Coordination Group (ICG) created by the first World Telecommunication Standardization Conference (WTSC) has assisted in clarifying the role of the two Sectors (ITU-T and ITU-R) in their respective field of competence and assisted in some cases in the transfer of work.

The ICG on satellite matters has established the following work programme:

a) To ensure that remaining issues from the Joint Ad Hoc Group (JAHG) on ISDN/satellite matters are taken into account.

b) To monitor the work programme of the relevant study groups (SG) in relation to the use of satellites in order to identify:
   i) inconsistent target dates;
   ii) areas of possible duplication;
   iii) areas missing from the studies.

c) To draw attention of the relevant SGs to emerging technologies and elements of public networks such as on-board processing, application of VSATs, non-geostationary satellite systems, mobile-satellite systems.

d) To draw the attention of the relevant SGs to plans for handbooks related to satellite matters.

e) To ensure, through coordination, that Recommendations being produced by relevant SGs allow continuing full integration of the satellite transmission medium in public networks.

The ICG on satellite matters has reported on the work plan for satellite activities in the ITU-T-Sector. The work plan sets out the generic satellite-related issues, the questions concerned and the planned Recommendations.

The ICG on satellite matters has also reported on the activities of the ITU-R Sector on satellite systems which might have an impact upon the work of ITU-T Sector.

Several ITU-T study groups (SGs 1, 2, 4, 7, 8, 9, 11, 12, 13, 14 and 15) are concerned with the integration of telecommunication satellites in the general network. ITU-T Study Group 13 (General network aspects) has acted as lead group in the ITU-T Sector for the ICG on satellite matters.

The ITU-T studies consider the use of telecommunication satellites for a whole range of transmissions: telephony, television, teleconference, data transmission, business services, communication between computers, aeronautical mobile and maritime mobile communications, telecommunication services to remote regions, weather forecasting, etc. Where necessary, they also investigate the signalling associated with these various types of information.

Specific satellite system issues, such as VSAT interworking with PSPDN (packet switched public data network), with ISDN , with PSTN (public switched telephone network) and with FPLMTS (future public land mobile telecommunication systems), have been considered. Other specific satellite system issues will be further studied, such as non-geostationary satellite system (non-GSO) encoding, fixed-satellite system extension to FPLMTS, non-GSO system networking with terrestrial systems, and in particular with ISDN and PSTN.

With regard to signalling, ITU-T has established Recommendations on interworking between ITU-T Signalling Systems (SS) Nos. 5, 7 and R2 and Inmarsat's Standard B maritime system. ITU-T has also approved Recommendations on the Inmarsat aeronautical mobile-satellite system and interworking between the above-mentioned systems standardized by ITU-T and Inmarsat's aeronautical system (for Signalling System No. 7, also with the telephone user part (TUP)). New Recommendations are to be approved shortly (mobility services application part - MSAP) to provide for all types of mobility for users and user terminal equipments in all mobile networks. ITU-T has also published a Recommendation on maritime mobile telecommunication store-and-forward services (packet mode) via satellite.

A new Recommendation was approved in 1995 on a signalling interface between an international switching centre (ISC) and an ISDN satellite subnetwork; in this Recommendation a new SS No. 7 satellite ISDN user part (SIUP) is defined.

Earlier Recommendations were developed providing operational guidelines and quality of service requirements for an international point-to-multipoint telecommunication service via satellite and operational guidance and quality of service requirements for an international two-way multipoint telecommunication service via satellite. These have recently been augmented by a new Recommendation dealing with multipoint satellite capability to telecommunication services.

A new Recommendation was developed covering the framing structure, channel coding and modulation for digital multi-programme signals for television, sound and data services received from a satellite system and distributed in a transparent way through satellite master antenna television networks (SMAN).

Recommendations have been developed on the service provisions for aeronautical public correspondence supported by mobile-satellite systems and on traffic engineering aspects of mobile networks, including satellite.

Further to requests for country codes received from global mobile satellite operators, a study has commenced on the criteria and guiding principles to be used in the assignment of ITU-T numbering resources.

In the field of data transmission, the X.350 series Recommendations have defined the procedures for calling subscribers from a mobile data terminating equipment (DTE) by way of packet-switched data transmission services. Recommendation X.351 defines the interface and the procedures applicable for the purposes of providing a gateway function in a PSPDN to a private PSDN. Some draft Recommendations to be approved in 1996 will meet the satellite connection requirements; in particular, Recommendation X.361 applies to private network implementation of VSAT systems, and Recommendations X.nlf and X.blf deal with fast byte protocol eliminating the round trip delay associated with the establishment and release of satellite connections.

Studies are progressing on performance for satellite connections, on signal processing, on the different techniques of echo protection and control and in speech and video encoding on ATM with the aim of achieving a full integration of satellite with terrestrial network and systems.

4.2 *Technical Recommendations for radiocommunications using space techniques (radiocommunication study group activities)*

The radiocommunication study groups are the part of the Radiocommunication Sector of the ITU (ITU-R) responsible for studying technical, operational and regulatory/procedural questions on radiocommunication, for issuing relevant ITU-R Recommendations and for preparing a report to the Conference Preparatory Meeting (CPM). Current ITU-R Recommendations are contained in the Volumes of the Radiocommunication Assembly (Geneva, 1995) and in the "pink" documents of the relevant ITU-R study groups approved by the 1995 Radiocommunication Assembly. The Assembly also approved the work programme for all ITU-R study groups, which may be found in the Resolution ITU-R 5-1. Publications of special interest for space radiocommunications are:

Topic	*Volume (Series)*
Space applications and meteorology	SA Series (1995)
Radio astronomy	RA Series (1995)
Fixed-satellite service using communication satellites	S Series (1995)
Radiowave propagation in non-ionized media	P Series (1995)
Time signals and frequency standards emissions	TF Series (1995)
Mobile-satellite services and radiodetermination-satellite service	M Series-Part 5 (1995)
Frequency sharing between the fixed-satellite service and the fixed service	SF Series (1995)
Broadcasting-satellite service (sound and television)	BO Series (1995)
Satellite news gathering	SNG Series (1995)
Inter-service sharing and compatibility	IS Series (1995)

The texts are prepared by experts in the field of space communication and are finally approved either by the Assembly or by correspondence. They form the basis for harmonization of the technical development of space radiocommunication systems and contain criteria for the sharing of frequency bands between the various space services and between the space services and terrestrial services.

4.2.1 *Fixed-satellite service (Radiocommunication Study Group 4)*

Thirteen draft new and revised Recommendations were adopted by ITU-R Study Group 4 in June 1995 and then approved by the Radiocommunication Assembly in November 1995. These new Recommendations were prepared by the various working parties and task groups of Study Group 4 on the following subjects: frequency sharing between the inter-satellite service and the radionavigation service at 33 GHz; technical criteria to be used in examinations relating to the probability of harmful interference between frequency assignments; digital satellite systems forming part of synchronous digital hierarchy (SDH) transport network; connection of very small aperture terminals (VSAT) systems with packet-switched public data networks (PSPDN) based on ITU-T Recommendation X.25; carrier-to-interference calculations between earth stations and radio-relay systems; use of digital transmission techniques for satellite news gathering (sound).

In addition to the approved Recommendations mentioned above, intensive studies are being carried out in the following areas: urgent work arising from WRC-95 on frequency sharing with networks using non-geostationary satellites, including non-geostationary MSS feeder links and non-geostationary FSS networks; studies on the technical aspects of Resolution 18 (Kyoto, 1994) insofar as it relates to the FSS; satellite SDH systems and the transmission of ATM traffic via satellite; preparation of the third edition of the Handbook on satellite communications and the SNG (satellite news gathering) user's guide, etc.

4.2.2 *Mobile-satellite services (Radiocommunication Study Group 8)*

The increasing importance of space radiocommunications for various mobile applications is reflected in the growing related activities of Study Group 8 as summarized below:

i) Mobile-satellite service: Studies are being pursued in the traditional area related to geostationary (GSO) satellite systems, where Recommendations have been adopted regarding: efficient use of the orbit and spectrum in the 1-3 GHz frequency band; determination of the need for coordination; availability performance objectives and coordination of aeronautical (R) systems; reference radiation patterns for earth station antennas in land systems; and frequency plans for SCPC systems. Special attention is being paid to applications involving non-GSO systems and new Recommendations have been adopted regarding sharing with other services using bands below 3 GHz and the impact of propagation on system design. With regard to future public land mobile telecommunication systems (FPLMTS), new and revised Recommendations have been approved relevant to the operation of the satellite component as well as to spectrum considerations on the allocated 2 GHz band. Other general topics continue to be studied and Recommendations have been prepared relating to the integration of terrestrial and satellite systems and sharing in the 1.6 GHz band with the radio astronomy service.

ii) Radiodetermination-satellite service: The recent deployment of radionavigation space systems has resulted in increasing activity for Study Group 8 in this area, in particular concerning sharing involving the global positioning system (GPS), where a new Recommendation has been adopted.

iii) Amateur-satellite service: New Recommendations have been approved concerning future amateur radio systems (FARS); disaster communications; the use of this service in developing countries; and frequency sharing.

In addition to the approved Recommendations mentioned above, urgent studies are being initiated by the various working parties of Study Group 8 in the following areas related to space activities: multimode handsets, disaster communications, and characteristics of mobile earth stations operating with global non-geostationary systems.

4.2.3 *Science services (Radiocommunication Study Group 7)*

The 1995 Radiocommunication Assembly has approved twenty new and revised ITU-R Recommendations on space applications in meteorology and radio astronomy. The Assembly has also approved the work programme (40 ITU-R Questions) for Study Group 7 for the 1995-1997 study period.

Eleven ITU-R SA Series Recommendations concern the data collection and transmission systems operating in the Earth exploration-satellite and meteorological-satellite services using satellites in low-Earth orbit and geostationary orbit. Methods of calculating low-orbit satellite visibility statistics may be found in Recommendation ITU-R SA.1156. Provisions to protect the space research, space operations and Earth exploration-satellite services and to facilitate sharing with the mobile service in the 2 025-2 110 MHz and 2 200-2 290 MHz bands are contained in Recommendation ITU-R SA.1154. Recommendations ITU-R SA.577-4 and SA.1166 recommend preferred frequencies, necessary bandwidths and performance and interference criteria for active spaceborne sensors. Recommendations ITU-R SA.1155 and SA.1157 contain protection criteria for data-relay satellite systems and for deep-space research.

Three revised ITU-R RA Series Recommendations cover the different aspects of protection of the radio astronomy service. The first edition of the Handbook of Radio Astronomy has been developed by experts of Working Party 7D of Study Group 7 (Science service) under the chairmanship of Mr. J. Whiteoak (Australia), and published by ITU. This Handbook will be useful to spectrum managers, radiocommunication engineers and astronomers.

4.2.4 *Broadcasting-satellite service (sound and television) (Radiocommunication Study Groups 10 and 11)*

Satellite broadcasting is dealt with by Working Party 10-11S, which reports to ITU-R Study Group 11 on satellite television broadcasting and to Study Group 10 on satellite sound broadcasting. WP 10-11S held a meeting in Rome in September 1995, particularly devoted to preparation of the 1997 World Radiocommunication Conference (WRC-97).

The report on work towards a Recommendation on the review of the BSS frequency Plans for Region 1 (11.7-12.5 GHz) and Region 3 (11.7-12.2 GHz) and associated Feeder-Link Plans as contained in Appendices 30 and 30A of the Radio Regulations was extensively updated to include the results of recent studies. It will represent the basic contribution from WP10-11S to the forthcoming Conference Preparatory Meeting, and will continue to be updated during the next meetings in 1996.

Further work is focused on multiprogramme emission systems for satellites operating at 11/12 GHz and on HDTV systems for satellites operating at 17/21 GHz.

5. Technical cooperation activities of the BDT

5a. Technical cooperation

5a.1 *Kiribati*

The ITU, acting as executing agency for UNDP, prepared a Telecommunication Development Plan for the Government of Kiribati, a country comprising 33 coral atolls dispersed over 4 500 km in the Pacific Ocean.

A network of 15 satellite earth stations, telephone exchanges, cables and terrestrial radio systems is planned to provide quality domestic and international telecommunication services to the 23 inhabited islands.

5a.2 *Tonga*

The Tonga Telecommunications Commission plans to establish a domestic satellite network linking five islands of the Kingdom.

ITU/BDT has prepared a feasibility study as well as the bidding documents for the project, including the technical specifications. The request for proposals will be issued as soon as the financing is secured.

5a.3 *Tokelau*

ITU/BDT manages a satellite communication project to provide domestic and international services to the three atolls of Tokelau in the Pacific Ocean. An earth station, a telephone exchange and underground cables will be installed on each atoll. The project is financed by Tokelau, New Zealand, UNDP and ITU.

5b. International teleconference on thyroid cancer in children during TELECOM 95

The first satellite teleconference between Geneva and Obninsk (Russian Federation) took place on the occasion of TELECOM 95 in October 1995. Scientists and medical experts in both cities exchanged information and consulted while examining real-time diagnostic images of patients suffering from thyroid cancer linked to the Chernobyl accident of 1986.

The teleconference had a medical purpose: to verify the diagnosis of thyroid cancer in three children by an international team of experts, and to discuss treatment. It highlighted a particularly serious problem associated with Chernobyl: the rise in the incidence of thyroid cancer among children. Children living in areas exposed to contamination are particularly vulnerable to thyroid gland disorders.

Dr. Hiroshi Nakajima, Director-General of the World Health Organization (WHO), said after the teleconference: "Although carried by two satellites, the demonstration was a down-to-earth application of high technology. WHO intends to work closely with the International Telecommunication Union in realizing the International Programme on the Health Effects of the Chernobyl Accident (IPHECA) as regards health, telecommunications and informatics". Each case of thyroid cancer identified within that Programme has to be verified internationally. Satellite communications will be a powerful tool in that exercise.

The teleconference, organized jointly by ITU and WHO, followed a memorandum of understanding signed in May 1995 by Pekka Tarjanne, ITU Secretary-General and Dr. Nakajima. The equipment used for the teleconference was provided by the International Maritime Satellite Organization (Inmarsat), Morsviazsputnik (the Russian Signatory to Inmarsat), Satelcom (United Kingdom), 7E Communications (United Kingdom), BASIC Association of Japan and CINV (Obninsk). The equipment used for the teleconference can provide still and dynamic diagnostic images. It is highly portable and may allow for the provision of telemedicine anywhere in the world.

5c. Pilot project in educational use of interactive television

In its mission to promote Education for All, UNESCO has recognized the potential of modern technology to contribute towards the aim of Education for All. Television, because of its wide availability and natural user interface, has been in use in this context for several decades and delivered educational programmes in both industrialized and developing countries for both distance education and support of classroom teaching. To bring in interactivity, television has often been supplemented by written information, direct face-to-face contact and the use of telephone, fax or data communication in addition to the primary video channel.

For rural and possibly peri-urban sites where no terrestrial facilities are available, satellite communication terminals are foreseen. The satellite also has the advantage of being a powerful means of distribution.

Technological enhancements offer great potential for the improvement of the interactive capabilities of broadcast learning systems. Interactive TV allows the viewer instantaneously to respond to and/or control the programme through a special return channel. Through new digital compression techniques, the various communication streams (voice, data, graphics, computer conferencing, etc.) can be integrated and used more efficiently. These new developments give the instructional designer many more options than those that were traditionally available. It is of the greatest importance that such capabilities be tested in educational settings, so as to ensure that future development of this technology, particularly the standards under preparation by ITU, take into account possible educational uses.

The proposed pilot project is sponsored jointly by ITU, through its Telecommunication Development Sector (ITU-D) and its Radiocommunication Sector (ITU-R), and by UNESCO. At the education level, it aims at improving in-service teacher training, both in terms of instruments and methodologies used. It will develop and test a model for teacher training that takes account of the current and future developments in interactive television, on the basis of the specific educational requirements and technological capabilities in developing countries. At the technical level, the project will build on public sector/private sector cooperation to ensure effective implementation and provide opportunities for future endogenous technological development.

During a preparatory planning meeting held in Paris at UNESCO Headquarters from 14 to 16 May 1995, experts in educational technology from Brazil, Egypt and South Africa, together with telecommunication specialists working with ITU, formulated the overall framework for the project. This framework was approved by ITU-D Study Group 2 (meeting in Geneva from 1 to 11 May 1995) and the Joint Steering Committee of ITU-R Study Groups 10 and 11 (31 May 1995). It was considered within the South African context by an ITU-UNESCO survey mission (27 May to 2 June 1995) which visited several educational institutions, broadcasters and telecommunication operators in the Johannesburg area and Pretoria.

A presentation and discussions with potential donors and industrial representatives was organized during the TELECOM 95 Exhibition in Geneva in October 1995. Proposals from several potential host countries have been received and are presently being considered. Once the host country (or countries) has been selected, the project document would be refined accordingly by the ITU/UNESCO.

5d. SPACECOM Project

5d.1 *Background*

The SPACECOM project launched by ITU/BDT in 1994 represents a model of partnership for bringing space technology to rural development, as well as pace-setting to future cooperation for telecommunications enhancement in the developing world.

The basic concept of the project is to build a strong partnership between the space communication industry and the telecommunication operator/user community in developing countries, with ITU/BDT serving as catalytic coordinator.

The space industry is called upon to support the project as sponsors and to participate in it by providing financial and technical contributions.

According to the working structure decided together with the core of initial sponsors, the project will be implemented in three consecutive phases and the overall activities have been divided into 11 workpackages, in order to enable partners to share their participation in the project activities according to their capacities and interests. The programme is proceeding well, in line with the established work plan, and the successful development of the project during its first year of operational activity culminated with the recent Steering Committee Meeting held in Geneva on 15 November 1995.

The major assignments and achievements of Phase 1, presently under completion, are summarized below.

5d.2 *Major assignments under Phase 1*

a) To broaden the number of sponsors and encourage the active participation of partners in the development of the work.

b) To collect data and information needed for the study:
   — written contributions from sponsors;
   — answers to the questionnaire addressed to developing countries.

c) To explore possible synergy with other ongoing ITU/BDT development programmes and to establish cooperation agreements with other international and/or regional organizations for the identification/ definition of joint pilot application projects to be implemented in developing countries.

5d.3 *Major achievements*

5d.3.1 *Present participation*

For the time being, 30 sponsors have offered cash and/or in-kind contributions while 65 telecommunication organizations of developing countries have confirmed their interest in taking part in the project development. Fifteen sponsors have undertaken to pay the level of contribution established to join the Steering Committee.

5d.3.2 *Questionnaire for developing countries*

In the context of Phase 1 activities, a questionnaire has been prepared and sent to more than 160 telecommunication organizations of different developing countries. The questionnaire covers a total of 63 questions grouped in nine different sections:

— Section 1: current situation in rural telecommunications.

— Section 2: current and future plans, strategies and projects for rural telecommunication development.

— Section 3: current and planned applications of satellite communication technology.

— Section 4: policy and regulatory environment.

— Section 5: competition.

— Section 6: licensing.

— Section 7: customs duties.

— Section 8: billing and tariff issues.

— Section 9: case studies.

The active participation of all involved telecommunication organizations is considered an essential element for the successful outcome of the ongoing survey. Expected answers to the questionnaire would provide a better understanding of rural telecommunication requirements in the various regions and of the major constraints hampering widespread application of satellite communication technologies.

It is also anticipated that indications will be received on concrete projects to extend telecommunication services in remote and rural areas, with a view to submission to the space communication industry and financing institutions for appropriate consideration and possible implementation.

5d.3.3 *Written contributions received from sponsors*

For the time being, 13 sponsors have provided written contributions highlighting available and new proposed systems/services which are well suited for application in developing countries.

ESA has confirmed its willingness to provide in-kind expertise to assist the SPACECOM central office for the integration of all data/information received concerning players and the solutions proposed. The terms of reference established for the work to be performed with the participation of experts made available by ESA (as in-kind contribution) and under the coordination of the project central office, include *inter alia*:

— analysis of the relevant parts of the responses of developing countries to the questionnaire relating to present needs and current plans for rural telecommunication development in the various regions;

— analysis and harmonization of the various written contributions received from sponsors concerning proposed systems/services, potential benefits and drawbacks for applications in developing countries;

— integration of all data/information concerning players and solutions proposed;

— elaboration of a comprehensive report.

It is expected that all the elements needed to start work with ESA will be available by December 1995 and that the task will be completed in about three months' time.

5d.3.4 *Responses of developing countries to the questionnaire*

For the time being (mid-December 1995), a total of 60 answers have been received while 10 telecom organizations have indicated that their answers are still under preparation.

Actions to elicit further answers have been undertaken in coordination with ITU/BDT Regional Offices.

The European Commission has confirmed its support to SPACECOM central office for development of tasks concerning policy and regulatory aspects. Terms of reference established for the work of selected experts, made available in-kind by the European Commission, include *inter alia*:

— analysis of the relevant parts of responses from the developing countries to the questionnaire relating to regulatory and policy matters;

— identification and analysis of perceived regulatory barriers in developing countries;

— identification and analysis of legislation and policies relevant to developed countries so as to provide appropriate examples for developing countries;

— review of the changing regulatory environment in the area of satellite communications, taking into consideration current efforts and activities in the various regions (i.e. African Green Book, Americas Blue Book, etc.);
— preparation of proposals for recommendations and guidelines on regulatory policies to be considered by the developing countries.

Experts recruited by the European Commission are expected to start their work in December 1995 and to complete it in about three months. To ensure proper coordination, two formal meetings will be held with the participation of the SPACECOM Project Coordinator (a kick-off meeting and another meeting to review the draft final report).

5d.3.5 *Synergy with other ITU/BDT development programmes (BAAP-P.9 and P.12 in particular) for the identification/definition of pilot projects*

Cooperation has been established with P.9 and P.12 to create synergy and avoid duplication of efforts. Areas where such cooperation would be of mutual benefit include the identification and definition of pilot projects where the support of satellite communications technology is envisaged.

Programmes 9 and 12 were defined during the first World Telecommunication Development Conference in Buenos Aires, March 1994, and are included in the Buenos Aires Action Plan (BAAP). Programme 9 deals with "Integrated Rural Development" and Programme 12 with "Development of Telematics and Computer Networks".

Guidelines for the preparation of pilot project proposals have been jointly elaborated and also take into consideration some comments/suggestions received from sponsors. The document includes the list of information to be provided in order to make the proposed project eligible to be considered for further development, as well as the basic criteria that will be applied for selection of the successful proposals.

A call for pilot project proposals document, issued in English, has already been addressed to various telecom organizations of developing countries. Intelsat has offered in-kind support for translation of the document and it is expected that French and Spanish versions will be available by December 1995. According to the indications received from developing countries, concrete proposals for pilot projects are now expected to come from various regions:

— Africa: Angola, Benin, Eritrea, Ethiopia, Gambia, Ghana, Kenya, Mozambique, Nigeria, Namibia, South Africa, Uganda, Zambia, etc.;

— Americas: Argentina, Brazil, Chile, Guyana, Haiti, Mexico, Peru, etc.;

— Asia & the Pacific: Bhutan, Cambodia, India, Iran, Philippines, Micronesia, Mongolia, Sri Lanka, Thailand, Viet Nam, etc.;

— Arab States: Egypt, Oman, etc.;

— Europe: Hungary, Kazakstan, Ukraine, etc.;

Within the framework of the cooperation with Programmes 9 and 12, it is planned to provide limited assistance to the various regions for the preparation of concrete proposals in accordance with the established guidelines. A limited number of experts should be recruited to help the telecom organizations concerned by elaborating projects and collecting the data/information needed to complete a pre-investment study.

5d.3.6 *Possible cooperation with other international and/or regional organizations*

Actions are in progress to activate concrete cooperation with the World Bank, UNESCO, UNEP, RASCOM, SADCC, VITA, etc.

Contacts with UNEP are at an advanced stage to explore potential for joining resources and integrating pilot projects in the new UNEP satellite-based network (Mercure) under worldwide implementation.

A coordinated plan of actions is under definition with ESA and Nuova Telespazio, in order to:

— identify an appropriate solution for the rehabilitation/upgrading of three UNEP satellite earth stations already operating in Africa (Ghana, Kenya, Zimbabwe);

— integrate the existing stations into the new Mercure network;

— make use of the existing and upgraded stations to also support joint SPACECOM/Mercure applications (such as telemedicine, tele-education, etc.).

During recent meetings with RASCOM officials, potential areas of cooperation have been reviewed and concrete actions have been agreed upon in order to jointly define pilot projects for implementation in Africa.

Contacts already undertaken will be pursued by ITU and efforts will be also devoted to activate cooperation with other regional telecommunication organizations (such as ASIASAT, APT and APSCC for pilot projects in Asia and the Pacific, CITEL for pilot projects in the Americas, etc.). All SPACECOM sponsors have been invited to stimulate contacts and identify other potential partners.

6. Activities of TELECOM concerned with space matters

The TELECOM Secretariat of the ITU is responsible for organization of the World Telecommunication Exhibition and Forum event, TELECOM, as well as companion regional events in the American, Asian and African continents. The most recent event, the 7th World Exhibition and Forum, TELECOM 95, was held from 3 to 11 October 1995 in Geneva, Switzerland, seat of the Union.

The exhibition, an extensive trade-show with a host of impressive stands, attracted large crowds, with more than 189,000 participants converging on Geneva. The different demonstrations (especially the many multimedia applications) were very accessible to the public, and ITU and a select number of exhibitors endeavoured particularly to share their knowledge and capabilities with the many developing countries, Members of the Union. The Programme for Development and the Newly Industrializing Countries (NIC) pilot project are an exemplary form of cooperation reflecting a desire to transfer information. Together with the "1 in 10" stand for people with disabilities and the elderly, these undertakings typify the more humanitarian focus of TELECOM 95.

The industry involved in the use of outer space was widely represented at the exhibition: from earth station equipment to antennas, from global positioning systems to microwave components or links, from mobile terminals to LEO satellite systems, from transportable equipment to satellite news gathering, broadcast or other communications systems, all applications, technologies and services were there for the public to see.

The Forum also generated much interest. Forum 95 comprised two main events, the Strategies Summit and the Technology Summit, attended by more than 4 000 delegates, and a special session on Internet and on-line services, which attracted over 2 000 visitors. The Strategies Summit, the theme of which was "Breaking down the barriers towards the global information society", brought out the opposing trends that exist at the moment. On the one hand, the leading group and the developed countries sang the praises of global markets and universal applications and services. On the other, the developing countries and emerging industries expressed their dismay or anger at the shortage of capital, the barriers to transfers of technology and knowledge, the lack of training for their human resources, the difficulty of obtaining access to information — in other words, the constantly growing gap between the two worlds. The Technology Summit witnessed the growing intercorrelation of technologies and supported applications; the entry — now an established fact — of new partners from the realm of services and applications into the previously exclusive world of telecommunication standardization; the revolution that is occurring at the threshold of the new millennium, with the convergence of three powerful industries — information technology, telecommunications and radio and television media — into a single global industry of planetary import.

Subjects covered include technology: speech recognition and processing, ATM, optoelectronics, wireless, satellite; services: mobile, broadband, personal and personalized, intelligent, secure communication, interactive broadcast; networks: management, public and corporate, intelligent; applications: information highways, multimedia, computer supported collaborative work, cable television; and general themes: user needs, human factors, restructuring of the telecommunication sector, telecommunications and development, rural telecommunications, regulation and standardization.

Once again, the different players from the space, satellite and wireless industries were invited to submit papers or to present their vision in both the Technology and the Strategies Summits. Bodies such as Inmarsat, Time Warner Telecommunications (USA), Mobile Communications International (UK), Cable and Wireless (UK) and the Radiocommunication Bureau were represented and participated actively in the Forum Programme Advisory Committee. News Corporation (USA), MCI (USA), INTELSAT, RASCOM, Teledesic (USA), Reuters (UK), the European Broadcasting Union (EBU), Société Européenne des Satellites (Luxembourg), Mobile Communications Holdings (USA), TDF (France), EUTELSAT, Hughes Electronics (USA), Iridium, Pakistan Broadcasting Union (Pakistan), SITA, Intersputnik (Russian Federation), NHK (Japan) and CCETT (France) — to name but a few — participated as keynote speakers or panelists in the fruitful debates of the Forum.

In addition, the 7th Forum hosted a joint session of the two Summits "Wireless for the 21st Century", under the chairmanship of Dr. Pekka Tarjanne, ITU Secretary-General, and Mr. Robert Jones, Director of the Radiocommunication Bureau, to celebrate the 100th anniversary of radiocommunication by recalling the origins of radiocommunication and looking forward to the future.

Preparations are now under way for Americas TELECOM 96, which will be held in Rio de Janeiro (Brazil) from 10 to 15 June, 1996. The Forum will again comprise a Strategies and a Technology Summit, and the main theme will be "Telecommunications and Sustainable Development — From Potential to Growth".

7. Information and documentation activities

In pursuance of Council Resolutions 636 and 637, the General Secretariat has continued the dissemination of information on the activities and role of ITU in space telecommunications.

Ten times a year, the ITU Newsletter publishes a list of artificial satellites launched in the previous weeks as well as articles and information regarding space techniques, telecommunications and launching devices.

8. Cooperation with other international organizations concerned with space matters

8.1 *General*

In 1995, ITU pursued its cooperation activities with the relevant international organizations dealing with space matters, namely COSPAR, EUTELSAT, Inmarsat, etc.

In addition, these organizations participated actively in:

— the TELECOM 95 World Exhibition which took place in October 1995, and

— the World Radiocommunication Conference that addressed questions related to space technology in October-November 1995.

During the period under review, ITU has also continued to follow closely the work of the Inter-Agency Meeting on Outer Space Activities and participated in the meetings convened by the Office for Outer Space Affairs in Vienna.

In the area of space telecommunications, the Union continues to work in close collaboration with the specialized agencies concerned, namely:

— the International Civil Aviation Organization (ICAO);

— the International Maritime Organization (IMO);

— the World Meteorological Organization (WMO);

— the United Nations Educational, Scientific and Cultural Organization (UNESCO);

— other intergovernmental regional organizations worldwide.

8.2 *Participation of ITU in the meeting of the United Nations Committee on Peaceful Uses of Outer Space*

ITU representatives have participated in the work of the Scientific and Technical Subcommittees (Thirty-second Session, Vienna, 6-17 February 1995), Legal Subcommittee (Thirty-fourth Session, Vienna, 27 March-

7 April 1995) and the Committee on the Peaceful Uses of Outer Space (Vienna, 12-23 June 1995) at which the following specific questions of special interest to ITU were considered:

1) matters relating to the definition and delimitation of outer space and to the character and utilization of the geostationary orbit, including consideration of ways and means to ensure rational and equitable use of the geostationary orbit;

2) consideration of the legal aspects related to application of the principle that the exploration and utilization of outer space should be carried out for the benefit and in the interests of all States, taking into particular account the needs of developing countries;

3) examination of the physical nature and technical attributes of the geostationary orbit; examination of its utilization and applications, including, *inter alia*, in the field of space communications;

4) space debris;

5) implementation of the recommendations of the second United Nations Conference on the Exploration and Peaceful Uses of Outer Space;

6) Space applications and the coordination of space activities within the United Nations system.

ANNEX

Reports on progress made in the development of space communications

7 April 1995) and the Committee on the Peaceful Uses of Outer Space (Vienna, 12-23 June 1995) at which the following specific questions of special interest to ITU were considered:

1) matters relating to the definition and delimitation of outer space and to the character and utilization of the geostationary orbit, including consideration of ways and means to ensure rational and equitable use of the geostationary orbit;

2) consideration of the legal aspects related to application of the principle that the exploration and utilization of outer space should be carried out for the benefit and in the interests of all States, taking into particular account the needs of developing countries;

3) examination of the physical nature and technical attributes of the geostationary orbit; examination of its utilization and applications, including, *inter alia*, in the field of space communications;

4) space debris;

5) implementation of the recommendations of the second United Nations Conference on the Exploration and Peaceful Uses of Outer Space;

6) Space applications and the coordination of space activities within the United Nations system;

DENMARK

(See also Iceland, Norway and Sweden.)

Intelsat

In January 1995, Tele Danmark began installation of an Intelsat Standard A IDR earth station at Blaavand, comprising a 16 m antenna. The earth station was ready for service on 1 June 1995, and will handle traffic growth in the IOR region on Intelsat 704 at 66° E.

Orion

In mid-1995, a cable restoration system was established between Denmark and the Faroe Islands using capacity on the Orion F1 satellite. An 11 m earth station on the Faroe Islands and a 9.2 m earth station in Blaavand were rebuilt for use on Orion.

Other systems

A 1.8 m TV-uplink station for 7 Mbit/s MPEG-2 digital transmission to Tele-X has been established at a customer's premises.

Various smaller VSAT circuits for voice, data and video have been established for Danish companies, providing communication with their European affiliates.

Tele Danmark has acquired a new fully automatic SNG van, prepared for digital transmissions.

EGYPT (ARAB REPUBLIC OF)

1. Telecommunication

1.1 *International communications via Intelsat satellites*

The Maadi-1 Standard A earth station has been in operation since 1978 via the Atlantic Ocean satellite at 335.5° E. Presently, it handles FDM/FM traffic with seven destinations, with a total capacity of 96 circuits, and digital (IDR) traffic with eight destinations, with a total capacity of 744 circuits.

The Maadi-2 Standard A earth station has been in operation via the Indian Ocean satellite at 60° E since 1984. Currently, it handles FDM/FM traffic with 11 destinations, with a total capacity of 132 circuits, and digital (IDR) traffic with 11 destinations, with a total capacity of 738 circuits.

During 1995, 563 television transmissions and 367 receptions of a total duration of 22 522 minutes were handled by the two stations.

The Maadi-4 Standard F-2 earth station has been in operation since April 1990 for CBD via the Atlantic Ocean satellite at 332.5° E.

The Maadi-7 Intelsat Standard B earth station has been in operation since September 1994 for the transmission of the International Nile TV programme via the satellite at 359° E.

The Maadi-8 Intelsat Standard G antenna has been in operation since September 1994. Currently, it transmits three Egyptian TV programmes to the Orbit Corporation via Intelsat satellite at 66° E.

1.2 *Regional communications via Arabsat satellites*

The Maadi-5 Arabsat C-band earth station (11 m antenna) has been in operation since November 1990 via the Arabsat-1A satellite. It is now working with Arabsat-1C at 31° E. Currently, it handles FDM/FM traffic with 11 destinations, with a total capacity of 612 circuits. In addition, there are three destinations working on SCPC, with a total capacity of 60 circuits. During 1995, 431 television transmissions and 253 TV receptions of a total duration of 19 013 minutes were handled, besides a daily (round-the-clock) television programme transmission (Egypt space channel).

1.3 *Domestic communications via Intelsat satellites*

Two domestic Intelsat business service networks have been in operation since 1992. The first network, for civil aviation air traffic control, consisting of a centre hub earth station at Cairo International Airport and six earth stations at national airports, started operation in January 1992.

The second network, for National Oil Company data communications, consisting of a centre hub earth station at Maadi site and two earth stations at drilling sites, started operation in March 1992, with transmission rates of 576 kbit/s at Ras Shukhier and 320 kbit/s at Abu Gharadiv.

1.4 *Maritime satellite communications*

Egypt has been a member of Inmarsat since 1979. The Maadi-3 Inmarsat coast earth station has been in operation since October 1987, via the East Atlantic Ocean Region satellite. Presently, it provides telephone, telex, data, safety and distress services with a total capacity of six telephone circuits and eight telex circuits.

2. Other space activities

2.1 *Meteorological satellite applications*

Since 1969, the Egyptian Meteorological Authority (APT) earth station has operated with a satellite in near-polar orbit to receive both visible and infrared channels. In 1979, the earth station was modified to operate with Meteosat-3. In 1982, a new earth station was constructed, with the capability of receiving pictures from both polar-orbiting and geostationary satellites. In addition, a specialized data processing system has been acquired to provide meteorologists with pictorial information on the different types of cloud systems and associated weather phenomena. The earth station is also equipped for the reception of digitally transmitted high-resolution data based on personal computers.

2.2 *Remote sensing from space*

The Egyptian remote sensing centre is part of Egypt's Academy of Scientific Research and Technology. It possesses a complete line of state-of-the-art digital image processing facilities for aircraft and earth resources monitoring satellite data, as well as a photographic facility. The centre also has a complete photometric unit, including a modern aircraft equipped with a digital and photographic sensor camera in addition to the latest computer-oriented analytical stereoplotter for digital mapping.

GERMANY (FEDERAL REPUBLIC OF)

1. Earth segment equipment

In 1995, an antenna was completed at the Inmarsat land earth station (LES) at Raisting for use in the Indian Ocean region. In addition, LES Raisting was equipped with technical facilities for use of Inmarsat-M and B services.

Inmarsat LES Raisting thus provides Inmarsat-A, C, B and M services for the Atlantic Ocean East and Indian Ocean beam areas.

In addition, Inmarsat LES Raisting is equipped with facilities for the Inmarsat-E system which automatically route incoming nautical emergency calls from the two beam areas to the *Gesellschaft zur Rettung Schiffbrüchiger* (Lifeboat Service; MRCC Bremen).

Extension of the service range by the Inmarsat-B high-speed data service (HSD) is scheduled for 1996.

2. Examining and developing new satellite applications

Deutsche Telekom AG carried out or was involved in several research and development projects on new satellite applications.

For instance, research was carried out to determine options for improved use of satellite capacity for digital TV and audio transmissions (eg. VIDISAT) by means of new transmission procedures with data compression.

In cooperation with the German Cancer Research Institute, high-quality stereoscopic transmissions were performed for medical purposes, for example making direct 3-D images of operations immediately available for universities or other clinics (SILONET project).

Under field trials, organization units of Deutsche Telekom AG took over the maintenance of DAB/DVB-20/30 GHz satellite distribution services.

In cooperation with ESA, research was conducted to look into new communications means for specific applications (code experiment).

Field trials were conducted to study the question of how ATM networks could be used via satellite.

3. Research in the area of satellite-based radiocommunication services

In 1995, the Deutsche Telekom AG Research Centre continued its propagation studies with the 20/30 GHz beacon signals of the Italsat satellite and registered, in parallel, the 12 GHz beacon of the Intelsat-VI satellite at 60° longitude East at a low elevation angle (10.5°). Radio meter measurements were also continued at four climatically different German locations at 20 and 30 GHz.

In cooperation with the State Research Institute of the Russian Telecommunication Administration (NTIR), radiometrical measurements were launched at 12 and 30 GHz in the vicinity of Moscow. In conjunction with these measurements, attenuating cloud structures were examined with the help of a LIDAR.

All these activities pursue the objective of using the frequency bands assigned to satellite communications in a more efficient and less costly manner, and of enabling the introduction of new services.

ICELAND

(See also Denmark, Norway and Sweden.)

1. Intelsat

The Intelsat Standard A earth station Skyggnir has been in operation since October 1980.

At the end of 1995, Skyggnir 1A carried traffic and leased circuits via the Intelsat VI (F5) satellite at 335.5° E to and from Tanum in Sweden, Nittedal in Norway, Goonhilly in the United Kingdom, Fuchsstadt in Germany, Bercenay in France, Etam in the United States and Des Laurentides in Canada. Most of the circuits are type IDR/DCMS. During the year, circuits continued to be transferred from satellite to the new submarine cable, Cantat-3. At the end of 1995, the total number of international circuits routed via Skyggnir had fallen to approximately 325, as compared with 400 at the end of 1994.

A 13 m Standard B antenna, Skyggnir 2B, has been in operation since 1983. The antenna is normally used for television reception only (B-MAC) and accesses a leased television channel on Intelsat VII (F2) at 359° E. This antenna also has transmission capabilities.

Occasional television programmes were transmitted from Skyggnir or received on a number of occasions during 1995.

A 16 m Standard A earth station, in the town of Höfn on the south-east coast of Iceland, was used as a restoration facility for the Cantat-3 cable circuits, via the Intelsat satellite at 328.6° E.

A 10 m Standard B earth station in the town of Keflavik has been in operation since October 1992 and carries IBS traffic between Iceland and the United States.

An 11 m Standard B earth station at the Skyggnir site, Skyggnir 3B, was used to carry leased circuits between the air traffic control centre in Reykjavik and Søndre Strømfjord and Ammassalik in Greenland.

An increasing number of full-time satellite TV programmes, received by small and medium-size Ku-Band antennas, was distributed to hotels in Reykjavik and to television stations for terrestrial rebroadcast.

2. Eutelsat

Iceland has been a member of Eutelsat since August 1985.

A 6 m SMS earth station at the Skyggnir site carries leased circuits between the air traffic control centre in Reykjavik and the Faroe Islands.

A 13 m earth station in Reykjavik was used to receive daily Eurovision transmissions via the EBU transponders on Eutelsat II (F-4) at 7° E. Transmission capability was added to the station.

An increasing number of full-time satellite TV programmes, received by small and medium-size Ku-Band antennas, was distributed to hotels in Reykjavik and to television stations for terrestrial rebroadcast.

Three VSAT terminals for exchange of financial data were in use in Reykjavik.

In addition, numerous private antennas were in use by individuals for the reception of television programmes via telecommunication satellites.

3. Inmarsat

Iceland is a member of Inmarsat and makes use of the land earth stations in Eik (Norway) and Blaavand (Denmark). An Inmarsat A terminal in Reykjavik is used as an emergency back-up for international air traffic control circuits.

4. Iridium

An agreement was made between Post and Telecom Iceland and Motorola Inc. for the installation and operation in Iceland of a tracking and telemetry earth station for use during the implementation phase of the planned Iridium mobile satellite communications system. Station site preparatory work started in the autumn of 1995, and equipment installation is planned for early 1996.

INDONESIA

The Indonesian Administration's activities in space radiocommunication in 1995 included coordination meetings and satellite filing.

1. Satellite frequency coordination meetings

The Indonesian Administration held satellite frequency coordination meetings with Russia, China and Japan. The meeting with the Administration of Japan was held in Tokyo in May 1995. The coordination meeting with the Administration of Russia took place in Moscow in July 1995. In August 1995, coordination was effected with the administration of China in Denpasar. While significant progress was achieved at these meetings, coordination has not yet been completed.

2. Satellite filing

In 1995, the Indonesian Administration submitted Appendix 4 and Appendix 3 notices to the Radiocommunication Bureau for the following new satellites:

— Appendix 4 and Appendix 3 for Palapa B5 (139.5° E)

— Appendix 4 and Appendix 3 for Palapa B6 (130° E)

— Appendix 4 and Appendix 3 for Palapa B7 (110.4° E)

— Appendix 4 and Appendix 3 for Palapa B8 (87° E).

Palapa B5, B6, B7 and B8 are the next generation of the Palapa B series, which will be owned and operated by PT. Telekomunikasi Indonesia.

3. ACeS project

On 5 July 1995, PT Asia Cellular Satellite Systems (ACeS), a multinational telecommunication company based in Jakarta, signed a contract with Lockheed Martin Corporation on a project for the development of a mobile-satellite communication system.

The ACeS will provide mobile personal communication services fully compatible with GSM to the Asia market, covering the South East Asia region, Pakistan, India, China, Korea and Japan. The services offered are voice, facsimile, data, DTMF signaling and roaming ability to the terrestrial network. Various types of terminals can be served, such as handheld, vehicle, aircraft and ship terminals.

The first generation of powerful ACeS satellites with a 12 m diameter L-band antenna, called Garuda-1, is currently being constructed at Lockheed Martin based in Ben Salem, New Jersey, in the United States. There will in fact be four generations of Garuda, Garuda-1, 2, 3 and 4, at orbital positions 118° E, 123° E, 135° E and 80,5° E, respectively. The first-generation satellite will use L-band for the service link and extended C-band for the feeder link. The launch is scheduled in early 1998 using Russia's Proton rocket, and the service will be availabe in mid-1998.

4. Satellite launching plan

At 31 January 1996, it is planned to launch the third generation of Palapa satellites, Palapa C1 , at orbital position 113° E. The satellite will be placed in orbit by the Atlas II rocket from Cape Canaveral, Florida, in the United States.

Palapa C1 is intended to replace the Palapa B-2P satellite and will be operated by PT Satelindo.

Palapa C1 has 42 transponders, 24 C-band, 14 extended C-band and 4 Ku-band.

IRAN (ISLAMIC REPUBLIC OF)

1. Domestic communications

Phase two of the VSAT project for providing satellite data services is already operational, and more than 100 terminals out of 700 are now in service.

Development of the second phase of the establishment of local satellite earth stations (831 terminals) is in the process of contract.

Three satellites have been purchased and deployed at 26° E and 34° E and are already operational.

2. International communications

Purchase of a new Standard A international earth station is in the process of contract, and the station will be installed and commissioned in 1996.

About 500 international circuits were added last year, so that there are now some 3500 circuits in service.

MEXICO

In 1995, the second of Mexico's new-generation satellites, Solidaridad II, with a useful life of 14 years, was placed in orbit, providing, together with Morelos II and Solidaridad I, regional coverage for 23 countries on the American continent. At the same time, the use of digital technology for satellite television, data and voice services was consolidated, and the number of open television systems and companies, cable and digital, increased.

During this period, design and configuration work began with a view to replacing the Morelos II satellite, the useful life of which comes to an end in the third quarter of 1998.

With its new satellite control centre for fixed-satellite services, Mexico now has two geostationary satellite control, operations and telemetry centres. Also, the operations control centre for mobile satellite signals is nearing completion.

The satellite and terrestrial infrastructure is being developed as part of the move toward future direct to home systems, global communication and universal personal communication systems, and broadband services.

Major constitutional and legal reforms were introduced with a view to encouraging private investment in the sector. Thus, following the reform of Article 28 of the Political Constitution of the United States of Mexico, the Federal Law on Telecommunications was passed, the effect of which has been to initiate change in the pattern of exclusive, monopolistic telecommunication companies in favour of a competitive environment. This is resulting in the creation of new companies backed by foreign investment and the intensive pursuit of strategic alliances, coordination agreements and new funding, marketing and tariff arrangements.

A state-of-the-art infrastructure is being developed for public service purposes. A new digital satellite network, with six channels compressed into a single transponder, was designed and set up for distance learning with an initial 10 462 stations. It is the public education authorities' objective to increase this number to over 120 000 stations — the equivalent of every school having an audiovisual satellite system. Design work also began on a rural satellite telephone network serving 20 000 villages with less than 500 inhabitants, using the L-band and semi-fixed stations powered by solar cells.

The integration of the extensive telecommunication network includes modernization of the national telegraphic system through its provision via telephone and telematics lines, as well as via satellite links using VSAT stations.

To this end, a network of 500 such stations has been designed to serve those offices handling the highest volumes of telegraphic and money transfer trafic, with the aim of improving service quality and reliability. Computing equipment for the electronic transfer of funds (money orders) has also been installed in 300 telegraph offices, which, with the support of 1573 telegraph offices in 1325 towns nationwide (60% of them located in communities of less than 10 000 inhabitants), serve one-fifth of the population.

Mexico is a member of the Intenational Telecommunications Satellite Organization (Intelsat) and the International Mobile Maritime Satellite Organization (Inmarsat).

Mexico's decentralized telecommunication body (TELECOMM) is a shareholder in the company ICO of the global MEO project for telephony and data transfer by satellite, known as Inmarsat-P.

The following objectives have been set with regard to satellite communications:

— maintain State control in this area;

— encourage the taking up of available satellite capacity for both national and intenational communications;

— promote the introduction of new telecommunication technologies and services;

— increase the coverage and the number of links for broadcasting (audio and visual), and the quality and effectiveness of those links for cable television and for DTH, DBS, MVS and subscriber services;

— promote networks for distance leaming, telemedicine and rural development.

MOROCCO (KINGDOM OF)

1. Extension of equipment

— Introduction, in April 1994, of IDR/DCMS digital carriers allowing, on the one hand, the extension and digitization of Morocco's domestic satellite network and, on the other, the introduction of IDR digital links with countries belonging to the Arabsat, Intelsat and Eutelsat systems.

— Introduction of a Standard F1 trailer-mounted mobile earth station equipped with a: 2×2 Mbit/s IDR digital telephony carrier and television equipment for occasional TV transmissions.

— Acquisition of Inmarsat-M transportable terminals.

2. Extension of circuits

Relation	Satellite	Number of circuits	Date of introduction
Norway	Intelsat	16	19.05.94
Denmark	Intelsat	10	21.09.94
Canada	Intelsat	30	06.09.94
United States of America	Intelsat	60	29.08.94
Saudi Arabia	Arabsat	12	02.05.94
Saudi Arabia	Arabsat	12	18.04.95
Egypt	Arabsat	4	22.02.94
Syria	Arabsat	2	07.03.94
Syria	Arabsat	2	12.11.94
Europe	Eutelsat	1	04.06.94
+ Club Méditerranée	Eutelsat	1 TV channel	
+ Middle East	Eutelsat	+ 3 sound sub-carrier	04.06.94

NORWAY

(See also Denmark, Iceland and Sweden.)

1. Inmarsat

Norway is one of the largest shareholders in Inmarsat. The Nordic land earth station (LES) at Eik in Norway is jointly owned by the public network operators in Denmark, Finland, Iceland, Sweden and Norway. Eik LES has been in successful operation for Inmarsat-A services in the Indian Ocean Region (IOR) since 1983. It has been providing Inmarsat-A services in the AOR-East since 1990, and in the AOR-West since March 1993. Early in 1991 , Eik LES was expanded with an Inmarsat aeronautical ground earth station (GES) for the IOR. Inmarsat-C services have been offered in the IOR since September 1991. Inmarsat-M services via Eik LES have been offered in the IOR since December 1993, and since December 1994 also in the AOR-East and AOR-West. Inmarsat-B services via Eik LES have been available in the IOR since December 1994.

2. Intelsat

Telenor Satellite Services AS (Norway's Signatory to Intelsat, Eutelsat and Inmarsat) has leased eight Ku-band transponders on Intelsat 702. These transponders are used for business communications and TV distribution.

2.1 *Norsat A*

The Norwegian domestic satellite system Norsat A was established in 1976 to improve communications between oil production platforms in the North Sea and the Norwegian mainland. Altogether, seven earth stations are in operation:

— the mainland station at Eik;

— five platform stations in the North Sea;

— the Isfjord station in the Arctic islands of Svalbard.

2.2 *Norsat Eurolink*

Parts of the Intelsat 702 transponders are used by Norsat Eurolink, which is a switched digital business communications system. It comprises a main station located at Eik and several outstations with antenna sizes of 1.8 m or 3.3 m. The data rates of Norsat Eurolink range from 64 kbit/s to 2 048 Mbit/s. As of the end of 1995, Norsat Eurolink stations were located in nine European countries.

2.3 Norsat Sealink uses C/Ku-band capacity on Intelsat 702 to provide non-switched communications for maritime mobile users, i.e. passenger ferries, oil rigs and oil exploration vessels. Norsat Sealink offers data rates of 64 kbit/s - 2 048 Mbit/s via 1.2 m - 2.4 m antennas.

2.4 *Norsat Plus*

Using capacity on Intelsat 702, Telenor Satellite Services AS also operates a two-way VSAT system called Norsat Plus.

2.5 *IBS (Intelsat Business Communications)*

IBS traffic in the C/Ku bands covering both the IOR and AOR is provided via Eik and Nittedal earth stations.

2.6 *Fixed-satellite circuits for public switched traffic*

Telenor Satellite Services AS provides fixed-satellite links in the C and Ku bands to thirty-five international destinations via its earth stations at Eik and Nittedal.

2.7 *Transit traffic*

In addition to TV contribution and broadcast turnaround services, Telenor Satellite Services AS provides gateway services to and from different countries.

3. **Eutelsat**

Two standard SMS stations used for business communications have been in operation since 1987, both located at the Nittedal earth station outside Oslo.

4. **Distribution of television programmes**

4.1 *Tele-X*

Telenor Satellite Services AS uplinks five digital TV channels via the Tele-X satellite (5° E).

4.2 *Thor*

Telenor Satellite Services AS owns and operates the DBS satellite Thor at orbital location 0.8° W. Its five transponders are used for distributing TV programmes to the Nordic countries.

4.3 *TV-Sat*

Telenor Satellite Services AS also operates the TV-Sat satellite (0.6° W) for the purpose of television distribution.

4.4 *Intelsat DTH capacity*

Eight Ku-band transponders on intelsat 702 (1° W) are leased by Telenor Satellite Services AS for the distribution of TV channels.

As of end 1995, a total of 22 television channels are distributed by Telenor Satellite Services AS via the Thor, TV-Sat, Tele-X and Intelsat 702 satellites.

OMAN (SULTANATE OF)

A fully digital earth station (ALR-02A) was installed, tested and commissioned at the Al Amerat satellite telecommunications complex in the capital area on 25 October 1995.

This earth station is capable of operating with 28 destinations using IDR (intermediate data rate) carriers in the Indian Ocean Region (IOR) of the Intelsat satellite network. All the existing analogue circuits will be transferred to the station in due course.

PORTUGAL

1. International organizations

1.1 *Intelsat*

By the end of 1995, seven Standard A antennas, three Standard B antennas, one F-3 (IBS) and one E-1 (IBS) were in operation.

The conversion from analogue FM/FDM to IDR transmission is ongoing. The number of IDR circuits increased from 2272 in 1994 to 2405 in 1995; there are still 61 FDM circuits in operation.

1.2 *Eutelsat*

By the end of 1995, three fixed antennas and one transportable antenna for SMS, videoconference and digital sound broadcasting were in operation.

The number of TDMA/DSI circuits fell during 1995, to a current total of 415 circuits.

The Eutelsat-10° E satellite is used for VSAT service.

The Euteltracs service is in operation for radiolocation and data communications from transportation vehicles.

1.3 *Intersputnik*

One transponder was leased on Statsionar 12 (40° E) for RTP international broadcasting to the East (Macau) and Africa, and another on Express (14° W) for RTP international broadcasting to North and South America.

1.4 *Inmarsat*

One earth station (CES) specially dedicated to Inmarsat-C microterminals is still in operation.

1.5 *Panamsat*

One transponder was leased on Panamsat 1 (45° W) for RTP international broadcasting to North America, for occasional use.

1.6 *Hispasat*

Five point-to-point data connections were established for national and international customers.

This satellite system is also used for occasional TV transmissions.

2. VSAT networks

For international customers there are several IBS connections in a point-to-point configuration, and the number of VSAT terminals has increased to 135 two-way terminals and 90 one-way terminals. Average availability is around 99.95%.

3. SCPC service via Intelsat

Although this service is on the decrease from an Intelsat point of view, in Portugal there has been an increase from seven circuits in 1994 to 16 in 1995.

4. Posat-1 satellite

A new software was developed for this satellite and for the first time a complete set of Keplerian parameters was generated based on the data obtained from the GPS receiver on board the satellite.

Posat-1 is the first microsatellite generating its own Keplerian parameters, making the tracking system of the earth station independent of the NORAD.

SAUDI ARABIA (KINGDOM OF)

Saudi Arabia has consistently kept pace with progress in the utilization of space telecommunications for the betterment of the country. The Ministry of Post, Telegraph and Telephone is the administrative organization. In 1995, work on 1.5 million telephone lines and 500 thousand GSM projects was well underway. It will be completed by the end of 2001. The earlier interim project for the commissioning of 190 thousand telephone lines has been completed.

The main highlights of the part of the new expansion project pertaining to satellite communications are:

Arabsat – Modification of the existing Jeddah-8 earth station for operation with the second generation satellites;

– Implementation of digital services: IDR and IBS;

– Commissioning of a new Ku-band antenna.

Inmarsat – Integration of Inmarsat-B/M, C and mini-M services in the existing Jeddah-7 earth station for IOR;

– Installation and Commissioning of a new earth station (Jeddah-6) for AOR with Inmarsat-B/M, C and mini-M services.

Intelsat – Replacement of C-band antennas at the Riyadh-1 and 4 earth stations and implementation of digital services: IBS, IDR, new low-cost TDMA and DAMA;

– Commissioning of two new Ku-band antennas;

– Upgrading of the Jeddah-4 and 5 earth stations for implementation of digital services: IBS, IDR;

– Installation of a VSAT network in Ku-band to provide data/voice and video teleconferencing, with an initial capacity of 100 remote stations, but also capability for upgrading and operation in either star or mesh configuration.

Domestic network with Arabsat:

The domestic network operating with Arabsat is being digitized and expanded by commissioning new transportable earth stations. A VSAT network in C-band is installed to provide data, voice and video teleconferencing, with an initial capacity of 20 remote stations, but also capability for upgrading and operation in either star or mesh configuration.

The Ministry, as the official government organ for telecommunication services, takes an active part in the international and regional satellite organizations, Intelsat, Inmarsat and Arabsat.

1. Arabsat

Saudi Arabia is the host country to this regional satellite organization and a major shareholder.

The second generation satellite project is underway and the first of the two satellites is scheduled to be launched in 1996.

1.1 *Domestic and regional network*

The Arabsat space segment is utilized for Saudi Arabia's domestic satellite network (Domsat) and other special services in various government agencies. These services include data transmission, TV distribution, teleconferencing, etc. The Domsat network consists of three fixed and nine mobile earth stations carrying a number of circuits. The Jeddah-8 earth station presently operates 717 circuits to regional destinations in the Arab world, in addition to a number of circuits for Domsat.

2. Inmarsat

There are more than 500 Inmarsat MES terminals presently on the commissioned list for Inmarsat services (A, B, C, M and Aero) under Saudi Arabia. These are maritime, aeronautical, land-based fixed and mobile operating with Inmarsat-A, Inmarsat-C, M and Aero. The capacity of Jeddah-7 can accommodate 40 000 Inmarsat terminals in the earth station data base. The Ministry continued representing Saudi Arabia in Inmarsat's Assembly, Council and ATCOM, and actively participating in their sessions.

The Kingdom is also a shareholder in ICO, the Inmarsat partnership company for Inmarsat-P services.

3. Intelsat

Presently, there are four earth stations operational in IOR and AOR. The bulk of traffic carried through those stations is as follows:

Earth station (satellite)	Number of circuits
Riyadh-4A (AOR)	867
Jeddah-4A	Sea-Me-We Restoration
Jeddah-5A (IOR)	277
Riyadh-1 (IOR)	750

SINGAPORE

Two satellite projects were launched by Singapore Telecom in 1995.

1. Mobile-satellite project

This project, called the Asia Pacific Mobile Telecommunications (APMT) satellite projet, aims to create a regional mobile satellite system in the Asia-Pacific region by 1998. The system will offer essentially handheld communication for voice. In general, the APMT services are similar to those of the proposed global LEO and MEO MSS systems, except that it will be a regional MSS system operating in the GSO.

The other parties involved in the APMT project include a Chinese consortium, Singapore Technologies Telecom and some investors in the region.

A request for proposal for the APMT satellite system was issued in June 1995 to satellite system suppliers. Award of the contract to a supplier is expected in the first quarter of 1996.

2. Fixed-satellite project

Singapore and Taiwan have entered into a business joint-venture to launch a regional satellite system in 1998. The satellite will provide C-band coverage over Asia and high-power Ku-band spot beams over targeted markets in the Asia-Pacific region.

A request for proposal for the satellite system was issued in mid-October 1995 to satellite system suppliers. Award of the contract to a supplier is expected in the second quarter of 1996.

SPAIN

Telefónica de España

Telefónica de España was very active in satellite communications in 1995.

In the area of the fixed-satellite service, Telefónica is a signatory to the Intelsat and Eutelsat international organizations with holdings of 2% and 9.8% respectively. In that context, Telefónica de España has an extensive network of earth stations comprising 68 fixed stations, 20 transportable stations, 6 TVROs and 33 VSAT networks whose composition is extremely varied in terms of the number of stations.

One important Telefónica activity was continuation of the testing programme for satellite integration into the European ATM pilot network. This programme was launched in 1994 and has continued in 1995 with tests of high-definition digital television in the pilot network using a 34 Mbit/s link. Tests of ATM transmision by TDMA are planned for the first quarter of 1996.

Mention may also be made of the tests of GSM communications, establishing a satellite link between a transportable base station and the GSM central switching station.

In the area of the mobile-satellite service, Telefónica, as a signatory to Inmarsat with a 1.2% holding, is involved in activities related to that organization. During the current year, 79 Inmarsat-A stations, 123 Inmarsat-C stations and 19 Inmarsat-M stations have been commissioned for terrestrial use.

Three Inmarsat-M terminals have been acquired in order to expand Telefónica's network of earth stations and provide a wider range of services.

Lastly, Telefónica has decided to go into the personal satellite communications business and has accordingly joined ICO as an investor. The associated decision-making process and the desire to provide its customers with state-of-the-art technology have entailed a considerable amount of research in this domain during the current year.

National Meteorology Institute (INM)

INM is preparing to carry out the necessary work to adapt one of its reception chains to receive variable format (GVAR) emissions from the NOAA/USA geostationary meteorological satellite positioned at 75° W, GOES-8 and the successor satellites in the same series.

INM, as a member of Eumetsat, is preparing its processing software in order to obtain temperature and humidity profiles from the data to be provided in future by the ATOVS system, the advanded successor to the TOVS with a new set of microwave sounding instruments AMSU-A (channels at 23.8 GHz, 31.4 GHz, 50.3-57.3 GHz and 89 GHz) and AMSU-B or MHS (channels at 89 GHz, 166 GHz and 183.3 GHz).

RESOURCES AND UTILIZATION OF THE HISPASAT-1 SYSTEM IN THE THIRD QUARTER OF 1995

Channel No.	Band-width	Application	Services provided to operators				Use
			Retevisión	Telefónica	Correos	Others	
1	46 MHz	Fixed service (FSS)				Digital Services	73 hours' use
2	36 MHz		Occasional TV			Occasional TV	142 hours' use
3	36 MHz		Television: Tele 5 Radio[1]				24 hours/day
4	36 MHz		Occasional TV			Occasional TV	211 hours' use
5	36 MHz		Occasional TV				24 hours/day
7	72 MHz		VSAT networks Digital TV TVE 1 and TVE 2 Occasional TV				24 hours/day
8	72 MHz			Digital carriers - Telephony			24 hours/day
9	54 MHz		Occasional TV				23 hours'use

RESOURCES AND UTILIZATION OF THE HISPASAT-1 SYSTEM IN THE THIRD QUARTER OF 1995 *(cont.)*

Channel No.	Band-width	Application	Services provided to operators				Use
			Retevisión	Telefónica	Correos	Others	
10	54 MHz	Fixed service (FSS)		Digital carriers - VSAT networks			24 hours/day
11	36 MHz		Occasional TV			Occasional TV	247 hours' use
12	36 MHz		Occasional TV			Occasional TV	307 hours' use
13	36 MHz		Television: Antena 3 Radio[2]				24 hours/day
14	36 MHz		Television: Canal plus Radio[3]				24 hours/day
16	72 MHz			Digital Carriers - Telephony			24 hours/day
17	72 MHz				POSTALSAT Networks		24 hours/day

RESOURCES AND UTILIZATION OF THE HISPASAT-1 SYSTEM IN THE THIRD QUARTER OF 1995
(end)

Channel No.	Band-width	Application	Services provided to operators				Use
			Retevisión	Telefónica	Correos	Others	
18	27 MHz	Fixed service (FSS)	Digital TV				24 hours/day
18	27 MHz		Occasional TVR				1 hours' use
23	27 MHz	Direct broadcasting (DBS)	Telesport Radio[4]				24 hours/day
27	27 MHz		Canal clásico Radio[5]				24 hours/day
31	27 MHz		Cinemanía 2				24 hours/day
35	27 MHz		Telesat 5				24 hours/day
39	27 MHz		Telenoticias				24 hours/day
6	36 MHz	TV America (TVA)	TVE internacional Radio[6]				24 hours/day
15	36 MHz		Hispavisión				24 hours/day

[1] Radio Voz, Cataluña O. Municipal, Sistelcom, CERSA.
[2] COPE, Cadena 100, Onda Cero, TC ONCE (Digital).
[3] COPE, Onda 10, Cadena TOP Radio.
[4] Radio 1, Radio 5, Radio Exterior.
[5] Radio Clásica, Radio 3.
[6] Radio 1, Radio Exterior, EFE Radio (Digital).
[7] CLH, SER, MARCA, AS, ABC, AENA, UNISAT (COLPISA). ETSIT project, MENSATEL, ST. HILO, Agency EFE.

SATELLITE (TSS) COMMUNICATION NETWORKS VIA HISPASAT (Date: August 1995)				UNI: UNIDIRECTIONAL BI: BIDIRECTIONAL		
Nerwork	21 networks	Number of stations	953	1051	1053	1253
	Type	TX Speed	Currently	End-1995	End-1996	Total network
CLH (TDM/TDMA network) Central station → VSAT VSAT → Central station	BI	1 × 512 kbit/s (Partial) 5 × 64 kbit/s	180	180	180	180
SER chain (digital audio, 6 stereo channels)	UNI	6 × 256 kbit/s	210	210	210	210
EFE agency (digital audio, 2 mono channels)	UNI	1 × 256 kbit/s	90	90	90	90
Hilo Musical (digital audio, 3 stereo channels)	UNI	3 × 256 kbit/s	71	71	71	71
MARCA (data broadcasting)	UNI	1 × 2 Mbit/s	8	8	8	8
AS (data broadcasting)	UNI	1 × 512 kbit/s	2	2	2	2
ABC (data broadcasting)	UNI	1 × 2 Mbit/s	2	2	2	2
Mensatel (broadcasting of message data and VAS)	UNI	1 × 9,6 kbit/s	200	200	200	200
AENA (Contribution of radar data)	UNI	2 × 9,6 kbit/s	3	3	9	9

SATELLITE (TSS) COMMUNICATION NETWORKS VIA HISPASAT (Date: August 1995)				UNI: UNIDIRECTIONAL BI: BIDIRECTIONAL		
Nerwork	21 networks	Number of stations	953	1051	1053	1253
	Type	TX Speed	Currently	End-1995	End-1996	Total network
ETSIT (distance learning) Central station → VSAT VSAT → Central station VSAT → VSAT (1 central station, 8 VSAT)	BI	1 × 1544 Mbit/s 3 × 56 kbit/s 2 × 56 kbit/s	8	8	8	8
COLPISA (Shared data broadcasting hub – UNISAT service)	UNI	1 × 64 kbit/s (Colpisa uses 1200 bit/s)	25	25	25	25
Aguas del Ter-Llobregat Central station → VSAT VSAT → Central station	BI	1 × 9,6 kbit/s 1 × 9,6 kbit/s	10	20	–	200
MOPTMA (SAICA) Central station → VSAT VSAT → Central station	BI	1 × 512 kbit/s (Partial) 1 × 64 kbit/s	120	123	123	123
EFE agency (TDM/TDMA network) Data broadcasting Contribution of photos	BI	1 × 512 kbit/s (Partial) 1 × 64 kbit/s	–	–	20	20
AMWAY (point-to-point link) Barcelona-Lisbon (data)	BI	2 × 64 kbit/s	2	2	4	4

SATELLITE (TSS) COMMUNICATION NETWORKS VIA HISPASAT (Date: August 1995)				UNI: UNIDIRECTIONAL BI: BIDIRECTIONAL		
Nerwork	21 networks	Number of stations	953	1051	1053	1253
	Type	TX Speed	Currently	End-1995	End-1996	Total network
BANCO LUSO (point-to-point link) Lisbon-Madrid	BI	2 × 64 kbit/s	2	2	2	2
TELEPAC (point-to-point link)						
Lisbon-Porto	BI	2 × 64 kbit/s	2	2	2	2
Oeiras-Aceitão	BI	2 × 64 kbit/s	2	2	2	2
Lisbon-Madeira	BI	2 × 64 kbit/s	2	2	2	2
LOOK & FIND (Data broadcasting)	UNI	1 × 19,2 kbit/s	–	80	80	80
EFE CANARIAS (Data broadcasting)	UNI	1 × 64 kbit/s	20	20	20	20
VIGIA "2000" (DAMA network)	BI	Access 1 × 9,6 kbit/s Circuits 1 × 128 kbit/s	2	2	–	–
Network with						
INTELESYS hub	BI	2 × 19,2 kbit/s	2	2	–	–
Remolque S. Social	BI	2 × 19,2 kbit/s	2	2	–	–
Autobus CAJAMADRID						

VSAT = microstation

SWEDEN

(See also Denmark, Iceland and Norway.)

The telecommunication market in Sweden is entirely open to competition. Each operator has the freedom to choose whatever medium constitutes the best technical solution, subject to the availability of radio frequencies.

This also applies to satellite communications, often proving to be very efficient, with a number of service providers operating. It has brought about a large increase in traffic, with the result that the Nordic countries are building their own earth stations, in addition to those which are jointly owned, in order to cope with this traffic.

Thus, in addition to the large Swedish earth stations at Tanum and Agesta, operating in the Intelsat and Eutelsat space segments, respectively, and where Telia is the dominant actor in Sweden, there are many independent operators using various other satellite systems, particularly for satellite broadcasting. Many of their earth stations in Sweden are co-located with Telia's, while others are installed at the operators' own premises. These stations may be either receiving/transmitting or receive only.

THAILAND

1. Satellite frequency coordination meeetings

In 1995, the Administration of Thailand held satellite frecuency coordination meetings with the People's Republic of China, Japan, Singapore, India and the Russian Federation. Two meetings were held with Japan, one in Bangkok in January and one in Tokyo in December. The meetings with the People's Republic of China, Singapore and India took place in Bangkok in January and March, while the meeting with the Russian Federation was held in Geneva in November. Only the coordination of Thaicom-A2 (78.5° E) was completed. However, for other key networks, the Administrations concerned agreed to exchange necessary data on interference assessment, calculation methods, calculation results and other useful information by correspondence, and if required discuss detailed interference calculation at future meetings.

2. National satellite network

The first generation of Thaicom consists of two satellites, Thaicom-1 and Thaicom-2. Both are model HS-376 satellites from Hughes Aircraft of the United States. Each Thaicom has 12 transponders: 10 C-band and 2 Ku-band. With a lifetime of 15 years, Thaicom-1 and Thaicom-2 have footprints covering Thailand, Laos, Cambodia, Myanmar, Viet Nam, Malaysia, the Philippines, Korea, Japan and the east coast of China. The satellite control station — TTC & M (Tracking, Telemetry, Control & Monitoring) station — is in Nonthaburi province about 20 km north of Bangkok.

Following nearly two years of preparation, Thaicom-1 was successfully launched by Arianespace of France on 17 December 1993. Subsequently, on 7 october 1994, Thaicom-2 was also successfully launched. The two satellites have co-located orbital slots at 78.5° E.

In the area of telecommunications, Thaicom-1 and Thaicom-2 provide telecommunication services to many governmental administrations and state enterprises through private VSAT networks. Through the VSAT operators, Thaicom provides high-speed communications such as voice, data and video for many leading business institutions in all sectors. Thaicom is also becoming the platform for trunk and thin-route transmission for telephone and cellular companies. Altogether, some 3000 VSAT terminals and other satellite antennas are installed nationwide.

Thaicom's role in the area in television applications is even more dramatic. Thaicom is the platform for television distribution for all five national TV stations in Thailand. Some one hundred rebroadcast stations are equipped with downlink systems to receive programme via Thaicom from headquarters stations. The signals are then relayed on VHF frequencies in their local areas, which altogether provide TV coverage to some 12 million household.

Morehover, Thaicom's four high-powered Ku-band transponders equipped with the most advanced digital compression technology support the first digital direct-to-home broadcasting system (DTH) in Thailand and the Asian region. The DTH system can deliver some 30 high-quality TV channels to home viewers with 60 cm receive dish antennas.

In addition, DTH can support two-way communications such as interactive TV, video-on-demand and pay-per-view. The DTH broadcasters include subscription-TV, advertising-supported TV and educational TV from the government's long-distance educational institutions. The DTH service, which started up in 1995, will pay an important role in the cable TV business. Additionnally, the Ku-band transponders will also be used for satellite news gathering (SNG) applications, employing the new digital compression technology that enables a van-size mobile unit with a mere 90 cm uplink antenna to transmit live or urgent coverage of events from anywhere in the country.

3. Domestic satellite communications

The Ministry of Transport and Communications has decided that all new satellite networks to be set up by any governement agency operating on a "free-of-charge transponder" shall use exclusively the TDMA/DAMA system. Many official agencies will have to change their SCPC pre-assigned system to TDMA/DAMA by 1997.

The Post and Telegraph Department (PTD) set up the master control (reference) station for the TDMA/DAMA system in 1994. There are two reference stations and one mobile station. The Suranaree University of Technology has established two TDMA/DAMA satellite stations for interconnection with the National Electric and Computer Technology Electronic Centre. During 1996, PTD will set up six TDMA/DAMA satellite stations at regional radio monitoring stations. The Land Transport Department will set up ten stations and the Ministry of Commerce will have nine stations established throughout Thailand.

Other ministries such as the Ministries of Agriculture, Finance, Education, Public Health, Industry, the University Bureau and the Harbour Department are planning to establish TDMA/DAMA stations in the coming years. DAMA technology is also being utilized for promoting telemedicine in Thailand, with 60 hospitals interconnected through the SCPC/DAMA network.

TURKEY

The Türk Telekomünikasyon A.S. has signed an agreement with its prime contractor for the Turksat satellite networks, Aerospatiale, to modify the Gölbasi Turksat satellite control station in order to incorporate it in the Ku-band ground control network directed by CNES. With this modification, the control station will be able to provide operations and monitoring facilities for the launch phases of Ku-band satellites from all over the world. As a first step, Gölbasi control station will form part of the CNES network for the LEOP operations of five satellites manufactured by Aerospatiale.

In connection with the Turksat contract, various associated agreements are being signed between the Turkish and French authorities for cooperation in space and satellite communication technologies. Within the framework of these agreements, a protocol is being signed between the Turkish and French authorities for the establishment of a space research laboratory at the Izmir High Technology Institute (IZ-TECH) located in Izmir. This laboratory will be equipped with facilities such as satellite simulators and communication system monitoring (CSM) modules. A similar study is also being carried at the Middle East Technical University in Ankara with a view to setting a space research laboratory in the Department of Aeronautical Engineering.

VATICAN CITY

At the end of 1995, Vatican City State had put into service, within the State's boundaries, i.e. in the Vatican gardens, two earth stations operating with the Intelsat system. The antennas have a 7.5 m diameter.

Vatican City State has reserved capacity for global coverage on two Intelsat satellites, one at 325.5° E, with a footprint covering both sides of the Atlantic Ocean, and one at 66° E, with a footprint stretching from Eastern Europe and Africa to Japan, the Philippines and Australia.

The services provided are:

— broadcasting of Vatican Radio programmes, mostly intended for rebroadcasting by local stations;

— data transmission;

— public telephone and telegraph, set up in connection with international carriers;

— occasional video transmission, receivable by standard A, B and F stations;

— bidirectional telecommunications for selected users.

ZAMBIA

1. Introduction

Mwembeshi, the site for Zambia's two earth stations, lies some 42 km west of Lusaka, the country's capital city.

The two earth stations are of Standard A (32 m diameter) for Mwembeshi 1A and revised Standard A (18 m diameter) for Mwembeshi 2A, operating in the IOR and AOR respectively.

Mwembeshi 1A and 2A, which were commissioned in 1974 and 1988, respectively, are analogue. However, with technological advances, analogue transmission systems are no longer adequate due to their inefficient utilization of the scarce space segment and lack of flexibility. Intelsat no longer permits expansion of analogue satellite systems, thereby making it impossible for Zamtel to meet its obligation of providing direct satellite links to more countries whose traffic levels demand the establishment of direct satellite service.

It is for the above reasons that Zamtel has considered digitizing the two earth stations using intermediate data rate (IDR) and low-cost TDMA technologies, respectively.

2. Proposed digital systems for Zambia's earth stations

In order to overcome capacity and connectivity constraints, Zamtel has decided to convert its satellite communication service to digital technologies. This will involve the provision of a digital backhaul link between the earth station and ITMC, provision of a new digital earth station to operate at 60° E, using IDR or low-cost TDMA for the IOR and conversion of the analogue equipment to digital for the Mwembeshi 2A earth station using low-cost TDMA technology.

3. Domestic satellite network (Domsat)

The Domsat network based on DAMA technology was proposed to cater for remote areas with no access to PSTN. The kind of telecommunication services planned are telephone, fax, data and multimedia where necessary.

The Domsat network to be implemented marks the beginning of the efforts to introduce VSAT terminals in this country.

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Booklet No. 27 – [illegible]enth Report by the [illegible] telecommunication and the [illegible]

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Booklet No. 25 – Eighteenth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1979)

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Published by the International Telecommunication Union, Geneva 1995

55171 ARCHIVES

ISBN 92-61-06222-9

Price: 12 Swiss francs