INTERNATIONAL TELECOMMUNICATION UNION

Thirtieth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space

Booklet No. 39

Geneva 1991

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THIRTIETH 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 Twenty-ninth Report in 1990.

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 the information of Members of the Union.

While the Plenipotentiary Conference is the supreme organ of the Union, the work related to international regulation is performed at world administrative conferences; these are intergovernmental conferences and the regulations they adopt have the force of international treaties. The international registration of frequency assignments for space telecommunications is carried out by the International Frequency Registration Board (IFRB), in accordance with Radio Regulations drawn up by the competent ITU world administrative radio conferences. Technical studies relating to the standardization of equipment and systems, their operation and the general use of telecommunications in outer space are conducted by the International Radio Consultative Committee (CCIR) and the International Telegraph and Telephone Consultative Committee (CCITT). Telecommunications Development Bureau (BDT) and General Secretariat are also performing the activities on space communication matters and inter-agency cooperation.

Details of the work of the conferences and permanent organs of the Union are given in the sections which follow.

1. International regulations

1.1 *General*

The Plenipotentiary Conference (Nice, 1989) set the programme of future Conferences for the period 1989-1994 (Resolution No. 1) to hold a World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum.

At its 45th Session, the Administrative Council (11-12 June 1990) decided:

" _

1. that the World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum (WARC-92) be convened in Spain from 3 February 1992 for a period of four weeks and two days;

2. the agenda for WARC-92 shall be as follows:

on the basis of proposals by administrations and taking account of reports from the IFRB and the CCIR:

2.1 to consider definitions for certain new space applications and to review the relevant provisions of Article 1;

2.2 to review the provisions of Article 8, taking account of *considering further* above, with a view to:

2.2.1 the consideration of possible allocations of frequency bands above 20 GHz to the new space service applications[1];

2.2.2 the possible extension of the frequency spectrum allocated exclusively to HF broadcasting, as indicated in Recommendation No. 511 (WARC HFBC-87);

2.2.3 the consideration of the allocation of frequency bands to the broadcasting-satellite service and the associated feeder links:

a) for the broadcasting-satellite service (sound) in the range 500 - 3000 MHz, as indicated in Resolution No. 520 (Orb-88), including the accommodation of complementary terrestrial sound broadcasting uses within this allocation;

[1] Communications with manned space vehicles may be defined as a new space application which may require the indication of the space service and the frequency bands that this service may use for this purpose.

b) for wide RF-band high definition television on a world-wide basis, as indicated in Resolution No. 521 (Orb-88) giving consideration to the results of CCIR studies carried out in accordance with this Resolution;

2.2.4 the consideration of an allocation of frequency bands to the mobile and mobile-satellite services and associated feeder-links:

a) in the approximate range 1 - 3 GHz, as indicated in Resolution No. 208 (Mob-87);

b) for the development in the approximate range 1 - 3 GHz of a world-wide system of public correspondence with aircraft, as indicated in Recommendation No. 408 (Mob-87), or designate for this use a band already allocated to the mobile service in the same range;

c) for the development of the international use of the mobile service for future public land mobile telecommunication systems, as indicated in Recommendation No. 205 (Mob-87), or designate for this use a band already allocated to the mobile service;

d) consider possible allocations of up to 5 MHz of a frequency band below 1 GHz to low-orbit satellites on the basis of appropriate sharing criteria;

2.2.5 the consideration of the allocation of the frequency band 14.5 - 14.8 GHz to the fixed-satellite service (Earth-to-space) with due protection of assignments appearing in Appendix 30A of the Radio Regulations, and to take account of services to which these frequency bands are currently allocated;

2.2.6 the examination of the frequency bands 2025 - 2110 MHz and 2200 - 2290 MHz for the space operations and space research services, as indicated in Recommendation No. 716 (Orb-88);

2.2.7 the consideration of footnotes relating to the radiodetermination-satellite service in the frequency range 1.6 - 2.5 GHz with the view to harmonizing them and allowing administrations to revise the status of their respective allocations to this service and to review the sharing criteria as indicated in Resolution No. 708 (Mob-87);

2.2.8 the examination of the footnotes RR 635 and RR 797B;

2.3 to consider the provisions of Articles 55(Rev.) and 56(Rev.) of the Radio Regulations which concern the mandatory carriage on board ships of personnel certificated for the on-board maintenance of shipborne radio and electronic equipment, as indicated in Resolution No. 7 (PLEN/8)[2];

2.4 to consider minimum modifications to Article 12 of the Radio Regulations as a result of actions taken with regard to Appendix 26, as indicated in Resolution No. 9 (PL-B/2)[2];

2.5 to consider appropriate action, in light of the decision of the Conference relating to definitions in accordance with Resolution No. 11 (PL/10)[2];

2.6 to make such consequential changes and amendments in the Radio Regulations as may be necessitated by the decisions of the Conference;

2.7 to develop new Recommendations and Resolutions in relation to the agenda of the Conference including Meteorological aids service in frequency bands below 1000 MHz and present allocations to space services above 20 GHz which were not placed on this agenda;

2.8 to consider problems associated with the use of the frequency bands in the range 401 - 403 MHz by the meteorological satellite and earth exploration satellite services with the view to recommend their consideration by the next competent administrative radio conference;

2.9 to consider, revise as necessary, and take other appropriate action upon the relevant Recommendations and Resolutions;

2.9.1 to safeguard the interests of services that may be affected by changes to the Table of frequency allocations by adopting appropriate sharing criteria when required and to adopt appropriate schedule for the entering into force of the decisions adopted by the Conference;

2.9.2 to review Resolution No. 703 in the light of the procedure adopted by the XVIIth CCIR Plenary Assembly (Resolution PLEN/75) for the approval of Recommendations in the interval between Plenary Assemblies;

2.10 to identify the financial implication of the decisions of the Conference, taking into account the Union's budgetary provisions, and as necessary to submit a statement thereon to the Administrative Council in accordance with Article 80 of the International Telecommunication Convention, Nairobi, 1982,

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[2] Plenipotentiary Conference, Nice, 1989.

invites

1. the CCIR to prepare the technical and operational bases for the Conference and to submit to administrations a report setting out the results of its work at least eight months prior to the opening of the Conference;

2. the IFRB to provide technical assistance for the preparation and organization of the Conference and to submit to all administrations a report on results with respect to the appropriate above agenda items at least ten months prior to the opening of the Conference,

instructs the Secretary-General

1. to make all the arrangements necessary for holding the Conference;

2. to communicate this Resolution to ICAO, IMO, WMO and to other concerned international organizations."

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

2.1 Since the publication of the Twenty-ninth Report, the IFRB has continued to apply the relevant provisions of the Radio Regulations annexed to the International Telecommunication Convention. In accordance with these provisions, administrations:

a) send information concerning their planned satellite systems to the IFRB and inform the IFRB 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 IFRB, where necessary, concerning coordination of the use of their assignments to space stations on geostationary satellites or to earth stations that are to communicate with such space stations for publication in another Special Section of the weekly Circular;

c) notify their frequency assignments to the IFRB for registration 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 and Geneva, 1988.

2.2 In 1990, the IFRB received information relating to 106 new satellite networks, which it published under the advance publication procedure. This information was submitted by the following administrations (listed in French alphabetical order):

Notifying Administration	System or network	Summary description
Germany (Federal Republic of)	LOOPUS-EUROPE*	Satellite network forming a part of the LOOPUS space system which is intended to be complementary to the terrestrial Public Land Mobile Network and will provide Mobile-satellite services. (11-12/14 GHz)
Australia	ACSAT-2	Satellite network which will provide government communication services for Australia. (<1 GHz, 12/14 GHz)
	AUSSAT (AUSSAT-PAC1) (AUSSAT-PAC2)	Satellite networks which will provide Fixed-satellite services for domestic pilot communications for south pacific island nations. (12/14 GHz)
	(AUSSAT-A 152) (AUSSAT-A 152 PAC)	Satellite networks which will provide Fixed and Broadcasting-satellite services for Australia, Papua New Guinea, New Zealand and other pacific nations. (12/14 GHz)
	(AUSSAT B 164°)	Satellite network which will provide Fixed-satellite and Broadcasting-satellite services for Australia and New Zealand. The network will also provide the Radiodetermination and beacons services for Australia. (<2 GHz, 12/14 GHz, 30 GHz)
	(AUSSAT B 164° MOB)	Satellite network to provide Aeronautical and Land mobile-satellite services for Australia. (<2 GHz, 12/14 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
Brazil	SBTS-B1	Satellite network of the SBTS system which will provide Fixed-satellite services for the territory of Brazil including Trinidad, Martim Vaz and Fernando de Noronha islands, the Atol das Rocas and the S. Pedro and S. Paulo Rocks. (4/6 GHz)
United States of America	USASAT (USASAT 22H) (USASAT 23B to 23E) (USASAT 24A to 24C) (USASAT 24H) (USASAT 25A to 25H) (USASAT 26A to 26H)	Satellite system providing domestic telecommunications services. (4/6 GHz, 11-12/14 GHz)
	ACS-2A	Satellite network which will provide domestic communications in the Mobile-satellite service for mobile stations located in or enroute between USA, Alaska, Hawaii, Puerto Rico and Virgin islands. (<2 GHz)
	ATDRSS (Advanced Tracking and Data Relay Satellite System) (ATDRS 41W) (ATDRS 46W) (ATDRS 171W) (ATDRS 174W)	Satellite system consisting of several satellites spaced to provide world-wide coverage of low altitude earth-orbiting satellites and a dedicated ground station. (2 GHz, 14/15 GHz, 20/30 GHz)

Notifying Administration	System or network	Summary description
United States of America (cont.)	MARS OBSERVER*	Satellite network planned to orbit planet Mars for the purpose of making scientific measurements to determine characteristics of the surface, nature of the magnetic field, gravitational field topography, structure and circulation of the atmosphere and to measure movements of volatile materials and dust over a seasonal cycle. (7/8 GHz, 33 GHz)
	ISTP (ISTP POLAR)*	Polar Plasma Laboratory (POLAR) which is part of the Global Geospace Science (GGS) support programme of the International Solar Terrestrial programme (ISTP). The spacecraft POLAR is designed to measure, model and quantitatively assess the processes in the Sun-Earth interaction chain. (2 GHz)
	(ISTP WIND)*	Interplanetary Physics Laboratory (WIND) which is a part of the Global Geospace Science (GGS) support programme (ISTP). The spacecraft WIND is designed to measure, model and quantitatively assess the processes in the Sun-Earth interaction chain. (2 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
United States of America (on behalf of the Administration of Member countries of INTELSAT)	INTELSAT (INTELSAT 7 57E) (INTELSAT 7 60E) (INTELSAT 7 66E) (INTELSAT 7 304E) (INTELSAT 7 310E) (INTELSAT 7 319.5E) (INTELSAT 7 329E) (INTELSAT 7 335.5E) (INTELSAT 7 338.5E) (INTELSAT K 319.5E) (INTELSAT K 338.5E) (INTELSAT T 186E) (INTELSAT 5A 183E) (INTELSAT IBS 183E) (INTELSAT 7 183E)	INTELSAT global communications satellite system consisting of a large number of earth stations and several satellites working together. (4/6 GHz, 11-12/14 GHz)
France	VIDEOSAT-4	Satellite network which will provide specialized services within the territories of Metropolitan France. (2 GHz, 12/14 GHz)
France (on behalf of Member administrations of the European Space Agency)	EDRS (European Data Relay System) (EDRSS-E) (EDRSS-EC) (EDRSS-W) (EDRSS-WC)	Satellite system which will provide communication links between low-altitude, earth-orbiting space craft, with nearly worldwide coverage, and earth stations located primarily in Europe but also elsewhere in the world. (2 GHz, 18-20/30 GHz)
France (on behalf of the Administration of member countries of the European Telecommunication satellite organization)	EUTELSAT (EUTELSAT 2-21.5E) (EUTELSAT 2-31E) (EUTELSAT 2-33E)	Satellite system which will replace the EUTELSAT 1 series by a new series of satellites offering higher capacity. (2 GHz)

Notifying Administration	System or network	Summary description
India (Republic of)	IRS (Indian Remote sensing satellite) (IRS-1B)* (IRS-1E)*	Satellite networks for acquiring imageries of earth resources applications. The data from IRS will also be used for survey and management of resources in areas such as agriculture, geology and hydrology in India. (<1 GHz, 2 GHz, 8 GHz)
	SROSS-3*	Satellite network intended for scientific and remote sensing experiments to carry out studies in the area of Cloud stereoscopy, Geology and Cartography. (<1 GHz, 2 GHz)
Italy	SAX*	Satellite network consisting of an active satellite in low equatorial orbit which will be used for the observation of X-Ray sources and for the survey of celestial sky. (2 GHz)
Japan	BS-2	Satellite network which will provide TT&C mode for Television broadcasting service in conformity with the plan of WARC-BS (Geneva, 1977). (4/6 GHz, 14 GHz)
	SOLAR-A*	Satellite network intended to observe the sun in X-ray and to clarify the machanism of solar flares. (2 GHz, 8 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
Japan (cont.)	JERS-1*	Satellite network to collect worldwide data of non-renewable resources and to collect information for agriculture, fishery, environmental preservation, prevention of disasters and coastal activities. (<2 GHz, 2 GHz, 8 GHz)
	GMS-120E	Satellite network intended to provide meteorological satellite services. (<1 GHz, <2 GHz, 2 GHz)
United Kingdom of Great Britain and Northern Ireland	ASIASAT (ASIASAT-D)	Satellite network which will provide the domestic communications services on a regional basis. (4/6 GHz, 11/14 GHz)
	UOSAT-3* UOSAT-4*	Satellite network intended to perform scientific, communications and educational experiments to be carried out by Radio amateurs throughout the world. (<1 GHz)
United Kingdom (on behalf of the administrations of Member countries of the International Maritime Satellite Organization (INMARSAT)	INMARSAT (INMARSAT-3 AOR-EAST) (INMARSAT-3 AOR-CENT1) (INMARSAT-3 AOR-CENT1A) (INMARSAT-3 AOR-CENT2A) (INMARSAT-3 AOR-WEST) (INMARSAT-3 IOR-1) (INMARSAT-3 POR-1)	Satellite system to provide mobile-satellite and navigation services in the Atlantic, Indian and Pacific Ocean Regions. (<2 GHz, 4/6 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
Seychelles (Republic of)	SEYSAT (SEYSAT-1) (SEYSAT-2)	Satellite system which will provide telecommunications and broadcasting services to the exclusive economic zone of Seychelles. (4/6 GHz, 11/14 GHz)
Thailand	THAISAT (THAISAT-A1) (THAISAT-A2) (THAISAT-A3) (THAISAT-A4)	Satellite system which will provide Fixed-satellite service to Thailand, Burma, Lao, Malaysia, Cambodia, and Viet Nam. (4/6 GHz, 11 GHz)
Tonga (Kingdom of)	TONGASAT (TONGASAT C/KU-1 to TONGASAT C/KU-8) (TONGASAT AP-C-1) (TONGASAT AP-KU-1)	Satellite system consisting of several satellite networks providing Fixed-satellite service. (4/6 GHz, 11-12/14 GHz)
Turkey	TURKSAT-1 (TURKSAT-1A) (TURKSAT-1B) (TURKSAT-1C) (TURKSAT-1D)	Satellite system consisting of four space stations intended to provide the Fixed-satellite service. (11-12/14 GHz)
Union of Soviet Socialist Republics	SPEKTR-R*	Satellite network for the purpose of studying the Earth's gravitational potential and the form and magnitude of cosmic radiation sources. (8 GHz)
Venezuela (Republic of)	SIMON BOLIVAR-2 SIMON BOLIVAR-3	Satellite system of the Member countries of the Andean Sub-Regional Agreement, intended to provide domestic and intraregional telecommunications. (4/6 GHz)

* Non-geostationary

2.3 In addition, the IFRB published in 1990, the necessary information concerning the request for coordination of space services assignments relating to 146 geostationary satellite networks, for which advance publication has already been made. Assistance to about thirty administrations was also provided on request in the coordination of frequency assignments to stations in the space radiocommunication services.

2.4 In 1990 the IFRB received 4485 frequency assignment notices for stations in the space radiocommunication services submitted for recording in the Master Register. These notices consisted of 1271 notices relating to 42 space stations, received from 8 administrations and 3214 notices relating to 430 earth stations, received from 31 administrations.

2.5 A list of positions assigned to space stations installed on board geostationary satellites, together with frequency bands used by these stations which were communicated in the framework of the Radio Regulations, is kept up to date by the IFRB and distributed regularly to the administrations. A copy of this list, to which are added projected space stations which have undergone the advance publication procedure referred to in paragraph 2.2 above, is given in the following table:

LIST OF GEOSTATIONARY SPACE STATIONS BY ORBITAL POSITIONS

(RR 1042, RR 1060, RR 1488-1491)

(31.12.1990)

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
178.00 W C	USA	USASAT-13K				4		6														
177.00 W A	USA	FLTSATCOM-A W PAC	0						7	8												
175.00 W A	PNG	PACSTAR A-2		C1			5	6														
175.00 W C	PNG	PACSTAR-2				4		6				12		14								
174.00 W A	USA	ATDRS 174W			2								13		15				20	*	*	
174.00 W A	USA	TDRS 174W			2								13	14								
174.00 W A	USAIT	INTELSAT T 186E				4		6														
172.50 W C	TON	TONGASAT C-4				4		6														
171.00 W A	USA	ATDRS 171W			2								13		15				20		*	*
171.00 W N	USA	TDRS WEST			2									14	15							
171.00 W C	USA	USASAT-14E				4		6														
170.00 W N	URS	GALS-4							7	8												
170.00 W N	URS	STATSIONAR-10				4	5	6														
170.00 W C	URS	STATSIONAR-10A				4		6														
170.00 W C	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 A	URS	FOTON-3				4		6														
168.00 W N	URS	POTOK-3				4																
165.00 W A	USA	USASAT-13L									11	12		14								
160.00 W N	URS	ESDRN									11			14								
159.00 W C	URS	PROGNOZ-7			2	4																
155.00 W C	URS	STATSIONAR-26				4	5	6														
148.00 W A	USA	MILSTAR-12	0		C2														C20			C*
146.00 W A	MEX	AMIGO-2										12				17						
146.00 W C	USA	USASAT-20C				4		6														
145.00 W A	MEX	MORELOS 4				4		6				12		14								
145.00 W C	URS	VOLNA-21M		1																		
145.00 W A	USA	FLTSATCOM-A PAC	0						7	8												
144.00 W A	USA	USASAT-20B				4		6														
143.00 W N	USA	US SATCOM-5				4		6														
141.00 W A	MEX	MORELOS 3				4		6				12		14								
140.00 W C	USA	USASAT-17C				4		6														
139.00 W N	USA	US SATCOM 1-R				4		6														
137.00 W A	USA	USASAT-17B				4		6														
136.00 W A	MEX	AMIGO-1										12				17						
136.00 W N	USA	USASAT-16D										12		14								
135.00 W N	USA	GOES WEST	0	1	2																	
135.00 W N	USA	US SATCOM-1				4		6														
135.00 W A	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												
134.00 W N	USA	USASAT-11D				4		6														
134.00 W C	USA	USASAT-16C										12		14								

A Only advance publication under RR 1042
C Presently being coordinated under RR 1060
N Notified

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
133.00 W C	USA	USASAT-22A				4		6														
132.00 W C	USA	USASAT-11C										12		14								
131.00 W N	USA	US SATCOM 3-R				4		6														
131.00 W A	USA	USASAT-22H				4		6														
130.00 W C	USA	ACS-3		1																		
130.00 W C	USA	USASAT-10D										12		14								
130.00 W A	USA	USGCSS PH2 E PAC-2							7	8												
130.00 W A	USA	USGCSS PH3 E PAC-2			2				7	8												
130.00 W A	USA	USRDSS WEST		1	2		5	6														
129.00 W A	USA	USASAT-24A				4		6				12		14								
128.00 W N	USA	ACS-1				4		6				12		14								
128.00 W N	USA	COMSTAR D-1				4		6														
127.00 W A	USA	USASAT-21B				4		6														
126.00 W C	USA	USASAT-10C										12		14								
126.00 W N	USA	USASAT-20A				4		6														
125.00 W C	USA	USASAT-22B				4		6														
125.00 W C	USA	USASAT-23E										12		14								
124.00 W C	USA	USASAT-10B										12		14								
123.50 W N	USA	WESTAR-2				4		6														
123.00 W N	USA	WESTAR-5				4		6														
122.00 W N	USA	USASAT-10A										12		14								
121.00 W C	USA	USASAT-23C										12		14								
120.00 W A	USA	MILSTAR-6	0		C2														C20			C*
120.00 W C	USA	SPACENET-1				4		6				12		14								
119.00 W A	USA	OMRDSS WEST		1	2		5	6														
119.00 W N	USA	US SATCOM-2				4		6														
118.70 W C	CAN	ANIK C-3										12		14								
116.80 W N	MEX	MORELOS 2				4		6				12		14								
114.90 W C	CAN	ANIK C-1										12		14								
113.50 W N	MEX	MORELOS 1				4		6				12		14								
111.10 W N	CAN	ANIK D-2				C4		C6														
111.10 W C	CAN	ANIK E-B				4		6				12		14								
110.00 W N	CAN	ANIK C-2										12		14								
109.00 W A	USA	USGCSS PH4 E PAC-1			2														20			*
109.00 W A	VENASA	SIMON BOLIVAR-3				4		6														
107.30 W C	CAN	ANIK E-A				4		6				12		14								
106.50 W A	CAN	MSAT	0	C1	2						11	12	13	14								
106.00 W A	VENASA	SIMON BOLIVAR-1				4		6														
105.00 W N	USA	ATS-5	0	1																		
105.00 W N	USA	FLTSATCOM-A EAST PAC	0						7	8												
105.00 W C	USA	GSTAR-2										12		14								
104.50 W N	CAN	ANIK D-1				4		6														
103.00 W C	USA	GSTAR-1										12		14								
103.00 W C	USA	USASAT-24B				4		6				12		14								
103.00 W A	VENASA	SIMON BOLIVAR-2				4		6														
101.00 W C	USA	USASAT-16B										12		14								
101.00 W C	USA	USASAT-17A				4		6														
101.00 W A	USA	USASAT-24C				4		6				12		14								
100.00 W A	USA	ACS-1		C1																		
100.00 W A	USA	ACTS																19	20	*	*	

A Only advance publication under RR 1042
C Presently being coordinated under RR 1060
N Notified

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
100.00 W N	USA	FLTSATCOM E PAC	0						7	8												
100.00 W N	USA	FLTSATCOM-B EAST PAC																	20			*
100.00 W A	USA	USRDSS CENTRAL		1	2		5	6														
99.00 W C	USA	USASAT-22C				4		6														
99.00 W A	USA	USASAT-23D										12		14								
99.00 W N	USA	USASAT-6B										12		14								
99.00 W N	USA	WESTAR-1				4		6														
99.00 W N	USA	WESTAR-4				4		6														
97.00 W A	CUB	STSC-2				4		6														
97.00 W N	USA	TELSTAR-3A				4		6														
97.00 W A	USA	USASAT-24D				4		6				12		14								
97.00 W N	USA	USASAT-6A										12		14								
95.00 W N	USA	COMSTAR D-2				4		6														
95.00 W A	USA	USASAT-22D				4		6														
95.00 W N	USA	USASAT-6C										12		14								
93.50 W N	USA	USASAT-12B				4		6														
93.00 W C	USA	USASAT-16A										12		14								
91.00 W C	USA	USASAT-9A										12		14								
91.00 W C	USA	WESTAR 6-S				4		6														
91.00 W N	USA	WESTAR-3				4		6														
90.00 W A	USA	MILSTAR-1	0		C2														C20			C*
89.00 W A	USA	OMRDSS EAST		1	2		5	6														
89.00 W A	USA	USASAT-24E				4		6				12		14								
89.00 W A	VENASA	SIMON BOLIVAR-B				4		6														
88.50 W A	USA	USASAT-12D				4		6														
87.00 W N	USA	COMSTAR D-3				4		6														
87.00 W N	USA	SPACENET-3				4		6				12		14								
87.00 W A	USA	USASAT-9B										12		14								
86.00 W N	USA	USASAT-3C				4		6														
85.00 W A	ARG	NAHUEL-2				4		6				12		14								
85.00 W C	USA	USASAT-9C										12		14								
83.00 W A	CUB	STSC-1				4		6														
83.00 W C	USA	USASAT-9D										12		14								
81.00 W A	USA	USASAT-22F				4		6														
81.00 W N	USA	USASAT-7B				4		6														
80.00 W A	ARG	NAHUEL-1				4		6				12		14								
79.00 W N	USA	TDRS CENTRAL			2									14	15							
79.00 W C	USA	TDRS-C2			2								13	14	15							
79.00 W C	USA	USASAT-11A										12		14								
79.00 W N	USA	USASAT-12A				4		6														
79.00 W C	USA	USASAT-24F				4		6				12		14								
77.50 W A	VENASA	SIMON BOLIVAR-A				4		6														
77.00 W C	USA	USASAT-11B										12		14								
76.00 W C	USA	USASAT-12C				4		6														
75.40 W A	CLM	COLOMBIA 1A				4		6														
75.40 W N	CLM	SATCOL-1A				4		6														
75.40 W N	CLM	SATCOL-1B				4		6														
75.00 W A	CLM	COLOMBIA 2				4		6														
75.00 W N	CLM	SATCOL-2				4		6														
75.00 W N	USA	GOES EAST	0	1	2																	

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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
75.00 W C	USA	USASAT-18A										12		14								
74.00 W A	USA	USASAT-22E				4		6														
74.00 W C	USA	USASAT-7A				4		6														
73.00 W C	USA	USASAT-18B										12		14								
72.00 W C	USA	ACS-2		1																		
72.00 W N	USA	USASAT-8B				4		6														
72.00 W A	VENASA	SIMON BOLIVAR-C				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	SISCOMIS 3							7	8												
70.00 W A	USA	FLTSATCOM-B W ATL																	20			*
70.00 W A	USA	USRDSS EAST		1	2		5	6														
69.00 W A	USA	USASAT-24H				4		6				12		14								
69.00 W C	USA	USASAT-7C				4		6				12		14								
68.00 W A	USA	MILSTAR-8	0		C2														C20			C*
67.00 W C	USA	USASAT-15D										12		14								
67.00 W C	USA	USASAT-8A				4		6														
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										12		14								
65.00 W A	B	SISCOMIS 2							7	8												
64.00 W C	USA	USASAT-14D				4		6														
64.00 W C	USA	USASAT-15C										12		14								
62.00 W A	USA	ACS-2A		1																		
62.00 W C	USA	TDRS 62W			2								13		15							
62.00 W C	USA	USASAT-14C				4		6														
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										12		14								
61.00 W A	B	SISCOMIS 1							7	8												
60.00 W A	BEL	SATCOM PHASE-3B							7	8												
60.00 W A	USA	USASAT-15A										12		14								
60.00 W A	USA	USASAT-17D				4		6														
60.00 W A	USA	USASAT-25H				4		6														
60.00 W A	USA	USASAT-26H									11	12		14								
58.00 W C	USA	USASAT-13E									11	12		14								
58.00 W A	USA	USASAT-25G				4		6														
58.00 W A	USA	USASAT-26G									11	12		14								
58.00 W A	USA	USASAT-8C				4		6														
57.00 W A	USA	USASAT-13H				4		6			11											
56.00 W C	USA	USASAT-13D									11	12		14								
56.00 W A	USA	USASAT-25F				4		6														
56.00 W A	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 A	USAIT	INTELSAT7 304E				4		6			11	12		14								
55.00 W C	G INM	INMARSAT AOR-WEST		1		4		6														

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			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
55.00 W A	G INM	INMARSAT3 AOR-WEST		1		4		6														
55.00 W A	USA	USASAT-14B				4		6														
54.50 W A	F ESA	MARECS ATL4		1		4		6														
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	INTELSAT6 307E				4	5	6			11			14								
53.00 W A	USAIT	INTELSAT7 307E				4		6			11	12		14								
52.50 W N	USA	USGCSS PH3 W ATL			C2				7	8												
50.00 W C	USA	USASAT-13C									11			14								
50.00 W C	USAIT	INTELSAT IBS 310E				4		6			11	12		14								
50.00 W N	USAIT	INTELSAT5 CONT2				4		6			11			14								
50.00 W C	USAIT	INTELSAT5A CONT2				4		6			11			14								
50.00 W C	USAIT	INTELSAT6 310E				4	5	6			11			14								
50.00 W A	USAIT	INTELSAT7 310E				4		6			11	12		14								
47.00 W C	USA	USASAT-13B									11	12		14								
47.00 W C	USA	USASAT-13J				4		6														
47.00 W A	USA	USASAT-25E				4		6														
47.00 W A	USA	USASAT-26E									11	12		14								
46.00 W A	USA	ATDRS 46W			2								13		15				20	*	*	
46.00 W A	USA	TDRS 46W			2								13	14								
45.00 W C	USA	USASAT-13F									11	12		14								
45.00 W A	USA	USASAT-13I				C4		C6			11											
45.00 W A	USA	USASAT-25D				4		6														
45.00 W A	USA	USASAT-26D									11	12		14								
44.00 W A	F ESA	EDRSS-W			2												18	19	20	*	*	
43.50 W C	F	VIDEOSAT-3			2							12		14								
43.00 W C	USA	USASAT-13G									11	12		14								
43.00 W A	USA	USASAT-25C				4		6														
43.00 W A	USA	USASAT-26C									11	12		14								
42.50 W A	USA	USGCSS PH3 MID-ATL			2				7	8												
42.50 W A	USA	USGCSS PH4 ATL3			2														20			*
41.00 W A	USA	ATDRS 41W			2								13		15				20	*	*	
41.00 W N	USA	TDRS EAST			2									14	15							
41.00 W C	USA	USASAT-14A				4		6														
41.00 W A	USA	USASAT-25B				4		6														
41.00 W A	USA	USASAT-26B									11	12		14								
40.50 W C	USAIT	INTELSAT IBS 319.5E				4		6			11	12		14								
40.50 W A	USAIT	INTELSAT K 319.5E									11	12		14								
40.50 W C	USAIT	INTELSAT5A 319.5E				4		6			11			14								
40.50 W A	USAIT	INTELSAT7 319.5E				4		6			11	12		14								
39.00 W A	USA	USGCSS PH4 ATL2			2														20			*
37.50 W C	F	VIDEOSAT-2			2							12		14								
37.50 W C	URS	STATSIONAR-25				4	5	6														
37.50 W C	USA	USASAT-13A									11	12		14								
37.50 W A	USA	USASAT-25A				4		6														
37.50 W A	USA	USASAT-26A									11	12		14								
35.00 W A	USA	USGCSS PH4 ATL1			2														20			*
34.50 W N	USAIT	INTELSAT5 ATL4				4		6			11			14								
34.50 W C	USAIT	INTELSAT5A ATL3				4		6			11			14								
34.50 W C	USAIT	INTELSAT6 325.5E				4	5	6			11			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
34.50 W A	USAIT	INTELSAT7 325.5E				4		6			11	12		14								
34.00 W C	G INM	INMARSAT AOR-CENT 1A		1		4		6														
34.00 W A	G INM	INMARSAT3 AOR-CL-1A		1		4		6														
33.00 W A	G	SKYNET 4D	0						7	8												*
32.50 W A	F ESA	MARECS ATL3		1		4		6														
32.00 W A	F ESA	EDRSS-WC			2												18	19	20	*	*	
32.00 W C	G INM	INMARSAT AOR-CENT 2A		1		4		6														
32.00 W A	G INM	INMARSAT3 AOR-CL-2A		1		4		6														
31.00 W A	E	HISPASAT-1			2				C7	C8	C11	C12		C14								
31.00 W N	G	BSB-1										12		14		C17						
31.00 W C	IRL	EIRESAT-1									11		13									
31.00 W C	USAIT	INTELSAT5 ATL6				4		6			11			14								
31.00 W C	USAIT	INTELSAT5A ATL6				4		6			11			14								
31.00 W A	USAIT	INTELSAT7 329E				4		6			11	12		14								
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 A	USAIT	INTELSAT7 332.5E				4		6			11	12		14								
26.50 W N	URS	GALS-1							7	8												
26.50 W C	URS	STATSIONAR-17				4	5	6														
26.50 W C	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														
26.00 W C	G INM	INMARSAT AOR-CENT		1		4		6														
26.00 W A	G INM	INMARSAT3 AOR-CL-1		1		4		6														
25.00 W N	URS	GALS-9							7	8												
25.00 W N	URS	STATSIONAR-8				4	5															
25.00 W C	URS	TOR-9															18	19	20			*
25.00 W C	URS	VOLNA-1A	0	1																		
25.00 W C	URS	VOLNA-1M		1																		
24.50 W N	USAIT	INTELSAT5A ATL1				4		6			11			14								
24.50 W N	USAIT	INTELSAT6 335.5E				C4	C5	C6			11			14								
24.50 W A	USAIT	INTELSAT7 335.5E				4		6			11	12		14								
24.40 W C	LUX	GDL-5						6			11											
24.00 W C	G INM	INMARSAT AOR-CENT 2		1		4		6														
24.00 W N	URS	PROGNOZ-1			2																	
23.00 W N	USA	FLTSATCOM ATL	0						7	8												
23.00 W N	USA	FLTSATCOM-B EAST ATL																	20			*
21.50 W A	USAIT	INTELSAT K 338.5E									11	12		14								
21.50 W N	USAIT	INTELSAT MCS ATL C		1		4		6														
21.50 W N	USAIT	INTELSAT5 ATL5				4		6			11			14								
21.50 W C	USAIT	INTELSAT5A 338.5E				4		6			11			14								
21.50 W A	USAIT	INTELSAT7 338.5E				4		6			11	12		14								
20.00 W C	LUX	GDL-4						6			11											
20.00 W A	USA	ACS-4		1																		
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	*	*	
19.00 W A	I	SARIT			C2						11		13			17	18		20		*	

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			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
19.00 W A	LUX	LUX-SAT										12				17						
19.00 W A	SUI	SUI-19W/1										12				17						
18.50 W N	USAIT	INTELSAT MCS ATL A		C1		C4		C6														
18.50 W N	USAIT	INTELSAT5 ATL2				4		6			11			14								
18.00 W N	BEL	SATCOM PHASE-3							7	8												
18.00 W C	URS	GOMS-1M	0	1	2				7	8									20	*		
18.00 W C	USAIT	INTELSAT IBS 342E				4		6			11	12		14								
18.00 W C	USAIT	INTELSAT5A 342E				4		6			11			14								
18.00 W A	USAIT	INTELSAT7 342E				4		6			11	12		14								
17.80 W A	BEL	SATCOM-4	C0						C7	C8									20			C*
16.00 W N	URS	WSDRN									11			14								
16.00 W N	URS	ZSSRD-2									11	12	13	14								
16.00 W A	USA	MILSTAR-3	0		C2														C20			C*
15.50 W C	G INM	INMARSAT AOR-EAST		1		4		6														
15.50 W A	G INM	INMARSAT3 AOR-EAST		1		4		6														
15.00 W N	USA	FLTSATCOM-A ATL	0						7	8												
15.00 W N	USA	MARISAT-ATL	0	1		4		6														
14.00 W C	URS	GOMS-1	0	1	2				7	8									20	*		
14.00 W N	URS	LOUTCH-1									C11			C14				19		*		
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				4		6														
13.50 W A	URS	FOTON-1				4		6														
13.50 W N	URS	POTOK-1				4																
12.00 W N	F ESA	HIPPARCOS			2																	
12.00 W N	USA	USGCSS PH2 ATL							7	8												
12.00 W N	USA	USGCSS PH3 ATL			2				7	8												
11.00 W C	F	F-SAT 2			2							12		14					20		*	
11.00 W C	URS	LOUTCH-6									11			14								
11.00 W N	URS	STATSIONAR-11				4		6														
10.00 W C	F ESA	METEOSAT S2			2																	
9.00 W A	USA	MILSTAR-2	0		C2														C20			C*
8.00 W N	F	TELECOM-1A			2	4		6	7	8		12		14								
8.00 W C	F	TELECOM-2A			2	4		6	7	8		12		14								
8.00 W A	F	ZENON-A		1	2						11			14								
5.00 W A	F	LOCSTAR OUEST		1	2		5	6														
5.00 W N	F	TELECOM-1B			2	4		6	7	8		12		14								
5.00 W C	F	TELECOM-2B			2	4		6	7	8		12		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												*
1.00 W N	USAIT	INTELSAT5A CONT4				4		6			11			14								
1.00 W A	USAIT	INTELSAT7 359E				4		6			11	12		14								
0.00 E N	F ESA	GEOS-2	0																			
0.00 E N	F ESA	METEOSAT	0	C1	C2																	
1.00 E C	URS	GALS-15							7	8												
1.00 E N	URS	STATSIONAR-22				4	5															
1.00 E C	URS	TOR-15															18	19	20			*
1.00 E C	URS	VOLNA-21	0																			
3.00 E N	F	TELECOM-1C			2	4		6	7	8		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	>4
3.00 E	C	F TELECOM-2C			2	4		6	7	8		12		14								
4.00 E	A	F EUT EUTELSAT 1-6	C0								C11	C12		C14								
4.00 E	A	USA MILSTAR-13	0		C2														C20			C
5.00 E	N	F ESA OTS	0								11			14								
5.00 E	N	S NOT TELE-X			2							12		14		17						
5.00 E	C	URS TOR-19															18	19	20			
6.00 E	C	G SKYNET-4B	0						7	8												
7.00 E	C	F F-SAT 1			2	4		6											20		*	
7.00 E	N	F EUT EUTELSAT 1-3	0								11	12		14								
7.00 E	A	F EUT EUTELSAT 2-7E		C1	C2						C11	C12		C14								
8.00 E	C	URS GALS-7							7	8												
8.00 E	C	URS STATSIONAR-18				4	5	6														
8.00 E	C	URS TOR-8															18	19	20			
8.00 E	C	URS VOLNA-15	0	1																		
10.00 E	A	F APEX			C2	C4		C6											C20		C*	
10.00 E	A	F LOCSTAR CENTRE		1	2		5	6														
10.00 E	C	F ESA METEOSAT S1			2																	
10.00 E	A	F EUT EUTELSAT 2-10E		C1	C2						C11	C12		C14								
10.00 E	N	F EUT EUTELSAT-1	0								11	12		14								
12.00 E	C	URS GALS-17							7	8												
12.00 E	N	URS PROGNOZ-2			2																	
12.00 E	C	URS STATSIONAR-27				4		6														
12.00 E	C	URS TOR-18															18	19	20			
12.00 E	C	URS VOLNA-27	0																			
13.00 E	N	F EUT EUTELSAT 1-2	C0								C11	12		14								
13.00 E	A	F EUT EUTELSAT 2-13E		C1	C2						C11	C12		C14								
13.00 E	C	I ITALSAT			2													19	20	*	*	
15.00 E	A	F ZENON-B		1	2	4		6														
15.00 E	C	ISR AMS-1									11			14								
15.00 E	C	ISR AMS-2									11			14								
15.00 E	C	URS GALS-12							7	8												
15.00 E	C	URS STATSIONAR-23				4		6														
15.00 E	C	URS TOR-12															18	19	20			
15.00 E	C	URS VOLNA-23	0																			
16.00 E	A	F EUT EUTELSAT 1-4	C0								C11	C12		C14								
16.00 E	A	F EUT EUTELSAT 2-16E		C1	C2						C11	C12		C14								
16.00 E	A	I SICRAL-1A	C0		2				C7	C8		C12		C14					C20			C
17.00 E	A	ARS SABS									11			14								
17.00 E	C	ARS SABS 1-2									11			14								
19.00 E	N	ARSARB ARABSAT 1-A			2	4		6														
19.00 E	A	F ZENON-C		1	2						11			14								
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			11	12	13	14								
19.20 E	C	LUX GDL-7									11			14								
21.00 E	A	IRQ BABYLONSAT-3									11			14								
21.50 E	A	F EUT EUTELSAT 1-5	C0								C11	C12		C14								
22.00 E	A	I SICRAL-1B	C0		2				C7	C8		C12		C14					C20			C
23.00 E	C	URS GALS-8							7	8												
23.00 E	C	URS STATSIONAR-19				4	5	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
23.00 E C	URS	TOR-7															18	19	20			*
23.00 E C	URS	VOLNA-17	0	1																		
23.50 E C	D	DFS-1			2						11	12		14					20		*	
25.00 E A	F	LOCSTAR EST		1	2		5	6														
26.00 E N	ARSARB	ARABSAT 1-B			2	C4		C6														
26.00 E C	IRN	ZOHREH-2									11			14								
26.40 E A	D	DFS-6			2						11	12		14					20	*	*	
27.00 E C	URS	TOR-20															18	19	20			*
28.50 E C	D	DFS-2			2						11	12		14					20		*	
28.50 E A	D	KEPLER 1			2						11	12		14								
29.00 E N	F ESA	GEOS-2	0		2																	
30.00 E A	IRQ	BABYLONSAT-1									11			14								
30.00 E A	USA	MILSTAR-10	0		C2														C20			C*
31.00 E C	ARSARB	ARABSAT 1-C				4		6														
31.00 E A	TUR	TURKSAT-1B									11	12		14								
32.00 E C	F	VIDEOSAT-1			2							12		14								
32.00 E A	F	VIDEOSAT-4			2							12		14								
32.00 E C	URS	TOR-21															18	19	20			*
33.50 E A	D	DFS-5			2						11	12	13	14					20	*	*	
34.00 E C	IRN	ZOHREH-1									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-2				4	5	6														
35.00 E C	URS	STATSIONAR-D3				4		6														
35.00 E C	URS	TOR-2															18	19	20			*
35.00 E C	URS	VOLNA-11	0	1																		
36.00 E A	F EUT	EUTELSAT 2-36E		C1	C2						C11	C12		C14								
37.50 E A	SEY	SEYSAT-2				4		6			11			14								
38.00 E C	PAK	PAKSAT-1	0								11			14								
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			*
41.00 E A	IRN	ZOHREH-4									11			14								
41.00 E A	PAK	PAKSAT-2										12		14								
42.00 E A	TUR	TURKSAT-1A									11	12		14								
42.50 E A	SEY	SEYSAT-1				4		6			11			14								
45.00 E N	URS	GALS-2							7	8												
45.00 E N	URS	STATSIONAR-9				4	5	6														
45.00 E C	URS	STATSIONAR-9A				4		6														
45.00 E C	URS	STATSIONAR-D4				4		6														
45.00 E N	URS	TOR-3															18	19	20			*
45.00 E N	URS	VOLNA-3	0	1																		
45.00 E C	URS	VOLNA-3M		1																		
47.00 E A	F ESA	EDRSS-EC			2												18	19	20	*	*	
47.00 E C	IRN	ZOHREH-3									11			14								
49.00 E C	URS	GALS-13							7	8												
49.00 E N	URS	STATSIONAR-24				4	5	6														
49.00 E C	URS	TOR-16															18	19	20			*
49.00 E C	URS	VOLNA-25	0																			
50.00 E A	TUR	TURKSAT-1C									11	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
51.00 E	A	IRQ BABYLONSAT-2									11			14								
53.00 E	C	G SKYNET-4C	0						7	8												*
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				C4		6														
53.00 E	A	USA USGCSS PH4 INDOC1			2														20			*
55.00 E	A	USA MILSTAR-4	0		C2														C20			C*
57.00 E	A	USA USGCSS PH2 INDOC2							7	8												
57.00 E	A	USA USGCSS PH3 INDOC2			2				7	8												
57.00 E	N	USAIT INTELSAT5 INDOC3				4		6			11			14								
57.00 E	C	USAIT INTELSAT5A INDOC2				4		6			11			14								
57.00 E	C	USAIT INTELSAT6 57E				4	5	6			11			14								
57.00 E	A	USAIT INTELSAT7 57E				4		6			11	12		14								
58.00 E	C	URS TOR-13															18	19	20			*
58.00 E	A	USA USGCSS PH4 INDOC2			2														20			*
59.00 E	A	F ESA EDRSS-E			2												18	19	20	*	*	
60.00 E	N	USA USGCSS PH2 INDOC							7	8												
60.00 E	C	USA USGCSS PH3 INDOC			2				7	8												
60.00 E	N	USAIT INTELSAT MCS INDOC B		C1		C4		C6														
60.00 E	N	USAIT INTELSAT5A INDOC1				4		6			11			14								
60.00 E	C	USAIT INTELSAT6 60E				4	5	6			11			14								
60.00 E	A	USAIT INTELSAT7 60E				4		6			11	12		14								
61.50 E	A	USA ACS-7		1																		
62.00 E	C	URS TOR-24															18	19	20			*
63.00 E	N	USAIT INTELSAT MCS INDOC A		C1		C4		C6														
63.00 E	N	USAIT INTELSAT5 INDOC1				4		6			11			14								
63.00 E	C	USAIT INTELSAT5A INDOC3				4		6			11			14								
63.00 E	C	USAIT INTELSAT6 63E				4	5	6			11			14								
63.00 E	A	USAIT INTELSAT7 63E				4		6			11	12		14								
64.50 E	C	G INM INMARSAT IOR		1		4		6														
64.50 E	A	G INM INMARSAT3 IOR-1		1		4		6														
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	C	USAIT INTELSAT5A 66E				4		6			11			14								
66.00 E	A	USAIT INTELSAT7 66E				4		6			11	12		14								
66.50 E	C	G INM INMARSAT IOR-2		1		4		6														
69.00 E	C	URS GALS-14							7	8												
69.00 E	C	URS TOR-14															18	19	20			*
70.00 E	C	URS GALS-16							7	8												
70.00 E	N	URS STATSIONAR-20				4		6														
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								
72.00 E	A	USA FLTSATCOM INDOC	0						7	8												
72.00 E	A	USA FLTSATCOM-B INDOC																	20			*
72.50 E	N	USA MARISAT-INDOC	0		C2	C4		C6														
73.50 E	A	TUR TURKSAT-1D									11	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
74.00 E N	IND	INSAT-1B	0			4	5	6														
74.00 E C	IND	INSAT-2C	0			4	5	6														
75.00 E N	USA	FLTSATCOM INDOC	0						7	8												
76.00 E C	URS	GOMS	0						7	8									20	*		
76.00 E C	URS	GOMS-M	0	1	2				7	8									20	*		
77.00 E N	URS	CSSRD-2									11	12	13	14								
77.00 E A	USA	FLTSATCOM-A INDOC	0						7	8												
77.50 E A	G	ASIASAT-D				4		6			11			14								
78.50 E A	THA	THAISAT-A2				4		6			11											
80.00 E C	URS	FOTON-2				4		6														
80.00 E N	URS	LOUTCH-8									11			14								
80.00 E N	URS	POTOK-2				4																
80.00 E N	URS	PROGNOZ-4			2																	
80.00 E N	URS	STATSIONAR-1				4	5	6														
80.00 E N	URSIK	STATSIONAR-13				4		6														
83.00 E N	IND	INSAT-1D	0			4	5	6														
83.00 E N	IND	INSAT-2A	0			4	5	6														
85.00 E N	URS	GALS-3							7	8												
85.00 E N	URS	STATSIONAR-3				4	5	6														
85.00 E C	URS	STATSIONAR-D5				4		6														
85.00 E N	URS	TOR-4															18	19	20			*
85.00 E N	URS	VOLNA-5	0	1																		
85.00 E C	URS	VOLNA-5M		1																		
87.50 E C	CHN	CHINASAT-1				4		6														
87.50 E A	CHN	DFH-3-0C				4		6														
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	MILSTAR-5	0		C2														C20			C*
93.50 E N	IND	INSAT-1C	0			4	5	6														
93.50 E N	IND	INSAT-2B	0			4	5	6														
95.00 E N	URS	CSDRN									11			14								
96.50 E N	URS	LOUTCH-9									11			14								
96.50 E N	URS	STATSIONAR-14				C4		C6														
98.00 E C	CHN	CHINASAT-3				4		6														
99.00 E N	URS	STATSIONAR-T						6														
99.00 E N	URS	STATSIONAR-T2						6														
101.00 E A	THA	THAISAT-A1				4		6			11											
103.00 E A	CHN	DFH-3-0B				4		6														
103.00 E C	CHN	STW-2				4		6														
103.00 E N	URS	LOUTCH-5									11			14								
103.00 E N	URS	STATSIONAR-21				4	5	6														
105.00 E A	CHN	FY-2A	0	1	2	4		6														
105.50 E C	G	ASIASAT-C				4		6														
105.50 E C	TON	TONGASAT C-5				4		6														
108.00 E N	INS	PALAPA-B1				4		6														
110.00 E N	J	BS-2			2	4		6				12		14								
110.00 E N	J	BS-3			2							12		14								
110.00 E N	J	BSE			2									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
110.50 E C	CHN	CHINASAT-2				4		6														
113.00 E N	INS	PALAPA-B2				4		6														
115.50 E A	CHN	DFH-3-0D				4		6														
115.50 E C	TON	TONGASAT C-6				4		6														
116.00 E C	G	ASIASAT-B				4		6														
118.00 E N	INS	PALAPA-B3				4		6														
120.00 E N	J	GMS-120E	0	1	2																	
120.00 E A	THA	THAISAT-A3				4		6			11											
121.50 E C	TON	TONGASAT C-7				4		6														
122.00 E C	G	ASIASAT-A				4		6														
124.00 E C	J	SCS-1B										12		14		17	18	19		*		
125.00 E A	CHN	DFH-3-0A				4		6														
125.00 E N	CHN	STW-1				4		6														
128.00 E C	J	SCS-1A										12		14		17	18	19		*		
128.00 E N	URS	GALS-10							7	8												
128.00 E N	URS	STATSIONAR-15				4	5	6														
128.00 E C	URS	STATSIONAR-D6				4		6														
128.00 E C	URS	TOR-6															18	19	20			*
128.00 E C	URS	VOLNA-9	0	1																		
128.00 E C	URS	VOLNA-9M		1																		
130.00 E N	J	ETS-2	0	1	2						11										*	
130.00 E C	TON	TONGASAT AP-1				4		6														
130.00 E N	URS	GALS-5							7	8												
130.00 E C	URS	PROGNOZ-5			2																	
130.00 E C	URS	TOR-10															18	19	20			*
131.00 E A	TON	TONGASAT C-8				4		6														
132.00 E N	J	CS-2A			2	4		6								17	18	19		*		
132.00 E N	J	CS-3A			2	4		6								17	18	19		*		
133.00 E A	USA	MILSTAR-7	0		C2														C20			C*
134.00 E C	TON	TONGASAT AP-2				4		6														
134.00 E A	USA	ACS-6		1																		
135.00 E N	J	CSE			2	4		6								17	18	19	20	*	*	
136.00 E N	J	CS-2B			2	4		6								17	18	19		*		
136.00 E N	J	CS-3B			2	4		6								17	18	19		*		
138.00 E C	TON	TONGASAT AP-3				4		6														
140.00 E N	J	GMS-2	0	1	2																	
140.00 E N	J	GMS-3	0	1	2																	
140.00 E N	J	GMS-4	0	1	2																	
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 A	THA	THAISAT-A4				4		6			11											
142.50 E C	TON	TONGASAT AP-4				4		6														
145.00 E N	URS	STATSIONAR-16				4		6														
148.00 E C	TON	TONGASAT AP-5				4		6														
150.00 E N	J	ETS-5		1	2		5	6														
150.00 E N	J	JCSAT-1										C12		C14								
150.00 E A	USA	MILSTAR-15	0		C2														C20			C*
151.00 E C	TON	TONGASAT AP-8				4		6														

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			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
152.00 E	A	AUS	AUSSAT A 152E									12		14								
152.00 E	A	AUS	AUSSAT A 152E PAC									12		14								
152.00 E	A	USA	MILSTAR-11	0		C2													C20			C*
154.00 E	A	J	ETS-6-FS			2	4		6							17			20	*	*	*
154.00 E	C	J	ETS-6-IS			2														*	*	*
154.00 E	A	J	ETS-6-MSS			2																
154.00 E	C	J	ETS-6-T			2																
154.00 E	N	J	JCSAT-2									C12		C14								
154.00 E	C	TON	TONGASAT AP-7				4		6													
155.00 E	A	USA	USGCSS PH4 W PAC-1			2													20			*
156.00 E	A	AUS	AUSSAT B2									12		14								
156.00 E	A	AUS	AUSSAT B2 MC									12		14								
156.00 E	A	AUS	AUSSAT B2-MOB		1							12		14								
156.00 E	A	AUS	AUSSAT B2-NZ									12		14								
156.00 E	A	AUS	AUSSAT B2-R		1							12										
156.00 E	A	AUS	AUSSAT B2-S									12									*	
156.00 E	A	AUS	AUSSAT PACIFIC-2									12		14								
156.00 E	N	AUS	AUSSAT-2									12	13	14								
157.00 E	C	TON	TONGASAT AP-6				4		6													
158.00 E	N	J	SUPERBIRD-A							7	8	12		14		17	18	19		*		
160.00 E	A	AUS	ACSAT-1							7	8											
160.00 E	A	AUS	AUSSAT B1									12		14								
160.00 E	A	AUS	AUSSAT B1 MC									12		14								
160.00 E	A	AUS	AUSSAT B1-MOB		1							12		14								
160.00 E	A	AUS	AUSSAT B1-NZ									12		14								
160.00 E	A	AUS	AUSSAT B1-R		1							12										
160.00 E	A	AUS	AUSSAT B1-S									12									*	
160.00 E	A	AUS	AUSSAT PACIFIC-1									12		14								
160.00 E	N	AUS	AUSSAT-1									12	13	14								
160.00 E	N	J	GMS-160E	0	1	2																
160.00 E	C	TON	TONGASAT C-3				4		6													
162.00 E	N	J	SUPERBIRD-B							7	8	12		14		17	18	19		*		
164.00 E	A	AUS	ACSAT-2	0						7	8											
164.00 E	N	AUS	AUSSAT PACIFIC-3									12		14								
164.00 E	N	AUS	AUSSAT-3									12	13	14								
164.00 E	C	TON	TONGASAT C-2				4		6													
166.00 E	C	URS	GOMS-2	0	1	2				7	8								20	*		
166.00 E	C	URS	GOMS-2M	0	1	2				7	8								20	*		
166.00 E	C	URS	PROGNOZ-6			2																
167.00 E	N	URS	VSSRD-2									11	12	13	14							
167.45 E	A	PNG	PACSTAR A-1		C1			5	6													
167.45 E	C	PNG	PACSTAR-1				4		6				12		14							
170.00 E	C	USA	USASAT-13M										12		14							
170.75 E	C	TON	TONGASAT C-1				4		6													
171.00 E	A	USA	ACS-5		1																	
172.00 E	N	USA	FLTSATCOM W PAC	0						7	8											
172.00 E	N	USA	FLTSATCOM-B WEST PAC																20			*
174.00 E	N	USAIT	INTELSAT5 PAC1				4		6			11			14							
174.00 E	C	USAIT	INTELSAT5A PAC1				4		6			11			14							
174.00 E	C	USAIT	INTELSAT7 174E				4		6			11	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
175.00 E	N	USA USGCSS PH2 W PAC							7	8												
175.00 E	N	USA USGCSS PH3 W PAC			C2				C7	C8												
176.50 E	N	USA MARISAT-PAC	0	1		4		6														
177.00 E	N	USAIT INTELSAT5 PAC2				4		6			11			14								
177.00 E	C	USAIT INTELSAT5A PAC2				4		6			11			14								
177.00 E	C	USAIT INTELSAT7 177E				4		6			11	12		14								
177.50 E	C	G INM INMARSAT POR-II		1		4		6														
177.50 E	A	USA MILSTAR-14	0		C2														C20			C*
178.00 E	N	F ESA MARECS PAC1	0	1		4		6														
179.50 E	C	G INM INMARSAT POR-I		1		4		6														
179.50 E	A	G INM INMARSAT3 POR-I		1		4		6														
180.00 E	A	USA USGCSS PH2 W PAC-2							7	8												
180.00 E	A	USA USGCSS PH3 W PAC-2			2				7	8												
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 INTELSAT5A PAC3				4		6			11			14								
180.00 E	C	USAIT INTELSAT7 180E				4		6			11	12		14								

A Only advance publication under RR1042
C Presently being coordinated under RR1060
N Notified

3. Studies and standardization in the field of telecommunication

3.1 *General*

3.2 *Integration of telecommunication satellites in the general network (activities of the CCITT)*

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

In its studies, the CCITT investigates the integration of telecommunication satellites in the general network. Accordingly, it is studying the use of telecommunication satellites for a whole range of transmissions; telephony, television, teleconference, data transmission, business services, communication between computers, telecommunication services to remote regions and weather forecasting. Where necessary, it also investigates the signalling associated with these various types of information.

As stated in previous ITU Reports on telecommunication and the peaceful uses of outer space, numerous CCITT Study Groups are developing standards, drawing up specifications and contributing to this work.

In telephony, research to improve the quality of communications involving extremely long propagation paths such as satellite communications, has achieved satisfactory results, in particular by using adaptable echo cancellers.

In collaboration with the CCIR, the studies on the identification of transmission parameters for the maritime telephone communication system by satellite have led to the preparation of Recommendations.

In the context of modern technology the research conducted on echo suppressors and the Recommendations on echo cancellers specifying the characteristics of non-linear processors have been notable.

A considerable amount of work has been carried out on the integrated services digital network (ISDN), drawing up Recommendations on the concept and principles of an ISDN, its potential in terms of satellites, its general features and functions and user/network and inter-network interfaces;

here again, careful attention is given to the problems associated with satellite communications.

The CCITT Plenary Assembly held in Melbourne in 1988 approved amendments to existing Recommendations and new Recommendations on the ISDN, interworking and basic user access, including maintenance aspects. These Recommendations are also of significance for systems employing satellite communications. The CCITT is also currently studying applications of speech presentation in packets and the future wideband ISDN. Studies of digital speech interpolation are still mainly concentrated on the collection of data from DSI systems operating on associated media. Those studies have resulted in Recommendations, particularly relating to digital circuit multiplication equipments (DCME) and digital circuit multiplication systems (DCMS) and to 32 kbit/s differential adaptive PCM (DAPCM) coding.

With regard to signalling, as a result of its studies the CCITT is now in a position to put forward Recommendations on interworking between CCITT Signalling Systems Nos. 5, 7 and R2 and INMARSAT's standard B maritime system. The 1988 CCITT Plenary Assembly also approved Recommendations on the INMARSAT aeronautical mobile-satellite system and interworking between the above-mentioned systems standardized by the CCITT and INMARSAT's aeronautical system (for Signalling System No. 7, also with the Telephone User Part (TUP)). Next Recommendations are being prepared (Mobility Services Application Part – MSAP) to provide for all types of mobility for uses and user terminal equipments in all mobile networks.

New Recommendations were developed specifying a telephone/ISDN numbering plan and a telex numbering plan for mobile earth stations in systems operated by INMARSAT.

Related new Recommendations defining the selection procedures for subscribers in the public switched telephone network or ISDN and for subscribers in the international telex service, calling a ship earth station in the INMARSAT systems were also developed.

A new Recommendation was developed providing operational guidelines and quality of service requirements for an international point-to-multipoint telecommunication service via satellite.

Standards have been established for interworking between signalling in the mobile-satellite service and the ISDN/PSTN network, and on an upgrade of CCITT Signalling System No. 7 to cater for additional mobile services for telephone and non-telephone applications.

3.3 *Technical recommendations for radiocommunications by space techniques (CCIR activities)*

The International Radio Consultative Committee (CCIR) is the permanent organ of the ITU responsible for the study of technical and operational questions on radiocommunications and for the issue of relevant Recommendations. Current CCIR Recommendations, Reports and Questions are contained in the Volumes of the CCIR XVIIth Plenary Assembly, Düsseldorf, 1990. Volumes of special interest for space telecommunications are:

Topic	*Volume (+ Annex)*
– Space research and radioastronomy	II, XV-1
– Fixed service using communication satellites	IV-1, XV-4
– Propagation in non-ionized media	V, XV-1
– Standard frequency and time signals	VII, XV-1
– Amateur satellite services	VIII-1, XV-2
– Mobile satellite services (Aeronautical, land, maritime-mobile and radio-determination)	VIII-3, XV-2
– Sharing between the fixed-satellite service and radio-relay systems	IV/IX-2, XV-4
– Broadcasting-satellite service	X/XI-2, XV-3

The texts are prepared by experts in the field of space communication and are finally approved by administrations in the CCIR Plenary Assembly. They form the basis for the harmonization of the technical development of the space services and contain criteria for the sharing of frequencies between the various space services and between space services and terrestrial radiocommunication services.

As a result of the restructuring of the CCIR Study Groups agreed at the XVIIth Plenary Assembly, Study Group 7 (Science services) took responsibility for the Questions of former Study Group 2 (Space research and radioastronomy) and a new Study Group 12 (Interservice sharing and compatibility) took responsibility for a limited number of urgent Questions on interservice-sharing concerning the space services.

3.3.1 *CCIR preparations for WARC-92*

Preparation of technical bases for Administrative Radio Conferences is an important activity of the CCIR Study Groups. The Agenda of WARC-92 includes several allocation issues affecting space services which require consideration by the Study Groups concerned. They are:

- frequency bands above 20 GHz for new space service allocations,
- a suitable frequency band for satellite-sound broadcasting in the range 500-3000 MHz,
- a suitable frequency band for HDTV on a world-wide basis,
- frequency bands for the mobile and mobile-satellite services,
- a frequency band 14.5-14.8 GHz for use by the fixed-satellite service (Earth-to-space),
- frequency bands 2025-2110 MHz and 2200-2290 MHz for the space operation and space research services.

While the preparatory technical work directly related to the specific services is being carried out by the individual Study Groups, a Joint Interim Working Party of CCIR Study Groups 1, 4, 5, 6, 7, 8, 9, 10, 11 and 12 has been set up to develop suitable sharing parameters among these services. This JIWP WARC-92 will meet in Geneva in March 1991 with the objective of:

- developing the necessary sharing criteria for WARC-92,
- preparing a consolidated CCIR Report to WARC-92.

The Chairman of the JIWP WARC-92 held a meeting with the Chairmen and Vice-Chairmen of the Working Parties involved in conference preparations in July 1990 in Geneva. A coordinated work schedule was completed and a draft outline of the Report to the Conference was prepared.

The following IWP's and JIWP's are preparing information for WARC-92:

IWP 1/6, IWP 2/2, IWP 4/1, IWP 8/13, IWP 8/14, IWP 8/15, IWP 9/6, JIWP 10-3-6-8/1, JIWP 10-11/1 and JIWP 10-11/3.

The work which has been carried out by the individual IWP's or JIWP's in 1990 is as follows:

Spectrum Utilization (Study Group 1)

IWP 1/6 met in Geneva in November 1990 and finalized its report on the technical criteria appropriate for frequency sharing.

Fixed Satellite Service (Study Group 4)

IWP 4/1 met in Geneva in December 1990 and finalized its report which also included proposed Recommendations on frequency bands above 20 MHz for allocation to space services and which are not included in the agenda of WARC-92.

Space Services (Study Group 7)

IWP 2/2 (now part of Study Group 7) met in Washington in October 1990 and finalized its report dealing with interservice sharing problems and any proposed space services in frequency bands above 20 GHz.

Mobile Services (Study Group 8)

IWP 8/13 on Future Public Land Mobile Telecommunication Systems (FPLMTS) met in Harrogate (UK) in July 1990 and prepared a report dealing with the spectrum requirements for FPLMTS and the possibilities of sharing with a limited number of other services.

IWP 8/14 met in Melbourne in August 1990 and prepared a report dealing with the technical and spectrum requirements and sharing issues for all mobile-satellite services including the preferred frequency band for a future worldwide terrestrial aeronautical public correspondence system.

IWP 8/15 met in Helsinki in November 1990 and finalized, on behalf of Study Group 8, the report for submission to JIWP WARC-92. The report incorporates the contributions of IWP's 8/13 and 8/14 and also includes the technical and spectrum requirements and sharing issues not covered by these contributions.

Fixed Services using Radio-Relay Systems (Study Group 9)

IWP 9/6 met in Geneva in November 1990 and finalized its report dealing with interservice sharing problems.

Broadcasting Satellite Service (Study Groups 10 and 11)

IWP 10-11/1 met in Sydney (Australia) in November 1990 and finalized its report on the spectrum requirements and sharing considerations for satellite sound broadcasting in the range 500 - 3000 MHz.

IWP 10-11/3 met in Sydney (Australia) in November 1990 and finalized its report on the sharing and spectrum occupancy aspects of wide RF band HDTV satellite broadcasting.

3.3.2 *Fixed Satellite Service (Study Group 4)*

In accordance with Resolution 103 of the XVIIth Plenary Assembly, a Joint ad hoc CCIR/CCITT Group on ISDN/Satellite matters was established to examine certain CCITT Recommendations which might be incompatible with operation over satellite links. The first meeting of this Group took place in Geneva in November 1990 and identified the CCIR Recommendations which might inhibit the use of satellite links in the ISDN. Liaison statements have been sent to the CCITT Study Groups concerned and a further meeting of the Joint ad hoc Group will take place in April to consider the replies.

IWP 4/2 on the implementation of digital satellite systems met in Canterbury (UK) in April 1990 and considered a range of topics concerned with the ISDN. A number of liaison statements were prepared for consideration by the relevant CCITT Study Groups.

The ad hoc Group of Experts for Updating the Handbook on Satellite Communications (FSS) has continued its work during 1990 and is proposing to issue four supplements rather than a complete revision of the previous edition (Geneva, 1988). Each of the Supplements will deal with a single technical subject selected for their relevance to the future evolution of satellite communications and the needs of developing countries.

3.3.3 *Mobile Satellite Services (Study Group 8)*

Thirty-five new or modified Recommendations and Reports of Study Group 8 dealing with satellite services were adopted by the XVIIth Plenary Assembly. Among the subjects which were dealt with were:

- Methodology for the derivation of mobile-satellite interference criteria,
- Land-mobile satellite systems,
- Multi-purpose mobile satellite system for providing land, maritime and aeronautical mobile satellite services using shared system resources,
- Signal propagation criteria for the maritime-mobile satellite service,
- Distress and safety systems in the mobile-satellite services.

IWP 8/14 dealing with compatibility and performance levels for systems in the mobile-satellite services held its 3rd meeting in Melbourne in August 1990. Special attention was given to public correspondence with aircraft through the use of aeronautical satellites and a general mobile-satellite service with stations on a land vehicle, ships or aircraft.

Under the new structure of CCIR Study Groups, Working Party 8D will carry out future studies on all mobile-satellite questions.

In the maritime-mobile satellite service (INMARSAT system), attention is being given to new ship Earth stations (Standard C) for much smaller ships. This service will be of importance to a completely new category of users, e.g. fishing vessels, etc.

3.3.4 *Science Services (Study Group 7)*

Seventy-one new modified Recommendations and Reports of former Study Groups 2 and 7 were adopted at the XVIIth Plenary Assembly. Among the subjects which were dealt with were:

- technology considerations for spacecraft antennas and power systems,
- methods for calculating performance parameters for telecommunication links between Earth and Space,
- methods for developing performance and sharing criteria and coordination thresholds for the Earth Exploration satellite service,
- Recommendation defining more precisely the radio-frequency lines of great importance in radioastronomy,
- sharing criteria between the radioastronomy service and other services,
- methods of time and frequency transfer using satellites.

The ad hoc Group (HB/7) is nearing the completion of its work on the Handbook on Standard Frequency and Time Signals from Satellites.

3.3.5 *Broadcasting Satellite Service (Sound and Television) (Study Groups 10 and 11)*

The XVIIth Plenary Assembly adopted all the texts concerning the Broadcasting Satellite Service which were proposed by Study Groups 10 and 11. These included a new Recommendation on sound and data standards in the 12 GHz band and a new Report describing the characteristics of the systems. Revisions to existing texts covering the fields of systems, technology, planning and frequency sharing were also adopted.

The work in 1990 was focused on the preparations for the WARC-92 and, in particular, on the technical parameters for the selection of suitable frequency bands for satellite emission of HDTV and high quality sound.

3.3.6 *Satellite News Gathering*

The XVIIth Plenary Assembly adopted the Recommendation proposed by Study Groups 4, 10, 11 and the CMTT concerning the technical standards and uniform operational procedures to be adopted for Satellite News Gathering.

Following the new working methods adopted by the XVIIth Plenary Assembly, Task Group CMTT/5 took over the responsibilities of JIWP CMTT-4-10-11/1 and held their first meeting during December 1990 in Geneva.

4. Planning

4.1 *International telecommunication network*

The World Plan Committee and the four Regional Plan Committees (Africa, Latin America, Asia and Oceania, Europe and the Mediterranean Basin), which are joint CCITT/CCIR Committees administered by the CCITT, are responsible for developing a General Plan for the International Telecommunication Network to facilitate the coordinated development of international telecommunication services.

Their meetings, in particular those held in the developing countries, constitute an opportunity for exchange of views between experts and participants, thereby providing a better insight into ways of interconnecting space and terrestrial services.

In addition, the Plan Committees gather data and forecasts on volume of traffic, numbers of circuits and the list of earth stations for regional and interregional satellite links. This information, designed to facilitate planning, is published in the Plan Books and their supplements and is stored in the ITU/Plan database.

The Regional Plan Committee for Asia and Oceania met in Bangkok (Thailand) in November 1990.

The Regional Plan Committees for Africa and Europe and the Mediterranean Basin will be meeting in Dakar (Senegal) in March 1991 and Belgrade (Yugoslavia) in September 1991, respectively.

5. Technical cooperation activities

5.1 A technical cooperation project has been drawn up at the Research and Development Center of ENTEL-Peru for the development of four industrial prototypes.

One of these prototypes consists in the study and manufacture of a low capacity earth station (up to four channels) for rural telephony and television reception in Peru.

5.2 Training courses on satellite space segment and on domestic satellite systems were held respectively in Western Samoa and the Solomon Islands.

5.3 The feasibility study of the Regional African Satellite Communication System (RASCOM) is now completed. The final report consists of a Regional report and 50 country reports.

The report include the status of telecommunication in Africa including broadcasting and specialised telecommunication services, and in depth analysis of the existing situation, the traffic evaluation and forecast up to the year 2005, satellite system options for Africa to satisfy all the requirements with emphasis on rural needs, a comparison of options, financial and socio-economic evaluation, implementation proposals and series of recommendations.

The Report will be presented to the Conference of African Ministers for telecommunication, to be held in early February 1991.

5.4 ITU organized or sent lecturers to satellite communications seminars in Cuba, Malawi and Nigeria. Technical assistance in satellite earth station projects was granted to Burkina Faso, Malta and Namibia.

6. Information and documentation activities

The General Secretariat has continued, in pursuance of Administrative Council Resolutions No. 636 and No. 637, the dissemination of information on the activities and role of the ITU in space telecommunications.

Every month the ITU Journal published a list of artificial satellites launched in the previous weeks as well as articles and information regarding space techniques, telecommunications and launching devices.

In May 1990 a recapitulatory list of artificial satellites launched in 1989 was published as an annex to the Journal. This was prepared from information supplied by the Members of the Union, the International Frequency Registration Board (IFRB), the Committee on Space Research (COSPAR), and national space research organizations.

7. Cooperation with other international organizations concerned with space matters

7.1 *General*

In 1990 the ITU pursued its consistent cooperation with relevant international organizations concerned with space matters (COSPAR, EUTELSAT, INTELSAT, INMARSAT, etc.), with a view to exchanging technical data and appropriate documentation. In particular, it took part in the meetings of the United Nations Committee on the Peaceful Uses of Outer Space and its sub-committees.

In the area of space telecommunications the Union continued to collaborate with the specialized agencies concerned, such as International Civil Aviation Organization (ICAO), International Maritime Organization (IMO), World Meteorological Organization (WMO), United Nations Educational, Scientific and Cultural Organization (UNESCO), as well as intergovernmental regional organizations.

7.2 *Participation of the ITU in the meetings of the United Nations Space Applications Programme*

During the inter-agency meeting on outer space activities which was held in Roma on 26-28 September 1990, the following specific questions were considered:

– Implementation of the recommendation of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space;

- Co-ordination of plans and programmes and exchange of views on current activities in the practical applications of space technology;
- Planning and co-ordination of activities of the organizations of the United Nations system on International Space Year 1992.
- Current and future plans of common interest.

The inter-agency meeting considered and approved a draft Report entitled "Co-ordination of outer space activities within the United Nations system; Programmes of work for 1991 and 1992 and future years".

ANNEX

Reports on progress made in the development of space communications

ANNEX

BARBADOS

The Barbados earth station is a Standard A station operating with the Intelsat 325.5° satellite.

During the year, conversion of Barbados' transmission network from analogue to digital continued. In 1989 an 11 GHz digital microwave link operating at 140 Mbit/s was installed to replace the analogue backhaul microwave link.

By the end of 1990, the Barbados earth station had established 2 Mbit/s IDR carriers to the United States of America, the United Kingdom and Canada. Digital Channel Multiplication Equipment (DCME) was installed and utilized to expand the capacity of the 2 Mbit/s carriers.

BELGIUM

Development of the Lessive station

Development of the Lessive earth station continued during 1990.

Operating in the INTELSAT system, the Lessive 1 earth station routes some 150 circuits in analogue mode via the Intelsat VI (F-2) satellite to about 15 countries in Africa.

Traffic with the American continent, which constitutes the main artery, is routed by the Lessive 2 station via the Intelsat V (F-6) satellite stationed at 342° E. This station uses both conventional analogue technology and time-division multiple access. Roughly 700 circuits of traffic are handled. The introduction of digital circuit multiplication DCMS equipment makes for more efficient use of the space sector.

The Lessive 3 Benelux station enables links to be established with a dozen European countries. Traffic has continued to grow through the opening of a link with the Canary Islands. The total volume of European traffic exceeds 1000 circuits.

The year was also marked by a considerable increase in occasional television transmissions in both the INTELSAT and the EUTELSAT systems.

Propagation tests carried out using 12.5 GHz and 20 GHz beacons via the Olympus satellite also continued in collaboration with the Catholic University of Louvain and have already revealed some interesting scintillation phenomena.

BRAZIL (FEDERATIVE REPUBLIC OF)

Introduction

The Brazilian Telecommunications System via satellite – SBTS – operated by EMBRATEL has continued to expand its earth station network, ensuring the growth of several services via satellite essential for the integrated development of telecommunications in Brazil.

Domestic space radiocommunications

In 1990 an agreement was signed with Hughes Communications International for the purchase of two more satellites (SBTS 2nd generation) destined to continue the communication services provided by EMBRATEL.

Space segment

Two satellites HS-376 type, called Brasilsat A1 and A2 are in operation; the former was launched in 1985, at the orbital position of 65° W, and the latter was launched in 1986, at 70° W. Both use C-band and have 24 transponders of 36 MHz bandwidth and linear polarization.

Two satellites HS-376W type called Brasilsat B1 and B2 have been contracted for the 2nd generation, to be launched in 1994. Both will use C-band with 28 transponders of 36 MHz bandwidth and linear polarization. These satellites will replace those in operation at the end of their life span expected for 1995 and 1997 respectively.

Earth stations

At the end of the year, the SBTS was operating 221 earth stations, 47 of which are dedicated to public services. The other stations are dedicated to private data communication networks in high and low speed, and to television signal transmission.

Traffic

The satellites transponder allocation reached 79% with the following configuration:

— Brasilsat A1 (number of transponders):
  24 transponders for public telephone network
  1 transponder for television network.

— Brasilsat A2 (number of transponders):
  2 transponders for high-speed data networks
  2 transponders for low-speed data networks
  9 transponders for television network.

10 782 channels are allocated for telephone, telex and data traffic, 8698 of which for FDM/FM/FDMA stations and 2084 for SCPC stations.

762 channels of 48/64 kbps are contracted for high-speed data networks service.

Seven networks made up of seven major stations and 2170 microstations are contracted for the low-speed data networks service. Two networks were activated in 1990 and the other ones will be activated in 1991/1992.

Control centres

The Space Segment Control Centre (TT&C) and the Communications Control and Operations Centre of SBTS are installed at Guaratiba earth station in the state of Rio de Janeiro.

Industry

A great part of the transmission equipment used in the earth stations with a capacity equal to or lower than 300 telephone channels has been manufactured by the Brazilian industry.

It is worth noting the 3.6 m, 4.5 m, 6 m and 10 m parabolic antennas, the low noise 80°K amplifiers (LNA), and the 5 W, 10 W and 100 W power amplifiers.

During 1990 we had to import equipment and even complete stations, due to the great number of earth stations and high- and low-speed data networks implementation.

CANADA

1. International satellite communication

1.1 *INTELSAT*

Teleglobe Canada Inc., as the Canadian Signatory to INTELSAT, was involved in a number of INTELSAT related activities during 1990. After the contract award for the Intelsat VII satellites in 1988, the activities in 1989 and 1990 involved some studies to determine the nature of future procurement. These studies, in which Teleglobe had been actively involved, led to the procurement of two Intelsat VII-A satellites in 1990 from SS/Loral. In the area of earth station facilities, the activity has been quite intense. At the Weir earth station complex near Montreal a nine metre Standard F-3 (C-band) earth station has been constructed to operate with the Intelsat satellites. A 9 metre earth station operating at C-band has also been constructed at Mill Village to access the domestic satellite network. This earth station will provide a transit link to Europe via the INTELSAT space segment. Three 2.4 metre V-Sat earth terminals operating at C-band were provided to the Department for National Defense. Procurement of equipment is continuing for the implementation of the digital communication network which is designed primarily for the international public switched telephone service.

1.2 *INMARSAT*

Teleglobe Canada Inc., as the Canadian Signatory to INMARSAT, has been actively involved in a number of INMARSAT activities during 1990, the most important of which was the selection of the manufacturer to provide the Inmarsat-3 generation satellites. Teleglobe has taken an active role in the evaluation of the bids submitted to INMARSAT that led to the contract being signed with GETSCO early 1991. During 1990 INMARSAT has implemented four ocean region operations which includes a satellite at 55° W that Teleglobe sought for many years. Teleglobe, together with France Telecom, OTC Australia and SITA commenced satellite communications for aircraft operational control, public correspondence and administrative matters by the end of 1990. In Canada these services are provided through Teleglobe's ground earth station at Weir near Montreal. Teleglobe has been the initiator and leader in providing General Aviation Services using satellites, where it is currently providing INMARSAT capacity for the Ontario Air Ambulance Service. INMARSAT has decided to invite its members to submit proposals for a new location for its Headquarters. Teleglobe has been instrumental in assisting a Montreal organization to submit a proposal to INMARSAT that has put Montreal on the short list for the future sites to be considered for the new Headquarters. During 1990, INMARSAT launched its first 2nd generation satellite, which now operates in the Indian Ocean region. Three more satellites are to be launched during 1991 for the Atlantic and Pacific Ocean regions.

2. Domestic satellite communications

Canadian domestic satellite communications are provided by the Anik satellites which are owned and operated by Telesat Canada. The Telesat space segment consists of two separate systems. The Anik D satellites operate in the 6/4 GHz band and the Anik C satellites operate in the 14/12 GHz band. The 6/4 space segment comprises the following: Anik D-1, launched in 1982; and Anik D-2, launched in 1984. The 14/12 consists of Anik C-1 and Anik C-2. Anik E-1 and Anik E-2 are replacement satellites with launches planned for both satellites during 1991. Telesat is also considering procurement of an Anik E-3. Each Anik E spacecraft, which is a dual-band design, will replace an Anik C and Anik D spacecraft. These fixed satellite service satellites provide transmission of voice, video (including subscription television) and data signals within Canada.

3. The MSAT programme

In 1979, the Canadian Department of Communications and Telesat Canada started studying and planning a commercial mobile satellite system (MSAT) that would provide economical voice and data communications to land vehicles, ships, aircraft and transportable terminals primarily in rural and remote areas of Canada. The 1987 Warc-Mob allocated spectrum for a land mobile satellite service in addition to maritime and aeronautical satellite services around 1.5 GHz. In 1988, Telesat Canada joined with a number of other investors to form Telesat Mobile Inc., to build and operate the MSAT service in Canada. In April 1990, Telesat Mobile Inc. signed a joint operating agreement with the American Mobile Satellite Corporation (AMSC) to cooperate and provide compatible North American-wide mobile satellite services. In June 1990, Telesat Mobile launched a mobile store-and-forward packet data service using INMARSAT space segment in the Atlantic region. Telesat Mobile Inc. and the AMSC signed contracts for two MSAT satellites in 1990. The first of these satellites is due for delivery and launch in the second quarter of 1994 with all MSAT services scheduled to commence shortly after launch.

4. The search and rescue programme

The satellite-aided Search and Rescue Project (SARSAT) is a joint Canada-France-USA project with the objective of using space-borne technology to demonstrate the detection and location of emergency beacon signals operating at the 121.5 MHz and 406 MHz distress frequencies. A SARSAT Memorandum of Understanding negotiated in 1984 will extend the system's life at least until the early 1990s.

The COSPAS-SARSAT programme was initiated in 1979 by the USSR, the USA, Canada and France, and since the launch of the first satellite in 1982, the system has been used in a large number of distress incidents, which has resulted in the rescue of over 1130 human lives in over 420 SAR operations.

In 1988, the COSPAS-SARSAT Parties signed an International Programme Agreement which ensures the continuity of the satellite system for at least the next fifteen years. COSPAS-SARSAT has also negotiated a Memorandum of Understanding with INMARSAT for the provision of secretariat services.

5. RADARSAT

DARSAT is a Canadian-led cooperative programme with the USA, to launch and operate a remote sensing satellite with a C-Band Synthetic Aperture RADAR (SAR sensor). The spacecraft is scheduled for launch into a sun-synchronous polar orbit in 1994 on an expendable launch vehicle for a five-year mission. The orbit altitude and inclination are 792 km and 98.5° respectively. The south-bound equatorial crossing will be at 0600 hours local mean time.

The objective of the RADARSAT programme is to generate data of both applications and research value added to global ice, oceans, renewable resources and non-renewable resources.

Progress on RADARSAT during 1990 included final system definition and development work of the radar, the overall system and data applications, and final approval from the Govermment to proceed with Phase C, the main development and test part of the programme. Also the Memorandum of Understanding between the Canadian Space Agency and NASA was finalized in preparation for signature.

6. The European Space Agency (ESA)

Canada's international space activities include participation in the programmes of the European Space Agency under an Agreement of Cooperation. In the satellite communications area, Canada is involved in ESA's OLYMPUS programme and the Payload and Spacecraft Development and Experimentation (PSDE) programme. Participation in the Data Relay and Technology Mission (DRTM) and Advanced Systems and Technology Programme (ASTP) has been requested.

Canada's contribution to the OLYMPUS programme comprises the provision of the solar arrays, payload amplifiers and microwave components, as well as being a major contributor to the satellite assembly, integration and test (AIT) function. In this latter regard, the AIT was completed and the satellite was launched from Kourou, French Guiana in July 1989. Canada is participating in the 20/30 GHz trials and demonstrations. With regard to PSDE, Canada is contributing to the basic support activity which is primarily concerned with conceptual studies, and to the pre-development of communications payloads as a preliminary to the definition of specific flight missions. Of particular interest is potential involvement in the development of land mobile payloads, the development of on-board processing for satellite systems, and in the development of an optical inter-satellite/inter-orbit link (ISL/IOL) payload.

CHAD (REPUBLIC OF)

The advances made by Chad have largely been in the field of satellite communications (satellite telecommunication link).

As part of the implementation of a national satellite telecommunication network, in 1990 Chad set up the SAOSAT network comprising:

— one class B master station at N'Djamena;

— four peripheral class Z stations at the major towns of Sarh, Abeche, Moundou and Faya;

— the space segment consists of a half repeater (of the 22/22 repeater) acquired jointly with two other countries of the sub-region;

— the network uses the Intelsat V-A (F-12) satellite at 359° E.

The services offered are:

— telephony,

— telex,

— facsimile,

— data transmission,

— television reception,

—broadcasting of radio programmes by the master station.

The master station has a capacity of 31 circuits distributed as follows:

— N'Djamena-Sarh: 10 telephone circuits,

— N'Djamena-Moundou: 10 telephone circuits,

— N'Djamena-Abeche: 6 telephone circuits,

— N'Djamena-Faya: 6 telephone circuits, including 3 S + DX circuits.

There are also interregional links between N'Djamena and Libreville (Gabon) and between N'Djamena and Bangui (Central African Republic).

CHILE (1989)

1. International satellite communications

International calls are routed through the Longovilo earth station, specifically through the Longovilo 1, Longovilo 2 and Longovilo 3 antennas which point to the ITS V-A (F-10), ITS V-A (F-6) and ITS V-A (F-13) satellites at 335° E, 341.5° E and 301° E, respectively.

In addition, television transmissions are occasionally received from other satellites using the Longovilo 4 antenna.

There are altogether 735 circuits in service, distributed over 28 direct routes. Of the total, 688 circuits are used for telephony and the remaining 47 for both public and private telegram, telex, data transmission and other services.

During the year, seven new countries or territories (Botswana, Burundi, Central African Republic, Chad, Equatorial Guinea, Mali and the Malvinas or Falkland Islands) were brought into the international direct dialling system, thus bringing the total number of countries within the system to 180 by the end of 1989.

2. Domestic satellite communications

These are established via the Longovilo, Coyhaique and Punta Arenas earth station antennas using capacity on board the ITS V-A (F-13) satellite at 307° E.

The carriers used were of the following capacities:

Carrier	Capacity	Occupancy
Longovilo 3	372 (396)	375
Coyhaique	132	124
Punta Arenas	252 (264)	254

SATEL has three IBS services to different countries such as Canada, Germany and the United States of America.

The domestic television system uses an 18 MHz carrier in the PANAMSAT southern spot beam (No. 2).

CHILE

— In 1988, CHILESAT Ltda. was granted an intermediate service concession authorizing it to install a network of earth stations for transmitting and receiving via satellite throughout the country. The network is now being implemented.

— In 1989 a similar concession was granted to Transradio Chilena (VTR) authorizing it, like CHILESAT Ltda., to install a network of earth stations for transmitting and receiving via satellite throughout the national territory. This network has not yet been started.

— In May 1990, ENTEL CHILE's concession was extended to cover the installation of three new earth stations at Palena, Futaleufú and Puerto Williams. ENTEL was also authorized to install an earth station for transmitting and receiving via satellite on Easter Island.

— It is intended that all the earth stations will operate in band C, i.e. from 5925 MHz to 6425 MHz for transmission and from 3700 MHz to 4200 MHz for reception.

CÔTE D'IVOIRE (REPUBLIC OF)

Côte d'Ivoire made the following advances:

— extension of telecommunications equipment at Akakro;

— replacement of a servo system;

— modernization study for the Akakro station (to be implemented in 1991);

— feasibility study for a fibre-optic television link between Akakro and Abidjan (to be implemented in 1991);

— improved operations at two earth stations for handling traffic between Yamoussoukro and Abidjan (antenna of 7.2 m diameter);

— study of a DOMSAT network for Côte d'Ivoire (studies available);

— participation in the RASCOM project.

CYPRUS (REPUBLIC OF)

Space telecommunications in Cyprus take place via the Makarios satellite earth station as follows:

— MKR 1-A (Standard A) earth station during 1990 operated with Intelsat V-A (F-10) (and later with VI (F-2)) AOR satellite located at 335.5° E. This earth station handles normal telephony traffic using FDM/FM carriers and is also equipped for television transmission and reception.

In addition to the above, the station incorporates a SPADE terminal for telephony, acting also as an alternative network reference station as from 1990.

At the end of 1990, the number of FDM/FM telephony channels was 236 whilst SPADE enabled telephone service access to 11 countries.

— MKR 2-B (Standard B) station, during 1990 operated with Intelsat V (F-15) IOR satellite located at 60° E. This station supports telephony service via the SCPC system and also a sound programme service consisting of seven programme channels. In addition the station has capability for television reception only.

The number of operating SCPC telephony channels at the end of 1990 was 48.

— MKR 3 station, during the same period operated with Eutelsat I (F-2) (and later with Eutelsat I (F-1)) satellite located at 16° E. The station operates in the EUTELSAT TDMA system for telephony, handling 381 TDMA channels by the end of 1990.

— In the last quarter of 1990 the civil works began for the installation of MKR 4 (revised Standard A) earth station. This earth station will be providing IDR/DCMS telephony service on the 60° E Intelsat satellite and will be ready for operation by mid 1991. In addition, the station will have the capability for television transmission and reception. It should be noted that under the same project, equipment will be purchased for the digital operation of MKR 1-A and MKR 2-B earth stations, as well as the RF interconnection of the three earth stations.

— MKR 5 earth station was put in operation in November 1990 and it is dedicated to the bidirectional television link between Cyprus and Greece

on Eutelsat I (F-4). This station comprises a 7-metre dish antenna and equipment for the transmission and reception of television programmes.

— Works for the installation of MKR 6, a 9-metre television Tx/Rx Ku band earth station, commenced at the end of 1990 and will be completed by the first quarter of 1991. MKR 6 earth station will eventually free MKR 5 from the television link Cyprus-Greece, and the latter will then be available for other applications.

CZECH AND SLOVAK FEDERAL REPUBLIC

The Czech and Slovak Federal Republic has utilized satellite communications since 1975 by means of technical facilities of the INTERSPUTNIK system via its own earth station working in the 6/4 GHz frequency band.

The development of satellite communications in the Czech and Slovak Federal Republic can be summarized by mentioning the following domains.

Fixed satellite service

The Czech and Slovak Federal Republic has extended the second earth station of the INTERSPUTNIK system by equipment for telephone operation.

At present the Czech and Slovak Federal Republic utilizes two earth stations of the INTERSPUTNIK system. On the satellite Stationar 4 in the Pacific Ocean region it utilizes four transponders. Two for analogue transmission of the television signal by the FM method and two for telephone operation. In one radio-frequency channel the signal is transmitted in analogue form by the method FDMA/SCPC/FM and in the other radio-frequency channel in digital form by the method TDMA/PSK/PCM. On the satellite Stacionar 13 in the Pacific Ocean region, one transponder is utilized for analogue transmission of the television signal (FM), the other for analogue transmission of telephone channels, FDMA/SCPC/FM.

The Czech and Slovak Federal Republic utilizes also satellites of the INTELSAT system for telephone operation by means of earth stations of neighbouring countries for communication with the Indian and Atlantic regions.

At present, conditions for the build-up of earth stations of the systems INTELSAT and EUTELSAT on Czech and Slovak Federal Republic territory are being specified.

Mobile satellite service

In 1989 the Czech and Slovak Federal Republic became a member country of the INMARSAT organization and utilizes the system for communication with the Czechoslovak fleet which is equipped with ship stations of the A Standard. On the up-path a coastal earth station in Poland is utilized. The communication is, for the time being, utilized only for sea-going ships.

The Czech and Slovak Federal Republic participates in research and development of satellite communication systems and satellite broadcasting systems within the international scientific programme INTERKOSMOS. Besides theoretical works, there were several experiments made with the transmission of television signals and with the transmission of data up to the data signalling of 20 Mbit/s in laboratory conditions as well as on a real satellite link in the 14/11 GHz band.

DENMARK

Nordic activities in the field of satellite telecommunications:

See under Finland, Iceland, Norway and Sweden.

1. INTELSAT

One earth station with a 13 m antenna diameter currently carrying domestic telephone, data and occasional television traffic has been approved as a Standard A station and is now ready to carry AOR telephone traffic.

2. INMARSAT

An Inmarsat-C earth station with a 13 m combined C and L band antenna has been approved by the INMARSAT and INTELSAT organizations and is now in operation as a coast earth station in the INMARSAT-C system.

3. EUTELSAT

In Denmark there is a growing demand for occasional television transmission via satellite. This could be sports, political or cultural events. For this purpose an earth station with an 11 m antenna has been dedicated.

4. Satellite television and radio reception

Television and radio programmes from INTELSAT, EUTELSAT, ASTRA, TV-SAT and TELE-X are currently received for the cable television networks, among these is The Hybrid Network which is operated by the telephone companies.

5. Other activities

Denmark is participating in the COST 210 project within the European Cooperation on Scientific and Technical Research concerning the influence of the atmosphere on interference between radiocommunication systems.

Various successful synchronization experiments have been performed on the OLYMPUS Specialized Service Payload within the international project team of BT (UK), DB-FTZ (G) and TELECOM Denmark (DK). Phase 1 was terminated with the successful demonstration of 3-beam satellite switched TDMA of standard 2 Mbps data traffic between Denmark and Germany.

EGYPT (ARAB REPUBLIC OF)

1. International communications via Intelsat satellites

In Egypt, international communications are covered by two Intelsat Standard A earth stations, an Arabsat Major earth station and submarine cables. At the end of 1990, communications via satellites were about 37% of the total international traffic with Egypt.

Maadi-1 Standard A earth station has been in operation since 1978 via the Atlantic Ocean Primary path satellite. Presently it handles the traffic with 11 countries on the FDM/FM with a total capacity of 621 circuits.

Maadi-2 Standard A earth station has been in operation via the Indian Ocean primary path satellite since 1984. Currently, it handles traffic with 18 countries on FDM/FM with a total capacity of 420 circuits.

During 1990, 1220 television transmissions and 147 receptions of a total duration of 32,368 minutes were handled by the two earth stations.

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

2. Regional communications via Arabsat satellites

Maadi-5 Arabsat Major C-band earth station (11 m antenna) has been in operation since November 1990 via the Arabsat 1-A 19° E satellite.

Currently, it handles traffic with six countries on FDM/FM with a total capacity of 348 circuits. In addition there are two destinations working on SCPC with a total capacity of 60 circuits during 1990, seven television transmissions and 70 television receptions with a total duration of 2603 minutes were handled via the C/C frequency bands. In addition, a daily (15 hours) television programme is transmitted via the direct broadcast C/S transponder.

3. Maritime satellite communications

Egypt has been a member of INMARSAT since 1979. The Maadi Inmarsat coast earth station has been in operation since October 1987 via the 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.

4. Meteorological satellite application

Since 1969, the Egyptian Meteorological Authority (APT) earth station has been operating with near polar-orbiting satellites to receive both visible and infra-red channels. In 1979, the earth station was modified to operate with

Meteosat 3. In 1982, an earth station was constructed with the capabilities 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 about the different types of cloud systems and associated weather phenomena.

5. Remote sensing from space

The Egyptian Remote Sensing Centre is a part of the 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 satellites data as well as photographic facilities.

The Centre also has a complete photogrametric unit including a modern aircraft equipped with digital and photographic sensors including one of the most advanced photogrametric aerial cameras in addition to the latest computer oriented analytical stereoplotter for digital mapping.

FINLAND

1. Nordic activities in the field of satellite telecommunications

See under Denmark, Iceland, Norway and Sweden.

Telecom Finland owned 14% of the INTELSAT earth station in Tanum, Sweden.

2. Other activities

International video conferencing via the Eutelsat SMT station in Helsinki increased notably during 1990.

Numerous television programme channels originating in Europe and the USA have been received via Eutelsat, Intelsat and the Gorizont satellite for distribution into cable networks as well as by individual receiving stations. Because of the liberal radiocommunications law the number of receiving stations is not known.

Satellite telecommunications traffic showed an unusual surge during the Helsinki Summit Meeting between the Presidents of the United States and the Soviet Union in 1991. Nine television companies installed and used their own portable earth stations, in addition to the four permanent international television circuits available.

FRANCE

In 1990, satellite transmissions had a significant impact on the development of modern telecommunication services.

In this area, French telecommunications are well represented with the international organizations INTELSAT, EUTELSAT and INMARSAT, while the TELECOM 1 national system and the direct broadcasting satellite TDF 1 have continued operating satisfactorily.

1. The TELECOM 1 national system

The TELECOM 1 national telecommunications system, which has been operating since 1985, fulfils three very important tasks for FRANCE TELECOM:

— Telecommunication links between mainland France, French Guiana, Martinique, Guadeloupe, Reunion, Mayotte and Saint-Pierre-et-Miquelon have continued to grow steadily, with nearly 2200 digital circuits in service and two television programmes transmitted overseas.

— A further key activity is the distribution of television and radio channels in mainland France. In addition to the transmission of six television and 21 radio programmes on a permanent basis, temporary links are currently set up for professional video transmissions or sport and news reporting. These activities accounted in 1990 for over 3500 hours of transmission, using either TELECOM 1, INTELSAT or EUTELSAT, as necessary. FRANCE TELECOM's know-how in this sector is internationally recognized, especially where transportable stations are concerned. Apart from the familiar type of coverage, such as the Tour de France or the Paris-Dakar, FRANCE TELECOM also provided the EBU in 1990 with technical facilities for Gulf War reporting.

— The TRANSDYN digital business services continue to operate satisfactorily, with international extensions under an agreement with EUTELSAT.

The satellites of the TELECOM 2 programme, which as of 1992 will be replacing TELECOM 1 satellites, are currently under construction and will help meet the above rapidly growing requirements, especially in the audio-visual field.

2. Intercontinental telecommunications

With a contribution of 4.4% FRANCE TELECOM is the fourth largest investor in the INTELSAT system, after the United States, the United Kingdom and Japan.

Access to INTELSAT satellites has been improved with the introduction of new antennas at Pleumeur-Bodou and Bercenay-en-Othe. The third metropolitan centre for INTELSAT traffic, Rambouillet, apart from conventional traffic, carries some 150 digital data transmission circuits, with bit rates in multiples of 56 or 64 kbit/s. The centre at Aubervilliers is used more for international television transmissions, which also increased significantly in 1990.

3. The European regional system

FRANCE TELECOM plays a major role in the EUTELSAT regional satellite system and accounts for a large proportion of the organization's investments.

Since its contribution is adjusted according to its use of the space segment, in 1990 FRANCE TELECOM was the third largest investor, contributing 13.7% of the capital.

After the successful launch in 1990 of the first of five second-generation satellites, altogether five satellites are now operational enabling EUTELSAT to fulfil its regional objectives:

— transmission of television programmes for cable networks or individual reception over a large part of Europe,

— television transmission between member countries of the European Broadcasting Union,

— spot television transmissions,

— digital telephony between distant European countries,

— data transmission networks for enterprises, operating either on the EUTELSAT or on the TELECOM 1 space segment.

France took a very active part in 1990 in the launch of the Europesat project, which should lead to replacements for TDF and TV-SAT direct television satellites within a few years.

4. Satellite links with mobile units

In 1990 a large part of telephone and telex traffic by satellite to or from ships at sea in the Atlantic Ocean region was routed via the coast station of Pleumeur-Bodou.

A fourth geographical coverage area has been introduced in response to the continued strong growth in traffic. The first of four second-generation satellites was launched in 1990 and four third-generation satellites have been ordered.

This activity is growing rapidly and France's share in INMARSAT currently stands at 4.4%.

The services offered by the world organization and its signatories will be extended in the near future to include low bit-rate data transmissions with mobile land and maritime units, and communications with aircraft.

5. France's direct broadcasting satellite TDF 1

The French direct broadcasting satellite TDF 1 is currently operational. It has now been joined by its twin TDF 2, which was launched in the summer of 1990. Efforts are at present being concentrated on the development of D2MAC receiving equipment and high-definition television transmissions.

GERMANY (FEDERAL REPUBLIC OF)

1. Participation in the INTELSAT and EUTELSAT systems with earth segment equipment

1.1 *INTELSAT*

The volume of INTELSAT traffic continued to increase in 1990. In the regions of the Atlantic and Indian Ocean connection to a total of 77 countries were operated while the number of operating agencies involved increased additionally for some countries.

Business communication (IBS INTELSAT Business Service) was further gaining in importance.

The distribution of television programmes via satellite capacities of INTELSAT was continued without change in 1990. However, the majority of the programmes was distributed by the Federal Republic's own satellites DFS-1 and TV-Sat-2.

At Raisting earth station a new TTC station was established to monitor Intelsat satellites and was put into operation at the end of 1990.

1.2 *EUTELSAT*

In 1990 telephone traffic with five counterparts (Canary Islands, Portugal, Spain, Turkey and Cyprus) was handled via Eutelsat satellites int the TDMA system based on digital transmission technology.

In 1991 telephone traffic to Ireland and Yugoslavia will be added.

In addition, television distribution services, television occasional-use services and a television transmission service for EBU as well as special services (SMS) for business communication purposes (data transmission/videoconferencing, VSAT) are operated.

2. Participation in the INMARSAT system

2.1 *Earth segment equipment*

Early in 1990 the establishment of the German Inmarsat earth station was started. It is planned to be put into operation via the satellite in the Atlantic East region in spring 1991. The earth station will be provided with equipment for handling the Inmarsat Standard A service and the Inmarsat Standard C service.

2.2 *The maritime distress radio call system DRCS*

The preoperational trials and demonstrations of the DRCS system coordinated by INMARSAT were completed succesfully. Seventeen ships from ten nations participated in these preoperations trials.

Deutsche Bundespost Telekom intends to provide a receiver processor for the DRCS in its new Inmarsat earth station, which is to be put into operation at the same time for the Atlantic East region.

3. Studies concerning the mobile radio service via satellite

The DLR (Deutsche Forschungsanstalt für Luft - und Raumfahrt/German Association for aeronautics and space engineering) has developed a frequency-stable Nd:YAG monomode laser with an output power of 620 mW and an experimental coherent optical transmission system for optical communication in space. The transmission system operates with heterodyne reception and differential phase modulation (DPSK) at a wave length of 1064 µm and a bit rate of 565 Mbit/s.

There will be applications for the transmission system suche as links between satellites and spacecrafts and intersatellite links. Trials are planned for the future.

4. German satellite system

4.1 *DFS-2 Kopernikus*

The second German communications satellite DFS-2 Kopernikus was successfully launched in July 1990. It was put into operation early in September 1990 after its positioning at 28,5° E and successful in-orbit tests.

The satellite's payload consists of ten transponders in the Ka band and one transponder in the Ku band. Dual linear polarisation is used for transmission and reception to utilize the frequency bands to a larger extent.

Thus two national satellites are available in the FSS band, which are used for different tasks.

DFS-1 Kopernikus is used exclusively for the distribution of sound and television programmes.

After the unification of Germany DFS-2 Kopernikus has gained special importance for the establishment of the telecommunications infrastructure in the five new states of Germany.

DFS-2 Kopernikus is utilized as follows:

— business communication up to two Mbit/s;

— provision of telephone transmission lines;

— provision of television modulation and televison programme exchange lines;

— provision of capacity for operators of private satellite networks.

5. The OLYMPUS satellite project

Within the OLYMPUS satellite project Deutsche Bundespost Telekom participates in Europe-wide propagation measurements at 12,5 GHz, 19,77 GHz and 20,66 GHz.

For this purpose receiving equipment was procured and installed.

Apart from these measurements radiometer tests were carried out allowing measurements to be made of very low attenuations. Thus propagation attenuations can be recorded reliably also for higher time percentages.

ICELAND

1. Nordic activities in the field of satellite telecommunications

See under Denmark, Finland, Norway and Sweden.

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

At the end of 1990, Skyggnir carried traffic and leased circuits via the Intelsat VI (F-2) satellite at 335.5° E to and from Tanum in Sweden, Goonhilly in the United Kingdom, Fuchsstadt in the Federal Republic of Germany, Buitrago in Spain, Mill Village in Canada and Etam in the United States. The conversion from analogue FDM/FM circuits to digital, type IDR/DCMS circuits, which started in 1989, continued in 1990. At the end of the year, the total number of international circuits was 327, including 238 circuits via IDR/DCME.

In 1983 a Standard B antenna which is co-located with the Standard A antenna commenced operation. The antenna is normally used for television reception only (B-MAC) and accesses a leased television channel in the Intelsat V (F-12) at 359° E. This antenna has also transmission capabilities and is used as a backup for carrying traffic via Intelsat VI (F-2) in case of outage of the Standard A antenna.

Occasional television programmes were transmitted from Skyggnir or received on a number of occasions during 1990.

A daily full time news programme was received with a TVRO via the Intelsat satellite (V-A (F-11)/VI (F-4)) at 332.5° E for distribution to hotels in Reykjavik.

2. EUTELSAT

Iceland has been a member of EUTELSAT since 1985.

During 1990 a number of TVRO antennas were used to receive news and television programmes via the West Spot Beams of the Eutelsat I satellites for distribution to the two television stations (RUV and Channel 2) and to hotels in Reykjavik.

A 7.7 m TVRO in Reykjavik was used to receive daily transmissions via the EBU Eurobeam transponders on the Eutelsat I (F-1) satellite, which is in an inclined orbit at 16° E.

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

INDIA (REPUBLIC OF)

1. Indian national satellite system (INSAT)

1.1 The INSAT system is a joint venture of the Department of Space, Department of Telecommunications, the Indian Meteorological Department and the Ministry of Information and Broadcasting. Insat I-D, the last spacecraft in the first generation Insat-I series was launched in June 1990 and put into operational service in July 1990. Insat I-B, the second spacecraft of the first generation multipurpose Indian National Satellite System (Insat I) launched in August 1983 completed its designed life of seven years in August 1990. Now the satellite is used as a standby for Insat I-D.

The services being provided by the INSAT-I system are:

— long-distance telecommunications (telephony, data, facsimile etc.);
— round-the-clock meteorological earth observation and data relay;
— direct television broadcast to augmented community television sets in rural areas;
— national and regional networking of television and radio transmitters;
— dedicated communication networks for the business and industrial sectors including VSAT networks;
— a Disaster Warning System (DWS) for alerts on cyclonic events;
— a satellite-based news dissemination service for the national news agency is operational;
— satellite-based standard time and frequency dissemination systems.

1.2 The second generation Insat satellites (Insat 2) are being built indigenously. The Insat 2 satellite will provide telecommunications, television broadcasting and meteorological services as in the case of Insat I but with quantitative and qualitative enhancements. A 406 MHz Search and Rescue payload is also included in Insat 2. The launch of the first satellite in the Insat 2 series is planned for 1991.

2. Activities in the satellite communications area

2.1 India is actively contributing to the development of the International Satellite Aided Search and Rescue system for the Maritime, Aviation and Land distress alert detection and position location. The first Local User Terminal (LUT) in India was set up in 1989, the second LUT in 1990. Development of 406 MHz emergency location beacons is also in progress.

2.2 India is establishing an earth station for satellite monitoring. The earth station is being built by the Space Applications Centre of the Indian Space Research Organisation and will be operated by the Wireless Planning and Coordination Wing of the Ministry of Communications.

3. Indian remote sensing satellite

The Indian Remote Sensing Satellite (IRS I-A), launched in 1988, is continuing its useful service. The payload system consists of two types of linear imaging self-scanning cameras with resolution 36.25 m and 72 m. The data transmission is in the X and S-bands.

The IRS I-A data is received by the data reception station at Hyderabad and after reprocessing at the National Remote Sensing Agency, Hyderabad, various data products are generated and disseminated to various users on a requirement basis. About 300,000 images from IRS I-A collected over 50 cycles are now available in the archives. During the year, the National Remote Sensing Agency continued to receive, process and disseminate data from the US Landsat and French SPOT and Metsat satellites besides IRS I-A. The availability of high quality data on a variety of types has strengthened the operation of remote sensing techniques for resource mapping and management. Several studies have been carried out using IRS I-A data through both visual and digital techniques for various application themes such as geology, geomorphology, agriculture, soils, water resources, forestry, environment, etc.

IRS I-A satellite will be followed by IRS I-B and IRS I-E and these satellites are planned to be launched in 1991.

4. ISRO telemetry, tracking and command network (ISTRAC)

Ground stations in ISTRAC provide telemetry, ranging and command support to Indian low earth orbit satellite and launch vehicle missions. ISTRAC provided TTC support to the European Eutelsat II (F-1) and (F-II) missions during launch and early orbit phases.

5. Stretched Rohini satellite series (SROSS)

Sross series satellites are intended for scientific research and experiments. Under this series, the satellite Sross C is under development.

IRAN (ISLAMIC REPUBLIC OF)

The progress made by the Islamic Republic of Iran in the development of space radiocommunications during 1990 is as follows:

In order to expand domestic services, the installation of 61 earth stations operating with Intelsat 66° E has commenced and it is anticipated to be put into operation during the year 1991. They will serve as the main earth-stations of Iran's domestic satellite (Zohreh) network.

ITALY

Most of the activities in space telecommunications in Italy, carried on behalf of the Italian P.T.P. Ministry by Telespazio, can be grouped, particularly into the following branches:

— satellite commercial telecommunications,

— support and in orbit control of satellites,

— studies, experimental and other activities,

— satellite remote sensing.

1. Satellite commercial telecommunications

In its quality as exclusive carrier for space telecommunications in Italy, Telespazio supplies national and foreign traffic management with the necessary means of communications in the framework of the international systems INTELSAT, EUTELSAT and INMARSAT.

The installations of Telespazio are located in the Piana del Fucino in Abruzzi (Fucino Space Centre), at Lake Como (Lario station) and near Palermo in Sicily (Scanzano station).

At the end of 1990, the number of overseas countries linked to Italy by means of Intelsat satellites were 84 for a total of 3301 circuits, of which nine do not terminate in Italy, but transit toward several countries of the Mediterranean area and the Far East.

Moreover, Telespazio provided 1367 circuits via the EUTELSAT system and mobile maritime services through 16 accesses on the INMARSAT system, to the Italian responsible carriers, respectively ASST and DCSR.

As far as television is concerned, in 1990 the total number of services could be estimated as 5826 for an overall duration of 5444 hours.

In response to the development of the national market for telecommunications and in accordance with SIP, Telespazio has promoted the employment of small stations for business services which enable the major national users to set up their own satellite telecommunications networks capable of satisfying the most diverse needs.

2. Support and in orbit control of satellites

On the basis of pluri-annual contracts, Telespazio is responsible for providing the following services:

— TTC&M (Telemetry, Tracking, Command and Monitoring) and IOT (in Orbit Test) to INTELSAT and INMARSAT;

— TTC&M and in Orbit Control to ESA for OLYMPUS;

— TRMS (TDMA Reference and Monitoring Station) to INTELSAT and EUTELSAT;

— TTC&M and in Orbit Control to ASI for ITALSAT.

3. Studies and experiments

During 1990 studies and experimental activities continued with the aim of contributing to the development of future satellite applications and services; the following significant activities were performed:

— starting phase B development for an On Board Processing satellite for ISDN business users in the framework of the PENCOM project of ESA;

— study contract for the evaluation of industrial offer for the development of the satellite Primosat of Intermercato;

— continuing studies to evaluate the possibility of interconnecting or integrating terrestrial cellular and satellite mobile networks in Europe for broadcast communication;

— collaborating in the design and prototype of a satellite communication system supporting a distributed authoring environment for multimedia courseware.

4. Satellite remote sensing

The development of this activity continued throughout 1990 with the following main applications:

— earth observation and remote sensing for forest environment; for the management and preservation of forest heritage, based upon the integrated use of satellite remote sensed data and conventional data;

— marine environment monitoring system; for the management of marine environment quality, as far as pollution, eutrophication and other algal phenomena and problems are concerned;

— service of coastal marine pollution control through spaceborne remote sensing techniques;

— earth observation system for agriculture to support the planning, management and control of agricultural activities.

JAPAN

1. Satellite projects

1.1 *Communications*

1.1.1 *CS-3*

The communications satellite-3 (CS-3), a succeeding system to the communications satellite-2 (Japan's first operational communications satellite), consists of two spacecrafts, CS-3a and CS-3b. CS-3a was launched into the geostation-

ary orbit at 132° E in February 1988 and CS-3b at 136° E in September 1988, respectively, by Japan's H-I launch vehicle from the Tanegashima Space Centre of the National Space Development Agency of Japan (NASDA).

These satellites are spin-stabilized satellites and weigh about 550 kg (beginning of life) in orbit with a design life of seven years. Each satellite is equipped with 12 transponders in operation (10 for 30/20 GHz band, two for 6/4 GHz band) and six spare transponders. CS-3 is being used to offer communications with remote islands, communications in case of disaster, occasional communications and house communications.

The Telecommunications Satellite Corporation of Japan (TSCJ) controls the orbital slots and attitude of CS-3.

1.1.2 *JCSAT-1, JCSAT-2*

JCSAT-1 is the first commercial communications satellite in Japan. It was launched in 1989 by Ariane-4 from the Guiana Space Centre in Kourou, French Guiana. JCSAT-2 was launched in 1990 by Titan-III from the Cape Canaveral Air Force Station, Florida, USA. JCSAT-1 and JCSAT-2 are located in geostationary orbits at 150° E and 154° E respectively.

These satellites are spin-stabilized satellites built by Hughes Aircraft Company and weigh 1.37 tons in orbit with a desigh life of 10 years. Each satellite is equipped with 32 transponders (14/12 GHz band) and eight spare TWTAs.

Japan Communications Satellite Company, Inc. (JCSAT) started its telecommunication service in April 1989 to provide private television network and video transmission to CATV, etc.

1.1.3 *Superbird-A and Superbird-B*

Superbird-A, the commercial communications satellite, was launched into geostationary orbit at 158° E in June, 1989 by Ariane-4 from the Guiana Space Center in Kourou, French Guiana. Space Communications Corporation (SCC) started its telecommunication services in July 1989 to provide SNG (Satellite News Gathering) and video transmission to CATV, etc. SCC discontinued its services in December 1990 due to the Superbird-A accident.

Superbird-B is expected to be launched at the end of 1991. The satellite is a three-axis-stabilized satellite built by Space Systems/Loral and weighs 1.55 tons in orbit with a design life of 10 years. It is equipped with 26 transponders (three for 28/18 GHz band, 23 for 14/12 GHz) and eight spare TWTAs of 14/12 GHz band. A substitute satellite for Superbird-A is expected to be launched in the year 1993.

1.2 *Broadcasting*

1.2.1 *BS-2b*

The broadcasting satellite-2b (BS-2b), launched into the geostationary orbit at 110° E in 1986 by the Japanese N-II launch vehicle from Tanegashima Space Centre and used to provide two-colour television services by the Broadcasting Corporation of Japan (NHK) since 1986, became the back-up satellite of BS-3a in 1990, because BS-3a was launched and located at its final position in the orbit successfully.

1.2.2 *BS-3*

The broadcasting satellite-3 (BS-3), succeeding system to BS-2, consists of two spacecraft, BS-3a and BS-3b. BS-3a was launched into the geostationary orbit at 110° E in August 1990 by H-I launch vehicle from Tanegashima Space Centre. BS-3a was hit by trouble and her total electrical power was down to two thirds (2/3) of the original power. But NHK and JSB (Japan Satellite Broadcasting, Inc. established in 1984) have started providing 3 CHs colour television services (NHK 2 CHs, JSB 1CH) via BS-3a since the end of 1990, on the original schedule. BS-3b will be launched in the summer of 1991. These satellites are three-axis-stabilized satellites and weigh 550 kg in orbit with a design life of seven years. Each satellite is equipped with 3 CHs for NTSC television broadcasting services and High Definition Television broadcasting service.

TSCJ controls the orbital slots and attitudes of BS-2b and BS-3a.

1.2.3 *BS-3H*

BS-3H is a satellite which had been manufactured by General Electric Co. of America and subsequently modified to fit with the specifications of Japanese satellite broadcasting. It will be launched in 1991 by Atlas rocket from Kennedy Space Centre, Florida, USA, as a precautious emergency measure to cope with unexpected situation of BS-3a satellite. It has a seven-year life span and carries three 200 W transponders.

1.3 *Meteorology*

1.3.1 *GMS-4*

The geostationary meteorological satellite-4 (GMS-4) was launched in 1989 by H-I launch vehicle from the Tanegashima Space Centre. The satellite is kept at 140° E performing all missions including VISSR (Visible and Infrared Spin Scan Radiometer) observation, S-VISSR (Stretched VISSR) and WEFAX (Weather Facsimile) transmission and data collection satisfactorily.

1.3.2 *GMS-5*

The geostationary meteorological satellite-5 (GMS-5) is scheduled to be launched in 1994 as the successor to the GMS-4 and is now under development in due course. The satellite will be equipped with a imager capable of imaging the Earth in visible, two adjacent infrared windows (split window) and water vapour channels.

1.4 *Research of space science*

1.4.1 *EXOS-D (Akebono)*

EXOS-D is the fourth upper atmosphere research satellite devoted to the study of the particle acceleration process in the auroral ionosphere from a polar orbit. It was launched in 1989 by M-3S II-4 rocket from the Kagoshima Space Centre of the Institute of Space and Astronautical Science (ISAS). It has been making an important contribution to aurora physics by imaging time-varying aurora in UV and visible regions.

The suprathermal energy particle mass spectrometer (SMS), one of the major experimental instruments, was prepared in collaboration with Canadian scientists.

1.4.2 *MUSES-A (Hiten)*

MUSES-A series using M-type rocket is the new initiative for ISAS.

The first space engineering satellite MUSES-A has been established to conduct engineering experiments such as the lunar swingby and X-band telemetry essential to future planetary missions. It was launched into a double lunar swingby orbit in 1990 by M-3S II-5 rocket from the Kagoshima Space Centre. Starting with the first swingby and injection of Hagoromo into orbit around the Moon in 1990. MUSES-A carried out successive swingby manoeuvers to establish a technology indispensable for future planetary exploration.

1.4.3 *MUSES-B*

MUSES-B, the second space engineering satellite, is for the space VLBI programme. It will be launched into an eccentric earth orbit in 1995 by M-V-1 rocket. Using this satellite, we will be able to obtain fine images of distant celestial objects.

1.4.4. *SOLAR-A*

SOLAR-A, the second solar observation satellite, has wideband X-ray telescopes and a Bragg crystal spectrometer. It will be launched by M-3S II6 rocket in 1991.

Using this satellite, a Japan/United States/United Kingdom collaborative study of solar physics on the occasion of the next solar maximum period will be carried out.

1.4.5 *ASTRO-D*

ASTRO-D, the fourth X-ray astronomy satellite, following the X-ray astronomy satellites Hakucho, Tenma and Ginga, is another Japanese contribution to X-ray astronomy. It will be launched by M-3S II-7 rocket early in 1993. ASTRO-D will carry out a high-throughput grazing-incident by reflecting X-ray telescope.

1.4.6 *GEOTAIL*

GEOTAIL is one of the major satellites in the International Solar-Terrestrial Physics Program (ISTP) devoted to study the structure and dynamics of the Earth's magnetotail, particularly to investigate the particle acceleration by detailed observation of the fields and particles in the magnetotail.

It will be launched by Delta-II rocket in 1992.

1.4.7 *LUNAR-A*

Lunar explorer LUNAR-A is scheduled to be launched early in 1996 by M-V-2 rocket. It will drop three penetrators from orbit around the Moon toward penetration into the Moon's surface. On-board seismometers are supposed to explore the internal structure of the Moon.

1.4.8 *SFU*

The Space Flyer Unit (SFU) is an unmanned, reusable and free-flying platform for multipurpose use. It has been developed by MOE (ISAS), STA (NASDA) and MITI since FY 1987. The mission 1 system of SFU will be launched by H-II launch vehicle in early 1994 and retrieved by Space Shuttle in mid 1994.

1.5 *Space technology*

1.5.1 *MOS*

The Marine Observation Satellite (MOS) is a satellite designed to observe marine phenomena using three kinds of on-board sensors including a Multi-spectral Electronic Self-Scanning Radiometer (MESSR) whose resolution is approximately 50 m, and to establish the fundamental technology needed for an earth observation satellite.

MOS consists of two spacecraft, MOS-1 and MOS-1b. MOS-1 was launched into a sun-synchronous subrecurrent orbit at an altitude of 909 km in 1987 by N-II launch vehicle from the Tanegashima Space Centre. MOS-1b, a succeeding satellite to MOS-1, was launched into the same orbit in 1990 by H-I launch vehicle from the Tanegashima Space Centre.

1.5.2 *JERS-1*

The Japanese Earth Resources Satellite 1 (JERS-1) is a satellite intended to develop optical sensors and synthetic aperture radar (SAR), and to establish the integrated system for observing earth resources. It will have the objectives of making surveys of the nation's land, monitoring agriculture, forestry and fishery, preserving the environment, preventing disaster and monitoring the coast in addition to its main purpose, exploring resources.

JERS-1 will be launched into a sun-synchronous subrecurrent orbit at an altitude of 570 km in early 1992 by H-I launch vehicle.

1.5.3 *ADEOS*

The Advanced Earth Observing Satellite (ADEOS) is a satellite intended to establish platform technology for future spacecraft and inter-orbit communication technology for the transmission of earth observation data. It is equipped with two NASDA sensors; OCTS for marine observation with high precision, and AVNIR for land and coastal observation with high resolution. It also carries six A0 sensors.

ADEOS will be launched into a sun-synchronous subrecurrent orbit at an altitude of 800 km in early 1995 by H-II launch vehicle.

1.5.4 *ETS-V*

The Engineering Test Satellite-V (ETS-V) is a satellite intended to establish the basic technology for the bus systems needed for a three-axis-stabilized geostationary satellite. Using this satellite, the mobile satellite communications experiments with aircraft, ships, etc. has been carried out.

ETS-V is a three-axis-stabilized satellite and weighs 550 kg in orbit. It was launched into geostationary orbit at 150° E in 1987 by H-I launch vehicle from the Tanegashima Space Centre.

1.5.5 *ETS-VI*

The Engineering Test Satellite-VI (ETS-VI) is a satellite intended to develop the spacecraft bus which meets the requirements in the field of satellite communications and broadcasting services in the 1990's, and also to develop the technology for advanced satellite communications in the future.

ETS-VI is a three-axis-stabilized satellite and weighs 2.0 tons in orbit. It will be launched in the summer of 1993 by H-II launch vehicle.

1.5.6 *Communications and broadcasting engineering satellite*

The communications and broadcasting engineering satellite is a satellite intended to develop the new technology in the field of the inter-orbit communication, the advanced satellite broadcasting and the advanced satellite mobile communications, and also develop the multi-frequency integration technology and the 2-ton class advanced spacecraft bus technology.

The communications and broadcasting engineering satellite is a three-axis-stabilized satellite and weighs 2 tons in orbit. It will be launched in early 1997 by H-II launch vehicle.

2. International satellite communications

2.1 *INTELSAT*

Kokusai Denshin Denwa Co. Ltd (KDD; the signatory of Japan to INTELSAT), International Telecom Japan Inc. (ITJ) and International Digital Communications Inc. (IDC) have been providing overseas telecommunication services through the INTELSAT system in Japan.

As of December 1990, 465 analogue channels and 1798 digital bearer channels via Pacific Ocean satellites, and 939 analogue channels and 1549 digital bearer channels via Indian Ocean satellites had been established in Japan.

2.2 *INMARSAT*

KDD, the signatory of Japan to INMARSAT, has been providing maritime satellite communication services through the INMARSAT system in Japan.

During 1990, Ibaraki Coast Earth Station (CES) handled 350 000 ship-to-shore telephone calls, 260 000 shore-to-ship telephone calls, 400 000 ship-to-shore telex calls and 170 000 shore-to-ship telex calls. During the same period, Yamaguchi CES handled 110 000 ship-to-shore telephone calls, 90 000 shore-to-ship telephone calls, 150 000 ship-to-shore telex calls and 70 000 shore-to-ship telex calls.

Note: The number of calls indicated above does not include the calls which do not originate or terminate in Japan.

KOREA (REPUBLIC OF)

1. Introduction

The current situation of the Korean space programme has two classes of project: one is the KOREASAT (Korean domestic communication and broadcasting satellite), the other is the experimental Microsatellite.

2. Programme KOREASAT

The technical specification of the KOREASAT was recently established by the Ministry of Communications of Korea after completing a systematic study to determine the system definition, key parameters, and to perform the conceptual system design of satellite, ground TT & C stations.

The baseline KOREASAT system can be summarized as follows:

— Koreasat comprises two Ku-band geostationary satellites co-located at 116° E of the nominal orbital position;

— Koreasat has multi-purpose functions, one for DBS, another for FSS;

— operational life-time of Koreasat is at least ten years;

— Koreasat is supposed to be launched in 1995.

The KOREASAT system is aiming for the following services:

— direct-to-home broadcasting of standard NTSC TV;

— video relay;

— Inter-city relay;

— rural area/administrative communication;

— high/low speed private communication.

The general characteristics of Koreasat are as follows:

— DBS frequency bands: 14.5-14.8/11.7-12.0 GHz

— FSS frequency bands: 14.0-14.5/12.25-12.75 GHz

— Transponder: DBS 27 MHz × 3ea
FSS 36 MHz × 12ea.

3. Experimental Microsatellite programme

The Korea Advanced Institute of Science and Technology established a research centre, called the Satellite Technology Research Centre (SaTRec) in 1990, in order to promote space science and the spacecraft engineering field as well. SaTReC is planning to launch a microsatellite, in early 1993 or late 1992 as an Ariane vehicle for Auxiliary Payload (ASAP) with the main payload, Topex/Poseidon.

The KITSAT microsatellite programme will have the following objectives:

— to develop low-cost experimental satellites;

— to understand the space environment;

— to obtain proven space technology;

— to promote satellite related education programmes;

— to promote international collaboration.

Four experimental payloads are being considered and one payload on KITSAT is a digital store-and-forward communications transponder supporting many ground stations to communicate with each other through multiple access to the satellite links. Digitalker will transmit the telemetry information or message by the voice synthesizer. The experimental payloads of KITSAT also include an earth imaging camera and a channel electron multiplier.

MADAGASCAR (DEMOCRATIC REPUBLIC OF)

Madagascar has decided to set up a domestic satellite system (DOMSAT) in order to diversify and improve security and the quality of its telecommunication services.

The pilot phase DOMSAT-1, which was completed in 1990, interconnects the Antananarivo-Mahajanga and Antananarivo-Antsiranana links. The network uses INTELSAT's SCPC-VISTA system and operates in the band 4/6 GHz (band C) with the Intelsat V-A (F-12) satellite at 359° E over the Atlantic Ocean. It uses 18 circuits, half of them to Antsiranana and the other half to Mahajanga, with analogue modulation.

The characteristics of the station are given in the table below:

Parameter	Stations	
	Master (Antananarivo)	Peripheral (Antsiranana-Mahajanga)
Antenna	diameter 6 m Scientific Atlanta	diameter 7.3 m, type D1
Number of SCPC/CFM channels	18	9
Tracking	no automatic tracking	no automatic tracking
LNA	80° K	70° K
Transmission gain	49.7 dBi	51.1 dBi
HPA	200 W	125 W redundant
G/T	25.8 dB/K	28.06 dB/K

Telephone and facsimile services are already provided and telegraphy and telex are under study. Subscribers are connected to an OPUS-300 PABX initially designed to accommodate about 100 subscribers. The number of subscribers now connected is given in the table below:

Station	Subscribers connected	Subscribers waiting list
Antsiranana	74	24
Mahajanga	63	70

The second phase of the project (DOMSAT-2) will be the subject of a pre-planning study with a view to integrating the system in the master telecommunication plan prepared for Madagascar by the ITU.

The study will take account of present and future link requirements and of the general objectives laid down by the Administration. The main objective is to provide first-choice routing between Antananarivo and the major towns of Antsiranana, Mahajanga, Toamasina and Toliary.

Other economically strategic places will also be served by the DOMSAT network, e.g. Antalaha, Maintirano, Mananjary, Morondava, Nosy-Be, Sainte-Marie and Tolagnaro. The number and choice of such places will be determined after completion of the planning study. It is expected that mobile stations will be used to meet urgent requirements in inaccessible areas, and that modulation will be of the digital type with fully automatic operation.

MAURITIUS

After going through an open international tender, OTS Co. Ltd. allocated a contract in July 1990 to Satellite Transmission Systems, Inc. of New York, for the supply, test, installation and commissioning of one Intelsat revised Standard A earth station antenna and Intermediate Data Rate (IDR) equipment, with Digital Circuit Multiplication Equipment (DCME).

The implementation of the contract is now well under way and the system is expected to go into operation in early June 1991.

This project will enable the conversion of all our heavy traffic routes from analogue to digital. It will also enable OTS Co. Ltd. to operate IDR carriers directly with an Atlantic Ocean region Intelsat satellite, thereby giving direct satellite access to the United States and other Atlantic Ocean region countries as well as India.

NORWAY

1. Nordic progress in the field of space telecommunications

See under Denmark, Finland, Iceland and Sweden.

The Nordic earth station Eik in Norway, jointly owned by the four telecommunications administrations in Denmark, Finland, Sweden and Norway has been in successful operation in the Indian Ocean region (IOR) since 1982.

From the end of 1990, Eik has also operated an Inmarsat A LES in the Atlantic Ocean region/east (AOR-E).

Early in 1991, Eik was expanded with an Inmarsat (aeronautical ground earth station (GES)) for the IOR.

Furthermore, in 1991, Eik will operate an Inmarsat C LES in the IOR.

2. Domestic satellite communications

2.1 *Intelsat transponders*

The Norwegian domestic satellite system NORSAT A was established to improve the communications between oil production platforms in the North Sea and the Norwegian mainland. The system has been operational since 1976.

A half hemispheric C-band transponder on the Intelsat V-A (F-12) satellite has been purchased for this purpose.

Altogether eight earth stations are in operation:

— the mainland station Eik,
— six platform stations in the North Sea,
— the Isfjord station in the Arctic islands of Svalbard.

In addition, Norwegian Telecom has purchased three Ku-band transponders on the Intelsat V-A (F-12) satellite.

One of the transponders is used for domestic distribution of the two Swedish public service television programmes. The modulation is in D-MAC.

This transponder also carries a VSAT system.

The second transponder is used for a television channel, and for distribution of occasional television from transportable earth stations.

The third transponder is used for another television channel and also for the switched, digital business communications system NORSAT B.

The NORSAT B system consists of a main station located at Eik and several out stations with antenna diameters of 1.8 m or 3.3 m. The data rates offered in the system are 64 kbit/s, 384 kbit/s, 768 kbit/s and 2.048 Mbit/s.

2.1.1 *IBS-stations*

Norway has three stations for IBS-traffic in operation since 1989, two operating in the C-band and located at the Eik earth station, and one operating in Ku-band located at Nittedal outside Oslo.

2.2 *TELE-X transponders*

Norway uses a DBS transponder on TELE-X for transmission of the Norwegian public service television programme, modulated in D-MAC.

2.3 *Eutelsat transponders*

Norway has two Standard 1 SMS stations in operation since 1987, located at Nittedal outside Oslo and at Stavanger.

2.4 *INMARSAT*

Norway is one of the largest shareholders in INMARSAT, and the Nordic Land Earth Station (LES) at Eik has provided services to ship earth stations in the Indian Ocean region (IOR) since 1983.

OMAN (SULTANATE OF)

All the civil works in connection with the modifications of the Al Amerat satellite telecommunications complex at Muscat were completed, including the work of expansion of the Intelsat Standard A earth station.

A new Standard A earth station at Ibri to operate on purely digital links with INTELSAT through AOR (SAT) including the digital links to the earth station will be operational in the early part of the year 1992.

The international voice and non-voice circuits that, worked through Intelsat and Arabsat, from Oman, are mentioned in the following tables.

Al Amerat satellite telecommunications complex

International circuits

			Circuits				
Country	Network	Mode	Voice	Record	Data	Lease	Total
Bahrain	ARABSAT	FDM	21	0	2	5	28
Djibouti.....	ARABSAT	SCPC	2	0	0	0	2
Iraq	ARABSAT	SCPC	3	0	0	0	3
Jordan.....	ARABSAT	FDM	9	0	0	0	9
Kuwait.....	ARABSAT	FDM	6	0	1	0	7
Morocco	ARABSAT	SCPC	3	0	0	0	3
Qatar	ARABSAT	SCPC	12	0	0	0	12
Saudi Arabia....	ARABSAT	FDM	19	0	1	9	29
Sudan	ARABSAT	SCPC	2	0	0	0	2
Tunisia.....	ARABSAT	SCPC	4	0	0	0	4
United Arab Emirates	ARABSAT	FDM	5	0	1	7	13
Yemen Arab Republic	ARABSAT	SCPC	2	0	0	0	2
Total			88	0	5	21	114

Al Amerat satellite telecommunications complex

International circuits

Country	Network	Mode	Circuits				
			Voice	Record	Data	Lease	Total
Australia	INTELSAT	FDM	5	0	0	0	5
Cyprus	INTELSAT	FDM	6	0	0	0	6
Egypt	INTELSAT	FDM	16	0	1	0	17
France	INTELSAT	FDM	15	1	0	0	16
Germany	INTELSAT	FDM	10	0	1	1	12
Greece	INTELSAT	FDM	5	0	0	0	5
India	INTELSAT	FDM	40	1	0	1	42
Italy	INTELSAT	FDM	15	1	0	0	16
Japan	INTELSAT	FDM	5	1	0	0	6
Kuwait	INTELSAT	FDM	7	0	0	0	7
Netherlands	INTELSAT	FDM	9	0	1	0	10
Pakistan	INTELSAT	FDM	22	1	0	1	24
Philippines	INTELSAT	FDM	7	0	0	0	7
Singapore	INTELSAT	FDM	4	1	0	0	5
Spain	INTELSAT	FDM	5	0	0	0	5
Sweden (Nordic countries)	INTELSAT	FDM	4	0	0	0	4
Switzerland	INTELSAT	FDM	4	0	0	0	4
United Kingdom .	INTELSAT	FDM	67	0	1	4	72
United States of America ...	INTELSAT	FDM	9	0	1	1	11
Total			255	6	5	8	274

PAKISTAN (ISLAMIC REPUBLIC OF)

1. Pakistan's experimental satellites

Pakistan's first experimental satellite, BADR-1 was successfully injected into the Earth's orbit at 5:50 AM Pakistan standard time in July 1990 from Xichang Launch Centre of the People's Republic of China on a Chinese Long March 2E launch vehicle.

The salient features of BADR-1 are as follows:

Weight:	52 kg
Orbital period:	96.5 minutes
Apogee (farthest distance from Earth):	992 km
Perigee (nearest distance from Earth):	210 km
Orbital inclination:	28.5 degrees

The satellite was tracked during its very first pass over Pakistan by satellite tracking stations established by SUPARCO at Karachi and Lahore. The satellite, which was launched to test the performance of indigenously developed satellite subsystems in a space environment and to perform experiments to demonstrate store-and-forward type message communication, had provided valuable data during its active life of more than 500 orbits.

2. COSPAS-SARSAT programme

To facilitate search and rescue activities in Pakistan and adjoining areas the Pakistan Local User Terminal (PALUT) and Mission Control Centre (PAMCC) were installed at Lahore, in 1990. The PALUT has the capability to process 121.5 MHz, 243 MHz and 406 MHz frequencies and to locate transmitters and distress beacons in both real time as well as 406 MHz global mode. In addition, it has a 406 MHz bent pipe processor section which can be used for interference monitoring in the region. PAMCC is fully automatic with the latest Standard Interface Description (SID) format incorporated for inter-MCC communications. PAMCC is connected to the international telex network and connection to the ISD network is planned.

The real time coverage of PALUT will include countries from Saudi Arabia to China from west to east and Russia to Sri Lanka and adjacent sea regions from north to south. The PAMCC and PALUT operate 24 hours a day throughout the year. The Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) is responsible for the operation of PAMCC and PALUT.

3. Establishment of ARGOS network

SUPARCO has set up the ARGOS data collection network in Pakistan. The Local User Terminal (LUT) which was commissioned at Karachi around mid 1990 has started a collection of data from a number of Data Collection Platforms (DCPs) located at various remote locations in Pakistan. The prime objective of the ARGOS system is the collection of meteorological, hydrological and environmental data by unmanned, remotely located, DCPs and the acquisition of these data through satellite at conveniently located user terminals. These data could pertain to a wide range of parameters, such as the physical, chemical or biological properties of the solid earth, the Earth's hydrosphere (rivers, lakes, oceans) or the atmosphere. The data acquired by LUT will be provided to a number of national user organizations.

4. Ground receiving stations

The satellite ground stations, one each at Karachi and Lahore, being operated by SUPARCO to track and receive signals from low earth orbit satellites, were augmented during 1990, to track and receive signals from and transmit commands to Pakistan's first experimental satellite BADR-1.

Another station established during 1989 near the federal capital Islamabad for acquisition of satellite remote sensing data from the Landsat, SPOT, and NOAA series of satellites is fully operational.

PORTUGAL

Portugal has informed us of:

— the construction of an earth station at Angra do Heroísmo;

— the digitization of networks throughout the country;

— the purchase of Intelsat A terminals for distress calls.

SPAIN

Contribution by HISPASAT

1990 witnessed the preliminary and critical reviews of the HISPASAT-1 satellite system design, for the first time with the active participation of Spanish engineers and experts.

Technical studies were also carried out to define the best geographical location for the satellite control, tracking and monitoring centre.

In the course of the year, the most important steps were completed in the international frequency coordination process for the country's first satellite communication system (HISPASAT-1), which in view of the multi-service payload, involved numerous administrative procedures and considerable technical complexity.

The systems engineering was also completed for the purpose of defining the telecommunication services that can be carried by a satellite system, as well as technical studies for specifying user terminals that meet industrial, CCIR and ETSI quality, cost and technological environmental standards.

HISPASAT S.A. started participating in the European EUREKA-95 research project for developing high-definition television. It also participated in different international and national forums where it submitted technical contributions, some of which were hailed by the international scientific community (CCIR Plenary Assembly, CCTS/CEPT, ETSI, etc.)

Numerous technical presentations, papers, communications and articles were produced to familiarize telecommunication network designers with satellite communication technology.

Through the implementation of the HISPASAT-1 satellite system, local industry is now acquiring high technology through participation in projects and is cooperating internationally in the development and manufacture of equipment for the space industry.

A permanent secretariat has been set up for development and cooperation in the introduction of satellite telecommunication networks based on the HISPASAT-1 system, covering all the Latin American countries which are actively participating in the scheme.

Robledo de Chavela earth station

Contribution by INTA

Introduction

The Robledo de Chavela station, located 60 km west of Madrid, forms part of the NASA network for tracking both manned and unmanned space vehicles whether in orbit close to the Earth or in outer space.

The station has four antennas:

DSS-63 Cassegrain, diameter 70 m, with three downlinks in bands S, X and L and one uplink in band S.

DSS-61 Cassegrain, diameter 34 m, with two downlinks in bands S and X and one uplink in band S.

DSS-65 Cassegrain, diameter 34 m, with two downlinks in bands S and X and one uplink in band S.

DSS-66 Cassegrain, diameter 26 m, with one downlink and one uplink, both in band S.

Activities

In 1990, the station helped to support the following space missions:

— Voyager 1, interplanetary/interstellar orbit. Photographed Neptune (nearest approach in August) and will continue with the interstellar space study.

— Voyager 2, interplanetary/interstellar orbit. Study of interplanetary and interstellar phenomena.

— Pioneer 6, 7 and 8, solar orbits. Study of interplanetary phenomena at an approximate distance of 0.8-1.2 AU from the Sun.

— Pioneer 10 and 11, interplanetary/interstellar orbits. Study of interplanetary and interstellar phenomena.

— Pioneer 12, in orbit around Venus. Exploration of Venus.

— ICE, solar orbit. Comet exploration.

— Giotto, solar orbit. Comet exploration.

— Magellan, in orbit around Venus. Map, altimetry and reflectivity of Venus.

— Galileo, in orbit around Jupiter. Exploration of Jupiter and its satellites.

— Ulysses, solar orbit. Exploration of the Sun.

— STS, earth orbit. Space shuttle (manned flights).

— AMPTE, earth orbit. Interaction of solar wind with the Earth's magnetosphere.
— DE-1, earth orbit. Earth's electromagnetic field.
— Landsat-5 and Nimbus-7, earth orbits. The Earth's resources.
— Rosat, earth orbit. Study of stars and other celestrial bodies in band X of the electromagnetic spectrum.
— DFS-2, geostationary orbit. Telecommunications.
— TDF-2, geostationary orbit. Direct television.
— BS-3, geostationary orbit. Direct television.
— Eutelsat II-F1, geostationary orbit. Telecommunications.
— HITEN (MUSES-A), earth-moon orbit. Lunar exploration.

Those supports programmes normally involved obtaining tracking data (Doppler shift and transit time of signals received), receiving telemetering data, transmitting commands and conducting radio-scientific experiments (ocultation of transmission signals by stars or rings).

The station also participates in radioastronomy activities, mainly in the field of very long based interferometry.

Villafranca del Castillo earth station

Introduction

The Villafranca del Castillo station is located 25 km west of Madrid and forms part of ESA's ESOC space-vehicle tracking network.

The station has seven antennas:

— Cassegrain, diameter 15 m, with one downlink in band S.
— Cassegrain, diameter 15 m, with one downlink and one uplink, both in band S.
— Cassegrain, diameter 12 m, with one downlink and one uplink, both in band C.
— Parabolic, diameter 4 m, with one downlink and one uplink, both in band L.
— Parabolic, diameter 3 m, with one downlink and one uplink, both in band Ku.
— Cassegrain, transportable, diameter 5.5 m, with one downlink and one uplink, both in band S.
— One 9-dipole antenna, with one uplink in the VHF band.

Activities

In 1990, the station helped to support the following space missions:

— IUE, geosynchronous orbit. Study of stars and other celestial bodies in the ultraviolet band of the electromagnetic spectrum.
— MARECS-B2, geostationary orbit. Maritime communications and mobile links (land and aeronautical).
— OTS-II, geostationary orbit. Communications.
— ECS-1, 2, 4 and 5, geostationary orbits. Communications.
— MOP-1, geostationary orbit. Meteorology.
— Olympus-1, geostationary orbit. Communications.
— Hipparcos, geostationary orbit. Communications.

Such support normally involved obtaining tracking data (Doppler shift and transit time of signals received), receiving telemetering data and transmitting commands.

The station also processes photographs from IUE.

Maspalomas earth station

Introduction

The Maspalomas station in the south of Grand Canary forms part of ESA's EARTHNET and ESOC space-vehicle tracking networks.

The station has two antennas:

— Cassegrain, diameter 10 m, with two downlinks in bands S and L.
— Cassegrain, diameter 15 m, with two downlinks in bands S and X and one uplink in band S.

Activities

In 1990, the station helped to support the following missions:

EARTHNET 10-m antenna

— Landsat-5, earth orbit. The Earth's resources.
— SPOT-1, earth orbit. The Earth's resources.
— NOAA-10 and NOAA-11, earth orbits. Meteorology.
— MOS-1 earth orbit. Marine observation.

This support normally involved receiving and processing data (photographs).

ESOC 15-m antenna

This antenna was installed in 1989 but has not been used.

Existing earth stations

Name of earth station	Antenna diameter (m)	Plant installed	Satellite	Organi-zation	Remarks	Code
Aguimes-1	30.0	April 71	325.5° E	INT	TP, TV, SCPC (TV Spanish peninsula + Canary Islands)	AGU-1
Aguimes-2	13.0	March 90	16° E	EUT	TP (TDMA), TV	AGU-2
Aguimes-3	13.0	Dec. 90	10° E	EUT	National telephony (IDR/SMS)	AGU-3
Aguimes-4	04.57	May 90	10° E	EUT	Inter-island domestic traffic	AGU-4
Barcelona-1	04.5	June 88	7° E	EUT	TVRO (Regional TV) BS San Pedro Mártir	BAR-1
Bilbao-1	04.5	Dec. 88	7° E	EUT	TVRO (Regional TV) BS Santa Maña)	BIL-1
Buitrago-1	29.0	Jan. 68	325.5° E	INT	TP, TV (Spanish peninsula + Canary Islands)	BUI-1
Buitrago-2	30.0	March 70	60° E	INT	TP (TDMA), TV, SCPC	BUI-2
Buitrago-3	30.0	Sep. 73	335.5° E	INT	TP, TV, SCPC, SPADE	BUI-3
Buitrago-5	32.0	May 82	342° E	INT	TP, TV	BUI-5
Buitrago-6	11.0	Dec. 88	332.5° E	INT	Ibero-American TV (EFE Agency Service)	BUI-6
Buitrago-9	13.0	July 90	332.5° E	INT	TV (Atlantic TV channel)	BUI-9
E.T.R.D.-1 - 8	02.4	July 90	S/T	EUT	SMS relocatable	—
E.T.R.D.-10	03.7	July 90	S/T	INT	IBS relocatable	—
E.T.T.-1	07.0	June 88	7° E	EUT	TV (based at Guadalajara)	E-1
E.T.T.-2	04.5	May 89	S/T	EUT/INT	TV transportable (elliptical antenna)	E-2
E.T.T.-3	04.5	May 89	S/T	EUT/INT	TV transportable (elliptical antenna)	E-3
E.T.T.D.-1	02.4	Aug. 89	S/T	EUT/INT	SMS/IBS trans-portable	E-6

Existing earth stations *(cont.)*

Name of earth station	Antenna diameter (m)	Plant installed	Satellite	Organi-zation	Remarks	Code
EFE-1 to 34	01.8	Nov. 89	332.5° E	INT	VSAT data distrib. network transmitting to EFE (EST BUI-6)	—
Ford-Valencia	02.4	Jan. 90	10° E	EUT	SMS relocatable	E-7
G.S.R.-1	04.0	Jan. 86	7° E	EUT	TVRO (based at Guadalajara)	—
G.S.R.-2	04.0	Jan. 86	10° E	EUT	TVRO (based at Guadalajara)	—
Guadalajara-01	18.0	July 85	16° E	EUT	TP (TDMA), TV, TRMS service	GDA-1
Guadalajara-02	13.0	Sep. 90	S/T	EUT/INT	TP (IDR), TV	GDA-2
Guadalajara-03	06.0	June 88	7° E	EUT	SMS business service (teleport)	GDA-3
Guadalajara-04	09.2	Dec. 88	307° E	INT	IBS teleport	GDA-4
Guadalajara-05	09.2	July 89	10° E	EUT	TV (relocatable)	GDA-5
Guadalajara-07	04.57	Dec. 88	10° E	EUT	SMS business service	GDA-7
Guadalajara-09	09.2	Oct. 89	7° E	EUT	TV (relocatable)	GDA-9
Guadalajara-10	04.57	Dec. 88	10° E	EUT	SMS business service	GDA-10
Guadalajara-11	09.2	Nov 90	S/T	EUT/INT	TV (multipurpose)	GDA-11
Guadalajara-12	03.7	Apr. 90	63° E	INT	IBS relocatable Video conference Japan	GDA-12
Lanzarote-1	04.57	May 90	10° E	EUT	Inter-island domestic traffic	LAN-1
Madrid-1	11.0	Dec. 89	332.5° E	INT	TVRO (EBU trans-Atlantic)	MAD-1
Madrid-2	06.4	Nov. 90	10° E	EUT	SMS teleport (Alcobendas)	MAD-2
Madrid-3	09.2	Nov. 90	307° E	INT	IBS teleport (Alcobendas)	MAD-3
Madrid-4	07.0	Nov. 88	359° E	INT	TVRO (Encinar de los Reyes)	MAD-4
Madrid-5	03.0	Nov. 88	332.5° E	ASTRA	TVRO (Encinar de los Reyes)	MAD-5

Existing earth stations *(end)*

Name of earth station	Antenna diameter (m)	Plant installed	Satellite	Organi-zation	Remarks	Code
Malaga-1	04.57	Aug. 89	10° E	EUT	Domestic traffic	MAG-1
Mantis-1	01.9	Apr. 89	S/T	EUT/INT	Portable ES for TV (leased)	E-4
Mantis-2	01.9	Apr. 89	S/T	EUT/INT	Portable ES for TV (leased)	E-5
Melilla-1	04.57	June 90	10° E	EUT	Domestic traffic	MEL-1
Pace-A	01.0	Aug. 88	26° W	INM	Emergency communications	—
Pace-B	01.0	Aug. 88	26° W	INM	Emergency communications	—
Radio Liberty-1	04.5	Dec. 88	7° E	EUT	Digital radio programme (Pals-Gerona)	—
Robledo-1	04.57	Dec. 88	335° E	INT	IBS (NASA)	RBL-1
Rota-1	11.0	July 87	359° E	INT	TVRO (TV for USAF)	ROT-1
S.E.R.-1 to 28	02.4	Sep. 88	7° E	EUT	SER/chain broadcasting (EST Guadalajara-3)	—
S.E.R.-29 to 54	02.4	Apr. 90	7° E	EUT	SER/chain broadcasting (EST Guadalajara-3)	—
Santiago-1	04.5	June 88	7° E	EUT	TVRO (regional TV) (BS Fontecoba)	SGO-1
Stock-26	02.4	March 90	S/T	EUT/INT	26 ES receivers (2Mbit/s) (SER chain type)	—
Torrejon-1	11.0	July 87	359° E	INT	TVRO (TV for USAF)	TOR-1
Torrejon-2	03.0	Oct. 88	332.5° E	INT	TVRO (TV for USAF)	TOR-2
Zaragoza-1	11.0	July 87	359° E	INT	TVRO (TV for USAF)	ZAR-1

TP Frequency-division multiple access (FDMA) telephony and data
TV Television
SCPC Single channel per carrier telephony and data
SPADE Telephony – SCPC multiple access demand assignment equipment
TDMA Time-division multiple access telephony and data
TVRO Television receive only earth station
SMS EUTELSAT business services
IBS INTELSAT business services

SWEDEN

Nordic activities in the field of satellite telecommunications

See under Denmark, Finland, Iceland and Norway.

1. Intelsat earth station

The Intelsat earth station at Tanum in Sweden, now jointly owned by Sweden and Finland, has been in successful operation in the Atlantic Ocean region since 1971.

At the end of 1990 the station carried traffic from the four Nordic countries to 34 destinations. The station was equipped for preassigned digital as well as analogue telephony. It was also equipped for the transmission of two television programmes.

Two new Intelsat Standard A antennas were installed during the year 1990. The new antennas will be used for Nordic eastbound traffic by the use of the Intelsat Indian Ocean satellites.

The station also carried data traffic via a Standard E antenna, designated for Intelsat Business Services (IBS) traffic.

The Tanum earth station also provided test and monitoring for the TDMA and SSTDMA systems on behalf of INTELSAT.

2. Eutelsat earth station

Sweden is a member of EUTELSAT.

An earth station situated in Aagesta, south of Stockholm, Sweden, is jointly used by the Nordic countries for services via the EUTELSAT system.

At the end of 1990 the number of destinations of the TDMA system for preassigned digital telephony was 11.

The earth station was also used for television transmissions within the European Broadcasting Union (EBU) network and for uplinking of television to cable networks.

3. The TELE-X satellite system

The Swedish DBS and data communications satellite TELE-X, launched in 1989 and located at 5° E, is operated by the Swedish Space Corporation and, in 1990, carried television and data traffic for customers in Sweden, Norway and Finland.

SWITZERLAND (CONFEDERATION OF)

1. INTELSAT network

The three class A antennas, Leuk-1, Leuk-2 and Leuk-3, handle traffic over the Atlantic and Indian Oceans with high reliability. At the end of 1990, more than 1630 channels were being operated over the three antennas with 59 partner countries. The multiplexing/modulation techniques used in the three systems are: FDM/FM, SCPC/PSK (phase-shift keying), TDMA/PSK and IDR/PSK (IDR = digital carrier used in conjunction with digital concentration).

2. EUTELSAT network

The class 1 ECS antenna (41 dB/K in band K) has been handling telephone traffic in TDMA mode and television traffic in FDM/FM in the EUTELSAT network since 1986 and 1985, respectively. By the end of 1990, more than 600 telephone and data channels were being operated with 10 partner countries via the ECS-F1 satellite at 16° E. Availability of the TDMA equipment exeeded 99.96%.

Three antennas for exhanging television programmes between EBU members are now nearing completion (TV/OR). All are located near television studios in Geneva, Zurich and Lugano. Their main technical characteristics are: antenna diameter of 7.6 m, G/T = 33 dB/K, all designed initially to receive up to four PAL or SECAM television programmes simultaneously, with sound in synch. Transmission equipment may optionally be installed later. All point to the same Eutelsat satellite.

A temporary television receiving antenna with a diameter of 9 m, G/T = 34 dB/K, is installed and operating at Basel. It is used for occasional television transmissions, which are increasing in number each year.

THAILAND

1. International telecommunications

At the end of 1990, three satellite earth stations, namely, Siracha-II, Siracha-IV, and Siracha-V were dedicated for international telecommunications services via Intelsat satellite at 60° E, 63° E and 174° E over the Indian and Pacific Oceans.

The Siracha-IV earth station, which is planned for 174° E satellite, has employed FDM/FM, IBS, and IDR technology. The IBS and IDR services are new digital voice/data carriers introduced in 1990. Presently, Siracha-II employs only FDM/FM technique for voice graded services. It is used for 63° E satellite. Siracha-V, as the replacement of Siracha-II, was introduced in early 1990. It employs TDMA/DSI technology which is a digital carrier, SCPC, and FDM for 60° E satellite. In 1991, Siracha-V will also provide the IDR and IBS services to the Indian Ocean region.

Besides voice graded services, television transmission service is also provided via these earth stations.

2. Domestic telecommunications

2.1 As of the end of the year 1990, there were six television receive only (TVRO) earth stations for the domestic satellite network run by the Communications Authority of Thailand (CAT) via Intelsat satellite. Another sixteen earth stations have the extended capability to provide both television transmission service and voice graded services. Moreover, there are eight more earth stations serving only voice graded services.

In up-grading the domestic satellite network from the present conventional SCPC system to a more digitalized network, CAT plans to implement the IDR system into the domestic satellite network in 1991. Five main earth stations at Chiang Mai, Khon Kaon, Chanthaburi, Phuket, and Hat Yai will be included during the first stage.

2.2 Domestic communications via Palapa satellite are run by the Domestic Satellite (DOMSAT) Communications Centre of the Post and Telegraph Department.

The usage of Palapa space segments in 1990 is 4 1/4 transponders for the purposes of domestic communications applications. The leased transponders are designed to provide a variety of telecommunications services that encompass the distribution of two television programmes and the transmission of sound, voice, telex, facsimile and data. The networks have approximately 84 earth stations including a certain number of mobile earth stations that are equipped with 12 two-way voice channels and a TDMA system to be used as the back up to the terrestrial telephone network.

The utilization of satellite communications has rapidly grown and evolved to become an integral part of the national telecommunication infrastructure. Therefore, the Government has been considering the proposals of the private sectors to grant a concession to launch the country's satellite.

3. Meteorological satellite applications

Since the completion of the Meteorological Satellite Receiving Station in February 1990, the Thai Meteorological Department has been routinely acquiring weather satellite data for its operation. Such data include the Advanced Very High Resolution Radiometer (AVHRR) from the polar-

orbiting satellites, NOAA-10, NOAA-11 and the Stretched Visible Spin Scan Radiometer (SVSSR) from the geostationary satellite, GMS-4. The AVHRR and SVSSR data have been incorporated into daily weather forecasting and typhoon tracking activities. In addition, the Thai Meteorological Department is conducting research on drought early warning, vegetation monitoring, and flood forecasting applications.

4. Remote sensing activities in Thailand

The development of remote sensing applications using satellite data has become more successful since 1987 due to the capabilities of receiving, processing and providing the multi-level satellite data of Landsat MSS and TM, SPOT and MOS-1 by Thailand ground receiving stations. For the year 1990, the remote sensing activities in Thailand satisfactorily expanded. Several operational projects were actively conducted both in the government agencies and in the private sectors since it is now increasingly viable by a lower cost as compared to the conventional methods. The User Service Centre therefore recorded nearly a 100% increase in the value of satellite data distribution.

Regional and international cooperation was still a main activity in 1990. Research cooperation with China and Japan was in the form of study visits, exchange of researchers and conduction of joint projects. Cooperation with Australia was also initiated last year. Thailand, in cooperation with the Environmental Research Institute of Michigan (ERIM), organized the 23rd International Symposium on Remote Sensing of Environment in Bangkok in 1990 and under CIDA sponsorship. McGill University and Khon Kaen University, located in the northeast of Thailand, also organized the seminar on Remote Sensing and GIS for Soil and Water Management. Besides, Thai scientists actively participated in conferences or seminars on Remote Sensing held in and outside the country in order to broaden and exchange views and ideas in the use of satellite data for the benefit of the country and the region. For instance, at the 11th Asian Conference on Remote Sensing held in Guangzhou, China, in November, fourteen papers from various Thai government agencies were presented.

In the area of research support of FY 1990, the National Research Council of Thailand provided funding for thirteen projects submitted by Thai researchers. The total value of the grants amounted to 1.3 million Baht.

TURKEY

In our country, the most important development in space communication during 1990 was the study to realize the National Communication Satellite System.

For the purpose of providing communication services (such as cable television, television broadcasting, special services, telephone services) faster and economically, a bid for TURKSAT satellites system was declared at the end of 1989. The companies of Hughes (USA), British Aerospace (England), Aerospatiale (France) participated in the bid. After technical and administrative studies in 1990, the said project was awarded to the consortium headed by Aerospatiale Company.

The first Turksat satellite will be launched in its orbital position at the beginning of 1994. One year after, the second one will be launched. They will provide 16 communications channels, six wideband (usable bandwidth 72 MHz) and 10 narrowband (usable bandwidth 36 MHz). Operating frequencies will be at Ku-band. Turksat satellites will have a three-axis stabilization system, its maximun dry mass will be around 850 kg and its minimum life time is expected to be 10 years.

In parallel with the TURKSAT project, it has been planned to establish a Space Research Institute, for the purposes of promoting activities in the field of space sciences; training of personnel in the space technologies area; development, launching and operation of scientific satellites.

UGANDA (REPUBLIC OF)

The Uganda Administration communicated the following:

Plans for installation of ground satellite communications equipment are under way.

ZAMBIA (REPUBLIC OF)

Introduction

The Zambia Posts and Telecommunications Corporation limited is a member of INTELSAT and operates two earth station antennas, i.e. Mwembeshi I-A (60° E) and Mwembeshi II-A (335.5° E) facing the Indian and Atlantic Ocean regions respectively. Mwembeshi I meets a figure of merit of 40.7 dB/k and Mwembeshi II has a figure of merit of 35 dB/K under Intelsat revised A.

Mwembeshi I-A (MWB-I-A) transmits and receives from eight destinations using two FM/FDM carriers. Mwembeshi II-A (MWB-2-A) has a capacity to operate in the Intelsat extended band at 6/4 GHz. This station transmits and receives from six destinations using two FM/FDM carriers and SCPC equipment with fourteen channels.

Developments made during the period 1990-1991

Zambia activated the first two SCPC circuits to Lesotho. This opened Zambia's first satellite direct link to her remote SADCC member correspondent in the region and Africa, apart from South Africa, after the commissioning of the PANAFTEL microwave link which made Kenya go to microwave. Zambia also installed and commissioned the television Standard converters. This enables Zambia to receive television from North America via MWB-2-A.

At the moment we are embarking on a programme of digitalization of satellite links. It is hoped that the comissioning of the Digital intermediate data rate single destination carrier to the United Kingdom with digital circuit multiplication will be done before the end of this year.

Efforts will continue to be made until we operate multi-destination digital IDR carriers to most of our correspondents.

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

Booklet No. 26 — CCIR 50th Anniversary (1929-1979)

Booklet No. 27 — Nineteenth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1980)

Booklet No. 28 — 1979 ITU Technical Co-operation

Booklet No. 29 — Twentieth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1981)

Booklet No. 30 — Twenty-first Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1982)

Booklet No. 31 — Twenty-second Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1983)

Booklet No. 32 — Twenty-third Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1984)

Booklet No. 33 — Twenty-fourth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1985)

Booklet No. 34 — Twenty-fifth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1986)

Booklet No. 35 — Twenty-sixth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1987)

Booklet No. 36 — Twenty-seventh Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1988)

Booklet No. 37 — Twenty-eighth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1989)

Booklet No. 38 — Twenty-ninth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1990)

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