INTERNATIONAL TELECOMMUNICATION UNION

Twenty-seventh Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space

Booklet No. 36

Geneva 1988

ISBN 92-61-03211-7

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TWENTY-SEVENTH REPORT OF THE INTERNATIONAL TELECOMMUNICATION UNION ON TELECOMMUNICATION AND THE PEACEFUL USES OF OUTER SPACE

Introduction

This report provides information on the action taken by the International Telecommunication Union (ITU) with regard to outer space since the submission of the Twenty-Sixth Report in 1987.

It is submitted for the attention of the United Nations Committee on the Peaceful Uses of Outer Space and of the Economic and Social Council (ECOSOC) and for the information of Members of the Union.

While the Plenipotentiary Conference is the supreme organ of the Union, the work of international regulation is done at world administrative conferences; these are intergovernmental conferences and the regulations they adopt have the force of international treaties. The international registration of frequency assignements for space telecommunications is carried out by a permanent organ of the ITU, 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 and their operation and the general use of telecommunications in outer space are conducted by two other permanent organs, the International Radio Consultative Committee (CCIR) and the International Telegraph and Telephone Consultative Committee (CCITT). Work concerning space applications in developing countries is entrusted to the Technical Cooperation Department of the General Secretariat of the ITU.

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*

No World Administrative Radio Conference with an agenda relating specifically to space matters was held in 1987.

Nevertheless, the World Administrative Radio Conference for the mobile services (MOB-87) which was held in September 1987 found practical ways to enable the implementation of new forms of satellite communication, for example, the radiodetermination satellite services and land mobile-satellite services in certain bands with common user sharing between services having primary allocations, for example land mobile-satellite service with the aeronautical mobile-satellite services, to respond to the growing needs of users. Article 8 of the Radio Regulations entitled "Frequency Allocations" was accordingly modified to make provisions for these requirements.

Furhtermore, in Chapter XII of the Radio Regulations, to be henceforth called "Land mobile service and land mobile-satellite service", a section has been inserted relating to land mobile earth stations of the land mobile-satellite service. The "Land mobile earth station" was defined by the Conference as a "mobile earth station in the land mobile-satellite service capable of surface movement within the geographical limits of a country of a continent".

The regulatory basis and definitive frequency provisions for the Global Maritime Distress and Safety System (GMDSS), which would extensively use satellite based facilities, were also established. Accordingly a new Chapter IX dealing with distress and safety communications in the GMDSS was established containing all the provisions with a specific bearing on the GMDSS. This will permit to carry forward the implementation of the new distress and safety system.

The partial revision of the Radio Regulations carried out by the Conference will enter into force on 30 October 1989.

The Administrative Council at its 42nd Session (15-26 June 1987), maintained the dates of the Second Session of the World Administrative Radio Conference on the Use of Geostationary Satellite Orbit and the Planning of the Space Service Utilizing It. This session will take place in Geneva from 29 August to 5 October 1988.

This Second Session will establish revised or new regulatory provisions to include implementation of a dual planning approach for the fixed-satellite service. This involves on the one hand an allotment plan and associated regulatory procedures in certain bands and, on the other, improved planning and procedures, including multilateral planning meetings, in certain other bands. Regulatory provisions will also be adopted to meet improved planning and co-ordination requirements for other services in order to meet the needs of all Members of the Union.

The International Frequency Registration Board (IFRB) commenced its inter-sessional activities on the basis of the Report to the Second Session. In this regard, the IFRB developed a document (ORB System) which is intended to provide Administrations with a detailed description of the inter-sessional activities. This document also contains a number of working assumptions adopted by the IFRB in order to proceed with the planning exercises. The main inter-sessional tasks under-

taken are the establishment of the standardised technical parameters to be used for the planning exercises and the development of computer software that will permit the execution of planning exercises and the preparation of a plan by the Conference in the frequency bands designated for the Allotment Plan.

In this respect, Administrations were requested to submit their requirements, and planning exercises using the working assumptions have been undertaken.

For the feeder-link Plan related to the Broadcasting Satellite Service in 12 GHz band in Regions 1 and 3, appropriate computer software to be used for the inter-sessional planning exercises and for the planning at the Second Session, was developed. Three initial planning exercises in accordance with the Report to the Second Session, have already been carried out.

The results of the three initial planning exercises were reported to Administrations and those who wished to submit adjustments to their requirements were invited to do so.

The IFRB organized the Second Information Meeting regarding the Conference from 25 to 27 May 1987. The ORB System document was revised to take account, where practicable, of the comments made during this Meeting. A Third Information Meeting is scheduled from 16 to 18 March 1988.

A special meeting of the Joint Interim Working Party JIWP/ORB(2) of the International Radio Consultative Committee (CCIR) held in December 1987 has finalised a Report which will serve as a basis on which the Conference itself will be able to make the appropriate decisions concerning technical aspects (see para. 3.3.1).

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

2.1 Since the publication of the Twenty-Sixth Report, the IFRB has continued to apply the relevent 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 and a Resolution of the World Administrative Radio Conference, Geneva 1979.

2.2 In 1987, the IFRB received information relating to 66 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)	TV-SAT (TV-SAT 2) (TV-SAT 3)	Satellite system comprising two satellites and a spare satellite at 19 degrees west, which will provide broadcasting services in accordance with the Final Acts of the BC-WARC, Geneva, 1977. (2 GHz, 11 GHz, 17 GHz)
Saudi Arabia	ARABSAT (ARABSAT 1-C)	Satellite system operating within the fixed-satellite service to provide telephony, television and data for public services. (4/6 GHz)
	SABS (SABS-1)	Saudi Arabian Broadcasting Satellite System for television and radio networking, which will provide domestic television broadcasting for direct reception and networking of all medium-wave broadcasting stations in the Kingdom. (11-12/14 GHz)
Australia	AUSSAT (AUSSAT B1-MOB) (AUSSAT B2-MOB)	Satellite system which will provide aeronautical mobile-satellite services for Australia. (< 2 GHz, 12/14 GHz)
	(AUSSAT B1) (AUSSAT B2)	Satellite systems replacing AUSSAT I and II respectively, which will provide fixed and broadcasting services to Australia. (12/14 GHz)
	(AUSSAT B1 NZ) (AUSSAT B2 NZ)	Networks which will include part of AUSSAT B1 and AUSSAT B2 spacecrafts and which are intended to provide fixed-satellite services to New Zealand. (12/14 GHz)
	ACSAT-1	Satellite network which will provide government communication satellite services for Australia. (7/8 GHz)
Belgium	SATCOM (SATCOM IV)	Satellite system providing fixed-satellite and maritime mobile-satellite services to earth stations on the European and American continents. (< 1 GHz, 7/8 GHz, 43/45 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
Belgium (cont.)	(SATCOM-PH III B)	Satellite system operating in the fixed-satellite service which will interconnect earth stations on the European and American continents. (< 7/8 GHz)
Brazil	MECB/S1*	Low-orbit experimental meteorological satellite system designed for collection and dissemination of meteorological information acquired by data-collecting platforms distributed over the Brazilian territory. (< 1 GHz, 2 GHz)
	SBTS (SBTS B2, B3) (SBTS C2, C3)	Extension of the Brazilian Satellite Telecommunication System consisting of several networks which will provide television, telephony and data communication services. (4/6 GHz, 12/14 GHz)
	(SATS-1) (SATS-2)	Extension of the Brazilian Satellite Telecommunication System (SBTS) comprising two distinct satellite networks. These networks will provide communication services to South American countries excluding Brazil. (4/6 GHz)
China (People's Republic of)	FY-1*	Satellite system providing a worldwide civil meteorological-satellite service. The satellite will have the capability to transmit the satellite cloud image broadcasting and acquisition signals in the specified frequency bands allocated to the meteorological-satellite service. (< 2 GHz)
United States of America	FLTSATCOM-A (FLTSATCOM-A WEST PACIFIC, A INDIAN OCEAN)	Communications satellite system for exclusive government use providing services to the Atlantic Ocean region, Pacific Ocean region and the Indian Ocean region in the mobile-satellite and the fixed-satellite service. (< 1 GHz, 7/8 GHz)
	FLTSATCOM-B (FLTSATCOM-B INDIAN OCEAN)	Communications satellite system for exclusive government use providing services to the Atlantic Ocean region, Pacific Ocean region and the Indian Ocean region in the mobile-satellite service. (20-21/43-45 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
United States of America	FLTSATCOM (FLTSATCOM INDIAN OCEAN)	Communication satellite system for exclusive government use providing services to the Atlantic Ocean region, Pacific Ocean region and the Indian Ocean region in the mobile-satellite and the fixed-satellite service. (< 1 GHz, 7/8 GHz)
	COBE* (COSMIC BACKGROUND EXPLORER)	Satellite network designed to measure diffuse radiation of the universe. COBE spacecraft will carry scientific measuring instruments which will gather information relating to the origin, evolution and nature of the universe. (2 GHz)
	USASAT (USASAT 13L, 13M, 13N)	Satellite system providing domestic communication services. (11-12/14 GHz)
	ACS (ACS-4) (ACS-5) (ACS-6) (ACS-7)	Satellite system providing communications within the aeronautical mobile-satellite service. (< 2 GHz)
United States of America (on behalf of the Administrations of member countries of INTELSAT)	INTELSAT (INTELSAT VI 63E)	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	SPOT* (SPOT-4) (SPOT-5)	Satellite system providing earth exploration-satellite service. (< 1 GHz, 2 GHz, 8 GHz)
	SPOT-2*	Stand-by model of the SPOT-1 satellite which would be launched in the event of a break-down of the SPOT-1 picture-taking or transmission system. (2 GHz, 8 GHz)
	ZENON (ZENON-A) (ZENON-B) (ZENON-C)	Satellite network forming part of a satellite system comprising three geostationary satellites, which will provide a communications service with the aeronautical mobile stations. (< 2 GHz, 2 GHz, 4/6 GHz, 11-12/14 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
France (cont.) (on behalf of the Administrations of member countries of the European Telecommunications Satellite Organization)	EUTELSAT (EUTELSAT II-10E)	Satellite system which will replace EUTELSAT I series by a new series of satellites of higher capacity. The system will offer services in the Space operations and Fixed-satellite service. (2 GHz, 10-12/14 GHz)
India (Republic of)	SROSS-II*	Satellite network intended for scientific and remote-sensing experiments with the objective of carrying out studies in the area of cloud stereoscopy geology, cartography and detection of Gamma-ray bursts. (< 1 GHz, 2 GHz)
Iran (Islamic Republic of)	ZOHREH (ZOHREH 4)	Satellite network consisting of two control stations and a variety of telecommunication and television distribution stations. (10-12/14 GHz)
Japan	SUPERBIRD (SUPERBIRD-A) (SUPERBIRD-B)	Satellite system providing domestic public telecommunications services and mobile telecommunication services for exclusive government use. (7/8 GHz, 12/14 GHz, 20/30 GHz)
	EXOS-D*	Scientific satellite system for observation of the acceleration mechanism of aurora particles in the magnetic exosphere. (< 1 GHz, 2 GHz)
United Kingdom (on behalf of the Administrations of member countries in the International Maritime Satellite Organization) (INMARSAT)	INMARSAT (INMARSAT AOR-CENTRAL IA, IIA)	Satellite system to provide commercial international public correspondence maritime and aeronautical (R) telecommunication services, as well as ship-to-shore distress and safety operations (EPIRBS) to the Atlantic Ocean Region. (< 2 GHz, 4/6 GHz)
Union of Soviet Socialist Republics	VOLNA (VOLNA-19, 21, 23, 25, 27)	Satellite system providing communications in the mobile-satellite services. (< 1 GHz)
	TOR (TOR-15, 17, 18, 19, 20)	Satellite system consisting of several networks intended for telephony, telegraphy and phototelegraphy within the fixed and mobile-satellite services. (18/19/20 GHz, 42/43/45 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
Union of Soviet Socialist Republics (cont.)	STATSIONAR (STATSIONAR-25, 26, 27)	Satellite system consisting of several networks intended to provide telephone, telegraphic and photographic communications and broadcast radio and television programmes. (4/6 GHz)
	GOMS (GOMS-M) (GOMS-1M) (GOMS-2M)	Satellite system consisting of three geostationary satellites, intended for collection and dissemination of meteorological data and for transmission of data on the fixed terrestrial network. (7/8 GHz)
	GALS (GALS-15, 16, 17)	Satellite system planned for the exclusive use of the government, which will provide fixed-satellite service. (7/8 GHz)

* Non-geostationary

2.3 In addition in 1987, the IFRB published the necessary information concerning the request for coordination of space service, assignments relating to 109 geostationary satellite networks for which advance publication has already been made. Assistance to some Administrations was also provided on request, in the coordination of frequency assignments to stations in the space radiocommunication services.

2.4 In 1987 the IFRB received 3841 frequency assignment notices for stations in the space radiocommunication services submitted for recording in the Master Register. These notices consisted of 524 notices relating to 30 space stations, received from 8 Administrations and 3317 notices relating to 271 earth stations, received from 34 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

(RR1042, RR1060, RR1488-1491)

(31.12.1987)

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
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		1			5	6												
175.00 W C	PNG	PACSTAR-2				4		6				12		14						
171.00 W N	USA	TDRS WEST			2									14	15					
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-D2				4		6												
170.00 W A	URS	TOR-5															18	19	20	45
170.00 W N	URS	VOLNA-7	0	1																
169.50 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 A	URS	STATSIONAR-26				4	5	6												
149.00 W N	USA	ATS-1	0			4		6												
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 A	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 A	USA	US SATCOM 2-R				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 C	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 N	USA	USGCSS PH2 E PAC							7	8										
135.00 W N	USA	USGCSS PH3 E PAC			C2				7	8										
134.00 W N	USA	USASAT-11D				4		6												
134.00 W C	USA	USASAT-16C										12		14						
132.00 W C	USA	USASAT-11C										12		14						
131.00 W N	USA	US SATCOM 3-R				4		6												
130.00 W C	USA	ACS-3		1																
130.00 W C	USA	USASAT-10D										12		14						
130.00 W A	USA	USRDSS WEST		1	2		5	6												
128.00 W C	USA	ACS-1				4		6				12		14						
128.00 W N	USA	COMSTAR D-1				4		6												
126.00 W C	USA	USASAT-10C										12		14						

A Only advance publication under RR1042
C Presently being coordinated under RR1060
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
126.00 W C	USA	USASAT-20A				4		6												
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 C	USA	USASAT-10A										12		14						
120.00 W C	USA	SPACENET-1				4		6				12		14						
119.00 W N	USA	US SATCOM-2				4		6												
117.50 W N	CAN	ANIK C-3										12		14						
116.50 W N	MEX	MORELOS 2				4		6				12		14						
113.50 W N	MEX	MORELOS 1				4		6				12		14						
110.50 W N	CAN	ANIK D-2				C4		C6												
110.50 W A	CAN	TELESAT E-B				4		6				12		14						
110.00 W N	CAN	ANIK C-2										12		14						
107.50 W N	CAN	ANIK C-1										12		14						
107.50 W A	CAN	TELESAT E-A				4		6				12		14						
106.50 W A	CAN	MSAT	0	C1	2						11	12	13	14						
105.00 W N	USA	ATS-5	0	1																
105.00 W N	USA	FLTSATCOM-A E 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						
101.00 W C	USA	USASAT-16B										12		14						
101.00 W C	USA	USASAT-17A				4		6												
100.00 W A	USA	ACS-1		C1																
100.00 W A	USA	ACTS																19	20	30
100.00 W N	USA	FLTSATCOM E PAC	0						7	8										
100.00 W N	USA	FLTSATCOM-B E PAC																	20	44
100.00 W A	USA	USRDSS CENTRAL		1	2		5	6												
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 C	USA	TELSTAR-3A				4		6												
97.00 W N	USA	USASAT-6A										12		14						
95.00 W N	USA	COMSTAR D-2				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 A	USA	ADV. WESTAR 1				4		6				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												
89.00 W A	ASETA	CONDOR-B				4		6												
88.50 W C	USA	SPACENET-3				4		6				12		14						
88.50 W A	USA	USASAT-12D				4		6												
87.00 W N	USA	COMSTAR D-3				4		6												
87.00 W A	USA	TELSTAR-3B				4		6												
87.00 W A	USA	USASAT-9B										12		14						
86.00 W N	USA	ATS-3	0																	
86.00 W C	USA	USASAT-3C				4		6												
85.00 W A	ARG	NAHUEL-2				4		6				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
85.00 W C	USA	USASAT-9C										12		14						
83.00 W A	CUB	STSC-1				4		6												
83.00 W N	USA	USASAT-7B				4		6												
83.00 W C	USA	USASAT-9D										12		14						
81.00 W N	USA	USASAT-7D				4		6				12		14						
80.00 W A	ARG	NAHUEL-1				4		6				12		14						
79.00 W N	USA	TDRS CENTRAL			2									14	15					
79.00 W A	USA	TDRS-C2			2									14						
79.00 W C	USA	USASAT-11A										12		14						
79.00 W C	USA	USASAT-12A				4		6												
77.50 W A	ASETA	CONDOR-A				4		6												
77.00 W C	USA	USASAT-11B										12		14						
76.00 W C	USA	USASAT-12C				4		6												
75.40 W N	CLM	SATCOL-1A				4		6												
75.40 W N	CLM	SATCOL-1B				4		6												
75.00 W N	CLM	SATCOL-2				4		6												
75.00 W N	USA	GOES EAST	0	1	2															
75.00 W C	USA	USASAT-18A										12		14						
74.00 W C	USA	USASAT-7A				4		6												
73.00 W C	USA	USASAT-18B										12		14						
72.00 W A	ASETA	CONDOR-C				4		6												
72.00 W C	USA	ACS-2		1																
72.00 W C	USA	USASAT-8B				4		6												
71.00 W C	USA	USASAT-18C										12		14						
70.00 W A	B	SATS-1				4		6												
70.00 W N	B	SBTS A1				4		6												
70.00 W A	USA	FLTSATCOM-B W ATL																	20	44
70.00 W A	USA	USRDSS EAST		1	2		5	6												
69.00 W C	USA	USASAT-7C				4		6				12		14						
67.00 W C	USA	USASAT-15D										12		14						
67.00 W C	USA	USASAT-8A				4		6												
65.00 W A	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						
64.00 W C	USA	USASAT-14D				4		6												
64.00 W C	USA	USASAT-15C										12		14						
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						
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												
58.00 W C	USA	USASAT-13E									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 C	USAIT	INTELSAT IBS 304E				4		6			11	12		14						
56.00 W C	USAIT	INTELSAT5A 304E				4		6			11			14						
55.00 W A	G INM	INMARSAT AOR-WEST		1		4		6												

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Orbital position	Space station		Frequency bands GHz																
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20
55.00 W	A	USA USASAT-14B				4		6												
53.00 W	C	USAIT INTELSAT IBS 307E				4		6			11	12		14						
53.00 W	N	USAIT INTELSAT5 CONT1				4		6			11			14						
53.00 W	C	USAIT INTELSAT5A CONT1				4		6			11			14						
53.00 W	A	USAIT INTELSAT6 307E				4	5	6			11			14						
52.50 W	C	USA USGCSS PH3 W ATL			2				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	A	USAIT INTELSAT6 310E				4	5	6			11			14						
47.00 W	C	USA USASAT-13B									11			14						
47.00 W	C	USA USASAT-13J				4		6												
45.00 W	C	USA USASAT-13F									11	12		14						
45.00 W	A	USA USASAT-13I				C4		C6			11									
43.50 W	C	F VIDEOSAT-3			2							12		14						
43.00 W	C	USA USASAT-13G									11	12		14						
42.50 W	A	USA USGCSS PH3 MID-ATL			2				7	8										
41.00 W	N	USA TDRS EAST			C2									14	15					
41.00 W	C	USA USASAT-14A				4		6												
40.50 W	C	USAIT INTELSAT IBS 319.5E				4		6			11	12		14						
40.50 W	C	USAIT INTELSAT5A 319.5E				4		6			11			14						
37.50 W	C	F VIDEOSAT-2			2							12		14						
37.50 W	A	URS STATSIONAR-25				4	5	6												
37.50 W	C	USA USASAT-13A									11			14						
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	A	USAIT INTELSAT6 324.5E				4	5	6			11			14						
34.00 W	A	G INM INMARSAT AOR-CENT 1A		1		4		6												
33.00 W	A	G SKYNET 4D	0						7	8										45
32.00 W	A	G INM INMARSAT AOR-CENT 2A		1		4		6												
31.00 W	C	G BSB-1										12		14						
31.00 W	A	IRL EIRESAT-1									11		13							
31.00 W	N	USAIT INTELSAT4A ATL4				4		6												
31.00 W	C	USAIT INTELSAT5 ATL6				4		6			11			14						
31.00 W	C	USAIT INTELSAT5A ATL6				4		6			11			14						
27.50 W	N	USAIT INTELSAT5 ATL3				4		6			11			14						
27.50 W	N	USAIT INTELSAT5A ATL2				4		6			11			14						
27.50 W	C	USAIT INTELSAT6 332.5E				4	5	6			11			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	A	URS TOR-1															18	19	20	45
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												
25.00 W	C	URS GALS-9							7	8										
25.00 W	N	URS STATSIONAR-8				4	5													
25.00 W	A	URS TOR-9															18	19	20	45
25.00 W	A	URS VOLNA-1A	0	1																
25.00 W	A	URS VOLNA-1M		1																

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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
24.50 W N	USAIT	INTELSAT5 ATL1				4		6			11			14						
24.50 W N	USAIT	INTELSAT5A ATL1				4		6			11			14						
24.50 W C	USAIT	INTELSAT6 335.5E				4	5	6			11			14						
24.00 W A	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 E ATL																	20	44
21.50 W C	USAIT	INTELSAT MCS ATL C		1		4		6												
21.50 W N	USAIT	INTELSAT4A ATL1				4		6												
21.50 W C	USAIT	INTELSAT5A 338.5E				4		6			11			14						
20.00 W C	LUX	GDL-4						6						14						
20.00 W A	USA	ACS-4		1																
19.00 W N	D	TV-SAT 1			2							12				17				
19.00 W A	D	TV-SAT 2			2							12				17				
19.00 W N	F	TDF-1			C2						11					17				
19.00 W A	F	TDF-2			2						11	12				17				
19.00 W N	F ESA	L-SAT			2							12	13	C14		17		19	20	30
19.00 W A	I	SARIT			2						11		13			17	18		20	30
19.00 W A	LUX	LUX-SAT										12				17				
19.00 W A	SUI	SUI-19W/1										12				17				
18.50 W N	USA	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 N	BEL	SATCOM-2							7	8										
18.00 W A	BEL	SATCOM-4	0						7	8										45
18.00 W A	URS	GOMS-1M	0	1	2				7	8									20	29
18.00 W C	USAIT	INTELSAT IBS 342E				4		6			11	12		14						
18.00 W C	USAIT	INTELSAT5A ATL4				4		6			11			14						
16.00 W N	URS	WSDRN									11			14						
16.00 W C	URS	ZSSRD-2									11	12	13	14						
15.00 W C	G INM	INMARSAT AOR-EAST		1		4		6												
15.00 W A	URS	FOTON-1				4		6												
15.00 W C	USA	FLTSATCOM-A ATL							7	8										
15.00 W N	USA	MARISAT-ATL	0	1		4		6												
14.00 W A	URS	GOMS-1	0	1	2				7	8									20	28
14.00 W N	URS	LOUTCH-1									C11			C14						
14.00 W C	URS	MORE-14		1		4		6												
14.00 W N	URS	VOLNA-2		1																
14.00 W N	URSIK	STATSIONAR-4				C4		C6												
13.50 W N	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			C2				7	8										
11.00 W C	F	F-SAT 2			2							12		14					20	30
11.00 W C	URS	LOUTCH-6									11			14						
11.00 W N	URS	STATSIONAR-11				C4		C6												
8.00 W N	F	TELECOM-1A			2	4		6	7	8		12		14						
8.00 W A	F	TELECOM-2A			2	C4		C6	C7	C8		C12		C14						
8.00 W A	F	ZENON-A		1	2						11			14						
5.00 W N	F	TELECOM-1B			2	4		6	7	8		12		14						
5.00 W A	F	TELECOM-2B			2	C4		C6	C7	C8		C12		C14						

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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
3.00 W A	URS	GALS-11							7	8										
3.00 W A	URS	TOR-11																19	20	42
1.00 W C	G	SKYNET-4A	0						7	8										44
1.00 W N	USAIT	INTELSAT5 CONT4				4		6			11			14						
1.00 W C	USAIT	INTELSAT5A CONT4				4		6			11			14						
0.00 E N	F ESA	GEOS-2	0																	
0.00 E N	F ESA	METEOSAT	0	1	2															
0.00 E A	G	SKYNET-A	0						7	8										44
1.00 E C	LUX	GDL-5						6			11	12	13	14						
1.00 E A	URS	GALS-15							7	8										
1.00 E A	URS	TOR-15															18	19	20	45
1.00 E A	URS	VOLNA-21	0																	
3.00 E C	F	TELECOM-1C			2	4		6	7	8		12		14						
3.00 E A	F	TELECOM-2C			2	C4		C6	C7	C8		C12		C14						
5.00 E N	F ESA	OTS	0								11			14						
5.00 E N	S NOT	TELE-X			C2							12		14		C17				
5.00 E A	URS	TOR-19															18	19	20	45
6.00 E C	G	SKYNET-4B	0						7	8										44
7.00 E C	F	F-SAT 1			2	4		6											20	30
7.00 E N	F EUT	EUTELSAT 1-3	C0								C11	12		14						
7.00 E A	F EUT	EUTELSAT 2-7E			2						11	12		14						
8.00 E C	URS	GALS-7							7	8										
8.00 E C	URS	STATSIONAR-18				4	5	6												
8.00 E A	URS	TOR-8															18	19	20	45
8.00 E C	URS	VOLNA-15	0	1																
10.00 E A	F	APEX			C2	C4		C6											C20	C30
10.00 E A	F EUT	EUTELSAT 2-10E			2						11	12		14						
10.00 E N	F EUT	EUTELSAT-1	C0								C11	12		14						
12.00 E A	URS	GALS-17							7	8										
12.00 E N	URS	PROGNOZ-2			2															
12.00 E A	URS	STATSIONAR-27				4		6												
12.00 E A	URS	TOR-18															18	19	20	21
12.00 E A	URS	VOLNA-27	0																	
13.00 E N	F EUT	EUTELSAT 1-2	C0								C11	C12		C14						
13.00 E A	F EUT	EUTELSAT 2-13E			2						11	12		14						
13.00 E C	I	ITALSAT			2													19	20	40
15.00 E A	F	ZENON-B		1	2	4		6												
15.00 E C	ISR	AMS-1				4		6			11			14						
15.00 E C	ISR	AMS-2				4		6			11			14						
15.00 E A	URS	GALS-12							7	8										
15.00 E A	URS	STATSIONAR-23				4		6												
15.00 E A	URS	TOR-12																19	20	42
15.00 E A	URS	VOLNA-23	0																	
16.00 E A	F EUT	EUTELSAT 1-4	C0								C11	C12		C14						
16.00 E A	I	SICRAL-1A	0						7	8		12		14					20	44
17.00 E A	ARS	SABS									11			14						
17.00 E A	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						
19.20 E N	LUX	GDL6						6			11	12		14						
22.00 E A	I	SICRAL-1B	0						7	8		12		14					20	44

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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
23.00 E C	URS	GALS-8							7	8										
23.00 E C	URS	STATSIONAR-19				4	5	6												
23.00 E A	URS	TOR-7															18	19	20	45
23.00 E C	URS	VOLNA-17	0	1																
23.50 E C	D	DFS-1			2						11	12		14					20	30
26.00 E N	ARSARB	ARABSAT 1-B			2	4		6												
26.00 E A	IRN	ZOHREH-2									11			14						
27.00 E A	URS	TOR-20															18	19	20	45
28.50 E C	D	DFS-2			2						11	12		14					20	30
29.00 E N	F ESA	GEOS-2	0		2															
31.00 E A	ARSARB	ARABSAT 1-C				4		6												
32.00 E C	F	VIDEOSAT-1			2							12		14						
34.00 E A	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 A	URS	TOR-2															18	19	20	45
35.00 E C	URS	VOLNA-11	0	1																
36.00 E A	F EUT	EUTELSAT 2-36E			2						11	12		14						
38.00 E A	PAK	PAKSAT-1										12		14						
40.00 E C	URS	LOUTCH-7									11			14						
40.00 E N	URS	STATSIONAR-12				C4	5	C6												
41.00 E A	IRN	ZOHREH-4									11			14						
41.00 E A	PAK	PAKSAT-2										12		14						
45.00 E N	URS	GALS-2							7	8										
45.00 E C	URS	LOUTCH P2									11			14						
45.00 E N	URS	STATSIONAR-9				4	5	6												
45.00 E C	URS	STATSIONAR-D4				4		6												
45.00 E A	URS	TOR-3															18	19	20	45
45.00 E N	URS	VOLNA-3	0	1																
45.00 E A	URS	VOLNA-3M		1																
47.00 E A	IRN	ZOHREH-3									11			14						
49.00 E A	URS	GALS-13							7	8										
49.00 E A	URS	TOR-16															18	19	20	45
49.00 E A	URS	VOLNA-25	0																	
53.00 E A	G	SKYNET-4C	0						C7	C8										44
53.00 E N	URS	LOUTCH-2									C11			C14						
53.00 E C	URS	MORE-53		1		4		6												
53.00 E N	URS	VOLNA-4		1																
53.00 E N	URSIK	STATSIONAR-5				C4		C6												
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						
58.00 E A	URS	TOR-13																19	20	42
60.00 E N	USA	USGCSS PH2 INDOC							7	8										
60.00 E N	USA	USGCSS PH3 INDOC			C2				7	8										
60.00 E N	USAIT	INTELSAT MCS INDOC B		C1		C4		C6												
60.00 E N	USAIT	INTELSAT5 INDOC2				4		6			11			14						
60.00 E N	USAIT	INTELSAT5A INDOC1				4		6			11			14						
60.00 E C	USAIT	INTELSAT6 60E				4	5	6			11			14						

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Orbital position	Space station		Frequency bands GHz																
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20
61.50 E	A	USA ACS-7		1																
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	A	USAIT INTELSAT6 63E				4	5	6			11			14						
64.50 E	C	G INM INMARSAT IOR		1		4		6												
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						
66.50 E	A	G INM INMARSAT IOR-2		1		4		6												
69.00 E	A	URS GALS-14							7	8										
69.00 E	A	URS STATSIONAR-20				4		6												
69.00 E	A	URS TOR-14																19	20	42
70.00 E	A	URS GALS-16							7	8										
70.00 E	A	URS TOR-17															18	19	20	45
70.00 E	A	URS VOLNA-19	0																	
70.00 E	A	USA USASAT-13N										12		14						
72.00 E	A	USA FLTSATCOM INDOC	0						7	8										
72.00 E	A	USA FLTSATCOM-B INDOC																	20	44
72.50 E	N	USA MARISAT-INDOC	0		C2	C4		C6												
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	A	URS GOMS	0						7	8									20	28
76.00 E	A	URS GOMS-M	0	1	2				7	8									20	29
77.00 E	N	INS PALAPA-A2				4		6												
77.00 E	N	URS CSSRD-2									11	12	13	14						
77.00 E	A	USA FLTSATCOM-A INDOC	0						7	8										
80.00 E	C	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	URS STATSIONAR-13				C4		C6												
81.50 E	C	URS FOTON-2				4		6												
83.00 E	C	IND INSAT-1D	0			4	5	6												
83.00 E	C	IND INSAT-2A	0			4	5	6												
83.00 E	N	INS PALAPA-A1				4		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	A	URS TOR-4															18	19	20	45
85.00 E	N	URS VOLNA-5	0	1																
85.00 E	A	URS VOLNA-5M		1																
87.50 E	C	CHN CHINASAT-1				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				C4		C6												
90.00 E	N	URS VOLNA-8		1																
93.50 E	N	IND INSAT-1C	0			4	5	6												
93.50 E	C	IND INSAT-2B	0			4	5	6												
95.00 E	N	URS CSDRN									11			14						

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Orbital position	Space station		Frequency bands GHz																	
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20
96.50 E C	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												
103.00 E C	CHN	STW-2				4		6												
103.00 E C	URS	LOUTCH-5									11			14						
103.00 E C	URS	STATSIONAR-21				4	5	6												
108.00 E N	INS	PALAPA-B1				4		6												
110.00 E N	J	BSE			2									14						
110.00 E N	J	BS-2			2							12		14						
110.00 E A	J	BS-3			2							12		14						
110.50 E C	CHN	CHINASAT-2				4		6												
113.00 E N	INS	PALAPA-B2				4		6												
118.00 E N	INS	PALAPA-B3				4		6												
124.00 E A	J	SCS-1B										12		14		17	18	19		28
125.00 E N	CHN	STW-1				4		6												
128.00 E A	J	SCS-1A										12		14		17	18	19		28
128.00 E C	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 A	URS	TOR-6															18	19	20	45
128.00 E C	URS	VOLNA-9	0	1																
128.00 E A	URS	VOLNA-9M		1																
130.00 E N	J	ETS-2	0	1	2						11									34
130.00 E N	URS	GALS-5							7	8										
130.00 E C	URS	PROGNOZ-5			2															
130.00 E A	URS	TOR-10															18	19	20	45
132.00 E N	J	CS-2A			2	4		6								17	18	19		28
132.00 E C	J	CS-3A			2	4		6								17	18	19		28
134.00 E A	USA	ACS-6		1																
135.00 E N	J	CSE			2	4		6								17	18	19	20	30
136.00 E N	J	CS-2B			2	4		6								17	18	19		28
136.00 E C	J	CS-3B			2	4		6								17	18	19		28
140.00 E N	J	GMS	0	1	2															
140.00 E N	J	GMS-2	0	1	2															
140.00 E N	J	GMS-3	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				C4		C6												
140.00 E N	URS	VOLNA-6		1																
145.00 E N	URS	STATSIONAR-16				C4		C6												
150.00 E C	J	ETS-5		1	2		5	6												
150.00 E C	J	JCSAT-1										12		14						
154.00 E C	J	JCSAT-2										12		14						
156.00 E A	AUS	AUSSAT B2										12		14						
156.00 E A	AUS	AUSSAT B2 NZ										12		14						
156.00 E A	AUS	AUSSAT B2-MOB		1								12		14						
156.00 E N	AUS	AUSSAT-2										12	13	14						
158.00 E A	J	SUPERBIRD-A							7	8		12		14		17	18	19		28
160.00 E A	AUS	ACSAT-1							7	8										

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Orbital position	Space station		Frequency bands GHz																	
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20
160.00 E A	AUS	AUSSAT B1										12		14						
160.00 E A	AUS	AUSSAT B1 NZ										12		14						
160.00 E A	AUS	AUSSAT B1-MOB		1								12		14						
160.00 E N	AUS	AUSSAT-1										12	13	14						
160.00 E N	J	GMS-160E	0	1	2															
162.00 E A	J	SUPERBIRD-B							7	8		12		14		17	18	19		28
164.00 E N	AUS	AUSSAT PAC3										12		14						
164.00 E N	AUS	AUSSAT-3										12	13	14						
166.00 E A	URS	GOMS-2	0	1	2				7	8									20	28
166.00 E A	URS	GOMS-2M	0	1	2					8									20	27
166.00 E C	URS	PROGNOZ-6			2															
167.00 E A	PNG	PACSTAR A-1		1			5	6												
167.00 E N	URS	VSSRD-2									11	12	13	14						
167.45 E C	PNG	PACSTAR-1				4		6				12		14						
170.00 E A	USA	USASAT-13M										12		14						
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 W PAC																	20	44
174.00 E N	USAIT	INTELSAT5 PAC1				4		6			11			14						
174.00 E C	USAIT	INTELSAT5A PAC1				4		6			11			14						
175.00 E N	USA	USGCSS PH2 W PAC							7	8										
175.00 E N	USA	USGCSS PH3 W PAC			C2				7	8										
176.50 E N	USA	MARISAT-PAC	0	1		4		6												
177.00 E N	USAIT	INTELSAT4A PAC2				4		6												
177.00 E C	USAIT	INTELSAT5 PAC2				4		6			11			14						
177.00 E C	USAIT	INTELSAT5A PAC2				4		6			11			14						
178.00 E N	F ESA	MARECS PAC1	0	1		4		6												
179.50 E A	G INM	INMARSAT POR-1		1		4		6												
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						

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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 CCITT issues Recommendations concerning standards and specifications as well as the operation and charging of public telecommunication services.

The fixed satellite service and mobile satellite services, which form part of public service telecommunications, have radically evolved 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 times like satellite communications, in particular by using adaptable echo cancellers, has achieved acceptable results.

Other work undertaken in collaboration with the CCIR in order to identify transmission parameters for the maritime telephone communication system by satellite has 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.

The CCITT has also performed a considerable amount of work 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 internetwork interfaces; here again, careful attention has been given to the problems associated with satellite communications.

Work on digital speech interpolation has concentrated chiefly on the collection of data from DSI systems currently operating on the various associated media. This has secured a clearer understanding of the implementation of such systems and laid the foundations for future CCITT work in this field.

The next CCITT Plenary Assembly to be held in Melbourne in 1988 will be called upon to approve amendments to existing Recommendations and a set of new Recommendations on the ISDN and interworking. These Recommendations are also of significance for systems employing satellite communications.

With regard to signalling, as a result of its studies the CCITT will be 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. Recommendations will also be submitted to the next

CCITT Plenary Assembly on the INMARSAT aeronautical mobile-satellite system and interworking between the above-mentioned systems standardized by the CCITT and INMARSAT's aeronautical system.

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.

In the field of telex and data transmission, studies have been conducted by the CCITT on the use of telecommunication satellites and its impact on operation and tariff-setting, not only for the public services but also for the maritime mobile services.

Thus, the procedures applicable for subscribers in a public data network wishing to call ship-earth stations in the maritime data transmission satellite service have been standardized, and the procedures for calling subscribers from ship-earth stations by way of packet-switched data transmission facilities have been set out in the X-series Recommendations.

The CCITT final meetings will be held during the first six months of 1988, and an account of the work accomplished at most meetings will be given in the next Report.

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 operating questions on radiocommunications and for the issue of relevant Recommendations. Current CCIR Recommendations and Reports, along with Questions and Study Programmes dealing with space communications are contained in the Volumes of the CCIR XVIth Plenary Assembly, Dubrovnik, 1986. Volumes of special interest for space telecommunications are:

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

The texts are prepared by experts and institutions in the respective fields of space communication and are finally approved by Administrations in the Plenary Assemby of the CCIR. They form the basis for harmonious technical development of various space services and contain criteria for the sharing of frequencies among the various space services and between space services and terrestrial radiocommunication services.

3.3.1 *Intersessional work for the Second Session of the World Administrative Radio Conference on the use of the geostationary-satellite orbit and the planning of the space service using it (WARC-ORB(2), August/October 1988).*

The first session (1985) of the WARC-ORB identified intersessional studies to be carried out by the CCIR to provide certain technical information for the second session in 1988. This work refers to CCIR Study Groups 1, 2, 4, 5, 8, 9, 10 and 11 . On the basis of consultations among these Study Groups, the XVIth Plenary Assembly of the CCIR (Dubrovnik, May 1986) adopted Resolution 90 which contains all the relevant guidelines for this intersessional work.

Following the studies carried out by different Interim Working Parties, the CCIR Secretariat assembled a "preliminary draft report" which constitutes the first document of Joint Interim Working Party (JIWP/ORB(2)).

The JIWP/ORB(2) met from 7-18 December 1987 at Geneva and decided that the Report which was based on the above-mentioned contributions for Study Groups and input documents from Administrations and international organizations, should be presented in three parts.

A separate executive summary gives a condensed survey and conclusions, where they could be reached, on the technical information contained in the other parts of the report.

Part I provides technical information relevant to items 1, 2, 3, 4, 7 and 10 of the agenda for the Second Session of the WARC-ORB (Resolution No. 953 of the ITU Administrative Council). It contains material to assist the Second Session in deciding on planning and coordination procedures for the different frequency bands specified for allotment planning, for those subject to improved regulatory procedures and for those not subject to planning, as assigned by the First Session of the WARC-ORB. In particular, the concepts of generalized parameters and predetermined arcs are analyzed in this part.

Part II refers to items 6, 9 and 11 of the agenda and deals essentially with matters relating to broadcasting. In particular, technical information is presented on feeder-links to broadcasting-satellite planning, on UHF satellite sound broadcasting and on satellite HDTV transmission.

As shown above, the structure of the Report follows closely the Agenda of the Second Session of the Orbit Conference. Therefore, the CCIR Report can easily be used as a technical base by the different working groups of the orbit conference, which then can concentrate on specific chapters on sections of the report. Since the report has been prepared as a working paper, it seemed useful to prepare an executive summary which gives a clear view of the results and follows the task list appended to Resolution 90 rather than the agenda of the conference. However, references to the relevant parts of the report are given.

3.3.2 *Space Research and Radioastronomy (Study Group 2)*

This Study Group deals with questions relating to systems for the space research service, the Earth exploration-satellite service, including the meteorological satellite service and systems for the radioastronomy service and radar astronomy. Matters pertaining to the space operation service are also studied.

The Interim Meeting of Study Group 2 which was held in Geneva from 23 November to 4 December 1987, considered topics of general interest, the radiocommunication aspects of systems to search for extra-terrestrial intelligence (SETI). There was discussion of the special problems, requirements and techniques involved in detecting and identifying extremely weak signals with unknown parameters, in a noisy environment of man-made signals.

Information was given on the analysis needed to identify preferred frequencies for telecommunication links of interest to Study Group 2.

Texts were drafted in connection with interference and sharing criteria, coordination thresholds and methods to improve performance for the earth-exploration-satellite service. Some problems concerning the Meteorological-satellite service operating in the 1 670 – 1 700 MHz band were considered in another draft new report.

Regarding radioastronomy, new material relating to the characteristics of this service and the feasibility of frequency sharing between radioastronomy and other services are included in Reports 852 and 696. New material on spurious emissions, in particular interference from other services, is proposed for inclusion in Report 697.

3.3.3 *Fixed-satellite service (Study Group 4)*

The CCIR Report "Technical factors influencing the efficiency of use of the geostationary-satellite orbit by radiocommunication satellites sharing the same frequency bands" was extensively revised to include many of the new findings of Interim Working Party (IWP) 4/1 concerning various aspects of orbit/spectrum utilization. The Interim Meeting of Study Group 4 (November 1987) adopted texts relating to:

— flexibility in the positioning of satellites as a design objective;

— geostationary satellite antenna pointing accuracy;

— optimization methods to identify satellite orbital positions;

— stochastic approach in the evaluation of interference between satellite networks.

Interim Working Party 4/1 which met in Rio de Janeiro from 5 to 14 May 1987, carried out part of the CCIR intersessional studies defined by CCIR Resolution 90 in connection with the fixed-satellite service. Its report covers each of the points allocated to it in CCIR Resolution 90 and the topics on technical character of FSS at 30/20 GHz, orbit sectorisation and reverse band working.

A great deal of work has been done by IWP 4/2, in coordination with the CCITT, to ensure that satellite system performance standards are developed to satisfactorily meet the demands of new digital telecommunication services, notably in the area of ISDN. Recommendation 614 on allowable error performance for a hypothetical reference digital path in the fixed-satellite service operating below 15 GHz when forming part of an international connection in an integrated services digital network was revised to take into account some of the concerns of CCITT Study Group XVIII. The study of burst errors, in particular of relevance to Forward Error Correction (FEC), is contained in a new Annex V to Report 997.

Dedicated satellite systems, sometimes also known as satellite business systems (SBS), take advantage of the "broadcast" capabilities and flexibilities of satellites, and many national and international systems (INTELSAT and EUTELSAT) are emerging, using small aperture earth stations.

At present, these are for dedicated or closed user-group networks and error performance and availability may be mutually agreed upon by the users and service providers. Another category of SBS may evolve that is suitable for connection into the standard ISDN. An existing Study Programme is being elarged to study the SBS for the ISDN and closed user networks. A guideline for drafting a new Report in this field on digital satellite dedicated networks was adopted by the Interim Meeting of Study Group 4.

A Working Group to update the CCIR Handbook on Satellite Communications was established. This Group held its first Plenary Meeting in Paris from 2 to 6 March, 1987. At this meeting the group decided that the updating should be done in form of a new edition, rather than an addition to the existing Handbook. Eight sub-groups have been formed with designated tasks to provide material for the second meeting, which was held from 12 to 16 November 1987 in Geneva. During the second meeting, most parts of the existing CCIR Handbook were revised and updated. The final meeting is planned for April 1988.

3.3.4 *Mobile satellite services (Study Group 8)*

Studies on the use of satellite techniques for the aeronautical, land and maritime mobile satellite service continue during the new study period.

Much interest is focussed on public correspondence with aircraft through the use of aeronautical satellites and on a general mobile satellite service, where mobile stations could be operated on a vehicle on land, on board a ship or an aircraft. The WARC-MOB-87 made provisions for the use of a frequency spectrum for the two services and it is expected that much experimentation will take place in the near future.

In the maritime mobile service (the only operational one with more than 6000 ships equipped), attention is given to new ships with stations for much smaller ships, such as fishing vessels, therefore opening this service for an important new category of users.

3.3.5 *Satellites for standard frequency and time signals (Study Group 7)*

The availability of satellites in the pre-deployment stage of the Global Positioning System (GPS) continues to receive attention in the new Study Period, both in developing receivers and in the technique of time transfer between laboratories and observatories.

Work is in progress to prepare a handbook on satellite-based services of time and frequency dissemination, in which satellite methods of dissemination may increasingly supplement and replace the existing ground-based services of standard frequency and time signals and such dissemination may therefore find application in a number of developing countries desirous of establishing a national time and frequency service.

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

The Interim Meetings of Study Groups 10 and 11 were held in Geneva in November 1987. The activities of these Study Groups related to the broadcasting-satellite service and associated feeder links were dealt with in Joint Working Group 10-11S and focussing on completing the intersessional work required to prepare CCIR technical information for the Second Session of WARC-ORB (see § 3.3.1).

JIWP 10-11/1 completed the required technical information for the preparation of a Plan for the feeder links to the broacasting-satellite service in Regions 1 and 3, with respect for the 12 GHz band Plan adopted by WARC BS-77. It also dealt with the matter of satellite sound broadcasting to portable and vehicle receivers in the band 500 – 2000 MHz (and nearby frequencies). Results of its work have been submitted for final consideration by JIWP ORB(2) in December 1987.

JIWP 10-11/3 completed a comprehensive report on the satellite broadcasting of high-definition television (HDTV) concerning those elements of interest to WARC-ORB (2). The results of its work have been submitted as well for final consideration by JIWP ORB (2) in December 1987.

The Interim Meetings of Study Groups 10 and 11 also prepared extensive modifications to several Reports, largely based on the preparatory work for WARC-ORB (2). Studies were carried out in connection with:

characteristics of ground receiving equipment for the broadcasting-satellite service;

technical characteristics of feeder links to broadcasting satellites;

satellite sound broadcasting with portable receivers and receivers in automobiles; and

high-definition television by satellite.

In addition, the Reports entitled "Television standards for the broadcasting-satellite service" and "Satellite transmission of multiplexed analogue component (MAC) vision signals" were updated, mainly to reflect the addition of the D-MAC/packet system to the MAC/packet family of systems.

It was also decided to undertake an extensive revision and updating of the fundamental texts on satellite broadcasting contained in the Report 215-6 on (Systems for the broadcasting-satellite service). An *ad hoc* group was established to carry out this work by correspondence. Administrations and other participants in the work of the CCIR were invited to contribute to this *ad hoc* group.

3.3.7 *Satellite news gathering*

A new Joint Interim Working Party CMTT-4-10-11/1 was established under Decision 76 to prepare an overall strategy for satellite news gathering (SNG) transmissions, including proposals intended to solve the technical, operating and organizational aspects associated with the use of transportable or portable transmitting earth stations for SNG. Initial draft report that was reviewed at a joint meeting of Study Group 10, 11 and CMTT.

4. Planning

4.1 Pursuant to the decision of the World Administrative Radio Conference (Geneva, 1979) and the Plenipotentiary Conference (Nairobi, 1982), the ITU Administrative Council at its 42nd Session on 1987 confirmed the convening of the Second Session of the World Administrative Radio Conference on the Use of the Geostationary Satellite Orbit and the Planning of the Space Service Utilizing It (See paragraph 1.1).

4.2 *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.

The World Plan Committee will be meeting from 3 to 10 February 1988 in Lisbon-Estoril (Portugal).

5. Technical cooperation activities

The Feasibility Study of the Regional African Satellite Communication System for the Development of Africa (RASCOM) is being undertaken, based on the Cairo and Harare Resolutions of the Conference of African Ministers of Transport, Communications and Planning. An Inter-Agency Coordinating Committee (IACC) of ten subregional, regional and international organizations, and chaired by the Organization of African Unity (OAU), was set up by the said Ministers to supervise and monitor the implementation of the Study.

A project office has been established at the ITU Headquarters which is responsible for undertaking parts of the study and ensuring its day-to-day follow-up. The office, which commenced its activities in March 1987, is manned by a small team of international experts recruited on behalf of IACC by the ITU in its capacity as the Coordinator.

Multidisciplinary National Coordination Committees (NCCs) have been established under the chairmanship of a National Coordinator in each African country. By the end of the year, the number of countries participating in the RASCOM Feasibility Study was 49 out of a total number of 50.

Under ITU guidance the project office is responsible for establishing the norms for field work, and guides and supervises the work of national and international experts involved in the Study. It will, further, compile and analyse reports from the various NCCs responsible for the national level studies.

To this effect the Project Office has elaborated a document entitled "Guidelines for conducting the National Level Feasibility Studies" and prepared a country model report based on a hypothetical country called "RASCOMIA", using an environment typical of Africa. The purpose of these documents is to give to NCCs the necessary information to assist them in undertaking the national feasibility studies within a uniform framework.

Consulting firms will be invited, at an appropriate stage, to make offers on the basis of invitations for particular technical components of the study to service project activities as per the approved Terms of Reference to the project. The project office is to be responsible for evaluating offers as to the best combination of quality and price. Selection of particular contractors will be made by the IACC, with due regard to the same principle.

The project is financed by funds from various contributors who have agreed to provide untied resources.

The Feasibility Study is expected to be completed by mid-1989.

Assistance given by the ITU to the R & D Centre of the Brazilian Administration (TELEBRAS) continues to be focused on research and prototypes construction of satellite communication antennae and accessories (feeders, active elements, etc.).

Various aspects of a feasibility study for the establishment of a regional satellite communication system in the Caribbean are under negotiation.

Negotiations have been initiated with ASETA (Association of State telecommunication undertakings of the Andean Sub-Regional Agreement) to assist the Association in the feasibility study of a sub-regional Satellite Communication System in the five countries of the Andean Pact.

Under an UNDP/ITU training project, courses in operation and maintenance of satellite communication were introduced in the training programmes for technicians at the Telecommunication Training Institutes in Jeddah and Riyadh (Saudi Arabia).

At the request of Saudi Arabia, ITU continued through 1987 to provide to the Ministry of Information the services of a Senior Expert in satellite broadcasting.

ITU continued to provide assistance in the development of the ARABSAT system and the preparatory activities for the second generation of satellites.

Within the framework of the Master Plan of Malta the preparation of specifications for a new satellite earth station in Malta is in progress.

The ITU participated in a Design Review Meeting of a major telecommunication project in Monrovia, Liberia which included an Intelsat Standard A earth station, and the associated microwave link and digital telephone switch.

An engineer participated in the evaluation of bids for an Intelsat Standard A earth station in Aruba, a newly independant island in the Antilles.

Lectures have been given in China and Korea (People's Republic) in the framework of national seminars on satellite communications and frequency coordination between space and terrestrial services.

Advice was given to Bhutan on the preparation of specifications for an Intelsat Standard A earth station and the selection of a suitable site for this station.

6. Information and documentation activities

The General Secretariat has continued, in pursuance of Administrative Council Resolution Nos. 636 and 637, the dissemination of information on the activities and role of the ITU in space telecommunications.

The Telecommunication Journal has published each month a list of satellites launched during the preceding period as well as articles on space techniques, satellite communications and launch vehicles.

A recapitulatory list of all artificial satellites launched in 1986 was published as an annex to the May 1987 issue of the Journal. It was prepared with the assistance of ITU Member countries, the International Frequency Registration Board (IFRB), the Committee on Space Research (COSPAR), and national space research organizations and from details published in the specialized press.

Telecom 87, in Geneva the 5th World Telecommunication Forum and Exhibition organized by the ITU, took place in Geneva from 20 to 27 October 1987. Telecom 87 gave due emphasis to the use of space telecommunications.

7. Cooperation with other international organizations concerned with space

7.1 *General*

In 1987 the ITU pursued its consistent cooperation with many international organizations concerned with space matters (COSPAR, 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.

The Union was represented at the XXXVIIIth International Astronautical Congress of the IAF in Brighton in 10-17 October 1987 at which a paper on the Role of the ITU in the use of Geostationary Orbit was presented.

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

The ITU participated in the Inter-Agency Meeting on Space Activities held in London in October 1987.

7.3 *Collaboration concerning implementation of UNISPACE 82 recommendations*

The ITU maintained close collaboration with the Outer Space Affairs Division of the United Nations in regard to the implementation of the recommendations of UNISPACE 82 and also in respect of the United Nations Space Application Programme.

ANNEX

Reports on progress made in the development of space communications

ANNEX

Reports on progress made in the development of space communications

AUSTRIA

Pursuing in 1987 its lasting endeavours to fulfill ever increasing needs for satellite communication links, the Austrian Postal and Telegraph Administration has put into service three new earth stations for the INTELSAT and EUTELSAT systems respectively, one of these being a mobile station.

1. INTELSAT

Two Standard A antennas (Aflenz 1 and Aflenz 3) provide for all communication needs in the Atlantic Ocean and Indian Ocean regions as from 1979 and 1985 respectively. 323 circuits to 38 countries have been established on these two antennas. A Standard E1 antenna (Aflenz 4) for the INTELSAT Business System (IBS) in the Atlantic Ocean region is planned to commence service in spring 1988.

2. EUTELSAT

A 18 m antenna (Aflenz 2), in service since 1985, provides for 206 TDMA circuits to 11 European countries, and is also used for international television programmes exchange by the European Broadcasting Union (EBU).

A 7.5 m antenna has been established in Vienna in October 1987 for Business Communications via the Satellite Multiservice System (SMS), a 4.6 m antenna has been established in Innsbruck in November 1987 to serve the same purpose.

3. A multifunctional mobile earth station equipped for television as well as for IBS and SMS transmissions (e.g. videoconferencing) is ready for occasional use as from December 1987.

BELGIUM

The Belgian Administration has three additional 2.2 m antennas for reception only of television-type signals (TVRO), one of which is transportable (mounted on a trailer).

The LDK 2E-2 antenna at the Liedekerke earth station is now beamed to the Intelsat V (F-4) satellite at 325.5°E. This 7.6 m antenna was formerly beamed to the Eutelsat I (F-2) satellite at 7°E for MSS operations, but will henceforth be used for Intelsat Business Service (IBS) purposes.

The 9.2 m LDK 3E-3 antenna also located at the Liedekerke earth station is beamed to the Intelsat V (F-3) satellite at 307°E, and will be used for IBS operations.

The two antennas will handle high-speed data transmission and videoconference.

BOTSWANA (REPUBLIC OF)

1. On March 1987, Botswana Standard B earth station changed over from the 325.5° east satellite to the 341.5° east satellite.

2. On the same date a route was opened direct to the United States with six SCPC channels and an additional SCPC circuit was opened with the United Kingdom.

3. At the year's end the number of SCPC circuits operating was 21 voice and one telegraph bearer to the United Kingdom and six voice to United States.

4. No other significant changes were made during 1987.

BRAZIL (FEDERATIVE REPUBLIC OF)

Introduction

The Brazilian telecommunications system via satellite (SBTS) has been expanding its network since the successful launch of its satellites (Brasilsat-1 and Brasilsat-2 in 1985 and 1986, respectively).

EMBRATEL, the company responsible for the national and international public telecommunications service and the SBTS operator, has relied on the Brazilian industry and on the Telebras Research Centre in order to introduce several essential services to the development of the communications in the country.

2. The use of the SBTS

2.1 The space segment

The space segment is composed of two HS-376 type satellites, with 24 transponders with 36 MHz of bandwidth each, operating in the C-band.

In 1987, the Brasilsat-2 started its commercial operation, carrying a high speed data network.

The satellites positioning manœuvres were performed according to plans, considering the amount of fuel expected to be used in the operations. No defects took place in the electromechanical units. The space segment control centre, located in Guaratiba, Rio de Janeiro State, didn't have any problems.

The Satellite Communications Department of EMBRATEL, responsible for the planning, implementation and operation of the SBTS, has started its studies of a second generation of the SBTS. The team working on this project estimates a five year period for the study, purchase and implementation of the next generation. The launch is planned to occur in 1993.

At the end of 1987, the satellites occupation was:

- Brasilsat-1 – Twelve transponders used for public telephony
  Eight for television carriers
  Two for contingency
  Two spares

- Brasilsat-2 – Only one transponder was used to carry a high speed data network. In 1988, a large amount of the traffic being carried in the Brasilsat-1 will be transferred to the Brasilsat-2, including the television carriers.

2.2 *The terrestrial segment*

The terrestrial segment is composed of several earth stations of different sizes, with a main one that controls the communications system (the Communications Operations Control Centre) sited in the Guaratiba Earth Station, in Rio de Janeiro State.

Embratel's public telephony earth stations totalled a number of 28 at the end of 1987, five more than the previous year. Most of them are located in the Amazon region.

At the end of the year, the number of active carrier were:
SCPC – 1777
FDM – 6072

In 1987, four television networks started satellite broadcasting, one of them being a private television network. High speed data transmission was started for IBM Do Brasil, operating with two of its four earth stations. In the next two years, five new data networks will begin operation, performing a total of 38 new earth stations.

2.3 *New services*

In 1987, EMBRATEL started studies for a second satellite generation, that will offer new services as tele-education, professional training, tele-medicine. Studies are also carried on in the use of RDSS (Radio Determination Satellite System) and Terrestrial Mobile Satellite Service.

3. Research and development

The Telebras Research and Development Centre, located in Campiñas, São Paulo State, has developed a prototype of a terminal earth station for high speed data communication and are under development three-meter antennas, 65° kelvin low noise amplifiers and 20W high power amplifiers.

Other project is the SAMSAT – a multiple access TDMA system. The system uses 6 m antennas and 10W HPA in the earth stations.

4. Industry

At the end of 1987, the Brazilian industry provided almost all the necessary equipment to the SBTS eart stations. In relation to TVRO stations, about ten local companies were able to provide all the needed equipment. It is estimated that a total of three thousand TVRO earth stations were in operation at the end of 1987.

CANADA

1. International Satellite Communications

Canadian international satellite communication services are provided by Teleglobe Canada Inc.

Teleglobe Canada Inc., as the Canadian Signatory to INTELSAT has been actively involved with INTELSAT during 1987, and in particular the preparations and issue of the Request for Proposals for the Intelsat VII satellites. Special earth station facilities were established near Calgary for the transmission of the 1988 Winter Olympics television signals internationally using Intelsat satellites located over the Atlantic and the Pacific Ocean regions. Special equipment is being procured for the implementation of an integrated digital communications service, designed to provide primarily international public switched telephony service, but including also digital television and video conferencing, with information rates from 64 kbit/s up to 45 Mbit/s.

Teleglobe Canada Inc., as the Canadian Signatory to INMARSAT, has also been actively involved with INMARSAT during 1987 in the resolution of such major issues as the selection of the appropriate launch vehicle services for INMARSAT for its second generation satellites; the development of operational plans to meet future demands, particularly in the Atlantic Ocean region; and the finance leasing of the second generation system.

Teleglobe Canada Inc. is also a participant in international aeronautical satellite communications. At the INMARSAT Council it was successful in having its application approved for space segment capacity to provide the Ontario Air Ambulance service with aeronautical satellite communications. Furthermore, an agreement has been entered into with the Société Internationale des Télécommunications Aéronautiques (SITA) to provide satellite data and cockpit communications for aircraft safety purposes as well as public correspondence, commencing in 1989. These services will access the INMARSAT system from Teleglobe's ground earth stations to be located in Eastern and Western Canada.

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: Anik D-1, launched in August 1982; and Anik D-2, launched in November 1984. The 14/12 GHz space segment comprises Anik C-3, Anik C-2 and Anick C-1. Anik E-1 and Anik E-2 have been contracted for delivery in the early 1990's. 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 Pay TV) and data signals within Canada.

3. The MSAT programme

The Canadian Department of Communications and Telesat Canada have been studying and planning for a commercial mobile satellite system (MSAT) since 1982.

This would provide economical voice and data communications to land vehicles, ships, aircraft and transportable terminals primarily in rural and remote areas in Canada. In October 1987 the MOB WARC allocated spectrum for land-mobile satellite service in addition to maritime and aeronautical satellite services around 1.5 GHz. Canada continued negotiations with the United States to implement joint mobile satellite systems commencing in 1992. In 1987, Telesat Canada finalized plans for an interim mobile satellite system (IMSS) to provide service to land vehicles primarily to trucks beginning in 1989, using an Inmarsat space segment in the Atlantic Ocean region.

4. The search and rescue programme

The Satellite-aided Search and Rescue Project (SARSAT) is a joint Canada-France-United States of America 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, 243 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 1990's.

An MOU was also signed in 1984 between the SARSAT participants and the USSR's Ministry of Merchant Maritime to continue a joint project (COSPAS/SARSAT) until such time as an international operational system can be put in place. In 1987 the COSPAS-SARSAT Parties pursued the development of an intergovernmental agreement which will ensure continuity of the COSPAS/SARSAT system beyond the 1990's and negotiated an understanding with INMARSAT for the provision of secretariat services.

5. RADARSAT

RADARSAT is a Canadian-led co-operative programme with the United Kingdom and United States of America to launch and operate a remote sensing satellite with a C-band Synthetic Aperture Radar (SAR) as the principal sensor. Other instruments may include a Radar Altimeter (RA) and an Along Track Scanning Radiometer (ATSR). 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 1030 hours local mean time.

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

Progress on RADARSAT during 1987 included system definition and development work on the spacecraft, its sensors, the overall system and data applications.

6. The European Space Agency (ESA)

Canada's international space activities include participation in the programs 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.

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 function. In this latter regard, the satellite was delivered to the Communications Canada David Florida Laboratory during the course of 1987 for final integration and test prior to being shipped to the launch site for launch currently scheduled for early in 1989. With regard to PSDE, Canada is currently contributing to the basic support activity which is primarily concerned with conceptual studies, and to the predevelopment of possible communications payload as a preliminary to the definition of specific flight missions. Of particular interest is potential involvement in the development of the ARAMIS (aeromaritime mobile satellite system) payload which is of significant interest to INMARSAT as a precursor to this next generation of satellites.

7. Report from Industry

During 1987, SPAR Aerospace Ltd. completed in Mozambique the upgrading of an Intelsat A station that meets the new Intelsat 18 meter antennas specification. Previously, the specification called for an antenna size of 30 meters.

MICROTEL Ltd. delivered, during 1987, a master control and four remote telephony terminals to NorthwesTel. NorthwesTel is a telephone company which provides service to Northern British Columbia, Yukon, and western Northwest Territories. In addition, MICROTEL has been contracted for the delivery of a VSAT System (Very Small Aperture Terminal) consisting of a hub and twenty remote terminals.

CHILE

1. International satellite communications

These are handled through the Longovilo earth station, specifically by the Longovilo 1 and 2 antennas which are beamed on the ITS (F.10) and ITS V (F-6) satellites at 335.5° and 341.5° East respectively.

In addition, occasional television transmissions are received from other satellites via the Longovilo 4 antenna.

A total of 613 operating circuits spread over 29 direct routes has been reached. Of these, 559 were used for the telephone service and the remaining 54 for both public and private telegraphy, telex, data transmission and other services.

In 1987, the international direct dialling system was extended to six new countries (Bulgaria, Benin, Fiji, Nigeria, Sierra Leone and Zaire), thus bringing the total number of countries in the system to 149 by the end of the year.

2. National satellite communications

These are established via the antennas of the Longovilo 3, Punta Arenas and Coyhaique earth stations using the ITS V-A (F-11) satellite at 332.5° East.

The following carrier capacities were reached:

Carrier	Capacity	Occupancy
Longovilo-3	372	336
Coyhaique	132	96
Punta Arenas	252	240

The domestic television system uses a 20 MHz carrier.

One 36 MHz spot-beam transponder on board the future ITS V (F-13) satellite was purchased late in 1987 and will be used for domestic services.

CHINA (PEOPLE'S REPUBLIC OF)

China started to develop her space cause on her own strength comparatively early and has now established a well completed system for space scientific research and industrial production. China has the ability to develop and manufacture satellites, launchers, TT&C ground networks, communication earth stations and range launching support facilities, providing services in these fields for domestic and abroad customers.

1. Communication satellite

At the experimental phase, China successfully launched two communication satellites. The first one, STW-1, with global antenna beams, was launched in 1984 and located at 125°E. The second one, STW-2, was launched in 1986 and located at 103°E, adopting domestic antenna beams. With these two satellites, China has successfully conducted a great number of experiments on satellite launching, operating and communication techniques, and the two satellites have been providing part of the domestic communication service which includes television programme transmission, radio broadcasting, telephone, telegraph, data transmission, etc.

China has planned to launch, from early 1988, Chinasat series domestic satellites which consist of three satellites and all of them will adopt domestic antenna beams. The Chinasat series will partially meet the needs for domestic satellite communication service, including the transmission of television programmes, especially educational programmes as well as telegraph, telephone, etc.

According to the plan, China has started to develop DFH-3 series satellites with medium communication capabilities. They will replace Chinasat series and the leased or purchased transponders of Intelsat satellite at 66°E to meet the ever increasing needs for television transmission and communication.

2. Scientific probe and technological experiment satellite

Two Retrieval Scientific Probe and Technological Experiment Satellites (RSPTES) have been launched successfully during 1987. So far China has successfully launched 10 RSPTES. The data obtained from these missions have played important roles in the fields of territory survey, geological prospecting, the planning of villages and towns, forest development and environment protection, etc. The 9th one, carrying two micro-gravity experimental devices which belong to the SA Matra Limited of France, was launched in 1987 and retrieved back successfully. It is the first time that China has provided satellite piggyback service for a foreign company. The 10th RSPTES was a new model one with improved performance and was launched on September 9 and retrieved back on September 17. Thirty-four scientific experimental devices which belong to the Chinese Academy of Science were carried successfully during this mission.

3. Launch vehicles of CZ series

China has developed three different types of launch vehicles successfully, named as Long March series including Long March-1 (CZ-1), Long March-2 (CZ-2) and Long March-3 (CZ-3) respectively. Their main features are as follows:

Feature	CZ-1	CZ-2	CZ-3
Total length (M)	29.45	32.57	43.25
Diameter (M)	2.25	3.35	3.35
Total mass (Ton)	81.6	191.0	202.0
Number of stages (propellants)	3 (2L + 1S)	2 (2L)	3 (2L + 1C)
Performance	300 kg circular orbit i = 70° H = 440 km	1700 kg circular orbit i = 63° H = 350 km	3500 kg circular orbit i = 90° H = 450 km or 1400 kg transfer orbit Hp = 200 km i = 31.1°
Operation time	1970	1974	1984

Note: L: conventional liquid propellant stage
S: solid propellant (powder) stage
C: cryogentic propellant stage
i: inclination angle
H, Hp: orbital altitude and the height of perrige

China has two satellite launch sites now. They are Jouquan launch site located at Jouquan, Gansu province, for low orbital satellite launching and Xichang launch site located at Xichang, Sichuan province, for geostationary satellite launching respectively.

China has established a complete TT&C network including the Control Center located in Xian, Shaanxi province, a number of TT&C earth stations located all over China mainland, measurement ships and other related facilities.

The Long March series launch vehicles, launching techniques and TT&C techniques, etc. have entered the application phase now. China started to put the China made Long March series launch vehicles into international market in 1985 and provide launch service for foreign customers, as a contribution from China to the space cause of mankind.

4. Communication earth station

While developing the satellite technique, China has also started to develop the communication earth station techniques. Up to now, China has built 25 communication earth stations for domestic services, with antenna diameters of more than 6 meters, including one of 18.3 meter station, one of 15 meter station, nine of 11 to

13 meter stations, three of 9 to 10 meter stations and eleven of 6 to 7.3 meter stations. Quite a few of them were developed and manufactured by China. Part of these stations are used for television transmission and communication via the purchased transponders of Intelsat satellite at 66°E. The rest of them are used for communication experiments and for television transmission and communication service via STW-1 and STW-2. China has a plan to set up another 14 stations in the near future, two of 11 to 13 m stations and twelve of 6 m stations. By now, about 5000 TVRO stations with 3 to 6 m antennas have been built and more such stations will be built soon.

COLOMBIA (REPUBLIC OF)

The National Telecommunications Corporation implemented two projects for the further development of domestic satellite communications, namely:

1. Earth stations for satellite communications using the demand-assignment system.

This project covers the installation of ten earth stations of G/T = 26 dB/°K for satellite communications, to be installed mainly on the Pacific coast and operate in demand-assignment multiple access (DAMA) mode with an initial capacity for television reception and two SCPC/CFM channels for telephony, plus the service channel.

All communications will be effected through the Chocontá-2 station, the land link between Chocontá and Bogotá and one NEAX-61 telephone exchange at Bogotá.

The places at which the earth stations are to be installed are given below, together with their coordinates.

Name	Department	Latitude (N)	Longitude (W)	Height (m)
1. Alto Baudó	Chocó	5° 30'	76° 58'	80
2. Barbacoas	Nariño	1° 41'	78° 09'	36
3. Juradó	Chocó	7° 06'	77° 46'	5
4. La Gabarra	N. Santander	9° 00'	72° 54'	25
5. La Macarena	Meta	2° 12'	73° 46'	230
6. López de Micay	Cauca	2° 51'	76° 15'	100
7. Magui	Nariño	1° 48'	78° 10'	28
8. Mosquera	Nariño	2° 30'	78° 29'	20
9. Nuguí	Chocó	5° 42'	77° 16'	5
10. Puerto Merizalda	Valle del Cauca	3° 10'	77° 25'	5

The stations for this project will come into service towards the end of 1988.
AUSTRIA

2. Earth stations for the National Territories (formerly Comisarías).

This project, awarded to NEC of Japan, covers the supply, installation and placing in operation of 20 earth stations of G/T = 26 dB/°K with initial capacities of two and five speech channels plus the service line channel.

The earth stations will operate in SCPC/CFM mode and be equipped for television reception in accordance with the INTELSAT requirement for Standard Z stations with an axial ratio of 1.06.

The earth segment will operate on solar energy and have a power-saving device, i.e. the solid-state (2 and 5 W) amplifiers will be activated when the telephone is picked up. The stations will have no redundant systems because highly reliable equipment has been ordered.

For supervision and maintenance, a centralized supervision system has been ordered for proper operation and control of the equipment.

The places at which the stations are to be installed are given below, together with their coordinates.

Name	Territory	Latitude (N/S)	Longitude (W)
1. El Encanto	Amazonas	01° 46' 47" S	73° 12' 37"
2. La Chorrera	Amazonas	01° 27' 17" S	72° 12' 37"
3. Mirití	Amazonas	01° 11' 51" S	69° 51' 45"
4. La Pedrera	Amazonas	01° 18' 58" S	69° 35' 18"
5. Tarapacá	Amazonas	02° 53' 11" S	69° 44' 44"
6. Arica	Amazonas	02° 10' 27" S	71° 44' 29"
7. Pacoa	Amazonas	00° 03' 36" N	71° 13' 28"
8. Araracuara	Amazonas	00° 35' 55" N	71° 13' 28"
9. Teresita	Vaupes	00° 44' 32" N	69° 28' 22"
10. Monfort	Vaupes	00° 37' 30" N	69° 45' 11"
11. Acaricuara	Vaupes	00° 41' 16" N	70° 14' 40"
12. Caruru	Vaupes	01° 00' 31" N	71° 25' 34"
13. San Felipe	Guainía	01° 54' 51" N	67° 04' 46"
14. Barrancominas	Guainía	03° 29' 36" N	69° 49' 06"
15. La Primavera	Vichada	05° 29' 38" N	70° 25' 19"
16. Santa Rita	Vichada	04° 52' 04" N	68° 21' 50"
17. Marandúa	Vichada	05° 31' 34" N	68° 41' 24"
18. Miraflores	Vaupes	01° 20' 12" N	71° 57' 22"
19. Puerto Ospina	Putumayo	00° 08' 22" N	75° 51' 33"
20. Zona Miraflores	Vaupes	01° 20' 12" N	71° 57' 22"

CYPRUS (REPUBLIC OF)

Space radiocommunications in Cyprus are effected via the Makarios satellite earth station which comprises:

- The Makarios-1 (Standard A) station, which during 1987 operated with the Intelsat V-A (F-10) AOR satellite.
  This station incorporates a SPADE terminal in addition to the normal direct links with FDM/FM telephone channels, and is also equipped for television transmission and reception.
- The Makarios-2 (Standard B) station, which operated with the Intelsat V-A (F-12) IOR during the same period.
  The Makarios-2 station supports telephone service via SCPC channels and is equipped for television reception only. In addition a sound programme service consisting of six programme channels is provided.
- The Makarios-3 (Standard C) station, which operated with the Eutelsat I (F-2) satellite throughout the year.
  This station supports telephony via TDMA channels and is equipped for television transmission and reception.

During 1987, the Makarios-1 station offered 157 FDM/FM telephony channels. The SPADE system enabled telephony service access on demand with 13 countries.

The number of SCPC telephony channels operating via the Makarios-2 was 36, whilst the Makarios-3 station offered 193 TDMA telephony channels, most of which were introduced in early 1987.

The continuity of service of all three stations reaches very good standards, averaging at a 99.9663% availability.

DENMARK

Nordic activities in the field of satellite telecommunications.

See under Denmark, Finland, Iceland, Norway and Sweden.

1. The domestic satellite system via an Intelsat V satellite at 307°E is fully operational with eight satellite stations in Denmark and Greenland.

2. At the launch of Eutelsat I, F-4 another domestic satellite system was brought in operation via a leased transponder in this satellite with the purpose of establishing communications between Denmark and the Faroe Islands. Initially one station is located in Denmark and one at the Faroe Islands.

3. One satellite station for the Eutelsat TELECOM I multiservice network on the French satellite system TELECOM I has been completed.

4. One satellite station with the purpose of transmitting and receiving television signals for European Broadcasting Union (EBU) via the two EBU leased transponders in Eutelsat I (F-2) has been brought in operation.

5. In 1987 Greenland's Telecom Service established a 6 metre e/s at Fredericksdal in South Greenland corresponding with a Standard A station at Des Laurentides in Canada via an Intelsat satellite on SSL 325,5 degrees East for the purpose of modulating extended range air-to/ground VFH transceivers in South Greenland from Gander Airport in Canada. The station is operated by the Greenland Telecom Service on behalf of the International Civil Aviation Organization (ICAO).

6. Propagation measurements at 20 and 30 GHz are performed with radiometers in elevation angles of 10 and 20 degrees. The measurements are supported by the Finnish and Swedish Administrations.

7. Low elevation beacon measurements at 11 GHz on an Intelsat V satellite have been performed in cooperation with the Technical University of Denmark.

8. Denmark is participating in a project (COST 210) within the European Corporation on Scientific and Technical research concerning the influence of the atmosphere on interference between radiocommunication systems.

DENMARK, FINLAND, ICELAND, NORWAY AND SWEDEN

1. The Nordic Intelsat earth station

The Nordic Intelsat earth station at Tanum in Sweden, jointly owned by the four telecommunications administrations in Denmark, Finland, Norway and Sweden, has been in operation with one antenna for traffic via an Atlantic Ocean satellite since 1971. The traffic has substantially increased since the start of the operation of the Tanum earth station. During 1981 a second antenna was introduced at the station. This antenna also operates towards a satellite in the Atlantic Ocean region.

Part of the telephony traffic is transmitted through the TDMA system. Tanum also provides test and monitoring services for the TDMA system.

During 1987 the station carried a traffic of more than 1000 preassigned circuits and up to two television channels.

In addition the station can carry a traffic of 24 circuits via the SPADE system.

2. Eutelsat earth station

Denmark, Finland, Iceland, Norway and Sweden are members of EUTELSAT.

An earth station is situated in Aagesta, south of Stockholm. The station is jointly used by the countries (except for Iceland) for services via the EUTELSAT system.

The station has a capacity of 2000 telephony channels. It can also receive two television channels and transmit one television channel.

3. The Nordic Inmarsat coast earth station

No comments.

4. Telex-X, an experimental telecommunication satellite system

Finland, Norway and Sweden are engaged in the experimental satellite programme named TELE-X. The Norwegian and Swedish telecommunications administrations are collaborating in an operating company called Notelsat. The satellite is planned to be launched in early 1989. The TELE-X mission centres on the following experiments:

- data communication
- video communication for outside broadcasting and other video applications
- direct television and sound broadcasting to home receivers and cable television networks.

ECUADOR

The advances Ecuador has made in space radiocommunications may be summarized as follows:

1. Studies for expanding its earth segment for satellite communications with the INTELSAT system and for international telecommunications through the installation of a Standard A earth station near Guayaquil.

2. Expansion of its earth segment for international communications via INTELSAT through the expansion of various subsystems of the Quito earth station built in 1972.

3. Studies for implementing a satellite link between the Galapagos Islands and mainland Ecuador through the installation of a Standard B station in the Galapagos Islands.

4. Study for implementing a DOMSAT system of approximately 12 stations scattered throughout Ecuadorian territory and interconnected with a Standard B master station at Quito.

5. Studies have been conducted jointly with four countries of the Andean subregion for implementing an Andean satellite communications system, the orbital positions of which have already been notified to the IFRB.

6. From the administrative standpoint, the possibility has been opened for direct private use of the specialized business services provided by INTELSAT, IBS and INTELNET, which are expected to expand considerably.

EGYPT (ARAB REPUBLIC OF)

1. International communication via Intelsat satellites

In Egypt, the international communications are covered by two Standard A earth stations and submarine cables. At the end of 1987 communications via satellites were about 43 percent 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 439 circuits. In addition there are 22 destinations working with Egypt via the SPADE system with a capacity of 17 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 17 countries with a total capacity of 420 circuits.

During 1987, 290 television and 472 receptions of a total duration of 25 785 minutes were handled by the two earth stations.

2. 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. Presently it provides telephone, telex, data, safety and distress services with a total capacity of six telephone circuits and eight telex circuits.

3. Meteorological satellite application

Since 1979, the Egyptian meteorological authority (APT) earth station operates with near polar orbiting satellites to receive both visible and infra-red channels. In 1979, the earth station has been modified to operate with geo-synchronous (ETEOSAT). In 1982, a new SDUS earth station has been constructed with the capabilities of receiving pictures from both polar-orbiting and geo-synchronous satellites. In addition specialized data processing system has been acquired to provide meteorologists with pictorial information about the different types of cloud systems and associated weather phenomena.

4. Remote sensing from space

The Egyptian Remote Sensing Center is a part of the Academy of Scientific Research and Technology. It possesses a complete line of state of the art digital image processing facility for aircraft and earth resources monitoring satellites data.

The Center also has a complete photogrammetric unit including a well equipped modern aircraft and the latest computer oriented analytical stereoplotter for digital mapping.

FINLAND

1. Nordic activities in the field of satellite communications

See under Denmark, Finland, Iceland, Norway and Sweden.

2. EUTELSAT

The implementation of an earth station for the satellite multiservices is completed. The station is located in Helsinki and is approved by EUTELSAT.

The station is provided with one 2 Mbit/s and six 64 kbit/s channel units with optional data encryption capability.

3. Satellite-television reception

Several television programme channels originating in the United Kingdom, France, Belgium, the Netherlands and USA have been received via Eutelsat and Intelsat satellites and a programme originating in the USSR via Gorizont for distribution into cable networks. At the end of the year satellite television was available at over 400 locations in Finland.

FRANCE

French telecommunications have continued to promote the use of satellites for developing networks and services through their activity within the INTELSAT, INMARSAT and EUTELSAT organizations, through large-scale bilateral cooperation and by the operation of France's TELECOM 1 system.

1. The TELECOM 1 system

With the launching of a second satellite in May 1985, the TELECOM 1 system has been fully operational since 1986. It now provides all telephone and television links between metropolitan France and Martinique, Guadeloupe, French Guiana, Saint Pierre and Miquelon, Réunion and Mayotte.

Besides fulfilling the above purpose, in 1987 TELECOM 1 ensured the sustained development of commercial digital business services offering a broad range of bit rates and assorted facilities to major national enterprises; through a central network management station at Mulhouse. Some 10 radio programmes and 2 television channels are also distributed by satellite.

2. Intercontinental telecommunications

French telecommunications are the third largest investor in the INTELSAT system after the United States of America and the United Kingdom. They access the INTELSAT satellites through some 20 antennas installed in the metropolitan centres of Pleumeur-Bodou, Bercenay-en-Othe and Rambouillet and in the overseas departments and territories, of Guiana, Martinique, French Polynesia and New Caledonia. Since they contribute almost 4.5% of INTELSAT's investments, they play an active part in the work of its management and consultative organs. France has participated in the technical definition of the future generation of INTELSAT VII satellites and of the digital transmission equipment which will come into general use in the coming years.

3. Strengthening European cooperation

French telecommunications are still promoting the use of the TELECOM 1 system by their European partners under agreements concluded with the Deutsche Bundespost and the European EUTELSAT Organization, will a view to enabling European companies to establish digital links within Europe via TELECOM 1.

Within EUTELSAT, French telecommunications have taken an active share in the use of the first two ECS satellites operated in TDMA mode. These are used to carry telephone circuits within Europe and television programmes for either the European Broadcasting Union (EBU) or cable networks.

In May 1986, EUTELSAT placed an order with Aérospatiale for the first three satellites of the EUTELSAT II generation, which will be launched by Ariane and come into service in 1989.

4. Maritime satellite links

The mobile-satellite service opened in 1982 by the INMARSAT Organization is still growing rapidly and considerably improving links with ships. Some 100 French ships had been fitted with INMARSAT stations by the end of 1987.

The development of the French direct-broadcasting satellite programme was marked by the incorporation of the TDF-1 satellite and the completion of equipment for the TDF-2 satellite. The launching of the first satellite had to be postponed beyond 1987 owing to launcher difficulties. In parallel with the development of this satellite, the associated ground facilities (connection and control) were completed. Major progress was made in constructing the integrated circuits needed for finalizing the D2 MAC receiving equipment.

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 1987. In the regions of the Atlantic and Indian Ocean connections to a total of 71 countries were operated.

In addition to the international public telephone and data traffic other services such as business communication and television distribution are increasingly gaining in importance.

As the demand for data and videoconference services increases constantly, a variety of stationary and mobile Intelsat-IBS stations are planned.

In addition to the existing earth stations in Raisting, Fuchsstadt and Usingen and the Berlin earth station under construction, it is planned to establish another earth station in Hameln. This new earth station will be operated with three Standard C antennas and will thus help to reduce the traffic running over the other earth stations.

1.2 EUTELSAT

The telephone traffic via EUTELSAT to Turkey as the first country of destination increased in 1987. It is planned to establish traffic relations to eight other countries in 1988.

Apart from that, television distribution services and SMS services (Satellite-Multi-Services) are operated for business communication.

Two mobile earth stations as television reporting stations were provided for the television transmission network of the European Broadcasting Union (EBU).

In September 1987 the third Eutelsat satellite was successfully launched and put into operation on 1 November. The Deutsche Bundespost participated in the in-orbit tests on the basis of a service contract.

In connection with the distribution service (directional data traffic) and the interactive service (star-shaped configuration) trials with Very Small Aperture Terminals (VSAT) at an overall bit rate of 19.2 Kbit/s were carried out.

As regards distribution services, the data coming from a large earth station can be received via satellite by many small movable receiving earth stations. The interactive service allows traffic to be handled both in the receive and transmit direction. The bit rate that can be transmitted depends on the antenna size used.

2. INMARSAT

2.1 The maritime distress radio call system DRCS

The preoperational trials and L band maritime distress call system demonstrations coordinated by INMARSAT were continued in 1987 in the coverage area of the Atlantic satellite MARECS B-2. During the trial phase 15 ships from 11 nations were equipped with a L band buoy. In November 1987 the coordination group elaborated a final report which will be submitted to IMO (International Maritime Organisation) in January 1988.

3. Trials in the mobile satellite service

A new procedure for coded modulation which is also suited for mobile radio channels was designed and simulated.

The trials with the cloud radar for measuring wave propagation channels and those with small mobile radio antennas were continued. The result was a flat disk-type antenna in microstrip design for integration into a metallic surface (e.g. a car roof) with a 6 dB gain.

4. The German telecommunication satellite system DFS Kopernikus

The activities aiming at implementing a national telecommunication satellite system were continued. In December 1983 the Deutsche Bundespost had commissioned a German industrial consortium to establish this system. The overall system comprises the space segment (two satellites in orbit; one spare ground satellite), the earth segment with earth stations for the various types of use and equipment for integration into the terrestrial networks. The subsystem new services implemented there is a complete digital switched network for the direct connection of subscribers, which, as an efficient and flexible element of the network, allows telecommunication services to be provided early and nationwide thus supplementing the digital terrestrial networks that are extended step by step. The satellite system will furthermore be used for delivering television programmes to broadband cable networks,

supporting the satellite distribution network for data that is planned by the Deutsche Bundespost as well as extending and securing the telecommunications traffic to and from Berlin (West). Moreover it is intended, by technologically opening up the 20/30 GHz band, to allow innovative uses.

It is planned to put the system into operation in 1989.

5. The German broadcasting satellite system TV-Sat

The activities to put the broadcasting satellite system TV-Sat with two high-power satellites for the direct reception of sound and television broadcasting programmes into operation were continued. In 1987 the first satellite (TV-Sat 1) was launched and placed in the planned position. However, difficulties with the solar generator prevent the satellite from being put into operation. A second satellite (TV-Sat 2) is being built at present and will be launched in 1989.

The television programmes transmitted over the broadcasting satellite system TV-Sat which was designed in line with WARC 77 regulations are broadcast in the new D2 MAC standard. Moreover, it is possible to use a television channel for the transmission of 16 digital sound broadcasting programmes in stereo quality.

GREECE

In 1987 Greece (OTE SA) continued actively its participation in the field of satellite communications.

1. Intelsat system

Three Intelsat Standard A antennas, in Thermopylae site, continued to provide service in Altantic Ocean region (335,5° and 342° satellites) and in Indian Ocean region (60° satellite). In 1987, the number of circuits for both the Atlantic and Indian satellite regions was about 660 circuits establishing connections with more than 33 countries. A number of those circuits have been assigned to several other countries as permanent point-to-point transit circuits. During 1987, traffic via the SPADE system was exchanged with Angola, Argentina, Nigeria, Mexico, Paraguay, Sudan and Uganda.

The introduction of the digital technology in the transmission of voice was achieved via the installation of TDMA/DSI System to serve the traffic in 342° satellite. This TDMA/DSI System is planned to start operation in March 1988.

2. EUTELSAT system

An international call for bids was launched in 1987 for the procurement of the EUTELSAT TDMA/EBU earth station to be installed in the new satellite communications center, in Nemea, 110 km South of Athens.

A SMS earth station is also under procurement mainly for occasional videoconference.

3. INMARSAT system

Greece, one of the founding members of the INMARSAT Organization, is currently the 8th shareholder with approximately 2.69% of the INMARSAT Investment Shares.

More than 400 ships of greek ownership (about 200 of them fly the greek flag) were using the INMARSAT system by the end of 1987.

The Thermopylae Coast Earth Station (CES) was brought into service in September 1985. The CES operates in the Indian Ocean region in cooperation with the Italian CES which is covering the Atlantic. This arrangement applies to telephone as well as telex traffic and enables the two stations to operate as though they were a single two-ocean station, with economic benefit to the users in both countries.

The CES is equipped with 16 telephone and 20 telex channels and offers telephony, telex, facsimile, data to and from ship and special 2-digit code services. It is directly connected through dedicated lines to the Greek Rescue Coordination Centre (RCC) in Pireaus for handling distress messages. A capacity increase by 8 telephone and 10 telex circuits is scheduled for 1988.

ICELAND

1. Nordic activities in the field of satellite telecommunications.

See under Denmark, Finland, Iceland, Norway and Sweden.

2. INTELSAT

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

At the end of 1987, Skyggnir carried traffic via the Intelsat VA (E-10) Primary Path satellite 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, a total of 214 circuits.

In 1983 a Standard B antenna which is colocated with the Standard A antenna commenced operation. The antenna is normally used for television reception only and accesses a leased television channel in a spare Intelsat satellite (Intelsat V (F-2)). This antenna has also transmission capabilities and is used as a backup for carrying traffic via Intelsat F-10 in case of outage of the Standard A antenna.

From October 1st, daily television news were received from EBU via Bercenay in France and the Intelsat F-10 satellite. Occasional television programmes were transmitted from Skyggnir or received on more than 60 occasions during 1987.

3. EUTELSAT

During 1987 daily television news were received with a TVRO antenna from London via Madley and the Eutelsat F-2 satellite. A TVRO antenna was also used to receive television programmes via Eutelsat F-1 for distribution to a private television company. Iceland is a member of EUTELSAT since August 1985.

INDIA (REPUBLIC OF)

1. Indian National Satellite System (INSAT)

1.1 Insat-IB, the second spacecraft of the first generation multipurpose Indian National Satellite System (INSAT-I), which was launched in 1983, is fully operational. As on 31st December 1987 the services being provided by INSAT-IB system are:

- Long distance telecommunications (telephony, data, facsimile, etc.)
- Total of about 53 earth stations providing about 4001 two-way voice circuits or equivalent.
- Round the clock meteorological earth observation and data relay.
- Transmission of weather pictures in analog facsimile mode every three hours to 20 Secondary Data Utilization centres.

- 100 Data Collection Platforms (DCP) including one at Indian base station at Antartica.
- Experimental anchored buoy DCP and 15 DCP's in Yamuna catchment area for flood forecasting scheme under implementation.
- Direct television broadcast to augmented community television sets in rural areas.
- Of the total 224 television transmitters, all except 4 are in INSAT television network.
- Over 6000 direct reception sets are deployed.
- National and regional networking of radio transmitters.
- Dedicated communication networks for the business and industrial sectors.
- A Disaster Warning System (DWS) for alerts on cyclonic events.
- 100 DWS receivers are presently deployed in field on an experimental-cum-demonstration mode.
- A satellite based news dissemination service for the national news agency.
- A satellite based standard time and frequency dissemination systems.

1.2 The launch of the third Insat-I satellite, Insat-IC, is scheduled for mid 1988. This will not only provide certain on-orbit back-up capability but also make available additional capacities to support new or expanded services such as;

- Long distance telecommunications including a satellite based rural telegraphy network and several business communication networks.
- A spread-spectrum data network using VSATs for governmental information transmission and other purposes.
- Expanded regional-language television broadcasts.
- A satellite based dissemination network for processed meteorological data derived from Insat-I meteorological payload.

1.3 Insat-ID will be the fourth and the last satellite in the Insat-I series. Its launch is scheduled in 1989.

1.4 The second generation Insat satellites (INSAT-II) are being built indigenously. They will continue to provide all services on Insat-I, with appropriate quantitative and qualitative enhancements. A 406 MHz search-and-rescue payload also is included on Insat-II.

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. To this effect an agreement between India and Cospas-Sarsat space segment and establishment of ground system in India has been signed. A local user terminal is being set up in India. India is actively pursuing the development of 406 MHz emergency location beacon.

2.2 India is actively participating in the studies conducted by ICAO and is participating in the joint studies with ESA and GEOSTAR separately for the purpose of evolving a system capable of providing mobile satellite communication services and radio determination services on a global basis.

2.3 A pilot project for providing a quick messaging (telegraphy) service to remote and rural areas using inexpensive terminals and geostationary communication satellites is under progress.

2.4 Projects for news dissemination and weather data dissemination using satellite are near to completion.

3. Indian remote sensing satellite (IRS)

3.1 All acceptance tests on IRS-IA spacecraft have been completed and the launch is planned in March 1988. The payload system consists of two types of Linear Imaging Self Scanning Cameras with resolution 36.25m and 72m. The data transmission will be in the X and S bands.

3.2 Establishment of ground terminal at Hyderabad for reception of data from IRS-IA is completed.

3.3 At Hyderabad the X/S band terminal is being used for receiving data from Landsat-4 satellite. Regular acquisition of Metsat data from NOAA satellites is done through the new Metsat terminal.

3.4 Installation of X band terminal for receiving data from SPOT satellite has been completed.

3.5 Digital version of X-band Side Looking Radar (SLAR) system has been developed.

4. Stretched Rohini satellite series (SROSS)

SROSS-2, the 150 kg low earth orbit satellite scheduled for launch around June 1988 is in the advanced stage of testing and integration. This satellite will carry two scientific research payloads, gamma-ray experiment module and monocular electro-optical stereo scanner.

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

As a part of ISTRAC network, installation, testing and commissioning of S-band TT&C ground stations at Bangalore and Lucknow have been completed to provide telemetry and telecommand support for the Indian low earth orbit satellite and launch vehicles.

INDONESIA (REPUBLIC OF)

1. Domestic satellite communications.

The Indonesia domestic satellite system, known as the PALAPA domestic satellite system is owned and operated by PERUMTEL, a government owned telecommunications company.

The first-generation Palapa satellites, Palapa A-1 and Palapa A-2, each carrying 12 transponders, were launched in 1976 and 1977 respectively.

At present the operational satellite is Palapa B-1, which was launched in 1983, while in 1984 the in-orbit spare for Palapa B-1, i.e. the Palapa B-2, was launched by STS Challenger, but failed to achieve geosynchronous orbit due to malfunction of the PAM-D upper stage. Later in 1984 this satellite was retrieved back to earth by NASA on behalf of the insurance companies.

To replace the failed B-2 satellite to orbit, a new satellite called B2-P was successfully launched in 1987 by-using Delta rocket from Mac Donnel Douglas.

The recovered B-2 satellite, at the end of 1987 was purchased back by PERUMTEL and was renamed B-2R and scheduled to be launched in 1990.

The B series satellites are bigger and more powerful than the A series, and each carry 24 transponders.

The PALAPA system provides long distance telecommunication as well as television distribution in Indonesia. Palapa satellites are also utilized by neighbouring ASEAN (Association of South East Asian Nations) countries for their domestic requirements.

At present the PALAPA network consist of more than 130 earth stations for telecommunication with antenna diameter ranging from 4.5 m up to 10 m and hundreds of homes installed TVRO (Television Receive Only) for national television receptions.

Installation of 100 additional small earth stations for telecommunication in rural areas are under way, while a TDMA network serving several big cities is under final test, ready for operation.

PALAPA system is also used for data transmission. An experimental Packet Satellite Data Network, called PACKSATNET, was successfully demonstrated in 1984 using ALOHA internal protocol with selective error corrections.

Today, effort to integrate terrestrial data links using high capacity packet switched and satellite based using distributed processing data network is under way, while other alternative for data communication by using VSAT (Very Small Aperture Terminal) is under investigation.

For tele-education, in which lectures for several universities in eastern part of Indonesia are directly transmitted from Jakarta through PALAPA system, a certain number of experiments has been carried out successfully for several years.

2. International satellite communications

International public telecommunications service, including international satellite communications is provided and operated by PT. INDOSAT, a government-owned company for international public telecommunications.

Indonesia was among the first countries to participate in the global satellite communications network provided by INTELSAT.

The first Intelsat earth station with a Standard A antenna located at Jatiluhur, Indonesia, was constructed and put into service in 1969, thus marking the beginning of satellite communications era in Indonesia.

In order to provide additional circuits for increasing international telecommunications traffic, a second Standard A antenna was built and put into service in 1979 for services with Intelsat Indian Ocean satellite.

With the growing experience and expertise in satellite communications operation and maintenance in Indonesia, Indonesia was awarded a contract by INTELSAT for the provision and operation of TDMA Reference and monitoring station services in 1984. In the same year Indonesia was again awarded a contract by INTELSAT to provide and operate an INTELSAT Telemetry, Tracking, Command and Monitoring Station located at Jatiluhur earth station.

Initially only FDM/FM/FDMA transmission through Intelsat satellite was implemented in Indonesia for services with other countries. With the introduction of TDMA in the Indian Ocean region, PCM/QPSK/TDMA transmission is implemented for services between Indonesia and European countries.

INMARSAT service in Indonesia to/from ships in the Indian Ocean and Pacific Ocean had been implemented since 1983 through coast earth stations in Singapore and Japan. Indonesia is also a member of INMARSAT since 1986.

3. Other space activities (Indonesia and European countries)

Indonesia participates in other space activities through Lapan, the Indonesian Institute of Aeronautics and Space, which operates an earth station for remote sensing and meteorological purposes, accessing available satellites.

IRAN (ISLAMIC REPUBLIC OF)

1. Preparation of technical specification for domestic satellite network was completed.

It is anticipated that operation of Iran's first domestic satellite network called ZOHREH to be commenced in 1992.

2. Islamic Republic of Iran purchased three Ku-Band Intelsat transponders, one of which is going to provide telephony services for 51 points of remote areas, and the other two transponders will be used for television services and standby.

3. In order to expand international services two more Standard B antennas operating with AOR and IOR Intelsat Satellites were installed, and another Standard A antenna is anticipated to operate with IOR in 1988.

4. Preparation of technical specification for Iran's first coast earth-station communicating via Inmarsat was completed and it is going to operate in 1988.

ISRAEL (STATE OF)

1. International services (general)

During 1987, international telephone, data and facsimile traffic increased at an accelerated rate. The new international switch in Tel-Aviv was exploited to its maximum and its expansion is already in hand.

The number of international circuits increased by 18% from 1374 at the end of 1986 to 1626 at the end of 1987.

Israel became a member of INMARSAT on the 13th October 1987.

2. Space telecommunication service

Of Isarel's 1626 international circuits, 619 (38%) were routed via Intelsat satellites and the rest via two submarine cables linking Israel with Europe.

The distribution of the satellite voice-grade channels is as follows:

Intelsat satellites	No. of links	No. of circuits
AOR/335.5°	15	345
AOR/325.5°	10	244
IOR/63°	2	30
Total		619

During the year, plans for the digitalization of the satellite services were completed and in 1988 Israel's main satellite links will be converted to end-to-end digital links. The contracts for this work have already been placed.

In addition a new digital link was established between Emeq Ha'Ela earth station and Tel-Aviv.

The digitalization of satellite links is in line with the trend to operate most of the country's international circuits in the digital mode. By end-1990 part of these circuits will be routed via the new EMOS 1 fiber optic submarine cable between Israel and Europe.

Satellite Television

The volume of occasional television transmissions via satellite increased considerably during 1987 and both satellite and back-haul television equipment is being procured to receive the television transmissions from the Summer Olympic Games in South Korea in 1988.

3. Domestic satellite services via Intelsat satellite

The year review saw the experimental distribution of the second national television channel via the East-spot transponders of an Intelsat AOR satellite. It is planned to extend the use of these transponders in 1988 to provide Pay-television, SNG and digital links.

ITALY

The activities of Telespazio can be grouped into five major headings:
- Satellite commercial telecommunications,
- Support and in orbit control of satellites,
- Experimental and other activities,
- Satellite remote sensing,
- International cooperation.

1. Satellite commercial telecommunications

Telespazio is the Italian Signatory of the Operating Agreement for the INTELSAT, INMARSAT and EUTELSAT Organizations. It has been operating commercial satellite telecommunications since 1965 under an Agreement with the Italian PP.TT. Ministry. This Agreement was renewed in 1984, confirming and strenghtening the role of Telespazio as the only carrier for national, european and intercontinental satellite telecommunications.

These activities are performed by operating two earth stations:

— the Piero Fanti Telecommunications Center, located at Fucino. It works at 6/4 GHz with the Atlantic Primary and the Major Path 1 satellites and with the Indian Primary Path satellite, this latter antenna using also TDMA techniques; and at 11/4 GHz with the Atlantic Primary satellite.

— The Lario earth station located near the lake of Como, working at 6/4 GHz with the Atlantic Major Path 2 satellite and, since 1985, with the Indian Major Path satellite through a second Standard A antenna.

Telespazio has also continued works for the construction of a third earth station to be located in Sicily. This is expected to be operational in 1990 and will complete the access system to the Italian telecommunication network of intercontinental satellite circuits.

At the end of 1987, the number of overseas countries linked to Italy by means of Intelsat satellites were 83 for a total of 2262 circuits, of which 108 in TDMA and 60 not terminating in Italy but hard patched, as permanent rigid transit circuits, to several countries, mostly in the Mediterranean basin and the Far East. The network is utilized principally by the Italian international carrier Italcable and by several PP.TT. Administrations and Operating entities in other countries for their provision of point to point telecommunication services.

Moreover, in 1987, Telespazio has provided to the Italian responsible Carrier (ASST) a total of 503 circuits (502 for voice + 1 for data) via the EUTELSAT system.

As far as television is concerned, the total number of services accounted for 3593 transmissions for an overall duration of 2930 hours, including 750 national transmissions for 702 hours through two transportable antennas.

Moreover, television services were provided through INTELSAT and EUTELSAT to AFRTS, to the Italian Broadcasting Company (RAI), to the European UER and also to private broadcasters.

The Italian coast earth station at the Fucino Center entered the third year of operations. The station is connected to the INMARSAT system through 16 accesses, according to arrangements made with the "Direzione Centrale dei Servizi Radioelettrici" of the PP.TT. Ministry, which is responsible in Italy for the provision of the mobile maritime service. The Italian traffic quote expanded from 1.18% to 1.43% of the whole INMARSAT traffic during 1987.

Arrangements have also been made with the responsible Italian carriers for the provision of business services via INTELSAT (IBS) and EUTELSAT (SMS), as well as of user oriented networks especially designed for domestic traffic (mainly data distribution) through leased capacity on both systems, which will be operational by 1988, following an experimental phase started in 1986.

2. Support and in orbit control of satellites.

On the basis of a pluriannual contract, Telespazio is responsible for providing the following services:

- Telemetry, Tracking, Command and Monitoring (TTC&M) to INTELSAT;
- IOT (In Orbit Test) services to INTELSAT;
- TTC&M to MARISAT;
- TRMS (TDMA Reference and Monitoring Station) to INTELSAT and EUTELSAT.

In addition, Telespazio has implemented the needed equipment (including two news antennas) for providing TTC&M and IOT services to INMARSAT (starting 1988), on the basis of a contract awarded to Telespazio after an international bid.

Telespazio has also completed the installation of the TTC&M and in Orbit Control Center of the Olympus satellite (formerly L-SAT) for the subsequent provision to ESA of the relative services for a five year period.

3. Experimental and other activities

In the framework of Telespazio experimental activities, carried out with the aim of contributing to the development of future utilizations of the satellite telecommunications, the following significant activities were performed in 1987:

- continuing a study for INMARSAT on onboard processing for Standard C stations;
- continuing the SATNET experiment, linking the CNUCE (Centro Nazionale Universitario di Calcolo Elettronico) of Pisa with the ARPANET network in the United States, which allow to improve access techniques to the satellite in packet switched networks;
- continuing the studies for the ITALSAT programme, the 20/30 GHz domestic satellite system, concerning the technical specifications as well as the orbital control of Italsat F-1, and the basic specifications of Italsat F-2;
- continuing a study for ESA on the integration of terrestrial and satellite network in Europe;
- continuing the activity on the DRS (Data Relay Satellite) for ESA, with the acquisition of the A2-phase study;
- completed the mission and earth segment study for the SAX programme of CNR/PSN (National Space Plan), which involves the launch of a low orbit satellite by early 1990's to find out and measure cosmic sources of X-rays;
- continuing the activity to define the involvement of Telespazio in the ESA/COLUMBUS programme;
- continuing the implementation of the phase for the experiments with the Olympus and Italsat satellites through the acquisition of earth stations of different size (small, medium and large) partly operating at 12/14 GHz and partly at 20/30 GHz.

Moreover Telespazio continued, on behalf of CNR/PSN, the operational management of the Matera laser station for measurements using geodetic satellites. The received data are utilized not only to measure movements of the earth's crust but also to study drifts of the North pole.

4. Satellite remote sensing

Remote sensing activities related to the acquisition and distribution of data from NASA Landsat 4 and 5 spacecrafts and to the distribution of data from SPOT satellite continued regularly throughout 1987.

The pre-operational project concerning the applications of Thematic Mapper data for agricultural resources control and forecasting, is continuing and its territorial coverage has been extended.

The collaboration between Telespazio and ENEA, the Italian body responsible for research and development in the field of alternative energy sources continued on a project applying satellite technology to the observation of earth resources.

Moreover there was a major progress in the provision of geographical information systems (GIS) combining data gathered from satellites and other sources (terrestrial platforms, aircrafts, etc.).

5. International cooperation

In the area of the international cooperation activity, Telespazio participated in the organization of the IRI 25th specialized training course for technicians and managerial personnel, carrying on lectures in the specific field of satellite telecommunications.

As far as operation and maintenance of earth stations is concerned, it finished the assistance of a Telespazio expert in Somalia for the operation of the local earth station in September 1987.

In the area of the bilateral cooperation activity a Czechoslovakian specialist attended a short stage on remote sensing organized by Telespazio with the financial support of the Italian Foreign Secretary.

The cooperation with the United Nations and its specialized organizations continued as well.

In 1987 Telespazio contributed as in previous years to the organization of the following course:

- 10th FAO/UNDRO/WMO/ESA training course: on Remote Sensing Applications to Agriculture Drought and Desertification (July 1987).

JAPAN

1. Satellite projects

1.1 Communications

The CS-2 system, Japan's first operational communications satellite system, consists of two spacecrafts, CS-2A and CS-2B.

CS-2A was launched on February 1983 into the geostationary orbit at 132 E and CS-2B was launched on August 1983 into the geostationary orbit at 136 E, both by Japan's N-II launch vehicle from the Tanegashima Space Center of the National Space Development Agency of Japan (NASDA).

Operational services of the CS-2 system started in May 1983 using CS-2A, and in November 1983 CS-2B came into operation. The CS-2 system is being used for offering communications with remote islands, and for such services as communica-

tions for anti-disaster measures, occasional communications, etc. by the following users; the Nippon Telegraph and Telephone Corporation, the Japanese Railways: JR Higashi Nippon and JR Tokai, Electrical Power Companies, the National Police Agency, the Ministry of Construction, the Fire Defence Agency and the Ministry of Post and Telecommunications.

The Telecommunications Satellite Corporation of Japan (TSCJ) is controlling the orbital slots and attitudes of the CS-2 satellites. The CS-2 system is in good condition now.

The next-generation communications satellites, the CS-3 satellites (CS-3A and CS-3B), are planned to be launched in February and August or September of 1988 respectively by Japan's H-I launch vehicle from Tanegashima Space Center of NASDA.

The CS-3 satellites are designed to have a lifetime of seven years. They are spin-stabilized satellite weighing 550 Kg in orbit with 12 transponders in operation (ten for 30/20 GHz band and two for 6/4 GHz band) with six spare transponders.

The CS-3 programme is now being carried out as scheduled and CS-3A is before launching. The users of CS-3 will be the seven new organizations to add to the CS-2.

1.2 Broadcasting

The BS-2 system, the first direct-broadcasting satellite system in the world, consists of two spacecrafts, BS-2A and BS-2B.

The BS-2 system is intended to improve the television broadcasting service in Japan's mountainous areas, remote islands and places in urban areas where receiving conditions of terrestrial broadcasting service are not good, and to acquire new knowledge of the broadcasting satellite technology.

BS-2A and BS-2B were launched on January 1984 and February 1986 respectively into geostationary orbit at 110°E by Japan's N-II launch vehicles at the Tanegashima Center of NASDA. The TSCJ has been controlling the orbital slot and attitude of the satellites after the initial checkout by NASDA.

NHK (the Broadcasting Corporation of Japan) has been providing the two channels of color television service via BS-2 to all parts of the country.

The next-generation broadcasting satellites, the BS-3 satellites (BS-3A and BS-3B), are planned to be launched in summer of 1990 and in summer of 1991 respectively by Japan's H-I launch vehicles at the Tanegashima Space Center of NASDA.

The BS-3 satellites are designed to have a lifetime of seven years. They are three axis stabilized satellites weighing 550 Kg in the orbit and having a capacity of NTSC standard broadcasting service and High Definition Television service.

The design and launch of BS-3 satellites were ordered to NASDA by the TSCJ in October 1985. In 1987, BS-3 system came to the final design phase after the preliminary design phase.

1.3 Meteorology

The Geostationary Meteorological Satellite (GMS), as part of the Global Observing System of the World Meteorological Organization, has vitally been serving meteorological service of many nations in Asia, Oceania, and Western Pacific. The telecommunication functions of the GMS are:

1. Transmission of VISSR (Visible and Infrared Spin Scan Radiometer) observation data to the ground station;

2. Direct facsimile broadcast of the satellite imagery:

3. Collection of the meteorological data from the Data Collection Platforms (Number of DCPs installed are increasing); and

4. Transmission of telemetry and command.

Since March 1987 both the services of (1) and (2) have been made on an hourly basis instead of a three-hour basis.

The GMS-3 launched on 2 August 1984 is now in operation in the geostationary orbit at 140°E. The GMS-4, as the successor of the GMS-3, is expected to be launched in summer 1989.

1.4 Space Research

ISAS (the Institute of Space and Astronautical Science) launched a scientific satellite EXOS-D on February 14, 1984 (JST) with M-3S rocket from Kagoshima Space Center, Uchinoura, and renamed it Ohzora (Sky). It was given the international designation 1984-015A. Ohzora has investigated the structure of the earth's middle atmosphere and interactions between auroral particles and polar ionosphere.

MS-T5, Japan's first interplanetary spacecraft, was successfully launched on January 8, 1985 (JST) with M-3SII rocket. MS-T5 escaped from the earth gravitation for the first time in the space development effort of Japan, and was renamed Sakigake (Pioneer) with the international designation 1985-A. Sakigake successfully carried out the technological missions, such as performance verification of the new type launch vehicle, deep space communication using S-band, orbit and so forth. Sakigake flew by 7 million Km from Halley's comet on March 11, 1986 (JST), and observed the interplanetary magnetic field and the interaction between solar wind and Halley's comet.

Halley's comet explorer Planet-A was injected into orbit on August, 1985 (JST) with M-3SII rocket, and was renamed Suisei (Comet) with international designation 1985-A. Suisei passed by 0.15 million Km from Halley's nucleus on March, 1986 (JST). It took the ultra-violet images of hydrogen coma around the nucleus, and studied also the interaction between solar wind and Halley's coma.

On February 5, 1987 (JST), ISAS launched an X-ray astronomy satellite ASTRO-C using M-3SII rocket, and renamed it Ginga (Galaxy) with the international designation 1987-012A. Ginga has been observing a lot of X-ray and gamma-ray sources of celestial origin with high precision, and, in addition, caught the invaluable X-ray from the Supernova SN 1987A which had suddenly appeared in February, 1987.

1.5 Space technology

1.5.1 Marine Observation Satellite (MOS-1B)

MOS-1 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 about 50 m, and to establish the fundamental technology needed for an earth observation satellite, weighing approximately 740 Kg. MOS-1 was launched into a sunsynchronous subrecurrent orbit at an altitude of about 909 Km by Japan's N-II launch vehicle in February, 1987. As a succeeding satellite to MOS-1, MOS-1B will be launched into the same orbit by Japan's H-I launch vehicle in January 1990.

1.5.2 Earth Resource Satellite-1 (ERS-1)

The main purposes of the ERS-1 are to develop optical sensors and synthetic aperture radar and to establish an integrated system for observing the earth resources. Other objectives will be making surveys of the nation's land, monitoring agriculture and forestry, preserving the environment, preventing disaster and monitoring the coasts. The ERS-1 will weigh approximately 1400 Kg and will be launched into a sunsynchronous subrecurrent orbit at an altitude of about 570 Km by Japan's H-I launch vehicle (2-stage) in January-February 1991.

1.5.3 Engineering Test Satellite-V (ETS-V)

ETS-V is a satellite intended to verify the performance of the H-I launch vehicle as well as to establish basic technology for the bus systems needed for a three-axis stabilized geostationary satellite. Also this satellite will perform mobile-satellite etc. Weighing approximately 550 Kg at the beginning of life, ETS-V was launched into a geostationary orbit at 150°E. long, by Japan's H-I launch vehicle in August 1987. The experiments began in December 1987 and have been progressing well.

1.5.4 Engineering Test Satellite-VI (ETS-VI)

The ETS-VI is a two-ton-class and three-axis-stabilized satellite for the purpose of developing the spacecraft bus which meets the requirements in the field of satellite communications and broadcasting services in the 1990's. It is intended to develop the technologies for the advanced satellite communications in the future. The ETS-VI will weigh approximately 2000 Kg at the geostationary orbit and will be launched by Japan's H-II launch vehicle in August-September 1992.

2. International commercial satellite communications

2.1 INTELSAT

Kokusai Denshin Denwa Co., Ltd. (KDD), the signatory of Japan to INTELSAT, has been providing overseas telecommunications services through the INTELSAT system. As of 30 November 1987, KDD had 1949 voice grade circuits via the Indian Ocean satellites and Yamaguchi earth station, and 2794 voice grade circuits via the Pacific Ocean satellite and the Ibaraki earth station.

KDD introduced international teleconference service in Indian Ocean region in June 1987.

2.2 INMARSAT

KDD, the signatory of Japan to INMARSAT, has been providing maritime satellite communications services through the INMARSAT system. During the period from January through December 1987, the Yamaguchi Coast Earth Station (CES) handled 43030 ship-to-shore telephone calls, 38330 shore-to-ship telephone calls, 116608 ship-to-shore telex calls and 57000 shore-to-ship telex calls. During the same period, the Ibaraki CES handled 87470 ship-to-shore telephone calls, 72124 shore-to-ship telephone calls,, 238668 ship-to-shore telex calls and 113052 shore-to-ship telex calls.

Ministry of Posts and Telecommunications has started field experiments of aeronautical satellite communications via Inmarsat satellite at Ibaraki CES in collaboration with KDD and Japan Air Lines (JAL) from October 1987.

Note: The number of calls at Yamaguchi CES and Ibaraki CES are calls originated or terminated in Japan.

KUWAIT (STATE OF)

Kuwait, with its largest earth station complex in the Middle East, is linked with the rest of the world through six satellite communication earth station antenna.

Out of the three Standard A antennae, one works with the 60° Intelsat satellite, while the other two work with the 335° and 342° satellites. A Standard B mobile earth station, being lined up currently, will soon point over to the 342° satellite to take up part of the traffic. Another antenna is linked with the MARECS B-2 satellite at 26° W to operate in the INMARSAT communication system. The sixth antenna handles communications with most of the Arab countries through the ARABSAT system. In addition to the above, Kuwait recently procured two units of portable earth stations which were tested and commissioned to work in the INMARSAT system.

With the above mentioned satellite communications system, Kuwait at present has 941 working telephone circuits via satellites. An average of four hours television programmes are being received or transmitted by these stations each day.

UML 1-A antenna, built in 1969, is being modified with the latest GCE equipment and modern tracking system.

MALTA (REPUBLIC OF)

The Malta Administration communicated the following:

During 1987 Telemalta Corporation continued to operate an Intelsat standard B earth station working with the 335.5° E (Atlantic Primary Path) satellite, providing direct voice communication between Malta and Algeria and the United States of America. This station commenced operation in December 1986.

MEXICO

1. Introduction

Mexico's progress in space radiocommunication in 1987 was mainly in the use of its domestic satellite Morelos 1.

2. Television services

Five of the main television channels from Mexico City are broadcast via the Morelos I satellite to more than 200 places in the rest of the country.

These signals are also well received by a large number of private TVRO earth stations.

A total of six permanent television services are carried via satellite: channel 2, channel 7, channel 13, cablevision Tijuana, channel 4 and channel 5. The last two were launched in 1987.

December saw the start of television transmissions using the Morelos I satellite's Ku band. In line with the policy of using the Morelos satellite system for educational purposes, an educational channel was introduced in the Ku band, for which three television receiving earth stations were set up in the State of Durango. They feed a transmitter operating in the VHF band and broadcasting the signal, thus serving subsidiary stations in each earth station's area of influence. This service is provided on a permanent basis and is intended for broadcasting educational and entertainment programmes to rural areas.

Because the Morelos system satellites have the advantage in band C of operating with two linear polarizations, and as part of the programme for making greater use of this facility, the two-port feeder system of the television receiving earth station at La Paz, BCS "Baja California Sur", was replaced by a four-port one. In order to integrate this station into the existing FDM/FM multi-channel telephone network, it was equipped as a telephone transmitter-receiver and at the same time as a television transmitter.

Through the kind assistance of the INTELSAT SHARE project, medical lectures were broadcast from the Mexico children's hospital to various South American countries. This new service was put out weekly from 29 July to 25 November, using the Iztapalapa five earth station and the INTELSAT 332.5° satellite (Atlantic standby).

These programmes were transmitted at the same time via the Morelos I satellite to various medical institutions in the country.

3. Telephone service

In 1987, FDM-FDMA telephone traffic via the Morelos I satellite increased significantly, and the La Paz earth station was equipped as a television and telephone transmitter, using a 1092-channel carrier with a bandwidth of 36 MHz.

The national satellite telephone system at present uses five 36-MHz transponders and involves another five earth stations in Mexico City, Monterrey, Tijuana, Hermosillo and Guadalajara.

The rural satellite telephone project using earth stations operating in the Ku band begun in 1983 was further consolidated in 1987, the aim being to evaluate operational and service performance within the national territory. It consists at present of 27 earth stations, eight state cells, one master earth station, eight urban earth stations and 18 rural earth stations providing telephone and data services operating in the SCPC-QPSK mode. Five rural stations were adjusted and approved so as to make six of the state cells fully operational and two partially so. In addition, in order to determine the most appropriate conditions for planning the extension of rural services via the Morelos satellite system, an analysis was made of the results achieved by the network during 1987.

MOROCCO (KINGDOM OF)

The Kingdom of Morocco has made the following advances in space communications:

- establishment of new international links with Arab countries via the Arabsat satellite;
- equipment of a second television transmission channel for the Intelsat Standard A station;
- creation of a new domestic Standard B earth station at Smara.

NEW ZEALAND

The Telecom Corporation of New Zealand Limited, which is responsible for New Zealand's domestic and international telecommunications services, operates four Standard A satellite earth stations in the INTELSAT system, two at Warkworth, each with 30 metre dish antenna, and one each at Wellington and Christchurch with 18 metre antenna.

International satellite services from New Zealand will be enhanced during 1988 with the introduction of IDR (intermediate data rate) service on major routes, together with IBS (INTELSAT Business Service). The Intelsat Vista service for thin-route traffic will be introduced between New Zealand and Niue about the second quarter 1988.

An additional earth station antenna of 9.2 metre diameter is being constructed at Warkworth for domestic telecommunications services via the south-west Pacific beam of the Aussat A-3 satellite commencing about August 1988. The antenna will operate with a number of transportable earth stations at various locations throughout New Zealand to provide video, video conference, and voice/data links. The services will include voice/data links with the Chatham Islands.

The New Zealand Meteorological Service continues to operate a satellite receiving terminal at Wellington to obtain weather forecasting and other information utilising geostationary and polar orbiting satellites. The data derived has been extended to include the monitoring of crop stress.

The ionospheric observation programme conducted by the Department of Scientific and Industrial Research has been substantially reduced. The Department is continuing the routine provision of magnetic activity indices from three (instead of four) stations.

NIGER (REPUBLIC OF THE)

The communications-satellite network in Niger is as follows:

Type of station	Antenna diameter	Installed at	Use
Standard A	32 m	Karma (Niamey)	International telecommunications
Standard B	13 m	Goudel (Niamey)	International telecommunications
Standard B	11.5 m	Karma (Niamey)	National telecommunications
Standard B	11.5 m	Agadez	National telecommunications
Standard B	11.5 m	Diffa	National telecommunications

NORWAY

1. Nordic progress in the field of space telecommunications

See under Denmark, Finland, Iceland, Norway and Sweden.

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 (F-2) satellite has been purchased for this purpose.

Altogether nine earth stations are in operation:

- the mainland station Eik,
- seven platform stations in the North Sea,
- the Isfjord station at the Arctic islands of Svalbard.

2.2 In addition, the Norwegian Telecommunications Administration (NTA) has purchased three K-band transponders on the Intelsat V (F-2) satellite.

One of the transponders is used for domestic distribution of the two Swedish public service television programmes. The modulation type is C-MAC, which is a new modulation standard for television.

The second transponder is to be used for the national business communication system NORSAT B (to be introduced in 1988).

The capacity of the third transponder is used for the distribution of private television programmes and transmission of occasional television from transportable earth stations.

2.3 Eutelsat transponders

Norway is leasing a full-time transponder on Eutelsat I (F-4). This transponder is used for transmissions of the Norwegian public service television programme, modulated in C-MAC to Svalbard and to the oil rigs in the North Sea.

The leased relay capacity in F-4 is also being used for domestic business communication (called the NORSAT B-O system).

Two earth stations serving international business communication by means of the SMS transponder on F-2 are in operation at Nittedal outside Oslo and at Stavanger. These earth stations became operational in 1987 and offer the following capacities: 3 × 64 kbit/s and 2 × 2.048 Mbit/s.

OMAN (SULTANATE OF)

The Sultanate of Oman presently utilizes the services of INTELSAT for the flow of international telecommunications traffic and the services of ARABSAT for the regional and domestic telecommunications traffic.

1. Operation through INTELSAT

- The installation of A Standard earth station (32 m antenna) took place in 1976 at Al Amerat in the capital area of Muscat. The telecommunications services from Oman are now provided to 17 countries through INTELSAT. There are 206 voice circuits and 14 non voice circuits presently working through INTELSAT.
- Another earth station of 11 m antenna was installed in 1977 at Maamurah in Salalah (southern part of Oman). This started the operation of domestic satellite network in Oman, with the control terminal at Al Amerat through 11 m antenna installations.

2. Operation through ARABSAT

In the year 1984 there further was an addition of 11 m antenna installations at Al Amerat for operation with ARABSAT. At present nine countries mostly of the Middle East are connected with Oman through ARABSAT. There are 67 voice circuits and 18 non voice circuits from Oman through ARABSAT.

3. Expansion of DOMSAT network

The domestic satellite network of Oman which initially worked with INTELSAT was diverted in 1986 to ARABSAT. The DOMSAT network was further expanded

with the installation of more earth stations of 11 m antenna at Khasab, Masirah Island, Nizwa, Saham, Buraimi and Sur. The features of these DOMSAT earth stations are mentioned in the following:

Earth station	Size of antenna	Features of operation
Al Amerat (Muscat) and Maamurah (Salalah)	11 m each	Transmission and reception of voice and non voice telecommunications traffic including television.
Khasab and Masirah Island	11 m each	Transmission and reception of voice and non voice telecommunications traffic and only reception of television.
Nizwa, Saham, Buraimi and Sur	11 m each	These operate television reception only.

4. Operation with INMARSAT

With a number of land mobile Inmarsat terminals and ship earth station terminals Oman has a working arrangement with INMARSAT.

PAKISTAN (ISLAMIC REPUBLIC OF)

1. Ground receiving stations

Two satellite ground stations having capability to track and receive signals from a number of satellites like UOSAT-1 and 2, METEOR, NOAA-9, 10 etc. in low-earth orbits were commissioned at Space and Atmospheric Research Center (SPARCENT), Karachi and at Space Applications and Research Center (SPARC) Lahore. Engineering, scientific and satellite tracking data received at the two stations is recorded, archived and analysed to obtain information about the satellites in the space environment, radiowave propagation and meteorology.

2. Landsat-Spot ground station

A ground is being set up at Islamabad to receive real time remotely sensed data from US Landsat, French Spot and US NOAA satellites, which will be used in the survey of natural resources and environment. The station will permit acquisition and processing of Thematic Mapper (TM) and Multi-Spectral Scanner (MSS) data from Landsat, panchromatic and multispectral data from Spot satellites and AVHRR data from NOAA satellites. The station will have facilities for production of full resolution images, archival tapes and for retrieval of data under computer control. The station is expected to be commissioned by mid 1988.

3. Pakistan's first low earth orbit satellite (BADR-A)

Suparco's scientists and engineers have fabricated all the engineering subsystems of first low earth orbiting scientific satellite of Pakistan namely BADR-A, which is expected to be launched during 1988. The satellite has been fully integrated and is currently undergoing ground tests. It carries experiments of inhouse telemetry monitoring, telecommand, radio beacon and digital communications.

4. COSPAS/SARSAT programme

SUPARCO has drawn up a proposal to participate in the demonstration and evaluation phase of the COSPAS/SARSAT programme. This involves installation and commissioning of Local User Terminal (LUT) and Mission Control Center (MCC) and coordination with the concerned national agencies involved in rescue operations and the COSPAS/SARSAT parties.

5. ARGOS programme

SUPARCO is establishing a direct readout station and would initially deploy 10 PTTs for:

- acquisition of meteorological data from inaccessible areas,
- development of a snow-melt run-off monitoring system for water resources management and
- measurement of ocean/sea parameters for better management of ports and ocean resources.

6. Pakistan's proposed Domestic Communication Satellite System (PAKSAT)

SUPARCO has carried out a feasibility and system definition study for a Domestic Communication Satellite System (PAKSAT). The system caters for two spacecrafts: one positioned at 38°E in operational mode and the other positioned at 41°E as in orbit spare and the associated ground stations. The planned services include:

- television broadcasting and FM radio networking,
- trunk and thin route telephony,
- telecommunications for air traffic control and meteorological services,
- business services such as data communications, facsimile transmissions, teleconferencing, computer-to-computer link, teleprinting, etc.,
- emergency services and mobile communication,
- data collection from unattended data collection platform (DCPs).

Necessary frequency coordination process with various space telecommunication administrations is under way.

PERU

ENTEL Peru S.A., which operates and manages the country's telecommunication services, except in the Lima and Callao area where the Compañía Peruana de Teléfonos S.A. has concessions, has made substantial headway in its development process over the past two years. It has kept pace with its medium-term plan for 1987-1990, the basic objective of which is to develop telecommunication services in support of social welfare, development, integration, decentralization and national security. These advances and development have taken the following form:

1. Expansion programmes based on the use of advanced technology for extending the telephone infrastructure, such as:

- the purchase of two hemispherical beam transponders on board the satellite Intelsat V (F-3) to meet basic needs for the development of domestic satellite communication services, such as: defining the most suitable satellite technology to be developed over the coming years, increasing the space capacity for operating three multichannel carriers, and ensuring the availability of space capacity for the State television network to provide better picture reception quality in the more remote provinces of the country;

- an international call for tenders for 29 domestic earth stations to be installed in inaccessible rural areas of Peru's highland, jungle and frontier areas;
- the purchase of computerized PRX exchanges to meet the service requirements of nine of the country's towns, with a total initial capacity of 28 000 telephone lines;
- the signing on INMARSAT's Constitutive Convention and Operating Agreement on 8 August 1987 and 30 October 1987 respectively, with a view to providing and improving telecommunication services in the shipping and commercial aviation sectors.

2. Support policies for subregional, frontier and regional development projects, such as:

- the integrationist project studies of the Andean Telecommunication System (SATS) of the countries of the Andean subregion, i.e. Colombia, Bolivia, Venezuela, Ecuador and Peru, which are especially interested in the use of satellite technology as part of the Andean telecommunication network, through the setting up of a body for implementing, operating and developing the system;
- the signing of bilateral agreements for the installation of automatic access links between the capital and the major cities of neighbouring Bolivia, Ecuador and Colombia;
- with a view to serving neglected rural populations, Entel Peru has planned the new Community Telecommunication Centers (CCT) service which gives vast sectors of the poorer population access to the telephone service by sharing a telephone line installed in premises strategically located in poorer areas and in new towns and estates remote from urban centers. Users are able to make local or long-distance national and international calls from such centers either via the operator or by direct dialling. In addition, in exchange for a modest monthly payment, the CCTs offers users message-receiving services and inclusion in the telephone directory. So far 400 CCTs have been installed in the same number of settlements.

3. Investment in technological development

Since August 1987 ENTEL Peru has been boosting the ANTARA project, the aim of which is to design and construct a prototype 1000-line digital telephone exchange based on the highest and most advanced technology in the world.

The exchange will enable the national telecommunication network to incorporate low-demand urban localities, as well as marginal and rural areas which will subsequently enjoy the automatic local telephone service in addition to national and international direct dialling and telephone services.

So far, the ANTARA project has laid down the necessary infrastructure and appropriate circuit diagrams have been designed for subscriber cards, the time-division switching exchange, trunks and the central and energy processors.

In order to continue fulfilling its project at the national level, and as a way of combatting present-day credit restrictions, ENTEL Peru has devised a system of shared investment by signing agreements with communities which, through the decentralized Development Corporations and municipal authorities, finance a part of telecommunication projects. For instance, it has signed 25 agreements totalling $ 123 million, 45 million of which the Development Corporations are to provide up by 1989. These agreements will benefit 6933 localities under 87 shared investment projects.

PORTUGAL

The volume of traffic continued to increase in 1987.

1. INTELSAT

Two Intelsat Standard A antennas, situated at Sintra, continued to provide service in the Atlantic Primary Path and the Indian Primary Path. In 1987, the number of circuits for both the Atlantic and Indian satellite regions was raised to about 400.

2. EUTELSAT

- The Sintra-4 earth station, operating in the EUTELSAT system, was handling about 280 circuits with 12 European countries.
- The ACT-8 meeting was held in Porto, Portugal (1-5 June).

3. Domestic satellite communications

Three earth stations (Sintra-2, Funchal and Ponta Delgada) continue to provide telecommunications services between the mainland and the islands, since 1982.

SAUDI ARABIA (KINGDOM OF)

1. Arab satellite communications

The two satellites Arabsat 1-A and 1-B, owned and operated by a consortium of Arab nations, are in orbit since 1985. The organizational headquarters are situated in Riyadh, as well as Riyadh-1, the primary TT&C facility for the satellites. The Kingdom of Saudi Arabia is the major shareholder in the organization.

The Kingdom started communications with the satellite using transportable earth station, pending the commissioning of Jeddah earth station. Jeddah-8 earth station became operational in December 1986. Its capacity is 852 FDM + 81 SCPC channels and 1 + 1 television channel. The traffic which the antenna carries has increased from 100 to 357 voice circuits to different destinations in the Arab world.

1.1 Domestic satellite service

This service has expanded during the year. There are now a total of 14 earth stations, transportable as well as fixed. They belong to different users, governmental departments and provide services such as television distribution, telephone and telex to remote areas, meteorological data collection and video teleconferencing.

2. International satellite communications

2.1 INTELSAT

There are five earth stations with Standard A antenna having access to Intelsat satellites. Riyadh-1 and Jeddah 5-A earth stations operate with Indian Ocean region (IOR) satellites, whereas Taif, Riyadh-4 and Jeddah 4-A operate with Atlantic Ocean region (AOR) satellites. Jeddah 4-A and 5-A were planned and subsequently commissioned during the 1st quarter of 1987 to meet the increased demand of traffic. The capacity of Jeddah 4-A is 540 FDM and 1 + 1 television channel. The capacity of Jeddah 5-A is 1320 FDM, and 1 + 1 television channel.

All these earth stations carry international telecommunications traffic, exchange of television programmes to cover regular news, national and international events including multiple transmission to cover the Hajj event.

The Kingdom is actively represented in the deliberation of the Board of Governors, Meeting of Signatories and Assembly of Parties. It has participated in all the INTELSAT meetings and conferences during the year.

2.2 INMARSAT

Since its joining the INMARSAT organization in October 1983, the Kingdom has been continuously represented in the Council on the basis of its investment share.

Jeddah-7 coast earth station began operations with the IOR satellite since December 1986. There is a continuous growth of maritime traffic through the coast earth station. The capacity of the CES has increased from 7 to 11 telephone circuits, the telex circuits remaining the same i.e. 22 circuits. The software capability at the coast earth station has been increased to handle 15000 ship earth stations instead of 5000 at the time of commissioning. The Inmarsat terminals being commissioned under Saudi Arabian registration is continuously increasing. At present there are 74 terminals, on marine vessels as well as land-based.

SINGAPORE (REPUBLIC OF)

1. Intelsat satellite communications

1.1 To cater for the ever increasing satellite traffic demand and to provide diversity and back-up, a new Intelsat Standard antenna was constructed at a new site called Bukit Timah. This new Bukit Timah satellite earth station was equipped with Computerised Supervisory, Control and Testing Systems. New Intelsat satellite technology i.e. TDMA is also introduced in this new satellite earth station. The antenna began operation in the Indian Ocean region (IOR) in 1986.

1.2 A second Intelsat revised Standard A antenna at Bukit Timah satellite earth station will be ready for service in the last quarter of 1988 to access the Pacific Ocean region (POR) satellite.

1.3 At present, the two Singapore satellite earth station, Sentosa satellite earth station and Bukit Timah satellite earth station, carry between them about half of Singapore's international telephone traffic and all of its international television and high speed 56 Kbps and 64 Kbps data circuits. The traffic was carried via three Intelsat Standard A antenna, operating with two IOR Intelsat V satellites and a POR Intelsat V satellite. Satellite circuits grew from an initial 30 odd telephone circuits in 1971 to 1212 circuits as of end 1987.

2. Inmarsat satellite communications

2.1 The Singapore coast earth station located at Sentosa operates with the Intelsat MCS-D satellite over the Pacific Ocean region. Despite the recession in world

shipping in recent years, the number of ship earth stations is increasing. The number of ships presently equipped with ship earth stations is more than 6000. To meet the need for mobile maritime satellite traffic, seven additional satellite telephone channels were implemented at the coast earth station making a total of 22 satellite telex channels and 14 satellite telephone channels. Another 22 telex channels are also being planned for. Plans to introduce more services such as group call, high speed data, packet switching, etc. at the Singapore coast earth station are actively being developed.

3. Palapa regional satellite communications

3.1 Four Indonesian border towns are presently connected to Singapore via the Palapa satellite earth station located at Telecoms' headquarters (Comcentre). The station operates with the Palapa B-1 satellite using SCPC. Satellite communications to further Indonesian border towns are being planned.

SPAIN

1. Telefónica's satellite communications activites

It is impossible to analyse the satellite communications field in Spain without reference to the present general context, including digitization and the transition to the ISDN, the future introduction of private television and general changes in that sector, and the adaptation of infrastructures for the Barcelona Olympic Games and the Sevilla Universal Exhibition, both taking place in 1992, all of which are dominated by the resolute aim of extending and improving services to users.

Consequently, 1987 has been marked by:

- Intensive planning and programming;
- An increase in the number of satellite circuits (about 20%) combined with improvements in their quality and use;
- A considerable increase in leased capacity aboard recently launched satellites;
- Introduction of the first small-diameter antennas.

1.1 National and international traffic handled by satellite in 1987

The number of circuits at the different stations by the end of 1987 was as follows:

– Agüimes (MP-1 Atlantic Ocean)	170 circuits
– Buitrago I (MP-1 Atlantic Ocean)	221 circuits
– Buitrago II (Indian Ocean)	375 circuits
– Buitrago III (SP Atlantic Ocean)	354 circuits
– Buitrago V (MP-2 Atlantic Ocean)	301 circuits
– Guadalajara	203 circuits

The following television services should also be added:

- The national television service (Peninsula-Canary Islands) handled 1399 programmes for a total of 926.6 hours
- The international service handled a total of 1631 television programmes (occasional use) lasting 726.26 hours.

1.2 Achievements in 1987

Although the Armuña de Tajuña (Guadalajara) earth station came into service in 1986, it was officially inaugurated only on 17 November 1987, at the end of which year it consisted of the GUA-I standard wide-aperture station working with the Eutelsat F-2 satellite and two small-aperture antennas for television reception.

Signatures were exchanged for leasing the capacity of two transponders (Atlantic Spot and West) on board the Eutelsat I (F-4) satellite. In fact 1987 was seen out by the inauguration of the West Spot transponder for a television service.

An agreement was signed with Cadena SER offering a high-quality stereophonic radio distribution service via satellite for use by that chain.

1.3 Satellite communications in 1988-1992

The Agüimes, Buitrago and Armuña complexes are to be supplemented by further complexes to be built before 1992 at Barcelona, Seville and Buitrago II.

The plan therefore provides for increasing the capacity to six complexes and 16 standard earth stations by 1992.

Concerning the three new SCCs, Buitrago II will have two earth stations for operations with INMARSAT and INTELSAT, the one at Barcelona — which will play a fundamental role in broadcasting the Olympic Games world-wide — will have three earth stations, one for Eutelsat and two for Intelsat, while the one at Seville will have one earth station for Intelsat and another for Eutelsat offering television services and serving as a standby channel in the event of failure of the TAT 9 and MAT-2 fibre-optic submarine cables.

Plans are afoot for creating two teleports, one at Alcobendas (Madrid) in 1989 and the other at Barcelona in 1990. These teleports for satellite communications will enable a series of medium- and small-diameter earth stations to be installed, operated and maintained.

2. International organizations

2.1 INTELSAT

In 1987, Telefónica continued participating in all INTELSAT meetings and representing Peru on the Board of Governors; it also offered to host the 76th meeting of the Board of Governors, a proposal which was accepted and will result in the meeting being held in Seville in June 1988.

2.2 EUTELSAT

Besides attending all the meetings of this Organization, Telefónica offered to host the meeting of RTM 10 in Spain; its offer was accepted and the meetings are to take place at Las Palmas (Canary Islands) in August-September 1988.

The Spanish representative who had been Vice-Chairman and was acting as Chairman, was elected Chairman of the Board of Signatories at its 10th meeting.

2.3 INMARSAT

Negotiations are continuing for ratification of the amendments to the Operative Agreement for aeronautical services provided through this Organization.

All INMARSAT meetings were attended and the 27th Council met at Bayona (Pontevedra) in July 1987.

By the end of 1987, a total of 88 maritime terminals had been installed on board Spanish vessels, i.e. an increase of 69.23% over 1986.

Robledo de Chavela earth station

Introduction

The station forms part of NASA's network for tracking manned and unmanned space vehicles both in orbits close to the earth and in outer space. The NASA designation for the complex is DSCC (Madrid).

The complex has four antennas:

DSS-61 – 34 m dish antenna with two downlinks in bands S and X and one uplink in band S;

DSS-63 – 70 m dish antenna with three downlinks in bands S, X and L and one uplink in band S;

DSS-65 – 34 m dish antenna with one downlink in band S and another in band X;

DSS-66 – 26 m dish antenna with one downlink and one uplink in band S.

Activities

In 1987 the Robledo complex helped to support the following space missions:

- Voyager 1, Pioneer 10 and Pioneer 11 which are continuing their journeys into interstellar space;
- Voyager 2, which will approach Neptune in 1989;
- Pioneer 12, in orbit around Venus;
- Helios 1, Pioneer 6 and Pioneer 7, in orbit around the Sun;
- ICE, in a highly eccentric solar orbit;
- AMPTE, in a highly elliptical terrestrial orbit for studying the interaction of the solar wind and the earth's magnetosphere;
- ISEE-1 and ISEE-2, in elliptical earth orbit;
- DE-1, in earth orbit for atmospheric studies;
- Landsat-4, Landsat-5, Nimbus-7 and Erbs, in earth orbit for earth resource research;
- SME and SMM, in earth orbit for studying the Sun.

This support work normally includes the acquisition of tracking data (Doppler shift and transit time of signals received), receiving telemetering data, the transmission of orders and radio-science experiments (transmission signal occultation by stars or rings).

The station also participates in radioastronomy activities, particularly very long base interferometry (VLBI) measurements.

Villafranca del Castillo earth station

Introduction

The Villafranca del Castillo station forms part of the ESA network for tracking space satellites in geosynchronous orbit.

The station has six antennas:

- a steerable 15 m dish antenna with one downlink in band S;
- a steerable 15 m dish antenna whith one downlink and one uplink in band S;
- a steerable 12 m dish antenna with one downlink and one uplink in band C;
- a steerable dipole antenna with one VHF uplink;
- a fixed 4m dish antenna with one downlink and one uplink in band L;
- a fixed 3m dish antenna with one downlink and one uplink in band Ku.

Activities

In 1987 the Villafranca station participated in the following space missions:

- IUE — satellite carrying a telescope for the ultraviolet spectrum;
- MARECS — satellite for maritime communications;
- OST — orbital test satellite;
- ECS — communication satellite.

This support work normally includes the acquisition of tracking data (Doppler shift and transit time of signals received), the reception of telemetering data and the transmission of orders.

Maspalomas earth station

Introduction

The Maspalomas earth station forms part of the ESA's EARTHNET network for securing and processing data from earth-resource satellites.

The station has a 10 m dish antenna with one downlink in band S.

Activities

In 1987 the Maspalomas station helped to support the following space missions:

– Nimbus-7, Landsat-4, Landsat-5, NOAA-9 and NOAA-10, United States earth orbit satellites for studying the earth's resources;

– MOS-1, a Japanese satellite in earth orbit for studying the earth's resources;

– SPOT-1, a French satellite in earth orbit for studying the earth's resources.

This support work normally includes the reception of telemetering data (photographs taken by different instruments on board) and processing them with the station's computers.

SWEDEN

1. Nordic activities in the field of satellite Telecommunications

See under Denmark, Finland, Iceland, Norway and Sweden.

2. EUTELSAT

In 1987 the Swedish Telecommunications Administration has built a second earth station in Aagesta, south of Stockholm. This station, Aagesta 2, will primarily be used for television up-link services starting in the Spring of 1988.

3. INTELSAT

A Standard E-3 earth station for IBS services was brought into use in 1987. The station, Tanum 3, is placed in Tanum on the west coast.

4. Satellite television reception

Television programmes for distribution into cable networks are currently received from Eutelsat, Intelsat and Gorizont satellites.

At the end of 1987 satellite television could be received by more than 325 000 households.

SWITZERLAND (CONFEDERATION OF)

1. INTELSAT network

The three class A antennae (Leuk 1, Leuk 2 and Leuk 3) continued to route traffic over the Atlantic and Indian Oceans with remarkable reliability. Use was made mainly of three modulation techniques (FDM/FM, SCPC — single channel per carrier, and TDMA). The TDMA modulation technique, the first terminal which was brought into operation in 1986, has proved to be highly reliable. It is however more sensitive to the interference liable to affect satellite transponders.

By the end of 1987, 1100 channels were being operated using these three antennas with 53 partner countries. Traffic increased by about 4% in comparison with 1986.

Two E1 IBS antennae for business communications were brought into service. One of these antennae was installed with a private user to cover its specific requirements. The other is located in Zurich and handles digital traffic for our clients to North America. A further class E3 IBS antenna has been ordered. It will be set up in Basel in 1988, thus iincreasing the services offered over the IBS network. By the end of 1987 a total of four IBS antennae were operational.

2. EUTELSAT network

The Leuk ECS antenna, operated using tthe TDMA technique, continued to handle telephone and data traffic over the EUTELSAT network with a high degree of reliability. By the end of 1987 no less than 370 telephone and data channels had been connected to this antenna which serves nine partner countries.

A class 1 ECS/SMS antenna was set up in Zurich and brought into operation in the Spring of 1987. It is used to route data traffic for business communications in the EUTELSAT network.

By the end of 1987, two ECS/SMS antennae were operational and were routing over ten data circuits, with variable bit rates ranging from 64 to 2048 kbit/s via the EUTELSAT network.

THAILAND

1. International telecommunications

Up to 1987, the Communications Authority of Thailand (CAT) was operating direct satellite circuits via Si Racha E/S 2 and 4 to most of the countries in Asia, America and Europe using Intelsat satellite over Pacific and Indian Oceans.

Presently, FDM/FM and SCPC systems are employed at the earth stations for international public telephone, telex, telegraph, facsimile, etc.

At the end of 1987, the total number of circuits are 481 which can be divided as follows:

FDM/FM circuits for POR satellite = 257
FDM/FM circuits for IOR satellite = 212
SCPC/PCM/PSK circuits for IOR satellite = 12

It is expected that around October 1989, new Standard A E/S SR-V will be installed and ready for service. This new E/S is to replace SR-2 E/S.

To cope with digital technology, INTELSAT TDMA/DSI system will be introduced in 1988 and IDR will be introduced around 1990.

2. Domestic telecommunications

2.1 Domestic satellite network using INTELSAT capacity are expanding. Nine more earth stations are being added and they will be ready by the year 1988. At the same time, additional equipments are being added to 14 earth stations in order to expand their capability to cover two television signal transmissions. This project will also be ready in 1988. In addition, further expansion for television coverage is planned for 8 more locations which is expected to be ready in 1989.

2.2 The present use of the leased 1 ¾ Palapa transponders comprise: 1 ⅛ transponders for transmission of television programmes, 1/8 transponder for public telephone services and the government administration network utilized the remaining 1/2 transponder to supplement existing terrestrial network. This government administrations network comprises 42 earth stations.

There are 22 ground stations which are used for distributing television programmes from Bangkok to the television broadcasting stations in the provincial areas for nationwide television broadcast.

The Telephone Organization of Thailand (TOT) which is responsible for providing the telephone services in Thailand, has two mobile earth stations each equipped with 12 two-way voice channels to be used as a backup to the terrestrial network in case of emergency.

3. Meteorological satellite applications

Since the completion of the national Landsat-Meteosat satellite receiving station in 1982, the Meteorological Department of Thailand has been routinely acquiring weather satellite data from its operation. This system enables the user to receive Advanced Very High Resolution Radiometer (AVHRR) data from the polar-orbi-

ting satellite, NOAA-9, NOAA-10 as well as the Medium Data Utilization Station (MDUS) from the geosynchronous satellite, GMS-3. The advantages of real time images serve the daily forecast as contribution to detecting severe weather disturbances. They have also been used in many activities, such as the study and analysis of the Drought Early Warning, Crop Monitoring and Flood Forecasting in Thailand.

4. Remote sensing activities in Thailand

In 1987 there were about fifty-two thousand LANDSAT MSS scenes archived at Thailand Remote Sensing Centre (TRSC). Data sales valued at about US$183,000. International organizations continued to be the largest user group, accounted for over 85% of the data users.

The upgrading of the Thailand Landsat station for reception and processing of LANDSAT TM and SPOT HRV data was completed with test reception taking place in 1987. TM data would be available for distribution around February-March 1988.

The seven Thai-Japanese research projetcs which had been initiated in 1986 made considerable progress and there were ten research projects funded by TRSC. International cooperation in personnel development was made with Australia, Canada and the ESCAP/UNDP Regional Remote Sensing Programme.

The National Training Course on Remote Sensing and Mangroves was conducted in cooperation with the Royal Thai Forest Department under the support of the International Development Research Center. A training course on digital image processing was also organized by TRSC to train national remote sensing users.

TOGOLESE (REPUBLIC)

1. Operative at end 1986

3 carrier frequencies: Europe, Africa, North America

11 direct correspondents: France, Federal Republic of Germany, United Kingdom, Switzerland, Italy, Belgium and the Netherlands

– Côte d'Ivoire, Gabon and Senegal
– United States of America

100 telephone circuits (including 6 for telegraph-type circuits and 2 AVD)

79 telex circuits (including 7 leased circuits)

2. Achievements in 1987

16 telephone circuits:

Country	Number	Date	Type	Nature
France	03	05/03/87	Z49-Z30 and Z32	Z49 outgoing Z30-Z32 incoming
Côte d'Ivoire	02	01/07/87	MX13 and MX14	combined
Italy	01	07/08/87	MX3	combined
United Kingdom	01	18/09/87	Z7	combined
Switzerland	01	24/09/87	Z4	combined
France	03	24/09/87	Z51-Z53-Z34	Z51-Z53 outgoing Z34 incoming
France	01	25/09/87	Z36	Z36 incoming
USA	02	21/10/87	M309-M310	combined
Belgium	01	27/10/87	BUX 303	combined
Gabon	01	29/10/87	Z8	Z8 outgoing

1 telex circuit

Italy	01	06/04/87	TX3	combined

3. Operative at end 1987

Telephony

Country	Telephone				Telegraph		
	Outgoing circuits	Incoming circuits	Combined circuits	Manual circuits	Message circuits	AVD	Total
France	27	18	5	0	2	0	52
Côte d'Ivoire	5	4	5	0	1	2	17
Gabon	3	3	2	0	0	0	8
USA	0	0	10	0	1	0	11
United Kingdom	0	0	7	0	0	0	7
Fed. Rep. of Germany	0	0	4	0	1	0	5
Senegal	0	0	3	0	0	0	3
Switzerland	0	0	4	0	0	0	4
Italy	0	0	3	0	1	0	4
Belgium	0	0	3	0	0	0	3
Netherlands	0	0	2	0	0	0	2
	35	25	48	0	6	2	116
	108				8		
	116						

Telex

		Telex			Telegraph		
	System	Outgoing	Incoming	Combined	Message	Leased	Total
France	T1	7	3	0	1	4 (1)	151
	T2	12	11	0	0	1 (2)	24
Côte d'Ivoire	T1	10	7	0	1	2 (3)	20
USA	T1	0	0	11	1	0	12 (4)
Fed. Rep. of Germany	T1	0	0	6	0	0	6
Italy	T1	0	0	3	0	0	3
United Kingdom	T1	0	0	(6)	0	0	(6)
		29	21	20	3	7	80
		70			10		
		80					

UNION OF SOVIET SOCIALIST REPUBLICS

The year 1987 was marked in the USSR by continued development of telecommunication facilities on the basis of communication satellite systems.

Tests were successfully carried out on a new system for the distribution of a large number of sound broadcasting programmes throughout the territory of the USSR. This system operates in the 11-14 GHz band via the Luch satellite and is based on the use of small stations with 4 metre diameter antennas.

Within the framework of the MOSKVA television distribution system, work continued on the establishment of links for the transmission of newspaper page images together with television signals. In 1987, five new links were introduced for the transmission of newspaper pages.

Work continued on the development of the network of Orbita earth station and Ekran and Moskva receiving installations. Thanks to the joint use of the Ekran satellite television broadcasting system — a system for direct television reception via the Statsionar-T satellite, which was brought into operation in 1976 –, the Moskva and Orbita satellite television distribution systems and the terrestrial facilities available, it is now possible for 96% of the country's population to receive the programmes of the central television broadcasting service.

Further work was carried out on the establishment of duplex communication links using TDMA and FDMA equipment.

In the international arena, the Soviet Union was active in a number of fields of satellite communications.

With USSR technical assistance, an earth station in the INTERSPUTNIK international space communications system was brought into operation in Syria.

An international United Nations seminar on the problems of space communications for the developing countries was held in Moscow in May 1987. Lecturers delivered more than 20 papers on the problem of space communications and progress in this area. Seminar participants visited the sites of the international experimental centre for satellite communications in Dubna and Sochi. As a result of the work carried out at these centres, a substantial body of statistical material has been obtained on fading and depolarization in the atmosphere in the 10-30 GHz bands, the intensity of precipitations and the noise temperature of the sky, the transmission of analogue and digital television signals and also of telephone signals and digital information.

The Soviet Union continues to take an active part in the INTERKOSMOS programme.

Soviet experts attended the interim meetings of CCIR Study Groups 4 and 10/11 and also took part in the work of JIWP/ORB(2) (Study Group 4), in preparation for the Second Session of WARC ORB-88.

The USSR is at present making preparations to set up a satellite television broadcasting system in the 12 GHz band (STV-12) which will distribute throughout the territory of the USSR two additional all-Union programmes apportioned according

UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

1. Using its three main earth stations of Goonhilly, Madley and London Teleport, BTI has continued to increase its activities in telephony, television transmission and television distribution during this year. More business communication links were established using small earth stations at or near customer premises. Also notable was the use of a BTI transportable earth station which provided many television transmissions from unique events around the world.

2. British Telecom Research Laboratories are continuing to conduct propagation measurements to improve the knowledge of rainfall attenuation and depolarisation effects on earth/space paths. Other work is being conducted at the same establishment which covers many aspects of propagation of interference between satellite systems and terrestrial systems and how it may be reduced.

3. The BTI Training College at Leafield provides residential courses for engineers and technicians on the theory and practice of operating satellite earth stations. Courses on associated techniques covering computers and digital modulation are also provided. All the courses relating to satellite communications have been well subscribed by students from all parts of the world as well as from British Telecom.

4. Mercury Communications now has a total of nine antennae accessing the geostationary orbit via their two earth station sites. The Thamesside site in London Docklands had three antennae working to Telecom, Eutelsat and Intelsat satellites. The Whitehill complex, near Oxford has six earth stations all accessing the INTELSAT system. A comprehensive range of switched and linked services are now available by means of analogue and digital transmissions.

5. The Rutherford Appleton Laboratory of the Science and Research Council (SERC) have obtained three years of measurements on a low elevation propagation path at Chilbolton, Hampshire. Beacon transmissions at 11.2 GHz from the Indian Ocean Intelsat V satellite were monitored on elevations ranging from 8 to 11 degrees. Analysis of these data are in progress.

The design and development phase of beacon receivers for the OLYMPUS propagation experiment at 12, 20 and 30 GHz is continuing. Two types of beacon receiver stations are being considered:

- a system, operating at all three frequencies with cross polar measurements on the switched polarisation channel at 20 GHz, to be located at Chilbolton and
- smaller systems (60 cm diameter dishes) operating at 50 GHz for remote site operation.

These 30 GHz systems will have combined receivers and radiometers integrated into one system. A novel digital signal processing approach is being developed as part of the overall system. This method which uses automatic frequency control could provide a much greater sensitivity in terms of overall fade depth which could be tracked, when compared with conventional analogue phase locked loop techniques.

Measurements at 78 and 94 GHz on a range of elevation angles from 10 to 80° have also been reformed using a radiometric method. Comparison of the results of these measurements has been used to develop models for prediction of attenuation on satellite paths, at these millimetric wavelengths.

6. Several Universities, Bradford, Kings College, Loughborough, Manchester, Queen Mary College, Portsmouth Polytechnic and Surrey, co-ordinated through Rutherford Appleton Laboratory, continue to develop the advanced on-board processing mobile payload previously studied as part of the CERS study. This package has been selected as the prime payload for a related T-SAT study which would be injected into a high inclination Molniya orbit. The University Consortium has almost completed construction of the bread-board subsystem for the payload. Integration of this electronic payload is near completion. Performance tests of the transparent transponder mode in conjunction with a mobile terminal are in progress. Integration of the payload modems, codec and on-board subsystems is scheduled for the Summer of 1988 with field tests of the complete system in the latter half of 1988.

7. The Department of Trade and Industry, Radiocommunications Division's computer-based Satellite Coordination System (SATCOS), as mentioned in last year's review, has been enhanced by a number of features. These include map recognition, whereby the system will match a satellite footprint map to its related map projection type (e.g. Plat Carree, Mercator, etc.), automatic Radio Regulations (RR) Appendix 29 calculations, automatic measurement of Land-Sea-Land distances for use in Radio Regulations Appendix 28 calculations, and improved graphics facilities.

8. In the Overseas Territories for whose external relations the United Kingdom is responsible, the Cable and Wireless Group continues to operate six earth stations in conjunction with Intelsat satellites. These earth stations and others operated by Cable and Wireless are within the Indian, Pacific and Atlantic Intelsat Ocean regions. All the stations are, or are being modified to work dual frequency polarisation via the Intelsat V/V-A satellites. Various television transmit and receive facilities are available from these earth stations.

9. At its Porthcurno Engineering College in Cornwell, Cable and Wireless provides satellite engineering courses for the development of technical maintenance personnel in new techniques required by the rapidly growing system of space telecommunications. This training is supplemented by field experience at one of the operational earth stations. In addition to the existing wide range of telecommunication training given to Cable and Wireless engineers and technicians, provision is also made for the training of both engineers and technicians of administrations for whom Cable and Wireless act as consultants.

10. Cable and Wireless, as part of a consortium with China and Hutchinson Communications, is negotiating the purchase of a satellite to provide space segment for domestic service in China and neighbouring territories.

to time zones, national programmes for the Union Republics and two or three sound stereo broadcasting programmes.

Preparations are also being made for the entry into service of a system for the distribution of television programmes over a network of small stations using global beams of STATSIONAR satellites.

ZIMBABWE (REPUBLIC OF)

The Zimbabwe Administration communicated the following:

Country	Number of bothway circuits
Austria	2
United Kingdom	61
USA	27
France	7
Italy	10
Germany (Federal Republic of)	7
Greece	3
Malawi	22
Belgium	3
Nordic countries (Denmark, Sweden+Norway	5
Canada	8
Netherlands	3

Plans are under way for the establishment of a second antenna facing the Indian Ocean by 1990.

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)

Published by the International Telecommunication Union, Geneva, 1988

ISBN 92-61-03211-7

Price: 10 Swiss francs