INTERNATIONAL TELECOMMUNICATION UNION

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

Booklet No. 35

Geneva 1987

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Booklet No. 13 — PANAFTEL — The Pan-African telecommunication network (1974)

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Booklet No. 15 — Thirteenth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1974)

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Booklet No. 22 — Telecommunication and development (1978)

Booklet No. 23 — Seventeenth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1978)

Booklet No. 24 — The ITU and vocational training (1978)

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TWENTY-SIXTH 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-Fifth Report in 1986.

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 by world administrative conferences; these are intergovernmental conferences and the regulations they adopt have the force of international treaties. The international registration of frequency assignments for space telecommunications is carried out by 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

The Administrative Council at its 41st Session (16-27 June 1986), re-examined the schedule and changed the dates of the administrative conferences appearing in Resolution No. 1 of the Plenipotentiary Conference (Nairobi, 1982), with respect to the administrative radio conference on space radiocommunication. 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 will take place from 29 August to 5 October 1988.

1.2 The Agenda 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 Utilizing It, (ORB (2)), as contained in Administrative Council Resolution No. 953, 41st Session, 1986, is as follows:

"1. to establish the allotment Plan and the associated regulatory procedures, for the fixed-satellite service in the bands:

- 4500-4800 MHz and 300 MHz to be selected in the band 6425-7075 MHz; and

- 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz,

according to the principles and methods established at the First Session;

2. to establish the improved regulatory procedures, for the fixed-satellite service in the bands:

- 3700-4200 MHz
  5850-6425 MHz

- 10.95-11.20 GHz
  11.45-11.70 GHz
  11.70-12.20 GHz in Region 2[1])
  12.50-12.75 GHz in Regions 1 and 3)[1])
  14.00-14.50 GHz

- 18.10-18.30 GHz[1])
  18.30-20.20 GHz
  27.00-30.00 GHz

according to the principles and methods established at the First Session;

---

[1]) In these bands the improved procedures shall apply between networks of the FSS only.

3. to adopt appropriate technical standards, parameters and criteria, pertaining to the fixed-satellite service in the frequency bands specified in items 1 and 2 above;

4. to review and revise, as necessary, the regulatory procedures and appropriate technical standards, parameters and criteria pertaining to space services and frequency bands not to be subject to planning;

5. to review and revise, as necessary, the definitions relating to space services;

6. to establish the provisions and associated Plan for feeder links, in the bands 14.5-14.8 GHz (for countries outside Europe and for Malta) and 17.3-18.1 GHz, to stations in the broadcasting-satellite service in Regions 1 and 3 operating in accordance with Appendix 30 (ORB-85) to the Radio Regulations, and to incorporate these decisions in the Radio Regulations, revising the Radio Regulations, as well as related Resolutions and Recommendations, only for these purposes as necessary;

7. to consider, subject to the adoption of a suitable feeder-link assignment Plan for Region 1, the amendment of the relevant Articles of the Radio Regulations and associated Resolutions and Recommendations, if it is appropriate, to permit the use of the band 10.7-11.7 GHz (Earth-to-space) in Region 1 for all modes of fixed-satellite service operation, taking into account the frequency bands identified for planning in items 1 and 2 above;

8. to consider the possible correction of minor errors in the revision of Appendix 30 (ORB-85) on the basis of a list to be submitted by the IFRB after consultation with administrations. Such corrections shall be made without impact on either Plan, on the interactions between the two Plans, or on the balance of the provisions relating to the various services in different Regions;

9. in accordance with Recommendation No. 2 of the First Session, to consider the results of the various up-to-date studies and, in reviewing the situation prevailing at that time, take appropriate decisions concerning the various aspects of satellite sound-broadcasting systems as outlined in Resolution No. 505 of WARC-79;

10. to review the possibility of the long-term applicability of Resolution No. 2 (SAT-R2), and to take a definitive decision on this matter;

11. in accordance with Recommendation No. 3 of the First Session of the Conference, and without prejudice to the present BSS allocation in the 22.5-23 GHz band in Regions 2 and 3, to consider the question of a suitable frequency band for the broadcasting-satellite service, preferably on a world-wide basis, to accommodate HDTV, including possible action as appropriate on the necessary changes to Article 8 at a later competent conference;"

_ _

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

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

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

b) send information to the IFRB, where necessary, concerning coordination of the use of their frequency 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 1986, the IFRB received information relating to 80 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
Canada	MSAT	Satellite system providing communications within the aeronautical mobile-satellite service (< 2 GHz)
	TELESAT ANIK E (TELESAT E-A, TELESAT E-B)	Satellite system providing domestic telecommunication services within the fixed-satellite service (4/6 GHz, 11-12/14 GHz)

Notifying administration	System or network	Summary description
China (People's Republic of)	CHINASAT (CHINASAT-1, 2, 3)	Satellite network intended for multiple use, i.e. telephony, telegraphy, broadcasting, television - sound and vision, etc. (4/6 GHz)
Cuba	STSC-2 (Cuban satellite communications system)	Satellite network providing national and regional telecommunication services (4/6 GHz)
United States of America	ACS (ACS-1, 2, 3)	Satellite system providing communications within the aeronautical mobile-satellite service for aircraft located in or en route between United States, Alaska, Hawaii, Puerto Rico and Virgin Islands (< 2 GHz)
	TDRS (TDRS-C2) (Tracking and Data Relay Satellite System)	Satellite network forming a part of the satellite system TDRSS, consisting of three geostationary satellites to provide nearly worldwide coverage of low altitude earth-orbiting satellites and a dedicated ground station (2 GHz, 14 GHz)
	USASAT (USASAT 13J, 13K, 20A, 20B, 20C)	Satellite system providing domestic communication services (4/6 GHz)
	USGCSS (USGCSS PHASE 3 INDIAN OCEAN, USGCSS PHASE 3 WEST PACIFIC) (Government communication satellite services programme)	Satellite system providing communications within the mobile-satellite services and the fixed-satellite service in the Pacific Ocean and Indian Ocean regions (< 2 GHz, 7/8 GHz)
	WESTAR (WESTAR VI-S)	National satellite communication network providing fixed-satellite service (4/6 GHz)

Notifying administration	System or network	Summary description
United States of America (cont.)	ACTS (Advanced Communications Technology Satellite)	Satellite network planned to conduct experimentation for the development of advance communication technology (19-20/29-30 GHz)
	MAGELLAN*	Scientific space station to orbit the planet Venus for the purpose of studying the topography and gravity field and to provide images of the planet (2 GHz, 7/8 GHz)
United States of America (on behalf of the administrations of member countries of INTELSAT)	INTELSAT (INTELSAT VI 307E, 310E, 325.5E)	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	EURECA*	A reusable platform which will be launched by the shuttle, released in a free-flying mode for six months or more, and then retrieved by the shuttle and returned to Earth (2 GHz, 19/29 GHz)
	TELECOM (TELECOM 2A, 2B and 2C)	Satellite system comprising three satellite networks providing a continuous telecommunication link between metropolitan France and Overseas Departments and Territories for television, telephony and data transmission (2 GHz, 4/6 GHz, 7/8 GHz, 12/14 GHz)
France (on behalf of the administrations of member countries of the European Telecommunications Satellite Organization)	EUTELSAT (EUTELSAT II-7E, 13E, 36E)	Satellite system which will replace TELECOM 1 series, providing communication services to cover metropolitan France, part of Europe and French Overseas Departments and Territories (DOM-TOM) (2 GHz)

* Non-geostationary

Notifying administration	System or network	Summary description
Italy	SARIT	Additional telecommunication payload on planned SARIT broadcasting satellite providing domestic telecommunication services in 13 GHz and 20/30 GHz bands (2 GHz, 13 GHz, 20/30 GHz)
India (Republic of)	ASLV* (Augmented Satellite Launch Vehicle)	Satellite launch vehicle for occasional use, not exceeding 30 hours each time (2 GHz)
	INSAT (INSAT-IIA, IIB and IIC)	Multipurpose satellite system to provide telecommunication, broadcasting and meteorological services (4/6 GHz)
Iran (Islamic Republic of)	ZOHREH (ZOHREH 1, 2 and 3)	National satellite system which will provide variety of telecommunication services, including television (11-12/14 GHz)
Japan	SCS-1 (SCS-1A, 1B)	Satellite system providing domestic telecommunication services which will operate in the 20/30 GHz and 11-12/14 GHz bands allocated to the fixed-satellite service (11-12/14 GHz, 20/30 GHz)
	BS-3	Satellite system which will provide domestic television broadcasting service in Japan using 11.7-12.2 GHz band. It will also provide experimental television broadcasting and experimental fixed-satellite service in Japan using 12.5-12.75 GHz band. (2 GHz, 11-12/14 GHz)
Papua New Guinea	PACSTAR (PACSTAR A-1, A-2)	Satellite system providing communications in the mobile-satellite services (< 2 GHz)
United Kingdom of Great Britain and Northern Ireland	SKYNET (SKYNET 4D)	Satellite network intended to provide communications for distant territories, including Belize and Cyprus, and for naval units transiting from Atlantic to Pacific Ocean (7/8 GHz, 43/45 GHz)

* Non-geostationary

Notifying administration	System or network	Summary description
United Kingdom (on behalf of the administrations of member countries of the International Maritime Satellite Organization (INMARSAT))	INMARSAT (INMARSAT AOR CENTRAL-II, AOR WEST, IOR-II, POR-I)	Satellite system to provide commercial international public correspondence, maritime and aeronautical (R) telecommunication services, as well as ship-to-shore distress and safety operations (< 2 GHz, 4/6 GHz)
Union of Soviet Socialist Republics	LOUTCH (LOUTCH-6, 7, 8 and 9	Satellite system to provide telephone, telegraph and photograph communications and broadcast radio and television programmes to the territory of the USSR and within the framework of international cooperation (11/14 GHz)
	PROGNOZ (PROGNOZ-5, 6 and 7)	Satellite system for the space research service which will transmit scientific data for study of the processes occurring in the atmosphere, the composition of the world's oceans and natural resources (2 GHz)
	TOR (TOR-1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14)	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)
	GALS (GALS-11, 12, 13 and 14)	Satellite system planned for the exclusive use of the government, providing fixed-satellite service (7/8 GHz)
	STATSIONAR (STATSIONAR-20, 22, 23 and 24)	Satellite system consisting of several networks intended to provide telephone, telegraph and phototelegraph communications and broadcast radio and television programmes (4/6 GHz)

Notifying administration	System or network	Summary description
Union of Soviet Socialist Republics (cont.)	RADIO-M*	Satellite designed for use by radio amateurs throughout the world and also for educational and scientific experiments (20/28 GHz)
	VOLNA (VOLNA-1A)	Satellite network providing communications in the mobile-satellite services (< 1 GHz, < 2 GHz)

2.3 In addition, the IFRB published in 1986, the necessary information concerning the request for coordination of space services assignments relating to 65 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 1986 the IFRB received 7294 frequency assignments notices for stations in the space radiocommunication services submitted for recording in the Master Register. These notices consisted of 1738 notices relating to 47 space stations, received from 9 administrations and 5556 notices relating to 446 earth stations, received from 37 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 the projected space stations which have undergone the advance publication procedure referred to in paragraph 2.2 above, is given in the following table:

* Non-geostationary

LIST OF GEOSTATIONARY SPACE STATIONS
BY ORBITAL POSITIONS

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

(31.12.1986)

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
178.0 W	A	USA	USASAT-13K				4		6												
175.0 W	A	PNG	PACSTAR A-2		1																
175.0 W	A	PNG	PACSTAR-2				4		6				12		14						
171.0 W	N	USA	TDRS WEST			2									14	15					
170.0 W	N	URS	GALS-4							7	8										
170.0 W	C	URS	LOUTCH P4									11			14						
170.0 W	N	URS	STATSIONAR-10				4	5	6												
170.0 W	A	URS	STATSIONAR-D2				4		6												
170.0 W	A	URS	TOR-5															18	19	20	45
170.0 W	C	URS	VOLNA-7	0	1																
169.5 W	A	URS	FOTON-3				4		6												
168.0 W	N	URS	POTOK-3				4														
160.0 W	N	URS	ESDRN									11			14						
159.0 W	A	URS	PROGNOZ-7			2	4														
149.0 W	N	USA	ATS-1	0			4		6												
146.0 W	A	MEX	AMIGO-2										12				17				
145.0 W	A	MEX	MORELOS 4				4		6				12		14						
145.0 W	A	URS	VOLNA-21M		1																
145.0 W	A	USA	FLTSATCOM-A PAC	0						7	8										
144.0 W	A	USA	USASAT-20B				4		6												
143.0 W	A	USA	US SATCOM 2-R				4		6												
143.0 W	N	USA	US SATCOM 5				4		6												
141.0 W	A	MEX	MORELOS 3				4		6				12		14						
141.0 W	A	USA	USASAT-17C				4		6												
139.0 W	N	USA	US SATCOM 1-R				4		6												
137.0 W	A	USA	USASAT-17B				4		6												
136.0 W	A	MEX	AMIGO-1										12				17				
136.0 W	A	USA	USASAT-16D										12		14						
135.0 W	N	USA	GOES WEST	0	1	2															
135.0 W	N	USA	US SATCOM-1				4		6												
135.0 W	N	USA	USGCSS PH2 E PAC							7	8										
135.0 W	N	USA	USGCSS PH3 E PAC			C2				7	8										
134.0 W	N	USA	USASAT-11D				4		6												
134.0 W	A	USA	USASAT-16C										12		14						
132.0 W	A	USA	USASAT-11C										12		14						
131.0 W	N	USA	US SATCOM 3-R				4		6												
130.0 W	A	USA	ACS-3		1																
130.0 W	A	USA	USASAT-10D										12		14						
130.0 W	A	USA	USRDSS WEST		1	2		5	6												
128.0 W	A	USA	ACS-1				4		6				12		14						
128.0 W	N	USA	COMSTAR D-1				4		6												
126.0 W	A	USA	USASAT-10C										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
126.0	W	A	USA USASAT-20A				4		6												
124.0	W	A	USA USASAT-10B										12		14						
123.5	W	N	USA WESTAR-2				4		6												
123.0	W	N	USA WESTAR-5				4		6												
122.0	W	C	USA USASAT-10A										12		14						
120.0	W	C	USA SPACENET-1				4		6				12		14						
119.0	W	N	USA US SATCOM-2				4		6												
117.5	W	N	CAN ANIK C-3										12		14						
116.5	W	N	MEX MORELOS 2				4		6				12		14						
113.5	W	N	MEX MORELOS 1				4		6				12		14						
110.5	W	A	CAN TELESAT E-B				4		6				12		14						
110.0	W	N	CAN ANIK C-2										12		14						
109.0	W	N	CAN ANIK B-1				4		6				12		14						
108.0	W	N	CAN ANIK D-2				4		6												
107.5	W	N	CAN ANIK C-1										12		14						
107.5	W	A	CAN TELESAT E-A				4		6				12		14						
106.5	W	A	CAN MSAT	0	1	2						11	12	13	14						
106.0	W	A	USA GSTAR-1										12		14						
105.0	W	N	USA ATS-5	0	1																
104.5	W	N	CAN ANIK D-1				4		6												
103.0	W	A	USA GSTAR-2										12		14						
101.0	W	A	USA USASAT-16B										12		14						
101.0	W	C	USA USASAT-17A				4														
100.0	W	A	USA ACS-1		1																
100.0	W	A	USA ACTS																19	20	30
100.0	W	N	USA FLTSATCOM E PAC	0						7	8										
100.0	W	A	USA FLTSATCOM-A E PAC	0						7	8									20	44
100.0	W	A	USA USRDSS CENTRAL		1	2		5	6												
99.0	W	N	USA USASAT-6B										12		14						
99.0	W	N	USA WESTAR-1				4		6												
99.0	W	N	USA WESTAR-4				4		6												
97.0	W	A	CUB STSC-2				4		6												
97.0	W	C	USA TELSTAR-3A				4		6												
97.0	W	N	USA USASAT-6A										12		14						
95.0	W	N	USA COMSTAR D-2				4		6												
95.0	W	N	USA USASAT-6C										12		14						
93.5	W	N	USA USASAT-12B				4		6												
93.0	W	A	USA USASAT-16A										12		14						
91.0	W	A	USA ADV. WESTAR 1				4		6				12		14						
91.0	W	C	USA USASAT-9A										12		14						
91.0	W	A	USA WESTAR 6-S				4		6												
91.0	W	N	USA WESTAR-3				4		6												
89.0	W	A	ASETA CONDOR-B				4		6												
88.5	W	C	USA SPACENET-3				4		6				12		14						
88.5	W	A	USA USASAT-12D				4		6												
87.0	W	N	USA COMSTAR D-3				4		6												
87.0	W	A	USA TELSTAR-3B				4		6												
87.0	W	A	USA USASAT-9B										12		14						
86.0	W	N	USA ATS-3	0																	

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
86.0	W	C	USA USASAT-3C				4		6												
85.0	W	A	ARG NAHUEL-2				4		6				12		14						
85.0	W	A	USA USASAT-9C										12		14						
83.0	W	A	CUB STSC-1				4		6												
83.0	W	N	USA USASAT-7B				4		6												
83.0	W	A	USA USASAT-9D										12		14						
81.0	W	C	USA USASAT-7D				4		6				12		14						
80.0	W	A	ARG NAHUEL-1				4		6				12		14						
79.0	W	N	USA TDRS CENTRAL			2									14	15					
79.0	W	A	USA TDRS-C2			2									14						
79.0	W	A	USA USASAT-11A										12		14						
79.0	W	C	USA USASAT-12A				4		6												
77.5	W	A	ASETA CONDOR-A				4		6												
77.0	W	A	USA USASAT-11B										12		14						
76.0	W	C	USA USASAT-12C				4		6												
75.4	W	N	CLM SATCOL-1A				4		6												
75.4	W	N	CLM SATCOL-1B				4		6												
75.0	W	N	CLM SATCOL-2				4		6												
75.0	W	N	USA GOES EAST	0	1	2															
75.0	W	A	USA USASAT-18A										12		14						
74.0	W	C	USA USASAT-7A				4		6												
73.0	W	A	USA USASAT-18B										12		14						
72.0	W	A	ASETA CONDOR-C				4		6												
72.0	W	A	USA ACS-2		1																
72.0	W	C	USA USASAT-8B				4		6												
71.0	W	A	USA USASAT-18C										12		14						
70.0	W	N	B SBTS A1				4		6												
70.0	W	A	USA FLTSATCOM-B W ATL																	20	44
70.0	W	A	USA USRDSS EAST		1	2		5	6												
69.0	W	C	USA USASAT-7C				4		6				12		14						
67.0	W	C	USA USASAT-8A				4		6												
66.0	W	A	USA USASAT-15D										12		14						
65.0	W	N	B SBTS A2				4		6												
64.0	W	C	USA USASAT-14D				4		6												
64.0	W	A	USA USASAT-15C										12		14						
62.0	W	C	USA USASAT-14C				4		6												
62.0	W	A	USA USASAT-15B										12		14						
62.0	W	A	USA USASAT-8B				4		6												
60.0	W	A	USA USASAT-15A										12		14						
60.0	W	A	USA USASAT-17D				4		6												
58.0	W	C	USA USASAT-13E									11	12		14						
58.0	W	A	USA USASAT-8C				4		6												
57.0	W	A	USA USASAT-13H				4		6			11									
56.0	W	C	USA USASAT-13D									11	12		14						
56.0	W	C	USAIT INTELSAT IBS 304E				4		6			11	12		14						
56.0	W	C	USAIT INTELSAT5A 304E				4		6			11			14						
55.0	W	A	G INM INMARSAT AOR-WEST		1		4		6												
55.0	W	A	USA USASAT-14B				4		6												
53.0	W	C	USAIT INTELSAT IBS 307E				4		6			11	12		14						

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Orbital position		Space station	Frequency bands GHz																	
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20
53.0 W	N	USAIT INTELSAT4A ATL3				4		6												
53.0 W	N	USAIT INTELSAT5 CONT1				4		6			11			14						
53.0 W	C	USAIT INTELSAT5A CONT1				4		6			11			14						
53.0 W	A	USAIT INTELSAT6 307E				4	5	6			11			14						
52.5 W	A	USA USGCSS PH3 W ATL			C2				7	8										
50.0 W	C	USA USASAT-13C									11			14						
50.0 W	C	USAIT INTELSAT IBS 310E				4		6			11	12		14						
50.0 W	C	USAIT INTELSAT4A ATL2				4		6												
50.0 W	N	USAIT INTELSAT5 CONT2				4		6			11			14						
50.0 W	C	USAIT INTELSAT5A CONT2				4		6			11			14						
50.0 W	A	USAIT INTELSAT6 310E				4	5	6			11			14						
47.0 W	C	USA USASAT-13B									11			14						
47.0 W	A	USA USASAT-13J				4		6												
45.0 W	C	USA USASAT-13F									11	12		14						
45.0 W	A	USA USASAT-13I				C4		C6			11									
43.5 W	C	F VIDEOSAT-3			2							12		14						
43.0 W	C	USA USASAT-13G									11	12		14						
42.5 W	A	USA USGCSS PH3 MID-ATL			2				7	8										
41.0 W	N	USA TDRS EAST			2									14	15					
41.0 W	C	USA USASAT-14A				4		6												
40.5 W	C	USAIT INTELSAT IBS 319.5E				4		6			11	12		14						
40.5 W	C	USAIT INTELSAT5A 319.5E				4		6			11			14						
37.5 W	C	F VIDEOSAT-2			2							12		14						
37.5 W	C	USA USASAT-13A									11			14						
34.5 W	N	USAIT INTELSAT5 ATL4				4		6			11			14						
34.5 W	C	USAIT INTELSAT5A ATL3				4		6			11			14						
34.5 W	A	USAIT INTELSAT6 324.5E				4	5	6			11			14						
33.0 W	A	G SKYNET 4D	0						7	8										45
31.0 W	C	G UNISAT-1										12		14		17				
31.0 W	C	G UNISAT-1 ATL										12		14						
31.0 W	A	IRL EIRESAT-1									11		13							
31.0 W	N	USAIT INTELSAT4A ATL4				4		6												
31.0 W	C	USAIT INTELSAT5 ATL6				4		6			11			14						
31.0 W	C	USAIT INTELSAT5A ATL6				4		6			11			14						
27.5 W	N	USAIT INTELSAT5 ATL3				4		6			11			14						
27.5 W	N	USAIT INTELSAT5A ATL2				4		6			11			14						
27.5 W	C	USAIT INTELSAT6 332.5E				4	5	6			11			14						
26.5 W	N	URS GALS-1							7	8										
26.5 W	C	URS STATSIONAR-17				4	5	6												
26.5 W	A	URS STATSIONAR-D1				4		6												
26.5 W	A	URS TOR-1															18	19	20	45
26.5 W	A	URS VOLNA-13	0	1																
26.0 W	N	F MRS MARECS ATL1	0	1		4		6												
26.0 W	C	G INM INMARSAT AOR-CENTRAL		1		4		6												
25.0 W	C	URS GALS-9							7	8										
25.0 W	C	URS LOUTCH P1									11			14						
25.0 W	A	URS TOR-9															18	19	20	45
25.0 W	C	URS VOLNA-1	0	1																
25.0 W	A	URS VOLNA-1A	0	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
25.0	W	A	URS	VOLNA-1M		1															
25.0	W	N	URSIK	STATSIONAR-8				4	5												
24.5	W	N	USAIT	INTELSAT5 ATL1				4		6			11			14					
24.5	W	N	USAIT	INTELSAT5A ATL1				4		6			11			14					
24.5	W	C	USAIT	INTELSAT6 335.5E				4	5	6			11			14					
24.0	W	A	G INM	INMARSAT AOR-CENTRAL 2		1		4		6											
24.0	W	N	URS	PROGNOZ-1			2														
23.0	W	C	F MRS	MARECS ATL2	0	1		4		6											
23.0	W	N	USA	FLTSATCOM ATL	0						7	8									
23.0	W	A	USA	FLTSATCOM-A ATL	0						7	8									
23.0	W	A	USA	FLTSATCOM-B E ATL																20	44
21.5	W	C	USAIT	INTELSAT MCS ATL C		1		4		6											
21.5	W	N	USAIT	INTELSAT4A ATL1				4		6											
21.5	W	C	USAIT	INTELSAT5 ATL5				4		6			11			14					
21.5	W	C	USAIT	INTELSAT5A 338.5E				4		6			11			14					
20.0	W	C	LUX	GDL-4						6			11	12		14					
19.0	W	N	D	TV-SAT			2							12				17			
19.0	W	N	F	TDF-1			C2						11					17			
19.0	W	A	F	TDF-2			2						11	12				17			
19.0	W	N	F LST	L-SAT			2							12	13	C14		17		19	20	30
19.0	W	A	I	SARIT			2						11		13			17	18		20	30
19.0	W	A	LUX	LUX-SAT										12				17			
19.0	W	A	SUI	HELVESAT-1										12				17			
18.5	W	N	USA	INTELSAT MCS ATL A		1		4		6											
18.5	W	C	USAIT	INTELSAT IBS 341.5E				4		6			11	12		14					
18.5	W	N	USAIT	INTELSAT5 ATL2				4		6			11			14					
18.5	W	C	USAIT	INTELSAT5A ATL4				4		6			11			14					
18.0	W	N	BEL	SATCOM PHASE-3							7	8									
18.0	W	N	BEL	SATCOM-2							7	8									
16.5	W	C	USAIT	INTELSAT IBS 343.5E				4		6			11	12		14					
16.5	W	C	USAIT	INTELSAT4A 343.5E				4		6											
16.5	W	C	USAIT	INTELSAT5 343.5E				4		6			11			14					
16.5	W	C	USAIT	INTELSAT5A 343.5E				4		6			11			14					
16.0	W	N	URS	WSDRN									11			14					
16.0	W	C	URS	ZSSRD-2									11	12	13	14					
15.0	W	C	G INM	INMARSAT AOR-EAST		1		4		6											
15.0	W	A	URS	FOTON-1				4		6											
15.0	W	A	URS	STATSIONAR-23				4		6											
15.0	W	N	USA	MARISAT-ATL	0	1		4		6											
14.0	W	A	URS	GOMS-1	0	1	2				7	8								20	28
14.0	W	N	URS	LOUTCH-1									C11			C14					
14.0	W	A	URS	MORE-14		1		4		6											
14.0	W	N	URS	VOLNA-2		1															
14.0	W	N	URSIK	STATSIONAR-4				C4		6											
13.5	W	N	URS	POTOK-1				4													
12.5	W	A	F	MAROTS-B	0	1															
12.0	W	C	F HIP	HIPPARCOS			2														
12.0	W	N	USA	USGCSS PH2 ATL							7	8									
12.0	W	N	USA	USGCSS PH3 ATL			C2				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
11.0	W	C	F	F-SAT 2			2						12		14					20	30
11.0	W	A	URS	LOUTCH-6								11			14						
11.0	W	N	URS	STATSIONAR-11				C4		6											
8.0	W	A	F	TELECOM 2A			2	4		6	7	8		12		14					
8.0	W	N	F	TELECOM-1A			2	4		6	7	8		12		14					
5.0	W	A	F	TELECOM 2B			2	4		6	7	8		12		14					
5.0	W	N	F	TELECOM-1B			2	4		6	7	8		12		14					
3.0	W	A	URS	GALS-11							7	8									
3.0	W	A	URS	STATSIONAR-22				4		6											
3.0	W	A	URS	TOR-11															19	20	42
1.0	W	C	G	SKYNET-4A	0						7	8									44
1.0	W	C	USAIT	INTELSAT4A ATL2				4		6											
1.0	W	N	USAIT	INTELSAT5 CONT4				4		6			11			14					
1.0	W	C	USAIT	INTELSAT5A CONT4				4		6			11			14					
0.0	E	N	F GEO	GEOS-2	0																
0.0	E	N	F MET	METEOSAT	0	1	2														
0.0	E	A	G	SKYNET-A	0						7	8									44
1.0	E	C	LUX	GDL-5						6			11	12	13	14					
3.0	E	A	F	TELECOM 2C			2	4		6	7	8		12		14					
3.0	E	C	F	TELECOM-1C			2	4		6	7	8		12		14					
5.0	E	N	F OTS	OTS	0								11			14					
5.0	E	C	S NOT	TELE-X			2							12		14		17			
6.0	E	C	G	SKYNET-4B	0						7	8									44
7.0	E	C	F	F-SAT 1			2	4		6										20	30
7.0	E	N	F EUT	EUTELSAT 1-3									11	12		14					
7.0	E	A	F EUT	EUTELSAT 2-7E			2														
8.0	E	C	URS	GALS-7							7	8									
8.0	E	C	URS	STATSIONAR-18				4	5	6											
8.0	E	A	URS	TOR-8														18	19	20	45
8.0	E	A	URS	VOLNA-15	0	1															
10.0	E	A	F	APEX			C2	C4		C6										C20	C30
10.0	E	N	F EUT	EUTELSAT 1	0								C11	C12		C14					
12.0	E	N	URS	PROGNOZ-2			2														
13.0	E	N	F EUT	EUTELSAT 1-2	0								C11	C12		C14					
13.0	E	A	F EUT	EUTELSAT 2-13E			2														
13.0	E	A	I	ITALSAT			C2												18	C19	C20	C40
14.0	E	A	NIG	NIGERIA-1				4	5												
15.0	E	C	ISR	AMS-1				4		6			11			14					
15.0	E	C	ISR	AMS-2				4		6			11			14					
15.0	E	A	URS	GALS-12							7	8									
15.0	E	A	URS	TOR-12															19	20	42
16.0	E	A	F	EUTELSAT 1-4	0								C11	C12		C14					
16.0	E	A	I	SICRAL-1A	0						7	8		12		14				20	44
17.0	E	A	ARS	SABS 1-2									11			14					
17.0	E	N	ARS	SABS-1									11			14					
19.0	E	N	ARSARB	ARABSAT 1-A			2	4		6											
19.2	E	N	LUX	GDL6-F1						C6			11	C12		14					
20.0	E	A	NIG	NIGERIA-2				4		6											
22.0	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
23.0 E C	URS	GALS-8							7	8										
23.0 E C	URS	STATSIONAR-19				4	5	6												
23.0 E A	URS	TOR-7															18	19	20	45
23.0 E A	URS	VOLNA-17	0	1																
23.5 E C	D	DFS-1			2						11	12		14					20	30
26.0 E N	ARSARB	ARABSAT 1-B			2	4		6												
26.0 E A	IRN	ZOHREH-2									11			14						
28.5 E C	D	DFS-2			2						11	12		14					20	30
29.0 E N	F GEO	GEOS-2	0		2															
32.0 E C	F	VIDEOSAT-1			2							12		14						
34.0 E A	IRN	ZOHREH-1									11			14						
35.0 E N	URS	GALS-6							7	8										
35.0 E N	URS	PROGNOZ-3			2	4														
35.0 E N	URS	STATSIONAR-2				4	5	6												
35.0 E A	URS	STATSIONAR-D3				4		6												
35.0 E A	URS	TOR-2															18	19	20	45
35.0 E A	URS	VOLNA-11	0	1																
36.0 E A	F EUT	EUTELSAT 2-36E			2															
38.0 E A	PAK	PAKSAT-1										12		14						
40.0 E A	URS	LOUTCH-7									11			14						
40.0 E N	URS	STATSIONAR-12				C4	5	6												
41.0 E A	IRN	ZOHREH-4									11			14						
41.0 E A	PAK	PAKSAT-2										12		14						
45.0 E N	URS	GALS-2							7	8										
45.0 E C	URS	LOUTCH P2									11			14						
45.0 E N	URS	STATSIONAR-9				4	5	6												
45.0 E A	URS	STATSIONAR-D4				4		6												
45.0 E A	URS	TOR-3															18	19	20	45
45.0 E C	URS	VOLNA-3	0	1																
45.0 E A	URS	VOLNA-3M		1																
47.0 E A	IRN	ZOHREH-3									11			14						
53.0 E A	G	SKYNET-4C	0						C7	C8										44
53.0 E N	URS	LOUTCH-2									C11			C14						
53.0 E A	URS	MORE-53		1		4		6												
53.0 E N	URS	VOLNA-4		1																
53.0 E N	URSIK	STATSIONAR-5				C4		6												
57.0 E N	USAIT	INTELSAT5 INDOC3				4		6			11			14						
57.0 E C	USAIT	INTELSAT5A INDOC2				4		6			11			14						
57.0 E C	USAIT	INTELSAT6 57E				4	5	6			11			14						
58.0 E A	URS	GALS-13							7	8										
58.0 E A	URS	STATSIONAR-24				4		6												
58.0 E A	URS	TOR-13																19	20	42
60.0 E N	USA	USGCSS PH2 INDOC							7	8										
60.0 E N	USA	USGCSS PH3 INDOC			C2				7	8										
60.0 E N	USAIT	INTELSAT MCS INDOC B		1		4		6												
60.0 E N	USAIT	INTELSAT5 INDOC2				4		6			11			14						
60.0 E N	USAIT	INTELSAT5A INDOC1				4		6			11			14						
60.0 E C	USAIT	INTELSAT6 60E				4	5	6			11			14						
63.0 E N	USAIT	INTELSAT MCS INDOC A		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
63.0 E N	USAIT	INTELSAT5 INDOC1				4		6			11			14						
63.0 E C	USAIT	INTELSAT5A INDOC3				4		6			11			14						
64.5 E C	F MRS	MARECS INDOC1	0	1		4		6												
64.5 E C	G INM	INMARSAT IOR		1		4		6												
65.0 E C	I	SIRIO	0								11	12								
66.0 E N	USAIT	INTELSAT MCS INDOC D		C1		C4		C6												
66.0 E N	USAIT	INTELSAT5 INDOC4				4		6			11			14						
66.0 E C	USAIT	INTELSAT5A 66E				4		6			11			14						
66.5 E A	G INM	INMARSAT IOR-2		1		4		6												
69.0 E A	URS	GALS-14							7	8										
69.0 E A	URS	STATSIONAR-20				4		6												
69.0 E A	URS	TOR-14																19	20	42
70.0 E A	CHN	STW-2				4		6												
72.0 E A	USA	FLTSATCOM-A INDOC	0						7	8										
72.5 E N	USA	MARISAT-INDOC	0		C2	C4		C6												
73.0 E C	F MRS	MARECS INDOC2	0	1		4		6												
74.0 E N	IND	INSAT-1B	0			4	5	6												
74.0 E A	IND	INSAT-2C	0			4	5	6												
75.0 E N	USA	FLTSATCOM INDOC	0						7	8										
75.0 E A	USA	FLTSATCOM-B INDOC																	20	44
76.0 E A	URS	GOMS	0						7	8									20	28
76.0 E C	URS	GOMSS	0	1	2															
77.0 E N	INS	PALAPA-A2				4		6												
77.0 E N	URS	CSSRD-2									11	12	13	14						
80.0 E A	URS	LOUTCH-8									11			14						
80.0 E N	URS	POTOK-2				4														
80.0 E N	URS	PROGNOZ-4			C2	C4														
80.0 E N	URS	STATSIONAR-1				4	5	6												
80.0 E C	URS	STATSIONAR-13				4		6												
81.5 E A	URS	FOTON-2				4		6												
83.0 E C	IND	INSAT-1D	0		2	4	5	6												
83.0 E A	IND	INSAT-2A	0			4	5	6												
83.0 E N	INS	PALAPA-A1				4		6												
85.0 E N	URS	GALS-3							7	8										
85.0 E C	URS	LOUTCH P3									11			14						
85.0 E N	URS	STATSIONAR-3				4	5	6												
85.0 E A	URS	STATSIONAR-D5				4		6												
85.0 E A	URS	TOR-4															18	19	20	45
85.0 E C	URS	VOLNA-5	0	1																
85.0 E A	URS	VOLNA-5M		1																
87.5 E A	CHN	CHINASAT-1				4		6												
90.0 E N	URS	LOUTCH-3									11			14						
90.0 E A	URS	MORE-90		1		4		6												
90.0 E N	URS	VOLNA-8		1																
90.0 E N	URSIK	STATSIONAR-6				4		6												
93.5 E N	IND	INSAT-1C	0			4	5	6												
93.5 E A	IND	INSAT-2B	0			4	5	6												
94.0 E N	IND	INSAT-1B	0		2	4	5	6												
95.0 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
96.5	E	A	URS	LOUTCH-9									11			14						
96.5	E	C	URS	STATSIONAR-14				4		6												
98.0	E	A	CHN	CHINASAT-3				4		6												
99.0	E	N	URS	STATSIONAR-T	0					6												
99.0	E	N	URS	STATSIONAR-T2	0					6												
103.0	E	A	CHN	STW-2				4		6												
103.0	E	A	URS	LOUTCH-5									11			14						
103.0	E	C	URS	STATSIONAR-21				4	5	6												
108.0	E	N	INS	PALAPA-B1				4		6												
110.0	E	N	J	BS-2			2							12		14						
110.0	E	A	J	BS-3			2							12		14						
110.0	E	N	J	BSE			2									14						
110.5	E	A	CHN	CHINASAT-2				4		6												
113.0	E	N	INS	PALAPA-B2				4		6												
118.0	E	C	INS	PALAPA-B3				4		6												
124.0	E	A	J	SCS-1B										12		14		17	18	19		28
125.0	E	N	CHN	STW-1				4		6												
128.0	E	A	J	SCS-1A										12		14		17	18	19		28
128.0	E	C	URS	GALS-10							7	8										
128.0	E	N	URS	STATSIONAR-15				4	5	6												
128.0	E	A	URS	STATSIONAR-D6				4		6												
128.0	E	A	URS	TOR-6															18	19	20	45
128.0	E	A	URS	VOLNA-9	0	1																
128.0	E	A	URS	VOLNA-9M		1																
130.0	E	N	J	ETS-2	0	1	2						11									34
130.0	E	N	URS	GALS-5							7	8										
130.0	E	A	URS	PROGNOZ-5			2															
130.0	E	A	URS	TOR-10															18	19	20	45
132.0	E	N	J	CS-2A			2	4		6								17	18	19		28
132.0	E	A	J	CS-3A				4		6								17	18	19		40
135.0	E	N	J	CSE			2	4		6								17	18	19	20	30
136.0	E	N	J	CS-2B			2	4		6								17	18	19		28
136.0	E	A	J	CS-3B				4		6								17	18	19		40
140.0	E	N	J	GMS	0	1	2															
140.0	E	N	J	GMS-2	0	1	2															
140.0	E	N	J	GMS-3	0	1	2															
140.0	E	N	URS	LOUTCH-4									11			14						
140.0	E	A	URS	MORE-140		1		4		6												
140.0	E	N	URS	STATSIONAR-7				4		6												
140.0	E	N	URS	VOLNA-6		1																
145.0	E	C	URS	STATSIONAR-16				4		6												
150.0	E	C	J	CSE				4		6												
150.0	E	C	J	ETS-5		1	2		5	6												
150.0	E	A	J	JCSAT-1										12		14						
154.0	E	A	J	JCSAT-2										12		14						
156.0	E	N	AUS	AUSSAT-1										12	13	14						
160.0	E	N	AUS	AUSSAT-2										12	13	14						
160.0	E	N	J	GMS-160E	0	1	2															
164.0	E	A	AUS	AUSSAT PAC3										12		14						

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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
164.0	E	N	AUS	AUSSAT-3									12	13	14						
166.0	E	A	URS	GOMS-2	0	1	2				7	8								20	28
166.0	E	A	URS	PROGNOZ-6			2														
167.0	E	A	PNG	PACSTAR A-1		1															
167.0	E	A	PNG	PACSTAR-1				4		6				12		14					
167.0	E	N	URS	VSSRD-2								11	12	13	14						
172.0	E	N	USA	FLTSATCOM W PAC	0						7	8									
172.0	E	A	USA	FLTSATCOM-A W PAC	0						7	8								20	44
174.0	E	N	USAIT	INTELSAT4A PAC1				4		6											
174.0	E	N	USAIT	INTELSAT5 PAC1				4		6			11			14					
174.0	E	C	USAIT	INTELSAT5A PAC1				4		6			11			14					
175.0	E	N	USA	USGCSS PH2 W PAC							7	8									
175.0	E	N	USA	USGCSS PH3 W PAC			C2				7	8									
176.5	E	N	USA	MARISAT-PAC	0	1		4		6											
177.0	E	N	USAIT	INTELSAT4A PAC2				4		6											
177.0	E	C	USAIT	INTELSAT5 PAC2				4		6			11			14					
177.0	E	C	USAIT	INTELSAT5A PAC2				4		6			11			14					
177.5	E	N	F MRS	MARECS PAC1	0	1		4		6											
179.0	E	N	USAIT	INTELSAT4A PAC2				4		6											
179.5	E	A	G INM	INMARSAT AOR-POR-1		1		4		6											
180.0	E	N	USAIT	INTELSAT MCS PAC A		C1		C4		C6											
180.0	E	N	USAIT	INTELSAT5 PAC3				4		6			11			14					
180.0	E	C	USAIT	INTELSAT5A PAC3				4		6			11			14					

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3. Telecommunication studies and standardization

3.1 General

This work is carried out mainly by two permanent organs of the ITU: the CCIR and the CCITT.

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

The CCITT is studying the use of telecommunication satellites for telegraph, telephone, data and telematics transmissions and, where necessary, the signalling associated with these various types of information. Numerous Study Groups are developing standards, drawing up specifications and contributing to this work.

3.2.1 Telephony

Study Group XII (Transmission performance of telephone networks and terminals), is investigating ways of improving the quality of communications, such as satellite communications, with very long propagation times, especially by the use of adaptive echo cancellers.

This Study Group has worked closely with CCIR Study Group 8 to determine values for the transmission parameters envisaged for a maritime satellite telephone communication system. This collaboration resulted in Recommendation G.473, indicating limits for the transmission parameters applicable to this service, and Supplement No. 23 in Volume III.2 of the CCITT Red Book, containing explanatory notes for engineers concerned with the planning of a maritime mobile satellite system.

With regard to equipments and their use in satellite links, Study Group XV (Transmission systems) has finalized the studies relating to echo suppressors and has completed the Recommendation on echo cancellers with the addition of a new section giving the characteristics of non-linear processors (Recommendation G.166 — Red Book, Volume III.1). The echo canceller characteristics are compatible with those of echo suppressors already recommended (Recommendation G.164 — Red Book, Volume III.1).

Study Group XVIII (Digital networks), acting as coordinator between the various specialized Study Groups of the CCITT and the CCIR, has agreed on new I-series of Recommendations dedicated to integrated services digital networks (Red Book — Volume III.5).

The work on digital speech interpolation has been mainly devoted to collecting data of currently operating DSI systems on the associated technology. This has allowed a better understanding of the

implementation of such systems and will constitute the preparatory work for possible future Recommendations in this field.

The following points have been established for the interworking between digital systems based on different standards:

- the A/μ converter is located in the μ-law country;

- the multiplex system converter (MSC) location is not necessarily a matter for a CCITT Recommendation. Other signal processing devices would most likely require equipment in both countries (it is possible that the MSC, etc. may not always be required);

- signal processing devices will need to be under the control of the transit exchange. They may be located wherever in the country that allows this control to be exercised, and this location is a national matter, not a subject for a CCITT Recommendation;

- Recommendation G.802 illustrates the hybrid hierarchy operating at 2048, 6312, 44 736 and 139 264 kbit/s as a standard interworking solution. Corresponding multiplex Recommendations have been developed.

Studies have continued in the field of speech processing with the endorsement of a revised text for Recommendation G.721 (32 kbit/s ADPCM), of a text for a new draft Recommendation G.722 (7 kHz audio-coding within 64 kbit/s) and with consideration of speech coding at lower rates (e.g. 16 kbit/s).

The Questions on the quality of service and performance of digital networks including ISDNs and on interworking will require continuous attention and further work and are relevant also for systems using satellite communications.

3.2.2 Telephone switching, signalling and operation

Two studies carried out in this field concern the use of satellites in the international telephone network.

The subject of the first study is dealt with under heading 3.2.3.2 "Interconnection of maritime satellite communications services...".

The second subject of study relates to the effects of the propagation time of satellite circuits on the signalling systems standardized by the CCITT.

Up to the last study period, only three of the seven signalling systems standardized by the CCITT had been regarded as compatible with the operation of telephone circuits by satellite: systems No. 5, No. 6 and R1.

Following a long series of studies and careful tests (tests carried out by the Brazilian Administration on its national network and international tests between the CTNE (Spain) and the Deutsche Bundespost over circuits using the Symphonie satellite, etc.), it was found that the R2 system could be used on satellite links with a speed sufficient for automatic operation.

This decision is of considerable importance in view of the large number of countries in which the R2 system is used both nationally and internationally. It is, in fact, the R2 system which is recommended and is most commonly used for regional international relations in Europe, Africa and some parts of Latin America and South East Asia. The R2 system is also the standardized system for national signalling in certain countries which use satellite links for their long-distance national relations (e.g., Indonesia and the Philippines).

The present Q series Recommendations — Q.60, Q.61 and Q.62 — dealing with requirements for the interworking of CCITT Signalling Systems No. 5 and R2 and the signalling systems used in the INMARSAT Standard A system are being amended. Recommendations of the Q series for the interworking between CCITT Signalling Systems No. 5, No. 7 and R2 and the INMARSAT B signalling system are being developed.

New Q. Recommendations are being prepared on the service capabilities of the INMARSAT aeronautical mobile satellite system, and on the interworking between CCITT Signalling Systems No. 5, No. 7 and R2 and the INMARSAT aeronautical system.

A new Q. Recommendation is also being developed dealing with the Mobile Application Part of Signalling System No. 7; the necessary signalling functions required for use of Signalling System No. 7 to provide services as mobile facilities for voice and non-voice applications are specified therein.

3.2.3 Telegraph and data services

3.2.3.1 A general idea of the integration of satellite circuits in the terrestrial telecommunication services — with particular reference to telegraphy and data transmission — can be gained from the previous reports.

The study of the use of telecommunication satellites for the provision of a maritime mobile service has been pursued actively and the technical, operational and tariff implications have been highlighted.

The general concept of such a new system for the telegraph and telex services has been laid down as well as the access codes.

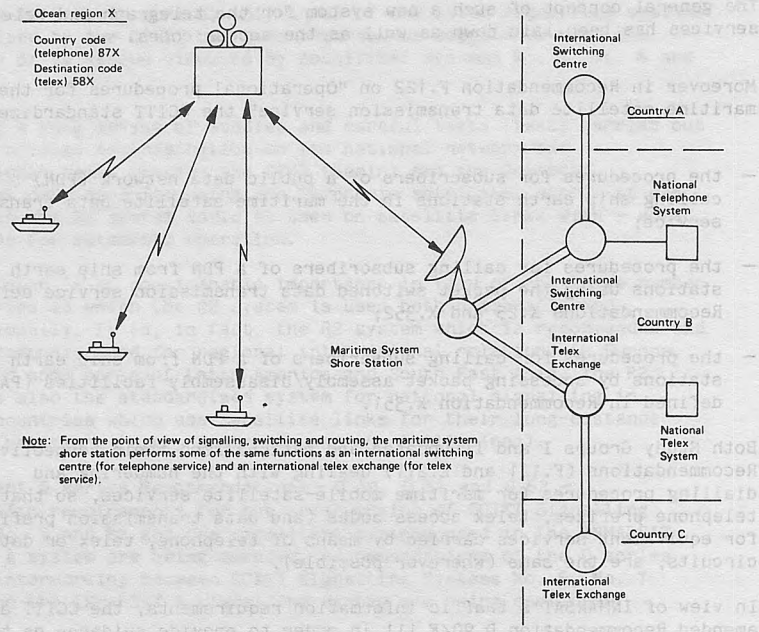
Moreover in Recommendation F.122 on "Operational procedures for the maritime satellite data transmission service" the CCITT standardized:

- the procedures for subscribers of a public data network (PDN) calling ship earth stations in the maritime satellite data transmission service;
- the procedures for calling subscribers of a PDN from ship earth stations using the packet switched data transmission service defined in Recommendations X.25 and X.352;
- the procedures for calling subscribers of a PDN from ship earth stations by accessing packet assembly/disassembly facilities (PAD) as defined in Recommendation X.351.

Both Study Groups I and II updated and rationalized their respective Recommendations (F.121 and E.211) dealing with the numbering and dialling procedures for maritime mobile-satellite services, so that the telephone prefixes, telex access codes (and data transmission prefixes) for equivalent services carried by means of telephone, telex or data circuits, are the same (wherever possible).

In view of INMARSAT's traffic information requirements, the CCITT also amended Recommendation D.90/F.111 in order to provide guidance on the manner in which maritime mobile satellite accounts should be exchanged between Administrations.

3.2.3.2 The above studies carried out by the CCITT are concerned with the interconnection of maritime satellite communications services with terrestrial telephone and telex networks and these studies are based on the premise that the maritime satellite service, between country and ship, is an international service and that access to such a service from land should therefore be by use of a country code relating to a given ocean region. Maritime mobile terminals in an ocean region would in many respects be analogous to subscriber equipment in a national telephone, telex or data network. The shore stations (or earth stations) may have some of the functions of an international switching centre for telephony or an international exchange for telegraphy as such centres or exchanges relate to the maritime mobile terminals they serve. The figure below shows a typical arrangement of a maritime satellite system for an ocean region based on the premises described above.



Note: From the point of view of signalling, switching and routing, the maritime system shore station performs some of the same functions as an international switching centre (for telephone service) and an international telex exchange (for telex service).

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 issuance 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 Assembly 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 Preparations for administrative radio conferences

3.3.1.1 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 services using it (WARC ORB (2), August/October, 1988).

During the CCIR Final Meetings in 1985 Decision 73 was adopted by Study Groups 1, 2, 4, 5, 8, 9, 10 and 11 to establish a Joint Interim Working Party to consolidate the intersessional work of the CCIR, to complete the CCIR studies on the sharing issues involved and to prepare the CCIR report to the Second Session of WARC ORB. At the same time, these same Study Groups began preparation of additional technical information falling within their specific areas of competence, identified by WARC ORB-85 as being required for the Second Session.

As called for in Decision 73, the XVIth Plenary Assembly of the CCIR reviewed the situation of this JIWP. As a result, Decision 73 was suppressed and replaced by Resolution 90, which calls for a single meeting of JIWP/ORB(2)/SG4 to take place in December 1987, immediately following the Interim Meetings of CCIR Study Groups 2, 3, 4, 9, 10, 11 and CMTT. This will enable, to the greatest extent possible, the contributions of concerned Study Groups to the JIWP.

Following the CCIR Plenary Assembly, the 41st session of the ITU Administrative Council invited the CCIR to ensure the timely completion of its preparation for WARC-ORB(2) and provided funding for a two-week meeting of the JIWP.

CCIR Administrative Circular 278 of 1 August 1986 announces that the meeting of JIWP/ORB(2)/SG4 will be held in Geneva from 7 to 18 December 1987.

In accordance with CCIR Resolution 90, the Chairman of the JIWP prepared the draft table of contents and organization of material for the CCIR report to the Second Session in consultation with the other concerned Study Group Chairmen and the Director of the CCIR. The resulting material was circulated to all members of the CCIR and other participants in its work in an Addendum to A.C./278 on 31 October 1986.

The CCIR report to the Second Session of WARC-ORB will deal with the following topics:

- Technical information pertaining to the frequency bands: (1) specified for allotment planning, (2) specified for improved regulatory procedures and (3) not to be subject to planning.

- Technical parameters for feeder link planning, including technical information to establish the provisions and associated plan for feeder links in the bands 14.5-14.8 GHz and 17.3-18.1 GHz to stations in the BSS in Regions 1 and 3.

- Technical information to define the practical system parameters for satellite sound broadcasting.

- Results of studies on satellite HDTV transmissions.

3.3.1.2 The World Administrative Radio Conference for the Mobile Services (WARC MOB-87)

Study Group 8, during its Final Meeting in Geneva in November 1985, continued the work leading up to a special preparatory meeting for WARC MOB-87. This special meeting, endorsed by the 40th Session of the ITU Administrative Council in June 1985, was held in Geneva from 30 June until 11 July 1986 and prepared the CCIR report to the Conference.

3.3.2 Study Group 2 – Research on space technology, space topics of general interest, space operations, data relay satellites, space research, earth exploration satellites, radioastronomy and radar astronomy

The final meeting of Study Group 2 (space research and radioastronomy) of the International Radio Consultative Committee (CCIR) of the ITU that was held in September 1985 approved a new Report that deals with the difficulties in providing for space operation functions in the broadcasting-satellite service bands.

Close attention was paid to the possible effects on radioastronomy due to the increasing use of geostationary-orbit satellites in several services and a criterion intended to reduce such effects was introduced.

Important radioastronomy line frequencies above 275 GHz were listed, and information on the interference effects from microwave ovens to the radioastronomy service was updated. This work led to the adoption of a new Recommendation on protection of the radioastronomy service from spurious emissions by the XVIth Plenary Assembly of the CCIR (Dubrovnik, 1986).

Other major topics treated in CCIR Reports and Recommendations adopted by the Plenary Assembly included: factors relative to establishment of spurious emission limits for space services; potential interference and sharing problems between satellites in the earth exploration, space research and space operation services and terrestrial line-of-sight radio-relay systems of the fixed service; frequency sharing between data relay satellites; the basis for the selection of frequencies for transmission to and from manned and unmanned spacecraft and protection criteria for near-Earth space research systems; protection criteria for telecommunication links for manned and unmanned near-Earth space research; the results of analyses to determine the compatibility between remote passive microwave sensors on satellites and active services in adjacent and sub-harmonic bands; satellite systems for geodesy and geodynamics.

In topics of general interest, factors relative to establishment of spurious emission limits for space services have been described in new Report 980.

New Report 981 examines potential interference and sharing problems between satellites in the earth exploration, space research and space operation services and terrestrial line-of-sight radio-relay systems of the fixed service.

The subject of data relay satellites is covered by several texts. The principal field of interest is the matter of frequency sharing between data relay satellites (Report 983). Data relay satellites are of growing importance to space research, earth exploration and meteorology.

Most studies in the field of space research relate to near-Earth space. The basis for the selection of frequencies for transmission to and from manned and unmanned spacecraft and protection criteria for near-Earth space research systems are given in Reports 984 and 985.

New Recommendation 609 contains protection criteria for telecommunication links for manned and unmanned near-Earth space research.

Earth exploration satellites are of particular interest because of their use of active and passive sensors. New Report 987 presents the results of analyses to determine the compatibility between remote passive microwave sensors on satellites and active services in adjacent and sub-harmonic bands.

Satellite systems for geodesy and geodynamics are considered in new Report 988.

As regards radioastronomy, the continuing increase in the use of the radio frequency spectrum and in particular the increasing number of transmitters in satellites on the geostationary orbit has brought the problem of spurious emissions to the fore (Reports 697 and 224). The results of these studies were included in new Recommendation 611, "Protection of the Radioastronomy service from spurious emissions".

3.3.3 Study Group 4 — Fixed-satellite service

The CCIR Report "Technical factors influencing the efficiency of use of the geostationary-satellite orbit by radiocommmunication satellites sharing the same frequency bands" (Report 453) was revised extensively by Study Group 4 to include many of the new findings of Interim Working Party 4/1 concerning various aspects of orbit/spectrum utilization. Five new Reports related to this subject were adopted and one related Recommendation was revised by the XVIth CCIR Plenary Assembly:

- Radiation diagrams for use as design objectives for antennas of earth stations operating with geostationary satellites (Recommendation 580).

- Performance of small earth-station antennas (new Report 998).

- Off-axis e.i.r.p. density limits for fixed-satellite service earth stations (new Report 1001).

- Flexibility in the positioning of satellites (new Report 1002).

- A technical method of multilateral coordination among satellite networks (new Report 1003).

- Spectrum utilization methodologies (new Report 1000).

As noted above, the CCIR has been charged with the study, in the intersessional period between the First and Second Sessions of WARC ORB, to provide necessary technical information to the Second Session. The topics related to Study Group 4 were annexed to the revised terms of reference of IWP 4/1 in Decision 2-6.

A great deal of work has been done by IWP 4/2 of CCIR Study Group 4, 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. A new draft Recommendation and a new associated Report were adopted by the XVIth CCIR Plenary Assembly:

- New Recommendation 614. 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.

- New Report 997. Characteristics of a fixed-satellite service hypothetical reference digital path forming part of an integrated services digital network.

Two new Reports on other subjects were also adopted:

- Determination of the bi-directional coordination area, and

- Physical interference in the Geostationary Satellite Orbit.

The special publication "CCIR Handbook on Satellite Communications (Fixed-satellite Service) 1985" presents the technical bases for the various aspects of fixed-satellite service communications and summarizes fundamentals of the main technologies and equipment used, including digital techniques. The texts are of a tutorial character and are intended to assist administrations and organizations in the planning and development of satellite communication programs and for training personnel.

Advances in the technology of satellite communications, and the expected evolution of the regulatory and planning environment, would justify an updating of this Handbook. Decision 64, concerning the establishment of a "Handbook Group" to prepare an appropriately updated version of the Handbook, possibly in the form of a Supplement, to be issued in 1987/1988, is being implemented by Study Group 4.

3.3.4 Maritime mobile satellite service

Two new Recommendations on satellite emergency position indicating radio beacon (EPIRB) systems were adopted by the XVIth CCIR Plenary Assembly, one on EPIRBs using geostationary satellites at 1.6 GHz and the second on EPIRBs using low polar orbiting satellites at 406 MHz.

Work continues during the new Study Period on updating the Reports on mobile satellite techniques, on the Radiodetermination Satellite Service and on future ship earth stations, which will be suitable

for much smaller ships, such as fishing vessels, thereby opening the maritime mobile satellite service to a big new category of users.

3.3.5 Satellites for standard frequency and time signals

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 that 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 nation time and frequency service.

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

The joint activities of Study Groups 10 and 11 related to the broadcasting-satellite service and associated feeder links are focussed on the intersessional work required to prepare CCIR technical information for the Second Session of WARC ORB (see paragraph 3.3.1.1).

Two existing Joint Interim Working Parties of Study Groups 10 and 11 have been charged to carry out the required intersessional work:

- JIWP 10-11/1 is preparing required technical information for the preparation of a Plan for the feeder links to the broadcasting-satellite service in Regions 1 and 3, with respect to the 12 GHz band Plan adopted by WARC BS-77. It also deals with the question of satellite sound broadcasting to portable and automobile receivers in the band 500-2000 MHz (and nearby frequencies). It held one meeting in 1986 and will complete its work after a meeting in May 1987 in time to present the results to the Interim Meetings of Study Groups 10 and 11 in November 1987 and, following consideration by the Study Groups, to JIWP-ORB(2)/SG4 in December 1987.

- JIWP 10-11/3 is dealing with the satellite transmission of high definition television (HDTV) in addition to continuing its work on the accommodation of picture signals and several audio signals and data signals in terrestrial and satellite television channels. The draft of the CCIR Special Publication on specification of transmission systems for the broadcasting-satellite service was completed prior to the XVIth CCIR Plenary Assembly and the Special Publication will be released in 1987.

The first meeting of JIWP 10-11/3 in the new Study Period (early 1987) was charged with the task of completing preparatory work for WARC-ORB(2) on those HDTV topics assigned to it. The resulting draft report will be submitted to the Interim Meetings of Study Groups 10 and 11 in November 1987 and, following consideration by the Study Groups, to the meeting of JIWP-ORB(2)/SG4 in December 1987.

Work continues during the new Study Period in Study Groups 10 and 11 on three new Recommendations adopted by the XVIth Plenary Assembly:

- Television standards for satellite broadcasting in the channels defined by WARC BS-77 and RARC SAT-83 (Recommendation 650).

- 12 GHz receiving earth station antenna and satellite transmitting antenna reference patterns (Recommendation 652).

- Digital PCM coding for the emission of high-quality sound signals in satellite broadcasting (15 kHz nominal bandwidth) (Recommendation 651).

Report 952, "Technical characteristics of feeder links to broadcasting satellites", is of special interest in preparation for WARC ORB(2), as is new Report 1073, "Television standards for the broadcasting-satellite service".

4. Planning

4.1 Pursuant to decision by the World Administrative Radio Conference (Geneva, 1979) and the Plenipotentiary Conference at Nairobi, the ITU Administrative Council at its 41st Session in 1986 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 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.

For this purpose, in addition to gathering data on traffic volume and the number of circuits, they have to keep up to date, by region, the list of earth stations, for existing or planned satellite links. This information is published in the "Plan Books" and their supplements.

In pursuance of CCITT Resolution No. 12, the Administrative Council at its 1986 Session made the necessary arrangements to hold the following meeting of the Plan Committees in 1987:

- Regional Plan Committee for Africa.

- Regional Plan Committee for Europe and the Mediterranean Basin.

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 (OUA) (established by the said Ministers to supervise and monitor the implementation of the Study) decided to set up a Project Office at ITU Headquarters to be responsible for undertaking the study and ensuring its day-to-day follow-up. The office is to be manned by a team of international experts recruited on behalf of IACC by the ITU in its capacity as the Coordinator.

Under ITU guidance the Project Office is to assume the responsibility for establishing the norms for field work, and guide and supervise the work of national and international experts involved in the Study. It will, further, compile and analyse reports from the various National Coordination Committees responsible for the national level studies.

Consulting firms are to 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 for 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.

The Project will be financed by funds from various contributors who are willing to provide untied resources.

The Feasibility Study is expected to be completed within 24 months.

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.

Within the framework of assistance provided to the ARABSAT Organization, a meeting was held in Geneva in October 1986 in which the Administration of Saudi Arabia and the ARABSAT Organization took part.

At this meeting, the further development of the ARABSAT system was considered. With the cooperation of the IFRB, studies to find an appropriate third orbital position were started. As a result of these studies, an advance publication will be issued beginning 1987 and frequency coordination procedures with some neighbouring countries are expected to start, prior to notification of the new satellite position. Separate advice has been given on the technological developments since the planning of the first series of the Arabsat satellites. The information could be useful in the considerations for any new generation of satellites for this system, including from the service and economic viewpoints.

Within the framework of a technical assistance project, assistance in the field of satellite communications continued to be provided to the Saudi Ministry of Information in 1986 through the services of an adviser in satellite broadcasting systems.

Feasibility studies were carried out for domestic satellite telecommunication systems for the Solomon Islands, Micronesia, and the Maldive Islands. Various satellite systems and earth station configurations were considered.

The Angolan domestic satellite project was reviewed and proposals for follow-up activities were made to the appropriate authorities.

Evaluation of the damage to the satellite earth station of the Islamic Republic of Iran in the INTELSAT network was undertaken. Technical assistance for the restoration of the three antennas was offered.

Guidance was provided for the development of the earth station (four existing antennas, one project) in Thailand. The introduction of new techniques, the future utilization of the antennas and the traffic routing were reviewed.

The signalling and interface aspects for the projected domestic satellite system in Cameroon were studied and proposals for solving various problems offered.

Within the framework of a UNDP/ITU project, a technical and economic feasibility study for establishing small satellite earth stations for inter-atoll telecommunications was undertaken in the Republic of the Maldives.

Under a regional UNDP/ITU project, expertise as regards to site selection, relocation and extension of the existing Standard B earth station was provided to Western Samoa.

6. Information and documentation activities

The General Secretariat has continued, in pursuance of Administrative Council Resolutions 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, telecommunications and launch vehicles.

A recapitulatory list of all artificial satellites launched in 1985 was published as an annex to the June 1986 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.

7. Cooperation with other international organizations concerned with space

7.1 General

In 1986 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 it continued to collaborate with the specialized agencies concerned such as International Civil Aviation Organization (ICAO), International Maritime Organization (IMO), World Meteorological Organization (WMO), United Nations Educational, Scientific and Cultural Organization (UNESCO) as well as intergovernmental regional organizations.

7.2 Participation of the International Telecommunication Union in the meetings of the United Nations Space Applications Programme

The ITU participated in the Inter-Agency Meeting on Space Activities held in Vienna in October 1986.

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 Applications Programme.

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ANNEX

Reports on progress made in the development

of space communications

ANGOLA (PEOPLE'S REPUBLIC OF)

The first phase of work on the expansion of the Cacuaco earth station is to begin in 1987. The Angolan Administration plans to increase the number of circuits to handle the steady increase in traffic and provide direct links with a number of countries.

In December 1986, Angola resumed contacts with the international space telecommunications organization INTERSPUTNIK with a view to incorporating the Standard B antenna at Cacuaco in the INTERSPUTNIK system and discussing the future status of the Angolan Administration within that organization.

To ensure the safety of international communications, the Angolan Administration is planning to install a second earth station at Benguela. In this connection, the Southern Africa CIDA (Canadian International Development Agency), within the framework of SATCC, is engaged on a prefeasibility study of the project, which it expects to complete in the first quarter of 1987.

BELGIUM

In 1986, the Belgian Administration brought two TDMA/DSI terminals into service at the Lessive earth station, one operating in the EUTELSAT system and the other in the INTELSAT system.

In addition, as part of the multiservice satellite systems (MSS and IBS), the Belgian Administration installed and brought into service four earth stations for high-speed data transmission (64 kbit/s to 2 Mbit/s) and videoconference.

The first, a small-capacity station installed in Brussels, is fitted with a 3.7 m (E1) antenna and provides access to the IBS system (Intelsat satellite on 307° E).

The second earth station, also located in Brussels, is used for digital links via the MSS facility of the Telecom 1 satellite on 352° E.

The third earth station is situated in Liederkerke (18 km from Brussels). This station, equipped with a 7.6 m diameter antenna beamed to the Eutelsat-I F2 satellite on 7° E (MSS space segment), has a relatively large capacity.

The fourth earth station, similarly in Liederkerke, has a 9.2 m diameter antenna pointed at the Intelsat V (F-4) satellite on 325.5° E (IBS space segment), and also offers a relatively high capacity.

CANADA

1. International satellite communications

In Canada, international satellite communication services are provided by Teleglobe Canada.

Teleglobe Canada, as a Signatory to the INTELSAT Operating Agreement has been actively involved with INTELSAT during 1986. Special earth station facilities were established, near the Laurentides earth station, for the reception of video broadcasts in connection with the World Cup Soccer and the Commonwealth Games. Arrangements are also underway for the establishment of special earth station facilities for the transmission of Calgary Olympics television signals in early 1988. Preparations are currently underway for the introduction of TDMA/DSI traffic terminal at its Mill Village earth station. INTELSAT business services, already available in Toronto have now been extended to Montreal. The use of 16 Kb/s encoding, for telephony signals for specialized satellite private services, was introduced in Toronto.

As a Signatory to the INMARSAT Operating Agreement, Teleglobe Canada participated in the continued development of the services carried by INMARSAT and in the selection of contractors for launch services for its second generation satellites.

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 Anik C-1. Anik E-1 and Anik E-2 have been contracted for delivery in the early 1990's. Each Anik E spacecraft, which is a dual-band design, will replace an Anik C and Anik D spacecraft.

3. Research, operations and development

3.1 *The MSAT programme*

In 1982 the Canadian Department of Communications established the technical feasibility and commercial demand for a mobile-satellite system called MSAT. This system would provide two-way mobile radio and telephone services to all Canadians via inexpensive, portable terminals. These services would include voice and data communications to land vehicles, ships, aircraft and to transportable terminals, primarily in rural and remote areas of Canada.

In 1986 MSAT was announced as the major satellite communications element of the federal government's Long Term Space Plan, with support approved over the period 1986/87 to 1994/95.

Presently the Canadian government, in consultation with TELESAT Canada, is actively negotiating with the United States to assign and coordinate sufficient spectrum for MSAT services in the UHF and L bands. The service is expected to commence in 1991.

3.2 *The search and rescue programme*

The Satellite-aided Search and Rescue Project (SARSAT) is a joint Canada-France-USA project with the objective of using space-borne technology to demonstrate the detection and location of emergency beacon signals operating at the 121.5 MHz, 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 Marine to continue a joint project (COSPAS/SARSAT) until such time as an international operational system can be put in place. In 1986, the COSPAS-SARSAT Parties pursued the development of an intergovernmental agreement which would ensure continuity of the COSPAS-SARSAT system beyond the 1990's and negotiated an understanding with INMARSAT for the provision of secretariat services.

As of the end of 1985, the COSPAS/SARSAT system has helped save more than 650 lives world-wide. Canada is also co-operating with the USA, France and the USSR in a new experimental programme to determine the suitability of geostationary satellites for distress alerting at 406 MHz. This programme will begin after the launch of the United States GOES-H satellite planned for early 1987.

3.3 *Remote area communications*

In 1983 the Department of Communications developed a new 14/12 GHz stabilized satellite terminal to significantly reduce the costs of delivering communications to off-shore installations. In conjunction with the Department, a Canadian manufacturer, SPAR Aerospace Limited, developed a commercial unit (sparmarine). Full telephone service is now offered by the Newfoundland Telephone Company to the off-shore Hibernia Oil Fields.

Another new terminal was field-tested in 1986 for use in remote and emergency communications conditions. This is the highly transportable 14/12 GHz field quality telephony terminal, often referred to as the suitcase terminal.

3.4 *The European Space Agency (ESA)*

Canada's international space activities include participation in ESA. In the satellite communications area, Canada is presently involved in the General Studies program, and subscribes to the following optional endeavours: the OLYMPUS (L-SAT) programme the Earth Resources Satellite (ERS-1) System, the Environmental Observation Preparatory Programme (EOPP), the Payload and Spacecraft Development and Experimentation (PSDE) Programme, and the HERMES Programme.

Canada's contribution to the OLYMPUS programme comprises provision of the solar arrays and payload amplifiers, as well as satellite assembly. In addition, the Canadian Department of Communications (DOC) David Florida Laboratory will perform integration and testing of the satellite in late Spring 1987. Canadian involvement in the ERS-1 programme consists mainly of providing data processing hardware. With regard to PSDE, the DOC is presently identifying potential domestic industry input and benefits. As for the EOPP and HERMES programmes, the major roles for Canadian industry are not yet defined as the programs are in the preparatory stages.

4. Reports from industry

Contracts were awarded to SPAR Aerospace during 1986 for 18 meter Intelsat A stations to be installed in Zambia and Liberia. These will be the first such stations in accordance with the recently approved 18 meter antenna specifications.

In 1986 SPAR Aerospace was awarded a contract by TELESAT Canada for two dual band (C and Ku) communications satellites, Anik E. Each spacecraft will have 24 C-band channels and 26 Ku-band channels. The first satellite will be launched in 1990.

MICROTEL received an order from the Thai police for a C-band Master Control Station and a six-channel Spacetel remote station. This is part of a family of low cost transportable digital SCPC satellite earth stations, which are available in either C or Ku band. Spacetel is in service with a number of Canadian telephone companies. Microtel has also announced the development of their VSAT (very small aperture data terminal) for business applications.

COM DEL Limited, has successfully developed contiguous multiplexers for multi-channel satellite earth terminals. These new multiplexers result in significant capital and operating cost savings for earth terminal owners. Ten 14/12 GHz systems have been sold in the United States for domestic communications, and one 6/4 GHz system in Australia for international communications.

COLOMBIA (REPUBLIC OF)

1. In 1986 invitations to tender were issued for the purchase of 20 new earth stations to form part of the country's domestic satellite communications service alongside the 13 existing stations.

2. Work continued on the adjustment of the San Andrés and Leticia earth station antennas to meet INTELSAT's requirements for operation with an axial ratio of 1.06.

CYPRUS (REPUBLIC OF)

The Cyprus Telecommunications Authority established a third satellite earth station which operates with the EUTELSAT system providing telephone and telegraph service with eight european countries. The station is also equipped with television transmission and reception facilities allowing access to the two transponders leased by the European Broadcasting Union (EBU) on the Eutelsat I (F-2) satellite, and can be used for occasional television service on other transponders of the same satellite.

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 1986 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 Denmark, Finland, Norway and Sweden 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 (CES)

A joint Nordic coast earth station for the INMARSAT system has been in operation at Eik in Norway since 1982, operating in the Atlantic Ocean region (AOR) until 1983. In accordance with a joint agreement with the United Kingdom, the Eik CES from then on handled traffic in the Indian Ocean region (IOR) while Goonhilly has carried the traffic in the AOR. There is also an agreement with the telecommunication authority of Singapore for the use of their CES in the Pacific Ocean region. The tripartite agreement makes it possible to offer customer global coverage at reasonable charges. The traffic via Eik continued to increase during 1986.

4. TELE-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 1988. 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.

DENMARK

Nordic activities in the field of satellite telecommunications

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

1. Two earth stations have been installed for domestic telephone traffic between Denmark and the Faroe Islands. The earth stations are ready for operation and will be put into service as soon as the satellite Eutelsat I (F-4) on which Denmark has leased one transponder, has been put into orbit. The antenna diameters are 11 m, and initially the capacity is 120 64 kbit/s circuits.

2. Denmark has installed one earth station for the EUTELSAT multiservice network (SMS). The earth station is a Standard 1 earth station. The antenna diameter is 7.6 m, and the initial capacity is 2 × 2 Mbit/s and 3 × 64 kbit/s.

3. Furthermore one Intelsat Standard E-3 earth station for intercontinental IBS service has been installed. The antenna diameter is 9.2 m and the initial capacity is 2 × 2 Mbit/s and 3 × 64 kbit/s.

4. One earth station for the Eutelsat Telecom 1 multiservice network on the French domestic satellite system TELECOM 1 is being installed near Copenhagen. The earth station will be ready for operation in march 1987.

5. The domestic satellite system to Greenland via the Intelsat V satellite at 307° E has been expanded with the capability of television transmission from Denmark to Greenland.

6. Propagation measurements at 20 and 30 GHz are performed with radiometers in elevation angles of 10 and 20 degrees.

These measurements are supported by the Finnish and the Swedish Administration.

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

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.

DJIBOUTI (REPUBLIC OF)

In 1986 the Republic of Djibouti brought the following new direct (SCPC) telephone links into service:

- in the ARABSAT system:
  Saudi Arabia (1 full duplex + 1 half duplex)
  Kuwait (2 hybrid)
  Yemen Arab Republic (A hybrid + 1 full duplex + 1 half duplex)
  Jordan (1 hybrid)
  Algeria (1 hybrid)
  United Arab Emirates (1 full duplex + 1 half duplex)
  Tunisia (A hybrid)
- in the INTELSAT system:
  United Kingdom (3 full duplex + 3 half duplex)

A second circuit with Kenya was opened in February 1986.

The numbers of telephone channels to France has been reduced from 42 to 16 owing to the entry into service of corresponding facilities on the South-East Asia, Middle-East and Western Europe (SEA, ME, WE) submarine cables.

EGYPT (ARAB REPUBLIC OF)

1. International communication via Intelsat satellites

In Egypt, international communications are operated through two Standard A earth stations and submarine cables. By the end of 1986, communications via satellite accounted for about 50 percent of 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 traffic with 11 countries on the FDM/FM with a total capacity of 415 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 15 countries with a total capacity of 348 circuits.

During 1986, 241 television transmissions and 830 receptions of a total duration of 41016 minutes were handled by the two earth stations.

2. Maritime satellite communication

Egypt has been a member of INMARSAT since 1979. Construction of the Inmarsat coast earth station located at Maadi has been started, and it is expected to be in service by the end of 1987.

3. Meteorological satellite application

Since 1969, the Egyptian Meteorological Authority (APT) earth station has been operating with near-polar orbiting satellites to receive both visible and infra-red channels. In 1979, the earth station was modified to operate with geosynchronous satellites (Meteosat). In 1982, a new station was constructed with the capability of receiving pictures from both polar-orbiting and geosynchronous satellites. In addition a specialized data processing system has been acquired to provide meteorologists with pictorial information about the different types of cloud systems and associated weather phenomena.

4. Remote sensing from space

The Egyptian centre for remote sensing is a part of the Egyptian Academy of Scientific Research and Technology. The RSC offers the full range of earth resources data acquisition and processing services. It has completed its photogrammetric line by establishing a most advanced cartography and mapping processing unit. The centre is in the final stages for starting to construct an earth resources ground receiving station.

ETHIOPIA

In 1986, in the area of space radiocommunication, the Ethiopian telecommunications authority expended a substantial effort for the enhancement and promotion of the country's international communication facilities. The establishment of the country's first Standard A earth station in 1979 for operation in the Atlantic Ocean region and a Standard B earth station for operation with the Indian Ocean region satellite is indicative of these efforts to satisfy the national requirement for direct communication with the countries of the regions concerned. Although the newly designed and built Standard B earth station became operational only in 1986. It already handles traffic to three separate destinations. Moreover, according to the traffic data base, the number of voice-grade circuits through the Standard B earth station is expected to grow by 45 channels and to serve around 10 new destinations by the end of 1988. The newly built station is located with the Standard A earth station at Sululta.

FINLAND

1. Nordic activities in the field of satellite telecommunications

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

2. EUTELSAT

The implementation of an earth station for the satellite multiservice is nearly completed. The station is located in Helsinki and was approved by EUTELSAT in September 1986.

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 and the Netherlands have been received via Eutelsat F-1 and a programme originating in the USSR via Gorizont for distributions into cable networks. At the end of the year satellite television was available at 300 locations in Finland.

4. Space research

Ionospheric and magnetospheric research using both satellite and ground based data has been continued at three institutes in Finland. The Institutes involved are: Finnish Meteorological Institute, University of Oulu and Sodankylä, Geophysical Observatory. The Finnish Meteorological Institute participates in the design and construction of instruments for the Soviet Phobos-spacecraft which will be launched in 1988. The instruments will be used for space plasma studies and for planetary science.

The Finnish Geodetic Institute operates a satellite laser station situated about 40 km from Helsinki. Several satellites have been used for the studies of the high-resolution geoid and the gravity field of the earth.

The Universities of Helsinki, Turku, Oulu and Metsähovi Radio Research station have used satellites for astronomical research. European Space Agency (ESA), NASA and Soviet satellites have been used for ultraviolet, X-ray, stellar, planetary and solar research.

FRANCE

The French telecommunication authorities continued to promote the use of satellites for network and service development through their participation in INTELSAT, INMARSAT and EUTELSAT, their involvement in a large number of bilateral cooperation activities and their operation of the national system TELECOM 1.

1. The TELECOM 1 system

With the launching of the second satellite in May 1985, the TELECOM 1 system became fully operational in 1986. It now provides all the telephone and television links between metropolitan France on the one hand and Martinique, Guadeloupe, Guyana, Saint-Pierre-and-Miquelon, Reunion and Mayotte on the other.

Over and above that conventional function, TELECOM 1 was used in 1986 for the steady development of digital business services offering a wide range of transmission rates and a variety of facilities to large French companies. The central network management station is at Mulhouse.

2. Intercontinental telecommunications

France, the third largest user of the INTELSAT system after the United States of America and the United Kingdom, accesses the organization's satellites via some 20 antennas at the two metropolitan centres of Pleumeur-Bodou and Bercenay-en-Othe and at centres in the overseas departments and territories of Guyana, Martinique, French Polynesia and New Caledonia. Since its contributions amount to almost 5% of the organization's investment, France plays an active role in INTELSAT's managerial and consultative bodies and, in 1986, was instrumental in securing the adoption of decisions relating to the entry into operational service of time-division multiple access (TDMA) between France and a number of foreign countries, the placing of orders for two additional Ariane IV launchers for Intelsat VI satellites, and the participation of French industry in the future generation of Intelsat VI satellites.

3. Strengthening of European cooperation

The French telecommunication authorities are continuing to promote the use of the TELECOM 1 system by their European partners, under agreements concluded with the Federal German Bundespost and the European organization EUTELSAT. Thus TELECOM 1 is available to European companies for the establishment of digital links inside Europe.

As the largest investor in EUTELSAT (16.35%), France has been closely involved in work on the first two TDMA-operated ECS satellites, which are used to handle telephone circuits in Europe and television programmes for either the European Broadcasting Union (EBU) or distribution over cable networks.

In May 1986, EUTELSAT placed an order with the company Aérospatiale for the first three EUTELSAT II satellites, which are to be commissioned starting in 1989 and will be launched by Ariane.

4. Maritime satellite links

The mobile-satellite service opened by INMARSAT in 1982 continues to develop space, enabling links with vessels to be considerably enhanced. Seventy French vessels had been fitted with Inmarsat stations by the end of 1986.

Further progress was made in carrying out the French direct broadcast-satellite programme through the introduction of the TDF 1 satellite and the completion of equipment for TDF 2. The first satellite could not be launched in 1986 owing to difficulties with the launchers. While the satellite was being developed, the associated ground facilities (feeder link and control) were completed. Substantial progress was made in producing the integrated circuits required for the D2 MAC receiving equipment.

GERMANY (FEDERAL REPUBLIC OF)

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

1.1 *INTELSAT*

The volume of INTELSAT traffic continued to increase in 1986. In the regions of the Atlantic and Indian Ocean, connections to a total of 68 countries are being operated.

In addition to international telephone and data traffic, other services such as business communication and television distribution are increasingly gaining in importance. Technical systems are therefore being constantly extended and improved.

For the antenna systems 4 and 5 of Raisting earth station, the TDMA/DSI system has been put into operation for the traffic areas of Indian Ocean region (IOR) and Atlantic Ocean region (AOR).

After the first Intelsat-IBS stations had been supplied and set up, a data and videoconference service was introduced via various AOR satellites.

1.2 *EUTELSAT*

By the end of 1986, the technical systems used for opening international telephone traffic via the EUTELSAT system had been installed to meet demand. Turkey is the first country of destination and some 400 lines are being used. The TDMA/DSI systems of antenna system 3 were installed in Usingen.

Several small stations at various locations were set up for the SMS services (Satellite-Multi-Services). The data and videoconference services were opened via these stations.

Apart from the in-orbit tests using a special measuring antenna in Darmstadt and television control for the EBU (European Broadcasting Union), the Deutsche Bundespost took up two additional services for EUTELSAT. These are television control of the occasional use transponder and control of the RF spectrum from flight model 1. These systems were installed in Usingen.

2. INMARSAT

2.1 *The maritime distress radio call system DRCS*

The first pre-operational trials with the L band maritime distress radio call system were carried out by INMARSAT via the MARECS B-2 satellites in April 1986. Meanwhile the acceptance test of the buoy have taken place, so that 11 EPIRBs (Emergency Position Indicating Radio Beacons) are now available. Eight of these buoys will be loaned free of charge to interested countries for the purpose of trials.

The first three buoys were fitted to German ships in mid-November 1986.

The other participating countries (Norway, Great Britain, Greece, Denmark, USA, Spain and Bulgaria) were to be supplied with the other buoys by mid-December 1986.

The trials carried out so far have shown again that the transmission time from triggering a distress message to printing out the message in the central survival office takes less than two minutes.

3. Testing the aeronautical satellite service

In 1986 the aeronautical satellite service was tested:

During five test flights for determining the channel with satellite elevation angles between 5° and 24°. Data and speech were also transmitted between the ground station and the airplane via the satellites MARECS B-2.

Two new coordination methods were developed and tested. The method of using parity check codes is particularly noteworthy. This is a simplified method requiring few calculations for high-rate data transmission.

4. Videoconference trials via satellite transmission paths

An experimental videoconference system was tested via a satellite path for operations with videoconference codecs. Additional systems are to be tested, such as a graphics communication system and the possible application for preparing and carrying out future space missions.

5. Domestic satellite systems

5.1 *The German telecommunication satellite system DFS Kopernikus*

The Deutsche Bundespost is currently installing a national telecommunication satellite that will make use of the frequency ranges 11/14 GHz, 12/14 GHz and 20/30 GHz. In addition to supplementing terrestrial telecommunication networks, the satellite system is to distribute television channels among cable networks and contribute to implementing new digital telecommunication services for business communications.

The terrestrial systems comprise two earth stations each for telecommunication traffic in the 20-30 and 11-14 GHz range as well as 30 connection stations for business communications. The satellite system also distributes television programmes among broadband cable networks of the Deutsche Bundespost.

5.2 The German television broadcasting satellite TV-SAT

The high-capacity satellite TV-SAT for direct reception of television and sound broadcasting has largely been completed.

TV-SAT provides four channels for direct television broadcasting. It is planned to operate one of these channels with 16 digital stereo sound broadcasting programmes.

By launching a second largely identical TV-SAT 2, it is planned to increase the number of channels in the operational satellite broadcasting system from four to five channels.

5.3 The ground operations system

The Deutsche Bundespost is preparing the operation of TV-SAT and DFS-Kopernikus. For spacecraft control, it was decided to install a Ground Operations System (GOS) at earth station Usingen near Frankfurt.

The GOS consists of four main parts, the Satellite Control Centre (SCC) with its workstations, station computers (STC) for real-time and off-line use, baseband equipment (BB) and antennas with associated RF-equipment.

GREECE

In 1986, Greece (OTE) continued its activities in the field of satellite communications.

1. INTELSAT system

Three Intelsat Standard A antennas, situated at Thermopylae, continued to provide service in the Atlantic Primary Path, Indian Primary Path and the Atlantic Major Path 2 regions. In 1986, the number of circuits for both the Atlantic and Indian satellite regions was raised to about 750.

A number of those circuits have been assigned to several other countries as permanent point-to-point transit circuits. During 1986, traffic via the SPADE system was exchanged with Angola, Argentina, Ivory Coast, Mexico, Nigeria, Paraguay, Sudan and Uganda.

A decision has been taken to introduce digital technology in voice transmission via the satellite link, by operating a TDMA/DSI system in our Major Path 2 earth station located in Thermopylae. The relevant contract has been signed and the system should be operational by the 4th quarter of 1987.

About 60% of Greek satellite traffic is expected to be routed via this digital system.

2. EUTELSAT system

In 1986, OTE continued to play an active part in the work of the European Telecommunications Satellite organisation with a share of 3,18043%.

A decision has been taken to build a satellite earth station of the fixed service in a new location called NEMEA, south of Athens. An international call for tenders will be launched shortly.

3. INMARSAT system

Greece, one of the founding members of the INMARSAT Organization, is currently the 10th shareholder, with approximately 1.99% of INMARSAT investment shares.

More than 350 ships of Greek ownership (about 150 of which fly the Greek flag) were using the INMARSAT system by the end of 1986.

The Thermopylae coast earth station (CES) was brought into service in 1985. The CES operates in the Indian Ocean region in cooperation with the Italian CES, which covers the Atlantic. This arrangement applies only for telex traffic and it enables the two stations to operate as though they were a single two-ocean station, with economic benefit to users in both countries. Telephone traffic will also be included in the immediate future.

The CES is equipped with 16 telephone and 20 telex channels and offers telephony, telex, facsimile, data to/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 is scheduled for 1987.

ICELAND

1. Nordic activities in the field of satellite telecommunications

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

2. Domestic activities

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

At the end of 1986, Skyggnir carried traffic via the Intelsat V (F-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 209 circuits.

Skyggnir received television news daily from London via Goonhilly and the Intelsat Primary Path satellite until the end of September. Other occasional television programmes were transmitted from Skyggnir or received on more than 100 occasions during 1986.

As from October, daily television news were received from London via Madley and the Eutelsat F-2 satellite West Spot Beam with a small antenna. Also from beginning of October television programmes via Eutelsat F-1 were received with a similar antenna for distribution to a private television company. Iceland is a member of EUTELSAT since August 1985.

In 1983 a Standard B antenna which is colocated with the Standard A antenna commenced operation. The antenna is at present used for television reception only and accesses a leased television channel in a spare Intelsat satellite (Intelsat V (F-2)).

INDIA (REPUBLIC OF)

1. Indian National Satellite System (INSAT)

The second spacecraft Insat-IB, of the first-generation multipurpose Indian National Satellite System (INSAT-I) launched in 1983 is fully operational. The INSAT system provides the following services:

- Long distance telecommunications (telephony, data, facsimile, etc.).
- Round-the-clock meteorological earth observation and data relay.
- Direct television broadcast to augmented community television sets in rural areas and networking of terrestrial television transmitters.
- National and regional networking of radio transmitters.
- Dedicated communication networks for the business and industrial sectors.
- A Disaster Warning System for alerts on cyclonic events.
- A satellite-based news dissemination service for the national news agency.

The launch of the third Insat-I satellite, Insat-IC, is scheduled for early 1988. This will primarily function as the on-orbit backup satellite, but the available additional capacity will also 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 the Insat-I meteorological payload.

Insat-ID will be the fourth and last satellite in the INSAT-I series. It is planned for launch in 1989.

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 is also included on Insat-II.

Activities in the satellite communications area

2.1 India has decided to actively promote, participate in and contribute to the development of the international Satellite-aided Search and Rescue System for maritime, aviation and land distress alert detection and position location. The Indian programme for satellite-based distress alert detection and position location is being developed as an Inter-Agency programme with participation of all the concerned departments and agencies in India. This programme is also being integrated with other national and international efforts. India participated in the 1986 COSPAS-SARSAT 406 MHz Beacon Exercise.

2.2 India is active in evolving a system capable of providing Mobile Satellite Communication Services and Radio Determination Satellite Services. To this effect India is actively participating in the studies being conducted by various International agencies like ICAO. India has also initiated a joint study with the United States GEOSTAR System for exploring the feasibility of an RDSS System over the Indian Ocean.

2.3 A sustained research and development programme in the field of small terminals for fixed satellite services and also use of advanced modulation techniques like TDMA system are underway. A pilot project for providing a quick messaging (telegraphy) service to remote and rural areas using inexpensive terminals and geostationary communications satellites has made significant progress. This scheme uses spectrum effective TDM-TDMA technology.

2.4 Projects for News Dissemination and Weather Data Dissemination using satellite have also been initiated.

2.5 A study on propagation in the 13 GHz band using radiometers and line-of-sight links has been completed.

3. Indian remote sensing satellite (IRS)

3.1 The Indian Remote Sensing Satellite (IRS-1A) has reached the level of fabrication of the flight model. This has cameras based of CCD array detectors for ground resolution of 36 and 72 m. The data transmissions will be in the X and S bands. Launch is planned for mid-1987.

3.2 The ground terminal for reception of data from IRS-1A is being prepared at Hyderabad.

3.3 The X/S band terminal for receiving data from LANDSAT 4 and 5 is operating at Hyderabad.

3.4 X band terminal for receiving data from the SPOT satellite is nearing completion at Hyderabad.

4. Stretched Rohini satellite series (SROSS)

An indigenous capability to put low earth orbit satellites in the weight range of 150 kg will become available shortly, through the ASLV launcher which is an augmented version of the existing SLV-3. To make effective use of this class of satellite to carry out technological and scientific experiments, the SROSS programme is being implemented to develop versatile platforms of 150 Kg. The launch of the first SROSS satellite on the ASLV launcher is scheduled in 1987.

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

As part of the ISTRAC network, TTC ground stations have been commissioned at Sriharikota, Trivandrum and Car Nicobar to provide telemetry and telecommand support in the frequency bands 2025-2110 MHz and 2200-2290 MHz for Indian low earth orbit satellites and launch vehicles.

INDONESIA (REPUBLIC OF)

1. Domestic satellite communications

The Indonesian 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, were launched in 1976 and 1977 respectively.

At present the operational satellite is Palapa B-1, which was launched in 1983.

In 1984 the in-orbit spare for Palapa B-1, i.e. the Palapa B-2, was launched by STS challenger.

After successful deployment from the orbiter, the satellite failed to achieve geosynchronous orbit due to malfunction of the PAM D upper stage.

A third Palapa B satellite is being prepared for launch in March 1987 to replace the failed Palapa B-2.

The PALAPA system provides long distance telecommunication as well as television distribution in Indonesia.

In addition, the palapa satellites are utilized by neighbouring ASEAN (Association of South East Asian Nations) countries for their domestic requirements.

At present the PALAPA network consists of more than 200 earth stations (including TVRO's) scattered throughout the country. Procurement of 100 additional small earth stations is underway. These earth stations will be installed in small cities which at present have no telecommunication facilities or are still served by HF radio.

In 1981 a pilot project for a public data network, partly funded by ITU, was implemented.

The network was called PACKSATNET, short for Packet Satellite Data Network. It is intended to provide data exchange capabilities as well as a test bed to continue research and development of both equipment and networks.

The network utilizes the satellite for long haul traffic while local traffic is handled by terrestrial UHF radio.

A TDMA network is at present being installed and is expected to be operational soon.

2. International satellite communications

International satellite communications in Indonesia are provided by PT. INDOSAT, a government owned company.

The first earth station working with an Intelsat satellite, located in Jatiluhur, West Java, began operations in 1969.

A second antenna, which was provided in 1979, enables the station to work with IOR as well as POR satellites.

In early 1983, Indonesia was awarded a contract by Intelsat through international tender for the provision, maintenance and operation of a TDMA reference and monitoring station service (TRMS) for an initial period of five years.

The TRMS is to serve the Indian Ocean satellite, and was brought into operation in 1986.

Also in 1983, Indonesia was again awarded a contract by INTELSAT for the provision, maintenance and operation of a telemetry, tracking, command and monitoring station (TTC&M) for an initial period of five years. The TTC&M station is to serve Intelsat's South East Indian Ocean region (IOR) and South West Pacific Ocean region (POR).

The system was brought into operation in 1985.

2.1 *Other space activities*

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.

ISRAEL (STATE OF)

1. International services (general)

During 1986, an ITT type 12/40 digital switch was put into operation in Tel Aviv, and the transfer from the old analogue to the new digital switch was initiated. This new switch serves both international and inter-city circuits in Israel.

The transfer of the international circuits was somewhat delayed due to some software difficulties. At present, the international telephone circuits terminate on one analogue and one digital switch, both located in Tel Aviv, and one analogue switch located in Jerusalem.

The activation of the new digital switch has required that the grouping of circuits be restructured, in view of the fact that in the past, telephone, voice grade data, and private circuits were intermixed. Such a configuration is presently unacceptable when operating via the digital switch.

The total number of Israel's international circuits, as of 31 December 1986, was 1374, of which 500 were routed via Intelsat satellite.

2. Space telecommunication services via Intelsat satellites

The three antenna systems of the Emeq Ha-Ela earth station operated well during 1986. It is envisaged that the SCPC system operating via EMH3B and presently providing service to Australia and Singapore, will be developed further during 1987, enabling the number of circuits to be increased and circuits added to Japan.

During 1986, five more satellite links, Israel – Chile, Israel – Cyprus, Israel – Singapore, Israel – Turkey, and Israel – Venezuela, were opened up.

The following table shows the current distribution of telecommunication circuits via the Intelsat satellites.

Emeq Ha-Ela Antenna	Satellite	Number of links	Number of voice grade circuits
EHA 1-A	AOR/335.5 Deg.	15	233
EHA 2-A	AOR/325.5 Deg.	10	237
EHA 3-B	IOR/63 Deg.	2	30
Total		27	500

The number of satellite circuits was increased in 1986 by about 25%.

3. Domestic satellite services via Intelsat satellite

The second phase of developing domestic satellite services was completed by year's end 1986, and experimental television transmissions were initiated in order to verify the quality of the proposed service.

It is foreseen that the distribution of television programming for the second national television broadcasting channel, as well as for a pay television channel, will be completed during 1987.

During the year, negotiations have been carried out with Intelsat concerning a follow – on satellite, in order for Israel to obtain the use of Intelsat transponders for domestic service beyond 1989.

ITALY

The activities of Telespazio can be grouped under five major headings:

- satellite commercial telecommunications,
- support and in-orbit control of satellite,
- 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 Organization and, since 1 January 1985, for the INMARSAT and EUTELSAT Organizations. It has been operating commercial satellite telecommunications since 1965 under an Agreement with the Italian PTT Ministry. This Agreement was renewed in 1984, confirming and strengthening the role of Telespazio as the "only carrier's carrier" for national, European and intercontinental satellite telecommunications.

These activities are performed by operating two earth stations:

- the Piero Fanti telecommunications Centre, 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 also using TDMA techniques; and at 11/14 GHz with the Atlantic Primary satellite.

– The Lario earth station located near Lake 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 work on 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.

By the end of 1986, altogether 74 overseas countries were linked to Italy by means of Intelsat satellites over a total of 2005 circuits, of which 28 in TDMA and 43 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 PTT Administrations and operating entities in other countries for the provision of point-to-point telecommunication services.

In 1986 the EUTELSAT system also became operational for voice and data services, and Telespazio has been providing the Italian responsible Carrier (ASST) with a total of 63 circuits (62 for voice + 1 for data).

As far as television is concerned, all services together accounted for 3696 transmissions for an overall duration of 2320 hours, including the regular transmission of EVN services for EBU (1440 transmissions for a duration of 767 hours).

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 Centre entered its second year of operation. The station is connected to the INMARSAT system through 16 accesses, according to arrangements made with the "Direzione Centrale dei Servizi Radioelettrici" of the PTT Ministry, which is responsible in Italy for the provision of the mobile maritime service. The Italian traffic share expanded from 0.98 to 1.18% of all INMARSAT traffic during 1986.

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 1987/1988.

2. Support and in orbit control of satellites

On the basis of a contract for several years, 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;

– Continuing the control centre service for the residual life of the Italian Sirio experimental satellite, operating on 18/12 GHz;

– TRMS (TDMA Reference and Monitoring Station) to INTELSAT and EUTELSAT.

In addition, Telespazio is implementing the necessary equipment (including 2 new 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.

Work is also in progress to complete 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 related services for a five-year period.

3. Experimental and other activities

In the framework of Telespazio's experimental work carried out with the aim of contributing to the development of future uses of satellite telecommunications, the following activities were performed in 1986:

- starting 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 USA, to improve satellite access techniques in packet switched networks;
- continuing studies for the ITALSAT programme, the 20/30 GHz domestic satellite system, with regard to technical specifications as well as orbital control of the system;
- starting a study for ESA on the integration of terrestrial and satellite networks in Europe;
- continuing a study on the DRS (Data Relay Satellite) for ESA;
- continuing 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 the early 1990's to identify and measure cosmic sources of X rays;
- defining the terms of involvement of Telespazio in the study for the ITU of the African satellite co-financed by the Italian Foreign Office;
- defining the terms of involvement of Telespazio in the ESA/Columbus programme;
- implementing 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.

On behalf of CNR/PSN, Telespazio continued operational management of the Matera laser station for measurements using geodetic satellites. 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 continued regularly throughout 1986. Equally distributed by Telespazio are data from the SPOT satellite on the basis of a contract signed with SPOT-IMAGE in 1986.

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.

Following the agreement between Telespazio and ENEA, the Italian body responsible for research and development in the field of alternative energy sources, a collaboration involving a close coordination between the two organizations in the application of satellite remote sensing technologies started in 1986.

There was a move towards the implementation of geographical information systems (GIS) combining data gathered from satellites and other sources (terrestrial platforms, aircrafts, etc.). One such example is a project whereby Telespazio will provide a system for monitoring regulations set up by the competent Ministry for the Safeguard of Historical and Environmental Resources.

5. International cooperation

In the area of international cooperation, telespazio participated in the organization of the IRI's 24th specialized training course for technicians and managerial personnel, providing lectures in the specific field of satellite telecommunications.

As far as the operation and maintenance of earth stations is concerned, a Telespazio expert has been in Somalia to provide assistance for the operation of the local earth station.

Cooperation with the United Nations and its specialized agencies continued as well.

In 1986 Telespazio contributed as in previous years to the organization of the following courses:

- 11th UN - NATO International Training Course, in conjunction with the governments of Italy and France: Remote Sensing Applications in Agricultural Statistics (May 1986);
- 9th FAO/UNDRO/WMO/ESA Training Course: Applications of Remote Sensing to Control and Prevention of Floods (July 1986).

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).

The CS-2 system is now in the stage of operational phase; operational services of the 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 emergency communications, occasional communications, etc. by the following users: the Nippon Telegraph and Telephone Corporation, the Japanese National Railways, electrical power companies, the National Police Agency, the Ministry of Construction, the Fire Defense Agency and the Ministry of Posts 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 a good condition now.

The next-generation communications satellites, the CS-3 satellites (CS-3a and CS-3b), are planned to be launched in the winter and the summer of 1988 respectively by Japan's H-I launch vehicle from the Tanegashima Space Center.

A CS-3 satellite is designed to have a life of seven years. It is a spin-stabilized satellite weighing 550 kg in orbit with 12 transponders (10 for 30/20 GHz band and 2 for 6/4 GHz band) in operation.

The CS-3 programme is now being carried out as scheduled.

1.2 *Broadcasting*

The BS-2 system, the first direct-broadcasting satellite system, 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 the geostationary orbit at 110° E, by N-II launch vehicles from the Tanegashima Space Center, and the TSCJ has been controlling the orbital slots and attitude of the satellites after the initial checkout by NASDA.

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

The next-generation broadcasting satellites, the BS-3 satellites (BS-3a and BS-3b), are planned to be launched in the summer of 1990 and in the summer of 1991 respectively by H-I launch vehicles from the Tanegashima Space Center.

A BS-3 satellite is designed to have a life of seven years. It is a three-axis-stabilized satellite weighing 550 kg in orbit and having a capacity of 3CH broadcasting services.

The design and launch of BS-3 satellites were ordered to NASDA by the TSCJ in October 1985.

The users of the BS-3 system will be NHK and the JSB (the Japan Satellite Broadcasting Inc.; a new private company, established in 1984 to offer commercial satellite broadcasting services by direct-broadcasting satellite).

1.3 *Meteorology*

The network of geostationary meteorological satellites plays an important role as a space-based sub-system of the World Weather Watch (WWW) Programme of the World Meteorological Organization. Japan has been contributing to the implementation of the WWW Programme by making meteorological observations of the Asia-Oceania-Pacific area by the GMS-series satellite.

Major telecommunications functions of GMS-series satellites are: transmission on 1.7 GHz band to the ground station of earth imagery acquired by the VISSR (Visible and Infrared Spin Scan Radiometer); facsimile dissemination on 2.0 and 1.7 GHz bands; collection of meteorological data from DCPs (Data Collection Platforms) on 402 MHz and 1.7 GHz bands; and operation of telemetry and command on 2.0 GHz and 1.7 GHz bands backed up by USB (Unified S-band). Solar particles information measured by the Space environment monitor is included in telemetry data.

GMS-3 was launched in August 1984 (UTC) and has been in operation in the geostationary orbit at 140° E.

GMS-4, as the successor of GMS-3, is being developed and is scheduled to be launched in the summer, 1989.

1.4 *Space Research*

MS-T5, Japanese first interplanetary spacecraft, was successfully launched in January 1985 (JST) with M-3SII rocket from the Kagoshima Space Center, Uchinoura, by the Institute of Space and Astronautical Science. MS-T5 escaped from the earth gravitation for the first time in the space development effort of japan, and renamed "Sakigake" (Pioneer). She was given 1985-001A as the international designation.

Sakigake successfully carried out the technological missions such as performance verification of the new type of rocket, deep space communication using S-band, orbital determination and guidance-control beyond a long distance, and so forth. Sakigake flew by 7 million km from Halley's comet on 11 March 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 launched on 19 August 1985 (JST) with M-3SII rocket, and was renamed Suisei (Comet) with the international designation 1985-073A.

Suisei passed by 0.15 million km from Halley's comet on 8 March 1986 (JST), and took the ultra-violet images of hydrogen coma around Halley's comet using Ultra-Violet Imager and studied also the interaction between solar wind and the coma of Halley's comet using Energy Spectrum of Particles.

An X-ray astronomy satellite ASTRO-C was launched on February 1987 using M-3SII rocket by ISAS. On board ASTRO-C are Large Area Proportional Counter, Gamma-Ray Burst Detector and All Sky Monitor. Her main mission is the observation of active galaxies.

1.5 *Space technology*

1.5.1 *Marine observation satellite-I (MOS-I)*

MOS-I 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-I will be launched into a sunsynchronous sub-recurrent orbit at an altitude of about 909 km by an N-II launch vehicle in February, 1987.

1.5.2 *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 communications experiments with aircraft, ships, etc. Weighing about 550 kg at the beginning of life, ETS-V will be launched into a geostationary orbit at 150° E by an H-I launch vehicle in the summer of 1987.

1.6 *Amateur communications satellite*

JAS-1 was launched by NASDA in August 1986 (JST) as one of the payloads of H-1 vehicle test flight. JAS-1 could obtain a fine circular orbit with inclination angle of 50°, altitude of 1500 km and period of 116 minutes, and JAS-1 became the first amateur communications satellite in Japan. JAS-1 has experienced cases both of sun-lit over ten days and eclipse up to 30%. JAS-1 is now operating normally.

JAS-1 carries two transponders, the one for analog and the other for digital system, both are made by radio amateurs, operating on 145 and 430 MHz bands. The analog system is used for relaying radio signal of the Morse code and SSB in real time, and the digital system operates as a mail box with a procedure of store and forward. Many radio amateurs in the world are now enjoying their communications via JAS-1.

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 November 1986, KDD had 1563 voice grade circuits via the Indian Ocean satellites and the Yamaguchi earth station, and 2329 voice grade circuits via the Pacific Ocean satellites and the Ibaraki earth station.

KDD's Yamaguchi earth station started, following successful conclusion of various tests, the carriage of TDMA traffic in January 1986.

KDD introduced the high speed digital communication services using INTELSAT Business Service in the Pacific Ocean region in december, 1986. For that purpose, a Standard E-2 earth station was constructed at the centre of Tokyo.

2.2 *INMARSAT*

KDD, the Signatory of Japan to INMARSAT, has been providing maritime satellite communications services through the INMARSAT system. During the period of January to September in 1986, the Yamaguchi coast earth station (CES) handled 38 203 ship-to-shore telephone calls, 22 793 shore-to-ship telephone calls, 171 034 ship-to-shore telex calls and 79 784 shore-to-ship telex calls. During the same period, the Ibaraki CES handled 43 212 ship-to-shore telephone calls, 30 523 shore-to-ship telephone calls, 177 783 ship-to-shore telex calls and 75 900 shore-to-ship telex calls.

KDD invited the Twenty-Fifth Session of the Council held from 29 October to 5 November at the Kyoto International Conference Hall in Kyoto, Japan.

KENYA (REPUBLIC OF)

The Kenyan Administration reports the following activities:

Dual polarization transmit and receive capability was provided for the Longonot-1 earth station. The antenna Intelsat Standard A type works to an Intelsat satellite at 60 degrees longitude over the Indian Ocean region. The dual polarization capability includes the provision of three uncooled low noise amplifiers, one 3 kW high power amplifier and associated wayguide runs.

KUWAIT (STATE OF)

Kuwait has one of the largest earth station complexes operating in the Middle East. Three Standard A antennas operate in the INTELSAT system, one Standard B antenna operates in the INMARSAT system and another antenna operates with the ARABSAT system. At the end of December, 1986, a total of 724 circuits were operational with Intelsat. This included 24 SPADE circuits and 13 SCPC circuits. The Inmarsat station handled a total of 19917 minutes of telex service and 5543 minutes of telephone service via 6 Inmarsat circuits. The Arabsat station worked with 8 Arab destinations over a total of 113 circuits including 6 SCPC circuits.

Kuwait procured a mobile earth station to work with the Atlantic Ocean Major Path two satellite and to be linked with two chosen destinations. The station will have a capacity of 60 channels and will operate in the GFDM/FM mode. The station is under installation at present.

MALI (REPUBLIC OF)

In the Republic of Mali, the following developments in space radiocommunications occurred in 1986:

Antenna construction

SLY-1B – opening of four circuits
– installation of inverters and batteries (power supply)

SLY-2B – change of antenna source (retrofit) = adaptation to new satellites.

MALTA (REPUBLIC OF)

A Standard B earth station was installed in 1986.

MOROCCO (KINGDOM OF)

The National Posts and Telecommunications Office of the Kingdom of Morocco has set up a new earth station of the Arabsat type. It is equipped with an 11-metre Standard B antenna and can provide the following services:

- telephony,
- telegraphy,
- television,
- broadcasting.

It has been operational since 31 December 1986.

Morocco has also approached INMARSAT with a view to joining that organization.

MEXICO

1. Introduction

The launch of the satellites Morelos I and II in 1985 represented a significant step forward for Mexico in the field of space radiocommunications. With the Morelos satellite system in operation, it has been possible to meet planned telecommunication objectives.

One of these objectives was the World Football Championship "Mexico 86", the most widely broadcast event in history, far surpassing any other event of worldwide interest before it. That occasion provided a clear demonstration of the advantages of space radiocommunications over other means of telecommunications. Thanks to their efficiency, quality and flexibility, television and telephone signals could be transmitted nationally and internationally to a satisfactory standard.

2. Ground infrastructure

2.1 The Mexican Government's investment in the purchase of telecommunication systems for the World Football Championship "Mexico 86" was used to modernize and complete the existing telecommunications infrastructure. The following measures were implemented:

- A Standard B earth station was installed, with an 11-metre antenna, at the International Broadcasting Centre, to establish communication with the new provincial stadiums and the earth station Hermosillo I via the Morelos I satellite.
- Five semi-fixed earth stations and four transportable earth stations were installed in the provincial stadiums. The two way capacity of these stations was 2 + 1 television channels and 1+ 1 telephone carriers.
- In order to provide the Atlantic region with six permanent television channels via the satellite INTELSAT 307° E, a Standard B earth station was installed in Iztapalapa with an 11-metre antenna and a capacity of 4 + 1 television channels. The two extra channels were provided by a transportable earth station leased from a private company.
- For communication with the Pacific region, a Standard B earth station was installed in Hermosillo, equipped with a 13-metre antenna with a capacity of 60 SCPC channels and 2 + 1 television channels.
- Lastly, at the international earth stations Tulancingo 1 and 2, equipment was installed for the simultaneous transmission of 5 television channels (including one permanent) and 2 telephone carriers for wideband audio circuits used for coordination and commentaries.

2.2 Mexico is now launching a pilot project for earth stations in the Ku band for the rural telephony service. The system comprises 32 earth stations (urban and rural), of which 16 (including 4 which are already carrying rural telephone traffic) are already fully installed.

3. Use of outer space for peaceful purposes

Our Government and the United Nations organization signed an agreement whereby our country would support and co-sponsor the United Nations Meeting of Experts on Space Science and Technology and its applications within the framework of educational systems, which was held in Mexico City, on the premises of the Central Telecommunications Tower, from 13 to 17 October 1986, and attended by 46 experts from 15 countries and 12 national and international organizations.

The meeting discussed in depth many aspects of development and training in space science and technology, leading up to the presentation of a final document containing a number of recommendations concerning various activities to promote the introduction of space technology and science features in education. These recommendations will be included in the report of the meeting for the United Nations organization, for submission to the Committee on the Peaceful Uses of Outer Space.

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 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.

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 will be reserved for the distribution of private television programmes.

2.2 *EUTELSAT transponders*

Norway is leasing a full-time transponder on Eutelsat I (F-2). Since December 1984 the transponder has been 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-2 will also be used for domestic business communication (called the NORSAT B-0 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 January 1987 and offer the following capacities: 3 × 64 kbit/s and 2 × 2.048 Mbit/s.

Norway has signed an option contract for the lease of an international transponder on Eutelsat I (F-4). The utilization of this transponder is not yet finalized.

OMAN (SULTANATE OF)

1. The progress made by the Sultanate of Oman in the field of space radiocommunications is as follows:

1.1 An 11-metre C-band Arabsat Standard A earth station, built in 1985 at Al-Hajar near Muscat, has been in operation since 1985 and works within the ARABSAT network utilizing the satellite located at 26° E longitude in the geostationary orbit.

This earth station is equipped to radiate one telephony carrier, one television carrier and about 48 SCPC/CFM carriers. Reception of regional television programmes in the C-band and those in the S-band directly broadcast by the satellite are possible.

Six countries, namely Saudi Arabia, Bahrain, Jordan, Kuwait, Lebanon and UAE, will be on FDM/FM mode, while the remaining 15 countries will be on SCPC/CFM. As of December 1986, about 60 circuits have been operating with 6 ARABSAT member countries.

1.2 A new 11-metre C-band satellite earth station, built in 1985, has been operating within the Oman domestic satellite system at Masirah island off the eastern coast of Oman.

This station is equipped for 24 SCPC/CFM circuits to the control station at Al-Hajar. Television and FM radio can be received for re-broadcast locally.

The Oman DOMSAT system has been operating utilizing a leased full transponder of the Arabsat satellite at 26° E longitude since November 1986.

1.3 In addition to the above, five 11-metre antennas of the DOMSAT network were retrofitted with dual-polarization, frequency re-use feeds.

1.4 A new 11-metre dual-polarized antenna was installed at Mamurah earth station near Salalah. This was done to improve the quality of communication by replacing the old, rusted antenna there.

PAPUA NEW GUINEA

The progress made by Papua New Guinea in the development of space radiocommunications as follows:

1. International traffic facilities were increased through the Port Moresby earth station (inaugurated early 1985) under the INTELSAT agreement, to which Papua New Guinea is a party.
2. The registration with the IFRB of the planned Pacstar satellite by the Papua New Guinea Administration was advanced.

PERU

The Peruvian Administration has reported the following activities:

– study of the performance of small earth stations (6.1 m) installed in rural areas (Saposoa, Tocache, Juanjui);

– study of rain absorption in tropical regions on 11-20-30 GHz (1983, 1984, 1985);

– participation in the studies with a view to establishment of the Andean satellite telecommunication system.

PORTUGAL

The number of links and volume of traffic continued to increase in 1986. New links, through the EUTELSAT system, were brought into service with France, the United Kingdom, Belgium and the Nordic countries.

1. INTELSAT

- The use of INTELSAT facilities to carry Portugal's international telecommunications continued to increase and by the end of 1986 altogether 310 satellite circuits had been provided.
- The AOR operations representatives conference was held in Algarve, Portugal (1-9 Oct.).

2. EUTELSAT

- Portugal began operating TDMA traffic through the EUTELSAT system. At the end of 1986, the Sintra earth station handled 169 circuits with four European countries.
- Installation of 3 TVRO (television receive only) for Eutelsat F-1.
- The 8th Regional Traffic Meeting was held in Cascais, Portugal (1-3rd Sept.).

3. INMARSAT

CPRM decided to acquire a transportable Inmarsat terminal. This terminal will be operated from Ponta Delgada (Azores).

4. Domestic satellite communications

This system has been operational since 1982, with three earth stations (Sintra-2, Funchal and Ponta Delgada E/S).

During 1986, CPRM decided to lease 1.5 transponder in the Intelsat V (F-2) satellite.

SAUDI ARABIA (KINGDOM OF)

1. Arab satellite communications

The Arabsat 1-A and Arabsat 1-B satellites were launched in 1985. Riyadh-1 is the primary TTC&M facility for ARABSAT. The Kingdom started communication with the satellite using a transportable earth station pending the commissioning of the Jeddah-8 earth station in 1986. At present, its antenna carries traffic of 100 voice circuits to different destinations in the Arab world. More traffic is being planned for routing through this antenna as the ground segment for the ARABSAT system is completed through the Arab region.

1.1 *Domestic satellite services*

The Kingdom has on lease three Arabsat transponders for its domestic communications services, comprising television distribution, telephone and telex to remote areas and meteorological data collection. Besides, certain government departments use part transponders for their private communication needs including video teleconferencing.

2. International satellite communication

2.1 *INTELSAT system*

Communication with overseas countries is carried out through the INTELSAT system. Taif and Riyadh-1 and four earth stations with Standard A antennas have access to Atlantic and Indian Ocean region satellites. Together they handle traffic of more than 2000 voice circuits to over 50 destinations. Also, these earth stations carry international television programmes covering regular news and national and international events, including multiple transmissions during the Hajj season.

In order to meet the continuously increasing demand for international traffic, two additional Standard A earth stations, Jeddah-4 for the Atlantic Ocean region satellite and Jeddah-5 for the Indian Ocean region satellite are due to be commissioned in January, 1987.

The Kingdom actively participated in the deliberations of the INTELSAT Board of Governors, Meeting of Signatories, Assembly of Parties, and Operational Representatives Conferences.

2.2 *INMARSAT system*

The Kingdom formally joined the INMARSAT organisation in October 1983. The Ministry of PTT was designated as the signatory to the Operating Agreement, and has been continuously represented in the Council on the basis of its investment share.

Jeddah-7 coast earth station began operations with the INMARSAT satellite network in December 1986. Its antenna operates with the satellite over the Indian Ocean region. It provides telecommunication links between ships and rigs equipped with Inmarsat satellite terminals and the national and international telephone, telex and data networks.

So far, 51 Inmarsat terminals have been commissioned under Saudi Arabian registration. These include ships as well as land-based units and an aeronautical Standard A.

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 a computerised supervisory, control and testing system. New Intelsat satellite technology i.e. TDMA has also been introduced in the new station. The antenna began operation in the Indian Ocean region in June 86.

1.2 The two Singapore satellite earth stations, Sentosa and Bukit Timah, between them carry more than half of Singapore's international telephone and all of its international television and high-speed 56 Kbit/s data circuits. The traffic is carried via three Intelsat Standard A antennas, operating with two Indian Ocean region Intelsat V-A satellites and a Pacific Ocean region Intelsat V satellite. Satellite circuits grew from an initial 30-odd telephone circuits in 1971 to 1194 circuits by end 1986.

1.3 Plans are being made to construct a second Pacific Ocean region Standard A antenna which would operate from the early 1990's.

2. INMARSAT satellite communications

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 5000. The annual growth rate on a global basis is 40%. To meet the need for mobile maritime satellite traffic, 7 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 being planned. Plans to introduce more services such as group call, high speed data, packet switching etc. at the Singapore coast earth station are also being actively developed.

3. Palapa regional satellite communications

Four Indonesian border towns are presently connected to Singapore via the Palapa satellite earth station located at the Telecoms headquarters (Comcentre). The station operates with the Palapa B2 satellite using SCPC. Satellite communications with more Indonesian border towns are being planned.

SPAIN

1. Compañía Telefónica Nacional de España (CTNE) in the field of satellite telecommunication

After some years of spectacular growth in satellite communications, we have reached a stage where progress is to be measured not so much in terms of the number of new circuits opened, as of the increasingly striking improvement in the quality and possibilities offered by the circuits, an aspect on which the CTNE is concentrating its efforts.

1.1 *National and international satellite traffic*

By the end of 1986, the following circuits were operating at the various stations:

- Agüimes (MPI Atlántico) 149 circuits.
- Buitrago I (MPI Atlántico) 191 circuits.
- Buitrago II (Índico) 327 circuits.
- Buitrago III (SP Atlántico) 369 circuits.
- Buitrago V (MPI Atlántico) 258 circuits.
- Guadalajara 56 circuits.

To those figures may be added those of the television service:

- The National Television Service (Peninsula – Canaries) put out 3027 programmes totalling 9080 hours.
- The International Service produced a total of 1026 hours of occasional programmes.

By end-1986, there where 52 maritime terminals operating on Spanish ships, an increase of 18.75% over 1985.

1.2 *Projects completed in 1986*

- Entry into service of the TDMA terminal of Buitrago II for the INTELSAT network.
- Entry into service of the TDMA network of EUTELSAT, for which the reference earth station is Guadalajara, and entry into service of a terminal of the same network, also in Guadalajara.

1.3 *Current projects*

- Continuation of the study for the construction at the earth station of Guadalajara of an antenna to work with the INMARSAT network.
- Installation of a standard antenna, for telephony and television, in the EUTELSAT system in Agüimes (Canaries) – planning stage.
- Installation of an antenna for the MSS service and one for the IBS service at the earth station of Guadalajara – planning stage.
- Acquisition of single-user antennas for the MSS service.

1.4 *International organizations*

In 1986, the CTNE continued to participate in all the meetings of international satellite organizations.

2. Activities of the Instituto Nacional de Técnicas Aeroespaciales (INTA) "Esteban Terradas"

2.1 *Robledo de Chavela earth station*

2.1.1 *Introduction*

This station is part of the NASA network for tracking spacecraft, both manned and unmanned, on low Earth orbits and in outer space. The NASA reference for the complex is D888 (Madrid).

The complex has three antennas:

DSS-63: Parabolic antenna, 70 m diameter, with three down-links in the S, X and L bands and one up-link in the S band.

DSS-61: Parabolic antenna, 34 m diameter, with two down-links in the S and X bands and one up-link in the S band.

DSS-66: Parabolic antenna, 26 m diameter, with one down-link and one up-link in the S band.

2.1.2 *Activities*

In 1986, the Robledo complex provided support for the following space missions:

- Voyager 1, Pioneer 10 and Pioneer 11, which are proceeding on their journey to interstellar space.
- Voyager 2, which will be approaching Neptune in 1989.
- Pioneer 12, in orbit around Venus.
- Helios 1, Pioneer 6 and Pioneer 7, in orbit round the Sun.
- ICE, on an orbit which crossed the tail of the Halley comet.
- AMPTE, on a highly elliptical Earth orbit, for a study of the interaction of the solar wind and the Earth's magnetosphere.
- ISEE 1 and ISEE 2, on elliptical Earth orbit.
- DE 1, on Earth orbit for atmospheric studies.
- Landsat 4, Landsat 5, Nimbus 7 and Erbs, on earth orbit for a survey of earth resources.
- SME and SMM, on Earth orbit for a study of the Sun.
- STS (Space Shuttle), on Earth orbit at low altitude.

These support duties normally include obtaining tracking data (Doppler shift of in-coming signals and transit time of signals), receiving telemetry data, and transmitting commands, as well as radio-science experiments (occultation of signals transmitted by stars or rings).

The station also takes part in radio astronomy activities, mainly for Very Long Baseline Interferometry (VLBI) measurements.

2.2 *Villafranca del Castillo earth station*

2.2.1 *Introduction*

The Villafranca station is part of the ESA network for tracking space satellites on geosynchronous orbit.

The space station has six antennas:

- Steerable parabolic antenna, 15 m diameter, with one down-link in the S band.
- Steerable parabolic antenna, 12 m diameter, with one down-link and one up-link in the C band.
- Steerable parabolic antenna, 15 m diameter, with one down-link and one up-link in the S band.
- Steerable dipole antenna, with one VHF up-link.
- Fixed parabolic antenna, 4 m diameter, with one down-link and one up-link in the L band.
- Fixed parabolic antenna, 3 m diameter, with one down-link and one up-link in the Ku band.

2.2.2 *Activities*

In 1986, the Villafranca station took part in the following space missions:

- IUE – satellite bearing an ultraviolet spectrum telescope.
- MARECS – maritime communication satellite.
- EXOSAT – satellite on a highly eccentric orbit with a telescope for the X-ray part of the spectrum.
- ECS – communication satellite.

Support duties normally include obtaining tracking data (Doppler shift of incoming signals and transit time of signals), receiving telemetry data and transmitting commands.

Earth station of Maspalomas

2.3.1 *Introduction*

The space station of Maspalomas is part of the ESA EARTHNET network for obtaining and processing satellite data on earth resources.

The station has a 10 m-diameter parabolic antenna with a down-link in the S band.

2.3.2 *Activities*

In 1986, the station of Maspalomas participated in support for the following space missions:

– Nimbus 7, Landsat 4, Landsat 5, NOAA 6, NOAA 9 and NOAA 10, on Earth orbit for the study of earth resources.

These support duties normally include receiving telemetry data (photographs taken by on-board instruments) and processing data on the station's computers.

SWEDEN

1. Nordic activities in the field of satellite telecommunications

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

2. EUTELSAT

Sweden has an option to lease a transponder in Eutelsat I (F-4). The Swedish Telecommunications Administration is building an up-link earth-station in Aagesta, south of Stockholm. This station will be operational in the summer of 1987.

3. INTELSAT

Sweden is building a Standard E-3 station in Tanum, on the west coast, for IBS services. This station will be operational in the summer of 1987.

4. Satellite television reception

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

At the end of 1986 such satellite television could be received by more than 200 000 households.

SWITZERLAND (CONFEDERATION OF)

1. INTELSAT network

The three class A antennas (Leuk 1, Leuk 2 and Leuk 3) continued to route traffic over the Atlantic and Indian Oceans with remarkable reliability.

By the end of 1986, 1060 channels were being operated by the three antennas with 50 partners countries. This represents an increase in traffic of 6% with respect to 1985.

TDMA operation began via the satellite located on 335.5° E. No fewer than 156 telephone channels use this new modulation technology, and the number will increase sharply during 1987. In 1987 a further TDMA terminal will also be implemented via the Indian Ocean satellite on 60° E.

A standard E3 IBS antenna for business communications was completed and brought into operation in October 1986 in Geneva. It routes digital traffic to the United States. A standard E1 IBS antenna was also installed with a private user to cover its specific requirements, and another one also intended for a private customer is on order.

2. EUTELSAT network

TDMA operation for telephone and data traffic was launched at the beginning of 1986 via the ECS antenna in Leuk. By the end of 1986, 347 telephone and data channels were connected to the antenna serving nine partner countries.

A non-standard 3 m diameter ECS/MSS antenna for business communications was brought into use with a private user.

THAILAND

1. International telecommunication

Since 1970 Thailand's international telecommunication via Intelsat satellite has been successfully operated by the Communications Authority of Thailand (CAT). Currently, two satellite earth stations, namely Si Racha-II and Si Racha-IV, are providing services via IOR and POR satellites respectively for countries in Asia, Europe and North America. By the end of 1986, the traffic capacity handled by these two earth stations was 240 FDM/FM voice channels in POR and 185 FDM/FM plus SCPC voice channels in IOR.

To cater for new digital technology, CAT plans to install an Intelsat Time Division Multiple Access/Digital Speech Interpolation (TDMA/DSI) system. It is expected that the TDMA/DSI system will be complete and operational by the first quarter of 1988.

2. Domestic telecommunication

2.1 *Public telecommunication services*

Presently, there are about 50 two-way SCPC/CFM voice channel circuits connecting the master station and 14 local earth stations around the country using the Intelsat Space Segment.

It is expected that the installation of nine more local earth stations to expand the domestic network to cover most of the north-eastern part of Thailand will be completed by the first half of 1988.

2.2 *Transmission of television programmes*

Thailand has been using communication satellites for relaying television programmes from Bangkok to the provinces since the end of 1979, when one of the four existing television companies decided to lease capacity on the Indonesian satellite, Palapa, to set up a network for relaying its programmes to a northern provincial city, about 700 km to the north of Bangkok.

As of 1986, there are two PALAPA satellite networks operated by two television companies, and the total number of ground receiving stations stands at 24. Five more stations are planned for construction in 1987.

Besides these two networks, two other television companies plan to set up a network, which will consist of 30 receiving stations spread throughout the country working with a spare satellite of the INTELSAT system.

2.3 *Government telecommunication network*

The Government of the Kingdom of Thailand has established a telecommunication network for facilitating communications among government departments and offices. It introduced satellite techniques into the network early in 1980. The network consists mainly of terrestrial systems, with satellite communications providing supplementary facilities. Currently, the total number of earth stations in the public administration telecommunication network is 43. All of them work with the Indonesian Palapa satellite.

3. Meteorological satellite application

Since the completion of the national Landsat-Meteosat satellite receiving station in 1982, the Thai National Weather Service has been routinely acquiring weather satellite data for its operation. Such data include the Very High Resolution Radiometer (AVHRR) from the polar-orbiting satellite, NOAA-9, NOAA-10 and the Medium Data Utilization Station (MDUS) from the geosynchronous satellite, GMS-3. The data have been also used in research, such a studies of Drought Early Warning, Crop Monitoring, Solar Radiation and Heat Exchange between land and reservoir.

4. Remote sensing activities in Thailand

In 1986, there were more than 45 000 Landsat scenes archived at the Thailand Remote Sensing Centre (TRSC). Data distribution increased to 2877 frames at a value of US$ 258 353. It is an increase of 20% in volume and 40% in value over the last fiscal year. International organizations continued to be largest user group, amounting to over 60% of data users.

In the field of international cooperation, two memoranda of understanding were signed, one with the Canadian International Development Agency (CIDA) and the other with the National Space Development Agency (NASDA) of Japan. CIDA will help upgrade the Thailand Landsat Station (TLS) for reception and processing of Landsat TM and SPOT HRV data, while NASDA will provide equipment for reception of MOS-1 data at TLS. Research cooperation with Japanese agencies had been initiated in the fields of fisheries and agriculture.

Under Thailand's LANDSAT project, which is supported by CIDA and is executed by TRSC, eight government officials from natural resource related agencies, including TRSC, were trained in Canada in various disciplines for a two-month period at the end of 1986. They will conduct demonstration projects in their respective fields in 1987.

TRSC in cooperation with Chulalongkorn University and the Ministry of Agriculture and Cooperatives organized the 6th Digital Image Processing Training Course in August, and in cooperation with CIDA and SPOT Image organized the Seminar on the Future Trends of Applications of New Generation Remote Sensing Satellites in September. For research promotion, TRSC funded eight projects for FY 1986.

TUNISIA

1. Introduction

Besides international land and submarine links, Tunisia (Directorate-General of Telecommunications) has decided to meet the constant increase in demand for international telecommunications by installing a space telecommunication centre at Dkhila, which at present comprises a class A earth station operating with the Intelsat V-A network and a second one operating in the regional Arabsat system.

2. DKHILA – Intelsat

This is a Standard A earth station which was brought into service in 1984 and operates via the Intelsat V-A satellite of the Atlantic Ocean region. It is used for providing permanent services such as telephony and telex and occasional services for television.

It has two FDM/FM carriers (East and West) affording direct links with the United States of America, Canada, Yugoslavia, the Nordic countries, Turkey and Saudi Arabia.

3. DKHILA – Arabsat

The DKHILA Arabsat earth station was brought into service in 1985 to handle links with the Arab countries via the Arabsat satellite. Its initial capacity was:

- one 168-channel FDM/FM carrier;
- one television channel for transmitting and receiving regional television programmes.

TURKEY

During 1986, Turkey was very active in international and domestic space telecommunications.

1. INTELSAT system

Turkey continued its international communication and television transmission services via the Ankara Standard A earth station operating with the Intelsat Atlantic Ocean region primary satellite in 1986.

An agreement has been signed with INTELSAT for the purchase of two transponders in order to provide domestic satellite communications for television services. For this purpose the main transmitting earth station was installed and became operational in October 1986. The system will allow for two nationwide television programmes to be distributed simultaneously. Three portable earth stations will also be used to permit more efficient use of the system.

2. EUTELSAT system

The Ankara-2 earth station operating with the Eutelsat I (F-2) satellite was brought into service in early 1986. It is the first implementation of digital technique based on the TDMA/DSI system in Turkey. The Ankara-2 earth station provides both telephony and television transmit/receive facilities. It is already being used by the radio-television organization of Turkey on a permanent basis for receiving EBU television signals since February 1986.

3. Maritime satellite communications

In the field of maritime satellite communications, Turkey prepared technical specifications for a coast earth station to operate in the INMARSAT system. Tenders submitted by companies are being evaluated.

UNION OF SOVIET SOCIALIST REPUBLICS

In 1986 the Soviet Union continued to improve existing satellite systems and develop new ones for the future.

The system for satellite transmission of newpaper page images (NPI) was completed and brought into operation. The equipment can handle analogue transmission of NPI signals through the Soviet ORBITA and MOSKVA satellite distribution networks, and digital transmission through the ORBITA-RV (broadcasting) satellite network.

In the ORBITA and MOSKVA networks, the NPI signals are transmitted together with television signals using frequency modulation of the subcarrier outside the image signal band. Transmission of NPI signals with television signal, through the MOSKVA system, using relatively simple and cheap receiving installations (antenna dish diameter 2.5 m), which can be set up at the printing works itself, is highly cost-effective.

At the end of 1986, a more sophisticated system for transmission of NPI signals on the MOSKVA network – a digital system with a bit rate of 480 Kbit/s – was developed and tested.

Installation of time division multiple access equipment with a bit rate of 40 Mbit/s (TDMA-40) continued in satellite telephony. The TDMA-40 equipment and the terminal channelling equipment uses modern methods of signal processing and transmission (coherent 2-PSK, adaptive PCM and delta modulation). The terminal equipment used in systems with TDMA-40 equipment can be used to organize standard voice frequency channels, supergroup 60-channel links and transmission of digital information at a bit rate of 2048 Mbit/s.

TDMA-40 equipment is widely used both in satellite links within the Soviet Union and on international lines of the INTERSPUTNIK satellite network.

1986 saw the completion of the Group 2 improved channelling system with frequency division multiple access. This equipment will increase the traffic capacity of the Soviet telecommunication system for separate carrier transmission of digital flows with a bit rate of 512 kbit/s. The Group 2 equipment doubles the traffic capacity of the Group equipment currently in use by means of noise-immune coding and adaptive regulation of radiated power.

Improvements were made to the EKRAN satellite television broadcasting network and preparations were made for testing the system using Statsionar-T2 satellite facilities.

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

In 1986 earth stations of the INTERSPUTNIK international space communications system were brought into service in the People's Democratic Republic of Yemen, Nicaragua and Kampuchea, with the technical cooperation of the Soviet Union.

Satellite communication facilities for the INTELSAT system were further developed. At the end of 1986, a new antenna system (Mark-4B) with a diameter of 32 m was brought into operation at the L'vov earth station.

The Soviet Union participated in the international INMARSAT and SARSAT-COSPAS systems. The commercial operation of the Centre for International Maritime Satellite Communications in Odessa continued as part of INMARSAT. A similar centre was brought into operation in the city of Nakhodka.

The Soviet Union continued to play an active part in the INTERKOSMOS programme.

The bulk of the work on the development of the Interchat channelling equipment, a joint venture of the Soviet Union and the Hungarian People's Republic, was completed. This equipment was tested on the Budapest-Moscow satellite link. In 1987 a start will be made on introducing Interchat equipment into the INTERSPUTNIK system.

A number of theoretical and practical tests were run to check the transmission quality of voice channel second order multiplex signals over satellite communication links.

In preparation for WARC ORB(2), feasibility studies were made on the establishment of a feeder-link plan for satellites in the broadcasting-satellite service (12 GHz band) in Regions 1 and 3.

UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

1. British Telecom International's (BTI) first earth station in Scotland was opened in mid-1986 with the commissioning of an 8 m dish at Aberdeen dedicated to the communication requirements of the United Kingdom's offshore oil and gas industries. This earth station makes use of a Eutelsat satellite to link platforms with the United Kingdom local, national and international networks for both voice and data.

2. Using its three main earth stations at Goonhilly, Madley and London Teleport, BTI has continued to increase its activities in telephony, television, transmission and television distribution during the 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.

3. 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.

4. 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.

5. Mercury Communications Limited now has five antennas operating from their two sites. Four operates to Intelsat spacecraft and the other one to a spacecraft owned by the French TELECOM system. A further antenna is currently being modified to operate to EUTELSAT and plans are in hand to install further antennas in the near future.

6. During the year Mercury Communications conducted some tests and demonstrations of the INTELNET system of data distribution and collection involving a hub station of 8 m diameter and remote customer located antenna of 1.2 m diameter. These tests were conducted via an Intelsat V-A Atlantic Ocean satellite.

7. The Rutherford Appleton Laboratory of the Science and Research Council (SERC) continued to make low elevation propagation measurements at Chilbolton, Hampshire during 1986. Beacon transmissions at 11.5 GHz from the Indian Ocean Intelsat V satellite were monitored on a path at 11 degrees elevation.

The design and development phase of beacon receivers for the Olympus propagation experiment at 12, 20 and 30 GHz was initiated during 1986. Two types of beacon receiver stations are being considered:

- a large station with a 3 m diameter dish, operating at all three frequencies and suitable for cross polar measurements on the switched polarization channel at 20 GHz, to be located at Chilbolton,
- smaller systems (1 m diameter dishes) operating at 30 GHz (and possibly 12 GHz) for remote site operation. Radiometers operating at 10 and 30 GHz would also be included in these receiver systems.

A novel digital signal processing approach is being investigated as part of the overall system concept. This all digital method 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.

8. Several Universities Bradford, Kings College, Essex, Loughborough, Manchester, Queen Mary College, Portsmouth Polytechnic and Surrey coordinated through Rutherford Appleton Laboratory continue to review the mobile payload previously studied as part of the CERS study. This package has been selected as the prime payload for a related study – T-SAT which would be injected into a highly elliptical Molniya orbit. Currently the University consortium has completed the refinement of the mobile system design. The building bread board models of the key element of the payload and mobile station is in an advanced stage of development. In the next phase during 1987 it is hoped to integrate these subsystems into a full bread board payload and conduct a series of tests on the full system.

9. A new in-house Satellite Co-ordination System (SATCOS) has been developed by the Radiocommunications Division of the Department of Trade and Industry. This computerised system maintains a database of satellite networks and performs co-ordination calculations for satellites and associated earth stations in accordance with ITU Radio Regulations.

10. During 1986 the Independent Broadcasting Authority (IBA) awarded a contract to the British Satellite Broadcasting (BSB) consortium to operate three DBS channels. These services, which will operate on channels in the 11.7 to 12.5 GHz band in accordance with WARC-DBS-77, should be in operation in 1990.

11. In the Overseas Territories for whose external relations the United Kingdom is responsible, the Cable and Wireless Group continues to operate seven 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.

12. At its Porthcurno Engineering College in Cornwall, Cable and Wireless provides satellite engineering courses for the development of technical maintenance personnel in new techniques required for 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.

URUGUAY (EASTERN REPUBLIC OF)

The National Telecommunications Administration (ANTEL) of the Eastern Republic of Uruguay officially opened the Standard A earth station in March 1986 at a ceremony attended by Dr. Julio M. Sanguinetti, President of the Republic, Mr. R.E. Butler, Secretary-General of the ITU and senior national officials. The new earth station is in the Manga area in which the Standard B earth station inaugurated in 1980 is also sited.

The Standard A station is equipped with a King Post 32-m Cassegrain antenna aligned on the Intelsat major path 1 satellite. The antenna has a low axial ratio feeder for dual-polarization operation.

The receiving system consists of two parametric amplifiers equipped with manual and automatic switching, supervision and monitoring facilities.

The transmission system has five 3-kW amplifiers two of which are intended for the two FDM telephone carriers, one for television, one for a set of 30 SCPC channels and the other as a standby.

The Standard B earth station resumed service in August 1986 upon completion of the maintenance and adaptation of the feeder; it operates with the Intelsat primary satellite for SCPC telephony and television.

Direct telephone services were opened via satellite with Mexico a few days before the start of the World Football Championship, using the tenth receiving chain.

YEMEN (PEOPLE'S DEMOCRATIC REPUBLIC OF)

The Administration of Yemen has reported the following activities:

1. An Arabsat earth station located in the capital, Aden, with an 11-meter antenna working with the Arabsat satellite 1-B was inaugurated in October 1986. The equipped capacity is for 50 regional SCPC channels, 36 domestic SCPC channels, regional television transmit and receive, domestic television transmit and receive and community television transmit.

2. An Intersputnik earth station located in Aden with an 11-meter antenna working with the Statsionar-4 satellite was inaugurated in October 1986. Equipped capacity is for 24 SCPC channels and television transmit and receive.

3. The existing Intelsat IOR earth station located in Aden was expanded to include a television transmit capability in October 1986.

ZAMBIA (REPUBLIC OF)

The only space project in Zambia is the construction of the second earth station antenna (Mwembeshi II) to face the Atlantic Ocean region.

The need for Zambia to set up an additional earth station is mainly due to the increased volume of traffic on the routes working to the Atlantic Ocean region. Other reasons are diversity and the need to free captive traffic, which can only be handled through other transit centres. At the moment our traffic to North and South America is routed via various transit centres or leased transit circuits.

Civil works on the second antenna have already commenced and it is expected to be operational by the end of 1987.

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)

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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)

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