INTERNATIONAL TELECOMMUNICATION UNION

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

Booklet No. 41

Geneva 1993

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Booklet No. 1	–	1865-1965, a hundred years of international co-operation (1967)
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Booklet No. 3	–	Eighth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1969)
Booklet No. 4	–	Symposium "Space and Radiocommunication", Paris, 1969 (1969)
Booklet No. 5	–	World Telecommunication Day – 17 May 1969 (1969)
Booklet No. 6	–	Ninth Report by the International Telecommunication Union on Telecommunication and the peaceful uses of outer space (1970)
Booklet No. 7	–	World Telecommunication Day – 17 May 1970 (1971)
Booklet No. 8	–	Tenth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1971)
Booklet No. 9	–	Speeches made at the inaugural meeting of the second World Administrative Radio Conference for Space Telecommunications on 7 June 1971 (1971)
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Booklet No. 11	–	Twelfth Report by the International Telecommunication Union on telecommunication and the peaceful uses of outer space (1973)
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Booklet No. 14	–	Symposium "Space and Radiocommunication", Paris, 1973 (1974)
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THIRTY-SECOND REPORT OF THE INTERNATIONAL TELECOMMUNICATION UNION ON TELECOMMUNICATION AND THE PEACEFUL USES OF OUTER SPACE

Introduction

This report provides information on the activities of the International Telecommunication Union (ITU) with regard to outer space since the submission of the thirty-first Report in 1992.

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

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

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 Additional Plenipotentiary Conference of the ITU, held in Geneva from 7 to 22 December 1992, adopted a new structure for the Union which comprises three sectors: radiocommunication, standardization and development.

Management of the radio-frequency spectrum for terrestrial and space radiocommunications and the study of the technical and operational questions relating to radiocommunications have been integrated within the new Radiocommunication Sector with the activities of the International Frequency Registration Board (IFRB).

Legislative decisions within the Radiocommunication Sector will be taken by world radiocommunication conferences. A part-time Radio Regulations Board will be the successor to the IFRB. This Board will be assisted by a Radiocommunication Bureau, headed by a Director elected by the Plenipotentiary Conference.

World radiocommunication conferences will be held every two years at the same time as a Radiocommunication Assembly, which will perform the duties at present carried out by the CCIR Plenary Assembly.

Within this new Sector, work will be carried out by study groups on the use of the radiofrequency spectrum in terrestrial and space radiocommunication including the geostationary-satellite orbit and the LEO satellite network.

This new ITU structure will be set up and will become operational on a provisional basis on 1 March 1993.

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 thirty-first Report, the IFRB has continued to apply the relevant provisions of the Radio Regulations annexed to the International Telecommunication Convention. In accordance with these provisions, administrations:

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

b) send information to the IFRB, where necessary, concerning coordination of the use of their assignments to space stations on geostationary satellites or to earth stations that are to communicate with such space stations for publication in another Special Section of the Weekly Circular;

c) notify their frequency assignments to the IFRB for registration in the Master International Frequency Register (Master Register).

The publication, coordinations notification and registration procedures which are applicable are those prescribed in the Radio Regulations in force and in the Resolutions of the World Administrative Radio Conferences, Geneva, 1979, Geneva, 1985, Geneva, 1988 and Málaga-Torremolinos, 1992.

2.2 In 1992, the IFRB received information relating to 86 new satellite networks, which it published under the advance publication procedure. This information was submitted by the following administrations (listed in French alphabetical order):

Notifying Administration	System or network	Summary description
Germany (Federal Republic of)	SAFIR*	Satellite network which will provide services for the pollution measurement, position determination and scientific environmental measurements. (< 1 GHz)
Saudi Arabia (Kingdom of)	STRATSAT (STRATSAT-1) (STRATSAT-2) (STRATSAT-3)	Multipurpose satellite system for meeting the requirements of communications involving fixed satellite and mobile satellite services covering several areas of the globe. (7/8 GHz)
Australia	AUSSAT (AUSSAT-B-156E-MXL) (AUSSAT-B-160E-MXL) (AUSSAT-B-164E-MXL)	Satellite network which will provide Fixed-satellite as well as Maritime and Land mobile-satellite services for Australia. (< 2 GHz, 12/14 GHz)
Canada	MSAT-1A	Satellite network which will provide communications services in the Mobile-satellite and the Radiodetermination-satellite services. (< 2 GHz, 11-12/14 GHz)
Korea (Republic of)	KITSAT-1*	Satellite network intended to carry scientific communications and educational experiments by radio amateurs and scientists anywhere in the world. (< 1 GHz)
United States of America	MCS-1	Satellite network which will provide services in the Mobile-satellite service for the United States and its territories Alaska, Hawaii, Puerto Rico and Virgin Islands. (< 2 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
United States of America *(cont.)*	USASAT (USASAT-14K) (USASAT-22I)	Satellite system providing domestic telecommunications services. (4/6 GHz, 12/14 GHz)
	STEP MISSION-00* STEP MISSION-01*	Satellite networks which will provide the space research service. (< 2 GHz, 2 GHz)
	HIBLEO*	Satellite network which will provide Fixed, Mobile and Radiodetermination-satellite services. (< 2 GHz, 2 GHz, 18-20 GHz, 27-30 GHz)
	LEOTELCOM*	Satellite network which will provide Mobile-satellite and standard frequency-satellite services. (< 1 GHz)
	TDE/TAP* (Tether Dynamics Explorer/Tether Atmospheric Probe)	TDE/TAP is intended to investigate the aerodynamics of the mildly constrained deployment of a sub-satellite on a 20 km non-conducting tether, employing attitude, force and acceleration sensing instruments. (2 GHz)
	BLOCK 5D-3*	Satellite network which will provide the Meteorological-satellite service for the United States, Hawaii and Guam. (< 1 GHz, < 2 GHz, 2 GHz)
	TOMS-EP* (Total Ozone Monitoring Spectro-meter Earth Probe)	Satellite network which will provide global mapping of the total ozone on a daily basis from space and study changes in the Earth's ozone. (2 GHz)
	COMET*	Satellite network which will provide the space research and the Earth exploration-satellite services. (2 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
United States of America *(cont.)*	FAST* (Fast Aural Snapshot Explorer)	Satellite network intended to investigate the plasma physics of the low altitude auroral zone, such as auroral particle acceleration and wave production. (2 GHz)
	SEASTAR*	Satellite network developed to provide measured data which will enable calculations of the variability of ocean chlorophyll concentration, other ocean bio-optical properties and the uptake of carbon dioxide for climate change monitoring. (< 2 GHz, 2 GHz)
	TRMM* (Tropical Rainfall Measuring Mission)	Satellite network intended to collect data on rainfall rate and distribution between 35 degrees North and South Latitude. (2 GHz, 14 GHz)
	ACS (ACS-2K) (ACS-3K)	Satellite system which will provide the Fixed-satellite service for the United States, Alaska, Hawaii, Puerto Rico and Virgin Island. (11-12/14 GHz)
	MCS (MCS-2) (MCS-3)	Satellite system which will provide the Mobile-satellite service. (< 2 GHz)
	AFRIBSS	Satellite network which will provide the Fixed-satellite and Broadcasting-satellite service to all points in the African and Middle Eastern Regions. (< 2 GHz, 7 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
United States of America(on behalf of the Administrations of member countries of INTELSAT)	INTELSAT (INTELSAT-5A-91.5E) (INTELSAT 5A-95E) (INTELSAT-7-91.5E) (INTELSAT-7-95E) (INTELSAT FOS-57E, 66E, 174E, 177E, 180E, 183E, 319, 5E, 325, 5E, 338, 5E, 342E)	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	S80-T*	Satellite network for the space research service. (< 1 GHz)
	CERISE*	Satellite network for the space research service. (< 1 GHz)
	VIDEOSAT (VIDEOSAT-6) (VIDEOSAT-7)	Satellite system which will provide a Digital transmission service and Videotransmission service within Metropolitan France and the neighbouring countries. (2 GHz, 11-12/14 GHz)
Indonesia (Republic of)	PALAPA (PALAPA PACIFIC-1) (PALAPA PACIFIC-2) (PALAPA PACIFIC-3)	National communication satellite system. (4/6 GHz)
Israel (State of)	AMOS (AMOS 1-A) (AMOS 1-B) (AMOS 1-C)	Satellite system consisting of satellites planned to be located at 4°W, 1.5°E and 39°E. The system will provide Fixed-satellite service. (11-12/14 GHz)
Japan	JMCS (JMCS-1) (JMCS-2)	Satellite system for the exclusive government use which will provide the telecommunications services in the Mobile-satellite service. (7/8 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
Japan *(cont)*	GMS-140E SFU*	Satellite network which will provide the meteorological-satellite service. (< 1 GHz, < 2 GHz, 2 GHz) Satellite network which will provide the Space research service. (2 GHz)
Malaysia	MEASAT-1 (MEASAT-2) (MEASAT-3)	Satellite system which will provide the Fixed-satellite service. (4/6 GHz, 11-12/14 GHz)
Mexico	SOLIDARIDAD (SOLIDARIDAD-1MA) (SOLIDARIDAD-2MA)	Satellite system which will provide the Fixed-satellite and Mobile-satellite service. (< 2 GHz, 11-12/14 GHz)
United Kingdom of Great Britain and Northern Ireland (on behalf of the administrations of member countries of the International Maritime Satellite Organizations)	MARSAT (-3 AOR EAST-2) (-3 AOR WEST-2) (-3 POR-2) (-3 IOR-2) (-4 GSO-1A) (-4 GSO-1B) (-4 GSO-1C) (-4 GSO-1D) (-4 GSO-1E) (-4 GSO-1F) (-4 GSO-1G) (-4 GSO-2A) (-4 GSO-2B) (-4 GSO-2C) (-4 GSO-2D) (-4 GSO-2E) (-4 GSO-2F (-4 GSO-2G) INMARSAT-4 LEO-1* INMARSAT-4 LEO-2*	Satellite system to provide commercial international public correspondence Maritime and Aeronautical telecommunications services as well as Ship-to-shore distress and Safety operation (EPIRBS) to the Pacific ocean region. (< 2 GHz, 2 GHz, 4/6 GHz, 14 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
Russian Federation	VOLNA (VOLNA-11W) (VOLNA-40E) (VOLNA-103E)	Satellite system providing communications services in the Mobile-satellite service. (< 2 Ghz, 4/6 GHz)
	MARAFON-4	Satellite network which will provide communications services in the Mobile-satellite service. (< 2 GHz, 4/6 GHz)
	GONETS*	Satellite network which will provide telecommunications services in the Mobile-satellite service. (< 1 GHz, < 2 GHz, 2 GHz, 6 Ghz)
	GLONASS-M*	Satellite network for the Radionavigation-satellite service. (< 2 GHz)
	UOSAT-5*	Satellite network providing telecommunications services in the Land Mobile-satellite service. (< 1 GHz)
	KOSKON*	Satellite network to provide telecommunications services in the Mobile-satellite and the space research service. (< 1 GHz, < 2 GHz, 2 GHz)
Tonga (Kingdom of)	TONGASAT (TONGASAT-H70)	Satellite system consisting of several satellite networks to provide global communications services. (4/6 GHz, 11-12/14 GHz)
	(TONGASAT-LEO-1200)* (TONGASAT-LEO-1300)* (TONGASAT-LEO-10000)* (TONGASAT-ELL-1)* (TONGASAT-RADIO/TV-8)*	(< 1 GHz, 2 GHz, 4/6 GHz, 11-14/19-30 GHz)

* Non-geostationary

Notifying Administration	System or network	Summary description
Turkey	TURKSAT (TURKSAT-K1) (TURKSAT-K2)	Satellite system which will provide the Fixed-satellite service. (11-12/14 GHz)

* Non-geostationary

2.3 In addition, the IFRB published in 1992, the necessary information concerning the request for coordination of space services assignments relating to geostationary satellite networks, for which advance publication has already been made. Assistance to about forty-four administrations was also provided on request in the coordination of frequency assignments to stations in the space radiocommunication services.

2.4 In 1992, the IFRB received 6500 frequency assignment notices for stations in the space radiocommunications services submitted for recording in the Master Register. These notices consisted of 4200 notices relating to 79 space stations and 2300 notices relating to 250 earth stations. During the same period, the IFRB treated 2929 notices of frequency assignments in above-mentioned service, of which 3537 notices were related to earth stations and 429 notices were related to space stations.

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

LIST OF GEOSTATIONARY SPACE STATIONS BY ORBITAL POSITIONS
(RR 1042, RR 1060, RR 1488-1491)
(31.12.1992)

Orbital position		Space station	Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
178.00 W C	USA	USASAT-13K				4		6														
177.00 W N	USA	FLTSATCOM-A W PAC	0						7	8												
177.00 W A	USA	FLTSATCOM-C W PAC2	0		2				7	8									20			•
177.00 W A	USAIT	INTELSAT FOS 183E				4		6			11	12		14								
177.00 W C	USAIT	INTELSAT IBS 183E				4		6			11	12		14								
177.00 W N	USAIT	INTELSAT5 183E				4		6			11			14								
177.00 W C	USAIT	INTELSAT5A 183E				4		6			11			14								
177.00 W C	USAIT	INTELSAT7 183E				4		6			11	12		14								
175.00 W A	PNG	PACSTAR A-2		C1			5	6														
175.00 W C	PNG	PACSTAR-2				4		6				12		14								
174.00 W A	USA	ATDRS 174W			2								13		15				C20		•	
174.00 W N	USA	TDRS 174W			2								13		15							
174.00 W C	USA	USASAT-14E				4		6														
174.00 W A	USAIT	INTELSAT T 186E				4		6														
171.00 W A	USA	ATDRS 171W			2								13		15				C20		•	
171.00 W N	USA	TDRS WEST			2									14	15							
170.00 W N	URS	GALS-4							7	8												
170.00 W N	URS	STATSIONAR-10				4	5	6														
170.00 W C	URS	STATSIONAR-10A				4		6														
170.00 W C	URS	STATSIONAR-D2				4		6														
170.00 W N	URS	TOR-5															18	19	20			•
170.00 W N	URS	VOLNA-7	0	1																		
168.00 W N	URS	FOTON-3				4		6														
168.00 W N	URS	POTOK-3				4																
165.00 W A	USA	USASAT-13L									11	12		14								
160.00 W A	RUS	MARAFON-4		1		4		6														
160.00 W N	URS	ESDRN									11			14								
159.00 W C	URS	PROGNOZ-7			2	4																
155.00 W A	URS	EXPRESS-12				4		6			11			14								
155.00 W N	URS	STATSIONAR-26				4	5	6														
148.00 W A	USA	MILSTAR-12	0		C2														C20			C*
146.00 W A	MEX	AMIGO-2										12				17						
146.00 W C	USA	USASAT-20C				4		6														
145.00 W A	MEX	MORELOS 4				4		6				12		14								
145.00 W C	URS	VOLNA-21M		1																		
145.00 W A	USA	FLTSATCOM-A PAC	0						7	8												
145.00 W A	USA	FLTSATCOM-C W PAC3	0		2				7	8									20			•
144.00 W A	USA	USASAT-20B				4		6														
143.00 W N	USA	US SATCOM-5				4		6														
140.00 W C	USA	USASAT-17C				4		6														
139.00 W C	USA	ACS-3		1																		
139.00 W N	USA	US SATCOM 1-R				4		6														
139.00 W A	USA	USASAT-22I				4		6														
138.00 W A	MEX	SOLIDARIDAD KU										12		14								

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

Orbital position		Space station	Frequency bands GHz 0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
137.00 W A	USA	USASAT-17B				4		6														
137.00 W C	USA	USASAT-22G				4		6														
136.00 W A	MEX	AMIGO-1										12				17						
136.00 W N	USA	USASAT-16D										12		14								
135.00 W N	USA	GOES WEST	0	1	2																	
135.00 W N	USA	US SATCOM-1				4		6														
135.00 W C	USA	USASAT-21A				4		6														
135.00 W N	USA	USGCSS PH2 E PAC							7	8												
135.00 W N	USA	USGCSS PH3 E PAC			2				7	8												
135.00 W N	USA	USGCSS PH3B E PAC			2				7	8												
135.00 W A	USA	USGCSS PH4 E PAC-3			2														20			•
134.00 W C	USA	USASAT-16C										12		14								
133.00 W N	USA	USASAT-11D				4		6														
133.00 W C	USA	USASAT-22A				4		6														
132.00 W C	USA	USASAT-11C										12		14								
131.00 W N	USA	US SATCOM 3-R				4		6														
131.00 W C	USA	USASAT-22H				4		6														
131.00 W A	USA	USASAT-23B										12		14								
130.00 W C	USA	USASAT-10D										12		14								
130.00 W A	USA	USGCSS PH2 E PAC-2							7	8												
130.00 W N	USA	USGCSS PH3 E PAC-2			2				7	8												
130.00 W A	USA	USGCSS PH3B E PAC-2			2				7	8												
130.00 W A	USA	USGCSS PH4 E PAC-2			2														20			•
130.00 W N	USA	USRDSS WEST		1	2		5	6														
129.00 W C	USA	USASAT-24A				4		6				12		14								
128.00 W N	USA	ACS-1				4		6				12		14								
128.00 W N	USA	COMSTAR D-1				4		6														
127.00 W A	USA	USASAT-21B				4		6														
126.00 W C	USA	USASAT-10C										12		14								
126.00 W N	USA	USASAT-20A				4		6														
125.00 W C	USA	USASAT-22B				4		6														
125.00 W C	USA	USASAT-23E										12		14								
124.00 W C	USA	USASAT-10B										12		14								
123.50 W N	USA	WESTAR-2				4		6														
123.00 W N	USA	WESTAR-5				4		6														
122.00 W N	USA	USASAT-10A										12		14								
121.00 W C	USA	USASAT-23C										12		14								
120.00 W A	USA	MILSTAR-6	0		C2														C20			C•
120.00 W C	USA	SPACENET-1				4		6				12		14								
119.00 W A	USA	OMRDSS WEST		1	2		5	6														
119.00 W N	USA	US SATCOM-2				4		6														
118.70 W C	CAN	ANIK C-3										12		14								
118.70 W N	CAN	ANIK D-1				C4		C6														
116.80 W N	MEX	MORELOS 2				4		6				12		14								
114.90 W C	CAN	ANIK C-1										12		14								
114.90 W N	CAN	ANIK D-2				C4		C6														
113.50 W N	MEX	MORELOS 1				4		6				12		14								
113.00 W A	MEX	SOLIDARIDAD 2MA										12		14								
113.00 W A	MEX	SOLIDARIDAD M2		1																		
111.10 W C	CAN	ANIK E-B				4		6				12		14								

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

Orbital position	Space station		Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
110.00 W N	CAN	ANIK C-2										12		14								
109.20 W A	MEX	SOLIDARIDAD 1M		1																		
109.20 W A	MEX	SOLIDARIDAD 1MA										12		14								
109.20 W C	MEX	SOLIDARIDAD-1				4		6				12		14								
109.00 W C	USA	USGCSS PH4 E PAC-1			2														20			44
109.00 W C	VENASA	SIMON BOLIVAR-3				4		6														
107.30 W C	CAN	ANIK E-A				4		6				12		14								
106.50 W A	CAN	MSAT		C1	2						11	12	13	14								
106.50 W A	CAN	MSAT-1A		1								12		14								
106.00 W A	USA	MARISAT-CONUS		1		4		6														
106.00 W C	VENASA	SIMON BOLIVAR-1				4		6														
105.00 W N	USA	ATS-5	0	1																		
105.00 W N	USA	FLTSATCOM-A EAST PAC	C0						7	8												
105.00 W A	USA	FLTSATCOM-C E PAC1	0		2				7	8									20			•
105.00 W C	USA	GSTAR-2										12		14								
103.00 W C	USA	GSTAR-1										12		14								
103.00 W C	USA	USASAT-24B				4		6				12		14								
103.00 W C	VENASA	SIMON BOLIVAR-2				4		6														
101.00 W A	USA	MCS-1		1																		
101.00 W C	USA	USASAT-16B										12		14								
101.00 W C	USA	USASAT-17A				4		6														
101.00 W C	USA	USASAT-7D				4		6				12		14								
100.00 W A	USA	ACS-1		C1																		
100.00 W C	USA	ACTS																19	20	29		
100.00 W N	USA	FLTSATCOM E PAC	0						7	8												
100.00 W N	USA	FLTSATCOM-B EAST PAC																	20			44
100.00 W A	USA	FLTSATCOM-C E PAC2	0		2				7	8									20			•
100.00 W N	USA	USRDSS CENTRAL		1	2		5	6														
99.00 W C	USA	USASAT-24J				4		6				12		14								
99.00 W N	USA	USASAT-6B										12		14								
99.00 W C	USA	WESTAR 6-S				4		6														
99.00 W N	USA	WESTAR-1				4		6														
99.00 W N	USA	WESTAR-4				4		6														
97.00 W A	CUB	STSC-2				4		6														
97.00 W N	USA	TELSTAR-3A				4		6														
97.00 W C	USA	USASAT-24D				4		6				12		14								
97.00 W N	USA	USASAT-6A										12		14								
95.00 W N	USA	COMSTAR D-2				4		6														
95.00 W C	USA	USASAT-22D				4		6														
95.00 W N	USA	USASAT-6C										12		14								
93.50 W N	USA	USASAT-12B				4		6														
93.00 W C	USA	USASAT-16A										12		14								
91.00 W C	USA	USASAT-9A										12		14								
91.00 W N	USA	WESTAR-3				4		6														
90.00 W A	G INM	INMARSAT4 GSO-1A		1	2	4		6														
90.00 W A	G INM	INMARSAT4 GSO-2A		1	2	4		6														
90.00 W A	USA	MILSTAR-1	0		C2														C20			C•
89.00 W A	USA	OMRDSS EAST		1	2		5	6														
89.00 W C	USA	USASAT-24E				4		6				12		14								
89.00 W A	VENASA	SIMON BOLIVAR-B				4		6														

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Orbital position	Space station		Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
88.50 W A	USA	USASAT-12D				4		6														
87.00 W N	USA	COMSTAR D-3				4		6														
87.00 W N	USA	SPACENET-3				4		6				12		14								
87.00 W A	USA	USASAT-9B										12		14								
86.00 W N	USA	USASAT-3C				4		6														
85.00 W A	ARG	NAHUEL-2				4		6				12		14								
85.00 W C	USA	USASAT-9C										12		14								
83.00 W A	CUB	STSC-1				4		6														
83.00 W A	USA	USASAT-24C				4		6				12		14								
81.00 W C	USA	USASAT-22F				4		6														
81.00 W N	USA	USASAT-7B				4		6														
81.00 W C	USA	USASAT-9D									11	12		14								
80.00 W A	ARG	NAHUEL-1				4		6				12		14								
79.00 W N	USA	TDRS CENTRAL			2									14	15							
79.00 W C	USA	TDRS-C2			2								13	14	15							
79.00 W C	USA	USASAT-11A										12		14								
79.00 W N	USA	USASAT-12A				4		6														
79.00 W C	USA	USASAT-24F				4		6				12		14								
77.50 W A	VENASA	SIMON BOLIVAR-A				4		6														
77.00 W C	USA	USASAT-11B										12		14								
76.00 W C	USA	USASAT-12C				4		6														
75.40 W A	CLM	COLOMBIA 1A				4		6														
75.00 W A	CLM	COLOMBIA 2				4		6														
75.00 W N	USA	GOES EAST	0	1	2																	
75.00 W C	USA	USASAT-18A										12		14								
74.00 W C	USA	USASAT-22E				4		6														
74.00 W C	USA	USASAT-7A				4		6														
73.00 W C	USA	USASAT-18B										12		14								
72.00 W C	USA	ACS-2		1																		
72.00 W N	USA	USASAT-8B				4		6														
72.00 W A	VENASA	SIMON BOLIVAR-C				4		6														
71.00 W C	USA	USASAT-18C										12		14								
70.00 W C	B	SATS-1				4		6														
70.00 W N	B	SBTS A1				4		6														
70.00 W A	B	SBTS B1				4		6														
70.00 W C	B	SISCOMIS-3							7	8												
70.00 W A	USA	FLTSATCOM-B W ATL																	20			44
70.00 W N	USA	USRDSS EAST		1	2		5	6														
69.00 W C	USA	USASAT-24H				4		6				12		14								
69.00 W C	USA	USASAT-7C				4		6				12		14								
68.00 W A	USA	MILSTAR-8	0		C2														C20			C*
67.00 W C	USA	USASAT-15D										12		14								
65.00 W C	B	SATS-2				4		6														
65.00 W N	B	SBTS A2				4		6														
65.00 W A	B	SBTS B2				4	5	6														
65.00 W A	B	SBTS C2										12		14								
65.00 W C	B	SISCOMIS-2							7	8												
64.00 W C	USA	USASAT-14D				4		6														
64.00 W C	USA	USASAT-15C										12		14								
62.00 W A	USA	ACS-2A		1																		

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Orbital position	Space station		Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
62.00 W C	USA	TDRS 62W			2								13		15							
62.00 W C	USA	USASAT-14C				4		6														
62.00 W C	USA	USASAT-15B										12		14								
61.00 W A	B	SBTS B3				4	5	6														
61.00 W A	B	SBTS C3										12		14								
61.00 W C	B	SISCOMIS-1							7	8												
60.00 W C	BEL	SATCOM PHASE-3B							7	8												
60.00 W A	USA	USASAT-15A										12		14								
60.00 W A	USA	USASAT-17D				4		6														
60.00 W C	USA	USASAT-25H				4		6														
60.00 W C	USA	USASAT-26H									11	12		14								
58.00 W C	USA	USASAT-13E									11	12		14								
58.00 W C	USA	USASAT-25G				4		6														
58.00 W C	USA	USASAT-26G									11	12		14								
57.00 W A	USA	USASAT-13H				4		6			11											
56.00 W C	USA	USASAT-13D									11	12		14								
56.00 W C	USA	USASAT-25F				4		6														
56.00 W C	USA	USASAT-26F									11	12		14								
56.00 W C	USAIT	INTELSAT IBS 304E				4		6			11	12		14								
56.00 W C	USAIT	INTELSAT5A 304E				4		6			11			14								
56.00 W C	USAIT	INTELSAT7 304E				4		6			11	12		14								
55.50 W C	F ESA	MARECS ATL4		1		4		6														
55.00 W C	G INM	INMARSAT2 AOR-WEST		1		4		6														
55.00 W A	G INM	INMARSAT3 AOR-WEST		C1		C4		C6														
55.00 W A	G INM	INMARSAT4 GSO-1B		1	2	4		6														
55.00 W A	G INM	INMARSAT4 GSO-2B		1	2	4		6														
55.00 W A	USA	USASAT-14B				4		6														
54.00 W A	G INM	INMARSAT2 AOR-WEST-2		1		4		6														
53.50 W C	G INM	INMARSAT3 AOR-WEST-2		1		4		6														
53.00 W N	USAIT	INTELSAT IBS 307E				4		6			11	12		14								
53.00 W N	USAIT	INTELSAT5A CONT1				C4		C6			11			14								
53.00 W C	USAIT	INTELSAT6 307E				4	5	6			11			14								
53.00 W C	USAIT	INTELSAT7 307E				4		6			11	12		14								
52.50 W N	USA	USGCSS PH3 W ATL			C2				7	8												
52.50 W A	USA	USGCSS PH3B W ATL			2				7	8												
52.50 W A	USA	USGCSS PH4 W ATL			2														20			
50.00 W C	USA	USASAT-13C									11			14								
50.00 W C	USAIT	INTELSAT IBS 310E				4		6			11	12		14								
50.00 W C	USAIT	INTELSAT MCS ATL A		1		4		6														
50.00 W N	USAIT	INTELSAT5 CONT2				4		6			11			14								
50.00 W N	USAIT	INTELSAT5A CONT2				4		6			11			14								
50.00 W C	USAIT	INTELSAT6 310E				4	5	6			11			14								
50.00 W C	USAIT	INTELSAT7 310E				4		6			11	12		14								
47.00 W C	USA	USASAT-13B									11	12		14								
47.00 W C	USA	USASAT-13J				4		6														
47.00 W C	USA	USASAT-25E				4		6														
47.00 W C	USA	USASAT-26E									11	12		14								
46.00 W A	USA	ATDRS 46W			2								13		15				C20			
46.00 W A	USA	TDRS 46W			2								13	14								
45.00 W C	USA	USASAT-13F									11	12		14								

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Orbital position	Space station		Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
45.00 W A	USA	USASAT-13I				C4		C6			11											
45.00 W C	USA	USASAT-25D				4		6														
45.00 W C	USA	USASAT-26D									11	12		14								
44.00 W A	F ESA	EDRSS-W			2												18	19	20	•	30	
43.50 W C	F	VIDEOSAT-3			2							12		14								
43.00 W C	USA	USASAT-13G									11	12		14								
43.00 W C	USA	USASAT-25C				4		6														
43.00 W C	USA	USASAT-26C									11	12		14								
42.50 W A	USA	USGCSS PH3 MID-ATL			2				7	8												
42.50 W A	USA	USGCSS PH3B MID-ATL			2				7	8												
42.50 W C	USA	USGCSS PH4 ATL3			2														20			44
41.00 W A	USA	ATDRS 41W			2								13		15				C20		•	
41.00 W N	USA	TDRS EAST			2									14	15							
41.00 W C	USA	USASAT-14A				4		6														
41.00 W C	USA	USASAT-25B				4		6														
41.00 W C	USA	USASAT-26B									11	12		14								
40.50 W A	USAIT	INTELSAT FOS 319.5E				4		6			11	12		14								
40.50 W N	USAIT	INTELSAT IBS 319.5E				4		6			11	12		14								
40.50 W C	USAIT	INTELSAT K 319.5E									11	12		14								
40.50 W N	USAIT	INTELSAT5A 319.5E				4		6			11			14								
40.50 W C	USAIT	INTELSAT7 319.5E				4		6			11	12		14								
39.00 W C	USA	USGCSS PH4 ATL2			2														20			44
37.50 W C	F	VIDEOSAT-2			2							12		14								
37.50 W A	URS	EXPRESS-1				4		6			11			14								
37.50 W C	URS	STATSIONAR-25				4	5	6														
37.50 W C	USA	USASAT-13A									11	12		14								
37.50 W C	USA	USASAT-25A				4		6														
37.50 W C	USA	USASAT-26A									11	12		14								
35.00 W C	G	SKYNET-4D	0						7	8												44
35.00 W C	USA	USGCSS PH4 ATL1			2														20			44
34.50 W A	USAIT	INTELSAT FOS 325.5E				4		6			11	12		14								
34.50 W N	USAIT	INTELSAT6 325.5E				4	5	6			11			14								
34.50 W C	USAIT	INTELSAT7 325.5E				4		6			11	12		14								
33.00 W A	G	SKYNET-4I																	20			•
32.50 W C	F ESA	MARECS ATL3		1		4		6														
32.00 W A	F ESA	EDRSS-WC			2												18	19	20	•	30	
32.00 W C	G INM	INMARSAT2 AOR-CL-2A		1		4		6														
32.00 W A	G INM	INMARSAT3 AOR-CL-2A		C1		C4		C6														
31.00 W N	G	BSB-1										12		14		C17						
31.00 W C	IRL	EIRESAT-1									11		13									
31.00 W C	USAIT	INTELSAT5 ATL6				4		6			11			14								
31.00 W C	USAIT	INTELSAT5A ATL6				4		6			11			14								
31.00 W C	USAIT	INTELSAT7 329E				4		6			11	12		14								
30.00 W N	E	HISPASAT-1			2				7	8	11	12		14								
27.50 W N	USAIT	INTELSAT5A ATL2				4		6			11			14								
27.50 W N	USAIT	INTELSAT6 332.5E				C4	C5	C6			11			14								
27.50 W C	USAIT	INTELSAT7 332.5E				4		6			11	12		14								
26.50 W N	URS	GALS-1							7	8												
26.50 W C	URS	STATSIONAR-17				4	5	6														
26.50 W C	URS	STATSIONAR-D1				4		6														

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Orbital position	Space station		0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
			Frequency bands GHz																			
26.50 W C	URS	TOR-1															18	19	20			*
26.50 W C	URS	VOLNA-13	0	1																		
26.00 W N	F ESA	MARECS ATL1	0	1		4		6												•		
25.00 W N	URS	GALS-9							7	8												
25.00 W N	URS	STATSIONAR-8				4	5															
25.00 W C	URS	TOR-9															18	19	20			*
25.00 W C	URS	VOLNA-1A	0	1																		
25.00 W C	URS	VOLNA-1M		1																		
24.50 W N	USAIT	INTELSAT6 335.5E				C4	C5	C6			11			14								
24.50 W C	USAIT	INTELSAT7 335.5E				4		6			11	12		14								
24.40 W C	LUX	GDL-5						6			11											
24.00 W N	URS	PROGNOZ-1			2																	
23.00 W N	USA	FLTSATCOM ATL	0						7	8												
22.50 W N	USA	FLTSATCOM-B EAST ATL																	20			44
22.50 W A	USA	FLTSATCOM-C E ATL1	0		2				7	8									20			*
21.50 W A	USAIT	INTELSAT FOS 338.5E				4		6			11	12		14								
21.50 W N	USAIT	INTELSAT K 338.5E									11	12		14								
21.50 W N	USAIT	INTELSAT MCS ATL C		1		4		6														
21.50 W N	USAIT	INTELSAT5 ATL5				4		6			11			14								
21.50 W C	USAIT	INTELSAT5A 338.5E				4		6			11			14								
21.50 W C	USAIT	INTELSAT7 338.5E				4		6			11	12		14								
20.00 W C	LUX	GDL-4						6			11											
19.00 W A	D	TV-SAT 2			C2							12				17						
19.00 W N	F	TDF-1			C2						11	12				17						
19.00 W A	F	TDF-2			C2						11	12				17						
19.00 W N	F ESA	L-SAT			2							12	13	14		17		19	20	28	30	
19.00 W A	I	SARIT			C2						11		13			17	18		20		30	
18.00 W N	BEL	SATCOM PHASE-3							7	8												
18.00 W A	USAIT	INTELSAT FOS 342E				4		6			11	12		14								
18.00 W N	USAIT	INTELSAT IBS 342E				4		6			11	12		14								
18.00 W N	USAIT	INTELSAT5A 342E				4		6			11			14								
18.00 W C	USAIT	INTELSAT7 342E				4		6			11	12		14								
17.80 W A	BEL	SATCOM-4	C0						C7	C8									20			C*
17.00 W A	G INM	INMARSAT2 AOR-EAST-2		1		4		6														
17.00 W C	G INM	INMARSAT3 AOR-EAST-2		1		4		6														
16.00 W N	URS	WSDRN									11			14								
16.00 W N	URS	ZSSRD-2									11	12	13	14								
16.00 W A	USA	MILSTAR-3	0		C2														C20			C*
15.50 W N	G INM	INMARSAT2 AOR-EAST		1		4		6														
15.50 W A	G INM	INMARSAT3 AOR-EAST		C1		C4		C6														
15.50 W A	G INM	INMARSAT4 GSO-1C		1	2	4		6														
15.50 W A	G INM	INMARSAT4 GSO-2C		1	2	4		6														
15.00 W N	USA	FLTSATCOM-A ATL	C0						7	8												
15.00 W A	USA	FLTSATCOM-C E ATL2	0		2				7	8									20			*
14.50 W A	URS	GOMS-1M	C0	C1	C2	4		6	C7	C8									C20	C29		
14.00 W A	URS	EXPRESS-2				4		6			11			14								
14.00 W C	URS	GOMS-1	0	1	2				7	8									20	29		
14.00 W N	URS	LOUTCH-1									C11			C14				A19		A28		
14.00 W C	URS	MORE-14		1		4		6														
14.00 W N	URS	VOLNA-2		1																		

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			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
14.00 W N	URSIK	STATSIONAR-4				C4		C6														
13.50 W N	URS	FOTON-1				4		6														
13.50 W N	URS	POTOK-1				4																
12.00 W N	F ESA	HIPPARCOS			2																	
12.00 W N	USA	USGCSS PH2 ATL							7	8												
12.00 W N	USA	USGCSS PH3 ATL			2				7	8												
12.00 W A	USA	USGCSS PH3B ATL			2				7	8												
12.00 W A	USA	USGCSS PH4 ATL-4			2														20			*
11.00 W N	F	F-SAT 2			C2							12		14					C20		C30	
11.00 W A	URS	EXPRESS-3				4		6			11			14								
11.00 W C	URS	LOUTCH-6									11			14								
11.00 W N	URS	STATSIONAR-11				4		6														
11.00 W A	URS	VOLNA-11W		1		4		6														
10.00 W C	F ESA	METEOSAT S2			2																	
9.00 W A	USA	MILSTAR-2	0		C2														C20			C*
8.00 W N	F	TELECOM-1A			2	4		6	7	8		12		14								
8.00 W N	F	TELECOM-2A			C2	4		6	C7	C8		12		14								
8.00 W A	F	VIDEOSAT-6			2						11	12		14								
8.00 W A	F	ZENON-A		1	2						11			14								
7.00 W A	F	VIDEOSAT-5			2						C11	C12		C14								
5.00 W N	F	TELECOM-1B			2	4		6	7	8		12		14								
5.00 W N	F	TELECOM-2B			C2	4		6	C7	C8		12		14								
5.00 W A	F	VIDEOSAT-7			2						11	12		14								
4.00 W A	ISR	AMOS 1-B									11			14								
3.00 W C	URS	GALS-11							7	8												
3.00 W C	URS	TOR-11															18	19	20			*
1.00 W C	G	SKYNET-4A	0						7	8												44
1.00 W A	G	SKYNET-4F																	20			*
1.00 W N	USAIT	INTELSAT5A CONT4				4		6			11			14								
1.00 W C	USAIT	INTELSAT7 359E				4		6			11	12		14								
0.00 E C	F	LOCSTAR OUEST		1	2		5	6														
0.00 E N	F ESA	METEOSAT	0	C1	C2																	
1.00 E C	URS	GALS-15							7	8												
1.00 E N	URS	STATSIONAR-22				4	5															
1.00 E C	URS	TOR-15															18	19	20			*
1.00 E C	URS	VOLNA-21	0																			
1.50 E A	ISR	AMOS 1-A									11			14								
3.00 E N	F	TELECOM-1C			2	4		6	7	8		12		14								
3.00 E N	F	TELECOM-2C			C2	4		6	C7	C8		12		14								
4.00 E A	F EUT	EUTELSAT 1-6	C0								C11	C12		C14								
4.00 E A	USA	MILSTAR-13	0		C2														C20			C*
5.00 E N	F ESA	OTS	0								11			14								
5.00 E N	S NOT	TELE-X			2							12		14		17						
5.00 E C	URS	TOR-19															18	19	20			*
6.00 E N	G	SKYNET-4B	0						7	8												44
6.00 E A	G	SKYNET-4G																	20			*
7.00 E C	F	F-SAT 1			2	4		6											20		30	
7.00 E N	F EUT	EUTELSAT 1-3	0								11	12		14								
7.00 E N	F EUT	EUTELSAT 2-7E		C1	C2						11	12		14								
8.00 E C	URS	GALS-7							7	8												

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			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
8.00 E C	URS	STATSIONAR-18				4	5	6														
8.00 E C	URS	TOR-8															18	19	20			•
8.00 E C	URS	VOLNA-15	0	1																		
10.00 E A	F	APEX			C2	C4		C6											C20		C30	40
10.00 E C	F	LOCSTAR CENTRE		1	2		5	6														
10.00 E C	F ESA	METEOSAT S1			2																	
10.00 E N	F EUT	EUTELSAT 2-10E		C1	C2						11	12		14								
10.00 E N	F EUT	EUTELSAT-1	0								11	12		14								
12.00 E C	URS	GALS-17							7	8												
12.00 E N	URS	PROGNOZ-2			2																	
12.00 E C	URS	STATSIONAR-27				4		6														
12.00 E C	URS	TOR-18															18	19	20			•
12.00 E C	URS	VOLNA-27	0																			
13.00 E N	F EUT	EUTELSAT 1-2	C0								C11	12		14								
13.00 E N	F EUT	EUTELSAT 2-13E		C1	C2						11	12		14								
13.20 E N	I	ITALSAT			2													19	20	28	•	40
15.00 E A	F	ZENON-B		1	2	4		6														
15.00 E C	ISR	AMS-1									11			14								
15.00 E C	ISR	AMS-2									11			14								
15.00 E C	URS	GALS-12							7	8												
15.00 E C	URS	STATSIONAR-23				4		6														
15.00 E C	URS	TOR-12															18	19	20			•
15.00 E C	URS	VOLNA-23	0																			
16.00 E A	F EUT	EUTELSAT 1-4	C0								C11	C12		C14								
16.00 E A	F EUT	EUTELSAT 2-16E		C1	C2						11	12		14								
16.00 E C	I	SICRAL-1A	0		2				7	8		12		14					20			•
17.00 E C	ARS	SABS 1-2									11			14								
17.00 E A	ARS	SABS-1									11			14								
19.00 E N	ARSARB	ARABSAT 1-A			2	4		6														
19.00 E C	ARSARB	ARABSAT 2-A				4		6			11			14								
19.00 E A	F	ZENON-C		1	2						11			14								
19.00 E A	URS	TOR-26															18	19	20			•
19.00 E A	USA	MILSTAR-9	0		C2														C20			C•
19.20 E N	LUX	GDL-6						C6			11	12	13	14								
19.20 E C	LUX	GDL-7									11		13	14								
20.00 E A	G INM	INMARSAT4 GSO-1D		1	2	4		6														
20.00 E A	G INM	INMARSAT4 GSO-2D		1	2	4		6														
21.00 E A	IRQ	BABYLONSAT-3									11			14								
21.50 E N	F EUT	EUTELSAT 1-5	C0								11	12		14								
21.50 E C	F EUT	EUTELSAT 2-21.5E			2						11	12		14								
22.00 E C	I	SICRAL-1B	0		2				7	8		12		14					20			•
22.50 E C	F	LOCSTAR EST		1	2		5	6														
23.00 E C	URS	GALS-8							7	8												
23.00 E C	URS	STATSIONAR-19				4	5	6														
23.00 E C	URS	TOR-7															18	19	20			•
23.00 E C	URS	VOLNA-17	0	1																		
23.50 E N	D	DFS-1			2						11	12		14					20		30	
26.00 E N	ARSARB	ARABSAT 1-B			2	C4		C6														
26.00 E C	ARSARB	ARABSAT 2-B				4		6			11			14								
26.00 E C	D	DFS-6			2						11	12		14					20	29		

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Orbital position		Space station	Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
26.00 E C	IRN	ZOHREH-2									11			14								
26.00 E A	TUR	TURKSAT-1									11			14								
27.00 E C	URS	TOR-20															18	19	20			*
28.00 E A	USA	FLTSATCOM-C INDOC1	0		2				7	8									20			*
28.50 E N	D	DFS-2			2						11	12		14					20		30	
28.50 E A	D	KEPLER 1			2						11	12		14								
29.00 E A	ARS	STRATSAT-1							7	8												
30.00 E A	IRQ	BABYLONSAT-1									11			14								
30.00 E A	USA	MILSTAR-10	0		C2														C20			C*
31.00 E C	ARSARB	ARABSAT 1-C				4		6														
31.00 E C	F EUT	EUTELSAT 2-31E			2						11	12		14								
31.00 E C	TUR	TURKSAT-1B									11			14								
32.00 E C	F	VIDEOSAT-1			2							12		14								
32.00 E A	F	VIDEOSAT-4			2							C12		C14								
32.00 E C	URS	TOR-21															18	19	20			*
33.00 E C	F EUT	EUTELSAT 2-33E			2						11	12		14								
33.50 E C	D	DFS-5			2						11	12		14				19	20	29		
34.00 E C	IRN	ZOHREH-1									11			14								
35.00 E N	URS	GALS-6							7	8												
35.00 E N	URS	PROGNOZ-3			2	4																
35.00 E N	URS	STATSIONAR-2				C4	5	C6														
35.00 E C	URS	STATSIONAR-D3				4		6														
35.00 E C	URS	TOR-2															18	19	20			*
35.00 E C	URS	VOLNA-11	0	1																		
36.00 E N	F EUT	EUTELSAT 2-36E		C1	C2						11	12		14								
37.50 E A	SEY	SEYSAT-2				4		6			11			14								
38.00 E C	PAK	PAKSAT-1	0								11			14								
39.00 E A	ISR	AMOS 1-C									11			14								
40.00 E A	URS	EXPRESS-4				4		6			11			14								
40.00 E C	URS	LOUTCH-7									11			14								
40.00 E N	URS	STATSIONAR-12				4	5	6														
40.00 E C	URS	TOR-22															18	19	20			*
40.00 E A	URS	VOLNA-40E		1		4		6														
41.00 E A	ARS	STRATSAT-2							7	8												
41.00 E A	IRN	ZOHREH-4									11			14								
41.00 E A	PAK	PAKSAT-2										12		14								
42.00 E C	TUR	TURKSAT-1A									11			14								
42.50 E A	SEY	SEYSAT-1				4		6			11			14								
43.00 E A	D	EUROPE STAR-2									11	12		14								
45.00 E A	D	EUROPE STAR-1									11	12		14								
45.00 E A	MLT	MELITASAT-1A						6			11	12		14								
45.00 E N	URS	GALS-2							7	8												
45.00 E N	URS	STATSIONAR-9				4	5	6														
45.00 E C	URS	STATSIONAR-9A				4		6														
45.00 E C	URS	STATSIONAR-D4				4		6														
45.00 E N	URS	TOR-3															18	19	20			*
45.00 E N	URS	VOLNA-3	0	1																		
45.00 E C	URS	VOLNA-3M		1																		
45.50 E A	MLT	MELITASAT-1B						6			11	12		14								
46.00 E A	TUR	TURKSAT-2									11			14								

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Orbital position		Space station		Frequency bands GHz																			
				0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
47.00 E	A	F ESA	EDRSS-EC			2												18	19	20	*	30	
47.00 E	C	IRN	ZOHREH-3									11			14								
47.50 E	A	D	EUROPE STAR-3									11	12		14								
49.00 E	C	URS	GALS-13							7	8												
49.00 E	N	URS	STATSIONAR-24				4	5	6														
49.00 E	C	URS	TOR-16															18	19	20			*
49.00 E	C	URS	VOLNA-25	0																			
50.00 E	C	TUR	TURKSAT-1C									11			14								
51.00 E	A	IRQ	BABYLONSAT-2									11			14								
53.00 E	C	G	SKYNET-4C	0						7	8												44
53.00 E	A	G	SKYNET-4H																	20			*
53.00 E	A	URS	EXPRESS-5				4		6			11			14								
53.00 E	N	URS	LOUTCH-2									C11			C14								
53.00 E	C	URS	MORE-53		1		4		6														
53.00 E	C	URS	TOR-23															18	19	20			*
53.00 E	N	URS	VOLNA-4		1																		
53.00 E	N	URSIK	STATSIONAR-5				C4		6														
55.00 E	A	USA	MILSTAR-4	0		C2														C20			C*
56.00 E	C	USA	USGCSS PH4 INDOC1			2														20			44
57.00 E	A	USA	USGCSS PH2 INDOC2							7	8												
57.00 E	A	USA	USGCSS PH3 INDOC2			2				7	8												
57.00 E	A	USA	USGCSS PH3B INDOC2			2				7	8												
57.00 E	A	USAIT	INTELSAT FOS 57E				4		6			11	12		14								
57.00 E	N	USAIT	INTELSAT5 INDOC3				4		6			11			14								
57.00 E	N	USAIT	INTELSAT5A INDOC2				4		6			11			14								
57.00 E	C	USAIT	INTELSAT7 57E				4		6			11	12		14								
58.00 E	C	URS	TOR-13															18	19	20			*
59.00 E	A	F ESA	EDRSS-E			2												18	19	20	*	30	
60.00 E	N	USA	USGCSS PH2 INDOC							7	8												
60.00 E	C	USA	USGCSS PH3 INDOC			2				7	8												
60.00 E	A	USA	USGCSS PH3B INDOC			2				7	8												
60.00 E	C	USA	USGCSS PH4 INDOC2			2														20			44
60.00 E	N	USAIT	INTELSAT5A INDOC1				4		6			11			14								
60.00 E	C	USAIT	INTELSAT6 60E				4	5	6			11			14								
60.00 E	C	USAIT	INTELSAT7 60E				4		6			11	12		14								
62.00 E	C	URS	TOR-24															18	19	20			*
63.00 E	N	USAIT	INTELSAT MCS INDOC A		C1		C4		C6														
63.00 E	C	USAIT	INTELSAT5A INDOC3				4		6			11			14								
63.00 E	C	USAIT	INTELSAT6 63E				4	5	6			11			14								
63.00 E	C	USAIT	INTELSAT7 63E				4		6			11	12		14								
64.00 E	A	G INM	INMARSAT3 IOR-1		C1		C4		C6														
64.00 E	A	G INM	INMARSAT4 GSO-1E		1	2	4		6														
64.00 E	A	G INM	INMARSAT4 GSO-2E		1	2	4		6														
64.50 E	C	F ESA	MARECS IND1		1		4		6														
64.50 E	N	G INM	INMARSAT2 IOR-1		1		4		6														
65.00 E	C	G INM	INMARSAT2 IOR-2		1		4		6														
65.00 E	C	G INM	INMARSAT3 IOR-2		1		4		6														
65.00 E	C	URS	TOR-25															18	19	20			*
66.00 E	A	USAIT	INTELSAT FOS 66E				4		6			11	12		14								
66.00 E	N	USAIT	INTELSAT MCS INDOC D		C1		C4		C6														

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Orbital position	Space station		Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
66.00 E N	USAIT	INTELSAT5 INDOC4				4		6			11			14								
66.00 E C	USAIT	INTELSAT5A 66E				4		6			11			14								
66.00 E C	USAIT	INTELSAT7 66E				4		6			11	12		14								
68.00 E A	USA	USASAT-14I				4		6			11	12		14								
69.00 E C	URS	GALS-14							7	8												
69.00 E C	URS	TOR-14															18	19	20			*
70.00 E A	TON	TONGASAT-H70				4		6			11			14								
70.00 E C	URS	GALS-16							7	8												
70.00 E N	URS	STATSIONAR-20				4		6														
70.00 E C	URS	TOR-17															18	19	20			*
70.00 E C	URS	VOLNA-19	0																			
70.00 E C	USA	USASAT-13N									11	12		14								
72.00 E A	USA	FLTSATCOM INDOC	0						7	8												
72.00 E A	USA	FLTSATCOM-B INDOC																	20			44
72.00 E A	USA	FLTSATCOM-C INDOC2	0		2				7	8									20			*
72.00 E A	USA	USASAT-14J				4		6			11	12		14								
72.50 E N	USA	MARISAT-INDOC	0		C2	C4		C6														
73.50 E A	ARS	STRATSAT-3							7	8												
73.50 E A	TUR	TURKSAT-1D									11	12		14								
74.00 E N	IND	INSAT-1B	0			4	5	6														
74.00 E C	IND	INSAT-2C	0			4	5	6														
74.00 E A	IND	INSAT-2KC									11			14								
75.00 E N	USA	FLTSATCOM INDOC	0						7	8												
75.00 E A	USA	FLTSATCOM-C INDOC3	0		2				7	8									20			*
76.00 E C	URS	GOMS	0						7	8									20	29		
76.00 E A	URS	GOMS-M	C0	C1	C2	4		6	C7	C8									C20	C29		
77.00 E N	URS	CSSRD-2									11	12	13	14								
77.00 E A	USA	FLTSATCOM-A INDOC	0						7	8												
77.50 E C	G	ASIASAT-D				4		6			11			14								
77.50 E C	G	ASIASAT-DK1										12		14								
78.50 E A	THA	THAICOM-2				C4		C6				C12		C14								
80.00 E A	URS	EXPRESS-6				4		6			11			14								
80.00 E N	URS	LOUTCH-8									11			14								
80.00 E N	URS	POTOK-2				4																
80.00 E N	URS	PROGNOZ-4			A2															A		
80.00 E N	URS	STATSIONAR-1				4	5	6														
80.00 E N	URSIK	STATSIONAR-13				4		6														
81.50 E N	URS	FOTON-2				4		6														
83.00 E N	IND	INSAT-1D	0			4	5	6														
83.00 E N	IND	INSAT-2A	0			4	5	6														
83.00 E A	IND	INSAT-2KA									11			14								
83.30 E C	TON	TONGASAT AP-KU-4										12		14								
85.00 E N	URS	GALS-3							7	8												
85.00 E N	URS	STATSIONAR-3				4	5	6														
85.00 E C	URS	STATSIONAR-D5				4		6														
85.00 E N	URS	TOR-4															18	19	20			*
85.00 E N	URS	VOLNA-5	0	1																		
85.00 E C	URS	VOLNA-5M		1																		
87.50 E C	CHN	CHINASAT-1				4		6														
87.50 E C	CHN	DFH-3-0C				4		6														

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Orbital position		Space station		0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
				Frequency bands GHz																			
90.00 E	A	URS	EXPRESS-7				4		6			11			14								
90.00 E	N	URS	LOUTCH-3									11			14								
90.00 E	C	URS	MORE-90		1		4		6														
90.00 E	N	URS	STATSIONAR-6				4		6														
90.00 E	N	URS	VOLNA-8		1																		
90.00 E	A	USA	MILSTAR-5	0		C2														C20			C*
91.50 E	A	MLA	MEASAT-1				4		6			11	12		14								
91.50 E	A	USAIT	INTELSAT5A 91.5E				4		6			11			14								
91.50 E	A	USAIT	INTELSAT7 91.5E				4		6			11	12		14								
93.50 E	N	IND	INSAT-1C	0			4	5	6														
93.50 E	N	IND	INSAT-2B	0			4	5	6														
93.50 E	A	IND	INSAT-2KB									11			14								
95.00 E	A	MLA	MEASAT-3				4		6			11	12		14								
95.00 E	N	URS	CSDRN									11			14								
95.00 E	A	USAIT	INTELSAT5A 95E				4		6			11			14								
95.00 E	A	USAIT	INTELSAT7 95E				4		6			11	12		14								
96.50 E	A	URS	EXPRESS-8				4		6			11			14								
96.50 E	N	URS	LOUTCH-9									11			14								
96.50 E	N	URS	STATSIONAR-14				C4		C6														
98.00 E	C	CHN	CHINASAT-3				4		6														
99.00 E	A	URS	EXPRESS-13				4		6			11			14								
99.00 E	N	URS	STATSIONAR-T						6														
99.00 E	N	URS	STATSIONAR-T2						6														
100.50 E	C	G	ASIASAT-E				4		6			11			14								
100.50 E	C	G	ASIASAT-EK1										12		14								
101.00 E	A	THA	THAICOM-1				C4		C6				C12		C14								
101.50 E	A	CHN	CHINASAT-11									11			14								
103.00 E	C	CHN	DFH-3-0B				4		6														
103.00 E	C	CHN	STW-2				4		6														
103.00 E	A	URS	EXPRESS-9				4		6			11			14								
103.00 E	N	URS	LOUTCH-5									11			14								
103.00 E	N	URS	STATSIONAR-21				4	5	6														
103.00 E	A	URS	VOLNA-103E		1		4		6														
105.00 E	A	CHN	FY-2A	0	1	2	4		6														
105.50 E	A	CHN	CHINASAT-12									11			14								
105.50 E	C	G	ASIASAT-1				4		6														
105.50 E	C	G	ASIASAT-CK				4		6			11			14								
105.50 E	C	G	ASIASAT-CK1										12		14								
108.00 E	N	INS	PALAPA-B1				4		6														
110.00 E	A	G INM	INMARSAT4 GSO-1F		1	2	4		6														
110.00 E	A	G INM	INMARSAT4 GSO-2F		1	2	4		6														
110.00 E	N	J	BS-2			2							12		C14								
110.00 E	N	J	BS-3			2							12		14								
110.00 E	N	J	BSE			2									14								
110.00 E	A	J	JMCS-2							7	8												
110.00 E	C	J	N-SAT-110										12		14								
110.50 E	C	CHN	CHINASAT-2				4		6														
113.00 E	N	INS	PALAPA-B2				4		6														
113.00 E	C	KOR	KOREASAT-2										12		14								
115.50 E	A	CHN	DFH-3-0D				4		6														

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Orbital position	Space station		Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
116.00 E C	G	ASIASAT-B				4		6														
116.00 E C	G	ASIASAT-BK				4		6			11			14								
116.00 E C	G	ASIASAT-BK1										12		14								
116.00 E C	KOR	KOREASAT-1										12		14								
118.00 E N	INS	PALAPA-B3				4		6														
120.00 E C	J	GMS-120E	0	1	2																	
120.00 E C	J	SJC-2										12		14								
120.00 E A	THA	THAICOM-3				C4		C6				C12		C14								
121.00 E A	CHN	DFH-3-0E				4		6														
122.00 E C	G	ASIASAT-A				4		6														
122.00 E C	G	ASIASAT-AK				4		6			11			14								
122.00 E C	G	ASIASAT-AK1										12		14								
124.00 E C	J	SCS-1B										12		14		17	18	19		•		
124.00 E C	J	SJC-1										12		14								
125.00 E C	CHN	DFH-3-0A				4		6														
125.00 E N	CHN	STW-1				4		6														
128.00 E C	J	N-SAT-128										12		14								
128.00 E C	J	SCS-1A										12		14		17	18	19		•		
128.00 E N	URS	GALS-10							7	8												
128.00 E N	URS	STATSIONAR-15				4	5	6														
128.00 E C	URS	STATSIONAR-D6				4		6														
128.00 E C	URS	TOR-6															18	19	20			•
128.00 E C	URS	VOLNA-9	0	1																		
128.00 E C	URS	VOLNA-9M		1																		
130.00 E A	CHN	CHINASAT-4				4		6														
130.00 E N	J	ETS-2	0	1	2						11										34	
130.00 E C	TON	TONGASAT AP-1				4		6														
130.00 E C	TON	TONGASAT C/KU-1				4		6				12		14								
130.00 E N	URS	GALS-5							7	8												
130.00 E C	URS	PROGNOZ-5			2																	
130.00 E C	URS	TOR-10															18	19	20			•
132.00 E N	J	CS-2A			2	4		6								17	18	19		28		
132.00 E N	J	CS-3A			2	4		6								17	18	19		28		
132.00 E C	J	N-STAR-A			2	4		6				12		14		17	18	19	20	•	30	
133.00 E A	USA	MILSTAR-7	0		C2														C20			C•
134.00 E N	INS	PALAPA PAC-1				4		6														
134.00 E C	TON	TONGASAT AP-2				4		6														
134.00 E C	TON	TONGASAT C/KU-2				4		6				12		14								
135.00 E N	J	CSE			2	4		6								17	18	19	20	28	30	
136.00 E N	J	CS-2B			2	4		6								17	18	19		28		
136.00 E N	J	CS-3B			2	4		6								17	18	19		28		
136.00 E C	J	N-STAR-B			2	4		6				12		14		17	18	19	20	•	30	
138.00 E C	TON	TONGASAT AP-3				4		6														
138.00 E C	TON	TONGASAT C/KU-3				4		6				12		14								
139.00 E A	INS	PALAPA PAC2				4		6														
140.00 E A	J	GMS-140E	0	1	2																	
140.00 E N	J	GMS-3	0	1	2																	
140.00 E N	J	GMS-4	0	1	2																	
140.00 E A	URS	EXPRESS-10				4		6			11			14								
140.00 E N	URS	LOUTCH-4									11			14								

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Orbital position	Space station		Frequency bands GHz																			
			0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
140.00 E C	URS	MORE-140		1		4		6														
140.00 E N	URS	STATSIONAR-7				4		6														
140.00 E N	URS	VOLNA-6		1																		
142.00 E A	THA	THAICOM-4				4		6			11	12		14								
142.50 E C	TON	TONGASAT AP-4				4		6														
142.50 E C	TON	TONGASAT C/KU-4				4		6				12		14								
144.00 E A	INS	PALAPA PAC-3				4		6														
145.00 E A	URS	EXPRESS-11				4		6			11			14								
145.00 E C	URS	LOUTCH-10									11			14								
145.00 E N	URS	STATSIONAR-16				4		6														
146.00 E A	J	JMCS-1							7	8												
146.00 E C	J	N-SAT-146										12		14								
148.00 E A	MLA	MEASAT-2				4		6			11	12		14								
150.00 E N	J	ETS-5		1	2		5	6														
150.00 E N	J	JCSAT-1										12		14								
150.00 E A	USA	MILSTAR-15	0		C2														C20			C*
152.00 E N	AUS	AUSSAT A 152E										12		14								
152.00 E C	AUS	AUSSAT A 152E PAC										12		14								
152.00 E A	USA	MILSTAR-11	0		C2														C20			C*
154.00 E C	J	ETS-6-FS			2												18	19	20	29	*	43
154.00 E C	J	ETS-6-FSM																	20	*		
154.00 E C	J	ETS-6-I			2																	
154.00 E C	J	ETS-6-IS			2															23	*	43
154.00 E C	J	ETS-6-ISM																		*		
154.00 E C	J	ETS-6-MSS			2																	
154.00 E N	J	JCSAT-2										12		14								
155.00 E C	USA	USGCSS PH4 W PAC-1			2														20			44
156.00 E N	AUS	AUSSAT B2										12		14								
156.00 E N	AUS	AUSSAT B2 MC										12		14								
156.00 E C	AUS	AUSSAT B2-MOB		1								12		14								
156.00 E N	AUS	AUSSAT B2-NZ										12		14								
156.00 E C	AUS	AUSSAT B2-R		1								12										
156.00 E N	AUS	AUSSAT B2-S										12									30	
156.00 E N	AUS	AUSSAT-A 156E										12	13	14								
156.00 E N	AUS	AUSSAT-A 156E PAC										12		14								
156.00 E C	AUS	AUSSAT-B 156E MXL										12		14								
158.00 E N	J	SUPERBIRD-A							7	8		C12		C14		C17	C18	C19		C*		
160.00 E A	AUS	ACSAT-1							7	8												
160.00 E N	AUS	AUSSAT B1										12		14								
160.00 E N	AUS	AUSSAT B1 MC										12		14								
160.00 E C	AUS	AUSSAT B1-MOB		1								12		14								
160.00 E N	AUS	AUSSAT B1-NZ										12		14								
160.00 E C	AUS	AUSSAT B1-R		1								12										
160.00 E N	AUS	AUSSAT B1-S										12										
160.00 E N	AUS	AUSSAT-A 160E										12	13	14								
160.00 E N	AUS	AUSSAT-A 160E PAC										12		14								
160.00 E C	AUS	AUSSAT-B 160E MXL		1								12		14								
160.00 E N	J	GMS-160E	0	1	2																	
162.00 E N	J	SUPERBIRD-B							7	8		12		14		17	18	19		*		
164.00 E A	AUS	ACSAT-2	0						7	8												

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Orbital position		Space station		Frequency bands GHz																			
				0	1	2	4	5	6	7	8	11	12	13	14	15	17	18	19	20	>20	>30	>40
164.00 E	N	AUS	AUSSAT-A 164E										12	13	14								
164.00 E	N	AUS	AUSSAT-A 164E PAC										12		14								
164.00 E	C	AUS	AUSSAT-B 164E		1								12		14							30	
164.00 E	C	AUS	AUSSAT-B 164E MOB		1								12		14								
164.00 E	C	AUS	AUSSAT-B 164E MXL		1								12		14								
166.00 E	C	URS	GOMS-2	0	1	2				7	8									20	29		
166.00 E	A	URS	GOMS-2M	C0	C1	C2	4		6	C7	C8									C20	C29		
166.00 E	C	URS	PROGNOZ-6			2																	
166.00 E	A	USA	USASAT-14H				4		6				12		14								
167.00 E	N	URS	VSSRD-2									11	12	13	14								
167.45 E	A	PNG	PACSTAR A-1		C1			5	6														
167.45 E	C	PNG	PACSTAR-1				4		6				12		14								
168.00 E	A	USA	USASAT-14G				4		6				12		14								
170.00 E	C	USA	USASAT-13M										12		14								
170.75 E	C	TON	TONGASAT C-1				4		6				12		14								
170.75 E	A	TON	TONGASAT C-1-R										12		14								
172.00 E	N	USA	FLTSATCOM W PAC	0						7	8												
172.00 E	N	USA	FLTSATCOM-B WEST PAC																	20			44
172.00 E	A	USA	FLTSATCOM-C W PAC1	0		2				7	8									20			*
172.00 E	A	USA	USASAT-14K				4		6				12		14								
174.00 E	A	USAIT	INTELSAT FOS 174E				4		6			11	12		14								
174.00 E	C	USAIT	INTELSAT5A PAC1				4		6			11			14								
174.00 E	C	USAIT	INTELSAT7 174E				4		6			11	12		14								
175.00 E	N	USA	USGCSS PH2 W PAC							7	8												
175.00 E	N	USA	USGCSS PH3 W PAC			C2				C7	C8												
175.00 E	A	USA	USGCSS PH3B W PAC			2				7	8												
175.00 E	A	USA	USGCSS PH4 W PAC-3			2														20			*
176.50 E	N	USA	MARISAT-PAC	0	1		4		6														
177.00 E	A	USAIT	INTELSAT FOS 177E				4		6			11	12		14								
177.00 E	N	USAIT	INTELSAT5 PAC2				4		6			11			14								
177.00 E	N	USAIT	INTELSAT5A PAC2				4		6			11			14								
177.00 E	C	USAIT	INTELSAT7 177E				4		6			11	12		14								
177.50 E	A	USA	MILSTAR-14	0		C2														C20			C*
178.00 E	N	F ESA	MARECS PAC1	0	1		4		6														
178.00 E	C	G INM	INMARSAT2 POR-2		1		4		6														
178.00 E	C	G INM	INMARSAT3 POR-2		1		4		6														
179.00 E	C	G INM	INMARSAT2 POR-1		1		4		6														
179.00 E	A	G INM	INMARSAT3 POR-1		C1		C4		C6														
179.00 E	A	G INM	INMARSAT4 GSO-1G		1	2	4		6														
179.00 E	A	G INM	INMARSAT4 GSO-2G		1	2	4		6														
180.00 E	A	USA	USGCSS PH2 W PAC-2							7	8												
180.00 E	A	USA	USGCSS PH3 W PAC-2			2				7	8												
180.00 E	A	USA	USGCSS PH3B W PAC-2			2				7	8												
180.00 E	A	USA	USGCSS PH4 W PAC-2			2														20			*
180.00 E	A	USAIT	INTELSAT FOS 180E				4		6			11	12		14								
180.00 E	N	USAIT	INTELSAT MCS PAC A		C1		C4		C6														
180.00 E	N	USAIT	INTELSAT5 PAC3				4		6			11			14								
180.00 E	C	USAIT	INTELSAT5A PAC3				4		6			11			14								
180.00 E	C	USAIT	INTELSAT7 180E				4		6			11	12		14								

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3. Studies and standardization in the field of telecommunication

3.1 *General*

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

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

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

As stated in previous ITU Reports on Telecommunication and the Peaceful Uses of Outer Space, numerous CCITT Study Groups are developing standards, drawing up specifications and contributing to this work.

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

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

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

A considerable amount of work has been carried out on the integrated services digital network (ISDN), drawing up Recommendations on the concept and principles of an ISDN, its potential in terms of satellites, its general features and functions and user/network and inter-network interfaces; here again, careful attention is given to the problem associated with satellite communications.

In order to keep pace with technological development, the CCITT has approved amendments to existing Recommendations and new Recommendations on the ISDN, interworking and basic user access, including maintenance aspects. These Recommendations are also of significance for systems employing satellite communications. The CCITT is also currently studying applications of speech presentation in packets and the future wideband ISDN. Studies of digital speech interpolation are still mainly concentrated on the collection of data from DSI systems operating on associated media. Those studies have resulted in Recommendations, particularly relating to digital circuit multiplication equipments (DCME) and digital circuit multiplication systems (DCMS) and to 40, 32, 24, and 16 kbit/s differential adaptive PCM (DAPCM) coding and 16 kbit/s speech coding using shorts delay excited linear predictive coding. New Recommendations in this area have been prepared for approval by the next CCITT Plenary Assembly (March 1993) and other important studies have been started.

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

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

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

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

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

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

In the field of telex and data transmission, studies have been carried out by the CCITT on the use of telecommunication satellites and its impact on operation and on the establishment of tariffs, not only for public services but also for maritime mobile services.

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

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

Current CCIR Recommendations, Reports and Questions are contained in the Volumes of the CCIR XVIIth Plenary Assembly, Düsseldorf, 1990. Volumes of special interest for space telecommunications are:

Topic	*Volume (+Annex) (1990)*	*Series (1992)*
– Space research and radioastronomy	II, XV-1	RSA, RRA
– Fixed service using communication satellites	IV-1, XV-4	RS
– Propagation in non-ionized media	V, XV-1	RPN
– Standard frequency and time signals	VII, XV-1	RTF
– Amateur satellite services	VIII-1, XV-2	RM
– Mobile satellite services (Aeronautical, land, maritime-mobile and radiodetermination)	VII-3, XV-2	RM
– Sharing between the fixed-satellite service and radio-relay systems	IV/IX-2, XV-4	RSF
– Broadcasting-satellite service	X/XI-2, XV-3	RBO

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

Following the view of the ITU Plenipotentiary Conference (Nice, 1989), XVIIth Plenary Assembly of the CCIR (Düsseldorf, 1990) adopted Resolution 97 which contains a procedure for approval of Recommendations between Plenary Assembly to better respond to the requirement of the scientific, technical and user communities. A number of New and Revised CCIR Recommendations concerning the space activities have been approved and published under different series titles according to this procedure.

3.3.1 *WARC-92*

The World Administrative Radio Conference (WARC-92), Torremolinos (Spain), 3 February-3 March 1992 allocated new frequency bands for mobile and mobile-satellite services, satellite-broadcasting for digital sound and high definition television, and a number of space services. More than 1400 delegates from 127 countries participated. The CCIR Report "Technical and operational bases for the WARC-92", figured in most of the allocation and frequency sharing considerations.

Following CCIR estimates of 230 MHz required for future public land mobile telecommunication systems (FPLMTS) and associated provision for the "satellite component" of such systems, the conference identified two bands for allocation to the mobile service, 1885-2025 MHz and 2110-2200 MHz for use of FPLMTS. For the satellite component a Resolution of the Conference identifies an up-link band 1980-2010 MHz, and a downlink band 2170-2200 MHz.

For mobile satellite services operating above 1 GHz (including low earth orbiting LEO), allocations were made in bands near 1.5, 1.6 and 2 GHz. A new world-wide primary allocation was made to maritime mobile satellite service at 1525-1530 MHz.

Frequency bands for HDTV were allocated to the broadcasting-satellite service. In Regions 1 and 3, a band of 600 MHz was allocated at 21.4-22.0 GHz; in Region 2, a band of 500 MHz was allocated at 17.3-17.8 GHz.

A bandwidth of 40 MHz for digital satellite sound broadcasting was allocated at 1452-1492 MHz, except the USA. In a number of countries the allocation is on a secondary basis until the year 2007. In the USA, the band 2310 to 2360 MHz is allocated; in twelve countries of Region 3, the band 2535-2655 MHz is identified for satellite sound broadcasting and complementary terrestrial broadcasting, in addition to the band 1452-1492 MHz.

The bands 2025-2110 MHz (Earth-to-space, space-to-space) and 2200-2290 MHz (space-to-Earth, space-to-space) have been allocated to the space research, space operation and Earth exploration-satellite services on a world-wide primary basis. Administrations are urged to take all practicable measures to ensure that space-to-space transmissions between two or more non-geostationary satellites shall not impose any constraints on Earth-to-space, space-to-Earth and other space-to-space transmissions of those services and in those bands between geostationary and non-geostationary satellites. The Conference (Resolution No. 711) also calls for the reallocation in the frequency bands above 20 GHz of those assignments of space missions at present in the 2 GHz band. On the same basis the band 2110-2120 MHz was allocated to the space research service (deep space, Earth-to-space).

Approximately 1 GHz of bandwidth was allocated in three bands between 24.45 GHz and 27.5 GHz on a world-wide primary basis to the inter-satellite service.

A number of new bands above 20 GHz were also allocated to the Earth exploration-satellite and the space research services.

Moreover, Resolution No. 712 was adopted for including in the agenda of a future conference, space issues not dealt with by WARC-92 and particularly in respect of the Earth exploration-satellite service used for sensing ecologically important data and for monitoring environmental data. The task of the conference would include the consideration of a common worldwide primary allocation to the Earth exploration-satellite and the space operation service in the band 8.2-18.8 GHz and provide additional frequency bands for the inter-satellite service near 23 GHz.

New CCIR studies

Among the 19 Resolutions and Recommendations of WARC-92 on future CCIR studies a number of urgent ones cover:

1) compatibility between:

- the primary allocation to the FSS (Earth-to-space) and the secondary allocations to the SRS and EESS in the band 13.75-14 GHz;
- the meteorological aids and METSAT services and the MSS, in the band 1670-1710 MHz taking into account the needs of the radio-astronomy service in the adjacent band;
- multiservice satellites and the FSS in the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz in Region 2, and 20.1-20.2 GHz and 29.9-30.0 GHz in Region 1;
- the MSS and other services in the same frequency bands, including power limits and power flux-density as indicated in Articles 27 and 28 of the RR, while placing minimum restrictions on the services operating in these bands.

2) protection of the space services operating in the bands 2025-2110 MHz and 2200-2290 MHz from harmful interference from emissions by stations of the mobile service;

3) improvement of the efficiency and flexibility of the Plans for Regions 1 and 3 contained in Appendices 30 and 30A to the RR and implementation of HDTV in the 12 GHz band in the countries with high rainfall rate climate zones;

4) establishment of standards governing the operation of low-orbit satellite systems so as to ensure equitable and standard conditions of access for all countries and to proper world-wide protection for existing services and systems in the telecommunication network;

5) the Broadcasting Satellite (sound) service, in particular:

   i) the characteristics of GSO and non-GSO BSS (sound) systems,

   ii) the appropriate sharing criteria;

6) the spurious emissions resulting from space services transmissions;

7) the characteristics and requirements of wind profiler radars.

3.3.2 *Fixed-Satellite Service (Study Group 4)*

Recommendations and 10 draft revised Recommendations were approved. The new Recommendations deal with the use of FSS systems in the event of natural disasters and similar emergencies for warning and relief operations, orbit management techniques for the FSS and environmental protection of the GSO. A new Task Group 4/4 was established dealing with

Resolution No. 112 (WARC-92) which requires CCIR studies to be completed prior to 31 January 1994.

The joint meeting of Study Groups 4 and 9 approved 4 draft new Recommendations and 3 draft revised Recommendations on frequency sharing between the fixed service and the fixed-satellite service. The topics of new Recommendations include interference assessment for detailed coordination, maximum allowable e.i.r.p. transmitted towards the horizon by earth stations, the feasibility of sharing with bidirectional usage in bands above 10 GHz and the possible use by space stations of orbits slightly inclined with respect to the GSO.

Working Party 4A on efficient orbit/spectrum utilization drafted 3 new Recommendations and 9 amendments to existing Recommendations. In addition, 5 preliminary draft new Recommendations and 8 new Reports were agreed covering topics on short-term increases in interference in networks forming part of ISDN, interference effect from TDMA systems, FSS and radiolocation sharing in the 13.75-14 GHz band, interference between FSS and MSS in the 20-30 GHz band, non-GSO/GSO sharing, stochastic statistical considerations in coordination, TV protection ratios and spread spectrum modulation.

Working Party 4B on systems, performance, availability and maintenance prepared 1 draft new Recommendation and 2 revised Recommendations. Corresponding to draft CCITT Recommendation G.82x, a preliminary draft new Recommendation on allowable error performance for an HRDP operating at or above the primary rate was prepared. Two preliminary draft new Recommendations on integration in SDH of FSS transport subnetworks were revised. Other topics on digital performance, networking aspects of satellite systems and earth station characteristics were considered.

Working Party 4-9S on frequency sharing and coordination between systems in the fixed-satellite service and radio-relay systems approved 3 draft new Recommendations and 3 amendments to existing Recommendations.

Task Group 4/3 on interconnection of VSAT systems with public switched networks drafted a new Recommendation on connection of VSAT systems with packet switched public data networks (PSPDN) based on CCITT Recommendation X.25. The meeting discussed in detail the connection of VSAT systems with the ISDN. It was recognized that the drafting of a CCIR Recommendation on VSAT/ISDN interconnection is still at a premature stage. Further study is required to align with CCITT Recommendations on interworking between public and private networks. Interconnection of VSAT systems with public switched telephone networks (PSTN) was also considered.

Task Group 4/4 in response to *resolves 1* of Resolution No. 112 (WARC-92) prepared a draft new Report and an associated draft new Recommendation which provides information on the capability of FSS and radiolocation systems to be consistent with the sharing criteria set forth in No. 855A of the Radio Regulations.

The joint ad hoc CCIR/CCITT Experts Group on ISDN/satellite matters made great progress. It should now be possible to integrate narrow-band ISDN and satellite systems with the assurance that the relevant CCIR and CCITT Recommendations are compatible. With the rapid development of new technology, it will be important to ensure the future compatibility of ISDN and digital satellite system standards. The meeting identified potential new areas of emerging technology e.g. VSAT, LEO, B-ISDN, On-Board processing and high speed data frame relay services. The JAHG considers that coordination of the work between the Standardization Sector and Radiocommunication Sector is required in the future development of Recommendation/Standards in these areas.

The ad hoc Group for updating the CCIR Handbook on Satellite Communications (fixed-satellite service) continued its work on Supplement No. 3 (VSAT systems and earth stations) to the Handbook. Supplement No. 2 on computer programmes for satellite communications was published at the end of 1992.

3.3.3 *Mobile-Satellite Service (Study Group 8)*

Four draft new and one draft revised Recommendations concerning Future Public Land Mobile Telecommunication Systems (FPLMTS), the concept of which includes satellite components for personal communications and rural communications, were approved. They had been drafted by Task Group 8/1 and one of them was a draft new Recommendation specifically on the satellite operation within FPLMTS.

Study Group 8 also approved four draft new Recommendations related to the mobile-satellite services which had been drafted by Working Party 8D. They were on the operational procedure for distress and safety communications, Hypothetical Reference Digital Path (HRDP) for the systems in the mobile-satellite service, definition of availability for communication circuits in the mobile-satellite services and frequency sharing between the mobile-satellite service and frequency sharing between the mobile-satellite service and the radioastronomy service in the 1.6 GHz band.

Also approved were a draft new Recommendation on the technical characteristics of differential transmission for Global Navigation Satellite System (GNSS) from maritime radio beacons and a draft revised Recommendation on the protection of space station receivers in the fixed-satellite service in the 14 GHz band from radionavigation transmitters.

Study Group 8 also considered the outcome from the WARC-92, which added and modified frequency allocations and related regulations for the mobile-satellite services, etc., and prepared a number of draft new and revised Questions to conduct studies requested by the WARC-92.

3.3.4 *Science Services (Study Group 7)*

Nine draft new or revised Recommendations were approved. The fascicle containing the texts of these Recommendations (RTF, RSA and RRA Series) has been published. Recommendation 767 concerns the use of satellite systems for high-accuracy time transfer and Recommendation 769 concerns radioastronomical measurements. The revised Recommendations cover space radio systems (Recommendations 609-1 and 364-5) and radioastronomy service (Recommendations 314-8, 517-2 and 611-2). It was also decided to prepare two new Handbooks on Time Signals and Frequency Standards and on Radioastronomy.

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

Approved new and revised Recommendations are as follows:

- Recommendation 788 on coding for the wide RF-band HDTV broadcasting-satellite service;
- Recommendation 789 on digital sound broadcasting to vehicular, portable and fixed receivers for BSS (sound) in the frequency range 500-3000 MHz;
- Recommendation 790 on characteristics of receiving equipment and calculation of receiver figure-of-merit (G/T) for the broadcasting-satellite service;
- Recommendation 794 on techniques for minimizing the impact on the overall BSS system performance due to rain along the feeder-link path.

WARC-92 adopted several Resolutions and Recommendations that have direct impact on the work of Working Party 10-11S:

- Resolution No. 522 on further work of the CCIR concerning the broadcasting-satellite service (sound). The characteristics of geostationary-orbit and non-geostationary-orbit BSS sound systems and appropriate sharing criteria will also be dealt with;
- Resolution No. 524 on future consideration of the Plans for the broadcasting-satellite service in the 12 GHz band and associated feeder link band;
- Resolution No. 525 on the introduction of high-definition television (HDTV) systems of the broadcasting satellite service in the band 21.4-22.0 GHz in Regions 1 and 3;
- Resolution No. 526 on flexibility in use of the frequency band allocated to the BSS for wide RF-band HDTV (including associated feeder links).
- Resolution No. 528 on the introduction of BSS (sound) systems and complementary terrestrial broadcasting in the bands allocated to these services within the range 1-3 GHz.

3.3.6 *Satellite News Gathering*

Task Group CMTT/5, which deals with satellite news gathering and outside broadcasts via satellite, prepared and revised several Recommendations for approval by the joint CCIR/CCIT Study Group on television transmission (CMTT).

- Recommendation 722-1 on uniform technical standards (analogue) for satellite news gathering (SNG);
- Recommendation 770 on uniform operational and control procedures for SNG; and
- Recommendation 771 on auxillary coordination satellite circuits for SNG terminals.

The Task Group is working actively on preparing a new Recommendation on digital satellite news gathering, and is gathering information on designated points of contact and operational manuals from administrations and satellite operators, for inclusion in the existing Recommendations.

4. Technical cooperation activities

Assistance on matters concerning satellite communications was offered to Bangladesh, Nepal, the Netherlands Antilles, Tokelau and Tonga.

The Regional African Satellite Communication System (RASCOM) feasibility study report was presented to the African Ministers for Telecommunications at their meeting held in Abuja (Nigeria), 4-6 February 1991. The Ministers decided to proceed with the project in two phases: the transitional stage and the operational stage. All the legal documents required to establish the RASCOM Organization were to be prepared during the transitional stage. The Ministers met again in Abidjan (Côte d'Ivoire), 25-27 May 1992, to consider the report of the transitional stage. At the meeting, they decided to establish the RASCOM Organization, with Headquarters in Abidjan. They also established the modalities for starting the organization. The first meeting of the interim Board of Directors of the new organization is foreseen for early 1993.

The organization will start with the pooling of transponders used by the African countries in various satellites for Africa; it will then proceed to the long term objective of establishing a dedicated satellite for Africa.

5. Information and documentation activities

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

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

In September 1992, a recapitulatory list of artificial satellites launched in 1991 was published as an annex to the Journal. This was prepared from information supplied by the Members of the Union, the International Frequency Registration Board (IFRB), the Committee on Space Research (COSPAR), and national space research organizations.

6. Cooperation with other international organizations concerned with space matters

6.1 *General*

In 1992, the ITU pursued its consistent cooperation with relevant international organizations concerned with space matters (COSPAR, EUTELSAT, INTELSAT, INMARSAT, etc.), with a view to exchanging technical data and appropriate documentation. In particular, it took part in the meetings of the United Nations Committee on the Peaceful Uses of Outer Space and its sub-committees.

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

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

During the inter-agency meeting on outer space activities which was held in Paris on 5-7 October 1992, the following specific questions were considered:

- Implementation of the recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space;
- Coordination of plans and programmes and exchange of views on current activities in the practical applications of space technology;
- In-depth review of the co-operation of organizations in the United Nations system in remote sensing activities;
- Review and coordination of follow-up activities of the organizations of the United Nations system on International Space Year 1992.

The inter-agency meeting considered and approved a draft Report entitled "Coordination of outer space activities within the United Nations system; Programmes of work for 1993 and 1994 and future years".

ANNEX

Reports on progress made in the development of space communications

ALGERIA (PEOPLE'S DEMOCRATIC REPUBLIC OF)

Installation and entry into service of 12 earth stations using the INTELSAT system.

These stations will be used for telephony and for the reception of television programmes nationwide.

They are equipped with 7-metre antennas with a G/T of 26.6 dB/°K.

Each station has a capacity of four SCPC/FM channels and a television receiver.

They are mainly solar-powered.

The 12-station network has centralized supervision.

AUSTRIA

During 1992, an interactive VSAT system was put into operation by the Austrian PTT in co-operation with Radio Austria Communications. The Austrian VSAT system is based on the Personal earth station (PES) technology developed and manufactured by Hughes Network Systems Inc. It is a two-way transmission system for data (up to 64 kbit/s) and digitized voice traffic (16 kbit/s). All traffic is carried digitally using an advanced Demand Assigned Multiple Access system with three traffic allocation methods for efficient transponder utilization.

The Austrian VSAT system uses space segment capacity leased in the EUTELSAT satellite system. From the beginning, the Eutelsat II (F-2) satellite at the 10° E orbital location was used. In September, the service was transferred to the Eutelsat II (F-4) satellite at 7° E which has the advantage to provide extended Eastern European coverage. VSAT's with an antenna diameter of typically 1.8 m may be installed throughout the satellite's footprint covering the whole European continent.

The VSAT hub earth station consists of a 7.6 m dish and necessary RF and IF equipment in a fully redundant configuration. This earth station was put into operation in 1987 with the aim to provide satellite business services as part of the earth segment in the EUTELSAT Satellite Multi Services (SMS) System. It is located near PTT Austria's ITMC in Vienna. In 1991, the station was retrofitted in order to serve as the hub station for the Austrian VSAT system.

The earth station IF equipment dedicated to the VSAT system is connected via a two Mbit/s link to the VSAT baseband and customer interface equipment which is installed on premises of Radio Austria Communications in about five km distance to the hub earth station. This unique approach was selected to ensure optimum customer support by staff of Radio Austria Communications specialized in provision of digital services for business communications, while using the exisiting RF and IF equipment owned by PTT Austria and operated by staff specialized in satellite communications technologies.

BARBADOS

During this year, Barbados continued the transfer of its space telecommunications services from analogue to digital with the establishment of an IDR carrier on the INTELSAT system to Jamaica.

Direct space telecommunications services were also opened to the Scandinavian countries with the establisment of an IDR on the INTELSAT system to Denmark.

By the end of 1992, Barbados utilising digital technology on the INTELSAT system, was operating space telecommunications services to the following countries:

— Canada, Denmark, Jamaica
— United Kingdom (Mercury Communications Ltd., British Telecom)
— United States of America (AT&T, MCI, Sprint)

Barbados is currently considering:
— Opening additional routes to Europe.
— The installation of an F-3 Station at the Harbour Industrial Park.
— The installation of a revised Standard A earth station to replace the existing Standard A station which was built over twenty years ago.

BELGIUM

Development of the Lessive station

The main event in 1992 for the Lessive earth station was the construction of a fourth antenna designated Lessive 4. This antenna, with a diameter of 18 metres, will be pointed at an Intelsat Atlantic Ocean region satellite. The earth station is designed to replace the first antenna, Lessive 1, which has reached the end of its theoretical service life. However, before taking over from Lessive 1, it will route services via the satellite located at 359° E, pending the implementation of an extension scheduled very shortly.

The digitization of transmission continued with the introduction of a new IDR carrier to Canada.

As in the two previous years, there was a considerable increase in occasional television broadcasts, via both the INTELSAT and EUTELSAT systems.

Development of the Liedekerke station

In 1992, a new antenna was brought into service at Liedekerke (LDK 4). The station is equipped with a VSAT hub and MSS modems (Ku band). The antenna is directed and the Eutelsat II (F-4) satellite at 7° E. The main reflector has a diameter of 8.1 m.

Two mobile earth stations (with antenna diameters of 3.7 and 2.6 m) allow satellite links to be set up very quickly. They may be used for occasional television broadcasts of IBS/MSS transmissions (e.g. videoconference), via both the INTELSAT and the EUTELSAT systems.

BRAZIL (FEDERATIVE REPUBLIC OF)

Introduction

The Brazilian satellite telecommunication service (SBTS), operated by EMBRATEL, has kept the expansion of its network enabling the growth of satellite services essential to integrated development of the coutry's telecommunications.

1. Domestic space radiocommunications

1.1 *The space segment*

The SBTS space segment has two HS-376 type satellites: Brasilsat-1 and Brasilsat-2. The Brasilsat-1 was launched in 1985 to operate at 65° W. The Brasilsat-2 was launched in 1986 to operate at a longitude of 70° W. Each of them operate 24 transponders of 36 MHz in the C-band.

Two Hughes US-393 based spacecrafts will replace in 1994 the two satellites now in operation. Each of them will operate 28 transponders in the C-band and 1 transponder in the X-band.

1.2 *Earth segment*

By the end of 1992 the earth segment of the SBTS was formed by 1431 earth stations, from which 55 provide public services and 1376 are dedicated to private telecommunications network.

2. Traffic

The occupation rate amount to 93.48% as follows:

Brasilsat-1: 19 transponders for public switched telephony,
1 transponder for data;

Brasilsat-2: 15 transponders for television,
3 transponders for public switched telephony,
5 transponders for data.

The telephone, telex and data traffic occupy 10,042 channels (8370 FDM/FM/FDMA, 1527 SCPC/FM and SCPC/QPSK.

3. Control center

The control center of the space segment (TT&C) as well as the center of operation and control of communications of the SBTS are installed at the earth station of Guaratiba, Rio de Janeiro.

4. Research and development

4.1 *Industry*

A major portion of transmission equipment utilized in earth stations with capacity equal or less than 300 telephony channels were manufactured by the Brasilian industry. Special references should be made to 1.8 to 6 m parabolic antennas, LNA of 80°K, solid state HPA of 5 and 10 W and SCPC analogic equipments. For larger stations 100 W HPA and 10 m diameter antennas were manufactured.

Complete 48 to 64 KBPS data transmission earth stations are also manufactured by the Brazilian industry. These earth stations are largely used by private networks.

CAMEROON (REPUBLIC OF)

The Republic of Cameroon has:
— acquired Inmarsat terminals;
— studied the installation of an Inmarsat land earth station;
— studied the modernization of the Intelsat Standard A earth station at Yaounde;
— participated in RASCOM.

CANADA

1. International satellite communication

1.1 *INTELSAT*

Teleglobe Canada Inc., as the Canadian Signatory to INTELSAT was involved in a number of INTELSAT-related activities during 1992. Following the contract award for the IS-VII A series of satellites in 1990, the activities in 1991 and 1992 involved studies to determine the nature of future procurement. These studies, in which Teleglobe was actively involved, led to the procurement of IS-VIII series of satellites from GE. In the area of earth station activity several earth stations were constructed to operate with Intelsat satellites, these include a Standard C earth station in Toronto, operating at Ku-band to access the 325.5° E satellite, a Standard A C-band earth station at Pennant Point for the restoration of TAT-9 fibre optic transoceanic cable system and a C-band earth station in Toronto to provide broadcast services. Procurement of equipment is also continuing, at an accelerated pace, for the digitization of the communication network for the international public switched telephone service.

1.2 *INMARSAT*

Teleglobe Canada Inc., as the Canadian Signatory to INMARSAT was involved in a number of INMARSAT-related activities during 1992. Teleglobe Canada Inc. played host to one INMARSAT Council session and one of the INMARSAT Aeronautical conferences. Throughout 1992 Teleglobe has taken an active role in procurement of launch vehicles for INMARSAT third generation satellites due to be launched during 1994-1995 time frame. Teleglobe was successful in signing two contracts with INMARSAT for provision of TT&C services in Atlantic and Pacific Ocean regions, for both second and third generation Inmarsat satellites. Teleglobe was one of seven bidders that submitted proposals to INMARSAT for Tracking, Telemetry, Telecommand and Ranging Services. In 1992 substantial work was implemented for introduction of Global Paging during 1993. Substantial efforts have been put in Project INMARSAT-P service (Handheld Satellite Terminal) with a major decision to be taken by mid 1993 for implementation during the later part of this decade. Teleglobe Canada Inc. continues to play a leading role in implementation of this service.

2. Domestic satellite communications

Canadian domestic satellite communications have been provided by the Anik satellites which are owned and operated by Telesat Canada. The Telesat space fleet comprises two generations of systems. The new generation of Anik E satellites consists of Anik E-1 and E-2 satellites, both launched in 1991. The Anik E satellites are dual-band C (6/4) / Ku (14/12) design. These fixed satellite service spacecraft provide transmission of voice, video (including subscription television) in both digital and analogue formats and data signals within Canada. The previous generation of Anik satellites consists of Anik D (operating in 6/4 GHz band) and Anik C (operating in 14/12 GHz band) satellites. Anik D-2 launched in 1984, and sold to GE Americom in 1991, will be returned to Telesat in early 1993 to provide restoration and occasional use services operating in inclined orbit. The Anik C series of satellites has three remaining satellites in operation, namely, Anik C-1, C-2 and C-3. Anik C-3 is fully utilized for restoration services operating in inclined mode since early 1992. The remaining Anik C satellites are also available as in-orbit spares.

3. The MSAT programme

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

4. The COSPAS-SARSAT programme

In 1988, Canada, France, the United States of America and the Union of Soviet Socialist Republics signed The International COSPAS-SARSAT programme Agreement which assures the long-term operation of the COSPAS-SARSAT system.

The COSPAS-SARSAT system, initiated in 1979 by agencies in the four states signatory to the 1988 Agreement, uses space-borne equipment and associated ground stations to detect and localize emergency radio beacons operating at 121.5 or 406 MHz.

Since the launch of the first COSPAS satellite in 1982, the system has played a role in the saving of over 1,600 lives worldwide.

The four states, which provide space segment of the system and ground stations to meet their own regional needs, have been joined in the programme by states throughout the world operating ground stations which extend the geographic coverage of the system.

5. RADARSAT

RADARSAT is a Canadian-led cooperative programme with the United States of America, to launch and operate a remote sensing satellite with a C-band Synthetic Aperture Radar (SAR Sensor). The spacecraft is scheduled for launch into a sun-synchronous polar orbit in early 1995 on an expandable Delta II launch vehicle for a five-year mission. The orbit altitude and inclination of about 800 km and 98.5°, respectively. The south-bound crossing will be at 0600 hours local mean time.

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

In 1991, significant progress was made in the development and implementation of the RADARSAT system. Successful critical design reviews were held on all spacecraft payload module subsystems. In parallel, construction of the spacecraft bus flight model was well underway. The definition of all the ground segment functional area and the planning for system operations and utilization are all making good progress.

6. Cooperative International space activities

The Canadian Space Agency, realizing the importance of international cooperation in achieving Canada's objective in space activities, has been presently involved primarily with two partners, namely the United States of America and the European Space Agency (ESA).

Canada, in its long-standing partnership with the United States of America, is currently involved in space station Freedom, RADARSAT, and MSAT programmes. Canada will be providing mobile servicing system for space station Freedom. Both partners will also launch mobile communications satellites which will interlink to provide total North American mobile-satellite services coverage.

Additionally, Canada also cooperates on other space activity related programmes and projects including earth observation, Astronaut Programme and space sciences programmes through which wind imaging interferometer (WIND II) was recently launched onboard upper atmospheric research satellite.

Canada has for some time has a special partnership agreement with the European Space Agency.

Canada currently participates in ESA programmes in the area of satellite communications, namely, Olympus, Payload and Spacecraft Development and Experimentation (PSDE), Data Relay and Technology Mission (DRTM) and Advanced Systems and Technology Missions (ASTP).

Canada also participates in ESA programmes such as European Remote Sensing Programmes ERS-1 and ERS-2, Polar Orbit Earth Observation Missions (POEM) and Earth Observation Preparatory Programme (EOPP).

CHAD (REPUBLIC OF)

Introduction

Chad, which is located at the heart of Africa and has borders with Sudan, the Central African Republic, Cameroon, Nigeria, Niger and Libya, is a vast country with a surface area of 1 284 000 km².

Like many other African countries, Chad has opted for satellite telecommunications for the modernization of both its international and national communications. Satellite systems, which have undergone considerable technical and technological development, are highly suited to coping with large distances between towns and with obstacles such as relief.

1. National satellite telecommunication network (SAOSAT)

Work on the SAOSAT network was started in 1989 by Alcatel Telspace, with funding from the Central Fund for Economic Cooperation and under the supervision of the SOFRECOM Consultant Engineer. The network was officially brought into service in 1991.

The SAOSAT network comprises five earth stations, the main station at N'Djamena and four peripheral stations at Sarh, Moundou, Abeche and Faya.

— N'Djamena (Goudji station), which is the capital city, is equipped with 31 channels and 1 broadcasting channel.

— Sarh (Kokaga station) is equipped with 10 channels, 9 for speech (5 outgoing and 4 incoming) and 1 for telex.

— Moundou (Dombao station) is equipped with 10 channels, 9 for speech (5 outgoing and 4 incoming) and 1 for telex.

— Abeche (Torodona station) is equipped with 6 channels, including 5 for speech (4 outgoing and 2 incoming) and 1 for telex.

— Faya (Tchoulouk station) is equipped with 5 channels, including 4 for speech (2 outgoing and 2 incoming) and 1 S + D channel.

Main earth station:	Standard:	B
	Antenna diameter:	11 m
	e.i.r.p.:	45/48/55 SCPC/pilot/broadcasting
	G/T:	31.7
	Modulator:	SCPC/FM
	C/N:	12
Peripheral earth station:	Standard:	D2
	Antenna diameter:	7.3 m
	e.i.r.p.:	42
	G/T:	28
	Modulator:	SCPC/FM
	C/N:	12.2/141/12.5 SCPC/pilot/broadcasting

The whole SAOSAT network is equipped with automatic satellite tracking systems and remote signalling.

The network has a star configuration operating in band C via Intelsat V-A (F-12) at 359°, transponder 22/22 Hemi/Hemi Atlantic Ocean region. This transponder (bandwidth 36 MHz) has been purchased jointly by Chad, the Central African Republic and Gabon to meet their domestic and subregional communication requirements. The subregional link, called the UDEAC link (UDEAC: Customs and Economic Union of Central Africa), is not yet operational because the States involved have not yet managed to identify practical operating procedures.

The SAOSAT network provides the following services:
— telephony;
— telex;
— data transmission;
— television (each station is equipped with a television receiver) (system not yet in operation);
— broadcasting of sound programmes by the main station (arrangements in place but not yet in operation).

The SAOSAT network offers an enhanced quality of service, but the inadequate number of channels often gives rise to congestion, with the result that traffic does not flow very smoothly. Extension of the channels is being contemplated.

2. International links

The country is connected to the outside world by a Standard B earth station operating with the Intelsat 603 satellite at 325° E. The sole destination is France, from which communications can be set up to the rest of the world by transit over the switched network.

International earth station:	Standard:	B
	Antenna diameter:	11 m
	Tracking system:	automatic step-by-step
	e.i.r.p.:	68 dBW
	G/T:	31.7 dB/K
	Modulation:	CFDM/FM
	No. of circuits in service:	41

CROATIA (REPUBLIC OF)

The Republic of Croatia inform that television satellite earth station has been established in Croatia in 1992, location Zagreb 15 563° E, 45 462° N satellite Eutelsat II (F-3), uplink frequency 14 286.667 MHz and downlink frequency 10 986.667 MHz.

CYPRUS (REPUBLIC OF)

Additional satellite antennas were erected by the Cyprus Telecommunications Authority at the Makarios satellite earth station bringing their total number to six.

DENMARK

Nordic activities in the field of satellite telecommunications

See under Finland and Iceland.

1. INTELSAT

A new Standard A earth station for telephony and data traffic was put into operation in 1992. The earth station operates in the advanced Intelsat Satellite Switched Time Division Multiple Access system (SS TDMA) and the

Intermediate Data Rate system (IDR). In the course of the year traffic was routed to 11 destinations, among others Australia, Japan, China and South Africa. Additional 14 destinations in the Indian Ocean region (IOR) will be connected during 1993 and 1994.

A domestic satellite system with a number of earth stations in Greenland, Denmark and the North Sea, using leased capacity in an Intelsat VI satellite, is carrying telephone and data traffic. In addition this system is now also used for transmission of television programmes between Denmark and Greenland and for internal television programme distribution in Greenland. These transmissions utilize 6.6 Mbit/s codecs.

2. EUTELSAT

A TDMA earth station with a 13 m antenna was acceptance tested at the end of the year. The station is planned to go into service January 1993.

For exchange of EBU television programmes an earth station with a 7.6 m antenna is in service. The station has been extended with an additional transmitting channel.

An earth station with an 11 m antenna has been prepared for television uplink and is regulary uplinking for Continental television.

A new VSAT service controlled by a HUB station located near Copenhagen, was introduced. So far terminals are installed in Germany and Hungary. The system is for voice as well as for data up to 64 kbps.

Earth stations with 3.6 m antennas are put into service in Lithuania and Moldova. The sypply these countries with telephone channels for international traffic.

3. Satellite television and radio reception

Television and radio programmes from INTELSAT, EUTELSAT, ASTRA, PANAMSAT, TV-SAT, TDF, KOPERNIKUS and TELE-X are currently received for the national Danish cable television network, The Hybrid Network.

4. Other activities

In cooperation with the Swedish administration, propagation measurements were performed with the Olympus satellite and with radiometers at 20 and 30 GHz. This activity was terminated at the end of the year due to the deteriorating performance of the Olympus satellite.

EGYPT (ARAB REPUBLIC OF)

I. TELECOMMUNICATIONS

1. International communications via Intelsat satellites

Maadi-1 Standard A earth station has been in operation since 1978 via the Atlantic Ocean primary path satellite. Presently it handles the traffic with nine destinations on the FDM/FM with a total capacity of 252 circuits and three destinations on digital (IDR) of total capacity of 390 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 eighteen destinations and FDM/FM with a total capacity of 456 circuits and two destinations on digital (IDR) of total capacity of 38 circuits.

During 1992, 615 television transmissions and 286 receptions of a total duration of 18 850 minutes were handled by the two earth stations.

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

2. Regional communications via Arabsat satellites

Maadi-5 Arabsat major C-band earth station (11 m antenna) has been in operation since November 1990 via ARABSAT-A now working with (1-C) 31° E satellite.

Currently, it handles traffic with nine destinations on FDM/FM with a total capacity of 348 circuits. In addition, there are two destinations working on SCPC with a total capacity of the 63 circuits during 1992, 314 television transmission and 432 television receptions with a total duration of 26 742 minutes were handled besides a daily (18 hours) television programme, transmitted to the direct broadcast ESC (Egypt space channel).

3. Domestic communications via Intelsat satellites

Domestic networks for INTELSAT business service are on operation, one network for civil aviation air traffic control, consists of one centre HUB E/S at Cairo International Airport, and four earth stations at National Airports. The network started in operation on January 1992. The second network for a national oil company data communication, GUPCO, consists of one centre HUB E/S at the Maadi site and two earth stations at drilling sites. The network started operation on March, 1992 of 564 kbit/s at Ras Shukhier and 384 kbit/s at Jbu Gharadiv.

4. Maritime satellite communications

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

II. OTHER SPACE ACTIVITIES

1. Meteorological satellite application

Since 1969, the Egyptian meteorological authority (APT) earth station operates with near polar-orbiting satellites to receive both visible and infra-red channels. In 1979, the earth station has been modified to operate with Meteosat-3 geosynchronous. In 1982, a new earth station has been constructed with the capabilities of receiving pictures from both polar-orbiting and geostationary satellites. In addition a specialized data processing system has been acquired to provide meteorologists with pictorial information about the different types of cloud systems and associated weather phenomena. The authority is contemplating to acquire primary data user station of digitally transmitted high resolution data based on personel computers.

2. Remote sensing from space

The Egyptian Remote Sensing Centre is a part of the Egyptian Academy of Scientific Research and Technology. It possesses a complete line of state-of-the-art digital image processing facility for aircraft and earth resources monitoring satellites data as well as photographic facility. The centre also has a complete photogrametric unit including a modern aircraft equipped with digital and photographic sensors including one of the most advanced photogrametric aerial cameras in addition to the latest computer oriented analytical stereoplotter for digital mapping.

ESTONIA (REPUBLIC OF)

In the Republic of Estonia there are two earth stations registered in Estonian territory:
— EST-TLN-EMB
— EST-TLN-INTEX.

The earth station EST-TLN-EMB belongs to IDB Communication Group (USA) and it is used by the Embassy of the USA in Tallin. The station is used for administrative communication by the satellite Stationar-11 with orbit position of 11° W. The station is working since September, 1992.

The earth station EST-TLN-INTEX belongs to the joint-venture INTEX. This earth station is used for mediating telephone communication between Russia and Europe (30 phone channels). The joint-venture INTEX does not provide communication services to third persons. The satellite Stationar-12 is exploited with orbit position of 35° E. The station has been working since June, 1992.

The international co-ordination of the earth stations above-mentioned is not completed and therefore they are working on basis of preliminary licences.

For the time being a legislation is being worked out that will regulate the utilisation of satellite communication in the territory of the country.

EQUATORIAL GUINEA (REPUBLIC OF)

Status of international satellite circuits:

— Vista de Bata earth station:
  6 circuits (5 TPH + 1 TG) with the earth station at Bercenay-en-Othe (France);
— technical transit via the earth station at Douala Bepanda (Cameroon):
  3 TPH circuits Bata/Reims (France);
  5 TPH circuits Bata/Madrid (Spain).

FINLAND

Nordic activities in the field of satellite telecommunications

See also under Denmark and Iceland.

1. Telecom Finland is the signatory to EUTELSAT, INTELSAT and INMARSAT organizations.

Telecom Finland routes part of its international telephony traffic via Tanum Teleport in Sweden, with joint ownership of the station, and under joint Nordic use via Agesta earth station, also in Sweden.

Telecom Finland uses the Inmarsat (A, B and Aero) land earth stations in Eik, Norway, jointly owned by the Nordic countries as well.

2. EUTELSAT

Since 1991 Telecom Finland has operated a dedicated television earth station in Helsinki, mainly used for access to the EBU network and also for occasional television transmissions. The station is also used for uplink of television transmissions originated from the Baltic countries and Russia.

Since 1986 another earth station in Helsinki has been used for Eutelsat/SMS (Satellite Multiservice System) traffic i.e. data services and video conferencing.

Smaller Standard S2 and non-standard SMS stations have been introduced for digital business services and used as dedicated customer terminals and for transportable applications.

Several VSAT terminals have been installed and operated by Telecom Finland in Helsinki in cooperation with foreign service providers.

3. Other activities

A C-band earth station has been taken into operation in Porvoo, some 50 km East of Helsinki. The station is used as gateway for traffic originated from various sites in CIS countries.

Some digital transponder capacity in Tele-X-satellite has been used by Telecom Finland, Technical Research Centre of Finland and universities for service development and demonstration purposes.

Numerous international television programmes distributed via various satellite systems (EUTELSAT, ASTRA, INTELSAT, TELE-X, etc.) have been monitored by cable network operators as well as private homes using TVRO terminals. No licensing is required in Finland.

FRANCE

Satellite communications are an important tool in the development of France's national and international telecommunications. In addition to operating in its own national system TELECOM 1/TELECOM 2 and the direct broadcasting system TDF 1/TDF 2, France participates in the work of the international organizations INTELSAT, EUTELSAT and INMARSAT.

1. The TELECOM 1/TELECOM 2 system

The high point of 1992 was the entry into service of the two second-generation satellites TELECOM 2-A and TELECOM 2-B. Each of the new satellites has a ten C-band and eleven Ku-band transponder, as well as a government payload (Syracuse 2).

The TELECOM 2 satellites provide virtually all communications with the overseas departments; at the end of 1992 there were almost 2400 digital circuits in service, as well as two television programmes.

A further key activity is the distribution of television and radio programmes in mainland France. In 1992 eleven new channels transmitted on TELECOM 2-A were introduced for direct reception.

Finally the TELECOM 1-C satellite, which is still operational, is used for video transmissions and for the Transdyn digital services.

2. The direct broadcasting system TDF-1/TDF-2

The French direct broadcasting satellites TDF-1 and TDF-2 were launched in 1988 and 1990, respectively. They are co-located at orbital position 19° W and broadcast four D2-MAC television programmes. Efforts are currently focusing on the development of HDTV broadcasting.

3. Intercontinental telecommunications

With a contribution of 4.23 %, France Telecom is the fourth largest investor in the INTELSAT system, of which is makes extensive use of intercontinental links and the international transmission of permanent or occasional television programmes, as well as for links with its overseas territories (New Caledonia and Polynesia). At the end of 1992, France Telecom was routing about 6500 intercontinental circuits and about 10 permanent television channels through the INTELSAT network.

4. The European regional system

France Telecom plays a major role in the EUTELSAT regional satellite system and, with a share of 19.4 %, was the largest investor and user in 1992. Following the launch of the fourth second-generation satellite, EUTELSAT has continued to develop its activites with regard to the permanent or occasional transmission of television programmes, public and business telephone services and the Euteltracs mobile messaging service.

France also participated actively in studies on the EUROPESAT project, aimed at finding replacements for the TDF and TV-SAT direct television satellites.

5. Mobile-satellite links

France Telecom is a 5.41 % shareholder in INMARSAT, which provides satellite links with mobile stations. Initially, limited to maritime mobile stations, the services offered by the organization are now expanding rapidly to include land and aeronautical facilities.

France is the fifth largest user of the system, with 507 Standard A stations for telephony and telex and 299 Standard C stations for messaging. French earth stations handle 6.2 % of INMARSAT's Standard A traffic and 22.5 % of the Standard C traffic.

GERMANY (FEDERAL REPUBLIC OF)

1. Participation in INTELSAT and EUTELSAT systems including earth segment equipment

1.1 *INTELSAT*

The changeover from the analogue transmission technique to the digital transmission technique in telephony was continued in 1992. However, the extent of the changeover was not as large as had been planned, since there had been delays on the part of industry in supplying compatible DCME (Digital Circuit Multiplication Equipment).

Due to the connection of telephone and data circuits to the new trans-Atlantic optical fibre cable between Europe/Germany and North America, a slight decrease in satellite-based circuits in the Atlantic East region occurred. However, because there was heavy demand for connections to the Middle East and the Far East, in the end there was a slight overall growth in telephone, data and leased circuits.

By now, Deutsche Bundespost Telekom — by means of leased satellite transponders — has made it possible for customers in Eastern Europe to gain direct access to the international telephone network via a network access point in Frankfurt/Main.

1.2 *EUTELSAT*

The VSAT (Very Small Aperture Terminal) system, which is operated via Eutelsat satellites and is mainly used for data transmissions, was further extended also in 1992. The use of VSAT systems for telephone operations was also initiated.

In spite of fierce competition, the development of VSAT networks in Eastern Europe could be further continued with success.

In the Hameln earth station, a new antenna facility was installed for exclusive use by VSAT systems, which was put into operation in June 1992.

2. Participation in the INMARSAT system

2.1 *Earth segment equipment*

The traffic volume via the Inmarsat land earth station (LES) in Raisting developed very favourably in 1992. 16 modems for the land-sea direction and 15 modems for the sea-land direction are now available because eight additional modems in each direction could be put into operation in the autumn of 1992.

The installation of the equipment required for the INMARSAT-C system in the Raisting LES was completed in the autumn of 1992, so that in addition to the existing telephone, telex and data traffic (INMARSAT-A), the INMARSAT-C service is now also provided.

2.2 *INMARSAT-E (L-Band Distress Radio Call System)*

Since October 1992, the INMARSAT-E system in the Atlantic East region has been in operation. Distress calls from this region are received by Raisting LES and automatically forewarded to the MRCC (Maritime Rescue Coordination Centre) based in Bremen.

In order to make the INMARSAT-E system available worldwide, additional DRPs (Digital Receiver Processors) will be installed and operated in other LESs for the other ocean regions.

The INMARSAT-E system is to be considered as one of the most important distress call and alerting systems within the Global Maritime Distress and Safety System (GMDSS).

3. Participation in the INTERSPUTNIK system

Deutsche Bundespost Telekom's Intersputnik telephone traffic to Cuba was switched over to the INTELSAT system. A videoconference service from Germany to Russia was introduced. In addition, digital international leased circuits to Russia were also established.

4. German satellite system

4.1 *DFS-3 Kopernikus*

After nearly 12 months of preparation, the German telecommunications satellite DFS-3 Kopernikus was successfully launched from Cape Canaveral with a United States launch vehicle in October 1992. After commissioning, it will perform the DFS-1 satellite's functions, i.e. primarily broadcasting (television and radio programmes). DFS-3 Kopernikus has, like the other DFS satellites, 11 transponders:

— 3 transponders in the 11/14 GHz range,
— 7 transponders in the 12/14 GHz range,
— 1 transponder in the 20/30 GHz range.

The DFS-1 will then be used as a backup for DFS-2 and DFS-3. In addition, DFS-1 provides additional capacity for television distribution, telephone traffic, data transmissions etc., mostly to the Eastern Europe region.

The ground operations system in Usingen used to be designed for operating the DFS-1, DFS-2, and TV-SAT satellites. Within just one year, it was expanded such as to operate DFS-3 as well.

5. OLYMPUS satellite project

Within the OPEX (Olympus Propagation Experiments) Group of ESA and the GECO (Groupe des Expérimentateurs de la CEPT pour Olympus), Deutsche Bundespost Telekom participates in a large-scale experimental programme to open up the frequency ranges up to 30 GHz for satellite communications.

The propagation measurements with the Olympus satellite at 12.5 GHz, 20 GHz and 30 GHz were continued also in 1992. The main interest was focused on analyzing individual experiments in order to study the dynamic characteristics of the signals in respect of control techniques (fade countermeasures, up-link power control, frequency scaling).

Another main area of interest consisted in the radiometer measurements of the frequency propagation characteristics at 20 GHz and 30 GHz.

6. Studies on optical communications

The technology of the future for communications outside the earth's atmosphere is optical space communications. Light waves propagate freely in space and can be focused much more closely than electrical waves due to their very short wavelengths. The DLR (Deutsche Forschungsanstalt für Luft- und Raumfahrt, or German Aerospace Research Establishment) has developed a new coherent optical homodyne system with two-phase modulation. It works at a wavelength of 1064 nm and transmits 565 Mbit/s. For the receiver implemented in the laboratory, a sensitivity of 20 photons per bit was achieved for an error rate of 10^{-9}, which so far has been unparalleled in the world.

7. Radio astromomy service

The 100 m telescope in Effelsberg near Bonn has now been in operations for 20 years. Its worth has been widely proved, and it has also been used by visiting scientists from many countries. A key factor has been its flexibility in selecting the appropriate frequency from a range between 400 MHz to 80 GHz.

Highlights were the discovery of a large number of molecular lines which led to far-reaching studies of interstellar dust.

Measurements of radiation polarization are a unique means to study the structure of the magnetic field in neighbouring galaxies.

ICELAND

Nordic activities in the field of satellite telecommunications

See under Denmark and Finland.

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

At the end of 1992, Skyggnir 1-A carried traffic and leased circuits via the Intelsat VI (F-5) satellite at 335.5° E to and from Tanum in Sweden, Nittedal in Norway, Goonhilly in the United Kingdom, Fuchsstadt in the Federal Republic of Germany, Buitrago in Spain, Etam and Shenandoah in the United States and Mill Village in Canada. The conversion from analogue FDM/FM circuits to digital, type IDR/DCMS circuits, which was started in 1989, continued during 1992. At the end of the year, the total number of international circuits was 422, including 360 circuits via IDR/DCME.

A 13 m Standard B antenna, Skyggnir 2-B, has been in operation since 1983. The antenna is normally used for television reception only (B-MAC) and accesses a leased television channel in the Intelsat V-A (F-12) at 359° E. This antenna has also transmission capabilities and has been used as a backup for carrying traffic via Intelsat 335.5° E in case of outage of Skyggnir 1-A.

Occasional television programmes were transmitted for Skyggnir or received on a number of occasions during 1992.

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

The following new Intelsat earth stations were built in 1992:

- A 16 m Standard A earth station, in the town of Höfn on the south-east coast of Iceland, approximately 450 km from Reykjavik. This is an all-digital IDR earth station and will act as a hot standby for the digital services normally carried by Skyggnir 1-A. This station will be ready for service early 1993.
- A 10 m Standard B earth station in Keflavik, a town 40 km south of Reykjavik, has been in operation since 1992 and carries IBS traffic between Iceland and USA.
- An 11 m Standard B earth station at the Skyggnir site, Skyggnir 3-B, was ready for operation at the end of the year. It is used to carry leased circuits between the Air Traffic Control Center in Reykjavik and Søndre Strømfjord in Greenland.

2. EUTELSAT

Iceland is a member of EUTELSAT since 1985.

A 6 m SMS earth station was built at the Skyggnir site in 1992. Its first assignment is to carry leased circuits between the Air Traffic Control Center in Reykjavik and the Faroe Islands. It will start operation early 1993.

During 1992 a number of TVRO antennas were used to receive news and television programmes via Eutelsat satellites for distribution to the television stations and to hotels in Reykjavik.

A 13 m TVRO in Reykjavik was used to receive daily Eurovision transmissions via the EBU Eurobeam transponders on the Eutelsat I (F-5) at 21.5° E.

A 7.7 m TVRO in Reykjavik was used to receive daily newsfeed via the Eutelsat I (F-5) at 13° E, for a private television station in Reykjavik.

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

INDIA (REPUBLIC OF)

1. Introduction

1.1 India has been making use of space telecommunications for more than 20 years. The space telecommunications have been used for various purposes like point-to-point domestic/international telecommunications, distribution of television signals and satellite meteorology/dissemination of weather information throughout the country.

1.2 In the Indian National Satellite Network (INSAT), two satellites at 74° E and 83° E are fully operational with a third satellite at 93.5° E in the inclined orbit. The next satellite in the series is due to be launched in the middle of 1993.

2. General segment of space telecommunications

2.1 At present more than 130 earth stations are in operation for domestic telecommunications. About 25,000 Television Receive Only (TVROs) dish antennae are receiving satellite television programmes, all over the country. The distribution and interlinking of television and radio broadcasting programme through satellite, all over the country is also being undertaken through the INSAT. At present 540 television transmitters and 170 sound broadcast stations are interconnected through satellite. The reception and distribution of weather data is also carried out, which is specially beneficial for the coastal areas of India, prone to cyclones/storms, etc.

2.2 The Administrative Headquarters in all the districts numbering more than 240, of a large country like India, have been inteconnected through a satellite used data network for real time and efficient exchange of essential information for the use by the Government. Besides this, various large organisations have their own dedicated satellite based networks, to connect their operational units and offices spread all over the country.

3. International telecommunication

The international telecommunication is provided with the help of satellite-communication through INTELSAT and EUTELSAT besides submarines cable links. There are two large earth stations and approximate six medium sized earth stations for international telecommunication links provided for including television and data transmission.

4. Space segment activities

Detailed information regarding the progress in space segment capability is given in the following sections:

4.1 *Indian National Satellite System (INSAT)*

The INSAT system is a joint venture of the Department of Space, Department of Telecommunications, Indian Meteorological Department and the Ministry of Information & Broadcasting. The last satellite in the first generation INSAT series, INSAT 1-D launched in 1990 is currently operational.

The first satellite in the second generation INSAT-2 satellite series was launched on July 1992 by an Ariane launch vehicle from Kourou, French Guinea and was placed at 74° E orbital position. It was commanded from the Master Control Facility at Hassan, India, for necessary orbit raising maneuvers and solar array, antenna and solar-sail deployments.

Insat-2 spacecraft configuration

The dry mass of the Insat-2 spacecraft is about 905 kg and the solar panels are sized to generate approximately 1025 W power at end of life (summer solstice).

Insat-2 carries 12 C-band transponders and 6 extended C-band transponders, 2 high-power S-band transponders, a very high resolution radiometer with 2 km resolution in the visible band and 8 km resolution in the infrared band and a data relay transponder operating at 400 MHz for the uplink and extended C-band for the downlink. Insat 2-A also includes a transponder for providing instantaneous alert capability for search and rescue missions. This operates at 406 MHz (uplink) and extended C-band (downlink). Insat 2-A is the first spacecraft in the world to use the extended C-band (4500-4800 MHz downlink and 6725-7025 MHz uplink) as per the Allotment Plan of the World Administrative Radio Conference on the use of the geostationary-satellite orbit and the space services utilizing it (Orb-88).

Detailed characterization of all the payloads on Insat 2-A has been completed and all the payloads are working according to specifications. Insat 2-A has already been put into operational use. It was built in India by ISRO.

Services provided by Insat-2

Like Insat-1, Insat-2 is also a multipurpose satellite and 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.
— National and regional networking of television and radio transmitters.
— Dedicated communication networks for the business and industrial sectors including VSAT networks.
— A Disaster Warning System (DWS) for alerts on cyclonic events.
— Satellite aided search and rescue services.

Future Insat-2 satellites will carry a Ku-band payload also. Development of Ku-band payload is in progress.

4.2 *Indian remote sensing satellite*

IRS 1-A, the first in the operational series of Indian remote sensing satellites launched in March 1988, has been functioning satisfactorily for the past 5 years much beyond its designed life of 3 years. The second satellite in the IRS series, IRS 1-B launched on August 29, 1991, is functioning well. The payloads on-board IRS satellites include two types of Linear Imaging Self Scanning (LISS) cameras with spatial resolutions of 36.25 m and 72.5 m and swaths of 145 km and 148 km. The data transmission is in X and S-bands.

Data from IRS 1-A and IRS 1-B satellites are being received by the Data Reception Station at Hyderabad. Satellite data products are being disseminated to a wide variety of users in different forms like photographic films, paper prints, Computer Compatible Tapes (CCT), floppy disks and cartridge tape products. An Integrated Information Management System (IIMS) has been established to cater for the multimission data processing and dissemination operations.

Availability of high quality data on a variety of types has strengthened the operationalization of remote sensing techniques for resources mapping and management. Several studies have been carried out using IRS 1-A and IRS 1-B data through both visual and digital techniques and data received from other satellites for various application themes such as agriculture, water resources, land use, forestry and environment, ocean resources, meteorology, monitoring volcanic activity, geosphere-biosphere studies etc.

The second generation IRS satellites to be launched in future, IRS 1-C and IRS 1-D, will have better spectral and spatial resolution and other additional features like stereo viewing, on-board recording capability and more frequent re-visits to meet the user requirements during the nineties. Significant progress has been made during the year in realization of IRS 1-C spacecraft hardware/software.

4.3 *ISRO telemetry, tracing and command network (ISTRAC)*

Ground stations in ISTRAC Network provide telemetry, ranging and command support to Indian low earth orbiting satellites and launch vehicle missiôns. The Spacecraft Control Centre (SCC) of ISTRAC located at Bangalore is responsible for spacecraft control, mission analysis and for planning spacecraft operations. IRS 1-A and IRS 1-B payload operations are being carried out on a regular basis at SCC.

4.4 *Stretched Rohini satellite series (SROSS)*

Indian low earth orbit satellite SROSS-C carrying two scientific payloads for aeronomy and X-ray burst detection was built in India and launched by Indian launch vehicle ASLV in May, 1992. Both the payloads and the sub-systems on-board have functioned very satisfactorily and valuable scientific data have been obtained.

IRAN (ISLAMIC REPUBLIC OF)

1. Domestic and rural communications

Islamic Republic of Iran leased 4.72 MHz Ku-band transponders from Intelsat, three transponders for television and one transponder providing telephony and data transmission for phase 1 of the rural satellite communications and VSAT. Both projets (phase 1) of VSAT and rural communications are already operational.

Technical evaluation of the 2nd phase of the above mentioned projects are already finalized and the contracts are under consideration.

2. International communications

For international communications we have three earth stations Shahid Dr. Ghandi SDG earth station with two Standard A and one Standard B earth stations. The number of bearer channel increased to 656 in SDG (292 IDR and 364 FDM channels).

In Boumehen earth station there are, one Standard A earth station with 270 IDR channels which is operational from early 1992 and one operational Standard B earth station with 433 CFDM channels.

In Isfahan earth station the number of channels increased to 454 (334 CFDM, 120 IDR). Due to the increased channels during the year 1992, the utilizations ranking of the Islamic Republic of Iran among the Intelsat signatories went up to the 10th level.

Boumehen CES earth station (INMARSAT) is operational from beginning of the year 1992 for the maritime and mobile services.

ITALY

1. Foreword

Telespazio is the Italian competence centre for space. Its activities span virtually all spatial sectors and can be divided in four distinct items:

- telecommunications,
- space systems and services,
- earth observation and remote sensing,
- studies and experiments.

2. Telecommunications

As exclusive carrier for space telecommunications in Italy, Telespazio is the sole Italian company signatory to INTELSAT, EUTELSAT and INMARSAT.

In 1992 through INTELSAT Telespazio linked Italy to 90 countries working 3,400 hours of international and occasional television services and 4,300 voice circuits. About 1,600 voice circuits and 4,500 television hours have been operated through EUTELSAT system with 15 European countries. As far as mobile maritime services are concerned, through 16 access to INMARSAT over 530,000 and 580,000 minutes of telephone and telex communications were carried out.

ITALSAT, Italian domestic system pioneering assignment on demand, multi-spot and base-band switching techniques, successfully passed the pre-operational phase. Commercial activity will follow the launch of F-2 planned by 1995.

Telespazio satellite services to the business community are steadily growing with the implementation of private and shared VSAT networks for data transmission, high speed facsimile, audio and compressed video. Over 500 VSAT stations have been already installed at banks, companies and government agencies. ARGO, to name but one, is a network operative for emergency purposes that, through a number of fixed and mobile stations, assures the prompt establishment of communications with virtually any location in the Italian territory. The system is also linked to a network of "in situ" sensors gathering seismic and hydrogeological data to monitor relevant phenomena and to alert authorities in case of critical conditions.

Business television services are made available either on occasional or on permanent use. A network of about 100 stations has been realised at the biggest hotels in the country.

Distance Learning university programmes using ESA (European Space Agency) Olympus satellite full video transmission are being started. Students can attend courses in various classrooms spread in the country, equipped to create a multi-media environment.

Land Mobile Satellite Services are made available on a commercial basis via EUTELTRACS. This system, European version of the American OMNITRACS, uses EUTELSAT space segment to provide vehicle positioning and two-way message communications to a control centre. Turn-key applications have been developed to optimise trucks fleet management for goods and materials logistics and improve security through real time tracking of the vehicle.

Testing of PRODAT, the ESA low-rate data system for business mobile users, have been successfully performed. Further tests and commercial phase will follow the exploitation of EMS, a payload for mobile services to be embarked on Italsat F-2.

3. Space systems and services

The main operational services rendered by Telespazio in 1992 are the following:

- TT&C (Tracking, Telemetry and Command) and IOT (in Orbit Test) to INTELSAT and INMARSAT;
- TT&C and In Orbit Control to ESA for the satellite Olympus;
- TRMS (TDMA Reference and Monitoring Station) to INTELSAT and EUTELSAT;
- TT&C and In Orbit Control to ASI (Italian Space Agency) for Italsat;
- Space geodesy for ASI at the Matena Station where VLBI (Very Long Baseline Interferometry) activity integrates basic laser geodesy.

Besides operational services, Telespazio provides engineering of ground systems for control of satellites, for Remote Sensing and Space Geodesy.

4. Earth observation and remote sensing

As National Remote Sensing Centre Telespazio receives, process and distributes data from most of the world earth observation satellites (Landsat, NOAA, SPOT, ERS 1, MOS 1).

Applications implemented throughout 1992 include: land use classification, mapping, cartography, planning of urban areas, oceanography, classification and evaluation of renewable resources. Particular emphasis has been given to the development and promotion of applications devoted to the monitoring of phenomena likely to affect the environment: acid rain, forest fires, waters pollution, tankers spilling, algae invasion. Two programmes scheduled for 1993 and 1994 respectively will use minisatellites technology, i.e., bus of 10/50 kg mass placed at 700/900 km height (L.E.O., Low Earth Orbit). One of these programmes will be aimed to the realisation of a satellite system for the collection of data transmitted by "in situ" terminals. The collected data, once processed, are distributed to the users. The frequency of the measures (4/5 per day) and the whole year availability of the service make this system a powerful tool for meteorologists, environmental agencies, water and electric companies, land and maritime transport bodies. The second minisatellite programme will be dedicated to the dynamic measure and mapping of Sulphurous Anhydride air pollution, basis of the acid rain phenomenon.

5. Studies and experiments

During 1992 Telespazio continued the intense and prolific research activity on new satellite systems and technologies with particular regard to the following topics:

— Development of HDTV (High Definition television) satellite network architectures.

— Study of mobile satellite systems networks based on the payload EMS (European Mobile System – PRODAT ESA programme).

— Investigation for 40/50 GHz band inclined elliptic orbit satellite communication system for land mobile service.

— Development of advanced satellite systems (multi-beam, On Board Processing, assignment on demand) and study of the integration with existing and future ground telecommunications networks (ISDN, B-ISDN, ATM).

— Advanced telecommunication and propagation experiments using the Olympus and Italsat satellites.

6. Radiopropagation

During 1992 the experiments in radio propagation with the Olympus and Italsat satellites as provided for in April 1998 by the Administration PT and as approved by the Upper Council of the PT continued.

The programme was prosecuted into two specific tasks:

— The performance of a huge campaign of attenuation measurement at 20 GHz with Olympus. This is to be carried out using 25 (so-called "auxiliary") receiving stations located in 25 sites throughout the national territory. The campaign is directed towards the features of the territory itself from the point of view of attenuation on the satellite links.

— A realisation of a sophisticated experiment in the area of Rome, under the guidance of the FUB, and one in Turin under the guidance of the CSELT, with two stations per site – the so-called principals, one for Olympus, the other for Italsat – capable of thoroughly taking the measures for the features of the e.m. channel in the 20 to 50 GHz frequency bands.

The greater part of the activities carried out have concerned the analyses of the first measurements taken with Olympus, the refinement of the experimentation project with the Italsat satellite, the testing of the different measuring equipment and the predisposition of the necessary infrastructures.

7. Transmission

The beginning of experimentation on the technique of reception and transmission in diversities of space on a small scale was planned for the second half of 1992. It was organised in collaboration with the communication experiments with Olympus. The non-availability of the receiving-transmitting stations meant that the mesures were postponed until the first half of 1993. Research activity has been directed towards an in-depth investigation into the techniques of antifading that have already been stated in the past as well as into the bringing up to date of matters in the forefront of the field of satellite communications.

The investigations into the techniques capable of combating the strong attenuations caused by rain that appear on connections of frequencies of over 10 GHz, were finalized with the achievement of very strict availability objectives, characteristic of satellite systems integrated with ground networks. Following the evolution presently taking place, oriented towards systems directed at the user, the investigations were also extended to this type of application which, as its main prerequisite is to be economical, requires a performance level that is not as strict as in the previous case. In keeping with this line of inquiry, there was an in-depth investigation of the technique known as Service Diversity (the adapting of the service to the conditions of the channel through variations in the speed of transmission and/or opportune encodings). Studies were also begun on the techniques of multiple access to the satellite which allow for light mixed traffic (voices, data, videos, etc.). On this last aspect in particular, there was collaboration with the CNUCE with respect to the Thin Route TDMA experimentation and the LAN interconnection in the OLYMPUS programme.

Also, in the context of OLYMPUS programme, the point-to-point videoconference, the atomic clock synchronization and ranging measurement, the radiomobile coding and the digital television broadcasting experiments prosecuted.

The point-to-point videoconference sessions studied ergonomic aspects and user reaction in relation to videoconference connections, entirely based on satellite links. A very important role had been played by small transportable earth stations and transportable conference rooms (i.e. room equipment). This investigation is preliminary to multipoint videoconference experiment that will be carried out with gathering technique during next months of 1993.

Atomic clock synchronization and ranging measurements was realized to investigate synchronization and accuracy of two atomic clocks located in distant places.

About Italian satellite Italsat we are waiting for use earth stations to start with the SS/TDMA and traffic rearrangements that will be carried out by seven earth stations located according to the six Italsat spots.

JAPAN

1. Satellite projects

1.1 *Communications*

1.1.1 *CS-3*

The communications satellite-3 (CS-3), a succeeding system to the communications satellite-2 (Japan's first operational communications satellite), consists of two spacecrafts, CS-3a and CS-3b. CS-3a was launched into the geostationary orbit at 132° E in February 1988 and CS-3b at 136° E in September 1988, respectively, by Japan's H-I launch vehicle from the Tanegashima Space Centre of the National Space Development Agency of Japan (NASDA).

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

The Telecommunications Advancement Organization of Japan (TAO) is controlling the orbital sorts and attitude of CS-3.

1.1.2 *N-STAR*

N-STAR, succeeding system to CS-3, consists of two spacecraft, N-STAR a and N-STAR b. They will be lauched into the same orbits as CS-3a and CS-3b. Nippon Telegraph and Telephone Corporation (NTT) will receive the satellites in-orbit from Space Systems/Loral in April 1995 and October 1995. Each satellite is equipped with 26 transponders.

1.1.3 *JCSAT*

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

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

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

1.1.4 *Superbird*

Superbird-A, the commercial communications satellite, was launched into geostationary orbit at 158° E in 1989 by Ariane-4 from the Guiana Space Center in Kourou, French Guiana. Space Communications Corporation (SCC) started its telecommunication services in July 1989 to provide SNG (Satellite News Gathering) and video transmission to CATV, etc. SCC discontinued its services in 1990 due to the Superbird-A accident. Superbird-B was launched in 1992 and SCC reopened the services in 1992. A substitute satellite for Superbird-A was lauched in December 1992. These satellites are three-axis-stabilized satellites built by Space Systems/Loral and weigh 1.55 tons in orbit with a design life of 10 years. It is equipped with 26 transponders (three for 28/18 GHz band, 23 for 14/12 GHz band) and eight spare TWTAs of 14/12 GHz band.

1.2 *Broadcasting*

1.2.1 *BS-3*

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

BS-3N, a supplement satellite of BS-3a and BS-3b, will be launched in 1994. TAO is controlling the orbital sorts and altitudes of BS-3a and BS-3b.

1.3 *Meteorology*

1.3.1 *GMS-4*

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

1.3.2 *GMS-5*

The Geostationary Meteorological Satellite-5 (GMS-5) is scheduled to be launched in early 1995 as the successor to the GMS-4 and is now being developed. The satellite will be equipped with an imager capable of imaging the earth, two adjacent infrared windows (split window) and water vapor channels.

1.4 *Space technology*

1.4.1 *MOS*

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

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

1.4.2 *JERS-1*

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

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

1.4.3 *ADEOS*

The Advanced Earth Observing Satellite (ADEOS) is a satellite intended to establish platform technology for future spacecraft and interorbit communication technology for the transmission of earth observation data. It is equipped with two NASDA sensors; OCTS for marine observation with high precision, and AVNIR for land and coastal observation with high resolution. It also carries six AO sensors. ADEOS will be launched into a sun-synchronous subrecurrent orbit at an altitude of 800 km in early 1996 by an H-II launch vehicle.

1.4.4 *ETS-V*

The Engineering Test Satellite-V (ETS-V) is a satellite intended to establish the basic technology for the bus systems needed for a three-axis-stabilized geostationary satellite. Using this satellite, the mobile satellite communications experiments with aircraft, ships, etc. has been carried out. ETS-V is a three-axis-stabilized satellite and weighs 550 kg in orbit. It was launched into geostationary orbit at 150° E in 1987 by an H-I launch vehicle from the Tanegashima Space Centre.

After the mobile satellite communication experiments were almost completed, the ETS-V are being used to conduct PARTNERS project from the end of 1992, according to the objective of ISY (International Space Year). This project is for the promotion of the international cooperation by the satellite communication technology transfer through a few field experiments in such fields as education and medicine in cooperation with several Asia-Pacific nations.

1.4.5 *ETS-VI*

The Engineering Test Satellite-VI (ETS-VI) is a satellite intended to develop the spacecraft bus which meets the requirements in the field of satellite communications and broadcasting services in the 1990's, and also to develop the technology for advanced satellite communications in the future. ETS-VI is a three-axis-stabilized satellite and weighs 2.0 tons in orbit. It will be launched in the summer of 1994 by a H-II launch vehicle.

1.4.6 *COMETS*

The Communications and Broadcasting Engineering Satellite (COMETS) is a satellite intended to develop the new technology in the field of the inter-orbit communication, the advanced satellite broadcasting and the advanced satellite mobile communication, and also develop the multifrequency integration technology and the two ton-class advanced spacecraft bus technology. COMETS is a three-axis-stabilized satellite and weighs two tons in orbit. It will be launched in early 1997 by a H-II launch vehicle.

1.4.7 *TRMM*

TRMM is a joint project between Japan and the United States. It is the first space mission dedicated to quantitatively measuring tropical and subtropical rainfall which is one of the most important and least-known parameters affecting the global climate system. It will be launched in 1997 by a H-II launch vehicle.

2. International satellite communications

2.1 *INTELSAT*

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

2.2 *INMARSAT*

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

KOREA (REPUBLIC OF)

1. INTELSAT

1.1 Korea Telecommunication (KT), the signatory of Korea to INTELSAT, leased one 72 MHz transponder from the Intelsat V-A (F-11) and established an earth station in five cities including Seoul to provide services such as high speed data, video relay, VSAT, etc.

1.2 Also Dacom established an Intelsat Standard A earth station located at Ah-San in 1992 and started the international satellite communication service to 60 countries.

2. KOREASAT national programme

2.1 As for the KOREASAT programme initiated from 1991, General Electric (GE) has been under the construction of its bus since December 1991, while McDonnel Douglas is due to launch it by Delta II at the Cape Canaveral Airforce Station in Florida in 1995.

2.2 The major services and characteristics of KOREASAT are, as follows:

The major services:

— Direct broadcasting satellite service,

— Video relay,

— Digital trunking inter-city communication,

— Remote/Rural area communication,

— Wide band digital data,

— VSAT.

General characteristics:

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

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

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

— Bus: GE Astro 3000;

— Mass (B.O.L.): 910 kg;

— Life time: 10 years.

3. The experimental microsatellite Kitsat-1

Korea's first experimental satellite, Kitsat-1, was successfully launched into the earth's orbit at 23:08 h (GMT) in August 1992 by the Ariane V-52 alongside the main passenger, the Topex/Poseidon from the Guiana Space Centre in Kourou of the French Guiana into a circular orbit with an altitude of 1,300 km, an inclination of 66° and an orbit period of 110 minutes. After the launch, the Satellite Technology Research Center (SaTReC) which is a groundstation at Taejon, Korea has successfully communicated with the Kitsat-1.

3.1 *Mission*

Digital Store-and-Forward Communication Experiment (DSFCE)

The DSFCE allows all the amateur HAMs in the world to have open access store-and-forward digital communications. The standard PACSAT protocol is utilized and its transmission speed is 9.6 kbps. It is based on an 80C186 CPU and 13 Mbytes of CMOS SRAM.

CCD Earth Imaging System (CEIS)

The CEIS captures meteorological scale images in a 578 × 576 pixel format. It is comprised of two CCD cameras and a transputer based on image processing system. One of the cameras has a wide angle (96°) with a low resolution (4 km × 4 km per pixel) while the other has a narrow angle (12°) with a high resolution (400 m × 400 m per pixel) to spot the centre of the picture taken by the wide angle camera in more detail.

Digital Signal Processing Experiment (DSPE)

The DSPE provides speech processing applications such as voice store-and-broadcasting and voice telemetry broadcasting. This includes speech coding, filtering, compression and so forth.

Cosmic Ray Experiment (CRE)

The CRE consists of the Total Dose Experiment (TDE) and the Cosmic Particle Experiment (CTE). The TDE measures the accumulated ionizing dose at various locations on-board the Kitsat-1, and the CPE characterizes the Kitsat-1 orbit radiation environment in terms of the observed Linear Energy Transfer (LET) spectrum inside the spacecraft.

4. 1992 UN Workshop on Space Communication for Development

The United Nations decided the year of 1992 as the Year of Space Communication. To celebrate this, ETRI organized in 1993 to convene the workshop on space communication for development supported by the United Nations and the Ministry of Communications, Republic of Korea. Many space communication experts and key personnel of Asia-Pacific countries (ESCAP members) were invited to attend the workshop where twenty-five topics of technical development experiences were presented and the direction of the space communication technology was discussed.

LITHUANIA (REPUBLIC OF)

The most important event was the opening of the gateway with Western countries via Eutelsat-2, using the second new switching centre in Kaunas (Lithuania) system S-12 and earth station with a space antenna, the diameter of which is 5.5 m, which works in the Ku-band.

Our operator is the Danish Telecom, and we get two-ways communications with 13 countries, including USA, Canada, Israel and 10 European countries. We have here a two Mbit/s stream compressed four times (120 links).

An alternative way to the world is a new bounded antenna near Vilnius, the diameter of which is 11 m, which is joined with Vilnius International Toll Exchange, and it gives us the possibility to communicate with USA and Canada customers, using the IDB International as the operator.

The existing space communication with Oslo (Norway Telecom) via Norsat was expanded from 64 kbit/s to 2048 Mbit/s. This gateway is basically used for data communications with Western Europe.

Our cellular mobile network, NMT-450, also was introduced in 1992. We have covered the area of three largest cities of Lithuania (Vilnius, Kaunas, Klaipeda) and we have established space gateway with Denmark, with all the world via Denmark, and have improved the roaming system with Denmark, Sweden and Norway.

MADAGASCAR (DEMOCRATIC REPUBLIC OF)

In 1992, Madagascar's DOMSAT system did not undergo any significant development.

A pilot phase, DOMSAT-1, which was completed in 1990, interconnects the Antananarivo-Mahajanga and Antananarivo-Antsiranana links.

The network uses INTELSAT's SCPC-VISTA system and operates in the band 4/6 GHz (C-band) with the Intelsat VI satellite at 63° E over the Indian Ocean. It uses 18 circuits, half of them to Antsiranana and the other half to Mahajanga, with analogue modulation.

Telephone and facsimile services are provided, and telegraphy and telex were brought into operation in 1991. Subscribers are connected to an OPUS-300 PABX initially designed to accommodate about 100 subscribers.

The number of subscribers now connected is given in the table below:

Station	Subscribers connected	Subscribers waiting list
Antsiranana	97	24
Mahajanga	95	30

The second phase of the project (DOMSAT-2) will be the subject of a pre-planning study with a view to integrating the system in Madagascar's five-year telecommunication plan, prepared in collaboration with the ITU.

The study will take account of present and future requirements and of the general objectives laid down by the Administration.

In September, the Madagascar-France link was digitized; the FDM/FM carrier was replaced by a 2 Mbit/s IDR carrier.

MALI (REPUBLIC OF)

The following developments took place in the Republic of Mali:

— installation and bringing into service in December of a 16 m diameter Standard A earth station operating with the primary AOR satellite at 335.5° E and equipped with IDR, FDM/FM and SCPC carriers;

— the link between Mali and France is now set up over the IDR carrier with 2048 Mbit/s DCME, replacing the old SCPC equipment;

— bringing into service of two FDM/FM carriers:
  - — Europe carrier, 36 circuits (Germany, Belgium-Netherlands, Switzerland, Italy, United Kingdom);
  - — Africa carrier, 48 circuits (Côte d'Ivoire, Congo, Gabon, Togo, Saudi Arabia).

It should be noted that:

— the following existing SCPC links have been converted to FDM/FM;
Mali-Germany;
Mali-Italy;
Mali-Belgium;

— the following new direct links have been or are currently being set up;
Mali-United Kingdom;
Mali-Switzerland;
Mali-Gabon;
Mali-Côte d'Ivoire;
Mali-Saudi Arabia.

Transfer of all international circuits from SLY-02B (SCPC) to SLY-03A is in progress.

NEW ZEALAND

New Zealand has for many years taken advantage of satellite communications to extend its ability in its dealings with the rest of the world.

It has a number of merchant vessels and fishing vessels operating through the INMARSAT system, using both Standard A and Standard C. This is expected to grow with the advent of land-mobile usage becoming more attractive.

For its international communications a number of transponders are accessed on the Intelsat 174 and 180 satellites, with major earth stations at Warkworth, Aukland, Wellington and Rangiora.

The OPTUS/AUSSAT Ku-band satellites B-1 and A-3 are also accessed for a variety of services including VSAT.

New Zealand also operates satellite service from its offshore islands at Chatham Islands, and also from its Antarctic base at Scott Base. This service replaced the unreliable HF radio systems that had been in use for many years.

OMAN (SULTANATE OF)

Significant progress was achieved in the existing satellite network, mainly in the regional and domestic satellite networks which operate with Arabsat first generation satellite. A total of nine 11-metre dia earth stations, namely one for the Arab Regional Network, and the remaining eight operating within the Domestic Network, were modified to add capabilities to work with inclined orbit satellites employing INTRAC-3 systems from Signal Processing Limited (SPL), United Kingdom.

On the other hand, an Intelsat Standard A earth station (21 m) operating with an AOR satellite at 342° E longitude was expected to be operational at Ibri by year end '92 but, owing to some technical problems, could not be commissioned. Anticipated date of operation is now June 1993. This fully-digital earth station incorporates IDR and DCME technologies to INTELSAT specifications.

The existing fully-analog Intelsat Standard A earth station (32 m) operating in the IOR with 60° E longitude satellite is expected to be replaced by a new Standard A earth station by early 1995 which will also employ digital technologies such as IDR and DCME.

One 4.5 metre fly away earth station (designated OMA-01F1) was installed in the capital area of the Sultanate of Oman in 1992. This station is capable of transmitting and receiving one 64 kbit/s IBS (IINTELSAT Business Service) circuit and at present working with Lario earth station in Italy via the Intelsat satellite at 63° E.

PHILIPPINES (REPUBLIC OF THE)

1. Review of the space related activities

1.1 *Latest development on international satellite communications*

The Philippine Communications Satellite Corporation, PHILCOMSAT, the government-designated Signatory to INTELSAT and INMARSAT provides public telecommunications services utilizing these two existing international satellite communications systems. PHILCOMSAT updates its facilities as required by developments towards digitalization of satellite communications services and integration of computers and communications, ultimately universal ISDN services.

At present, the Philippines does not have a Coastal Earth Station (CES) of its own. It provides INMARSAT Maritime Mobile Services using the CES facilities of its neighbouring member countries in INMARSAT.

PHILCOMSAT with 25 years of managerial experience and technical expertise in satellite communications has conscientiously pursued its mission in providing reliable, cost-effective, global-access telecommunications services. To effectively maintain such highly reliable service, PHILCOMSAT has replaced the original 20-year old Pinugay 1-A antenna and associated electronics equipment.

The new antenna designated as Pinugay 4-A was inaugurated in 1989 in conjunction with PHILCOMSAT's 22nd Anniversary. PGY 4-A has a smaller 21 m diameter compared with those of earlier stations PGY-1 and PGY-2 with 30 m diameter antennae used by PHILCOMSAT since 1967.

PHILCOMSAT introduced the INTELSAT Business Service (IBS) in 1990 and now has established three IBS earth stations at customer premises running digital private network with initial data rate of a T-1 (1,544 MBPS).

In 1992 PHILCOMSAT in its objective of going full digital operation has introduced Intermediate Data Rate (IDR) services initially in the Pacific Ocean region and the follow on the Indian Ocean region in 1994 time frame.

2. Number of regional distribution of full-time circuit as of December 1992

Pinugay 4-A (Pacific Ocean region)
— FDM/FM/FDMA 159
— SCPC/QPSK/FDMA 12
— IDR/QPSK/FDMA 5 × 2 bit/s

Pinugay 2-A (Indian Ocean region)
— FDM/FM/FDMA 260
— TDM/QPSK/TDMA 318

3. Services offered

Overseas telephone
Telex
Telegrams
INTELSAT Business Service (IBS) for private network
INMARSAT Maritime Mobile Service
Contract Television Service (CTS)
High Speed Data Circuits
Television (Occ. basis)
Television standards conversion NTSC/PAL/SECAM
Service restoration for the fiber optic cable system

As the need arises for new services, PHILCOMSAT will provide the facilities for the following telecommunications services:

— Aeronautical Air to ground or air to air communications requirements of (international and domestic) airlines.

— INTELNET Primarily for multi-destination data distribution and/or collection.

— VISTA Voice/data which will serve the users requirements for circuits low density traffic.

POLAND (REPUBLIC OF)

1. Communication Centre Psary of Polska Telekomunikacja S.A. (Polish Telecommunications C.O.) is located about 160 km South of Warsaw (capital of Poland) close to Psary village. It comprises five satellite earth stations (E/S) operating in three Global Satellite Systems (INTERSPUTNIK, INTELSAT and INMARSAT). The sixth station operating in Regional Satellite System (EUTELSAT) is planned to be put into service this year.

2. Intersputnik E/S (built in 1971) is equipped with 10 m antenna. It is designed for television and TP/SCPC services and operates via Stationar-4 located on 346° E (AOR). A new series of Express satellites will be launched in coming years and modern digital technic of telephony (IDR) will be implemented in this system.

In 1992 Intersputnik E/S-Psary was the first one in this system maintaining series of tests to check IDR telephony transmitting capabilities using existing ground and space facilities. Test results have proven system users that offered service quality meets requirements. Based on traffic needs and technical investigations, during this year Intersputnik E/S will be modified for different size IDR carriers.

3. The first Polish Intelsat E/S (built in 1982) with 32 m antenna is pointed to Intelsat VI satellite located on 335.5° E (AOR). This station is capable to operate in both A and B polarisations in 500 MHz of C-band and is carrying occasional television services and significant telephony traffic between Poland and North America and some small capacity carriers to African and Middle East countries.

To meet INTELSAT requirements a great part of existing telephone circuits was transferred from analog FDM/FM into digital IDR carriers between May 1991 and February 1992 (traffic USA-ATT, USA-MCI and Teleglobe Canada) and a new 2 Mbit/s IDR carrier was established for Polish-USA connectivity. Presently 89% of telephony traffic is digital and it is planned to achieve almost 100% in incoming years (using different size IDR carriers).

4. Second Polish Intelsat E/S (built in late 1989) is equipped with 16 m antenna and operates via Intelsat VI satellite located on 60° E (IOR). This station is capable to operate in full 575 MHz C-band in both A and B polari-

zations. Intelsat IOR E/S provides connectivity for television occasional services and regular telephone traffic with Asia and Australia continents.

In 1992 digital circuits with a new Japan operator (ITJ-Japan) were established. The whole existing telephone traffic between Poland and Japan KDD was transferred from analog FDM/FM to digital IDR carriers. Simultaneously a number of circuits was increased, twice. Based on international agreements made in 1992 in early 1993 telephone traffic with ORC Australia will be transferred from analog to digital IDR. That will significantly improve Poland-Australia telephone service quality and increase a number of circuits. That will also make a free space on FDM/FM carrier for establishing some new connectivity (China, Hong Kong, Tailand) and increase to existing ones (India, Korea). That will finalize plans for 1992 telephone service. All existing and new small services on FDM/FM carrier will be transferred into different size IDR carriers in near future.

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5. Two Inmarsat Standard A land earth station (built in 1987) presently operate with second generation satellites (Inmarsat II) in four regions configuration. One antenna is positioned to Atlantic Ocean region-East (AOR-E) satellite, second is positioned to Indian Ocean region (IOR) satellite. Both provide connectivity ship to ship and ship to Land Public Network for telephone, telex, fax and slow rate data.

In 1992 in IOR region station number of satellite channels increased from eight to nine.

In late 1992 in AOR region station tests in new configuration of dual satellite mode were performing. Consequently AOR station started operating in dual satellite mode using additional new small antenna for L-band transmission.

Polish delegates actively participated in INMARSAT conferences and technical meetings, as system signatories:

a) investment works connected with so-called Project 21,
b) works of ACTOM (Advisory Committee of Technical Operational Matters),
c) joint Implementation Meetings for INMARSAT B/M.

6. In May 1992 Contract for satellite earth station for EUTELSAT between Telekomunikacja Polska S.A. and Satellite Transmission System Inc. was signed. Based on it in the middle of 1993 a new Eutelsat E/S should start operation providing a big improvement in connectivity between Poland and whole of Europe. This new E/S will be equipped with 13 m antenna and will be capable to operate in both II and V polarisations in Ku-band. This station will be equipped with 120 Mbit/s TDMA/DSI terminal with transponder hopping switch facilities for five up-links and four down-links and high quality television for occasional use. It is agreed to start operation on Eutelsat I (F-1) 21.5° satellite initially with almost 1,200 telephone channels.

7. Psary satellite centre is connected with Warsaw via Analog Microwave Link and 140 Mbit/s Microwave Digital Radio and 140 Mbit/s Fibre Optic Cable. Both: Digital Microwave Radio and Fibre Optic Cable are extended to Katowice (a capital of industrial centre of Poland, Silesia).

PORTUGAL

1. International organizations

1.1 *INTELSAT*

Till the end of 1992, they were operating in this system six Standard A antennas, two Standard B antennas and one (F-3) (IBS) antenna. The analog transmission FM/FDM to IDR conversion is growing up to 1,615 IDR circuits (550 beares) and up to 415 FDM circuits.

About SCPC service (32 circuits), we observed a significant decrease utilization of this service and we expect its complete extinction by the end of 1994.

In 1992, they were established connexions with six new correspondents totalizing 40 different connexions.

1.2 *EUTELSAT*

They were operating three fixed antennas and one transportable antenna, with capacity for television and data transmission (2 Mbit/s, for videoconferencing and digital radio programmes).

The TDMA/DSI circuit supports were decreased as a result of the introduction of the DCME equipment.

The portuguese signatory agency, Marconi, was leased one transponder (EUT II (F-3), 16° E), for transmission of the RTP International broadcasting as well for radio broadcasting.

The EUT (10° E) satellite is used for VSAT service, with 70 remote terminals and the hub station is installed on Sintra seven earth station.

Other earth stations for TTC&M services are TCR four and five for second generation of Eutelsat satellites.

It brought into use for experimental uses, the EUTELTRACS service for radiolocation and data communication of transportation vehicles.

1.3 *INTERSPUTNIK*

It was leased one transponder in the Stationar-12 (40° E) for RTP International broadcasting to the East (Macau) and Africa.

1.4 *INMARSAT*

It started in 1992, the studies and the competition's launch for the construction of the Inmarsat C terminals.

2. The system driven POSAT-1 project

The goal of this project (that began in 1992) is to place a portuguese satellite into a 820 km LEO polar orbit and provide training facilities for engineers and scientists in satellite radio communications and new space technologies. The satellite's launch is scheduled for September 1993, by Ariane, using ASAP (Ariane Structure for Auxiliary Payloads).

The main technologies implemented in the POSAT-1 concerning radiocommunication and TT&C, consist of the following systems:
— On-board computer and data sharing network,
— RF system including the receivers and transmitters,
— Modems,
— Store and forward packet communication system,
— Digital signal processing experiment.

SAO TOME AND PRINCIPE (DEMOCRATIC REPUBLIC OF)

A single Standard B earth station was set up in 1980, using SCPC technology. By the end of 1993, IDR digital technology will have replaced SCPC technology.

SAUDI ARABIA (KINGDOM OF)

Overview of maintenance and extension activities of the Ministry of Post, Telegraph and Telephone related to the satellite communications system of the Kingdom.

Applications and use of services of ARABSAT, INTELSAT and INMARSAT satellite networks present an important part of the national, regional and international transmission network.

Following earth stations are in operation and provide the mentioned services:

ARABSAT

To be noted that the organization has undertaken its initial steps for the establisment of its second generation satellite network. Because of the end of life time of satellite 1-A and 1-B, the third satellite 1-C of the first generation was launched and brought into its geostationary service position at 31° E.

The main TT&C operations are executed via the earth stations at Riyadh. Jeddah-8 earth station carries all regional traffic by a total of 565 circuits to 19 countries. The MoPTT and other government departments of Saudi Arabia have leased three and a quarter transponder for their particular transmission requirements. Beside other services, MoPTT operates a DOMSAT network consisting of three fixed and eight mobile stations; other services provided to various governmental/private sectors include meteorological data collection and distribution, data transmission and videoconferencing.

INTELSAT

Five Standard A earth stations operate with Atlantic and Indian Ocean satellite systems and carry following traffic:

Earth station (satellite)	Number of circuits
Riyadh-4A (AOR)	743
Jeddah-4A (AOR)	SEA-ME-WE Restoration
Jeddah-5A (IOR)	741
Taif (AOR)	340
Riyadh-1 (IOR)	248

IDR services are put into service through Riyadh-4 earth station.

INMARSAT

More than 450 mobile Inmarsat terminals are in use by governmental and public services.

An extensive programme for up-grading the existing facilities is envisaged for the near future to improve digital transmission and enable introduction of ISDN.

SENEGAL (REPUBLIC OF)

Following the upgrading of the whole mechanical structure and the replacement of the tracking system of the Gandoul antenna in 1991, work on the modernization programme of the Gandoul earth station – which involved the replacement of part of the power amplifiers (HPA) – was continued in 1992.

SONATEL began drafting the technological specifications for the digitization of a number of its links and the construction of a second Standard A earth station.

Parallel to these activities, SONATEL was involved in two international events:

— Television coverage of the XVIIIth Africa Nations Football Cup. A transportable earth station was leased and installed at Ziguinchor, the second town which hosted the competitions.

— The Intelsat satellite 603 reboost Mission with the setting up, on the site of the Gandoul station, of a TTC&M antenna to strengthen the network of INTELSAT TTC&M stations.

At the end of the year, the Gandoul earth station was routing 211 circuits serving 22 destinations.

SPAIN

Contribution from Telefónica de España S.A.

In 1992, Telefonica of Spain, as a signatory member of the international organizations INTELSAT, EUTELSAT and INMARSAT, with a 3.09%, 17.91% and 1.47% share, respectively, completed a major strategic plan for the installation of satellite communications, providing the international network with greater capacity and flexibility by increasing its interconnectivity and enhancing its safety.

At the same time, work continued on implementing the current digitization plan, under which the latest digital techniques will be used to provide all types of public service with access to Intelsat Atlantic and Indian Ocean satellites as well as to the European regional system EUTELSAT.

With regard to business communications, the Sevilla-Pineda teleport was brought into service, with two earth stations for Eutelsat satellites and the

Barcelona-8 earth station, also working with EUTELSAT, providing instantaneous satellite support in all cases of demand for business services.

In addition, the VSAT satellite data networks were expanded substantially in 1992 and now comprise some 200 terminals.

Finally, five transportable digital earth stations based at the Guadalajara SCC were procured for occasional business services, videoconferences and special events.

A list of existing earth stations as at 31 December 1992 is given below.

Existing earth stations

Name of earth station	Antenna diameter (m)	Plant installed	Satellite	Organization	Remarks	Code
2 ES TVRO	04.5	Nov. 90	10° E	EUT	TV	—
Aguimes-1	30.0	April 71	325.5° E	INT	TF, TV, SCPC (TV Spanish peninsula + Canary Islands)	AGU-1
Aguimes-1R	04.5	Sep. 91	10° E	EUT	TVRO	AGU-1R
Aguimes-2	13.0	March 90	21.5° E	EUT	TF (TDMA), TV	AGU-2
Aguimes-2R	04.5	Sep. 91	10° E	EUT	TVRO	AGU-2R
Aguimes-3	13.0	Dec. 90	10° E	EUT	National telephony (IDR/SMS)	AGU-3
Aguimes-4	04.57	May 90	10° E	EUT	Inter-island domestic traffic	AGU-4
Barcelona-1	04.5	June 88	7° E	EUT	TVRO (BS San Pedro Mártir)	BAR-1
Barcelona-2	06.4	Feb. 91	10° E	EUT	SMS teleport (Castellbisbal)	BAR-2
Barcelona-3	09.2	Feb. 91	307° E	INT	SMS teleport (Castellbisbal)	BAR-3
Barcelona-4	13.0	Oct. 91	21.5° E	EUT	TVSC EUTELSAT (temporary)	BAR-4
Barcelona-5	18.0	Dec. 91	335.5° E	INT	TF (IDR), TV	BAR-5
Barcelona-6	18.0	Feb. 92	63° E	INT	TF (IDR), TV	BAR-6

Existing earth stations *(cont.)*

Name of earth station	Antenna diameter (m)	Plant installed	Satellite	Organi-zation	Remarks	Code
Barcelona-7	13.0	Apr. 92	338.5° E	INT	Rest. subm. cables	BAR-7
Barcelona-8	07.4	Jun. 92	10° E	EUT	SMS service (Philips)	BAR-8
Barcelona-9	09.2	May 92	21.5° E	EUT	TVSC EUTELSAT (in preparation)	BAR-9
Bilbao-1	04.5	Dec. 88	7° E	EUT	TVRO (BS Santa Maña)	BIL-1
Buitrago-1	29.0	Jan. 68	325.5° E	INT	TF, TV (Spanish peninsula + Canary Islands)	BUI-1
Buitrago-2	30.0	March 70	60° E	INT	TF (TDMA), TV, SCPC	BUI-2
Buitrago-3	30.0	Sep. 73	335.5° E	INT	TF, TV, SCPC	BUI-3
Buitrago-5	32.0	May 82	342° E	INT	TF, TV	BUI-5
Buitrago-6	11.0	Dec. 88	332.5° E	INT	Ibero-American TV Agency Service EFE, VISTA-CUBA	BUI-6
Buitrago-9	13.0	July 90	63° E	INT	TV	BUI-9
CAMPSA I	01.8	Sept. 91	10° E	EUT	VSAT network	—
CAMPSA II	01.8	Sept. 92	10° E	EUT	VSAT network	—
Datasat	00.9	Aug. 92	10° E	EUT	VSAT network Data distribution	—
E.T.R.D.-1 to 8	02.4	July 90	as app.	EUT	SMS relocatable (in stock)	—
E.T.R.D.-10	03.7	July 90	as app.	INT	IBS relocatable	—
E.T.T.-1	07.0	June 88	as app.	EUT/INT	TV (based at Guadalajara)	E-1
E.T.T.-2	04.5	May 89	as app.	EUT/INT	TV transportable (elliptical antenna)	E-2
E.T.T.-3	04.5	May 89	as app.	EUT/INT	TV transportable (elliptical antenna)	E-3
E.T.T.D.-1	02.4	Aug. 89	as app.	EUT/INT	SMS/IBS trans-portable	E-6

Existing earth stations *(cont.)*

Name of earth station	Antenna diameter (m)	Plant installed	Satellite	Organi-zation	Remarks	Code
E.T.T.D.-2 to 6	02.6	Nov. 92	as app.	EUT/INT	5 EST (2×2 Mbit/s) special events	—
EFE-1 to 34	01.8	Nov. 89	332.5° E	INT	VSAT data distrib. network	—
FA 1 to 2	01.9	Apr. 89	as app.	EUT/INT	Portable ES, TV (located at Guadalajara SCC)	—
FA 3 to 4	01.9	Feb. 91	as app.	EUT/INT	Portable ES, TV (located at Guadalajara SCC)	—
Ford-Valencia	02.4	Jan. 90	10° E	EUT	SMS relocatable	E-7
G.S.R.-1	04.0	Jan. 86	7° E	EUT	TVRO (based at Guadalajara)	—
G.S.R.-2	04.0	Jan. 86	10° E	EUT	TVRO (based at Guadalajara)	—
Guadalajara-01	18.0	July 85	21.5° E	EUT	TF (TDMA), TV, TRMS service	GDA-1
Guadalajara-02	13.0	Sep. 90	10° E	EUT	TV (leased transponders TVE), RNE, SER, EFE	GDA-2
Guadalajara-03	06.4	June 88	10° E	EUT	SMS teleport, VSAT network, CAMPSA	GDA-3
Guadalajara-04	09.2	Dec. 88	307° E	INT	IBS teleport	GDA-4
Guadalajara-06	13.1	Oct. 91	10° E	EUT	National telephony	GDA-6
Guadalajara-07	04.57	Dec. 88	7° E	EUT	SMS business service, SER chain	GDA-7
Guadalajara-08	13.0	Feb. 91	325° E	INT	TF (IDR), TV	GDA-8
Guadalajara-09	09.2	Oct. 89	7° E	EUT	TV	GDA-9
Guadalajara-10	04.57	Dec. 88	10° E	EUT	SMS business service (videoconference)	GDA-10
Guadalajara-11	09.2	Nov 90	16° E	EUT	TV	GDA-11
Guadalajara-12	03.7	Apr. 90	63° E	INT	IBS relocatable (videoconference)	GDA-12

Existing earth stations *(cont.)*

Name of earth station	Antenna diameter (m)	Plant installed	Satellite	Organi-zation	Remarks	Code
Lanzarote-1	04.57	May 90	10° E	EUT	Inter-island domestic traffic	LAN-1
Madrid-1	11.0	Dec. 89	332.5° E	INT	TVRO (EBU trans-Atlantic)	MAD-1
Madrid-2	06.4	Nov. 90	10° E	EUT	SMS teleport (Alcobendas)	MAD-2
Madrid-3	09.2	Nov. 90	307° E	INT	IBS teleport (Alcobendas)	MAD-3
Madrid-8	03.6	Aug. 89	7° E	EUT	SMS service (TIDSA)	MAD-8
Malaga-1	04.57	Aug. 89	10° E	EUT	Domestic traffic	MAG-1
Melilla-1	04.57	June 90	10° E	EUT	Domestic traffic	MEL-1
Pace-A	01.0	Aug. 88	26° W	INM	Emergency communications	—
Pace-B	01.0	Aug. 88	26° W	INM	Emergency communications	—
Radio Liberty-1	04.5	Dec. 88	10° E	EUT	Digital radio programme (Pals-Gerona)	RAL-1
Robledo-1	04.57	Dec. 88	307° E	INT	IBS (NASA)	RBL-1
Rota-1	11.0	July 87	359° E	INT	TVRO (TV for USAF)	ROT-1
S.E.R.-1 to 28	02.4	Sep. 88	7° E	EUT	SER chain broadcasting (EST Guadalajara-7)	—
S.E.R.-29 to 54	02.4	Apr. 90	7° E	EUT	SER chain broadcasting (EST Guadalajara-7)	—
Santiago-1	04.5	June 88	7° E	EUT	TVRO (BS Fontecoba)	SGO-1
Sevilla-1	13.0	Dec. 91	21.5° E	EUT	TF (TDMA), TV	SEV-1
Sevilla-2	15.2	Feb. 92	359° E	INT	TF (IDR), TV	SEV-2
Sevilla-3	06.4	Feb. 92	10° E	EUT	SMS teleport	SEV-3

Existing earth stations *(end)*

Name of earth station	Antenna diameter (m)	Plant installed	Satellite	Organi-zation	Remarks	Code
Sevilla-4	09.2	Feb. 92	307° E	INT	IBS teleport	SEV-4
Sevilla-6	03.7	March 92	10° E	EUT	SMS teleport (Pineda)	SEV-6
Sevilla-7	03.7	March 92	10° E	EUT	SMS teleport (Pineda)	SEV-7
Stock-26 ES	02.4	March 90	as app.	EUT/INT	26 ES receivers (2Mbit/s) (SER chain type)	—
Torrejon-1	11.0	July 87	359° E	INT	TVRO (TV for USAF)	TOR-1
Torrejon-2	03.0	Oct. 88	332.5° E	INT	TVRO (TV for USAF)	TOR-2
Zaragoza-1	11.0	July 87	359° E	INT	TVRO (TV for USAF)	ZAR-1

Notes:

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

Report on HISPASAT, 1992

In September 1992 the first satellite of the HISPASAT (1A and 1B) network was launched, starting up the country's first satellite communication system, with the nominal orbit position 30° W (330° E) in accordance with the WARC-77 assignment for direct satellite broadcasting.

HISPASAT is a multipurpose system comprising:

— direct satellite broadcasting (BSS);

— fixed satellite service (FSS);

— both-way Spain-America links for television and other services;

— governmental communication service.

System applications include the development of telecommunication systems (transit and access links, dedicated networks) and of television and radio signals carrier and broadcasting systems (direct broadcasting, contribution, exchange and distribution networks; satellite news gathering (SNG)).

The in-orbit test (IOT) period was concluded successfully in 1992 and commercial operation of the system is due to begin in 1993 (the second satellite, Hispasat 1B, is to be launched in the middle of the year).

The characteristics of the Arganda satellite control centre, which is responsible for operating the HISPASAT system, are given below.

HISPASAT S.A. satellite control centre at Arganda

Name of earth station	Antenna diameter (m)	Plant installed	Satellite	Organi-zation	Remarks	Code
Arganda TTC-1/3	3.3	Sept. 92	330° E	HISPASAT S.A.	TTC	ARG-1/3
Arganda TTC-4/5	7.6	Sept. 92	330° E	HISPASAT S.A.	TTC	ARG-4/5
Arganda TTC-6	9.2	Sept. 92	330° E	HISPASAT S.A.	TTC	ARG-6
Arganda SFS/IOT	6.0	Sept. 92	330° E	HISPASAT S.A.	In-orbit tests (FSS)	ARG-IOT-1
Arganda SRS/IOT	8.0	Sept. 92	330° E	HISPASAT S.A.	In-orbit tests (BSS)	ARG-IOT-2

SWITZERLAND (CONFEDERATION OF)

INTELSAT network

Swiss PTT Telecom has got three E/S antennas of the Intelsat Standard A type in service. The antenna Leuk-1 operates at present with the satellite at 325.5° E, the antenna Leuk-2 with the one at 335.5° E, and the antenna Leuk-3 with the one at 60° E. The conversion from analogue MRF/MF circuits to digital type IDR and TDMA circuits continued in 1992. At the end of the year 1992 there were about 1,200 bearers in operation (analogue and digital circuits).

EUTELSAT network

Swiss PTT Telecom operates with one EUTELSAT type 1 antenna in the EUTELSAT network (Leuk-4). The antenna has facilities for operation in TDMA system. At the end of the year 1992 there were about 500 bearers in operation.

The EBU-SRG programme exchange operates by separate TVO TeleVision Only) earth stations located in Zurich, Geneva and Lugano and has been working with the satellite 7° E on leased EBU transponders since the beginning of 1993. The TVO earth stations on Geneva and Lugano have received facilities only for operating on six (respectively two) television channels simultaneously. The TVO earth station located in Zurich has facilities for transmitting (two channels simultaneously) and receiving (four channels simultaneously).

RAS Fly Away earth station

A mobile earth station (RAS Fly Away) with an antenna diameter of 1.9 m is available for operating with Intelsat and Eutelsat satellites, only for television links. The equipment is made up of Flight-Case modules, which may be transported by road or by air.

Mobile service EUTELTRACS

Swiss PTT Telecom has introduced the EUTELTRACS service and is service provider for Switzerland. The EUTELTRACS service provides within the european coverage the exchange of two way alphanumerical messages between mobile/fixe terminals. At the end of 1992 there were more than 20 Mobile Communication Terminals (MCT) in operation.

SWAZILAND (KINGDOM OF)

Kingdom of Swaziland only has an operating Intelsat earth station.

SYRIAN ARAB REPUBLIC

The Syrian Arab Republic was making contracts and future studies for the following projects:

— optical fiber project between the station and the television and ITMC,
— the project of station to work with the Atlas satellite in INTELSAT,
— the digital microwave link between the station, television and the coaxial cables.

The Syrian Arab Republic has also installed 11 m antenna E/S by MCI to operate with F-3 Atlantic Ocean region, other E/S is under installation by ATT.

Also change to digital radio equipment of the existing 32 m E/S operating with Intelsat Indian Ocean has started after the contract awarded with Cosmos for supplying IDR equipment.

New fiber optic cable to connect the E/S with ITMC a distance of 30 km is under installation by Siemens.

THAILAND

1. International telecommunications

The Communications Authority of Thailand (CAT) is a wholly State-owned Enterprise which provides postal and telecommunication services to the public. In the telecommunication area, CAT gives both domestic and international services via various transmission systems including satellite communications. CAT plays an important role in the satellite communications for business, on account of the ability to pass information and data through an international satellite gateway (Si Racha earth station) to anywhere in the world using INTELSAT's global communication system.

Up to now, several digital services have been emerging in the INTELSAT's network providing much more capability to access the space segment. CAT employs more digital communication system for interconnection within the international public switched and private leased network. At the end of 1992, CAT utilizes the space segment for international services as follows:

— FDM/FM	35.40%
— IDR	34.38%
— IBS	3.32%
— TDMA/DSI	25.36%
— SCPC/PCM/PSK	1.54%

2. Domestic telecommunications

2.1 For the domestic services, CAT is introducing IDR with DCMS system to fade out the use of SCPC. The project is expected to start within 1993.

By the end of 1994, CAT will have the second international satellite gateway in Nontaburi province to serve the business network which is growing very fast. The new gateway will access to several satellite systems such as INTELSAT, INMARSAT, PALAPA, THAICOM, ASIASAT, etc.

2.2 The present use of domestic satellite communications comprises: distributing television programmes from Bangkok to the television broadcasting stations in the provincial and rural areas for nationwide television broadcast, providing public telephone services, high speed digital data communication services, administration network for government services.

2.3 In 1991, Shinawatra Computer and Communications Group (SC & C) was selected by the Ministry of Transport and Communications to acquire, launch and operate Thailand's first national satellite system.

In 1991, His Majesty King Bhumiphol has officially named the satellites Thaicom which symbolizes the link between Thailand and modern communications technology.

Thaicom specification

Design life:	Minimum 13 years
Contractors:	Hughes Aircraft (spacecraft, ground station, training) Arianespace (laucher), Telespace Ltd. (technical support)
Launch date:	December 1993 for Thaicom 1 May-December 1994 for Thaicom 2
Location:	101° E for Thaicom 1 78.5° E or 120° E for Thaicom 2
Operating date:	February 1994 for Thaicom 1 July 1994-January 1995 for Thaicom 2
Capacity:	10 C-band transponders (plus two transponders redundancy) with minimum e.i.r.p. of 37 dBW for Thailand 2 Ku-band transponders (plus one transponders redundancy) with minimum e.i.r.p. of 50 dBW for Thailand

3. Meteorological satellite activities

Since the completion of the Meteorological Satellite Receiving Station in February 1990, the Thai Meteorological Department has been routinely acquiring weather satellite data for its operation. Such data includes the Advance Very High Resolution Radiometer (AVHRR) from the polar-orbiting satellite, NOAA-11, NOAA-12 and the Stretched Visible Spin Scan Radiometer (SVSSR) from the Geostationary Satellite, GMS-4. The AVHRR and SVSSR data have been incorporated into daily weather forecasting and typhoon tracking activities. In addition, the Thai Meteorological Department is conducting research on drought early warning, vegetation monitoring, and flood forecasting applications.

4. The applications of remote sensing in Thailand

Satellite remote sensing technology provided an authentic source of information for surveying, identifying, classifying, mapping and monitoring of natural resources, environment and disaster. The satellite imagery/data have been used in various fields of application such as agriculture, forestry, cartography, hydrology, meteorology, land use, environmental management, etc.

Since 1972, Thailand participated in the satellite remote sensing programme of the United States and established a ground receiving station in Thailand as an operational unit under the Remote Sensing Division, National Research Council of Thailand.

The station initially acquired data from Landsat-2 and 3 and meteorological satellite: TIROS-N and NOAA. With the upgrade in 1987, the station now receives high resolution data from Landsat-5/TM, SPOT-2 and MOS-1. In 1993, Thailand receiving station will be upgraded to receive JERS-1 and ERS-1/SAR which will provide microwave active sensor for all weather observation. Moreover, remote sensing data is being integrated with the Geographic Information System which would enable the decision-maker to have better informatioan for natural resources management and environment monitoring.

The use of satellite data

Agriculture:	Satellite data provides information about land-use, the crop damage, flooding areas and irrigated pattern which are useful in land-use planning.
Forestry:	Major forest type classification and forest or non-forest areas can be detected from satellite imagery. Disturbed areas can be easily mapped.
Geology:	Satellite imagery shows geological structure which is much helpful in geological mapping, mineral resources and petroleum exploration and also useful for engineering works such as dams and reservoirs construction as well as roads and bridges.
Oceanography:	Satellite data helps to indicate the possible location of fish schools. This is very useful for coastal zone agriculture as well as marine environmental monitoring and forecasting. Such information is being supplied to govermental organization, aquacultures/fish farming, tourist industry, etc.

Satellite data is increasingly applied in the management of natural resources which consists of the utilization, development, conservation and rehabilitation. Thailand with its ground receiving station located in the geographical centre of South-East Asia is playing an important role as the source of remote sensing data in this region.

TURKEY

Space Sciences Department (SSD) has been established at Marmara Research Centre (MRC) of TUBITAK in 1991. Presently, there are about 20 scientists, engineers and technicians, some of which foreign nationals in the department. The Department established a programme in which a proper combination of theoretical, observational, instrumental and applicational aspects of space-related topics. They are formulated in three separate projects with headlines of:

— Radio-telescope / Microwave development,
— Remote sensing and image processing,
— Space sciences (astronomy, astrophysics, atmospheric physics).

Main aim in these projects can be summarized as follows:

— Establishment of a millimetric radio telescope for world class research at these and nearby wavelengths and establishing a fully equipped laboratory to support research in the related radio and microwave technologies;
— Establishment of a national remote sensing centre and a data centre for use and participation of several groups in the universities and public offices already working in the areas of remote sensing and image processing;
— Support basic research in space sciences and establishment of a national optical observatory to serve national and international research groups in the area of astronomy and astrophysics.

Work carried out in recent years in each area can be summarized as follows:

— Site selection and feasibility studies for the radio telescope have been conducted and technical reports have been prepared.
— Purchase of an image processing equipment and software has been completed, initial steps for a National Data Centre at MRC have been taken. In this respect, a national grain acreage estimation project (started in 1991) has been continued and reports from participating groups combined to prepare the yearly report to be submitted to Ministry of Agriculture, State Planning Office, State Statistical Office and other public offices interested.
— Site selection for the national optical, observatory which was already in program when SSD was established, has been finalized and initial steps for the ownership of its infrastructure (road, water, electricty) to the mountain top at western Taurus mountains have been completed.

Cooperation with Azerbaijan, Ukraine and Russian Federation as well as Germany, France and the Netherlands at various phases of above mentioned projects have been established. United Nation's UNIDO Organization is providing equipment and expertise support to aimed radio telescope and "national remote sensing centre" projects under a joint grant with Turkish Government.

The first satellite of the Turkish satellite system, namely TURKSAT, carrying 16 Ku-band transponders will be launched in 1993 and is expected to be operational in early 1994. The lifetime of the satellite is assumed to be 10 years and will be used for both domestic and international telecommunications services.

The project prepared for the telecommunications services between Turkey and Turkmenistan, Kazakhstan, Uzbekistan, Kirgizia and Tadzhikistan has been realized and telephony and television service are now available. Progress will continue in 1993 and more capacity will also be available for transit traffic between these countries and the other countries in the world via Turkey.

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