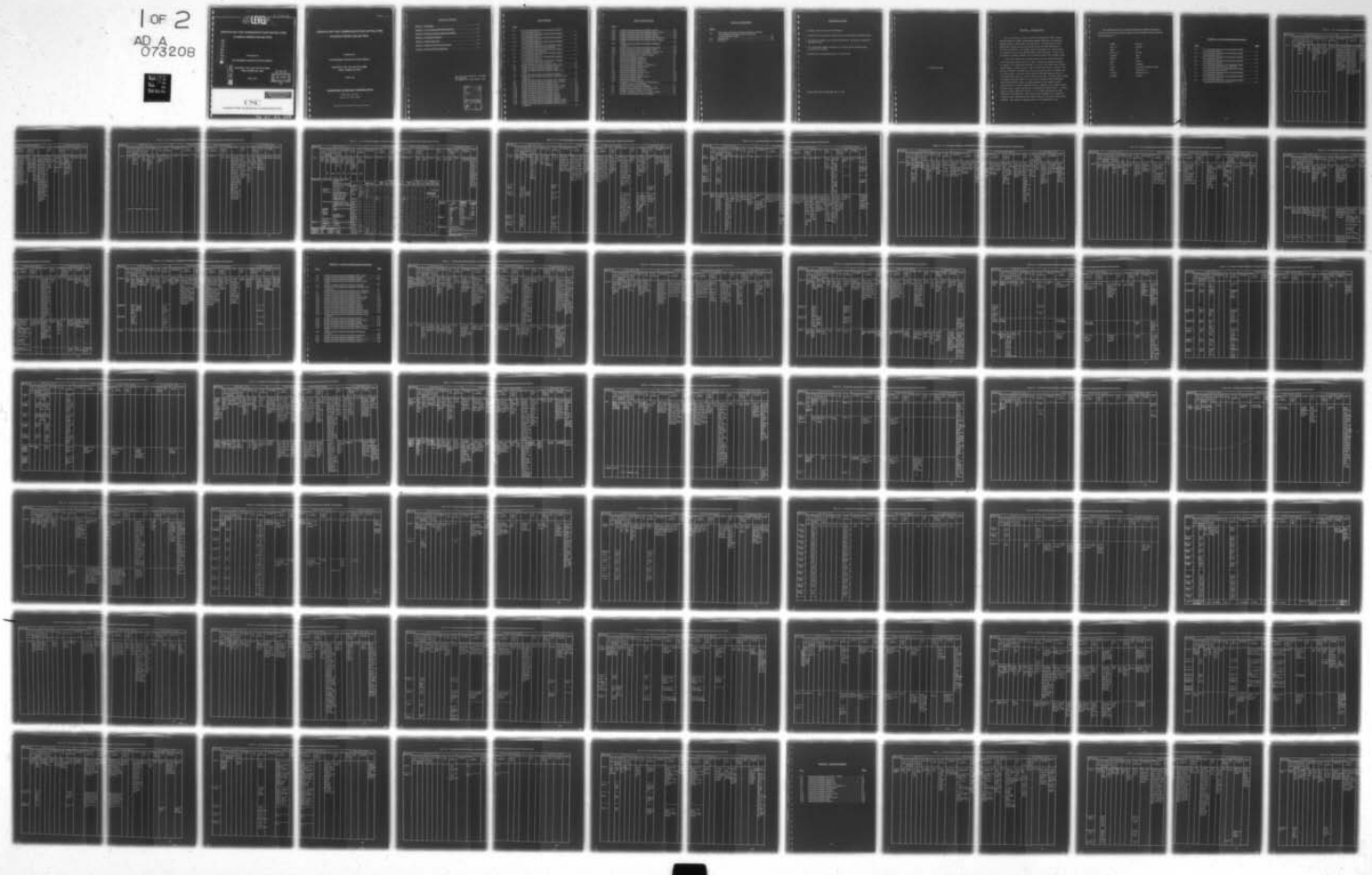
AD-A073 208 COMPUTER SCIENCES CORP FALLS CHURCH VA F/G 17/2
UPDATE ON THE COMMUNICATION SATELLITES CHARACTERISTICS MATRIX,(U)
APR 79 B PATTAN, G T ANDERSON DCA100-76-C-0089
UNCLASSIFIED SBIE-AD-E100 249 NL

1 OF 2
AD A 073208



(2) LEVEL III

SC

UPDATE ON THE COMMUNICATION SATELLITES CHARACTERISTICS MATRIX

Prepared for

THE DEFENSE COMMUNICATION AGENCY

CONTRACT NO. DCA 100-76-C-0089
TASK ORDER NO. 0312

APRIL 1979

CSC
COMPUTER SCIENCES CORPORATION

Copy No. ____

UPDATE ON THE COMMUNICATION SATELLITES CHARACTERISTICS MATRIX

Prepared for

THE DEFENSE COMMUNICATION AGENCY

CONTRACT NO. DCA 100-76-C-0089
TASK ORDER NO. 0312

APRIL 1979

COMPUTER SCIENCES CORPORATION

6565 Arlington Boulevard

Falls Church, Virginia 22046

Major Offices and Facilities Throughout the World

TABLE OF CONTENTS

RE: Classified references, distribution unlimited-
No change per Ms. Mary Bonnett, DCA

LIST OF TABLES

LIST OF TABLES (Cont'd)

LIST OF ILLUSTRATIONS

Figure

STATSIONAR UPDATE

- Operates in both 4/6 GHz and 7/8 GHz bands.
- 25 square feet of solar cells on panels and some cells mounted on cylindrical body.
- Two spot beam antennas, one a dish (4 foot diameter), the other an "orange peel" operating at 4 GHz.
- Two "orange peel" antennas operating at 7 GHz band (can be rotated to change coverage prior to launch).
- Global horns for transmitting at both 4 GHz and 7 GHz.

Aviation Week & Space Technology, July 11, 1979.

1-0 INTRODUCTION

SECTION 1 - INTRODUCTION

This is the third in a series of Satellite Characteristics Matrix reports which describes the salient communication payload parameters of international satellite systems - both military and commercial. The information has been gleaned from various sources and attempts to describe these systems up to the time of publication. The satellite systems described are at various stages of completion, that is, from planning stage to fully operational. Clearly, some information on military satellites is not included because of the classified nature.

Several new satellites are presented which were not indicated previously. In the commerical sector, there is a trend to regional and domestic satellites as opposed to the international INTELSATS. Several of the better known domestic include Westar, Comstar, Satcom, ANIK, Statsionar and Palapa. However, even here the distinction is flexible since these may provide service to countries close to the host nation. Examples of these include ANIK which supplied service to the United States before the advent of Westar and Satcom, and Palapa which belongs to Indonesia providing service to nations such as Australia and the Philippines. Other satellite systems which are gaining impedus are the regional systems providing service to several contiguous nations. Satellites in the category include Arabsat, Norsat, Condor and European Communications Satellite (ECS). In addition several satellites which have decayed or are no longer operational have been deleted from the publication. The report has been expanded by the inclusion of a general section which includes the orbital locations of all known communication satellites. This applies to satellites which are in geosynchronous orbit.

The satellites which were previously included in the satellite characteristic matrix have had their characteristics updated. The new satellites which are included in this publication are :

GPSHF	NORSAT
NATO IV	RADUGA
SFCS	RS
ANIK A-D	SATCOL
CONDOR	SBTS
EKRAN	STW
GALS	VOLNA
GMS	ZOHREH
H-SAT	ADVANCED WESTAR/TDRSS
INSAT	INTELSAT VI
LOUTCH	INTELSAT MCS
MARECS	LEASAT

SECTION 2 - U.S Government Sponsored Satellites

Table 2-1. U.S. Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
ATS-1	NASA; HAC	12/6/1966; Atlas-Agena D (AKM)	1550; 775	Geo-Synchronous	Spin; mono-propellant hydrazine with redundant thrusters	Solar array; 2 Ni-Cd batteries	175W BOL; partial eclipse capability	149°W ± 0.2° E-W; 7.4°	SHF: 2 integrated triple mode repeaters, (a) IF translation soft-limited (b) real-time IF modulation conversion (c) onboard WB data. Any 2 modes operate simultaneously. VHF:1 single IF translation hard-limited repeater.	Uplinks at 6212.094 MHz, 6301.05 MHz 6212.294 MHz, 6217.694 MHz, 6301.25 MHz, 6306.65 MHz, 149.22 MHz, 149.195 MHz, 149.245 MHz. Downlinks at 4119.599 MHz, 4178.591 MHz, 135.575 MHz, 135.625 MHz, 135.6 MHz. Command at 148.26 MHZ. Telemetry at 136.47 MHz.	SHF: (a) 25 MHz (b) 5.45 MHz up 25 MHz down (c) 25 MHz VHF: 100 kHz
In orbit and continuing to supply useful service.											

nsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
Uplinks at 6212.094 MHz, 6301.05 MHz 6212.294 MHz, 6217.694 MHz, 6301.25 MHz, 6306.65 MHz, 149.22 MHz, 149.195 MHz, 149.245 MHz. Downlinks at 4119.599 MHz, 4178.591 MHz, 135.575 MHz, 135.625 MHz, 135.6 MHz. Command at 148.26 MHZ. Telemetry at 136.47 MHz.	SHF: (a) 25 MHz (b) 5.45 MHz up. 25 MHz down (c) 25 MHz VHF: 100 kHz	4135.946 MHz, 4195.172 MHz, 4119.599 MHz, 4178.591 MHz, 137.37 MHz, 412.05 MHz	SHF xmit has 1-16 element electronically despun phased array with 14dB peak gain and 21° beamwidth. SHF rcve has 1 collinear array with 7.8 dB peak gain. VHF has 1-8 element electronically despun phased array with 9 dB xmit peak gain and 8dB rcve peak gain and 60° beamwidth. VHF TT&C has 1 8-whip turnstile, omnidirectional.	SHF has 2-4W TWTA'S. VHF has 8-5W solid state devices	SHF: 22dBW with both TWTA's. VHF: 23dBW for 1 carrier.	-23.0 dB/°K for SHF; -20.6 dB/°K for VHF	S/C active; limited station-keeping capability left; solar array output degraded. Transmits on command only.	Applications experiments	See Ref. (19), (52)

Table 2-2. U.S. Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
ATS-3	NASA; HAC	11/5/1967; Atlas-Agena D (AKM)	1550; 805	Geo-Synchronous	Spin; hydrazine monopropellant or nitrogen jets	s/a ATS-1	175 BOL; partial eclipse capability	70°W ± 0.2° E-W; 5.7°	s/a ATS-1	s/a ATS-1	s/a ATS-1
In orbit and continuing to supply useful service.											

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
on	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	s/a ATS-1	s/a ATS-1	s/a ATS-1	1 SHF mechanically despun cylindrical parabolic collimator illuminated by collinear xmit and rcve line feeds, peak xmit gain 16dB, peak rcve gain 17.5dB, 20° beam width. 1 VHF 8-element electronically despun phased array, peak xmit gain 10dB, peak rcve gain 8dB, 60° beam width. 1 VHF TT&C 8-whip turnstile, omnidirectional	2-4W TWTA'S and 2-12W TWTA'S in SHF; 1-12W TWTA failed. 8-6.3W solid-state devices in VHF.	SHF: 24.5 dBW with 2 TWTA's, or 26.5 dBW with 2 TWTA's. VHF: 25.8 dBW for 1 carrier	-13.3 dB/°K for SHF; -20.1 dB/°K for VHF	S/C active Solar array output degraded. Xmits on command only. 1-12W TWTA has failed	Applications experiments	See Ref. (19), (52)

Table 2-3. U.S. Government Sponsored Communications S

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
ATS-6	NASA; Fairchild	5/30/1974; Titan III C	1403kg (3094 lb) 1357kg (2991 lb)	Geosynchronous; 2 years	3 axis; hydrazine jets	Solar array; Ni-Cd batteries	600 W BOL; 470 W EOL; partial eclipse capability	35° E ± 0.1° E-W and N-S; 0.3°	See insert	See insert	See Insert
	This system will be turned off September 1979.										

Communications	**Parabolic antenna**	**9.1-meter (30-foot) diameter 100 MHz to 10 GHz f/d = 0.44 Stowed dimensions, annulus with 2.0 meter OD x 1.5 meter ID x 0.2 meter (6.6 feet OD x 4.8 feet ID x 0.8 feet) high**
	Communication frequency	VHF, UHF, L-, S-, C-, Ku, and Ka-Bands
	Power amplifiers	Solid state transmitters UHF--105 watts (SITE/TRUST) L-Band--40 watts (PLACE) S-Band--20 watts (TDRE) S-Band--15 watts (HET) Traveling Wave Tubes C-Band--12/24 watts
	Repeater operation	Full duplex, coherent linear translation and/or modulation conversion (øM) of up to 3 independent RF channels simultaneously
	Transponder bandwidths	Selectable RF bandwidths 12 and 40 MHz
	Experiment interface	
	Baseband	VCO (5 MHz) Discriminator (6 MHz)
	IF	Bandwidth 40 MHz
	Peak antenna gain	49 dB
	Peak EIRP	54.5 dBW
Telemetry	Telemetry transmission (ERP)	13 dBW (high gain link)--4 dBW (omni-link)
	Telemetry transmitter	2 watt FM/PM

Assumes the following nominal antenna gains:

C-band horn - 17 dB	L-band fan	- 32 dB	
C-band dish - 50 dB	L-band pencil	- 38 dB	
S-band array - 39 dB	VHF dish	- 18 dB	

Mode	User	Nominal Frequency (MHz)	Bandwidth (MHz)	Polarization	Antenna Field of View (degrees)	Receiver Peak Antenna Gain (dB)	Receiver Min G/T Over FOV (dB/K)
9-meter (30-foot) C-Band Receive	MMW Monopulse	63.50 61.50	40 12	Linear	0.4	49.0	10.5
9-meter (30-foot) C-Band Transmit	MMW	3750 3950	40	Linear	0.6	46.0	-
Horn C-Band Receive	T&DRE SITE PLACE MMW ATS-R	6350 6150 5950	40 12	Linear	20	16.5	-30
Horn C-Band Transmit	T&DRE Beacon PLACE MMW Radiometer RFI	3950 3950 3750 4150 3950	40 500	 Linear Linear	 10 10	 16.6 16.7	 -
9-meter (30-foot) C-Band Receive	RFI	6150	500	Horizontal Vertical RCP	0.4	48.5	NA
9-meter (30-foot) S-Band Receive Beam	T&DRE	2750	40	RCP	9	40.5	-
9-meter (30-foot) S-Band Transmit on Axis	T&DRE	2075	12	RCP	-	39.5	-
9-meter (30-foot) S-Band Transmit Beam	T&DRE	2075	12	RCP	9	39.0	-
9-meter (30-foot) S-Band Receive on Axis	T&DRE	2250	12 40	RCP	-	40.5	-
9-meter (30-foot) L-Band Pencil Beam Receive	PLACE	1650	12	RCP	1.5	38.5	2.5
9-meter (30-foot) L-Band Pencil Beam Transmit	PLACE	1550	40 12	RCP	1.5	38.5	-
9-meter (30-foot) L-Band Fan Beam Receive	PLACE	1650	40 12	RCP	1 x 7.5	31.5	8.0
9-meter (30-foot) L-Band Fan Beam Transmit	PLACE	1550	40 12	RCP	1 x 7.5	31.5	-
9-meter (30-foot) UHF Transmit	SITE/ TRUST	860	40	RCP	2.8	33.0	-
9-meter (30-foot) VHF Receive	Monopulse	150	6	RCP	15	17	-20
9-meter (30-foot) VHF Receive	Command	148.26 154.2	3	RCP	15	17	-20
9-meter (30-foot) VHF Transmit	Telemetry EME	136.23 137.11	3	RCP	15	17	-
9-meter (30-foot) S-Band Transmit	ETV	2569.2 2670.0	40 40	LCP	0.9(3)	43.2	-

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ation em	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	See insert	See Insert	See Insert	See Insert	See Insert	See Insert	See insert	Active	Applications experiments	Located at 94° W for first year; located at 35° E second year; located at 94° E until EOL Return trip from 8/76 to 10/76. See Ref. (19), (21), (34), (52)

			Receiver			Transmitter		
	Polarization	Antenna Field of View (degrees)	Peak Antenna Gain (dB)	Min G/T Over FOV (dB/K)	G/T (Peak) (dB/K)	Transmitter Output Power (watts)	Min EIRP Over FOV (dBW)	EIRP (Peak) (dBW)
	Linear	0.4	49.0	10.5	13.5	-	-	-
	Linear	0.6	46.0	-	-	21.0	51.5(1) 47.3(2)	54.5(1) 50.3(2)
	Linear	20	16.5	-20	-17	-	-	-
	Linear	10	16.8	-	-	21.0	26.0(1) 20.7(2)	26.0(1) 23.7(2)
	Linear	10	16.7			20.0		
	Horizontal Vertical RCP	0.4	48.5	NA	NA	NA	NA	NA
	RCP	9	40.5	-	-	-	-	-
	RCP	-	39.5	-	-	20.0	-	20.5
	RCP	9	39.0	-	-	20.0	48	-
	RCP	-	40.5	-	9.5	-	-	-
	RCP	1.5	36.5	2.5	5.5	-	-	-
	RCP	1.5	36.5	-	-	40.0	49.0	51
	RCP	1 x 7.5	31.5	5.0	-2	-	-	-
	RCP	1 x 7.5	31.5	-	-	40.0	42.0	45
	RCP	2.5	33.0	-	-	105	48.0	51
	RCP	15	17	-20	-18	-	-	-
	RCP	15	17	-20	-18	-	-	-
	RCP	15	17	-	-	2.0	17	20
	LCP	0.9(3)	43.2	-	-	12 12	44.5(3)	53

(1) Single Carrier Operation
(2) Dual Carrier Operation
(3) Either of two offset beams.

Transmitters

Type	Frequencies (Synthesized)	Power Output
C-Band	3950, 4150 and 3750 MHz	11 watts
Designed for HET experiment	2569 and 2670 MHz	15 watts
S-Band	2075 MHz	21 watts
L-Band	1550 MHz	40 watts
UHF	860 MHz	105 watts

Receivers

Type	Frequencies (Synthesized)
C-Band*	5950, 6150, and 6350 MHz
S-Band*	2250 MHz
L-Band	1650 MHz
VHF	150 MHz

Special Features

Monopulse operation

Coherent phase-lock operation

Receipt/transmission of up to 3 frequencies simultaneously

17 frequencies, ** with direct synthesis of 14 from a single frequency standard

Table 2-4. U.S. Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
DSCS II (F-4)	DOD/ SAMSO; TRW	12/13/ 1973; Titan III C	567 kg (1250#)	Geo-synchronous; 5 year design life; 3.2 year mean mission duration (MMD)	Spin with hydrazine jets	Solar array; 3 Ni-Cd batteries	520 W BOL; 390 W EOL; full eclipse capability	60° E ± 3° E-W; <2.5°	Single conversion multi-channel cross-strapped repeaters. Each of 4 channels operate in linear, semi-linear, or hard-limiting modes.	Uplink: CH 1 from 7.975 to 8.1 GHz; CH2 from 8.125 to 8.175 GHz; CH 3 from 8.215 to 8.4 GHz; CH 4 from 7.9 to 7.95 GHz. Downlink: CH 1 from 7.25 to 7.375 GHz; CH 2 from 7.4 to 7.45 GHz; CH 3 from 7.49 to 7.675 GHz; CH 4 from 7.7 to 7.75 GHz. TT & C at S-band.	CH 1: 125 MH CH 2: 50 MHz CH 3: 185 MH CH 4: 50 MHz 410 MH usable BW
DSCS II (F-5/6)		5/75 TITAN IIIC						Not in orbit			
DSCS II (F-7/8)		5/77; Titan III C	587KG (1294#)					12° W, ± 3° E-W, <2.5°			
DSCS II (F-9/10)		3/78; Titan III C						Not in orbit			
DSCS II (F-11/12)		12/78; Titan III C						135° W 175°E ±3° E-W; <2.5°			

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
on	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
-	Uplink: CH 1 from 7.975 to 8.1 GHz; CH2 from 8.125 to 8.175 GHz; CH 3 from 8.215 to 8.4 GHz; CH 4 from 7.9 to 7.95 GHz. Downlink: CH 1 from 7.25 to 7.375 GHz; CH 2 from 7.4 to 7.45 GHz; CH 3 from 7.49 to 7.675 GHz; CH 4 from 7.7 to 7.75 GHz. TT & C at S-band.	CH 1: 125 MHz CH 2: 50 MHz; CH 3: 185 MHz CH 4: 50 MHz. 410 MHz usable BW	7.2501 and 7.6751 GHz	2 EC horns, 18° BW, 17 dB gain at beam edge. 2 NB parabolic steerable dishes, 2.5° BW, 33 dB gain at beam edge. 1 S-band TT&C bicone antenna, 32° toroidal beam 3 dB peak gain. Xmit LHCP, rcve RHCP.	2-20 W TWTA's. TWTA driver	28 dBW in EC mode; 43 dBW in single NB mode; 40 dBW in dual NB mode	-16.9 dB/K in CH 1 and CH 4; -4.4 dB/K in CH 2 and CH 3	In operation	1300 duplex audio channels, or up to 100 Mbps data	CH 1 is EC-EC; CH 2 is NB-EC; CH 3 is NB-NB; CH 4 is EC-NB. See Ref. (3), (5), (6) (7), (19), (39)
								Failed at launch		
				S/A DSCS II (F-5/6 except that 1 NB (2.4°) antenna will be defocused to provide broadened NB pattern. This is called AC or defocused narrow coverage (DNC) Sats F-7 - F-16 use NB & AC beam		S/A DSCS II (F-5/6 except 28.5 dBW for AC at 6° BW in dual NB/AC mode	S/A DSCS II (F-5/6 except - 10.7 dB/K for AC	F-7 NC/AC TWTA failed. Only EC Xmit available		
								Failed at launch		
								In operation		

Table 2-5. U.S. Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
DSCS II (F-13/14	DOD/ SAMSO; TRW	or 1979	617 kg (1360 lb	s/a F-4	s/a F-4	s/a F-4	s/a F-4	UNK	s/a F-4	s/a F-4	s/a F-4
DSCS II (F-15)+ * DFS-1 of DSCS III		April 1980; TITAN III C									
DSCS II (F-16)+ * DFS - 2 of DSCS III		April 1981; TITAN III C									
DSCS III	DOD/ SAMSO; GE	DFS-1 launch in Apr 1980. Flight models operational in '83; TITAN III C	907 kg (2000 lb)	Geo-synchronous; 7 years with design goal of 10 yrs, MMD of 6 years with 1/2 of communications capability still operable	3-axis with hydrazine jets	Solar array; Ni-Cd batteries	800 W EOL; full eclipse capability	DSCS II locations; $\pm 0.5^{o}$ E-W and N-S station-keeping; i=0.1°	6-channel repeater operating in linear, semi-linear or saturating modes. Redundant local oscillator	S/A DSCS II; rcves from 7.9 to 8.4 GHz; xmits from 7.25 to 7.75 GHz. TT&C at X- and S-band	CH 1: 60 MHz* CH 2: 60 MHz CH 3: 85 MHz CH 4: 60 MHz CH 5: 60 MHz CH 6: 50 MHz * 50 MHz exclusi for sats

ponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
s/a F-4	s/a F-4	s/a F-4	s/a F-7	2-40W TWTA's F-13-F-16 carry 40w tubes	Single antenna mode: 31 dBW for EC; 46 dBW for NB; 34.5 dBW for AC. Dual antenna mode: 31 dBW for EC; 40 dBW for NB; 33 dBW for AC	S/A F-7	In launch preparation	Greater than F-4	One in LANT One in WPAC
									DSCS II, III launch together
									* Launched together
S/A DSCS II; rcves from 7.9 to 8.4 GHz; xmits from 7.25 to 7.75 GHz. TT&C at X- and S-band	CH 1: 60 MHz*; CH 2: 60 MHz; CH 3: 85 MHz; CH 4: 60 MHz; CH 5: 60 MHz; CH 6: 50 MHz * 50 MHz exclusive for sats	Located between CH 4 & CH 5; also carries X-band telemetry Bcn freqs: 7600 7605 MHz	4-EC horns; 1-61 element rcvr multiple beam antenna (MBA); 2-19 beam xmit MBA s; Gimballed dish dwnlink antenna	10 W TWTAs in chs. 3, 4, 5, 6; 1 for 2 redundancy in ch 3-4 & chs 5 & 6 —— 40 W TWTAs in chs 1 and 2; 1 for 1 redundancy	CH 1, 2 MBA Mc=40 EC=29 CH 3, 4 MBA NC=34 EC=23 CH 5, 6 EC=25 CH 3, 4 EC=25 CH 1, 2 GDA=44 CN=4 GDA: 37.5	-15 dB/°K for EC; -16 dB/°K for MBA EC mode; -1 db/°K for 1/2° spot	DFS-1, 2 in development		Production version to be launch beginning 1983 to replace DSCS II, using STS and IUS

Table 2-6. U.S. Government Sponsored Communications Sate

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
Fltsatcom	DoD/ SAMSO; TRW	2/1978; Atlas-Centaur (AKM) No. II: 79 No. III; Dec 79 Being built: No. IV & V	1860kg (4100 lb) 948kg (2100 lb)	Geo-synchronous; 5 years	3 axis; hydrazine mono-propellant with redundant thrusters.	Solar array; 3 Ni-Cd batteries.	1435W BOL; 1200W EOL; full eclipse capability.	100°W Others to be placed at: 23°W 172°E 75°E 2.1° Inc.	Single conversion transponders. Contains Fleet broadcast and relay channels, DoD WB channel, USAF NB channel.	Command and telemetry operates at S-band. Transponders operate at UHF and X-band. SHF BCN: 7260 MHz	CH(SHF 1: 20 MHz CHS(UH 2-10: 25 MH CH(UHF 11-22: 5 KHz CH(UH 23: 500 KH

ponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
cation tem	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP dBW	System Figure Of Merit (G/T) dB/ K	Satellite Status	Operational Capability	Notes
nver-s- Fleet t and nnels, USAF el.	Command and telemetry operates at S-band. Transponders operate at UHF and X-band. SHF BCN: 7260 MHz	CH(SHF) 1: 20 MHz CHS(UHF) 2-10: 25 MHz CH(UHF) 11-22: 5 KHz CH(UHF) 23: 500 KHz	BCN at S-band, BCN at SHF	16 ft. UHF xmit paraboloid; 18-turn UHF rcve helix; SHF horn antenna; log conical spiral TT&C antenna.	UHF transponder features low-level amps, predrivers and power amps; output power levels of about 26W, 38W, and 42W. 12 UHF transmitters, 1 SHF transmitter.	CHS 4 & 5: 28 dBW CHS 1, 2, 3, 6 7, 8, 9, 10: 26 dBW	UHF: -15.7 SHF: -20	One operational. Several ready for launch. Two in construction. No. II will be located at 23°W about July 27.	Will provide at least 30 voice and 12 TTY channels to serve small mobile users	4 satellite system; protected against hostile radiation; ground spare. See Ref. (4), (8), (37), (38)

Table 2-7. U.S. Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTERIS			
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	Bea
LES-8/9	DOD; Lincoln Lab	3/14/1976; TITAN III C	453kg (1000 lb)	Geo-synchronous; 3 years	3 axis; gas thrusters	Radioisotope electric power generators	290 W BOL	LES-8; 116.3°W; LES-9: 26.3°W; 23° inclination for both S/C	On-board signal proc. rcvrs. Provides AJ protection	LES-8: receives at 36.7876 and 36.8333 GHz, xmits at 37.04 GHz. LES-9: receives at 38.0924 and 38.0474 GHz, xmits at 36.9 & 38.84 GHz.; UHF up/down link TT&C at S-Band	(C)	

nment Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
cation tem	Repeater and TT&C Frequencies	RF Channel Band-width	Beacon	Antenna	Power Ampli-fier	EIRP	System Figure Of Merit (G/T) dB/°K	Satellite Status	Operational Capability	Notes
l roc. s AJ on	LES-8: receives at 36.7876 and 36.8333 GHz, xmits at 37.04 GHz. LES-9: receives at 38.0924 and 38.0474 GHz, xmits at 36.9 & 38.84 GHz.; UHF up/down link TT&C at S-Band	(C)		18 inch diameter K-Band para-boloid, 42.7 dBi gain 1.15° beam width. 2.5 inch diameter K-band horn, 25 dBi gain, 10° beam width. UHF ant.: G = 8 dB BW = 35°	0.5 W IMPATT diodes	K-band 22 dBW with horn; 39 dBW with para-boloid UHF: 25 dBW	Dish CH +10 Horn CH: -7 UHF CH: -23	In operation	Experiments	See Ref. (4), (8), (26), (28), (40), (41)

Table 2-8. U.S. Government Sponsored Communications Satell

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
LES-10	DOD; MIT	TBD; Titan III C	1452 kg (3200#) at launch	Geo-synchronous	Spin; hydrazine mono-propellant or pulsed plasma thrusters	Solar array; Ni-Cd battery	1200 W BOL; full elipse capability	TBD	Will include signal processing equipment, anti-jam capability. UHF diplexer and RF preamp, uses FDM on uplink and TDM on downlink	SHF & UHF	TBD
Skynet IIB	U.K./ DOD; Marconi/Ford	11/22/ 1974; Thor Delta	435KG (960#); 235kg (518#)	Geo-synchronous; 3 years	Spin; mono-propellant hydrazine	Solar array; 2 Ni-Cd batteries	258 W BOL; 196 W EOL; full eclipse capability	0°	Hard-limiting single-conversion dual-channel repeater. S-band TT&C repeater.	Uplink: 7.976 to 7.978 GHz for NB; 7.985 to 8.005 GHz for WB. Downlink: 7.2573 to 7.2593 GHz for NB; 7.2664 to 7.2864 GHz for WB. TT&C at S-band Two comm. channels Crypto command	2 MHz for NB; 20 MHz for WB
SFCS	SAMSO	1985		Polar					15 UHF CHs 10 SHF or EHF Chs; voice comm. & data	UHF freqs. SHF or EHF freqs.	

nsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ation tem	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T) dB/K	Satellite Status	Operational Capability	Notes
de ocess- nent, capa- HF and RF uses plink on	SHF & UHF	TBD	TBD	UHF multibeam antenna system (MBA) with 19 narrow beams; SHF MBA with 37 narrow beams; UHF circular array of 12 crossed dipoles for EC. UHF MBA has 26.7dB minimum gain; UHF circular array has 13 dB minimum gain; SHF MBA has 32.5 dB minimum gain.	19 UHF PA's at 20W	TBD	TBD	In proposal stage	500 kbps total data rate in TDM mode	This is a tentative design. See Ref. (27)
iting nver- chan- ter. S- &C er.	Uplink: 7.976 to 7.978 GHz for NB; 7.985 to 8.005 GHz for WB. Downlink: 7.2573 to 7.2593 GHz for NB; 7.2664 to 7.2864 GHz for WB. ——— TT&C at S-band ——— Two comm. channels ——— Crypto command	2 MHz for NB; 20 MHz for WB	7.2995 GHz carrier	Mechanically despun X-band horn, 19^{0} beam width, 17 dB peak gain; 2 S-band omnidirectional antennas (TT&C), 4.0 dB peak gain, RHCP.	2-20 W TWTA's	CH 1: 23.2 dBW for WB; CH 2: 17.2 dBW for WB	-17	In operation, but has TT&C problems	Strategic and tactical communications. FDMA/SSMA	See Ref. (5), (9), (19), (34)
Hs EHF e data	UHF freqs. SHF or EHF freqs.							Concept stage	High survivability	AFSATCOM & other users

Table 2-9. U.S. Government Communications Satellites Cha

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
NATO IIIA	DoD/ NATO; Ford	4/22/ 1976; Thor-Delta 2914 (AKM)	1540; 699 kg (1590#) 351 kg (1774#)	Geo-synchronous; 7 years	Spin; hydrazine jets	Solar array; 3 Ni-Cd batteries	538 W BOL; 421 W EOL; full eclipse capability	18° W ± 0.3 E-W and ± 0.4° N-S	Single conversion transponders. Redundant active units	Uplink: CH1 from 7.975 to 7.992 GHz; CH2 from 8.077 to 8.162 GHz; CH3 from 8.002 to 8.052 GHz. Downlink: CH1 from 7.25 to 7.267 GHz; CH2 from 7.352 to 7.437 GHz; CH3 from 7.277 to 7.327 GHz. Telemetry from 2.2 to 2.3 GHz. Command from 1.76 to 1.84 GHz. Crypto command.	CH1: 1 MHz; CH2: 8 MHz; CH 3 (EC): 50 MHz
NATO IIIB		1/27 1977 Thor-Delta 2914 (AKM)	720 KG (1528 lb) 376 KG (830 lb)					23°W ± 0.3° E-W and ± 0.4° N-S			
NATO IIIC		11/78 Thor-Delta 2914 (AKM)						26°W ± 0.3° E-W and ± 0.4° N-S 4.3° Inc.			
NATO IV	In concept stage - may assume configuration similar to DSCS III, with MBA(s),										

mmunications Satellites Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ion n	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
er- on- n-	Uplink: CH1 from 7.975 to 7.992 GHz; CH2 from 8.077 to 8.162 GHz; CH3 from 8.002 to 8.052 GHz. Downlink: CH1 from 7.25 to 7.267 GHz; CH2 from 7.352 to 7.437 GHz; CH3 from 7.277 to 7.327 GHz. Telemetry from 2.2 to 2.3 GHz. Command from 1.76 to 1.84 GHz. Crypto command.	CH1: 17 MHz; CH2: 85 MHz; CH 3 (EC): 50 MHz	7.34 GHz at 6.5 dBW	2 EC horns, 15° x 12° beamwidth, 19.3dB peak xmit gain, 18.5dB peak rcve gain. 1 NB horn, 7.5° beamwidth, 27.5 dB peak gain for xmit and rcve. TT&C ring array. Circular polarization.	4-22W TWTA's	CH1: 35dBW; CH2: 35dBW; CH3: 29dBW	-14.1 dB/ K	In operation; 85 MHz CH 2 out (narrow-beam down link)	Audio, TTY, facsimile and data on 3 simultaneous independent channels, FDMA/SSMA	CH1: NB; CH2: NB; CH3: WB. See Ref. (5), (9), (19), (46)
								In operation		
								In operation		
DSCS III, with MBA(s), etc.										

2

SECTION 3 - Foreign Government Sponsored Satellites

Table 3-1. Foreign Government Sponsored Communications S

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channe Bandwidth
Medium Scale Broadcasting Satellite for Experimental Purpose (BSE)	Japan/ NASDA; Toshiba Electric General Electric	7 Apr 1978 Thor-Delta 1494 (AKM)	678kg (1404 lb); 317kg (700 lb)	Geo-synchronous; 3 years	3-axis; hydrazine mono-propellant with redundant thrusters	Solar array; 3 Ni-Cd batteries	1000W BOL; 780W EOL; partial eclipse capability	110° E ± 0.1° E-W and N-S; 0°	2 single - conversion channels with redundant receiver and transmitter. Both channels use TDA preamps.	TT&C: 14 to 14.025 GHz up, 11.7 to 11.725 GHz down. Channel A: 14.25 to 14.3 GHz up, 11.95 to 12 GHz down. Channel B: 14.35 to 14.43 GHz up, 12.05 to 12.13 GHz down. Telemetry and ranging downlink is 2.2 GHz: command and ranging is 2.1 GHz.	25 MH 430 M effecti total B
Acme	India	No immediate plans for implementation	389kg (858 lb); 208kg 458 lb)	Geo-synchronous	Spin with hydrazine jets	Solar array; Ag-Cd batteries	360 W BOL; limited eclipse capability	82° E	RF-to-RF transponder with direct frequency translation. WB frequency modulation.	6.055 to 6.4 GHz uplink; 3.855 to 4.2 GHz downlink	345 MH

nsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
on	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
on- h - s	TT&C: 14 to 14.025 GHz up, 11.7 to 11.725 GHz down. Channel A: 14.25 to 14.3 GHz up, 11.95 to 12 GHz down. Channel B: 14.35 to 14.43 GHz up, 12.05 to 12.13 GHz down. Telemetry and ranging downlink is 2.2 GHz: command and ranging is 2.1 GHz.	25 MHz, 430 MHz effective total BW		S-band turnstile antenna for TT&C; K-band antenna is elliptical dish reflector with multibeam pattern to provide main-island coverage (MIC) and out-island coverage (OIC). MIC has 37dB xmit gain at beam edge, 41.5 dB rcve gain OIC has 28dB xmit gain at beam edge. K-band antenna uses 3-horn feed.	2-100W TWTA'S (Hughes)	55.5 dBW		Operational	Mission includes experiments to evaluate performance of ground systems, experiments of operational techniques for broadcasting satellite systems, experiments of S/C control techniques, experimental video and voice signal transmission	Beams color TV xmissions to small user terminals in remote & urban areas of Japan. Can relay TV to small earth terminals as small as 3.3 ft in diameter. See Ref (53), (54), (78), (91)-(93).
B -	6.055 to 6.4 GHz uplink; 3.855 to 4.2 GHz downlink	345 MHz	140 MHz signal on command	3.12 ft. parabolic antenna, mechanically despun with 5.1° BW.	TWTA	48 dBW		Proposed	Video, audio, data and facsimile. Multiple access to earth terminals. 1560 duplex telephone and 1 video capacity, or 1800 full duplex telephone capacity.	

Table 3-2. Foreign Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARA		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Chann Band width
Aerosat	Comsat General acting for F.A.A. ESRO, Canada; GE	TBD; Thor Delta 3914 (AKM)	793kg (1748 lb); 398kg (877lb)	Geo-synchronous; 7 years	3-axis zero momentum	One axis sun oriented high power array; 3 Ni-Cd batts.	1415W BOL; 1086W EOL 250W eclipse load cap.		5 ET-to-S/C channels, 15 S/C-to-ET channels, 3 A/C-to-S/C channels, 2 S/C-to-ET experimental channels, 2 ET-to-S/C experimental channels. Single ch per Xmtr	1.5435 to 1.5585 GHz for S/C-to-AC. 1.645 to 1.66 GHz for A/C-to-S/C. 5.0 to 5.125 GHz for ET-to-S/C. 5.125 to 5.25 GHz for S/C-to-ET. TT&C: C-band	80 kH ET-to S/C. 40 S/C-t ET. 400 k and 1 MHz exper menta chann

nt Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ication stem	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T) dB/°K	Satellite Status	Operational Capability	Notes
S/C , 15 CT , 3 S/C , 2 CT ental , 2 /C ental . ch tr	1.5435 to 1.5585 GHz for S/C-to-AC. 1.645 to 1.66 GHz for A/C-to-S/C. 5.0 to 5.125 GHz for ET-to-S/C. 5.125 to 5.25 GHz for S/C-to-ET. TT&C: C-band	80 kHz ET-to-S/C. 40 S/C-to-ET. 400 kHz and 10 MHz experimental channels		4 fixed parabolic ants(.87m D) 3 -zone Xmit 1 - EC Rec. G=21.5 dB; 1 VHF log periodic ant.: E. Coverage; 1 C-band WG horn : E/ Coverage G=17.2 dB	209 W at L-band	23 dBW for A/C, 55 dBW for forward channel, 70 dBW for experimental channel	-12 to -13	Proposed	225 CMDS TLM: 162 anolog 96 bi-level 43 digital serial ; Split phase/PSK	3 S/C system See Ref. (47)

Table 3-3. Foreign Government Sponsored Communications S

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
ANIK A-I	Telesat Canada; HAC	11/9/1972; Thor-Delta 1914 (AKM)	567kg (1250 lb) 297kg (654 lb)	Geo-sync; 6 yrs	Spin; hydrazine jets	Solar array; 2 Ni-Cd batteries	300W BOL; 220 W EOL; partial eclipse capability	113° W ± 0.1° E-W and N-S; 0.0°	Nonlinear, single conversion transponders. 1 WB rcvr drives 12 NB xmtrs.	Rcve center frequencies from 5.945 to 6.345 GHz in 40 MHz steps. Xmit center frequencies from 3.72 to 4.16 GHz in 40 MHz steps. Telemetry at 4.198 and at 4.199 GHz. Command at 6.42 GHz.	36 MHz for each xmtr.
ANIK A-II		4/20/1973; Thor-Delta 1914 (AKM)						109° W ± 0.1° E-W and N-S; 0.0°			
ANIK A-III		5/7/1975; Thor-Delta 1914 (AKM)	680kg (1500 lb); 410kg (904 lb)					104° W ± 0.1° E-W and N-S; 0.0°			
ANIK B	Telesat Canada; RCA	16 Dec 1978; Thor Delta 3914	440kg (970 lb)	Geo-sta; 7 yrs	3-axis		840W	251.0°E; 0.1°		6 and 14 GHz uplink, 4 and 12 GHZ downlink	36 MHz at C-ba 72 MHz at Ku-b

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
tion m	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
er-on- 12	Rcve center frequencies from 5.945 to 6.345 GHz in 40 MHz steps. Xmit center frequencies from 3.72 to 4.16 GHz in 40 MHz steps. Telemetry at 4.198 and at 4.199 GHz. Command at 6.42 GHz.	36 MHz for each xmtr.	4.5 GHz carrier	Dual-mode 5 ft. diameter dish, rcves vertically, xmits horizontally, 27 dB peak gain, 3^{o} x 8^{o} beam width, illuminates Canada. Bicone telemetry antenna. Cloverleaf command antenna	12-5W TWTA's	33 dBW per channel	-7.4 dB/^{o}K for CONUS; -18 dB/^{o}K for Hawaii	In operation	5000 duplex audio or 12 video channels	10 RF channels during eclipse. See Ref. (10), (19), (44), (74) Greater fuel allotment of 250 lbs for station keeping
	6 and 14 GHz uplink, 4 and 12 GHZ downlink	36 MHz at C-band, 72 MHz at Ku-band		14 beams at C-band, 1 beam at Ku-band; linear polarization	Ku-band has four 20W TWTAs	36 dBW at C-band, 47.5 dBW at Ku-band	-6 dB/K at C-band, -1 dB/K at Ku-band		12 XPDRs at C-band, 6 XPDRs at Ku-band with 80 MHz spacing. FDM/FM, QPSK, & SCPC modulation; FDMA & TDMA access.	Domestic use, covers Canada; telephone service to fixed points. Ku-band dedicated to experiment. Govt use for 2 yrs, w/ options for 3 additional yrs. See Ref. (66), (67), (74).

Table 3-4. Foreign Government Sponsored Communications Sat

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTE			
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	
ANIK C-1 (Telesat III-1)	Telesat Canada; Hughes	1981; STS	522kg (1151 lb)	Geo-sta.; 7 yrs.	Spin stab.		925W	247.5°E ±0.1°; incl. tolerance ±0.1°	16 XPDRs, 22 CHs	14.000-14.497 GHz uplink; 11.70045-12.18400 GHz downlink	54 MHz	
ANIK C-2 (Telesat III-2)								244.0°E				
ANIK C-3 (Telesat III-3)								TBD				
ANIK D (Telesat IV)	Telesat Canada									6 GHz uplink, 4 GHz downlink		
STW-1	Radio Management Bureau (PRC)	1980; new booster based on CSS-X4 (similar to the Atlas Centaur)	420kg (926 lb) in orbit	Geo-sta.				125°E		6.2-6.4 GHz uplink; 4-4.2 GHz downlink		
STW-2		1981; Same launch vehicle as STW-1						70°E				

nsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
14.000-14.497 GHz uplink; 11.70045-12.18400 GHz downlink	54 MHz		1 or 4 beams, linear polarization. Polarization diversity for frequency reuse, thus doubling capacity.	13.0 dBW	48 dBW	+1 dB/K T=1250K		FDMA, TDMA, & frequency reuse. FDM/FM, QPSK, & SCPC modulation.	Cover fixed points in most densely populated southern portion of Canada. Three satellites planned. See Ref. (66), (67), (74)
6 GHz uplink, 4 GHz downlink							Concept only.		Provide comm. capabilities into the 1980's. See Ref. (66)
6.2-6.4 GHz uplink; 4-4.2 GHz downlink			Polyhedral in shape, 2.1 meter diameter				Future launch		Has solid fuel rocket motor for apogee kick to achieve gestation any orbit once placed in transfer orbit. Experimental use. See Ref. (66), (67), (88)

Table 3-5. Foreign Government Sponsored Communications Satell

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTER			
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	B
Cosmos 637	USSR	3/26/1974		Geo-syn-chro-nous				75°-85° E; 1.1°				
Cosmos 665		6/29/1974		39160 x 1239 km				Elliptical; 64.3°; 718.6 minute period				
Cosmos 711-718		2/28/1975		1500 x 1480 km (ave.)				Circular; 73.9°; 115.5 minute period (ave.)				
Cosmos 775		10/8/1975		Geo-syn-chro-nous				No data; 0.1°				
Cosmos 791-798		1/28/1976		1538 x 1453 km (ave.)				Circular; 74.0°; 115.6 minute period (ave.)				
Cosmos 825-832		6/15/1976		1530 x 1450 km (ave.)				Circular; 74.0°; 115.5 minute period (ave.)				
Cosmos 871-878		12/7/1976		1520 x 1450 km (ave.)				Circular; 74.0°; 115.3 minute period (ave.)				

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
cation tem	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
								In operation		Military communications See Ref. A6, A14, A15

Table 3-6. Foreign Government Sponsored Communications Sa

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
Cosmos 923		1 July 1977; C-1	900 kg (1984 lb); in orbit	797 x 817 km				Circular; 74.0°; 101.0 minute period			
Cosmos 939-946		25 Aug 1977; C-1	40 kg (88 lb); in orbit	1444 x 1474 km (avg)				Circular; 40°; 115.1 minute period (avg)			
Cosmos 968		16 Dec 1977; C-1	750 kg (1653 lb) in orbit	762 x 810 km				Circular; 74.0°; 100.7 minute period			
Cosmos 976-983		10 Jan 1978		1452 x 1520 km (avg)				Circular; 74.0°; 115.3 minute period (avg)			
Cosmos 1013-1020		7 June 1978		1456 x 1539 km (avg)				Circular; 74°; 115.6 minute period (avg)			
Nigerian National Satellite System 1	Nigeria	June 1981		Geo-sta.				14°E±0.1°; incl. tolerance ±0.1°		5.725-6.425 GHz uplink; 3-4-4.0 GHz downlink	
Nigerian National Satellite System 2								20°E ± 0.1°; incl. tolerance ±0.1°			

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
cation tem	Repeater and TT&C Frequencies	RF Channel Band-width	Beacon	Antenna	Power Ampli-fier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	5.725-6.425 GHz uplink; 3-4-4.0 GHz downlink			Circular antenna footprint; -2 dB point just larger than Nigeria					SCPC, TV & trunk telephone	

Table 3-7. Foreign Government Sponsored Communication

SATELLITE	SPACECRAFT DATA								PAYLOAD CHAR		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	R Cha Ba wid
Communications Satellite (CS); a/k/a Medium - Capacity Communications Satellite for Experimental Purposes; a/k/a Sakura	Japan/ NASDA; Mitsubishi Electric Aeronutronic Ford	12/77 Thor-Delta 2914 (AKM)	671kg (1479 lb); 340kg (750 lb)	Geosynchronous; 3 years	Spin; hydrazine monopropellant with redundant thrusters	Solar array; 1 Ni-Cd battery	529W BOL; 475W EOL; full eclipse capability	135° E ± 0.1° E-W and N-S; 0° ± 0.1°	6 double-conversion K-band and 2 single-conversion C-band transponders. TDA preamps for K-band; no preamps for C-band	K_a-band uplink from 27.5 to 31 GHz, downlink from 17.7 to 21.2 GHz. C-band uplink from 5.925 to 6.425 GHz, downlink from 3.7 to 4.2 GHz. TT&C operates at S-band and at C-band, xmits at 2.2865 GHz, rcves at 2.1108 and at 6.175 GHz.	6-2 MHz chan for band 2-20 MHz chan for band S-ba 1dB band widt 4MH
Maritime Orbital Test Satellite (MAROTS or OTS 2)	ESRO; Hawker Siddeley Dynamics	5/11/77 Thor-Delta 3914 (AKM)	865kg (1907 lb); 444kg (979 lb)	Geosynchronous; 5 years.	3 axis	Solar array Ni-Cd batt.	360 W EOL; limited eclipse capability	10° E ±0.1°E-W and N-S; 0.0°	Solid-State L-band repeater	S/C to ship: 1540 to 1542.5 MHz. Ship to S/C: 1641.5 to 1644.5 MHz. Shore to S/C: 14490 to 15500 MHz. S/C to shore: 11690 to 11700 MHz. Xmits on 137.05 MHz on command only.	2.5 in sh to-s dire tion. MHz ship shor dire tion

onsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ion n	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
n- and - C- on- r K- e-	K_a-band uplink from 27.5 to 31 GHz, downlink from 17.7 to 21.2 GHz. C-band uplink from 5.925 to 6.425 GHz, downlink from 3.7 to 4.2 GHz. TT&C operates at S-band and at C-band, xmits at 2.2865 GHz, rcves at 2.1108 and at 6.175 GHz.	6-200 MHz channels for K-band; 2-200 MHz channels for C-band. S-band 1dB bandwidth is 4MHz.	3.95 GHz carrier	1 despun horn reflector used for C- and K-band. K-band pattern covers main island group with 33 dBi gain at beam edge. C-band pattern covers Japanese territory with 25dBi gain at beam edge. Reflector has CP. S-band antenna is ring array with near-isotropic coverage. S-band antenna has RHCP for transmit and receive.	6-5W TWTA's for K-band; 2-5W TWTA's for C-band; TT&C use 1W device.	Output power is 34 dBm for K-band, 34.5 dBm for C-band, 31.5 dBm for S-band.	-4.6 dB/^{o}K for K-band; -5.6 dB/^{o}K for C-band; -7 dB/^{o}K for S-band	Operational	Video, data and audio capabilities. Mission includes emergency communication, S/C control and system operation, experiments at K-band.	Original contract let for 2 S/C. See Ref. (55) (68), (70)
	S/C to ship: 1540 to 1542.5 MHz. Ship to S/C: 1641.5 to 1644.5 MHz. Shore to S/C: 14490 to 15500 MHz. S/C to shore: 11690 to 11700 MHz. Xmits on 137.05 MHz on command only.	2.5 MHz in shore-to-ship direction. 3.0 MHz in ship-to-shore direction		L-band shaped reflector (2 meters in diameter) with edge gain of 17.6 dB. Two X-band horns. This will provide earth coverage extending from mid-Atlantic to Singapore to Northern Antarctica to Scandinavia.	Linearized transistor PA for L-band. TWTA for X-band.	34 to 37 dBW	-14 dB/°K	Operational	To be used in collaboration with two Marisat satellites. Audio, high speed data, teleprinter and telex capabilities.	Adaptation of OTS. Communications capacity influenced by ship terminals. See Ref. (33), (65), (68), (70), (75).

2

Table 3-8. Foreign Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARA		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	R Char Ban wid
Communications Technology Satellite (CTS)	Canada and NASA; SPAR, RCA, SED, Bristol Aerospace	1/17/1976; Thor-Delta 2914 (AKM)	675kg (1489 lb); 347kg (764 lb)	Geosynchronous; 2 years	3 axis with momentum wheel and hydrazine jets.	Solar array; 2 Ni-Cid batteries	1260 W BOL (1040 W for experiment) 220 W for housekeeping; 1000 W EOL; Limited eclipse capability.	116° W ± 0.2° E-W; 0.6°	Single conversion linear repeaters. High-power TWTA has efficiency greater than 50%.	Receives from 14.01 to 14.29 GHz. Transmits from 11.843 to 12.123 GHz. Tracking uplink is 2097.198 MHz, downlink is 2277.5 MHz.	Four MHz chan 10 M tele- metr 1.5 M com- mand
Engineering Test Satellite, Type II (ETS II)	**Japan/ NASDA; Mitsubishi Electric/ Aeronutronic-Ford**	23 Feb 1977; NLV	254 kg (559 lb) 137 kg (302 lb)	Geosynchronous; 1 year	Spin; monopropellant hydrazine	Solar array; 2 Ni-Cd batteries	107 W BOL; 92 W EOL; partial eclipse capability	130° E ± 0.5° E-W and ± 1.0° N-S; 0.5° ± 0.5°	6-channel vibration data xmtr; S, X, and K-band propagation experiments. S-band transponder provides ranging and communications. VHF telemetry and command transponder.	S-band: 2.1 GHz up, 1.7 GHz down. VHF: 136 MHz down, 148 MHz up. Coherent signals transmitted at 11 GHz and at 34 GHz.	8.2 M for S- band

nsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
Receives from 14.01 to 14.29 GHz. Transmits from 11.843 to 12.123 GHz. Tracking uplink is 2097.198 MHz, downlink is 2277.5 MHz.	Four 85 MHz channels. 10 MHz telemetry. 1.5 MHz command.	11.7 GHz carrier	Two SHF gimballed parabolic reflectors with 2.5° beamwidth, 36.2 dB maximum gain, 71.1 cm. in diameter, steerable within 14.5° cone, using orthogonal polarization. T, T&C uses 1 conical beam antenna, circular polarization, 16° x 16° beamwidth. 1 SHF beacon antenna.	2-20 W TWTAs in communications transponder. 1-200 W TWTA for experiments. 2 W solid-state telemetry transmitter.	59 dBW	+2.6 dB/°K	In operation	Experiments: video broadcast to 8 ft. diameter earth terminals, audio broadcast, digital data transmission, TDMA distribution of WB information.	Antenna coverage depends upon experiment being performed. Control ET is in Ottawa. See Ref. (19), (20), (34), (42), (43) (68), (78).
S-band: 2.1 GHz up, 1.7 GHz down. VHF: 136 MHz down, 148 MHz up. Coherent signals transmitted at 11 GHz and at 34 GHz.	8.2 MHz for S-band	1.7 GHz carrier	1 S-band dish, 1 X-band dish, 1 K-band dish, all mechanically despun and fed by rotary joint. All have RHCP. VHF 4-whip antenna has omni-directional composite LHCP/RHCP in xmit and rcve modes. K-band antenna coverage pattern illuminates main island.	Solid state devices.	Xmtr power 2W or 8W for VHF.		In manufacture	Propagation experiments	See Ref. (45) (68), (78).

Table 3-9. Foreign Government Sponsored Communicati

SATELLITE	SPACECRAFT DATA								PAYLOAD CHAR		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	I Cha Ba wi
ECS	EEPT; MESH/ British Aerospace Telefunken	1980; Ariane	865 kg (1903 lb); 444 kg (977 lb)	Geo-sync; 3 yrs	3-axis	Solar array; Ni-Cd batt.	600W Bol; 520 W. EOL; limited eclipse capability	10°E; Up to 3° incl.	Double conversion. Module A has two WB & two NB ch. Module B (MB) has two very NB channels.	MA: TC up is 14125 MHz, NB up is 14152.5 to 14192.5 MHz, WB up is 14242.5 to 14362.5 MHz. TC down is 11575 MHz, NB down is 11490 to 11530 MHz, WB down is 11580 to 11700 MHz. MB: Down is 11742.5 to 11797.5 MHz; up is 14455 to 14460 MHz.	MC NB MH WH 120 MO 5
CONDOR	ASETA	In the planning stage.									

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
tion m	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
er-le A & MB) y s.	MA: TC up is 14125 MHz, NB up is 14152.5 to 14192.5 MHz, WB up is 14242.5 to 14362.5 MHz. TC down is 11575 MHz, NB down is 11490 to 11530 MHz, WB down is 11580 to 11700 MHz. MB: Down is 11742.5 to 11797.5 MHz; up is 14455 to 14460 MHz.	MOD A: NB 40 MHz, WB is 120 MHz. MOD B: 5 MHz	11.786 GHz carrier	Six circular reflectors: 3 Eurobeam A(EBA), 2 Eurobeam B (EBB), 1 spct beam (SB). Peak gains of EBA, EBB, & SB are, resp., 26.5 dB, 29.1 dB, & 35.5 dB. EBA uses orthogonal polarization. EBB uses circular pol. SB uses orthogonal pol. EBA is elliptical E-W, EBB is elliptical WNW-ESE; both cover N. Africa, Scandanavia, Middle East. SB is circular & centered on Switzerland. EBA: 7.5° x 4.25°. EBB 5° x 3.5°; SB: 2.5°	4-20W TWTAs	TBD	-3.6 dB/K	In manufacture	Frequency reuse. TDMA direct TV broadcasting & Xmission of data to small Earth terminal.	Save OTS, which was destroyed at launch because of booster failure. Fixed service regional system. Five satellites planned between 1980 & 1990; one is backup. See Ref. (32), (64), (65), (67), (70).
										Northern South America regional comm. sat.

Table 3-10. Foreign Government Sponsored Communications S

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channe Band-width
Ekran (Statsionar-T)	Min. of Posts & Telecom. (USSR)	26 Oct 1976		Geo-sta.				99°E; 0.3°			
Ekran B (Ekran-2, or Statsionar)		20 Sep 1977; D-Ie	2000kg (4409 lb) in orbit	Geo-sta.	3-axis	Solar cells		99°E; 0.4°		5.7-6.2 GHz uplink; 3.4-3.9 GHz downlink	
Gals 1	Min. of Posts & Telecom. (USSR)	1980		Geo-sta.				335°E	10 channels, 50 MHz apart	7.9-8.4 GHz uplink; 229°-7.75 GHz downlink	
Gals 2								45°E			

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ion n	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
										Relay color & black & white TV from central TV to Siberia.
	5.7-6.2 GHz uplink; 3.4-3.9 GHz downlink									Carries apparatus for Xmitting TV programs & multi-channel radio, apparatus of the command measuring complex, orientation system, orbit corrections system, & power supply system. See Ref. (68)
t	7.9-8.4 GHz uplink; 229°-7.75 GHz downlink			19 dB gain. Earth coverage for circular 3 dB beamwidth. 30 dB gain for circular narrow beam.						Govt. services. Four satellite planned--all fixed services. See Ref. (67), (69).
				s/a	1					Govt. services

Table 3-11. Foreign Government Sponsored Communications S

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
Gals 3	Min. of Posts & Telecom. (USSR)			Geo-sta.				85°E			
Gals 4								190°E			

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
on	Repeater and TT&C Frequencies	RF Channel Band-width	Beacon	Antenna	Power Ampli-fier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
				s/a	1					Domestic use.
										Govt. services.

2

Table 3-12. Foreign Government Sponsored Communication

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
H-Sat Phebus, or Lo-4)	ESA; Aerospatiale	1984; Ariane	816 kg (1799 lb); in orbit		3-axis				Two transponders	14 GHz uplink; 11 GHz downlink	

t Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
tion m	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	14 GHz uplink; 11 GHz downlink			Common high-gain antenna for 2 narrow broadcast beams	450W TWTA for direct TV ch; 150W TWTA for combined telecom channel			In planning stage		Experimental TV broadcast--direct & community. Service to Europe. Payloads will include 20/30 GHz comm. experiment & a mercury ion thruster station-keeping experiment. Satellite will be a modular structure capable of carrying different payloads for different missions. Development cost will be about $70m. See Ref. (64)-(66).

Table 3-13. Foreign Government Sponsored Communicatio

SATELLITE	SPACECRAFT DATA								PAYLOAD CHAR		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	R Char Ban wid
Insat-1A	ISRO (India); Ford	1981; STS or Delta 3910	1054kg (2324 lb); 898 kg (1980 lb)	Geo-sync	3-axis with hydro-gen jets		1250W	71°E	Telecom: C-band up & down; TV: C-band uplink; S-band downlink. Meteorological services will use UHF up-link & C-band downlink. TT&C: C-band	36 MHz, S and C-band. 200 KHz at UHF.	
Insat-1B		May 1983						94°E ±0.1°; inclination tolerance ±0.1°		Telecommunications: 5850-6425 MHz up, 3700-4200 MHz down. TV: 5850-6425 MHz up, 2500-2640 MHz down. Met. service: 402.75 MHz up & 4038.1 MHz down. TT&C will use 4031 & 4039 MHz.	

t Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ation em	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
& nd -band gical will up- band -band	36 MHz, S and C-band. 200 KHz at UHF.			Truncated parabolic antenna at S-band. Two symetrically located parabolic dishes at C-band. Four crossed dipoles for VHF receiving. Array of crossed dipoles for TT&C links. Covers India; one beam, linear pol. Receiving ant. gain is 28.5 dB at 6 GHz & 11.0 dB at UHF. Xmitting ant. gain is 31 dB (nominal) for 2.5/4.0 GHz.		34 dBW at S-band, 42 dBW at C-band		In construction	12 Telecom XPDRs at C-band & 2 broadcast TV XPDRs at S-band. FM QPSK mode; FDMA. Telemetry date will be PCM-FSK-PM	Provide telephone relay & weather monitoring capabilities & make TV broadcasts direct to rural community receivers. Also provide a disaster warning comm. capability. Carries very high resolution radiometer. See Ref. (71)-(74). Standby for Insat-1A.
	Telecommunications: 5850-6425 MHz up, 3700-4200 MHz down. TV: 5850-6425 MHz up, 2500-2640 MHz down. Met. service: 402.75 MHz up & 4038.1 MHz down. TT&C will use 4031 & 4039 MHz.			Antennas same as "1A". Main beam center will be at 79°E, 21°N						Standby for Insat-1A.

Table 3-14. Foreign Government Sponsored Communications S

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channe Band-width
Loutch P1	Min. of Posts & Telecom. (USSR)	1981						25°W ±0.5°; incl. tolerance ±0.5°	10 channels; 50 MHz between center freqs.	14.0-14.5 GHz uplink, 11.0-11.7 GHz downlink	
Loutch P2		1981						45°E, ±0.5°, incl. tolerance ±0.5°			
Loutch P3		1978-1981						85°E ±0.5°; incl. tolerance ±0.5°			
Loutch P4		1981						170°W ±0.5°; incl. tolerance 0.5°			
Loutch 1		1981						14°W ±0.5°; incl. tolerance ±0.5°		14.007-14443 GHz uplink; 10.457-11.693 GHz downlink	36 MHz
Loutch 2		1981						58°E ±0.5°; incl. tolerance ±0.5°			
Loutch 3		1981						90°E ±0.5°; incl. tolerance ±0.5°			
Loutch 4		1981						140°E ±0.5°; incl. tolerance ±0.5°			

...ent Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
...munication ...-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
...annels; ...Hz between ...er freqs.	14.0-14.5 GHz uplink, 11.0-11.7 GHz downlink				20W					P1-P4 make up 1 network Domestic use. See Ref. (67)
	14.007-14443 GHz uplink; 10.457-11.693 GHz downlink	36 MHz		Shaped beam	10W total peak power		T=4000K			Govt. services

Table 3-15. Foreign Government Sponsored Communication

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARA		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Chann Band width
Marecs A	ESA; British Aerospace Dynamics	Oct 1980; Ariane or STS	466kg (1027 lb)	Geo-sync; 7 yrs	3-axis with hydrazinc jets	Solar array	500W	40°E		6 GHz uplink, 4 GHz downlink for shore-satellite links; 1.6 GHz uplink, 1.5 GHz downlink for ship-satellite service	2.5, & 0.5 MHz
Marecs B		Apr 1982; Ariane or STS						40°W			

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
ion n	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	6 GHz uplink, 4 GHz downlink for shore-satellite links; 1.6 GHz uplink, 1.5 GHz downlink for ship-satellite service	2.5, 3, & 0.5 MHz		Single parabolic ant. 1 beam, circular polarization		35.5 dBW at L-band	-11.2 dB/k L-band		36 2-way noise circuits; 3 XPDRs. TDMA, CPSK, FM, & SCPC modulation	Service is mobile telephone & TTY. Basic configuration is similar to ECS. Four satellites planned. Inmarsat will be a subset of the 4 Marecs satellites and the 4 Intelsat MCS satellites. See Ref. (65), (67), (70), (72), (74), (89), (99).

Table 3-16. Foreign Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
Molniya 1 (F-24)	USSR	8/30/1973 A-IIe	1000kg (2205 lb); on orbit	Elliptical; 12-hour orbit	Gyro, orbital correction engine, gas jets or liquid fuel jets	Solar array; battery	500 W to 700 W BOL	39491 x 1415 km; 65.5°	Nonlinear frequency translating repeaters, 1 operating and 2 spares. Front-end rcvr is a Si diode mixer.	Xmits in 800 MHz band; rcves in 1 GHz band; video xmit from 3.4 to 4.1 GHz.	
Molniya 1 (F-25)		11/14/1973; A-IIe						39577 x 775 km; 65.4°			
Molniya 1 (F-26)		11/30/1973; A-IIe						39646 x 709 km; 63.0°			
Molniya 1 (F-27)		4/20/1974; A-IIe						39827 x 522 km; 64.1°			
Molniya 1 (F-28)		10/24/1974; A-IIe						39515 x 840 km; 63.1°			

ent Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
lcation stem	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
r frequency ans- peaters, ng and Front is a nixer.	Xmits in 800 MHz band; rcves in 1 GHz band; video xmit from 3.4 to 4.1 GHz.			2-3 ft. steerable EC dishes (1 reserve) 16 to 18 dB gain, 22° beamwidth. Circular polarization.	1-2-stage TWTA per repeater. 40 W for video or 14W per duplex multichannel telephony. 4th TWTA held in reserve.	30 dBW	Est. -15.6 to -18.6 dB/°K	In operation	1 video channel and multichannel audio. Some telephone channels can be multiplexed for VHF telegraphy, photo-facsimile, audio.	See Ref. (9), (19), (34), (68), (75), (76)

Table 3-17. Foreign Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channe Band-width
Molniya 1 (F-29)	USSR	4/29/ 1975; A-IIe	s/a F-18	s/a F-18	s/a F-18	s/a F-18	s/a F-18	39582 x 770 km; 63.0°	s/a F-18	s/a F-18	
Molniya 1 (F-30)		6/5/ 1975; A-IIe						39601 x 744 km; 62.9°			
Molniya 1 (F-31)		9/2/ 1975; A-IIe						35794 x 611 km; 63.0°			
Molniya 1 (F-32)		1/22/ 1976; A-IIe						39848 x 506 km; 62.9°			
Molniya 1 (F-33)		3/12/ 1976; A-IIe						40683 x 518 km; 62.5°			
Molniya 1 (F-34)		3/19/ 1976; A-IIe						38984 x 494 km; 63.0°			
Molniya 1 (F-35)		7/23/ 1976; A-IIe						39059 x 499 km; 62.9°			
Molniya 1 (F-36)		3/24/ 1977; A-IIe						40816 x 484 km; 62.8°			
Molniya 1 (F-37)		6/24/ 1977; A-IIe						39016 x 480 km; 62.9°			
Molniya 1 (F-38)		8/30/ 1977; A-IIe						40800 x 480 km; 62.8°			
Molniya 1 (F-39)		3/21/ 1978						39756 x 592 km; 63.2°			
Molniya 1 (F-40)		6/2/ 1978						39912 x 432 km; 63.0°			

t Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ation em	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	s/a F-18			s/a F-18	s/a F-18	s/a F-18	s/a F-18	In operation	s/a F-18	

Table 3-18. Foreign Government Sponsored Communications S

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTE		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
Molniya 1 (F-41)		7/4/ 1978						39746 x 608 km; 62.8°			
Molniya 1 (F-42)		8/22/ 1978						39913 x 462 km; 62.8°			
Molniya 1-S		7/23/ 1974				Solar array; batt.		90°E	s/a Molniya 2 except NB channel center frequency shifted 7 MHz	5.7 to 6.4 GHz up, 3.4 to 4 2 GHz down link	10 MHz for NB channels 40 MHz for WB channels

ent Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
cation stem	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
ilya 2 B center y MHz	5.7 to 6.4 GHz up, 3.4 to 4 2 GHz down link	10 MHz for NB channels; 40 MHz for WB channels							Audio and video broadcast capabilities	

Table 3-20. Foreign Government Sponsored Communications Sate

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
Molniya 3 (F-1)		11/21 1974	1500 kg (330 lb) in orbit	Elliptical orbit; 12-hr period	Orbit correction system			39559 x 793 km; 63.0°			
Molniya 3 (F-2)		4/14/ 1975						39768 x 586 km; 63.6°			
Molniya 3 (F-3)		11/14/ 1975						39755 x 605 km; 63.0°			
Molniya 3 (F-4)		12/28/ 1975						39846 x 507 km; 62.8°			
Molniya 3 (F-5)		5/12/ 1976; A-IIe						40660 x 405 km;			
Molniya 3 (F-6)		12/28 1976; A-IIe						40630 x 640 km; 62.8°			
Molniya 3 (F-7)		4/28/ 1977; A-IIe						40807 x 467 km; 62.8°			
Molniya 3 (F-8)		10/28/ 1977; A-IIe						40764 x 478 km; 62.8°			
Molniya 3 (F-9)		1/24/ 1978; A-IIe						39556 x 795 km; 62.9°			
Molniya 3 (F-10)		10/13/ 1978						40805 x 397 km; 63.0°			
NORSAT	Nordic Council of Ministers	1982 Ariane	In	the	planning		stage		5-8 channels	11/14 GHz	

ponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
cation tem	Repeater and TT&C Frequencies	RF Channel Band-width	Beacon	Antenna	Power Ampli-fier	EIRP dB/^{o}K	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
									Video and multi-channel radio commo.	Uprated version of Molniya 1 & 2. See Ref. (34), A5, A14.
nnels	11/14 GHz			BW^{o}= 1x1.6^{o}	250 W or 450 W TWTA	62			TV	Regional TV intra & inter country

Table 3-20. Foreign Government Sponsored Communicatio

SATELLITE	SPACECRAFT DATA								PAYLOAD CHAR		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight (lbs)	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	R Cha Ba wid
Oscar 7	AMSAT	11/15/1974; piggyback aboard Thor-Delta	29kg 65 lb;) launch & on-orbit weight	Sun synchronous; 3 years	None	Solar array; Ni-Cd batteries		1480 x 1442 km; 101.6°; 114.9 minute period	2 linear repeaters	2/10 rcves from 145.85 to 145.95 MHz, xmits from 29.4 to 29.5 MHz. 70/2 rcves from 432.125 to 432.175 MHz, xmits from 145.975 to 145.925 MHz.	2/10 100 70/2 50 M

nent Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
nication ystem	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
re-	2/10 rcves from 145.85 to 145.95 MHz, xmits from 29.4 to 29.5 MHz. 70/2 rcves from 432.125 to 432.175 MHz, xmits from 145.975 to 145.925 MHz.	2/10: 100 kHz 70/2: 50 MHz	2.304 GHz, 435.1 MHz, 29.5 MHz, 145.98 MHz	2/10 rcve is LHCP canted turnstile, 2/10 xmit is linearly polarized dipole. 70/2 rcve and xmit is RHCP canted turnstile. 435.1 MHz beacon is LHCP dipole; 2.304 GHz beacon is RHCP dipole. Both control turnstiles have 4 elements and 5 dB gain. Half-wave dipole has 2 dB gain.	2/10 is 2 W solid state; 70/2 is 8 W solid state; 435.1 MHz beacon is 0.3 W solid state; 2.304 GHz beacon is 40 mW solid state	14.03 dBW		Partial failure	Morse code telemetry, teletype telemetry	100W ERP max. Radio amateur. (See Ref. (81).

Table 3-21. Foreign Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
OSCAR-8	ARRL, AMSAT; AMSAT	2 Mar 1978; Delta 2910	27.2kg (60 lbs); launch & on-orbit wt.	Sun-sync 9,10,89 km 3 yrs.	Bar magnets	Solar array; Ni-Cd batt.	6-8W	25.8° longitudinal progression per orbit to west; 101°	2 XPDRs, Mode A & Mode J. Triple conversion. Linear power amp. Both A&J XPDRs use the same receiving antenna.	Mode A: 145.850-145.950 MHz uplink & 29.400-29.500 MHz downlink. Mode J: 145.900-146.000 MHz uplink & 435.100-435.200 MHz downlink.	100 KHz Mode A & Mode J

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
Mode A: 145.850-145.950 MHz uplink & 29.400-29.500 MHz downlink. Mode J: 145.900-146.000 MHz uplink & 435.100-435.200 MHz downlink.	100 KHz Mode A & Mode J	Mode A 29.402 MHz (24 dBM). Mode J 435.095 MHz (20 dBM)	10-meter dipole, linearly polarized. 2-meter turnstile comprised of four 483 mm lengths of 12.7mm carpenter's rule configured for circular pol; 5 dB gain in direction of bottom of satellite. Mode A: Requires lefthand circular Pol for northern Hemisphere users, righthand circular pol. for southern Hemisphere users. Mode J requires righthand circular Pol. for N. Hemisphere users & lefthand circular Pol. for S. Hemisphere users. 435 MHz ant. is linearly Pol. dipole.	1W linear transistor amp. Mode A & Mode J		Mode A: -95 dBM input for 1W output. Mode J: -105 dBM input for 1W output.	Operational	Two XPDRs six Telemetry channels	Mode J: XPDR inverts signals. Mode A: Operates Mon/Tue/Thurs/Fri; Mode J: Operates Sat/Sun; Wed is for experimental use on Mode A or J or recharge (Mode D). Monday orbits for low power use only-10W ERP max. Normal max ERP is 100W. ARRL in charge of operation. See Ref. (79)-(86)

Table 3-22. Foreign Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
Palapa 1	Indonesia; HAC	7/8/1976; Thor-Delta 2914 (AKM)	573kg (1268 lb); 293kg (646 lb)	Geo-synchronous; 7 years	Spin; hydrazine mono-propellant	Solar array; Ni-Cd batteries	300 W BOL: 220 W EOL; partial eclipse capability	83° E ± 0.1° E-W	Single-conversion C-band transponders; 1 WB rcvr driving 12 NB xmtrs; redundant rcvr.	Rcves from 5.925 to 6.425 GHz; xmits from 3.7 to 4.2 GHz; telemetry at 4.19825, 4.19875, 4.19925 GHz; tracking at 5.767 GHz.	36 MH for ea xmtr
Palapa 2		10 Mar 1977; Thor-Delta 2914 (AKM)						77° E ± 0.1° E-W			
Palapa 3		Mar 1983						118.00°E +0.5°; inclination tolerance +0.5°		5.850-6.425 GHz uplink, 3.625-4.200 GHz downlink	
Palapa 4		Mar 1983						108.00°E +0.5°; inclination tolerance +0.5°			
Palapa 5		Mar 1983						113.00°E +0.5°; inclination tolerance +0.5°			

t Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
cation tem	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
nver- and lers; r 2 NB edun- .	Rcves from 5.925 to 6.425 GHz; xmits from 3.7 to 4.2 GHz; telemetry at 4.19825, 4.19875, 4.19925 GHz; tracking at 5.767 GHz.	36 MHz for each xmtr	5.767 GHz carrier	5 ft. diameter parabolic reflector with offset feed horn configuration; coverage pattern includes Samatra, Java, West Irian, Kalimantar Islands. Uplink polarization parallel to spin axis; down link polarization perpendicular to spin axis. 28 dB peak gain.	12-5 W TWTA's	30 dBW	-7 dB/ K	In operation	7000 duplex voice or 12 color video channels per satellite. 50 Mbps data rate per transponder.	Almost identical to Westar I. See Ref. (59), (67), (76).
								In orbit		Spare
	5.850-6.425 GHz uplink, 3.625-4.200 GHz downlink							In manufacture		

Table 3-23. Foreign Government Sponsored Communications S

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTE			
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	
Raduga 1 (Statsionar 1)	Ministry of Posts & Telecommunications (USSR)	22 Dec 1975; A-2 Soyuz Proton 56-12)	1250kg (2756 lb)	Geosync	3-axis with orbital correction system			99°E ± 0.1°; 0.3°		6.2 GHz ± 12 MHz uplink, 714 ± 12 MHz downlink	40 MHz	
Raduga 2 (Raduga 1-B or Statsioner 1-B)		11 Sep 1976						80°E; 0.3°		5.75 - 6.2 GHz uplink; 3.42 - 3.87 GHz downlink		
Raduga 3 (Statsionar 2)		24 Jul 1977; D-Ie	2000kg (4409 lb) in orbit					35°E; 0.4°		14 GHz uplink, 11 GHz downlink		
Raduga 4		18 Jul 1978						0.0° inclination		5.7-6.2 GHz uplink 3.4-3.9 GHz downlink		

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
6.2 GHz ± 12 MHz uplink, 714 ± 12 MHz downlink	40 MHz		2 to 4 beams, circular polarization. Global & spot coverage		30.8 dBW	-15.8 dB/K	In operation	6 XPDRs FDMA; FDM/FM modulation	Ten satellites planned. Provides color & black & white TV & telephone & telegraph channels. Domestic use. See Ref (65), (67), (74), (76), (88)
5.75 - 6.2 GHz uplink; 3.42 - 3.87 GHz downlink			S/a "1", Peak gain in 23 dB						
14 GHz uplink, 11 GHz downlink									
5.7-6.2 GHz uplink, 3.4-3.9 GHz downlink									

Table 3-24. Foreign Government Sponsored Communications S

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
RS	USSR; "Students of Moscow's Higher Schools" & "Voluntary Society for Assistance to the Army, Air Force & Navy of the USSR"	29 Oct 1978; Same as Cosmos 1045		1688 X 1724 km	None	Solar array		In Van Allen Belt; progresses 30.2°W every revolution; 120.4 min. period; 82.5° inclination		145.870-145.915 MHz uplink, 29.350-29.395 MHz downlink	30 KHz
SATCOL 1	Colombia	1981		Geo-sta.				75° W+0.1° inclination tolerance +0.1°	12 XPDRS, 40 MHz between center freq.	5.947-6.323 GHz uplink, 3.722-4.198 GHz downlink	36 MHz
SATCOL 2								75.4°W +0.1°, inclination tolerance +0.1°			

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
ion n	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	145.870-145.915 MHz uplink, 29.350-29.395 MHz downlink	30 KHz	29.401 MHz	Inverted "V" at 2 meters; 1/4 wavelength at 10 meters				Two satellites were orbited--one is operational, one failed		Users should xmit no more than 10W ERP max. RS will turn off if power level is exceeded. XPDRs are active 24 hrs/day except Monday & Wednesday which are reserved for scientific & educational uses. See Ref. (94), (95).
veen	5.947-6.323 GHz uplink, 3.722-4.198 GHz downlink	36 MHz		linear polarization; 36.5 dB gain at 4 GHz, 38.3 dB gain at 6 GHz	6 dBW peak power for single carrier & TV; -7 to -13.5 dBW for multi-carrier XPDRs; -22.5 dBW for SCPC		T = 3000K		FDM/FM on XPDRS 1-4, 12; TV on 3,4; SCPC/FM on 5-12	

Table 3-25. Foreign Government Sponsored Communication

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
SBTS 1 (Brazilsat)	Brazil	1979		Geosync.				70°W	10 XPDRs 40 MHz between center frequencies	5.927-6.303 GHz uplink, 3.702-4.178 GHz downlink	36MHz
SBTS 2								65°W			
Sirio	Italian National Research Council; CIA S.p.A.	8/25/77 Thor-Delta 2910 (AKM)	397 ky (875lb); 182 ky (401 lb)	Geosynchronous; 2 years	Spin; hydrazine jets	Solar array; 2 Ni-Cd batteries	118°W BOL; 102°W EOL; no eclipse capability	15°W ± 1° E-W and ± 0.3° N-S; 0° ± 0.2°	Propagation experiments: (1) absolute attenuation at 12 and 18 GHz, (2) differential attenuation at 12 and 18 GHz, (3) phase distortion at 12 GHz. NB communications experiment: 12 multiple access telephone carriers. WB communications experiment: digital or FM video.	SHF: 11.15 to 12.05 GHz down, 16.95 to 17.85 GHz up. Command at 136.62, 136.14 and 148.26 MHz. Telemetry at 11.476, 2.2445, 2.2415 and 2.2505 GHz.	NB: 1.5MHz; WB: 35MHz
GMS	NASDA (Japan)	18 Jul 1977		Geostationary				140°E ± 1°; inclination tolerance ± 1°.	5 channels, 3 UHF and 2 L-band	402.2, 2026-2034, 2034.974 MHz uplink; 468.875, 468.883, 466.424, 1691, 1694.5 MHz downlink.	24 KHz at UHF; 94 KHz at 1691 MHz, 468 KHz at 1694.5 MHz

onsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
5.927-6.303 GHz uplink, 3.702-4.178 GHz downlink	36MHz		One antenna, producing circular spot beam; 30.5dB transmit gain 28 dB receive gain					TDMA in all XPDRs TV/FM in transponders 1-5, 12; FDM/FM in 3-12	
SHF: 11.15 to 12.05 GHz down, 16.95 to 17.85 GHz up. Command at 136.62, 136.14 and 148.26 MHz. Telemetry at 11.476, 2.2445, 2.2415 and 2.2505 GHz.	NB: 1.5MHz; WB: 35MHz		0.35m SHF paraboloid, 22.5 dB gain at 12 GHz, 23.5 dB gain at 18 GHz, CP. VHF whip antenna. SHF coverage: (1) Italy, (2) Central Europe, (3) Europe plus North American East Coast	1-10W TWTA	31 5 dBW at beam center	-22.2 dB/K Ku-band, -17.2 dB/k at K-band	In operation	Experiments with PCM-PSK and FM video. SCPC	See Ref. (65), (69), (74).
402.2, 2026-2034, 2034.974 MHz uplink; 468.875, 468.883, 466.424, 1691, 1694.5 MHz downlink.	24 KHz at UHF; 94 KHz at 1691 MHz, 468 KHz at 1694.5 MHz		RHC pol. at UHF, vertical pol. at L-band; elliptical pattern, 8dB gain at UHF; elliptical pattern, 18dB gain at L-band	7.4 dBW peak power				F2 modulation at 1691 MHz, F4 at others.	

Table 3-26. Foreign Government Sponsored Communication

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARA		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Chann Band width
Statsionar 3	Min. of Posts & Telecom. (USSR)		1250kg (2756 lb) in orbit	Geo-synchronous	3 axis with orbital correction system	Solar array		85° E		5.75 to 6.2 GHz up, 3.42 to 3.87 GHz down. TV at 6.200 & 3.875 GHz	40 M
Statsionar 4		1978-1979						13.5° W		6.0 to 6.25 GHz up, 3.5 to 3.9 GHz down	
Statsionar 5								58° E		6.0 to 6.25 GHz up, 3.67 to 3.9 GHz down	
Statsionar 6		1979-1980						90° E		6 GHz up, 3.4-4 GHz down	
Statsionar 7								140° E			
Statsionar 8		TBD						25° W		5.75 to 6.0 GHz up, 3.42 to 3.67 GHz down	
Statsionar 9								45° E			
Statsionar 10								170° W			
Arabsat 1	Arab League	1982						19°E±1.0°; incl. tol. ±1.0°	> 14 XPDRs; 2 X PDRs for community TV and Brdcast programs	5.925-6.425 GHz uplink; 3.7-4.2 GHz downlink	
Arabsat 2								26°E±1.0°; incl. tol. ±1°			

onsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
5.75 to 6.2 GHz up, 3.42 to 3.87 GHz down. TV at 6.200 & 3.875 GHz	40 MHz		Peak gain 23 dB. Two to eleven beams, circular polarization		30.8 dBW	-15.8 dB/K	In flight preparation	Telephone, telegraph, photo-telegraph, audio and video capabilities. Six XPDRs. FDM/FM modulation, TDMA. For fixed service.	See Ref. (61), (67), (69), (74)
6.0 to 6.25 GHz up, 3.5 to 3.9 GHz down							In proposal stage		For international service.
6.0 to 6.25 GHz up, 3.67 to 3.9 GHz down									
6 GHz up, 3.4-4 GHz down			Two antennas						
5.75 to 6.0 GHz up, 3.42 to 3.67 GHz down									
5.925-6.425 GHz uplink; 3.7-4.2 GHz downlink			28 dB gain. Shaped beam to cover Arab geographical region.			T=1000K			Telephone, low & high speed data, multiplexed telex/telegraph, community reception of radio & TV ——— One spare on grd

Table 3-27. Foreign Government Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channe Band-width
Symphonie A	Fr/FRG CIFAS consortium	12/18/1974; Thor-Delta 2914 (AKM)	401kg (884 lb); 230kg (506 lb)	Geo-synchronous; 5 years	3-axis with N jets	Solar array; 2 Ni-Cd batteries	300 W BOL; 180W EOL; partial eclipse capability	11.5^{o} W $\pm$ 0.5^{o} E-W and N-S; 0.1^{o}	2 repeaters using double conversion	Uplink from 5.94 to 6.03 GHz and from 6.195 to 6.285 GHz. Downlink from 3.715 to 3.80 GHz and from 3.97 to 4.06 GHz. Telemetry from 136 to 138 MHz. Command from 148 to 150 MHz.	90 MHz for eac repeate
Symphonie B		8/26/1975; Thor-Delta 2914 (AKM)						11.5^{o}W $\pm$ 0.5^{o}E-W and N-S; 0.0^{o}		Uplink from 6.32 to 6.41 GHz and from 6.065 to 6.155 GHz. Downlink from 4.095 to 4.185 GHz and from 3.855 to 3.93 GHz. TC s/a "A"	
Symphonie C		TBD						TBD		s/a "A"	

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ion n	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	Uplink from 5.94 to 6.03 GHz and from 6.195 to 6.285 GHz. Downlink from 3.715 to 3.80 GHz and from 3.97 to 4.06 GHz. Telemetry from 136 to 138 MHz. Command from 148 to 150 MHz.	90 MHz for each repeater		2-parabolic xmit antennas each with 13° x 8° BW, one centered on 11°E-11°N with main axis U.K. - Madagaskar, the other centered on 43°W-3°N with main axis Montreal - Buenos Aires. 1-horn rcve antenna, 17.2° BW, 16 dB peak gain.	2-13 W TWTA's	29 dBW at beam edge	-15 dB/°K	In operation	1 video with 3 audio and 1 order-wire circuit per repeater, or 192 duplex audio circuits per repeater	See Ref. (10)
	Uplink from 6.32 to 6.41 GHz and from 6.065 to 6.155 GHz. Downlink from 4.095 to 4.185 GHz and from 3.855 to 3.93 GHz. TC s/a "A"									
	s/a "A"							Ground spare		May be placed over India

Table 3-28. Foreign Government Sponsored Communicatio

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARA		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
Volna 1	Ministry of Posts & Telecommunication (USSR)	1980		Geostationary				25°W ±0.5°; incl. tolerance ±0.5°		1.6365-1.644 GHz uplink, 1.535-1.5425 GHz downlink for maritime service; 1.645-1.660 GHz uplink, 1.5435-1.5585 GHz downlink for aeronautical service; 335.4-399.9 MHz uplink, 240-328.6 MHz downlink for land-mobile service.	
Volna 2								135°W ±0.5°; incl. tolerance ±0.5°		1.6365-1.644 GHz uplink, 1.535-1.5425 GHz downlink for maritime service; 1.645-1.660 GHz uplink, 1.543-1.5585 GHz downlink for aeronautical service.	
Volna 3								45°E ±0.5°; Incl. tolerance ±0.5°		S/a "1"	
Volna 4								58°E ±0.5°; Incl. tolerance ±.5°		S/a "2"	
Volna 5								85°E ±0.5°; Incl. tolerance ±.5°		S/a "1"	

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
1.6365-1.644 GHz uplink, 1.535-1.5425 GHz downlink for maritime service; 1.645-1.660 GHz uplink, 1.5435-1.5585 GHz downlink for aeronautical service; 335.4-399.9 MHz uplink, 240-328.6 MHz downlink for land-mobile service.			18 dB gain at L-band, 12 dB gain at UHF. Ant. pattern covers territory within 72° earth central angle from the sub-satellite point. Satellite receiving antennas have gain of 18 dB at L-band & 14 dB at UHF	8W peak power					Military system; 7 satellites planned for mobile use. Much redundancy. See Ref. A5, A7
1.6365-1.644 GHz uplink, 1.535-1.5425 GHz downlink for maritime service; 1.645-1.660 GHz uplink, 1.543-1.5585 GHz downlink for aeronautical service.									
S/a "1"									
S/a "2"									
S/a "1"									

Table 3-29. Foreign Government Sponsored Communications S

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTE			
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	
Volna 6								140°E ±0.5°; Incl. tolerance ±0.5°		S/a "2"		
Volna 7								170°W ±0.5°; Incl. tolerance ±0.5°		S/a "1"		

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
on	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	S/a "2"									
	S/a "1"									

Table 3-30. Foreign Government Sponsored Communicatio

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARA		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Chan Ban wid
Zohreh 1	Iran; Amer. Bell International	Nov. 1981; STS	1814kg (4000 lb in orbit	Geo-stationary		Silion solar cells; Ni-Cd batteries.		34°E±0.1° inclination tolerance ±0.1°		14.4930-14.450 uplink; 11.1930-11.700GHz downlink. Two channels each 7 MHz wide; 12 XPDR 14.00-14.48 GHz uplink; 11.15-14.48 GHz downlink	40 M (for t 12 XPD
Zohreh 2		Dec. 1981; STS						26°E±0.1°; inclination tolerance ±0.1°			
Zohreh 3		1982; STS						45°E±0.1°; inclination tolerance ±0.1°			
Zohreh 4		1982; STS						41°E±0.1°; inclination tolerance ±0.1°		14.0-14.5 GHz uplink, 10.95-11.2 GHz, 11.45-16.7 GHz downlink	

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
on	Repeater and TT&C Frequencies	RF Channel Band-width	Beacon	Antenna	Power Ampli-fier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	14.4930-14.450 uplink; 11.1930-11.700GHz downlink. Two channels each 7 MHz wide; 12 XPDR 14.00-14.48 GHz uplink; 11.15-14.48 GHz downlink	40 MHz (for the 12 XPDRs)		37 dB gain for TV & telcom, 15.0 dB gain for telemetry link earth coverage antenna	-3 dBW peak power on 7 MHz ch; +13 dBW on 12 XPDR	20 dBW for ea. TV XPDR 13 dBW for ea. telephone, data, & facsimile XPDR			3 TV XPDRs, 12 telephone, data, & facsimile XPDRs. Demand assigned multiple access (DAMA)	XPDR 1 receives on highest freq. & xmit on on lowest freq. XPDR. 2 is on next highest & next lowest, etc. May be delayed or cancelled due to unrest in Iran. First 3 plus spare to be launched in 1982. Total of 10 planned. See Ref. (90).
	14.0-14.5 GHz uplink, 10.95-11.2 GHz, 11.45-16.7 GHz downlink									

SECTION 4 - Commerical Satellites

Table 4-1. Commercially Sponsored Communications S

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manu-facturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabili-zation	Power Source	Power Capa-city	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Chann Band-width
Advanced Westar & TDRSS	NASA; WU/ TRW	1980; STS	1088 kg (4400 lb) AKM	Geo-sync; 10yrs	3-axis stab.	Solar panals + batts.	1800 W EOL	TDRS - WEST: 173°W: TDRS Center (ADV Westar): 100°W TDRS - Center (Spare) : TDRS - EAST: 41°W	Repeater tpe Adv. Westar: 12 C-band XPDRs 4 K-band XPDRs	3 frequency band service:S, C, K C-band:6 MHz UP, 4 MHz DWN ; K-band : 14 UP 12 Down ; S-band TT&C NASA: Grd/SC UP:14-15 GHz DWN::13-14 GHz User/SC: 2.2-2.3 returen (221/240) ratio FWD; 13 GHz Forward (1600/1469) ratio return	Total BW: UP:62 MH DWN:6 Mhz C-ban XPDR BW: 36 MH K_u-ba XPDR BW: 225 M

onsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
on	Repeater and TT&C Frequencies	RF Channel Band-width	Beacon	Antenna	Power Ampli-fier	EIRP dBW	System Figure Of Merit (G/T) dB/°K	Satellite Status	Operational Capability	Notes
e PDRs DRs	3 frequency band service:S, C, K C-band:6 MHz UP, 4 MHz DWN ; K-band : 14 UP 12 Down ; S-band TT&C NASA: Grd/SC UP:14-15 GHz DWN::13-14 GHz User/SC: 2.2-2.3 returen (221/240) ratio FWD; 13 GHz Forward (1600/1469) ratio return	Total BW: UP:625 MHz DWN:650 Mhz C-band XPDR BW: 36 MHz K_u-band XPDR BW: 225 MHz	S-band	For Adv. Westar fns: 4 FT C-band dsih ("D") shaped; K-band refl: (CONUS only) Large dishes for K-band spot cov. NASA fns: 2-16 FT S-band dishes; 1- K band air/grd link dish; S-band phased array conical spiral S-band ant. for TT&C	TWTAs for S&K comm. with users ; 30 W for space/grd link	Space/grd link: 50 ; Multiple access service: 34; S-band single access: 46.4 K-band single access: 49.4	C-band: -12	In develop.	K & S band comm. with NASA users. K-band down link to grd station. C & K band to comm-erical users	2 sats will serve as NASA TDRS One will serve as Advanced Westar One will be spare on grd all sats identical

Table 4-2. Commercially Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHAR.		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	R Cha Ba wi
Comstar A (D-1)	Comsat General; HAC	5/13/1976; Atlas Centaur (AKM)	1490kg (3285 lb); 790kg (1741 lb)	Geosynchronous; 7 years.	Spin; hydrazine jets.	Solar array. Batteries.	760 W BOL, 610 E EOL. Limited eclipse capability	128° W ± 0.1° E-W and N-S; 0.0°	Single conversion. 2 WB working receivers with one-for-one protection, each driving 12 xmit channels.	Vertical transmit center frequencies from 3720 to 4160 MHz in 40 MHz steps. Vertical receive center frequencies from 5945 to 6385 MHz in 40 MHz steps. Horizontal transmit center frequencies from 3740 to 4180 MHz in 40 MHz steps. Horizontal receive center frequencies from 5965 to 6405 MHz steps. Telemetry at 3700.5 and 4198 MHz. Command from 5925 to 5928 MHz.	24-3 MHz tran pond
Comstar B (D-2)		7/22/1976; Atlas Centaur (AKM)						95° W ± 0.1 E-W and N-S			
Comstar C (D-3)		6/29/1978 Atlas Centaur (AKM)						87° W ± 0.1 E-W and N-S			
Comstar D		TBD						TBD			

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ation em	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
ver- B - th ie ng	Vertical transmit center frequencies from 3720 to 4160 MHz in 40 MHz steps. Vertical receive center frequencies from 5945 to 6385 MHz in 40 MHz steps. Horizontal transmit center frequencies from 3740 to 4180 MHz in 40 MHz steps. Horizontal receive center frequencies from 5965 to 6405 MHz steps. Telemetry at 3700.5 and 4198 MHz. Command from 5925 to 5928 MHz.	24-36 MHz transponders	19 GHz, 28.6 GHz	2 gridded reflectors, one vertically polarized, one horizontally polarized. Vertically polarized reflector fed by 5-horn array, horizontally polarized refelector fed by 6-horn array. Telemetry and command bicone antennas. 6 millimeter wave experimental horns. CONUS broad beam coverage, Alaska, Hawaii and Puerto Rico spot beam coverage.	24-5W TWTAs. 2-1. 5W TWT drivers.	33 dBW to CONUS Hawaii, Puerto Rico or Alaska only. 31 dB dBW to CONUS and Alaska combined.	-8.8 dB/ K	In operation	Approximately 14400 duplex audio circuits	19 GHz and 28.6 GHz experimental transmitters carried on-board. See Ref. (19), (56), (57), (58)
									Capacity of 18000 telephone circuits	
								Spare		

Table 4-3. Commercially Sponsored Communicatio

SATELLITE	SPACECRAFT DATA								PAYLOAD CHAR		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	Ch Ba wi
Intelsat IV (F-1)	Intelsat; HAC	5/22/1975; Atlas Centaur (AKM)	1415kg (3120 lb); 730kg (1610 lb)	Geosynchronous; 7 years	Spin; hydrazine jets	Solar array; 2 Ni-Cd batteries	569 W BOL; 460 W EOL; partial eclipse capability	63°E ± 0.12° E-W and ± 0.25° N-S; 0.0°	12 linear or limiting (command selectable) single conversion repeaters. Redundant rcvr.	Uplink center frequencies from 5.95 to 6.4 GHz in 40 MHz steps. Downlink center frequencies from 3.725 to 4.175 GHz in 40 MHz steps. Command from 6.168 to 6.182 GHz. Telemetry at 3.9475 and at 3.9525 GHz.	36 per pea
Intelsat IV (F-2)		1/25/1971; Atlas Centaur (AKM)						4° W ± 0.12° E-W and ± 0.25° N-S; 0.1°			

AD-A073 208 COMPUTER SCIENCES CORP FALLS CHURCH VA F/G 17/2
UPDATE ON THE COMMUNICATION SATELLITES CHARACTERISTICS MATRIX,(U)
APR 79 B PATTAN, G T ANDERSON DCA100-76-C-0089
UNCLASSIFIED SBIE-AD-E100 249 NL

2 OF 2
AD A 073208

END
DATE FILMED
6-80
DTIC

onsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
Uplink center frequencies from 5.95 to 6.4 GHz in 40 MHz steps. Downlink center frequencies from 3.725 to 4.175 GHz in 40 MHz steps. Command from 6.168 to 6.182 GHz. Telemetry at 3.9475 and at 3.9525 GHz.	36 MHz per repeater	3.95 GHz at 30 dBm	2-EC rcve and 2-EC xmit conical horns with flat plate reflectors, 2-50 inch nonsteerable parabolic SB reflectors for both rcve and xmit. Xmit beam width 17°/4.5° for EC/SB mode. Xmit gain 20.5 dB/31.7dB for EC/SB mode. Xmit RHCP, rcve LHCP. 1 omnidirectional command rcve antenna, 1 omnidirectional telemetry xmit antenna.	12-6 W TWTA's. Rcvr has 2-1.5 W TWTA drivers	22.5 dBW/34.2 dBW per repeater in EC/SB mode.	-18.6 dB/K	In operation	Average of 3750 circuits plus 2 video channels	See Ref. (5), (10), (19), (29), (30)
							In reserve		

Table 4-4. Commercially Sponsored Communications Sa

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACT		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
Intelsat IV (F-3)	Intelsat; HAC	12/19 1971; Atlas Centaur (AKM)	s/a F-1	s/a F-1	s/a F-1	s/a F-1	s/a F-1	19.5° (34.5°?) ±0.12° E-W & ± 0.25° N-S; 0.1°	s/a F-1	s/a F-1	s/a F-1
Intelsat IV (F-4)		1/22/ 1972; Atlas Centaur (AKM)						179.°E ±0.12° E-W & ±0.25° N-S: 0.1°			
Intelsat IV (F-5)		6/13/ 1972; Atlas Centaur (AKM)						60°E ±0.12° E-W & ±0.25° N-S: 0.0°			
Intelsat IV (F-7)		8/23/ 1973; Atlas Centaur (AKM)						1°W ±0.12° E-W & ±0.25° N-S; 0.1°			
Intelsat IV (F-8)		12/15/ 1974; Atlas Centaur (AKM)						174°E ±0.12° E-W & ±0.25° N-S: 0.6°			

nsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
s/a F-1	s/a F-1	s/a F-1	s/a F-1	s/a F-1	s/a F-1	s/a F-1	In operation	s/a F-1	
							In reserve		
							In operation; leased XPDR service		
							In operation.		

Table 4-5. Commercially Sponsored Communications Sat

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTE		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
Intelsat IVA (F-1)	Intelsat; HAC	9/25/1975; Atlas Centaur (AKM)	1470kg (3240 lb); 826kg (1820 lb)	Geosynchronous; 7 years	Dual spin; hydrazine jets	Solar array; 2 Ni-Cd batteries	708 W BOL; 600 W EOL; partial eclipse capability	24.5° W ± 0.1° E-W and N-S; 0.2°	20 repeaters; 4 in EC mode, 16 in AC and SB mode	Uplink from 5.932 to 6.418 GHz. Downlink from 3.707 to 4.193 GHz. Command from 6.168 to 6.182 GHz. Telemetry at 3.9475 and at 3.9525 GHz.	36 MHz per repeater in single carrier mode; 32.4 MHz per repeater in multiple carrier mode
Intelsat IVA (F-2)		1/29/1976; Atlas Centaur (AKM)						29.5° W ± 0.1° E-W and N-S; 0.1°			
Intelsat IVA (F-3)		7 Jan 1978 Atlas Centaur (AKM)						60.0°E; 0.0°			
Intelsat IVA (F-4)		26 May 1977; Atlas Centaur (AKM)						34.5°			
Intelsat IVA (F-6)		31 Mar 1978						63°E; 0.0°			

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ation em	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
rs; ode, nd	Uplink from 5.932 to 6.418 GHz. Downlink from 3.707 to 4.193 GHz. Command from 6.168 to 6.182 GHz. Telemetry at 3.9475 and at 3.9525 GHz.	36 MHz per repeater in single carrier mode; 32.4 MHz per repeater in multiple carrier mode		2-53 inch xmit and 1-35 inch rcve reflectors. 1-EC xmit horn, 1-EC rcve horn. Combined capability is 1-EC rcve, 1-EC xmit, 2-AC rcve, 2-AC xmit, 6-SB xmit antennas, 2 beacon horns. 2 omni-directional telemetry xmit antennas. Xmit RHCP, rcve LHCP.	4-6 W TWTA's in EC mode, 16-5W TWTA's in AC and SB mode.	22.0 dBW/ 26.0 dBW/ 29.0 dBW per repeater at beam edge in EC/ AC/SB mode, respectively	-18 dB/^{o}K in EC mode; -11 dB/^{o}K in AC and SB mode	In operation	Average of 6250 circuits plus 2 video channels	6-IVA flight models. See Ref. (19), (29), (30), (67) (68), (76).
								In reserve		
								In reserve		
								In operation		
								Planned for service		

Table 4-6. Commercially Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channe Band-width
Intelsat V	Intelsat; Ford	1979; Atlas Centaur STS, or Ariane	1897kg (4182 lb); 1714kg (3779 lb)	Geo-sync 7 yrs	3-axis with hydrazine jet	Solar array; Ni-Cd batt.	1320W BOL; 1200W EOL	Planned locations: 24.5°W, 19.5°W, 29.5°W, 34.5°W, 63°E, 60°E. long. and incl. tolerance is ±0.1°	27 repeaters. S/C will use beam separation & dual polarization	6 and 14 GHz uplink; 4 & 11 GHz downlink	2.41 GHz eff.
Intelsat VI	Intelsat		1986	Geo-stationary; 7 yrs				Atlantic		Depends on WARC decisions in 1979.	

onsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
6 and 14 GHz uplink; 4 & 11 GHz downlink	2.41 GHz eff.	11 GHz	TC&R omni. Beacon: horn 6 GHz hemi/zone 7-element phased array 6 GHz hemi/zone parabolic receive ant. 4 GHz global coverage bands. 4 GHz hemi/zone parabolic transmit ant. Two 11 GHz parabolic ant. for East and West spot beams.				In manufacture	12000 circuits plus 1 color video ch. FDM/FM, FM QPSK mod. TDMA, FDMA, reuse.	See Ref. (36), (66), (67), (72), (79), (96).
Depends on WARC decisions in 1979.							Concept only	75,000-85,000 channels	See Ref. (97).

BAND/COVERAGE	G/T
14 GHz WEST SPOT	5.33
14 GHz EAST SPOT	2.13
6 GHz HEMI	-8.37
6 GHz ZONE	-6.40
6 GHz GLOBAL	-16.76

COVERAGE	CHANNEL	TWTA POWER (W)	TWTA POWER (dBW)	NET ANTENNA GAIN[1] (dBi)	EIRP PREDICTED VALUE (dBW)
EARTH (18° COVERAGE AREA)	7-8	2-8.5	12.3	16.5	26.8
	9	2-4.5	9.54	16.5	23.8
	10, 11, 12	8.5	9.29	16.5	24.18
ZONE	ALL	4.5	6.53	25.0	30.16
HEMI (WEST)	1-2, 3-4, 5-6	8.5	9.29	22.0	29.92
	7-8	8.5	9.29	22.0	29.43
	9	4.5	6.53	22.0	26.44
EAST SPOT	1-2, 5-6	10.0	10.0	33.4	41.64
WEST SPOT	1-2, 5-6	10.0	10.0	37.2	45.44
11 GHz	—	0.16	-8.0	14.4	6.4

2

Table 4-7. Commercially Sponsored Communications Satellite C

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTERIS			
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	Bea
Intelsat MCS Atlantic A	Intelsat	June 1982						18.5W ±0.5°; incl. tolerance ±0.5°		Ship: 1636.5-1644.0 MHz uplink 1535.0-1542.5 MHz downlink Shore: 6417.5-6425.0 MHz uplink, 4192.5-4200.0 MHz downlink		
Intelsat MCS Atlantic B								29.5°W ±0.5°; incl. tolerance ±0.5°				
Intelsat MCS Indian A		June 1981						63.0°E, longitudinal tolerance 0.0°E, 1.0°W. Incl. tolerance ±0.5°				
Intelsat MCS Indian B								60.0°E, ±0.5°; incl. tolerance ±0.5°				

ed Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
Ship: 1636.5-1644.0 MHz uplink 1535.0-1542.5 MHz downlink Shore: 6417.5-6425.0 MHz uplink, 4192.5-4200.0 MHz downlink			Circular pattern, earth coverage; 21 dB gain at 4/6 GHz, 19 dB gain at L-band.				In planning stage.		Maritime service. Inmarsat will be formed of a subset of the 4 MCS satellites & the 4 Marecs satellites. See Ref (99).

Table 4-8. Commercially Sponsored Communications Satellite

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTERISTIC			
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon
LEASAT	DoD; Hughes	1982; STS	1197 kg (2640 lb)	Geosync; 5 yrs	Spin stab.	Drum mounted solar array plus batteries	1200W	Location of FLTSATS	UHF: Delay single up conversion. 1-500 KHz ch 6-25 KHz chs 5-5 KHz chs	UHF: Uplink:292-311 MHz Dwnlink: 250-270 MHz FLTBCT: 7995 MHz SHFBCN: 7260 MHz TT&C: CMD: 7980 MHz TLM: 7245-7295 MHz via bicone ant. & SHF horn	500 KHz NB 25 KHz Relay 5 KHz NB	At SHF operat thru FSC-7

ponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
ion n	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
on. h s s	UHF: Uplink:292-311 MHz Dwnlink: 250-270 MHz FLTBCT: 7995 MHz SHFBCN: 7260 MHz TT&C: CMD: 7980 MHz TLM: 7245-7295 MHz via bicone ant. & SHF horn	500 KHz NB 25 KHz Relay 5 KHz NB	At SHF operate thru FSC-79	Two UHF helices like Gapfiller. G_n=14.1 G_x=13.9 Two SHF EC horns G=17dB +9° TT&C: Two biconical horns, one for CMDS, other for TLM. CMD ant: LHCP G= 1.6 dBi TLM ant: RHCP G = 3.9 dBi	UHF: Transistor SHF BCN: S-Band transistor mult to SHF	UHF: wB:29.5 Relay: 27.5 NB:18 FLTBCT: (UHF) 27.5 BCN: 15	UHF: -14 SHF: -17	In development	1 FLTBRDCST channel 1 wideband channel 6 Relay chs 5 NB chs.	4 sat. system. After launch, Navy will lease system for at least 5 years. See Ref. (101)

Table 4-9. Commercially Sponsored Communications Satel

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTERI			
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	Be
Marisat A	Comsat General; HAC	2/19/1976; Thor Delta 2914 (AKM)	655kg (1445 lb); 331kg (730lb)	Geosynchronous; 5 years	Spin; hydrazine jets	Solar array; Ni-Cd batteries	330 W BOL; 300 W EOL; full eclipse capability	15° W; 2.4°	1-WB and 2-NB UHF channels for maritime communications (currently leased by U.S.N.). C-band repeater for S/C-to-ET civil communications. L-band repeater for S/C-to-S/C links.	C-band uplink from 6.42 to 6.424 GHz. L-band uplink from 1.6385 to 1.6425 GHz. UHF uplink at 300 MHz. Command and ranging from 6.1725 to 6.1765 GHz.	WB UHF: 480 kHz; NB UHF: 24 kHz; 4 MHz for L/C and C/L	Tr in 1. GH te m at 3. an 3. GH

onsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
on	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
NB s ons r T ni- and	C-band uplink from 6.42 to 6.424 GHz. L-band uplink from 1.6385 to 1.6425 GHz. UHF uplink at 300 MHz. Command and ranging from 6.1725 to 6.1765 GHz.	WB UHF: 480 kHz; NB UHF: 24 kHz; 4 MHz for L/C and C/L	Tracking at 1.5415 GHz; telemetry at 3.9455 and at 3.9545 GHz	UHF helical array, 14dB gain at beam center, RHCP, 12.6 dB gain at earth edge. L-band helical array, RHCP, 17.8 dB gain at beam center, 14.2 dB gain at beam edge. C-band circular xmit horn, LHCP; C-band circular rcve horn, RHCP; both have 19.1 dB gain at beam center, 15.7 dB gain at beam edge. Omnidirectional command cloverleaf, -1.5 dB gain. Linearly polarized telemetry bicone, 0 dB gain. Antenna coverage from Indian Ocean to Arctic Sea to Gulf of Mexico to Antarctic Ocean.	5W L-band TWTA. 3-level L-band TWTA with power outputs of 7 W, 30 W, 60 W	L-band: all UHF is 20 dBW; WB UHF only is 26 dBW. C-band: all UHF is 18.8 dBW; no UHF is 18.8 dBW. Total for all UHF is 30.1 dBW, for WB UHF is 28 dBW. These are representative operating modes	-17 dB/K for L/C; -25.4 dB/K for C/L	In operation	Telephony, real-time telegraphy, facsimile, data, broadcasting.	See Ref. (50), (51)

Table 4-10. Commercially Sponsored Communications Satellit

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTERIST			
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacc
Marisat B	Comsat General; HAC	6/10 1976; Thor-Delta 2914 (AKM)	s/a "A" above	s/a "A"	s/a "A"	s/a "A"	s/a "A"	176.5° W; 2.5°	s/a "A"	s/a "A"	s/a "A"	s/a "A"
Marisat C		10/14 1976; Thor-Delta 2914 (AKM)						73°E; 2.6°				

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
tion m	Repeater and TT&C Frequencies	RF Channel Band-width	Beacon	Antenna	Power Ampli-fier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	s/a "A"	s/a "A"	s/a "A"	Antennas s/a Marisat A. Coverage from Arctic Ocean to Indian Ocean to Pacific Ocean to Antarctic Ocean.	s/a "A"	s/a "A"	s/a "A"	In operation	s/a "A"	Exclusively for Navy use only

Table 4-11. Commercially Sponsored Communications

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARAC		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Chann Band width
Satcom 1 (F-1)	RCA Globcom; RCA AED	12/12/1975; Thor-Delta 3914 (AKM)	907kg (2000 lb 463kg (1020 lb	Geo-synchronous; 8 years	3 axis; hydrazine jets	Solar array; 3 Ni-Cd batteries	770 W BOL; 550 W EOL; full eclipse capability	135° W ± 0.1° E-W and N-S; 0.0°	24 single - conversion repeaters. Redundant rcvr/driver configuration.	Downlink: horizontal center frequencies from 3.74 to 4.18 GHz in 40 MHz steps, vertical center frequencies from 3.72 to 4.16 GHz in 40 MHz steps. Uplink: horizontal center frequencies from 5.945 to 6.385 GHz in 40 MHz steps, vertical center frequencies from 5.965 to 6.405 in 40 MHz steps. Telemetry at 4.1995 and at 3.7005 GHz. Command at 6.4235 GHz	24-36 MHz channe with fr quency spectr re-use Com-mand has 3 MHz b

nsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
Downlink: horizontal center frequencies from 3.74 to 4.18 GHz in 40 MHz steps, vertical center frequencies from 3.72 to 4.16 GHz in 40 MHz steps. Uplink: horizontal center frequencies from 5.945 to 6.385 GHz in 40 MHz steps, vertical center frequencies from 5.965 to 6.405 in 40 MHz steps. Telemetry at 4.1995 and at 3.7005 GHz. Command at 6.4235 GHz	24-36 MHz channels with frequency spectrum re-use. Command has 3 MHz BW	Ranging tones at 35.1 Hz, 283.4 Hz, 3.9681 MHz, 27.777 kHz	2 horizontally polarized and 2 vertically polarized reflectors. Horn has six feeds. Beams 1 and 3 cover CONUS and Alaska with beam size 8.4° x 3.2°, gain of 29.9 dB at beam center and 26.5 dB at beam edge, both horizontally polarized. Beams 2 & 4 cover CONUS and Alaska with beam size 8.4° x 3.2°, gain of 30 dB at beam center and 26.5 dB at beam edge, both vertically polarized. Beam 5 covers Hawaii with beam size 2.6° x 1°, gain of 31 dB at beam center and 30 dB at beam edge, horizontally polarized. Beam 6 covers Hawaii with beam size	24 - 5W TWTA's	32 dBW to CONUS; 26 dBW to Hawaii	-7 dB/°K for CONUS; -10 dB/°K for Hawaii	In operation	1 video with audio or 900 half-duplex audio or 64 Mbps data per channel	Primarily commercial, Govt., & Alaskan Services (67), (98)

Table 4-12. Commercially Sponsored Communications Sat

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTE		
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth
Satcom 1 (cont'd)	s/a "A"		s/a "A"	s/a "A"	s/a "A"	s/a "A"	s/a "A"		s/a "A"	s/a "A"	s/a "A"
Satcom 2 (F-1)		3/26/1976; Thor-Delta 3914 (AKM)						119° W ± 0.1° E-W and N-S			
Satcom 3		Dec 1979						132°W			
Satcom 4		1980; STS						TBD			

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ation tem	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
	s/a "A"	s/a "A"	s/a "A"	2.6° x 1°, gain of 29.4 dB at beam center and 28.9 dB at beam edge, vertically polarized	s/a "A"	s/a "A"	s/a "A"	s/a "A"	s/a "A"	
								In manufacture		CONUS coverage. Primarily TV service

Table 4-13. Commercially Sponsored Communications Satel

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTERI			
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	Be
SBS-A	Satellite Business Systems (SBS); Hughes	1980; Thor-Delta 3910 (AKM) or STS	907kg (2000 lb); 506kg (1115 lb)	Geo-synchronous; 7 years.	Spin	Solar array; 2 Ni-Cd Cd batteries	1 KW partial eclipse capability	122°W, Station keeping to be ± 0.05° E-W and N-S.	Single conversion. Medium level, linear solid state drivers. 10 XPDRs	Uplink center frequencies (GHz): 14.031, 14.092, 14.153, 14.214, 14.275, 14.336, 14.397, 14.458 Downlink center frequencies (GHz): 11.731, 11.792, 11.853, 11.914, 11.975, 12.036, 12.097, 12.158. T, T&C uplink at 6.0 and 14.0 GHz. T, T&C downlink at 4.19775, 4.19725, 11.701 and 12.199 GHz. Back-up telemetry is 4.19725 GHz.	Ten 43-MHz channels for total of 430 MHz.	
SBS-B		1981; Thor-Delta 3910 or STS						110°W; station-keeping to be +0.05° E-W & N-S				

Sponsored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS								OPERATIONAL DATA		
ion n	Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP	System Figure Of Merit (G/T)	Satellite Status	Operational Capability	Notes
r- um	Uplink center frequencies (GHz): 14.031, 14.092, 14.153, 14.214, 14.275, 14.336, 14.397, 14.458 Downlink center frequencies (GHz): 11.731, 11.792, 11.853, 11.914, 11.975, 12.036, 12.097, 12.158. T, T&C uplink at 6.0 and 14.0 GHz. T, T&C downlink at 4.19775, 4.19725, 11.701 and 12.199 GHz. Back-up telemetry is 4.19725 GHz.	Ten 43-MHz channels for total of 430 MHz.		One 60 cm. parabolic receive antenna. One or two 65 cm. parabolic transmit antennas. Transmitted signals are linearly polarized parallel to equatorial plane. Received signals are linearly polarized and orthogonal to the downlink signals. Each antenna will have dual feeds with shaped beamwidths of 2.8°. Will use one broad beam 4 GHz transmit antenna, one broad beam 6 GHz rcve antenna, one broad beam 12 GHz rcve antenna.	12-20W TWTA's (includes 4 spares) Total RF output communications power will will be 2W in the 4 GHz band, and 0.1W in the 12 GHz band.	40-43.7 dBW in primary cvrg zone	-2 dB/°K in region 1; -6 dB/°K in region 2	Under construction	Data rate will approach 48 Mbps per transponder.	Region 1 is in eastern Kentucky. Region 2 is centered in southern Pennsylvania and in Utah. 3 models built; 3rd is ground spare. See Ref. (31), (66), (67), (74).

Table 4-14. Commercially Sponsored Communications Sa

SATELLITE	SPACECRAFT DATA								PAYLOAD CHARACTE			
	Sponsor and Manufacturer	Launch Date and Launch Vehicle	Launch and On-Orbit Weight	Orbit and Design Life-Time	Stabilization	Power Source	Power Capacity	Location and Inclination	Communication Sub-system	Repeater and TT&C Frequencies	RF Channel Bandwidth	E
Westar I	Western Union; HAC	4/13/1974; Thor-Delta 2914 (AKM)	576kg (1270 lb); 249kg (549 lb)	Geo-synchronous; 7 years	Spin; hydrazine jets	Solar array; Ni-Cd batteries	300W BOL; 220 W EOL. Limited eclipse capability	99° W ± 0.1° E-W and N-S; 0.0°.	Single conversion redundant receiver. WB receiver drives transmitters. ——— 12 XPDRs	Receive center frequencies from 5945 to 6385 MHz in 40 MHz steps. Transmit center frequencies from 3720 to 4160 MHz in 40 MHz steps. Telemetry at 4198.25, 4198.75, 4199.25 MHz.	12-36 MHz channels	5 M
Westar II		10/10/1974 Thor-Delta 2914 (AKM)						123.5° W ± 0.1° E-W and N-S 0.0°. ——— CONUS				

sored Communications Satellite Characteristics

PAYLOAD CHARACTERISTICS							OPERATIONAL DATA		
Repeater and TT&C Frequencies	RF Channel Bandwidth	Beacon	Antenna	Power Amplifier	EIRP (dBW)	System Figure Of Merit (G_o/T) dB/K	Satellite Status	Operational Capability	Notes
eceive center frequencies from 945 to 6385 MHz n 40 MHz steps. Transmit center requencies from 3720 to 4160 MHz n 40 MHz steps. Telemetry at 4198.25, 4198.75, 4199.25 MHz.	12-36 MHz channels	5767 MHz	60 inch parabolic reflector with 4 dual-polarized feed horns. 27 dB gain at beam edge. Coverage to CONUS has beamwidth of 6.8 x 3.5°. 8.0° spot beam to Hawaii and Alaska. Receive polarization parallel to spin axis. Transmit polarization perpendicular to spin axis.	12-5W TWTAs	33 dBW for CONUS, 26 dBW for Alaska and Hawaii	-6	In operation	System capacity (2 satellites) is 24 video or 28000 FDM simplex audio channels, or 1.44 Gbps simplex. Each transponder has 1 video or 50 Mbps data rate in SCPC mode. 7000 duplex audio circuits per satellite.	See Ref. (19), (48), (49) Permanent location 91° W.

2

SECTION 5 - General Information

Table 5-1. Location of U.S. Geosynchronous Communication Satellites
(Present and Projected)

SATELLITE	LONGITUDE	REMARKS
COMSTAR D-1	28°W	
D-2	95°W	
D-3	87°W	
SATCOM I	135°W	
II	119°W	
WESTAR I	99°W	
II	123°W	
TDRSS EAST	40.6°W	
TDRSS CENTER	100°W	
TDRSS WEST	172.6°W	
SBS 6A	122°W	
SBS 6B	106°W	
MARISAT-ATL	15°W	
MARISAT-PAC	176.5°E	
MARISAT-INDO	73°E	
FLTSATCOM I	100°W	
FLTSATCOM II	23°W	Good launch May 4, 1979
FLTSATCOM III	172°E	
FLTSATCOM IV	75°E	
LES 9	0	
DSCS II ATL	12°W	NC HL* TWTA #2 Failed
II WPAC	175°E	
II EPAC	135°W	
II INDO	60°E	NC HL* TWTA #1 Failed NC LL TWTA Failed
II Spare	140°W	On-orbit spare
ATS-1	149°W	*High Level Low Level
ATS-3	-	
ATS-6	140°W	

TABLE 5-2 . Location of UK/NATO Military Satellites

SATELLITE	LONGITUDE	REMARKS
NATO IIIA	18^{o} W	
NATO III B	21^{o} W	
NATO IIIC	28^{o} W	On-orbit spare
SKYNET IIB	0^{o}	Has been experiencing TT&C problems

Table 5-3. Present Status of Intelsats Now in Orbit
(April 1979)

DESIGNATION	LONGITUDE	STATUS
ITS IV (F-1)	63°E	In service
(F-2)	4°W	In reserve
(F-3)	19.5°W	In service
(F-4)	179°E	In reserve
(F-5)	60°E	In reserve
(F-6)	Launch Failure	-
(F-7)	1°W	In service
(F-8)	174°E	In service
ITS IVA(F-1)	24.5°W	In service
(F-2)	29.5°W	In service
(F-3)	60°E	Spare
(F-4)	34.5°E	In service
(F-5)*	Did not achieve orbit	-
(F-6)*	63°E	In service

*Final TLS IVA to be launched.

Table 5-4. Projected Location of ITS V & MCS*

SATELLITE	LONGITUDE	REMARKS
ITS V	24.5°W	In development
V	19.5°W	
V	29.5°N	
V	34.5°W	
V	63°E	
V	60°E	
MCS ATL A	18.5°W	
MCS ATL B	29.5°W	
MCS IND A	63°W	
MCS IND B	60°W	

*MCS: Maritime Communication Subsystem

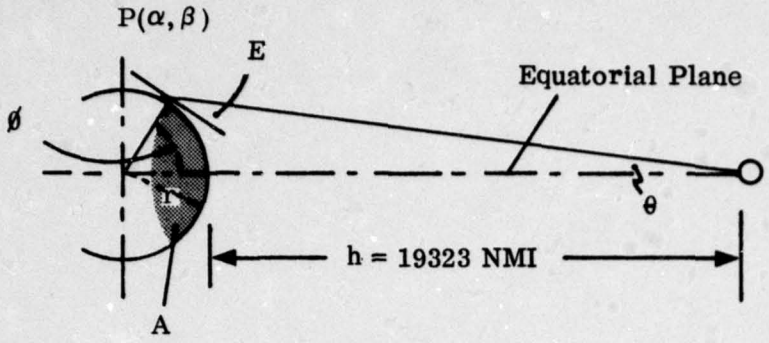
Table 5-5. Location & Projected Location of Foreign Satellites

SATELLITE	LOCATION
ARABSAT I	19°E
II	26 E
SBTS	75 W
SBTS	67.5 W
ANIK 1	104 W
2	109 W
3	114 W
TELESAT B-1 (ANIK B-1)	109 W
C-1 (| C-1)	112.5 W
C-2 (| C-2)	116 W
STW-1	125 E
STW-2	70 E
SATCOL-1	75 W
SATCOL-2	75.4 W
MARECES A	15 W
MARECES B	64.5 E
MARECES C	40 E
MARECES D	172 W
MAROTS	40 E
MAROTS-B	12.5 W
SYNPONIE IND 1	11.5 W
SIRO	15 W
INSAT	74 E
INSAT 1B	94 E
ISCOM	102 E
PALAPA 1	83 E
2	77 E
3	118 E
4	108 E
5	13 E
ZOHREN 1	34 E
2	26 E
3	47 E
4	41 E
BSE	1.0E
CORSA-b	-
CSE (SAKURA)	135 E
ECS	145 E
ETS-2	130 E
GMS	140 E
NIGERIAN	14 E
NIGERIAN	20 E

Table 5-6. Location of USSR Communication Satellites

SATELLITE	LOCATION
GALS 1	25°W
2	45 E
3	85 E
4	170 W
LOUTCH 1	14 W
2	58 E
3	90 E
4	140 E
LOUTCH P1	25 W
P2	45 E
P3	85 E
P4	170 W
MOLNIYA 3	Non-Geo Sync
RS	Non-Geo Sync
STATSIONAR-T	99 E
-1	80 E
-2	35 E
-3	85 E
-4	13.5 W
-5	58 E
-6	90 E
-7	140 E
-8	335 E
-9	45 E
-10	190 E
VOLNA 1	25 W
2	14 W
3	45 E
4	58 E
5	85 E
6	140 E
7	170 W

Maximum Latitude of Ground Terminal For Satellite at Geo-Synchronous Altitude



r = 3444 NMI

For E = 0 :

$\phi = (163/2^{o})$

$\theta = (17.4/2^{o})$

Ground terminal elevation angle

E Elevation Angle	ø Latitude Angle
0^{o}	81.3^{o}
2.5	78.8
5.0	76.3
7.5	73.9
10.0	71.4
12.5	69.0
15.0	66.6
17.5	64.2
20.0	61.8
22.5	59.5
25.0	57.1
27.5	54.8
30.0	52.3

Spherical Area Coverage of Earth Surface

$$A = 2\pi r^{2} (1 - \cos \phi)$$

$$A_{earth} = 4\pi r^{2}$$

$$\phi = [\arccos (r \cos E / r + h)] - E$$

	$E = 0^{o}$	$E=7.5^{o}$	$E=10^{o}$
Area	42.4%	36.1%	34.0%

For ground terminal location: P(longitude, latitude)=P(α, β), and from Napier's rule for right spherical triangles:

$$\cos \phi = \cos \alpha \cos \beta$$

Figure 5-1. Earth Terminal Maximum Latitude Location as a Function of Its Elevation Look Angle and the Cap Area (A) For Discrete Elevation Angles


60°
80°
120°
160°
160°
120°
80°
40°
80°
60°
40°
20°
0°
20°
40°
60°


120°
80°
40°
0°
40°
80°
80°
60°
40°
20°
0°
20°
40°
60°
120°
80°
40°
0°
40°
80°

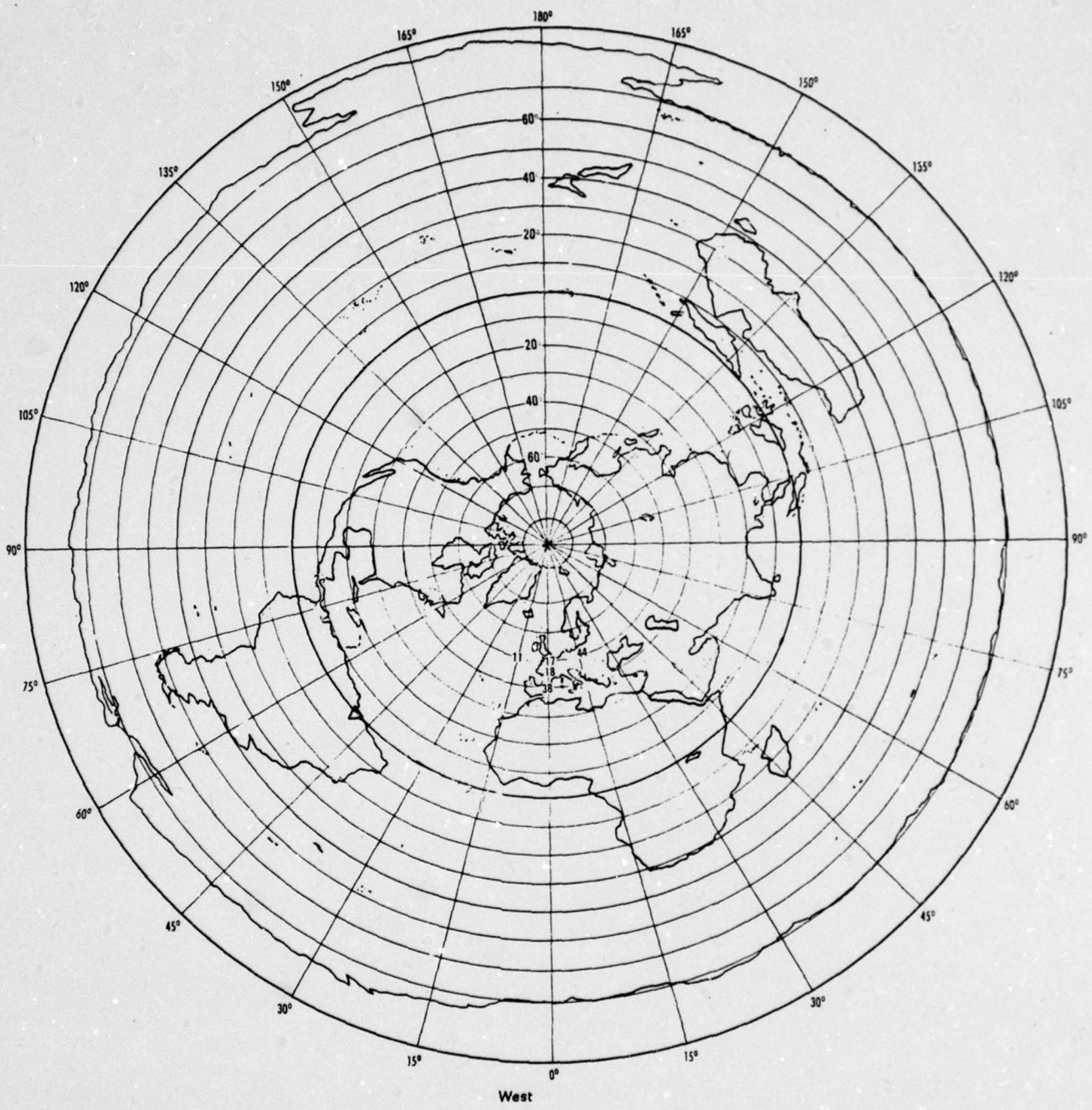


Figure 5-3 . Polar Map

6.0 GLOSSARY OF TERMS AND REFERENCES

GLOSSARY

"A"	refers to flight model "A" of a program series
AC	area coverage
A/C, a/c	aircraft
ADM	advanced development model
Ag-Cd	silver-cadmium
a/k/a	also known as
AKM	*apogee kick motor*
Alle	Soviet A-2 -e launch vehicle
AMSAT	Radio Amateur Satellite Corporation
APRL	American Radio Relay League
ASETA	Association of State Telecommunication Undertakings of the Andean Sub-Regional Agreement
ATS	Applications (Advanced) Technology Satellite
ave.	average
AW	Advance Westar
bps	bits per second
BOL	beginning of life
BSE	Broadcast Satellite, Experimental
BW	bandwidth, beam width
CH	channel
CIA S.p.A.	*Compagnia Industriale Aerospaziale*
cm.	centimeter
C/L, C-L	C-band to L-band
CMO	command
COMSAT	communication satellite
CONUS	Continental United States
CP	circular polarization
CS	communication satellite
CTS	Communication Technology Satellite

dB	decibel
dBi	decibels of antenna gain referred to isotropic radiator
dBm	decibels of power referred to one milliwatt
dBW	decibels of power referred to one watt
DCA	Defense Communications Agency
DFS	Demonstration Flight Satellite
DNC	defocused narrow coverage
DOC	Canadian Department of Communications
DOD, DoD	Department of Defense
domsat	domestic communication satellite
down(link)	*spacecraft transmitting*
DSCS	Defense Satellite Communications System
E., E	east
EC	earth coverage
ECS	European Communications Satellite
EDM	engineering development model
EEPT	European Conference of Postal and Telecommunications Administration
EIRP	effective isotropic radiated power
EOL	end of life
ESA	European Space Agency
ESE	east-southeast
ESOC	European Space Research Organization
Est., est.	estimated
ET	earth terminal
E-W	east-west
F.A.A.	Federal Aviation Administration
FDM	frequency division multiplexing
FDMA	frequency division multiple access

GLOSSARY (cont'd)

FM	frequency modulation
F-1	refers to flight model "1" of a program series
Fr/FRG	France/Federal Republic of Germany
ft.	foot, feet
Gbps	gigabits per second
G. E.	General Electric Co.
GHz	gigahertz
GSFC	Goddard Space Flight Center
H-Sat	Heavy Satellite
HAC	Hughes Aircraft company
Hz	hertz
IF	intermediate frequency
IMPATT (diode)	impact avalanche transit time diode
INCO	International Maritime Consultative Organization
INMARSAT	International Maritime Satellite Organization
Insat	India Satellite
IUS	Inertial Upper Stage
^{o}K	degrees kelvin
kbps	kilobits per second
kHz	kilohertz
km.	kilometers
kW	kilowatt
L/C, L-C	L-band to C-band
lbs.	pounds
LES	Lincoln Experimental Satellite
LHCP	left-hand circular polarization
MCS	Maritime Communications Subsystem
m	meters
Ml	Molniya 1

GLOSSARY (cont'd)

MA	module A, model A
MB	module B
MBA	multiple beam antenna
Mbps	megabits per second
MHz	megahertz
MIT	Massachusetts Institute of Technology
MMD	mean mission duration
MMW, mmw	millimeter wave
mW	milliwatt
N., N	north, nitrogen
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan
NATO	North Atlantic Treaty Organization
NB	narrowband, narrow beam
Ni-Cd	nickel-cadmium
N-S	north-south
NLV	N launch vehicle
OSCAR	Orbital Satellite Carrying Amateur Radio
OTS	Orbital Test Satellite
PA	power amplifier
PRC	Peoples Republic of China
preamp	preamplifier
PSK	phase shift keying
RCA	Radio Corporation of America
rcve, rcvr	receive, receiver
Ref.	reference
RHCP	right-hand circular polarization

GLOSSARY (cont'd)

sats	satellites
S., S	south
S/A, s/a	same as
SAMSO	Space and Millile Systems Organization
SB	spot beam
SAS	Satellite Business Systems
S/C, s/c	spacecraft
SCPC	single channel per carrier
SED	SED Systems, Ltd.
SFCS	Strategic Forces Communication Satellite
SHF	super high frequency
Si	silicon
SPAR	SPAR Aerospace Products, Ltd.
SSMA	Spread Spectrum Multiple Access
STS	Space Transportation System (Shuttle)
STW	Acronym in Chinese alphabet for "Experimental Communications Satellite"
TAD	Thrust-augmented Delta
TBD	to be determined
TC	telemetry and command
TDA	tunnel diode amplifier
TDMA	time division multiple access
TDRSS	Tracking and data relay satellite system
TLM	telemetry
TRW	TRW Systems Group
T, T&C	Telemetry, tracking and command
TTY	teletype
TWT, TWTA	traveling wave tube amplifier)

GLOSSARY (cont'd)

UHF	ultra high frequency
U.K.	United Kingdom
Up(link)	spacecraft receiving
U.S.A.F.	United States Air Force
U.S.N.	United States Navy
VHF	very high frequency
vocoded	voice coded
W., W	west, watt
WB	wideband, wide beam
WG	waveguide
WNW	west-northwest
xmit, xmtr	transmit, transmitter
XPDR	transponder
2/10	2 meter-to-10 meter
70/2	70 centimeter-to-2 meter

REFERENCES

1. "Space Segment Specification for DSCS Phase II, Space Segment (DSCS III)," (U) DCA Document 07868-DSCS III-1, August 1975, CONFIDENTIAL.

2. "Preliminary DSCS Phase III Space Segment Subsystem Performance Specification and Requirements Rationale," (U) prepared for DCA by Computer Sciences Corporation, June 1976, CONFIDENTIAL.

3. "System Performance Specification for the Stage 1C Phase II DSCS," (U) prepared for DCA by Computer Sciences Corporation, June 1975, SECRET.

4. "Supplement to Satellite Characteristics Matrix," (U) prepared for DCA by Computer Sciences Corporation, December 1972, CONFIDENTIAL.

5. "Satellite Communications Reference Data Handbook," prepared for DCA by Computer Sciences Corporation, March 1975, DRAFT.

6. "Test Plan for the Airborne Operation of the AN/USC-28 (ADM)," prepared for DCA by Computer Sciences Corporation, August 1974.

7. "A Digest of Satellite Communications Systems, Volume 1," prepared for DCA by Computer Sciences Corporation, August 1973.

8. "A Digest of Satellite Communications Systems, Volume 2, Part 2," (U) prepared for DCA by Computer Sciences Corporation, September 1974, SECRET.

9. "A Digest of Satellite Communications Systems, Volume 3," prepared for DCA by Computer Sciences Corporation, September 1973.

10. "A Digest of Satellite Communications Systems, Volume 4," prepared for DCA by Computer Sciences Corporation, September 1973.

11. "Updated Communications Satellite Characteristics Matrix," prepared for DCA by Computer Sciences Corporation, August 1974.

12. "Updated Communications Satellite Characteristics Matrix," prepared for DCA by Computer Sciences Corporation, January 1973.

13. "Updated Communications Satellite Characteristics Matrix," (U) prepared for DCA by Computer Sciences Corporation, August 1971, SECRET.

REFERENCES (Cont'd)

14. "Updated Communications Satellite Characteristics Matrix," prepared for DCA by Computer Sciences Corporation, May 1971.

15. "Updated Communications Satellite Characteristics Matrix," (U) prepared for DCA by C & S, February 1970, SECRET.

16. "Updated Communications Satellite Characteristics Matrix," (U) prepared for DCA by C & S, August 1969, SECRET.

17. "Updated Communications Satellite Characteristics Matrix," (U) prepared for DCA by C & S, February 1969, SECRET.

18. "Updated Communications Satellite Characteristics Matrix," (U) prepared for DCA by C & S, May 1968, SECRET.

19. "NASA Compendium of Satellite Communications Programs," prepared for NASA by Computer Sciences Corporation, December 1975.

20. "CTS Prelaunch Mission Report," NASA, December 1975.

21. "The ATS-F Data Book," NASA GSFC, May 1974.

22. "Satellite Situation Report, Volume 16, Number 3," NASA GSFC, June 1976.

23. "Satellite Situation Report, Volume 16, Number 2," NASA GSFC, April 1976.

24. "Satellite Situation Report, Volume 16, Number 1," NASA GSFC, February 1976.

25. "Satellite Situation Report, Volume 15, Number 6," NASA GSFC, December 1975.

26. "Communication Characteristics of Antennas, Transmitters and Receivers on LES-8/9," (U) MIT Lincoln Laboratory, March 1976, SECRET.

27. "A Tentative Design for LES-10," MIT Lincoln Laboratory, June 1974.

28. "LES-8/9: Communications - System Characteristics and Experimental Capabilities," (U) MIT Lincoln Laboratory, January 1973, SECRET.

29. "COMSAT's Pocket Guide to the Global Satellite System," COMSAT General Corp., April 1976.

REFERENCES (Cont'd)

30. "COMSAT's Pocket Guide to the Global Satellite System," COMSAT General Corporation, April 1975.

31. "Applications of SBS for a Domestic Communications Satellite System," SBS, December 1975.

32. "The Orbital Test Satellite Data Book," ESRO, March 1975.

33. "MAROTS: A European Satellite for Maritime Communications," ESRO, March 1975.

34. "The Encyclopedia Britannica," University of Chicago, 1975.

35. "RCA Satcom System Update," Signal, July 1976.

36. "Status Report: Microwave Communications Update-1976," Microwave Systems News, February/March 1976.

37. "Fleet Satellite Communications System Spacecraft," TRW.

38. "Fltsatcom Satellite," TRW, November 1974.

39. "A System for Worldwide Military Communications: DSCS II," TRW.

40. "Survsatcom Experimental Model Description," Naval Electronics Laboratory Center, April 1974.

41. "Lincoln Experimental Satellites LES-8 and -9," MIT Lincoln Laboratory.

42. "Communications Technology Satellite," NASA Lewis Research Center, March 1975.

43. "Mission Operation Report: CTS," NASA Report E-610-76-01, December 1975.

44. "Anik: The World's First National Synchronous Communications Satellite," HAC.

45. "Engineering Test Satellite Type II," NASDA, August 1974.

46. "NATO III," Aeronutronic-Ford.

47. "The Aerosat Programme," Journal of the British Interplanetary Society, Volume 27, 1974.

REFERENCES (Cont'd)

48. "Westar: First U.S. Domestic Synchronous Satellite System," HAC.

49. "System Performance of America's First Domestic Communications Satellite - WESTAR," Western Union Telegraph Company, 1974.

50. "MARISAT," COMSAT General Corporation, April 1976.

51. "MARISAT: The First Commerical Maritime Satellite Communications System," Western Union International, Inc.

52. "Project: ATS-F," NASA, May 1974.

53. "A High-Powered Satellite for Communication Applications," G.E.

54. "Medium - Scale Broadcasting Satellite for Experimental Purpose," NASDA.

55. "Medium - Capacity Communications Satellite for Experimental Purpose (CS)," NASDA, December 1974.

56. "COMSTAR I: COMSAT General Domestic Satellite," HAC.

57. "The Launch of COMSTAR," COMSAT General Corporation, May 1976.

58. "COMSTAR," COMSAT General Corporation, July 1975.

59. "Indonesian Satellite," HAC.

60. "Molniya System Analysis," (U) prepared for the Air Force Systems Command by C&S, April 1968, SECRET.

61. "Communication Satellite Systems (USSR)," (U) Air Force Systems Command, July 1971, SECRET.

62. "Space Systems Handbook - Foreign, Volume I," (U) Defense Intelligence Agency, December 1969, SECRET.

63. "Space Systems Handbook - Foreign, Volume 2," (U) Defense Intelligence Agency, December 1969, SECRET.

REFERENCES (Cont'd)

64. "Aviation Week and Space Technology,"Vol. 107, No. 10, 5 September 1977, pp. 48, 49.

65. "Aviation Week and Space Technology," Vol. 108, No. 11, 13 March 1978, pp. 92-93.

66. "Aviation Week and Space Technology," Vol. 107, No. 16, 17 October 1977, pp. 94, 95, 137, 139, 161.

67. "Comsat Technical Review," Vol. 8, No. 1, Spring, 1978, pp. 219-231.

68. "Table of Artificial Satellites Launched Between 1957 and 1977," Telecommunications Journal.

69. "Aviation Week and Space Technology," Vol. 107, No. 20, 14 November 1977, p. 20.

70. "Interavia," Vol. 33, September 1978, pp. 848-849.

71. "Aviation Week and Space Technology," Vol. 109, No. 6, 7 August 1978, p. 45.

72. "J. Spacecraft and Rockets," Vol. 15, No. 2, March-April, 1978, p. 72.

73. "Defense/Space Business Daily," Vol. 99, No. 13, 21 July 1978, p. 93.

74. "Electronics," Vol. 51, No. 21, 12 October 1978, p. 120.

75. "Satellite Situation Report, " Vol. 15, Number 6, NASA GSFC, December, 1978.

76. "TRW Space Log," 1977.

77. "Telecommunications Journal, Vol. 45, No. 4, April 1978, p. 189.

78. "Astronautics and Aeronautics", Vol. 16, No. 9, September 1978, pp. 74-76.

79. "Telecommunications Journal," Vol. 45, No. 3, March, 1978, pp. 139-140.

REFERENCES (Cont'd)

80. AMSAT, P.O. Box 27, Washington, D.C. 20044.

81. APRL, 225 Main St., Newington, CT 06111.

82. "QST," Vol. 62, No. 1, January 1978, pp. 55-57.

83. "QST," Vol. 62, No. 2, February, 1978, pp. 38-40.

84. "QST," Vol. 62, No. 7, July 1978, pp. 39-42.

85. "QST," Vol. 63, No. 1, January 1979, p. 93.

86. "IEEE Spectrum," Vol. 15, No. 12, December 1978, pp. 30-33. (A3), n66.

87. "Aviation Week and Space Technology," Vol. 109, No. 10, 4 September 1978, p. 27.

88. "Telecommunications Journal," Vol. 45, No. 11, November 1978, (A8) n. 70, p. 616.

89. "Aviation Week and Space Technology," Vol. 108, No. 17, 24 April 1978, p. 121.

90. "Electronic Engineering Times," 5 February 1979, p. 16.

91. "Microwave Systems News," Vol. 8, No. 3, March 1978, pp. 57-74.

92. "Aviation Week and Space Technology," Vol. 108, No. 16, 17 April 1979, p. 17.

93. "Aviation Week and Space Technology," Vol. 110, No. 4, 22 January 1979, p. 17.

94. "Defense/Space Business Daily," Vol. 100, No. 38, 30 October 1978, p. 261.

95. "QST," Vol. 62, No. 12, December 1978, p. 54.

96. "Intelsat V Design Summary," Electronic Ford, Palo Alto, CA, 20 August 1976.

REFERENCES (Cont'd)

97. "Aviation Week and Space Technology," Vol. 107, No. 22, 28 November 1977, pp. 77-80.

98. "Communications News," Vol. 16, No. 1, January 1979, p. 2.

99. Federal Communications Commission, Washington, D.C., 20554

100. "Aviation Week and Space Technology," No. 11, 12 March 1979, p. 77.

101. "Defense/Space Business Daily," Vol. 100, No. 4, 11 September 1978, p. 22.

7.0 INDEX OF SATELLITE SYSTEMS

INDEX

INDEX

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Update to the Communications Satellite Characteristic Matrix		5. TYPE OF REPORT & PERIOD COVERED Contract Deliverable 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) B. Pattan G. T. Anderson		8. CONTRACT OR GRANT NUMBER(s) DCA100-76-C-0089
9. PERFORMING ORGANIZATION NAME AND ADDRESS Computer Sciences Corporation 6565 Arlington Blvd., Falls Church, VA 22046		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Task No. 4982-31200
11. CONTROLLING OFFICE NAME AND ADDRESS Defense Communication Engineering Center, DCA 1860 Wiehle Avenue Reston, VA 22090		12. REPORT DATE April 1979 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Review relevance at aperiodic intervals from submission date.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Satellites, communications, COMSATS

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This matrix provides data on the communications satellites that are being developed or are nowbeing used in international, domestic and military satellite communications systems. The matrix contains information on the spacecraft performance (weight, prime power), the communications transponder (EIRP, G/T etc.) and operational status at the time of publication. The information contained in the matrix is the most accurate and up-to-date at the time of publication.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)