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PAPER SATELLITES AND SPACE NETWORKS

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Abstract

A Comparative Table of notified space networks and satellites present at or near nominal orbital positions illustrates the occupation of the geostationary orbit. Clear distinction has to be made between a network as transmission of information on one hand and a satellite as a solid body orbiting the Earth on the other hand. Paper satellites do not exist but there is an overabundance of over 2500 separate requests for transmission frequencies. The situation has been made transparent by showing which networks are fit to transmit by having both, a notification by the ITU as well as an active satellite in a correct orbital position. There are 802 notified networks and at least 84 networks in the Broadcasting Satellite Service operated on 372 satellites. More than 165 notified networks do not have a satellite at relevant orbital position.

1. INTRODUCTION

The term “paper satellites” gives the impression that some satellites are not real but exist on paper only. In fact, the number of active satellites in the most populated region, the geostationary orbit, **GEO**, at the end of June 2008 was 372.

On the other hand, the number of requests for frequency bands for radio transmissions from satellites to ground stations exceeds 5000. The requests exist only on paper until they have passed successfully through a coordinating process initiated by the International Telecommunication Union (ITU) and became “notified” space networks enjoying international recognition and protection. The ITU sieve is strict. In June 2008 only 802 networks in SNL, Section A1, made it and were supposed to transmit. The coordinating process is an attempt to prevent possible harmful interferences and eliminate interferences detected at a later stage.

In order to understand the problem at hand better, it is necessary to compare notified networks with reality, i.e. with active satellites in orbit. For that reason a Comparative Table has been set up listing side by side the “paper situation” of space communication networks with the “physical situation” of satellites in the geostationary orbit.

Also, the distinction between a network and a satellite has to be well understood. A space network is an electromagnetic transmission of information between radio stations in space and on the ground. A satellite is a solid body in outer space, in an orbit around the Earth. Official terminology, as well as its popular counterpart, evolved historically in such a way that the word “satellite” stands sometimes for the material body, sometimes for its function as the space component of a communication network. The present paper provides understanding. It is not a proposal for changing a widely used terminology.

2. THE COMPARATIVE TABLE

The operation of a space network depends on the presence of a satellite near the nominal orbital position of the network. There is

tolerance in position because a transmission lobe covers with sufficient intensity a certain area. The ITU passed a rule that a satellite operating a space network has to be within an angle of 0.1 degree in latitude as well as longitude from the nominal orbital position.

The Comparative Table in the Annex shows the relation between **"notified space networks"** which enjoy international recognition and protection, and **active satellites** which are close to the nominal orbital position. Networks appear on the left, satellites on the right. The reference date for Networks is 3 June 2008, i.e. the date of issue of the ITU Space Network List. For satellites it is the end of June 2008.

The main parameter in the table is the nominal position **(Nom. long.)** shown in the first column in bold characters. All notified networks operating at the same nominal position are contained within horizontal lines. On the right, between the same horizontal lines, are satellites which could operate networks on the left.

Data on space networks have been taken from the ITU Quarterly Publication of the Space Network List[1] (**SNL**), Section A1, issue of 3 June 2008. The columns show a symbol for the notifying administration **(Adm)**, for the organization operating the network **(Ntw org)**, and the **Space Network Name**. The heading of that column in the SNL is **"Sat_name"**. As explained in the preface to the SNL, it identifies the space network, not the satellite. Names of networks are sometimes changed by operators, and some networks are known under more than one name. The last column shows the symbol for **frequency bands** according to table 1 of the preface to the SNL. E.g., the C band corresponds approximately to numbers 43 - 49, the K_u band to 53 – 65, the K_a band to 75-80.

For satellites in the Broadcasting Satellite Services, BSS, Sections A10 and A11 of the SNL were used to supplement data of Section A1, in particular in cases when a satellite operates mostly networks in the BSS.

The right-hand half of the Comparative Table shows spacecraft launched before the end of June 2008. The first column gives the COSPAR international designator **(COSPAR Int. Desig.)** indicating the year of launch, the serial number of the launch in the year, and the serial letter of the object in the launch. The designator identifies the satellite in a unique way and for its entire lifetime.

The remaining columns show the **Satellite Name,** which sometimes is subject to a change[2], and **Status of Orbit** (see section 5). Notes concerning functions performed by the satellite, printed in red, appear on the same line or the line below, or in the left part of the table, wherever convenient. The notes are very brief in order not to extend the length of the table. More details on the satellite appear in the Encyclopedia of Satellites and Probes of the Czech Academy of Sciences[3].

3. SPACE NETWORKS

The total number of entries in the **SNL,** Section A1, has grown rapidly in the past. It attained around 3000 entries back in 1998, it slightly exceeded 4000 entries in 2001 and attained 5770 in March 2007. Since that time, possibly reflecting new measures by the ITU, the number declined to 5164 entries in December 2007. It increased to 5507 in June 2008. Some networks are listed separately at different stages of coordination, thus the number of

separate networks is smaller than the number of entries. In the December 2007 issue of the SNL, there are 2940 separate networks only, a reduction of the "paper population" by 43%.

An administration wishing to bring a network into use has to submit an advance announcement to the ITU. The announcement appears in the SNL as class **A**. When a coordinating process to avoid possible harmful interference with existing networks is initiated, the network is denoted as class **C**. Its entry as class **A** is, in most cases, retained. If and when the process is successfully completed, the network is notified in the Master International Frequency Register and denoted as category **N**. As before, entries of the same network in classes **A** and **C** are frequently retained. A possible reason may be to preserve a record of changes which the network was subjected to in the course of the coordinating process. Thus, in the June 2008 issue of the SNL, Section A1, 802 networks were notified in the Master International Frequency Register and received international recognition and protection. From Sections A10 and A11, 84 networks in Broadcasting Satellite Service have been added, making thus a total of 886 Networks.

4. DUE DILIGENCE

The ITU has adopted measures, termed Due Diligence, to restrict the growth of space networks. Without these steps, the present number would have been even larger. A significant reduction is, however, in the hands of launching and operating agencies.

Administrations have to provide evidence of seriousness of intentions to establish a space network[4] according to the ITU Resolution 49, Annex 2, of the World Radio Conference 2003. Among the many data required are (i) Identity of the satellite network, (ii) Name of the satellite, and (iii) Orbital characteristics.

Item (i) refers to the term "space network" used in the title of the SNL.

Item (ii) refers to a satellite as a material body. Its unique identification is desirable. Launching names have the disadvantage of rather frequent changes. The COSPAR international designation is the best option for objects in orbit. It is unique, does not change but it is rarely used. It is assigned after a successful launch, therefore it is not available as pre-launch announcement.

Item (iii) refers, in the case of a GEO, to the geographic longitude of the nominal orbital position.

A summary of the data appeared in a table provided by the courtesy of the ITU[5]. The table lists the "ITU Name" as well as the "Commercial Name". These two names are in most cases identical with the name of the space network and only rarely with the name of the satellite. The table lists networks in all three classes, A, C, N. That means, that only some of the networks have completed the coordinating process at the date of publication of the list.

The Administrative Due Diligence, together with the fees introduced in the Financial Due Diligence and Cost Recovery, and with the time limit of bringing into use, are very efficient measures adopted by the ITU for limiting the excessive number of applications for transmission frequencies.

5. SATELLITES IN THE GEO

For a meaningful comparison of space networks and satellites a reliable list of spacecraft and their positions in the GEO is required. The most authoritative information on objects

launched into outer space is provided by launching states. It appears in the UN Register in the form of governmental announcements[6]. Unfortunately it is not complete. An online searchable index listing all objects announced to the UN, as well as those not announced, appears at the same website. Additional information is, however, needed for computing actual positions of space objects at a given time. The best available and most reliable source of actual positions of objects in the geostationary orbit is the "Classification of Geosynchronous Objects" referring to situation at the end of each year[7]. It is based on the DISCOS database[8] which uses as source of information the NASA Two-Line Elements[9]. These, in their turn, are based on observations of physical presence of satellites in orbit. Only objects larger than 1m can be tracked on a regular basis at the distance of the geostationary orbit. All active satellites can be tracked but small inactive objects cannot be routinely detected. The most recent issue of the "Classification" refers to the end of 2007. Results can be summarized as follows, showing the complexity of the population of the geostationary orbit:

● The total number of objects in and reasonably close to the geostationary orbit was 1150, 29 more than the year before, 68 more than two years before.

Table1, **Objects with recently updated orbital elements:**

● **Status C1**: 243 objects are controlled in longitude and latitude. These are suitable for transmissions to fixed antennas. Five satellites launched towards the end of 2007 were supplemented with data obtained in 2008 and have been added to that group. Launchings in the 12 years, 1996-2007, averaged 19 per year. In years 1993-1995 the rate was lower.

● **Status C2**: 75 objects are controlled in longitude only, requiring movable ground antennas. These objects have been launched in the 23 years 1985-2007. One satellite, ATS 3, survives from 1967.

● **Status D**: 458 objects are in a drift orbit passing through all longitudes. These could obviously not been associated with a nominal orbital position, just as the following group,

● **Status L1, L2, L3**: 145 objects are at a libration orbit, oscillating around the Eastern (92), Western (36), or both (17) stable points in the orbit,

Table 2, **Objects without orbital elements determined during the last 6 months of 2007:**

● **Status C**: 47 objects under control. Their recent orbital elements are not available in the NASA Two-Line Elements. Orbits of 36 objects out of those 47 can be determined from amateur observations. Most of these objects are used for governmental uses, such as reconnaissance or verification of international treaties. There are thus at least 11 active satellites in controlled orbits at unknown positions,

● **Status D, L1, L2**: a total of 7 objects, mostly retired satellites.

● **Status U**: Uncontrolled: 99 objects, mostly rocket stages and debris, a few payloads, without available orbital elements. These objects are old. The most recent three objects have been launched in 1998, 1994, and 1992 respectively.

● **Status UU**: uncontrolled un-catalogued: 67 objects, all of them debris, such as covers and restraint cables, or rocket bodies,

● **Status UI**: 146 unidentified objects which have been repeatedly observed but not correlated to a specific launch. 22 of these objects have provisional identification coinciding with objects of status C. and finally,

● **Status Ind**: 9 objects launched or maneuvered close to the end of 2007 of indeterminate status. Positions of five of the objects, all launched in November and December 2007, have been computed by P. Lála[10]. ,from one or more orbital elements determined in 2008. In the Comparative Table they appear under Status of Orbit **PL**.

Of interest to the problem of paper satellites are active objects at their nominal positions within ITU tolerances (Status C1), those controlled in longitude only (Status C2), objects of Status C, and objects of Status Ind.

Also considered were objects launched in the first half of 2008. Positions have been computed and listed by P. Lála, Status **PL,** as above, and/or by A. Vítek and published in the Encyclopedia (see ref. 3), Status **Enc**. The physical presence of all 372 satellites listed in the Comparative Table has been confirmed by data derived from observations.

The number of notified space networks in the ITU tables is larger than the number of active spacecraft in orbit. Allowance, however, has to be made to the fact that more than one space network can be operated on one satellite,

6. RELATING NOTIFIED SPACE NETWORKS WITH SATELLITES

Operators know which satellites operate which of the networks but do not always publish the fact. If such information is available, e.g., on the web, or if the name of the satellite is sufficiently close to the name of the network, a bullet ● was put near the central line of the Comparative Table. An example is at nominal position 0.00 E. An ESA Meteosat network is operated by satellite 2006-049B, Meteosat 9. Very helpful in this respect was, e.g., the List of Satellites Approved to Provide Fixed-satellite Services in Canada[11].

In other cases, a possible match is a matter of conjecture. An example is at nominal position 4.00 E. Satellite 1997-049A, Hot Bird 3 = Eurobird 4, providing regional services in Europe in band $K_{u,}$ may be operating networks EUTELSAT 2-4E or EUTELSAT 3-4E or both. Without more detailed information we cannot say if it operates also network EUTELSAT-KA-4E transmitting in band K_a or network TELECOM-4E transmitting in band C.

In case there is no satellite at a nominal position of a network, the network cannot transmit. Possibly a satellite is being prepared to take up the position and will be launched at a future time. An example is at nominal position 5.70 E, where network MEASAT-SA1 has no satellite to transmit from. There are 83 nominal positions with a total of 165 networks with no satellite at the relevant position. These networks could not operate at the end of June 2008.

There are also cases when a satellite has no notified network at its position. Such a satellite may have terminated its activities, or it may be a spare to be brought into use at a later date. In fact, most of satellites having no corresponding notified network, have a pending application in the coordinating process. An example is satellite 1997-071A, Sirius 2, at 31.5 E. It was moved from its previous position at 4.80 E, where it had its network SIRIUS 2. Its services at 4.80 E have been taken over by 2007-057A, Sirius 4, in May 2008. At the same time Sirius 2 was moved to its new position at

31.5 E, where corresponding networks have classes A and C, but have not been "notified" at the time of the shift of position.

In general, the table considerably restricts the number of possibilities of matching networks with satellites but in some cases more detailed information may be desirable.

7. CONCLUSIONS

There are no "Paper Satellites". There is, however an overabundance of over 2500 separate requests for transmission frequencies. Many requests appear in the lists repeatedly, according to their status in processing and coordinating with existing space networks. The ITU instituted administrative and financial measures, called Due Diligence, to curb the excessive number of applications. Only networks which do not interfere with earlier comers receive international recognition and protection. The work of the ITU is essential for preventing harmful interference among space telecommunication networks and for providing a forum for removing interference whenever it appears. A Comparative Table listing both, space networks and satellites, illustrates the situation at occupied nominal orbital positions. It is proposed to maintain and regularly update the Comparative Table.

At the end of June 2008, there were 372 satellites in orbit operating not more than 886 networks duly notified or planned. The actual communication traffic is considerably less than the numbers would suggest because 165 networks are at nominal positions with no satellite present. Moreover, even if a satellite is present, there is no confirmation that it operates **all** networks at the relevant position. The situation is in constant change and evolution for several reasons. New ventures have been undertaken, some networks or satellites have been sold to other operators of networks or owners of satellites and acquired new names in the process.

The usage of the term "satellite" is ambiguous. Its context has to be considered to find out whether reference is made to a material body, or to a function provided by that material body.

References

[1] ITU Space Network List, Section A1, Editions of 3 December 2007, 3 March and 3 June 2008, Sections A1, A10 and A11 for Broadcasting SatelliteServices. See at www.itu.int/ITU-R/space/snl.

[2] E.g., the satellite at 121W, EchoStar 9, is also known as Telstar 13, or Intelsat Americas 13, or Galaxy 23, or G 23.

[3] Encyclopedia of Satellites and Probes of theCzech Academy of Sciences, author A. Vítek, at www.lib.cas.cz/space40.

[4] Ram Jakhu: Legal Issues of Satellite Telecommunications, the Geostationary Orbit, and Space Debris, Astropolitics, 5, p.173-208.

[5] ITU Space Network Systems Online, Special Query System: Administrative Due Diligence Information (Res, 49), List of Geostationary and Non-geostationary Satellite Networks.

[6] See at www.unoosa.org/oosa/SORegister/index.html.

[7] Classification of Geosynchronous Objects, Issue 10 by R. Choc and R. Jehn, February 2008, European Space Operations Centre, Darmstadt, Germany. Preceding issues cover years 1999-2007. For years 1990-1999 see Log of Objects Near the Geostationary Ring, Issues 1 to 20, also at ESOC, Darmstadt.

[8] Established at the European Space Operations Centre in Darmstad, Germany.

[9] See at ghrc.msfc.nasa.gov/orbit/tleformat.html.

[10] P. Lála, Private communication. Computed from CelesTrak elements and published in the Encyclopedia, ref. 3.

[11] See www.ic.gc.ca/epic/site/smt-gst.nsf/en/sf02104e.html.

Annex

Comparative Table of Space Networks and Satellites

Version of 21 August 2008

SPACE NETWORKS - NOTIFIED					SATELLITES IN GEO			
Nom. Long.	Adm	Ntwk org	Space Network Name	Frequency bands	COSPAR Int. Desig.	Satellite Name	Mean Long.	Status of orbit
0.00 E	F	ESA	METEOSAT	3-33 ●	2005-049B	MSG 2 Meteosat 9, i=0.93	0.05 E	C2
	F	ESA	MSG	17-35 ●		MSG 2		
	USA		USCID-A1	66-79				
1.00 E	RUS		GALS-15	49, 50				
	RUS		STATSIONAR-22	43-47				
.	RUS		VOLNA-21	9-13				
2.90 E	CTI	RAS	RASCOM-1F	43-55 ●	2007-063A	Rascom-QAF1	2.88 E	PL
	CTI	RAS	RASCOM-2F	43-55		Regional services in Africa		
3.00 E	F		SYRACUSE-3F	33-82 ●		Telecom 2C		
	F		TELECOM-2C	33-57 ●	1995-067A	Telecom 2C, i=3.82	3.05 E	C2
	F		TELECOM-3C	43-48				
4.00 E	F	EUT	EUTELSAT 2-4E	33-57	1997-049A	Hot Bird 3 = Eurobird 4	4.02 E	C1
	F	EUT	EUTELSAT 3-4E	33-57		Regional services in Europe		
	F	EUT	EUTELSAT-KA-4E	76-78				
	F		SMO-GEO-1B (BSS)					
	F		TELECOM-4E	47				
	USA		MILSTAR-13	31-84				
	USA		USGAE-2	31-84				
4.80 E	S		SIRIUS-2 (and BSS)	33,57 ●	2007-057A	Sirius 4	4.83 E	PL
	S		SIRIUS-4.8E-BSS		Services in North and East Europe, North Africa			
	S		SIRIUS-4.8E-BSS-2		1993-031A	Astra 1C, i=1.21	4.74 E	C2
5.00 E	S		SIRIUS-30B	52,55	1998-056B	Sirius 3	5.00 E	C1
	S		SIRIUS-30B-5E	43-55	Services in Scandinavia and Greenland			
	S	NOT	TELE-X (and BSS)	33-57				
	S		SIRIUS-5E-BSS					
	USA		USMB-5	35				
5.70 E	MLA		MEASAT-SA1	43-48				
6.00 E	G		SKYNET-4B	9-82				
	G		SKYNET-4K	9-35				
7.00 E	F	EUT	EUTELSAT 1-3	52-57				
	F	EUT	EUTELSAT 2-7E	33-57				
	F	EUT	EUTELSAT 3-7E	33-57 ●	2004-006A	Eutelsat W3A	7.00 E	C1
	F	EUT	EUTELSAT EXB-7E	52, 55	Services and Internet in Europe, Africa, Near East			
	F	EUT	EUTELSAT-KA-7E	76-78 ●		Eutelsat W3A		
	USA		USMB-6	35				
8.00 E	RUS		GALS-7	49, 50				
	RUS		STATSIONAR-18	43, 47				
	RUS		TOR-8M	67-72				
	RUS		VOLNA-15	9-13				
8.50 E	USA		USGON-2	35	2000-024A	USA 149,DSP F20	8.4 E	C
					Radiation detection, particle and plasma analysis			
9.00 E	F		F-SAT-30B	43-55	1996-067A	Hot Bird 2	9.01 E	C1
	F	EUT	EUTELSAT B-9E (BSS)		Services in Europe			
	I		INTERACT (BSS)					
10.00 E	F	EUT	EUTELSAT 2-10E	33-57				
	F	EUT	EUTELSAT 3-10E	33-57 ●	2000-052A	Eutelsat W1	9.99 E	C1
	F	EUT	EUTELSAT EXB 10E	52, 55	Services in Europe, North Africa, Near East			
	F	EUT	EUTELSAT EXB-10E C	43, 48				
	F	EUT	EUTELSAT-1	52-57				
	F	EUT	EUTELSAT-KA-10E	65-78				
	F	EUT	EUTELSAT B-10E (BSS)					
	F	ESA	MSG-S1	33, 35				
12.00 E	RUS		GALS-17	49, 50	2001-037A	Cosmos-2379, i=3.51	11.98 E	C2
	RUS		PROGNOZ-2	33-42	Early warning of rocket launches			
	RUS		STATSIONAR-27	43, 47				
	RUS		VOLNA-27	9-13				
13.00 E	F	EUT	EUTELSAT 2-13E	33-57	Three sat for direct TV in Eur, North Africa, Middle East			
	F	EUT	EUTELSAT 3-13E	33-57 ●	2002-038A	Hot Bird 6	13.03 E	C1
	F	EUT	EUTELSAT EXB-37.2W	52, 55	2006-007B	Hot Bird 7A	13.05 E	C1
	F	EUT	EUTELSAT EXB-37.2WC	43, 48	2006-032A	Hot Bird 8	13.05 E	C1
	F	EUT	EUTELSAT-KA-13E	76-78 ●		Hot Bird 6		
	F	EUT	EUTELSAT B-13E (BSS)					
14.00 E	RUS		TOR-12M	82				
15.00 E	RUS		GALS-12	49, 50				
	RUS		STATSIONAR-23	43, 47				
	RUS		VOLNA-23	9-13				
16.00 E	F	EUT	EUTELSAT 2-16E	33-57				
	F	EUT	EUTELSAT 3-16E	33-57 ●	1998-056A	Eutelsat W2	16.01 E	C1
	F	EUT	EUTELSAT EXB-16E	52, 55	Services in Eur, North Africa, Near East, Mauritius,Reunion			
	F	EUT	EUTELSAT KA-16B	76-78				
	F	EUT	EUTELSAT B-16E (BSS)					

16.20 E	I		SICRAL-2A	9-82	•	2001-005A	Sicral, i=0.49 Milit.comm	16.20 E	C2
17.00 E	BLR	IK	INTERSPUTNIK-17E	47					
19.00 E	LUX		:LUX-KA-19E	67-76					
19.20 E	LUX		GDL-6	52-57		1996-021A	Astra 1F BSS, FSS Europe	19.20 E	C1
	LUX		GDL-6 (30B)	52, 55		1997-076A	Astra 1G	19.20 E	C1
	LUX		GDL -7	52, 57		1999-033A	Astra 1H	19.19 E	C1
	LUX		GDL-30B-5	43-55		2006-012A	Astra 1KR	19.21 E	C1
	LUX		DBL-G4-19.2E (BSS)			2007-016A	Astra 1L HDTV for Europe	19.23 E	C1
20.00 E	ARS	ARB	ARABSAT 2-C	43-48					
	ARS	ARB	ARABSAT-VC20E (BSS)						
21.00 E	USA		AFRIBSS	48	•	1998-063A	AfriStar 1 = AfriBSS	21.01 E	C1
						Africa, SW Europe, Near East			
21.50 E	F	ESA	ARTEMIS-21.5E-DR	33-78	•	2001-029A	Artemis, i=6.10	21.42 E	C2
	F	ESA	ARTEMIS-21.5E-LM	25-57		Sevices for Europe, North Africa, Middle East			
	F	EUT	EUTELSAT 1-5	52-57		1999-018A	Eutelsat W3	21.61 E	C1
	F	EUT	EUTELSAT 2-21.5E	33-57		Direct TV for Europe, North Africa, Near East, Turkey			
	F	EUT	EUTELSAT 3-21.5E	33-57					
	F	EUT	EUTELSAT-KA-21.5E	76-78					
	LUX		LUX-30B-8	43-55					
	LUX		DBL-G4-21.5E (BSS)						
23.00 E	RUS		GALS-8	49, 50					
	RUS		ROSCOM-3	47-79					
	RUS		STATSIONAR-19	43, 47					
	RUS		STATSIONAR-M8	52,57					
	RUS		VOLNA-17	9-13					
23.50 E	D		DFS-1	33-78		1995-055A	Astra 1E BSS,FSS Europe	23.51 E	C1
	LUX		LUX-30B-6	52-55		2002-015B	Astra 3A Direct TV in Germa	23.52 E	C1
	LUX		DBL-G4-23.5E (BSS)						
25.00 E	G		INMARSAT-3 IOR WEST	25-47		1998-006B	Inmarsat-3 F5, i=0.41	25.01 E	C2
						Comm. with ships, airplanes			
25.50 E	F	EUT	EUTELSAT 1-8	3-57		1998-057A	Eurobird 2 = HotBird 5	25.77 E	C1
	F	EUT	EUTELSAT EXB-25.5E	52- 55		Operated by Arabsat			
	F	EUT	EUTELSAT EXB-25.5E C	43, 48					
26.00 E	ARS	ARB	ARABSAT 1-B	43, 47		1999-009A	Arabsat 3A	25.93 E	C1
	ARS	ARB	ARABSAT 2-B	43-57		2006-051A	Badr 4	26.01 E	C1
	ARS	ARB	ARABSAT-VB26E (BSS)			1997-046A	PAS 5=Arabsat 2C	26.17 E	C1
	IRN		ZOHREH-2	52, 57		Services fot the League of Arab states			
	IRN		IRNDBS-2 (BSS)						
27.00 E	BLR	IK	INTERSPUTNIK-27E	43-48					
28.00 E						1993-056A	USA 95 = UFO 2 Milit Com	28.1 E	C
28.20 E	LUX		LUX-30B-7	43-55		2000-081A	Astra 2D Direct TV	28.19 E	C1
	LUX		LUX-KA-28.2E	67		2000-054A	Astra 2B BSS, FSS Europe	28.20 E	C1
	LUX		DBL-G4-28.2E (BSS)			1998-050A	Astra 2A Direct TV	28.21 E	C1
						2001-025A	Astra 2C BSS,FSS Europe	28.22 E	C1
28.50 E	D		DFS-2	33-78		2001-011A	Eurobird 1	28.51 E	C1
	F	EUT	EUTELSAT EXB-28.5E	52, 55					
29.00 E	USA		FLTSATCOM-C INDOC-1	9-84		2005-005A	XTAR-EUR Serv. for NATO	29.00 E	C1
30.00 E						2002-001A	USA 164 = MILSTAR-2F3	29.9 E	C
						Military communications			
30.50 E	ARS	ARB	ARABSAT 2-A	43-57		1996-063A	Arabsat 2B Arab League	30.50 E	C1
	ARS	ARB	ARABSAT-VA30.5E (BSS)						
31.00 E	ARS	ARB	ARABSAT 1-C	43, 47		1994-070A	Astra 1D BSS, FSS Eur	31.01 E	C1
	TUR		TURKSAT-1B	52, 57					
	TUR		TURKSAT-K1	52, 57		1987-078A	Optus A3, i=9.20, Inactive	31.52 E	C2
31.50 E	LUX		DBL-G4-31.5E (BSS)			1997-071A	Sirius 2 = Astra 5A	31.50 E	PL
						Services in Europe. Moved from 4.80E in May, 2008			
33.00 E	F	EUT	EUTELSAT 2-33E	52-57					
	F	EUT	EUTELSAT 3-33E	33-57	•	2003-043A	Eurobird 3 Internet Europe	33.14 E	C1
	F	EUT	EUTELSAT EXB-33E	52, 55					
	F	EUT	EUTELSAT EXB-33E C	43, 48					
	F	EUT	EUTELSAT B-33E (BSS)						
	G		INTELSAT KA 33E	65-78					
	USA		FLTSATCOM-C INDOC-1	9-84					
	USA		INTELSAT5 33E	43, 47					
	USA		INTELSAT7 33E	43-57					
	USA		INTELSAT8 33E	43-57	•	1997-031A	Intelsat VIII F-2	32.91 E	C1
	USA		USMB-7	35		Services for Africa, IndOc			
34.00 E	IRN		ZOHREH-1	52, 57					
35.00 E	URS		GALS-6	49, 50					
	RUS		PROGNOZ-3	33-42					
	RUS		STATSIONAR-2	43, 47					
	RUS		STATSIONAR-D3	47, 48					
	RUS		STATSIONAR-D3-30B	43					
	RUS		TOR-2M	67-82					
	RUS		VOLNA-11	9-13					
36.00 E	F	EUT	EUTELSAT 2-36E	33-57					
	F	EUT	EUTELSAT 3-36E	33-57		2000-019A	Sesat	35.94 E	C1
	F	EUT	EUTELSAT EXB-36E	52, 55		Data, Internet for Europe, North Africa, West Asia			
	F	EUT	EUTELSAT EXB-36E C	43, 48					
	F	EUT	EUTELSAT B-36E (BSS)			2000-028A	Eutelsat W4	36.09 E	C1
	RUS		RST-1	53		Direct TV for Russia to Russia, Siberia, Africa			
	RUS		RST-1 (BSS)			1993-076A	NATO IVB, i=6.55 NATO	35.50 E	C2

37.50 E	SEY		SEYSAT-2	43, 47				
38.00 E	PAK		PAK 12712		1996-006A	Palapa C1 = Paksat 1	38.01 E	C1
	PAK		PAKSAT-1R-BSS-38.2EA		Regional customers, gov. organizations			
39.00 E	GRC		HELLAS-SAT	52-57 •	2003-020A	Hellas Sat 2	39.01 E	C1
	GRC		GRC 15002 (BSS)		Sevices for Europe, Middle East, South Africa			
39.50 E	G		DJCF-1A	23-54				
40.00 E	F	EUT	EUTELSAT EXB-40E	52, 55				
	F	EUT	EUTELSAT B-40E (BSS)					
	RUS		EXPRESS-4	43-57	2004-043A	Ekspress AM-1	40.00 E	C1
	RUS		LOUTCH-7	52, 57	Sevices for Europe, Middle East, North Africa, India			
	RUS		STATSIONAR-12	43, 47				
42.00 E	TUR		TURKSAT-1A	52, 57	1996-040B	Turksat 3	42.00 E	C1
	TUR		TURKSAT-1D	52, 57	National and regional TV			
	TUR		TURKSAT-K2	52, 57	2001-002A	Turksat 2A = Eurasiasat 1	42.00 E	C1
	TUR		TURKSAT-KX	57	2008-030B	Turksat3A		Enc
	TUR		TURKSAT-BSS					
42.50 E	SEY		SEYSAT-1	43-47	2007-018A	Nigcomsat Serv.for Africa	42.04 E	C1
44.00 E	F	EUT	EUTELSAT 3-44E	33, 35				
	F	EUT	EUTELSAT-KA-44E	76-78				
	USA		USCSID-A2	66-79	1998-029A	USA 139 = Orion 2 Elint	43.9 E	C
	USA		USGGR-4	23, 26				
	UAE				2003-026A	Thuraya 2 i=3.33	44.05 E	C2
					Services for Europe, Middle East, India, Africa, CIS			
45.00 E	D		EUROPE*STAR-1	52-57 •	2000-068A	Europe*Star F-1	45.00 E	C1
	D		EUROPE*STAR-2G-1B (BSS)		Services for Europe, S.Africa, Middle East, India,SW Asia			
	F		F-SATDAB-4	48				
	URS		GALS-2	49, 50	2000-049A	Raduga 1-5, i=5.17	44.93 E	C2
	RUS		STATSIONAR-9	43, 47	Civil services in Russia, military comm. on GALS			
	RUS		STATSIONAR-9A	43, 47				
	RUS		STATSIONAR-D4	47, 48				
	RUS		STATSIONAR-D4-30B	43				
	RUS		TOR-3	67-82				
	URS		VOLNA-3	9-27				
46.00 E	G		DJCF-1B	23-26	1996-002B	MEASAT 1 = Africasat 1	46.00 E	C1
	UAE		YAHSAT-BSS-46E		Services for Africa and Europe			
47.00 E	F		SYRACUSE-3H	33-82 •	2005-041B	Syracuse 3A Mllit. comm.	47.01 E	C1
	IRN		ZOHREH-3	52, 57				
47.50 E	D		EUROPE*STAR-3	52-57	1991-075A	Intelsat VI F-1, i=3.11	47.54 E	C2
	D		EUROPE*STAR-3B (BSS)		Mainly international phone			
48.00 E	F	EUT	EUTELSAT 3-48E	33-57				
	F	EUT	EUTELSAT EXB-48E	52, 55				
	F	EUT	EUTELSAT EXB-48E C	43, 48				
	F	EUT	EUTELSAT-E-48E	3-57				
	F	EUT	EUTELSAT B-48E (BSS)					
	F	EUT	EUTELSAT-KA-48E	76-78				
	IND		INSAT-2 (48)	17-57	2003-018A	GSAT-2	48.01 E	C1
	IND		INSAT-2M (48)	37-47	Technological satellite			
	IND		INSAT-2T (48)	47				
49.00 E	RUS		GALS-13	49, 50	2003-053A	Yamal 200 N2	48.99 E	C1
	RUS		ROSCOM-4	43-79	Mainly services for gas and oil industry			
	RUS		STATSIONAR-24	43, 47				
	RUS		VOLNA-25	9-13				
	USA		USMB-8	35				
50.00 E	TUR		TURKSAT-1C	52, 57	1995-023A	Intelsat VIIA F-1	50.25 E	C1
53.00 E	F	EUT	EUTELSAT EXB-44E	52, 55				
	F	EUT	EUTELSAT EXB-44E C	43, 48				
	RUS		EXPRESS-5	43-57	2003-060A	Ekspress AM-22	53.01 E	C1
	RUS		EXPRESS-5B	47	Reg.services for Europe, CIS, N.Africa, Near East			
	URS		LOUTCH-2	52, 57				
	RUS		STATSIONAR-5	43, 47				
	URS		VOLNA-4	25-27				
	G		SKYNET-4C	9-82	1999-009B	Skynet 4E, i=4.24 Military	53.02 E	C2
	G		SKYNET-4L	35	2007-056B	Skynet 5B Military comm.	52.71 E	PL
55.00 E	IND		INSAT-2 (55)	17-47	2003-043E	Insat 3E	54.99 E	C1
	IND		INSAT-2T (55)	43, 47	Services in Indian Subcontinent			
	IND		INSAT-EXC 55E	43,48				
	RUS		KUPON-1	52,57				
	RUS		KUPON-1T	43, 47				
	USA		MILSTAR-4	31-84				
					1994-034A	Intelsat 702	54.89 E	C1
56.00 E	RUS		RST-2	53 •	1998-068A	Bonum 1 = Most 1	55.99 E	C1
	RUS		RST-2 (BSS)		Services in Russia, CIS			
57.00 E	HOL		INTELSAT5A INDOC2	43-57				
	HOL		INTELSAT7 57E	43-57	1994-064A	Intelsat 703 = NSS703	57.01 E	C1
	HOL		INTELSAT8 57E	43-57				
	UAE		YAHSAT-BSS-57E					
	USA		USGCSS PH2 INDOC-2	49, 50	1993-074A	USA97 Military comm.	56.8 E	C
	USA		USGCSS PH3 INDOC-2	31-49				
	USA		USGCSS PH3B INDOC2	49, 50				
57.50 E			For ranging purposes		1997-049B	Meteosat 7, i=3.85	57.43 E	C2
58.00 E	RUS		TOR-13M	67-82				
58.75 E	CHN		COMPASS-58.75E	23, 45				

60.00 E	USA		INTELSAT6 60E	43-57				
	USA		INTELSAT8 60E	43-57	●	2002-007A Intelsat 904	59.99 E	C1
	G		INTELSAT KUEXT60E BSS					
	USA		USGCSS PH3 INDOC	31-50				
	USA		USGCSS PH3B INDOC	31-50		2003-008A USA167 Military comm.	59.9 E	C
	UAE		YAHSAT-BSS-60E					
62.00 E	USA		INTELSAT6 62E	43-57				
	USA		INTELSAT7 62E	43-57				
	USA		INTELSAT8 62E	43-57	●	2001-039A Intelsat 902	61.99 E	C1
	CHN		CHNBSAT-62E (BSS)					
	USA		USMB-9	35				
63.00 E	USA		INTELSAT5A INDOC3	43-57				
64.00 E						1996-020A Inmarsat 3 F-1	63.97 E	C1
	G		INMARSAT-3 IOR-1	25-47	●	2005-009A Inmarsat 4 F-1, i=2.40	63.92 E	C2
	USA		INTELSAT7 64E	43-57				
	USA		INTELSAT8 64E	43-57	●	2002-041A Intelsat 906	64.17 E	C1
64.50 E	G		INMARSAT-2 IOR 1	25-47				
65.00 E	G		INMARSAT-3 IOR-2	25-47				
66.00 E	G		INTELSAT KA 66E	65-78				
	G		INTELSAT KUEXT 66E BSS					
	USA		INTELSAT5 INDOC4	43-57				
	USA		INTELSAT5A 66E	43-57				
	USA		INTELSAT7 66E	43-57	●	1995-001A Intelsat VII F-4	66.03 E	C1
67.50 E	UAE		YAHSAT-BSS-67.5E			1993-073B Meteosat 6, i=7.07 out	67.47 E	C2
68.00 E	USA		USASAT-14I-2	43-57				
68.50 E	USA		USASAT-14I	43-57		2001-019A Pan American Satellite 10	68.57 E	C1
						Servces for East Europe, Africa, Middle East, Asia		
						1998-052A Pan American Satellite 7	68.66 E	C1
						Services for Europe, Africa, Asia		
69.00 E	RUS		GALS-14	49, 50				
	RUS		TOR-14M	67-82				
70.00 E	RUS		GALS-16	49, 50		2007-058A Cosmos 2434 (Raduga 1)	69.96 E	PL
	RUS		STATSIONAR-20	43, 47		Civil serv. for Orbita 2, miliary comm. possibly on GALS		
	RUS		VOLNA-19	9-13		Mobile stations on Volna		
	USA		USGON-1	35		2001-033A USA 159 = DSP F21	69.3 E	C
	TON		TONGASAT-H70	43-57		Early warnir ng, radiation detection, sci. equipment		
70.50 E	F	EUT	EUTELSAT 3-70.5E	33-35	●	2002-051A Eutelsat W5	70.50 E	C1
	F	EUT	EUTELSAT EXB-70.5E	52, 55		Services fro m West Europe to Asia, to South Japan		
	F	EUT	EUTELSAT EXB-70.5E C	43, 48				
	F	EUT	EUTELSAT-E-70.5E	33-57				
	F	EUT	EUTELSAT B-70.5E (BSS)					
72.00 E	AUS		DEF-R-SAT-2A	23,26				
	USA		FLTSATCOM-C INDOC-2	9-82		1999-063A USA 146 = UFO F10	72.8 E	C
						Military communications		
	USA		KASATCOM-3	72-79		1990-097B USA 67 = SDS 2F2	72.9 E	C
						Probably military comm. with satellites in LEO		
	USA		USASAT-14J	43-57		1995-040A Pan American Satellite 4	72.01 E	C1
						Direct TV to Near East, India and South Africa		
	USA		USASAT-14J-2	43-57		2003-057A USA 174 = UFO F11	71.3 E	C
						Military communications		
73.50 E	F	EUT	EUTELSAT EXB-73.5E	52, 55				
	F	EUT	EUTELSAT EXB-73.5E C	43,48				
74.00 E	IND		INSAT-1B	17-47		2002-043A Kalpana-1 = Metsat-1	74.00 E	C1
	IND		INSAT-2 (74)	17-47		Meteorology		
	IND		INSAT-EK 74R	52		2002-002A Insat 3C	74.00 E	C1
	IND		INSAT-2C	43-48		Regional services in the Indian Subcontinent		
	IND		INSAT-2K (74)	52, 57		2004-036A GSAT 3 = Edusat	74.02 E	C1
	IND		INSAT-2M (74)	37-47		Educational programs for remote areas in India		
	IND		INSAT-2T (74)	43, 47		2007-037A Insat 4CR	74.02 E	C1
	IND		INSAT-2E74	43		Services for Indian Subcontinent		
75.00 E	USA		FLTSATCOM-C INDOC-3	9-82		1999-053A LMI	74.99 E	C1
	USA		USCID-A3	66-79		Services for Russia, CIS, East and central Europe,		
	USA		USMB-10	35		parts of Asia and Africa		
	BLR	IK	INTERSPUTNIK-75E-Q	47-57				
	BLR	IK	INTERBELAR-2	43-57				
	BLR	IK	INTERSPUTNIK-74.9E (BSS)					
76.00 E	F	EUT	EUTELSAT 3-76E	33, 35				
	F	EUT	EUTELSAT EXB-76E	52, 55				
	F	EUT	EUTELSAT EXB-76E C	43, 48				
	F	EUT	EUTELSAT B-76E (BSS)					
	RUS		GOMS-M	17-77				
76.50 E	CHN		APSTAR-4	43-57	●	1997-062A Apstar 2R = Telestar 10	76.50 E	C1
						Regional services for Europe. Middle East, Japan, ε		Austr.
77.00 E	RUS		CSSRD-2	43-59				
78.50 E	THA		THAICOM-A2	43, 47		1994-065B Thaicom 2	78.53 E	C1
						Services for Thailand and several countries in Asia		
	THA		THAICOM-A2B	43-57		2006-020B Thaicom 5	78.51 E	C1
	THA		THAICOM-AK2	54, 57		Services for Thailand and SE Asia		

80.00 E	CHN		COMPASS-80E	23, 45	2000-082A Beidou 1B, i=0.65	80.34 E	C2
	CHN		CHNSAT-80E (BSS)		Regional navigation for surface, river, sea transport		
	RUS		EXPRESS-6	43-57	2005-010A Ekspres AM-2	80.00 E	C1
	RUS		FOTON-2	43, 47	Regional services for Europe, Russia, North Africa		
	URS		LOUTCH-8	52, 57	Near East, Indian Subcontinent		
	RUS		POTOK-2	43, 47	2000-036A Cosmos 2371 i=5.31	79.82 E	C2
	RUS		PROGNOZ-4	33-42	Military Telecommunications		
	URS		STATSIONAR-1	43, 47			
80.50 E	F	EUT	EUTELSAT EXB-80.5E	52, 55			
	F	EUT	EUTELSAT EXB-80.5E C	43, 48			
	F	EUT	EUTELSAT B-80.5E (BSS)				
81.75 E	RUS		YAMAL-E3	52, 57			
82.00 E	AUS		DEF-R-SAT-1A	23, 26			
	USA		USCID-A4	66-79			
	USA		USGGR	23, 26			
	USA		USMB-11	35			
83.00 E	IND		INSAT-1D	17-47	1999-016A Insat 2E	82.99 E	C1
	IND		INSAT-2 (83)	17-47	Telecom.services and meteorology		
	IND		INSAT-2A	43, 48	2000-016B Insat 3B	83.00 E	C1
	IND		INSAT-2E83	43, 47			
	IND		INSAT-2K (83)	52, 57	2005-049A Insat 4A	82.96 E	C1
	IND		INSAT-2M (83)	37-47	Services to S.Asia from Syria to Malaysia, direct TV to Ind		
83.50 E	F	EUT	EUTELSAT EXB-83.5E	52, 55			
	F	EUT	EUTELSAT EXB-83.5E C	43, 48			
	F	EUT	EUTELSAT B-83.5E (BSS)				
85.00 E	URS		GALS-3	49, 50	2004-010A Raduga-1 i=2.48	85.07 E	C2
	RUS		STATSIONAR-3	43, 47	Civil services for Orbita 2, military comm. possibly on Gals,		
	URS		VOLNA-5	9-27	mobile serices on Volna, experimental on Loutch		
	URS		TOR-4	67-82			
	USA		INTELSAT7 85E	43-57			
	USA		INTELSAT8 85E	52-57 •	1996-035A Intelsat VII F-6 = 709	85.15 E	C1
	USA		USABSS-29 (BSS)				
	USA		TDRS 85E	33-59	1988-091B TDRS West, i=10.77	84.72 E	C2
	URS		TOR-4M	67-82	Comm. wth LEO and Space Shuttle, intercontinental com.		
85,40 E	RUS		STATSIONAR-D5	47, 48			
	RUS		STATSIONAR-D5-30B	43			
86.00 E	F	EUT	EUTELSAT EXB-86E	52, 55			
	F	EUT	EUTELSAT B-86E (BSS)				
86.50 E	CHN		FY-2B	17-33	2006-053A Feng Yun 2D, i=1.64	86.42 E	C2
	CHN		FY-2BS	17-35	Radiometer, collection of meteo data		
87.50 E	CHN		CHINASAT-1	43, 47	1998-033A Zhongwei 1	87.48 E	C1
	CHN		DFH-3-OC	43	Regional services n China, India, Korea, SE Asia		
88.00 E	SNG		ST-1A	43-57 •	1998-049A ST-1 Reg.serv. in Asia	88.00 E	C1
88.50 E	F	EUT	EUTELSAT EXB-88.5E	52, 55			
	F	EUT	EUTELSAT EXB-88.5E C	43, 48			
	F	EUT	EUTELSAT B-88.5E (BSS)				
89.00 E					2000-034A TDRS 8, i=0.70	89.12 E	C2
90.00 E	RUS		EXPRESS-7	43-57	1999-047B Yamal-100 No 2 i=4.08	89.79 E	C2
	RUS		LOUTCH-3	52, 57	2003-053B Yamal 200 No 1	90.00 E	C1
	RUS		STATSIONAR-6	43, 47	Two satellites for gas and oil industry		
	URS		VOLNA-8	25-27			
	USA		MILSTAR 5	31-84			
90.75 E	J				2002-042B Kodama = DRTS	90.74 E	C1
					Transmission of data from satellites in LEO		
91.50 E	MLA		MEASAT-1	43-57	2006-056A Measat 3	91.45 E	C1
	MLA		MEASAT-AK 91.5	53-57	Services in Asia, Australia,E Europe, Africa		
	MLA		MEASAT-IC 91.5	43-48			
92.00 E	USA		USCSID-A5	66-79			
	USA		USMB-12	35			
93.00 E	AUS		DEF-R-SAT-3A	23, 26			
93.50 E	IND		INSAT-1C	17-47	2003-013A Insat 3A (data and meteo)	93.50 E	C1
	IND		INSAT-2 (93.5)	17-47	2007-007A Insat 4B	93.50 E	C1
	IND		INSAT-2B	43, 48	Regional services in South Asia		
	IND		INSAT-2K (93.5)	52, 57			
	IND		INSAT-2M (93.5)	37-47			
	IND		INSAT-2T (93.5)	47			
95.00 E	RUS		CSDRN	43-59			
	HOL		INTELSAT KA 95E	78	2002-057A NSS 6	95.01 E	C1
	HOL		INTELSAT5A 95E	52, 57	Services in Middle East, Indian Subcontinent, Australia		
	HOL		INTELSAT7 95E	52-57			
	HOL		INTELSAT8 95E	52-57			
96.50 E	RUS		EXPRESS-8	43-57	2008-003A Express-AM 33	96.49 E	PL
	RUS		LOUTCH-9	52, 57	Services for Russia, CIS, SE Asia, W Pacific		
	RUS		STATSIONAR-14	43, 47			
98.00 E	CHN		CHINASAT-22	11	2000-003A Zhongxing-22	97.99 E	C1
	CHN		CHINASAT-3	43, 47	2006-038A Zhongxing-22A	98.01 E	C1
	RUS		PROGNOZ-8	35	Both satelltes internal services in China		
98.5 E	UAE				2008-001A Thuraya 3	98.47 E	PL
					Services in Europe, CIS, N. Africa, Middle East, India		
99.00 E	RUS		STATSIONAR-T	47	2001-014A Ekran 21=Ekran M,i=4.57	99.14 E	C2
	RUS		STATSIONAR-T2	47	TV in Russian Federation, CIS		
					2008-028A Zhongxing-9	92.20 E	Enc
					1986-096A USA 20 = Fltsatcom F7	99.6 E	C

100.00 E				1990-002B Leasat 5=Syncom4F5,i=7.4	100.04 E	C2
				Both, USA 20 and Leasat 5, military		
				2006-048A Xinnuo 2, i=0.69	100.00 E	C2
				Services in China,including Hong Kong, Macao, Taiwan		
100.50 E	CHN	ASIASAT-E	43-48	1995-064A AsiaSat 2	100.51 E	C1
	CHN	ASIASAT-EK1	53-57	Services in Asia Pacific region		
	CHN	ASIASAT-EKX	53,54			
103.0 E	CHN	DFH-3-OB	47	2003-052A Zhongxing-20	103.01 E	C1
	CHN	STW-2	43, 47	Internal services in China		
	RUS	EXPRESS-9	43-57	2000-013A I Ekspress-2A, i=1.88	102.84 E	C2
	RUS	LOUTCH-5	52, 57	Control of KazSat lost on June 8, 2008		
	RUS	STATSIONAR-21	43, 47	2006-022A KazSat-1	102.99 E	C1
	USA	USGON-3	35	2004-004A USA 176 = DSP F22	103.7 E	C
				Early warning, Radiation Detection, plasma analysis		
105.00 E	AUS	ASIABSS	48	2000-016A AsiaStar	105.00 E	C1
	CHN	CHINASAT-46	35	Services in Asia, SE Europe, NE Africa		
	CHN	FY-2A	28-33	2004-042A Feng Yun 2C i=2.21	104.42 E	C2
	CHN	FY-2AS	17-35	Radiometer, coll. of meteo data, monitoring space environ.		
105.50 E	CHN	ASIASAT-1	43, 47	1999-013A Asiasat 3S	105.50 E	C1
	CHN	ASIASAT-CK	43-57	Services in Far East, CIS, India		
	CHN	ASIASAT-CK1	53-57			
106.50 E	USA	USMB-13	35			
107.70 E	INS	INDOSTAR-1	43, 47	1997-071B Cakrawatra 1, i=2.46	107.65 E	C2
				Services for Indonesia		
108.00 E	INS	PALAPA-B1	43, 47	1999-042A Telkom 1	107.99 E	C1
	INS	PALAPA-C2	43, 47	Regional services in SE Asia, N. Austarlia		
	CHN	CHNBSAT-108E (BSS)		2000-059A GE-1A, AAP-1	108.20 E	C1
				Servicers in China, SE Asia, India		
109.00 E	G	INMARSAT-3 POR WEST	25-47	1992-021B Inmarsat 2-F4, i=3.41	109.00 E	C2
109.85 E	J	BS-3N (and BSS)	57 •	1994-040B BS-3N HDTV in Japan	109.83 E	C1
	J	BSAT-109.85	53	1997-016B BSAT-1ADirect TV in Japan	109.73 E	C1
	J	TAIKI-109.65-34.5 (BSS)		2001-011B BSAT-2ADirect TV in Japan	109.87 E	C1
	J	NB-SAT-109.85AAE (BSS)		2003-028A BSAT-2CDirect TV in Japan	109.86 E	C1
110.00 E	J	BS-3 (and BSS)	33-57			
	J	BSAT-110	53	2007-036B BSAT 3ADirect TV in Japan	109.78 E	C1
	J	N-SAT-110	53-57	2000-060A NSAT-110 Serv. in Japan	110.05 E	C1
	J	NB-SA 110-AAE (BSS)				
	USA	USCSID-A6	66-79			
	USA	USGGR-11	23, 26			
110.50 E	CHN	CHINASAT-2	43, 47	1998-044A Sinosat 1	110.50 E	C1
	CHN	CHINASAT-6	43-57	Services in China and SE Asia		
	CHN	COMPASS-110.5E	23, 45	2003-021A Beidou 3	110.50 E	C1
	IND	INSAT-2 (111.5)	17-47	Regional navigation in transport		
113.00 E	KOR	KOREASAT-2 (and BSS)	53-57	2006-034A Mugunghwa 5	113.04 E	C1
	INS	PALAPA-B2	43, 47	Direct TV for E Asia, military comm. for Korea		
	INS	PALAPA-C1	43-52	1996-030A Palapa C2	113.01 E	C1
				TV and data for Indonesa and ASEAN		
116.00 E	CHN	ASIASAT-B	43-47	2007-031A Zhongxing 6B	115.56 E	C1
				TV for China, SE Asia, W Pacific, Oceania		
	KOR	INFOSAT-C	67-79	1996-003A Mugunghwa 2, i=098	116.35 E	C2
	KOR	KOREASAT-1	53-57	1999-046A Mugunghwa 3 = Koreasat 3	115.95 E	C1
				1993-069A Gorizont 28 Drifting ?	116.93 E	C2
118.00 E	INS	PALAPA-B3	43, 48	2005-046A Telkom 2 Asia-Pcific	118.00 E	C1
120.00 E	J	GMS-120E	20, 35			
	THA	THAICOM-A3	43, 47	2005-028A Thaicom 4 SE Asia-Austral	119.41 E	C1
	THA	THAICOM-AK3	54, 57	1993-078B Thaicom 1	120.00 E	C1
121.00 E	AUS	DEF-R-SAT-4B 121.0 E	23-79			
	CHN	DFH-3-OE	43, 47			
122.00 E	CHN	ASIASAT-A	43, 47	2003-014A AsiaSat 4	122.14 E	C1
	CHN	ASIASAT-AK	43-57	Services for China, CIS, Korea, Australia, New Zealand		
	CHN	ASIASAT-AK1	53-57			
	CHN	ASIASAT-DTH-A1 (BSS)				
	LAO	LSTAR 4B (BSS)				
123.00 E				2000-011A Garuda 1, i=0.42 SE Asia	123.01 E	C2
123.50 E	CHN	FY-2C	17-33			
	CHN	FY-2CS	17-35			
124.00 E	J	JCSAT-3B	53-57 •	1999-006A JC-Sat 6	123.93 E	C1
	J	SJC-1	53-57	Services in SE Asia, Australia, New Zealand, Hawaii		
125.00 E	CHN	DFH-3-OA	43, 47	2007-021A Xinnuo 3 =Sinosat 3	125.01 E	C1
	CHN	STW-1	43, 47	Services for China, including Hong Kong, Macao, Taiwan		
128.00 E	RUS	GALS-10	49, 50			
	RUS	STATSIONAR-15	43, 47			
	RUS	STATSONAR-D6	47, 48			
	RUS	STATSIONAR-D6-30B	43			
	RUS	TOR-6	67-82			
	RUS	VOLNA-9	9-13			
	J	JCSAT-3A	53-57 •	2006-033A JC-Sat 3A, i=0.33	127.63 E	C2
				Services in Japan, SE Asia, Oceania, Hawaii		
	J	N-SAT-128	53-57	1997-075A JC-Sat 5	128.00 E	C1
				Services in E, SE Asia,, Australia, New Zealand, Hawaii		

130.00 E	URS	GALS-5	49, 50	1996-039A Apstar 1A, i=2.48	130.02 E	C2
	RUS	PROGNOZ-5	33-42	Services in China, Philippines, Thailand, India,Singapore		
	RUS	T0R-10M	67-82			
	TON	TONGASAT AP-1	43, 47			
	TON	TONGASAT C/KU-1	43-57			
131.00 E	CHN	APSTAR 1	43, 47			
132.00 E	J	NSTAR-A	37-39	2006-010A JCSA 9	131.99 E	C1
				Services in Japan, SE Asia, Oceania, Hawaii		
				2008-018B Vinasat 1	131.96 E	PL
				Services for Vietnam, SE Asia, India, Japan, Australia		
134.00 E	CHN	APSTAR-2	43-57	2005-012A Apstar 6	134.00 E	C1
	CHN	CHNSAT-134E (BSS)				
	J	NB-SAT-134A (BSS)				
	TON	TONGASAT AP-2	43, 47	Services in China, Taiwan, SE Asia, Hawaii		
	TON	TONGASAT C/KU-2	43-57			
136.00 E	J	CS-3B	33-77	2002-035B N-Star 3 = N Star c	135.95 E	C1
	J	N-STAR-B	37-79	Mobil phones in Japan		
138.00 E	CHN	APSTAR-5-KU	53-57+F694	2004-024A Telstar 18 = Apstar 5	138.03 E	C1
	TON	TONGASAT AP-3	43, 47	Services in China, SE Asia, Australia, Hawaii		
	TON	TONGASAT C/KU-3	43-57			
140.00 E	CHN	COMPASS-140E	23, 45	2000-069A Beidou 1A, i=0.74	140.00 E	C2
				Regional navigation in transport		
	RUS	EXPRESS-10	43-57 ●	2005-023A Ekspress AM-3	140.01 E	C1
	RUS	LOUTCH-4	52, 57	Services in Siberia, Far East, Paific region		
	RUS	STATSIONAR-7	43, 47			
	URS	VOLNA-6	25-27			
	J	MTSAT-140E	20-79 ●	2005-006A Himawari-6 = MTSat-1R	140.22 E	C1
	J	GMS-140E	17-35	Airtraffic, meteo, tsunami warning		
142.00 E				1994-043A Apstar 1, i=3.10	142.04 E	C2
				Services in China, Taiwan, Phulippines, Singapore, Thailand		
142.50 E	TON	TONGASAT-AP4	43, 47			
	TON	TONGASAT C/KU-4	43-57			
143.00 E				2008-007A Kizuna	142.97 E	PL
				Services for Japan, Korea China, SE Asia		
143.50 E		Operational lifetime 2010		1990-093A Inmarsat 2-F1, i=5.36	143.51 E	C2
144.00 E	J	N-SAT-146	53-57	2004-007A MBSAT-1	144.07 E	C1
	KOR	SKDAB-2	53, 57	Services in Japan, Korea		
	J	SUPERBIRD-C	53-57 ●	1997-036A Superbird C	144.01 E	C1
	J	JMCS-1	49, 50	Services in NE, SE Asia, Japan, Hawaii		
	INS	PALAPA PACIFIC-3	43, 47			
145.00 E	RUS	EXPRESS-11	43-57	2000-029A Gorizont 33, i=5.35	144.85 E	C2
	RUS	LOUTCH-10	52, 57	Internal services in Russia, CIS. Loutch, Volna		
	RUS	STATSIONAR-16	43, 47			
	USA	USGON-6	35	1997-008A USA 130 = DSP F18	145.8 E	C
				Early warning, Radiation Detection, Plasma Analyser		
	J	Airtraffic. Meteo imager, data collection		2006-004A MTSAT-2	145.00 E	C1
		Spare for Beidou 1A at 140.00E		2007-003A Beidou 4, i=5.38	145.05 E	PL
146.00 E	INS	Intended position 144.00 E		1997-042A Agila 2 = Mabuhay 1	145.97 E	PL
				Regional services in SE Asia		
		Mobile phones, Caesium atomic clock		2006-059A Kiku 8 = ETS VIII	146.02 E	PL
148.00 E	MLA	MEASAT-148E	53	1996-063B Measat 2	147.99 E	C1
	MLA	MEASAT-2	43-57	Services in SE Asia, Australia		
150.00 E	J	JCSAT-1	53-57 ●	1997-007A JC-Sat 4	150.00 E	C1
	J	JCSAT-1R	43-57 ●	JC-Sat 4		
				Services in E Asia, Austr., New Zealand, India, Hawaii		
	USA	USGCSS PH3B W PAC-3	31-50	1992-037A USA 82 MIlitary Comm.	150.0 E	C
152.00 E	AUS	AUSSAT A 152E	53-57	2007-044A Optus D2	152.08 E	C1
	AUS	AUSSAT A 152E PAC	53-57	2001-009A USA 157 = Milstar 2F2	152.1 E	C
	AUS	AUSSAT B 152E MOB	25-57	Military communications		
	AUS	AUSSAT B 152E MXL	25-57			
	AUS	AUS BSS 152E				
153.50 E	BLR IK	INTERSPUTNIK-153.5EQ	47			
154.00 E	J	JCSAT-2	53-57 ●	2002-015A JC-Sat 8 = JC Sat 2A	154.00 E	C1
	J	JCSAT-2R	53, 54	Services in Japan, E Asia, Oceania, Hawaii, Australia		
156.00 E	AUS	AUSSAT A 156E	53-57			
	AUS	AUSSAT B 156E	53-57			
	AUS	AUSSAT B 156E MC	53-57			
	AUS	AUSSAT B 156E MOB	25-57			
	AUS	AUSSAT B 156E MXL	25-57			
	AUS	AUSSAT B 156E NZ	53-57			
	AUS	AUSSAT B 156E R	27-53			
	AUS	AUSSAT B 156E S	54-79			
	AUS	AUSSAT C 156E FSS	53-57	2003-028B Optus C1, Defence C1	156.01 E	C1
	AUS	AUSSAT C 156E GOV	9	FSS for Australia, SE Asia, Hawaii. Military comm.		
	AUS	AUSSAT C 156E BSS				
157.00 E	USA	INTELSAT5A 157E	43-57	1989-087A Intelsat VI F-2, i=5.58	157.02 E	C2
	USA	INTELSAT6 157E	43-57			
	USA	INTELSAT7 157E	53, 54			
	USA	INTELSAT8 157E	43-57			
	G	INTELSAT KUEXT 157E	(BSS)			
158.00 E	J	SUPERBIRD-A	49-77	1992-084A Superbird A1, i=2.14	158.01 E	C2
	J	SUPERBIRD-A2	53-57			
	J	SUPERBIRD-A2-KA	65-75			

160.00 E	AUS	AUSSAT A 160E	53-57			
	AUS	AUSSAT A 160E PAC	53-57	2006-043B Optus D1	160.01 E	C1
	AUS	AUSSAT B 160E	53-57	Direct TV, Internet,data for Australia, New Zealand		
	AUS	AUSSAT B 160E MC	53-57			
	AUS	AUSSAT B 160E MOB	25-57			
	AUS	AUSSAT B 160E MXL	25-57			
	AUS	AUSSAT B 160E NZ	53-57			
	AUS	AUSSAT B 160E R	27, 53			
	AUS	AUSSAT B 160E S	54-79			
	AUS	AUSSAT C 160E BSS				
	J	GMS-160E	1-33			
162.00 E	J	JMCS-3B	49, 50			
	J	SUPERBIRD-B	49-77 •	2000-012A Superbird 4	162.03 E	C1
	J	SUPERBIRD-B2	53, 57			
163.50 E	RUS	YAMAL-E5	43, 47			
164.00 E	AUS	AUSSAT A 164E	53-57	1992-054A Optus B1, i=1.46	164.00 E	C2
	AUS	AUSSAT A 164E PAC	53, 57	Mobile phones in Australia, SW Pacific. Laser reflector		
	AUS	AUSSAT B 164E	27-79	1994-055A Optus B3	164.03 E	PL
	AUS	AUSSAT B 164E MOB	25-57	Laser reflector. Covers Australia, SW part of Pacific		
	AUS	AUSSAT B 164E MXL	25-57	Moved in 2008		
	AUS	AUS BSS 164E (BSS)				
166.00 E	RUS	PROGNOZ-6	33-42			
	USA	USASAT-14H	43-57 •	1998-065A PAS 8 = IS 8	166.01 E	C1
				Direct TV and other services in Pacific region		
167.00 E	RUS	VSSRD-2	43-59			
169.00 E	USA	USASAT-14G	43-57 •	1994-040A PAS 2 = IS 2	169.01 E	C1
				Direct TV to China,NE Asia, Australia, New Zealand		
172.00 E	USA	FLTSATCOM W PAC	9-50	1998-016A USA 138 = UFO F8	172.3 E	C
	USA	FLTSATCOM-C W PAC-1	31-82	Military communications		
	USA	KASATCOM-5	72-79			
	USA	USASAT-14K	43-57 •	2005-052A AMC 23 =Worldsat 3	172.02 E	C1
	G	AM-SAT 172E (BSS)		Services for the Pacific Region		
174.00 E	USA	INTELSAT5A PAC1	43-57			
	USA	INTELSAT7 174E	43-57			
	USA	INTELSAT8 174E	43-57 •	1991-055A Intelsat VI F-5=605,i=3.04	174.00 E	C2
175.00 E	USA	USGCSS PH3 W PAC	31-50	2000-001A USA 148	175.2 E	C
	USA	USGCSS PH3B W PAC	31-50	Military communications		
176.00 E	USA	INTELSAT8 176E	43-54			
177.00 E	USA	INTELSAT5 PAC2	43-57			
	USA	INTELSAT7 177E	43-57			
	RUS	TOR-5M	67-82			
177.50 E	USA	MILSTAR 14	31-84			
	USA	USGAE-4	31-84			
178.00 E	G	INMARSAT-3 POR-2	25-47 •	1996-070A Inmarsat 3-F3	178.06 E	C1
179.00 E	G	INMARSAT-3 POR-1	25-47			
179.50 E	G	INMARSAT-2 POR 1	25-47			
180.00	USA	INTELSAT5 PAC3	43-57			
	USA	INTELSAT7 180E	43-57 •	1993-066A Intelsat VII F-1 = 701	180.02 E	C1
	USA	USGCSS PH3 W PAC-2	31-50			
	USA	USGCSS PH3B W PAC-2	31-50	1993-046A USA 93 Military Comm.	179.9 E	C
177.00 W	USA	FLTSATCOM-A W PAC	49, 50	1995-003A USA 108 = UFO F4	177.6 W	C
	USA	FLTSATCOM-C W PAC-2	9-82	Military communications		
	HOL	INTELSAT IBS 183E	54, 57			
	HOL	INTELSAT5 183E	43-57			
	HOL	INTELSAT5A 183E	43-57			
	HOL	INTELSAT7 183E	43-57			
	HOL	INTELSAT8 183E	43-57 •	1997--053A Intelsat VIII F-3 = NSS 803	176.99W	C1
175.00 W	USA	Edu, medical, cultural serv. to Pacific islan.		1987-022A GOES 7=Peacesat,i=10.4	175.00W	C2
174.30 W	USA	USASAT-14E	43, 47			
174.00 W	USA	TDRS 174W	33-59	1993-003B TDRS 6, i=7.91	173.75W	C2
				Intersatellite and intercontinental services		
171.00 W	USA	TDRS WEST	33-59	1991-054B TDRS 5, i=8.60	171.00W	C2
				Intersatellite comm. with LEO, Space Shuttle		
170.00 W	URS	GALS-4	49,5			
	RUS	ROSCOM-2	43-79			
	RUS	STATSIONAR-10	43, 47			
	RUS	STATSIONAR-10A	43, 47			
	RUS	STATSIONAR-D2	47, 48			
	RUS	STATSIONAR-D2-30B	43			
	RUS	STATSIONAR-M1	52, 57			
	RUS	TOR-5	67-82			
	RUS	VOLNA-7	9-27			
168.00 W	RUS	FOTON-3	43, 47			
	RUS	POTOK-3	43, 47			
165.00 W	USA	USGON-4	35			
160.00 W	RUS	ESDRN	43-59			

159.00 W	RUS	PROGNOZ-7	33-42				
150.00 W	USA	Intelsat. comm. with LEO, Space Shuttle		1995-035B	TDRS 7, i=9.85	150.62W	C2
		Military communications		1995-060A	USA 115 = Milstar DFS-2	150.0 W	C
148.00 W	USA	USABSS-9 (BSS)		1995-073A	EchoStar 1	148.05W	C1
				Internet for USA, Alaska, Hawaii			
				1996-055A	EchoStar 2	147.92W	C1
				Direct TV for USA, Alaska, Hawaii			
145.00 W	USA	FLTSATCOM-C W PAC-3	9-11	1989-046A	USA 39 = DSP-F14	145.0 W	C
	USA	USGON-7	35				
144.00 W	USA	P-197-2	31, 35	2000-046A	USA 162	143.8 W	C
	USA	P92-6	31, 35	Probably a military satellite			
	HOL	NSS-BSS 143.5W					
	USA	USCID-W2	66-79				
	USA	USLL-PAC	84				
142.00 W		Operational		1997-027A	Inmarsat 3-F4	141.99W	C1
141.00 W	USA	P-197-3	31, 35				
	USA	P92-5	31, 35				
	USA	USCID-W1	66-79				
	USA	USLL-PAC2	84				
139.00 W	USA	USASAT-22I	43, 47 ●	2000-081B	GE 8 = Americom 8	138.96W	C1
	USA	US SATCOM 1-R	43, 47	TV, Internet for USA and the Caribbean			
137.00 W	USA	USASAT-22G	43, 47 ●	2000-054B	GE 7 = Americom 7	136.98W	C1
	USA	USASAT-22J	47	TV, Internet for USA and the Caribbean			
135.00 W	USA	GOES WEST	1-33	2000--022A	GOES 11	135.23W	C1
	USA	GOES WEST-1	17-35	Imager, radiometer, space env. monitoring, SARSAT			
	USA	USASAT-21A	43, 47 ●	2004-003A	GE 10 = Americom 10	134.99W	C1
				Distribution of TV programs in the US			
	USA	USGCSS PH3B E PAC	31-50	1997-065A	USA 134 Milit. comm.	135.1 W	C
134.00 W	USA	USASAT-11D	43, 47				
133.00 W	USA	USASAT-22A	43, 47 ●	2005-041A	Galaxy 15	133.00W	C1
				TV, Internet for USA, Alaska, Hawaii. Navigation.			
131.00 W	USA	USASAT-22H	43, 47 ●	2004-017A	GE 11 = Americom 11	130.99W	C1
				Distribution of TV programs in the US, Alaska, Hawaii			
130.00 W	USA	USGCSS PH3 E PAC-2	31-50	1995-038A	USA 113	130.2 W	C
	USA	USGCSS PH3B E PAC-2	31-50	Military communications			
	USA	USRDSS WEST	27				
129.00 W	USA	USASAT-24N	43-57 ●	1999-052A	Telstar 7=Intelsat Amer.11	128.99W	C1
	CAN	CAN-BSS 7		Distribution of TV programs			
				1999-050A	EchoStar 5	128.84W	C1
				Direct TV, HDTV, Internet to USA,Alaska,Hawaii,Portorico			
128.00 W	USA	ASC-1	43-57				
127.00 W	USA	USASAT-24O	43, 47	2003-044A	Galaxy 13 = Horizons-1	126.99W	C1
				HDTV, Internet to US,Alaska,Hawaii,Mexico, Portorico			
125.00 W				2003-013B	Galaxy 12 US,Alaska,Hawa	125.10W	C1
	USA	USASAT-22B	43, 47 ●	2005-030A	Galaxy 14	124.99W	C1
	HOL	NSS-10 BSS		TV, Internet to US, Alaska, Hawaii, Caribbean			
123.00 W	USA	USASAT-24P	43-57 ●	2000-002A	Galaxy 10R	122.99W	C1
	G	IOMBSS-2 123.50W		2007-016B	Galaxy 17 North America	123.02W	PL
				2008-024A	Galaxy 18	123.07W	PL
121.00 W	USA	USASAT-31G	67-78	2003-034A	EchoStar 9=Int.Amer.13	121.00W	C1
	PNG	PACSTAR-L4	43, 47	TV in USA, Alaska, Hawaii, Mexico, Central America			
120.00 W	USA	MILSTAR 6	31-84				
119.00 W	USA	USABSS-10 (BSS)	53, 54	2004-016A	Direc-TV-7S	119.14W	C1
				TV in USA, Alaska, Hawaii, Portorico, Virgin Islands			
	USA	USABSS-7	53	2002-006A	EchoStar 7	118.90W	C1
				Direct TV in cont. USA, Alaska, Hawaii			
118.70 W	CAN	ANIK E-D	43-57	2007-009A	Anik F3	118.69W	C1
	USA	USABSS-4 BSS 118.80W		Regional services in the N. American continent			
116.90 W	G	INTELSAT KA 243.1E	76-78				
116.80 W	MEX	MORELOS 2	43-57 ●	1998-070A	Satmex 5	116.69W	C1
				TV and data to N and S America			
115.00 W				2006-049A	XM Radio 4 (Blues)	114.99W	C1
				Radio transmission in digital quality			
114.90 W	CAN	ANIK D-2	43, 47				
113.50 W	MEX	MORELOS 1	43-57				
113.00 W	MEX	SOLIDARIDAD 2M	25-57	2006-020A	Satmex 6	113.07W	C1
	MEX	SOLIDARIDAD 2MA	25-57	Services for cont. US, NAFTA countries, Carib., S America			
	MEX	SOLIDARIDAD-2	43-57 ●	1994-065A	Solidaridad 2	113.19W	C1
	USA	USASAT-31T	78	Services for Central America, SW USA, W South America			
111.10 W	CAN	ANIK E-B	43-57	2006-054A	Wild Blue 1 Internet in US	110.92W	C1
		ANIK-F2	53	2004-027A	Anik F2	111.23W	C1
				Services in Canada, US, Hawaii, Caribbean			
110.20 W	USA	USABSS-6 (BSS)	53	2006-003A	EchoStar 10	110.19W	C1
				TV to networks in USA, Alaska, Hawaii,Portorico, Cuba			
				2000-038A	EchoStar 6	110.26W	C1
				Direct TV, Internet to US, Alaska, Hawaii, Portorico			
110,00 W	USA	USABSS-5 (BSS)	53	2002-039A	EchoStar 8	110.00W	C1
				TV and Internet in USA, Alaska, Hawaii, Portorico			
				2002-023A	Direc-TV-5	109.93W	C1
				TV in USA, Alaska, Hawaii, Portorico, Virgin Islands			
109.20 W	MEX	SOLIDARIDAD 1M	25-57				
	MEX	SOLIDARIDAD 1MA	25-57				
	MEX	SOLIDARIDAD-1	43-57				

107.30 W	CAN	ANIK E-A	43-57	●	2000-076A Anik F1	107.30W	C1
					Services in Canada, USA, Mexico, Hawaii, S America		
	CAN	ANIK-F1	52-57		2005-036A Anik F1R	107.29W	C1
					North American continent		
106.50 W	CAN	MSAT	25-57		1996-022A MSAT, i=0.49	106.49W	C2
	CAN	MSAT(30B)	52, 55				
105.00 W	USA	ATS-5	1-25		1967-111A ATS 3, i=10.27	105.30W	C2
	USA	FLTSATCOM-C E PAC-1	9-82		1995-057A USA 114 = UFO F6	105.9 W	C
					Military communications		
	USA	USASAT-23H	53,57		2004-041A Americom 15	105.01W	C1
	USA	USASAT-31K	68-78		TV in cont. USA, Alaska, Hawaii, Mexico		
					2006-018A GOES N	105.36W	C1
					Radiometer, Space Environment Monitor, etc		
					2006-054B AMC-18	104.94W	C1
					Services in USA, Mexico, Caribbean		
104.30 W		Inactive ?			1985-035A Gstar 1, i=9.47	104.34W	C2
103.00 W	USA	USASAT-24F	43-57	●	1996-054A Americom 1 = GE 1	103.01W	C1
	USA	USASAT-31L	76-78		Distribution of TV in North America		
102.80 W					2005-015A Spaceway 1	102.81W	C1
					HDTV in North America		
					2007-032A DirecTV 10	102.71W	C1
					Continental USA, Alaska, Hawaii		
101.20 W	USA	USABSS-1 (BSS)	53, 65		2001-052A DirecTV-4S	101.16W	C1
					TV in cont. USA, Alaska, Hawaii		
101.00 W	USA	ACS-1	25-27		1999-060A Americom 4 =GE 4	101.06W	C1
					Distribution of TV in North, Central, and South America		
	USA	USASAT-7D	43-57		1995-019A AMSC-1, I=3.15	100.95W	C2
	USA	USASAT-31M	43-57		2006-043A DirecTV-9S	101.11W	C1
	USA	USABSS-21 (BSS)			Distribution of TV in cont. USA, Alaska, Hawaii		
100.80 W	USA	USABSS-2 (BSS)	53, 65		2005-019A DirecTV-8	100.79W	C1
					Direct TV in cont. USA, Alaska, Hawaii, Portorico, Virgin I.		
100.00 W	USA	FLTSATCOM E PAC	9-50		1995-027A USA 111 = UFO F5	100.4 W	C
	USA	FLTSATCOM-B EASTPAC	72, 82		Military communications		
	USA	FLTSATCOM-C E PAC-2	9-82				
	USA	USRDSS CENTRAL	27				
99.00 W					2005-046B Spaceway 2	99.19W	C1
					HDTV for North America		
	USA	USASAT-24J	43-57	●	2006-023A Galaxy 16	98.99W	C1
					Services in USA, Canada, Alaska, Hawaii		
	USA	USASAT-31N	69-78		2008-013A DirecTV-11	97.86W	PL
					HDTV in USA		
98.00 W		Operatioonal lifetime 2010			1991-018A Inmarsat 2-F2, i=4.49	99.6 W	C2
97.00 W	USA	USASAT-24D	43-57	●	1997-026A Telstar 5=Intelsat Amer. 5	97.00W	C1
	USA	USASAT-6A	53, 57		Services in USA, Canada, Alaska, Hawaii, Mexico, Caribb.		
95.00 W	USA	COMSTAR D-2	43, 47		2007-036A Spaceway 3	94.91W	C1
					Internet in North and Central America, Hawaii, part S Amer		
	USA	USASAT-23F	52, 57	●	Galaxy 3C		
	USA	USASAT-24L	43-57	●	2002-030A Galaxy 3C	95.05W	C1
	USA	USASAT-6C	53, 57		Direct TV, Internet in North and South America		
93.50 W	USA	USASAT-12B	43, 47				
93.00 W	USA	USASAT-24S	43-57	●	1999-005A Telstar 6=Intelsat Amer. 6	93.02W	C1
					Services in USA, Alaska, Hawaii, Canada, Mexico, Carib.		
	USA	USASAT-24V	53		2008-016A ICO G1	92.82W	PL
					Mobile services for cont. USA, Portorico, Virgin Islands		
92.00 W	B	SBTS B4	43, 47		1998-016A Brasilsat B2 Moved in 2008	92.03W	PL
91.00 W	CAN	CANSAT KA-2	71, 78		1999-027A Nimiq 1 TV for Canada	91.11W	C1
	USA	USASAT-24K	43-57	●	1999-071A Galaxy 11	90.99W	C1
	CAN	BSS2X (BSS) at 91.10W			TV in North and Central America, Hawaii, Carib., Brasil		
	USA	USASAT-9A	53, 57		1993-078A DirecTV-1 Antennas 30 cm	91.14W	C1
90.00 W	USA	MILSTAR 1	31, 35		2003-012A USA 169 = Milstar-2F4	90.00W	C
	USA	USGAE-1	31-84		Military communications		
89.00 W	USA	USASAT-24E	43-57	●	2005-022A Telsar 8=Intelsat Amer. 8	89.00W	C1
	USA	USASAT-31S	71-78		Direct TV to North, Central, South America, Hawaii		
87.00 W	USA	SPACENET-3	43-57		1997-050A GE 3 = Americom 3	87.06W	C1
	USA	USASAT-24T	43, 53		Distribution of TV in North America		
85.00 W	USA	USASAT-3C	43, 47		1997-002A GE 2 = Americom 2	84.99W	C1
	USA	USASAT-24U	43, 53		Distribution of TV in North America		
	USA	USASAT-9C	53, 57		2004-048A AMC 16	85.00 W	C1
	USA	USASAT-31U	68-78		Distribution of TV in North America Alaska, Hawaii, Mexico		
		Direct radio in digital quality			2001-018A XM Radio 1 (Roll)	85.20W	C1
		Direct radio in digital quality			2001-012A XM Radio 2 (Rock)	85.23W	C1
		Direct radio in digital quality			2005-008A XM Radio 3 (Rhytm)	85.10W	C1
84.00 W	B	B-SAT P	43, 47	●	1998-006A Brasilsat B-3A	84.01W	C1
					Services in Brasil and MERCOSUL		
					2003-024A GE 12 = Americom 9	83.75W	C1
					Serviceas for USA, Canada, Mexico, Caribbean		

82.00 W	CAN		CANSAT KA-3	71, 78	2002-062A Nimiq 2 Sevices for Canada	82.00W	C1
	CAN		CAN-BSS1X (BSS)		1995-029A DirecTV-3 Antenna 30 cm	81.99W	C1
81.00 W	USA		USASAT-9D	53, 57	1990-091A SBS VI Moved here in 2008	80.93W	PL
					1996-033A Galaxy IX	80.98W	C1
79.00 W	USA		TDRS CENTRAL	33-59	1992-060B Satcom C-3, i=3.02	79.06W	C2
					Services in cont. USA, Alaska, Hawaii, Portorico		
	USA		TDRS-C2	33-59	1998-063B GE 5 = Americom 5	79.00W	C1
					Distribution of TV in cont. USA		
77.00 W	MEX		QUETZSAT-77 (BSS)		1998-028A EchoStar 4, i=0.46	76.98W	C2
	MEX		MEX-TVD1 (BSS) at 76.80		TV, Internet in cont. USA, Alaska, Hawaii		
	USA		USASAT-24Q	43-59	2000-020A Galaxy IV R, i=1.32	76.85W	C2
76.00 W	USA		USASAT-12C	43, 47			
75.00 W	USA		GOES EAST	17-33	2001-031A GOES 12, i=0.46	75.00W	C2
	USA		GOES-EAST-1	17-35	Imager, radiometer, Space env. monitoring, SARSAT		
			Services in Brasil and MERCOSUL		1994-049A Brazilsat B1, I=0.79	75.01W	C2
74.00 W	USA		USASAT-15B	53, 57	2007-063B Horizons 2	74.07W	PL
	USA		USASAT-22E	43, 47	Services in cont. USA, SE Canada, Caribbean		
	USA		USASAT-35V	43-57			
72.50W	CAN		CAN BSS 3 at 72.70W		1999-056A DirecTV-1R Direct TV	72.50W	C1
72.00 W	ARG		NAHUEL-C	52-57 ●	1997-002B Nahuel 1A, I=0.40	71.82W	C2
					Direct TV in South and Central America		
	USA		USASAT-8B	43, 47	2000-067A GE 6 = Americom 6	72.00W	C1
					Direct TV, Internet in North and Central America		
70.00 W	B		SBTS B1	43, 47	2000-046A Brasilsat B4	70.01W	C1
	B		SBTS C1	52-57	Services in Brasil and MERCOSUL		
	B		SISCOMIS-3	49, 50	2008-018B Star One C2	70.05W	PL
	USA		USRDSS EAST	27	Services for Latin America, milit. communications		
68.00 W	USA		MILSTAR-8	31-84			
65.00 W	B		SBTS B2	43, 47 ●	2007-056A Star One C1	64.98W	PL
	B		SBTS A2	43, 47	To replace Brazilsat 2		
	B		SISCOMIS-2	49, 50			
63.00 W	B		B-SAT E	43, 47 ●	2004-001A Estrela do Sul 1	63.05W	C1
	B		B-SAT I	52-57	Brasil, S. America, Internet in airplanes in N. Atlantic		
62.00 W	USA		TDRS 62W	33-59	2002-011A TDRS 9, i=3.61	62.26W	C2
					Satellites in LEO, Space Shuttle, ISS		
61.50 W	USA		USABSS-8 (BSS)	53, 54	2003-033A Rainbow 1=Cablevision 1	61.65W	C1
					1997-059A EchoStar 3	61.48W	C1
					TV, Internet in cont. USA, Alaska, Hawaii		
61.00 W	B		B-SAT-Q	53 ●	2004-031A Amazonas	61.02W	C1
	B		SBTS B3	43, 47 ●	Amazonas		
	F	EUT	EUTELSAT EXB-64W	52, 55	Services in Spanish and Portuguese in Americas,		
	F	EUT	EUTELSAT EXB-64W C	43, 48	Caribbean, W. Europe		
	USA		USMB-1	35			
60.00 W			Operational		1997-019A GOES 10, i=2.27	59.79W	C2
					Imager, Radiometer, Space Env. Monitoring, X Ray Sensor		
58.00 W	USA		USASAT-26G(30B)	52, 55	2000-043A PAS 9	58.00W	C1
	USA		USASAT-25G	43, 47	Direct TV, Ir nternet in Americas, Caribbean, W Europe		
	USA		USASAT-26G	52-57			
55.50 W	USA		INTELSAT5A 304.5E	43-57			
	USA		INTELSAT7 304.5E	45-53			
	USA		INTELSAT8 304.5E	43-57 ●	1996-037A Intelsat 805	55.50W	C1
	G		INTELSAT KUEXT 304.5	(BSS)			
55.00 W	G		INMARSAT-2 AOR WEST	25-47			
	G		INMARSAT-3 AOR WEST	25-47			
54.00 W	G		INMARSAT-3 AORWEST2	25-47			
53.00 W	USA		INTELSAT IBS 307E	43-57			
	USA		INTELSAT5A CONT1	43-57			
	USA		INTELSAT7 307E	43-57 ●	1996-015A Intelsat 707 = VIIA F-2	53.00W	C1
	USA		INTELSAT8 307E	43-57			
					2005-044A Inmarsat 4F2, i=2.51	52.76W	C2
52.50 W	USA		USGCSS PH3B W ATL	31-50	2003-040A USA 170	52.7 W	C
50.00 W	USA		INTELSAT5A CONT2	43-57			
	USA		INTELSAT7 310E	43-57 ●	1995-013A Intelsat VII F-5 = 705	50.10W	C1
49.00 W	USA		TDRS 49W	33-59	1983--026B TDRS EAST, i=12.91	48.88W	C2
					1994-084A USA 107 = DSP F17	49.4 W	C
					Military communications		
47.00 W	USA		USASAT-25E	43, 47			
46.00 W	USA		TDRS 46W	33-59	1989-021B TDRS 4, i=9.30	45.92W	C2
					Intersatellite, Intercontinental services		
45.00 W	USA		USASAT-13I(30B)	52, 55	Below: Services in Americas, Caribbean, Europe, Africa		
	USA		USASAT-13I	43-57 ●	2000-072A PAS 1R = Intelsat 1R	45.01W	C1
	USA		USASAT-13I-2	52, 57 ●	PAS 1R = Intelsat 1R		
	USA		USASAT-25D	43-53 ●	PAS 1R = Intelsat 1R		
43.00 W	USA		USASAT-25C	43, 47 ●	1996-002A PAS 3R = Intelsat 3R	43.01W	C1
	USA		USASAT-26C	53-57 ●	PAS 3R = Intelsat 3R		
					Direct TV in Americas		
					1998-075A PAS 6B = Intelsat 6B	43.16W	C1
					Direct TV in S. America		
					2007-044B Intelsat 11	43.19W	C1
42.50 W	USA		USGCSS PH3 MID-ATL	31-50			
	USA		USGCSS PH3B MID-ATL	31-50			

41.00 W	USA		TDRS EAST	33-59		2002-055A TDRS 10, i=2.45	40.84W	C2
						Intersatellite comm. with LEO, Space Shuttle, ISS		
40.50 W	HOL		INTELSAT IBS 319.5E	43-57				
	HOL		INTELSAT K 319.5E	53, 57				
	HOL		INTELSAT5A 319.5E	43-57				
	HOL		INTELSAT7 319.5E	43-57				
	HOL		INTELSAT8 319.5E	43-57	●	1998-014A Intelsat 806 = NSS 806	40.50W	C1
	MCO		MCO-BSS-40.5W					
39.00 W	G		DJCF-2A	23-54		1994-009A USA 99 = Milstar DFS-1	38.8 W	C
						Military communications		
						1991-080B USA 75 = DSP F16	38.9 W	C
						Early warning, radiation detection, plasma analyser		
38.00 W	USA		USGON-5	35				
37.50 W	USA		USASAT-25A	43, 47	●	2005-003A Americom 12=Worldsat 2	37.40W	C1
						Services in Americas, Europe, Africa		
	USA		USASAT-26A	52-57	●	1994-079A Telstar 11=Orion 1, i=3.44	37.53W	C2
						Data e-mail in N America, Europe, N Africa		
34.50 W	USA		INTELSAT6 325.5E	43-57				
	USA		INTELSAT7 325.5E	43-57				
	USA		INTELSAT8 325.5E	43-52	●	2002-016A Intelsat 903	34.51W	C1
34.00 W	G		SKYNET-4D	9-82	●	1998-002A Skynet 4D, i=4.26	34.21W	C2
	G		UKDIGISAT-4A (BSS)at 33.50W			Military communications		
	G		SKYNET-4M	35-50		2001-005B Skynet 4F, i=2.47	33.94W	C2
						Miliitary communications		
31.50 W	USA		INTELSAT8 328.5E	43-57	●	1997-009A Intelsat VIII F-1 = 801	31.50W	C1
31.00 W	USA		INTELSAT5A ATL6	43-57				
30.00 W	E		HISPASAT-1 (and BSS)	33-57	●	Hispasat 1C		
	E		HISPASAT-1C	52, 55	●	2000-007A Hispasat 1C	30.04W	C1
	E		HISPASAT-2A KU	54, 57		Services in Spanish in Europe, Central and S. America		
	E		HISPASAT-2A X	49, 50		2006-007A Spainsat	29.99W	C1
	E		HISPASAT-2AKA	67-78		Services for gov.,military, police, NATO		
	E		HISPASAT-2B 30KA	72, 79				
	E		HISPASAT-2B KU	52, 57				
	E		HISPASAT-2C3 KU	52-57	●	Hispasat 1C		
	E		HISPASAT-2D KU	52-57	●	2002-044A Hispasat 1D	29.99W	C1
	E		HISPASAT 2U3 (BSS)			Services in Spanish in Europe, Central and S. America		
	USA		USCID-E4	66-79				
	USA		USGGR-3	23, 26				
	USA		USMB-2	35				
29.50 W	USA		INTELSAT6 330.5E	43-57				
	USA		INTELSAT8 330.5E	43-57				
27.50 W	USA		INTELSAT6 332.5E	43-57				
	USA		INTELSAT7 332.5E	43-57				
	USA		INTELSAT8 332.5E	43-57	●	2003-007A Intelsat 907	27.46W	C1
26.50 W	URS		GALS-1	49, 50				
	RUS		STATSIONAR-17	43, 47				
	RUS		STATSIONAR-D1	49, 50				
	RUS		STATSIONAR-D1-30B	43				
	RUS		VOLNA-13	9-13				
	RUS		TOR-1M	67-82				
	G		DJCF-2B	23-54				
25.00 W	RUS		GALS-9	49, 50				
	RUS		STATSIONAR-8	43, 47				
	RUS		TOR-9M	67-82				
	RUS		VOLNA-1A	9-13				
24.50 W	USA		INTELSAT6 335.5E	43-57				
	USA		INTELSAT7 335.5E	43-57				
	USA		INTELSAT8 335.5E	43-57	●	2002-027A Intelsat 905	24.52W	C1
24.00 W	F	EUT	EUTELSAT EXB-24W	52, 55				
	F	EUT	EUTELSAT EXB-24W C	43, 48				
	RUS		PROGNOZ-1	33-42				
	USA		USCID-E3	66-79				
23.00 W	USA		FLTSATCOM ATL	9-50		1996-042A USA 127 = UFO F7	23.3W	C
						Military communications		
22.50 W	USA		FLTSATCOM-B EAST ATL	72, 82				
	USA		FLTSATCOM-C E ATL-1	9-82				
	USA		KASATCOM-2	72, 79				
21.50 W	HOL		INTELSAT K 338.5E	52-57		2002-019A NSS-7	21.96W	C1
	HOL		INTELSAT5A 338.5E	43-57		Services for Americas,Europe,Africa, Near and Middle East		
	HOL		INTELSAT7 338.5E	43-57				
	HOL		INTELSAT8 338.5E	43-57				
20.00 W	USA		INTELSAT6 340E	43-57		1990-021A Intelsat 603, i=5.05	19.94W	C2
	USA		INTELSAT7 340E	43-57				
	USA		INTELSAT8 340E	43-57				
19.00 W	USA		USMB-3	35		1996-026A USA 118 = Mercury 2	20.7 W	C
18.00 W	F	EUT	EUTELSAT EXB-18W	52, 55				
	F	EUT	EUTELSAT EXB-18W C	43, 48				
	F	EUT	EUTELSAT B-18W (BSS)					
	USA		INTELSAT IBS 342E	43-57				
	USA		INTELSAT5A 342E	43-57				
	USA		INTELSAT7 342E	43-57				
	USA		INTELSAT8 342E	43-57	●	2001-024A Intelsat 901	18.00W	C1
	BEL		SATCOM PHASE-3	49, 50				
17.80 W	BEL		SATCOM 4	49, 50		2008-030A Skynet 5C	17.78W	Enc

17.00 W	G		INMARSAT-3 AOR EAST2	25-47				
16.00 W	RUS		WSDRN	43-59				
	RUS		ZSSRD-2	43-59				
	RUS		ZSSRD-2 (30B)	52				
15.50 W	USA		FLTSATCOM-C E ATL-2	9-82	1989-077A	USA 46 = Fltsatcom F8	16.0 W	C
	G		INMARSAT-2 AOR EAST	25-47	Military			
	G		INMARSAT-3 AOR EAST	25-47 ●	1996-053A	Inmarsat 3-F2	15.49W	C1
15.00 W	USA		USASAT-14L	52-57 ●	1999-059A	Telstar 12 = Orion 2	15.00W	C1
					TV and data in East USA, S. America, Europe, Middle East			
14.80 W	F	EUT	EUTELSAT-KA-14.8W	76-78				
14.50 W	RUS		GOMS-1M	17-77				
14.00 W	RUS		EXPRESS-2	43-57 ●	2002-029A	Ekspress A1R	14.00W	C1
	RUS		STATSIONAR-4	43, 47	Distribution of TV, data, Internet			
	RUS	IK	STATSIONAR-4A	43, 47				
	URS		LOUTCH-1	52, 57 ●	1996-034A	Gorizont 32, l=8.17	14.20W	C2
	URS		VOLNA-2	25-27 ●	Services in Russia, CIS, system Loutch, Volna			
13.50 W	RUS		FOTON-1	43, 47				
	RUS		POTOK-1	43, 47				
13.00 W	USA		P-197-4	31, 35				
	USA		P92-4	31, 35				
	USA		USCSID-E2	79				
12.50 W	F	EUT	EUTELSAT-3-12.5W	33-57	2002-040A	Atlantic Bird 1	12.48W	C1
	F	EUT	EUTELSAT EXB-12.5W	52, 55	Direct TV, phone, data, Internet for Europe, N and S Amer.			
	F	EUT	EUTELSAT-KA-12.5W	76-78				
	USA		USLL-ATL2	84				
12.00 W	USA		USGCSS PH3B ATL	31-50	2000-065A	USA 153 Military Comm.	12.1 W	C
	F	EUT	EUTELSAT B-12W (BSS)					
11.00 W	RUS		EXPRESS-3	43-57 ●	2000-031A	Ekspres 3A	11.0W	C1
	URS		LOUTCH-6	52, 57	Regional distribution of TV, data incl. Internet			
	URS		STATSIONAR-11	43, 47				
	F		F-SAT 2	54, 57				
10.00 W	F	ESA	MSG-S2	33, 35				
	USA		P-197-5	31, 35				
	USA		P92-3	31, 35				
	USA		USCSID-E1	66-79	2000-080A	USA 155	10.1 W	C
	USA		USLL-ATL	84	Probably military communications			
	USA		USMB-4	35				
9.50 W	RUS		KUPON-3	52, 57				
8.00 W	F		TELECOM-2A	33-57				
	F		TELECOM-30B	52, 55	1996-044B	Telecom 2D, i=1.53	7.90W	C2
	F		TELECOM-3A	43, 47	Phone, TV., gov. communications			
	F		VIDEOSAT-6	33-57 ●	2001-042A	Atlantic Bird 2	8.08W	C1
	F		SYRACUSE-3C	33-82	Services for Americas, Europe, N. Africa, Middle East			
	F		RADIOSAT-6C (BSS)					
7.00 W	F		GEOSAT-30B	52, 55	1998-013A	Hot Bird 4=Atlantic Bird 4	7.18W	C1
	F		TELECOM-4D	43-48	Regional services in Europe			
	EGY		NILESAT-102 (BSS)		2000-046B	Nilesat 102	6.99W	C1
	F		RADIOSAT-5C (BSS)		1998-024A	Nilesat 101	6.97W	C1
	F		F-SAT-E-BSS-7W		Both sat. services for N. Africa, Near East			
5.00 W	F		SyRACUSE-3E	33-82	2006-033B	Syracuse 3B	5.19W	C1
	F		TELECOM-2B	33-57	Military comm. for France and NATO			
	F		TELECOM-3B	43-48 ●	2002-035A	Atlantic Bird 3	5.01W	C1
	F		VIDEOSAT-7	33-57 ●	TV, radio and Internet in Europe, Africa,M. East, Americas			
4.00 W	ISR		AMOS 1-B	52, 57	1996-030B	AMOS 1	3.99W	C1
	ISR		AMOS-II 4W	52, 55	2003-059A	AMOS 2	3.99W	C1
	NOR		BIFROST-4W-BSS		2008-021A	AMOS 3	2.45W	PL
	HNG		CERES-1	52, 55	TV, data in Middle East, Central Europe			
	F		RADIOSAT-4C (BSS)					
3.50 W			Standby for Meteosat 9		2002-040B	MSG 1=Meteosat 8,i=0.44	3.46W	C2
3.00 W	RUS		GALS-11	49, 50				
	RUS		STATSIONAR-M2	52, 57				
	RUS		TOR-11M	67-82				
	BLR	IK	INTERSPUTNIK-3W	43-57				
	BLR	IK	INTERSPUTNIK-3W-Q	43-57				
1.00 W	USA		INTELSAT5A CONT4	43-57				
	USA		INTELSAT7 359E	43-57				
	USA		INTELSAT8 359E	43-57 ●	2004-022A	Intelsat 10-02	0.97W	C1
	G		SKYNET-4A	9-82	1990-079A	Skynet 4C, i=8.67 Military	1.00W	C2
	G		SKYNET-4J	31, 35	2007-007B	Skynet 5A Military comm.	1.10W	C1
0.80 W	NOR		BIFROST (and BSS)	57	2008-006A	Thor 5 Scandinavia, W Eur	0.62W	PL
	NOR		BIFROST-2-FSS	52, 55	1997-025A	Thor II	0.74W	C1
	NOR		BIFROST-3-FSS	52, 55	1998-035A	Thor III	0.84W	C1
	NOR		BIFROST-BSS-0.8W-NOR		Both sat. for Scandinavia, Greenland, N. E. Europe			
	NOR		BIFROST-19 (BSS)					