Commercial Space Transportation

QUARTERLY LAUNCH REPORT

Featuring the launch results from the previous quarter and forecasts for the next two quarters.

3rd Quarter 1996

United States Department of Transportation • Federal Aviation Administration

Office of the Associate Administrator for Commercial Space Transportation

3RD QUARTER REPORT

Objectives

This report summarizes recent and scheduled worldwide commercial, civil, and military orbital space launch events. Scheduled launches listed in this report are vehicle/payload combinations that have been identified in open sources, including industry references, company manifests, periodicals, and government documents. Note that such dates are subject to change.

This report highlights commercial launch activities, classifying commercial launches as one or more of the following:

- ***Internationally competed launch events (i.e., launch opportunities considered available in principle to competitors in the international launch services market),***
- ***Any launches licensed by the Office of the Associate Administrator for Commercial Space Transportation of the Federal Aviation Administration under U.S. Code Title 49, Section 701, Subsection 9 (previously known as the Commercial Space Launch Act), and***
- ***Certain European launches of post, telegraph and telecommunications payloads on Ariane vehicles.***

Photo credit: McDonnell Douglas (1996). Image is of the Delta II launch on May 23, 1996 from Cape Canaveral Air Station. It successfully orbited a Galaxy IV communications satellite for Hughes Communications, Inc.

CONTENTS

This document was prepared by Futron Corporation and was released on July 24, 1996

SUMMARY

Second Quarter 1996 Launch Events

- The United States launched all of its major vehicles: two Atlas, two Delta, two Titan 4, and two Shuttle launches as well as a Pegasus air-dropped launch. All, including four commercial launches, succeeded.
- Russia/CIS successfully launched a Cosmos SL-8 but failed in two of three Soyuz SL-4 launch attempts. Three Proton rockets (two SL-12 and one SL-13) orbited their payloads, including SES' Astra 1F TV satellite. This was the first launch of a commercial payload on a Proton, notable because the decline in state-sponsored launches has led the former Soviet space industry to seek commercial markets.
- Europe suffered a major setback when the first launch of the Ariane 5 failed, destroying four scientific satellites. At 30 seconds into the vehicle's inaugural flight its on-board computer directed it into a hard turn in response to incorrect information on attitude. The vehicle started to break up and was destroyed by automatic safety systems. The second Ariane 5 launch has been moved to early 1997 while this problem is resolved. The Ariane 4 performed well, however, with three successful launches.
- China made no launch attempts as it worked to rebuild satellite industry confidence in Long March rockets following its failure in February 1996.

Third and Fourth Quarter 1996 Scheduled Launch Events

- The United States plans 22 launches, nine commercial. Pegasus will launch five times. Lockheed Martin will try again after its August 1995 failure of the Lockheed Martin Launch Vehicle (LMLV), this time launching NASA's Clark satellite. Three Shuttle launches are planned but solid rocket booster burn-through problems may extend this schedule.
- Russia/CIS will conduct 16 launches, one of them a commercial Proton SL-12. This is a reduction from earlier projections. Financial instability in the Russian space industry has resulted in many plausible project announcements with fewer actual deployments.
- Two Long March vehicles will carry local payloads.
- Six Ariane 4 vehicles will launch, all commercial. No Ariane 5 launches are planned for this period.

SUMMARY

Commercial Products and Services
Second Quarter 1996

Two commercial U.S. payloads planned for the next two quarters reflect the emergence of a new commercial space market -- LEO satellite communications -- and expaned U.S. involvement in commercial remote sensing.

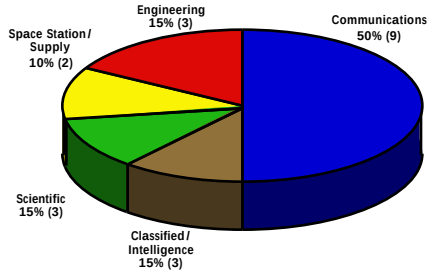
Earlybird

EarthWatch, Incorporated of Longmont, CO will launch the world's first wholly commercial high-resolution imaging satellite. The Earlybird satellite will capture digital imagery that is 11 to 100 times more detailed than that of current commercial satellite systems. These new images of the earth's surface will be archived in EarthWatch's Digital Globe™, a three-dimensional geographic database that will contain digital satellite imagery, aerial photography, terrain models, and perspective views of the entire earth.

Iridium 1, 2, 3 (Delta 2 7925)

The Iridium system, currently in manufacture by an international team of aerospace and electronics companies led by Motorola, Inc., will let users communicate worldwide using hand-held wireless telephones. Intended to be as simple to use as contemporary wireless telephones, the Iridium Subscriber Unit (ISU) will communicate directly with the system's constellation of 66 interconnected low earth orbit satellites. These satellites will route voice, data, and fax signals from cell phones, through the satellite network, to a ground based tracking station. The actual Iridium Phone weighs only 6 ounces and can contact any other Iridium Phone on the planet, as well as interface into existing phone systems via tracking station.

Payload Use Analysis
Third and Fourth Quarter 1996



For the period of April through June, the second quarter of 1996, the types of payloads launched were communications (50%), scientific (11%), intelligence (11%), engineering (17%), and space station supply (11%).

When only commercial launches are considered, communications satellites make up 78% of payloads. The remaining satellites perform scientific and engineering test functions.

LAUNCH SCHEDULE

Scheduled Launch Events

Vehicle	Payload	Site
JULY 1996		
DC-XA* (twice)	None	White Sands
Long March 3B	ChinaSat 7	Xichang
Molniya SL-6	Molniya 3-48	Plesetsk
TBA	Kosmos 96-07	
Pegasus XL	TOMS 1	VAFB
Titan 4	Classified USA-125	CCAS
Long March 2E	APStar 1A	Xichang
Ariane 44L	Arabsat 2A	Kourou
	Turksat 1C	
Delta 2 7925	Navstar GPS 2-26	CCAS
Soyuz SL-4	Progress M-32	Tyuratam
Atlas 2	UFO 7	CCAS
AUGUST 1996		
Ariane 44L	Italsat F2	Kourou
	Telecom 2D	
Soyuz SL-4	Soyuz TM-24	Tyuratam
Pegasus XL	FAST	VAFB
H2	ADEOS 1	Tanegashima
Atlas 2A	GE 1	CCAS
Cosmos SL-8	Unamsat B	Plesetsk
Delta 2 7925	Navstar GPS 2R- 1	CCAS
Molniya SL-6	Magion 5	TBA
	Prognoz Interbal-A	
TBA	Kosmos 96-08	
TR-1A*	None	Tanegashima
SEPTEMBER 1996		
Cosmos SL-8	Bion 11	Plesetsk
Shuttle Atlantis	STS 79	KSC
Soyuz SL-4	Progress M-33	Tyuratam
Ariane 4	Echostar 2	Kourou
Pegasus	Minisat 01	Spain
TBA	Kosmos 96-09	

* Denotes a suborbital launch

LAUNCH SCHEDULE

Scheduled Launch Events

Continued

Vehicle	Payload	Site
OCTOBER 1996		
Titan 4/Centaur	DSP-19	CCAS
Ariane 44LP	Insat 2D	Kourou
	Measat 2	
Atlas 2A	Hot Bird 2	CCAS
TBA	Kosmos 96-10	
Shuttle Columbia	STS 80	KSC
	ORFEUS SPAS 2	
HyFlyer*	None	VAFB
NOVEMBER 1996		
Ariane 4	PAS 6	Kourou
TBA	Kosmos 96-11	
LMLV	Clark	VAFB
Pegasus XL	SWAS	Wallops Island
Taurus 1	Geosat	VAFB
Delta 2	Iridium 1	VAFB
	Iridium 2	
	Iridium 3	
Proton SL-12	Mars 96	Tyuratam
Delta 2 7925	Mars Global Surv.	CCAS
DECEMBER 1996		
Proton SL-12	Tempo 2	TBA
TBA	Kosmos 96-12	
Pegasus XL	HETE	Wallops Island
	SAC B	
Delta 2 7925	Mars Pathfinder	CCAS
Zenit SL-16	Progress M-34	Tyuratam
Atlas 2	Inmarsat 3 F3	CCAS
Shuttle	STS-81	KSC

* Denotes a suborbital launch

LAUNCH SCHEDULE

Additional Launch Events to be Announced†

For the Third and Fourth Quarter of 1996

Vehicle	Payload	Site
FOURTH QUARTER OF 1996		
HyFlyer*		VAFB
Texus*		Esrange
TBA	Earlybird One	TBA
MSLS A*	None	VAFB

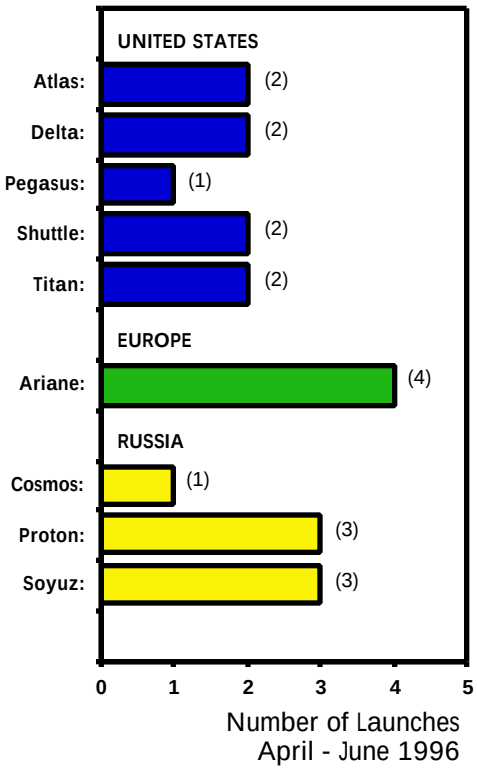
† This section summarizes launches and payloads that are expected to occur during the next two quarters. Exact launch dates were not available prior to publication of this report

* Denotes a suborbital launch

LAUNCH REPORT

Launch Events

Second Quarter
1996



Only the United States, Europe and Russia/CIS launched payloads in the second quarter of 1996. Of these three only the United States was fully successful, with nine total launches and four commercial launches. The United States launched two civilian communications satellites, Inmarsat 3 F1 and Galaxy 9. It also placed the Italian/Dutch Satellite per Astronomia a raggi X (SAX) science satellite in orbit. U.S. science missions were carried on two shuttle missions. One was a microgravity spacelab and the other carried an inflatable antenna experiment (IAE), a new satellite stabilization design, and further microgravity experiments. In the military sphere, two experimental military satellites, MSX, and MSTI 3 were orbited. Beyond these were two classified military satellites launched on Titan 4 launch vehicles, the second of which also carried three small satellites with it.

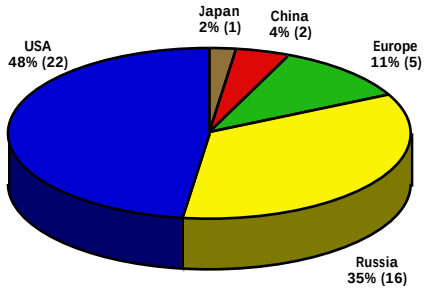
In contrast to the success experienced by the U.S. launch industry, the record of Russia/CIS was decidedly mixed. Two out of three attempts to launch the Soyuz SL-4 failed with the loss of the Spin 2 and Kosmos earth resources/photo reconnaissance satellites. Mir operations went well, however, with the successful launch of both the Progress M-31 supply ship (using the first SL-4 of the quarter) and also the Priroda Mir module, the last planned addition to Mir. Other successes included the launch of the Gorizont 32 geosynchronous communications satellite and the military Kosmos 2332. Perhaps most important to the future of the Russia/CIS space program was the first successful commercial launch of a Proton SL-12 carrying the Astra 1F direct broadcast satellite for SES of Luxembourg.

Europe also suffered a major failure in this quarter when the first Ariane 5 failed on launch. Along with it were lost the four Cluster scientific satellites, reportedly launched at a low price. Further Ariane 5 flights have now been pushed into 1997. In contrast to the Ariane 5, Ariane 4s had a flawless record orbiting 4 satellite in three launches. These consisted of MSAT-1, AMOS 1, Palapa C2, and Intelsat 709. All of these were geosynchronous communications satellites.

LAUNCH REPORT

Scheduled Launch Events

Third and Fourth Quarter 1996



Scheduled Launch Events, by Region
July - December 1996

In the third and fourth quarter of 1996 a little under half of projected launches, 22 in all, are on U.S. launch vehicles. Another 16 will be launched by Russia/CIS. Europe will conduct five and the remaining three will be conducted by China (two) and Japan (one).

The Russian Republic/CIS will once again be second to the United States in number of launches. The United States will launch many more commercial payloads (five) than Russia/CIS (one). For Russia/CIS, this payload is an Echostar DBS satellite. The United States will launch the first three Iridium communications satellites as well as four commercial geosynchronous satellites and a small earth observation satellite. The United States also has nearly twice as many science payloads (eight) as Russia (four) including six scientific satellites on five Pegasus launches. Both nations will be launching Mars probes in this period (the United States will launch two). Military flights continue with a planned six for the United States and an uncertain number for Russia/CIS. Both nations will also continue crewed spaceflight efforts with three shuttle missions and four Mir support flights respectively.

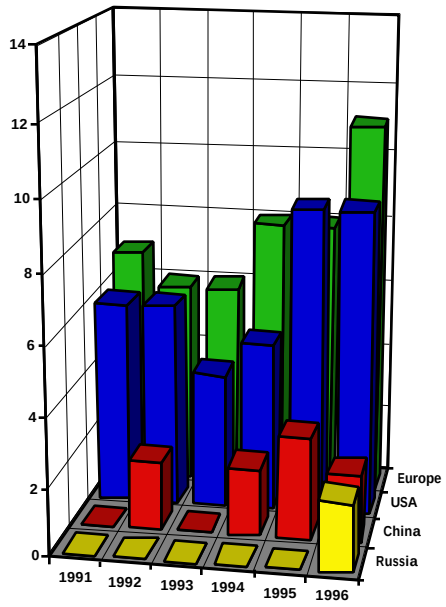
Japan plans to launch ADEOS 1 on its H2 rocket mid-way through the third quarter and China has two Long March launches planned.

Europe will continue its commercial operations with six launches of nine separate satellites.

LAUNCH REPORT

Scheduled Commercial Launch Events

Third and Fourth Quarter 1996



Commercial Launch Events
January 1991 - December 1996
(Small Vehicles Excluded)

The commercial launch marketplace can be largely described as undergoing rebirth in the second half of 1996. All of the major commercial space powers have launch systems returning to service (with the exception of Europe, which hopes to achieve this status for the Ariane 5 in 1997). In the case of the Russian Republic/CIS, a commercial launch market is just now being born.

In the United States, Orbital Sciences Corporation (OSC) is returning to the commercial launch marketplace in force with five Pegasus and Pegasus XL launches. OSC is also planning the second launch of its Taurus launch vehicle.

The first flight of the Lockheed Martin Launch Vehicle (LMLV) was a failure but Lockheed Martin intends to return with an LMLV launch this Fall.

EarthWatch Inc., hopes to launch a commercial earth observation satellite by the name of Earlybird before the end of 1996. This was the first such commercial system licensed by the Department of Commerce in June of 1994.

In China, the China Great Wall Industry Corporation has plans to return its Long March vehicle to commercial operations. The first attempt will be to launch the APStar 1A. This satellite belongs to the APT Satellite Co. Ltd. in which China is an investor. The second attempt will be the launch of the Hughes built ChinaSat 7 belonging to the China Telecommunications Broadcast Satellite Co. These flights, if successful, should return the Long March to competition for foreign launches.

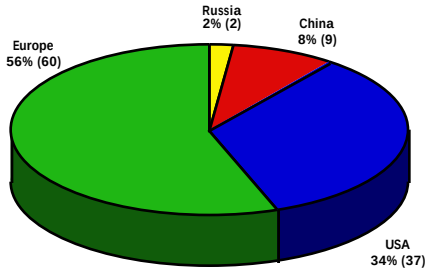
The Russian Republic/CIS has its best chance to enter the commercial launch market with its Proton SL-12. Handled commercially by International Launch Services (ILS), this booster will launch Tempo 2 into a geosynchronous orbit at the end of the year.

McDonnell Douglas continues to launch its Delta 2 with five flights scheduled for the next two quarters. Of these, one is a commercial Iridium launch, three are military, and two are the Mars planetary probes for NASA.

Lockheed Martin will launch four communications satellites before the end of the year. These satellites, GE-1, Hot Bird 2, UFO-7, and Inmarsat 3 F3 will all be launched into geosynchronous orbit on Atlas 2 variants.

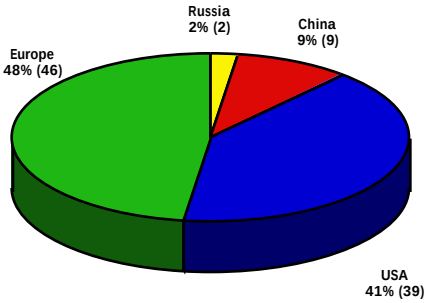
LAUNCH REPORT

Commercial Launch Trends



Commercially Launched Payloads
Market Trend
January 1991 - December 1996

(Small Vehicles Excluded)



Commercial Launch Market Trend
January 1991 - December 1996

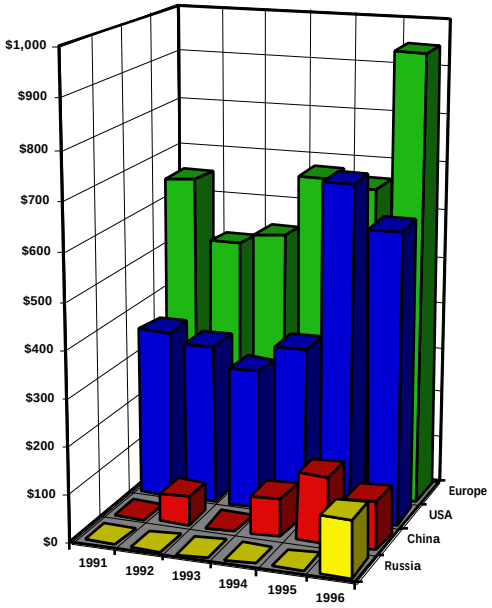
(Small Vehicles Excluded)

Over the past six years (1991through1996) the largest share of the commercial launch market has gone to Arianespace's Ariane rockets. Measured by launches over this period, they hold a 48% share of the market while, by payloads delivered to orbit, they hold a 56% share. (The share for payloads is higher than the share for launches because Arianes often launch multiple payloads). The European share is higher than that projected in the second quarter of this year. However, the current projections will fall if the Ariane 4 suffers any major delays. The Russian/CIS share has increased (slightly) and the United States and China have both seen market share lost to the Ariane.

It should be noted that there has been an increase in U.S. launches of small launchers, which not covered in these figures. The ability of U.S. satellite builders such as CTA Space Systems and Orbital Sciences Corporation (OSC) to produce small satellites with high capabilities is helping to fragment the launch field. New types and sizes of payloads are bringing with them the possibility of a more dynamic launch market in the future.

LAUNCH REPORT

Commercial Launch Revenues



Commercial Launch Revenues by Region (in U.S. $ Millions)*

January 1991 - December 1996

* Approximate revenues based on actual price quotes and historical price averages. Figures shown in constant 1994 dollars.

The total 1996 launch service revenues projected for U.S., European, Russian/CIS, and Chinese scheduled launches will amount to $1,792 million. Of this total, the largest amount (53% or $951 million) will go to European companies. U.S. companies will get 35% or $619 million while Russian and Chinese launch service providers will split the remainder with 7% or $120 million for Russia/CIS and 6% or $102 million going to China. This distribution is a change from previous years and results, in part, from 11 Ariane 4 launches in 1996. As of this writing, Ariane is still on track to make this unprecedented number which will call for a launch rate of one per month for the rest of 1996.

1996 is a down year for the Chinese who are suffering from the results of two consecutive Long March failures. Russia/CIS on the other hand, is just beginning to build a commercial launch business. Their great advantage is the excellent reliability of their launch vehicles, demonstrated over decades of use, and current advantageous pricing.

GEO Satellite Markets and Functions

The information revolution has transformed telecommunication markets. The explosive demand for global communication has spawned accelerating technical innovation and fierce competition for telecommunication revenues. Deregulation of telecommunications in the U.S. and in other countries combined with advances in technology have contributed to enhancements in computer capability and affordability, an explosion in use of the Internet, and the wide availability and use of mobile phones, facsimile machines, smart pagers, and other electronic communication tools.

Satellites in geosynchronous orbit (GEO) are a vital link in the world's telecommunication infrastructure. This Special Report summarizes the functions of satellites in geosynchronous orbit and describes the current satellite population in terms of the markets it serves.

Table 1. GEO Satellite Services, Markets, and Functions

GEO Satellite Communication Services	Markets
Telephone	International Relay
	Intra-national Relay
	Mobile Telephone Services
Television	Broadcast and Cable Relay
	Direct-to-Home Television Services
	Direct Radio Services
Data Communications	Personal/Mobile, VSAT, Broadband Data Communications Services
GEO Satellite Government-Dedicated Functions	
Military Intelligence	
Military Communications	
Civil Meteorological	
Civil Technology Research	
Civil Scientific	

GEO Satellite Functions

Geosynchronous orbit (GEO) is the orbit at 22,282 miles above the Earth in which a satellite completes its orbit in 24 hours -- the period of the Earth's rotation. Geosynchronous orbit is advantageous for communication services because satellites in GEO can always "see" their ground stations and just three satellites can provide coverage of most of the globe. More than 500 GEO satellites have been launched since the first geosynchronous satellite launch of Syncom 1 in 1963.

GEO satellites provide several different kinds of telephone, television, radio, and data communication services. They are also used by governments for military, weather, and science applications. GEO satellite functions are listed in Table 1.

Telephone Services

GEO satellites relay telephone signals via the terrestrial telephone network and also provide phone-to-satellite mobile telephone services.

- International and Intra-national Telephone Relay. GEO satellites relay telephone calls across oceans or large land masses that lack terrestrial telephone line infrastructure. Today, most satellite relay of international telephone calls is provided by the international organization, Intelsat. Additional intra-national telephone relay is provided by satellites owned by countries such as Indonesia and China, which have widely dispersed populations.

- Mobile Telephone Services. GEO satellites also provide some mobile telephone services. The vast majority of mobile telephones today use ground-based cellular networks, but satellites provide telephone services to ships at sea through the international organization, Inmarsat. There is also a limited market today for satellite mobile telephone services to augment cellular services. There are many planned and proposed systems to provide satellite mobile telephone services in the future, using satellites in both GEO and low Earth orbit (LEO).

Television and Radio

There are three television transmission media: broadcast, cable, and direct-to-home. The services provided using these media compete and overlap. Broadcast and cable entities produce their own programming. Broadcast and cable channels are typically transmitted via the same satellites and the signals transmitted via satellite are very similar. Some cable signals are also re-packaged and re-transmitted by direct-to-home (primarily by direct broadcast satellite) TV providers. GEO satellites also currently relay a number of radio channels.

- Broadcast and Cable Television Relay. GEO satellites relay broadcast and cable TV signals to ground stations that then transmit them to customers. Broadcast TV typically involves microwave transmissions to rooftop antennas. Cable TV services use coaxial cables attached directly to homes. Broadcast and cable channels are typically transmitted via the same satellites; the signals are very similar.

- Direct-to-Home Television. Many broadcast and cable channels can also be received directly by outdoor satellite dishes attached to the home. Generally, standard broadcast and cable signals were never intended for direct reception at the home. However, this approach to television distribution became popular in geographic regions where reception of normal broadcast signals was difficult. Today, some cable programming is also received, repackaged, and retransmitted digitally to homes using direct broadcast satellites (DBS), also in GEO. DBS is provided by dedicated or near-dedicated satellites.

- Direct Radio. A related category of service is radio. GEO satellites currently relay a very small number of some audio signals, much as they relay television signals. In the future, GEO satellites will provide mobile audio services broadcast directly from a dedicated satellite to the end-user via handsets or automobile tuners.

Data Communications

Satellite data communications is a diversified market that serves many users. Many service areas fall under the category of data communications, including broad categories of computer networking, video, facsimile, paging, and voice communications. These services do not require a dedicated satellite and can be delivered from the satellite to one point or multiple points. Data delivery can be fixed or mobile. The users for the various types of data communication services are primarily business but also include personal and educational users.

Civil Government Applications

Three general civil mission areas take advantage of GEO: meteorology, technology research, and communications.

- Meteorology. GEO provides a near ideal platform for long-duration Earth observations, but the relatively large distance to GEO limits the resolution of imaging data. Most civil meteorological programs (e.g., US, China, Russia) use a combination of GEO and polar-orbiting LEO systems to provide complete coverage of developing weather systems.

- Technology Research. Civil and military space authorities have a long history of sponsoring research dedicated to developing and advancing communications satellite technology. Most US communication satellite technology research was terminated in the 1970s (NASA's Advanced Communications Technology Satellite, launched in 1993 to study multiple antenna beam communications and satellite-switched operations in the Ka-band is an exception). Japan, France, and the European Space Agency continue to sponsor the development of systems to study advanced communication technologies. New entrants to the space field also use experimental communication satellites to establish the basic infrastructure for a space industry.

- Communications. Many governments are substantial consumers of communications

services. As the market value of GEO communications satellites was established during the 1970s and 1980s, most civil authorities transferred control of their GEO communications programs to governmental and quasi-governmental post, telegraph and telephone (PTT) organizations. These organizations provided services to the remainder of the government, as well as to meet non-governmental requirements. In some instances, these PTTs are virtually indistinguishable from government organizations. In other cases, they possess many of the characteristics of private commercial concerns. However, in almost all cases, the use of PTT assets in GEO are subject to at least some sort of commercial market. As a result, for the purpose of this study, PTTs are incorporated into all analyses of the commercial communications marketplace.

Geosynchronous orbit is of limited value for other kinds of civil space activities. For example, no current or planned space science missions (e.g., in the disciplines of astrophysics, space physics, and planetary science) require the use of GEO. Similarly, human space activity to date has been confined to LEO and trans-Lunar and Lunar orbits.

Military Government Applications

There are two primary uses of GEO for defense/military purposes: communications and intelligence gathering.

- Military Communications. Military organizations frequently use the unique characteristics of GEO to facilitate strategic and tactical communications. (These systems generally employ military-reserved frequencies and are not considered in this forecast to be part of the larger category of commercial and quasi-commercial communications.) The US, Russia, NATO, the United Kingdom, Saudi Arabia, Italy, and the People's Republic of China have all deployed, or are considering deploying, GEO assets for military communications.
- Intelligence. Both the US and Russia use GEO satellites to provide early warning of missile launches. Use of GEO allows these satellites to "stare" at the Earth for extended periods, providing constant monitoring of launches and other major thermal events (e.g., above-ground nuclear explosions). Similarly, GEO assets are used to gather intelligence on radio and radar transmissions from areas of military activity. Information about electronic intelligence satellites (ELINTS) is particularly closely held, and the details available in open sources are sketchy at best.

Ownership and Operation

This analysis has yielded an estimate of 238 currently active operational GEO satellites. It is important to remember that in estimating the number of GEO satellites, the population changes frequently. There are two or three launches of GEO satellites each month and inactive GEO satellites may sometimes be sold and reactivated. (For the purpose of this report, the cut-off for listing satellites as current (or operational) was December 31, 1995. Since that time, several GEO systems have been launched.)[1]

Of the 238 operational GEO satellites, 168 are communications satellites and 70 are military or civil/non-communications satellites. A listing by ownership shows that 68 of the communications satellites are also owned by government organizations. Many communications satellite systems are administered on a partial to full for-profit basis by governmental and quasi-governmental PTT organizations. Similarly, international non-profit consortia (e.g., Intelsat, Inmarsat) compete in the growing commercial marketplace for satellite communications capabilities.

GEO assets used to conduct strictly civil missions – meteorology or government-sponsored communications technology research – are categorized as "civil" in Figure 1 below and as "government/non-communications" in Figure 2.

[1] Currently, these systems include: PanAmSat (PAS) 3R (1/12), Measat 1 (1/12), Koreasat 2 (1/14), Gorizont 31 (1/25), Palapa C1 (2/1), N-Star B (2/5), and Intelsat 707 (3/14).

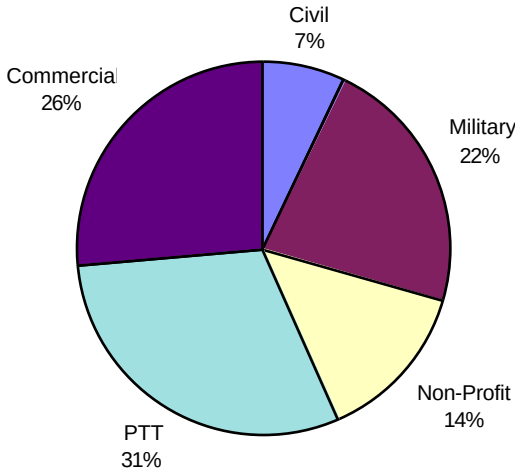


Figure 1. Operational GEO Satellites by Sponsor

The functions performed by these satellites were determined based on a compilation of many sources of information about current transponder use.[2] This information was then analyzed to determine typical use patterns (in terms of television, telephone, and data communications and backup transponders) for five classes of on-orbit satellites. Transponder-by-transponder data were very good for television uses but sketchier for telephone and data communication. Percentage values for each service were determined based on this analysis. These percentage values were modified somewhat for television and data communication to reflect additional information generated through analyses of market trends and industry revenues.

The capability of the currently active, on-orbit communications and government-owned satellites identified in this analysis is used for about 23% telephone, 35% television, 5% data communications, 29% government non-communications functions, and about 8% unused capacity (which can represent both backup capability and unleased transponders that are "on the market"). These percentages are based on capability normalized to 36-MHz transponder equivalents.

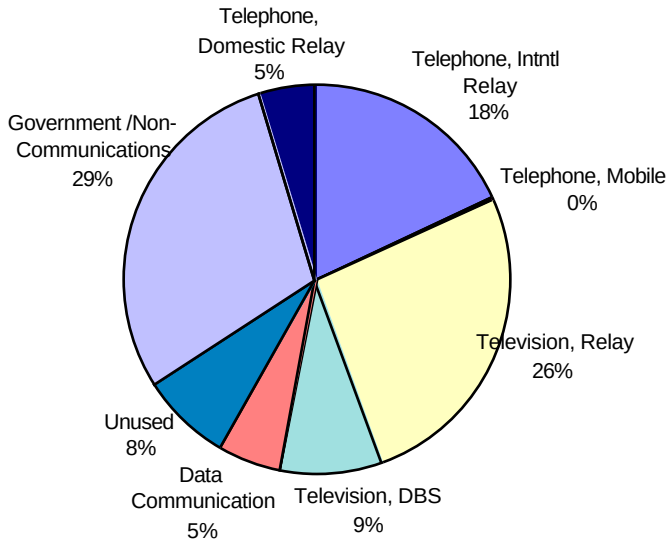


Figure 2. Current Satellite Functions (Percentage of On-Orbit Capability, 1996)

The current active GEO satellite population was estimated by comparing and integrating data from a range of sources. The FAA Office of Commercial Space Transportation's STAR database was used as the basis for accounting for operational GEO systems. Information on operational satellites was supplemented by data from open sources, particularly the International Satellite Directory (Design Publishers, 1996 Edition), Jane's Space Directory (11th Edition, 1995-1996) and The World Satellite Directory (Phillips Business Publishing, Inc., 1995).

The analysis presented in this Special Report was conducted by Futron Corporation.

[2] A transponder is the active telecommunications component of a satellite that is responsible for converting the signal from its up-link frequency to its corresponding down-link frequency and then amplifying the signal for retransmission. The usual bandwidth capacity of a transponder is in the 36-54 MHz range but can be as wide as 500 MHz.

GLOSSARY

For proper interpretation of the data in this report, the following definitions should be understood:

Commercial Launch Events: A commercial launch event is an internationally competed launch event, as defined below, and/or any launch licensed by the Department of Transportation/Office of Commercial Space Transportation (DoT/OCST), under the Commercial Space Launch Act (CSLA), or certain Post, Telegraph and Telecommunications launches.

Commercial Launch Revenue: Commercial launch revenues are generated from launch services provided by private and government licensed entities. It is understood that commercial launch providers of different countries operate within different economic, policy, and procedural contexts which affect the respective prices for a launch contract, however, this report does not attempt to adjust its data for these factors.

Geosynchronous Orbit (GEO): An orbit approximately 22,300 miles above the equator in which a payload completes one orbit around the Earth every 24 hours.

Geosynchronous Transfer Orbit (GTO): A temporary orbit used to later place payloads in a geosynchronous orbit.

Internationally-Competed Launch Events: An internationally competed launch event results from a launch opportunity which is available in principle to competitors in the international launch services market.

Low Earth Orbit (LEO): An orbit range on the order of 100-1000 nautical miles.

Market Share: That segment of a commercial market which is captured by a specified entity.

Microgravity: An environment in which gravitational forces are essentially nonexistent. Microgravity is used for materials processing, life-sciences, and other experiments. Suborbital flights generally are conducted to expose experimental payloads to a brief microgravity environment. Microgravity is also utilized for orbiting payloads.

Orbital Insertion: The point of a launch event at which a payload has attained planned orbital velocity and finally separates from its launch vehicle.

Payload: Cargo to be jettisoned or released which may include attached kick motors.

Payload Mass Class: Payloads are categorized in the following mass classes:

Microsat	0 - 200 lbs	Small	201 - 2,000 lbs
Medium	2,001 - 5,000 lbs	Intermediate	5,001 - 10,000 lbs
Large	10,001 - 20,000 lbs	Heavy	over 20,000 lbs

Scheduled Launch Events: Future launch events associated with specific dates as reported in open sources.

Secondary Payload: A payload of lesser dimensions and weight than the primary payload(s). These payloads are launched along with primary payload(s) due to excess launch capacity.

Suborbital: A term used to describe a launch event or payload that does not achieve a full earth orbit.

ACRONYMS

ADEOS	Advanced Earth Observing Satellite
AMOS	Afro-Mediterranean Orbital System
APT	Asia Pacific Telecommunications
ASCO	Arab Satellite Communications Organization
ASI	Italian Space Agency
CAST	Chinese Academy of Space Technology
CCAS	Cape Canaveral Air Station
CIS	Commonwealth of Independent States
DASA	Deutsche Aerospace
DGA	Delegation Generale pour l'Armement
DMSP	Defense Meteorological Satellite Program
DoD	Department of Defense
DoT	Department of Transportation
DSP	Defense Support Program
ELI	Elliptical
ELINTS	Electronic intelligence satellites
ELV	Expendable Launch Vehicle
ESA	European Space Agency
EXT	Extra-Orbital
FAA	Federal Aviation Administration
GE	General Electric
GEO	Geosynchronous Orbit
GTO	Geosynchronous Transfer Orbit
IAI	Israel Aircraft Industries
IKI	Space Research Institute
INMARSAT	International Maritime Satellite Organization
INTELSAT	International Telecommunications Satellite Organization
IRS	Indian Remote Sensing
ISRO	Indian Space Research Organization
JPL	Jet Propulsion Laboratory
KSC	Kennedy Space Center
LEO	Low Earth Orbit
LMLV	Lockheed Martin Launch Vehicle
Measat	Malaysian East Asia Satellite
MEO	Middle Earth Orbit
MoD	Ministry of Defense
MSAT	Mobile Satellite Communications System
MSTI	Miniature Sensor Technology Integration
MSX	Midcourse Sensor Experiment
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency (Japan)
NIVR	Netherlands Agency for Aerospace Programs
nMI	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NPO	Scientific Production Organization
OCST	Office of Commercial Space Transportation
ORFEUS-SPAS	Orbiting and Retrievable Far and Extreme UV Spectrometer - Space Pallet Satellite
OSC	Orbital Sciences Corporation
PAS	Pan American Satellite
PSLV	Polar Satellite Launch Vehicle
PTT	Post, Telegraph and Telecommunications
SAX	X-ray Astronomy Satellite
SES	Societe Europeene des Satellites
STS	Space Transportation System
SWAS	Submillimeter Wave Astronomy Satellite
TMI	Telesat Mobile, Inc.
TOMS	Total Ozone Mapping Spectrometer
TR	Test Rocket
UFO	Ultra-high frequency Follow-On
UNAM	Autonomous University of New Mexico
VAFB	Vandenberg Air Force Base
XA	Experimental Advanced
XL	Extra Long

Characteristics of Cited Vehicles

Vehicle Designation	(Successes + Partials)/Attempts	LEO 28 Degrees	GTO	GEO	Suborbital	Price per Launch (Approximate)	Launch Sites
Capacity: Heavy							
Ariane 5	N/A	39600 0 lbs , 179836 kg	15000 lbs, 6812 kg	N/A	N/A	$114 - 143M	Kourou
Proton SL-12	185/206|88%	46297 lbs, 21025 kg	12100 lbs, 5495 kg	4850 lbs, 2202 kg	N/A	$50 - 70M	Tyuratam
Proton SL-13	23/26|88%	46000 lbs, 20890 kg	16535 lbs, 7509 kg	N/A	N/A	$50 - 70M	Tyuratam
Shuttle Atlantis	15/15|100%	47300 lbs, 21480 kg	13007 lbs, 5907 kg	5203 lbs, 2363 kg	N/A	$161 - 215M	KSC
Shuttle Columbia	19/19|100%	47300 lbs, 21480 kg	13007 lbs, 5907 kg	5203 lbs, 2363 kg	N/A	$161 - 215M	KSC
Shuttle Endeavour	10/10|100%	47300 lbs, 21480 kg	13007 lbs, 5907 kg	5203 lbs, 2363 kg	N/A	$161 - 215M	KSC
Titan 4	7/8|87%	39100 lbs, 17756 kg	14000 lbs, 6358 kg	N/A	N/A	$160 - 180M	CCAS, VAFB
Titan 4/Centaur	6/6|100%	39100 lbs, 17756 kg	14000 lbs, 6358 kg	10200 lbs , 4632 kg	N/A	$240 - 270M	CCAS
Zenit 2 SL-16	20/24|83%	30300 lbs, 13760 kg	N/A	N/A	N/A	$25 - 40M	Tyuratam
Capacity: Intermediate							
Ariane 4-TBA	N/A	N/A	N/A	N/A	N/A	N/A	
Ariane 42P	7/8|87%	13400 lbs, 6085 kg	6260 lbs, 2843 kg	N/A	N/A	$60 - 75M	Kourou
Ariane 44L	17/18|94%	21100 lbs, 9582 kg	9965 lbs, 4525 kg	N/A	N/A	$90 - 110M	Kourou
Ariane 44LP	14/15|93%	18300 lbs, 8310 kg	8950 lbs, 4064 kg	N/A	N/A	$80 - 95M	Kourou
Ariane 44P	5/5|100%	15200 lbs, 6903 kg	7320 lbs, 3324 kg	N/A	N/A	$75 - 90M	Kourou
Atlas 1	7/9|66%	12569 lbs, 5708 kg	4970 lbs, 2257 kg	2511 lbs, 1140 kg	N/A	$60 - 70M	CCAS
Atlas 2	8/8|100%	14500 lbs, 6585 kg	6200 lbs, 2815 kg	3086 lbs, 1401 kg	N/A	$60 - 70M	CCAS
Atlas 2A	7/7|100%	16050 lbs, 7289 kg	6700 lbs, 3042 kg	3307 lbs, 1501 kg	N/A	$65 - 80M	CCAS
H 2	3/3|100%	23000 lbs, 10445 kg	8800 lbs, 3996 kg	4800 lbs, 2180 kg	N/A	$181 - 200M	Tanegashima
Long March 2E	5/7|71%	19400 lbs, 8810 kg	7430 lbs, 3374 kg	3300 lbs, 1498 kg	N/A	$40 - 50M	Xichang
Soyuz SL-4	927/932|99%	15400 lbs, 6993 kg	N/A	N/A	N/A	$12 - 25M	Plesetsk, Tyuratam
Capacity: Medium							
Delta 2 7920	2/2|100%	11109 lbs, 5045 kg	2800 lbs, 1271 kg	N/A	N/A	$45 - 50M	CCAS, VAFB
Delta 2 7925	29/29|96%	11220 lbs, 5095 kg	4060 lbs, 1844 kg	2000 lbs, 908 kg	N/A	$45 - 50M	CCAS, VAFB
Long March 3	9/9|78%	11023 lbs, 5006 kg	3100 lbs, 1408 kg	1600 lbs, 726 kg	N/A	$35 - 40M	Xichang
Capacity: Small							
Cosmos SL-8	403/407|99%	3100 lbs, 1408 kg	N/A	N/A	N/A	N/A	Kapustin Yar, Plesetsk, Tyuratam
LMLV 1	0/1|0%	1755 lbs, 797 kg	N/A	N/A	N/A	$14 - 16M	CCAS, VAFB
MSLS A	N/A	300 l bs, 136 kg	N/A	N/A	N/A	$5 - 8M	VAFB
Molniya SL-6	286/301|94%	N/A	N/A	N/A	N/A	$12 - 25M	Plesetsk, Tyuratam
Pegasus 1	5/5|100%	754 l bs, 342 kg	274 lbs, 124 kg	152 lbs, 69 kg	N/A	$10 - 14M	VAFB, Wallops Island, KSC
Pegasus XL	1/3|33%	943 l bs, 428 kg	322 lbs, 146 kg	181 lbs, 82 kg	N/A	$12 - 14M	VAFB, Wallops Island

* All Success/Partial/Failures as of July 15, 1996

Characteristics of Cited Vehicles

Vehicle Designation	(Successes + Partials)/Attempts	LEO 28 Degrees	GTO	GEO	Suborbital	Price per Launch (Approximate)	Launch Sites
Taurus 1	1/1|100%	3100 lbs, 1408 kg	990 lbs, 449 kg	N/A	N/A	$17 - 25M	VAFB
Capacity: Suborbital							
Delta Clipper XA	N/A	N/A	N/A	N/A	N/A	N/A	White Sands
HyFlyer	N/A	N/A	N/A	N/A	5000 lbs, 2270 kg	N/A	VAFB
Starfire 1	5/6|66%	N/A	N/A	N/A	1000 lbs, 454 kg	$1 - 2M	White Sands
TR 1A	3/3|100%	N/A	N/A	N/A	1653 lbs, 751 kg	N/A	Tanegashima
Texus	27/29|93%	N/A	N/A	N/A	661 lbs, 300 kg	N/A	Esrange

* All Success/Partial/Failures as of July 15, 1996

Characteristics of Cited Payloads

Payload	Use	Payload Price (Approximate)	Orbit Type	Orbital Apogee	Orbital Perigee	Mass at Launch	Mass in Orbit	Frequency bands & Transponders	Stabilization	Power Supply
AMOS 1A	Communications	$128M	GEO 015° E	35750 nMI	35750 nMI	2100 lbs, 953 kg	N/A	7 Ku, 1 X	3-axis	1100
APStar 1A	Communications	N/A	GEO	35750 nMI	35750 nMI	3086 lbs, 1401 kg	1235 lbs, 560 kg	24 C	Spin	N/A
Arabsat 2A	Communications	N/A	GEO TBA	35779 nMI	35750 nMI	7700 lbs, 3497 kg	N/A	22 C, 12 Ku, 2S	3-axis	N/A
Astra 1F	Communications	N/A	GEO 019.2° E	36090 nMI	35600 nMI	6151 lbs, 2793 kg	3748 lbs, 1702 kg	20 Ku	3-axis	3300
ChinaSat 7	Communications	N/A	GEO 110.5	N/A	N/A	1388 lbs, 630 kg	559 lbs, 254 kg	24 C	Spin	N/A
EchoStar 2	Communications	N/A	GEO 175° W	N/A	N/A	6393 lbs, 2903 kg	N/A	16 Ku	3-axis	N/A
GE 1	Communications	N/A	GEO 103° W	35880 nMI	N/A	5500 lbs, 2497 kg	N/A	24 C, 24 Ku	3-axis	N/A
Galaxy 9	Communications	N/A	GEO 123° W	35796 nMI	35781 nMI	1200 lbs, 545 kg	N/A	24 C	Spin	4700
Gorizont 32	Communications	N/A	GEO	N/A	N/A	N/A	N/A	6 C, 1 Ku	3-Axis	1300
Hot Bird 2	Communications	N/A	GEO 013° E	N/A	N/A	6380 lbs, 2897 kg	N/A	N/A	N/A	N/A
Inmarsat 3 F1	Communications	$80M	GEO TBA	35987 nMI	35880 nMI	4362 lbs, 1981 kg	2423 lbs, 1100 kg	2 C, L	3-axis	2400
Inmarsat 3 F3	Communications	$80M	GEO TBA	35987 nMI	35880 nMI	4362 lbs, 1981 kg	2423 lbs, 1100 kg	2 C, L	3-axis	2400
Insat 2D	Communications	N/A	GEO 093.5° E	35880 nMI	35750 nMI	4620 lbs, 2098 kg	1874 lbs, 851 kg	12 C, 2 S	3-axis	1180
Intelsat 7A F9	Communications	N/A	GEO 304° E	35845 nMI	35775 nMI	10236 lbs , 4648 kg	4189 lbs, 1902 kg	26 C, 14 Ku	3-axis	4000
Iridium 1	Communications	$5M	LEO	776 nMI	776 nMI	1500 lbs, 681 kg	N/A	Ka, L	3-axis	N/A
Iridium 2	Communications	$5M	LEO	776 nMI	776 nMI	1500 lbs, 681 kg	N/A	Ka, L	3-axis	N/A
Iridium 3	Communications	$5M	LEO	776 nMI	776 nMI	1500 lbs, 681 kg	N/A	Ka, L	3-axis	N/A
Italsat 2	Communications	$131M	GEO 013° E	35870 nMI	35703 nMI	4180 lbs, 1898 kg	1962 lbs, 891 kg	N/A	3-axis	1400
MSAT 1	Communications	$91M	GEO 106.5° W	35880 nMI	35880 nMI	5997 lbs, 2723 kg	3638 lbs, 1652 kg	Ku, L	3-axis	3000
Measat 2	Communications	$110M	GEO 148° E	N/A	N/A	2646 lbs, 1201 kg	1442 lbs, 654 kg	10 C, 3 Ku	Spin	N/A
Molniya 3-48	Communications	N/A	ELI	38736 nMI	444 nMI	3858 lbs, 1752 kg	N/A	3 C	3-axis	1000
PAS 6	Communications	N/A	GEO	35799 nMI	35777 nMI	6437 lbs, 2923 kg	N/A	N/A	N/A	4800
Palapa C2	Communications	$56M	GEO 108° E	N/A	N/A	6590 lbs, 2992 kg	2800 lbs, 1271 kg	24 C, 4 Ku	3-axis	N/A
Telecom 2D	Communications	N/A	GEO TBA	35987 nMI	N/A	4960 lbs, 2252 kg	2425 lbs, 1101 kg	10 C, 11 Ku, 6X	3-axis	3450
Tempo 2	Communications	$183M	GEO 166° W	N/A	N/A	7700 lbs, 3497 kg	4189 lbs, 1902 kg	32 Ku	3-axis	N/A
Turksat 1C	Communications	N/A	GEO 050° W	N/A	N/A	3931 lbs, 1785 kg	2377 lbs, 1079 kg	16 Ku	3-axis	2900
UFO 7	Communications	$181M	GEO	35750 nMI	35750 nMI	6319 lbs, 2869 kg	2304 lbs, 1046 kg	EHF, UHF	3-axis	2500
MSTI 3	Experimental	N/A	LEO	463 nMI	463 nMI	375 lbs, 170 kg	N/A	N/A	N/A	N/A
MSX	Experimental	$297M	LEO	900 nMI	900 nMI	6504 lbs, 2953 kg	N/A	N/A	N/A	N/A
Minisat 01	Experimental	$11M	N/A	N/A	N/A	460 lbs, 209 kg	N/A	N/A	N/A	N/A
DSP 18	Intelligence	N/A	GEO	35750 nMI	35750 nMI	5203 lbs, 2363 kg	N/A	N/A	N/A	1274
DSP 19	Intelligence	N/A	GEO	35750 nMI	35750 nMI	5203 lbs, 2363 kg	N/A	N/A	N/A	1274
Kosmos F1-1996	Intelligence	N/A	LEO	409 nMI	394 nMI	N/A	N/A	N/A	N/A	N/A
Soyuz TM-24	Manned	N/A	LEO	409 nMI	394 nMI	1558 7 lbs , 7078 kg	1496 9 lbs , 6798 kg	N/A	N/A	N/A
Mars 96	Mars	N/A	EXT	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Characteristics of Cited Payloads

Payload	Use	Payload Price (Approximate)	Orbit Type	Orbital Apogee	Orbital Perigee	Mass at Launch	Mass in Orbit	Frequency bands & Transponders	Stabilization	Power Supply
Mars Global Surveyor 1	Mars	$49M	EXT	N/A	N/A	2200 lbs, 999 kg	N/A	N/A	N/A	N/A
Mars Pathfinder	Mars	$160M	EXT	N/A	N/A	1760 lbs, 799 kg	630 lbs, 286 kg	N/A	Spin	N/A
Navstar GPS 2-26	Navigation	$59M	MEO	20183 nMI	20183 nMI	4147 lbs, 1883 kg	2050 lbs, 931 kg	L	Spin	710
Navstar GPS 2R- 1	Navigation	$27M	MEO	20183 nMI	20183 nMI	4480 lbs, 2034 kg	2370 lbs, 1076 kg	L	3-axis	1125
ADEOS 1	Remote Sensing	$620M	LEO	797 nMI	N/A	7716 lbs, 3504 kg	7055 lbs, 3204 kg	Ka, S, 3 X	3-axis	4500
Clark	Remote Sensing	$45M	LEO	458 nMI	N/A	612 lbs, 278 kg	N/A	N/A	N/A	N/A
Earlybird 1	Remote Sensing	N/A	LEO	470 nMI	470 nMI	992 lbs, 450 kg	N/A	N/A	N/A	N/A
Geosat Follow-On 1	Remote Sensing	N/A	LEO	800 nMI	782 nMI	576 lbs, 261 kg	N/A	N/A	N/A	N/A
Spin 2	Remote Sensing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOMS 1	Remote Sensing	$42M	LEO	955 nMI	955 nMI	650 lbs, 295 kg	N/A	N/A	3-axis	N/A
Bion 11	Scientific	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cluster 1	Scientific	N/A	TBA	N/A	N/A	2530 lbs, 1149 kg	N/A	N/A	Spin	145
Cluster 2	Scientific	N/A	TBA	N/A	N/A	2530 lbs, 1149 kg	3 lb s, 1 kg	N/A	Spin	145
Cluster 3	Scientific	N/A	TBA	N/A	N/A	2530 lbs, 1149 kg	N/A	N/A	Spin	145
Cluster 4	Scientific	N/A	TBA	N/A	N/A	2530 lbs, 1149 kg	N/A	N/A	Spin	145
FAST	Scientific	N/A	ELI	4200 nMI	350 nMI	331 lbs, 150 kg	331 lbs, 150 kg	N/A	Spin	N/A
HETE	Scientific	N/A	LEO	550 nMI	N/A	265 lbs, 120 kg	N/A	N/A	Spin	70
Magion 5	Scientific	N/A	ELI	20000 nMI	500 nMI	N/A	N/A	N/A	N/A	N/A
ORFEUS SPAS 2	Scientific	N/A	LEO	160 nMI	160 nMI	7900 lbs, 3587 kg	N/A	N/A	N/A	N/A
Prognoz Interbal-A	Scientific	N/A	ELI	20000 nMI	500 nMI	1764 lbs, 801 kg	N/A	N/A	Spin	N/A
SAC B	Scientific	$6M	LEO	500 nMI	N/A	770 lbs, 349 kg	N/A	N/A	3-axis	N/A
SAX	Scientific	$216M	LEO	600 nMI	600 nMI	3080 lbs, 1398 kg	N/A	N/A	3-axis	1640
SWAS	Scientific	N/A	LEO	N/A	N/A	397 lbs, 180 kg	397 lbs, 180 kg	N/A	3-axis	N/A
Priroda	Space Station	N/A	LEO	N/A	N/A	4343 1 lbs , 19723 kg	N/A	N/A	N/A	N/A
Progress M-31	Supply	N/A	LEO	406 nMI	390 nMI	1598 3 lbs , 7258 kg	N/A	N/A	N/A	N/A
Progress M-32	Supply	N/A	LEO	406 nMI	390 nMI	1598 3 lbs , 7258 kg	N/A	N/A	N/A	N/A
Progress M-33	Supply	N/A	LEO	406 nMI	390 nMI	1598 3 lbs , 7258 kg	N/A	N/A	N/A	N/A
Progress M-34	Supply	N/A	LEO	N/A	N/A	1598 3 lbs , 7258 kg	N/A	N/A	N/A	N/A

Launch Events*
April 1996 - June 1996

Launch Date	Vehicle	Payload	Operator	Manufacturer	Internationally Competed	Launch Type	Launch Outcome	Mission Outcome
Europe (ESA)								
Ariane								
4/20/96	Ariane 42P	MSAT 1	TMI Communications	Hughes	Yes	Commercial	Success	Success
5/15/96	Ariane 44L	AMOS 1A	Israel Aircraft Industries (IAI)	Israel Aircraft Industries (IAI)/MBT	Yes	Commercial	Success	Success
		Palapa C2	PT Satelindo	Hughes				
6/4/96	Ariane 5	Cluster 1	European SpaceAgency(ESA)	Dornier	No	Non-Commercial	Failure	Failure
		Cluster 2	European SpaceAgency(ESA)	Dornier				
		Cluster 3	European SpaceAgency(ESA)	Dornier				
		Cluster 4	European SpaceAgency(ESA)	Dornier				
6/15/96	Ariane 44P	Intelsat 7A F9	Intelsat	Space Systems/Loral	Yes	Commercial	Success	Success
Russia/CIS								
Cosmos								
4/24/96	Cosmos SL-8	Kosmos 2332	Russia/CIS	Russia/CIS	No	Non-Commercial	Success	Success
Proton								
4/9/96	Proton SL-12	Astra 1F	Societe Europeenne des Satellites (SES)	Hughes	Yes	Commercial	Success	Success
4/23/96	Proton SL-13	Priroda	NPO Energia	NPO Energia	No	Non-Commercial	Success	Success
5/25/96	Proton SL-12	Gorizont 32	Russia/CIS	NPO Prikladnoi Mekhaniki	No	Non-Commercial	Success	Success
Soyuz								
5/5/96	Soyuz SL-4	Progress M-31	NPO Energia	NPO Energia	No	Non-Commercial	Success	Success
5/14/96	Soyuz SL-4	Spin 2	LTI/CTS/AI Consortium	Russia/CIS	No	Non-Commercial	Failure	Failure
6/20/96	Soyuz SL-4	Kosmos F1-1996	Russia\CIS MoD		No	Non-Commercial	Failure	Failure

* High-profile suborbital launch events included

Launch Events*
April 1996 - June 1996

Launch Date	Vehicle	Payload	Operator	Manufacturer	Internationally Competed	Launch Type	Launch Outcome	Mission Outcome
USA								
Atlas								
4/3/96	Atlas 2A	Inmarsat 3 F1	Inmarsat	Lockheed Martin Astro Space	Yes	Commercial	Success	Success
4/30/96	Atlas 1	SAX	NIVR/Italian Space Agency (ASI)	Alenia Spazio	Yes	Commercial	Success	Success
Delta								
4/24/96	Delta 2 7920	MSX	DoD	Applied Physics Lab./Johns Hopkins	No	Non-Commercial	Success	Success
5/23/96	Delta 2 7925	Galaxy 9	Hughes Communications, Inc.	Hughes	Yes	Commercial	Success	Success
Delta Clipper								
5/18/96	Delta Clipper XA*				No	Non-Commercial	Success	Success
6/8/96	Delta Clipper XA*				No	Non-Commercial	Success	Success
Pegasus								
5/16/96	Pegasus 1	MSTI 3	DoD	Spectrum Astro	No	Commercial	Success	Success
Shuttle								
5/19/96	Shuttle Endeavour	STS 77	NASA	Rockwell International	No	Non-Commercial	Success	TBD
6/20/96	Shuttle Columbia	STS 78	NASA	Rockwell International	No	Non-Commercial	Success	Success
Starfire								
4/3/96	Starfire 1*				No	Commercial	TBA	TBA
Titan								
4/24/96	Titan 4/Centaur	DSP 18	DoD	TRW	No	Non-Commercial	Success	Success
5/12/96	Titan 4	Classified 1996-A	DoD		No	Non-Commercial	Success	Success

* High-profile suborbital launch events included

Future Launch Events*
July 1996 - December 1996

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Site
China							
Long March							
July 02 1996	Long March 2E	APStar 1A	APT Satellite Co.,Ltd.	Hughes	Yes	Commercial	Xichang
July 1996	Long March 3	ChinaSat 7	Ministry of Posts and Telecommunications	Hughes	Yes	Non-Commercial	Xichang
Europe (ESA)							
Ariane							
July 05 1996	Ariane 44L	Arabsat 2A Turksat 1C	ASCO Turkish Telecom	Aerospatiale Aerospatiale	Yes	Commercial	Kourou
August 07 1996	Ariane 44L	Italsat 2 Telecom 2D	Telespazio France Telecom/DGA	Alenia Spazio Matra Marconi	Yes	Commercial	Kourou
September 10 1996	Ariane 4-TBA	EchoStar 2	EchoStar Satellite Corp.	Lockheed Martin Astro Space	Yes	Commercial	Kourou
October 1996	Ariane 44LP	Insat 2D Measat 2	ISRO Bina Riang Pte. Ltd.	ISRO Hughes	Yes	Commercial	Kourou
November 14 1996	Ariane 4-TBA	PAS 6	Alpha Lyracom Pan American Satellite	Space Systems/Loral	Yes	Commercial	Kourou
Germany							
Texus							
4th Qtr 1996	Texus *				No	Non-Commercial	Esrange
Japan							
H							
August 17 1996	H 2	ADEOS 1	NASDA	Mitsubishi/NEC/Toshiba	No	Non-Commercial	Tanegashima
TR							
August 1996	TR 1A*	None 1996-08-XX			No	Non-Commercial	Tanegashima
Russia/CIS							
Cosmos							
August 20 1996	Cosmos SL-8	Unamsat B	Autonomous Universityof Mexico (UNAM)		No	Non-Commercial	Plesetsk
May 1996	Cosmos SL-8	Bion 11	Russia/CIS	Russia/CIS	No	Non-Commercial	Plesetsk
Molniya							
August 29 1996	Molniya SL-6	Magion 5	Czech Republic	Geophysical Institute	No	Non-Commercial	TBA

* High-profile suborbital launch events included

Future Launch Events*
July 1996 - December 1996

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Site
		Prognoz Interbal-A	Intercosmos	NPO Lavotchkin			
August 1996	Molniya SL-6	Molniya 3-48	Russia/CIS PTT	NPO Prikladnoi Mekhaniki	No	Non-Commercial	Plesetsk
Proton							
November 16 1996	Proton SL-12	Mars 96	Space Research Institute (IKI)	NPO Lavotchkin	No	Non-Commercial	Tyuratam
December 1996	Proton SL-12	Tempo 2	Tempo Satellite, Inc.	Space Systems/Loral	Yes	Commercial	Tyuratam
Soyuz							
July 22 1996	Soyuz SL-4	Progress M-32	NPO Energia	NPO Energia	No	Non-Commercial	Tyuratam
August 14 1996	Soyuz SL-4	Soyuz TM-24	NPO Energia	NPO Energia	No	Non-Commercial	Tyuratam
September 05 1996	Soyuz SL-4	Progress M-33	NPO Energia	NPO Energia	No	Non-Commercial	Tyuratam
TBA							
July 1996	TBA Russia/CIS	Kosmos 96-07	Russia/CIS	Russia/CIS	No	Non-Commercial	
August 1996	TBA Russia/CIS	Kosmos 96-08	Russia/CIS	Russia/CIS	No	Non-Commercial	
September 1996	TBA Russia/CIS	Kosmos 96-09	Russia/CIS	Russia/CIS	No	Non-Commercial	
October 1996	TBA Russia/CIS	Kosmos 96-10	Russia/CIS MoD	Russia/CIS	No	Non-Commercial	
November 1996	TBA Russia/CIS	Kosmos 96-11	Russia/CIS MoD	Russia/CIS	No	Non-Commercial	
December 1996	TBA Russia/CIS	Kosmos 96-12	Russia/CIS	Russia/CIS	No	Non-Commercial	
Zenit							
December 20 1996	Zenit 2 SL-16	Progress M-34	NPO Energia	NPO Energia	No	Non-Commercial	Tyuratam
USA							
Atlas							
July 25 1996	Atlas 2	UFO 7	DoD	Hughes	No	Commercial	CCAS
August 20 1996	Atlas 2A	GE 1	GE Americom	Lockheed Martin	Yes	Commercial	CCAS
October 1996	Atlas 2A	Hot Bird 2	Eutelsat	Matra Marconi	Yes	Commercial	CCAS
December 21 1996	Atlas 2	Inmarsat 3 F3	Inmarsat	Lockheed Martin Astro Space	Yes	Commercial	CCAS
Delta							
July 15 1996	Delta 2 7925	Navstar GPS 2-26	DoD	Rockwell International	No	Non-Commercial	CCAS
August 28 1996	Delta 2 7925	Navstar GPS 2R- 1	DoD	Lockheed Martin Astro Space	No	Non-Commercial	CCAS
November 06 1996	Delta 2 7925	Mars Global Surveyor	NASA	Martin Marietta Astro Space	No	Non-Commercial	CCAS
November 14 1996	Delta 2 7925	Iridium 1	Iridium, Inc.	Lockheed Martin	Yes	Commercial	VAFB

* High-profile suborbital launch events included

Future Launch Events*
July 1996 - December 1996

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Site
		Iridium 2	Iridium, Inc.	Lockheed Martin			
		Iridium 3	Iridium, Inc.	Lockheed Martin			
December 02 1996	Delta 2 7925	Mars Pathfinder	NASA	Jet Propulsion Laboratory	No	Non-Commercial	CCAS
Delta Clipper							
July 1996	Delta Clipper XA*				No	Non-Commercial	White Sands
July 1996	Delta Clipper XA*				No	Non-Commercial	White Sands
HyFlyer							
October 1996	HyFlyer *				No	Commercial	VAFB
4th Qtr 1996	HyFlyer *				No	Commercial	VAFB
LMLV							
November 1996	LMLV 1	Clark	NASA	CTA Space Systems, Inc.	No	Commercial	VAFB
MSLS							
1996	MSLS A*						VAFB
Pegasus							
July 02 1996	Pegasus XL	TOMS 1	NASA	TRW	No	Non-Commercial	VAFB
August 15 1996	Pegasus XL	FAST	NASA	NASA	No	Non-Commercial	VAFB
September 24 1996	Pegasus XL	Minisat 01	INTA	INTA	Yes	Commercial	Spain
November 1996	Pegasus XL	SWAS	Smithsonian Astrophysical Observatory	NASA	No	Non-Commercial	Wallops Island
December 12 1996	Pegasus XL	HETE	Massachusetts Institute of Technology	AeroAstro	Yes	Commercial	Wallops Island
		SAC B	Argentina	National Commission on Space Activities (CONAE)			
Shuttle							
September 1996	Shuttle Atlantis	STS 79	NASA	Rockwell International	No	Non-Commercial	KSC
October 31 1996	Shuttle Columbia	ORFEUS SPAS 2	NASA/DARA	MBB Erno	No	Non-Commercial	KSC
		STS 80	NASA	Rockwell International			
December 05 1996	Shuttle Atlantis	STS 81	NASA	Rockwell International	No	Non-Commercial	KSC
TBA							

* High-profile suborbital launch events included

Future Launch Events*
July 1996 - December 1996

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Site
1996	TBA USA	Earlybird 1	Earthwatch, Inc.	Defense Systems, Inc.	Yes	Commercial	TBA
Taurus							
November 30 1996	Taurus 1	Geosat Follow-On 1	DoD	Ball Aerospace	No	Non-Commercial	VAFB
Titan							
July 02 1996	Titan 4	Classified USA-125	DoD		No	Non-Commercial	CCAS
October 1996	Titan 4/Centaur	DSP 19	DoD	TRW	No	Non-Commercial	CCAS

* High-profile suborbital launch events included