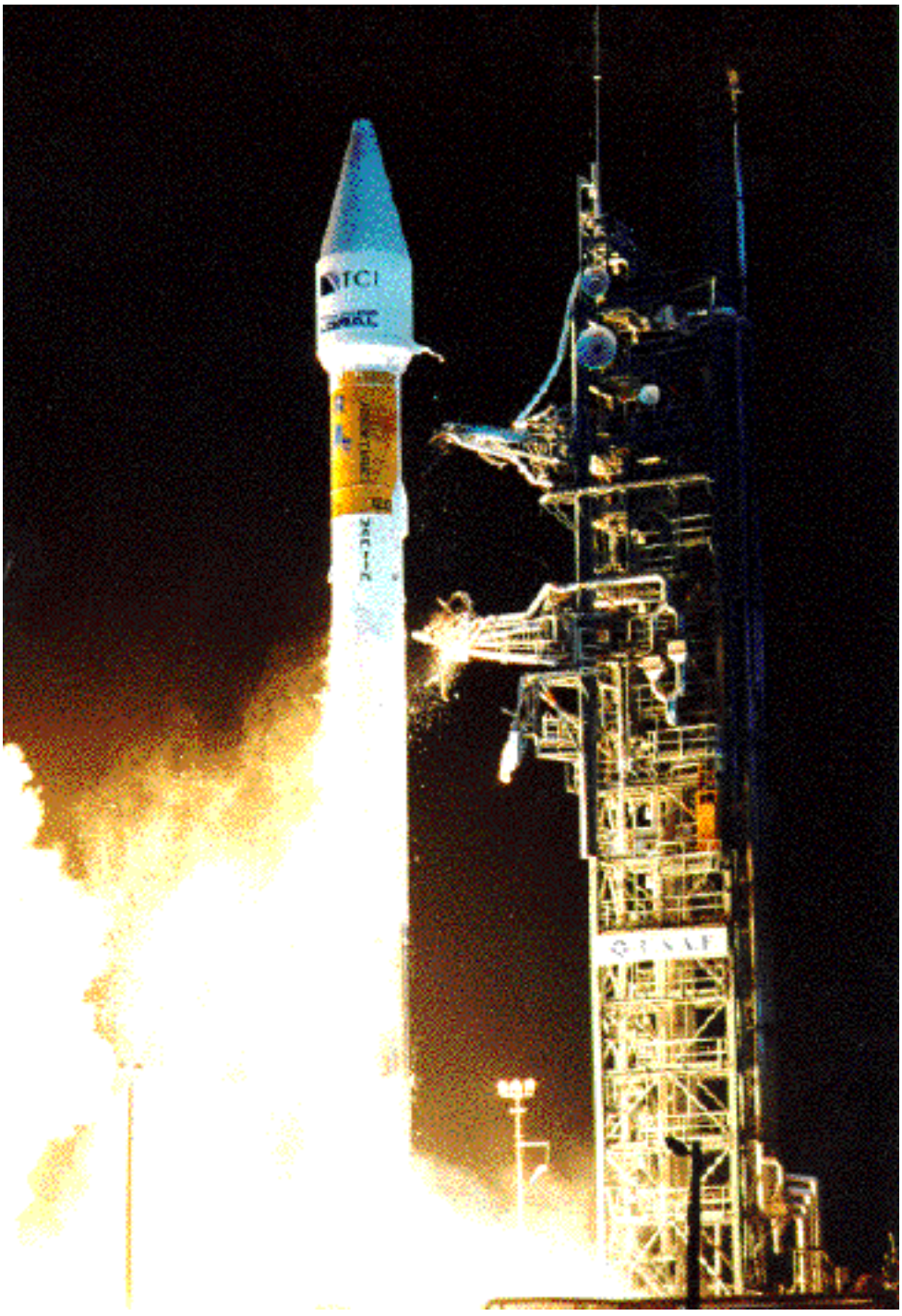
Commercial Space Transportation

QUARTERLY LAUNCH REPORT

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



2nd Quarter 1997

United States Department of Transportation • Federal Aviation Administration

Associate Administrator for Commercial Space Transportation

2ND QUARTER 1997 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: International Launch Services (1997). Image is of the Atlas 2A launch on March 8, 1997, from Cape Canaveral Air Station. It successfully orbited the Tempo direct broadcast satellite for Space Systems/Loral.

CONTENTS

This document was prepared by Futron Corporation and was released on April 25, 1997.

SUMMARY

First Quarter 1997 Launch Events

- There were six launches from the United States in the first quarter of 1997. Of these, two were commercial Atlas launches and the remaining four were all non-commercial (two Shuttle launches, one Titian 4, and one Delta). The United States suffered one launch failure when a Delta launch vehicle with a GPS Navstar satellite was lost to a solid rocket booster failure.
- The Russian Republic/CIS launched three times. These launches were made with a Cyclone, a Soyuz, and a START launch vehicle. All of these launches were non-commercial. The START launch on March 4 was the first launch from Russia's new Svobodny launch site.
- Two European Ariane 4 launch vehicles put three communication satellites in orbit.
- Japan successfully launched an astronomy payload on the first launch of its M 5 launch vehicle.

Second and Third Quarter 1997 Scheduled Launch Events

- The United States plans 24 launches in the second and third quarters of 1997, nine internationally competed. Four Atlas (three internationally competed and one non-commercial), seven Delta (four internationally competed and three non-commercial), and three non-commercial Lockheed Martin Launch Vehicles will be used. Four Pegasus launches are scheduled, two internationally competed and two non-commercial. Finally four non-commercial shuttle launches and a Titan 2 and Titan 4 (both non-commercial) are planned.
- The Russian Republic/CIS will launch 13 times of which seven will be internationally competed. These internationally competed launches will include six Proton launches and one on the START small launch vehicle. The non-commercial launches will include one Cosmos, one Molniya, and five on the Soyuz launch vehicle.
- Europe will conduct six internationally competed launches on its Ariane 4 and one non-commercial developmental launch of the Ariane 5.
- China will also conduct seven launches with its Long March vehicles of which four are internationally competed. The remaining three are non-commercial.
- Japan plans two non-commercial launches: one on the H2 and another on the M5 vehicle.
- Brazil will debut its VLS small launch vehicle with the non-commercial launch of a communication payload, SCD 2A.

SUMMARY

Commercial Products and Services

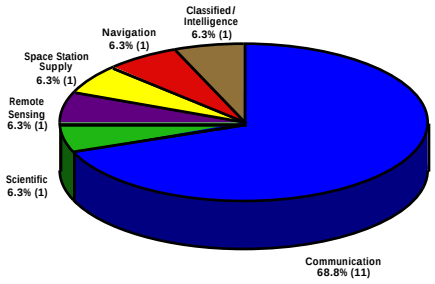
Second and Third Quarter 1997

EarlyBird

After repeated delays, EarthWatch's EarlyBird remote sensing satellite is slated to fly in June aboard a Russian START-1 launch vehicle. EarlyBird is a privately-funded commercial remote sensing spacecraft capable of 3-meter resolution (which will be the highest resolution currently available from a commercial satellite). START, a small launcher based on the SS-25 ballistic missile and marketed by STC Complex, had been EarthWatch's original choice to launch EarlyBird. EarthWatch later switched to Cosmos, manufactured by AO Polyot which has a longer record of reliability. The Russian government recently announced, however, that a Cosmos launcher would not be available to launch EarlyBird at the desired time. EarthWatch then turned back to STC's START. EarlyBird will be the first payload launched commercially from Russia's new Svobodny launch facility in the Russian Far East. It will be the second orbital launch, following the successful deployment of the Zeya satellite aboard a START in March 1997.

Payload Use Analysis

First Quarter 1997



Sixteen payloads were launched in the First Quarter of 1997. These payloads were divided between communication (70 percent), intelligence (six percent), navigation (six percent), scientific (six percent), remote sensing (six percent) and space station supply (six percent).

Communication payloads constituted 100 percent of commercially launched payloads.

LAUNCH SCHEDULE

Scheduled Launch Events

Vehicle	Payload	Site
APRIL 1997		
Ariane 44LP	BSAT 1	Kourou
	Thaicom 3	
Atlas 1	GOES K	CCAS
Cosmos SL-8	Kosmos 2341	Plesetsk
LMLV 1	Lewis	VAFB
Long March 3A	DFH 3-2	Xichang
Molniya SL-6	Kosmos 2340	Plesetsk
Pegasus XL	Minisat 01	Spain
Shuttle Columbia	STS 83	KSC
Soyuz SL-4	Progress M-34	Tyuratam
Titan 2	DMSP 5D-2-F14	VAFB
MAY 1997		
Pegasus XL	Orbcomm 03	VAFB
	SNOE	
Ariane 44P	PAS 6	Kourou
Delta 2 7925	Iridium 1	VAFB
	Iridium 2	
	Iridium 3	
Delta 2 7925	Thor 2A	CCAS
Pegasus XL	Seastar	VAFB
Proton SL-12	Telstar 5	Tyuratam
Shuttle Atlantis	STS 84	KSC
JUNE 1997		
Ariane 4-TBA	Inmarsat 3 F4	Kourou
	Insat 2D	
LMLV 1	Clark	VAFB
Long March 3B	Agila 2	Xichang
Proton SL-12	Iridium 4	Tyuratam
	Iridium 5	
	Iridium 6	
	Iridium 7	
	Iridium 8	
	Iridium 9	
	Iridium 10	
START 1	EarlyBird 1	Svobodny

LAUNCH SCHEDULE

Scheduled Launch Events

(Continued)

Vehicle	Payload	Site
JULY 1997		
Ariane 44P	Intelsat 8 F2	Kourou
Atlas 2AS	Superbird C1	CCAS
Delta 2 7925	Iridium 11	VAFB
	Iridium 12	
	Iridium 13	
	Iridium 14	
	Iridium 15	
H 2	COMETS 1	Tanegashima
Proton SL-12	PAS 5	Tyuratam
Shuttle Discovery	STS 85	KSC
	CRISTA SPAS 2	
Soyuz SL-4	Progress M-35	Tyuratam
AUGUST 1997		
Ariane 4-TBA	Hot Bird Plus 3	Kourou
	IndoStar 1	
Atlas 2AS	EchoStar 3	CCAS
Delta 2 7925	Iridium 16	VAFB
	Iridium 17	
	Iridium 18	
	Iridium 19	
	Iridium 20	
Long March 2C	Iridium 21	Taiyuan
	Iridium 22	
Long March 2C	Iridium 23	Taiyuan
	Iridium 24	
Pegasus XL	MUBLCOM	VAFB
	TERRIERS	
Proton SL-12	Astra 1G	Tyuratam
Titan 4/Centaur	USA 1997-08	CCAS
Soyuz SL-4	Soyuz TM-26	Tyuratam
SEPTEMBER 1997		
Ariane 4-TBA	Sirius 2	Kourou
Ariane 5	Phase 3D	Kourou
Atlas 2AS	Galaxy 8I	CCAS
LMLV 2	Lunar Prospector	CCAS
M 5	Lunar A	Kagoshima
Proton SL-12	Iridium 25	Tyuratam
	Iridium 26	
	Iridium 27	
	Iridium 28	
	Iridium 29	
	Iridium 30	
	Iridium 31	
Proton SL-12	Sky 1	Tyuratam
Shuttle Endeavour	STS 86	KSC
Soyuz SL-4	Progress M-35	Tyuratam

LAUNCH SCHEDULE

Additional Launch Events to be Announced †

† 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

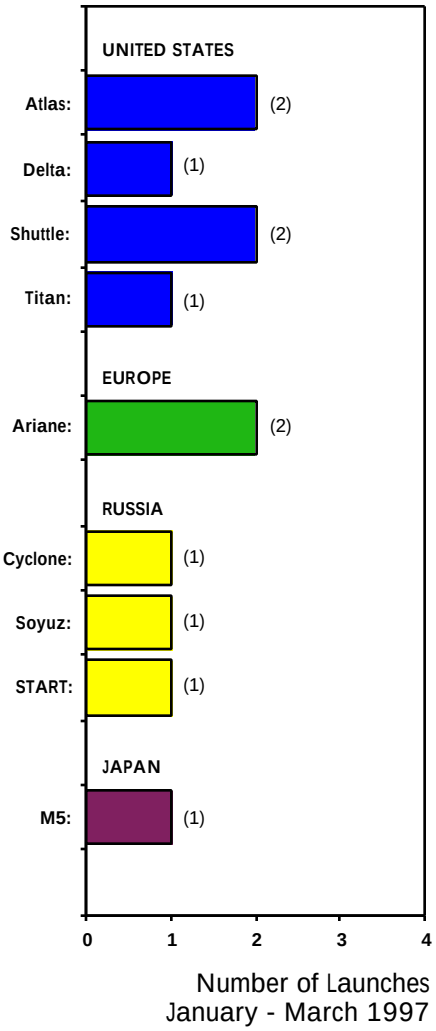
For the Second and Third Quarter 1997

Vehicle	Payload	Site
SECOND QUARTER OF 1997		
Long March 3	FY 2-1	Xichang
THIRD QUARTER OF 1997		
Delta 2 7920	Argos Oersted Sunsat	VAFB
Delta 2 7925	Navstar GPS 2-28	CCAS
Delta 2 7925	Navstar GPS 2R- 2	CCAS
Long March 3B	Sinosat 1	Xichang
Long March 3B	APStar 2R	Xichang
VLS	SCD 2A	Alcantara

LAUNCH REPORT

Launch Events

First Quarter
1997



Number of Launches
January - March 1997

The United States made six of the 12 launches that took place in the first quarter of 1997. Two of these launches, both of the quarter's Atlas launches, were commercial with communications payloads. The remaining four non-commercial launches were divided between two Shuttle missions and two military launches. The military launches were the first block 2R Navstar GPS satellite on a Delta launch vehicle and a DSP satellite on the first Titan 4B launch. Unfortunately the Navstar 2R payload was lost when one of its Delta launch vehicle's solid rocket motors ruptured and destroyed the vehicle.

The Russian Republic/CIS conducted three launches with eight payloads. The first of these was a crewed mission to Mir launched on a Soyuz booster. The second was a Cyclone launch of multiple store-and-forward communication satellites. Six satellites were launched, three civil Gonets satellites and three military satellites under the Kosmos (2337-2339) designator. The third and final launch was a START launch vehicle with the Zeya geodesy and amateur radio satellite designed jointly by the students of the Mozhaisky military space engineering academy and NPO PM.

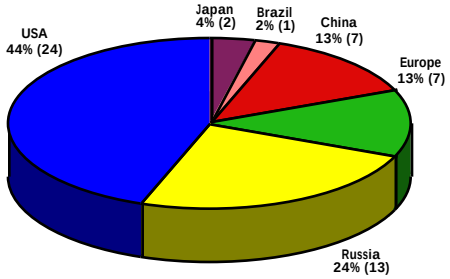
Two European Ariane 4 commercial launches put the GE 2, Nahuel 1A, and Intelsat 8 F1 communication satellites in orbit.

Japan successfully inaugurated the M 5 launch vehicle when it put the Muses B radio astronomy satellite in orbit.

LAUNCH REPORT

Scheduled Launch Events

Second and Third Quarter 1997



Scheduled Launch Events, by Region
April - September 1997

(includes small launch vehicles, excludes sub-orbital launch events)

The second and third quarters of 1997 will see 54 orbital launches conducted by six nations. Of these, 24 will be on United States launch vehicles and 13 on Russian vehicles. Seven each will go on Europe's Ariane and China's Long March vehicles. Finally, Japan will launch twice and Brazil once in the next two quarters.

The United States will launch 24 times. Of these, seven launches will carry communications payloads, four will be crewed shuttle missions, two each will be for meteorology and navigation. Three will be remote sensing and another five will carry scientific payloads. The purpose of the one remaining launch is classified.

Launches from the Russian Republic/CIS will total 13. They will include six launches with communications payloads, and one each for remote sensing, navigation, and intelligence. There will also be two crewed and three supply flights to support the Mir space station.

Europe's Ariane 5 will return to flight in this period. There will also be six Ariane 4 launches all with communication payloads.

China is projected to make seven Long March launches, all but one of which will carry communications payloads. The remaining launch on a Long March 3 will be a meteorological satellite.

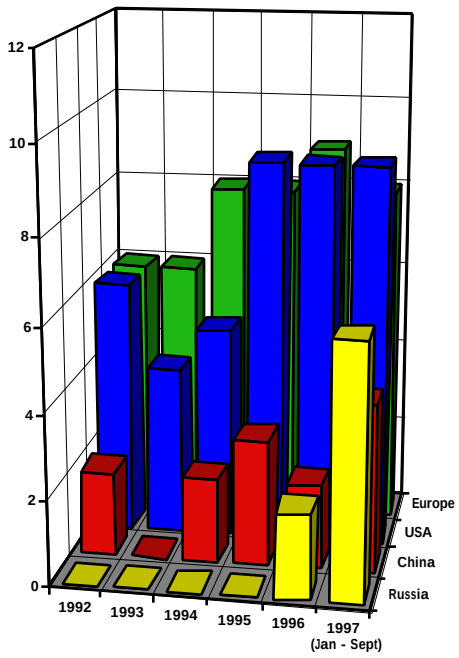
Japan will launch two scientific payloads, one each on the H2 and M5 vehicles.

Brazil will launch SCD 3, a data relay satellite, on the initial launch of its VLS launch vehicle.

LAUNCH REPORT

Scheduled Commercial Launch Events

Second and Third Quarter 1997



Commercial Launch Events
January 1992 - September 1997
(Small Vehicles Excluded)

Thirty of the 54 launches in the next two quarters will be commercial (26 are internationally competed launches). These launches will be conducted by the United States, The Russian Republic/CIS, Europe, and China.

Nine of 24 United States launches will be internationally competed, another four will be OCST licensed but are not internationally competed. This is the first time that OCST-licensed launches outnumber non-commercial United States launches. Two of the United States internationally competed launches will be scientific payloads on Pegasus launch vehicles. The remainder will be communication payloads, four GEO and three LEO. Three of the GEO communications satellites will be on Atlas launch vehicles with the remaining one on a Delta. The three LEO launches will all take place on Delta launch vehicles placing 13 Iridium satellites into LEO orbits.

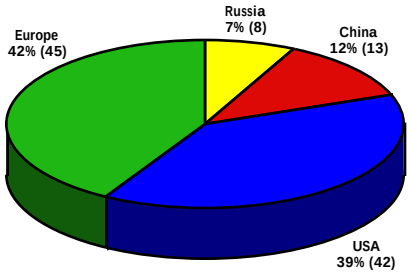
Europe intends to conduct six commercial launches of the Ariane 4, placing 9 communication satellites in GEO.

The Russian Republic/CIS intends to conduct seven commercial launches. One of these launches will loft the EarlyBird remote sensing satellite on a START launch vehicle. The remaining six launches are all on Proton launch vehicles with four launches of four GEO communication satellites, and two launches carrying 14 Iridium LEO communication satellites.

China's four commercial launches will be evenly divided between GEO and LEO payloads with two launches carrying four Iridium satellites and two launches of larger GEO communications satellites.

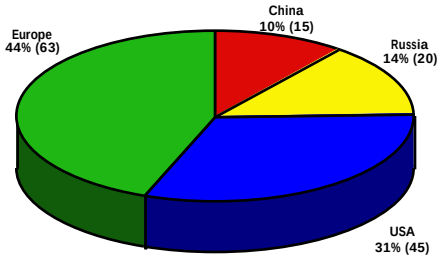
LAUNCH REPORT

Commercial Launch Trends



Commercial Launch Market Trend
January 1992 - September 1997

(Small Vehicles Excluded)



Internationally Competed Payloads Market Trend
January 1992 - September 1997

(Small Vehicles Excluded)

In the period of January 1992 through the end of the third quarter of 1997, it is estimated that there will be a total of 108 internationally competed commercial launch events (excluding small launch vehicles). Of these, the United States will have captured 42 launches or 39 percent. In terms of payloads, the United States will have launched 45 of the 143 internationally competed payloads in this period.

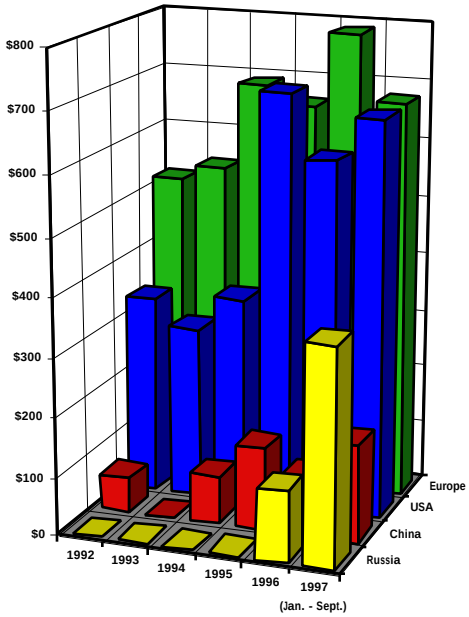
Europe's Arianespace will launch 45 times for a 42 percent share of launches, carrying 63 payloads or 44 percent of total internationally competed payloads in this period. China will have launched 13 times with 15 payloads for a ten percent share of internationally competed payloads, and a twelve percent share of launches. The Russian Republic/CIS has only been in the commercial launch business for two years, but, by September, it will have conducted eight commercial launches for a seven percent share. Russia will deploy 20 payloads for 14 percent of internationally competed payloads in this period.

Arianespace's payload share has dropped considerably from previous quarters. This is largely due to the fact that the United States, Russia, and China will all launch multiple sets of Iridium LEO communication satellites in the next two quarters. The United States' Delta will first launch a set of three and then two sets of five Iridium satellites. Russia will launch seven at a time on the Proton booster and China will use the Long March 2C to launch two pairs of Iridium satellites.

In the nine month period covered by this report, January 1997 through September 1997, there are 30 internationally competed launch events with 59 payloads. Once again, these figures are strongly affected by the multiple-payload Iridium launches. The United States holds 37 percent of launches (11 launches) and 36 percent of payloads (21 payloads). Europe has nine launches (30 percent) and 14 payloads (24 percent of payloads), while China's share is four launches (13 percent) and six payloads (ten percent of payloads). Russia launches 18 payloads on six launch vehicles for 31 percent of payloads and 20 percent of launches respectively.

LAUNCH REPORT

Commercial Launch Revenues



Commercial Launch Revenues by Region (in US $ Millions)*

January 1992 - September 1997

* Graph reflects approximate revenues based on actual price quotes and historical price averages. Launch vehicle pricing data is currently being verified for historical accuracy, which may affect figures shown in future quarterly launch reports. Figures here are shown in constant 1994 dollars. Includes small vehicles.

In the first three quarters of 1997, revenues for internationally competed launch events are expected to total $1,883 million. The United States and Europe both will have a 36-percent share of these revenues with $673 million and $678 million respectively. The Russian Republic/CIS holds an estimated 19-percent share with $368 million and China will have a nine-percent share with $165 million.

While Russia and China continue to hold the same basic share as reported during the last quarter, the United States has gained market share and Europe has lost market share. In this nine-month period, United States internationally competed launch revenues are equal to those of the European Arianespace, an increase over last quarter's projections.

Special Report

THE WORLDWIDE GROWTH OF LAUNCH VEHICLE TECHNOLOGY AND SERVICES

In the next five years, there will be an unprecedented number of new launch vehicles attempting to gain some portion of the commercial launch market. Some of these are the result of large existing programs like Arianespace's Ariane 5. Others are the first steps of emerging space capable nations like Brazil with its VLS launch vehicle. The launch vehicles involved range from small vehicles, such as Israel's Shavit, to large GEO-capable launchers like Japan's H2A. Many different technologies are being introduced: reusable launch vehicles like the Kistler K-1, new expendable vehicles like India's GSLV, and evolutionary developments of current vehicles like Lockheed Martin's Atlas 2AR.

This report will discuss primarily those vehicles being introduced by the newly emerging space nations. India, Israel, and Brazil are all trying to turn launch vehicle assets into profitable businesses. In this effort, they have found the technological development process less of a problem than the restraints imposed by outside factors like the Missile Technology Control Regime (MTCR). Such restraints have caused the greatest delays in the production of commercial launch vehicles as will be discussed for each case below.

This report will also discuss the changing trends in launch vehicle procurement and their possible effects on missile proliferation as well as on the United State's launch vehicle industry. In particular, the possibility of "Turn Key" launch systems will be considered along with their implications for changes in current launch practices.

INDIA

The most experienced of the new entrants into the commercial space market is India. India was the seventh nation to orbit a payload on an indigenous launch vehicle when it launched Rohini 1B on the Satellite Launch Vehicle (SLV) in 1980. It is currently marketing the Polar Satellite Launch Vehicle (PSLV) for commercial launches, and also plans to market the Geosynchronous Satellite Launch Vehicle (GSLV) once it is proven (it has not yet flown). Indian launch vehicles are marketed by the Antrix Corporation, LTD, a commercial marketing organization created by the Indian Department of Space (DOS). Both the PSLV and GSLV use India's launch facilities at Sriharikota.

The PSLV has been launched three times, including its initial launch in September of 1993. The first flight was a failure but the last two in October of 1994 and March of 1996 were successful. Its last two flights have put the IRS P2 and P3 into LEO orbits. The PSLV is not capable of putting large payloads into a geosynchronous orbit but it has provided a technological basis for the development of the GSLV, which can deliver payloads to GEO.

The GSLV will be able to launch a 2.5 ton payload into a geosynchronous transfer orbit (GTO). Its first flight is expected to take place in the year 2000. The GSLV is designed for the 2095 kg Insat-2-class of geosynchronous satellites but will be able to launch other commercial payloads when testing is complete. The GSLV program has suffered a two-year delay caused by problems importing Russian liquid propellant rocket engine technology.

Originally, India had planned to buy, rather than develop, additional rocket engine technology to augment the PSLV technology for the GSLV. Protests by the United States under the MTCR threw these plans into disorder and resulted in the development of an Indian engine. Russian engines will be imported (without the production technology needed to build them) for use on early GSLV flights, but the final commercial vehicle will be powered by entirely indigenous engines.

ISRAEL

Israel is the eighth and latest member of the space launch club with the launch of the Shavit (which is Hebrew for 'Comet') launch vehicle carrying the Ofeq 1 in 1988. Shavit was designed for the delivery of small (160 kg) payloads into LEO orbits. Israel has successfully launched the Shavit three times between 1988 and 1995 but, as of yet, has made no commercial sales. An upgraded version of the Shavit called NEXT is under development for commercial use.

In joining the commercial launch market, Israel has a particular problem with its launch site at Palmachim Air Force Base north of Tel Aviv. Because Israel is constrained from launching over neighboring countries, its launch facility has severely limited trajectories available for launches. Because of this limitation, Israel has a particular interest in launches from non-Israeli sites.

Israel has sought an exemption from the presidential directive requiring that US payloads launched from the United States also be launched on US vehicles. It has also unsuccessfully proposed the Shavit (in conjunction with United States partners) for NASA's Meteor program in 1990 and for the ultralight launcher competition in 1994. Currently, efforts are being made to get permission to launch the Shavit from Wallops Island, Virginia.

As with India's launch vehicle program, the MTCR has been a major roadblock to the success of the Shavit. Because many believe that the Shavit is developed from the Israeli Jerico 2 ballistic missile, it has been argued that the United States should not support Israeli efforts to market this technology. To do so, it is suggested, would weaken efforts to reduce tensions in the Middle East and would violate the MTCR.

BRAZIL

Brazil has yet to launch an indigenous launch vehicle but it plans to do so soon and become the ninth country to have its own launch vehicle capability. Current plans are to launch the first Veiculo Lancador de Satelites (VLS) launch vehicle sometime this year. It will carry the Brazilian SCD satellite into a LEO orbit. Like the Shavit, VLS is intended to put small payloads (in the 200 kg range) into LEO orbits. Also, like the Shavit, it is intended to become a commercial money maker for its builders.

The original timetable for the VLS called for a first launch in 1992 but Brazil's access to the necessary technology was limited by the MTCR. Because of this, the VLS had to be redesigned, a process which added five years to its development time. Four development flights are planned. If they are

successful, the VLS will be offered on the international commercial launch market.

	Initial Launch Date	Orbit Type	Payload Weight
India			
PSLV	1993	LEO GTO	2200 lbs 990 lbs
GSLV	2000	LEO GTO	11000 lbs 5500 lbs
Israel			
Shavit	1988	LEO	350 lbs
Brazil			
VLS	1997	LEO	440 lbs

TURN-KEY LAUNCH SYSTEMS

Beyond these new sources for commercial launchers, it is also becoming possible to buy "Turn-key" launch systems that will enable instant access to space. Both the Israeli Shavit and the Russian START launch vehicle have been offered to third parties for their own use. As previously mentioned, the Shavit has already been offered to teams of US companies for a number of NASA contracts as well as the more recent Wallops Island proposal.

In the case of START, Russia's STC Complex has already signed a "turn-key launch services package"[1] agreement with SpacePort Canada. Under the terms of this agreement, START vehicles would be launched from Churchill, Manitoba, on the shore of the Hudson Bay in Canada. Just as the launch of Shavit vehicles from Wallops Island would greatly increase their possible trajectories, the launch of START vehicles from SpacePort Canada would also open new orbital possibilities to users of the START vehicles.

MIXED NATIONALITY LAUNCHES

Another important development is the growing possibility of commercial launches of vehicles from sites in other countries. In recent years, proposals have been made for the launch of Russian Proton rockets from Cape Canaveral Air Station (CCAS) in Florida, Alcantara in Brazil, and from a proposed Australian Spaceport. There have also been proposals that the United States Delta or Ukrainian Cyclone launch vehicles use the ELA-2 Ariane 4 facilities at the Guinea Space Center (Kourou) once all Arianespace payloads have been shifted to Ariane 5 vehicles. There have even been suggestions that the X-33's commercial follow-on , the Lockheed Martin Venture Star, might be launched from outside of the United States in some cases.

In addition to the possibility of mixed nationality launches from fixed sites there are also site-free launch vehicles. Two of these vehicles are the Sea Launch Zenit, which is launched from a mobile ocean platform, and the OSC Pegasus which is launched from an aircraft. Neither of these launch vehicles call for ground based infrastructure as do pad-launched rockets. These mobile launch sites also allow one nation's launch vehicles to be launched from another country's "soil," but on a one-at-a-time basis. The upcoming Minisat 01 launch

[1] "Spaceport Deal Signed" in *Space News*, October 14-20, 1996, page 1

from Spain is an example of the flexibility of such vehicles.

Financial Implications of Mixed Nationality Launches

All of these suggestions raise a variety of important issues about the nature of the commercial launch business. As has been reported in Space News[2], Orbital Sciences Corporation (OSC) has gone on record against the Israeli use of United States launch sites because they are funded through US taxes, not just user fees.[3] OSC feels that foreign developed launch vehicles would have an advantage over domestic US vehicles if they were allowed to launch from United States launch sites.

At the same time that United States launch vehicle builders are concerned about foreign competition, commercial spaceports have taken a different view. Groups concerned with the Florida Spaceport have pushed for both Shavit and Proton launches from Florida in the hopes of raising the number of launches from Florida sites. The United States-based commercial spaceports are seeking launch opportunities, regardless of the origin of the launch vehicle. These trends are indicative of a maturing launch market but it is not clear at this point where they will lead.

Vehicle	Country of Origin	Suggested Launch Site
Cyclone	Ukraine	Guinea Space Center (Kourou)
Delta	United States	Guinea Space Center (Kourou)
Proton	Russia	CCAS, Florida; Alcantara, Brazil; Australia
Shavit	Israel	Wallops Island, VA; CCAS, Florida
START	Russia	SpacePort Canada, Manitoba, Canada

---

2 Warren Ferster, "Israel Spurs Policy Debate With Bid for U.S. Launches," in *Space News*, February 17-23, 1997, page 1

3 Current United States law calls for commercial users to pay only the marginal cost of using United States launch ranges. The rest of the expense of maintaining these sites is borne by the tax payer and ultimately, in part, by commercial entities like OSC. Foreign users would not bear these additional expenses.

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

APT Asia Pacific Telecommunications
BSAT Broadcast Satellite System Corp. Satellite
CAST Chinese Academy of Space Technology
CCAS Cape Canaveral Air Station
COMETS - Communications and Broadcasting and Tech Satellite
CRISTA SPAS - Cryogenic Infrared Spectrometer telescope for Atmosphere-Space Pallet Satellite
CIS Commonwealth of Independent States
DARA German Space Agency
DASA Deutsche Aerospace
DFH Dong Fang Hong
DMSP Defense Meteorological Satellite Program
DoD Department of Defense
DoT Department of Transportation
DSP Defense Support Program
EELV Evolved Expendable Launch Vehicle
ELI Elliptical
ELINTS Electronic intelligence satellites
ELV Expendable Launch Vehicle
ESA European Space Agency
EXT Extra-Orbital
FAA Federal Aviation Administration
FSW Fanhui Shi Weixing
FY Feng Yun
GE General Electric
GEO Geosynchronous Orbit
GOES Geostationary Operational Environmental Satellite
GSLV Geosynchronous Satellite Launch Vehicle
GTO Geosynchronous Transfer Orbit
IKI Space Research Institute
INMARSAT - International Maritime Satellite Organization
IRS Indian Resource Satellite
INTA Instituto Nacional de Tecnica Aeroespacial
INTELSAT - International Telecommunications Satellite Organization
ISAS Institute of Space and Astronautical Science
JCSAT Japan Communications Satellite Co. Satellite
JPL Jet Propulsion Laboratory
JSAT Japan Satellite Systems, Inc.
KB Design Bureau
KSC Kennedy Space Center
LEO Low Earth Orbit
LMLV Lockheed Martin Launch Vehicle
MEO Middle Earth Orbit
MTCR Missile Technology Control Regime
MoD Ministry of Defense
NASA National Aeronautics and Space Administration
NASDA National Space Development Agency (Japan)
NEC Nippon Electric Corp.
nMI Nautical Mile
NOAA National Oceanic and Atmospheric Administration
NPO Scientific Production Organization
OCST Office of Commercial Space Transportation
OSC Orbital Sciences Corporation
PAS Pan American Satellite
PSLV Polar Satellite Launch Vehicle
PTT Post Telegraph and Telecommunications
RKK Energia - Rocket and Space Company Energia
SCD Satellite de Coleta de Dados
SES Societe Europeene des Satellites
SLV Satellite Launch vehicle
SSTI Small Spacecraft Technology Initiative
STS Space Transportation System
SNOE Student Nitric Oxide Explorer
TERRIERS - Tomographic Experiment using Radiative Recombinitive Ionospheric EUV and Radio Sources
VAFB Vandenberg Air Force Base
VLS Veiculo Lancador de Satellites
XL Extra Long

Characteristics of Cited Vehicles

Vehicle Designation	(Success + Partials) / Attempts	LEO 28 Degrees	GTO	GEO	Suborbital	Price per Launch (Approximate)	Launch Sites
Heavy							
Ariane 5	0/1|0%	39600lbs 18000kg	15000 lbs 6800 kg	N/A	N/A	$130 M	Kourou
Long March 3B	0/1|0%	29900 lbs 13600 kg	9900 lbs 4500 kg	4950 lbs 2240 kg	N/A	$50-70 M	Xichang
Proton SL-12	188/209|89%	46297lbs 21000 kg	12100 lbs 5500 kg	4850 lbs 2200 kg	N/A	$50-70 M	Tyuratam
Shuttle Atlantis	16/16|100%	47300 lbs 21455 kg	13007 lbs 5900 kg	5202 lbs 2360 kg	N/A	$161-215 M	KSC
Shuttle Columbia	21/21|100%	47300 lbs 21455 kg	13007 lbs 5900 kg	5202 lbs 2360 kg	N/A	$161-215 M	KSC
Shuttle Discovery	23/23|100%	47300 lbs 21455 kg	13007 lbs 5900 kg	5202 lbs 2360 kg	N/A	$161-215 M	KSC
Shuttle Endevour	11/11|100%	47300 lbs 21455 kg	13007 lbs 5900 kg	5203 lbs 2360kg	N/A	$161-215 M	KSC
Titan 4/Centaur	7/0|100%	39100 lbs 17736 kg	14000 lbs 6350 kg	10200 lbs 4627 kg	N/A	$255 M	CCAS
Titan 4B/IUS	1/0|100%	47800 lbs 21727 kg	N/A	12700 lbs 5772 kg	N/A	N/A	CCAS,VAFB
Intermediate							
Ariane 44LP	15/16|93.8%	18300 lbs 8300 kg	8950 lbs 4060 kg	N/A	N/A	$80-95 M	Kourou
Ariane 44P	7/7|100%	15200 lbs 6900 kg	7320 lbs 3320 kg	N/A	N/A	$80-95 M	Kourou
Atlas 1	8/10|80%	12569 lbs 5700kg	4970lbs 2255 kg	2511 lbs 1140 kg	N/A	$65-75 M	CCAS
Atlas 2A	11/11|100%	16050 lbs 7280 kg	6700 lbs 3039 kg	3306 lbs 1500 kg	N/A	$80-90 M	CCAS
Atlas 2AS	8/8|100%	19050 lbs 8640 kg	7950 lbs 3606 kg	4604 lbs 2090 kg	N/A	$95-105 M	CCAS, VAFB
H 2	7/7|100%	23000 lbs 10500 kg	8800 lbs 4000kg	4800 lbs 2200 kg	N/A	$170-190 M	Tanegashima
Long March 3A	2/2|100%	15800 lbs7200 kg	5500 lbs 2500 kg	2700 lbs 1230 kg	N/A	$40-45 M	Xichang
Soyuz SL-4	933/940|99.3%	15400 lbs 7000 kg	N/A	N/A	N/A	$20-25 M	Plesetsk, Tyuratam
Medium							
Cyclone SL-14	113/114|99.1%	8818 lbs 4000 kg	N/A	N/A	N/A	$15-20 M	Plesetsk
Delta 2 7920	4/4|100%	11109 lbs 5039kg	2800 lbs 1270kg	N/A	N/A	$45-50 M	CCAS,VAFB
Delta 2 7925	37/38|97.4%	11220 lbs 5089 kg	4060 lbs 1840 kg	2000 lbs 907 kg	N/A	$45-50 M	CCAS,VAFB
LMLV 2	N/A	4390 lbs 1990 kg	N/A	N/A	N/A	$20 M	CCAS,VAFB
Long March 2C	14/14|100%	7040 lbs 3200 kg	2200 lbs 1000 kg	860 lbs 390 kg	N/A	$15-20 M	Jiuquan
Long March 3	10/11|91%	11023 lbs 5000 kg	3100 lbs 1400 kg	1600 lbs 730 kg	N/A	$35-40 M	Xichang
Titan 2	4/5|80%	7900 lbs 3583 kg	N/A	N/A	N/A	$41-46 M	VAFB
Small							
Cosmos SL-8	406/410|99%	3100 lbs 1400 kg	N/A	N/A	N/A	$10-14 M	Kapustin Yar, Plesetsk, Tyuratam
LMLV 1	0/1|0%	1755 lbs 800kg	N/A	N/A	N/A	$16 M	CCAS,VAFB
M5	1/1|100%	400 lbs 1800 kg	2680 lbs 1215 kg	1080 lbs 490 kg	N/A	$41-46	Kagoshima
Molniya SL-6	289/304|95%	3970 lbs 1800 kg	N/A	N/A	N/A	$19 M	Plesetsk, Tyuratam
Pegasus XL	3/5|60%	943 lbs 428 kg	322 lbs 146 kg	181 lbs 82 kg	N/A	$12-14 M	VAFB, Wallops Island
START 1	2/2|100%	360 lbs 790 kg	N/A	N/A	N/A	$5-10 M	Plesetsk
VLS	N/A	440 lbs 200 kg	N/A	N/A	N/A	N/A	Alcantara

Characteristics of Cited Payloads

Payload	Use	Price	Orbit	Apogee	Perigee	Launch Mass	Mass in orbit	Freq. Bands & trans.	Stab.	Power
Classified										
USA 1997-08	Classified	N/A	GEO TBA	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Communications										
Agila 2	Communications	N/A	GEO 155° E	N/A	N/A	N/A	N/A	N/A	N/A	N/A
APStar 2R	Communications	N/A	GEO 76.5° E	N/A	N/A	8140 lbs / 3700 kg	N/A	15 Ku, 1 Ku	N/A	N/A
Astra 1G	Communications	N/A	GEO 19.2° E	19305 nMI	19305 nMI	7260 lbs / 3300 kg	N/A	32 Ku	3-axis	N/A
BSAT 1	Communications	N/A	GEO 110° E	19330 nMI	19305 nMI	2750 lbs / 1250 kg	N/A	4 Ku	Spin	N/A
DFH 3-2	Communications	N/A	GEO 125° E	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EchoStar 3	Communications	N/A	GEO 298.5° E	N/A	N/A	6600 lbs / 3000 kg	N/A	16 Ku	3-axis	N/A
Galaxy 8I	Communications	N/A	GEO 265° E	19330 nMI	19322 nMI	6572 lbs / 2987 kg	N/A	24 Ku, 24 C	N/A	N/A
GE 2	Communications	N/A	GEO 275° E	19375 nMI	19375 nMI	5687 lbs / 2585 kg	N/A	24 Ku, 24 C	N/A	N/A
Gonets D1 04	Communications	N/A	LEO	756 nMI	756 nMI	528 lbs / 240 kg	N/A	N/A	N/A	N/A
Gonets D1 05	Communications	N/A	LEO	756 nMI	756 nMI	528 lbs / 240 kg	N/A	N/A	N/A	N/A
Gonets D1 06	Communications	N/A	LEO	756 nMI	756 nMI	528 lbs / 240 kg	N/A	N/A	N/A	N/A
Hot Bird Plus 3	Communications	N/A	GEO 13° E	N/A	N/A	6380 lbs / 2900 kg	N/A	20 Ku	N/A	N/A
IndoStar 1	Communications	N/A	GEO 106.1° E	N/A	N/A	2442 lbs / 1110 kg	N/A	5 S	N/A	N/A
Inmarsat 3 F4	Communications	N/A	GEO TBA	N/A	N/A	4352 lbs / 1978 kg	N/A	2 C, 1 L,	N/A	N/A
Insat 2D	Communications	N/A	GEO 74° E	N/A	N/A	4609 lbs / 2095 kg	N/A	1 Ku, 2 Ku,	N/A	N/A
Intelsat 8 F1	Communications	$74 M	GEO 174° E	19356 nMI	19319 nMI	8123 lbs / 3692 kg	N/A	38 C, 6 Ku	3-axis	N/A
Intelsat 8 F2	Communications	N/A	GEO 177° E	N/A	N/A	8122 lbs / 3692 kg	N/A	6 Ku, 18 C,	N/A	N/A
Iridium 1	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 2	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 3	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 4	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 5	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 6	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 7	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 8	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 9	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 10	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 11	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 12	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A

Characteristics of Cited Payloads

Payload	Use	Price	Orbit	Apogee	Perigee	Launch Mass	Mass in orbit	Freq. Bands & trans.	Stab.	Power
Iridium 13	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 14	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 15	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 16	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 17	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 18	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 19	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 20	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 21	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 22	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 23	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 24	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 25	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 26	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 27	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 28	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 29	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 30	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
Iridium 31	Communications	N/A	LEO	419 nMI	419 nMI	1496 lbs / 680 kg	N/A	1 L, 1 Ka	N/A	N/A
JCSAT 4	Communications	N/A	GEO TBA	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kosmos 2337	Communications	N/A	LEO	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kosmos 2338	Communications	N/A	LEO	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kosmos 2339	Communications	N/A	LEO	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nahuel 1A	Communications	N/A	GEO 288.2° E	N/A	N/A	4003 lbs / 1820 kg	N/A	18 Ku	N/A	N/A
Orbcomm 03	Communications	N/A	LEO	419 nMI	411 nMI	87 lbs / 40 kg	N/A	N/A	N/A	N/A
PAS 5	Communications	N/A	GEO 302° E	N/A	N/A	8184 lbs / 3720 kg	N/A	24 Ku, 24 C	N/A	N/A
PAS 6	Communications	N/A	GEO 317° E	N/A	N/A	6644 lbs / 3020 kg	N/A	36 Ku	N/A	N/A
SCD 2A	Communications	N/A	LEO	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sinosat 1	Communications	N/A	GEO TBA	N/A	N/A	7683 lbs / 3492 kg	N/A	14 Ku, 24 C	N/A	N/A
Sirius 2	Communications	N/A	GEO 5.2° E	N/A	N/A	6354 lbs / 2888 kg	N/A	26 Ku, 8 Ku	N/A	N/A
Sky 1	Communications	N/A	GEO 250° E	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Superbird C1	Communications	N/A	GEO 144° E	N/A	N/A	5938 lbs / 2699 kg	N/A	4 Ku, 4 Ku,	N/A	N/A

Characteristics of Cited Payloads

Payload	Use	Price	Orbit	Apogee	Perigee	Launch Mass	Mass in orbit	Freq. Bands & trans.	Stab.	Power
Telstar 5	Communications	N/A	GEO 267° E	N/A	N/A	7683 lbs / 3492 kg	N/A	4 Ku, 24 Ku	N/A	N/A
Tempo 2	Communications	N/A	GEO 241.2° E	N/A	N/A	7683 lbs / 3492 kg	N/A	32 Ku	N/A	N/A
Thaicom 3	Communications	N/A	GEO 78.5° E	N/A	N/A	6270 lbs / 2850 kg	N/A	2 Ku, 12 Ku	N/A	N/A
Thor 2A	Communications	N/A	GEO 359° E	N/A	N/A	2640 lbs / 1200 kg	N/A	15 Ku	N/A	N/A
Crewed										
Soyuz TM-25	Crewed	N/A	LEO	221 nMI	213 nMI	15554 lbs / 7070 kg	14969 lbs / 6804kg	N/A	N/A	N/A
Soyuz TM-26	Crewed	N/A	LEO	221 nMI	213 nMI	15554 lbs / 7070 kg	14969 lbs / 6804kg	N/A	N/A	N/A
Soyuz TM-27	Crewed	N/A	LEO	221 nMI	213 nMI	15554 lbs / 7070 kg	14969 lbs / 6804kg	N/A	N/A	N/A
Development										
Argos	Development	N/A	LEO	450 nMI	450 nMI	N/A	N/A	N/A	N/A	N/A
Geodesy										
Zeya	Geodesy	N/A	LEO	259 nMI	252 nMI	N/A	N/A	N/A	N/A	N/A
Intelligence										
DSP 18	Intelligence	N/A	GEO TBA	19305 nMI	19305 nMI	5192 lbs / 2360 kg	N/A	N/A	N/A	1274 W
Kosmos 2340	Intelligence	N/A	ELI	21600 nMI	324 nMI	N/A	N/A	N/A	N/A	N/A
Meteorological										
DMSP 5D-2-F14	Meteorological	N/A	LEO	462 nMI	451 nMI	1826 lbs / 830 kg	N/A	N/A	3-axis	1000 W
FY 2-1	Meteorological	$35 M	GEO 105° E	N/A	N/A	2640 lbs / 1200 kg	1323 lbs / 601kg	N/A	Spin	N/A
GOES K	Meteorological	N/A	GEO TBA	19330 nMI	19323 nMI	3991 lbs / 1814 kg	N/A	N/A	N/A	N/A
Navigation										
Kosmos 2341	Navigation	N/A	LEO	548 nMI	528 nMI	N/A	N/A	N/A	N/A	N/A
Navstar GPS 2-28	Navigation	N/A	MEO	10899 nMI	10899 nMI	4138 lbs / 1881 kg	N/A	1 L	N/A	N/A
Navstar GPS 2R- 1	Navigation	N/A	MEO	10899 nMI	10899 nMI	4138 lbs / 1881 kg	N/A	1 L	N/A	N/A
Navstar GPS 2R- 2	Navigation	N/A	MEO	10899 nMI	10899 nMI	4470 lbs / 2032 kg	N/A	1 L	N/A	N/A
Remote Sensing										
Clark	Remote Sensing	$49 M	LEO	268 nMI	268 nMI	612 lbs / 278 kg	N/A	N/A	N/A	N/A
Earlybird 1	Remote Sensing	N/A	LEO	254 nMI	254 nMI	682 lbs / 310 kg	N/A	N/A	N/A	N/A
Lewis	Remote Sensing	N/A	LEO	282 nMI	282 nMI	803 lbs / 365 kg	N/A	N/A	N/A	N/A
Seastar	Remote Sensing	N/A	LEO	432 nMI	N/A	603 lbs / 274 kg	N/A	N/A	N/A	N/A
Scientific										
COMETS 1	Scientific	N/A	GEO 121° E	N/A	N/A	7583 lbs / 3447 kg	N/A	1 S, 2 Ka	N/A	N/A
CRISTA SPAS 2	Scientific	N/A	LEO	162 nMI	162 nMI	N/A	N/A	N/A	N/A	N/A
Lunar A	Scientific	N/A	EXT	N/A	N/A	1199 lbs / 545 kg	N/A	N/A	N/A	N/A

Characteristics of Cited Payloads

Payload	Use	Price	Orbit	Apogee	Perigee	Launch Mass	Mass in orbit	Freq. Bands & trans.	Stab.	Power
Lunar Prospector	Scientific	N/A	EXT	N/A	N/A	513 lbs / 233 kg	N/A	N/A	N/A	N/A
Minisat 01	Scientific	N/A	LEO	324 nMI	324 nMI	442 lbs / 201 kg	N/A	N/A	N/A	N/A
Muses B	Scientific	N/A	ELI	10800 nMI	540 nMI	1756 lbs / 798 kg	N/A	N/A	N/A	N/A
Oersted	Scientific	N/A	LEO	464 nMI	243 nMI	136 lbs / 62 kg	N/A	N/A	N/A	44 W
Phase 3D	Scientific	N/A	EXT	25380 nMI	2160 nMI	1100 lbs / 500 kg	N/A	N/A	N/A	N/A
SNOE	Scientific	N/A	LEO	297 nMI	297 nMI	220 lbs / 100 kg	N/A	N/A	N/A	N/A
Sunsat	Scientific	N/A	LEO	464 nMI	243 nMI	132 lbs / 60 kg	N/A	N/A	N/A	N/A
TERRIERS	Scientific	N/A	LEO	297 nMI	297 nMI	268 lbs / 122 kg	N/A	N/A	N/A	N/A
Supply										
Progress M-34	Supply	N/A	LEO	N/A	N/A	15950 lbs / 7250 kg	N/A	N/A	N/A	N/A
Progress M-35	Supply	N/A	LEO	N/A	N/A	15950 lbs / 7250 kg	N/A	N/A	N/A	N/A
Progress M-36	Supply	N/A	LEO	N/A	N/A	15950 lbs / 7250 kg	N/A	N/A	N/A	N/A

Launch Events
January - March 1997

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Outcome	Mission Outcome
Europe (ESA)								
				Ariane				
January 30, 1997	Ariane 44LP	GE 2	GE Americom	Lockheed Martin Corp.	Yes	Commercial	Success	Success
		Nahuel 1A	Nahuelsat	Aerospatiale	Yes	Commercial	Success	Success
February 28, 1997	Ariane 44P	Intelsat 8 F1	Intelsat	Lockheed Martin Astro Space	Yes	Commercial	Success	Success
Japan								
				M				
February 12, 1997	M 5	Muses B	ISAS	NEC	No	Non-Commercial	Success	Success
Russia/CIS								
				Cyclone				
February 14, 1997	Cyclone SL-14	Gonets D1 04	Smolsat (NPO PM, et. al)	NPO Prikladnoi Mekhaniki	No	Non-Commercial	Success	Success
		Gonets D1 05	Smolsat (NPO PM, et. al)	NPO Prikladnoi Mekhaniki	No	Non-Commercial	Success	Success
		Gonets D1 06	Smolsat (NPO PM, et. al)	NPO Prikladnoi Mekhaniki	No	Non-Commercial	Success	Success
		Kosmos 2337	Russia/CIS MoD	AO Polyot	No	Non-Commercial	Success	Success
		Kosmos 2338	Russia/CIS MoD	AO Polyot	No	Non-Commercial	Success	Success
		Kosmos 2339	Russia/CIS MoD	AO Polyot	No	Non-Commercial	Success	Success
				Soyuz				
February 10, 1997	Soyuz SL-4	Soyuz TM-25	RKK Energia	RKK Energia	No	Non-Commercial	Success	Success
				Start				
March 4, 1997	START 1	Zeya	Russia/CIS MoD	Russia/CIS	No	Non-Commercial	Success	Success

Launch Events
January - March 1997

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Outcome	Mission Outcome
USA								
				Atlas				
February 15, 1997	Atlas 2AS	JCSAT 4	Japan Satellite Systems, Inc. (JSAT)	Hughes	Yes	Commercial	Success	Success
March 8, 1997	Atlas 2A	Tempo 2	TCI Satellite Entertainment, Inc.	Space Systems/Loral	Yes	Commercial	Success	Success
				Delta				
January 17, 1997	Delta 2 7925	Navstar GPS 2R- 1	DoD	Rockwell International	No	Non-Commercial	Failure	Failure
				Shuttle				
January 12, 1997	Shuttle Atlantis	STS 81	NASA	Rockwell International	No	Non-Commercial	Success	Success
February 11, 1997	Shuttle Discovery	STS 82	NASA	Rockwell International	No	Non-Commercial	Success	Success
				Titan				
February 23, 1997	Titan 4B/IUS	DSP 18	DoD	TRW	No	Non-Commercial	Success	Success

Scheduled Launch Events
April - September 1997

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Site
Brazil							
			VLS				
3rd Qtr 1997	VLS	SCD 2A	IAE	IAE	No	Non-Commercial	Alcantara
China							
			Long March				
April 1997	Long March 3A	DFH 3-2	Chinese Broadcasting Satellite Corp.	Chinese Academy of Space Technology (CAST)	No	Non-Commercial	Xichang
June 1997	Long March 3B	Agila 2	Mabuhay Philippine Satellite Corp.	Space Systems/Loral	Yes	Commercial	Xichang
2nd Qtr 1997	Long March 3	FY 2-1	Chinese Academy of Space Technology	Shanghai Institute of Satellite Engineering	No	Non-Commercial	Xichang
August 1997	Long March 2C	Iridium 21 Iridium 22	Iridium, Inc. Iridium, Inc.	Lockheed Martin Corp. Lockheed Martin Corp.	Yes Yes	Commercial Commercial	Taiyuan
August 1997	Long March 2C	Iridium 23 Iridium 24	Iridium, Inc. Iridium, Inc.	Lockheed Martin Corp. Lockheed Martin Corp.	Yes Yes	Commercial Commercial	Taiyuan
3rd Qtr 1997	Long March 3B	Sinosat 1	SINO-Satellite Communications Co. Ltd.	EuraSpace	No	Non-Commercial	Xichang
3rd Qtr 1997	Long March 3B	APStar 2R	APT Satellite Co., Ltd.	Space Systems/Loral	Yes	Commercial	Xichang
Europe (ESA)							
			Ariane				
April 16, 1997	Ariane 44LP	BSAT 1 Thaicom 3	Telecommunications Advancement Org. Shinawatra Satellite Public Ltd., Co.	Hughes Aerospatiale	Yes Yes	Commercial Commercial	Kourou
May 2, 1997	Ariane 44P	PAS 6	Pan American Satellite Corp.	Space Systems/Loral	Yes	Commercial	Kourou

Scheduled Launch Events
April - September 1997

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Site
Europe (ESA)							
			Ariane continued...				
June 1997	Ariane 4-TBA	Inmarsat 3 F4 Insat 2D	Inmarsat ISRO	Lockheed Martin Corp. ISRO	Yes Yes	Commercial Commercial	Kourou
July 1997	Ariane 44P	Intelsat 8 F2	Intelsat	Lockheed Martin Corp.	Yes	Commercial	Kourou
August 1997	Ariane 4-TBA	Hot Bird Plus 3 IndoStar 1	Eutelsat PT MediaCitra IndoStar	Matra Marconi CTA Space Systems	Yes Yes	Commercial Commercial	Kourou
September 1997	Ariane 5	Phase 3D	Amsat	Amsat DL	No	Non-Commercial	Kourou
September 1997	Ariane 4-TBA	Sirius 2	Nordska Satellitaktiebolaget (NSAB)	Aerospatiale	Yes	Commercial	Kourou
Japan							
			H				
July 1997	H 2	COMETS 1	NASDA	Toshiba	No	Non-Commercial	Tanegashima
			M				
September 1997	M 5	Lunar A	ISAS	Inst. of Space & Astronautical Science	No	Non-Commercial	Kagoshima
Russia/CIS							
			Cosmos				
April 17 1997	Cosmos SL-8	Kosmos 2341	Russia/CIS MoD	NPO PM	No	Non-Commercial	Plesetsk
			Molniya				
April 9 1997	Molniya SL-6	Kosmos 2340	Russia/CIS MoD	NPO Lavochkin	No	Non-Commercial	Plesetsk

Scheduled Launch Events
April - September 1997

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Site
Russia/CIS							
			Proton				
May 1997	Proton SL-12	Telstar 5	AT&T	Space Systems/Loral	Yes	Commercial	Tyuratam
June 1997	Proton SL-12	Iridium 4	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 5	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 6	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 7	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 8	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 9	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 10	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
July 1997	Proton SL-12	PAS 5	Pan American Satellite Corp.	Hughes	Yes	Commercial	Tyuratam
August 1997	Proton SL-12	Astra 1G	Societe Europeenne des Satellites (SES)	Hughes	Yes	Commercial	Tyuratam
September 1997	Proton SL-12	Iridium 25	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 26	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 27	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 28	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 29	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 30	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
		Iridium 31	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	Tyuratam
September 1997	Proton SL-12	Sky 1	American Sky Broadcasting	Space Systems/Loral	Yes	Commercial	Tyuratam
			Soyuz				
April 6, 1997	Soyuz SL-4	Progress M-34	RKK Energia	RKK Energia	No	Non-Commercial	Tyuratam
July 1997	Soyuz SL-4	Progress M-35	RKK Energia	RKK Energia	No	Non-Commercial	Tyuratam
August 1997	Soyuz SL-4	Soyuz TM-26	RKK Energia	RKK Energia	No	Non-Commercial	Tyuratam

Scheduled Launch Events
April - September 1997

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Site
Russia/CIS							
			Soyuz continued...				
September 1997	Soyuz SL-4	Progress M-36	RKK Energia	RKK Energia	No	Non-Commercial	Tyuratam
			Start				
June 1997	START 1	Earlybird 1	Earthwatch, Inc.	CTA Space Systems	Yes	Commercial	Svobodny
USA							
			Atlas				
April 24, 1997	Atlas 1	GOES K	NOAA	Space Systems/Loral	No	Non-Commercial	CCAS
July 8, 1997	Atlas 2AS	Superbird C1	Space Communications Corp.	Hughes	Yes	Commercial	CCAS
August 19, 1997	Atlas 2AS	EchoStar 3	EchoStar Satellite Corp.	Lockheed Martin Astro Space	Yes	Commercial	CCAS
September 11, 1997	Atlas 2AS	Galaxy 8I	Hughes Communications Inc.	Hughes	Yes	Commercial	CCAS
			Delta				
May 1, 1997	Delta 2 7925	Iridium 1 Iridium 2 Iridium 3	Iridium, Inc. Iridium, Inc. Iridium, Inc.	Lockheed Martin Corp. Lockheed Martin Corp. Lockheed Martin Corp.	Yes Yes Yes	Commercial Commercial Commercial	VAFB VAFB VAFB
May 9, 1997	Delta 2 7925	Thor 2A	Telenor A.S.	Hughes	Yes	Commercial	CCAS

Scheduled Launch Events
April - September 1997

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Site
USA							
			Delta continued...				
July 1997	Delta 2 7925	Iridium 11	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	VAFB
		Iridium 12	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	VAFB
		Iridium 13	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	VAFB
		Iridium 14	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	VAFB
		Iridium 15	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	VAFB
August 1997	Delta 2 7925	Iridium 16	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	VAFB
		Iridium 17	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	VAFB
		Iridium 18	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	VAFB
		Iridium 19	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	VAFB
		Iridium 20	Iridium, Inc.	Lockheed Martin Corp.	Yes	Commercial	VAFB
3rd Qtr 1997	Delta 2 7925	Navstar GPS 2-28	DoD	Rockwell International	No	Non-Commercial	CCAS
3rd Qtr 1997	Delta 2 7925	Navstar GPS 2R- 2	DoD	Lockheed Martin Corp.	No	Non-Commercial	CCAS
3rd Qtr 1997	Delta 2 7920	Argos	Space Test Program Office, USAF	TRW	No	Non-Commercial	VAFB
		Oersted	NASA/Danish Space Research Council	University of Copenhagen	No	Non-Commercial	VAFB
		Sunsat	University of Stellenbosch	Stellenbosch University	No	Non-Commercial	VAFB
			LMLV				
April 17, 1997	LMLV 1	Lewis	NASA	TRW	No	Commercial	VAFB
June 15, 1997	LMLV 1	Clark	NASA	CTA Space Systems, Inc.	No	Commercial	VAFB
September 27, 1997	LMLV 2	Lunar Prospector	NASA	Lockheed Martin Corp.	No	Non-Commercial	CCAS
			Pegasus				
April 20, 1997	Pegasus XL	Minisat 01	INTA	INTA	Yes	Commercial	Spain

Scheduled Launch Events
April - September 1997

Launch Date	Vehicle	Payload	Operator	Manufacturer	Int'l Comp	Launch Type	Launch Site
USA							
			Pegasus continued...				
May 1, 1997	Pegasus XL	Orbcomm 3	Orbital Communications Corp. (Orbcomm	Orbital Sciences Corp. (OSC)	No	Commercial	VAFB
		SNOE	University of Colorado/NASA	University of Colorado	No	Commercial	VAFB
May 23, 1997	Pegasus XL	Seastar	Orbital Sciences Corp. (OSC)	Orbital Sciences Corp. (OSC)	No	Commercial	VAFB
August 1, 1997	Pegasus XL	MUBLCOM	TBA	TBA	Yes	Commercial	VAFB
		TERRIERS	Boston University/NASA	AeroAstro	Yes	Commercial	VAFB
			Shuttle				
April 4, 1997	Shuttle Columbia	STS 83	NASA	Rockwell International	No	Non-Commercial	KSC
May 15, 1997	Shuttle Atlantis	STS 84	NASA	Rockwell International	No	Non-Commercial	KSC
July 17, 1997	Shuttle Discovery	STS 85	NASA	Rockwell International	No	Non-Commercial	KSC
		CRISTA SPAS 2	NASA/DARA	MBB Erno	No	Non-Commercial	KSC
September 18, 1997	Shuttle Endeavour	STS 86	NASA	Rockwell International	No	Non-Commercial	KSC
			Titan				
April 4, 1997	Titan 2	DMSP 5D-2-F14	DoD	Lockheed Martin	No	Non-Commercial	VAFB
August 5, 1997	Titan 4/Centaur	USA 1997-08			No	Non-Commercial	CCAS