Commercial Space Transportation

QUARTERLY LAUNCH REPORT

Featuring the launch results from the 3rd quarter 1999 and forecasts for the 4th quarter 1999 and the 1st quarter 2000

4th Quarter 1999

United States Department of Transportation • Federal Aviation Administration

Associate Administrator for Commercial Space Transportation

800 Independence Ave. SW Room 331

Washington, D.C. 20591

4TH QUARTER 1999 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.*

Certain industry terms are used in this document that may be unfamiliar to some readers. Such terms along with commonly used acronyms are defined in Appendix A.

Photo credit: The Boeing Company (1999). Image is of the Boeing Delta 2 launch vehicle lifting off from Space Launch Complex 17, Cape Canaveral Air Station with four Globalstar satellites on board.

CONTENTS

This document was released on October 21, 1999.

SUMMARY

Launch Events
Third Quarter 1999
(July 1999 – September 1999)

The United States conducted six successful launches in the third quarter of 1999. Five were commercial (one Athena, one Atlas, and three Delta 2). The Shuttle made the one non-commercial launch.

There were eleven Russian launches in this period. Two of these launches were commercial, one Proton and one Soyuz. Non-commercial launches included one Cosmos, one Molniya, two Proton, four Soyuz, and one Zenit. One non-commercial Proton launch failed and all other launches were successful.

Europe conducted three successful commercial launches of the Ariane 4.

Payload Use Analysis
Third Quarter 1999

In the third quarter of 1999, there were 33 payloads launched worldwide. These payloads were divided between communications (75.8 percent), science (3.0 percent), remote sensing (9.2 percent), navigation (3.0 percent), intelligence (3.0 percent), *Mir* supply (3.0 percent), and microgravity (3.0 percent).

Of the 22 commercially launched payloads 21 were communications payloads. The remaining payload was a remote sensing satellite.

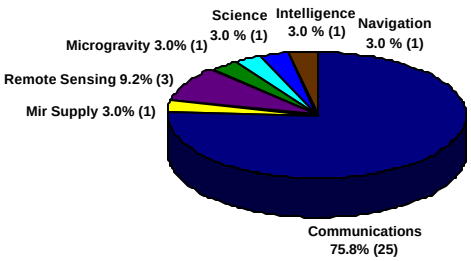

Figure 1: Payload Use
Third Quarter 1999

SUMMARY

Launch Log
Third Quarter 1999

Vehicle	Payload	Site
JULY 1999		
Proton	Raduga 35	Baikonur
Molniya	Molniya 3-50	Plesetsk
Dela 2 7420	Globalstar 30, 32, 35, 51	CCAS
Soyuz	Progress M-42	Baikonur
Zenit 2	Okean O1	Baikonur
Shuttle Columbia	STS 93 Chandra	KSC
Delta 2 7420	Globalstar 26, 28, 43, 48	CCAS
AUGUST 1999		
Ariane 42P	Telkom 1	Kourou
Delta 2 7420	Globalstar 24 , 27, 53, 54	CCAS
Soyuz	Kosmos 2365	Plesetsk
Cosmos	Kosmos 2366	Plesetsk
SEPTEMBER 1999		
Ariane 42P	KoreaSat 3	Kourou
Proton	Yamal 101 Yamal 102	Baikonur
Soyuz	Foton 12	Plesetsk
Soyuz	Globalstar 33, 50, 55, 58	Baikonur
Atlas 2AS	Echostar 5	CCAS
Athena 2	IKONOS 2	VAFB
Ariane 44LP	Telstar 7	Kourou
Proton	LMI 1	Baikonur
Soyuz	Resurs-F 1M 2	Plesetsk

For more information on third quarter launches please see Appendix D.

SUMMARY

Scheduled Launch Events
Fourth Quarter 1999 and
First Quarter 2000
(October 1999 – March 2000)

U.S. launch providers intend to make 24 launches in the next two quarters. Nine of these launches will be commercial: two Atlas 2, one Atlas 3, two Delta 2, three Pegasus, and one Taurus. Non-commercial launches will consist of four Atlas 2, three Delta 2, one Minotaur, one Pegasus, three Space Shuttle, one Taurus, one Titan 2, and one Titan 4.

Russian launch vehicles are scheduled to make 12 launches, eight of which are to be commercial. These commercial launches are scheduled to include one Cosmos, four Proton, one Rockot, and two Soyuz. Non-commercial launches will include one Cyclone, two Proton, and one Soyuz.

Europe plans eight flights. Five Ariane 4 launches (four commercial) and three Ariane 5 launches (two commercial) make up the European manifest.

China anticipates the launch of two Long March vehicles, neither of which is commercial.

Brazil will make a second attempt to launch its VLS launch vehicle following its initial failure on November 11, 1997 when one of its solid rocket motors failed to ignite and the vehicle was destroyed by range control.

Japan has one non-commercial H2 launch and one non-commercial M5 launch scheduled.

India plans to make the initial, non-commercial launch of its GSLV.

The Sea Launch international joint venture plans to launch a commercial GEO communications satellite.

Scheduled Launch Log
Fourth Quarter 1999

Vehicle	Payload	Site
OCTOBER 1999		
Ariane 44LP	Orion F2	Kourou
Delta 2 7925	Navstar GPS 2R- 3	CCAS
Long March 4B	CBERS/Ziyuan 1 SACI 1	Taiyuan
Proton	Garuda 1	Baikonur
Sea Launch	DBS 1R	Sea Launch Platform
Soyuz	Globalstar 65-68	Baikonur
NOVEMBER 1999		
Ariane 40	Clementine Helios 1B	Kourou
Ariane 44LP	GE 4	Kourou
Atlas 2A	GOES L	CCAS
Atlas 2AS	GBS 10	CCAS
Atlas 2AS	Terra	VAFB
H 2	MTSat 1	Tanegashima
Soyuz	Globalstar 29, 56, 57, 59	Baikonur
VLS	SACI 2	Alcantara
DECEMBER 1999		
Ariane 44L	Galaxy 11	Kourou
Ariane 5	XMM	Kourou
Delta 2 7320	Citizen Explorer Earth Orbiter 1 Munin SAC C	VAFB
Delta 2 7420	Globalstar 61-64	CCAS
Proton	Zvezda	Baikonur
Shuttle Discovery	STS 103	KSC
Titan 2	DMSP 5D-3-F15	VAFB
Titan 4B/IUS	DSP 20	CCAS

Scheduled Launch Log
First Quarter 2000

Vehicle	Payload	Site
JANUARY 2000		
Ariane 5	Eutelsat W4	Kourou
Atlas 2A	DSCS III 3-11	CCAS
M 5	Astro E	Kagoshima
Proton	CD Radio 1	Baikonur
Shuttle Endeavour	STS 99	KSC
FEBUARY 2000		
Ariane 4-TBA	Malaysia 1 Skynet 4F	Kourou
Ariane 5	AsiaStar 1 Insat 3B	Kourou
Delta 2 7326	IMAGE	VAFB
Shuttle Atlantis	SLP STS 101 Ultra High Frequency	KSC
MARCH 2000		
Atlas 2A	TDRS F8	CCAS
Soyuz	ISS 2R	Baikonur

Additional Launch Events to be Announced*

Fourth Quarter 1999 and
First Quarter 2000

Vehicle	Payload	Site
FOURTH QUARTER OF 1999		
Atlas 2AS	Hispasat 1C	CCAS
Cyclone 3	Coronas F	Plesetsk
Long March 2F	Unmanned Test	Jiuquan
Minotaur	Artemis Picosat	California
	ASUSat 1	Spaceport
	DARPA Picosat	
	FalconSat	
	Jawsat	
	MASAT	
	OPAL	
	STENSAT	
Pegasus XL	TSX 5	VAFB
Pegasus XL	OrbView 3	VAFB
Pegasus XL/HAPS	Orbcomm 29-36	Wallops Flight Facility
Taurus 1	ACRIMSAT	VAFB
	Celestis 3	
	Kompsat	
Proton	Sesat	Baikonur
Proton	Express A 1	Baikonur
FIRST QUARTER OF 2000		
Atlas 3A	Echostar 6	CCAS
Cosmos	QuickBird 1	Plesetsk
Delta 2 7420	Globalstar 72-75	CCAS
GSLV	GSat 1	Sriharikota Range
Pegasus XL	HETE-2	Kwajalein
Proton	GE 1A	Baikonur
Rockot	Iridium R- 21	Plesetsk
	Iridium R- 22	
Taurus 1	MTI P94-1	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.

SUMMARY

Commercial Products and Services

Globalstar System to Begin Service

A remarkable launch industry event that falls within the period of this report is the completion of the Globalstar LEO communications constellation and its entry into commercial service. Globalstar is scheduled to begin service in October 1999. It will provide mobile telephone, data, and messaging service through a constellation of 48 low-earth-orbit satellites. To date, 40 satellites have been deployed. With this number in orbit, Globalstar will be able to initiate a phased roll-out of service providing mobile telephone service to regions covered by its first nine ground stations. These regions include parts of the United States, Canada, Brazil, Argentina, China, Korea, South Africa, and Europe.

The deployment of the Globalstar system began in February 1998 when a Delta 2 vehicle delivered four Globalstar satellites to orbit. Globalstar satellites have been launched on three different vehicles: Boeing's Delta 2, the Soyuz provided by Starsem, and the Zenit 2 provided by the Ukrainian Space Agency. Six Delta 2 launches and four Soyuz launches have successfully deployed four satellites each since February 1998; the only Zenit 2 launch with 12 satellites aboard failed.

Globalstar is led by founding partner Loral Space & Communications, and the strategic partners include: Qualcomm, Inc., Alcatel, Alenia Aerospazio, China Telecom, DACOM, DaimlerChrysler Aerospace, Elsacom, France Telecom, Hyundai, Space Systems/Loral, and Vodafone AirTouch. Globalstar's satellites are built by Space Systems/Loral.

LAUNCH REPORT

Launch Events
Third Quarter 1999

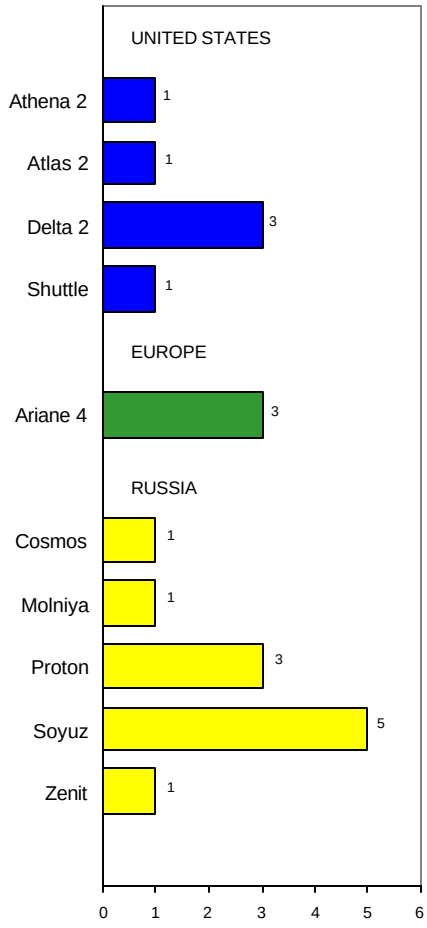

Figure 2: Launch Vehicle Use
Third Quarter 1999

In the third quarter of 1999, United States launch vehicles conducted six of 20 launches worldwide. Five of these launches were commercial: one Athena 2 with a remote sensing satellite, one Atlas 2 with a GEO communications satellite, and three Delta 2 with four LEO communications satellites each. The single non-commercial launch was made by a Shuttle carrying a science payload.

Russia carried out eleven launches, two were commercial. The commercial launches were a Proton vehicle with a GEO communications satellite on board, and a Soyuz with four LEO communications satellites. The remaining non-commercial launches were a Cosmos with a navigation satellite, a Molniya with a communications satellite, and two Protons, one with a pair of GEO communications satellites and another with a single communications satellite. One Soyuz sent supplies to the *Mir* space station, another lofted a microgravity payload, a third orbited an intelligence payload, and a fourth deployed a remote sensing payload, while a Zenit launch vehicle carried a remote sensing satellite to orbit.

Europe launched three commercial Ariane 4 vehicles. Each of these successfully carried a commercial communications satellite to GTO.

LAUNCH REPORT

Scheduled Launch Events
Fourth Quarter 1999

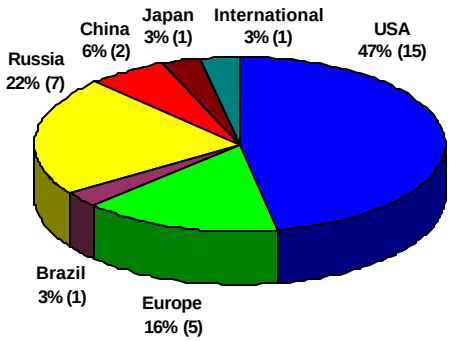

Figure 3: Scheduled Launch Events
Fourth Quarter

Thirty-two orbital launch events are planned in the fourth quarter of 1999. Launch providers from the United States plan to conduct 15 of these launches. Four Atlas 2 vehicles are scheduled to carry two communications, one remote sensing, and one meteorological satellite. Three Delta 2 vehicles will carry one set of four LEO communications satellites, as well as navigation, development, and scientific payloads. The first Minotaur (a converted Minuteman ICBM) will carry eight small scientific, communications, and development satellites. Three Pegasus launches will loft development and remote sensing payloads (one each), and a set of eight LEO communications satellites. The Shuttle is manifested to launch once to perform the third Hubble Space Telescope servicing mission. One Taurus launch will orbit remote sensing, science and funerary payloads. A Titan 2 will loft a meteorological satellite and a Titan 4 will carry an intelligence payload.

Russia plans to launch seven vehicles in this period. One Cyclone 3 launch is scheduled with a scientific satellite and four Proton launches are planned as well. The Protons will carry three communications satellites and the ISS Service Module, Zvezda. Two Soyuz launches will loft four LEO communications satellite each to finish the Russian schedule.

Europe's Ariane 4 is scheduled to orbit three GEO communications satellites on three Ariane 4 vehicles with a fourth vehicle lifting an intelligence and a development satellite. One Ariane 5 vehicle is to lift a science payload.

China intends to launch two Long March vehicles. One will carry two remote sensing satellites while the other will launch an uninhabited prototype of China's crewed space vehicle.

Japan plans the launch of an H2 with a navigation satellite.

Brazil will make a second attempt to launch its VLS small launch vehicle caring a remote sensing satellite.

An international launch provider (currently only the international Sea Launch venture is included in this category) intends to launch a GEO communications satellite.

LAUNCH REPORT

Scheduled Launch Events
First Quarter 2000

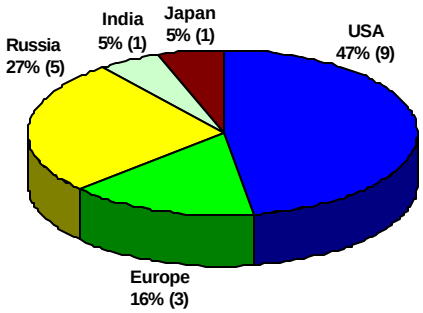

Figure 4: Scheduled Launch Events
First Quarter 2000

There are nineteen orbital launch events scheduled to occur in the first quarter of 2000. United States launch providers plan to conduct nine of these launches. Two Atlas 2 vehicles are to loft GEO communications payloads while an Atlas 3A is scheduled to launch another GEO communications satellite. Of two Delta 2 vehicles one will carry four LEO communications satellites and the other a science payload. A Pegasus launch vehicle will orbit a science satellite. The Shuttle will launch twice with an ISS assembly flight and the Shuttle Radar Topography Mission. One Taurus launch will orbit a military development payload.

Russia intends to launch five vehicles in the first quarter of 2000. One will be a Cosmos vehicle with a remote sensing payload and two others will be Proton vehicles with GEO communications satellites. A Soyuz launch will loft the first crew to the ISS and the Rockot vehicle will lift two LEO communications satellites.

Europe plans two Ariane 5 launches carrying three GEO communications satellites as well as an Ariane 4 carrying a GEO communications satellite and a scientific payload.

Japan is to launch a science satellite on an M5 launch vehicle.

India's GSLV is scheduled to make its initial launch with a developmental satellite.

LAUNCH REPORT

Commercial Launch Events
October 1999 – March 2000

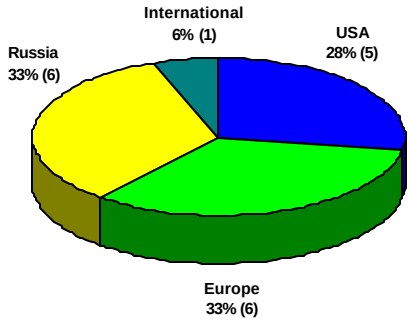

Figure 5: Scheduled Commercial Launch Events
October 1999 – March 2000

Excluding small launch vehicles, there are 18 commercial launch events planned for the next two quarters. Of these launches United States launch providers are to conduct five. These will consist of two Atlas 2 launches of GEO communications payloads, an Atlas 3 launch of a GEO communications satellite, and two Delta 2 carrying four LEO communications satellites each.

Russia plans to make six of these commercial launches. These launches will be made up of four Proton vehicles (all with GEO communications satellites onboard) and two Soyuz vehicles (with four LEO communications satellite each).

Europe intends to make six of the 18 launches. These launches will include two Ariane 5 vehicles carrying three GEO communications satellites between them, three Ariane 4 vehicles each carrying one GEO communications satellites, and an Ariane 4 with a science payload.

International launch providers are launch providers that do not have a clearly defined nationality. Currently Sea Launch is the only entity in this category because of the disparate nature of the corporation and its vehicle. Sea Launch plans one commercial launch of a GEO communications satellite in this period.

LAUNCH REPORT

Commercial Launch Market
July 1999 – March 2000

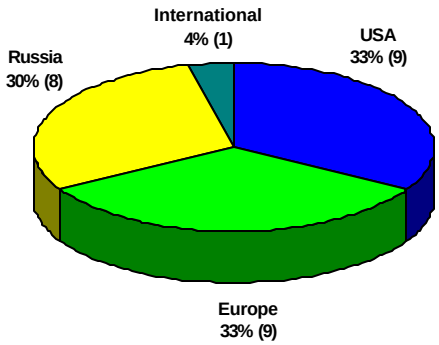

Figure 6: Commercial Launch Market
July 1999 – March 2000
(small vehicles excluded)

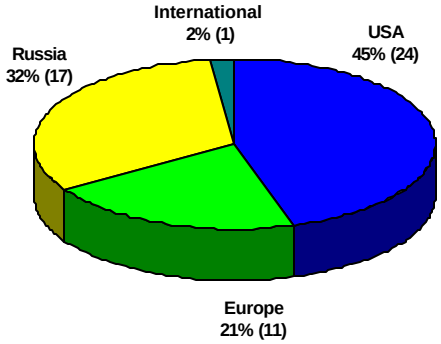

Figure 7: Commercially Launched Payloads Market
July 1999 - March 2000
(small vehicles excluded)

For the entire period of this report (July 1999 through March 2000), 27 commercial launch events (excluding small launch vehicles) are anticipated. The United States has a 33 percent share or nine launches. There are 53 commercially launched payloads projected for launch in this same period. Launch providers from the United States expect to have launched 24 of these payloads, for a 45 percent share of the period's payloads.

The European portion of the total is 9 launches, for a 33 percent share of launches, and 11 payloads, or 21 percent of total payloads.

Russia expects to have conducted 8 commercial launches for a 30 percent share and deployed 17 commercially launched payloads for 32 percent of the total.

International launches have comprised four percent of the total with one launch, and two percent of payloads with one commercially launched payload.

LAUNCH REPORT

Commercial Launch Market
January 1995 – March 2000

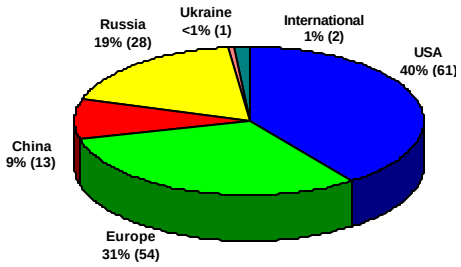

Figure 8: Commercial Launch Market
January 1995 – March 2000
(small vehicles excluded)

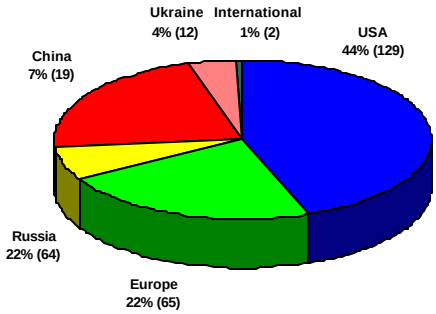

Figure 9: Commercially Launched Payloads Market
January 1995 - March 2000
(small vehicles excluded)

Excluding small launch vehicles, commercial launch events are projected to total 152 for the period between January 1995 and March 2000. The United States has a 40 percent share of these total or 61 launches. In terms of commercially launched payloads (excluding small launch vehicles), the United States will have launched 129 of 291 payloads, for a 44 percent share of payloads.

Europe's portion of the total is 47 launches, for a 31 percent share of launches, and 65 payloads, or 22 percent of total payloads.

China plans to have made 13 launches for nine percent of total launches over the period. These launches are to have carried 19 payloads for seven percent of the total.

Russia expects to conduct 28 commercial launches for a 19 percent share and deploy 64 commercially launched payloads or 22 percent of total payloads.

Ukraine has made one commercial launch from Russia's launch site at Baikonur representing just under one percent of launches, to deploy 12 payloads or four percent of total payloads.

International launches comprised one percent of total launches with two launches, and one percent of payloads with two commercially launched payloads.

LAUNCH REPORT

Commercial Launch Revenues

January 1995 – March 2000

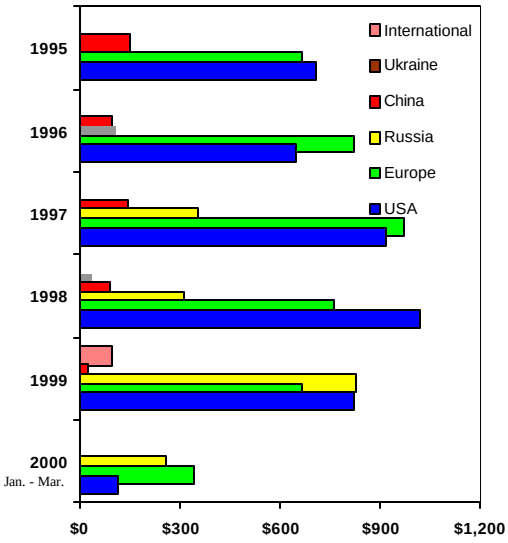

Figure 10: Commercial Launch Revenues by Region (in US $ Millions)*
January 1995 – March 2000
(revenue from small vehicles excluded)

* 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 current dollars. Excludes small vehicles.

Revenues for the period between January 1995 and March 2000 are expected to be approximately $10.9 billion. United States launch providers are expected to achieve a 39 percent share of these revenues (approximately $4.2 billion) and European launch providers are projected to capture 39 percent (approximately $4.2 billion). Russian launch providers hold an estimated 17 percent share (approximately $1.9 billion) and launch service revenues from China should consist of about $500 million representing a 5 percent share. Ukraine's single launch accounts for less than one percent of revenues at roughly $33 million. International launch providers hold one percent of total revenues with $95 million.

COMMERCIAL SPACE TRANSPORTATION LICENSING

INTRODUCTION

In order to conduct a commercial space launch or operate a commercial launch site in the U.S., it is necessary to obtain a license from the United States government.

Under the 1972 United Nations Convention on International Liability for Damage Caused by Space Objects, governments are liable for injury or damage to third parties caused by launch vehicles or payloads launched under their jurisdiction.

In order to control this liability and assure public safety, the United States government has created a regulatory framework for the commercial operation of both launch vehicles and launch sites.

THE OFFICE OF THE ASSOCIATE ADMINISTRATOR FOR COMMERCIAL SPACE TRANSPORTATION (AST)

The Federal Aviation Administration's Associate Administrator for Commercial Space Transportation (AST) licenses and regulates U.S. commercial space launch activity as authorized by Executive Order 12465 and *Commercial Space Launch Activities*, Title 49 of the United States Code, Subtitle IX, Chapter 701 (formerly the *Commercial Space Launch Act of 1984)*. AST's mission is to regulate the U.S. commercial launch industry; license commercial launch operations to ensure public health and safety and the safety of property; and protect national security and foreign policy interests of the United States during commercial launch operations. In addition, the Federal Aviation Administration is directed to encourage, facilitate, and promote commercial space launches.

WHO MUST BE LICENSED

AST has legislative authority to license any person conducting commercial launch activities (including the operation of a launch site) within the United States. It also has legislative authority in the case of a United States citizen, or an entity operating under United States jurisdiction, conducting a launch or operating a launch site outside of the United States.

Table 1. Who Requires a Launch or Launch Site License?

Any person conducting a launch operation or operating a launch site within the United States.
Any United States citizen or entity operating under United States jurisdiction conducting a launch or operating a launch site outside of the United States.
A foreign entity in which a United States citizen has a controlling interest if that entity wishes to operate in an area that is international and not under United States jurisdiction through some government agreement.

AST also licenses foreign entities in which a United States citizen has a controlling interest if that entity wishes to conduct launch operations in an area that is both outside the United States and outside of the territory of any foreign nation. If the United States has an agreement to allow another nation to regulate this area, that nation gains jurisdiction. If there is an

agreement that United States jurisdiction applies to a foreign location, then AST does have responsibility for licensing that launch or launch site.

AST does not review amateur rocket activities (defined as launch activities conducted at private sites involving rockets with a total impulse of 200,000 pound-seconds or less, an operating time of less than 15 seconds, and a ballistic coefficient less than 12 psi). Also, AST does not review space activities conducted by or on behalf of the United States government. However, safety issues are covered through other means.

COMMERCIAL LAUNCH LICENSING

AST issues two types of launch licenses: launch-specific licenses and launch operator licenses. These differ in that a launch-specific license typically only authorizes the licensee to conduct a single launch. The launch is specified in the license and the license expires when the launch has been conducted. The license will also expire when its expiration date is reached, unless that date is extended.

The second form of launch license, the launch operator license, allows a launch operator to conduct launches of members of a family of vehicles from a given launch site with specified classes of payloads. These licenses are valid for a period of five years from the date of issue.

For either type of license, the first element in licensing a commercial launch vehicle is the pre-application consultation. It consists of any/all meetings, communications, or draft application submittals that a potential applicant may undertake with AST prior to submitting a formal application. Pre-licensing consultation allows a prospective applicant to familiarize AST with its proposal. Likewise, the potential applicant also becomes familiar with the licensing process. The pre-licensing consultation also provides a potential applicant with an opportunity to identify any unique aspects of its proposal, and develop a schedule for submitting an application.

Following formal submission of an application, a policy review is undertaken in regard to the applicant. The application is reviewed to determine whether it presents any issues affecting U.S. national security or foreign policy interests, or international obligations of the United States. A major aspect of the policy review is an interagency review of each launch proposal. This allows government agencies to examine the proposed mission from their unique perspectives. During the interagency review, AST consults with the Department of Defense, the Department of State, and other federal agencies such as NASA that are uniquely situated to address such issues.

The next element in the licensing process determines whether an applicant can safely launch the vehicle(s) and the payload(s). For applicants proposing to launch from a federal launch range, AST will issue a safety approval only if the applicant demonstrates that there is no unacceptable risk to the public and if the launch services and the proposed use of launch property are within the federal launch range's experience.

The fourth element in the process is a payload review and determination. During this element, AST reviews proposed payloads to determine whether safety and policy issues concerning the launch of the payloads jeopardize public health and

safety, U.S. national security or foreign policy interests, or international obligations of the United States. AST also reviews payloads to determine whether a license applicant or payload owner or operator has obtained all required licenses, authorization, and permits, unless the payload is exempt from review. This process also includes inter-agency coordination.

AST does not review payloads that are subject to regulation by the Federal Communications Commission (FCC) or the Department of Commerce, National Oceanic and Atmospheric Administration (NOAA); or owned or operated by the U.S. Government.

The fifth element in the licensing process is the financial responsibility determination. The FAA requires that all licensees demonstrate financial responsibility to compensate for the maximum probable loss[1] (MPL) from claims by: a third party for death, bodily injury, or property damage or loss resulting from an activity carried out under the license; and the U.S. government against a person for damage or loss to government property resulting from an activity carried out under the license. AST sets the amount of financial responsibility required of the licensee. The licensee can then elect to meet this requirement by proving it has financial reserves equal to or exceeding the amount specified, by placing the required amount in escrow, or by purchasing liability insurance equal to the amount specified (the most common method).

The final element in the licensing process is the environmental evaluation. It ensures that proposed launch activities undergo a environmental review as required by the National Environmental Policy Act (NEPA). In order to be granted a license, the applicant must provide information sufficient to enable AST to comply with the requirements of NEPA.

AST has the authority to monitor the activities of a licensee to determine if the licensee is in compliance with FAA regulations and the terms of the license. Under the law, access shall be granted to individuals authorized by AST to observe any activities of the licensee, or of the licensee's contractors or subcontractors, associated with the licensed launch.

If a licensee has substantially failed to comply with the relevant laws, regulations, or terms of its license, the license can be suspended or revoked. Depending on the infraction, the licensee may also be subject to a civil penalty.

LICENSE RENEWAL

Licenses may be renewed by an application made at least 90 days before the expiration of the license. Renewal is subject to the same requirements as the original license and may be denied if the renewal application is inadequate or if requested modifications to the launch license are unacceptable.

[1] The MPL determination is based on an analysis and assessment of the maximum monetary losses likely to be incurred by government and third party personnel and property in the event of a mishap. It is calculated by assessing the dollar value of government and third party properties at risk by launch accidents likely to occur as the result of the conduct of launch activities.

Table 2. Elements in the Launch Licensing Process

Pre-Application Consultation	This process allows a prospective applicant to familiarize AST with its proposal and likewise be familiarized with the details of the licensing process.
Policy Review	The Policy Review entails reviewing an application for issues affecting U.S. national security, foreign policy interests, or international obligations.
Safety Evaluation	The purpose of the Safety Evaluation is to determine whether an applicant can safely launch vehicle(s) and payload(s).
Payload Review	The payload is reviewed by AST to determine whether its launch would jeopardize public health and safety, U.S. national security or foreign policy interests, or international obligations of the United States.
Financial Responsibility Determination	All licensees must demonstrate the financial ability to make compensation for the maximum probable loss from claims.
Environmental Review	AST must consider the environmental effects of a commercial space launch.

COMMERCIAL LAUNCH SITE LICENSING

An application for a license to operate a launch site is conducted in much the same way as an application for a launch vehicle license. As with a launch license, a site license requires the licensee to demonstrate that the site does not pose a threat to public health and safety, private property, United States national security or foreign policy interests, and will not violate the United States' international obligations. The applicant must demonstrate that it is possible to launch at least one vehicle type on at least one launch trajectory. However, AST does not conduct a financial responsibility determination for launch sites as it does for launch activities because this provision is not contained in the *Commercial Space Launch Act*.

A launch site operator is required to provide such environmental information as AST deems necessary to allow it to comply with NEPA. As with a vehicle license, it is necessary that a site operator diligently follow the terms of the site license in order to remain in compliance with AST rules and regulations.

STATUS OF LICENSING ACTIVITY

AST has issued launch operator's licenses for commercial launches of orbital launch vehicles such as the Atlas, Delta, Taurus, Zenit, and Athena launch vehicles, and the air-launched Pegasus vehicle. AST has also issued licenses for commercial launches of suborbital sounding rockets such as the Starfire. The first licensed launch was a suborbital launch of a Starfire on March 29, 1989. The 100th licensed launch was that of a Delta 2 from Vandenberg Air Force Base in California on September 8, 1998. AST has also licensed the conduct of launches from the Pacific Ocean (see Table 3).

While the vast majority of licensed launch activities occur from U.S. Federal Ranges - such as the Cape Canaveral Air Station, Florida, Vandenberg Air Force Base, California, White Sands Missile Range, New Mexico, and Wallops Flight Facility, Wallops Island, Virginia - many future launch activities are expected to occur from private or State-operated launch sites. AST has licensed the operation of several non-Federal launch sites including the California Spaceport at Vandenberg Air Force Base, Spaceport Florida at Cape

Canaveral Air Station, the Virginia Space Flight Center at Wallops Island, and Spaceport Alaska at Kodiak Island, Alaska (see Table 4). The first launch from a non-Federal range licensed by AST was that of NASA's Lunar Prospector aboard a Lockheed Martin Athena-2 rocket on January 6, 1998, from Spaceport Florida.

Table 3. Active AST Launch Licenses

License	Company	Vehicles	Location	Original Effective Date	Most Recent Renewal Date	Expiration Date
LLO 91-023	MDC	Delta 2,3	CCAS	1 May 1991	13 Apr 1999	1 May 2001
LLO 95-033	LMC	Atlas 1, 2, 2A, 2AS, 3A, 3B	CCAS	20 Feb 1998	12 Feb 1999	20 Feb 2001
LLO 97-041	OSC	Pegasus	CCAS	18 Mar 1997	11 Mar 1999	18 Mar 2001
LLO 99-046	OSC	Pegasus	KMR	23 Jul 1999		23 Jul 2004
LLS 99-045	SLLP	Zenit-3SL	Pacific Ocean	9 Mar 1999		3 Dec 1999
LLS 99-047	SLLP	Zenit-3SL	Pacific Ocean	24 Sep 1999		30 Apr 2000
LLO 94-031	OSC	Pegasus	VAFB	2 Sep 1994	2 Sep 1998	2 Sep 2000
LLO 96-034	MDC	Delta 2	VAFB	2 Jan 1996	24 Dec 1997	2 Jan 2000
LLO 96-037	OSC	Taurus	VAFB	13 Mar 1996	6 Mar 1998	13 Mar 2000
LLO 97-044	LMC	Athena 1, 2	VAFB	12 Sep 1997		31 Dec 1999
LLO 97-040	OSC	Pegasus	WFF	18 Mar 1997	11 Mar 1999	18 Mar 2001

Table 4. Launch Site Operator Licenses Issued

License	Operator / Launch Site	Location	Original Effective Date	Most Recent Renewal Date	Expiration Date
LSO 96-001	Spaceport Systems International / California Spaceport	VAFB	19 Sep 1996		19 Sep 2001
LSO 97-002	Spaceport Florida Flight Authority / Spaceport Florida	CCAS	22 May 1997		22 May 2002
LSO 97-003	VA Commercial Space Flight Authority / Virginia Space Flight Center	WFF	19 Dec 1997		19 Dec 2002
LSO 97-004	Alaska Aerospace Development Corporation / Kodiak Island	KLC	24 Sep 1998		24 Sep 2003

GLOSSARY

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

Apogee: Point most distant from Earth in a satellite's orbit.

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.

Frequency Bands: Different frequency ranges of the electromagnetic spectrum in which signals are transmitted.

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.

Launch Outcome: Refers to whether the launch vehicle properly deploys its payload.

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.

Mission Outcome: Evaluates if the launch mission is achieved (i.e., Does the primary payload achieve a functional orbit).

Payload: The spacecraft that is deployed by a launch vehicle.

Payload Use: This describes the payload's use according to the type of function it performs. Uses include:

Classified - Typically military missions.

Communication - Receives and transmits signals either directly or through a broadcast. Signals may take many different forms: voice, text, or electronic.

Crewed - Payload with a live human crew.

Development - Used for the development of hardware and technology.

Funerary - Carries the remains of deceased humans in space.

Intelligence - Provides images and data specifically to the intelligence communities of different countries.

Meteorological - Payloads primarily used to observe and forecast weather.

Microgravity - Payloads with a platform used to take advantage of the microgravity environment, including scientific and commercial applications.

Navigation - Track location and transmit data regarding location.

Other - Does not fit other categories.

Remote Sensing - Uses sensors to provide imagery (i.e., photographs).

Scientific - Used for the development of knowledge not hardware.

Supply - Carries supplies (for human and hardware maintenance) to space stations in orbit.

Test - Non-functional payloads used to simulate payload characteristics.

Unknown - There is no available information on the function of this payload.

Perigee: Point least distant to Earth in a satellite's orbit.

Power: Amount of projected power generated by spacecraft when it reaches the end of its design life.

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.

Transponder: The piece of hardware on a satellite that receives and transmits data.

Vehicle Mass Class: Vehicle Mass Classes are categorized according to the maximum advertised lift capacity to LEO, in pounds:

Small:	Up to 5,000	Medium:	5,001 to 12,000
Intermediate:	12,001 to 25,000	Heavy:	Greater than 25,000

ACRONYMS

ACeS Asia Cellular Satellite
ACRIMSAT Active Cavity Radiometer Irradience Monitor Satellite
ASUsat Arizona State University satellite
CBERS China-Brazil Earth Remote Sensing
CCAS Cape Canaveral Air Station
CNES Centre Nacional d'Etudes Spacial
DARPA Defense Advanced Research Projects Agency
DASA Deutsche Aerospace
DBS Direct Broadcast Satellite
DGA Delegation Generale a l'Armement
DMSP Defense Meteorological Satellite Program
DoD Department of Defense
DoT Department of Transportation
DSCS Defense Satellite Communication System
DSP Defense Support Program
ELI Elliptical
ESA European Space Agency
FAA Federal Aviation Administration
GBS Global Broadcast System
GE General Electric
GEO Geosynchronous Orbit
GOES Geostationary Operational Environmental Satellite
GPS Global Positioning System
GSLV Geostationary Launch Vehicle
GTO Geosynchronous Transfer Orbit
HETE High Energy Transient Experiment
IKI Space Research Institute (Russia)
IMAGE Imager for Magnetopaus-to-Aurora Global Exploration
INPE National Institute for Space Research
IRS Indian Resource Satellite
ISAS Institute of Space and Astronautical Science
ISRO Indian Space Research Organization
ISS International Space Station
IUS Inertial Upper Stage
Jawsat Joint Academy Weber State Satellite
KARI Korea Aerospace Research Institute
KLC Kodiak Launch Complex
KMR Kwajalein Missile Range
KSC Kennedy Space Center
LEO Low Earth Orbit
LMC Lockheed Martin Corporation
LMI Lockheed Martin Intersputnik
MDC McDonnell Douglas Corporation
MEO Medium Earth Orbit
MoD Ministry of Defense
MTI Multispectral Thermal Imaging
NASA National Aeronautics and Space Administration
nMI Nautical Mile
NOAA National Oceanic and Atmospheric Administration
NPO Scientific Production Organization
OPAL Orbiting Picosat Automatic Launcher
OSC Orbital Sciences Corporation
PM Prikladnoi Mekhaniki
PTT Post Telegraph and Telecommunications
RKA Russian Space Agency
RKK Energia - Rocket and Space Company Energia
SAC Satellite de Aplicaciones Cientificas
SACI Satellite Cientifico
SESAT Siberian-European Satellite
SLLP Sea Launch Limited Partnership
STS Space Transportation System
TDRS Tracking and Data Relay Satellite
TSX Tri-Service Experiment
VAFB Vandenberg Air Force Base
VLS Veiculo Lancador de Satelites
WFF Wallops Flight Facility
XL Extra Long
XMM X-ray Multi-Mirror

Characteristics of Cited Vehicles

Vehicle	(Success + Partials) / Attempts	LEO 28 Degrees	GTO	GEO	Price per Launch (Approx.)	Launch Sites
Heavy						
Ariane 5	2/3 | 66.7%	39600 lb 18000 kg	15000 lb 6800 kg	N/A	$150-180 M	Kourou
Long March 2F	First Launch	N/A	N/A	N/A	N/A	Jiuquan
Proton (SL-12)	209/233 | 89.7%	46297 lb 21000 kg	10851 lb 4910 kg	4155 lb 1880 kg	$75-95 M	Baikonur
Proton (SL-13)	25/28 | 89.3%	46000 lb 20900 kg	N/A	N/A	$75-95 M	Baikonur
Sea Launch	1/1 | 100%	35000 lb 15876 kg	11050 lb 5000 kg	N/A	$75-95 M	Sea Launch Platform
Shuttle Atlantis	19/19 | 100%	53800 lb 24400 kg	13007 lb 5900 kg	5203 lb 2360 kg	$300 M	KSC
Shuttle Columbia	26/26 | 100%	45800 lb 20770 kg	13007 lb 5900 kg	5203 lb 2360 kg	$300 M	KSC
Shuttle Discovery	28/28 | 100%	53800 lb 24400 kg	13007 lb 5900 kg	5203 lb 2360 kg	$300 M	KSC
Shuttle Endeavour	13/13 | 100%	53800 lb 24400 kg	13007 lb 5900 kg	5203 lb 2360 kg	$300 M	KSC
Titan 4B/IUS	1/2 | 50%	47800 lb 21629 kg	N/A	6321 lb 2860 kg	$350-450 M	CCAS
Zenit 2	26/32 | 81.3%	30300 lb 13740 kg	N/A	N/A	$35-50 M	Baikonur
Intermediate						
Ariane 42P	13/14 | 92.9%	13400 lb 6100 kg	6260 lb 2840 kg	N/A	$65-85 M	Kourou
Ariane 44L	27/28 | 96.4%	21100 lb 9600 kg	9965 lb 4520 kg	N/A	$100-125 M	Kourou
Ariane 44LP	19/20 | 95%	18300 lb 8300 kg	8950 lb 4060 kg	N/A	$90-110 M	Kourou
Atlas 2A	14/14 | 100%	16050 lb 7280 kg	6700 lb 3039 kg	3307 lb 1500 kg	$75-85 M	CCAS, VAFB
Atlas 2AS	18/18 | 100%	19050 lb 8640 kg	8150 lb 3688 kg	4604 lb 2090 kg	$90-105 M	CCAS, VAFB
Atlas 3A	First Launch	19097 lb 8641 kg	8940 lb 4055 kg	N/A	$90-105 M	CCAS
GSLV	First Launch	11000 lb 5000 kg	5500 lb 2500 kg	N/A	$25-45 M	Sriharikota Range
H 2	5/6 | 83.3%	23000 lb 10500 kg	8800 lb 4000 kg	4800 lb 2200 kg	$170-190 M	Tanegashima
Soyuz	962/969 | 99.3%	15400 lb 7000 kg	N/A	N/A	$35-40 M	Baikonur, Plesetsk
Medium						
Ariane 40	6/6 | 100%	10800 lb 4900 kg	4520 lb 2050 kg	N/A	$65-85 M	Kourou
Cyclone 3	112/114 | 98.2%	8818 lb 4000 kg	N/A	N/A	$20-25 M	Baikonur
Delta 2 7320	1/1 | 100%	4370 lb 1982 kg	2100 lb 952 kg	N/A	$45-55 M	CCAS, VAFB
Delta 2 7326	1/1 | 100%	4370 lb 1982 kg	2100 lb 952 kg	N/A	$45-55 M	CCAS, VAFB
Delta 2 7420	6/6 | 100%	N/A	N/A	N/A	$45-55 M	CCAS, VAFB
Delta 2 7925	40/41 | 97.6%	11330 lb 5139 kg	3965 lb 1799 kg	2000 lb 907 kg	$50-60 M	CCAS, VAFB
Long March 4B	First Launch	N/A	3315 lb 1500 kg	N/A	$25-35 M	Taiyuan
M 5	2/2 | 100%	5500 lb 2500 kg	2680 lb 1215 kg	1080 lb 490 kg	$35-45 M	Kagoshima
Molniya	296/311 | 95.2%	3970 lb 1805 kg	N/A	N/A	$30-40 M	Plesetsk
Titan 2	20/20 | 100%	7900 lb 3583 kg	N/A	N/A	$30-40 M	CCAS
Small						
Athena 2	2/3 | 66.7%	4390 lb 1990 kg	N/A	N/A	$22-26 M	Spaceport Florida, VAFB
Cosmos	412/416 | 99%	3100 lb 1400 kg	N/A	N/A	$12-14 M	Baikonur, Plesetsk, Kapustin Yar
Minotaur	First Launch	1472 lb 666 kg	N/A	N/A	$10-15 M	VAFB
Pegasus XL	12/15 | 80%	1015 lb 460 kg	322 lb 146 kg	181 lb 82 kg	$12-15 M	Wallops Flight Facility
Pegasus XL/HAPS	3/3 | 100%	1015 lb 460 kg	N/A	N/A	$12-15 M	Wallops Flight Facility
Rockot	1/1 | 100%	4100 lb 1850 kg	N/A	N/A	$12-15 M	Baikonur
Taurus 1	3/3 | 100%	3100 lb 1400 kg	990 lb 450 kg	N/A	$18-20 M	VAFB
VLS	0/1 | 0%	440 lb 200 kg	N/A	N/A	$6-7 M	Alcantara

Characterisitcs of Cited Payloads

Payload	Use	Price	Orbit	Apogee	Perigee	Launch Mass	Freq. Bands & Trans.	Power
Communications								
MASAT	Communication	Unknown	LEO	N/A	N/A	N/A		N/A
AsiaStar 1	Communications	Unknown	GEO 105 E	19305 nMi	19305 nMi	6155 lb 2785 kg	3L, 3X	N/A
CD Radio 1	Communications	Unknown	ELI	19305 nMi	19305 nMi	7896 lb 3589 kg	1S	N/A
DBS 1R	Communications	Unknown	GEO 259 E	N/A	N/A	N/A		N/A
DSCS III 3-11	Communications	Unknown	GEO	19326 nMi	19323 nMi	2475 lb 1125 kg	6 SHF	1240 W
Echostar 5	Communications	Unknown	GEO 250 E	N/A	N/A	N/A	32 Ku	N/A
Echostar 6	Communications	Unknown	GEO 250 E	N/A	N/A	7683 lb 3492 kg	32 Ku	N/A
Eutelsat W4	Communications	Unknown	GEO 36 E	N/A	N/A	N/A		N/A
Express A 1	Communications	Unknown	GEO	N/A	N/A	N/A		N/A
Galaxy 11	Communications	Unknown	GEO 261 E	N/A	N/A	9921 lb 4500 kg	24 Ku, 24C	N/A
Garuda 1	Communications	$377.5 M	GEO 123 E	N/A	N/A	5986 lb 2721 kg	6C, 88L	N/A
GBS 10	Communications	Unknown	GEO	N/A	N/A	6305 lb 2866 kg	UHF	2500 W
GE 1A	Communications	Unknown	GEO 97 E	N/A	N/A	N/A	24 Ku, 24 C	N/A
GE 4	Communications	Unknown	GEO 259 E	N/A	N/A	N/A	24 Ku, 24 C	N/A
Globalstar	Communications	Unknown	LEO	764 nMi	764 nMi	988 lb 449 kg	L, C, S	875 W
Hispasat 1C	Communications	Unknown	GEO 330 E	N/A	N/A	6144 lb 2780 kg	24 Ku	N/A
Insat 3B	Communications	Unknown	GEO	N/A	N/A	5525 lb 2500 kg	6 Ku, 18 C	N/A
Iridium R- 21	Communications	Unknown	LEO	419 nMi	419 nMi	1496 lb 680 kg		N/A
Iridium R- 22	Communications	Unknown	LEO	419 nMi	419 nMi	1496 lb 680 kg		N/A
KoreaSat 3	Communications	Unknown	GEO 116 E	N/A	N/A	2895 lb 1316 kg	30 Ku, 3 Ka	N/A
LMI 1	Communications	Unknown	GEO 75 E	N/A	N/A	N/A	38 Ku, 46 C	N/A
Molniya 3-50	Communications	Unknown	ELI	22039 nMi	255 nMi	3868 lb 1750 kg		1000 W
Orbcomm 29	Communications	Unknown	LEO	446 nMi	446 nMi	87 lb 40 kg		N/A
Orion F2	Communications	Unknown	GEO 348 E	N/A	N/A	8398 lb 3800 kg	34 ku	N/A
Raduga 35	Communications	Unknown	GEO	N/A	N/A	4332 lb 1965 kg		N/A
Sesat	Communications	Unknown	GEO 36 E	N/A	N/A	5720 lb 2600 kg	18 Ku	N/A
Skynet 4F	Communications	Unknown	GEO 326 E	N/A	N/A	3321 lb 1510 kg	3 X	N/A
TDRS F8	Communications	Unknown	GEO 319 E	N/A	N/A	6485 lb 2948 kg	1 Ku, 1 S, 1 Ka	N/A
Telkom 1	Communications	$84.6 M	GEO 108 E	N/A	N/A	5868 lb 2655 kg	36 C	N/A
Telstar 7	Communications	Unknown	GEO 231 E	N/A	N/A	7683 lb 3492 kg	28 Ku, 24 C	N/A
Yamal 101	Communications	Unknown	GEO 75 E	N/A	N/A	2992 lb 1360 kg	12 C	N/A
Yamal 102	Communications	Unknown	GEO 340.5 E	N/A	N/A	2992 lb 1360 kg	12 C	N/A

Characterisitcs of Cited Payloads

Payload	Use	Price	Orbit	Apogee	Perigee	Launch Mass	Freq. Bands & Trans.	Power
Crewed								
ISS 2R	Crewed	Unknown	LEO	N/A	N/A	N/A		N/A
Development								
Clementine	Development	Unknown	LEO	N/A	N/A	111 lb 50 kg		N/A
Earth Orbiter 1	Development	Unknown	LEO	N/A	N/A	939 lb 425 kg		N/A
FalconSat	Development	Unknown	LEO	N/A	N/A	N/A		N/A
GSat 1	Development	Unknown	GEO	N/A	N/A	N/A		N/A
MTI P94-1	Development	Unknown	LEO	N/A	N/A	N/A		N/A
OPAL	Development	$0.1 M	LEO	N/A	N/A	30 lb 14 kg		N/A
TSX 5	Development	$85 M	LEO	N/A	N/A	286 lb 130 kg		N/A
Intelligence								
DSP 20	Intelligence	Unknown	GEO	N/A	N/A	5200 lb 2353 kg		N/A
Helios 1B	Intelligence	Unknown	LEO	459 nMi	N/A	6050 lb 2750 kg		N/A
Kosmos 2365	Intelligence	Unknown	LEO	185 nMi	9N/A	14807 lb 6700 kg		N/A
Meteorological								
DMSP 5D-3-F15	Meteorological	$60 M	LEO	462 nMi	438 nMi	2539 lb 1154 kg		N/A
GOES L	Meteorological	Unknown	GEO 285 E	1933N/A	19323 nMi	3991 lb 1814 kg		N/A
Microgravity								
Foton 12	Microgravity	Unknown	LEO	N/A	N/A	13702 lb 6200 kg		400 W
Navigation								
Kosmos 2366	Navigation	Unknown	LEO	N/A	N/A	N/A		N/A
MTSat 1	Navigation	$109 M	GEO 140 E	N/A	N/A	6380 lb 2900 kg		N/A
Navstar GPS 2R- 3	Navigation	Unknown	MEO	10899 nMi	10899 nMi	4470 lb 2032 kg	L	N/A
Other								
Celestis 3	Other	Unknown	LEO	N/A	N/A	2 lb 1 kg		N/A
Remote Sensing								
CBERS/Ziyuan 1	Remote Sensing	$75 M	LEO	42N/A	42N/A	3190 lb 1450 kg		985 W
IKONOS 2	Remote Sensing	Unknown	LEO	367 nMi	367 nMi	1797 lb 817 kg		N/A
Kompsat	Remote Sensing	$92 M	LEO	N/A	N/A	1122 lb 510 kg	S, X	N/A
Okean O1	Remote Sensing	Unknown	LEO	N/A	N/A	4310 lb 1950 kg		N/A
OrbView 3	Remote Sensing	Unknown	LEO	248 nMi	248 nMi	407 lb 185 kg		N/A
QuickBird 1	Remote Sensing	$45 M	LEO	254 nMi	254 nMi	1803 lb 816 kg		N/A
Resurs-F 1M 2	Remote Sensing	Unknown	LEO	N/A	N/A	N/A		N/A
SACI 1	Remote Sensing	Unknown	LEO	42N/A	42N/A	132 lb 60 kg		N/A

Characterisitcs of Cited Payloads

Payload	Use	Price	Orbit	Apogee	Perigee	Launch Mass	Freq. Bands & Trans.	Power
Remote Sensing (cont)								
SACI 2	Remote Sensing	Unknown	LEO	N/A	N/A	N/A		N/A
Terra	Remote Sensing	$1200 M	LEO	381 nMi	381 nMi	11470 lb 5190 kg		N/A
Scientific								
ACRIMSAT	Scientific	$8.3 M	LEO	N/A	N/A	221 lb 100 kg		N/A
Artemis Picosat	Scientific	Unknown	LEO	N/A	N/A	1 lb 0 kg		N/A
Astro E	Scientific	$100 M	LEO	27N/A	27N/A	3315 lb 1500 kg		N/A
ASUSat 1	Scientific	Unknown	LEO	N/A	N/A	10 lb 5 kg		N/A
Chandra	Scientific	$1400 M	ELI	7560N/A	540N/A	62166 lb 28200 kg		N/A
Citizen Explorer	Scientific	Unknown	LEO	N/A	N/A	81 lb 37 kg		N/A
Coronas F	Scientific	Unknown	LEO	27N/A	27N/A	4752 lb 2160 kg		N/A
DARPA Picosat	Scientific	Unknown	LEO	N/A	N/A	2 lb 1 kg		N/A
HETE-2	Scientific	Unknown	LEO	324 nMi	324 nMi	N/A		N/A
IMAGE	Scientific	Unknown	LEO	N/A	N/A	N/A		N/A
Jawsat	Scientific	Unknown	LEO	N/A	N/A	150 lb 68 kg		N/A
Malaysia 1	Scientific	Unknown	LEO	N/A	N/A	110 lb 50 kg		N/A
Munin	Scientific	Unknown	LEO	N/A	N/A	12 lb 6 kg		N/A
SAC C	Scientific	Unknown	LEO	N/A	N/A	935 lb 425 kg		N/A
STENSAT	Scientific	Unknown	LEO	N/A	N/A	1 lb 0 kg		N/A
XMM	Scientific	Unknown	ELI	6156N/A	378N/A	8800 lb 4000 kg		N/A
Space Station								
Control Moment Gyros	Space Station	Unknown	LEO	N/A	N/A	N/A		N/A
Integrated Truss Str Z1	Space Station	Unknown	LEO	N/A	N/A	N/A		N/A
Ku-Band Communicatio 1	Space Station	Unknown	LEO	N/A	N/A	N/A		N/A
Pressurized Mating A 3	Space Station	Unknown	LEO	N/A	N/A	N/A		N/A
SLP	Space Station	Unknown	LEO	N/A	N/A	N/A		N/A
Ultra High Frequency	Space Station	Unknown	LEO	N/A	N/A	N/A		N/A
Zvezda	Space Station	Unknown	LEO	N/A	N/A	N/A		N/A
Supply								
Progress M-42	Supply	Unknown	LEO	N/A	N/A	15983 lb 7250 kg		N/A
Test								
Unmanned Test	Test	Unknown	LEO	N/A	N/A	N/A		N/A

Launch Events
July 1999 - September 1999

Launch Date	Vehicle	Payload	Payload Operator	Payload Manufacturer	Int'l Comp	Launch Type	Launch Outcome	Mission Outcome
Europe (ESA)								
				Ariane 4				
August 12, 1999	Ariane 42P	Telkom 1	PT Telekom	Lockheed Martin	Yes	Commercial	Success	Success
September 4, 1999	Ariane 42P	KoreaSat 3	Korea Telecom	Lockheed Martin Corp.	Yes	Commercial	Success	Success
September 25, 1999	Ariane 44LP	Telstar 7	Skynet	Space Systems/Loral	Yes	Commercial	Success	Success
Russia								
				Cosmos				
August 26, 1999	Cosmos	Kosmos 2366	Russian MoD	Polyot Production Association	No	Non-Commercial	Success	Success
				Molniya				
July 8, 1999	Molniya	Molniya 3-50	Russia/CIS PTT	NPO Prikladnoi Mekhaniki	No	Non-Commercial	Success	Success
				Proton				
July 5, 1999	Proton (SL-12)	Raduga 35	Russia/CIS PTT	NPO Prikladnoi Mekhaniki	No	Non-Commercial	Failure	Failure
September 6, 1999	Proton (SL-12)	Yamal 101 Yamal 102	Gazkom Gazkom	RKK Energia RKK Energia	No	Non-Commercial	Success	Success
September 26, 1999	Proton (SL-12)	LMI 1	Lockheed Martin Intersputnik	Lockheed Martin	Yes	Commercial	Success	Success
				Soyuz				
July 16, 1999	Soyuz	Progress M-42	RKK Energia	RKK Energia	No	Non-Commercial	Success	Success
August 18, 1999	Soyuz	Kosmos 2365	Russian MoD	Unknown	No	Non-Commercial	Success	Success
September 9, 1999	Soyuz	Foton 12	Space Research Institute (IKI)	KB Foton	No	Non-Commercial	Success	Success
September 22, 1999	Soyuz	Globalstars 33,50,55,58	Globalstar, Inc.	Space Systems/Loral	Yes	Commercial	Success	Success
September 28, 1999	Soyuz	Resurs-F 1M 2	Russian MoD	Central Specialized Design Bureau	No	Non-Commercial	Success	Success

Launch Events
July 1999 - September 1999

Launch Date	Vehicle	Payload	Payload Operator	Payload Manufacturer	Int'l Comp	Launch Type	Launch Outcome	Mission Outcome
Russia (cont.)								
				Zenit				
July 17, 1999	Zenit 2	Okean O1	NSAU	NPO Yuzhnoe	No	Non-Commercial	Success	Success
USA								
				Athena				
September 24, 1999	Athena 2	IKONOS 2	Space Imaging Inc.	Lockheed Martin	No	Commercial	Success	Success
				Atlas				
September 23, 1999	Atlas 2AS	Echostar 5	Echostar	Space Systems/Loral	Yes	Commercial	Success	Success
				Delta 2				
July 10, 1999	Delta 2 7420	Globalstars 30,32,35,51	Globalstar, Inc.	Space Systems/Loral	Yes	Commercial	Success	Success
July 25, 1999	Delta 2 7420	Globalstars 26,28,43,48	Globalstar, Inc.	Space Systems/Loral	Yes	Commercial	Success	Success
August 17, 1999	Delta 2 7420	Globalstars 24,27,53,54	Globalstar, Inc.	Space Systems/Loral	Yes	Commercial	Success	Success
				Shuttle				
July 23, 1999	Shuttle Columbia	STS 93 Chandra	NASA NASA	Rockwell International TRW	No	Non-Commercial	Success	Success

Launch Events
October 1999 - December 1999

Launch Date	Vehicle	Payload	Payload Operator	Payload Manufacturer	Int'l Comp	Launch Type	Site
Brazil							
			VLS				
November 1999	VLS	SACI 2	INPE	INPE	No	Non-Commercial	Alcantara
China							
			Long March				
October 14, 1999	Long March 4B	CBERS/Ziyuan 1 SACI 1	China/Brazil INPE	China Academy of Space Technology INPE	No	Non-Commercial	Taiyuan
4th Qtr 1999	Long March 2F	Unmanned Test	Unknown	Unknown	No	Non-Commercial	Jiuquan
Europe (ESA)							
			Ariane 4				
October 18, 1999	Ariane 44LP	Orion F2	Orion Network Services	Space Systems/Loral	Yes	Commercial	Kourou
November 13, 1999	Ariane 44LP	GE 4	GE Americom	Lockheed Martin	Yes	Commercial	Kourou
November 25, 1999	Ariane 40	Helios 1B Clementine	CNES/DGA DGA	Matra Marconi Surrey Satellite Technology Limited	No	Non-Commercial	Kourou
December 22, 1999	Ariane 44L	Galaxy 11	Pan American Satellite Corp.	Hughes	Yes	Commercial	Kourou
			Ariane 5				
December 8, 1999	Ariane 5	XMM	European Space Agency (ESA)	Deutsche Aerospace (DASA)	No	Non-Commercial	Kourou
International							
			Sea Launch				
October 10, 1999	Sea Launch	DBS 1R	Hughes Communications Inc.	Hughes	Yes	Commercial	Sea Launch Platform

Launch Events
October 1999 - December 1999

Launch Date	Vehicle	Payload	Payload Operator	Payload Manufacturer	Int'l Comp	Launch Type	Site
Japan							
			H 2				
November 1999	H 2	MTSat 1	Ministry of Transport	Space Systems/Loral	No	Non-Commercial	Tanegashima
Russia							
			Cyclone				
4th Qtr 1999	Cyclone 3	Coronas F	Izmiran & Lebedev Physical Institute	NPO Yuzhnoye	No	Non-Commercial	Plesetsk
			Proton				
October 21, 1999	Proton (SL-12)	Garuda 1	ACeS Consortium	Lockheed Martin Corp.	Yes	Commercial	Baikonur
December 26, 1999	Proton (SL-13)	Zvezda	Russia	RKK Energia	No	Non-Commercial	Baikonur
4th Qtr 1999	Proton (SL-12)	Sesat	Eutelsat	NPO PM	Yes	Commercial	Baikonur
4th Qtr 1999	Proton (SL-12)	Express A 1	NPO PM	Alcatel Espace	No	Non-Commercial	Baikonur
			Soyuz				
October 18, 1999	Soyuz	Soyuz Globalstar #5	Globalstar, Inc.	Space Systems/Loral	Yes	Commercial	Baikonur
November 14, 1999	Soyuz	Soyuz Globalstar #6	Globalstar, Inc.	Space Systems/Loral	Yes	Commercial	Baikonur
USA							
			Atlas 2				
November 4, 1999	Atlas 2AS	GBS 10	DoD	Hughes	No	Commercial	CCAS
November 23, 1999	Atlas 2AS	Terra	NASA	Lockheed Martin Corp.	No	Non-Commercial	VAFB
November 30, 1999	Atlas 2A	GOES L	NOAA	Space Systems/Loral	No	Non-Commercial	CCAS
4th Qtr 1999	Atlas 2AS	Hispasat 1C	Hispasat	Aerospatiale	Yes	Commercial	CCAS

Launch Events
October 1999 - December 1999

Launch Date	Vehicle	Payload	Payload Operator	Payload Manufacturer	Int'l Comp	Launch Type	Site
USA (cont.)							
			Delta 2				
October 7, 1999	Delta 2 7925	Navstar GPS 2R- 3	DoD	Lockheed Martin Corp.	No	Non-Commercial	CCAS
December 15, 1999	Delta 2 7320	Earth Orbiter 1 Citizen Explorer Munin SAC C	NASA Colorado Space Grant Consortium Swedish Institute of Space Physics Argentina	Swales & Associates Inc., MIT/Lincoln Labs Colorado Space Grant Consortium Swedish Institute of Space Physics (IRF) Bariloche Company Invap.	No	Non-Commercial	VAFB
December 18, 1999	Delta 2 7420	Delta Globalstar #7	Globalstar, Inc.	Space Systems/Loral	Yes	Commercial	CCAS
			Minotaur				
4th Qtr 1999	Minotaur	Jawsat Artemis Picosat ASUSat 1 DARPA Picosat FalconSat MASAT OPAL STENSAT	Air Force Academy & Weber State Univ. Santa Clara University Arizona State University DARPA USAF Unknown Space Systems Development Lab Radio Amateurs	Air Force Academy Santa Clara University Arizona State University DARPA USAF Unknown Space Systems Development Laboratory (SSDL) Radio Amateurs	No	Non-Commercial	California Spaceport
			Pegasus				
4th Qtr 1999	Pegasus XL/HAPS	Pegasus Orbcomm #4	Orbital Communications Corp.	Orbital Sciences Corp. (OSC)	No	Commercial	Wallops Flight Facility
4th Qtr 1999	Pegasus XL	TSX 5	DoD	Orbital Sciences Corp. (OSC)	Yes	Non-Commercial	VAFB
4th Qtr 1999	Pegasus XL	OrbView 3	Orbital Imaging Corp. (Orbimage)	Orbital Sciences Corp. (OSC)	No	Commercial	VAFB
			Shuttle				
December 2, 1999	Shuttle Discovery	STS 103	NASA	Rockwell International	No	Non-Commercial	KSC
			Taurus				
4th Qtr 1999	Taurus 1	Kompsat ACRIMSAT Celestis 3	Korea Aerospace Research Institute NASA Celestis, Inc.	TRW/KARI Orbital Sciences Corporation (OSC) Celestis, Inc.	Yes	Commercial	VAFB

Launch Events
October 1999 - December 1999

Launch Date	Vehicle	Payload	Payload Operator	Payload Manufacturer	Int'l Comp	Launch Type	Site
USA (cont.)							
			Titan 2				
December 1999	Titan 2	DMSP 5D-3-F15	DoD	Locheed Martin	No	Non-Commercial	VAFB
			Titan 4				
December 11, 1999	Titan 4B/IUS	DSP 20	DoD	TRW	No	Non-Commercial	CCAS

Launch Events
January 2000 - March 2000

Launch Date	Vehicle	Payload	Payload Operator	Payload Manufacturer	Int'l Comp	Launch Type	Site
Europe (ESA)							
			Ariane 4				
February 2000	Ariane 4-TBA	Skynet 4F Malaysia 1	British Defense Ministry Malaysian Space and Telecom Research	Matra Marconi ISRO	Yes	Commercial	Kourou
			Ariane 5				
January 2000	Ariane 5	Eutelsat W4	Eutelsat	Alcatel	Yes	Commercial	Kourou
February 18, 2000	Ariane 5	AsiaStar 1 Insat 3B	WorldSpace, Inc. ISRO	Alcatel ISRO	Yes	Commercial	Kourou
India							
			GSLV				
1st Qtr 2000	GSLV	GSat 1	ISRO	ISRO	No	Non-Commercial	Sriharikota Range
Japan							
			M 5				
January 2000	M 5	Astro E	ISAS	ISAS	No	Non-Commercial	Kagoshima
Russia							
			Cosmos				
1st Qtr 2000	Cosmos	QuickBird 1	EarthWatch, Inc.	Ball Aerospace	Yes	Commercial	Plesetsk
			Proton				
January 17, 2000	Proton (SL-12)	CD Radio 1	CD Radio, Inc.	Space Systems/Loral	Yes	Commercial	Baikonur
1st Qtr 2000	Proton (SL-12)	GE 1A	GE Americom/LM Global Telecom	Lockheed Martin	Yes	Commercial	Baikonur
			Rockot				
1st Qtr 2000	Rockot	Iridium R- 21 Iridium R- 22	Iridium, Inc. Iridium, Inc.	Lockheed Martin Lockheed Martin	Yes	Commercial	Plesetsk

Launch Events
January 2000 - March 2000

Launch Date	Vehicle	Payload	Payload Operator	Payload Manufacturer	Int'l Comp	Launch Type	Site
Russia (cont.)							
			Soyuz				
March 12, 2000	Soyuz	ISS 2R	Russian Space Agency	RKK Energia	No	Non-Commercial	Baikonur
USA							
			Atlas 2				
January 20, 2000	Atlas 2A	DSCS III 3-11	DoD	Lockheed Martin Corp.	No	Non-Commercial	CCAS
March 1, 2000	Atlas 2A	TDRS F8	NASA	Hughes	No	Non-Commercial	CCAS
			Atlas 3				
1st Qtr 2000	Atlas 3A	Echostar 6	Echostar	Space Systems/Loral	Yes	Commercial	CCAS
			Delta 2				
February 15, 2000	Delta 2 7326	IMAGE	NASA	NASA	No	Non-Commercial	VAFB
1st Qtr 2000	Delta 2 7420	Delta Globalstar #8	Globalstar, Inc.	Space Systems/Loral	Yes	Commercial	CCAS
			Pegasus				
1st Qtr 2000	Pegasus XL	HETE-2	Massachussetts Institute of Technology	Massachussetts Institute of Technology	No	Commercial	Kwajalein
			Shuttle				
January 13, 2000	Shuttle Endeavour	STS 99	NASA	Rockwell International	No	Non-Commercial	KSC
February 10, 2000	Shuttle Atlantis	SLP	NASA		Yes	Non-Commercial	KSC
		STS 101	NASA	Rockwell International			
		Ultra High Frequency	NASA	NASA			
March 2000	Shuttle Discovery	Integrated Truss Str Z1	NASA	NASA	No	Non-Commercial	KSC
		Control Moment Gyros	NASA	NASA			
		Ku-Band Communicatio 1	NASA	NASA			
		Pressurized Mating A 3	NASA	Boeing			
		STS 92	NASA	Rockwell International			
			Taurus				
1st Qtr 2000	Taurus 1	MTI P94-1	DoD	Unknown	No	Non-Commercial	VAFB