Commercial Space Transportation

QUARTERLY LAUNCH REPORT

Featuring the launch results from the 1st quarter 2002 and forecasts for the 2nd and 3rd quarters 2002

Quarterly Report Topic:

Launch Activity and Orbital Debris Mitigation

2nd Quarter 2002

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Associate Administrator for Commercial Space Transportation
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Introduction

The Second Quarter 2002 Quarterly Launch Report features launch results from the first quarter of 2002 (January-March 2002) and launch forecasts for the second quarter of 2002 (April-June 2002) and the third quarter of 2002 (July-September 2002). This report contains information on worldwide commercial, civil, and military orbital space launch events. Projected launches have been identified from open sources, including industry references, company manifests, periodicals, and government sources. Projected launches 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)

Contents

Cover: Cape Canaveral Air Force Station, Fla., Feb. 21, 2002 - An Atlas 3B launch vehicle successfully delivers its EchoStar 7 payload into orbit for EchoStar Communications Corporation. Courtesy of International Launch Services.

First Quarter 2002 Highlights

In the first quarter of 2002, two new vehicle variants made their first launches. These vehicles were International Launch Services' (ILS) Atlas 3B and Rocket System Corporation's H-2A. In addition, Arianespace's Ariane 5G launch vehicle returned to flight after a failed launch in July 2001.

The first launch of the ILS Atlas 3B occurred on February 21 from Cape Canaveral Air Force Station in Florida. The vehicle used the two-engine Centaur upper stage to place the EchoStar 7 communications satellite successfully into geosynchronous orbit. The Atlas 3B is an upgraded version of the recently-debuted Atlas 3A launch vehicle. While the Atlas 3A can lift a maximum of 4,060 kilograms (8,951 pounds) to geosynchronous transfer orbit (GTO), the Atlas 3B is capable of lifting 4,500 kilograms (9,921 pounds) to GTO. A replacement for the Atlas 2, the Atlas 3 will eventually be replaced by the Atlas 5 Evolved Expendable Launch Vehicle.

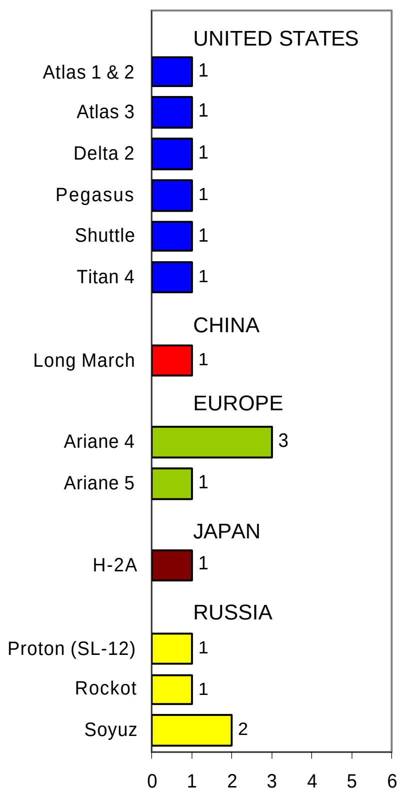
On February 4, Japan's first H-2A, with additional solid rocket strap-on boosters, carried the Mission Demonstration Satellite 1 (MDS-1), Vehicle Evaluation Payload 3 (VEP-3), and the Demonstration of Atmospheric Reentry Systems with Hyper Velocity (DASH) into Earth orbit. After the launch, however, DASH failed to separate from the H-2A 202 booster and was lost. The two other payloads functioned properly and reached their proper orbits.

On February 28, Arianespace successfully launched an Ariane 5G from its launch site at Kourou, carrying the European Space Agency's (ESA) Envisat 1 satellite, part of ESA's Earth Observation Program. This launch was the first of an Ariane 5 since the failed launch on July 12, 2001, when an Ariane 5G suffered a second-stage failure resulting in the loss of the ESA's Artemis and Japan's Broadcasting Satellite System Corporation's Bsat 2B.

Vehicle Use

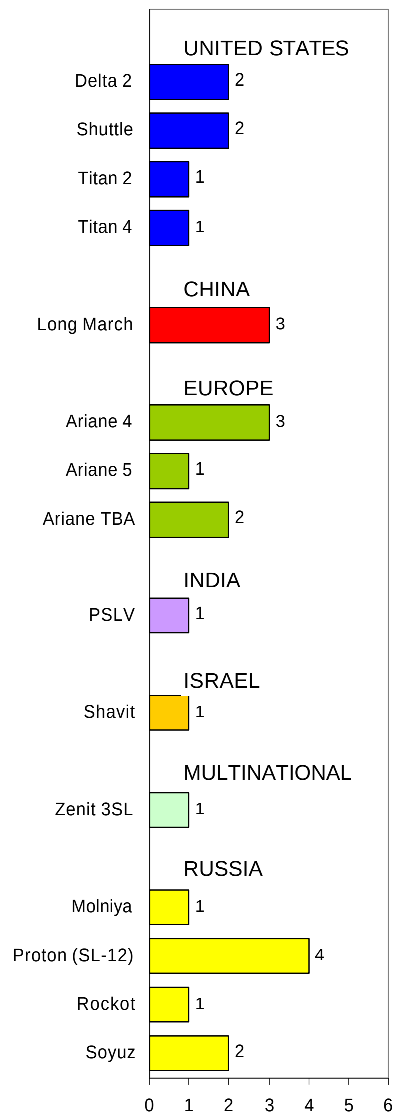
(January 2002 – September 2002)

Figure 1: First Quarter 2002 Total Launch Vehicle Use



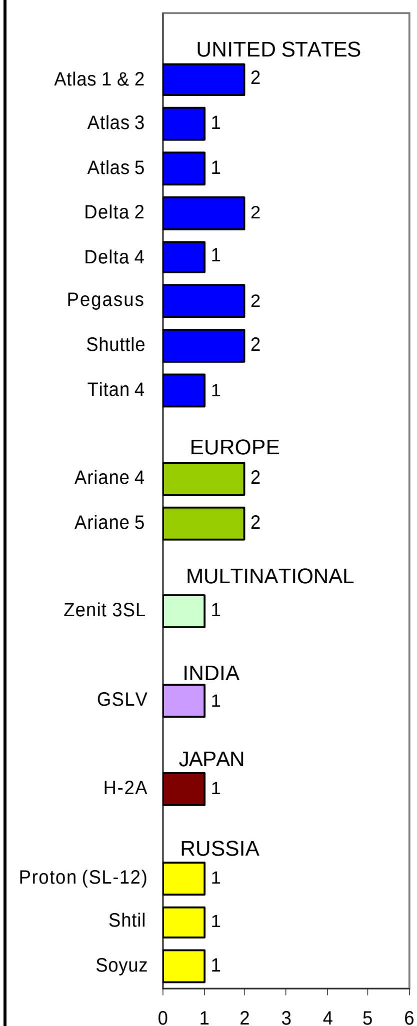
Total = 16

Figure 2: Second Quarter 2002 Total Projected Launch Vehicle Use



Total = 26

Figure 3: Third Quarter 2002 Total Projected Launch Vehicle Use



Total = 22

Figures 1-3 show the total number of orbital launches (commercial and government) of each launch vehicle that occurred in the first quarter of 2002 and that are projected for the second and third quarters of 2002. These launches are grouped by the country in which the primary vehicle manufacturer is based. Exceptions to this grouping are launches performed by Sea Launch, which are designated as multinational.

Total Launch Events by Country

(January 2002 – September 2002)

Figure 4: FIrst Quarter 2002 Total Launch Events by Country

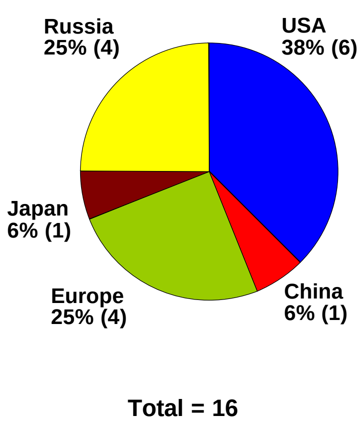


Figure 5: Second Quarter 2002 Total Projected Launch Events by Country

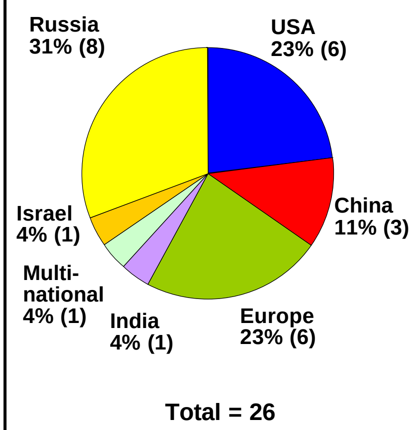
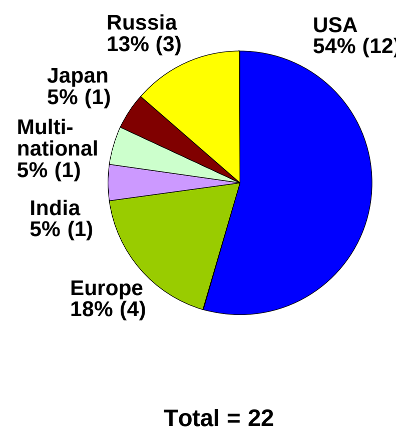


Figure 6: Third Quarter 2002 Total Projected Launch Events by Country



Figures 4-6 show all orbital launch events (commercial and government) that occurred in the first quarter of 2002 and that are projected for the second and third quarters of 2002.

Commercial Launch Events by Country

(January 2002 – September 2002)

Figure 7: First Quarter 2002 Commercial Launch Events by Country

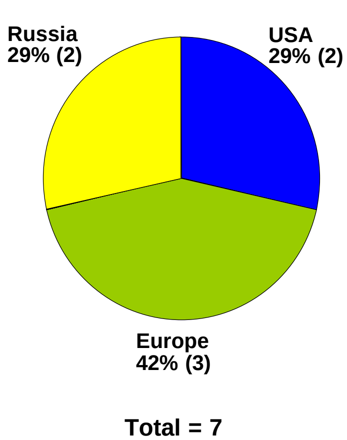


Figure 8: Second Quarter 2002 Projected Commercial Launch Events by Country

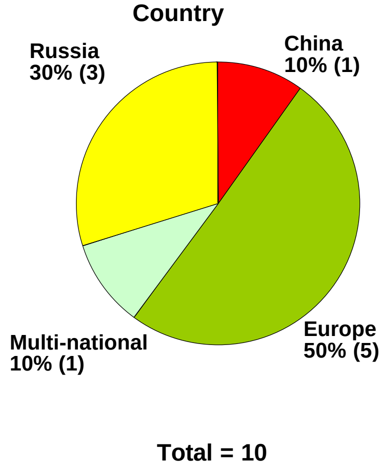
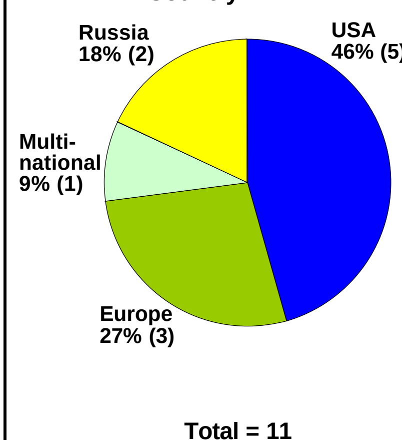


Figure 9: Third Quarter 2002 Projected Commercial Launch Events by Country

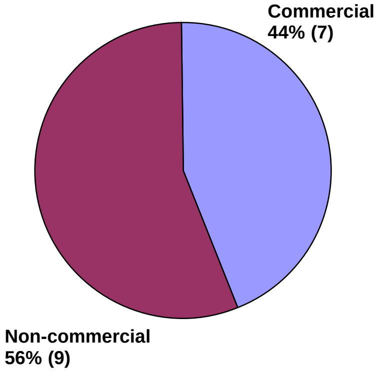


Figures 7-9 show all *commercial* orbital launch events that occurred in the first quarter of 2002 and that are projected for the second and third quarters of 2002.

Commercial vs. Non-commercial Launch Events

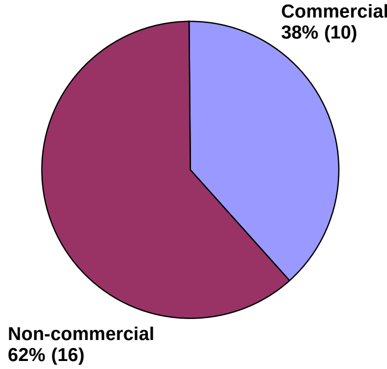
(January 2002 – September 2002)

Figure 10: First Quarter 2002 Commercial vs. Non-commercial Launch Events



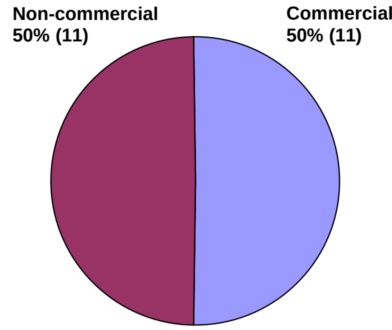
Total = 16

Figure 11: Second Quarter 2002 Commercial vs. Non-commercial Projected Launch Events



Total = 26

Figure 12: Third Quarter 2002 Commercial vs. Non-commercial Projected Launch Events



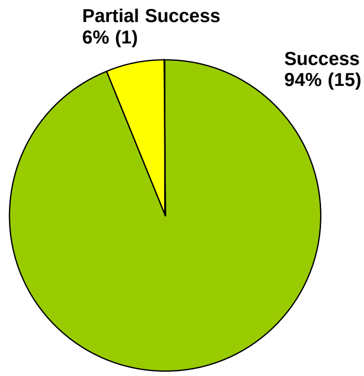
Total = 22

Figures 10-12 show commercial vs. non-commercial orbital launch events that occurred in the first quarter of 2002 and that are projected for the second and third quarters of 2002.

First Quarter 2002 Launch Successes vs. Failures

(January 2002 – March 2002)

Figure 13: Total Launch Successes vs. Failures



Total = 16

Figure 13 shows successful vs. failed orbital launch events that occurred in the first quarter of 2002. Partially-successful orbital launch events are those in which the launch vehicle fails to deploy its payload to the appropriate orbit but the payload is able to reach a useable orbit by using its own propulsion systems. Cases in which the payload is unable to reach a useable orbit or would use all of its fuel to do so are considered failures. The partially-successful launch was of NASA's TDRS I spacecraft, which did not reach its proper orbit. It is antipicated that it will be able to achieve this orbit by using its on-board thrusters.

Payload Use

(January 2002 – September 2002)

Figure 14: First Quarter 2002 Payload Use

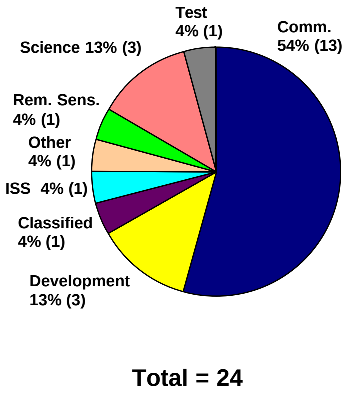


Figure 15: Second Quarter 2002 Projected Payload Use

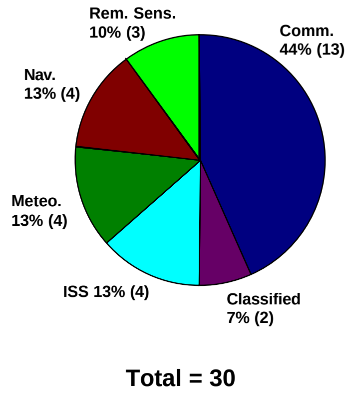
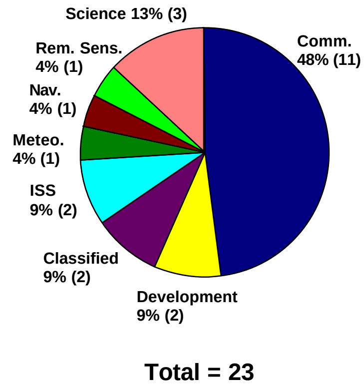


Figure 16: Third Quarter 2002 Projected Payload Use



Figures 14-16 show total payload use (commercial and government), actual for the first quarter of 2002 and that are projected for the second and third quarters of 2002. The total number of payloads launched may not equal the total number of launches due to multi-manifesting, i.e., the launching of more than one payload by a single launch vehicle.

Payload Mass Class

(January 2002 – September 2002)

Figure 17: First Quarter 2002 Payload Mass Class

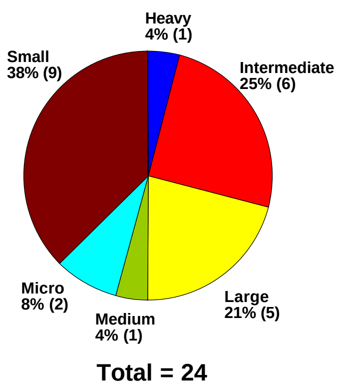


Figure 18: Second Quarter 2002 Projected Payload Mass Class

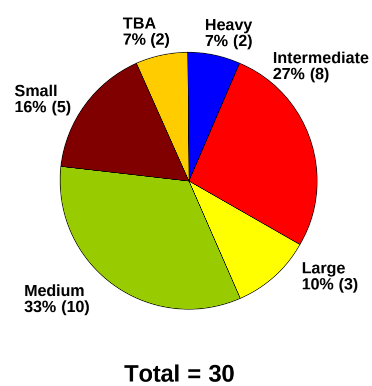
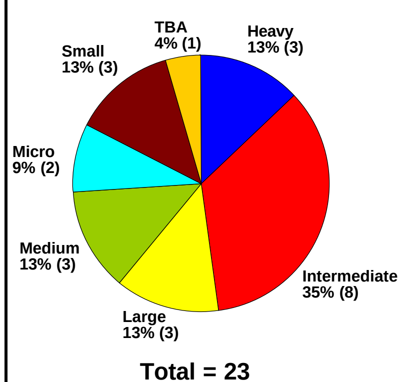


Figure 19: Third Quarter 2002 Projected Payload Mass Class



Figures 17-19 show total payloads by mass class (commercial and government), actual for the first quarter of 2002 and projected for the second and third quarters of 2002. The total number of payloads launched may not equal the total number of launches due to multi-manifesting, i.e., the launching of more than one payload by a single launch vehicle. Payload mass classes are defined as Micro: 0 to 91 kilograms (0 to 200 lbs.); Small: 92 to 907 kilograms (201 to 2,000 lbs.); Medium: 908 to 2,268 kilograms (2,001 to 5,000 lbs.); Intermediate: 2,269 to 4,536 kilograms (5,001 to 10,000 lbs.); Large: 4,537 to 9,072 kilograms (10,001 to 20,000 lbs.); and Heavy: over 9,073 kilograms (20,000 lbs.).

Commercial Launch Trends

(April 2001 – March 2002)

Figure 20: Commercial Launch Events, Last 12 Months

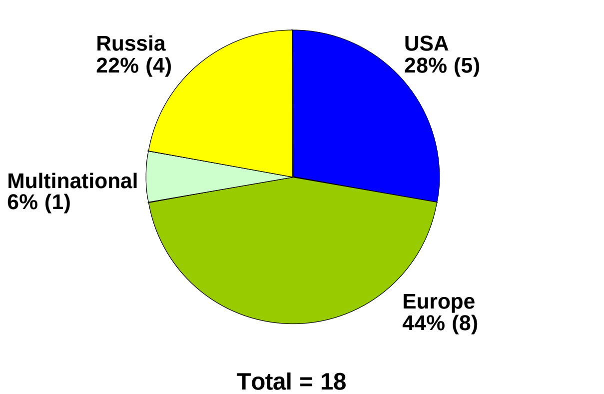


Figure 21: Commercial Launch Revenue, Last 12 Months

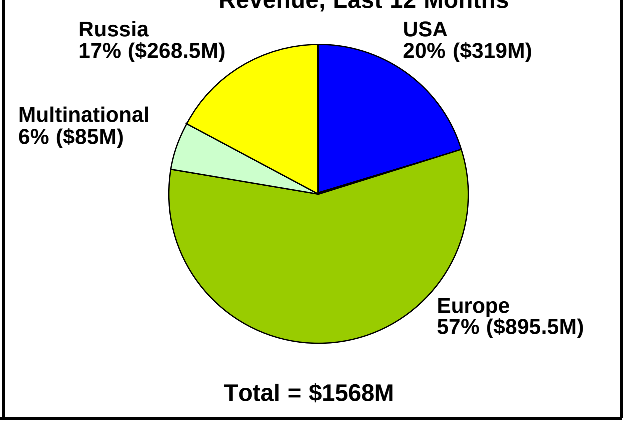


Figure 20 shows commercial launch events for the period April 2001 to March 2002 by country.

Figure 21 shows commercial launch revenue for the period April 2001 to March 2002 by country.

Figure 22: Commercial Launch Events by Country, Last Five Years

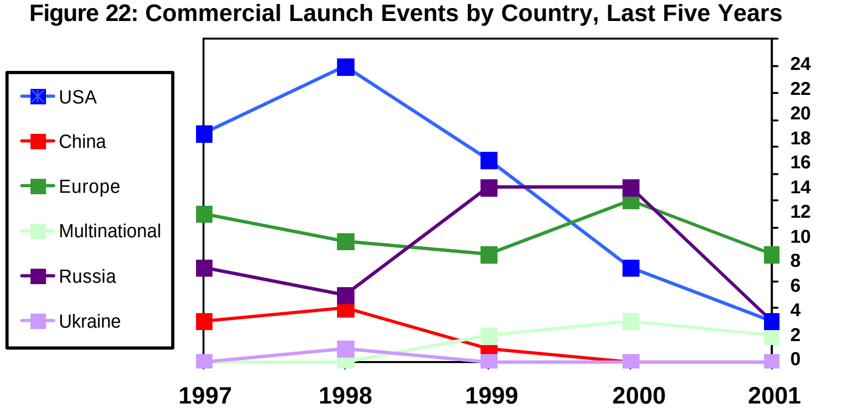


Figure 22 shows commercial launch events by country for the last five full years.

Figure 23: Commercial Launch Revenue (in $ million) by Country, Last Five Years

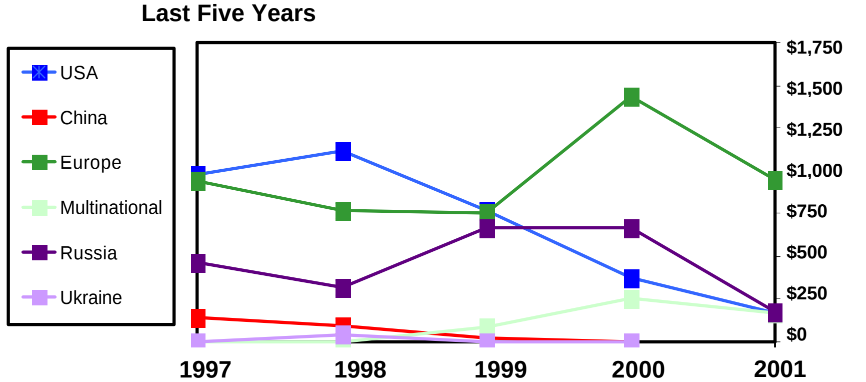


Figure 23 shows commercial launch revenue by country for the last five full years.

Launch Activity and Orbital Debris Mitigation

INTRODUCTION

Since the start of human space activity, the number of orbital debris, or artificial objects orbiting Earth that are no longer functional, has steadily increased. These debris make up 95 percent of all orbiting space objects and consist of spent satellites and upper stages, separation devices, bolts, paint chips, and still other spacecraft components. U.S. Space Command tracks more than 9,000 objects larger than ten centimeters wide with ground-based optical and radar telescopes; another 100,000 objects between one and ten centimeters are estimated to be orbiting Earth. Figure 1 shows computer-generated views of catalogued space objects, including debris, distributed in various Earth orbits.

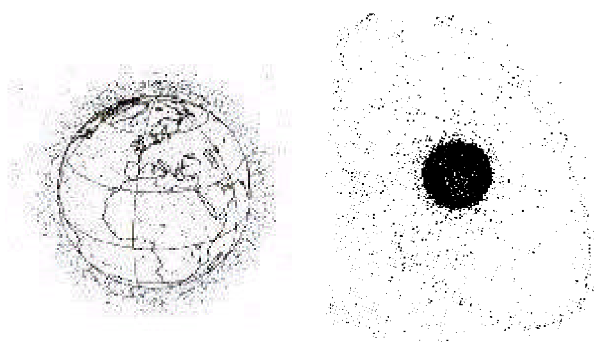


Figure 1: Space objects distributed in low-Earth (left) and geostationary, medium-Earth, and Molniya (right) orbits

While the risk of an orbital debris impact to an operational spacecraft is low, the debris population continues to grow at 175 metric tons per year and has caused damage to active spacecraft. Indeed, orbital debris' presence is apparent in the dings and dents observed on spacecraft such as the Space Shuttle, the Russian Mir space station, and the Hubble Space Telescope. As a result, efforts are underway in both the government and industry to mitigate orbital debris.

As indicated above, launch vehicle upper stages and their mechanisms and components have proven to be a considerable contributor to the orbital debris population. This report shows how launch vehicles and launch activity can create orbital debris and explains what the U.S. and foreign governments and the aerospace industry are doing to minimize the amount of orbital debris generated by launch activity.

LAUNCH ACTIVITY AND ORBITAL DEBRIS CREATION

Along with derelict spacecraft, upper stages comprise the greatest concentration of mass in Earth orbit. More than 1500 rocket bodies launched by the spacefaring nations of the world currently circle Earth, with nearly half of these in low orbits. The orbital stages of launch vehicles can create hazards to operational spacecraft in two main ways: through collisions and explosions.

Collisions involving launch vehicle orbital stages can occur if spent upper stages and their components remain in operational orbits after directly injecting their payloads. While rare, collisions can cause devastation to active spacecraft, as occurred when the Japanese ECS-1 (Ayame-1) satellite was incapacitated after colliding with the third stage of its own launch vehicle.

Accidental explosions of upper stages are the primary source of the approximately 2200 rocket body debris now in Earth orbit. Upper stages may explode when, after the upper stage successfully delivers satellites to orbit, stored energy, such as residual propellants and pressurants, undergoes thermal cycling or is over-pressurized due to solar heating. Such explosions can generate hundreds of fragments of orbital debris and, along with spacecraft explosions, account for almost 40 per-

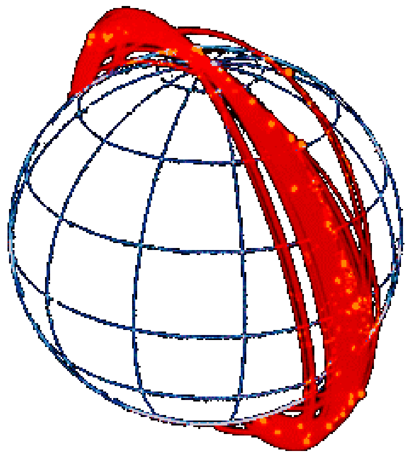


Figure 2: Notional spread of orbital debris after a spacecraft or upper stage explosion

cent of all orbiting objects tracked from the ground. Figures 2 and 3 depict how orbital debris can spread over time.

Upper stage explosions are considered to be the greatest source of the most hazardous debris in Earth orbit. The creation of more debris adds to the risk of collision with an active satellite. While Space Shuttle Discovery successfully avoided debris from an exploded Pegasus upper stage with an in-orbit maneuver in 1997, the less fortunate French military satellite CERISE was struck by a fragment of an exploded Ariane upper

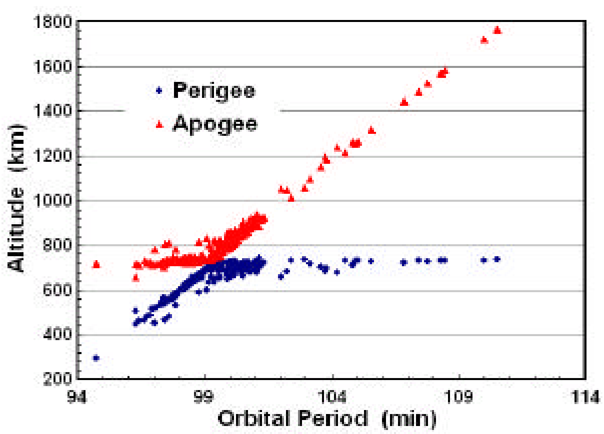


Figure 3: Gabbard diagram of the orbital debris distribution from a Long March upper stage explosion in March 2000

stage in 1996. Three upper stages and two upper stage components exploded in 2001.

The launch industry and U.S. government, along with governments around the world, have recognized the risks associated with upper stage collisions and explosions. The next section shares the efforts the U.S. government, international organizations, and the launch industry have made to minimize on-orbit collisions and explosions involving launch hardware, in turn mitigating orbital debris.

LAUNCH ACTIVITY AND ORBITAL DEBRIS MITIGATION

Recognizing that keeping the space environment clean is a common responsibility and desire, spacefaring governments and companies have worked to develop procedures and standards for minimizing the amount of orbital debris they produce in their launch activities. While some of the government procedures and standards developed pertain specifically to launch hardware, many are generally applicable to space activity. Though described in separate sections below, U.S. government, foreign and international, and launch industry orbital debris mitigation efforts have coincided in time and have influenced one another.

U.S. Government Efforts

In 1988, the Reagan Administration released the first national space policy that called for agencies to "seek to minimize the creation of orbital debris." The following year, the U.S. government issued a report on orbital debris. Noting the lack of good measurements on the orbital debris environment, the report called for the National Aeronautics and Space Administration (NASA) and the Department of Defense (DoD) to develop a plan to monitor the debris environment. As a result, these agencies embarked on programs to address this recommendation. Figure 4 shows the Haystack radar, a facility operated by the

Massachusetts Institute of Technology's Lincoln Laboratory that NASA and the Air Force have used since 1990 to track small orbital debris.

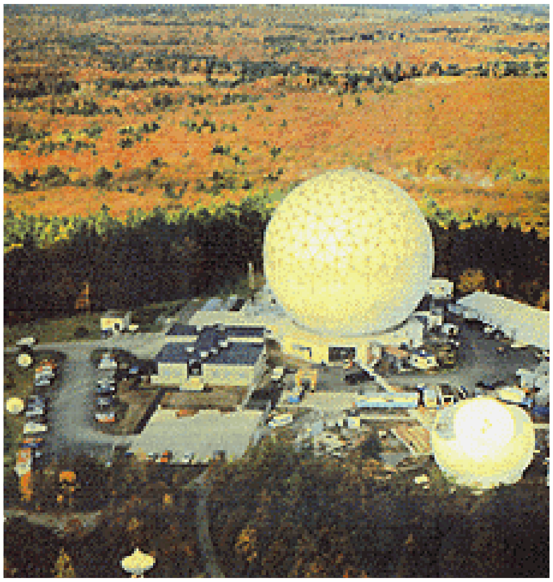


Figure 4: The Haystack radar

The Bush Administration took up orbital debris mitigation as a formal goal in its 1989 national space policy, adding that the United States would also encourage other nations to adopt debris mitigation policies and practices. Following the approval of that directive, NASA and DoD adopted policies concerning the mitigation of orbital debris in all of their space activities.

The government updated its orbital debris report in 1995, issuing five recommendations. These recommendations were to: (1) continue and enhance debris measurement, modeling, and monitoring capabilities; (2) conduct a focused study on debris and emerging low-Earth orbit (LEO) systems; (3) develop government/industry design guidelines on orbital debris; (4) develop a strategy for international discussion; and (5) review and update U.S. policy on debris. These recommendations have guided U.S. government activity regarding orbital debris mitigation since that time. Just one year after the issuance of this report, President Clinton's national space policy reaffirmed the earlier policy by calling for U.S. government agencies to minimize space debris. The 1996 policy also required NASA, DoD, the intelligence community and the private sector to develop design guidelines for U.S. government space hardware procurements and stressed a U.S. leadership role in urging other nations to adopt debris minimization practices and policies.

Shortly after the issuance of the report, a U.S. interagency working group led by NASA and DoD developed a work plan to study the debris environment and to work with U.S. government agencies and other spacefaring nations and international organizations to design and adopt guidelines to minimize orbital debris. In 1997, the working group created a set of "U.S. Government Orbital Debris Mitigation Standard Practices." Based on a NASA safety standard of procedures for limiting debris, the Standard Practices are intended for government-operated or -procured space systems, including satellites as well as launch vehicles. The interagency group has shared the guidelines with the aerospace industry to encourage voluntary compliance.

Now forming the foundation of U.S. government protocol regarding orbital debris, the Standard Practices support four objectives, presented below. All of the practices apply to launch vehicle components and upper stages.

1. *Control of debris released during normal operations.* Spacecraft as well as upper stages are to be designed to eliminate or minimize debris released under normal circumstances. Any planned release of debris larger than five millimeters that remain on orbit for over 25 years should be evaluated and justified on the basis of cost effectiveness and mission requirements.

2. *Minimization of debris generated by accidental explosions, during and after mission operations.* During missions, spacecraft

and upper stages should not have any credible failure modes for accidental explosions, or the probability of a failure mode's occurrence should be limited. After missions, on-board stored energy should be depleted or safed.

3. *Selection of safe flight profile and operational configuration.* Spacecraft and upper stage design and mission profiles should estimate and limit the probability of collision with known objects during orbital lifetime. Tether systems should be analyzed for intact and severed conditions.

4. *Post-mission disposal of space structures.* Launch vehicle components, upper stages, spacecraft, and other payloads should be disposed of at the end of mission life by one of three methods: atmospheric re-entry, maneuver to a designated storage orbit, or direct retrieval. Tether systems should be analyzed for intact and severed conditions when performing trade-offs between various disposal strategies.

Several U.S. government agencies have worked in recent years to develop guidelines and regulations on orbital debris production and mitigation for their activities and the industries they oversee. NASA, DoD, and Air Force Space Command orbital debris directives and guidelines have applied broadly to their launch as well as on-orbit activities. Air Force Space Command's Eastern and Western Range Requirement 127-1, for example, states that launches from federal ranges must have completed collision avoidance analyses. Regulatory agencies such as the Federal Communications Commission and the National Oceanic and Atmospheric Administration have proposed and published rules, respectively, pertaining to orbital debris mitigation for communications and remote sensing satellites, respectively.

The Federal Aviation Administration (FAA) has developed orbital debris-related regulations for the U.S. launch industry. The FAA attempts to mitigate orbital debris generated by space transportation in several ways. In 14 Code of Federal Regulations (CFR) part 415.39, the FAA requires expendable launch vehicle (ELV) launch license applicants to demonstrate that: (1) there will be no unplanned contact between the vehicle, its components, and payload after payload separation; (2) no debris will be generated from the conversion of chemical, pressure, and kinetic energy sources into energy that fragments the vehicle or its components; and (3) stored energy must be removed by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in permanent discharge state, and removing any remaining source of stored energy.

While part 415.39 applies to ELVs, 14 CFR part 431.43 specifies that the first two of the above stipulations apply to reusable launch and re-entry vehicles. The latter regulation also requires a reusable vehicle operator to perform a collision avoidance analysis to ensure a 200-kilometer separation between the vehicle and an inhabitable orbiting object during launch and re-entry. Finally, 14 CFR part 440, Appendix A, requires launch license applicants seeking a maximum probable loss determination for their activities to share with the FAA an analysis of risks posed by launch vehicles to operational satellites on orbit.

Foreign and International Efforts

As Table 1 shows, all major spacefaring nations have been responsible for adding to the number of space objects and debris in Earth orbit. Several foreign space agencies and organizations have recognized the risks associated with orbital debris and have issued or are currently developing orbital debris mitigation guidelines that apply to launch as well as all types of space activities. Many of these standards bear strong similarities to U.S. standards and have been patterned after them. The Japanese, European, French, and Russian space agencies have all developed orbital debris mitigation standards.

Country/ organization	Payloads	Rocket bodies	Debris	Total
China	32	20	285	337
CIS	1336	820	1687	3843
ESA	32	100	185	317
India	22	6	226	254
Japan	71	30	16	117
USA	966	570	2226	3762
Total	2459	1546	4625	8630

Table 1: Orbiting space objects and debris by origin

The subject of orbital debris has been and is currently being addressed in international fora. In 1993, several of the world's space agencies formed the Inter-Agency Space Debris Coordinating Committee (IADC) to facilitate the exchange of technical research and information related to orbital debris, to facilitate opportunities for space debris research cooperation, and to identify debris mitigation options. The IADC has compiled orbital debris mitigation guidelines for the world's spacefaring governments to follow that draw heavily from standards the space-faring nations have developed. In 2003, the IADC will present its guidelines to the Scientific and Technical Subcommittee of the United Nations' Committee for the Peaceful Uses of Outer Space (COPUOS), which since 1994 has included orbital debris as an annual agenda item.

Industry Efforts

Even before governments began to develop orbital debris-related policies and guidelines, launch vehicle developers became aware of the risks associated with orbital debris and began to explore ways to mitigate this hazard. One of the earliest procedures U.S. vehicle manufacturers adopted was the passivation, or depletion of on-board energy sources, of upper stages to prevent them from exploding and fragmenting. Passivation includes the burning or venting of residual propellants, the release of pressurants, the discharge of batteries, and the spinning down of momentum wheels and devices with rotational energy. It is believed that more than 80 percent of all upper stage explosions could have been prevented by passivation. Moreover, no passivated upper stages are known to have exploded.

The passivation of U.S. launch vehicles started in the early 1960s, when Thor-Ablestar upper stages vented leftover fuels. Over time, as upper stages of U.S. and non-U.S. upper stages experienced explosions and fragmented, passivation caught on among the world's launch vehicle developers. By the 1980s and 1990s, passivation became a standard procedure on Delta, Pegasus, Atlas, and Titan orbital stages. Foreign upper stages, such as those of the Ariane, Long March, and Zenit, now also employ passivation measures. The cost of passivation can be relatively small if it is planned in a vehicle's design phase.

U.S. launch vehicle manufacturers also have modified vehicle designs to reduce the amount of debris that upper stages can create. Catchers are now attached to explosive bolts to prevent these components from becoming orbital debris when they are used to separate launch vehicle stages from each other or from their payloads. In addition, spring-loaded payload release mechanisms and payload hold-down clamps are now retained with their upper stages.

Finally, some launch vehicle upper stages are now being removed from useful orbits at the end of their missions in order to avoid collisions with operational spacecraft. Although the FAA does not require post-mission disposal, several techniques can be and are being used to dispose of upper stages. Post-delivery burns can remove upper stages from payload delivery orbits and into lower orbits to accelerate re-entry. The Delta 2 and Long March upper stages both performed post-delivery maneuvers to lower their perigees after deploying Iridium satellites, accelerating their decay periods to under two years; the Russian Proton upper stages immediately performed de-orbit burns. The Pegasus Hydrazine

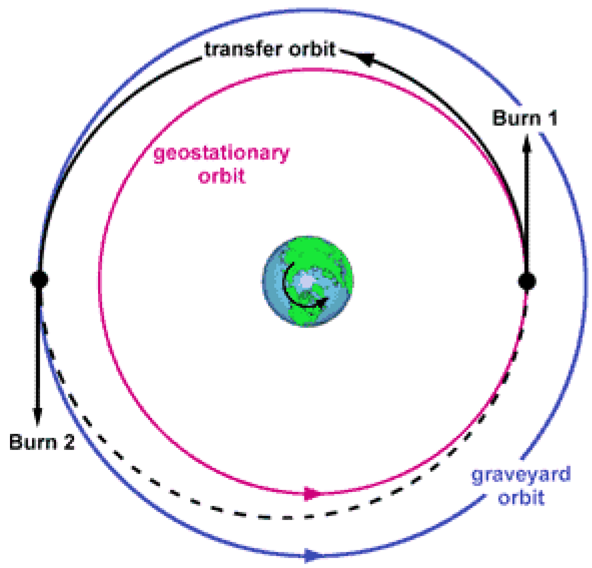


Figure 5: Movement of a space object from geostationary orbit to a graveyard orbit

Auxiliary Propulsion System (HAPS) also generally performs a depletion burn to move to a lower orbit shortly after payload delivery.

Extra burns can also remove upper stages from operational orbits and place them into "graveyard" orbits (see figure 5). In addition, upper stages can release their payloads early and leave the payloads to reach their final orbits using on-board thrusters. The U.S. Air Force is considering these various options for disposal of spent upper stages of the two Evolved Expendable Launch Vehicles, the Atlas 5 and Delta 4, from operational orbits after these vehicles deploy payloads into high-altitude orbits.

CONCLUSION

Although launch activity historically has been a major generator of orbital debris, the U.S. government, foreign governments, and the launch industry have become increasingly responsive to this issue over the decades since the beginning of the Space Age. The measures being taken by the launch industry, combined with the present creation of orbital debris mitigation standards and guidelines by national governments and international organizations, will help ensure that Earth orbit remains usable by the world's current and future spacecraft with minimal risk.

First Quarter 2002 Orbital Launch Events

Date		Vehicle	Site		Payload or Mission	Operator	Use	Vehicle Price	L	M
1/15/2002		Titan 4B/Centaur	CCAFS		Milstar F5	DoD	Communications	$350-450M	S	S
1/24/2002	√	Ariane 42L	Kourou	*	Insat 3C	Indian Space Research Organization	Communications	$80-100M	S	S
2/4/2002		H-2A 202	Tanegashima		MDS-1	National Space Development Agency	Development	$75-95M	S	S
					DASH	Institute of Space and Astronautical Science	Development			F
					VEP-3	National Space Development Agency	Test			S
2/5/2002		Pegasus XL	CCAFS		HESSI	NASA	Scientific	$12-15M	S	S
2/11/2002	√ +	Delta 2 7920	VAFB	*	Iridium 90	Iridium Satellite LLC	Communications	$50-60M	S	S
				*	Iridium 91	Iridium Satellite LLC	Communications			S
				*	Iridium 94	Iridium Satellite LLC	Communications			S
				*	Iridium 95	Iridium Satellite LLC	Communications			S
				*	Iridium 96	Iridium Satellite LLC	Communications			S
2/21/2002	√ +		CCAFS	*	EchoStar 7	Echostar Communications Corporation	Communications	$90-105M	S	S
2/23/2002	√	Ariane 44L	Kourou	*	Intelsat 904	Intelsat	Communications	$100-125M	S	S
2/25/2002		Soyuz	Plesetsk		Kosmos 2387	Russian Ministry of Defense	Classified	$30-40M	S	S
2/28/2002		Ariane 5G	Kourou		Envisat 1	European Space Agency	Remote Sensing	$150-180M	S	S
3/1/2002		Shuttle Columbia	KSC		STS 109	NASA	Crewed	$300M	S	S
					Hubble Servicing Mission 3B	NASA	Other			S
3/8/2002		Atlas 2A	CCAFS		TDRS I	NASA	Communications	$90-105M	P	S
3/17/2002	√	Rockot	Plesetsk		GRACE 1	NASA/Deutschen Zentrum für Luft und Raumfahrt	Scientific	$12-15M	S	S
					GRACE 2	NASA/GeoForschungs Zentrum	Scientific			S
3/21/2002		Soyuz	Baikonur		Progress ISS 7P	Rosaviakosmos/NASA	ISS	$30-40M	S	S

√ Denotes commercial launch, defined as a launch that is internationally-competed or FAA-licensed.

+ Denotes FAA-licensed launch.

* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is operated by a commercial entity.

L and M refer to the outcome of the **L**aunch and **M**ission (immediate status of the payload upon reaching orbit): S = success, P = partial success, F = failure

Note: All launch dates are based on local time at the launch site at the time of launch.

First Quarter 2002 Orbital Launch Events

Date		Vehicle	Site		Payload or Mission	Operator	Use	Vehicle Price	L	M
3/25/2002		Long March 2F	Jiuquan		Shenzhou 3	China National Space Administration	Development	N/A	S	S
3/28/2002	√	Ariane 44L	Kourou	*	JCSAT 8	Japan Satellite Systems (JSAT)	Communications	$100-125M	S	S
				*	Astra 3A	SES Global	Communications			S
3/30/2002	√	Proton (SL-12)	Baikonur	*	Intelsat 903	Intelsat	Communications	$75-95M	S	S

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L and M refer to the outcome of the **L**aunch and **M**ission (immediate status of the payload upon reaching orbit): S = success,
P = partial success, F = failure
Note: All launch dates are based on local time at the launch site at the time of launch.

Second Quarter 2002 Projected Orbital Launch Events

Date			Vehicle	Site		Payload or Mission	Operator	Use	Vehicle Price
4/2/2002			Molniya	Plesetsk		Kosmos 2388	Russian Ministry of Defense	Communications	$30-40M
4/8/2002			Shuttle Atlantis	KSC		STS 110	NASA		$300M
						ISS 8A	NASA	ISS	
4/16/2002	√		Ariane 4 TBA	Kourou	*	NSS 7	New Skies Satellites N.V.	Communications	N/A
4/25/2002			Soyuz	Baikonur		Soyuz ISS 4S	Rosaviakosmos/NASA	ISS	$30-40M
4/26/2002			Delta 2 7920	VAFB		Aqua	NASA	Remote Sensing	$50-60M
5/4/2002			Ariane 42P	Kourou		SPOT 5	SPOT Image	Remote Sensing	$65-85M
5/6/2002	√		Proton (SL-12)	Baikonur	*	DirecTV 5	DirecTV, Inc.	Communications	$75-95M
5/8/2002			Delta 2 7925-10	CCAFS		Navstar GPS 2R-8	DoD	Navigation	
5/14/2002			Soyuz	Baikonur		Progress ISS 8P	Rosaviakosmos/NASA	ISS	$30-40M
5/31/2002			Shuttle Endeavour	KSC		STS 111	NASA		$300M
						ISS UF-2	NASA	ISS	
5/2002	√	+	Zenit 3SL	Sea Launch Platform	*	Galaxy 3C	Pan American Satellite Corp.	Communications	$75-95M
5/2002			Proton (SL-12)	Baikonur		Glonass M R4	Russian Ministry of Defense	Navigation	$75-95M
						Glonass M R5	Russian Ministry of Defense	Navigation	
						Glonass M R6	Russian Ministry of Defense	Navigation	
5/2002			Proton (SL-12)	Baikonur	*	Express A1R	Russian Satellite Communciation Co.	Communications	$75-95M
5/2002			Long March 4B	Taiyuan		CBERS/Ziyuan 2	China/Brazil	Remote Sensing	$25-35M
6/3/2002			Titan 4B/Centaur	CCAFS		NRO T4	NRO	Classified	$350-450M
6/24/2002			Titan 2	VAFB		NOAA M	NOAA	Meteorological	$30-40M
6/2002	√		Long March 3A	Xichang	*	Atlantic Bird 1	Eutelsat	Communications	$45-55M
6/2002	√		Ariane TBA	Kourou	*	N-Star C	NTT Mobile Communications Network	Communications	N/A
6/2002	√		Rockot		*	Iridium 97	Iridium Satellite LLC	Communications	$12-15M
					*	Iridium 98	Iridium Satellite LLC	Communications	

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Second Quarter 2002 Projected Orbital Launch Events

Date		Vehicle	Site		Payload or Mission	Operator	Use	Vehicle Price
6/2002	√	Proton (SL-12)	Baikonur	*	EchoStar 8	Echostar Communications Corporation	Communications	$75-95M
6/2002		Long March 4B	Taiyuan		Fengyun 1D	China Meteorological Administration	Meteorological	$25-35M
					Haiyang 1	China Meteorological Administration	Meteorological	
6/2002	√	Ariane TBA	Kourou	*	Stellat 5	France Telecom	Communications	N/A
2Q/2002		PSLV	Sriharikota Range		Metsat	Indian Space Research Organization	Meteorological	$15-25M
2Q/2002	√	Ariane 5G	Kourou	*	eBird 1	Eutelsat	Communications	$150-180M
2Q/2002	√	Ariane 44L	Kourou	*	Intelsat 905	Intelsat	Communications	$100-125M
2Q/2002		Shavit 1	Palmachim AFB		Ofeq 5	Israel Space Agency	Classified	$10-15M

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Third Quarter 2002 Projected Orbital Launch Events

Date		Vehicle	Site		Payload or Mission	Operator	Use	Vehicle Price
7/1/2002		Delta 2 7425-10	CCAFS		Contour	NASA	Scientific	$45-55M
7/8/2002	√ +	Atlas 5 401	CCAFS	*	Hot Bird 6	Eutelsat	Communications	$85-110M
7/11/2002		Shuttle Columbia	KSC		STS 107 SpaceHab	NASA NASA	 Scientific	$300M
7/15/2002	√ +	Delta 4 Medium	CCAFS	*	Eutelsat W5	Eutelsat	Communications	$75-90M
7/20/2002		Soyuz	Baikonur		Progress ISS 9P	Rosaviakosmos/NASA	ISS	$30-40M
7/21/2002		Pegasus XL	CCAFS		GALEX	NASA	Scientific	$12-15M
7/25/2002		Delta 2 7925-10	CCAFS		Navstar GPS 2R-9 ProSEDS 2	DoD NASA	Navigation Development	$45-55M
7/2002	√	Ariane 5G	Kourou	*	Insat 3A	Indian Space Research Organization	Communications	$150-180M
7/2002		Ariane 4 TBA	Kourou		MSG 1	Eumetsat	Meteorological	N/A
8/1/2002		H-2A 202	Tanegashima		DRTS W	National Space Development Agency	Communications	$75-95M
8/14/2002	√ +	Atlas 2AS	CCAFS	*	Hispasat 1D	Hispasat	Communications	$90-105M
8/15/2002		Shuttle Atlantis	KSC		STS 112 ISS 9A	NASA NASA	 ISS	$300M
9/22/2002	√ +	Pegasus XL	VAFB	*	OrbView 3	ORBIMAGE	Remote Sensing	$12-15M
9/2002		Atlas 2AS	VAFB		NRO A3	NRO	Classified	$90-105M
9/2002		GSLV	Sriharikota Range		Gsat 2	Indian Space Research Organization	Communications	$25-45M
9/2002	√	Shtil	Barents Sea		Cosmos 1	The Planetary Society	Development	$0.1-0.3M
3Q/2002	√	Ariane 5 ESC-A	Kourou	*	Hot Bird 7	Eutelsat	Communications	$150-180M
3Q/2002	√	Zenit 3SL	Sea Launch Platform	*	Telstar 8	Loral Skynet	Communications	$75-95M
3Q/2002	√	Proton (SL-12)	Baikonur	*	Astra 1K	SES Global	Communications	$75-95M
3Q/2002		Titan 4B	VAFB		NRO T1	NRO	Classified	$350-450M
3Q/2002	√	Ariane 44L	Kourou	*	Intelsat 906	Intelsat	Communications	$100-125M
3Q/2002	√ +	Atlas 3B	CCAFS	*	AsiaSat 4	Asia Satellite Telecommunications Co.	Communications	$90-105M

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