



*Associate Administrator for
Commercial Space Transportation (AST)*

January 2001

COMMERCIAL SPACE TRANSPORTATION: 2000 YEAR IN REVIEW



Cover Photo Credits (from left):

International Launch Services (2000). Image is of the Atlas 3A launch on May 24, 2000, from Cape Canaveral Air Force Station. It successfully orbited the Eutelsat W4 communications satellite for Eutelsat.

Boeing Corporation (1999). Image is of the Delta 2 7420 launch on July 10, 1999, Cape Canaveral Air Force Station. It successfully orbited four Globalstar communications satellites for Globalstar, Inc.

Orbital Sciences Corp. (1997). Image is of the Pegasus XL that launched August 1, 1997 and deployed the Orbview 2 (Seastar) remote sensing satellite.

Sea Launch (1999). Image is of the inaugural Zenit 3SL launch on March 27, 1999, from the Odyssey Sea Launch Platform.

INTRODUCTION

In 2000, there were ten commercial launches licensed by the Federal Aviation Administration (FAA) for revenue that totaled about \$625 million. This total represents seven launches from U.S. ranges for commercial and government customers plus three launches by the multinational Sea Launch venture.

Overall, 35 worldwide commercial launches occurred in 2000. This number is slightly less than prior years (39 in 1999 and 41 in 1998). However, the U.S. percentage of commercial launches declined more precipitously. There were seven U.S. commercial launches in 2000, or 20 percent of the world total. The United States captured 38 percent of the commercial launches in 1999 and 54 percent in 1998. Also, the ten launches licensed by the FAA in 2000 were fewer than expected and represented a decrease from prior years (17 in 1999 and 22 in 1998).

Among the ten licensed launches was Boeing's third flight of the Delta 3. The flight was successful and the vehicle deployed a test payload. Lockheed Martin's International Launch Services successfully flew its new Atlas

3A vehicle, which deployed a communications spacecraft for Eutelsat.

Several new commercial space applications contributed to the worldwide commercial launch total. Three Proton rockets deployed satellites for Sirius Satellite Radio, a company that will offer direct radio broadcast services to the United States. Three Soyuz vehicles carried cargo and a cosmonaut crew to the Mir space station with private financing from MirCorp, a company that planned commercial development of the station through tourist flights.

Commercial Space Transportation: 2000 Year in Review summarizes U.S. and international launch activities for calendar year 2000 and provides a historical look at the past five years of commercial launch activities. This report has three parts:

- 2000 FAA-Licensed Commercial Activity
- 2000 Worldwide Launch Activity
- Five-Year Space Transportation Trends

ABOUT 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, *Commercial Expendable Launch Vehicle Activities*, and the *Commercial Space Launch Act of 1984*, as amended. AST's mission is to license and regulate commercial launch and reentry operations to protect public health and safety, the

safety of property, and the national security and foreign policy interests of the United States. The *Commercial Space Launch Act of 1984* and the *1996 National Space Policy* also directs the Federal Aviation Administration to encourage, facilitate, and promote commercial launches.

Additional information concerning space transportation can be found on AST's web site at <http://ast.faa.gov>.

2000 FAA-LICENSED LAUNCH SUMMARY

In 2000, there were 10 launches licensed by the FAA. Three of these launches were by Sea Launch Zenit 3SL from the Pacific Ocean while the remaining seven were from U.S. ranges. Four of these seven flights were for commercial customers, one was a test launch of Boeing's Delta 3, and two were commercially-procured launches for the U.S. government. The ten FAA-licensed launches are listed in Table 1. This represents a decline from 17 licensed launches in 1999.

The 10 FAA-licensed launches produced a total of approximately \$625 million in revenue¹:

- Four launches for commercial clients, worth \$343 million
- Two launches for the U.S. government, worth \$27 million
- Three flights for Sea Launch, at approximately \$255 million
- One test flight of Boeing's Delta 3 (no revenues were generated from the test launch)

Several factors resulted in significantly fewer licensed launches in 2000. The difficult business environment experienced by several non-geosynchronous (NGSO) systems such as Iridium, Orbcomm, Orbview, and ICO, forced the cancellation or postponement of many planned launches. Five Iridium launches and seven ICO launches from U.S. providers and Sea Launch did not occur. The Orbcomm and Orbview launches planned for 2000 are now tentatively scheduled for 2001. In addition, investigations surrounding the failures of a Zenit 3SL carrying the first ICO payload and that of a Delta 3 in 1999 introduced delays.

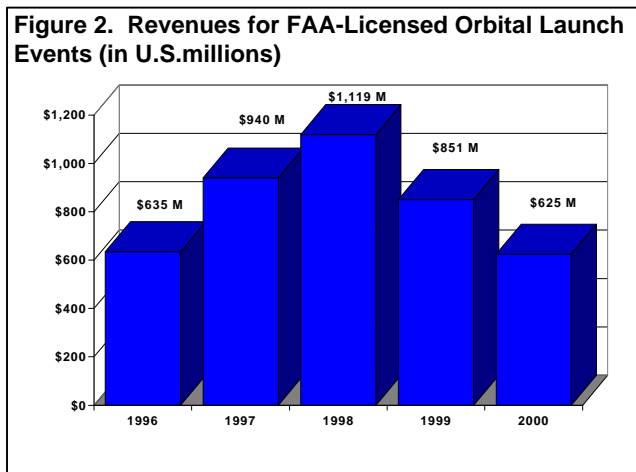
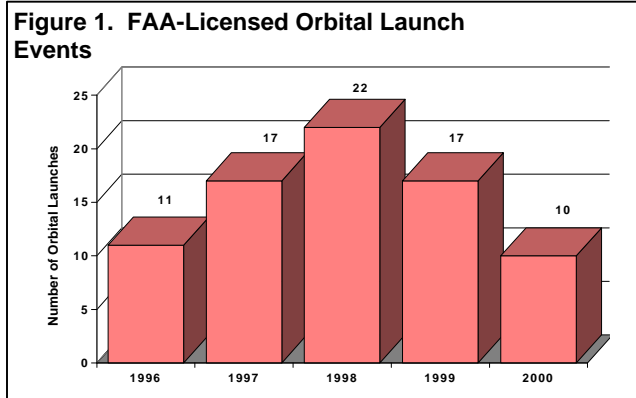


Table 1. 2000 FAA-Licensed Orbital Launch Events

Date	Vehicle	Payload	Govt/Coml	Launch Outcome	Orbit
Feb 3	Atlas 2AS	Hispasat 1C	Coml	Success	GEO
Feb 8	Delta 2 7420	Globalstars 60,62,63,64	Coml	Success	LEO
Mar 12	Zenit 3SL	ICO Z-1	Coml	Failure	MEO
May 24	Atlas 3A	Eutelsat W4	Coml	Success	GEO
June 7	Pegasus XL	TSX 5	Govt	Success	LEO
July 14	Atlas 2AS	Echostar 6	Coml	Success	GEO
July 28	Zenit 3SL	PAS 9	Coml	Success	GEO
Aug 23	Delta 3	DM-F3	Test	Success	GEO
Oct 9	Pegasus XL	HETE-2	Govt	Success	LEO
Oct 21	Zenit 3SL	Thuraya 1	Coml	Success	GEO

¹ Revenues for both U.S. and foreign commercial launches are based on open source information and estimates by AST and are approximations only.

Launch Activity in Detail

Sea Launch

Sea Launch's Zenit 3SL flew three times in 2000; the first launch on March 12 failed to deploy the first satellite for the ICO constellation when the Zenit's second stage malfunctioned. Investigators believe the fault was with the control software. The remaining two launches occurred successfully. In June, the Clinton Administration lifted the quota limiting the number of commercial launches that Sea Launch could conduct.² The company may now sell as many launches as the market will allow.

First Atlas 3A Launch a Success

International Launch Services launched the first Atlas 3A which deployed a payload for Eutelsat.

This successful launch debuted the new version of Atlas which uses an entirely new first stage. Powered by the Russian-made RD-180 engine, this new first stage will be the basis for the Atlas 5 series, Lockheed Martin's vehicle for the Air Force's Evolved Expendable Launch Vehicle (EELV) Program. The Atlas 2AS also deployed three commercial payloads in 2000.

Delta 3 Successful on Third Flight Attempt

Boeing conducted a successful test launch of its Delta 3 carrying a dummy payload. Two previous attempts to launch the new Delta ended in failure in 1998 and 1999. The Delta 3 was developed by Boeing to compete in mass ranges greater than the Delta 2. (See Table 2 below). There was only one commercial launch of a Delta 2 during the year and it deployed four satellites for Globalstar.

Table 2. FAA-Licensed Launch Vehicle Performance in 2000

	United States										Multinational (Sea Launch)
Vehicle	Pegasus	Taurus	Minotaur	Titan 2	Delta 2	Delta 3	Atlas 1&2	Atlas 3	Shuttle	Titan 4	Zenit 3SL
2000 Total Launches	2	1	2	1	6	1	7	1	5	2	3
Licensed Launches	2	0	0	0	1	1	2	1	0	0	3
Reliability	2/2	1/1	2/2	1/1	6/6	1/1	7/7	1/1	5/5	2/2	2/3
2000	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	66.7%
Last 10 Years	26/29	5/5	2/2	8/8	77/78	1/3	48/51	1/1	63/63	23/27	4/5
	89.7%	100.0%	100.0%	100.0%	98.7%	33.3%	94.1%	100.0%	100.0%	85.2%	80.0%
First Launch	1990	1994	2000	1964	1989	1998	1991	2000	1981	1989	1999
Launch Sites	VAFB, Wallops	VAFB	CA Spcprt	VAFB	CCAFS, VAFB	CCAFS	CCAFS, VAFB	CCAFS	KSC	CCAFS, VAFB	Odyssey Pacific Ocean Platform
LEO	1,015	3,300	1,408	7,900	11,220	18,280	19,050	19,050	53,800	47,800	35,000
GTO (lb.)	--	1,290	--	--	4,060	8,400	8,200	8,900	13,000	19,000	11,050

² The White House Office of the Press Secretary, "Press Briefing by Senior Administration Official on President's Meeting with President Kuchma," Kiev, Ukraine, June 5, 2000.

2000 WORLDWIDE LAUNCH ACTIVITY

Launch providers in the United States, Russia, and Europe, together with the Sea Launch partnership, conducted a total of 35 commercial launches in 2000. The United States share was 20 percent with seven launches. Russia captured 37 percent with 13 launches, Europe's 12 launches represent 34 percent, and Sea Launch's three launches gave the company nine percent of the total commercial launches. China did not conduct any commercial launches in 2000. A detailed list of non-U.S. commercial launches appears in Table 4 on the next page. In addition, the Appendix at the end of this report shows all 85 total launches worldwide in 2000 for commercial, civil, and military purposes.

New Commercial Missions in 2000

Commercial launches in 2000 serviced a variety of space applications. Russia conducted three privately financed flights to the Mir space station. MirCorp, the private company which intends to provide tourist flights to space, financed two Progress supply ships and one Soyuz crew capsule, all launched on Soyuz vehicles. Other launches included the first two deployments of satellites that will provide direct radio broadcasting services in the United States. Sirius Satellite Radio (formerly CD Radio) deployed three satellites on three Proton vehicles. The Sirius Radio satellites will operate in high-altitude elliptical orbits and will provide full coverage to the continental United States. Using special receivers in their cars, customers will be able to receive direct satellite radio broadcasts. Sirius's main competitor, XM Radio, plans to launch its first payloads in 2001.

Worldwide Launch Revenues

Revenues from the 35 commercial launches conducted globally in 2000 reached an estimated

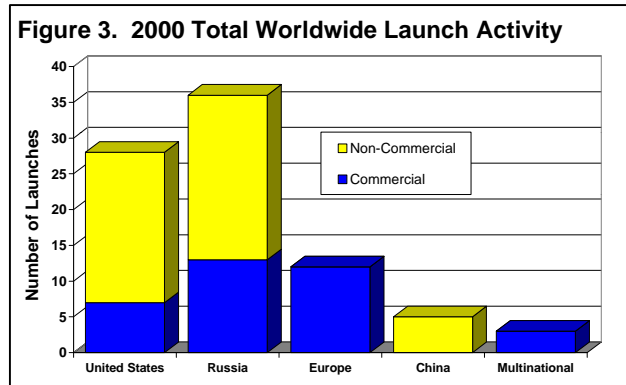
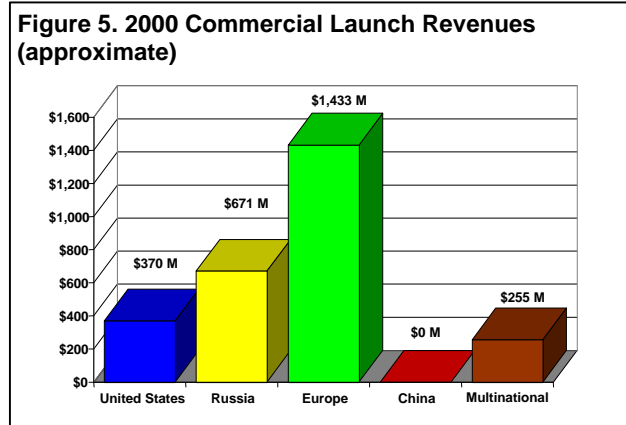
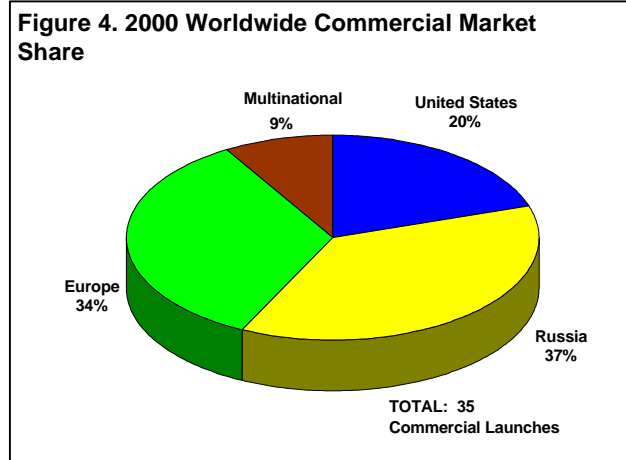


Table 3. 2000 Orbital Launch Events

	Commercial Launches	Non-Commercial Launches	TOTAL Launches
United States	7	21	28
Russia	13	23	36
Europe	12	0	12
China	0	5	5
Multinational	3	0	3
Japan	0	1	1
TOTAL	35	50	85



\$2.7 billion. U.S. commercial launch revenues were \$370 million; Russian revenues were \$671 million; European revenues were \$1,433 million; and the multinational Sea Launch venture had revenues of about \$255 million. China did not conduct any commercial launches in 2000 and therefore had no commercial launch revenue. (Figure 5).

Revenues are attributed to the country in which the primary vehicle manufacturer is based, with the exception of the Sea Launch venture, which is designated as "Multinational." In the past, this method has worked well because most launch vehicles were manufactured, sold, and launched by the same organization which resided entirely in one country or Europe.

With the rise of multinational launch service corporations, however, a clean division of revenue for particular launches among countries is becoming more difficult. For example, Russian launch activity is conducted in partnership with American and European launch service providers through a number of joint ventures. International Launch Services (ILS) markets launches of the Russian Proton vehicle, and Starsem, the French-Russian partnership, conducts launches of Soyuz. Also, Sea Launch represents a partnership among organizations in four countries and uses its own launch facility outside national borders. As a result, revenues actually accrued to each country may in fact be higher or lower than presented due to participation in launch programs from other countries.

Worldwide Payload Summary

A total of 117 spacecraft were launched on 85 vehicles in 2000. Of these 117, 49 were for commercial³ purposes and 68 were for governmental or scientific purposes.

Table 4. 2000 Non-U.S. Commercial Launch Events

Date	Vehicle	Payload(s)	Launch Outcome	Orbit
Jan 24	Ariane 42L	Galaxy 10R	Success	GEO
Feb 1	Soyuz	Progress M1-1	Success	LEO
Feb 12	Proton	Garuda 1	Success	GEO
Feb 17	Ariane 44LP	Superbird 4	Success	GEO
Mar 21	Ariane 5	AsiaStar 1	Success	GEO
		Insat 3B		
Apr 3	Soyuz	Soyuz TM-30	Success	LEO
Apr 18	Ariane 42L	Galaxy 4R	Success	GEO
June 30	Proton	Sirius Radio 1	Success	ELI
July 15	Cosmos	Champ	Success	LEO
		RUBIN		
		Mita		
Aug 17	Ariane 44LP	Brazilsat B4	Success	GEO
		Nilesat 102		
Sept 5	Proton	Sirius Radio 2	Success	ELI
Sept 6	Ariane 44P	Eutelsat W1R	Success	GEO
Sept 14	Ariane 5	GE 7	Success	GEO
		Astra 2B		
Sept 26	Dnepr 1	MegSat 1	Success	LEO
		Unisat		
		Tiungsat 1		
		Saudisat 1-1		
		Saudisat 1-2		
Oct 1	Proton	GE 1A	Success	GEO
Oct 6	Ariane 42L	NSat 110	Success	GEO
Oct 15	Soyuz	Progress M1-3	Success	LEO
Oct 21	Proton	GE 6	Success	GEO
Oct 29	Ariane 44LP	Europe Star 1	Success	GEO
Nov 15	Ariane 5	PAS 1R	Success	GEO
		AMSAT Phase 3-D		
		STRV 1C		
		STRV 1D		
Nov 21	Ariane 44L	Anik F1	Success	GEO
Nov 21	Cosmos	QuickBird 1	Failure	LEO
Nov 30	Proton	Sirius Radio 3	Success	ELI
Dec 5	START 1	EROS A1	Success	LEO
Dec 19	Ariane 5	Astra 2D	Success	GEO
		GE 8		
		Ldrex		

³ The term "commercial payload" refers to a spacecraft which serves a commercial function or is operated by a commercial entity, without regard to how it was launched. For this report, communications satellites launched for international consortia

such as Intelsat are considered commercial. Certain Russian and Chinese domestic communications satellites are commercial if a significant portion of the transponders are offered for lease through commercial operators.

Two commercial payloads and seven government payloads were lost to launch failures. A total of 30 commercially-owned payloads were launched to GEO, including Boeing's test payload on the Delta 3. Seven commercial payloads were deployed on launches that were not procured commercially; five to GEO and two to NGSO orbits. The GEO payloads included two Express satellites, one Gorizont, and the Sesat payload, all launched on Proton vehicles. The remaining GEO payload was DFH-3 launched on a Long March 3A. The two NGSO payloads were test payloads deployed by a Rockot vehicle in anticipation of Eurockot's first commercial launch in 2001.

Commercial Payloads Make Use of New Orbits

Several of the commercial payloads launched in 2000 had unique orbit profiles. The three Sirius Radio satellites were deployed into high elliptical orbits to provide continuous coverage to the continental United States. The ICO-Z1 payload, though lost in a launch failure, was intended to be the first satellite for ICO's mobile telephony system which uses 12-hour medium Earth orbits (MEO).

Launch Activities by Country

Russia – In 2000, Russia launched 36 vehicles, 13 of them commercial flights. Proton, Russia's GEO launcher marketed for commercial launches through International Launch Services (ILS), set a new flight record with 14 launches. The previous flight record of 13 launches was last achieved in 1994. Six of those 14 launches were commercial flights for ILS. In December, the State Department decided to allow the bilateral quota agreement limiting the number of commercial launches on the Proton to expire at the end of the year. The number of launches sold will now only depend on what the market will bear. The remaining eight flights deployed Russian domestic communications satellites, a military payload, and the Zarya module for the International Space Station. Starsem, the

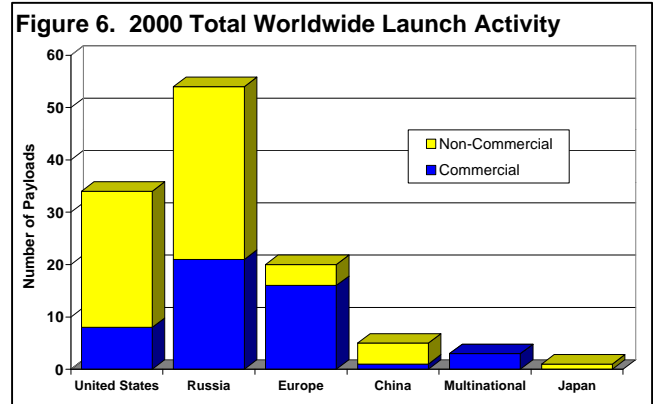
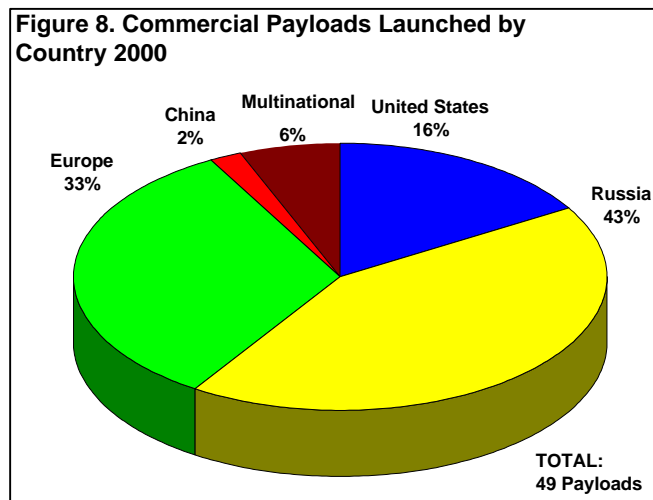
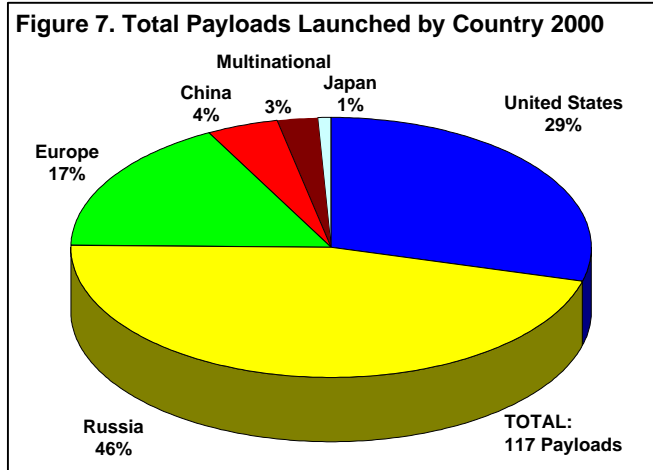


Table 5. Payloads Launched in 2000

	Commercial Payloads	Non-Commercial Payloads	TOTAL Payloads
United States	8	26	34
Russia	21	33	54
Europe	16	4	20
China	1	4	5
Multinational	3	0	3
Japan	0	1	1
TOTAL	49	68	117



partnership that markets the Soyuz vehicles, deployed the four Cluster II spacecraft on two launches. There were also two test flights of the new Soyuz-Fregat configuration; one carried a dummy payload to simulate the Cluster mission, and another carried a re-entry payload called IRDT. MirCorp, the private partnership formed to develop commercial use of Mir through tourist flights, paid for two Progress flights directly and money from the lease of the station went to partially finance a third. A crewed Soyuz capsule was dispatched to Mir also through MirCorp sponsorship. Two Progress flights ferried cargo to the International Space Station and another Soyuz crew capsule carried the Expedition One crew to the station. Russia launched seven vehicles from its small launcher fleet, two were launch failures. One Cosmos failed to deploy the Quickbird remote sensing spacecraft, and a Cyclone vehicles failed to deploy a set of six spacecraft based on the Strela design of military and civil communications spacecraft. Also, two Zenit 2 vehicles deployed military payloads.

Europe – Europe conducted twelve all-commercial launches: eight flights of Ariane 4 vehicles and four Ariane 5's. This was the largest number of Ariane 5 vehicles to fly in one year. These vehicles deployed 16 GEO communications spacecraft, as well as an AMSAT amateur radio payload, the LDREX and STRV technology experiments. Nevertheless, Ariane experienced delays in 2000 and had expected to launch 15 flights for the year.

China – China did not conduct any commercial launches in 2000, but did launch five times during the year. One DFH communications satellite was launched to GEO, as was two Beidou spacecraft for navigation. The remaining two launches deployed the remote sensing payloads Ziyuan 1 and Fen-Yung 2B. In November, the U.S. State Department announced it would resume processing licenses to export U.S.-built satellites for launching in China after China pledged not to assist other countries with missile technology. The two countries are expected to resume discussion of the 1995 trade agreement on commercial launch services.

Table 6. Russian and Ukrainian Launch Vehicle Performance in 2000

	Russia & Ukraine							
Vehicle	Cosmos	Cyclone 3	Dnepr	Rockot	START	Soyuz	Zenit 2	Proton
2000 Total Launches	3	1	1	1	1	13	2	14
Reliability 2000	2/3	0/1	1/1	1/1	1/1	13/13	2/2	14/14
Last 10 Years	66.7%	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	46/48	27/29	2/2	2/2	4/5	141/144	15/19	84/90
First Launch	1964	1977	1999	1994	1993	1963	1985	1967
Launch Sites	Plesetsk	Plesetsk	Baikonur	Plesetsk	Svobodny	Baikonur, Plesetsk	Baikonur	Baikonur
LEO (lb.)	3,100	9,020	9,700	3,970	1,393	15,400	30,300	44,200
GTO (lb.)	--	--	--	--	--	--	--	10,150

India - India did not launch anything in 2000 because the new GSLV launcher for GEO payloads was delayed into 2001. The GSLV will combine an indigenous Indian design with a Russian-designed cryogenic upper stage and will be capable of delivering up to 5,513 lbs. to GTO. India plans two test launches of the GSLV before declaring the vehicle operational. Once operational, India will begin using GSLV to launch domestic satellites and could conduct commercial launches of foreign-built satellites if market conditions allow.

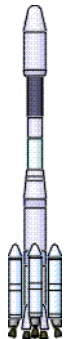
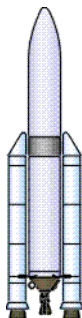
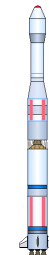
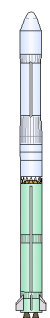

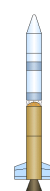
Japan – The M-5 launch of Astro E was Japan's only launch. The vehicle failed to deploy its payload into a useful orbit and the mission was lost. Graphite protecting the nozzle was apparently damaged, causing exhaust gases to leak and decreased performance.

In 1999 Japan decided to cancel the last flight of the H-2 following a string of failures and proceed directly with H-2A program. The first H2-A

launch will carry a test payload. NASDA officials want to make certain that difficulties surrounding the newly upgraded cryogenic first stage engines, which suffered hydrogen leaks in testing, are resolved before the first flight and will not harm efforts to offer commercial flights on the new vehicle. NASDA and ESA made a joint decision to consider other launch vehicles for the Artemis technology development satellite previously manifested for the first flight of H2-A. Artemis is now manifested on Ariane 5, and the first test flight of H2-A is now expected in summer 2001.

Brazil - In 1999, the second attempt to launch Brazil's indigenously built vehicle, the VLS, failed. The third attempt to launch Brazil's first orbital mission did not occur in 2000 but is planned for 2001. Brazil continues to invest in its Alcantara spaceport in an effort to attract foreign launch service providers to its site.

Table 7. European, Chinese, and Japanese Launch Vehicle Performance in 2000

	Europe		China			Japan
						
Vehicle	Ariane 4	Ariane 5	LM- 3	LM- 3A	LM- 4B	M 5
2000 Total Launches	8	4	1	3	1	1
Reliability 2000	8/8	4/4	1/1	3/3	1/1	0/1
	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%
Last 10 Years	86/89	7/8	4/6	6/6	2/2	2/3
	96.6%	87.5%	66.7%	100.0%	100.0%	66.7%
First Launch	1988	1996	1984	1994	1999	1997
Launch Sites	Kourou	Kourou	Xichang	Xichang	Taiyuan	Kagoshima
LEO (lb.)	21,100	39,600	11,013	5,507	4,851 (polar)	4,000
GTO (lb.)	10,900	15,000	3,300	5,700	3,315	2,680

FIVE-YEAR SPACE TRANSPORTATION TRENDS

During the last five-year period, the most notable trend was the rapid increase and decline of commercial flights to LEO. The Iridium and Globalstar constellations were fully deployed during this period, but the subsequent bankruptcy of Iridium and industry skepticism over the viability of LEO constellations generally resulted in a significant decline from previous projections. The overall rate of commercial launches, however, has remained relatively constant since the first Iridium launch in 1997. Continued strong demand for GEO communications satellites in addition to new space-based commercial activity have kept up the pace of commercial launches. These new activities included commercial remote sensing systems, new satellite services such as direct broadcast television and radio, test launches of new commercial launch systems, and privately

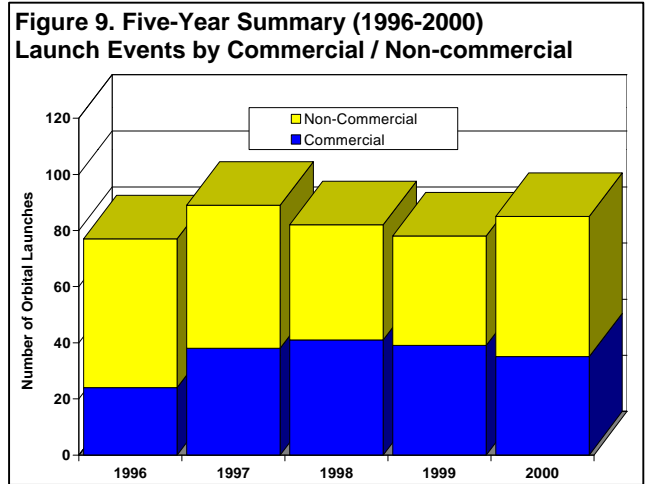


Table 9. Five-Year Summary (1996-2000) Launch Events by Commercial / Non-commercial

	Commercial Launches	Non-commercial Launches	TOTAL Launches
1996	24	53	77
1997	38	51	89
1998	41	41	82
1999	39	39	78
2000	35	50	85

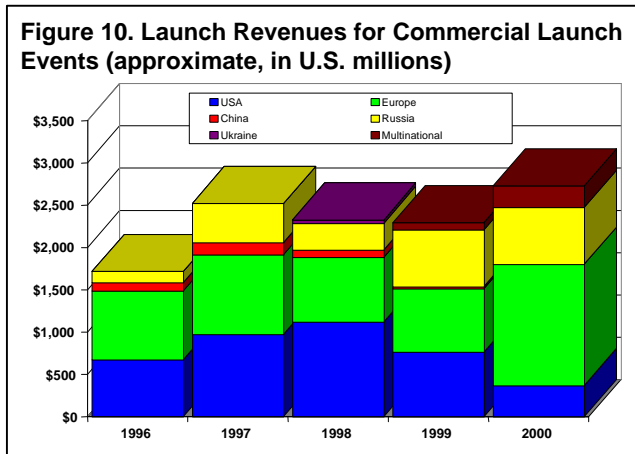


Table 8. Launch Revenues for Commercial Launch Events (approximate, in U.S. millions)

	1996	1997	1998	1999	2000
USA	\$673	\$974	\$1,120	\$766	\$370
Europe	\$815	\$940	\$763	\$750	\$1,433
China	\$98	\$143	\$90	\$23	
Russia	\$131	\$464	\$313	\$670	\$671
Ukraine			\$40		
Multinational				\$85	\$255
TOTAL	\$1,717	\$2,521	\$2,326	\$2,294	\$2,729

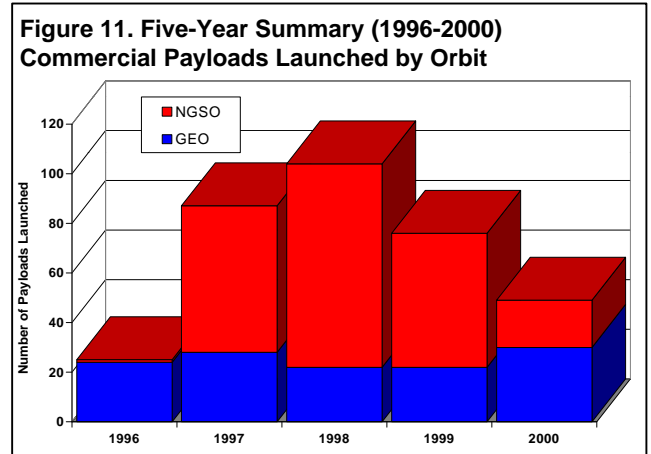


Table 10. Five-Year Summary (1996-2000) Commercial Payloads Launched by Orbit

	GEO Commercial Payloads	NGSO Commercial Payloads	TOTAL Commercial Payloads
1996	24	1	25
1997	28	59	87
1998	22	82	104
1999	22	54	76
2000	30	19	49

financed flights to the Mir space station.

Russia conducted its first commercial launch in 1996, and has since provided a significant portion of the world's commercial launch services. Russian and Ukrainian vehicle manufacturers have marketed nearly all of their launch systems through partnerships with American and European companies. The commercial launch industry has rapidly globalized during this period. Going beyond marketing partnerships for launch services, manufacturers such as Lockheed Martin have purchased Russian engine technology for use in their new Atlas 3 and Atlas 5 vehicles. Several companies working to build new reusable launch vehicles (RLV's) including Kistler have also opted for Russian engine technology.

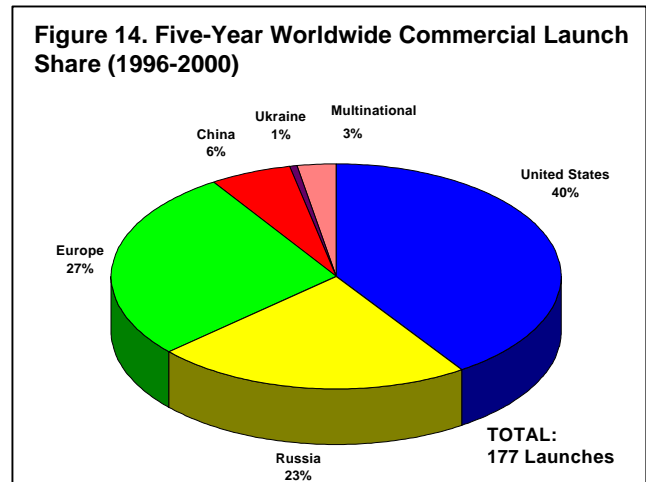
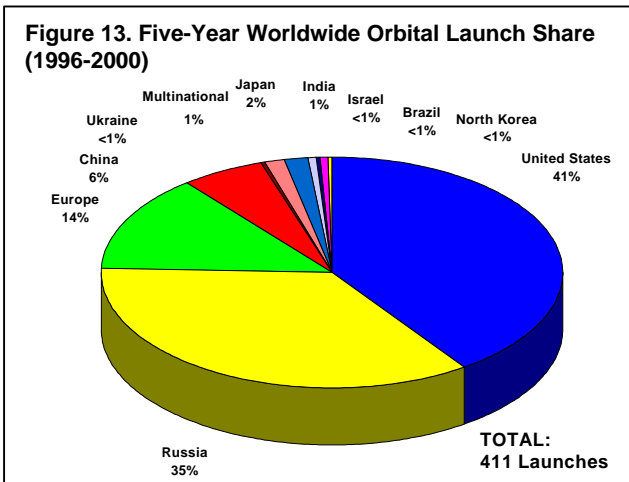
All the new vehicles offered by the major service providers feature increased lift capacity and bigger fairings to accommodate the trend towards larger, heavier spacecraft. Spacecraft size and mass grew as satellite customers demanded more power, greater transponder capacity, and longer service life. The heaviest commercial spacecraft launched to date was the Thuraya 1 mobile communications satellite weighing 11,576 pounds at launch. The satellite was deployed by a Sea Launch Zenit 3SL.

The same business environment that has hurt NGSO satellite systems like Iridium have also hurt the companies developing reusable launch

systems. Many companies were counting on a robust market for small to medium launches to LEO to maintain the constellations. RLV companies now expect an extended timeline for development in the face of a smaller than expected market for services in this category. Some companies hope to develop non-traditional launch market niches such as space tourism as a viable supplement to the satellite launch market.

The poor business environment for NGSO systems prompted a decrease in launch projections by the Commercial Space Transportation Advisory Committee (COMSTAC) and the FAA through 2010. The 2000 forecast, while still projecting growth, represented a 20 percent reduction in the launch rate compared to the 1999 forecast. The 2000 forecast predicts a demand for just over 41 launches per year to all orbits compared to 51 launches predicted the previous year.

Japan and India are moving closer to becoming active participants in the international launch market. The first test launch of the H-2A is expected in 2001 and the vehicle may deploy its first commercial payload soon thereafter. India's GSLV launch vehicle, developed to serve India's needs to deploy GEO spacecraft, will be offered for commercial services if market conditions allow. Many analysts believe an oversupply of launch vehicles will exist worldwide despite a steady or modestly growing demand for launch services.



2000 WORLDWIDE ORBITAL LAUNCH EVENTS

Date	Vehicle	Site	Payload(s)	Operator	Manufacturer	Use	Comml Price	L	M
1/20/00	Atlas 2A	CCAFS	DSCS III 3-11	DoD	Lockheed Martin	Communications		S	S
1/24/00	✓ Ariane 42L	Kourou	* Galaxy 10R	PanAmSat	Hughes	Communications	\$80-100 M	S	S
1/26/00	Long March 3A	Xichang	* DFH 3	Chin. Broad. Sat. Corp.	Chinese Acad. Of Space Tech.	Communications		S	S
1/26/00	Minotaur	California Spaceport	Jawsat	AF Acad. & Weber State U.	Air Force Academy	Scientific		S	S
			ASUSat 1	Ariz. State U.	Arizona State U	Scientific			
			DARPA Picosat	DARPA	DARPA	Scientific			
			FalconSat	USAF	USAF	Development			
			OPAL	SSDL	SSDL	Development			
2/1/00	Soyuz	Baikonur	Progress M1-1	RKK Energia	RKK Energia	Supply		S	S
2/3/00	✓ Atlas 2AS	CCAFS	* Hispasat 1C	Hispasat	Alcatel Espace	Communications	\$90-105 M	S	S
2/3/00	Zenit 2	Baikonur	Kosmos 2369	Russian MoD	KB Yuzhnoe	Intelligence		S	S
2/8/00	✓ Delta 2 7420	CCAFS	* Globalstars 60,62-64	Globalstar	Space Systems/Loral	Communications	\$45-55 M	S	S
2/9/00	Soyuz	Baikonur	IRDT	Starsem	DaimlerChrysler	Test		S	S
2/10/00	M 5 Shuttle	Kagoshima KSC	Astro E (STS-99)	ISAS	ISAS	Scientific		F	F
2/11/00	Endeavour		SRTM	NASA	NASA JPL	Remote Sensing		S	S
2/12/00	✓ Proton	Baikonur	* Garuda 1	Asia Cellular Satellite (ACeS)	Lockheed Martin	Communications	\$75-95 M	S	S
2/17/00	✓ Ariane 44LP	Kourou	* Superbird 4	Space Comm. Corp.	Hughes	Communications	\$90-110 M	S	S
3/12/00	✓ Zenit 3SL	Odyssey	* ICO Z-1	New ICO	Hughes	Communications	\$75-95 M	F	F
3/12/00	Taurus 1	VAFB	MTI	DoD	Ball Aerospace	Development		S	S
3/12/00	Proton	Baikonur	* Express 6A	Intersputnik	NPO Prikladnoi Mekhaniki	Communications		S	S
3/20/00	Soyuz	Baikonur	Cluster Replica	Starsem	Starsem	Test		S	S
3/21/00	✓ Ariane 5	Kourou	* AsiaStar 1	WorldSpace, Inc.	Alcatel Espace	Communications	\$150-180 M	S	S
			* Insat 3B	ISRO	ISRO	Communications			
3/25/00	Delta 2 7326	VAFB	IMAGE	NASA	Lockheed Martin	Scientific		S	S
4/3/00	✓ Soyuz	Baikonur	* Soyuz TM-30	MirCorp	RKK Energia	Crewed	\$35-40 M	S	S
4/17/00	Proton	Baikonur	* Sesat	Eutelsat	NPO Prikladnoi Mekhaniki	Communications		S	S
4/18/00	✓ Ariane 42L	Kourou	* Galaxy 4R	PanAmSat	Hughes	Communications	\$80-100 M	S	S
4/26/00	✓ Soyuz	Baikonur	* Progress M1-2	MirCorp	RKK Energia	Supply	\$35-40 M	S	S
5/3/00	Atlas 2A	CCAFS	GOES L	NOAA	Space Systems/Loral	Meteorological		S	S
5/3/00	Soyuz	Baikonur	Kosmos 2370	Russia	Russia	Intelligence		S	S
5/8/00	Titan 4B/IUS	CCAFS	DSP 20	DoD	TRW	Intelligence		S	S
5/10/00	Delta 2 7925	CCAFS	Navstar GPS 2R- 4	DoD	Lockheed Martin	Navigation		S	S
5/16/00	Rockot	Plesetsk	* Simsat 1	RSA, MoD	Khrunichev	Test		S	S
			* Simsat 2	RSA, MoD	Khrunichev	Test			
5/19/00	Shuttle Atlantis	KSC	ISS 2A.2a (STS 101)	NASA	NASA	Supply		S	S
5/24/00	✓ Atlas 3A	CCAFS	* Eutelsat W4	Eutelsat	Alcatel Espace	Communications	\$90-105 M	S	S
6/4/00	Proton	Baikonur	* Gorizont 45	PO Kosmicheskaya Sviaz	NPO Prikladnoi Mekhaniki	Communications		S	S
6/7/00	✓ Pegasus XL	VAFB	TSX 5	DoD	Orbital Sciences	Development	\$12-15 M	S	S
6/24/00	Proton	Baikonur	* Express 3A	Intersputnik	NPO Prikladnoi Mekhaniki	Communications		S	S
6/25/00	Long March 3	Xichang	FY 2B	China Meteo. Admin.	Shanghai Inst. of Sat. Eng.	Meteorological		S	S

✓ Denotes commercial launch, defined as a launch that is internationally competed, FAA-licensed, or represents privately-financed launch activity.

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

L/M refers to the outcome of the launch and mission: S = success, P = partial success, F = failure.

2000 Worldwide Orbital Launch Events (cont.)

Date	Vehicle	Site	Payload(s)	Operator	Manufacturer	Use	Comml Price	L	M
6/28/00	Cosmos	Plesetsk	Nadezhda M * SNAP 1 * Tsinghua 1	Russia Surrey Sat. Tech. Ltd. Tsinghua Univ. (Beijing)	NPO Polyot Surrey Sat. Tech. Ltd. Surrey Sat. Tech. Ltd.	Navigation Test Development			S S
6/30/00	✓ Proton	Baikonur	* Sirius Radio 1	Sirius Satellite Radio Inc.	Space Systems/Loral	Communications	\$75-95 M		S S
6/30/00	Atlas 2A	CCAFS	TDRS F8	NASA	Hughes	Communications			S S
7/5/00	Proton	Baikonur	Kosmos 2371	Russian MoD	Russia	Communications			S S
7/12/00	Proton	Baikonur	ISS 1R	Russia	RKK Energia	Space Station			S S
7/14/00	✓ Atlas 2AS	CCAFS	* Echostar 6	EchoStar Satellite Corp.	Space Systems/Loral	Communications	\$90-105 M		S S
7/15/00	✓ Cosmos	Plesetsk	Champ Mita RUBIN	DARA Italian Space Agency (ASI) Germany	Jena-Optronik Gm. Carlo Gavazzi Space OHB System	Scientific Communications Scientific	\$12-14 M		S S
7/16/00	Delta 2 7925	CCAFS	Navstar GPS 2R- 5	DoD	Lockheed Martin	Navigation			S S
7/16/00	Soyuz	Baikonur	Salsa Samba	ESA ESA	Dornier Dornier	Scientific Scientific			S S
7/19/00	Minotaur	CA Spaceport	MightySat 2-1	DoD	Spectrum Astro, Inc.	Development			S S
			DARPA Picosat 2	DARPA	DARPA	Scientific			
7/28/00	✓ Zenit 3SL	Odyssey	* PAS 9	PanAmSat	Hughes	Communications	\$75-95 M		S S
8/6/00	Soyuz	Baikonur	Progress M-ISS-01	RKK Energia	RKK Energia	Supply			S S
8/9/00	Soyuz	Baikonur	Rumba Tango	ESA ESA	Dornier Dornier	Scientific Scientific			S S
8/17/00	Titan 4B	VAFB	NRO 2000-2	NRO	Lockheed Martin	Classified			S S
8/17/00	✓ Ariane 44LP	Kourou	* Nilesat 102 * Brazilsat B4	Egypt Radio & TV Union (ERTU) Embratel	Astrium Hughes	Communications Communications	\$90-110 M		S S
8/23/00	✓ Delta 3	CCAFS	* DM-F3	Boeing	Boeing	Test	\$75-90 M		S S
8/28/00	Proton	Baikonur	Globus 2	Russia/CIS MoD	Russia	Communications			S S
9/1/00	Long March 4B	Taiyuan	Ziyuan 2	China	China	Remote Sensing			S S
9/5/00	✓ Proton	Baikonur	* Sirius Radio 2	Sirius Satellite Radio Inc.	Space Systems/Loral	Communications	\$75-95 M		S S
9/6/00	✓ Ariane 44P	Kourou	* Eutelsat W1R	Eutelsat	Alcatel Espace	Communications	\$80-100 M		S S
9/8/00	Shuttle Atlantis	KSC	ISS 2A.2b (STS 106)	NASA	NASA	Supply			S S
9/14/00	✓ Ariane 5	Kourou	* Astra 2B * GE 7	SES GE Americom	Matra Marconi Lockheed Martin	Communications Communications	\$150-180 M		S S
9/21/00	Titan 2	VAFB	NOAA L	NOAA	Lockheed Martin	Meteorological			S S
9/25/00	Zenit 2	Baikonur	Kosmos 2372	Russia	Russia	Classified			S S
9/26/00	✓ Dnepr 1	Baikonur	* MegSat 1 Saudisat 1-1 Saudisat 1-2 * Tiungsat 1 Unisat	MegSat S.P.A Space Rrsch. Inst. (S.A.) Space Rrsch. Inst. (S.A.) Malaysian Space & Telecom Rrsch. University of Rome	MegSat S.P.A Space Rrsch. Inst. (S.A.) Space Rrsch. Inst. (S.A.) Surrey Sat. Tech. Ltd. University of Rome	Communications Scientific Scientific Remote Sensing Scientific	\$10-20 M		S S
9/29/00	Soyuz	Baikonur	Kosmos 2373	Russia	Russia	Communications			S S

✓ Denotes commercial launch, defined as a launch that is internationally competed, FAA-licensed, or represents privately-financed launch activity.

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

L/M refers to the outcome of the launch and mission: S = success, P = partial success, F = failure.

2000 Worldwide Orbital Launch Events (cont.)

Date	Vehicle	Site	Payload(s)	Operator	Manufacturer	Use	Comml Price	L	M
10/1/00	✓ Proton	Baikonur	* GE 1A	Americom Asia-Pacific	Lockheed Martin	Communications	\$75-95 M	S	S
10/6/00	✓ Ariane 42L	Kourou	* NSat 110	JSAT/SCC	Lockheed Martin	Communications	\$80-100 M	S	S
10/9/00	✓ Pegasus XL	Kwajalein	HETE-2	MIT	MIT	Scientific	\$12-15 M	S	S
10/11/00	Shuttle Discovery	KSC	ISS 3A (STS 92)	NASA	NASA	Supply		S	S
			Z1 Truss	NASA	NASA	Space Station			
			PMA 3	NASA	NASA	Space Station			
10/13/00	Proton	Baikonur	Kosmos 2374- 2376	Russian MoD	NPO Prikladnoi Mekhaniki	Navigation		S	S
10/15/00	✓ Soyuz	Baikonur	* Progress M1-3	MirCorp	RKK Energia	Supply	\$35-40 M	S	S
10/20/00	Atlas 2A	CCAFS	DSCS III 3-12	DoD	Lockheed Martin	Communications		S	S
10/21/00	✓ Proton	Baikonur	* GE 6	GE Americom	Lockheed Martin	Communications	\$75-95 M	S	S
10/21/00	✓ Zenit 3SL	Odyssey	* Thuraya 1	Thuraya	Hughes	Communications	\$75-95 M	S	S
10/29/00	✓ Ariane 44LP	Kourou	* Europe Star 1	Europe Star	Alcatel Espace	Communications	\$90-110 M	S	S
10/31/00	Soyuz	Baikonur	ISS 2R	NASA	RKK Energia	Crewed		S	S
10/31/00	Long March 3A	Xichang	Beidou 1A	China	China	Navigation		S	S
11/10/00	Delta 2 7925	CCAFS	Navstar GPS 2R-6	DoD	Lockheed Martin	Navigation		S	S
			ProSEDS	NASA	U of Michigan	Development			
11/15/00	✓ Ariane 5	Kourou	* PAS 1R	PanAmSat	Hughes	Communications	\$150-180 M	S	S
			AMSAT Phase 3-D	AMSAT	AMSAT	Communications			
			STRV 1C	British MoD	Defense Research Agency	Development			
			STRV 1D	British MoD	Defense Research Agency	Development			
11/16/00	Soyuz	Baikonur	Progress M- ISS-02	RKK Energia	RKK Energia	Supply		S	S
11/21/00	Delta 2 7320	VAFB	Earth Observing 1	NASA	Swales & Associates Inc., MIT/Lincoln Labs	Development		S	S
			Munin	Swedish Inst. of Space Physics	Swedish Inst. of Space Physics	Scientific			
			SAC C	Argentina	Bariloche Company	Scientific			
11/21/00	✓ Ariane 44L	Kourou	* Anik F1	Telesat Canada	Hughes	Communications	\$100-125 M	S	S
11/21/00	✓ Cosmos	Plesetsk	* QuickBird 1	Earthwatch, Inc.	Ball Aerospace	Remote Sensing	\$12-14 M	F	F
11/30/00	Shuttle Endeavour	KSC	ISS 4A (STS 97)	NASA	NASA	Supply		S	S
			P6 Truss	NASA	NASA	Space Station			
11/30/00	✓ Proton	Baikonur	* Sirius Radio 3	Sirius Satellite Radio Inc.	Space Systems/Loral	Communications	\$75-95 M	S	S
12/5/00	✓ START 1	Svobodny	* EROS A1	Israel Space Agency	Israel Aircraft Industries	Remote Sensing	\$5-10 M	S	S
12/5/00	Atlas 2AS	CCAFS	NRO 2000-1	NRO	Boeing	Classified		S	S
12/19/00	✓ Ariane 5	Kourou	* GE 8	GE Americom	Lockheed Martin	Communications	\$150-180 M	S	S
			* Astra 2D	SES	Hughes	Communications			
			Ldrex	NASDA, Rocket Sys. Corp.	Toshiba	Development			
12/21/00	Long March 3A	Xichang	Beidou 1B	China	China	Navigation		S	S
12/28/00	Cyclone 3	Plesetsk	Gonets A-F	Russia/CIS MoD	NPO Prikladnoi Mekhaniki	Communications		F	F

✓ Denotes commercial launch, defined as a launch that is internationally competed, FAA-licensed, or represents privately-financed launch activity.

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

L/M refers to the outcome of the launch and mission: S = success, P = partial success, F = failure.