Commercial Space Transportation

QUARTERLY LAUNCH REPORT

Featuring the launch results from the 2nd quarter 2000 and forecasts for the 3rd quarter 2000 and the 4th quarter 2000

Special Report:
Trends in Vehicle Contract-to-Launch Intervals

3rd Quarter 2000

United States Department of Transportation • Federal Aviation Administration
Associate Administrator for Commercial Space Transportation
800 Independence Ave. SW Room 331
Washington, D.C. 20591

Introduction

The Third Quarter 2000 Quarterly Launch Report features launch results from the second quarter of 2000 (April-June 2000) and launch forecasts for the third quarter of 2000 (July-September 2000) and the fourth quarter of 2000 (October-December 2000). 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. Note that 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

Photo credit: Cape Canaveral Air Station, FL, May 24, 2000 - Atlas 3A, the newest rocket to fly from Complex 36 launch site at Cape Canaveral, made its debut. The liftoff occurred at 7:10 p.m. Eastern Daylight Time, followed by successful separation of the Eutelsat W4 spacecraft and insertion into geosynchronous transfer orbit just under 29 minutes later.

Highlights From Second Quarter 2000

Atlas 3 Successfully Launched

A major event in the second quarter was the successful inaugural launch of Lockheed Martin's new Atlas 3A launch vehicle carrying the Eutelsat W4 communications satellite. This launch occurred on May 24, 2000 at 7:10 EDT from Launch Complex 36 B at the Cape Canaveral Air Force Station in Florida.

The simplified, yet more powerful, Atlas 3 launch vehicle family replaces the previous Atlas 2 and serves as risk reduction pathfinder for the Lockheed Martin EELV, the Atlas 5. Where an Atlas 2AS could launch a mass of up to 8120 lbs. to GTO, the Atlas 3A is able to place 8930 lbs. into GTO. The greatest single improvement embodied in the Atlas 3 is the replacement of the three Rocketdyne MA-5 engines that powered previous Atlas vehicles with a single NPO Energomash RD-180 engine. This replacement reduces staging events and part counts for the new vehicle. The Atlas 3 will be followed by the Atlas 5, which will use the same engine. As a result of this commonality, the success of the Atlas 5 depends, in part, on the success of the Atlas 3.

Ukrainian Launch Quotas Removed

Another major launch vehicle related event that occurred in the second quarter was the decision by the U.S. government to remove quotas from Ukrainian launch vehicles allowing them to launch any number of U.S. built commercial satellites. Previously (1996 through this year) the number of U.S. built payloads that could be launched on Ukrainian-built vehicles was limited by an agreement between the U.S. and Ukrainian governments. The previous quota regime allowed five commercial launches to geosynchronous orbit plus another 11 launches as part of the multinational Sea Launch partnership through 2001. Ukraine and Sea Launch will now be able to make as many launches as they are able to sell.

Second Quarter 2000 Launch Events Summary
(April 2000 – June 2000)

Figure 1: Launch Vehicle Use

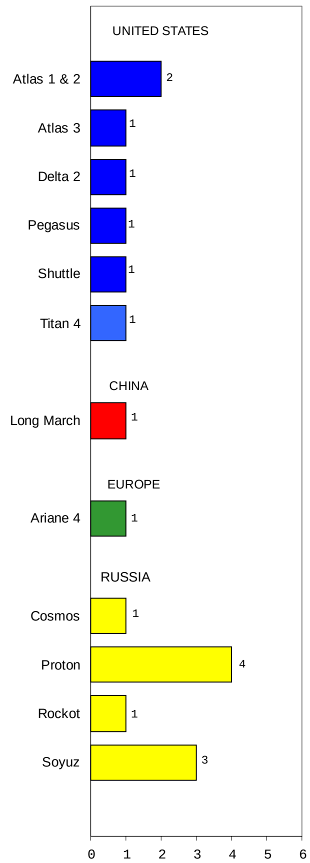


Figure 2: Launch Events by Country

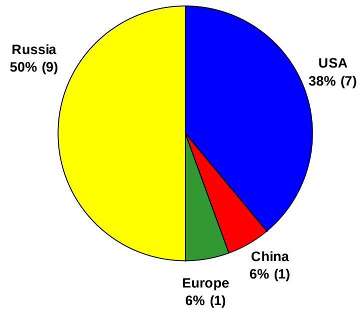


Figure 3: Commercial Launch Events by Country

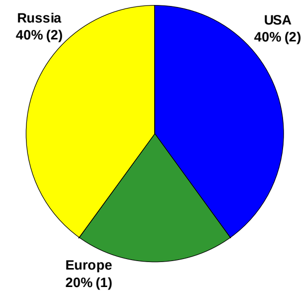


Figure 4: Payload Use Summary

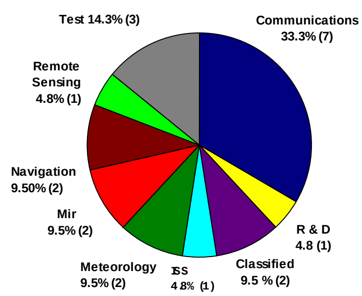


Figure 5: Launch Successes vs. Failures

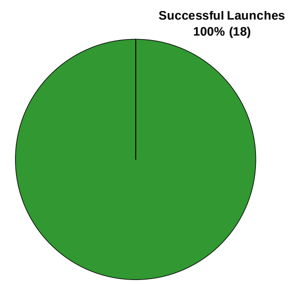


Figure 1 shows the number of launches of each launch vehicle that occurred in the second quarter of 2000. The launches are grouped by the country in which the primary vehicle manufacturer is based. Exceptions to this grouping are launches preformed by Sea Launch, which are designated as "Multinational."

Figure 2 shows all orbital launch events that occurred in the second quarter of 2000 by country.

Figure 3 shows all *commercial* orbital launch events that occurred in the second quarter of 2000 by country. The definition of "commercial" can be found on Page 1.

Figure 4 shows the payloads launched into orbit in the second quarter of 2000 by the mission of the payload. Note: the total number of payloads launched may not equal the total number of launches. This is due to multi-manifesting, i.e., the launching of more than one payload by a single launch vehicle.

Figure 5 shows launch outcome for all orbital launch events that occurred in the second quarter of 2000.

Third Quarter 2000 Launch Events Summary

(July – September 2000)

Figure 6: Projected Launch Vehicle Use

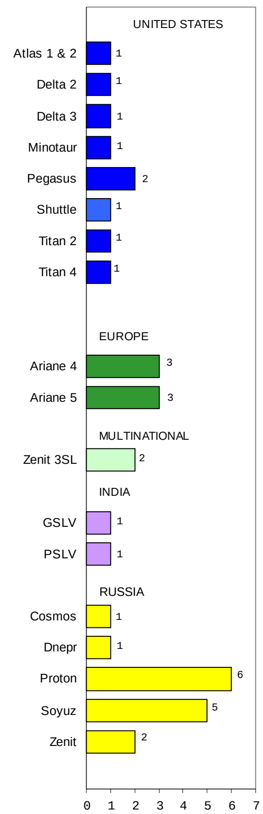


Figure 7: Projected Launch Events by Country

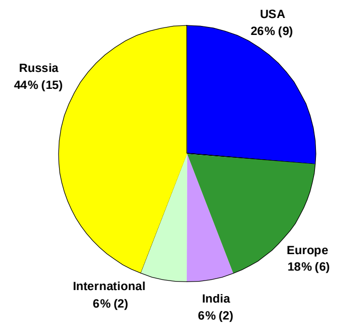


Figure 8: Projected Commercial Launch Events by Country

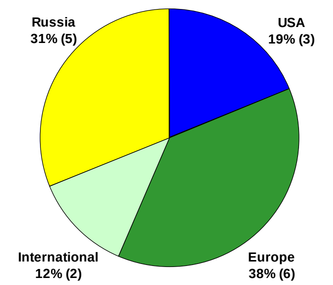


Figure 9: Projected Payload Use Summary

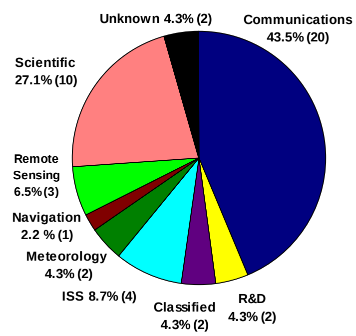


Figure 10: Projected Payload Mass Class Summary

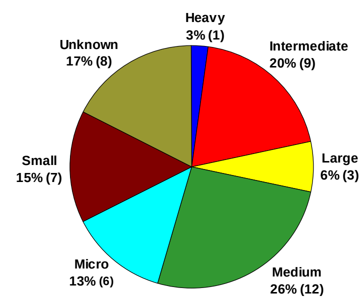


Figure 6 shows the number of launches projected to occur in the third quarter of 2000 by launch vehicle, by country.

Figure 7 shows all orbital launch events projected to occur in the third quarter of 2000 by country.

Figure 8 shows all *commercial* orbital launch events projected to occur in the third quarter of 2000 by country.

Figure 9 shows the payloads projected to launch into orbit in the third quarter of 2000 by the mission of the payload. Note: the total number of payloads launched may not equal the total number of launches. This is due to multi-manifesting, i.e., the launching of more than one payload by a single launch vehicle.

Figure 10 shows payloads projected to launch in the third quarter of 2000 by mass class. Micro (0 to 200 lbs.), Small (201 to 2,000 lbs.), Medium (2,001 to 5,000 lbs.), Intermediate (5,001 lbs. to 10,000 lbs.), Large (10,001 lbs. to 20,000 lbs.), and Heavy (Over 20,000 lbs.)

Fourth Quarter 2000 Launch Events Summary
(October – December 2000)

Figure 11: Projected Launch Vehicle Use

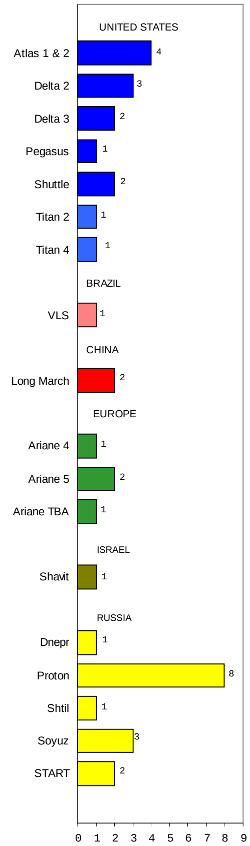


Figure 12: Projected Launch Events by Country

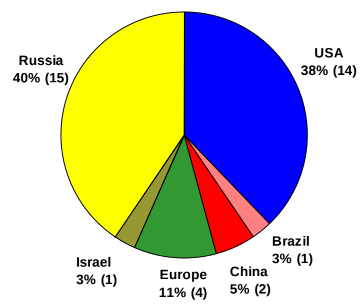


Figure 13: Projected Commercial Launch Events by Country

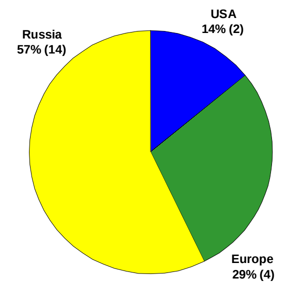


Figure 14: Projected Payload Use Summary

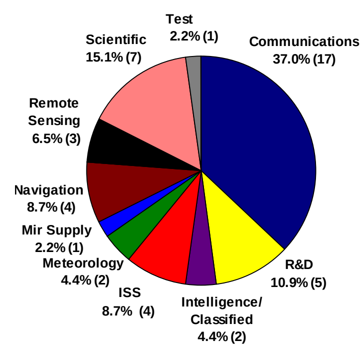


Figure 15: Projected Payload Mass Class Summary

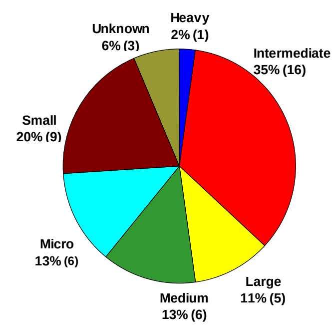


Figure 11 shows the number of launches projected to occur in the fourth quarter of 2000 by launch vehicle, by country.

Figure 12 shows all orbital launch events projected to occur in the fourth quarter of 2000 by country.

Figure 13 shows all *commercial* orbital launch events projected to occur in the fourth quarter of 2000 by country.

Figure 14 shows the payloads projected to launch into orbit in the fourth quarter of 2000 by the mission of the payload. Note: the total number of payloads launched may not equal the total number of launches. This is due to multi-manifesting, i.e., the launching of more than one payload by a single launch vehicle.

Figure 15 shows payloads projected to launch in the fourth quarter of 2000 by mass class. Micro (0 to 200 lbs.), Small (201 to 2,000 lbs.), Medium (2,001 to 5,000 lbs.), Intermediate (5,001 lbs. to 10,000 lbs.), Large (10,001 lbs. to 20,000 lbs.), and Heavy (Over 20,000 lbs.)

Historical Commercial Launch Trends

Figure 16: Commercial Launch Events, Last 12 Months

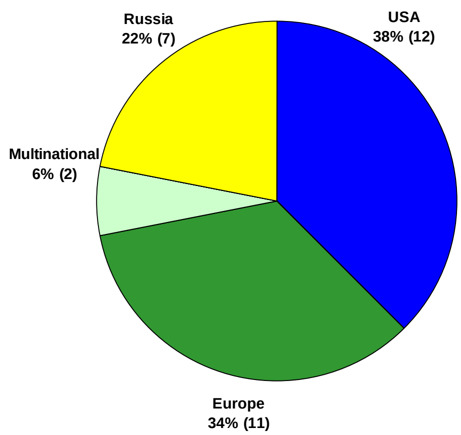


Figure 17: Commercial Launch Revenue, Last 12 Months

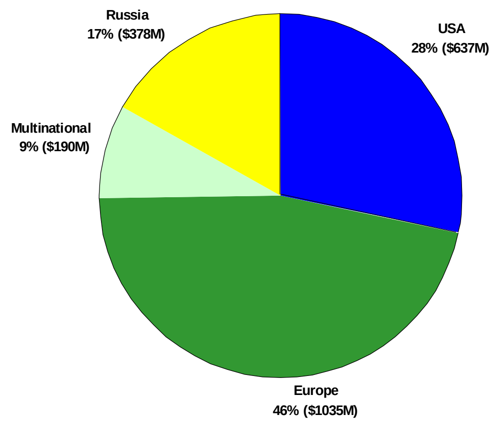


Figure 18: Commercial Launches by Country, Last Five Years

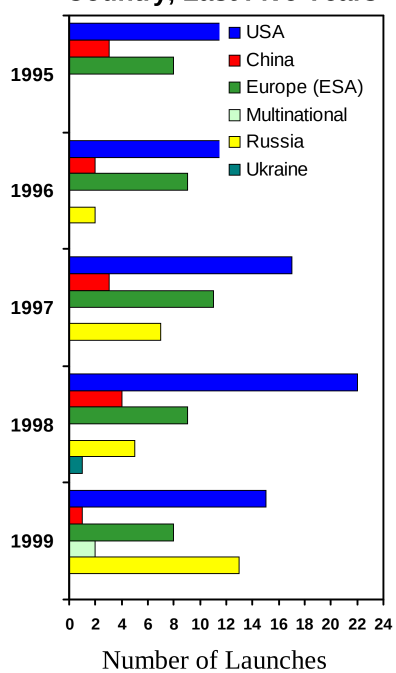


Figure 19: Commercial Launch Revenue by Country, Last Five Years

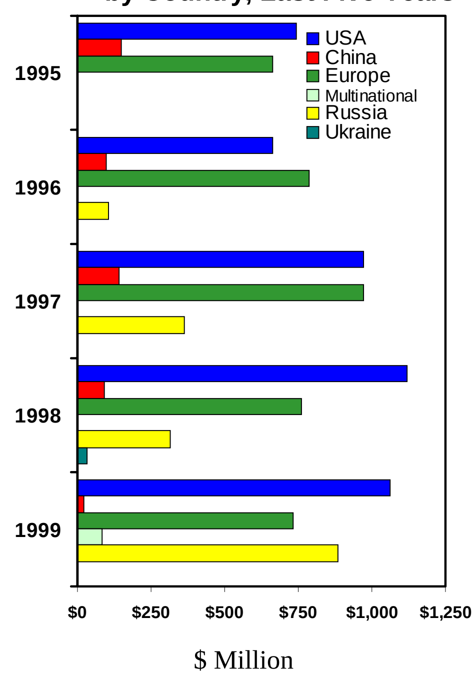


Figure 16 shows commercial launch events for the period July 1999 to June 2000 by country.

Figure 17 shows commercial launch revenue for the period July 1999 to June 2000 by country.

Figure 18 shows the trend in commercial launch events for the last five full years by country, by year.

Figure 19 shows the trend in commercial launch revenue for the last five full years by country, by year.

Special Report

Trends in Vehicle Contract-to-Launch Intervals

INTRODUCTION

In the past decade, the period between signing a launch contract to launching a geosynchronous satellite has decreased by over 50%. This Special Report discusses this trend in the vehicle contract-to-launch interval for the period 1990 to 1999. Also described are factors that influence the duration of this interval.

ANALYSIS METHODOLOGY

Worldwide commercial geosynchronous satellite launches that occurred between 1990 and 1999 were considered in this analysis. (The date of launch contract execution for these launches varied between 1988 and 1998.) Launches involving LEO satellites were excluded from the analysis because the nature and timelines of satellite manufacturing and integration are fairly different for LEO and GEO satellites.

Research was performed on the remaining launches to determine the date of launch contract execution. Of course, not all launch contracts are announced. However, a substantial number are announced allowing the data to be graphed and a trend line to be determined. In all, fifty-two (52) vehicle contract-to-launch intervals were calculated and used in the analysis.

Further research was then performed on the major activities performed during the vehicle contract-to-launch interval. Each major activity is described and its impact on the vehicle contract-to-launch interval is discussed.

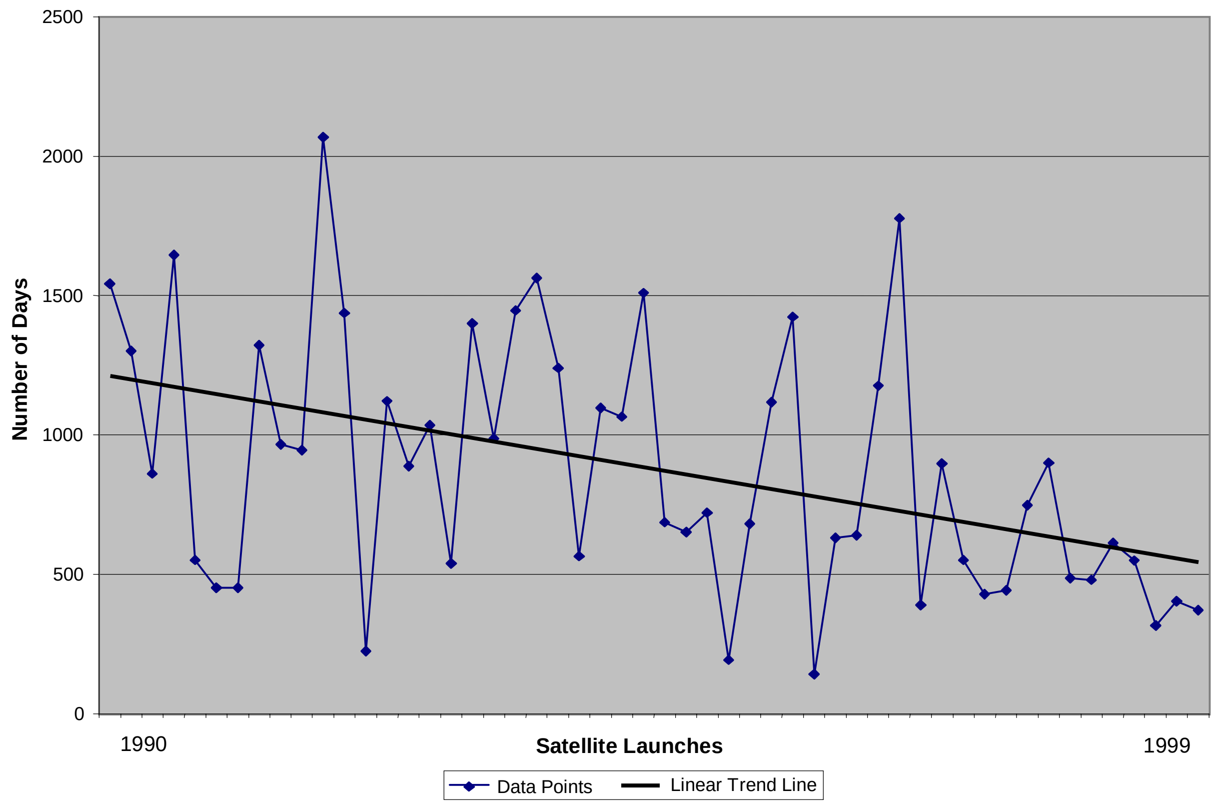
RESULTS

The graph below (Figure 1) shows the vehicle contract-to-launch intervals in number of days (along the y-axis). The x-axis represents all the satellite launches used in the analysis. The satellite launches are sorted chronologically by launch contract execution date, with earlier launches towards the left of the graph and the recent launches on the right.

The graph displays sharp point-to-point variations in the intervals between vehicle contract execution and launch. However, when a linear average is applied to the data and graphed, a definite trend emerges. The trend line shows that the vehicle contract-to-launch interval has decreased substantially over the past decade. The interval has decreased from an average of about 1225 days in the beginning of the decade to 550 days at the end of the decade - a 55% reduction.

This reduction shows the dramatic ability of the commercial space transportation industry to streamline its operations and improve its processes. It represents a maturing of the commercial space transportation industry and a growing responsiveness to customer requirements.

Figure 1. Vehicle Contract-to-Launch Intervals for Satellites Launched Between 1990 and 1999



Components of The Vehicle Contract-to-Launch Interval

The vehicle contract-to-launch interval as discussed in this report is the period between the execution of a launch contract and the actual launch of the satellite. During this interval, launch providers construct a vehicle while the satellite prime contractor builds the satellite. Figure 2 below shows some of the major mission integration activities that occur during this interval. The major satellite activities are on the left side of the figure and the major launch vehicle activities are on the right.

Typically, launch vehicle manufacturers construct a vehicle specifically for a contracted satellite, a process that can include the construction of several vehicles over the course of a few years if a bulk order has been signed. Sea Launch, for example, signed a contract with PanAmSat Corporation in February of this year for the launch of five satellites, with options for four more, through 2003. Recently, however, some launch vehicle manufacturers have begun ordering entire vehicles (not just long lead time components) prior to a launch contract being executed. Arianespace has been at the forefront of this practice.

When construction of the launch vehicle and satellite are complete, they are transported to the launch site and integrated. Satellite integration occurs either on the launch pad or in a separate facility.

Figure 2. Mission Integration: Linking the Satellite to the Launch Vehicle. *Courtesy: The Boeing Company*

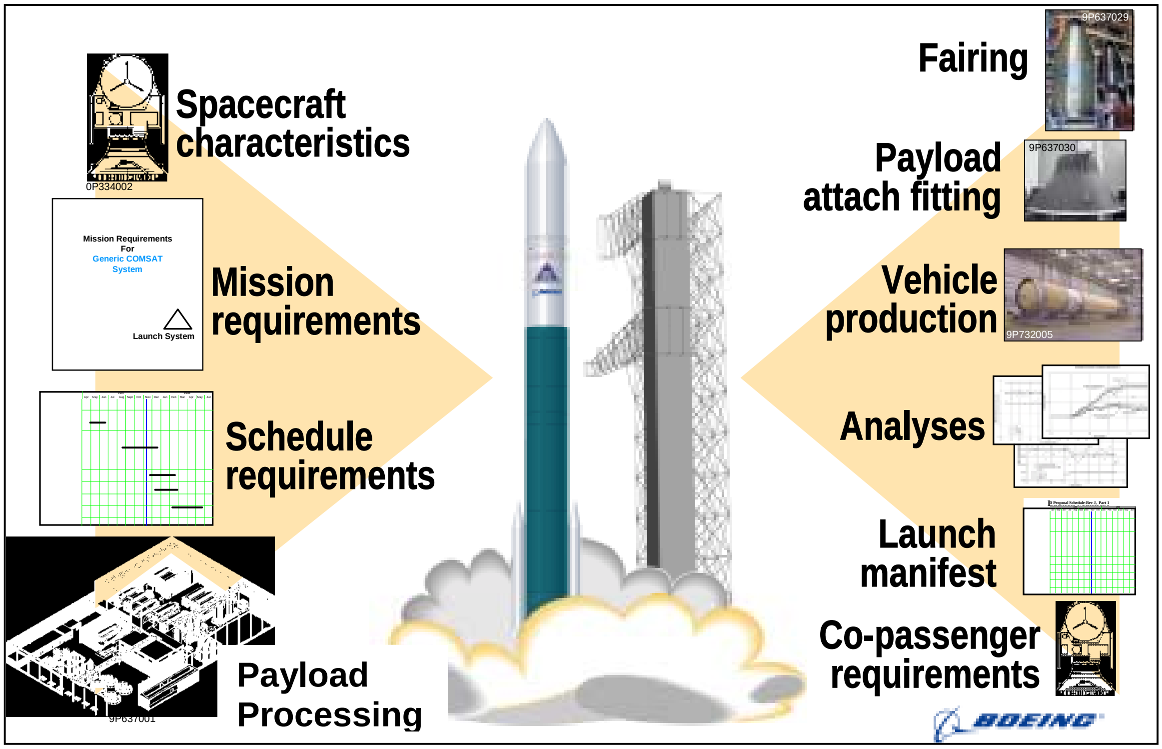


Figure 3 shows a typical flow for satellite integration. At an appropriate time before launch, the satellite and associated ground support equipment are shipped to the launch site, typically via either large transport aircraft, truck, or ship. The satellite is then transferred to the assigned processing facility. During several weeks of processing, the satellite is readied for integration with the launch vehicle. The satellite is typically encapsulated within a payload fairing. Then, the encapsulated payload is mated to the launch vehicle and integrated tests are performed to ensure all systems are ready for launch. The launch countdown is begun and, if all goes well, the vehicle is launched during the launch window.

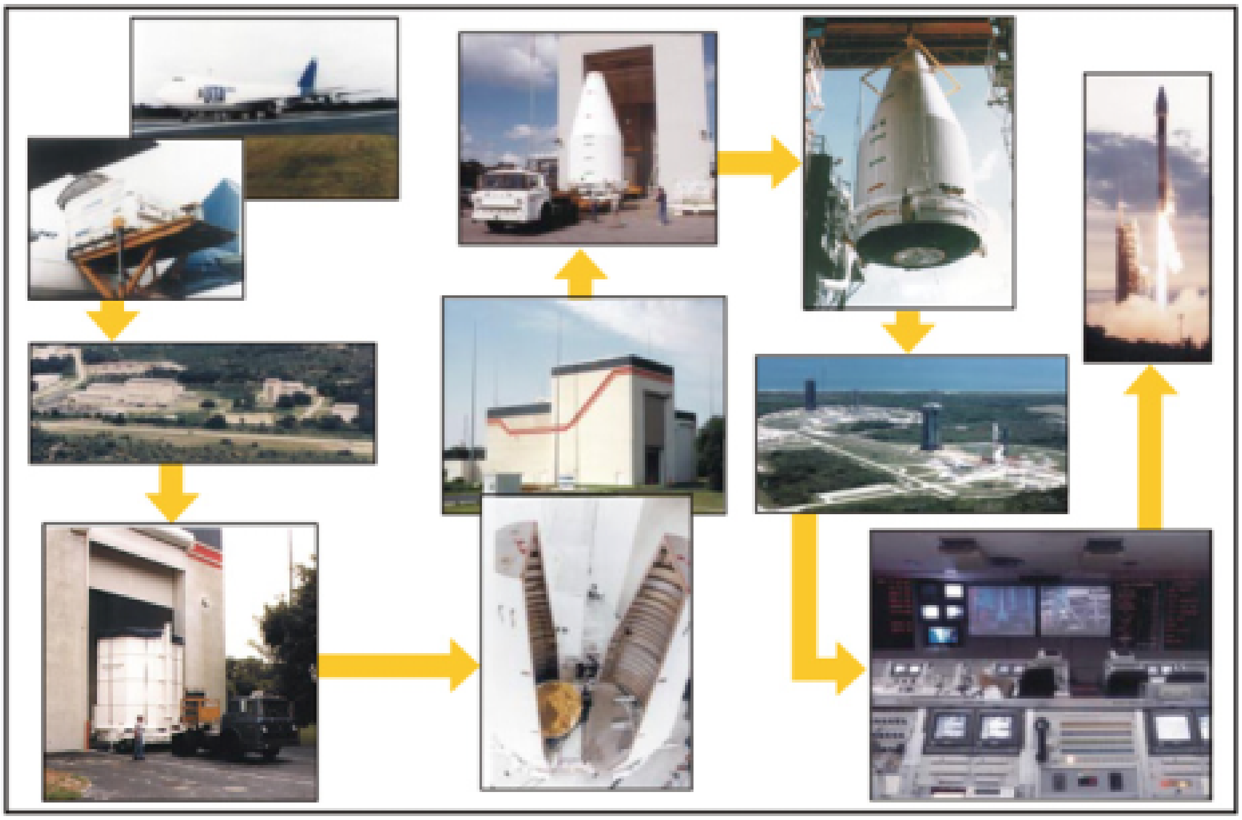
Factors Influencing The Duration of Vehicle Contract-to-Launch

A rule of thumb in the space transportation industry has been that it ordinarily takes about two years to build a launch vehicle. However, several factors influence the time required for the manufacture of a given vehicle.

The primary factors, of course, are the manufacturing of the launch vehicle and satellite. Additionally, financing issues and international trade issues can significantly affect the interval.

Furthermore, there are several factors that affect specific launch dates. While these

Figure 3. Typical Flow for Satellite Integration at the Launch Site. *Courtesy: ILS*



factors impact the vehicle contract-to-launch interval to a lesser degree, they are still important. Examples of these factors include, but are not limited to, launch site schedules, available launch windows, and weather conditions at the site.

Some specific categories of factors that can influence the vehicle contract-to-launch interval are discussed below.

Launch Vehicle Manufacturing

As mentioned before, most launch vehicle manufacturers build launch vehicles for a specific payload. They may, however, order long lead time items, such as engines, in advance of specific orders, based on market forecasts and sales plans. The availability of long lead time items can affect manufacturing time.

Another major factor is the capacity of manufacturing facilities. Launch vehicle manufacturing facilities reflect the vehicles themselves – meaning they are very large and represent huge capital investments on the part of the manufacturer. An inherent problem with large manufacturing facilities is that they are not easily resized to meet changing demand. Spot launch vehicle shortages can occur when production capacity is temporarily exceeded by demand. Conversely, if launch demand declines, a manufacturer may be burdened with oversized manufacturing facilities.
Consequently, it is critically important for vehicle manufacturers to accurately

understand future demand for its vehicles. If a vehicle manufacturer inappropriately sizes its manufacturing facilities, not only will the vehicle contract-to-launch interval be affected, but the manufacturer's financial status will also be impacted.

Suspension of Launch Services

Occasionally, a catastrophic launch failure will ground a specific type of vehicle for an extended period of time. Several years ago, the Chinese Long March 3 and 2E vehicles were grounded for about two years pending investigations of two severe accidents.

Manufacturing flaws, leading to a loss of payload, can also ground a specific vehicle type while repairs or redesigns are implemented. An example is the suspension of Proton launches in 1999 because of faulty welds in the main engine turbopumps. Other U.S. and European launch vehicles have also suspended service in the past because of manufacturing issues.

Launches can also be delayed for political reasons, such as when a temporary hold was imposed on launches from Baikonur while Kazakhstan negotiated with Russia on matters related to rent and safety issues.

Satellite Manufacturing

Satellite manufacturing can introduce significant variation into the vehicle contract-to-launch interval if a satellite is not completed or fully functional by its original completion date. This can be a particular problem if a satellite is highly specialized or employs new technologies.
Subcontracted components delivered to the satellite prime contractor may not be delivered on time due to export control restrictions or scheduling delays experienced by the subcontractor. The subcontracted hardware may be incomplete, incompatible, or otherwise fail a quality control test. If the hardware does not meet quality standards, it will be sent back to the subcontractor for replacement or rework with the subsequent danger of delays in satellite delivery.

The satellite itself may include a design limitation or engineering flaw, conditions usually attributed to an oversight in configuration control. The satellite operator may issue requirement changes to the satellite manufacturer, a development that can impact power distribution, spacecraft structure, or require a complete redesign effort.

Vehicle Integration

The launch vehicle may be delivered to the launch site as a complete system (such as the Sea Launch Zenit 3SL); it may be assembled in a special facility near the launch site (Proton and Soyuz, for example); or, it may be assembled on the launch pad itself (Atlas and Delta). Each process has its own unique advantages and disadvantages with respect to integration time.

The Evolved Expendable Launch Vehicle (EELV) programs currently underway are designed to reduce vehicle integration by delivering a launch-ready vehicle and payload to the launch pad. Lockheed Martin's Atlas V, for example, will be fully assembled and mated with the payload in a nearby facility, rolled out to the pad and launched. Boeing's Delta IV variants will be assembled and mated with a payload in a horizontal fashion, then rolled out to the site, erected and launched. These methods aim to reduce the time the vehicle spends on the launch pad.

Reducing the vehicle integration time is also a major impetus behind the emergence of reusable launch vehicles, which aim to streamline operations and shorten turnaround time, limiting the amount of time the vehicle and payload sit on the ground.

Problems on the Launch Pad

Even when the vehicle and payload are fully tested and ready to go, launches are sometimes delayed by aircraft and sea-going vessels wandering into either the launch site or into impact zones down range. These impact zones include areas where stage debris may reenter partially intact. Tracking stations around the world, some in the form of aircraft and ships, can also contribute to a launch delay for reasons that include system failure and weather. Mechanical and electrical problems may also occur at the launch site.

Weather is the most common cause of launch delays at the launch site, regardless of the method of launch. Vehicles launched from aircraft and from the sea must still monitor weather conditions constantly. Launch range personnel also check for high altitude moisture-induced lightning, a phenomenon common during the summer months at the Vandenberg Air Force Base launch site and also at Cape Canaveral Spaceport.

The Space Shuttle is unique in that the crew may be required to land at any one of several locations in the event of emergency, and weather conditions for these locations must be satisfactory at the time of lunch. These considerations, while not a factor in the launch operations of current uncrewed expendable vehicles, will be a consideration in the planning of future commercial reusable launch operations where crews are involved.

Range operations are a major factor in determining the scheduling of launches from a particular launch facility. If a serious problem occurs requiring the removal of the vehicle from the pad, a significant length of time is needed to transfer another vehicle to the pad. In these cases, the vehicle may simply be left on the pad for repairs or checkout. In either case, no further launches can take place from the launch facility (usually determined by range safety officers or their equivalent).

Summary

As the last decade progressed, commercial launch service providers strengthened their product offerings and became more responsive to their customers. One area that demonstrates this responsiveness is the vehicle contract to launch interval, which has decreased by over 50% from 1990 to 1999. The interval has decreased from an average of about 1225 days in the beginning of the decade to 550 days at the end of the decade - a 55% reduction. This trend is for commercial geosynchronous satellite launches.

Second Quarter 2000 Orbital Launch Events

Date		Vehicle	Site		Payload	Operator	Manufacturer	Use	Vehicle Price	L	M
4/3/00		Soyuz	Baikonur		Soyuz TM-30	RKK Energia	RKK Energia	Crewed	$35-40M	S	S
4/17/00	√	Proton (SL-12)	Baikonur	*	Sesat	Eutelsat	NPO PM	Communications	$75-95M	S	S
4/18/00	√	Ariane 42L	Kourou	*	Galaxy 4R	Pan American Satellite Corp.	Hughes	Communications	$80-100M	S	S
4/26/00		Soyuz	Baikonur		Progress M1-2	RKK Energia	RKK Energia	Supply	$35-40M	S	S
5/3/00		Atlas 2A	CCAS		GOES L	NOAA	Space Systems/Loral	Meteorological	$75-85M	S	S
5/3/00		Soyuz	Baikonur		Kosmos 2370	Russia	Russia	Intelligence	$35-40M	S	S
5/8/00		Titan 4B/IUS	CCAS		DSP 20	DoD	TRW	Intelligence	$350-400M	S	S
5/10/00		Delta 2 7925	CCAS		Navstar GPS 2R-4	DoD	Lockheed Martin Corp.	Navigation	$50-60M	S	S
5/16/00	√	Rockot	Plesetsk	*	Simsat 2		Khrunichev	Test	$12-15M	S	S
				*	Simsat 1		Khrunichev	Test	$12-15M	S	S
5/19/00		Shuttle Atlantis	KSC		ISS Cargo	NASA	NASA	Space Station	$300M	S	S
					STS 101	NASA	Rockwell International	Crewed	$300M	S	S
5/24/00	√ +	Atlas 3A	CCAS	*	Eutelsat W4	Eutelsat	Alcatel Espace	Communications	$90-105M	S	S
6/4/00	√	Proton (SL-12)	Baikonur	*	Gorizont 45	PO Kosmicheskaya Sviaz	NPO PM	Communications	$75-95M	S	S
6/7/00	√ +	Pegasus XL	VAFB		TSX 5	DoD	Orbital Sciences Corp.	Development	$12-15M	S	S
6/24/00		Proton (SL-12)	Baikonur		Express 3A	Intersputnik	NPO PM	Communications	$75-95M	S	S
6/25/00		Long March 3	Xichang		FY 2B	China Meteorological Administration	Shanghai Institute of Satellite Engineering	Meteorological	$35-40M	S	S
6/28/00	√	Cosmos	Plesetsk		Nadezhda M	Russia	NPO Polyot	Navigation	$12-14M	S	S
				*	SNAP 1	Surrey Satellite Technology Ltd.	Surrey Satellite Tech.	Test			
				*	Tsinghua 1	TBA	Surrey Satellite Tech.	Remote Sensing	$12-14M	S	S
6/30/00	√	Proton (SL-12)	Baikonur	*	Sirius Radio 1	Sirius Satellite Radio Inc.	Space Systems/Loral	Communications	$75-95M	S	S
6/30/00		Atlas 2A	CCAS		TDRS F8	NASA	Hughes	Communications	$75-85M	S	S

√ Denotes commercial launch, defined as a launch that is internationally competed or whose primary payload is commercial in nature.
+ Denotes FAA-licensed launch.
* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is opperated by a commercial entity.
L/M refers to the outcome of the launch and mission: S = success, P = partial success, F = failure

Third Quarter 2000 Projected Orbital Launch Events

Date	Vehicle	Site	Payload	Operator	Manufacturer	Use	Vehicle Price
7/5/00	Proton (SL-12)	Baikonur	Kosmos 2371	Russian MoD	Russia	Communications	$75-95M
7/12/00 √	Proton (SL-13)	Baikonur	Zvezda	Russia	RKK Energia	Space Station	$75-95M
7/14/00 √	+Atlas 2AS	CCAS	* Echostar 6	EchoStar Satellite Corp.	Space Systems/Loral	Communications	$90-105M
7/15/00	Soyuz	Baikonur	Cluster II 2	ESA	Dornier	Scientific	$35-40M
			Cluster II 1	ESA	Dornier	Scientific	$35-40M
7/15/00 √	Cosmos	Plesetsk	Mita	Italian Space Agency	Carlo Gavazzi Space	Communications	$12-14M
			Champ	DARA	Jena-Optronik GmbH	Scientific	$12-14M
7/16/00	Delta 2 7925	CCAS	Navstar GPS 2R- 5	DoD	Lockheed Martin Corp.	Navigation	$50-60M
7/19/00	Minotaur	VAFB	MightySat 2-1	DoD	Spectrum Astro, Inc.	Development	$10-15M
7/25/00 √	Ariane 5	Kourou	* GE 7	GE Americom	Lockheed Martin Corp.	Communications	$150-180M
			* Astra 2B	Societe Europeenne des Satellites (SES)	Matra Marconi Space	Communications	$150-180M
7/27/00 √	+Zenit 3SL	Sea Launch Platform	* PAS 9	PanAmSat Corp.	Hughes	Communications	$75-95M
7/31/00	Titan 4B	VAFB	NRO 2000-2	NRO	TBA	Classified	$350-400M
7/XX/00	Zenit 2	Baikonur	Kosmos TBD	Russia	Russia	Classified	$35-50M
7/XX/01	GSLV	Sriharikota Range (SHAR)	Gramsat 1	IRSO	IRSO	Communications	$25-45M
7/XX/02	PSLV	Sriharikota Range (SHAR)	PROBA	European Space Agency (ESA)	TBA	Scientific	$15-25M
8/2/00	Soyuz	Baikonur	Progress M-ISS-01	RKK Energia	RKK Energia	Supply	$35-40M
8/9/00	Soyuz	Baikonur	Cluster II 4	ESA	Dornier	Scientific	$35-40M
			Cluster II 3	ESA	Dornier	Scientific	
8/23/00 √	+Delta 3	CCAS	* DeltaDemo	Boeing	Boeing	Test	$75-90M
8/25/00 √	Dnepr 1	Baikonur	Saudisat 1-1	Space Research Institute (S.A.)	Space Research Institute	Scientific	$10-20M
			Saudisat 1-2	Space Research Institute (S.A.)	Space Research Institute	Scientific	
			Tiungsat 1	TBA	TBA	Remote Sensing	
			* MegSat 1	MegSat S.P.A	MegSat S.P.A	Communications	
			Unisat	University of Rome	University of Rome		

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Third Quarter 2000 Projected Orbital Launch Events

Date		Vehicle	Site		Payload	Operator	Manufacturer	Use	Vehicle Price
8/29/00		Titan 2	VAFB		NOAA L	NOAA	Lockheed Martin Corp.	Meteorological	$30-40M
8/XX/00	√	Proton (SL-12)	Baikonur	*	Eutelsat W1R	Eutelsat	Alcatel Espace	Communications	$75-95M
8/XX/00	√	Ariane 44LP	Kourou	*	Nilesat 102	Egyptian Radio and	Matra Marconi	Communications	$90-110M
8/XX/00				*	Brazilsat B4	Embratel	Hughes	Communications	
8/XX/00	√	Ariane 44L	Kourou	*	Anik F1	Telesat Canada	Hughes	Communications	$100-125M
8/XX/00	√	Proton (SL-12)	Baikonur	*	Ekran M	Russia/CIS PTT	NPO PM	Communications	$75-95M
8/XX/00		+Pegasus XL	Kwajalein		HETE-2	MIT	MIT	Scientific	$12-15M
9/8/00		Shuttle Atlantis	KSC		ISS 2A.2b	NASA	NASA	Space Station	$300M
9/8/00					STS 106	NASA	Rockwell International	Crewed	
9/21/00		Soyuz	Baikonur		Progress M-ISS-02	RKK Energia	RKK Energia	Supply	$35-40M
9/24/00		Zenit 2	Baikonur		Badr 2	SUPARCO	SUPARCO	Remote Sensing	$35-50M
9/24/00					Maroc-Tubsat	TBA	TBA	Development	$35-50M
9/24/00					Reflector	TBA	TBA	TBA	$35-50M
9/24/00					Meteor 3M-1	Russia	VNII Elektromekhaniki	Meteorological	$35-50M
9/30/00	√	Proton (SL-12)	Baikonur	*	GE 1A	Americom Asia-Pacific	Lockheed Martin Corp.	Communications	$75-95M
9/XX/00	√	Ariane 44LP	Kourou	*	Europe Star 1	Europe Star	Alcatel Espace	Communications	$90-110M
9/XX/00	√	Proton (SL-12)	Baikonur	*	Sirius Radio 2	Sirius Satellite Radio Inc.	Space Systems/Loral	Communications	$75-95M
9/XX/00	√	Ariane 5	Kourou	*	Eurasiasat 1	Eurasiasat SM	Alcatel Espace	Communications	$150-180M
9/XX/00	√	+Pegasus XL	VAFB	*	OrbView 3	Orbital Imaging Corp. (Orbimage)	Orbital Sciences Corp.	Remote Sensing	$12-15M
9/XX/00	√	+Zenit 3SL	Sea Launch Platform	*	Thuraya 1	Thuraya Satellite Communciations Company	Hughes	Communications	$75-95M
3rd Quarter		Soyuz	Plesetsk		Bion 12	Russia	Russia	Scientific	$35-40M
3rd Quarter	√	Ariane 5	Kourou	*	BSat 2A	Broadcasting Satellite System Corp.	Orbital Sciences Corp.	Communications	$150-180M
				*	NSat 110	JSAT/SCC	Lockheed Martin Corp.	Communications	

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Fourth Quarter 2000 Projected Orbital Launch Events

Date	Vehicle	Site	Payload	Operator	Manufacturer	Use	Vehicle Price
10/1/00	√ START 1	Svobodny	* EROS A1	West Indian Space	Israel Aircraft Industries	Remote Sensing	$5-10M
10/5/00	Shuttle Discovery	KSC	ISS 3A	NASA	NASA	Space Station	$300M
10/5/00			STS 92	NASA	Rockwell International	Crewed	
10/5/00	√ + Delta 3	CCAS	* ICO D-1	ICO	Hughes	Communications	$75-90M
10/12/00	Atlas 2A	CCAS	DSCS III 3-12	DoD	Lockheed Martin Corp.	Communications	$75-85M
10/17/00	Delta 2 7320	VAFB	Earth Observing 1	NASA	Swales & Associates Inc., MIT/Lincoln Labs	Development	$45-55M
			SAC C	Argentina	Bariloche	Scientific	
			Munin	TBA	IRF	Scientific	
			Citizen Explorer	Colorado Space Grant Consortium	Colorado Space Grant Consortium	Scientific	
10/26/00	√ + Atlas 2AS	CCAS	* Tempo 1	DirecTV, Inc.	Space Systems/Loral	Communications	$90-105M
10/30/00	Soyuz	Baikonur	ISS 2R	NASA	NASA	Space Station	$35-40M
10/XX/09	√ Proton (SL-12)	Baikonur	* Sirius Radio 3	Sirius Satellite Radio Inc.	Space Systems/Loral	Communications	$75-95M
11/30/00	Shuttle Endeavour	KSC	STS 97	NASA	Rockwell International	Crewed	$300M
			ISS 4A	NASA	NASA	Space Station	
11/30/00	Soyuz	Baikonur	Soyuz TM-31	RKK Energia	RKK Energia	Supply	$35-40M
11/XX/09	√ START 1	Svobodny	Odin	Swedish National Space Board	Swedish Space Corp.	Scientific	$5-10M
11/XX/10	√ Proton (SL-12)	TBA	* GE 6	GE Americom	Lockheed Martin Corp.	Communications	$75-95M
12/4/00	Atlas 2AS	CCAS	NRO 2000-1	NRO	TBA	Classified	$90-105M
12/10/00	Titan 2	VAFB	DMSP 5D-3-F16	DoD	Lockheed Martin Corp.	Meteorological	$30-40M
12/12/00	Soyuz	Baikonur	Progress M-ISS-03	RKK Energia	RKK Energia	Supply	$35-40M
12/14/00	Delta 2 7925	CCAS	ProSEDS	NASA	University of Michigan	Development	$50-60M
12/14/00			Navstar GPS 2R- 6	DoD	Lockheed Martin Corp.	Navigation	
12/20/00	Pegasus XL	CCAS	HESSI	NASA	Spectrum Astro, Inc.	Scientific	$12-15M
12/21/00	Delta 2 TBA	VAFB	Aqua	NASA	TRW	Remote Sensing	N/A

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Fourth Quarter 2000 Projected Orbital Launch Events

Date	Vehicle	Site	Payload	Operator	Manufacturer	Use	Vehicle Price
4th Quarter	√ +Delta 3	CCAS	* ICO D-2	ICO	Hughes	Communications	$75-90M
4th Quarter	Titan 4B/Centaur	CCAS	Milstar II-F2	DoD/USAF	Lockheed Martin Corp.	Communications	$350-400M
4th Quarter	√ Dnepr 1	Baikonur	* UoSat 13	Surrey Satellite Technology Ltd.	Surrey Satellite Tech.	Scientific	$10-20M
4th Quarter	√ Ariane TBA	TBA	* Insat 3A	TBA	IRSO	Communications	N/A
4th Quarter	√ Proton (SL-12)	TBA	* Express K 1	Troika	Alcatel Espace	Communications	$75-95M
4th Quarter	√ Ariane 5	Kourou	* AMSAT Phase 3-D	AMSAT	AMSAT	Communications	$150-180M
			STRV 1C	British MoD	Defense Research Agency	Development	
			STRV 1D	British MoD	Defense Research Agency	Development	
			* PAS 1R	PanAmSat Corp.	Hughes	Communications	
4th Quarter	Long March 2F	Jiuquan	Shenzhou 2	China National Space Administration	China Research Institute of Carrier Rocket Technol	Test	N/A
4th Quarter	Long March 4B	Taiyuan	New Gen. FSW	China (Unknown)	China	Meterological	$25-35M
4th Quarter	√ Ariane 4 TBA	Kourou	* GE 8	GE Americom	Lockheed Martin Corp.	Communications	N/A
2000	√ Proton (SL-12)	Baikonur	* ICO P-1	ICO	Hughes	Communications	$75-95M
2000	√ Proton (SL-12)	Baikonur	* Gals R16	Informkosmos	NPO PM	Communications	$75-95M
2000	Ariane 5	Kourou	Ldrex	NASDA, Rocket Systems Corp. (Commercial)		Development	$150-180M
2000	√ Shtil	Barents Sea	School-Sat	Germany	Technical University of Berlin	Scientific	$0.1-0.3M
2000	Proton (SL-12)	Baikonur	Luch 1-2	Tas-Luch	NPO PM	Communications	$75-95M
2000	√ +Atlas 2AS	CCAS	* ICO A-1	ICO Global Communications	Hughes	Communications	$90-105M
2000	Proton (SL-12)	Baikonur	Kosmos 2372	Russian MoD	NPO PM	Navigation	$75-95M
			Kosmos 2373	Russian MoD	NPO PM	Navigation	
			Kosmos 2374	Russian MoD	NPO PM	Navigation	
2000	√ Proton (SL-12)	Baikonur	* ICO P-2	ICO	Hughes	Communications	$75-95M
2000	Shavit 1	Palmachim AFB	Offeq 5	Israel Space Agency	Israel Aircraft Industries	Intelligence	$10-15M
2000	VLS	Alcantara	SCD 3	INPE	INPE	Remote Sensing	$6-7M

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