Commercial Space Transportation

QUARTERLY LAUNCH REPORT

Featuring the launch results from the 2nd quarter 2001 and forecasts for the 3rd and 4th quarter 2001

Quarterly Report Topic:

International Partnerships in the Commercial Space Launch Industry

3rd Quarter 2001

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 2001 Quarterly Launch Report features launch results from the second quarter of 2001 (April-June 2001) and launch forecasts for the third quarter of 2001 (July-September 2001) and the fourth quarter of 2001 (October-December 2001). 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

* Fourth quarter launch events include all launches projected for the fourth quarter as well as those projected to occur at some point in 2001 but not assigned to a specific month or quarter.

Cover: Cape Canaveral Air Force Station, Florida, June 19, 2001 - An Atlas IIAS rocket carries the ICO F-1 satellite into geosynchronous transfer orbit for ICO Global Communications. Courtesy of International Launch Services.

Second Quarter 2001 Highlights

In the second quarter of 2001, two new vehicles were introduced and a third was returned to service following a launch failure. The vehicles making their initial flights were Russia's Proton M and India's Geosynchronous Satellite Launch Vehicle (GSLV). In addition, the Russian Cosmos vehicle returned to flight after a failure in November of 2000.

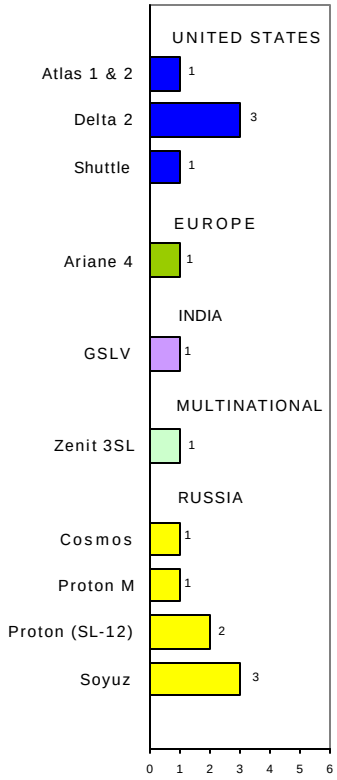
The first launch of Khrunichev's Proton M launch vehicle occurred on April 7 from the Baikonur Cosmodrome. The vehicle used a Breeze upper stage to place a non-commercial Ekran communications satellite successfully into geosynchronous orbit. The Proton M, commercially marketed by International Launch Services (ILS), is an upgraded version of the current Proton K (or SL-12) launch vehicle with more powerful engines, structural enhancements to support the increased lift capability, and a new digital guidance system. The Proton M also replaces the Proton K's Energomash Block DM upper stage with the Khrunichev-produced Breeze M upper stage. While the Proton K can lift a maximum of 4,910 kilograms to geosynchronous transfer orbit (GTO), the new Proton M is capable of lifting 8,800 kilograms to GTO. The new vehicle is to replace the Proton K over the next few years.

On April 18, India's first GSLV launched the 1,540-kilogram Gsat 1 experimental communications satellite from India's Sriharikota launch site. Initial GSLVs use Russian cryogenic upper stages as an interim measure while India develops its own upper stage. The launch was marred by a premature upper-stage cutoff 698 seconds into the planned 710-second burn. The launch placed the Gsat 1 satellite 4,000 kilometers short of its intended orbit, forcing the satellite to use additional onboard propellant to raise the apogee during its standard circularization burn.

On June 8, Russia successfully launched a Cosmos vehicle (built by AO Polyot and marketed commercially by Puskovye Uslugi) from its launch site at Plesetsk carrying Kosmos 2378, a Parus military navigation satellite. This was the first launch of a Cosmos since the failed launch on November 20, 2000, when a second-stage failure resulted in the loss of the EarthWatch QuickBird 1 commercial remote sensing satellite.

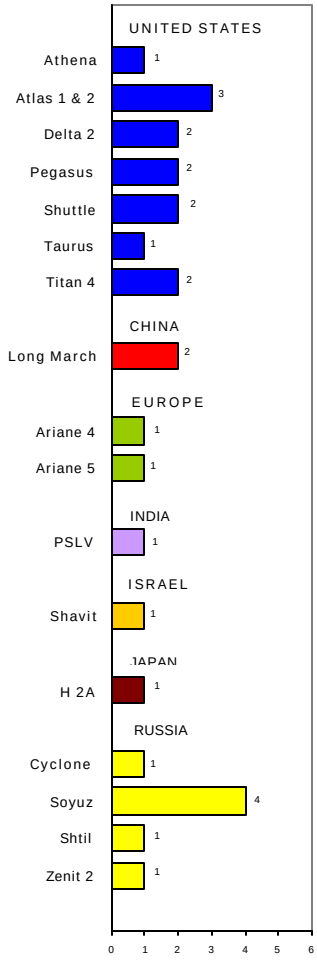
Vehicle Use
(April 2001 – December 2001)

Figure 1: Second Quarter 2001 Total Launch Vehicle Use



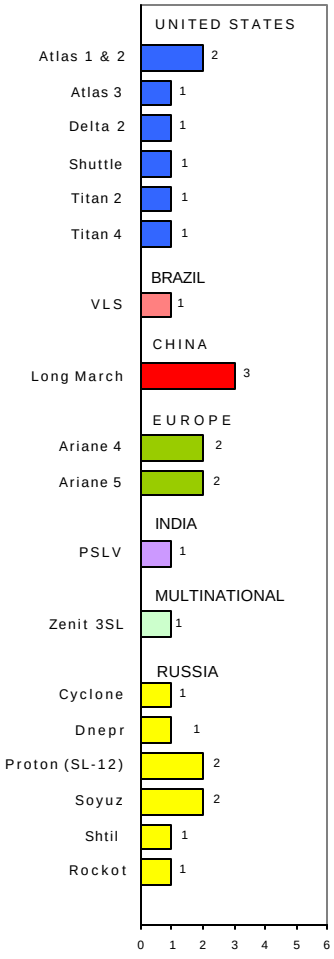
Total = 15

Figure 2: Third Quarter 2001 Total Projected Launch Vehicle Use



Total = 27

Figure 3: Fourth Quarter 2001 Total Projected Launch Vehicle Use

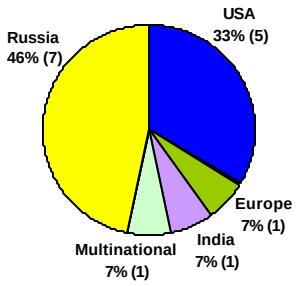


Total = 25

Figures 1-3 show the total number of orbital launches (commercial and government) of each launch vehicle that occurred in the second quarter of 2001 and that are projected for the third and fourth quarters of 2001. 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.

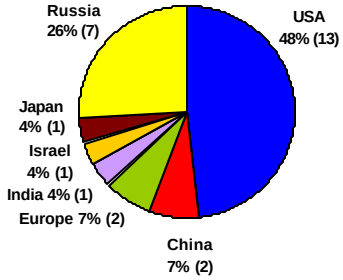
Total Launch Events by Country
(April 2001 – December 2001)

Figure 4: Second Quarter 2001 Total Launch Events by Country



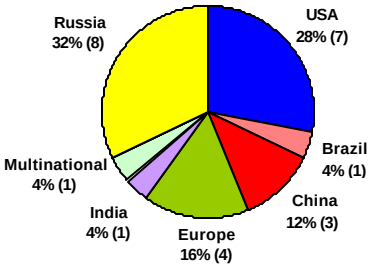
Total = 15

Figure 5: Third Quarter 2001 Total Projected Launch Events by Country



Total = 27

Figure 6: Fourth Quarter 2001 Total Projected Launch Events by Country

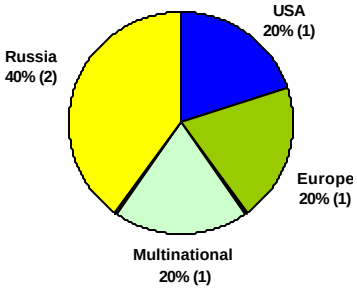


Total = 25

Figures 4-6 show all orbital launch events (commercial and government) that occurred in the second quarter of 2001 and that are projected for the third and fourth quarters of 2001.

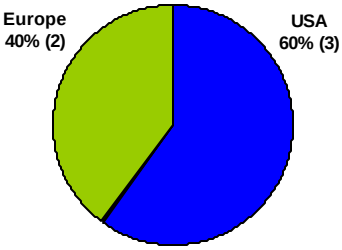
Commercial Launch Events by Country
(April 2001 – December 2001)

Figure 7: Second Quarter 2001 Commercial Launch Events by Country



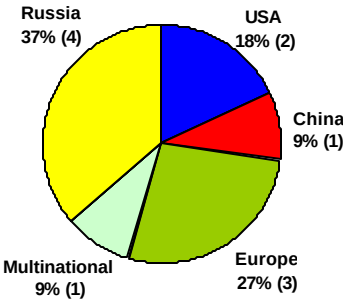
Total = 5

Figure 8: Third Quarter 2001 Projected Commercial Launch Events by Country



Total = 5

Figure 9: Fourth Quarter 2001 Projected Commercial Launch Events by Country

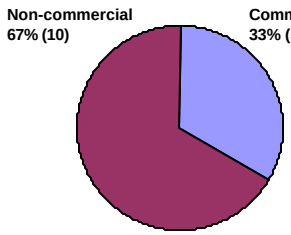


Total = 11

Figures 7-9 show all *commercial* orbital launch events that occurred in the second quarter of 2001 and that are projected for the third and fourth quarters of 2001.

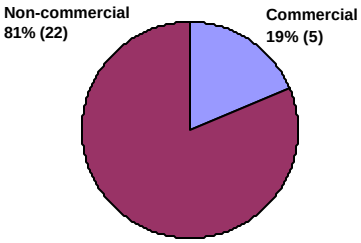
Commercial vs. Non-commercial Launch Events
(April 2001 – December 2001)

Figure 10: Second Quarter 2001 Commercial vs. Non-commercial Launch Events



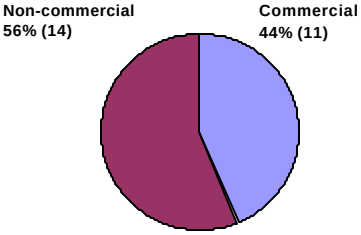
Total = 15

Figure 11: Third Quarter 2001 Commercial vs. Non-commercial Projected Launch Events



Total = 27

Figure 12: Fourth Quarter 2001 Commercial vs. Non-commercial Projected Launch Events

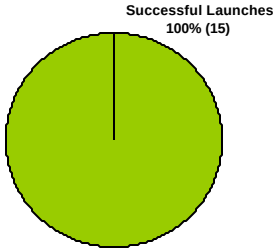


Total = 25

Figures 10-12 show commercial vs. non-commercial orbital launch events that occurred in the second quarter of 2001 and that are projected for the third and fourth quarters of 2001.

Second Quarter 2001 Launch Successes vs. Failures
(April 2001 – June 2001)

Figure 13: Total Launch Successes vs. Failures

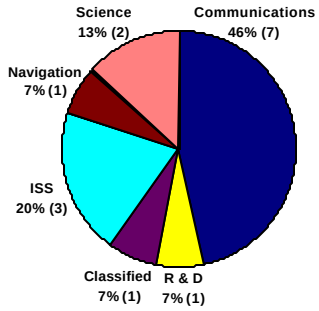


Total = 15

Figure 13 shows successful vs. failed orbital launch events that occurred in the second quarter of 2001.

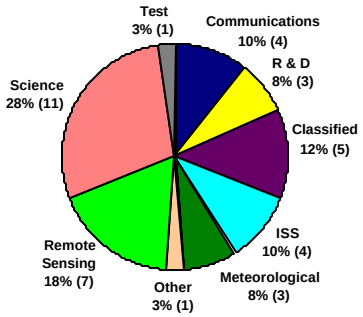
Payload Use
(April 2001 – December 2001)

Figure 14: Second Quarter 2001 Payload Use



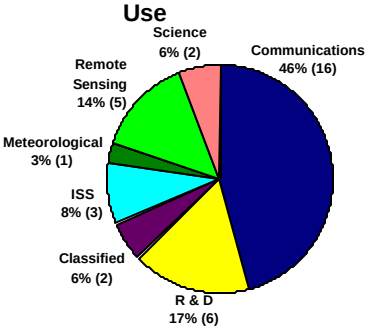
Total = 15

Figure 15: Third Quarter 2001 Projected Payload Use



Total = 39

Figure 16: Fourth Quarter 2001 Projected Payload Use

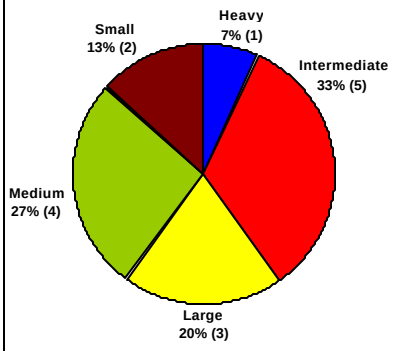


Total = 35

Figures 14-16 show total payload use (commercial and government), actual for the second quarter of 2001 and projected for the third and fourth quarters of 2001. 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.

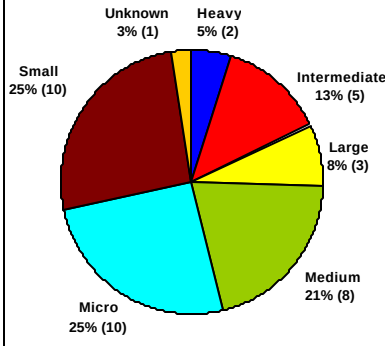
Payload Mass Class
(April 2001 – December 2001)

Figure 17: Second Quarter 2001 Payload Mass Class



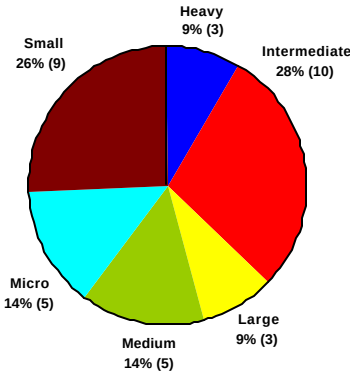
Total = 15

Figure 18: Third Quarter 2001 Projected Payload Mass Class



Total = 39

Figure 19: Fourth Quarter 2001 Projected Payload Mass Class

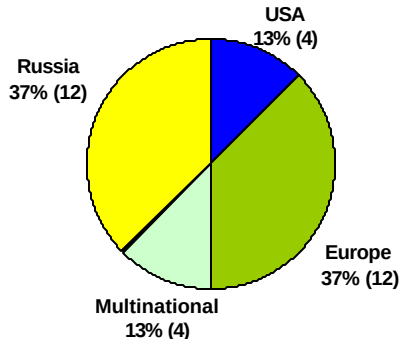


Total = 35

Figures 17-19 show total payloads by mass class (commercial and government), actual for the second quarter of 2001 and projected for the third and fourth quarters of 2001. 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.).

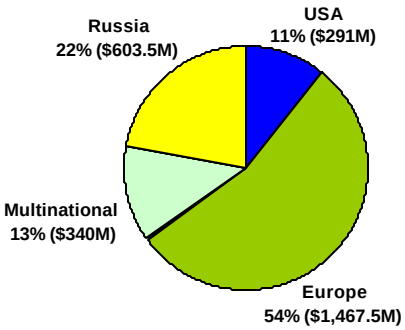
Commercial Launch Trends
(July 2000 - June 2001)

Figure 20: Commercial Launch Events, Last 12 Months



Total = 32

Figure 21: Commercial Launch Revenue, Last 12 Months



Total = $2,702M

Figure 20 shows commercial launch events for the period July 2000 to June 2001 by country.

Figure 21 shows commercial launch revenue for the period July 2000 to June 2001 by country.

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

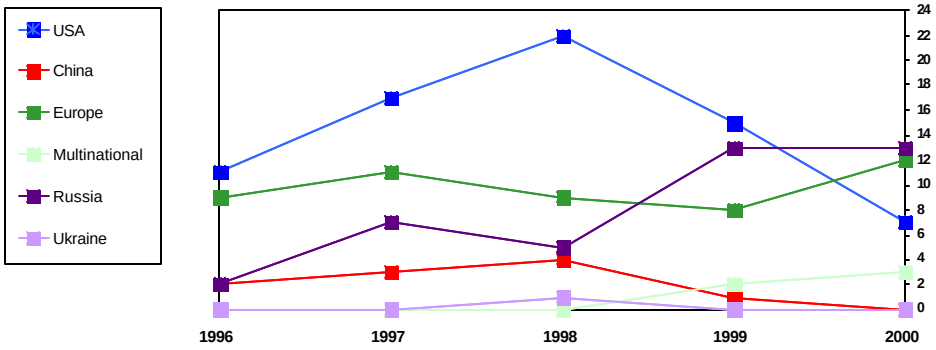


Figure 22 shows commercial launch events by country for the last five full years.

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

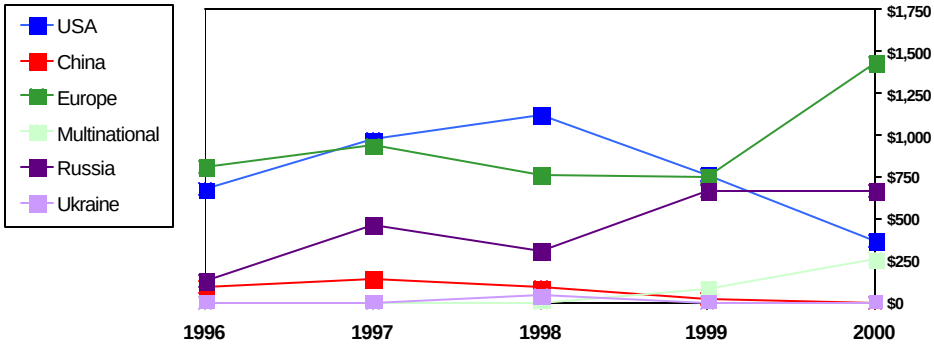


Figure 23 shows commercial launch revenue by country for the last five full years.

International Partnerships in the Commercial Space Launch Industry

INTRODUCTION

International partnerships are hardly a new concept in space activities: national governments and space agencies have been collaborating since the early years of the Space Age on projects such as scientific satellites and human space flight missions. National space agencies recognized that cooperation across borders presented challenges but afforded them the opportunity to achieve common goals and complete ambitious projects by sharing costs, risk, infrastructure, and expertise.

While governments undertook the earliest international collaboration projects in space, today increasing numbers of international partnerships involve one or more commercial players and focus on the business of space transportation. Indeed, like other modern, technology-based businesses, private launch-related companies operate in the global economy and have come to recognize the advantages of forging strategic alliances, regardless of the partner's location in the world.

This report explores the range of launch-related international partnerships involving private companies that exists today in an effort to understand the nature of these partnerships, the reasons for their emergence, and the impact they may have on the launch industry as well as the customers they serve. In this report, the term "partnership" refers to a contract between at least two entities in which each entity offers a product, service, or capability of value to the other or makes a contribution toward a common effort in an attempt to improve the economic condition of all entities involved. Partnerships, as discussed herein, are not simply payments of money for purchase or lease of goods or services, even as stipulated within a launch services contract. They also exclude mergers and acquisitions of companies and international launch trade agreements.

All of the partnerships considered herein have launch activity as a central focus, involve at least one purely commercial entity, and encompass players from at least two different nations.[1] This report also addresses only partnerships that have actually been enacted; agreements under discussion are not covered here. This report does not attempt to address every launch-related partnership that has ever existed.

As the next sections show, international partnerships in the launch business have proliferated in recent years. Involving combinations of launch vehicle and component manufacturers, launch service marketers, spaceport developers, satellite operators, and governments, today's launch-related alliances have been formed, most fundamentally, to improve the local and global business prospects of those involved. These partnerships fall into three major

[1] This report does not describe or analyze intra-European launch-related consortia such as Arianespace or the European Aeronautic Defense and Space Company (EADS) because, from the European perspective, these are enterprises of a single, solidified Europe.

categories of launch interest: technology, marketing, and customer relations. *Technology partnerships* encompass relationships formed to produce or assemble launch vehicles and their components as well as launch equipment and facilities. *Marketing partnerships* are relationships designed to expand the reach of various launch vehicles to global markets. *Provider/customer partnerships* involve the teaming of launch service providers with companies who use their launch services in various efforts to bring mutual benefits to themselves and their customers. While some partnerships span more than one category, the enterprises discussed here are listed according to their primary activities.

TECHNOLOGY PARTNERSHIPS

Sea Launch Company

Founded in 1995, the Sea Launch Company is the result of a meeting of minds and resources of companies from four nations. During the early 1990s, the Russian company NPO Energia met with the Boeing Commercial Space Company to discuss Russian design ideas for a sea-based space launch system. The launch-at-sea concept Energia proposed involved the use of Energia M, a launch vehicle design the company desired to promote; Boeing, for its part, had not yet acquired McDonnell Douglas and the Delta launch vehicle but was interested in entering the launch business. Recognizing the many advantages such a system could offer in the launch market, Energia and Boeing, along with SDO Yuzhnoye of Ukraine and Kvaerner of Norway, signed an agreement to form the joint venture Sea Launch. Today, Boeing owns 40 percent of Sea Launch, while Rocket Space Corporation (RSC) Energia owns 25 percent; the Anglo-Norwegian Kvaerner Group, 20 percent; and SDO Yuzhnoye/POYuzhmash, 15 percent.

Sea Launch offers satellite customers heavy-lift launch services (up to 5,700 kilograms to geosynchronous transfer orbit [GTO]), with launches taking place from a platform positioned on the equator in the Pacific Ocean. Instead of using the proposed Energia M vehicle, Sea Launch uses the Zenit 3SL—a model of the Ukrainian Zenit launch vehicle developed for Sea Launch. Launching from the equator enables the Zenit to travel the most direct route possible to GTO and thus maximize the payload mass it can carry there.

All partners in Sea Launch provide hardware and services to make the enterprise a reality. SDO Yuzhnoye/PO Yuzhmash provide the first and second stages of the Zenit 3SL vehicle as well as launch support operations. RSC Energia produces the vehicle's upper stage (the Block DM-SL), integrates the vehicle, and conducts mission operations. The Boeing Commercial Space Company manufactures the payload fairing and performs spacecraft integration and mission operations. The Kvaerner Group provides and operates the launch platform and assembly and command ship.

The first privately financed, working launch system and infrastructure, Sea Launch has completed six successful launches and has sold 19 launches to date.

Aerojet/Kuznetsov

Sacramento-based Aerojet and the Russian design bureau Kuznetsov formed an alliance in 1996 to produce and sell liquid oxygen/kerosene NK-33 engines in the United States. An improved version of the engine designed by Kuznetsov for use in Russia's N1 lunar rocket program, the NK-33 itself actually never flew due to the N1 program's cancellation in 1974. However, several hundred NK-33s were manufactured and 70 NK-33s remained stored in Russia.

When the U.S. Air Force announced the Evolved Expendable Launch Vehicle (EELV) program, Aerojet recognized an opportunity to be a major supplier of engines for the new vehicle: if it could secure the rights to NK-33, it could take advantage of the engine's desirable features without expending resources and time developing a new product. Kuznetsov, on the other hand, could sell the warehoused NK-33s while potentially reopening a production line that otherwise had no future. Under the agreement Aerojet and Kuznetsov reached, Kuznetsov is supplying the engine's design and engineering expertise while Aerojet is providing a manufacturing facility and has purchased 70 NK-33s. Aerojet has also acquired intellectual property data and holds rights to build NK-33s in the United States after the existing supply runs out.

While NK-33 engines were not selected for use in the EELV program, Seattle-based Kistler Aerospace Corporation has taken interest in using NK-33s in its K-1 reusable launch vehicle. Kistler has negotiated with Aerojet for exclusive rights for 58 of the 70 total NK-33s constructed, paying $4 million per engine. In addition, the Japanese space agency NASDA granted Aerojet a contract in March 2001 to design an engine based on the NK-33 for its new J1-U launch vehicle.

RD AMROSS

In 1997, Florida-based Pratt & Whitney and NPO Energomash of Russia established the RD AMROSS LLC joint venture to produce the Russian RD-180 engine for the American market. Having partnered to sell other engine models, Pratt & Whitney and Energomash came together again to attempt to meet Lockheed Martin's need for a new engine for its Atlas 3 and 5 vehicles with the RD-180 engine, then under development. Lockheed Martin selected the RD-180 as the first stage engine for its new Atlas models. Government policy, however, required that Lockheed Martin demonstrate the ability to manufacture RD-180s in the United States in order to avoid dependence on Russia to launch national security payloads. Therefore, under the RD AMROSS partnership, Energomash will produce 101 RD-180 engines for the Atlas 3 and commercial launches on Atlas 5 at its Khimky plant in Russia, while Pratt & Whitney will build some two dozen more RD-180s in Florida to launch government payloads. Pratt & Whitney also contributed $25 million to Energomash for upgrades at the Khimky plant. The two companies are 50-50 partners in the joint venture.

Production of RD-180 in the United States was expected to begin in 2005, but technology control issues and changes in Lockheed Martin's production plans have pushed back the

start of domestic production to 2008 at the earliest.

Asia Pacific Space Centre

The most recent of a series of Australian spaceport development concepts, the Australian-based Asia Pacific Space Centre's (APSC) plan is to establish a spaceport on Christmas Island, Australia, and develop a commercial space launch service using Russia's new Aurora launch vehicle design. A private company with investors in Australia, South Korea, and the United States, APSC intends to market the vehicle (capable of carrying 4,100 kilograms to GTO) to commercial payload operators.

APSC has entered into agreements with several Russian organizations, all of whom benefit from securing the use of this favorable launch site. Under the plan, APSC will construct and operate the launch site and market the Aurora vehicle. The Russian Space Agency, Rosaviakosmos, will act as the project's prime contractor and chief coordinator for the Russian companies involved. The Russian Samara Space Center (TsSKB-Progress) will provide the Aurora's first and second stages and fairing while RSC Energia will provide the third and fourth stages. The Russia Design Bureau of General Machine Building (KBOM) will contribute to the facility's launch infrastructure.

Although not technically a partner, the Australian government is heavily supporting this venture. Viewing the space launch industry as a provider of national revenues and jobs, the Australian government has given APSC "Major Project Facilitation" status, which ensures that all government approval processes related to the project are facilitated in a timely manner. The government also plans to support the effort by upgrading Christmas Island's airport, constructing a new port and road, and aiding the development of spaceport infrastructure. Australian and Russian officials signed a cooperative pact in May allowing Russian rockets to be launched from the Christmas Island site as well as from Woomera Rocket Range in central Australia.

APSC's Christmas Island office is responsible for design and construction of the spaceport, while a U.S. office is focused on marketing the spaceport and the Aurora. APSC expects construction of the spaceport to begin in September 2001, with the first launch slated for late 2003.

SpaceLift Australia

Founded in 1999, SpaceLift Australia is a private, Adelaide-based company working with two Russian organizations, the Scientific and Technical Center Complex and Puskovye Uslugi, to develop commercial space launch operations from Woomera. SpaceLift Australia intends to provide the launch site and vehicle marketing services while the Russian partners will provide turn-key Start launch vehicles that will be capable of making flights to low-Earth orbit (LEO). Like APSC, SpaceLift Australia has also received "Major Project Facilitation" from the Australian government.

Kistler/Australia

Kistler Aerospace Corporation and the Commonwealth of Australia have teamed to develop and re-open

Woomera Rocket Range to bring commercial launch activity to central Australia. Under this arrangement, the Australian government has offered Kistler the opportunity to develop the Woomera site for the launch of its K-1 reusable launch vehicle. Australia has also supported the development of commercial launch activity by establishing a legal framework allowing such operations to occur within its borders. Kistler will provide the K-1 vehicle to launch at the site and fund site development, using infrastructure leftover from the former Woomera launch range. The Australian government will also contribute to developing launch facilities for the K-1. Australia hopes the venture will generate revenues and jobs for the nation, while Kistler benefits from having secured a remote launch site for its reusable vehicle in a nation with an appropriate legal regime.

Ground breaking of the Kistler launch site took place in July 1998. Fundraising delays, however, have delayed Kistler's ability to complete construction of the site as well as the vehicle.

MARKETING PARTNERSHIPS

Eurockot

Marketing the Russian Rockot vehicle is the objective of the German-Russian Eurockot partnership. In 1995, three years after the Russians proposed the development of a vehicle using the SS-19 ICBM plus an additional third stage based on Soviet military hardware, Eurockot was founded when Germany's Minister of Economics agreed to allow Russia to repay part of its debt to Germany through profits earned by launches of this new vehicle. According to the agreement reached, Germany would receive a predetermined payment following each Rockot launch sale, which would be deducted from Russia's $35.5 billion debt to Germany. Each launch should help pay down Russia's debt to Germany while also ensuring the flow of hard currency to Russia.

Arranged between governments, Eurockot is presently a 51-49 percent partnership between DaimlerChrysler Aerospace (DASA) of Germany and Khrunichev State Research and Production Center of Russia, respectively. DASA provides marketing and technical management of the Rockot program, while also contributing funding for development, production, and launch facilities. Khrunichev manufactures the Rockot vehicle hardware and will perform mission analysis, payload integration, and mission control and launch operations.

The Rockot is a small vehicle, capable of lifting 1,860 kilograms to LEO from either the Baikonur Cosmodrome in Kazakhstan or Plesetsk in Russia. Eurockot is marketing the vehicle to both commercial and government entities. A successful demonstration flight took place in May 2000. Rockot's first commercial launch is scheduled for late 2001.

International Launch Services

In 1992, Lockheed and Khrunichev formed a commercial joint venture to market Russia's Proton launch vehicle outside of Russia. The following year, the partnership expanded to include Energia, the supplier of Proton's Block-

DM upper stage, and became Lockheed-Khrunichev-Energia International (LKEI). In June 1995, Lockheed merged with Martin Marietta, who was then producing and marketing the Atlas launch vehicle in the West, to form Lockheed Martin. Realizing that the Lockheed Martin Atlas and LKEI's Proton would become competitors for the same customers, the two companies created a new joint venture to market both launch vehicles. The new venture, International Launch Services (ILS), is a 50-50 partnership between LKEI and Lockheed Martin Commercial Launch Services.

Under this arrangement, Lockheed Martin wholly produces the Atlas launch vehicle, an intermediate booster capable of lifting 8,860 kilograms to LEO and 3,600 kilograms to GTO (the new Atlas 5 will be able to achieve much greater performance). Khrunichev produces the Proton vehicle, with Energia building the Block DM fourth stage for the Proton K. The largest Russian vehicle in service, the Proton can launch 20,900 kilograms to LEO and 5,500 kilograms to GTO. Lockheed Martin Commercial Launch Services provides marketing and mission management for the Atlas while LKEI provides the same for commercial Proton launches.

ILS is targeting the global telecommunications satellite market and intends to serve commercial operators as well as governments. The partnership combines the experience of more than 800 launches of two mature space launch systems. ILS is currently in the process of developing a system by which payloads scheduled for one of the vehicle models could be moved to the other in case of schedule delays. While the payload/vehicle interfaces for this type of back-up system are not yet in place, the ILS partnership can still provide greater flexibility for customers.

In 1999, ILS also received exclusive marketing rights to the new Angara family of launch vehicles currently under development at Khrunichev. ILS paid a "franchise fee" to Khrunichev for marketing rights. Lockheed Martin, in exchange, will receive a commission on the sale of each Angara vehicle.

LeoLink

Israel Aircraft Industries (IAI) and Coleman Aerospace (a division of Coleman Research Corporation) partnered in 1998 to bring the Shavit family of launch vehicles to the United States and market it here as LeoLink (LK). Capable of placing 200 kilograms into LEO, the LK-1 is a Shavit vehicle that will use a solid propellant motor for its first and second stages and a Star third stage motor, all built by Cordant Technologies (formerly Thiokol). The Shavit was modified in this way to market the vehicle in the United States, where Government payloads may only be launched on vehicles that are at least 51 percent comprised of American-made components. NASA approved the LK-1 for procurement under the agency's Small Expendable Launch Vehicle Services multi-launch procurement.

LeoLink plans to launch its first LK-A vehicle from Israel in late 2001, carrying the Ofeq 5 observation satellite. The first commercial flight of the LK-A is scheduled to launch an unidentified commercial payload from Alcantara, Brazil, in late 2002.

Starsem

During the mid-1990s, four organizations from France and Russia came together to bring to the commercial market various Russian spacecraft including Earth-observation satellites and launchers. Today, the consortium, called Starsem, focuses exclusively on marketing the highly reliable Russian Soyuz booster to both commercial and government entities desiring to launch satellites to LEO.

Partners in France-based Starsem include the European Aeronautic Defense and Space Company (EADS, originally Aerospatiale) with 35 percent ownership); Arianespace, 15 percent; Rosaviakosmos, 25 percent; and Russia's TsSKB-Progress, 25 percent. While the Russian entities produce the Soyuz vehicle and their engines, all four partners fund work to modernize Soyuz and upgrade the Soyuz's Baikonur Cosmodrome launch site in Kazakhstan. Involvement in the consortium offers the Russian partners access to Western customers while giving Europe a foothold in the LEO launch market without the need to develop a new vehicle.

Soyuz vehicles currently launch exclusively from Baikonur. Russian officials, however, have been in negotiations with the European Space Agency (ESA) about launching Soyuz from the ESA-owned Guiana Space Center.

PROVIDER/CUSTOMER PARTNERSHIPS

Boeing/Alenia Spazio

Boeing Space & Communications of Seal Beach, California, and Alenia Spazio of Rome formed an innovative partnership in March 2001. Boeing has agreed to purchase Alenia-built fuel tanks at "better than standard" prices for use in all five variants of its Delta 2 launchers. In exchange, Alenia Spazio will be able to purchase launch services on any Delta vehicle for its satellite customers at "better than standard" prices. This arrangement saves Boeing the time and expense of developing its own fuel tanks while allowing Alenia Spazio to receive launch services at discounted prices. Boeing expects to take delivery of the first group of tanks by the end of 2001.

Boeing/Mitsubishi

In June 2001, Boeing and the Mitsubishi Electric Corporation signed an agreement to formalize and expand the cooperation between the two companies in areas including launch services as well as space-based communications, air traffic management, multimedia, space infrastructure markets, and navigation. The agreement includes up to six Boeing Delta launches for Mitsubishi payloads (one firm Delta 4 launch and options for five other Delta launches) and names Boeing's Delta Launch Services as Mitsubishi's preferred non-Japanese launch provider. The arrangement will also allow Boeing to access the market for satellite construction in Asia. In return, Mitsubishi hopes to improve its ability to attract customers in the region by taking advantage of Boeing's

experience building and selling satellites. Subject to both companies' approval, the agreement is expected to be finalized before the end of 2001.

Previously, in February 2000, Boeing's Rocketdyne Propulsion and Power business and Mitsubishi Heavy Industries announced that they had teamed to develop a liquid oxygen/liquid hydrogen upper-stage engine for next-generation expendable launch vehicles.

AO Polyot/Final Analysis

In 1995, Final Analysis and AO Polyot, the Russian manufacturer of the Cosmos launch vehicle, created a partnership whereby Polyot would launch Final Analysis' FAISAT satellites aboard Cosmos vehicles and in exchange would market Final Analysis' satellite communications services in Russia. Final Analysis entered the agreement because of the Cosmos vehicle's affordability, reliability, and small size. With this agreement, Final Analysis became the first American company to launch a commercial payload, FAISAT 1, on a Russian rocket from Russia. As a result of FAISAT launch contract renegotiation during the 1998 Russian consolidation of commercial launch services using Cosmos and Start vehicles, FAISAT launches were captured by Russia's State Company Rosvooruzhenie.

Various: equity investments

Several launch providers have partnered with satellite customers in arrangements whereby the launch providers agree to invest in the satellite companies in exchange for their launch business. Such partnerships yield launch sales and potential returns on equity investment in the satellite systems for the launch providers while enabling the satellite companies to finance their ventures. Recently formed partnerships involving a launch provider acquiring an equity share in a satellite system include deals between Starsem and satellite broadband service provider SkyBridge; Boeing and global mobile satellite communications system company Ellipso; Arianespace and Ellipso; and Arianespace and the European space company Astrium.

CONCLUSIONS

The past few years have witnessed the formation of numerous international partnerships designed to strengthen and fulfill commercial and national business interests in space transportation activity. Comprised of innovative ideas to develop launch hardware and infrastructure, market vehicles, and attract customers, today's launch-related partnerships involve a range of players with space interests. They include not only companies but also governments. Some of the entities hail from nations with a long history of space launch capability: Russia's design bureaus, in particular, have become heavily involved in partnerships with foreign entities to sell their excess supplies of boosters for much-needed cash. Today's partnerships also include companies from countries such as Australia and Israel as well as start-up satellite companies that hope partnering with more mature players will help them gain a prominent place in the space launch industry. These partnerships exist despite the political risks, cultural differences, and conflicting priorities that could potentially hinder them.

In a business environment where launcher supply outstrips demand, launches are costly, and world markets are freer than they were a decade ago, the recent flurry of international partnerships in launch enterprises makes sense. Pooling resources—hardware, facilities, land, knowledge, marketing capabilities, and funds—enables the contributing partners to pursue business opportunities that would be too costly or risky for an individual entity to undertake. Joint efforts can also prove more efficient for partners, sparing them from having to develop, for example, designs, processes, or facilities in order to access a particular opportunity or market. The companies involved in these partnerships have also begun to engage in strategic alliances with long-time competitors in an effort to avoid preemption and instead leverage their strengths. Special arrangements between launch providers and their customers can encourage the customers to continue to patronize them. With launch capability and facilities so rare in the world, companies have often had little place other than foreign countries to seek partners.

There are still other reasons why companies have specifically pursued international alliances in the launch industry. Many companies have entered into international launch marketing partnerships as a means to gain access to new, foreign launch markets. Physical geography has also fostered international partnerships, bringing together launch vehicle manufacturers with nations or companies from nations that have land or facilities available and are situated in locations advantageous for launch. National governments have teamed with foreign-based companies in the area of launch to develop or improve their own space capabilities, generate revenues and jobs, repay outstanding debts and strengthen international relations. Governments and companies alike see merit in international partnerships as means to foster long-term relationships in the interest of cooperating on aerospace projects in the future.

In addition to benefiting the involved launch companies, the new wave of international partnerships in launch also has the potential to positively impact the commercial and government satellite owners and operators that depend on launch services. As already noted, those satellite companies involved in partnerships will enjoy discounted launches of their payloads as well as investment in and marketing of their satellite systems and services. But all satellite customers may benefit from the back-up launch arrangements toward which some launch providers are moving via partnerships. The partnering of several Russian launch vehicle manufacturers with Western entities in marketing arrangements and emergence of several spaceport partnerships will offer satellite operators more choices of launch vehicles and launch sites. As launch options grow, competition for satellite customers will increase, potentially driving down launch prices.

If the launch business environment remains unchanged and the launch industry continues to evolve in this way, it may be possible that within a few years an American launch vehicle with Russian engines will be launching a Japanese payload from a launch site in Australia. Over time, the benefits and implications of international partnerships will become understood more fully.

Second Quarter 2001 Orbital Launch Events

Date			Vehicle	Site		Payload or Mission	Operator	Use	Vehicle Price	L	M
4/7/01			Proton M	Baikonur	*	Ekran M16	Russia/CIS PTT	Communications	$75-95M	S	S
4/7/01			Delta 2 7925	CCAFS		2001 Mars Odyssey	NASA	Scientific	$50-60M	S	S
4/18/01			GSLV	Sriharikota Range (SHAR)		Gsat 1	Indian Space Research Organization	Communications	$25-45M	S	S
4/19/01			Shuttle Endeavour	KSC		STS 100	NASA	Crewed	$300M	S	S
						ISS 6A	NASA	ISS		S	S
4/28/01			Soyuz	Baikonur		Soyuz ISS 2S	NASA	ISS	$35-40M	S	S
5/8/01	√	+	Zenit 3SL	Sea Launch Platform	*	XM Roll	XM Satellite Radio, Inc.	Communications	$75-95M	S	S
5/15/01	√		Proton (SL-12)	Baikonur	*	PAS 10	Pan American Satellite Corp.	Communications	$75-95M	S	S
5/18/01			Delta 2 7925	CCAFS		GeoLite	NRO	Development	$50-60M	S	S
5/20/01			Soyuz	Baikonur		Progress ISS 4P	RKK Energia	ISS	$35-40M	S	S
5/29/01			Soyuz	Plesetsk		Kosmos TBA 5	Russian MoD	Classified	$35-40M	S	S
6/8/01			Cosmos	Plesetsk		Kosmos 2378	Russia	Navigation	$12-14M	S	S
6/9/01	√		Ariane 44L	Kourou	*	Intelsat 9 F1	Intelsat	Communications	$100-125M	S	S
6/16/01	√		Proton (SL-12)	Baikonur	*	Astra 2C	Societe Europeenne des Satellites (SES)	Communications	$75-95M	S	S
6/19/01	√	+	Atlas 2AS	CCAFS	*	ICO F-1	New ICO	Communications	$90-105M	S	S
6/30/01			Delta 2 7425	CCAFS		MAP	NASA	Scientific	$45-55M	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: S = success, P = partial success, F = failure

Third Quarter 2001 Projected Orbital Launch Events

Date		Vehicle	Site		Payload or Misson	Operator	Use	Vehicle Price
7/12/01	√	Ariane 5 G	Kourou		ARTEMIS	European Space Agency (ESA)	Scientific	$150-160M
				*	BSat 2B	Broadcasting Satellite System Corp. (BSAT)	Communications	
7/12/01		Shuttle Atlantis	KSC		STS 104	NASA	Crewed	$300M
					ISS 7A	NASA	ISS	
7/15/01		Atlas 2AS	CCAFS		GOES M	NOAA	Meteorological	$90-105M
7/25/01		Cyclone 3	Plesetsk		Coronas F	Izmiran and Lebedev Physical Institute	Scientific	$45-55M
7/25/01		Soyuz	Plesetsk		Resurs F2	Russian Space Agency	Remote Sensing	$35-40M
7/26/01		Soyuz	Baikonur		Kosmos TBA 6	Russian MoD	Classified	$35-40M
7/27/01		Titan 4B/IUS	CCAFS		DSP 21	DoD	Classified	$350-450M
7/30/01		Delta 2 7326	CCAFS		Genesis	NASA/ JPL	Scientific	$45-55M
7/XX/01		Long March 4B	Taiyuan		Fengyun 1D	China Meteorological Administration	Meteorological	$25-35M
					Haiyang 1	China Meteorological Administration	Remote Sensing	
7/XX/01		Pegasus XL	CCAFS		HESSI	NASA	Scientific	$12-15M
8/7/01		Shuttle Discovery	KSC		STS 105	NASA	Crewed	$300M
					ISS 7A.1	NASA	ISS	
8/13/01	√	+ Taurus 1	VAFB	*	OrbView 4	Orbital Imaging Corp. (Orbimage)	Remote Sensing	$18-20M
					QuikTOMS	Orbital Sciences Corp.	Scientific	
				*	Celestis 4	Celestis, Inc.	Other	
8/21/01		Soyuz	Baikonur		Progress ISS 5P	RKK Energia	ISS	$35-40M
8/25/01		Atlas 2AS	VAFB		NRO A1	NRO	Classified	$90-105M
8/25/01		H 2A 202	Tanegashima		Vehicle Evaluation Payload 2	NASDA	Test	$75-95M
8/31/01		Athena 1	Kodiak Launch Complex		PICOSAT 1	USAF	Development	$16-17M
					SAPPHIRE	USA	Scientific	
					Starshine 3	NASA	Scientific	
8/XX/01	√	Ariane 44L	Kourou	*	Intelsat 9 F2	Intelsat	Communications	$100-125M
8/XX/01	√	+ Atlas 2AS	CCAFS	*	DirecTV 5	DirecTV, Inc.	Communications	$90-105M
8/XX/01		Long March 4B	Taiyuan		Chuang Xing 1	Chinese Academy of Sciences	Communications	$25-35M
8/XX/01		PSLV	Sriharikota Range (SHAR)		TES	India	Remote Sensing	$15-25M
					PROBA	ESA	Scientific	
					BIRD	DLR	Development	
9/15/01		Delta 2 7920	VAFB		Jason 1	NASA/CNES	Remote Sensing	$50-60M
					TIMED	NASA	Scientific	
9/15/01		Soyuz	Baikonur		ISS 4R	RKA	ISS	$35-40M
9/25/01		Titan 4B	VAFB		NRO T3	NRO	Classified	$350-450M

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Third Quarter 2001 Projected Orbital Launch Events

Date		Vehicle	Site		Payload or Misson	Operator	Use	Vehicle Price
3rd Quarter	√	+ Pegasus XL	VAFB	*	OrbView 3	Orbital Imaging Corp. (Orbimage)	Remote Sensing	$12-15M
3rd Quarter		Shavit 1	Palmachim AFB		Ofeq 5	Israel Space Agency	Classified	$10-15M
3rd Quarter		Shtil	Barents Sea		Kompass	Russia	Scientific	$0.1-0.3M
3rd Quarter		Zenit 2	Baikonur		Meteor 3M-1	Russia	Meteorological	$35-50M
					Reflector	USAF	Scientific	
					Maroc-Tubsat	TBA	Development	
					Badr 2	SUPARCO	Remote Sensing	

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+ Denotes FAA-licensed launch.

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

Fourth Quarter 2001 Projected Orbital Launch Events

Date			Vehicle	Site		Payload or Mission	Operator	Use	Vehicle Price
10/2/01			Atlas 2AS	CCAFS		NRO A2	DoD	Classified	$90-105M
10/18/01	√		Delta 2 7320	VAFB	*	QuickBird 2	Earthwatch, Inc.	Remote Sensing	$45-55M
10/21/01			Soyuz	Baikonur		Soyuz ISS 3S	NASA	ISS	$35-40M
10/30/01			Atlas 2A	CCAFS		TDRS F9	NASA	Communications	$90-105M
10/XX/01	√		Ariane 4 TBA	Kourou	*	DirecTV 4S	DirecTV, Inc.	Communications	
10/XX/01	√	+	Zenit 3SL	Sea Launch Platform	*	Galaxy 3C	Pan American Satellite Corp.	Communications	$75-95M
11/14/01			Titan 2	VAFB		DMSP 5D-3-F16	DoD	Meteorological	$30-40M
11/14/01			Soyuz	Baikonur		Progress ISS 6P	RKK Energia	ISS	$35-40M
11/23/01			Rockot	Plesetsk		GRACE 1	NASA/DLR	Scientific	$12-15M
						GRACE 2	NASA/GFZ	Scientific	
11/29/01			Shuttle Endeavour	KSC		STS 108	NASA	Crewed	$300M
						ISS UF-1	NASA	ISS	
11/XX/01	√		Dnepr 1	Svobodny		Unisat 2	Italian Space Agency-ASI	Development	$10-20M
					*	Tropnet 1	Russia	Development	
					*	Tropnet 2	Russia	Development	
					*	Tropnet 3	Russia	Development	
12/18/01			Titan 4B	VAFB		NRO T1	NRO	Classified	$350-450M
12/19/01	√	+	Atlas 3B	CCAFS	*	EchoStar 7	EchoStar Satellite Corp.	Communications	$90-105M
12/XX/01			Long March 4B	Taiyuan		CBERS/Ziyuan 2	China/Brazil	Remote Sensing	$25-35M
12/XX/01	√		Proton (SL-12)	Baikonur	*	Astra 1K	Societe Europeenne de Propulsion (SEP)	Communications	$75-95M
4th Quarter	√		Shtil	Barents Sea		Cosmos 1	The Planetary Society	Development	$0.1-0.3M
4th Quarter			Long March 2F	Jiuquan		Shenzhou 3	China National Space Administration	Development	N/A
4th Quarter	√		Long March 3A	Xichang	*	Atlantic Bird 1	Eutelsat	Communications	$45-55M
4th Quarter	√		Proton (SL-12)	Baikonur	*	Intelsat 9 F3	Intelsat	Communications	$75-95M
4th Quarter	√		Ariane 44L	Kourou	*	Intelsat 9 F4	Intelsat	Communications	$100-125M
XX/XX/01	√		Ariane 5 G	Kourou	*	Atlantic Bird 2	Eutelsat	Communications	$150-160M
					*	Insat 3C	Indian Space Research Org	Communications	
XX/XX/01			Ariane 5 G	Kourou		Envisat 1	European Space Agency (ESA)	Remote Sensing	$150-160M
XX/XX/01			Cyclone 3	Plesetsk		Kosmos TBA 4	Russian MoD	Communications	$45-55M
						Kosmos TBA 3	Russian MoD	Communications	
						Kosmos TBA 2	Russian MoD	Communications	
					*	Gonets D1 7	Smolsat (NPO PM, et. al)	Communications	
					*	Gonets D1 8	Smolsat (NPO PM, et. al)	Communications	
					*	Gonets D1 9	Smolsat (NPO PM, et. al)	Communications	
XX/XX/01			PSLV	Sriharikota Range (SHAR)		IRS P6	ISRO	Remote Sensing	$15-25M
XX/XX/01			VLS	Alcantara		SCD 3	INPE	Remote Sensing	$6-7M

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