Commercial Space Transportation

QUARTERLY LAUNCH REPORT

Featuring the launch results from the 3rd quarter 2003 and forecasts for the 4th quarter 2003 and 1st quarter 2004

Quarterly Report Topic:

Trends in Communications Satellite Capacity and Their Impact on the Commercial Launch Industry

4th Quarter 2003

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Introduction

The Fourth Quarter 2003 Quarterly Launch Report *features launch results from the third quarter of 2003 (July-September 2003) and launch forecasts for the fourth quarter of 2003 (October-December 2003) and first quarter of 2004 (January-March 2004). 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 both 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 Associate Administrator for Commercial Space Transportation of the Federal Aviation Administration under 49 United States Code Subtitle IX, Chapter 701 (formerly the* Commercial Space Launch Act)

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Cover: An Atlas 5 521, marketed by International Launch Services, sends U.S.-based Cablevision's Rainbow 1 on its way to geosynchronous orbit on July 17, 2003 from Cape Canaveral Spaceport, Florida.

Third Quarter 2003 Highlights

Arianespace, Boeing Launch Services, and Mitsubishi Heavy Industries have entered into an alliance designed to provide launch vehicle backup capability for payload customers. Each organization will continue to promote its own services individually. Payload customers prefer to launch with an individual launch provider and specific vehicle, so transitioning to another launcher with different launch characteristics may present significant problems.

The Boeing Company is pulling its new Delta 4 booster out of the commercial satellite business. According to Boeing's Integrated Defense Systems Chief, the company is taking $1.1 billion in charges over seven years and will "eliminate all commercial launches over the next five years." This is a result of the downturn in space business; however, Boeing will continue to launch government payloads using the Delta 4 as part of its USAF Evolved Expendable Launch Vehicle (EELV) contract. Boeing will also continue to provide the Sea Launch Zenit 3SL for commercial missions and the Delta 2 for government missions.

The USAF transferred seven of the original 21 Delta 4 launch contracts from Boeing to Lockheed Martin. The penalty against Boeing is the result of its use of Lockheed documentation during the EELV bidding process. Since some of these launches will be conducted from Vandenberg Air Force Base, an Atlas 5 pad will be constructed there (previous plans to build the pad were cancelled when Lockheed/ILS determined no market existed to justify the site).

U.S.-based Scaled Composites filed a reusable launch vehicle mission license application with the FAA/AST for its suborbital vehicle, SpaceShipOne. SpaceShipOne is Scaled Composites' entry into the X PRIZE competition. A launch site license application for Mojave Airport was also filed with FAA/AST.

The USAF Research Laboratory has awarded a contract to SpaceDev to design and develop a low cost small launch vehicle, dubbed Streaker. The hybrid vehicle will offer quick response launches of payloads in the 500-kilogram (1,102-pound) class to LEO.

Kistler Aerospace, which joined the race to build a new booster to serve a predicted upturn in the commercial launcher business in the 1990s, filed for bankruptcy.

An upgraded launch pad at the Baikonur Cosmodrome in Kazakhstan has been completed for launches of the Proton-M booster. Launch Pad 39 at Launch Site 81 has been upgraded to include an automated pre-launch and launch sequence. A flexible system has been introduced on the Proton M to ensure that propellants are fully used before stage separation to avoid partially-fuelled stages hitting the ground.

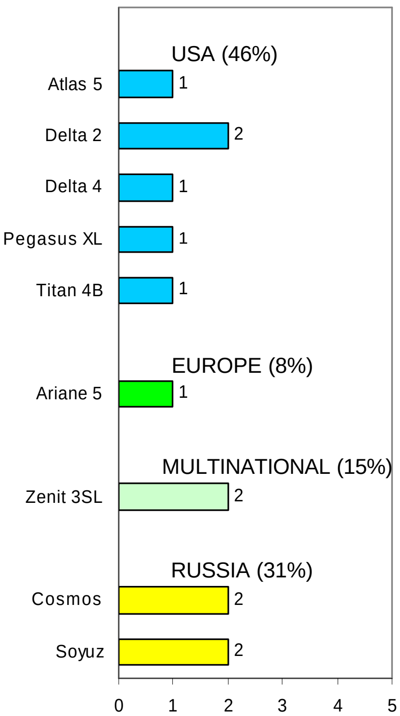
A ground-breaking ceremony has been performed at South Korea's Yenae-ri Kohung-gun Space Centre in South Jeolla Province in preparation for the launch of the country's first satellite using an indigenously-developed booster.

Brazil's third Velculo Lancador de Satelites (VLS) booster exploded on its launch pad at Alcantara on August 23. An investigation into the cause of the blast is ongoing.

Vehicle Use

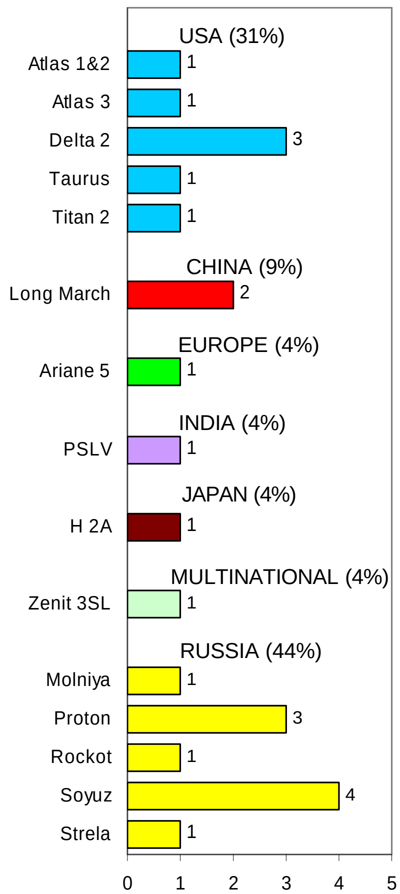
(July 2003 – March 2004)

Figure 1: Third Quarter 2003 Total Launch Vehicle Use



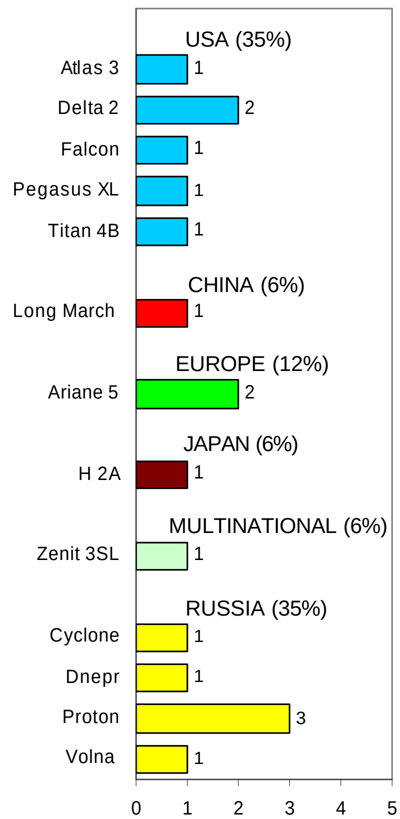
Total = 13

Figure 2: Fourth Quarter 2003 Total Projected Launch Vehicle Use



Total = 23

Figure 3: First Quarter 2004 Total Projected Launch Vehicle Use



Total = 17

Figures 1-3 show the total number of orbital launches (commercial and government) of each launch vehicle and resulting market share that occurred in the third quarter of 2003 and that are projected for the fourth quarter of 2003 and first quarter of 2004. 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.

Note: Percentages for these and subsequent figures may not add up to 100 percent due to rounding of individual values.

Commercial Launch Events by Country

(July 2003 – March 2004)

Figure 4: Third Quarter 2003 Commercial Launch Events by Country

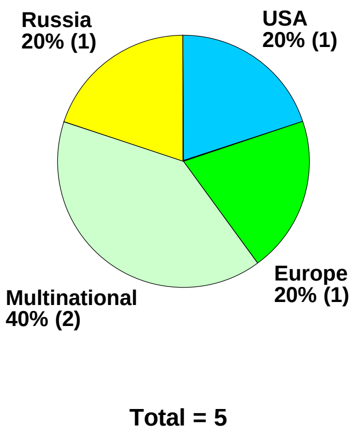


Figure 5: Fourth Quarter 2003 Projected Commercial Launch Events by Country

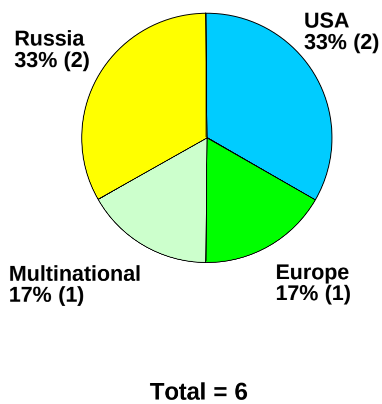
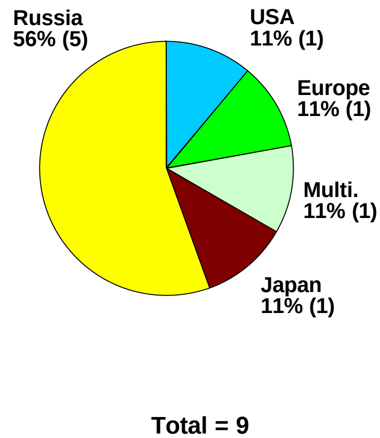


Figure 6: First Quarter 2004 Projected Commercial Launch Events by Country



Figures 4-6 show all *commercial* orbital launch events that occurred in the third quarter of 2003 and that are projected for the fourth quarter of 2003 and first quarter of 2004.

Commercial vs. Non-commercial Launch Events

(July 2003 – March 2004)

Figure 7: Third Quarter 2003 Commercial vs. Non-commercial Launch Events

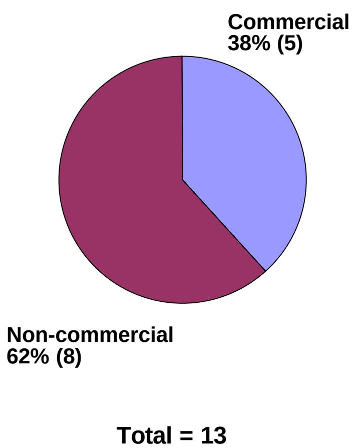


Figure 8: Fourth Quarter 2003 Projected Commercial vs. Non-commercial Launch Events

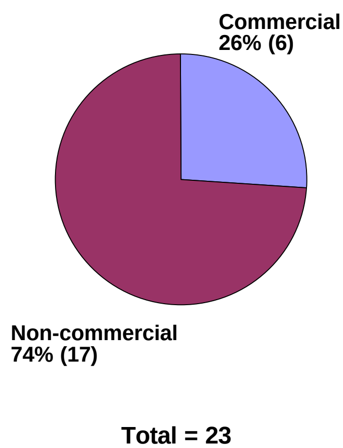
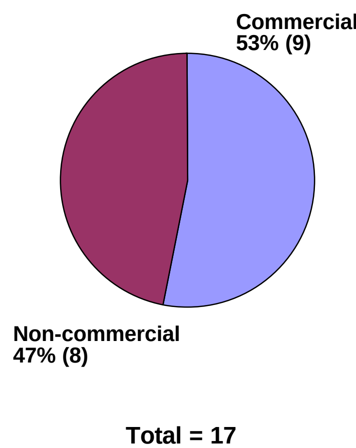


Figure 9: First Quarter 2004 Projected Commercial vs. Non-commercial Launch Events

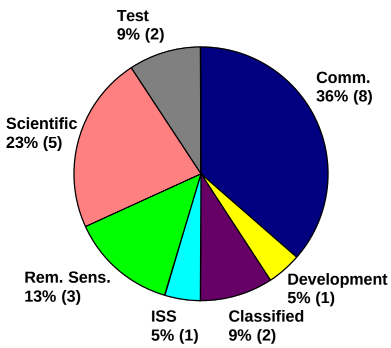


Figures 7-9 show commercial vs. non-commercial orbital launch events that occurred in the third quarter of 2003 and that are projected for the fourth quarter of 2003 and first quarter of 2004.

Payload Use

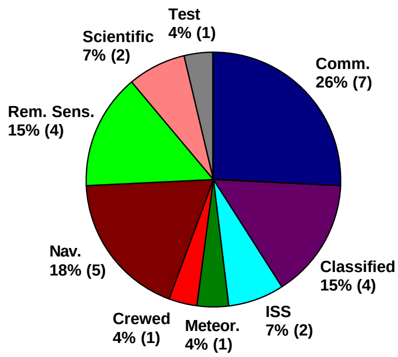
(July 2003 – March 2004)

Figure 10: Third Quarter 2003 Payload Use



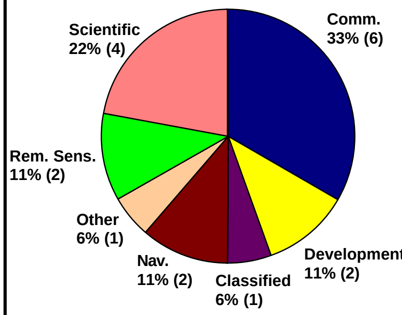
Total = 22

Figure 11: Fourth Quarter 2003 Projected Payload Use



Total = 27

Figure 12: First Quarter 2004 Projected Payload Use



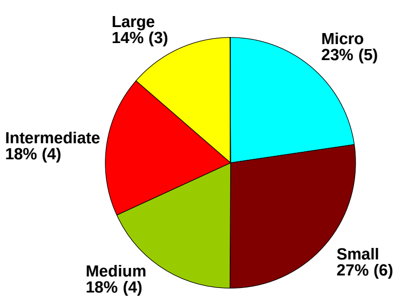
Total = 18

Figures 10-12 show total payload use (commercial and government), actual for the third quarter of 2003 and that are projected for the fourth quarter of 2003 and first quarter of 2004. 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

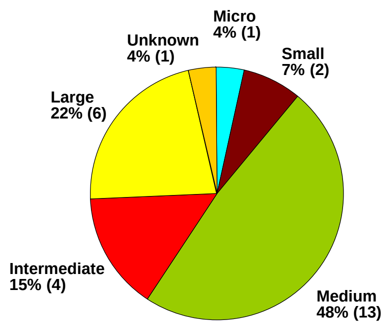
(July 2003 – March 2004)

Figure 13: Third Quarter 2003 Payload Mass Class



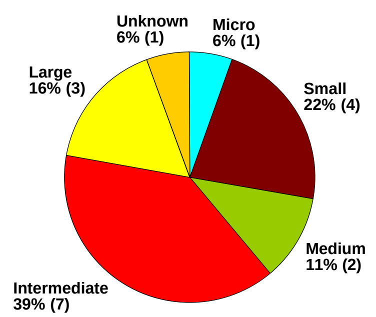
Total = 22

Figure 14: Fourth Quarter 2003 Projected Payload Mass Class



Total = 27

Figure 15: First Quarter 2004 Projected Payload Mass Class



Total = 18

Figures 13-15 show total payloads by mass class (commercial and government), actual for the third quarter of 2003 and projected for the fourth quarter of 2003 and first quarter of 2004. 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 9,072 kilograms (20,000 lbs.).

Commercial Launch Trends

(October 2002 – September 2003)

Figure 16: Commercial Launch Events, Last 12 Months

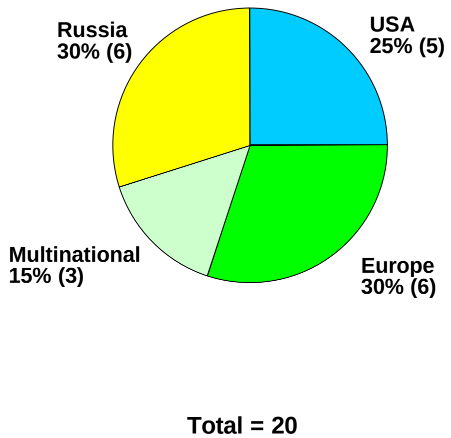


Figure 17: Commercial Launch Revenue, Last 12 Months

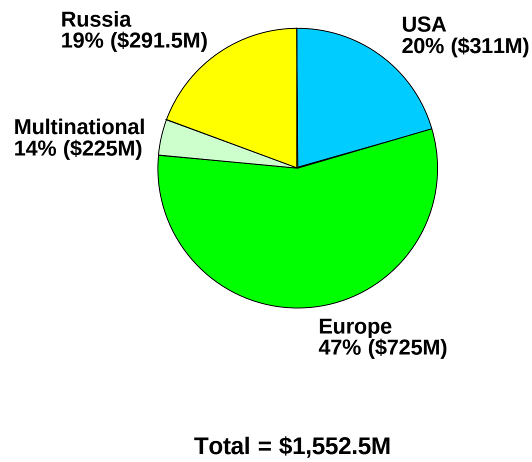


Figure 16 shows commercial launch events for the period October 2002 to September 2003 by country.

Figure 17 shows commercial launch revenue for the period October 2002 to September 2003 by country.

Figure 18: Commercial Launch Events by Country, Last Five Years

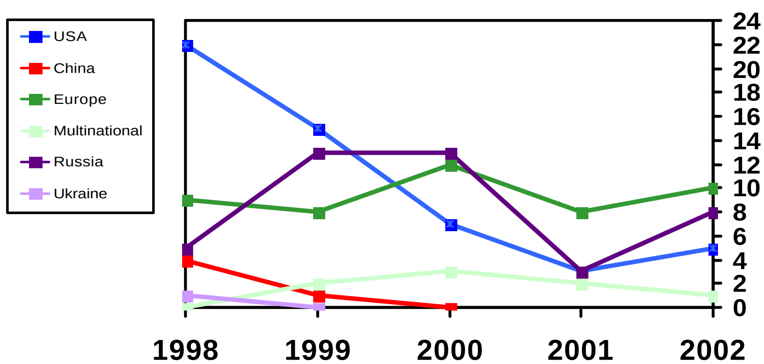


Figure 18 shows commercial launch events by country for the last five full years.

Figure 19: Commercial Launch Revenue (in $ million) by Country, Last Five Years

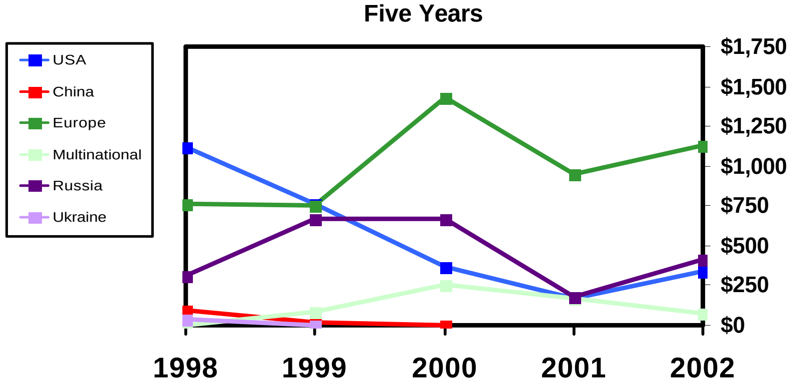


Figure 19 shows commercial launch revenue by country for the last five full years.

Trends in Communication Satellite Capacity and Their Impact on the Commercial Launch Industry

Introduction

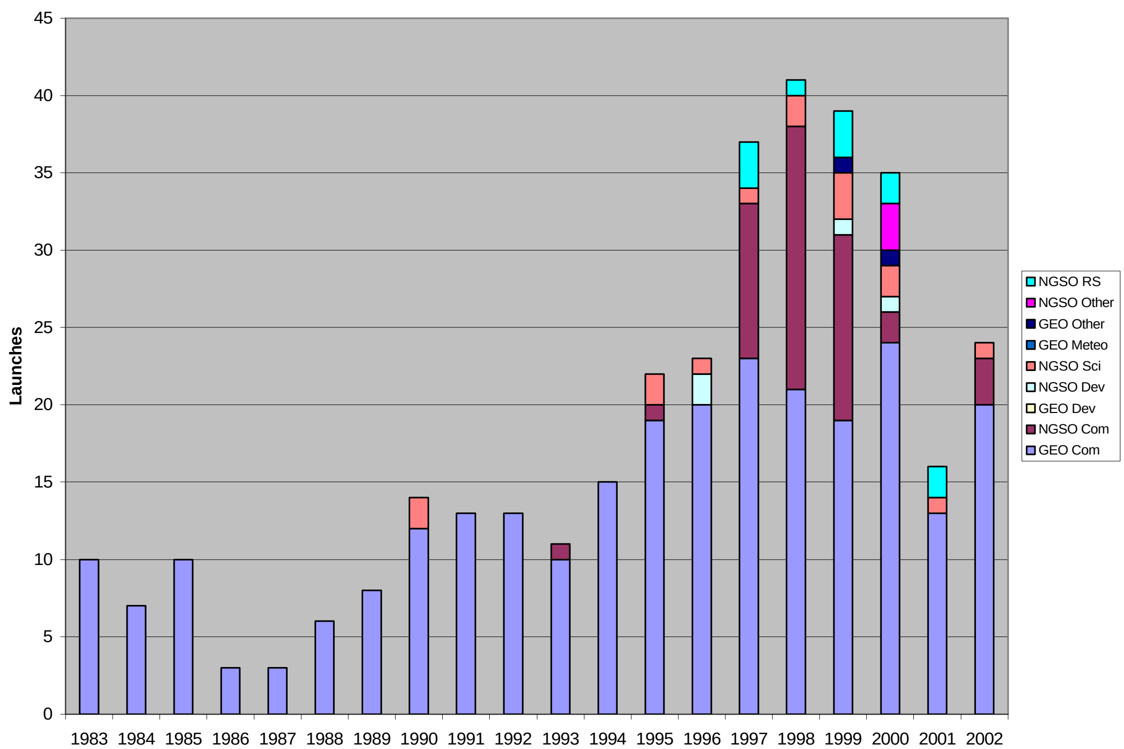
While the commercial space industry as a whole has experienced considerable growth over the past two decades, the growth has not been evenly distributed across the industry's various sectors. The satellite services sector has grown rapidly, particularly in recent years, while the launch vehicle manufacturing and services sector has contracted. These differences primarily reflect the changes in the relationship between the launch and satellite services sectors. Both sectors have met demand for their products and services, yet technological advances and competition in communications services have limited the need for additional launches and satellites. The number of launches and the size of GEO communications satellites have both doubled in the last 20 years. At the same time, satellite capacity (in terms of mass, power, and design life) has increased at a much greater rate. In 2002, the aggregate lifetime capacity of the 23 satellites launched in that year was approximately 80 times that of the 11 payloads launched in 1982.

This report is an in-depth study of the relationship between GEO commercial communications satellite capacity and annual commercial launch rates. It considers why launch rates have increased much more slowly than satellite capacity. Factors that may reduce the rate of satellite growth and, perhaps, raise future launch rates as more on-orbit capacity is required are also discussed.

Launch Sector Trends

Over the 20-year period between 1983 and 2002, the commercial space industry has changed considerably. In 1983, there were ten commercial launches; in 2002 there were 24. As shown in Figure 1, the majority of these launches are of GEO communications satellites and, although only half of 1998's record launch total were launches to GEO, the bulk of the remainder consisted of LEO

Figure 1: International Commercial Launches 1983-2002



constellation deployments. The business failure of the LEO constellations means that GEO communications satellites will remain the major driver of expendable launch vehicles. Excluding members of LEO constellations, non-GEO commercial satellites have considerably less impact on the commercial launch sector revenues. Therefore, the bulk of the commercial GEO launch sector's business are communications satellites operated by the satellite services sector.

The average number of launches between 1983 and 1992 was 8.5 annually. In the 1993 through 2002 period, the average was slightly over twice this, with 17.5 launches annually. The available supply of launch vehicle capacity far exceeds current launch rates. A recent presentation by Boeing Launch Services (BLS) projected a continuing demand of 15 to 20 commercial GEO launches annually. Ideally, with current launch vehicle throughput capability, a maximum launch rate of 78 commercial launches annually is attainable. BLS also felt that this oversupply was a long-term phenomenon and that it was unlikely that other currently available vehicles would be withdrawn from service (Boeing having already removed its Delta 4 from commercial service).

Multiple factors have contributed to overcapacity in the launch sector. New launch vehicles were designed to deliver both larger GEO satellites and multiple LEO satellites to orbit. Various nations have also sought to secure their access to space by creating their own launch vehicle capacity.

Launch vehicles are now commercially available from all of the world's space-faring nations, a major change from 1983 when only the U.S. and Europe offered commercial launch services. In 1983, there were four launch vehicles from two countries conducting commercial launches. In 2002, there were 12 operational vehicles from seven countries available to provide commercial GEO launch services (see Table 1 for a list). This diversity of available vehicles, coupled with the absence of a corresponding increase in payloads, has created a surplus of launch

Table 1: Commercially available launch vehicles: 1983-2002

Vehicle Family	Initial Commercial Launch	Capacity	Country	Status
Available in 1983				
Ariane 1/3	6/16/1983	Medium	Europe	No Longer in Service
Atlas	5/19/1983	Medium	USA	No Longer in Service
Delta	10/28/1982	Medium	USA	No Longer in Service
Shuttle	11/11/1982	Heavy	USA	No Longer in Commercial Service
Available post 1983				
Ariane 4	6/15/1988	Intermediate	Europe	No Longer in Service
Atlas 1 & 2	7/25/1990	Intermediate	USA	No Longer in Service
Proton	4/9/1996	Heavy	Russia	No Longer in Commercial Service
Delta 3	8/26/1998	Intermediate	USA	No Longer in Service
Titan 3	12/31/1989	Heavy	USA	No Longer in Service
Available in 2002				
Delta 2	2/14/1990	Medium	USA	Operational
Long March	4/7/1990	Assorted	China	Operational
Zenit 2	9/10/1998	Heavy	Ukraine	Operational
Soyuz	2/9/1999	Intermediate	Russia	Operational
Zenit 3SL	3/27/1999	Heavy	USA	Operational
Ariane 5	3/20/2000	Heavy	Europe	Operational
Atlas 3	5/24/2000	Intermediate	USA	Operational
Proton M	10/21/2000	Heavy	Russia	Operational
Atlas 5	8/21/2002	Heavy	USA	Operational
Delta 4	11/20/2002	Intermediate/ Heavy	USA	Operational
GSLV	None Yet	Medium	India	Operational
H 2A	None Yet	Intermediate/ Heavy	Japan	Operational

opportunities that has resulted in depressed prices and reduced launch industry profits.

Satellite Operator Sector Trends

Although the launch manufacturing and services sector has grown in the past 20 years, it has not grown as fast as the satellite services industry, which has expanded globally. Satellite communications capacity has increased many-fold and the space-based communications infrastructure that was largely limited to a few governments and international organizations has blossomed into a truly commercial marketplace. The availability of higher-bandwidth radio frequency spectrum for satellite services and advances in data compression and throughput have encouraged the proliferation of video and data satellite applications. According to the Satellite Industry Association, the satellite services industry had annual revenues on the order of $49.8 billion in 2002 (See Figure 2).

Note that in Figure 2 launch sector revenues have fallen in the past two years while satellite service sector revenues have grown considerably. Figure 2 also shows that, while launches doubled over two decades, satellite service revenues have tripled in only the last six years. While launches and revenues are not strictly comparable, they suggest that the launch and satellite services sectors are growing at markedly different rates.

The relative size of these revenues differ primarily because a communications satellite will generate revenue over the course of a lifetime of at least a decade while each revenue-earning launch event is measured in hours and minutes.

Overall Satellite Growth 1982-2002

Beyond issues of an oversupply of launch vehicles, there is a more fundamental issue regarding the relationship between the launch and satellite services industries. Constant improvements in satellite technology have continuously reduced the number of satellites required to fill the world's increasing demand for telecommunications services. While the number of satellites on-orbit has grown between 1982 and 2002, the communications capacity of those satellites has increased at an even higher rate due to increased mass, number of transponders, higher power and other factors such as improved data transmission rates. Satellite capacity has increased at a rate that greatly exceeds the growth of launch vehicle capacity over the same period as well. As Figure 3 shows, satellites launched in 1983 had an average mass of 1,324 kilograms (2,919 pounds). In 2002, the average mass was 3,680 kilograms (8,113 pounds), an increase of almost 200 percent. This roughly corresponds with the growth of launch vehicle capacity over the same period.

Figure 2: World Satellite Industry Revenues 1996-2002 (Chart Courtesy of SIA)

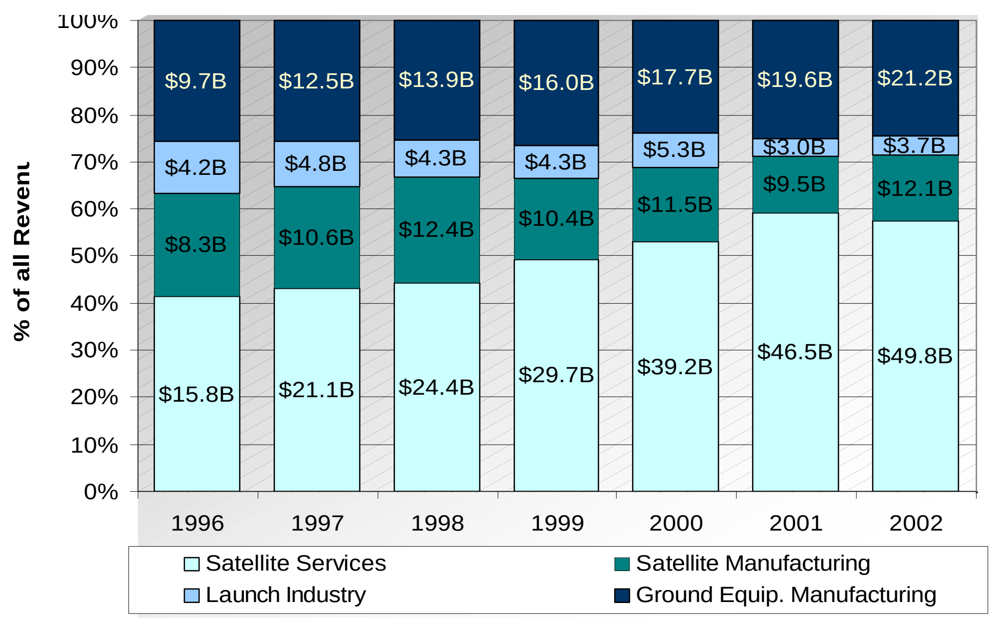


Figure 3: Average Satellite Mass and Power: 1983-2002

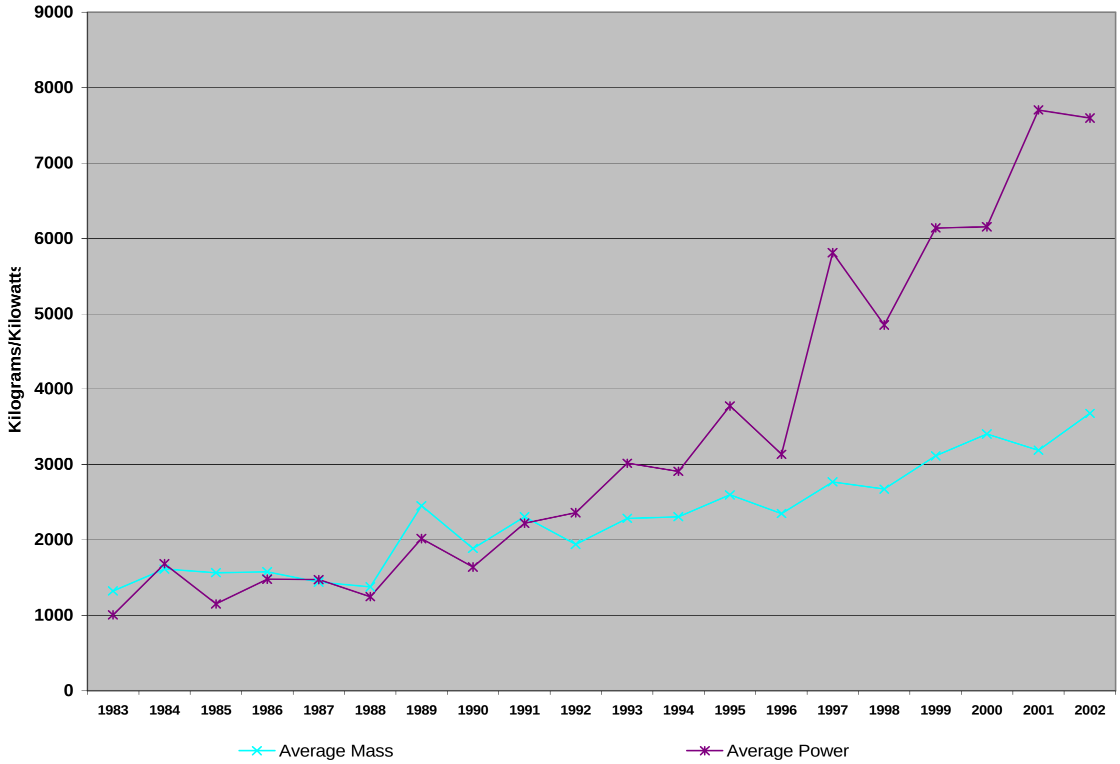


Figure 4: Commercial GEO Satellites and Launches: 1983-2002

Between 1993 and 2002, the average number of transponders carried per satellite has increased by more than 85 percent. In 2002, 1,106 total transponders were launched, with an average of 50 transponders per satellite. In comparison, 939 transponders were launched in 1997, with an average of 36 transponders per satellite. The total number of transponders launched in 2002 was more than 17 percent higher than in 1997, even though there were 27 percent more satellites launched in 1997. The average number of transponders per satellite correlates with the trend toward heavier higher power satellites.

Furthermore, the average satellite launched in 1983 had an end-of-life power (EOL power) of 1,008 kilowatts, which increased to 7,596 kilowatts by 2002. Given other improvements in satellite technology, the performance gap between a satellite of 1983 and that of 2002 is probably even greater than the eight-to-one ratio of the satellite's power supply would suggest, but power can be taken as a rough guide to the magnitude of improvements in satellite performance and efficiency.

To provide a representative comparison, see Table 2 for payload mass and nominal vehicle capacity for two Atlas variants, one in 1983 and the other in 2002.

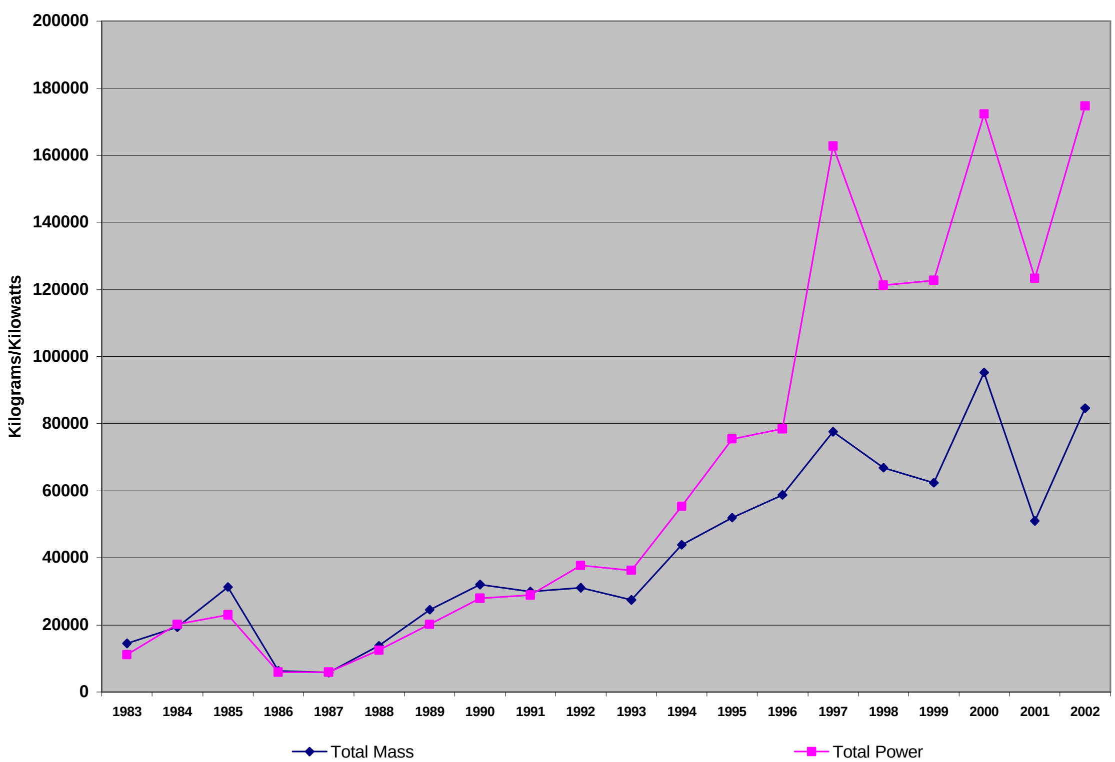
The improvement in individual satellite capacity, when coupled with a higher annual launch rate, results in a considerable increase in the communications capacity put in place each year. Figure 4 shows launches carrying commercial satellites and the total number of commercial satellites launched over the last 20 years. Figure 5 shows the total mass and power of commercial communications satellites launched annually for the previous 20 years. In 1983, the 11 satellites launched generated 11,086 kilowatts at end-of-life (EOL). In 2002, the corresponding number for 23 satellites was 174,702 kilowatts, an

Table 2: Atlas Payload and Capacity: 1983 and 2002

Year	Vehicle	GTO Capability* kg (lb)	Payload	Payload Mass kg (lb)
1983	Atlas SLV-3D	1,900 (4,189)	Intelsat 506	1,998 (4,404)
2002	Atlas 5 401	4,950 (10,913)	Hot Bird 6	3,905 (8,609)

*Vehicle capacity is not a fixed number but depends on factors such as accuracy of orbital insertion. Apparent mismatches may occur when specific payloads are considered.

Figure 5: Total Satellite Mass and Power: 1983-2002



increase of nearly 16 times. In terms of EOL power, roughly twice the number of payloads generated almost 16 times as much on-orbit power, with the corresponding increase in communications capability.

Growth in Satellite Design Life and Lifetime Capacity

One further factor influencing the relationship between launches and on-orbit capacity is the length of a satellite's life. Over the 1983-2002 period, satellite design life grew along with satellite mass and power (see Figure 6). The average design life of a commercial GEO communications satellite launched in 1983 was nine years. In 2002, this average was 13 years, almost 50 percent higher. This improvement in design life means that a payload launched in 2002 will not only have more power than one launched in 1983 but it will also provide that power for a longer period. In effect, the total amount of information this satellite can communicate over its lifetime will be 50 percent greater than an average satellite with the same EOL power launched in 1983.

Figure 7 shows the results of multiplying the annual total EOL power of payloads launched between 1983 and 2002 by their design lives. Instead of a close to 16-fold increase in annual capability, the total lifetime capacity launched in 2002 was 22.5 times that of 1982. Thus, the average satellite launched in 2002 will provide the same lifetime information throughput as close to 11 satellites launched in 1982. Despite this marked increase in capability, the satellite services industry is focused on achieving higher lifetime throughput to serve the market demand for video, audio and data services.

Factors Affecting Satellite Growth

Although capabilities are constantly growing this does not mean that new satellites can replace previously launched satellites on the basis of total power alone. Other factors are also important, orbital location (over Asia, over Europe, etc.), satellite operating frequency band (C, Ku, Ka, etc.), and application (direct-to-home television broadcasting or DTH, mobile phone/data, Internet trunking, etc.) are all issues that influence the number of payloads launched annually. Satellite deployment rates are determined by balancing various decision factors, not just the capability of a single satellite.

There are, in fact, a number of reasons to believe that payloads will not simply grow in a predictable linear fashion. While there will always be a demand for the most capable satellite possible, there are a number of factors suggesting that these will not be the bulk of all payloads launched. The advantages provided by large satellites are potentially

Figure 6: Average Satellite Design Life 1983-2002

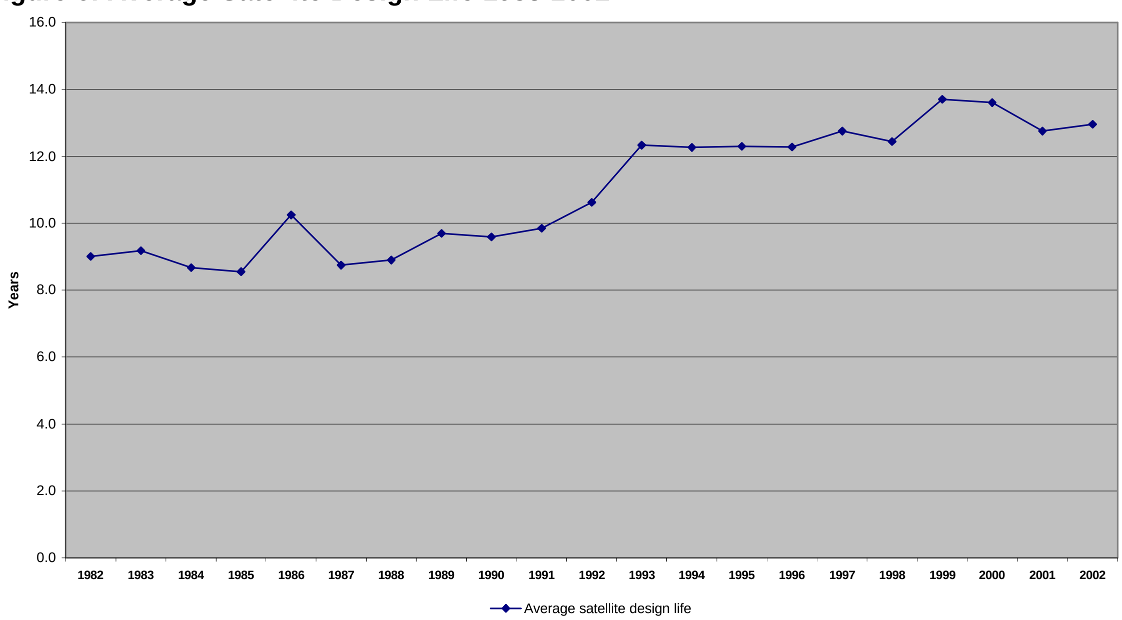
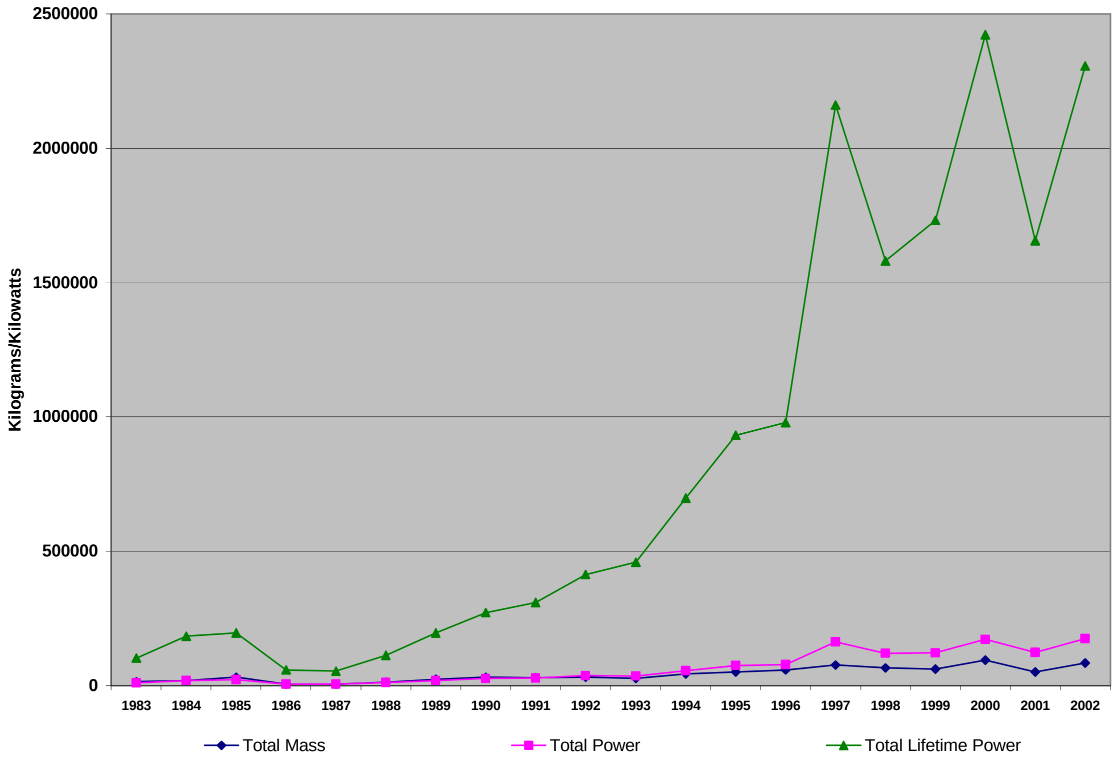


Figure 7: Total Annual Mass, Power, and Total Lifetime Power



offset by a series of weaknesses and vulnerabilities that such satellites introduce. Some factors that can reduce the desirability of larger satellites are listed below:

Satellite cost: Larger satellites cost more than small ones. For a small, startup, or entrepreneurial operator this may be a deciding factor. There will always be a market for low-cost and, therefore, smaller-sized satellites.

Launch cost: As with larger payloads, a larger launch vehicle often costs more. The difference can involve tens of millions of dollars, a significant amount for satellite operators to bear.

Insurance cost: As launch insurance premiums have reached the 20% range, this has become a more serious concern for operators. A smaller payload costs less to insure at launch. Insurance rates are also rising for on-orbit insurance, making larger, more-expensive-to-insure satellites also more expensive to operate. Another result of the tightening insurance market is that the total amount that can be insured at a given time is lower and large payloads coupled with large launch vehicles require correspondingly large sums to insure. To the extent that these sums approach the maximum available coverage, they also become more expensive and more difficult to obtain.

Market size: The predicted market demand for satellite communications drives the launch rate for new satellites. Satellite operators determine the size and capacity of new satellites based on the demand for additional capacity throughout the satellite's expected lifetime. Not all locations require or justify the largest possible satellite; in some cases, smaller, less-expensive satellites will effectively meet demand. Also, a satellite optimized for a single high-value location can not be moved easily if such flexibility becomes necessary.

Technological risk: Larger satellites are generally less technologically proven. This presents a number of problems that may affect the decision to procure a given satellite. These issues largely fall into two categories:

- *Business/schedule risk*: Satellite designs that incorporate newer technology are more likely to undergo delays in the course of manufacture. These delays increase the danger of delayed launches and ultimately the chance that the satellite will not enter service on time. Failure to maintain a schedule increases the risk that even a well-thought-out business plan will be crippled or fail outright.

- *Business/service risk*: Once a large satellite is in orbit and providing service, it offers more capacity and, hence (if demand is sufficient), more revenue. By the same token, however, the loss of such a satellite, partial or total, will have a correspondingly greater effect on its operator. The larger the satellite the more painful its loss, and because larger satellites are often less technologically mature, such a loss is correspondingly more likely.

Technological obsolescence: In addition to the issue of satellite capacity, there is also the issue of lifespan. Just as satellite capacity has increased, so has satellite design life. To the extent that this extended design life either costs more or involves new technologies, all of the previous discussion applies. In addition to those considerations, however, is the danger of technological or market obsolescence. As the services required by satellite users change, the satellite may no longer be able to fulfill them. The longer the design life of a satellite and the longer the time its cost is amortized, the greater the risk that it will no longer be desirable or profitable to operate. Although extended life beyond design life is a bonus, the inability of managers to correctly determine market conditions decades ahead of time limits the degree to which design life is a desirable attribute in a satellite system.

Future Considerations

None of these factors mean that the maximum size of commercial satellites will not continue to increase. Clearly there are applications where the maximum possible capability is desirable (satellite DTH and DARS services are possible examples). It is also clear, however, that for many applications a smaller satellite will more than suffice. Orbital Sciences' success in marketing its GEO Star Bus internationally and the continued popularity of buses such as Boeing's 601, Loral's FS-1300, and Lockheed Martin's A2100 show that demand for larger, more capable, satellites is not universal. If the overall growth rate for satellites slows and the need for telecommunications in both developed and developing regions continues, launch rates may grow even in the absence of other market factors, such as the development of new classes of services.

Conclusion

While the capability and capacity of commercial communications satellites have increased considerably between 1983 and 2002, the launch rates of those satellites have seen only modest increases. Both sectors have met demand for their products and services, but technological advances and increased efficiency in satellite manufacturing have limited the number of launches and satellites required to meet that demand. Factors affecting communication satellite capacity include increased satellite mass, more transponders, advances in power, improved data transmission rates, and longer satellite design life. As a result, worldwide revenues for satellite services have nearly doubled since 1998 while worldwide launch sector revenues have decreased.

Third Quarter 2003 Orbital Launch Events

Date	Vehicle	Site	Payload or Mission	Operator	Use	Vehicle Price	L	M
7/7/03	Delta 2 7925H	CCAFS	Opportunity	NASA	Scientific	$45-55M	S	S
7/17/03	√ + Atlas 5 521	CCAFS	* Rainbow 1	Cablevision Systems Corporation	Communications	$70-85M	S	S
8/7/03	√ + Zenit 3SL	Odyssey Launch Platform	* EchoStar 9	Echostar Communications Corporation	Communications	$65-85M	S	S
8/12/03	Pegasus XL	VAFB	Scisat 1	Canadian Space Agency	Scientific	$14-18M	S	S
8/12/03	Soyuz	Baikonur	Kosmos 2399	Russian MoD	Classified	$30-50M	S	S
8/19/03	Cosmos	Plesetsk	Kosmos 2400	Russian MoD	Communications	$12M	S	S
			Kosmos 2401	Russian MoD	Communications			S
8/25/03	Delta 2 7920H	CCAFS	Space Infrared Telescope Facility	NASA	Scientific	$45-55M	S	S
8/29/03	Soyuz	Baikonur	Progress ISS 12P	Rosaviakosmos	ISS	$65M	S	S
8/29/03	Delta 4 Medium	CCAFS	DSCS 3-14	USAF	Communications	$65-75M	S	S
9/8/03	Titan 4B/Centaur	CCAFS	USA 171	NRO	Classified	$350-450M	S	S
9/30/03	√ + Zenit 3SL	Odyssey Launch Platform	* Galaxy 13	Horizons	Communications	$65-85M	S	S
9/27/03	√ Cosmos	Plesetsk	Kaistsat 4	Korean Advanced Institute of Science and Technology	Scientific	$12M	S	S
			NigeriaSat 1	National Space Research and Development Agency (Nigeria)	Remote Sensing			S
			BNSCSat	British National Space Centre	Remote Sensing			S
			BilSat 1	Tubitak-Bilten (Turkey)	Remote Sensing			S
			Mozhayets 4	Mozhaiskiy Military Space Engineering Academy	Development			S
			Larets	Russian MoD	Test			S
			Rubin 4-DSI	OHB-System	Test			S
9/27/03	√ Ariane 5G	Kourou	* Insat 3E	Indian Space Research Organization	Communications	$125-155M	S	S
			SMART 1	European Space Agency	Scientific			S
			* eBird	Eutelsat	Communications			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 Launch and Mission (immediate status of the payload upon reaching orbit): S = success, P = partial success, F = failure
Note: All launch dates are based on local time at the launch site at the time of launch.

Fourth Quarter 2003 Projected Orbital Launch Events

Date	Vehicle	Site	Payload or Mission	Operator	Use	Vehicle Price
10/15/03	Titan 2	VAFB	DMSP 5D-3-F16	USAF	Meteorological	
10/18/03	Soyuz	Baikonur	Soyuz ISS 7S	Rosaviakosmos	ISS	$30-50M
10/29/03 √	Rockot	Plesetsk	SERVIS 1	Japanese Aerospace Exploration Agency	Scientific	$12-15M
10/31/03	Delta 2 7925-10	CCAFS	Navstar GPS 2R-10	USAF	Navigation	$45-55M
10/2003	H 2A 2024	Tanegashima	IGS 2B IGS 2A	Japan Defense Agency Japan Defense Agency	Classified Classified	$70-100M
10/2003	Long March 4B	Taiyuan	CBERS/Ziyuan 2	Chinese Academy of Space Technology	Remote Sensing	$25-35M
10/2003	PSLV	Satish Dhawan Space Center	IRS P6	Indian Space Research Organization	Remote Sensing	$15-17M
10/15/03	Long March 2F	Jiuquan	Shenzhou 5	Chinese National Space Administration	Crewed	$50-65M
11/14/03	Strela	Baikonur	Gruzomaket	NPO Machinostroyeniya	Test	$10M
11/20/03	Soyuz	Baikonur	Progress ISS 13P	Rosaviakosmos	ISS	$65M
11/20/03	Atlas 2AS	VAFB	NRO A3	NRO	Classified	$65-75M
11/25/03 √	Taurus XL	VAFB	Rocsat 2	National Space Program Office	Remote Sensing	$20-30M
11/30/03	Proton K	Baikonur	Glonass M R7 Glonass M R8 Glonass M R9	Russian MoD Russian MoD Russian MoD	Navigation Navigation Navigation	$60-85M
11/2003 √	Ariane 5G	Kourou	* SatMex 6	Satelites Mexicanos S.A. de C.V.	Communications	$125-155M
11/2003	Proton K	Baikonur	Yamal 201 Yamal 202	Russian MoD Russian MoD	Communications Communications	$60-85M
11/2003 √	Zenit 3SL	Odyssey Launch Platform	* Telstar 18	Loral Space and Communications	Communications	$65-85M
12/6/03	Delta 2 7920	VAFB	Gravity Probe B	NASA	Scientific	$45-55M
12/10/03 √	+ Atlas 3B	CCAFS	UHF-F11	U.S. Navy	Communications	$65-75M
12/15/03	Proton K	Baikonur	* Express AM22	Russian Satellite Communciation Co.	Communications	$60-85M
12/19/03	Delta 2 7925-10	CCAFS	Navstar GPS 2RM-11	USAF	Navigation	$45-55M
12/2003 √	Soyuz	Baikonur	* Amos 2	Spacecom	Communications	$30-50M
12/2003	Molniya	Plesetsk	Kosmos 2402	Russian MoD	Classified	$30-40M
12/2003	Soyuz	Plesetsk	Resurs DK 1	Rosaviakosmos	Remote Sensing	$30-50M

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* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is operated by a commercial entity.
Note: Ariane 5 payloads are usually multi-manifested, but the pairing of satellites scheduled for each launch is sometimes undisclosed for proprietary reasons until shortly before the launch date.

First Quarter 2004 Projected Orbital Launch Events

Date		Vehicle	Site		Payload or Mission	Operator	Use	Vehicle Price
1/22/04		Falcon	VAFB		TacSat 1	U.S. Navy	Development	$6M
1/2004		Pegasus XL	Kwajalein Island		C/NOFS	USAF	Scientific	$14-18M
1/2004		Long March 2C	Xichang		Double Star Equator	Chinese National Space Administration	Scientific	$20-25M
2/6/04		Delta 2 7920	VAFB		Aura	NASA	Remote Sensing	$45-55M
2/14/04		Titan 4B/IUS	CCAFS		DSP 22	USAF	Classified	$350-450M
2/26/04		Ariane 5G	Kourou		Rosetta Orbiter	European Space Agency	Scientific	$125-155M
					Rosetta Lander	European Space Agency	Scientific	
2/27/04	√ +	Atlas 3A	CCAFS	*	MBSAT	Mobile Broadcasting Corp.	Communications	$65-75M
2/2004	√ +	Zenit 3SL	Odyssey Launch Platform	*	Spaceway 1	Hughes Network Systems	Communications	$65-85M
3/2004	√	Ariane 5 ECA	Kourou	*	XTAR EUR	XTAR	Communications	$125-155M
1Q/2004	√	Proton M	Baikonur	*	Amazonas 1	Hispasat	Communications	$70-100M
1Q/2004		Cyclone 2	Plesetsk		Sich 1M	Ukraine Space Agency (NKAU)	Remote Sensing	$20-25M
1Q/2004		Delta 2 7925-10	CCAFS		Navstar GPS 2RM-12	USAF	Navigation	$45-55M
1Q/2004	√	H 2A 202	Tanegashima		MTSat 1R	Ministry of Land, Infrastructure, and Transport (Japan)	Navigation	$70-100M
1Q/2004	√	Proton M	Baikonur	*	Intelsat 10 02	Intelsat	Communications	$70-100M
1Q/2004	√	Volna	Barents Sea		Cosmos 1	The Planetary Society	Development	$0.8-1.5M
1Q/2004	√	Proton M	Baikonur	*	Eutelsat W3A	Eutelsat	Communications	$70-100M
1Q/2004	√	Dnepr 1	Baikonur	*	Trailblazer	TransOrbital, Inc.	Other	$8-11M

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