Federal Aviation Administration

2009 Commercial Space Transportation Forecasts

May 2009

FAA Commercial Space Transportation (AST)
and the Commercial Space Transportation
Advisory Committee (COMSTAC)

HQ-09847.INDD

About the Office of Commercial Space Transportation

The Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST) licenses and regulates U.S. commercial space launch and reentry activity, as well as the operation of non-federal launch and reentry sites, as authorized by Executive Order 12465 and Title 49 United States Code, Subtitle IX, Chapter 701 (formerly the Commercial Space Launch Act). FAA/AST's mission is to ensure public health and safety and the safety of property while protecting the national security and foreign policy interests of the United States during commercial launch and reentry operations. In addition, FAA/AST is directed to encourage, facilitate, and promote commercial space launches and reentries. Additional information concerning commercial space transportation can be found on FAA/AST's web site at http://ast.faa.gov.

Cover: Art by John Sloan (2009)

Dedicated to Dr. Alexander C. Liang

General Manager, Vehicle Systems Division, The Aerospace Corporation

COMSTAC member Dr. Alexander C. Liang, died of a heart attack after playing tennis on Saturday, May 2, 2009. Dr. Liang was general manager of the Vehicle Systems Division for The Aerospace Corporation in El Segundo, California, where he worked since 1970. He was appointed as a member of COMSTAC in 1996; in 2002 he was selected to be the Chairman of COMSTAC's Technology and Innovation Working Group. Dr. Liang was active participant in the development of the COMSTAC Commercial Geosynchronous Orbit (GSO) Launch Demand Forecast.

The COMSTAC members and FAA wish to extend sympathy to the family of Dr. Liang and to express the deepest appreciation of his outstanding work and service as a member of COMSTAC.

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EXECUTIVE SUMMARY

The Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST) and the Commercial Space Transportation Advisory Committee (COMSTAC) have prepared forecasts of global demand for commercial space launch services for the period 2009 to 2018.

The *2009 Commercial Space Transportation Forecasts* report includes:

- The *2009 COMSTAC Commercial Geosynchronous Orbit Launch Demand Forecast* that projects demand for commercial satellites operating in geosynchronous orbit (GSO) and the resulting commercial launch demand to geosynchronous transfer orbit (GTO); and
- The *FAA's 2009 Commercial Space Transportation Forecast for Non-Geosynchronous Orbits* that projects commercial launch demand for satellites to non-geosynchronous orbits (NGSO), such as low Earth orbit, medium Earth orbit, elliptical orbits, and external orbits beyond the Earth.

Together, the COMSTAC and FAA forecasts project an average annual demand of 26.7 commercial space launches worldwide from 2009 to 2018. The combined forecasts are a decrease of 3 percent compared to the 2008 forecast of 27.4 launches per year. Twenty-eight commercial launches occurred worldwide in 2008. The forecasts project a launch demand increase up to 29 launches during 2009 (21 GSO and 8 NGSO).

In the GSO market, demand averaged 20.8 satellites per year, compared to 21.8 satellites in the 2008 forecast. The resulting demand for launches, after accounting for dual-manifested missions, decreased to an average of 15.7 launches per year compared to 16.2 per year in last year's forecast. An analysis of mass trends in the report indicates a continued increase in the average mass per satellite.

In the NGSO market, the average number of satellites per year is 26, compared to 27.6 per year in last year's forecast. This year's forecast features fewer telecommunications and commercial remote sensing satellites but more commercial resupply missions to the International Space Station. After calculating the number of satellites that are multiple-manifested, launch demand decreased to an average of 11 launches per year compared with 11.2 launches per year forecasted in 2008.

COMSTAC and FAA project an average annual demand for:

- 15.7 launches of medium-to-heavy launch vehicles to GSO;
- 8.3 launches of medium-to-heavy launch vehicles to NGSO; and
- 2.7 launches of small vehicles to NGSO.

Table 1 shows the totals for the 2009 forecast. Figures 1, 2, and 3 compare historical activity in GSO and NGSO to the 2009 forecast.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total	Average
SATELLITES												
GSO Forecast (COMSTAC)	27	21	22	20	20	20	19	20	20	19	208	20.8
NGSO Forecast (FAA)	19	53	26	12	14	37	41	36	12	10	260	26.0
Total Satellites	46	74	48	32	34	57	60	56	32	29	468	46.8
LAUNCH DEMAND												
GSO Medium-to-Heavy	21	16	17	15	15	15	14	15	15	14	157	15.7
NGSO Medium-to-Heavy	6	10	6	7	8	12	12	11	6	5	83	8.3
NGSO Small	2	5	4	2	3	2	2	2	3	2	27	2.7
Total Launches	29	31	27	24	26	29	28	28	24	21	267	26.7

Table 1. Commercial Space Transportation Satellite and Launch Forecasts

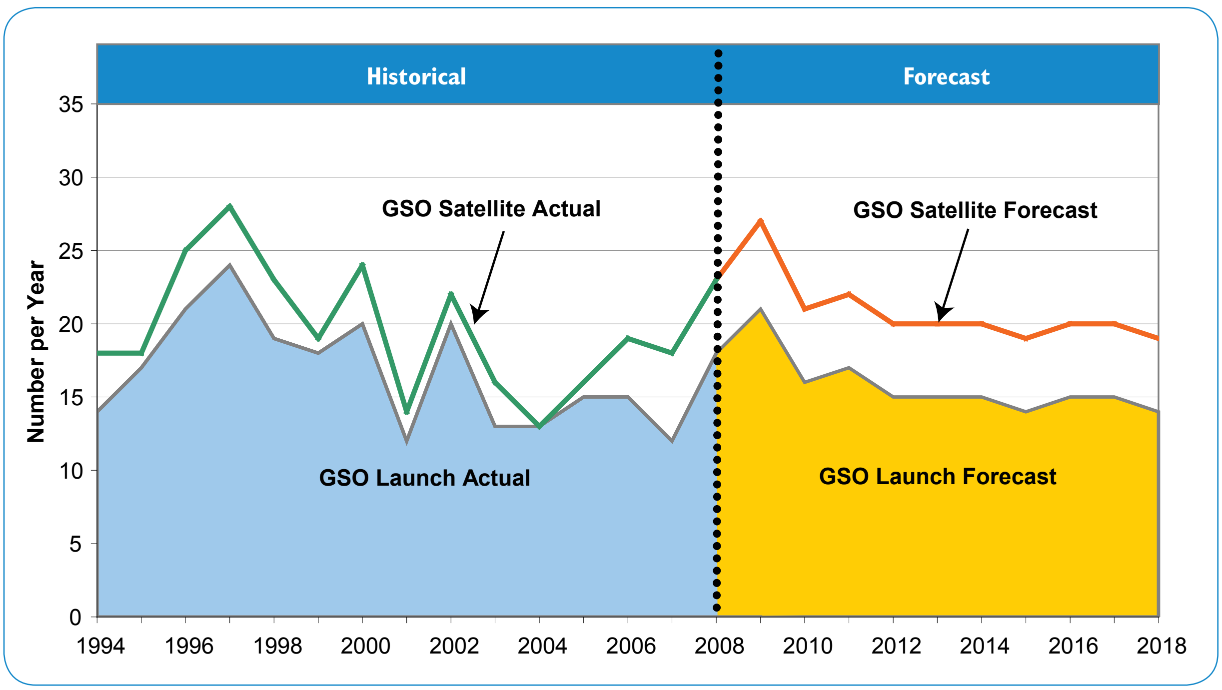

Figure 1. GSO Satellite and Launch Demand

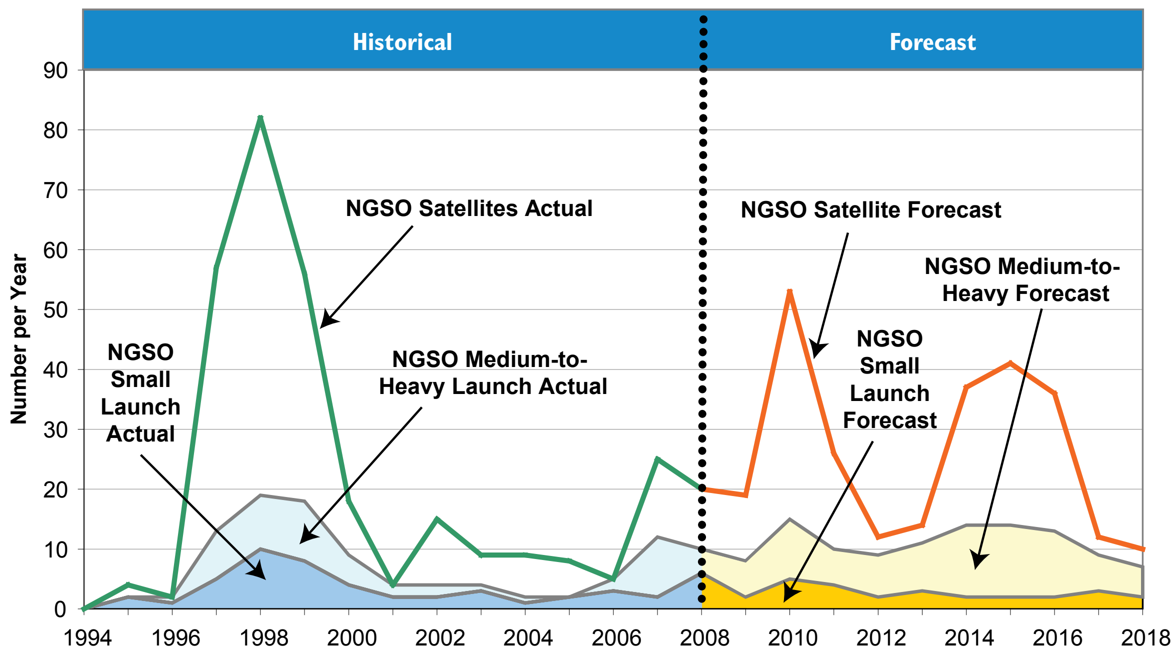

Figure 2. NGSO Satellite and Launch Demand

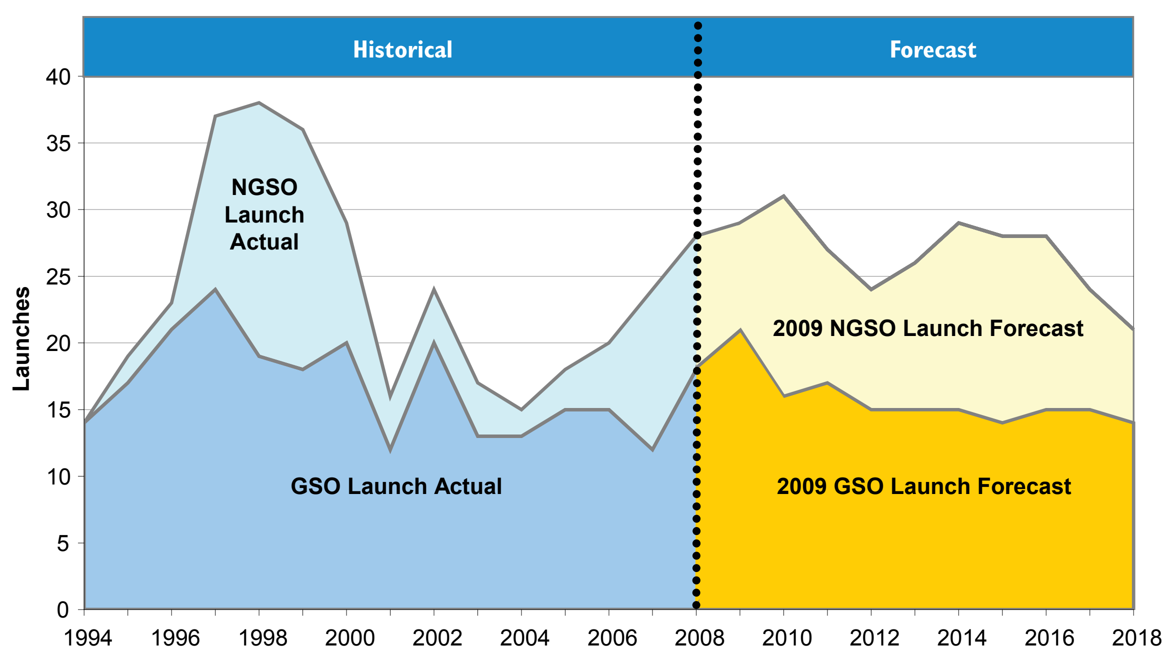

Figure 3. Combined GSO and NGSO Historical Launches and Launch Forecasts

INTRODUCTION

Each year, the Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST) and the Commercial Space Transportation Advisory Committee (COMSTAC) prepare forecasts of international demand for commercial space launch services.

The jointly-published 2009 Commercial Space Transportation Forecasts report covers the period from 2009 to 2018 and includes two separate forecasts: one for launches to geosynchronous orbit and one for launches to non-geosynchronous orbits.

About the COMSTAC GSO Forecast

The COMSTAC 2009 COMSTAC Commercial Geosynchronous Orbit Launch Demand Forecast projects demand for commercial satellites operating in geosynchronous orbit (GSO) and the resulting commercial launch demand to geosynchronous transfer orbit (GTO).

Established in 1993, the COMSTAC geosynchronous launch demand forecast is prepared using plans and projections supplied by U.S. and international commercial satellite and launch companies. Projected payload and launch demand is limited to those spacecraft and launches that are open to internationally competed launch services procurements. Since 1998, the forecast has also included a projection of launch vehicle demand derived from the payload demand and taking into account dual-manifesting of satellites on a single launch vehicle. COMSTAC is comprised of representatives from the U.S. satellite and launch industry.

About the FAA NGSO Forecast

The FAA's 2009 Commercial Space Transportation Forecast for Non-Geosynchronous Orbits projects commercial launch demand for all space systems to be deployed in non-geosynchronous orbits (NGSO), including low Earth orbit, medium Earth orbit, elliptical orbits, and external orbits, such as to the Moon or other solar system destinations.

First compiled in 1994, the FAA NGSO forecast assesses international satellite and other payloads most likely to seek commercial launch services during the next 10 years. The forecast uses a model to estimate launch demand after a review of multiple-manifesting; i.e., how many satellites will ride per launch vehicle.

The majority of the satellites included in the forecast were open to international launch services procurement. The NGSO forecast also includes satellites or payloads sponsored by commercial entities for commercial launch or commercially competed U.S. launches for orbital facility supply missions.

Characteristics of the Commercial Space Transportation Market

Demand for commercial launch services, a competitive international business, is directly affected by activity in the global satellite market ranging from customer needs and introduction of new applications to satellite lifespan and regional economic conditions.

The GSO market is served by both medium and heavy lift launch vehicles and has a steady commercial customer demand for telecommunications satellites with a current average satellite mass of about 4,315 kilograms. The NGSO market has a wider variety of satellite and payload missions but with more cycles of demand fluctuation. This market is served by small, medium, and heavy lift launch vehicles with a wide range of payload masses.

Prior to the 1980s, launching payloads into Earth orbit was a government-run operation. Since then, launch activity led by commercial companies has increased to meet the needs of both government and non-government payload owners. From 1997-2001, a peak era in commercial satellite telecommunications, commercial launches accounted for an average of about 42 percent of worldwide launches. During 2008, 28 out of 69 worldwide launches were commercial, representing 40 percent of global activity, an increase from 35 percent in 2007.

Demand Forecasts

It is important to note that the COMSTAC and FAA forecasts cover market demand for launch services and are not predictions of how many launches may actually occur based on historical averages of year to year delays or other factors.

Last year, 18 worldwide commercial GSO launches actually launched compared to a demand of 22 in the 2008 forecast. The GSO report contains a description of demand and a future two-year realization factor for greater insight into the number of satellites that would reasonably be expected to launch. Similarly, the NGSO report contains a one-year realization factor for the current year. There were 10 actual commercial NGSO launches last year while the 2008 forecast projected a demand for 11 launches.

Figure 4 shows historical launch forecasts from 1998 to 2009 compared with actual launch activity.

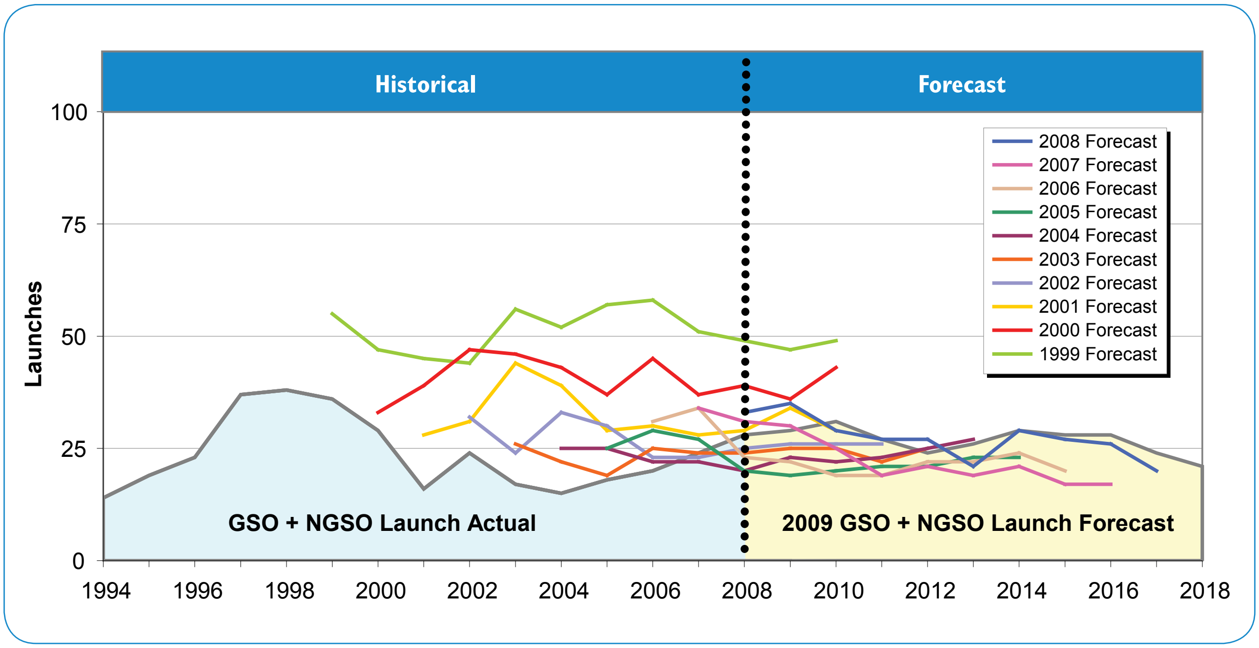

Figure 4. Historical Commercial Space Transportation Forecasts

COMSTAC 2009 COMMERCIAL GEOSYNCHRONOUS ORBIT (GSO) LAUNCH DEMAND FORECAST

Executive Summary

This report was compiled by the Commercial Space Transportation Advisory Committee (COMSTAC) for the Office of Commercial Space Transportation of the Federal Aviation Administration (FAA/AST). The *2009 Commercial Geosynchronous Orbit (GSO) Launch Demand Forecast* is the 17th annual forecast of the global demand for commercial GSO satellites and launches addressable to the U.S. commercial space launch industry. The forecast extends 10 years and provides more specific detail for the near-term three years. It is intended to assist FAA/AST in its planning for licensing and efforts to foster a healthy commercial space launch capability in the United States.

The commercial forecast is updated annually, and is prepared using the inputs from commercial companies across the operator, satellite, and launch industries. Both a satellite and a launch demand forecast are included in this report; the satellite demand is a forecast of the number of GSO satellites that satellite operators intend to have launched, and launch demand is determined by adjusting satellite demand by the number of satellites projected to be launched together, referred to in the report as a "dual-manifest" launch. This forecast includes only commercial satellite launches addressable to the U.S. space launch industry. Addressable is defined as launch service procurements open to international competition.

The 2009 Commercial GSO Launch Demand Forecast for 2009 through 2018 is shown in Figure 5. Table 2 provides the corresponding values of forecasted

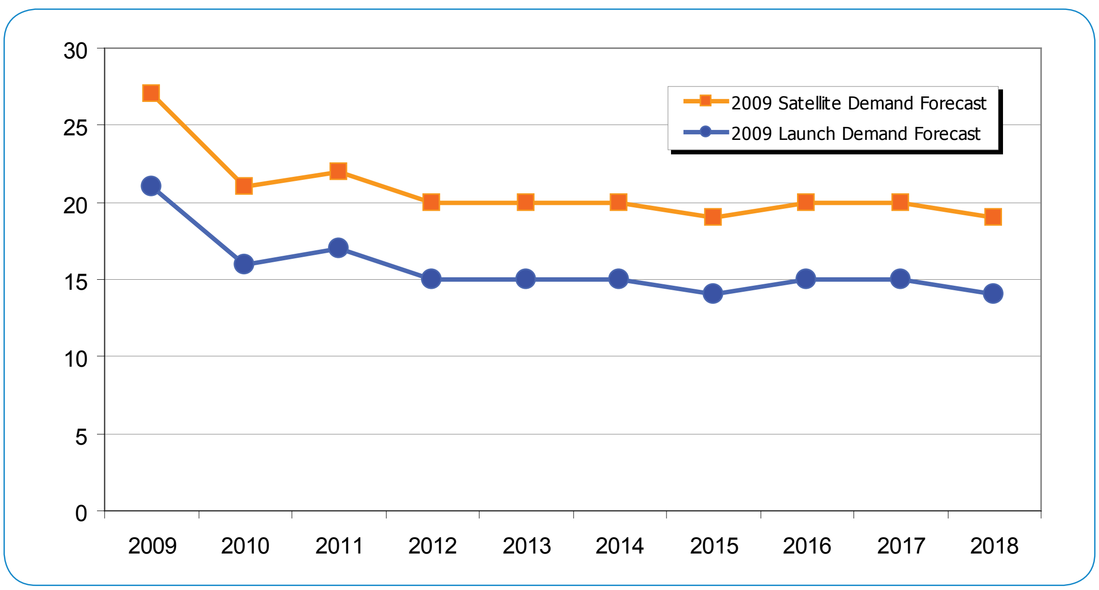

Figure 5. Commercial GSO Satellite and Launch Demand

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	TOTAL	Average 2009 to 2018
Satellite Demand	27	21	22	20	20	20	19	20	20	19	208	20.8
Dual Launch Forecast	6	5	5	5	5	5	5	5	5	5	51	5.1
Launch Demand	21	16	17	15	15	15	14	15	15	14	157	15.7

Table 2. Commercial GSO Satellite and Launch Demand Forecast Data

satellites to be launched, the estimated number of dual-manifested launches, and the resulting number of projected launches for each year. This year's data shows a slightly decreased demand from the two previous forecasts.

The 2009 forecast predicts an average demand for 20.8 satellites to be launched annually in the ten-year time frame from 2009 through 2018. The associated launch demand for the same period is 15.7 launches per year. This year's average satellite demand represents a slight decrease from the previous two COMSTAC GSO forecasts. An average of 21.8 satellites launched per year was forecast in 2008 and 21.0 satellites launched per year in 2007. The launch demand of 15.7 in 2009 is a decrease from 16.2 in 2008. The near-term forecast, which is based on specific existing and anticipated satellite programs for 2009 through 2011, shows demand for 21 launches in 2009, 16 in 2010, and 17 in 2011. Last year's forecast predicted 23 launches in 2009, 18 in 2010, and 16 in 2011.

It is important to distinguish between forecasted demand and the actual number of satellites that are actually launched. Space related projects, like most high-technology projects, are susceptible to delays, which tend to make the forecasted demand an upper limit of the number of satellites that might actually be launched. To attempt to account for these differences, a "launch realization factor" has been devised. This factor is based on historical data of actual satellites launched versus predicted satellite demand from previous commercial GSO forecasts. This factor has been applied to the near-term forecast in order to provide an idea of the actual number of satellites that may reasonably be expected to be launched. For example, while the demand forecast for satellites to be launched in 2009 is 27, the realization factor discounts this to a range of between 18 and 23.

Over the 17 years this report has been published, predicted demand in the first year of the forecast period has consistently exceeded the actual number of satellites launched in that year. Since the launch realization factor was added to the COMSTAC GSO Demand Forecast in 2002, the actual number of satellites launched has generally fallen within the discounted realization range.

In 2008, 23 commercial GSO satellites were launched, an increase of 5 from the 18 commercial satellites launched in 2007. The 2008 forecast had projected the 2008 satellite demand for 27 launches, with a launch realization range of 18 to 22.

Many factors impact the demand for commercial GSO satellites, including terrestrial infrastructure, global economic conditions, operator strategies, new market applications, and availability of financing for satellite projects. A more detailed description of these factors is discussed later in the report. The factors were generated by the Forecast team's industry experience as well as derived from inputs from the survey respondents.

An alternative view of satellite launch statistics is included in an assessment of the number of transponders launched and the mass of satellites launched over time. The expectation is that the average mass per satellite will trend towards constancy. The last four years have averaged around 5,000 kilograms and the expectation is that the next several years will be similar. The projected total satellite mass to be launched in 2009 will be an all-time high; nearly 116,500 kilograms.

Background

The Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST) of the U.S. Department of Transportation (DOT) is interested in fostering a healthy commercial space launch capability in the United States. In 1993, the DOT requested that its industry advisory group, the Commercial Space Transportation Advisory Committee (COMSTAC), annually prepare a commercial geosynchronous orbit (GSO) satellite launch demand forecast to obtain the commercial space launch industry's view of future space launch requirements.

COMSTAC prepared the first commercial demand forecast in April 1993 as part of a report on commercial space launch systems requirements. It was developed by the major U.S. launch service providers and covered the period 1992–2010. The following year, the major U.S. satellite manufacturers and the satellite service providers began to contribute to the demand forecast. In 1995, the Technology and Innovation Working Group (the Working Group) was formally chartered by the FAA/AST to prepare the annual Commercial Payload Mission Model Update. Since 2001, the Commercial Launch Demand Forecast has covered a ten-year period, with this year's report covering 2009 through 2018. This year the committee received inputs from 21 satellite service providers, satellite manufacturers, and launch service providers. COMSTAC would like to thank all of the participants in the 2009 Commercial GSO Launch Demand Forecast.

Forecast Methodology

Except for minor adjustments, the Working Group's launch demand forecast methodology has remained consistent throughout the history of the forecast. The Working Group, via the FAA Associate Administrator for Commercial Space Transportation, requests commercial GSO satellite forecasts from global satellite operators, satellite manufacturers, and launch service providers. Two types of requests are made: Individual input is requested from satellite operators for a projection of their individual company requirements for the period 2009–2018; and comprehensive input is requested for the same period from satellite manufacturers and launch service providers for a broad perspective.

Addressable payloads in the context of this report are defined as commercial satellite launches open to internationally competitive launch service procurement.

Excluded from this forecast are satellites captive to national flag launch service providers (i.e., U.S. or foreign government satellites that are captive to their own national launch providers or commercial satellites that are not internationally competed). In 2008, two commercial satellite launches (Venesat-1 (Venezuela) and Chinasat 9 (China)) were excluded from the actual number of addressable commercial launches listed in this report because they were not internationally competed.

As more nations without national launch providers enter the commercial satellite marketplace, it is likely to be more common to see government-to-government agreements on building and launching spacecraft. Such situations will affect the forecast.

The commercial GSO satellite demand forecast is divided into four different mass classes based on the mass of the satellite at separation into geosynchronous transfer orbit (GTO). The mass categories are logical divisions based on standard satellite models offered by satellite manufacturers. The four classifications are: below 2,500 kilograms (<5,510 pounds); 2,500 to 4,200 kilograms (5,510 to 9,260 pounds); 4,200 to 5,400 kilograms (9,260 to 11,905 pounds); and above 5,400 kilograms (>11,905 pounds). A list of current satellite models associated with each mass category is shown in Table 3.

GTO Launch Mass Requirement	Satellite Bus Models
Below 2,500 kg (<5,510 lbm)	LM A2100A, Orbital Star 2
2,500 - 4,200 kg (5,510 - 9,260 lbm)	LM A2100, Boeing 601/601HP, Loral 1300, Astrium ES2000+, Alcatel SB 3000A/B/B2, Orbital Star 2
4,200 - 5,400 kg (9,260 - 11,905 lbm)	LM A2100AX, Boeing 601HP/702, Loral 1300, Alcatel SB 3000B3
Above 5,400 kg (>11,905 lbm)	Boeing 702/GEM, Loral 1300, Astrium ES 3000, Alcatel SB 4000

Table 3. Satellite Mass Class Categorization

This year, the following 21 organizations (noted with the country in which their headquarters are located) responded with data used in developing the 2009 report:

- Arianespace (France)
- AirLaunch (U. S.)
- The Boeing Company* (U.S.)
- China Great Wall Corp (China)
- Hisdesat (Spain)
- Intelsat (U.S.)
- Lockheed Martin Commercial Launch Services * (U.S)
- MEASAT ITU Coordination (Malaysia)
- Mitsubishi Electric Company (Japan)
- Mobile Broadcasting Corporation (Japan)
- Orbital Sciences Corp.* (U.S.)
- Sea Launch* (U.S.)
- SES New Skies (The Netherlands)
- Shin Satellite (Thailand)
- SkyPerfect (JSAT, SCC) (Japan)
- SkyTerra (Mobile Satellite Ventures) (U.S.)

- Space Exploration Technologies Corp (U.S.)
- Space Systems/Loral* (U.S.)
- Telesat (Canada/U.S.)
- Thales Alenia (Europe)
- Thuraya (United Arab Emirates)

*The Working Group uses the comprehensive inputs from the U.S. respondents to derive the average satellite demand expected per year by mass class. The sum of the demand in the four mass categories then provides total demand per year.

Forecasting commercial satellite launch demand presents significant difficulty and thus there is uncertainty in the predictions. The satellite production cycle for an existing satellite design is approximately two years; it is typically longer for heavier, more complex satellites. Orders within a two-year time period are thus generally more certain. Satellite orders in the third year and beyond become more difficult to identify by name as many of these satellites are in premature stages of the procurement cycle. Beyond a five-year horizon, new markets or new uses of satellite technology may emerge that were not known during the forecast year.

Some of the factors that were considered by respondents in creating this forecast included:

- Firm contracted missions
- Current satellite operator planned and replenishment missions
- Projection of growth in demand from new and existing satellite services and applications
- Availability of financing for commercial space projects
- Industry health and consolidation

The combined comprehensive input from U.S. respondents was used to generate the long-term demand forecast 2012–2018. The remaining inputs were used for a cross check. The Working Group, using individual satellite operators' inputs, developed the near-term forecast, covering the first three years (2009–2011) of the ten-year forecast. It is a compilation of launch vehicle providers' and satellite manufacturers' manifests, as well as an assessment of potential satellite systems to be launched.

In order to determine the demand for commercial GSO launches, the satellite demand forecast was adjusted by the projected number of dual-manifested launches per year (i.e., launch of two satellites at once). Based on the future plans and capability of Arianespace's Ariane 5, it is estimated that five launches per year will be dual-manifested in the long-term forecast; the near-term forecast of dual-manifest launches is based on an assessment of the current Arianespace manifest.

COMSTAC Commercial GSO Launch Demand Forecast Results

Near-Term Demand Model

The three-year near-term demand forecast is based on input from each U.S. satellite manufacturer and launch services provider, along with the inputs received from individual satellite operators. Developing the near-term forecast in this way results in the maximum identifiable demand for satellites to be launched each year. Identified demand for any particular year is defined as the number of satellites that customers wish to have launched, with no adjustment for potential launch schedule delays. Table 4 shows the near-term mission model for 2009 through 2011.

	2009		2010		2011	
Total	27		21		22	
Below 2,500kg (<5,510 lbm)	0		2		1	
			Bsat 3B	Ariane/Soyuz	Telkom 3	Proton
			SES OS1	Proton		
2,500 - 4,200 kg (5,510 - 9,260 lbm)	14		8		8	
	*Measat 3a	Land Launch	Intelsat 16	Proton	AnikG	
	*Sicral 1B	Sea Launch	Intelsat 18	LandLaunch	Bsat 3C	Ariane
	*Telstar 11N	Land Launch	Koreasat 6	Ariane	Hispasat AG1	TBD
	Asiasat 5	Proton	Nilesat 201	Ariane/Soyuz	New Dawn	TBD
	COMS 1	Ariane	RASCOM 1R	Ariane	SES OS-3	Ariane (TBD)
	Hylas	Falcon 9	SatCom BW1	Ariane	Star C3	
	Insat 4G	Ariane	SatCom BW2	Ariane	Telstar 14R	
	Intelsat 15	Land Launch	SES OS-2	Ariane (TBD)	Thor 7	TBD
	JCSat 12	Ariane				
	NSS-9	Ariane				
	Optus D3	Ariane				
	Palapa D	Long March				
	Protostar II	Proton				
	Thor 6	Ariane				
4,200 - 5,400 kg (9,260 - 11,905 lbm)	4		2		5	
	Arabsat 5A	Ariane	BADR 5B	Proton	Arabsat 5C	Ariane (TBD)
	Astra 3B	Proton	Hispasat 1E	Ariane	ST-2	TBD
	Hot Bird 10	Ariane			Turksat 4A	Ariane
	Nimiq 5	Proton			Yamal 401	Ariane
					Yamal 402	Ariane
Over 5,400kg (>11,905 lbm)	9		9		8	
	Amazonas 2	Ariane	Echostar 14	TBD	Astra 1N	TBD
	DirecTV 12	Proton	Echostar 15	TBD	EuropaSat	Proton
	Eutelsat W2A	Proton	Eutelsat W3B	LongMarch	Eutelsat W3C	TBD
	Eutelsat W7	Sea Launch	KA-Sat	Sea Launch	Intelsat 17	Sea Launch
	Intelsat 14	Atlas 5	NSS-14	Proton	Quetzsat	TBD
	NSS-12	Ariane	SkyTerra 1	Proton	SES Sirius 5	Proton
	Sirius FM 5	Proton	SkyTerra 2	Sea Launch	Viasat 1	Proton
	Terrestar 1	Ariane	Terrestar 2	TBD	Yahsat 1B	Proton
	XM 5	Sea Launch	Yahsat 1A	Ariane		

Table 4. Commercial GSO Near-Term Manifest

* Indicates slip from COMSTAC 2008 GSO Forecast

Satellite Launch Forecast Mass Class Trend

Figure 6 and Table 5 show the trends in annual GSO satellite mass distribution. Actual data are presented for 1993 through 2008, followed by the distribution projected in this year's demand forecast.

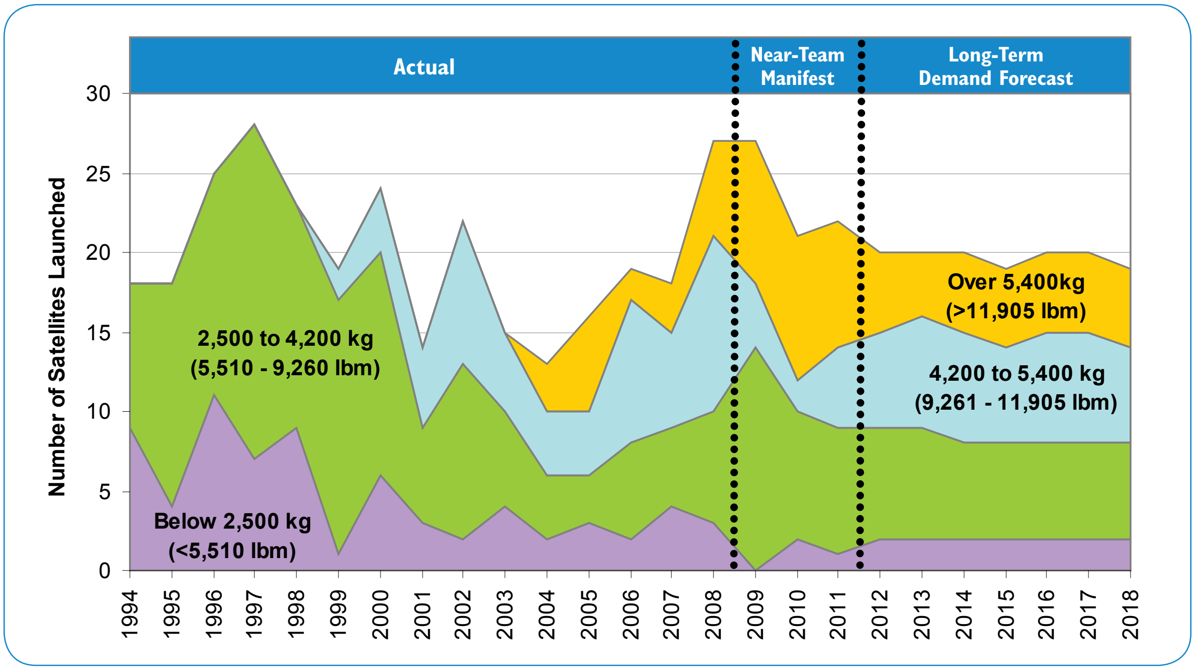

Figure 6. Trends in GSO Satellite Mass Distribution

2009 will be a unique year for the smallest of the mass classes since no satellites are forecasted to be launched. There were 3 small satellites launched in 2008, and while the trend for these very small GEO's appears to be declining, there is still an average of two per year from 2010 forward.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total 2009 to 2018	Avg. 2009 to 2018	% of Total
Below 2,500 kg (<5,510 lbm)	9	4	11	7	9	1	6	3	2	4	2	3	2	4	3	0	2	1	2	2	2	2	2	2	2	17	1.7	8%
2,500 to 4,200 kg (5,510 - 9,260 lbm)	9	14	14	21	14	16	14	6	11	6	4	3	6	5	7	14	8	8	7	7	6	6	6	6	6	74	7.4	36%
4,200 to 5,400 kg (9,260 - 11,905 lbm)	0	0	0	0	0	2	4	5	9	5	4	4	9	6	11	4	2	5	6	7	7	6	7	7	6	57	5.7	27%
Over 5,400 kg (>11,905 lbm)	0	0	0	0	0	0	0	0	0	0	3	6	2	3	6	9	9	8	5	4	5	5	5	5	5	60	6	29%
Total	18	18	25	28	23	19	24	14	22	15	13	16	19	18	27	27	21	22	20	20	20	19	20	20	19	208	21	100%

Table 5. Trends in GSO Satellite Mass Distribution

The smallest mass class group was changed in 2008 to include satellites up to 2,500 kilograms from a maximum of up to 2,200 kilograms analyzed in prior years. This adjustment was made to capture the recent growth in the mass of the smallest satellites being manufactured. Orbital's Star bus can be configured to bring its mass close to the 2,500-kilogram range, within the small mass class category.

There was a shift in the percentage of satellites in the medium and large mass class categories (satellites with mass greater 2,500 to 4,200 kilograms and 4,200 to 5,400 kilograms). The biggest growth was in the medium mass class with 14 launches projected in 2009. This is partially due to some small satellites increasing in mass just above the lowest class. The average number of satellites in the large mass class is dipping just below 4 for the next three years. From a high of 11 satellites launched in the mass range of 4,200 to 5,400 kilograms in 2008, this mass class is forecasted to settle back to its 5-year average of 6 to7 satellites. There is a rise in the forecast for the largest satellite class, over 5,400 kilograms, to 8.6 satellites per year for the next 3 years. This trend is anticipated to settle to around 5 per year beyond 2011.

Comparison with Previous COMSTAC Demand Forecasts

The 2009 forecast for commercial GSO satellites launched is compared to the 2004 through 2008 forecasts in Figure 7. The ten-year demand forecast dropped by 10–15 percent annually from 2001 to 2004. Since 2004, the ten-year forecast has remained fairly consistent, thus establishing the floor of the demand forecast. Based upon inputs received this year, there has been no increase in the 2009 and 2011 projections. There is a slight drop in the 2010 launch forecast. For outer years, the forecast levels to 19-20 spacecraft per year. The composition of the 27 spacecraft forecast for 2009 has changed however due to the slip of 3 payloads from 2008 into 2009 with a complementary slip of four payloads from last year's forecast for 2009 into 2010. One satellite moved forward from last year's forecast for 2010 into 2009.

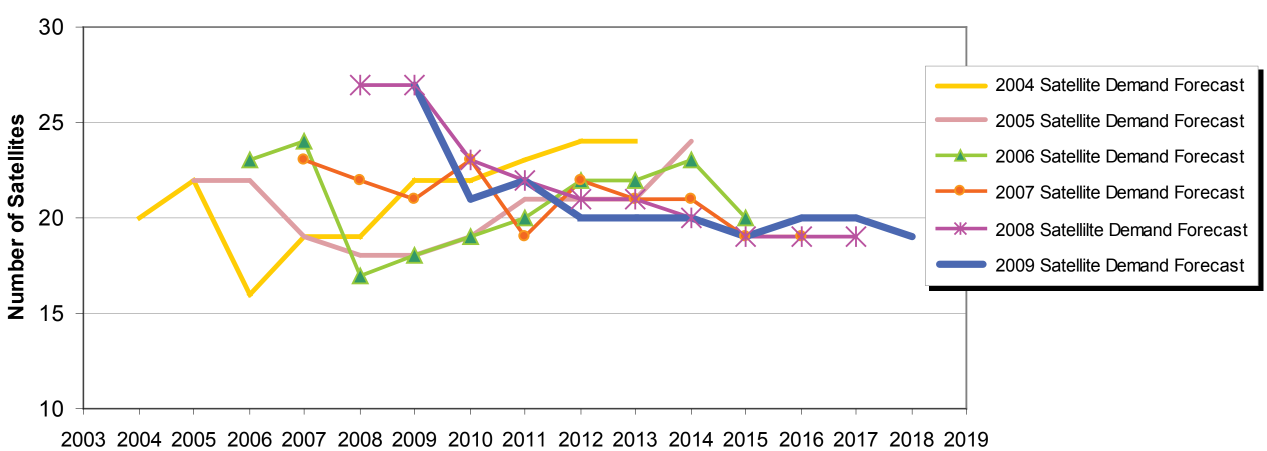

Figure 7. 2004 Through 2008 vs. 2009 Commercial GSO Satellite Demand Forecast

The 2010 forecast changed from last year's prediction of 23 spacecraft to this year's prediction of 21 spacecraft. Four payloads slipped from 2009 into 2010, but five slipped from last year's prediction for 2010 into 2011. One payload is no longer considered since it will fly on a Long March under a directed procurement that was not open to competition. The business cases for three other satellites appeared in question and hence these spacecraft were withdrawn from the current forecast for 2010. As noted previously, one satellite moved from 2010 forward into 2009. Launch vehicle contracts for four other satellites procured in late 2008 and early 2009 have been let for launch in 2010 so these have been added to the current forecast. The net result of these changes is a reduction of two satellites in the current forecast for 2010. Typically, the third year of the near-term forecast has been hardest to predict. In some cases satellites have been planned or manufacturing contracts have been let but have not been named publicly. But with crowded launch manifests the prediction for 2011 is more confident. Five satellites predicted last year to launch in 2010 have now slipped into 2011 with that year's count remaining at 22.

Comparison to International Comprehensive Inputs

This year, the Working Group received comprehensive inputs from two international launch service providers (Arianespace, China Great Wall) and two international satellite manufacturers (Thales Alenia, MELCO). The combined average of these international inputs is slightly lower than the combined 2009 demand forecast based on U.S. satellite and launch vehicle manufacturer inputs. The international input average annual demand for 2009 through 2018 is 20.8 satellites per year; the U.S.-based average annual demand forecast is 21.2 satellites per year. The differential between mass classes is highest in the small mass class where the percentage of total satellites is 19.3% for aggregate international inputs vs. only 10.7% for aggregate U.S. inputs. The differential is less pronounced in the medium class where the percentage of total satellites is 29.2% for international inputs vs. 33% for U.S. inputs. The disparity is more pronounced in the intermediate mass class where the percentage of total satellites is 23.8% for international inputs vs. 30.6% for U.S. inputs. Finally, the differential in the percentage of total satellites is the smallest in the large mass class where international inputs are 27.7% vs. 25.7% for U.S. inputs.

Launch Vehicle Demand

The commercial GSO launch forecast is based on the forecasted number of satellites expected to launch and an assumption on the extent to which launch vehicles will dual-manifest payloads (launch two satellites at once). Currently only the Ariane 5 has the capability to dual-manifest commercial GSO satellites.

Given the history of dual-manifest realization and the unlikely expectation that new dual-manifest capabilities will emerge during the forecast period, the Working Group has based its projection of dual-manifest launches on Arianespace's projected manifest. Arianespace has indicated a launch expectation of approximately seven Ariane 5 launches in 2009 and 2010, with most, if not all, commercial missions expected to be dual-manifested. Based on Arianespace's launch history, we project that one per year will likely be of a non-commercial (e.g., European government) payload, and one commercial mission will have to fly on a single-manifested mission due to schedule, manifesting, or customer choice, meaning that five dual-manifested missions can be expected each year for the 2012–2018 forecast period. The 2009–2011 near-term forecast includes dual-manifest launches consistent with the best current understanding of the mission set.

Figure 8 presents the 2009 satellite and launch demand forecast as well as actual values for 1993 through 2008.

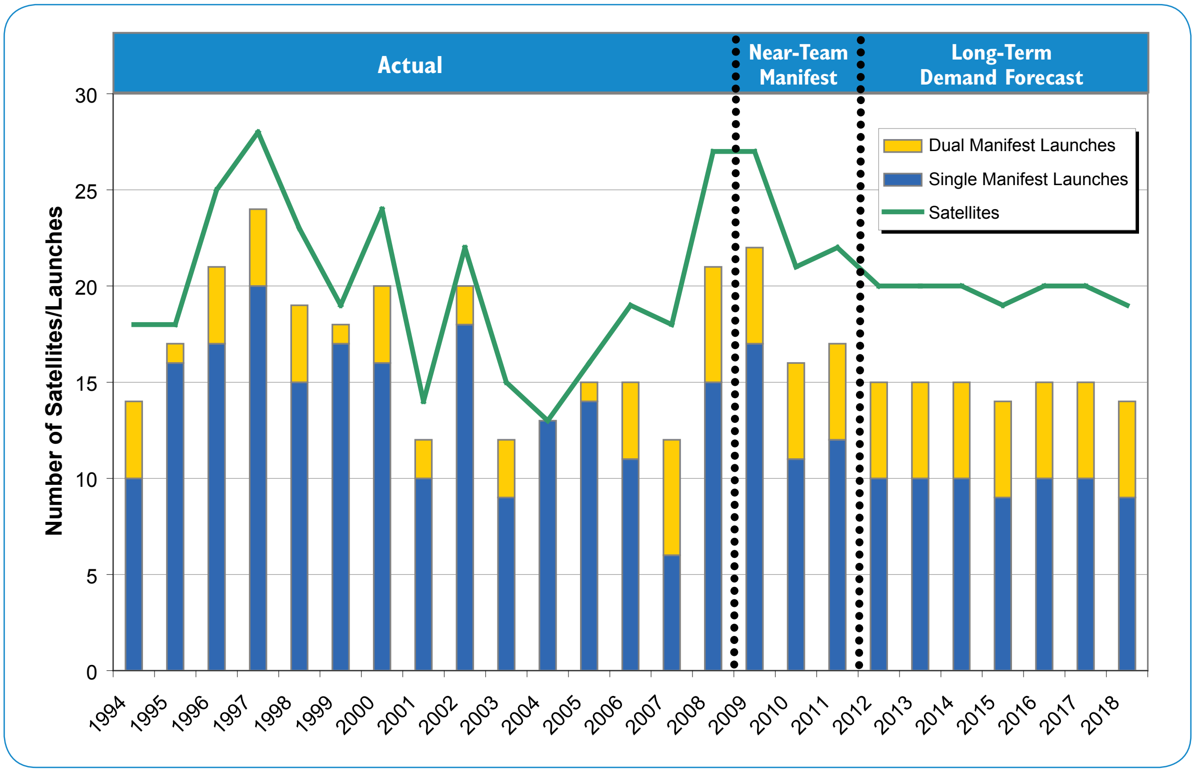

Figure 8. COMSTAC GSO Satellite and Launch Demand Forecast

COMSTAC Demand Projection vs. Actual Launches Realized

Factors That Affect Satellite Launch Realization

The demand projection is a representation of the number of new or replacement satellites that customers hope to launch in a given year. This demand is typically larger than the number of satellites actually launched.

Some of the factors that affect the realization of actual launches for a given year are:

Satellite issues. Satellite manufacturers may have factory, supplier, or component issues that can delay the delivery of a spacecraft. Increased satellite complexity has increased the likelihood of a delay due to technical challenges or immature planning. Delays in delivery of spacecraft to the launch site in turn impact the planning and order of launches.

Launch vehicle issues. Launch vehicle manufacturers may have factory, supplier, or component issues that can delay the availability of the launch vehicle or cause a delay at the launch pad. A launch failure or component problem can cause a stand-down to all subsequent launches until the anomaly is identified to determine if there are fleet issues that need to be resolved.

Scheduling issues. Both satellite and launch issues lead to scheduling issues. One individual launch delay has a cascading impact on subsequent launches scheduled in a given year. Missing one launch window may cause a significant delay, especially in a well-packed launch manifest.

Dual-manifesting. The desire to dual-manifest creates additional schedule complexity, in that one launch is dependent on two satellites being delivered on time. Payload compatibility issues may also cause manifesting challenges.

Weather. Inclement weather, including ground winds, flight winds, cloud cover, lightning, and ocean currents can cause multiple launch delays, though these typically are short-term delays (i.e. on the order of days).

Planning. Failure to perform to plan will result in delays. Corporate reprioritization or changing strategies may delay or even cancel currently planned launches.

Funding. Satellite service providers may be unable to obtain the funding needed to carry out their planned satellite launch, or it may be delayed until alternate funding is found.

Regulatory issues. Export compliance problems, Federal Communications Commission (FCC) licensing issues, or trouble in dealing with international licensing requirements can slow down or stop progress on a program. The U.S. Government policy regarding satellite and launch vehicle export control is hampering U.S. satellite suppliers and launch vehicle providers in their efforts to work with their international customers. This has caused both delays and program cancellations.

Projecting Actual Satellites Launched Using a Realization Factor

The Working Group acknowledges that over the history of this report, the forecasted demand in terms of both satellites and launches has almost always exceeded the actual number of satellites and launchers for the near-term (first three years) forecast. In order to provide an estimate of the number of near-term satellites one might reasonably expect to be launched, the near-term demand for satellites has been adjusted by a "realization factor." Each time the report is published, an historical variation is calculated, based on a five-year rolling window of forecasted demand. The working group believes this provides a more accurate factor for the near-term forecast.

The range of expected actual satellites launched is calculated by multiplying the near-term demand forecast for the first and second years by the highest and lowest variations over the past five years.

Since the GSO forecast was originally produced in 1993, the number of satellites projected to be launched in the first year of the forecast has consistently been greater than the number of satellites actually launched in that year. The actual number of satellites has been 58% to 85% of the forecast number, with an average of 75%. For the past five years, the range has been 65% to 85%, with an average of 77%.

The consistent overestimation illustrates the "bow-wave" effect of the forecast, by which respondents to the forecast survey look to "make up" for satellites that were planned for the previous year, but have slipped into the subsequent year, while not concurrently slipping forward any of the satellites planned for launch that subsequent year.

The methodology used by the Working Group to determine the expected realization is to multiply the projected number of satellites (27 for 2009) by the highest and lowest variations over the past five years (65% and 85%). Therefore, the expected realization for 2009 is 18 to 23 satellites.

For the second out-year, the calculation becomes less clear. The forecast had always overestimated the actual launches two years hence, until the 2007 report, which underestimated the number of satellites (22 forecast for 2008 vs. 23 actual) for the first time. Since 1993, the actual realization has ranged from 45% to 105%, with an average of 74%. For the past five years, the range has been 72% to 105%, with an average of 82%. Using the same methodology as above, the expected realization for 2010 is 15 to 22 satellites.

Since the launch realization factor was added to the COMSTAC GSO Launch Demand Forecast in 2002, the actual number of satellites launched has generally fallen within the launch realization range.

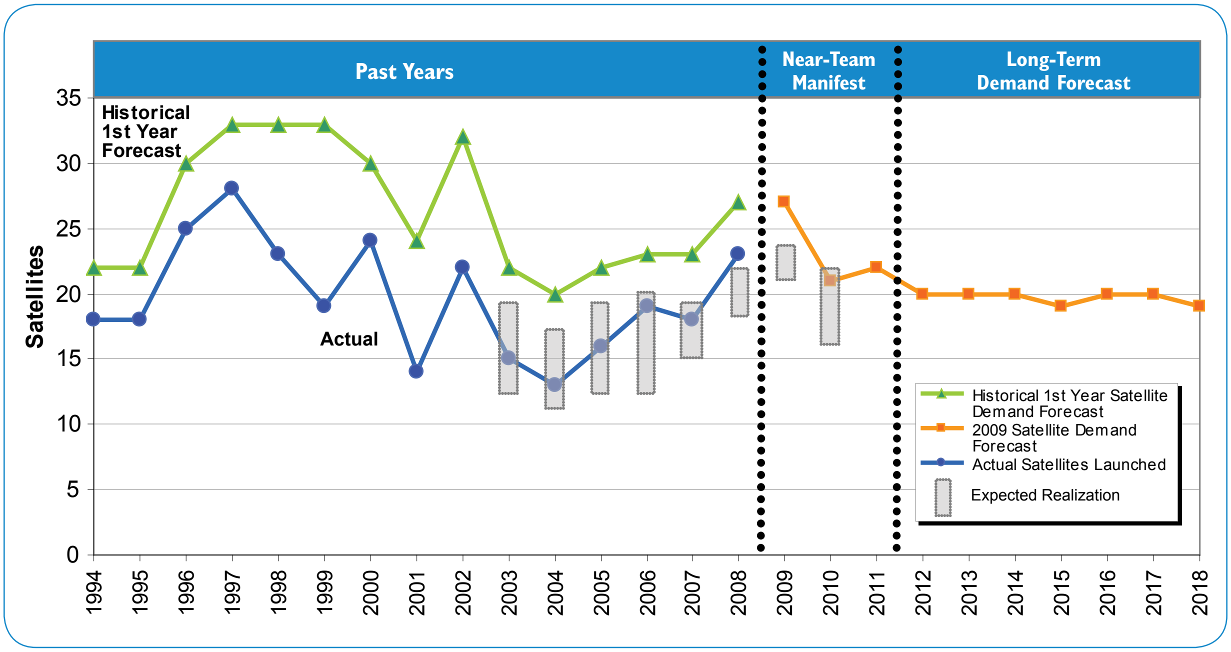

Figure 9. Commercial GSO Demand: Historical, Near-Term, and Long-Term Forecasts

Forecasted Satellite Demand versus Actual Satellite Launches in 2008

The 2008 COMSTAC Commercial GSO Demand Forecast listed 27 satellites for the 2008 near-term manifest. Twenty-three satellites were actually launched in 2008. The difference between actual and manifested satellite launches is due to two reasons:

- Three satellites were delayed due to logistics issues associated with Sea Launch and Land Launch
- One satellite scheduled to fly on Proton was cancelled (Echostar's CMBStar)

Of the three delayed satellites noted above, two have subsequently been launched as of publication of this report (Telstar 11N on Land Launch and Sicral 1B on Sea Launch). The other satellite (Measat 3) is awaiting launch in June on Land Launch.

Factors That May Affect Future Demand

The global satellite services industry is impacted by a variety of financial, regulatory, and environmental factors that can affect current and future demand forecasts for commercial GSO satellite launches. The Working Group has identified the following issues as potential factors that may impact satellite demand in the future.

Uncertainty in the financial markets extended quickly outside of the structured credit and sub-prime mortgages markets over the past twelve months. Limited access to corporate credit, the cost of credit, and the broad losses in major equity indices have impacted all businesses around the world, as they continue to work through the economic recession. Access to funds from private equity firms has dried up after a surge of interest in the sector over the past two years. While these conditions affect the growth prospects of satellite operators, the underlying strength of the Fixed Satellite Service (FSS) industry remains intact. For the time being, global and regional FSS operators have remained somewhat resistant to the effects of the ongoing downturn. This resiliency can be attributed in part to continued growth in the media and broadcast industries. Consumers are also choosing direct-to-home television services as cost-effective alternatives to other forms of entertainment. The FSS industry has also seen strong sales to the U.S. department of defense in support of deployed troops and unmanned vehicles. Anchored by high satellite use rates, long-term contracts, and large backlogs, satellite operators are continuing to build healthy balance sheets.

The growth prospects for the MSS operators are equally robust. However, the build-out of new hybrid networks may delay some operators going forward who are largely dependent upon the access to working capital which is scarce in the current economic climate. Small-fleet regional operators also may face some risk in obtaining reasonably priced credit going forward. Tight credit markets have increased operator demand for alternative project financing, including spacecraft and launch vehicle provided vendor-financing and government-backed financing from export credit agencies such as EXIM and Coface. Given the extended planning, budgeting, manufacturing, and launch lead-times associated with deploying GSO spacecraft assets on orbit, the continued effect that the ongoing uncertainty in the financial markets has on new satellite orders should be minimal barring a protracted economic recession.

New commercial launch competitors will impact the launch market over the next few years with increased competition. Land Launch is now operational from the Baikonur Cosmodrome. Using a Zenit-3SLB vehicle, modified slightly from the Sea Launch Zenit-3SL, its lift capability of 3,600 kilograms moves Sea Launch Company, L.L.C. into the medium launch market segment (2,500 – 4,000 kilograms), complementing the Sea Launch heavy-lift capability. Launch rate capacity is planned to be four launches per year. The debut of Arianespace's Soyuz launch from French Guiana (Kourou) has been delayed until 2009. This modified Soyuz will provide medium-lift capability: the Soyuz 2-1-a can lift 2,700 kilograms to GTO, and the Soyuz 2-1-b will be capable of lifting 3,000 kilograms to GTO. The near-equatorial launch location significantly increases the capacity of the upgraded Soyuz over the launch capacity from Baikonur. This will add another new competitor in the medium launch market segment. A new entrant to the space launch industry is SpaceX, a commercially-funded company designing the Falcon 1 and Falcon 9 launch vehicles. The Falcon 1 successfully reached orbit in Q3 of 2008. While the Falcon 1 is too small to launch payloads to GTO, the larger Falcon 9 will be able to launch just under 5,000 kilograms to GTO in the single core version and over 12,000 kilograms to GTO in the common booster core configuration. Its first launch is scheduled for 2009. Orbital may also enter the GTO market with a Taurus II equipped with an orbit raising upper-stage. The IOC for Taurus II for LEO launches is 2010. Finally, India plans to demonstrate in 2009 a further upgraded version of the GSLV launch vehicle, the GSLV Mark III, which is to be test launched in 2009. The Mark III is planned to have a payload capacity of four tons and use an indigenously-developed cryogenic engine.

Indigenous launch vehicles will continue to decrease the demand for internationally-competed commercial launches as more countries successfully build and launch their own government and commercial payloads. These new competitors have not only removed their government payloads from the internationally competed commercial launch market, but have now established a presence in the global commercial launch market. These competitors include the Indian GSLV, the Chinese Long March, and the Japanese H-IIA. The GSLV has a lift capability of 2,500 kilograms to GTO. While still early in its operational phase, GSLV is now successfully being used to launch the Insat satellites that had previously been part of the internationally-competed commercial launch market. The H-IIA launch system has a lift capacity of 4,100–7,500 kilograms to GTO. The H-IIA has performed well and Japan has successfully performed 14 out of 15 H-IIA launches. The Japanese Space Agency, JAXA, is well underway in developing the H-IIB configuration. The H-IIB provides increased lift capability to support International Space Station cargo resupply missions and is likely to be offered for commercial missions as required. Like China, the introduction of domestically manufactured satellites to the marketplace and an increased presence in the international commercial launch market will result in higher usage of the H-IIA. Like the H-IIA, various configurations of the Long March 3B provide a range of lift capabilities from 1,500 to 7,000 kilograms to GTO. Long March has been precluded from performing launch services for satellites containing U.S. ITAR restricted components. The newly introduced "ITAR-Free" satellites have provided Long March the opportunity to increase its presence in the internationally competed commercial launch market while maintaining its primary role launching payloads for the Chinese government. Long March is currently scheduled to launch one commercial GEO satellite in 2009, Palapa D. As more countries grow their internal launch capability, the degree of open (commercial) competition for launches will likely continue to decrease.

Demand for new video content and the need for interconnectivity from anywhere continue to push demand for satellite services and new satellite systems. High-definition television (HDTV) bandwidth, mobile services backhaul, and satellite broadband access services continue to drive growth in FSS services. DBS/DTH operators continue to order satellites with more video channel capability to enhance their current fleets. Wildblue and HNS broadband systems are serving the pent up consumer demand in North America for broadband. This market could be accelerated further by USG stimulus efforts to promote internet connectivity throughout the U.S.. ViaSat and Eutelsat will soon be providing consumer broadband services in the U.S. and in Europe, respectively. A third satellite launched, Inmarsat recently achieved close to global coverage with Broadband Global Area Network (BGAN), which provides mobile internet and telephone service. In the MSS segment, ICO has launched a satellite beginning its mobile video service. In addition, both MSV and TerreStar, will launch over the next year. All three systems plan to also use the Ancillary Terrestrial Component authorized by the FCC that enables an integrated terrestrial/satellite network solution for MSS providers. With the successful U.S. merger of XM and Sirius Satellite Radio, there continues to be interest in providing DARS and mobile video broadcast services in Europe and Asia.

U.S. Government regulatory environment continues to be an issue for domestic manufacturers as international competitors develop satellite and launch offerings that are not subject to U.S. export regulations for the commercial market. The U.S. Department of State approval to export satellites to international launch sites applies to domestic satellites and non-U.S. manufacturers that integrate ITAR- restricted U.S. components. Satellites with ITAR-restricted components have been denied licensing for export to selected countries with indigenous launch systems. Thales Alenia Space has recently introduced a configuration of its Spacebus platform without ITAR-restricted components. The introduction of ITAR free satellites will impact the global launch community, as well as U.S. satellite manufacturers, by enabling internationally competed commercial launch opportunities to be awarded to launch services providers which would normally not be allowed to launch satellites with ITAR-restricted components.

Hosted payloads are payloads that are too small to justify a dedicated mission due to payload size, government budget, or potential revenues. Typically a hosted payload is paired with a commercial satellite service mission, where the satellite operator is willing to accommodate the payload to offset its launch and operating costs. There are a variety of potential hosted payloads including: experimental, demonstration, scientific, remote sensing, weather and climate monitoring, FAA, GPS, and military communications missions. Payload hosting offers many benefits to both parties. The cost of the satellite and launch services is shared, thereby reducing the primary payload's launch costs while providing affordable space access for the hosted payload. In addition, the hosted payload gains the efficiency of using a commercial launch system that provides access to more orbital locations. In addition, the commercial launch schedule from start of program to launch is relatively short and fairly predictable compared to a shared launch with other government missions.

There are limitations to widespread acceptance and use of hosted payloads. The contractual relationships are more complex because there are three (or more) parties, rather than two, involved in the spacecraft purchase. In certain cases, the hosted payload is "added" after a contract is signed between the satellite manufacturer and the satellite owner. In some cases, the commercial satellite service provider does not want to impact its program and requires firm deadlines for delivery of the hosted payload as well as clearly defined interfaces at the start of satellite construction. If the hosted payload fails to arrive on time, the client could be liable for covering any residual impacts to the satellite cost and schedule. Further, the satellite manufacturer will likely seek "off-ramps" to offset the possibility of late delivery penalties if the hosted payload causes a delay in delivery of the satellite. To be sure, commercial satellite owners regularly formulate their satellite procurement contracts to address their business needs and take advantage of opportunities, like hosted payloads, to improve their return on investment.

Certainly, there is a broad interest in developing, launching, and operating hosted payloads. Industry or other collaborative leadership is necessary to coalesce the clients, their funding agencies/customers, the spacecraft owner/operators, and the launch vehicle providers into agreement on standardized hosted payload processes to make this a routine part of the commercial satellite business.

Supplementary Questionnaire Results

As part of the COMSTAC request for inputs from industry participants, a supplemental questionnaire was provided to satellite service providers. The questions focus on factors that impact service providers' plans to purchase and launch satellites. A summary of the responses to this questionnaire is provided in Table 6. The last column is a comparison to the survey responses received for the 2008 COMSTAC report.

	Significant Negative Impact	Some Negative Impact	No Effect	Some Positive Impact	Significant Positive Impact	Compared to 2008
Regional or global economic conditions	0%	77%	23%	0%	0%	↓
Demand for satellite services	8%	23%	23%	38%	8%	↓
Ability to compete with terrestrial services	15%	15%	69%	0%	0%	→
Availability of financing	23%	46%	8%	23%	0%	↓
Availability of affordable insurance	0%	23%	46%	31%	0%	→
Consolidation of service providers	0%	15%	77%	8%	0%	↓
Increasing satellite life times	0%	38%	54%	8%	0%	↓
Availability of satellite systems that meet your requirements	0%	8%	54%	31%	8%	→
Reliability of satellite systems	0%	38%	38%	15%	8%	↓
Availability of launch vehicles that meet your requirements	8%	15%	46%	23%	8%	↓
Reliability of launch systems	0%	31%	46%	23%	0%	↓
Ability to obtain required export licenses	0%	15%	69%	8%	8%	↑
Ability to obtain required operating licenses	8%	15%	69%	8%	0%	↑

Table 6. COMSTAC Survey Questionnaire Summary

↑ More positive nompared to 2008
→ No significant change from 2008
↓ More negative compared to 2008

The following 13 satellite service providers responded to the supplementary questionnaires. The Working Group would like to offer special thanks to these companies for providing this additional input:

DigitalGlobe
Hisdesat Servicios Estrategicos, S. A. *
JSAT Corporation *
Measat Satellite Systems Sdn. Bhd.
Mitsubishi Electric Corporation
Mobile Broadcasting Corporation *
Mobile Satellite Ventures (MSV) *
PanAmSat Corporation
SES New Skies
Shin Satellite (Thaicom Public Company Limited)

Telesat Canada *

Thales Alenia Space

Thuraya Satellite Telecommunications Company *

* Indicates 2008 survey respondent

The Supplementary Questionnaire inquiries can be broken down into three main categories: financial, technical, and regulatory. The 2009 survey reflects a generally negative perception of the industry and satellite market demand drivers. Global economic conditions were cited as having a negative impact by the vast majority of respondents. An increasing percentage of respondents were satisfied with the satellite component of their business, but there was an increase in concern about the reliability and availability of launch vehicles. The only area to see an unquestionably positive trend was the regulatory category.

As might be expected in the current economic situation, the trend in the financial category was overwhelmingly negative. The percentage of respondents who said they experienced some or significant negative impact due to global or regional economic conditions more than doubled to 77 percent in 2009 from 33 percent in 2008. The availability of financing was also a key issue for respondents, with 69 percent reporting some or significant negative impact in 2009 versus only 28 percent in 2008. The weaker economy may be contributing to the decline in demand for services seen by 31 percent of 2009 respondents, compared to only 17 percent of the respondents who saw a decline in demand for services in 2008. Negative trends were also apparent in the responses to questions on the ability to compete with terrestrial services, the availability of affordable insurance, and the impact of service provider consolidation. However, the increases in percent of negative responses to these questions were much smaller.

Operators appear to be satisfied with the variety and reliability of satellite systems available to them. Thirty-eight percent of the respondents in 2009 said that the reliability and longer lifetime of satellite systems was having a negative impact on their plans to purchase and launch satellites as compared to 17 percent of the 2008 respondents. Paradoxically, this increase in negative responses could indicate a positive situation for the industry, since this means that the increased reliability and lifetimes of existing satellites has a negative impact on plans to purchase additional satellites. Respondents were not as optimistic when it came to launch vehicles, however. Twenty-three percent of the respondents in 2009 said that the availability of launch vehicles had some or significant negative impact on their plans compared to only 11 percent of 2008 respondents. This is a reflection of operators' concerns about vehicle reliability and the full near-term manifests of almost all commercial launch providers. Launch vehicle reliability was cited as a negative factor by almost one-third (31 percent) of the 2009 respondents versus 22 percent in 2008, despite the fact that there was only one commercial launch vehicle failure in 2008 (ProtonM/AMC-14) as opposed to two failures in 2007 (Sea Launch/NSS 8 and Proton M/JCSAT-11).

The only survey area to show some improvement from 2008 to 2009 was the regulatory category. Fifteen percent of the 2009 respondents experienced some or significant negative impact as a result of their ability to obtain the required export licenses compared to 23 percent of the 2008 respondents. A similar improvement was seen in the ability to obtain the required operating licenses, with 23 percent of 2009 respondents experiencing some or significant negative impact versus 28 percent in 2008.

Commercial GSO Satellite Trends

Trends in Number of Transponders per Satellite

Figure 10 and Table 7 show the number of C-band, Ku-band, and Ka-band transponders launched per year and the average number of transponders per satellite launched from 1993 to 2008, with a projection for 2009 based on the near-term manifest shown in Table 4. Peaks in total number of transponders launched correspond to peaks in number of satellites launched for a given year. The average

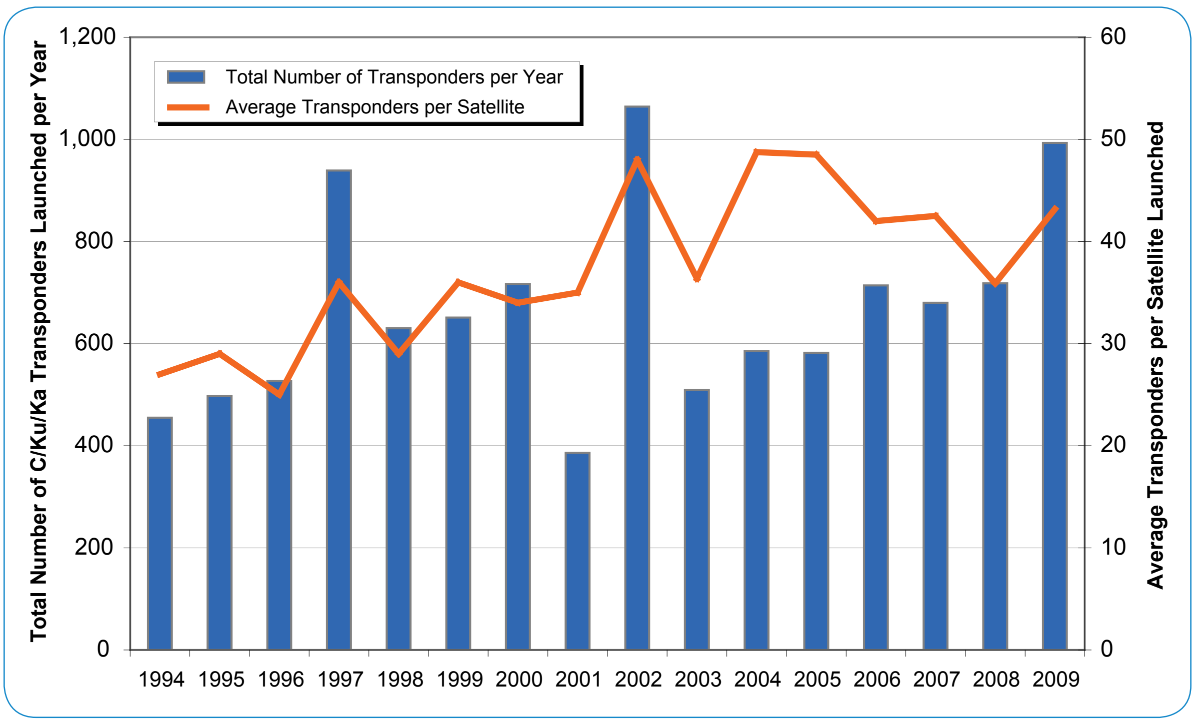

Figure 10. Total C/Ku/Ka Transponders Launched per Year and Average Transponders per Satellite

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total Number of Transponders per Year	455	497	527	939	630	651	717	386	1,064	509	585	582	714	680	718	993
Average Transponders per Satellite	27	29	25	36	29	36	34	35	48	36	49	49	42	43	36	43

Table 7. Total C/Ku/Ka Transponders Launched per Year and Average Transponders per Satellite

number of transponders launched in recent years tends to trend up and down with respect to the numbers of each class of satellite launched with variances year over year. The five-year moving average reveals that despite the growth period in the number of transponders per satellite seen in the early part of this decade, the past several years have remained relatively stable. This corresponds with the stabilization of the move to larger FSS/BSS transponder satellites. The average in 2009 is expected increase and future growth is expected to be relatively incremental. For the purpose of this analysis, a small number of satellites were excluded because their application is substantially different from the standard commercial GSO satellite. The satellites excluded are those used primarily for mobile applications because their communication payloads are not easily analyzed in terms of typical C-band, Ku-band, and Ka-band transponders. Examples include the Inmarsat, Paradigm (Skynet 5), Thuraya, XTAR/Spainsat, ICO, XM, and Sirius satellites, which have X-band, L-band, and/or S-band transponders.

Trends in Average Satellite Mass

Figure 11 and Table 8 show the total mass launched per year and the average mass per satellite launched. The total mass launched per year correlates with the number of satellites launched per year, as does the total number of transponders. The average satellite mass peaked in 2005 with 2006 showing a slight downturn. The average mass in 2009 is expected to increase slightly and growth trends in the future are also expected to be incremental. The last four years have averaged a little over 4,000 kilograms and the expectation is that the next several years will be similar. This again correlates to stabilizing the shift to heavier, higher-power satellites. The projected total mass to be launched in 2009 will be an all-time high, over 116,000 kilograms.

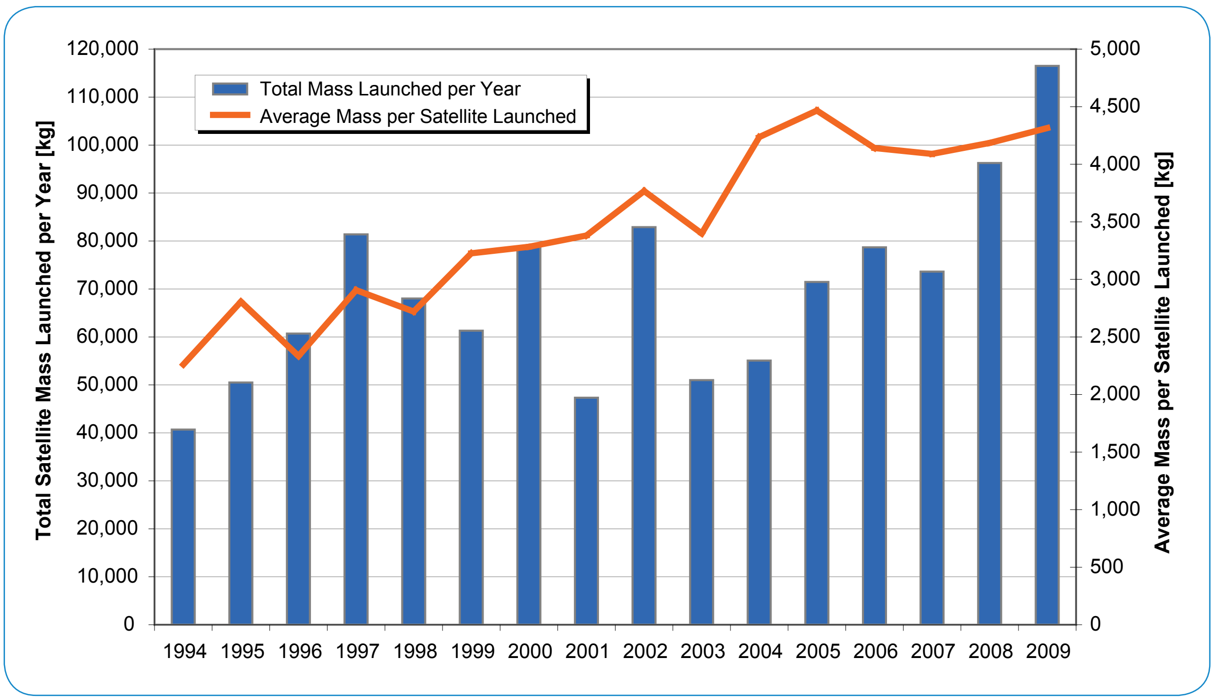

Figure 11. Total Satellite Mass Launched per Year and Average Mass per Satellite

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total Mass Launched per Year [kg]	40,689	50,502	60,695	81,373	68,015	61,295	78,784	47,329	82,880	50,990	55,070	71,456	78,680	73,611	96,251	116,496
Average Mass per Satellite [kg]	2,261	2,806	2,334	2,906	2,721	3,226	3,283	3,381	3,767	3,399	4,236	4,466	4,141	4,090	4,185	4,315

Table 8. Total Satellite Mass Launched per Year and Average Mass per Satellite

Summary

The 2009 COMSTAC Commercial GSO Launch Demand Forecast projects an average annual demand of 20.8 satellites to be launched from 2009 through 2018, a decrease of one satellite when compared to the 2008 forecast of 21.8 and the 2007 forecast of 21.0 satellites per year. Actual launches per year were above 20 for the first time since 2002 and the highest total since 2000, with 23 satellites launched in 2008.

The Working Group forecasts 21 total launches (including 6 dual-manifest) in 2009, decreasing to 16 total (including 5 dual-manifest) launches in 2010, with a slight increase to 17 (including 5 dual-manifest) launches expected in 2011. The long term forecast of average annual single-manifest launches over the ten-year period spanning 2009 through 2018 is 10.6 launches per year. The average annual dual-manifest launches during 2009 through 2018 are forecasted to be 5.1. Based on these data and the satellite demand projection, the 2009 Commercial GSO Launch Demand Forecast averages 15.7 launches per year from 2009 through 2018—a small decrease from last year's forecast.

There has been steady growth in satellite mass since 1993 and the trend continues toward the 2005 peak level of 4,500 kilograms. The total satellite mass launched is expected to remain near or slightly above 100,000 kilograms forecast for the coming years with an all-time high of nearly 116,500 kg in 2009. At the same time, the trend in increasing average number of transponders per satellite continues and, with the 2009 forecast at 993 transponders, is approaching the peak number of over 1,000 transponders launched in 2002.

With the uncertain future of the Delta II launch system, the launch vehicle industry is adding capacity with three new launch vehicle entrants capable of launching medium-class payloads in the immediate and mid-term periods. Land Launch successfully launched its initial commercial satellite in April 2008; Falcon 9 plans to launch in 2009; and Soyuz, launched from Kourou, plans to conduct its initial launch late in 2009. The Taurus II, currently in development, will also add launch capacity to support medium class payloads. While satellite demand may outnumber available commercial launch competitors in the near future, these new launch vehicles along with new applications of existing systems, with new systems from other emerging space nations, will maintain sufficient launch capacity in the future.

Table 9. Historical Addressable Commercial GSO Satellites Launched (1993-2008)

	1993	1994	1995	1996
Total Launches	8	14	17	21
Total Satellites	10	18	18	25
Over 5,400 kg (>11,905 lbm)	0	0	0	0
4,200 - 5,400 kg (9,260 - 11,905 lbm)	0	0	0	0
2,500 - 4,200 kg (5,510 - 9,260 lbm)	6	9	14	14
Below 2,500 kg (<5,510 lbm)	4	9	4	11

1993

2,500 - 4,200 kg (5,510 - 9,260 lbm)		Astra 1C	Ariane 42L
	DM2	DBS 1	Ariane 44L
		Galaxy 4	Ariane 42P
		Intelsat 701	Ariane 44LP
	DMN	Solidaridad 1	Ariane 44LP
		Telstar 401	Atlas IIAS
Below 2,500 kg (<5,510 lbm)	DM1	Insat 2B	Ariane 44L
	DM1	Hispasat 1B	Ariane 44L
	DM2	Thaicom 1	Ariane 44L

1994

2,500 - 4,200 kg (5,510 - 9,260 lbm)		Astra 1D	Ariane 42P
		Intelsat 702	Ariane 44LP
	DM2	PAS 2	Ariane 44L
		PAS 3 (Launch Failure)	Ariane 42P
	DM4	Solidaridad 2	Ariane 44L
		Telstar 402	Ariane 42L
		DBS 2	Atlas IIA
		Intelsat 703	Atlas IIAS
		Optus B3	Long March 2E
Below 2,500 kg (<5,510 lbm)	DM3	Brazilsat B1	Ariane 44LP
	DM2	BS-3N	Ariane 44L
	DM1	Eutelsat II F5 (Launch Failure)	Ariane 44LP
	DM4	Thaicom 2	Ariane 44L
	DM1	TurkSat 1A (Launch Failure)	Ariane 44LP
	DM3	TurkSat 1B	Ariane 44LP
		Orion 1	Atlas IIA
		Galaxy 1RS	Delta II
		APStar 1	Long March 3

1995

2,500 - 4,200 kg (5,510 - 9,260 lbm)		Astra 1E	Ariane 42L
		DBS 3	Ariane 42P
		Intelsat 706A	Ariane 44LP
		N-Star a	Ariane 44P
		PAS 4	Ariane 42L
		Telstar 402R	Ariane 42L
		AMSC 1	Atlas IIA
		Galaxy 3R	Atlas IIA
		Intelsat 704	Atlas IIAS
		Intelsat 705	Atlas IIAS
		JCSat 3	Atlas IIAS
		APStar 2 (Launch Failure)	Long March 2E
		ASIASAT 2	Long March 2E
		EchoStar 1	Long March 2E
Below 2,500 kg (<5,510 lbm)	DM1	Brazilsat B2	Ariane 44LP
	DM1	Hot Bird 1	Ariane 44LP
	DMN	Insat 2C	Ariane 44L
		Koreasat 1	Delta II

1996

2,500 - 4,200 kg (5,510 - 9,260 lbm)	DM3	Arabsat 2A	Ariane 44L
	DM4	Arabsat 2B	Ariane 44L
		EchoStar 2	Ariane 42P
		Intelsat 707A	Ariane 44LP
		Intelsat 709	Ariane 44P
		MSAT 1	Ariane 42P
		N-Star b	Ariane 44P
	DM2	Palapa C2	Ariane 44L
	DM1	PAS 3R	Ariane 44L
		AMC 1	Atlas IIA
		Hot Bird 2	Atlas IIA
		Palapa C1	Atlas IIAS
		Intelsat 708A (Launch Failure)	Long March 3B
		Astra 1F	Proton K/DM
Below 2,500 kg (<5,510 lbm)	DM2	Amos 1	Ariane 44L
	DMN	Italsat 2	Ariane 44L
	DM1	Measat 1	Ariane 44L
	DM4	Measat 2	Ariane 44L
	DM3	TurkSat 1C	Ariane 44L
		Inmarsat 3F1	Atlas IIA
		Inmarsat 3F3	Atlas IIA
		Galaxy 9	Delta II
		Koreasat 2	Delta II
		APStar 1A	Long March 3
		Inmarsat 3F2	Proton K/DM

(shaded) = Launch Failure

DM#= Dual Manifested Launch With Another COMSTAC Satellite. Example: DM1 was paired with DM1, DM2 with DM2, etc.

DMN = Dual Manifested Launch With Non-Addressable Satellite. DMN missions are counted as a single launch in the launch count

Note: The 1996 launch of Chinasat 7 was removed in 2004 as it was retroactively determined not to have been competitively bid.

Table 9. Historical Addressable Commercial GSO Satellites Launched (1993-2008) Cont'd

	1997	1998	1999	2000
Total Launches	24	19	18	20
Total Satellites	28	23	19	24
Over 5,400 kg (>11,905 lbm)	0	0	0	0
4,200 - 5,400 kg (9,260 - 11,905 lbm)	0	0	2	4
			Galaxy 11 – Ariane 44L Orion 3 – Delta III	Anik F1 – Ariane 44L PAS 1R – Ariane 5G Garuda 1 – Proton K/DM Thuraya 1 – Sea Launch
2,500 - 4,200 kg (5,510 - 9,260 lbm)	21	14	16	14
	DMN Hot Bird 3 – Ariane 44LP Intelsat 801 – Ariane 44P Intelsat 802 – Ariane 44P Intelsat 803 – Ariane 42L Intelsat 804 – Ariane 42L JCSat 5 – Ariane 44P PAS 6 – Ariane 44P DM4 Sirius 2 – Ariane 44L DM2 Thaicom 3 – Ariane 44LP AMC 3 – Atlas IIAS DirecTV 6 – Atlas IIA EchoStar 3 – Atlas IIAS Galaxy 8i – Atlas IIAS JCSat 4 – Atlas IIAS Superbird C – Atlas IIAS Agila II – Long March 3B APStar 2R – Long March 3B Aatra 1G – Proton K/DM Asiasat 3 – Proton K/DM PAS 5 – Proton K/DM Telstar 5 – Proton K/DM	DM4 Afristar – Ariane 44L DM3 Eutelsat W2 – Ariane 44L Hot Bird 4 – Ariane 42P PAS 6B – Ariane 42L PAS 7 – Ariane 44LP Satmex 5 – Ariane 42L ST-1 – Ariane 44P Hot Bird 5 – Atlas IIA Intelsat 805A – Atlas IIAS Intelsat 806A – Atlas IIAS Galaxy 10 – Delta III Astra 2A – Proton K/DM EchoStar 4 – Proton K/DM PAS 8 – Proton K/DM	AMC 4 – Ariane 44L DM1 Arabsat 3A – Ariane 44L Insat 2E – Ariane 42P Koreasat 3 – Ariane 42P Orion 2 – Ariane 44LP Telkom – Ariane 42P Telstar 7 – Ariane 44LP Echostar V – Atlas IIAS Eutelsat W3 – Atlas IIAS JCSat 6 – Atlas IIAS Asiasat 3S – Proton K/DM Astra 1H – Proton K/DM LMI 1 – Proton K/DM Nimiq – Proton K/DM Telstar 6 – Proton K/DM DirecTV 1R – Sea Launch	DM1 Asiastar 1 – Ariane 5G DM3 Astra 2B – Ariane 5G Europe*Star 1 – Ariane 44LP Eutelsat W1R – Ariane 44P Galaxy 10R – Ariane 42L Galaxy IVR – Ariane 42L N-Sat-110 – Ariane 42L Superbird 4 – Ariane 44LP Echostar VI – Atlas IIAS Eutelsat W4 – Atlas IIIA Hispasat 1C – Atlas IIAS AAP 1 – Proton K/DM AMC 6 – Proton K/DM PAS 9 – Sea Launch
Below 2,500 kg (<5,510 lbm)	7	9	1	6
	DM1 AMC 2 – Ariane 44L DM2 BSat 1A – Ariane 44LP DM4 Cakrawarta 1 – Ariane 44L DM3 Inmarsat 3F4 – Ariane 44LP DM3 Insat 2D – Ariane 44LP DM1 Nahuel 1A – Ariane 44L Thor II – Delta II	DM4 AMC 5 – Ariane 44L DM1 Brazilsat B3 – Ariane 44LP DM2 BSat 1B – Ariane 44P DM1 Inmarsat 3F5 – Ariane 44LP DM2 NileSat 101 – Ariane 44P DM3 Sirius 3 – Ariane 44L Bonum-1 – Delta II Skynet 4D – Delta II Thor III – Delta II	DM1 Skynet 4E – Ariane 44L	DM3 AMC 7 – Ariane 5G DM4 AMC 8 – Ariane 5G DM4 Astra 2D – Ariane 5G DM2 Brazilsat B4 – Ariane 44LP DM1 Insat 3B – Ariane 5G DM2 Nilesat 102 – Ariane 44LP

= Launch Failure

DM#= Dual Manifested Launch With Another COMSTAC Satellite. Example: DM1 was paired with DM1, DM2 with DM2, etc.

DMN = Dual Manifested Launch With Non-Addressable Satellite. DMN missions are counted as a single launch in the launch count

Note: The 1996 launch of Chinasat 7 was removed in 2004 as it was retroactively determined not to have been competitively bid.

Table 9. Historical Addressable Commercial GSO Satellites Launched (1993-2008) Cont'd

	2001			2002			2003			2004	
Total Launches		12			20			12		13	
Total Satellites		14			22			15		13	
Over 5,400 kg (>11,905 lbm)		0			0			0		3	
										Anik F2	Ariane 5G+
										Intelsat X	Proton M/M
										DirecTV 7S	Sea Launch
4,200 - 5,400 kg (9,260 - 11,905 lbm)		5			9			5		4	
		DirecTV 4S	Ariane 44LP		Intelsat 904	Ariane 44L		Intelsat 907	Ariane 44L	Eutelsat W3A	Proton M/M
		Intelsat 901	Ariane 44L		Intelsat 905	Ariane 44L	DM2	Optus C1	Ariane 5G	Amazonas	Proton M/M
		Intelsat 902	Ariane 44L		Intelsat 906	Ariane 44L		Rainbow 1	Atlas V 521	Estrela do Sul	Sea Launch
		XM Rock	Sea Launch		NSS-6	Ariane 44L		EchoStar 9	Sea Launch	APStar V	Sea Launch
		XM Roll	Sea Launch		NSS-7	Ariane 44L		Thuraya 2	Sea Launch		
					Astra 1K	Proton K/DM					
					Echostar 8	Proton K/DM					
					Intelsat 903	Proton K/DM					
					Galaxy IIIC	Sea Launch					
2,500 - 4,200 kg (5,510 - 9,260 lbm)		6			11			6		4	
	DM2	**Artemis**	Ariane 5G	DMN	Atlantic Bird 1	Ariane 5G	DM1	Insat 3A	Ariane 5G	Superbird 6	Atlas IIAS
		Atlantic Bird 2	Ariane 44P	DMN	**Hotbird 7**	Ariane 5ECA	DM3	Insat 3E	Ariane 5G	MBSat	Atlas IIIA
	DM1	Eurobird	Ariane 5G		Insat 3C	Ariane 42L		Asiasat 4	Atlas IIIB	AMC-16	Atlas V 521
		Turksat 2A	Ariane 44P	DM1	JCSat 8	Ariane 44L		Hellas-sat	Atlas V 401	AMC-15	Proton M/M
		Astra 2C	Proton K/DM	DM2	Stellat 5	Ariane 5G		AMC-9	Proton K/M		
		PAS 10	Proton K/DM		Echostar 7	Atlas IIIB		Galaxy XIII	Sea Launch		
					Hispasat 1D	Atlas IIAS					
					Hotbird 6	Atlas V 401					
					Eutelsat W5	Delta IV M+ (4,2)					
					DirecTV 5	Proton K/DM					
					Nimiq 2	Proton M/M					
Below 2,500 kg (<5,510 lbm)		3			2			4		2	
	DM1	BSat 2A	Ariane 5G	DM1	Astra 3A	Ariane 44L	DM2	Bsat 2C	Ariane 5G	AMC-10	Atlas IIAS
	DM2	**BSat 2B**	Ariane 5G	DM2	N-Star c	Ariane 5G	DM3	e-Bird 1	Ariane 5G	AMC-11	Atlas IIAS
	DMN	Skynet 4F	Ariane 44L				DM1	Galaxy XII	Ariane 5G		
								Amos 2	Soyuz		

(bold/shaded) = Launch Failure

DM#= Dual Manifested Launch With Another COMSTAC Satellite. Example: DM1 was paired with DM1, DM2 with DM2, etc.

DMN = Dual Manifested Launch With Non-Addressable Satellite. DMN missions are counted as a single launch in the launch count

Note: The 1996 launch of Chinasat 7 was removed in 2004 as it was retroactively determined not to have been competitively bid.

Table 9. Historical Addressable Commercial GSO Satellites Launched (1993-2008) Cont'd

	2005			2006			2007			2008		
Total Launches	15			15			12			18		
Total Satellites	16			19			18			23		
Over 5,400 kg (>11,905 lbm)	6			2			3			5		
	DM1	Spaceway 2	Ariane 5ECA	DM2	Satmex 6	Ariane 5ECA	DM3	Spaceway 3	Ariane 5ECS		Inmarsat 4F3	Proton M
		Thaicom 4	Ariane 5G+	DM3	DirecTV 9S	Ariane 5ECA		DirecTV 10	Proton M/M		DirecTV 11	Sea Launch
		Inmarsat 4F1	Atlas V 431					NSS-8	Sea Launch		ICO G-1	Atlas V
		IA-8	Sea Launch								Echostar 11	Sea Launch
		Inmarsat 4F2	Sea Launch								Ciel 2	Proton M
		Spaceway 1	Sea Launch									
4,200 - 5,400 kg (9,260 - 11,905 lbm)	4			9			6			8		
		AMC-12	Proton M/M	DM4	Wildblue 1	Ariane 5ECA	DM1	Skynet 5A	Ariane 5ECA	DM1	Skynet 5C	Ariane 5G
		Anik F1R	Proton M/M		Astra 1KR	Atlas V 411	DM2	Astra 1L	Ariane 5ECA		Astra 1M	Proton M
		AMC-23	Proton M/M		Hotbird 8	Proton M/M	DM5	Skynet 5B	Ariane 5ECA		Nimiq 4	Proton M
		XM-3	Sea Launch		Measat 3	Proton M/M		Nigcomsat	Long March 3B	DM3	HotBird 9	Ariane 5G
					Echostar X	Sea Launch		Anik F3	Proton M/M		Thuraya 3	Sea Launch
					JCSat 9	Sea Launch		SES Sirius 4	Proton M/M		Galaxy 18	Sea Launch
					Galaxy 16	Sea Launch					Galaxy 19	Sea Launch
					Koreasat 5	Sea Launch				DM5	Superbird 7	Ariane 5G
					XM-4	Sea Launch						
2,500 - 4,200 kg (5,510 - 9,260 lbm)	3			6			5			8		
	DMN	XTAR-EUR	Ariane 5ECA	DM1	Hotbird 7A	Ariane 5ECA	DM1	Insat 4B	Ariane 5ECA	DM2	BADR 6	Ariane 5G
		Insat 4A	Ariane 5G+	DM1	Spainsat	Ariane 5ECA	DM2	Galxy 17	Ariane 5ECA	DM3	Eutelsat W2M	Ariane 5G
		DirecTV 8	Proton M/M	DM2	Thaicom 5	Ariane 5ECA	DM5	Star One C1	Ariane 5ECA		AMC 14	Proton M
				DMN	JCSat 10	Ariane 5ECA	DM6	RASCOM 1	Ariane 5G+	DM4	Vinasat	Ariane 5G
					Arabsat 4A	Proton M/M		JCSat 11	Proton M/M	DM2	Protostar 1	Ariane 5G
					Arabsat 4B	Proton M/M				DM5	AMC 21	Ariane 5G
										DM1	Turksat 3A	Ariane 5G
										DM4	StarOne C2	Ariane 5G
Below 2,500 kg (<5,510 lbm)	3			2			4			2		
	DM1	Telkom 2	Ariane 5ECA	DM4	AMC-18	Ariane 5ECA	DM3	Bsat 3A	Ariane 5ECA		AMOS 3	Land Launch
	DMN	Galaxy 15	Ariane 5G+	DM3	Optus D1	Ariane 5ECA	DM4	Intelsat 11	Ariane 5G+		Thor 5	Proton M
		Galaxy 14	Soyuz				DM4	Optus D2	Ariane 5G+			
							DM6	Horizons	Ariane 5G+			

= Launch Failure

DM#= Dual Manifested Launch With Another COMSTAC Satellite. Example: DM1 was paired with DM1, DM2 with DM2, etc.

DMN = Dual Manifested Launch With Non-Addressable Satellite. DMN missions are counted as a single launch in the launch count

Note: The 1996 launch of Chinasat 7 was removed in 2004 as it was retroactively determined not to have been competitively bid.

Table 10. Historical Non-Addressable Commercial GSO Satellites Launched (1993–2008)

	1993		1994		1995			1996		
Total Launches	3		4		1			4		
Total Spacecraft	3		4		2			5		
	Gorizont	Proton K/DM	DFH 3-1	Long March 3A	DMC	Telecom 2D	Ariane 44L	DMC	Telecom 2D	Ariane 44L
	Gorizont 40	Proton K/DM	Express	Proton K/DM		Chinasat 7	Long March 3A		Chinasat 7	Long March 3A
	Gorizont 41	Proton K/DM	Gals-1	Proton K/DM		Express 2	Proton K/DM		Express 2	Proton K/DM
			Gorizont 42	Proton K/DM		Gorizont 43	Proton K/DM		Gorizont 43	Proton K/DM
						Gorizont 44	Proton K/DM		Gorizont 44	Proton K/DM

	1997		1998		1999			2000		
Total Launches	1		9		8			15		
Total Spacecraft	1		2		3			4		
	Chinasat 6	Long March 3A	ChinaStar-1	Long March 3B		Express A1	Proton K/DM		Express A2	Proton K/DM
			Sinosat-1	Long March 3C	DM1	Yamal 101	Proton K/DM		Express A3	Proton K/DM
					DM1	Yamal 102	Proton K/DM		Gorizont 45	Proton K/M
									SESAT	Proton K/DM

	2001		2002		2003			2004		
Total Launches	7		6		3			2		
Total Spacecraft	1		1		4			2		
	Ekran M	Proton M/M	Express A4	Proton K/DM		Express AM-22	Proton K/DM		Express AM-11	Proton K/DM
					DM1	Yamal 200 SC1^	Proton K/DM		Express AM 1	Proton K/DM
					DM1	Yamal 200 SC2^	Proton K/DM			
						Zhongxing 20	Long March 3A			

	2005		2006		2007			2008		
Total Launches	3		2		0			2		
Total Spacecraft	3		2		2			2		
	Express AM 2	Proton K/DM	Kazsat	Proton K/DM		Sinosat 3	Long March 3B		Venesat 1	Long March 3B
	Express AM 3	Proton K/DM	Sinosat 2	Long March 4B		Chinasat 6B	Long March 3B		Chinasat 9	Long March 3B
	Apstar 6	Long March 3B								

[grey box] = Launch Failure

DM#= Dual Manifested Launch With Another Non-Addressable GSO Satellite.
Example: DM1 was paired with DM1, DM2 with DM2, etc.

DMC = Dual Manifested Launch With Commercial Addressable Satellite. DMC missions are not counted as launches in this launch count

2009 COMMERCIAL SPACE TRANSPORTATION FORECAST FOR NON-GEOSYNCHRONOUS ORBITS

EXECUTIVE SUMMARY

The *2009 Commercial Space Transportation Forecast for Non-Geosynchronous Orbits (NGSO) is developed by the Office of Commercial Space Transportation of the Federal Aviation Administration (FAA/AST)*. The NGSO forecast projects commercial launch demand for all space systems to be deployed in nongeosynchronous orbits (NGSO), including low Earth orbit, medium Earth orbit, elliptical orbits, and external orbits such as to the Moon or other solar system destinations. First compiled in 1994, the FAA NGSO forecast assesses global satellite and other payloads most likely to seek commercial launch services during the next 10 years. It is intended to assist FAA/AST in its planning for licensing and efforts to foster a healthy commercial space launch capability in the United States.

This report is based on FAA/AST research and discussions with industry, including satellite service providers, satellite manufacturers, launch service providers, system operators, government offices, and independent analysts. The forecast tracks progress for publicly-announced satellites and considers the following factors:

- Financing
- Regulatory developments
- Spacecraft manufacturing and launch services contracts
- Investor confidence
- Competition from space and terrestrial sectors
- Overall economic conditions

Future deployments of satellites that have not yet been announced are projected based on market trends, the status of existing satellites, and the economic conditions of potential satellite developers.

The 2009 NGSO forecast projects a slight decrease in demand for worldwide commercial launches to non-geosynchronous orbits (NGSO) during 2009–2018 compared to last year's forecast. A total demand of 110 launches is forecast compared to 112 launches in the 2008 forecast. This decrease is attributed in part to uncertainty in the financing for deploying next generation communications constellations. However, the new category of launch demand called orbital facility assembly and services, added last year, strengthened as NASA issued $3.5 billion in contracts for commercial supply services to support the International Space Station (ISS). The forecast could fluctuate in the future depending on the successful development of new vehicles attempting to meet this new orbital services market.

The 2009 forecast contains 260 satellites during the next ten years, a decrease of 6 percent compared to the 2008 forecast of 276 satellites. Diversity continues to characterize the global NGSO market with combinations of private and government funding for missions ranging from science and commercial remote sensing to space station cargo and telecommunications.

2009 Launch Forecast: The FAA/AST forecasts an average demand of 10.8 worldwide launches per year during 2009–2018 with some sustained activity in the far term, a change from recent forecasts that showed declining activity in the far term. During 2008 there were 10 actual commercial NGSO launches.

Demand is divided into two vehicle size classes with an average of 8.1 medium-to-heavy launch vehicles per year and about 2.7 small vehicle launches per year during the forecast period. While the number of medium-to-heavy launches is similar to last year's forecast, the number of small launches decreased by almost half a launch per year.

Telecommunications makes up more than half of the satellite market but only about 19 percent of the launch market because of multiple-manifesting; each launch for the second-generation Iridium, Globalstar, and ORBCOMM fleets are expected to be multi-manifested at a rate of six satellites per launch. Depending on the launch vehicle, the new O3b Networks constellation will launch at a rate of six to eight satellites per vehicle.

About 28 percent of the satellite market is comprised of international science and other satellites, such as technology demonstrations. This translates to 34 percent of the launch market. The new orbital facilities assembly and services category accounts for 33 percent of the launch market. Commercial remote sensing satellites account for about 13 percent of the launch demand market.

INTRODUCTION

The 2009 non-geosynchronous orbits forecast breaks the trend of the previous four years of an increase in the number of launches in the ten-year projection. The decrease is influenced by scarcity of investment capital that occurred as a result of the economic downturn that began in 2008. However, this year's forecast does identify strong demand for launch services throughout the ten-year projection. To put the forecast in perspective, ten actual NGSO commercial launches took place in 2008, one launch short of the projection but, continuing to demonstrate a general increasing trend in the demand for launch services when compared to launch rates from earlier this decade (see Table 11).

In the 2007 report, the FAA began using a "realization" factor for the NGSO forecast because of a relatively high demand of 17 launches that appeared unlikely to occur in the first year (2007) of the 10-year forecast. The projected realization was for 10–13 launches during 2007. Last year, the FAA realization was only 8–10 launches with a demand for 11 launches. This year's realization factor will also be 8–10 launches with a demand for 11 launches (see Table 17). Because the realization matches closely with the demand forecast, this could be a continued sign of stabilization in the market. Four launches scheduled in 2008 carried over into 2009. This compares with four launches that also carried over from the 2007 into the 2008 forecast.

Year	NGSO	GSO	Total
1998	19	19	38
1999	18	18	36
2000	9	20	29
2001	4	12	16
2002	4	20	24
2003	4	13	17
2004	2	13	15
2005	3	15	18
2006	5	15	20
2007	12	12	24
2008	10	18	28
2009 est.	8	21	29

Table 11. Commercially Competed Launches

The near-term NGSO manifest shows a glut in NGSO launch demand in 2010 with 8 forecasted for 2009, 15 in 2010, 10 in 2011, and 9 in 2012. Unlike previous forecasts since 2003, the out-years also have a steady amount of activity comparable with the near-term because of the deployment of Iridium's next generation system of 72 satellites and projected consistent rate of commercial launches for resupply of the ISS.

Today's NGSO launch market is characterized by:

- An increase in activity by telecommunications satellites weakened by constricted capital markets;
- A steady demand by international science;
- The new and promising sector of orbital facility assembly and services; and
- A small but steady launch demand for commercial remote sensing satellites.

With replacement plans for second generation systems for Globalstar, ORBCOMM, and Iridium all included in the forecast, telecommunications comprises the largest sector of the market. Fifty-one percent of all satellites seeking commercial launch services during the next ten years are in the telecommunications sector. The initial launch of the new O3b Networks telecommunications constellation helps support launch demand that had been reduced given uncertainties about the financing for Globalstar's replacement fleet.

The second largest satellite market segment is international science or "other" satellites (such as technology demonstrations) at 28 percent. After accounting for multiple manifesting, where more than one satellite can ride aboard per launch, the science market accounts for 34 percent of the launch demand market. The future science market continues to be difficult to assess beyond the near term because of limited budgets and uncertainty on multiple- or single-manifesting. Also, new government-funded launch systems such as Europe's Vega may capture a share of the European science missions that currently seek commercially competed launch options. Alternatively, new commercial launch systems such as SpaceX or others may capture a portion of government launch demand that is not currently launched on commercially licensed vehicles. In this forecast, a new type of "Other" activity was created that includes the SpaceX DragonLab vehicle. This new type of space mission is described in detail within the Orbital Research Platform section of this report. Historically, the science and other sector is the most dependable sector of activity.

The newly emerging spacecraft market segment, Orbital Facility Assembly and Services (OFAS), contains 14 percent of total spacecraft in the forecast but accounts for 33 percent of the launch market demand, all on medium-to-heavy launch vehicles. The OFAS market is new and although demand is healthy and funding appears to be available both in the private sector and from government, forecasting the successful technical development by industry of new vehicles needed to meet the demand is uncertain. These vehicles include launch vehicles and automated rendezvous vehicles as well as spacecraft capable of carrying people. Extensive private investment is being made by Bigelow Aerospace, SpaceX, and Orbital Sciences. For the latter two, the investment in new launch and rendezvous vehicles is supported by NASA funding from the Commercial Orbital Transportation Services (COTS) program.

However, if a vehicle capable of carrying people is available, the market could grow quickly. Bigelow Aerospace, or emerging spacefaring countries, could buy launch and rendezvous services for its planned habitat modules, some of which are under construction today. The FAA forecasts a launch rate necessary for two launch providers to meet commercial ISS supply upmass and downmass needs based on NASA's Commercial Resupply Services (CRS) contract requirements. The forecast does extend CRS launch demand beyond the duration of the current contract. The forecast at this time does not include placeholders for Bigelow Aerospace modules or a projection of supply activity. It is entirely possible that flight rates and schedules to support both ISS and Bigelow Aerospace could change based on demand and when space transportation vehicles under development emerge.

The commercial remote sensing sector encompasses only seven percent of the satellite market and 13 percent of the launch demand market with up and down demand cycles for both new programs and replacements of existing satellites. The renewed commitment by the U.S. government in April 2009 to purchase commercial remote sensing imagery provides additional stability for steady satellite and launch services demand in this sector.

The financial situation for existing NGSO operators, as with the entire satellite business sector, had been positive in recent years because of favorable lending terms, driven by the overall increase in global private equity investment programs and a healthy economy. Unlike the 1990s when primary investors were the companies building the NGSO satellites, major backers today include private equity investors and global banking interests. Unfortunately, the recession in the U.S. and world economy has made it more challenging to attract investment capital for commercial space ventures. Given slow development cycles, space ventures will likely feel a delayed impact of the economic downturn but will conversely experience a prolonged downturn when the world economy begins recovery. However, much of the industry is directly or indirectly supported by government spending. As this forecast is written, government spending on space remains strong with few decreases and a number of notable increases in funding.

After bankruptcies of the first generation of NGSO mobile constellations, new owners of the fully-deployed orbital systems started with a clean balance sheet. ORBCOMM and Iridium have prospered with new subscribers. ORBCOMM's stock has performed well and it signed a second-generation satellite construction contract in May 2008. Iridium posted strong revenue during 2008 and plans to award a satellite construction contract in 2009 with the possibility of gaining further investment from hosting small guest payloads aboard its satellites. Globalstar finds itself in the opposite situation after initially gaining subscribers following restructuring from bankruptcy. With the voice capabilities of its first-generation system degrading from S-band antenna problems, Globalstar faces some urgency to start launching its second-generation replacement satellites as soon as it can. After completing two launches of remaining first-generation spare satellites in 2007, second-generation satellite launches are scheduled to start in late 2009. In March 2009, Globalstar announced that it had secured financing from the French export credit agency Coface. This and other investment should allow Globalstar to launch its first 24 replacement satellites. The O3b Networks constellation is a newly planned NGSO system that has had initial success raising a portion of the $700 million needed to manufacture and launch its satellites.

It is important to note that this report represents the FAA's assessment of how many satellites are seeking launch services to determine the overall demand for launches. It is not a prediction of how many launches might actually occur throughout the entire forecast. The forecast also does not evaluate if operators will attract enough business to prosper after launch. The results of this forecast do not indicate FAA support or preference for any particular satellite system. The majority of satellites in the forecast are (or were) open for international launch services procurement or sponsored by commercial entities for commercial launch. U.S. commercially-competed launches for ISS resupply missions were included in this forecast.

The following sections review each market segment and describe the results of the 2009 forecast.

NGSO SATELLITE SYSTEMS

International Science and Other Payloads

Government Earth observation programs, technology development missions, and other scientific missions are the significant customers of commercial launch services to NGSO. Though most government missions do not use commercially-procured or commercially-licensed launches, there are select missions that do, particularly by governments that do not have domestic launch capabilities. For technology demonstration missions, most involve small satellites on modest budgets, so the demand leans toward low-cost, small launch vehicles. The continued availability of inexpensive launches on refurbished Russian and Ukrainian ballistic missiles, and new U.S. vehicles, promises to support increased demand for such launch services. In the past few years, science or technology demonstration payloads have been launched commercially for operators in a number of countries, including China, Egypt, France, Germany, India, Italy, Russia, Saudi Arabia, South Korea, Thailand, Taiwan, Turkey, the United Kingdom, and the United States.

International science satellites can be classified into three groups. The first group is remote sensing satellites that are operated non-commercially, typically by government agencies, but are often built by commercial firms in other countries. The imagery products generated from these satellites are usually offered for free or are used for government purposes. RazakSat, built by Astronautic Technology (M) Sdn Bhd for the Malaysian government, is a small remote sensing satellite that will operate in a low-inclination orbit to permit frequent passes over Malaysia. The satellite is scheduled for launch in 2009 on a Falcon 1. The Disaster Monitoring Constellation (DMC) is a remote sensing system that provides multispectral imaging in support of disaster relief operations. The system currently consists of five spacecraft built by Surrey Satellite Technology Ltd. (SSTL) for Algeria, China, Nigeria, Turkey, Spain, and the UK individually. Two next-generation DMC satellites are currently under development for Spain and the UK, DEIMOS-1 and UK DMC-2. These satellites are planned to be launched together, along with two Aprize satellites and the primary payload Dubaisat-1, by a Dnepr vehicle in 2009.

Dubaisat-1, weighing in around 200 kilograms (440 pounds), is another remote sensing satellite within the international science market. The 2.5-meter (8.2-foot) resolution imaging satellite will serve civil infrastructure development and environmental monitoring purposes through the Emirates Institution for Advanced Science and Technology (EIAST), a Dubai government organization.

Argentina's National Commission on Space Activity (CONAE) is developing the SAOCOM radar based remote sensing satellites that will provide imagery for natural resources monitoring, as well as emergency and disaster management. The satellites will carry an L-band Synthetic Aperture Radar. In April 2009, SpaceX announced a contract with CONAE to launch the SAOCOM satellites on Falcon 9 around 2012-2013.

A second class of satellites includes spacecraft designed to carry out other scientific work in space, ranging from specialized Earth sciences research to planetary missions. One example is Gravity Field and Steady-State Ocean Circulation Explorer (GOCE), a European Space Agency (ESA) mission to generate high-resolution maps of the Earth's gravity field. That mission launched in March 2009.

The third class of satellites feature spacecraft designed to perform technology demonstrations. Examples are the Cascade, Smallsat, and Ionospheric Polar Explorer (CASSIOPE) spacecraft. A prime objective of the CASSIOPE mission, scheduled to launch in late 2010, is to space qualify high-performance payload components that will be used in the CASCADE mission currently under development at MacDonald, Dettwiler and Associates Ltd.(MDA). The CASCADE mission will enable a service business that will offer users in remote areas the ability to move potentially thousands of gigabits on a daily basis to and from anywhere on earth. MDA expects to launch the first two CASCADE satellites in 2016. The Swedish Space Corporation is also constructing a technology demonstration mission, named Prisma. This mission consists of two satellites demonstrating formation flying and rendezvous activities. The satellites are planned to launch in late 2009 on a Dnepr.

The maiden flight of the SpaceX Falcon 9 launch vehicle is currently scheduled for the third quarter of 2009. This launch will not transport a satellite to orbit but will be used to test the new launch system.

Nanosatellites, satellites with mass equal to or less than ten-kilograms, are increasingly popular with public and private institutions worldwide as research and educational tools. Over 40 universities have constructed nanosatellites for a variety of applications. At least 45 nanosatellites have been successfully launched from 2005 to April 2009. In 2008, a PSLV successfully launched 9 nanosatellites to orbit. Launch costs per nanosatellite can be as low as $40,000. Because of the small size of the satellites and their developers' limited budgets, these payloads do not stimulate commercial launch demand on their own.

DIGITAL AUDIO RADIO SERVICES

Satellite digital audio radio services (DARS) providers, commonly referred to as satellite radio, is dominated in the United States by Sirius XM. In 2008, the United States government approved the merger of Sirius and XM. The merger adds uncertainty to the number and timing of future NGSO DARS satellites in the United States. Sirius currently has plans for one NGSO satellite launch and both companies have additional GSO launches booked, but the merger could affect these deployments.

In Europe, Ondas Media is making the strongest movement towards an NGSO DARS system. They have signed an authorization to proceed with Space Systems/Loral for the design and development of their system, which would include three ELI satellites launched around 2012. In 2008, Ondas announced agreements with Nissan-Infiniti and BMW to install receivers in their automobiles. Ondas is currently in the financing phase and because significant investment has not been announced, the Ondas satellite launch demand is not currently included in the forecast. Ondas faces possible market competition from Europa Max, which reportedly plans a similar HEO system to Ondas, and GSO DARS players WorldSpace and an SES-Eutelsat partnership. This forecast assumes that there is a market for one European NGSO DARS system, based on the Ondas satellite and timeframe plans.

MILITARY

Commercial launches are sometimes procured by governments for military satellites. These are minority cases, but two government systems currently use this commercial method: Italy's Cosmo-Skymed and Canada's SAPPHIRE.

The Italian Cosmo-Skymed constellation is a grouping of four synthetic aperture radar imaging satellites procured by the Italian Space Agency (ASI) for Italian government use. The spacecraft have a mass of 1,700 kilograms (3,745 pounds) and will orbit at an altitude of around 619 kilometers (385 miles). ASI contracted with Boeing Launch Services for the first three Cosmo-Skymed launches. The first three satellites were launched individually by Delta II vehicles in 2007 and 2008. The fourth satellite is planned in 2010 on a Delta II.

MacDonald, Dettwiler and Associates (MDA) is developing the SAPPHIRE small satellite mission. SAPPHIRE will perform space surveillance of man-made objects and space debris in medium to high earth orbits - 6,000 to 40,000 kilometers. The mission is estimated to launch in 2011 aboard a launch vehicle yet to be determined. Follow-on SAPPHIRE missions are possible but not currently confirmed.

ORBITAL RESEARCH PLATFORM

In 2008, SpaceX announced a new commercial space research platform called DragonLab. The DragonLab will be a free-flying, reusable spacecraft capable of hosting pressurized and unpressurized payloads to and from space. DragonLab is a platform for in-space experimentation and deployment of small spacecraft according to SpaceX. In November 2008, SpaceX hosted a workshop to present DragonLab's capabilities to potential users. The first DragonLab missions are expected to launch in 2011 and 2012.

MARKET DEMAND

The FAA/AST projects that 74 satellites of the international science or other categories will be launched during the forecast period. These payloads will be deployed on 39 launches, including 17 medium-to-heavy and 22 small vehicles. Among the market categories, this is the second largest number of satellites to be launched and the greatest amount of demand for small launch vehicles in the forecast.

Commercial Remote Sensing Satellites

Remote sensing has become a strong worldwide market with the availability of lower-cost imagery, advancements in Geospatial Information Systems (GIS), and the fusion of both within web-based distribution systems such as Google Earth.

Commercial remote sensing satellites are one set of systems that provide imagery and data for GIS applications, often competing with high-resolution government satellites and aerial systems. One sign of competition within the market is investment in vertical markets by major players, such as combining aerial and satellite assets together while offering additional value-added GIS services. There is sufficient demand for imagery and data from both government and commercial customers, though, to support several new and existing commercial satellites.

Government support has been a major factor in commercial system development in this market. The U.S. Government continues to be an important driver of the commercial remote sensing satellite market. The National Geospatial-Intelligence Agency (NGA) partially funded developing the current generation of GeoEye and DigitalGlobe satellites through NextView contracts, and purchases imagery through ClearView contracts. The future of NGA contracts with commercial operators, which has yet to be announced, will be a significant determining factor on future satellite plans. Public-private partnerships in Europe have also spurred system development. For example, Germany and Infoterra partnered for the development of the TerraSAR system.

The National Oceanic and Atmospheric Administration (NOAA) is the U.S. agency with authority to license commercial remote sensing systems. There have been 28 licenses issued to date since 1993. Twelve of these licenses were granted to GeoEye and DigitalGlobe, or their predecessor companies. Fourteen other companies have received licenses, however, eight of these companies have retired their licenses. A listing of NOAA licenses is presented in Table 12.

The commercial remote sensing sector continues a trend of low, but steady, commercial launch demand. Much of this demand consists of cyclical replenishment of commercial remote sensing constellations. Advances in imaging and satellite technology allow commercial remote sensing satellites to provide more capability with less mass. This trend will likely result in a shift towards demand for smaller launch vehicles or multi-manifested launch options.

Licensee	Date License Granted	Remarks
DigitalGlobe	1/4/1993	Originally issued to WorldView.
ORBIMAGE (d/b/a GeoEye)	5/5/1994	Originally issued to Orbital Sciences Corp.
ORBIMAGE (d/b/a GeoEye)	7/1/1994	Originally issued to Orbital Sciences Corp.
DigitalGlobe	9/2/1994	
AstroVision	1/23/1995	First license issued for a commercial GSO system.
Ball Aerospace/Technologies	11/21/2000	
DigitalGlobe	12/6/2000	First licenses issued to commercial operators for 0.5 meter resolution.
DigitalGlobe	12/14/2000	
TransOrbital	3/6/2002	TransOrbital license for imaging Earth from lunar orbit.
DigitalGlobe	9/29/2003	License for four-satellite high-resolution system.
Northrop Grumman	2/20/2004	MEO system with 0.5-meter resolution.
ORBIMAGE (d/b/a GeoEye)	8/12/2004	Originally issued to ORBIMAGE Inc.
Technica	12/8/2005	Planned four satellite EaglEye system.
ORBIMAGE (d/b/a GeoEye)	1/10/2006	IKONOS system license transfer from Space Imaging to ORBIMAGE.
ORBIMAGE (d/b/a GeoEye)	1/10/2006	IKONOS system license transfer from Space Imaging to ORBIMAGE.
ORBIMAGE (d/b/a GeoEye)	1/10/2006	IKONOS system license transfer from Space Imaging to ORBIMAGE.
Echostar	3/6/2007	GSO satellite with television camera for low-resolution images.

Table 12. NOAA Remote Sensing Licenses

The major companies operating or actively developing remote sensing satellites across the globe are profiled below. A summary of the commercial remote sensing systems is provided in Table 13.

System	Operator	Manufacturer	Satellites	Mass kg (lbm)	Highest Resolution (m)	Launch Year	Status
OPERTIONAL & UNDER DEVELOPMENT							
EROS	ImageSat International	Israel Aircraft Industries	EROS A EROS B EROS C	280 (617) 350 (771) 350 (771)	1.5 0.7 0.7	2000 2006 2013	EROS A and B are operational. EROS C planned as EROS A replacement at end of life.
IKONOS	GeoEye	Lockheed Martin	IKONOS 1 IKONOS	816 (1,800) 816 (1,800)	1 1	1999 1999	IKONOS 1 lost due to launch vehicle malfunction. IKONOS continues to operate.
OrbView	GeoEye	Orbital Sciences Corp.	OrbView-1 OrbView-2 OrbView-3 OrbView-4	74 (163) 372 (819) 304 (670) 368 (811)	10,000 1,000 1 1	1995 1997 2003 2001	OrbView-2 continues to operate. OrbView-1 and -3 are no longer operational. OrbView 4 lost due to launch vehicle failure.
QuickBird	DigitalGlobe	Ball Aerospace	EarlyBird QuickBird 1 QuickBird	310 (682) 815 (1,797) 909 (2,004)	3 1 0.6	1997 2000 2001	QuickBird continues to operate. EarlyBird failed in orbit shortly after launch. First QuickBird launch failed in 2000.
RADARSAT	MacDonald, Dettwiler and Associates (Telesat Canada)	MacDonald, Dettwiler and Associates	RADARSAT-1 RADARSAT-2 RCM	2,750 (6,050) 2,195 (4,840) 1,200 (2,645)	8 3 TBD	1995 2007 2014-16	RADARSAT-1 and -2 are operational. RCM is the future three-satellite RADARSAT Constellation Mission.
TerraSAR	InfoTerra Group	Astrium	TerraSAR-X TanDEM-X TerraSAR-X2 TerraSAR-X3	1,023 (2,255) 1,023 (2,255) 2,060 (4,540) TBD	3 3 5 TBD	2007 2009 2013 2016	TerraSAR-X is currently operational. TanDEM-X will fly in formation with TerraSAR-X. TerraSAR-X2 & TerraSAR-X3 are end of life replacements for TerraSAR-X and TanDEM-X.
WorldView	DigitalGlobe	Ball Aerospace	WorldView 1 WorldView 2	2,500 (5,510) 2,800 (6,175)	0.5 0.5	2007 2009	WorldView 1 is operational. WorldView 2 will operate in a higher orbit than WorldView 1 and take imagery in additional spectral bands.
GeoEye	GeoEye	General Dynamics Advanced Info. Systems	GeoEye-1 GeoEye-2	907 (2,000) TBD	0.41 TBD	2008 2012	GeoEye 1 and 2 will provide very high-resolution imaging, upgrading GeoEye's current on-orbit fleet.
RapidEye	RapidEye AG	MDA	RapidEye 1-5	150 (330)	6.5	2008	String of five satellites provides high temporal frequency and redundancy.

Table 13. Commercial Satellite Remote Sensing Systems

DIGITAL GLOBE

DigitalGlobe is a U.S. commercial remote sensing data provider, based in Longmont, Colorado. The company was established in 1993 and is privately held. On April 29, 2009, DigitalGlobe filed a Registration Statement and IPO prospectus with the U.S. Securities and Exchange Commission. These steps could lead to a public IPO launch as soon as May 2009. DigitalGlobe has two remote sensing satellites on orbit within its Quickbird and WorldView systems. Quickbird, its first operational satellite, was launched by a Boeing Delta II on October 18, 2001, and continues to operate with a current projected operational lifetime lasting until around 2010. A higher-capability generation of satellites, beginning with WorldView 1, is also now operational. DigitalGlobe also has a second WorldView satellite in development, with another Boeing contract announced for a Delta II launch in 2009 and has an estimated lifetime of at least seven years.

GEOEYE

GeoEye, Inc., based in Dulles, Virginia, is a publicly-traded U.S. commercial remote sensing data provider. The company was formed by the acquisition of Space Imaging by ORBIMAGE in January 2006. GeoEye launched its next-generation satellite system in 2009, which will add higher-resolution satellite capability to its two currently-operational satellites. The satellite has a planned operational lifetime of seven years or longer. GeoEye has also begun developing its next satellite, GeoEye 2. The company announced a contract with ITT in October 2007 for developing GeoEye 2's imaging system. Current estimates place the GeoEye 2 launch around 2012.

IMAGESAT INTERNATIONAL NV

ImageSat, founded as West Indian Space in 1997 and officially a Netherlands Antilles company, provides commercial high-resolution imagery from its Earth Remote Observation Satellite (EROS) family of satellites. The EROS satellite contracting team includes Israel Aircraft Industries Ltd. as the satellite bus manufacturer and ELBIT-Electro Optics Industries as builder of the imaging system. ImageSat currently operates two satellites, EROS A and EROS B. EROS A was launched from Svobodny, Russia, in December 2000, and is expected to operate until 2012 or later. In April 2006, the second ImageSat satellite, EROS B, was launched and is projected to operate until 2018 or longer. ImageSat currently plans to develop a third satellite, EROS C, that is projected to launch around 2013 as a replacement for EROS A. EROS C is currently included in the forecast, however, a lawsuit filed by Pegasus Capital Advisors in early 2009 alleges mismanagement of Imagesat by majority shareholders Israel Aerospace Industries and Elbit Systems. This lawsuit and three previous lawsuits filed against Imagesat raise uncertainty about the deployment of EROS C. Furthermore, the latest lawsuit revealed that the Israeli Ministry of Defense declined to renew its satellite operating partner agreement that expired at the end of 2008. An alternate agreement has yet to be announced.

INFOTERRA GROUP

Infoterra GmbH is a part of the Infoterra Group and is a subsidiary of EADS Astrium GmbH. Through a public-private partnership with the German Aerospace Center (DLR), Infoterra provides radar imagery from the TerraSAR-X satellite. Infoterra is involved with commercial imagery, while DLR is responsible for science missions using the satellite. TerraSAR-X is the first of a pair of X-band synthetic aperture radar satellites that will be launched and operated for Infoterra commercial use. The operational satellite, built by EADS Astrium with a projected five-year or longer operational lifetime, was launched on June 15, 2007, by a Russian Dnepr vehicle. The second satellite of the pair is TanDEM-X, which will fly in close formation with TerraSAR-X. TanDEM-X is also developed by EADS Astrium and will have a five-year or longer expected lifetime. The satellite is scheduled to launch on a Dnepr in 2009.Two future satellite missions are under consideration to continue Infoterra's mission including TerraSAR-X2 in 2013 and TerraSAR-X3 in 2016-2018.

MACDONALD, DETTWILER AND ASSOCIATES

MacDonald, Dettwiler and Associates Ltd. (MDA) is a commercial provider of radar satellite remote sensing data coming from the Canadian RADARSAT series of satellites. The company distributes data from two operational satellites, RADARSAT-1 and RADARSAT-2. RADARSAT-1 was a Canadian Space Agency government-led program, while RADARSAT-2 is owned and operated by MDA as a private-sector program. The first RADARSAT satellite was launched in November 1995 aboard a Delta II, while the second was launched on December 14, 2007, using a Starsem Soyuz vehicle from the Baikonur Cosmodrome. To provide continuation of the radar data missions, the Government of Canada and the Canadian Space Agency have proposed a three-satellite RADARSAT Constellation as follow-on to RADARSAT-2. In November 2008 MDA was awarded $40 million Canadian (US$33 million) for a 16-month study that will result in a high-level design for the system. The RADARSAT Constellation Mission (RCM) satellites, projected to weigh approximately 1,200 kilograms (2,600 pounds) each, are currently planned to launch individually in 2014, 2015, and 2016.

RAPIDEYE AG

RapidEye, a German company providing satellite-based geo-information services, has developed a five-satellite multi-spectral remote sensing constellation designed to provide data for customers interested in agricultural and cartographic applications, among other possible markets. RapidEye revenues come from both commercial and government clients within these markets. MDA is the prime contractor for the mission responsible for the design and implementation of the satellite, including space and ground segments, launch, in-orbit commissioning, calibration of the spacecraft constellation, and establishing the mission operations infrastructure. SSTL built the satellite platforms and the German company Jena-Optronik GmbH provided the optical payload. Among others, MDA's Geospatial Services and U.S.-based MDA Federal Inc. will provide support to RapidEye by marketing and selling its products. Launching the five RapidEye satellites occurred in August 2008 on a Dnepr vehicle. Each RapidEye satellite is in the same orbital plane, and is supported by an S-band command center and an X-band downlink ground component. The satellites, each providing resolution of up to 6.5 meters (21 feet), have an expected operational lifetime of seven years. RapidEye currently intends to maintain a satellite system beyond the lifetime of these five first-generation satellites, but detailed planning for a next generation has yet to be determined.

MARKET DEMAND

The FAA/AST projects that the commercial satellite remote sensing sector will yield about 18 payloads throughout the forecast period, with a peak of 7 in 2015 due to the projected launch of future generation satellites for system continuity. The commercial remote sensing satellites will be deployed on 14 launches, including 12 on medium-to-heavy vehicles.

NGSO Telecommunications Systems

The NGSO telecommunications satellite market is based on large constellations of small-to-medium-sized satellites that provide worldwide or near-worldwide communications coverage. The constellations fall into three categories. The first two categories are Little LEO and Big LEO, derived from the frequencies that satellites use: Little LEO systems operate at frequencies below 1 GHz and Big LEO systems use frequencies in the range of 1.6–2.5 GHz. Little LEO systems provide narrowband data communications such as e-mail, two-way paging, and simple messaging for automated meter reading, vehicle fleet tracking, and other remote data monitoring applications. Big LEO systems provide mobile voice telephony and data services. There is one Little LEO system, ORBCOMM, and two Big LEO systems, Globalstar and Iridium, currently on-orbit and operational. All three of these systems are in the planning or development stage of their new generation of satellites. The third category is Broadband LEO, which represents satellite systems residing in NGSO and providing high-speed data services at Ka- and Ku-band frequencies. Past proposed Broadband LEO systems have not made it to fruition. However, O3b Networks proposes to deploy a Broadband LEO system in 2010 that will provide Internet links and 3G cellular backhaul to underserved regions. Big LEO systems are summarized in Table 14, Big LEO systems in Table 15, and Broadband LEO in Table 16.

System	Operator	Prime Contractor	Satellites		Orbit Type	First Launch	Status
			Number	Mass kg (lbm)			
OPERTIONAL							
Globalstar	Globalstar Inc.	Thales Alenia Space	60/48 (in orbit/ operational)	447 (985)	LEO	1998	Constellation on-orbit and operational, with some technical anomolies. Thermo Capital Partners acquired a majority interest in the company in December 2003. Eight replacement satellites launched in 2007. Next-generation system planned for launch starting in 2009.
Iridium	Iridium Satellite LLC	Motorola	90/74 (in orbit/ operational)	680 (1,500)	LEO	1997	Constellation on-orbit and operational. Assets acquired in December 2000 bankruptcy proceeding. Five spare satellites launched in February 2002, two additional spares launched June 2002. Next-generation system to be developed and launched.

Table 14. Big LEO Systems

System	Operator	Prime Contractor	Satellites: Number	Satellites: Mass kg (lbm)	Orbit Type	First Launch	Status
OPERTIONAL							
ORBCOMM	ORBCOMM Global LP	Orbital Sciences Corp.	41/27 (in orbit/ operational)	43 (95)	LEO	1997	System operational with 35 satellites on orbit; FCC licensed, October 1994. Emerged from bankruptcy protection in March 2002. 2008 FCC authorization for replacement satellite plan. Eighteen ORBCOMM Generation 2 satellites planned to begin launching in 2010.
UNDER DEVELOPMENT							
AprizeStar (LatinSat)	Aprize Satellite	SpaceQuest	4/2 (in orbit/ operational)	10 (22)	LEO	2002	Planned 30-satellite system, with intermittent launches based on availability of funding. Licensed by Argentine CNC in 1995.

Table 15. Little LEO Systems

System	Operator	Prime Contractor	Satellites: Number	Satellites: Mass kg (lbm)	Orbit Type	First Launch	Status
UNDER DEVELOPMENT							
O3b	O3b Networks Ltd.	Thales Alenia Space	0/0 (in orbit/ operational)	700 (1540)	LEO	2010	The first eight satellites of the constellation are planned to launch in 2010.

Table 16. Broadband LEO Systems

GLOBALSTAR

Globalstar, Inc. is a publicly-traded Big LEO system operator primarily serving the global satellite voice and data markets. Their full service offering began in the first quarter of 2000, after which the company filed for Chapter 11 bankruptcy. The company has since emerged from bankruptcy in 2004, held an IPO in 2006, and is in the process of updating its on-orbit satellite constellation that is currently suffering from partial technical failures.

For Globalstar's first-generation satellite constellation, a total of 52 satellites—48 operational satellites plus four on-orbit spares—were placed into orbit using Boeing Delta II boosters and Starsem Soyuz boosters between February 1998 and February 2000. An additional 12 satellites were launched on a Zenit 2 in September 1998, but they were lost due to a launch vehicle failure. The company announced in February 2007 that these operational satellites are continuing to experience S-band amplifier problems, a problem that started to a lesser extent in 2001, which was now affecting the company's voice and two-way data services. The simplex one-way L-band data services provided by the satellites are not affected by these problems.

The company reported $86.1 million in revenue in 2008. This compares with $98.4 million in revenue in 2007 and $136.7 million in 2006. The company reported a net loss of $68 million in 2008 compared with $27.9 million in 2007 and a net income of $23.6 million in 2006. Despite continued loss in revenues Globalstar added 60,204 subscribers in 2008 to bring total Globalstar subscribers to 344,330. The new subscribers are due primarily to simplex and SPOT satellite GPS messenger subscribers.

As a mitigation measure against the S-band problems and to begin the process of updating its on-orbit constellation, Globalstar launched its final eight first-generation replacement satellites on two Soyuz vehicles in May and October 2007. These satellites do not suffer from the technical anomalies of the other operational satellites. In addition to these two launches, the company plans to launch a second-generation system beginning in late 2009. Globalstar has contracted with Arianespace to launch the first 24 satellites on four Soyuz launches, with an option for four additional launches, for a total of 48 new spacecraft. The company intends to use the four launches in 2009 and 2010 to launch 24 of the satellites currently under construction by Thales Alenia Space, with six spacecraft per launch. Together with the eight replacement satellites launched in 2007, Globalstar will create a 32-satellite system as the initial deployment of its new constellation. The remaining 24 satellites being built by Thales Alenia will be launched at a later date to provide Globalstar continued communications capability and are not currently included in the forecast. Financing for Globalstar's new satellites and their launches gained a boost in March of 2009 when France's export credit agency stated it is supplying the company with $574 million in loan guarantees.

In addition to the FCC licenses granted for its first- and second-generation satellite constellation, Globalstar has also been involved in ancillary terrestrial component (ATC) licensing. The company was originally granted permission to use 11 MHz for an ATC system. In April 2008, the FCC granted it permission to use additional spectrum, 19.275 MHz, for ATC. Globalstar signed an agreement in late 2007 with Open Range Communications, permitting that company to use Globalstar's ATC spectrum to provide terrestrial WiMAX service, a technology to provide wireless data over long distances, in rural communities. Open Range Communications has yet to deploy that system, but has received a $267 million loan from the Department of Agriculture's Rural Utilities program in 2008 and $100 million from One Equity Partners in 2009.

IRIDIUM

Iridium Satellite LLC, a privately-held company, is the successor to the original Iridium LLC that built and launched the 66-spacecraft Iridium satellite constellation in the late 1990s. Iridium Satellite purchased the assets of Iridium LLC, including the satellite constellation, for approximately $25 million in December 2000 and restarted Big LEO commercial communications services using the satellite system a few months later. In addition to the 66 operational spacecraft, there are eight functioning spare satellites in orbit. In February 2009, an Iridium satellite collided with a non-operational Russian satellite causing the destruction of both satellites. The Iridium constellation was able to adapt with minimal loss of service and the company replaced the lost satellite with a spare.

A total of 95 Iridium satellites have been launched as a part of the first-generation system, including seven spare satellites launched in 2002: five on a Delta II and two on a Rockot. These satellites comprise a fully-operational system that is expected to provide service until at least 2014. Iridium is now taking the first steps to develop and launch a second-generation satellite constellation, named Iridium NEXT. The company has no spare satellites remaining on the ground and has no plans to build any until it deploys Iridium NEXT.

Iridium has begun the process to implement its next-generation constellation. In March 2008, Iridium announced it had selected three companies as finalists for the contract to develop the Iridium NEXT satellites: Lockheed Martin, Space Systems/Loral, and Thales Alenia Space. The three companies performed design studies for five months, after which Iridium selected Lockheed Martin and Thales Alenia Space in August 2008 to proceed into the system development phase. Iridium will select a prime contractor in 2009. Iridium is considering hosted payload options for its next-generation satellites in addition to the primary communications payload.

Iridium has made no formal plans for launching Iridium NEXT. The company's current notional launch plans call for launching 72 satellites on approximately 12 launches of 6 spacecraft each. Those launches would be spread over a three-year period, beginning around 2014. Iridium is considering a number of launch vehicle options.

As Iridium begins its Iridium NEXT plans, the company is experiencing continued growth of its current business. Iridium reported an EBITDA (earnings before interest, taxes, depreciation, and amortization) of $108.2 million in 2008, a 42 percent increase compared to operational EBITDA of $76.5 million in 2007 and $53.8 million in 2006. The company also reported increased revenues, totaling $320.9 million in 2008, compared with $260.4 million in 2007 and $212.4 million in 2006. The company had 320,000 subscribers (defined as customers, not active devices) at the end of 2008, an increase of 37percent from the end of 2007, which continues the trend in strong growth also seen in 2007.

In September 2008, Iridium and GHL Acquisition Corp., a special purpose acquisition company sponsored by Greenhill & Co., announced the signing of an agreement to combine. The transaction leaves Iridium debt free and financially prepared to develop and deploy Iridium NEXT. Iridium plans to apply for listing on the New York Stock Exchange.

ORBCOMM

Between 1995 and 1999, ORBCOMM deployed a Little LEO constellation of 35 satellites, 29 of which are operational as of April 2008. It is the only company to have fully deployed a system that provides low-bandwidth packet data services worldwide. At the end of 2008, ORBCOMM reported a total of 460,000 billable subscriber communicators, a 31 percent increase over 2007. ORBCOMM plans to launch a new generation of satellites early next decade, in addition to six satellites launched in 2008, to continue their telecommunications services.

ORBCOMM reported improved financial statistics in 2008. A publicly-traded company, ORBCOMM earned revenues of $30 million in 2008, compared with $28 million in 2007 and $24.5 million in 2006. Gains are attributed to a 34.4 percent increase in service revenues due to an increase in billable subscriber communicators, inclusion of ORBCOMM Japan, and the commencement of Automatic Identification System (AIS) revenue. ORBCOMM's product sales decreased 39.8 percent in 2008 which included lower communicator unit sales. The lower communicator sales may be attributed partially to ORBCOMM's focus on service revenues growth while letting the market chose the appropriate hardware from non-ORBCOMM sources, a move to attract and retain hardware vendors.

ORBCOMM launched six satellites on a Cosmos 3M in June 2008, as the first part of its plan to replenish its current 29-satellite constellation with 24 new satellites. Five of the six satellites launched in June 2008 are the company's "QuickLaunch" spacecraft, originally scheduled to be launched in 2007 but delayed due to "electromagnetic compatibility testing" problems. The sixth satellite was a U.S. Coast Guard demonstration satellite with an AIS payload. ORBCOMM signed a global AIS distribution agreement for commercial purposes with Lloyd's Register – Fairplay (LRF) in January 2009. The AIS system will be used by LRF to validate the position of the world's merchant fleet and includes a minimum annual license fee to ORBCOMM. In February 2009, one of the new "quick-launch" satellites experienced a power anomaly and subsequently stopped communicating with the ground control and is assumed to be lost. OHB engineers are analyzing the power system components that may have contributed to the failure. The other quick-launch satellites have experienced outages of redundant power system components and are being investigated.

The remaining 18 new satellites will be "Generation 2" satellites. In May 2008, ORBCOMM chose Sierra Nevada Corporation with subcontractors Boeing, ITT, and MicroSat to build the Generation 2 satellites, which all include the AIS payload. The projected plans are to launch these satellites in 2010 and 2011, most likely with three launches of six spacecraft each. Generation 2 will likely create demand for small launch vehicles, as did the first generation and QuickLaunch missions, although no launch contracts have yet been announced. The new ORBCOMM constellation will operate in four orbital planes, each in 750-kilometer circular orbits at an inclination of 48.5°. ORBCOMM received FCC authorization for these new satellite and launch plans in March 2008.

O3B

O3b Networks, headquartered in St. John, Jersey, Channel Islands, is a new company aimed at providing bandwidth access to underserved parts of the world. The O3b satellite system will offer low-latency (responsive) links from 1 Mbps to 10 Gbps for core transmission of the Internet, backup for fiber based connections, and transmission of data from remote cell towers to the larger telecommunications infrastructure.. The O3b constellation is designed to operate in the Ka-band in an equatorial orbit with a minimum of five satellites to cover +/- 45 degree of latitude around all 360 degrees of the Equator, and additional satellites can be added as need to meet demand. The smaller O3b satellites are relatively inexpensive to manufacture and launch and will provide a relatively large amount of capacity. Although the Ka-band spectrum allows for higher throughput than Big LEO and Small LEO spectrum, it is more susceptible to weather interference, requires large tracking antennas, and is not suited for mobile receivers.

In September 2008, O3b announced that Thales Alenia Space was beginning construction of 16 communications satellites that are scheduled for delivery in 2010 and are expected to have an on-orbit maneuvering lifetime of ten years. Design of the satellite began by Thales Alenia Space in 2007 and the preliminary design review was competed in February 2009. In September, O3b also announced a launch services agreement with Sea Launch for up to two launches with the first launch slated for late 2010. However, O3b may launch its first 8 satellites on 2 Soyuz-2 launch vehicles, although no contract has yet been announced. The decision to move the first eight satellites to Arianespace may help O3b secure financing through France's export credit agency. Because an alternate launch contract hasn't been announced, this forecast reflects the original Sea Launch contracts.

O3b estimates that it must raise $700 million to deploy its system. In September, 2008 O3b announced investment by Google, Inc.; Liberty Global Inc.; and HSBC Principal Investments. O3b has signed agreements with at least four telecommunications providers and reported that $200 million in customer contract backlog had been secured by the last quarter of 2008.

OTHER SYSTEMS

A number of additional NGSO satellite telecommunications systems have been proposed, but have not been major drivers of launch demand. These systems run the gamut of Big LEO, Little LEO, and Broadband LEO satellites. Some potential providers of satellite telecommunications services struggled to gain necessary funding or failed to follow through on their business plans. Others have had slow deployment timelines or have delayed satellite plans.

Some Little LEO satellite systems are so small that they do not necessarily generate launch demand. Aprize Satellite, Inc. is deploying one such system. A total of four AprizeStar (also known by its ITU registration as LatinSat) satellites weighing 10 kilograms (22 pounds) each were launched as secondary payloads on a Russian Dnepr rocket, two in 2002 and two in June 2004. Two AprizeStar satellites will be launched as secondary payloads on a Dnepr vehicle in 2009. In addition, two more Aprize microsatellites are planned for launch in 2010. A constellation with 30 satellites is planned by Aprize, depending on funding opportunities and customer demand for additional data-communication capacity and frequency of contact. Aprize received an experimental license from the FCC in 2004 for the two satellites launched that year. The systems also received licenses from the Argentine National Communications Commission (CNC) in 1995 and Industry Canada in 2003.

ICO Global Communications—a name derived from the acronym for intermediate circular orbit—had planned to deploy a Big LEO system of ten operational satellites plus two on-orbit spares located in medium Earth obit at an altitude of 10,390 kilometers (6,450 miles). ICO did begin NGSO launches, but did not complete the deployment of its planned system. One ICO satellite was lost in a launch failure in March 2000. A second satellite was successfully launched in June 2001. ICO then changed its satellite plans to a GSO system. In January 2005, ICO filed an application with the FCC seeking approval to modify its non-geosynchronous satellite service authorization to substitute a geosynchronous satellite system to access the United States market. The FCC approved this application in May 2005. The ICO G1 satellite, built by Space Systems/Loral, successfully launched to GSO on April 14, 2008. In May 2007, ICO stated intentions to pursue a European operating license and hoped to still launch its ten NGSO satellites that remain in storage, four of which are in various stages of assembly. However, in March 2009 the UK communications regulator Ofcom canceled the ITU registration of ICO's requested frequency assignments based on ICO's lack of progress in deploying its system.

Two companies have made initial plans to develop broadband satellite systems using a combination of GSO and NGSO satellites. AtContact and Northrop Grumman filed applications with the FCC for hybrid GSO/NGSO systems. Each company planned to incorporate four GSO satellites plus three HEO satellites in their system. AtContact received a license from the FCC for its Ka-band system in April 2006; the license included milestones that required the company to have its entire system certified as operational by April 2012. The company entered into a non-contingent satellite manufacturing contract with Space Systems/Loral in April 2007 and filed a confirmation with the FCC that it completed a critical design review of the system in April 2008. In February 2009, AtContact surrendered the NGSO satellite components of its license but requested that the long-lead items already constructed satisfy the construction milestone for its GSO satellites.

In March of 2009, the FCC granted Northrop a license for its planned Ka- and V-band frequency Global EHF Satellite Network. However, Northrop surrendered the license in early April citing unfavorable economic conditions.

MARKET DEMAND

The FAA/AST projects that 20 Little LEO satellites will be launched during the coming decade and generate a demand for three launches of small vehicles. The FAA/AST projects that 96 Big LEO satellites will be launched during the coming decade to cover the replenishment of two existing systems. These payloads will be deployed on 16 launches of medium-to-heavy vehicles. Broadband LEO will generate 16 satellites that will launch on 2 medium-to-heavy vehicles.

Orbital Facility Assembly and Services

A new market has emerged for launching commercial orbital facilities, as well as missions to service these facilities with crew and cargo. These commercial orbital facilities aim to serve space tourism, microgravity, and other scientific purposes. Service missions are necessary to bring people and goods to these facilities, using pressurized and unpressurized transportation. In late 2008, NASA contracted with U.S. industry for commercial cargo supply missions to support the International Space Station (ISS) during the transition from the Space Shuttle to the Constellation vehicles. NASA's Commercial Orbital Transportation Services (COTS) program has sparked the necessary technology development for these missions.

This is the second year that the orbital facility assembly and services (OFAS) market category has existed within the forecast. Orbital facility launches were previously part of the "other" market category.

BIGELOW AEROSPACE ORBITAL HABITATS

The first commercial orbital facilities are under development by Bigelow Aerospace. Bigelow's goal is to create crewed orbital facilities based on expandable habitats. Two initial demonstration spacecraft, Genesis I and Genesis II, were commercially launched by Dnepr rockets in 2006 and 2007, respectively. These spacecraft are successfully testing and validating systems critical for future Bigelow expandable habitats.

Bigelow Aerospace is now working to manufacture the Sundancer habitat, a full-scale human-habitable spacecraft. Sundancer will offer 175 cubic meters of habitable volume and be able to support up to three people. The first Sundancer launch date will be determined by the availability of the necessary transportation systems to support the transfer of crew and cargo. Shortly after Sundancer, Bigelow plans to launch a node and bus system that will be combined with Sundancer to add operational functionality as part of the first orbital complex. Bigelow then anticipates launching a second Sundancer and larger BA-330 habitat. The BA-330 spacecraft will provide roughly 300 cubic meters of habitable volume. The two Sundancers, the node and bus, and a BA-330 will form Bigelow's first orbital complex. The complex will require at least four launches to place it in orbit followed by an unknown number of servicing missions to support it.

Bigelow business plans include selling four-week trips to its modules to astronauts from various national space agencies. The company will also offer full module lease opportunities. A critical consideration for Bigelow's plans is the availability of affordable commercial transportation to carry people and cargo to and from its orbital facilities. Once in orbit, the habitats will require a regular supply of both crew and cargo. This requirement increases launch demand within the Orbital Facility Assembly and Supply market, but it necessitates developing a new private sector crew capsule to affordably, reliably, and safely transfer Bigelow personnel and customers to and from its orbital complexes. At this time the future launches associated with a Bigelow space complex are not include in the forecast.

NASA COTS

The COTS program at NASA supports developing orbital cargo transportation capabilities within U.S. commercial industry. Two current COTS funded Space Act Agreements, with SpaceX and Orbital Sciences, as well as several unfunded Space Act Agreements with other companies, are promoting systems that could provide cargo resupply to the ISS. There is an option for developing a COTS crew capability as well, but this option has not yet been exercised.

The funded Agreements require four FAA/AST-licensed demonstration launches during the next few years from SpaceX and Orbital Sciences. Both companies are developing new launch and orbital vehicles for COTS, combining their own private financing with the COTS funding. The SpaceX system uses the company's

Falcon 9 launch vehicle and Dragon orbital vehicle. Three demonstration flights are planned by SpaceX, one in 2009 and two in 2010. The Orbital Sciences system combines the Taurus II launch vehicle and the Cygnus orbital vehicle. One COTS demonstration launch is planned for Orbital Sciences in 2011.

COMMERCIAL ISS RESUPPLY

Building on the COTS program and other U.S. commercial space technology, NASA is beginning the process to acquire commercial cargo transportation services to resupply the ISS. Between the time when the Space Shuttle is retired and the new Constellation transportation systems are operational, the United States will face a shortfall in transportation capability to the ISS. Procuring U.S. commercial services is part of the solution for filling this transportation demand gap, which also includes the use of foreign orbital vehicles. NASA will depend on the cargo capability of the European ATV and Japanese HTV and rely on pre-positioned spares, delivered by the Shuttle before its scheduled retirement in 2010, until U.S. commercial cargo vehicles are operational.

The NASA ISS Commercial Resupply Services (CRS) program evaluated proposals for commercial ISS resupply services during 2008. The CRS program solicited suppliers of commercial companies capable of supplying pressurized upmass, unpressurized upmass, returned downmass, and disposal downmass to and from the International Space Station for the time period of 2009-2016. On December 23, 2008, NASA awarded CRS contracts to Orbital Sciences and SpaceX. The contracts included a basic requirement of carrying 20,000 kilograms to the ISS. The SpaceX contract includes 12 flights that will contain a combination of internal and external upmass and return downmass between 2010 and 2015. The SpaceX contract is valued at $1.6 billion and NASA has the option to order additional missions for a cumulative total value of up to $3.1 billion. The Orbital Sciences contract is valued at $1.9 billion with options for flights totaling $3.1 billion. Orbital Sciences will meet the contract requirements through eight missions between 2011 and 2015.

The ISS is a continuing market for cargo supply mission. Demand for commercial service could possibly continue after 2015, the last year under the RFP, depending on decisions regarding continued operations on the ISS and NASA transportation choices. This forecast includes a continuation of commercial ISS resupply missions at a rate of four launches a year from 2016 to 2018.

MARKET DEMAND

The FAA/AST projects that 36 orbital facility assembly and service missions will launch during the ten-year forecast period. Each of these missions will require a medium-to-heavy launch vehicle, therefore, creating a demand for 36 launches in this vehicle category.

Future Markets

Demand for commercial launches to NGSO could be affected by new emerging markets and even by a series of competitions. The launch demand possibilities of future markets are evidenced by the continued development of the orbital facility assembly and supply market category in the forecast model. The activities within this category—NASA COTS, commercial ISS resupply, and missions for Bigelow Aerospace on-orbit facilities—were considered to be future markets in previous years' forecasts. Now, through Bigelow's achievements, NASA contract activity, and progress made towards commercial orbital transfer vehicles, this market is now showing real demand potential within the forecast period.

The orbital public space travel market could blossom into a fruitful NGSO launch market. Somewhat connected with orbital facility and supply missions, public space travel would include paying customer missions to orbit on stand alone flights or on a trip to an orbital facility. A number of companies are developing suborbital vehicles to be used for public space travel—these are not considered in the forecast since they are not orbital missions—and other companies have proposed new commercial orbital vehicles. Though the suborbital industry is forming, the orbital industry has yet to come concretely together. There have been a number of individual space tourist missions onboard Russian Soyuz ISS missions. Historically these missions have been primarily government natured missions. However, in March 2009 Space Adventures discussed the possibility of brokering Soyuz flights dedicated to commercial space tourism in the 2011-2012 timeframe.

Space prize competitions are also driving possible new commercial launch demand. NASA's "Centennial Challenges" prize competition program, within the Innovative Partnerships Program, may include future Challenges for spacecraft missions, including breakthrough technology demonstration missions and missions to the Moon and other destinations that could stimulate demand for low-cost, emergent launch capabilities. The largest competition to date, the Northrop Grumman Lunar Lander Challenge, features $2 million in prizes for vehicles that can simulate the liftoff and landing of a lunar spacecraft; the same technology could be used for developing future commercial suborbital and orbital spacecraft. On October 25, 2008, first prize of Level One of the Lunar Lander Challenge was won by Armadillo Aerospace. Level Two prize money remains to be awarded.

The $30 million Google Lunar X PRIZE, while focused on safely landing a robot on the surface of the Moon, may create demand for commercial launch services. Beyond winning the prize Google Lunar participants may develop the technology and experience necessary to mount continued lunar exploration efforts that will require launch services. Bigelow Aerospace is also offering a space prize competition, America's Space Prize, to promote orbital transfer vehicle development for the future servicing of its habitats. This competition could advance the OFAS market, as well as future markets such as orbital public space travel.

Risk Factors That Affect Satellite and Launch Demand

Several factors could negatively or positively impact the NGSO forecast:

- U.S. national and global economy— Strong overall economic conditions have historically fostered growth and expansion in satellite markets. Similarly, relatively weaker currency exchange rates in one nation generally create favorable circumstances for exporters and buyers in a given marketplace. Global satellite manufacturers and purchasers have shown strong interest in taking advantage of the highly attractive values offered by the historically low U.S. dollar exchange rates. However, it is difficult to project if this trend will be sustained given the global economic recession that became pronounced in late 2008. The troubled credit markets have eroded investor confidence broadly and soaring prices for basic necessities such as food and fuel typically foreshadow significant contractions of all consumer based markets particularly in the short term.

- Investor confidence—After investors suffered large losses from the bankruptcies of high-profile NGSO systems, confidence in future and follow-on NGSO telecommunications systems plummeted. There are signs of renewed investor confidence in this market, but skepticism remains about broadband NGSO systems, especially because of high entry costs. The surrender of FCC licenses to operate NGSO communications systems by AtContact and Northrop Grumman underscores the difficulties in attracting investment at this time.

- Increase in government purchases of commercial services—For a variety of reasons, government entities have been purchasing more space-related services from commercial companies. For example, the DoD continues to purchase significant remote sensing data from commercial providers, as was demonstrated in April 2009 when the White House approved a plan to increase its purchase of commercial remote sensing data. The DOD also continues to be a major customer of Iridium and has made extensive use of its services in Afghanistan and Iraq.

- Satellite lifespan—Many satellites outlast their planned design life. The designated launch years in this forecast for replacement satellites are often estimates for when a new satellite would be needed. Lifespan estimates are critical for the timing of replacements of existing NGSO satellite systems, given the high capital investment required for deploying a replacement system.

- Need for replacement satellites—Although a satellite might have a long lifespan, it could be replaced early because it is no longer cost effective to maintain, or an opportunity could arise that would allow a satellite owner/operator to leap ahead of the competition with a technological advancement. An example of this factor is higher-resolution commercial remote sensing satellites.

- Business case changes—The satellite owner/operator can experience budget shortfalls, change strategies, or request technology upgrades late in the manufacturing stage, all of which can contribute to schedule delay. There could also be an infusion of cash from new investors that could revive a stalled system or accelerate schedules.

- Corporate mergers—The merging of two or more companies may make it less likely for each to continue previous plans and can reduce the number of competing satellites that launch. Conversely, mergers can have a positive impact by pooling the resources of two weaker firms to enable launches that would not have otherwise occurred.

- Regulatory and political changes—Changes in FCC or NOAA processes, export control issues associated with space technology, and political relations between countries can all affect demand. The FCC adopted a new licensing process in 2003 to speed up reviews that put pressure on companies that are not making progress towards launching satellites.

- Terrestrial competition—Satellite services can complement or compete with ground-based technology such as cellular telephones or communications delivered through fiber optic or cable television lines. Aerial remote sensing also competes with satellite imagery. Developers of new space systems have to plan ahead extensively for design, construction, and testing of space technologies, while developers of terrestrial technologies can react and build to market trends more quickly and possibly convince investors of a faster return on investment.

- Launch failure—A launch vehicle failure can delay plans, delay other satellites awaiting a ride on the same vehicle, or cause a shift to other vehicles and, thus, possibly impact their schedules. Failures, however, have not caused customers to terminate plans. The entire industry is affected by failures, however, because insurers raise rates on all launch providers.

- Satellite manufacturing delay—Increased efforts on quality control at large satellite-manufacturing firms seen in the past few years can delay delivery of completed satellites to launch sites. Schedule delays could impact timelines for future demand.

- Failure of orbiting satellites—From the launch services perspective, failure of orbiting satellites could mean ground spares are launched or new satellites are ordered. This would only amount to a small effect on the market, however. A total system failure has not happened to any NGSO constellation, although Globalstar is experiencing difficulties with its existing satellites.

- Increase in government missions open to launch services competition —Some governments keep launch services contracts within their borders to support domestic launch industries. The European Space Agency has held international launch competitions for some of its small science missions. Some remote sensing satellite launches are also competed. While established space-faring nations are reluctant to open up to international competition, the number of nations with new satellite programs but without space launch access is slowly increasing.

- Introduction of a low price launch vehicle—Although low priced Russian vehicles have been available for years, the emergence of the low-price SpaceX Falcon 1 and Falcon 9 have generated an increase in launch demand, especially for new customers in the market. Beyond commercial resupply services to the ISS, new efficient launch system could stimulate the development of a market for commercial human transportation to NGSO. A trend identified in the 2003 NASA ASCENT Study Final Report.

- New markets—The emergence of new markets, such as orbital public space travel, can be difficult to forecast with certainty. The development of these markets can be delayed or accelerated by a combination of technical, financial, and regulatory issues. The NASA COTS program is an example of government promotion of a new commercial market. Prize competitions can also stimulate the development of new markets, allowing both winning and losing competitors to pursue a return on the investment made to capture a prize. A successful competition can inspire other competitions. The SpaceX DragonLab system is an example of a capability—a free-flying, reusable spacecraft capable of hosting pressurized and unpressurized payloads to and from space—that may stimulate the development of a new market.

Methodology

This report is based on FAA/AST research and discussions with industry, including satellite service providers, satellite manufacturers, launch service providers, system operators, government offices, and independent analysts. The FCC was also interviewed for this report. The forecast considers progress for publicly-announced satellites, including financing, regulatory developments, spacecraft manufacturing and launch services contracts, investor confidence, competition from space and terrestrial sectors, and overall economic conditions. Future deployments of satellites that have not yet been announced are projected based on market trends, the status of existing satellites, and the economic conditions of potential satellite developers.

Traditionally, very small satellites—those with masses of less than 100 kilograms (220 pounds)—ride as secondary payloads and thus do not generate "demand" for a single launch in this forecast. However, the launch providers for the Russian/Ukrainian Dnepr and Russian Cosmos are flexible enough to fly several small satellites together without a single large primary payload. Therefore, these missions can act as a driver of demand in this report. Satellites below 10 kilograms (22 pounds) in mass are excluded from the forecast model because they do not create demand for a single launch, and therefore, have negligible effect on global launch demand.

Follow-on systems and replacement satellites for existing systems are evaluated on a case-by-case basis. In some cases, expected future activity is beyond the timeframe of the forecast or is not known with enough certainty to merit inclusion in the forecast model. Satellite systems considered likely to be launched are entered into an Excel-based "traffic model." The model tracks satellites and launches in this forecast based on the research discussed above, known replacement cycles, and other industry trends for existing and planned telecommunications and remote sensing systems. For the international science and other miscellaneous markets, near-term primary payloads that generated individual commercial launches were used in the model while future years were estimated based on historical activity.

In past years, the number of launches that have taken place has often been substantially less than the number in that year's forecast. This mismatch is due to a number of factors, including funding, satellite manufacturing, and launch vehicle delays, that cause the launch to be postponed to the following year. Historically only a small number of primary satellites scheduled for launch have been delayed indefinitely or canceled. International launch providers were surveyed for the latest available near-term manifests. Table 17 shows the announced near-term manifests for the markets analyzed in this report, as well as the realization factor for launches in the near-term manifest for 2009.

Service Type	2009	2010	2011	2012
Commercial Remote Sensing	WorldView 2 - Delta 2			GeoEye 2 - TBA
	TanDEM X - Dnepr			
International Science	RazakSAT* - Falcon 1	CASSIOPE - Falcon 9	EnMap - TBA	Kompsat 3A - TBA
	DubaiSat 1* - Dnepr DEIMOS* UK DMC 2* AprizeStar 3-4*	Kompsat 5 - Dnepr	Microscope - TBA	SAOCOM 1A - Falcon 9
		SWARM 1-3 - TBA	Kompsat 3 - H2A	
	GOCE* - Rockot			
	SMOS* - Rockot			
	Cryosat 2 - Dnepr			
	SERVIS 2 - Rockot			
Telecommunications	Globalstar (6) - Soyuz 2	Globalstar (6) - Soyuz 2	ORBCOMM (6) - TBA	
		Globalstar (6) - Soyuz 2	O3b (8) - Zenit 3SL	
		Globalstar (6) - Soyuz 2		
		ORBCOMM (6) - TBA		
		ORBCOMM (6) - TBA		
		O3b (8) - Zenit 3SL		
Orbital Facility Assembly and Services	Dragon COTS Demo 1- Falcon 9	Dragon COTS Demo 2 - Falcon 9	Cygnus COTS Demo - Taurus II	ISS Re-supply - Taurus II
		Dragon COTS Demo 3 - Falcon 9	ISS Re-supply - Taurus II	ISS Re-supply - Falcon 9
		ISS Re-supply - Falcon 9	ISS Re-supply - Falcon 9	ISS Re-supply - Falcon 9
Other	PRISMA 1 and 2 - Dnepr	Cosmo-Skymed 4 - Delta II	DragonLAB 1 - Falcon 9	DragonLAB 2 - Falcon 9
	Falcon 9 Maiden Flight	Sirius FM-6 - Proton M	SAPPHIRE -TBA	
		SSC TBA- Falcon 1e		
Total Payloads	21	49	22	7
Total Launches	11	15	10	7
FAA Realization Launches	8-10			

Table 17. Near-Term Identified NGSO Satellite Manifest

* Carryover from 2008
Note: Chart includes only those payloads announced as of April 17, 2009
Does not include secondary payloads that do not generate launch demand

Vehicle Sizes and Orbits

Small launch vehicles are defined as those with a payload capacity of less than 2,268 kilograms (5,000 pounds) to LEO, at 185 kilometers (100 nautical miles) altitude and 28.5° inclination. Medium-to-heavy launch vehicles are capable of carrying more than 2,268 kilograms at 185 kilometers altitude and 28.5° inclination.

Commercial NGSO systems use a variety of orbits, including the following:

- Low Earth orbits (LEO) range from 160-2,400 kilometers (100–1,500 miles) in altitude, varying between 0° inclination for equatorial coverage and 101° inclination for global coverage;
- Medium Earth orbits (MEO) begin at 2,400 kilometers (1,500 miles) in altitude and are typically at a 45° inclination to allow for global coverage using fewer higher-powered satellites. However, MEO is often a term applied to any orbit between LEO and GSO;
- Elliptical orbits (ELI, also known as highly-elliptical orbits, or HEO) have apogees ranging from 7,600 kilometers (4,725 miles) to 35,497 kilometers (22,000 miles) in altitude and up to 116.5° inclination, allowing satellites to "hang" over certain regions on Earth, such as North America; and
- External or non-geocentric orbits (EXT) are centered on a celestial body other than the Earth. They differ from highly-elliptical orbits (ELI) in that they are not closed loops around Earth and a spacecraft in EXT will not return to an Earth orbit. In some cases, this term is used for payloads intended to reach another celestial body (e.g., the Moon) even though part of the journey is spent in a free-return orbit that would result in an Earth return if not altered at the appropriate time to reach its destination orbit.

Satellite and Launch Forecast

In this forecast, 260 satellites are seeking future commercial launch, creating demand for 110 launches after multi-manifesting. These numbers are slightly lower than those in the 2008 forecast, which predicted 276 satellites to be launched on 112 vehicles in the 2008–2017 timeframe. The financing uncertainty for deployment of telecommunications systems including DARS has resulted to adjustments in the model that led to the slight decrease. Table 18 and Figures 12 and 13 show the satellites and launches forecasted between 2009 and 2018.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	TOTAL	Avg
SATELLITES												
Little LEO Telecom	2	12	6	0	0	0	0	0	0	0	20	2.0
Big LEO Telecom	6	18	0	0	0	24	24	24	0	0	96	9.6
Broadband LEO Telecom	0	8	8	0	0	0	0	0	0	0	16	1.6
Commercial Remote Sensing	2	0	0	1	2	2	7	2	2	0	18	1.8
Orbital Facility Assembly & Services	1	3	3	3	5	5	4	4	4	4	36	3.6
International Science/Other	8	12	9	8	7	6	6	6	6	6	74	7.4
Total Satellites	19	53	26	12	14	37	41	36	12	10	260	26
LAUNCH DEMAND												
Medium-to-Heavy Vehicles	6	10	6	7	8	12	12	11	6	5	83	8.3
Small Vehicles	2	5	4	2	3	2	2	2	3	2	27	2.7
Total Launches	8	15	10	9	11	14	14	13	9	7	110	11.0

Table 18. Satellite and Launch Demand Forecast

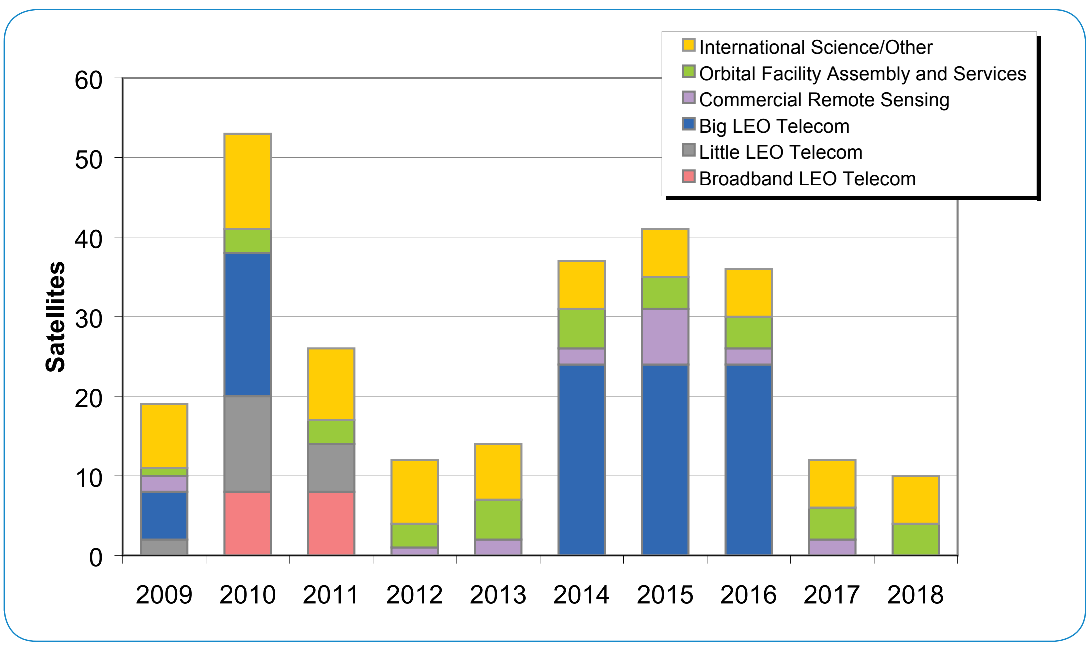

Figure 12. Satellite Forecast

The forecast anticipates the following satellite market characteristics from 2009–2018:

- Telecommunications satellites account for about 51 percent of the market with 132 satellites, a decrease from the 148 satellites in last year's forecast because of uncertainty in the financing for deploying telecommunications systems.
- International science and other satellites (such as military spacecraft and technology demonstrations) will comprise about 28 percent of the NGSO satellite market with 74 satellites, a steady continuation as compared to the 2008 forecast.
- Orbital facility assembly and service satellites account for 12 percent of the 2009 forecast with 35 spacecraft. This is a new market category in its second year of inclusion within the NGSO forecast.
- Commercial remote sensing satellites encompass 7 percent of the 2009 forecast with 18 satellites. This compares with a 13 percent share in the 2008 forecast. This decrease is attributed to the launch of six commercial remote sensing satellites in 2008.

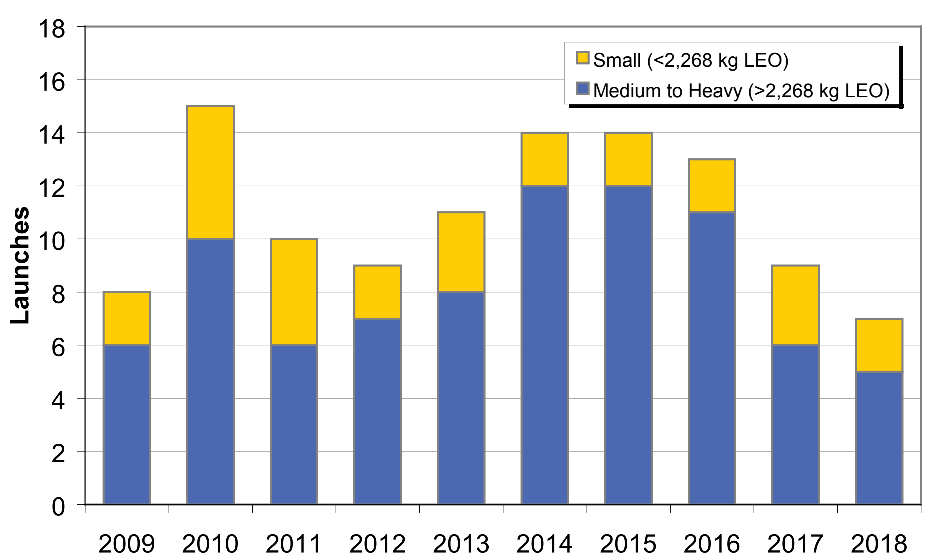

Figure 13. Launch Demand Forecast

Table 19 shows the mass distributions of known manifested satellites over the next four years. Large spacecraft, those with a mass higher than 600 kilograms (1324 pounds), make up 64 percent of those manifested from 2009 to 2012. This compares with a 55 percent share in the 2008 forecast, an increase attributed to inclusion of the O3b satellites and removal of the second set of 24 Globalstar next generation satellites.

	2009	2010	2011	2012	Total	Percent of Total
< 200 kg (< 441 lbm)	6	12	7	0	25	25%
200-600 kg (441-1323 lbm)	2	4	1	0	7	7%
601-1200 kg (1324-2646 lbm)	11	27	10	1	49	49%
> 1200 kg (> 2646 lbm)	2	6	4	6	18	18%
Total	21	49	22	7	99	100%

Table 19. Distribution of Satellite Masses in Near-Term Manifest

The launch forecast of 110 launches is composed of 27 small vehicle and 83 medium-to-heavy vehicle launches. This demand breaks down to an average of fewer than three launches annually on small launch vehicles and about eight launches annually on medium-to-heavy launch vehicles. The 2008 forecast included 112 total launches composed of 31 small and 81 medium-to-heavy launches.

The forecast starts with a total of 21 satellites demanding 11 launches in 2009. Because of launch vehicle and satellite schedule delays, as described in the Methodology section, a realization factor was applied to the number of launches planned for 2008. Therefore, the FAA expects 8 to 10 launches to occur in 2009. The highest amount of forecasted launch demand falls in 2010 with a total of 49 satellites expected to require 15 launches. The forecast shows an increase in demand from 2014 to 2016 that corresponds with the deployment of the Iridium NEXT constellation. Compared with 2008, this year forecast shows greater variability in launch rate over the next 10 years due to the bunching of launches of large telecommunications constellations around 2010 and 2015.

As usual the telecommunications market, led by Big LEO systems, dominates the forecasted satellite market. The projected launch demand for the telecommunications and remote sensing, the international science plus other, and the OFAS market categories are all consistent at approximately 37 total launches apiece. However, as can be seen in Table 20, OFAS spacecraft all require medium-to-heavy launch vehicles whereas international science plus other will use the majority of small launches. Commercial remote sensing satellites are projected to launch on 12 medium-to-heavy launch vehicles and 2 small launch vehicles.

		Launch Demand		
	Satellites	Small	Medium to Heavy	Total
Telecommunications	132	3	18	21
International Science/Other	74	22	17	39
Commercial Remote Sensing	18	2	12	14
Orbital Facility Assembly and Services	36	0	36	36
Total	260	27	83	110

Table 20. Distribution of Launches Among Market Sectors

Historical NGSO Market Assessments

The 2009 FAA/AST forecast of commercial NGSO launches and payloads for 2009–2018 shows greater variability than the 2008 forecast with spikes in launch demand surrounding the bunching of launches in support of the telecommunications market. However, the 2009 forecast, like the 2008 forecast, shows a greater long-term stability in the sector compared with earlier forecasts. For example, the 2004 through 2007 forecasts both began with the maximum number of forecasted launches in the first few years of the forecast period, generally decreasing to the end of the period. The 2009 forecast, though, begins with a spike in demand around 2010 and again around 2015, but then projects demand consistently higher than the seven launches per year average for the last ten years.

Historically, there have been significant changes in the amount of payloads and launches expected in the forecast period, particularly with a large increase from 1996 to 1998, a decrease from 1999 to 2001, and now a projected upswing that began in 2007. Figure 14 provides a historical comparison of the FAA/AST forecasts from 1994 to the present, with actual launches to date included. After the high rate of demand for launches in the late 1990s and forecasts projecting continued high rates of launches, the FAA/AST reduced its annual forecasts as it saw the demand for launches fall.

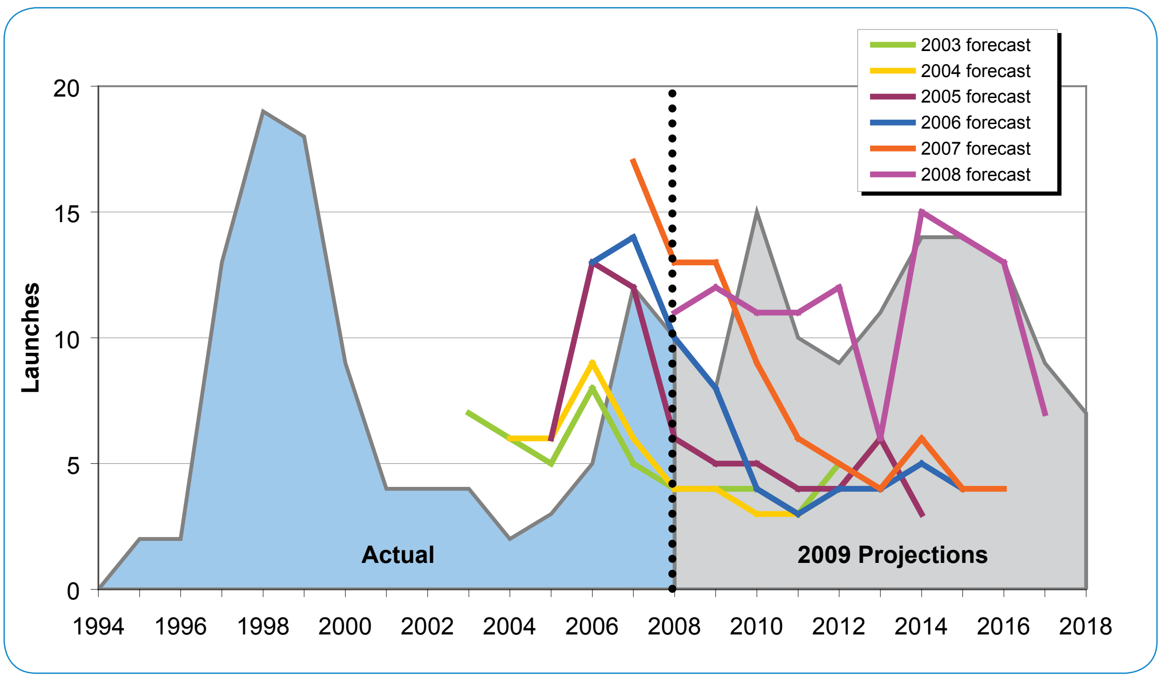

Figure 14. Comparison of Past Baseline Launch Demand Forecasts

The last few years' forecasts show a gradual upward trend in the amount of forecasted payloads and launches. This could be attributed to the successful performance of commercial Russian launch vehicles and an increase in commercial U.S. launches. The 2009 forecast of launch demand for the next 10 years, while slightly smaller that the 2008 forecast, continues to project sustained launch demand greater than what has been seen since the late 1990s. Figure 15 illustrates the launch trends by displaying the average number of launches each year in forecasts dating back to 1998, as well as the maximum number of launches in any given year of each forecast.

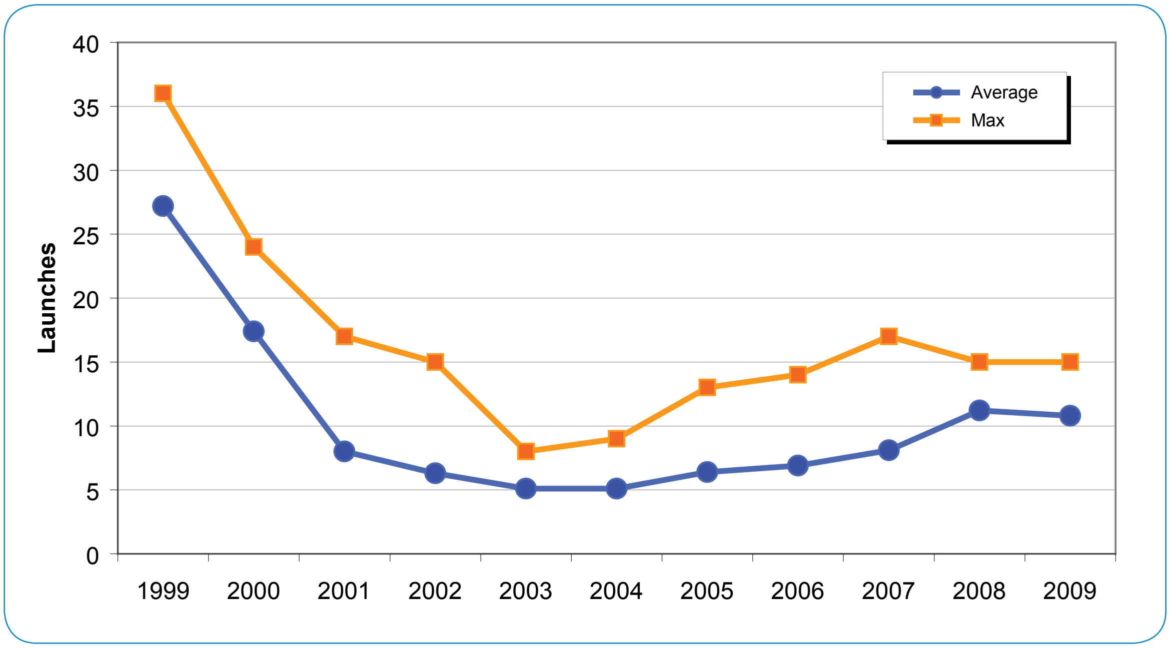

Figure 15. Average and Maximum Launches per Year from NGSO Forecasts 1999–2009

Examining historical commercial NGSO satellite launch activity, the telecommunications market put large constellations of satellites into orbit within a few years, creating a short spurt of intense launch activity. This was the case in 1997 to 1999 when the three major systems, Globalstar, Iridium, and ORBCOMM, were launched. The 2009 forecast shows a slightly more compressed schedule of launches as each of these systems is being replaced with new satellites and the new O3b constellation is being launched during the same time Globalstar and Orbcomm are planning major launch campaigns. The Iridium NEXT deployment schedule does not fully overlap with the other constellation as it did in the late 1990s.

The international science and commercial remote sensing satellite markets create steady launch demand according to historical figures. Since 1996, there has always been at least one international science or other satellite launched, with a maximum amount of 14 satellites launched in one year (2007). The commercial remote sensing market has low launch demand that is more sporadic than international science and other; since 1994 there have been five years with zero satellites launched, while there have been eight years with at least one satellite launched from this market. This is the first year historical data for the OFAS market has been tabulated. The Bigelow Genesis modules are included in the international science and other category because the OFAS market sector did not exist during the forecast period when the launches occurred.

Table 21 lists the number of payloads launched by market sector and total commercial launches that were internationally competed or commercially sponsored from 1994–2008. Small vehicles performed 48 launches during this period, while medium-to-heavy vehicles conducted 57 launches. In 2007, the historical number of launches between vehicle classes were roughly equal. This roughly even split is not expected to continue, as an increasing number of launches use medium-to-heavy vehicles. The 2009 forecast estimates that the larger vehicle class will continue to conduct the most launches.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
SATELLITES																
Big LEO	0	0	0	46	60	42	5	1	7	0	0	0	0	8	0	169
Little LEO	0	3	0	8	18	7	0	0	2	0	2	0	0	0	6	46
International Science/ Other	0	0	2	1	4	5	11	1	6	1	7	8	4	14	8	72
Commercial Remote Sensing	0	1	0	2	0	2	2	2	0	8	0	0	1	3	6	27
Orbital Facility Assembly and Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Satellites	0	4	2	57	82	56	18	4	15	9	9	8	5	25	20	314
LAUNCHES																
Medium-to-Heavy Vehicles	0	0	1	8	9	11	6	2	2	1	1	0	2	10	4	57
Small Vehicles	0	2	1	5	10	7	3	2	2	3	1	3	3	2	6	50
Total Launches	0	2	2	13	19	18	9	4	4	4	2	3	5	12	10	107

Table 21. Historical Commercial NGSO Activity*

*Includes payloads open to international launch services procurement and other commercially-sponsored payloads. Does not include dummy payloads. Also not included in this forecast are those satellites that are captive to national flag launch service providers (i.e., USAF or NASA satellites, or similar European, Russian, Japanese, or Chinese government satellites that are captive to their own launch providers). Does not include piggyback payloads. Only primary payloads that generate a launch are included unless combined secondaries generate the demand.

Historical satellite and launch data from 1994–2008 are shown in Table 22. This table includes payloads open to international launch services procurement and other commercially-sponsored payloads. Does not include dummy payloads. Also not included in this forecast are those satellites that are captive to national flag launch service providers (i.e., USAF or NASA satellites, or similar European, Russian, Japanese, or Chinese government satellites that are captive to their own launch providers). Does not include piggy-back payloads. Only primary payloads that generate launch demand are included unless combined secondaries generated the demand.

Table 22. Historical NGSO Satellite and Launch Activities (1994–2008)

Summary	Market Segment	Date	Satellite	Launch Vehicle	
2008					
20 Satellites 6 Little LEO Telecom 6 Remote Sensing 2 Int'l Science 6 Other 10 Launches 4 Medium-to-Heavy 6 Small	LIttle LEO	6/19/08	Orbcomm Replacement 1-5 Orbcomm CDS-3	Cosmos 3M	Small
	Remote Sensing	8/29/08 9/6/08	RapidEye 1-5 GeoEye-1	Dnepr 1 Delta II	Medium-to-Heavy Medium-to-Heavy
	International Science	10/1/08 6/19/08	THEOS UGATUSAT	Dnepr 1	Medium-to-Heavy
	Other	3/27/08 4/16/08 7/22/08 8/3/08 9/28/08 10/24/08	SAR Lupe 4 C/NOFS SAR Lupe 5 Trailblazer[F] Falcon 1 Mass Simulator Cosmo-Skymed 3	Cosmos 3M Pegasus XL Cosmos 3M Falcon 1 Falcon 1 Delta II	Small Small Small Small Small Medium-to-Heavy
2007					
25 Satellites 8 Big LEO Telecom 3 Remote Sensing 9 Int'l Science 5 Other 12 Launches 10 Medium-to-Heavy 2 Small	Big LEO	5/30/07 10/21/07	Globalstar Replacement 1-4 Globalstar Replacement 5-8	Soyuz Soyuz	Medium-to-Heavy Medium-to-Heavy
	Remote Sensing	6/15/07 9/18/07 12/14/07	TerraSAR-X WorldView 1 RADARSAT 2	Dnepr Delta II Soyuz	Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy
	International Science	4/17/07 4/23/07	Egyptsat SaudiComsat 3-7 Saudisat 3 AGILE AAM	Dnepr PSLV	Medium-to-Heavy Medium-to-Heavy
	Other	6/7/07 6/28/07 7/2/07 11/1/07 12/8/07	Cosmo-Skymed 1 Genesis II SAR Lupe 2 SAR Lupe 3 Cosmo-Skymed 2	Delta II Dnepr Cosmos 3M Cosmos 3M Delta II	Medium-to-Heavy Medium-to-Heavy Small Small Medium-to-Heavy
2006					
5 Satellites 1 Remote Sensing 2 Int'l Science 2 Other 5 Launches 2 Medium-to-Heavy 3 Small	Remote Sensing	4/25/06	EROS B	START 1	Small
	International Science	7/28/06 12/27/06	Kompsat 2 Corot	Rockot Soyuz 2 1B	Small Medium-to-Heavy
	Other	7/12/06 12/19/06	Genesis 1 SAR Lupe 1	Dnepr Cosmos	Medium-to-Heavy Small

Summary	Market Segment	Date	Satellite	Launch Vehicle	
			2005		
8 Satellites 8 Int'l Science 3 Launches 0 Medium-to-Heavy 3 Small	International Science	6/21/05 10/8/05 10/27/05	Cosmos 1 CryoSat Beijing 1 Mozhayets 5 Rubin 5 Sinah 1 SSETI Express Topsat	Volna[F] Rockot[F] Cosmos	Small Small Small
			2004		
9 Satellites 2 Little LEO Telecom 7 Int'l Science 2 Launches 1 Medium-to-Heavy 1 Small	Little LEO	6/29/04	LatinSat (2 sats)*	Dnepr	Medium-to-Heavy
	International Science	5/20/04 6/29/04	Rocsat 2 Demeter AMSat-Echo SaudiComSat 1-2 SaudiSat 2 Unisat 3	Taurus Dnepr	Small Medium-to-Heavy
			2003		
9 Satellites 1 Remote Sensing 8 Int'l Science 4 Launches 1 Medium-to-Heavy 3 Small	Remote Sensing	6/26/03	OrbView 3	Pegasus XL	Small
	International Science	6/2/03 9/27/03 10/30/03	Mars Express Beagle 2 BilSat 1 BNSCSat KaistSat 4 NigeriaSat 1 Rubin 4-DSI SERVIS 1	Soyuz Cosmos Rockot	Medium-to-Heavy Small Small
			2002		
15 Satellites 7 Big LEO Telecom 2 Little LEO Telecom 6 Int'l Science 4 Launches 2 Medium-to-Heavy 2 Small	Big LEO	2/11/02 6/20/02	Iridium (5 sats) Iridium (2 sats)	Delta II Rockot	Medium-to-Heavy Small
	Little LEO	12/20/02	LatinSat (2 sats)**	Dnepr	Medium-to-Heavy
	International Science	3/17/02 12/20/02	GRACE (2 sats) SaudiSat 1C Unisat 2 RUBIN 2 Trailblazer Structural Test Article	Rockot Dnepr	Small Medium-to-Heavy
			2001		
4 Satellites 1 Big LEO Telecom 2 Remote Sensing 1 Int'l. Science 4 Launches 2 Medium-to-Heavy 2 Small	Big LEO	6/19/01	ICO F-2	Atlas 2AS	Medium-to-Heavy
	Remote Sensing	9/21/01 10/18/01	OrbView 4 QuickBird 2	Taurus[F] Delta II	Small Medium-to-Heavy
	International Science	2/20/01	Odin	START 1	Small

* Launched on same mission as Demeter et al.
** Launched on same mission as SaudiSat 2 et al.
[F] Launch failure

Summary	Market Segment	Date	Satellite	Launch Vehicle	
2000					
18 Satellites 5 Big LEO Telecom 2 Remote Sensing 8 Int'l. Science 3 Other 9 Launches 6 Medium-to-Heavy 3 Small	Big LEO	2/8/00 3/12/00	Globalstar (4 sats) ICO F1	Delta II Zenit 3SL[F]	Medium-to-Heavy Medium-to-Heavy
	Remote Sensing	11/21/00 12/5/00	QuickBird 1 EROS A1	Cosmos[F] START 1	Small Small
	International Science	7/15/00 9/26/00	Champ Mita RUBIN MegSat 1 SaudiSat 1-1 SaudiSat 1-2 Tiungsat 1 Unisat	Cosmos Dnepr 1	Small Medium-to-Heavy
	Other	6/30/00 9/5/00 11/30/00	Sirius Radio 1 Sirius Radio 2 Sirius Radio 3	Proton Proton Proton	Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy
1999					
56 Satellites 42 Big LEO Telecom 7 Little LEO Telecom 2 Remote Sensing 5 Int'l. Science 18 Launches 11 Medium-to-Heavy 7 Small	Big LEO	2/9/99 3/15/99 4/15/99 6/10/99 6/11/99 7/10/99 7/25/99 8/17/99 9/22/99 10/18/99 11/22/99	Globalstar (4 sats) Globalstar (4 sats) Globalstar (4 sats) Globalstar (4 sats) Iridium (2 sats) Globalstar (4 sats) Globalstar (4 sats) Globalstar (4 sats) Globalstar (4 sats) Globalstar (4 sats) Globalstar (4 sats)	Soyuz Soyuz Soyuz Delta II LM-2C Delta II Delta II Delta II Soyuz Soyuz Soyuz	Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Small Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy
	Little LEO	12/4/99	ORBCOMM (7 sats)	Pegasus	Small
	Remote Sensing	4/27/99 9/24/99	IKONOS 1 IKONOS 2	Athena 2[F] Athena 2	Small Small
	International Science	1/26/99 4/21/99 4/29/99 12/21/99	Formosat 1 UoSat 12 Abrixas MegSat 0 Kompsat	Athena 1 Dnepr 1 Cosmos Taurus	Small Medium-to-Heavy Small Small
1998					
82 Satellites 1 Broadband LEO 60 Big LEO Telecom 18 Little LEO Telecom 3 Int'l. Science 19 Launches 9 Medium-to-Heavy 10 Small	Broadband LEO	2/25/98	Teledesic T1 (BATSAT)	Pegasus	Small
	Big LEO	2/14/98 2/18/98 3/25/98 3/29/98 4/7/98 4/24/98 5/2/98	Globalstar (4 sats) Iridium (5 sats) Iridium (2 sats) Iridium (5 sats) Iridium (7 sats) Globalstar (4 sats) Iridium (2 sats)	Delta II Delta II LM-2C Delta II Proton Delta II LM-2C	Medium-to-Heavy Medium-to-Heavy Small Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Small

* Launched on same mission as Demeter et al.
** Launched on same mission as SaudiSat 2 et al.
F Launch failure

Summary	Market Segment	Date	Satellite	Launch Vehicle	
			1998 (Cont'd)		
	Big LEO (Cont'd)	5/17/98 8/20/98 9/8/98 9/10/98 11/6/98 12/19/98	Iridium (5 sats) Iridium (2 sats) Iridium (5 sats) Globalstar (12 sats) Iridium (5 sats) Iridium (2 sats)	Delta II LM-2C Delta II Zenit 2[F] Delta II LM-2C	Medium-to-Heavy Small Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Small
	Little LEO	2/10/98 8/2/98 9/23/98	ORBCOMM (2 sats) ORBCOMM (8 sats) ORBCOMM (8 sats)	Taurus Pegasus Pegasus	Small Small Small
	International Science	7/7/98 10/22/98	Tubsat N & Tubsat N 1 SCD 2	Shtil Pegasus	Small Small
			1997		
57 Satellites 46 Big LEO Telecom 8 Little LEO Telecom 2 Remote Sensing 1 Int'l. Science 13 Launches 8 Medium-to-Heavy 5 Small	Big LEO	5/5/97 6/18/97 7/9/97 8/20/97 9/14/97 9/26/97 11/8/97 12/8/97 12/20/97	Iridium (5 sats) Iridium (7 sats) Iridium (5 sats) Iridium (5 sats) Iridium (7 sats) Iridium (5 sats) Iridium (5 sats) Iridium (2 sats) Iridium (5 sats)	Delta II Proton Delta II Delta II Proton Delta II Delta II LM-2C Delta II	Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Medium-to-Heavy Small Medium-to-Heavy
	Little LEO	12/23/97	ORBCOMM (8 sats)	Pegasus	Small
	Remote Sensing	8/1/97 12/24/97	OrbView 2 EarlyBird 1	Pegasus START 1	Small Small
	International Science	4/21/97	Minisat 0.1	Pegasus	Small
			1996		
2 Satellites 2 Int'l. Science 2 Launches 1 Medium-to-Heavy 1 Small	International Science	4/30/96 11/4/96	SAX SAC B	Atlas I Pegasus	Medium-to-Heavy Small
			1995		
4 Satellites 3 Little LEO Telecom 1 Remote Sensing 2 Launches 2 Small	Little LEO	4/3/95 8/15/95	ORBCOMM (2 sats) GEMStar 1	Pegasus Athena 1[F]	Small Small
	International Science	4/3/95	OrbView 1 (Microlab)	Pegasus	Small
			1994		
0 Satellites 0 Launches					

* Launched on same mission as Demeter et al.
** Launched on same mission as SaudiSat 2 et al.
F Launch failure