Federal Aviation
Administration

2010 Commercial Space Transportation Forecasts

May 2010

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

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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.

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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 2010 to 2019.

The *2010 Commercial Space Transportation Forecasts* report includes:

- The *2010 COMSTAC Commercial Geosynchronous Orbit Launch Demand Forecast* which projects demand for commercial satellites that operate in geosynchronous orbit (GSO) and the resulting commercial launch demand to geosynchronous transfer orbit (GTO); and
- The *FAA's 2010 Commercial Space Transportation Forecast for Non-Geosynchronous Orbits*, which 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 27.6 commercial space launches worldwide from 2010 to 2019. The combined forecasts are an increase of 3 percent compared to the 2009 forecast of 26.7 launches per year. Twenty-three commercial launches occurred worldwide in 2009. The forecasts project a launch demand increase up to 29 launches during 2010 (15 GSO and 14 NGSO).

In the GSO market, demand averaged 20.7 satellites per year, compared to 20.8 satellites in the 2009 forecast. The resulting demand for launches, after accounting for dual-manifested missions, stayed steady at an average of 15.7 launches per year in both forecasts. An analysis of mass trends in the report indicates a continued increase in the average mass per satellite.

In the NGSO market, the number of satellites per year averages 26.2 per year compared to 26.0 per year in last year's forecast. Less telecommunications and commercial remote sensing satellites but more commercial resupply missions to the International Space Station are included in this year's forecast. After calculating the number of satellites that are multiple-manifested, launch demand increased to an average of 11.9 launches per year compared with 11.0 launches per year forecasted in 2009.

COMSTAC and FAA project an average annual demand for:

- 15.7 launches of medium-to-heavy launch vehicles to GSO;
- 9.1 launches of medium-to-heavy launch vehicles to NGSO; and
- 2.8 launches of small vehicles to NGSO.

Table 1 shows the totals for the 2010 forecast. Figures 1, 2, and 3 compare historical activity in GSO and NGSO to the 2010 forecast.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total	Average
SATELLITES												
GSO Forecast (COMSTAC)	20	25	23	21	21	19	20	19	19	19	207	20.7
NGSO Forecast (FAA)	24	35	26	25	41	44	30	14	12	11	262	26.2
Total Satellites	44	60	49	46	62	63	50	33	31	30	469	46.9
LAUNCH DEMAND												
GSO Medium-to-Heavy	15	20	18	16	16	14	15	14	14	14	157	15.7
NGSO Medium-to-Heavy	11	8	9	11	12	11	9	8	6	6	91	9.1
NGSO Small	3	4	4	4	2	2	2	3	2	2	28	2.8
Total Launches	29	32	31	31	30	27	26	25	22	22	276	27.6

Table 1. Commercial Space Transportation Satellite and Launch Forecasts

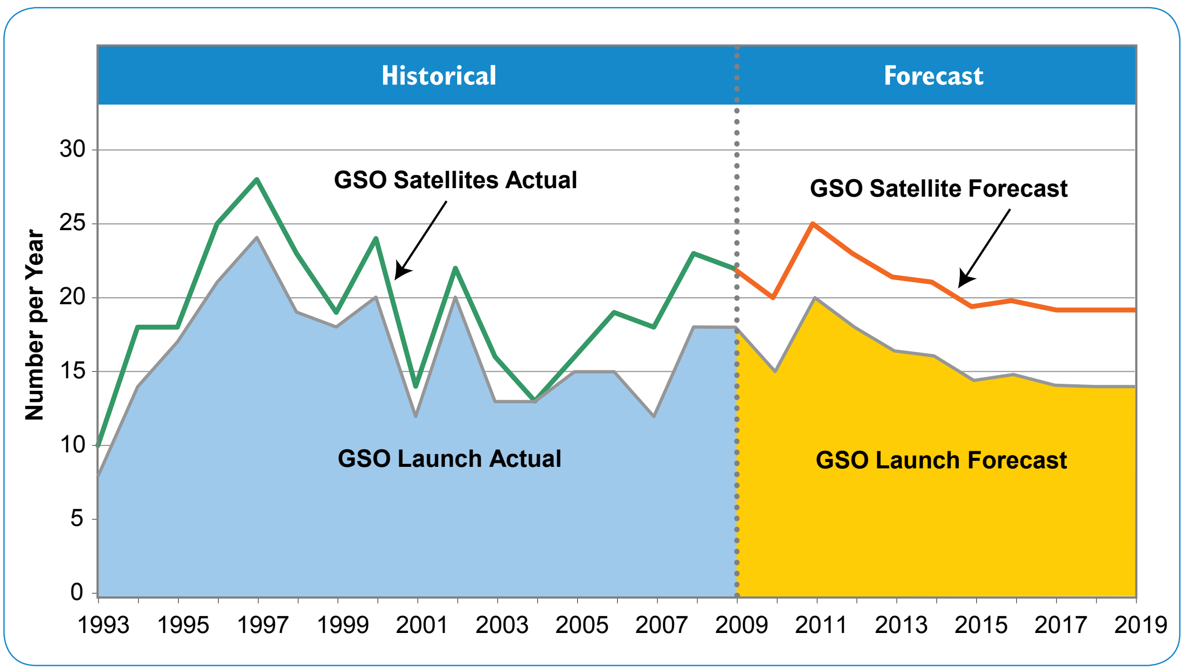

Figure 1. 2010 GSO Satellite and Launch Demand

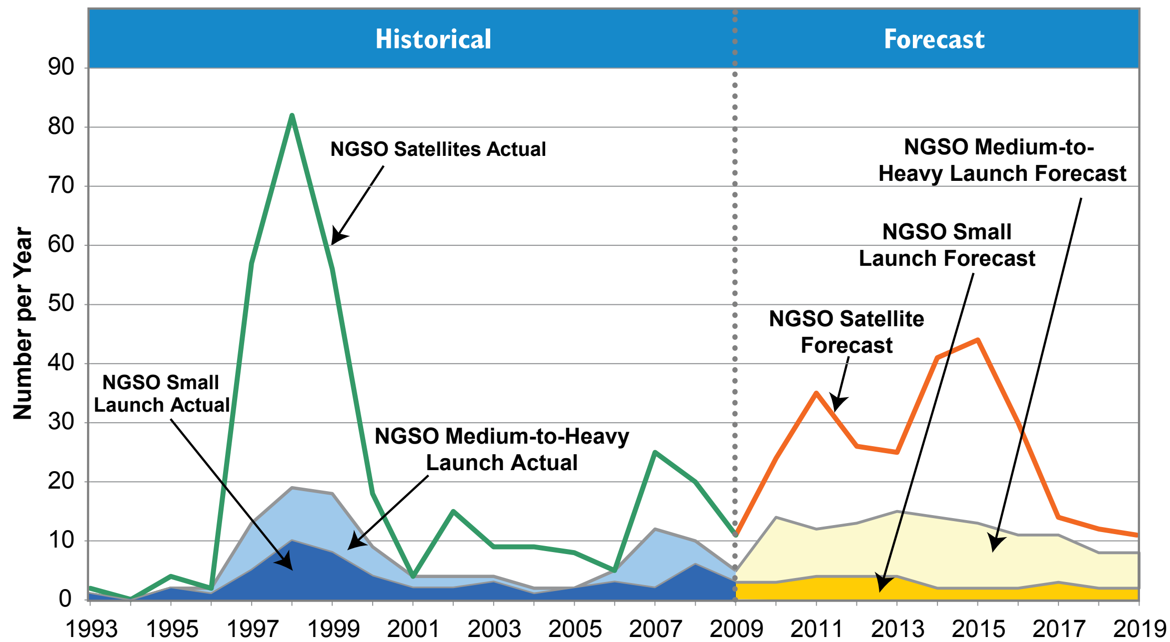

Figure 2. 2010 NGSO Satellite and Launch Demand

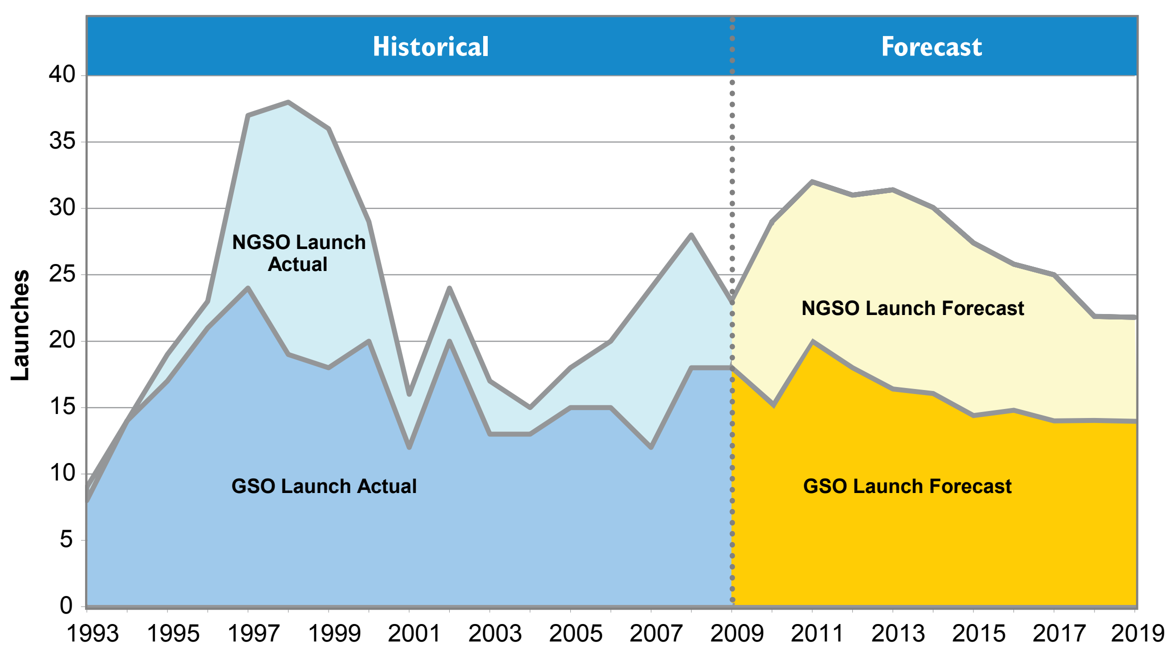

Figure 3. Combined 2010 GSO and NGSO Historical Launches and Launch Forecasts

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 *2010 Commercial Space Transportation Forecasts* report covers the period from 2010 to 2019 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 *2010 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 F*AA's 2010 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 licensed by the FAA including 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 4,130 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 2009, 24 out of 78 worldwide launches were commercial, representing 31 percent of global activity, a decrease from 40 percent in 2008.

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 21 in the 2009 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 five actual commercial NGSO launches last year while the 2009 forecast projected a demand for 8-10 launches.

Figure 4 shows historical launch forecasts from 2000 to 2010 compared with actual launch activity.

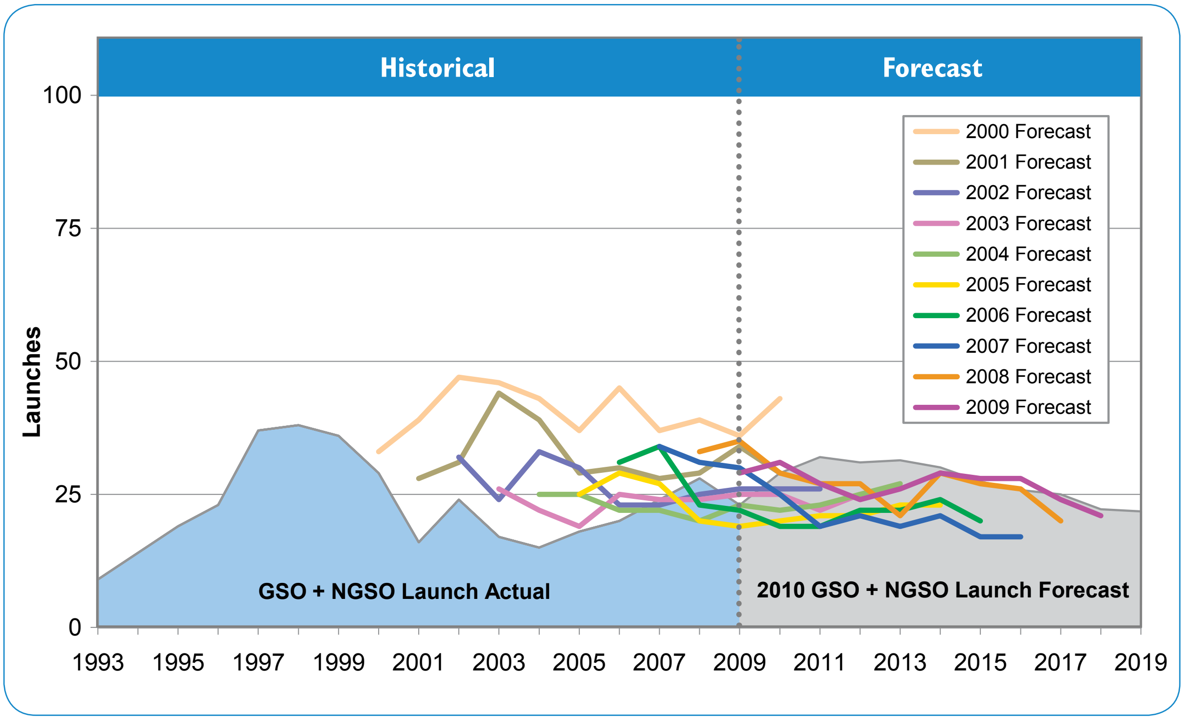

Figure 4. Historical Commercial Space Transportation Forecasts

COMSTAC 2010 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 *2010 Commercial Geosynchronous Orbit (GSO) Launch Demand Forecast* is the 18th annual forecast of the global demand for commercial GSO satellites and launches addressable to the U.S. commercial space launch industry. The forecast extends ten 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 2010 Commercial GSO Launch Demand Forecast for 2010 through 2019 is shown in Figure 5. Table 2 provides the corresponding values of forecasted 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 is very similar to last year's for satellite and launch demand.

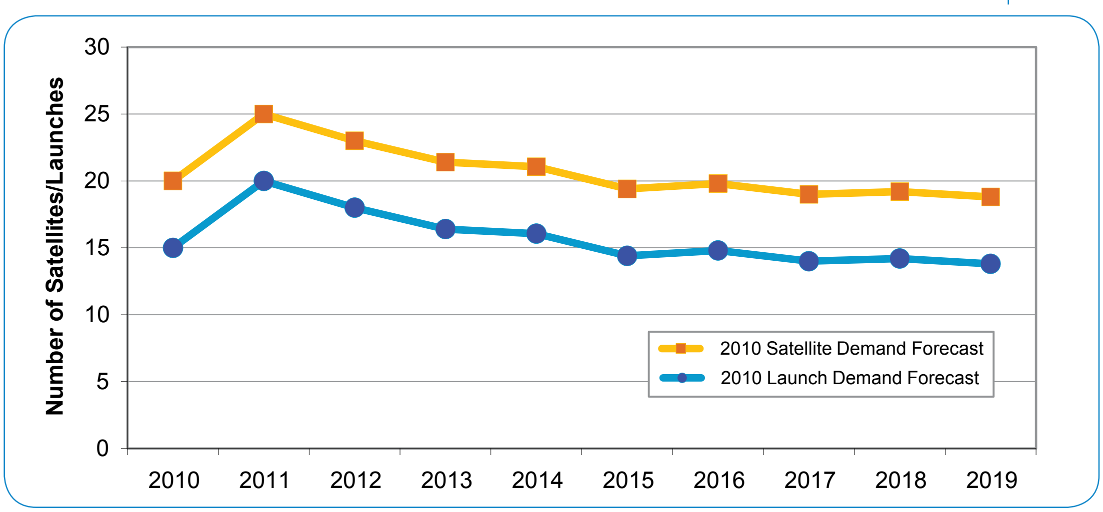

Figure 5. Commercial GSO Satellite and Launch Demand

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total	Average 2010 to 2019
Satellite Demand	20	25	23	21	21	19	20	19	19	19	207	20.7
Dual Launch Forecast	5	5	5	5	5	5	5	5	5	5	50	5.0
Launch Demand	15	20	18	16	16	14	15	14	14	14	157	15.7

Table 2. Commercial GSO Satellite and Launch Demand Forecast Data

The 2010 forecast predicts an average demand for 20.7 satellites to be launched annually in the ten-year time frame from 2010 through 2019. The associated launch demand for the same period is unchanged from last year at 15.7 launches per year. This year's average satellite demand is nearly identical to the demand predicted in the 2009 COMSTAC GSO forecast. An average of 20.8 satellites launched per year was forecast in 2009 and 21.8 satellites launches per year was forecast in 2008. The near-term forecast, which is based on specific existing and anticipated satellite programs for 2010 through 2012, shows demand for 15 launches in 2010, 20 in 2011, and 18 in 2012. Last year's forecast predicted 16 launches in 2010, 17 in 2011, and 15 in 2012.

It is important to distinguish between forecasted demand and the actual number of satellites 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 2010 is 20, the realization factor discounts this to a range of between 15 and 17.

Over the 18 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 2009, 22 commercial GSO satellites were launched, a decrease of one from the 23 commercial satellites launched in 2008. The 2009 forecast had projected the 2009 satellite demand for 27 launches, with a launch realization range of 18 to 23.

Many factors impact the demand for commercial GSO satellites, including terrestrial infrastructure, global economic conditions, operator strategies, new market applications, introduction of new launch systems, addition of dual or multiple manifest capability, 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 2010 is over 82,000 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 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 established by the FAA/AST to prepare the annual commercial payload mission model update. The Working Group consists of individual representatives from participating U.S. satellite manufacturers and launch vehicle providers. Since 2001, the *Commercial GSO Launch Demand Forecast* has covered a ten-year period, with this year's report covering 2010 through 2019. This year the committee received inputs from 15 satellite service providers, satellite manufacturers, and launch service providers; down from 21 inputs in 2009. COMSTAC would like to thank all of the participants in the *2010 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 2010–2019;
- Comprehensive input is requested for the same period from satellite manufacturers and launch service providers for a broad perspective.

Worldwide launch forecasts are broken down into "Addressable" or "Un-addressable" categories. 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 those un-addressable satellite launches 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 those commercial satellite launches that are not otherwise internationally competed. For example in 2009, the three commercial GSO satellite launch awards for Apstar-7 (China), GSAT-11(India) and Nigcomsat-1R (Nigeria) were excluded from the actual number of addressable commercial launches listed in this report because they were not internationally competed.

The *2010 Commercial GSO Launch Demand Forecast* is divided into four different mass classes based on the mass of the satellite at separation into geosynchronous transfer orbit (GTO). The defined mass categories are based upon mass divisions of standard satellite models offered by satellite manufacturers. The four classifications are: a) below 2,500 kilograms (<5,510 pounds); b) 2,500 to 4,200 kilograms (5,510 to 9,260 pounds); c) 4,200 to 5,400 kilograms (9,260 to 11,905 pounds); and d) above 5,400 kilograms (>11,905 pounds). A list of current satellite models associated with each mass category is depicted 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/702MP, Loral 1300, Alcatel SB 3000B3
Above 5,400 kg (>11,905 lbm)	Boeing 702HP, Loral 1300, Astrium ES 3000, Alcatel SB 4000

Table 3. Satellite Mass Class Categorization

This year, the following 15 organizations (noted with the country in which their headquarters are located) responded with data used in developing the 2010 report:

- Arianespace (France)
- Asiasat (Hong Kong)
- The Boeing Company* (U.S.)
- DFL Space LLC* (U.S.)
- Hisdesat (Spain)
- ICO (U.S.)
- Intelsat (U.S.)
- Sea Launch* (U.S.)
- SES Americom (U.S.)
- Sirius XM (U.S.)
- SkyPerfect JSAT Corporation (Japan)
- Spacecom (Israel)
- Space Exploration Technologies Corp* (U.S.)
- Space Systems/Loral* (U.S.)
- ViaSat (U.S.)

*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 2013–2019. 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 (2010–2012) 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 on one launch vehicle). Based on the future plans of International Launch Services' Proton and the existing 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 2010 through 2012.

	2010		2011		2012	
Total	20		25		23	
Below 2,500kg (<5,510 lbm)	3		1		0	
	Intelsat 16	Proton M	Bsat 3C	Ariane		
	*COMS 1	Ariane				
	Bsat 3B	Ariane				
2,500 - 4,200 kg (5,510 - 9,260 lbm)	7		4		11	
	*Hylas	Soyuz	Intelsat 18	LandLaunch	AnikG1	TBD
	*Insat 4G	Ariane	New Dawn	Ariane	AMOS-4	Falcon 9
	Koreasat 6	Ariane	SES-2	Ariane	Arsat	TBD
	Nilesat 201	Ariane	SES-3	Proton	Asiasat-7	TBD
	RASCOM 1R	Ariane			Azersat	TBD
	SatCom BW2	Ariane			Hispasat AG1	TBD
	SES-1	Proton			Hylas-2	Ariane/Soyuz
					Intelsat-23	Proton
					OHO-1	Ariane/Soyuz
					Star One C3	TBD
					Thor 7	TBD
4,200 - 5,400 kg (9,260 - 11,905 lbm)	3		7		3	
	*Arabsat 5A	Ariane	Arabsat 5C	Ariane	Arabsat 6B	Ariane
	*Astra 3B	Ariane	AtlanticBird-7	TBD	Astra-2F	TBD
	Hispasat 1E	Ariane	ST-2	Ariane	Nimiq-6	Proton
			Telstar 14R	Proton		
			Turksat 4A	Ariane		
			Yamal 401	Proton		
			Yamal 402	Proton		
Over 5,400kg (>11,905 lbm)	7		13		9	
	Arabsat 5B	Proton	Astra 1N	TBD	ABS-2	Ariane
	Echostar 14	Proton	EuropaSat	Proton	Alphasat-1XL	Ariane
	Echostar 15	Proton	Eutelsat W3C	LongMarch	Echostar-16	TBD
	Eutelsat W3B	Ariane	Intelsat 17	Sea Launch	Intelsat-20	Ariane
	KA-Sat	Proton	Intelsat 19	TBD	Intelsat-21	Proton
	SkyTerra 1	Proton	Quetzsat	Proton	Intelsat-22	Sea Launch
	*XM 5	Proton	SES-4	Proton	Jupiter-1	TBD
			SES-5	Proton	SatMex-8	TBD
			Sirius FM-6	Proton	Terrestar 2	Ariane
			SkyTerra 2	Proton		
			Viasat 1	Proton		
			Yahsat 1B	Proton		
			Yahsat 1A	Ariane		

Table 4. Commercial GSO Near-Term Manifest

* Indicates slip from COMSTAC 2009 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 2009, followed by the distribution projected in this year's demand forecast.

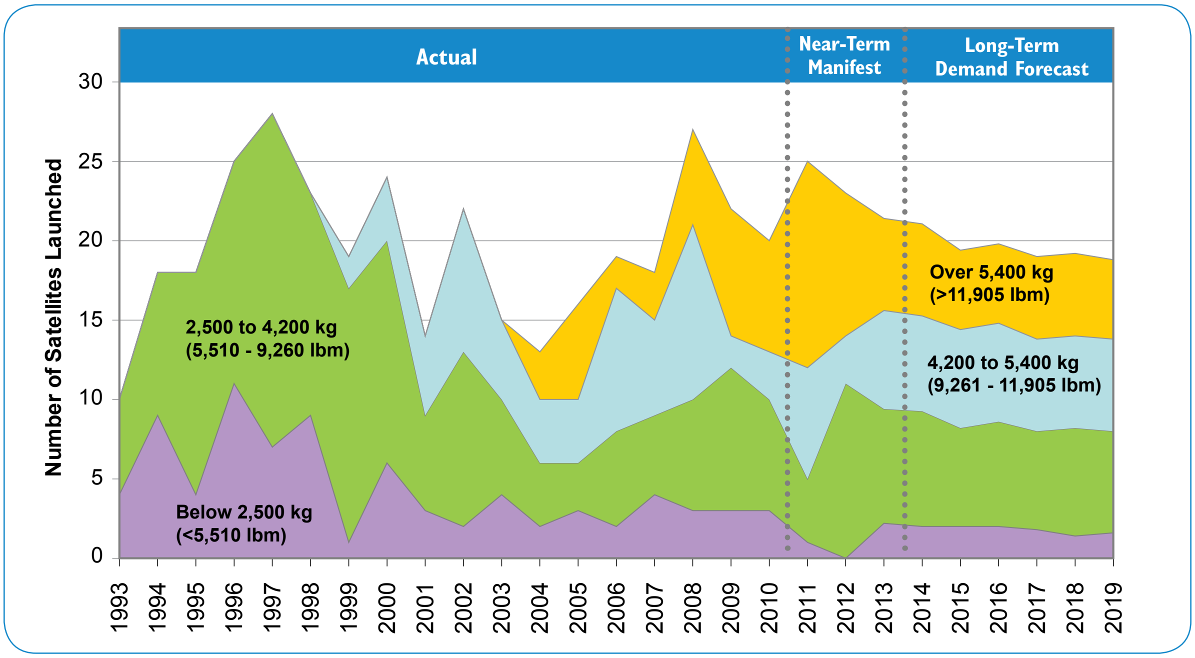

Figure 6. Trends in GSO Satellite Mass Distribution

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.

	1993	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	2019	Total 2010 to 2019	Avg. 2010 to 2019	% of Total
Below 2,500 kg (<5,510 lbm)	4	9	4	11	7	9	1	6	3	2	4	2	3	2	4	3	3	3	1	0	2	2	2	2	2	1	2	17	1.7	8%
2,500 to 4,200 kg (5,510 - 9,260 lbm)	6	9	14	14	21	14	16	14	6	11	6	4	3	6	5	7	9	7	4	11	7	7	6	7	6	7	6	69	6.9	33%
4,200 to 5,400 kg (9,260 - 11,905 lbm)	0	0	0	0	0	0	2	4	5	9	5	4	4	9	6	11	2	3	7	3	6	6	6	6	6	6	6	55	5.5	27%
Over 5,400 kg (>11,905 lbm)	0	0	0	0	0	0	0	0	0	0	0	3	6	2	3	6	8	7	13	9	6	6	5	5	5	5	5	66	6.6	32%
Total	10	18	18	25	28	23	19	24	14	22	15	13	16	19	18	27	22	20	25	23	21	21	19	20	19	19	19	207	20.7	100%

Table 5. Trends in GSO Satellite Mass Distribution

The 2009 forecast predicted no launches of satellites in the smallest of the mass classes in 2009. In actuality, three satellites in the smallest mass class launched. The forecast for 2010 indicates there are three satellites of this mass class scheduled to be launched in 2010, one in 2011, and zero in 2012. The trend for this mass class has been on the decline over the past decade, however, it is currently stable with an average of two per year expected from 2010 forward.

The forecasted trend in satellite mass class launches in 2010 is similar to that from 2009. The average number of satellites in the largest mass class has increased from 6.0 in the 2009 forecast to 6.6 in the 2010 forecast. There is a predicted peak of 13 satellite launches in the heaviest mass class in 2011, though this scales back to five to six per year in the remainder of the forecast.

Comparison with Previous COMSTAC Demand Forecasts

The 2010 forecast for commercial GSO satellites launched is compared to the 2007 through 2009 forecasts in Figure 7. While in the outer years, the forecasted number of satellites to be launched per year remains fairly consistent at 19-20, the near-term forecast in 2010 is slightly different from the prior three years. In the 2007 through 2009 reports, the predicted number of satellites to be launched in the first and second forecasted year was greater than that of the third and out years. In 2010, the forecast shows a smaller number of satellites to be launched in the first year, with a near-term increase for the second and third forecasted year, and then back to the average 19-20 launches per year. With the full manifests of the Proton and Ariane 5 vehicles, and the bankruptcy of Sea Launch, the first year forecast represents the effect of a temporary undercapacity of affordable launch capacity.

The composition of the forecasted 20 satellites to be launched in 2010 has changed somewhat from the 21 satellites forecast in the 2009 report for 2010. This is due to the slip of six satellites from 2009 into 2010 with a complementary slip of five satellites moving from 2010 into 2011.

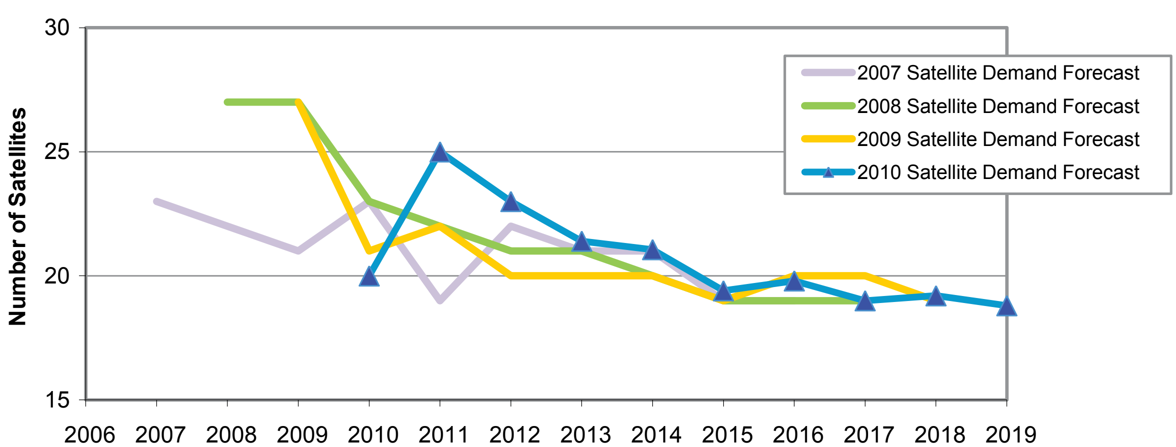

Figure 7. 2007 Through 2009 vs. 2010 Commercial GSO Satellite Demand Forecast

Comparison to International Comprehensive Inputs

This year, the Working Group received comprehensive inputs from one international launch service provider (Arianespace) and one international satellite manufacturer (Thales Alenia Space). The combined average of these international inputs is slightly higher in the near term than the combined 2010 demand forecast based on U.S. satellite and launch vehicle manufacturer inputs. The higher near term prediction drives the international input average annual demand upward for 2010 through 2018 at 22.3 satellites per year; the U.S.-based average annual demand forecast is 20.7 satellites per year. The differential between mass classes is highest in the small mass class where the percentage of total satellites is 19.5% for aggregate international inputs vs. only 8.2% for aggregate U.S. inputs. The differential is less pronounced in the medium class where the percentage of total satellites is 26.6% for international inputs vs. 32.2% for U.S. inputs. The intermediate mass class reflects the least disparity in the 2010 forecast where the percentage of total satellites is 25.6% for international inputs vs. 26.6% for U.S. inputs. Finally, the difference in the percentage of total satellites is relatively small in the large mass class where international inputs are 28.3% vs. 31.9% for U.S. inputs.

Launch Vehicle Demand

The *2010 Commercial GSO Launch Demand Forecast* begins with establishing a forecasted number of addressable satellites expected to launch during a given forecast period based upon respondent inputs for replacement or growth satellites and anticipated new demand drivers. In order to translate this into meaningful demand for individual launches, adjustments are made to reflect the estimated numbers of "dual-manifest" or "shared launch" payloads (the launch of two satellites at once).

Presently, the Ariane 5 ECA launch vehicle has the proven capability to dual-manifest commercial GSO satellites. In early 2010, International Launch Services (ILS) introduced its "shared launch" concept to customers whereby the Proton vehicle would launch "one customer, two spacecraft" on a given mission. This service is expected to demonstrate its capability to incorporate western spacecraft in 2011. This is a variant of the more flexible "mix and match" dual-manifesting approach taken by Arianespace. The Working Group bases its projection of the number of "dual-manifest" or "shared-launch" launches on the existing backlog of these two launch organizations, their expected use of their dual-manifest capabilities, and their projected manifests.

In 2009, Arianespace launched seven Ariane-5 vehicles, orbiting nine commercial satellites destined for GSO (using 4 ½ vehicles) and three European government satellites (using 1 ½ vehicles). A similar use is expected for Ariane 5 launches in 2010 and 2011, with most, if not all, commercial missions expected to be dual-manifested. Based on Arianespace's launch history, we project that one to two missions per year will likely be of a non-commercial or un-addressable (e.g., European government) satellite, and zero to one commercial mission will have to fly on a single-manifested mission due to schedule, manifesting, or customer choice, meaning that on average, four to five dual-manifested missions can be expected each year for the 2010–2019 forecast period. The near-term forecast includes dual-manifest launches consistent with the best current understanding of the mission set.

Based on estimated satellite demand in the small (below 2,500 kilograms) and medium (2,500 to 4,200 kilograms) categories, we project that one "shared launch" mission will take place every two years for the forecast period beginning in 2011. From a performance perspective, a subset of satellites from within these mass classes is also suitable for a "shared launch" Proton mission.

The number of "single" launches vs. "dual manifest" or "shared launch" launches may increase during the forecast period through the ramp-up or introduction of new launch vehicles, or variants of existing dedicated launch services such as the Land Launch Zenit-3SLB (2008), Soyuz ST-A/B/Fregat (late 2010), the Falcon-9 (2010), or the GSLV Mk-III. See the "Factors Affecting Launch Demand" section for more information.

Figure 8 presents the 2010 satellite and launch demand forecast as well as actual values for 1993 through 2009.

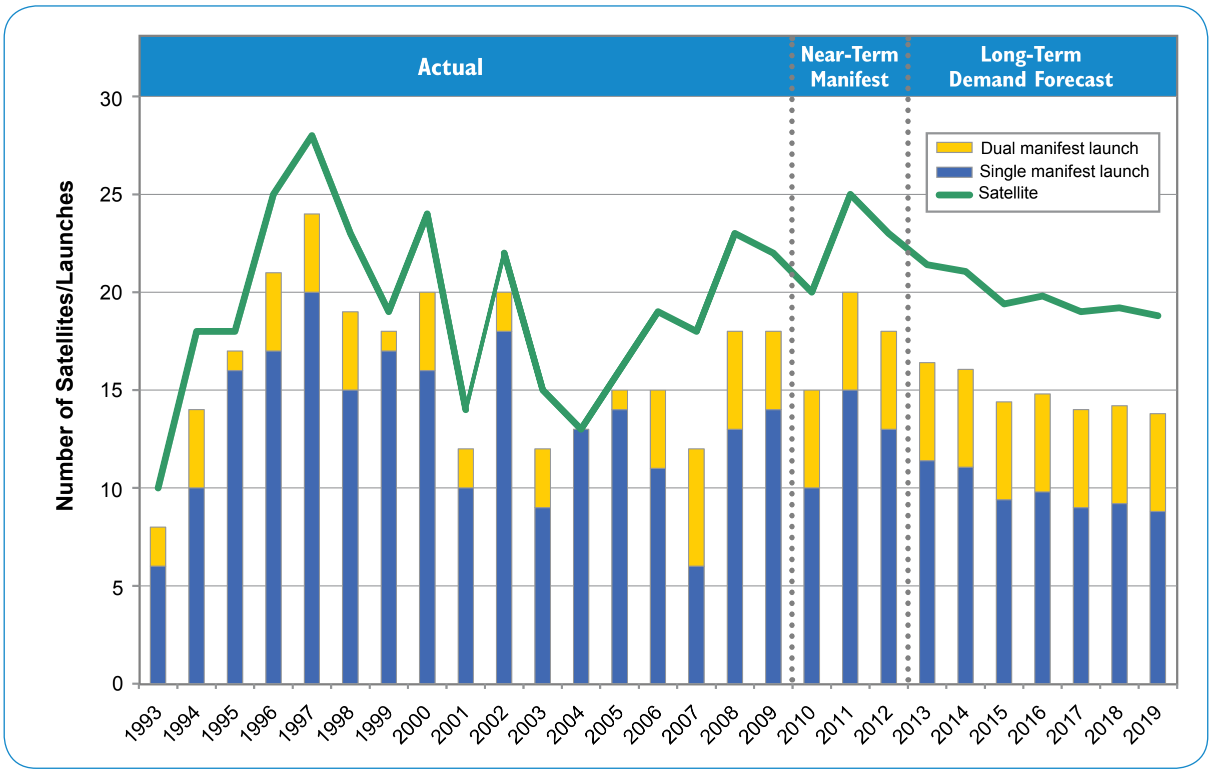

Figure 8. COMSTAC GSO Satellite and Launch Demand Forecast

COMSTAC Demand Projection vs. Actual Launches Realized

Factors That Affect Satellite Launch Realization

The demand projection is the number of satellites that operators expect to launch in a given year. This demand is typically larger than the number of satellites actually launched. Some of the factors that contribute to the difference between forecast and realized launches are:

Satellite technical issues. Satellite manufacturers may have factory, supplier, or component issues that can delay the delivery of a satellite. The likelihood of delays due to technical issues has risen with the increased complexity of satellite systems. Anomalies, whether on the ground or in orbit, can affect the delivery of satellites until potential fleet issues (e.g., commonality with parts on a satellite awaiting launch) are resolved. Delays in delivery of spacecraft to the launch site in turn impact the scheduling of launches.

Launch vehicle technical issues. Launch vehicle manufacturers and operators may have manufacturing, supplier, or component issues or launch anomalies or failures that can delay the availability of a launch vehicle or cause a delay at the launch pad. Launch delays can have a cascading effect on subsequent launches, and some missions have specific launch windows (e.g., science windows) which, if missed, may result in lengthy delays.

Dual-manifesting. Dual-manifesting, while limited to a few launch vehicles, 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 launch delays, though these typically are short-term (i.e., on the order of days).

Strategic Business Planning. Corporate reprioritization or changing business strategies or markets may delay or cancel currently planned satellites. This can have the upside of unanticipated launch slot availability.

Financing. Satellite operators may be unable to obtain the financing required to implement their business plans. Delays in financing or insurance directly affect the availability of a satellite for launch.

Regulatory issues. Export compliance, Federal Communications Commission (FCC) licensing, or international licensing requirements can halt progress on a satellite program. U.S. Government policy regarding satellite and launch vehicle export control has hindered U.S. satellite manufacturers and launch vehicle operators in their efforts to work with international customers. This has caused delays as well as cancellations of satellite programs.

Projecting Actual Satellites Launched Using a Realization Factor

Over the history of this report, the forecasted demand in satellites and launches has almost always exceeded the actual number of satellites and launches in the first three years of a forecast. In order to better estimate the number of near-term satellites reasonably expected to be launched, the near-term demand is adjusted by a "realization factor." This factor is based on the forecast vs. actual launches in the five years prior to the year of the report.

The range of satellites expected to be realized is calculated by multiplying the near-term demand forecast for the first three 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 73% to 85%, with an average of 80%.

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 satellites planned for launch that subsequent year.

Based on this methodology, the expected realization for 2010 is 15 to 17 satellites. While the high realization estimate for 2010 (17) is still below the forecast number of satellites (20), evidence of this realization can be seen by the fact that, while Arianespace has 11 of the 20 projected satellites, there were no Ariane launches through April of 2010.

For the second out-year, the calculation becomes less clear. The forecast had always overestimated the actual launches two years hence, except for 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 75%. For the past five years, the range has been 73% to 105%, with an average of 84%. Using the same methodology as above, the expected realization for 2011 is 19 to 26 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.

Forecasted Satellite Demand vs. Actual Satellite Launches in 2009

As represented in Figure 9, the 2009 report forecast 27 satellites for launch in 2009. In fact, 22 satellites were actually launched in 2009. The difference between actual and manifested satellite launches resulted from:

- Six satellites were delayed to 2010: ARABSAT 5A, ASTRA 3B, COMS 1, HYLAS 1, INSAT 4G and XM 5. Three were delayed due to full launch provider manifests, one due to a launch provider swap, one due to spacecraft delays, and one due to both spacecraft and launch vehicle delays.
- One satellite was brought forward from 2010 to 2009: COMSATBW 1

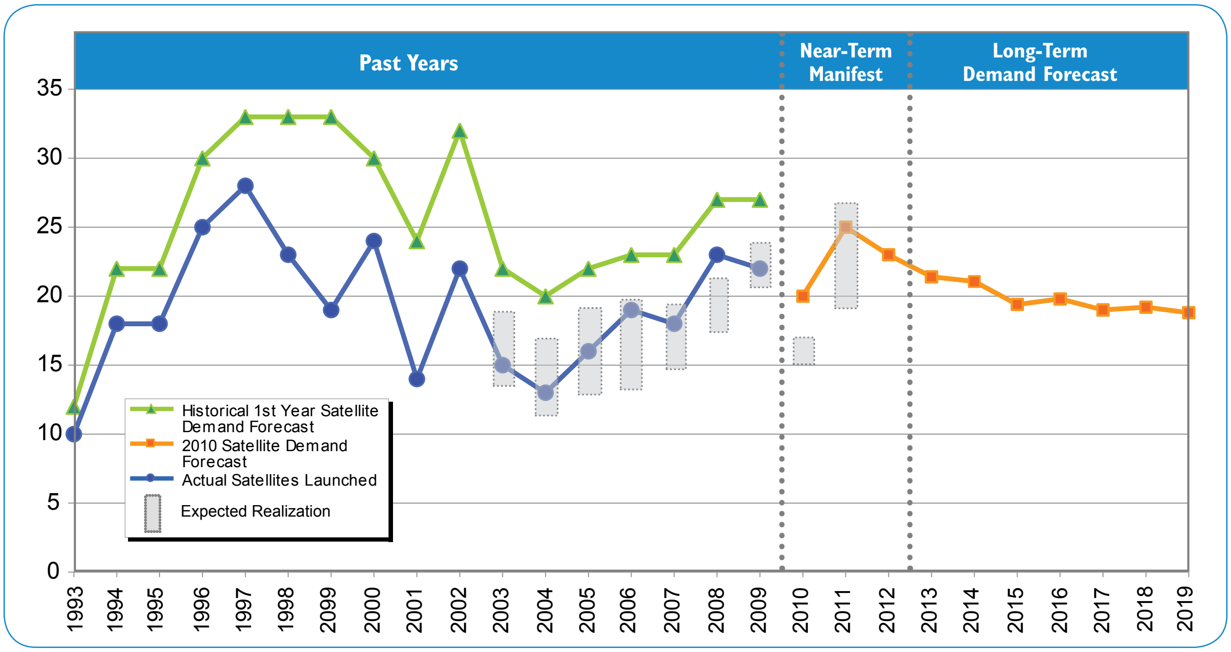

Figure 9. Commercial GSO Demand: Historical, Near-Term, and Long-Term Forecasts

Factors That May Affect Future Demand

The global satellite services industry is impacted by a variety of market, regulatory, and financial factors that affect current and future demand forecasts for commercial GSO satellite launches. The Working Group has identified the following issues as factors shaping the demand for future satellite and launch services orders.

Continued strong business, consumer, and government demand for transponder bandwidth use is driving increased requirements for updated satellite systems offering more capacity throughput than existing legacy systems on-orbit. The global Fixed Satellite Services market continues to experience strong performance in North America, Europe, and Asia with increasing fill rates in Latin America, Africa, and the Middle East. High-definition television (HDTV) bandwidth, mobile services backhaul, and satellite broadband access services continue to drive growth in FSS services. Coupled with this is strong financial performance for satellite systems operators who continue to show strong profit margins despite the lingering effects of the global recession and the slow but steady economic recovery. These profits have been in part reinvested in major recapitalization programs such as those of global operators Intelsat, SES Global, and Eutelsat and smaller regional operators such as Telenor, AsiaSat, and Arabsat.

The global Direct Broadcast/Direct-to-Home market remains strong with growing subscriber revenues in North America and Europe despite the continuing but slow rollout of terrestrial alternatives in urban and suburban areas with alternative means of delivery, such as fiber optics and wireless. Asia and the Middle East are slowly relaxing regulatory barriers and opening their markets to foreign content provision as middle class consumer demand continues to develop. Latin America and Africa remain weak as slow economic development and national regulatory barriers continue to inhibit growth. The global broadband services market continues to make steady progress in building business, consumer, and government demand.

Growth in North America and Europe is driven by consumer demand uptake from the likes of Hughes Network Services, WildBlue, and ViaSat. Government-funded initiatives to bring broadband services and Internet connectivity to the public in rural and remote regions and areas where the cost of laying fiber is too expensive are aiding this expansion. Demand in these regions is also driven by governments requiring more bandwidth for civil services applications and military services operations.

More and more these governments are using commercial procurement practices to lease bandwidth on existing systems with the intent to use significantly more capacity on planned commercial systems. Operators such as Intelsat, Eutelsat, and Hispasat are anticipating strong growth in government services derived revenues.

The geosynchronous MSS market segment presents mixed results. Global MSS operator Inmarsat recently achieved near global coverage with its Broadband Global Area Network (BGAN) that provides mobile internet and telephony services to vertical business markets. ICO entered Chapter 11 bankruptcy to rearrange its financing. MSV and TerreStar are planning service introductions shortly following completion of satellite system launches. All three systems, however, require expensive ancillary terrestrial component ground infrastructure yet to be deployed to enable widespread service capability. The digital audio radio market is now more stable in North America following the recent merger of XM Satellite Radio and Sirius Satellite Radio. MSS and DARS services are being pursued in Europe and Asia, and in particular in Japan and South Korea for mobile video broadcast.

The overall growth outlook for satellite services from geosynchronous orbit remains robust. Indeed several new players are entering the satellite business to advantage themselves of the marketplace, to provide domestic national services, and to preserve ITU allocation rights to select orbital slots. These new providers include Asia Broadcast Satellite, Avanti Communications, Petrosat, and Vietnam Post and Telecommunications, among others.

Hosted payloads are payloads that are typically too small to justify a dedicated mission due to payload size, government budgets, or potential revenues. Hosted payloads are potentially paired with a commercial satellite service mission, where the satellite owner/ operator accommodates the payload to offset its launch and operating costs or to add to a revenue stream to close a business case. There are a variety of potential hosted payload types including: experimental, new technology demonstration, scientific, remote sensing, weather and climate monitoring, FAA (WAAS), GPS, and military communications missions. Payload hosting offers many benefits to both parties. The cost of the satellite and launch services is shared, thereby offsetting 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 (22-36 months) and fairly predictable compared to a shared launch with other government missions. There is a ready supply of commercial satellite launches.

There were an increasing number of hosted payload launches and awards in the past year.

The Department of Defense (DOD) and Joint Capabilities Technology Demonstration (JCTD), with satellite sponsor Intelsat and Cisco Systems Inc., launched the Internet Router in Space (IRIS) aboard Intelsat 14 (built by Space Systems/ Loral). This system provides direct IP routing using existing ground equipment and will enable U.S. and allied military forces to communicate seamlessly. Demonstrations are in process.

The Australian Defense Force (ADF) agreed to purchase a specialized UHF communications payload for the Australian military from Intelsat. This payload will be hosted aboard Intelsat 22 (built by Boeing Space & Intelligence Systems) and is scheduled to launch in 2012.

The European Commission (EU) contracted with SES Astra to host two Satellite-Based Augmentation Systems (SBAS) for the European Geostationary Navigation Overlay Service (EGNOS). EGNOS will be used to supplement GPS, GLONASS, and Galileo systems by measuring the accuracy of satellite navigation signals. The first payload will be hosted aboard SES Sirius 5 (built by Space Systems/ Loral) and the second aboard Astra 5B (under construction by EADS Astrium).

Americom Government Services (AGS) will host an experimental Air Force sensor on SES Worldskies SES-2 satellite (under construction by Orbital). This Third Generation Infrared Surveillance (3GIRS) program is planned to validate missile-warning technologies.

There are limitations to widespread use of hosted payloads. The contractual relationships are 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. Generally, 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. Certainly, commercial satellite owners/operators 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.

There is a broad and growing 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.

The entrance of new commercial launch services providers into the market will further increase competition through increased pricing pressures, expansion of available launch sites, improved schedules, and streamlined commercial practices. New entrants from the United States include the SpaceX Falcon 9 and the Orbital Sciences Corporation (OSC) Minotaur V and Taurus II/II Enhanced launch vehicles. SpaceX's Falcon 9 launch vehicle is scheduled to make its inaugural flight from Cape Kennedy, Florida in 2Q2010. Falcon 9 is an EELV-class vehicle with a 5.2-meter fairing capable of launching a 4,540kg payload to GTO in its single core version and over 19,500 kg to GTO in its three-core heavy configuration from the Cape. Falcon 9 will also fly from Vandenberg Air Force Base, California and from the Reagan Test Site in the Republic of the Marshall Islands in the southwestern Pacific Ocean. Falcon 9 adds another option in the medium launch market segment as a replacement for the retiring ULA Delta II launch vehicle.

OSC's Minotaur V is scheduled to make its inaugural flight from Wallops Island, Virginia in mid-2012. Minotaur V features a 2-meter fairing and is capable of lofting small payloads up to 650kg into GTO. OSC may also enter the GTO market with its Taurus II launch vehicle equipped with an orbit raising upper-stage. Taurus II features a 3.9-meter fairing and is scheduled to make its inaugural flight from Wallops Island, Virginia in 2Q2011. Designed primarily for ISS resupply and LEO access, the Taurus II is capable of delivering ~1,900kg to GTO from Wallops and ~2,200kg to GTO from the Cape using an enhanced second stage now under study. The Taurus II Enhanced version scheduled for debut in early 2014 will provide increased performance to GTO.

The debut of the Arianespace launch of the Russian Soyuz-2 ST launch vehicle will occur from Kourou in French Guiana in late 2010. This modified Soyuz featuring a 4.1-meter fairing will provide medium-lift capability of 3,150 kilograms to GTO. The near-equatorial launch location significantly increases the capacity of the upgraded Soyuz over the launch capacity from Baikonur.

India continues development of its new GSLV Mark III launch vehicle which is slated to fly in mid-2011 from Satish Dhawan, Sriharikota. The Mark III features an indigenously-developed cryogenic engine with a 5-meter fairing and will have a payload capacity of 5,000kg to GTO.

International Launch Services continues to upgrade its Proton M/Breeze M launch vehicle capability. Proton M/Breeze M features a 4.3-meter fairing and is capable of placing up to 6,920 kg into GTO. A 5-meter fairing is being studied that would be capable of placing 5,850 kg into GTO. Additionally ILS is working with OSC to offer a dual launch capability for small/medium spacecraft based on OSC's Starbus platform.

Land Launch continues operations from Baikonur in Kazakhstan. The Land Launch Zenit-3SLB vehicle is a modified version of the heavy-lift Sea Launch Zenit-3SL. Land Launch features a 3.9-meter fairing and has lift capability of 3,600 kg to GTO.

Indigenous launch vehicles will continue to decrease the demand for internationally-competed commercial launches as more countries successfully build and launch their own commercial, civil, and government payloads. These new competitors have not only removed their government payloads from the internationally competed commercial launch market, but are now seeking an expanded presence in the global commercial launch market. Competitors include the Indian GSLV, the Japanese H-IIA, the Chinese Long March 3B, and the emerging South Korean KSLV.

The GSLV features a 3.4-meter fairing and has a lift capacity of 2,500 kg to GTO. While still early in its operational phase, GSLV is now being used to launch the Insat satellites that had previously been part of the internationally-competed commercial launch market.

The H-IIA features a 4-meter fairing and has lift capacity of 4,600kg to GTO. H-IIA is primarily being used to launch government payloads. JAXA is studying an augmented version capable of lofting 5,700kg. The introduction of domestically manufactured satellites into the marketplace and more competitive pricing in the international commercial launch market could result in increased usage of the H-IIA.

The Chinese Long March 3B features a 4.2-meter fairing and has lift capacity of 5,500kg to GTO. China is engaged in an ambitious launch vehicle development program to produce the new Long March 5 and 6 series, which are similar to the U.S. EELV, featuring a common core stage and various strap-on boosters and upper stages. A new spaceport is being built on Hainan Island to accommodate these vehicles. The new spaceport and Long March 5 are planned for operation in 2012-2013. The newly introduced "ITAR-free" satellites (see next section) have provided China Great Wall Industry Corporation (CGWIC) with the opportunity to increase its presence in the internationally competed commercial launch market.

South Korea is working towards establishing its domestic launch services capability with the testing of its KSLV-1 launch vehicle that uses the Russian Angara booster as its first stage. While a ways in the future, South Korea plans on having indigenous capability to launch its commercial satellites as has India.

The U.S. Government regulatory environment remains an issue for domestic satellite manufacturers as international competitors develop commercial satellite offerings that are not subject to U.S. export regulations. The U.S. Department of State approval to export satellites to international launch sites applies to domestic satellites. Thales Alenia Space recently introduced a configuration of its Spacebus platform produced without ITAR-restricted components. The introduction of these ITAR-free satellites will impact the global launch community and adversely impact U.S. satellite manufacturers. ITAR-free satellites will enable launch contracts to be awarded to launch services providers currently restricted from importing ITAR controlled components and drive U.S. satellite manufacturers to abandon flight-proven U.S. components. The Obama Administration, through the Departments of State, Commerce, and Defense and the U.S. Congress, are currently assessing changes to the export control regime that would make export regulations more business friendly to improve the competitiveness of U.S. satellite manufacturers in the global marketplace.

Global financial markets are experiencing a slow recovery from the deep recession of the last eighteen months. Recovery has been aided by the infusion of significant funding from government stimulus packages are beginning to stabilize the global economy. Access to corporate credit is beginning to become available again though terms and conditions vary globally from financial lending institutions. Access to funds from private equity firms is slowly returning as business plans are scrutinized for closure and for high probability of return on invested capital.

While global economic lending conditions have impacted the growth prospects of some satellite operators, the underlying strength of the Fixed Satellite Services (FSS) and Direct Broadcast Services (DBS) segments of the satellite services industry remain strong. Operator transponder usage rates are well above 85% in most cases with lease revenues locked in from long-term contracts. Consumers, though buffeted by economic forces, have generally cut back spending on discretionary expenditures other than satellite television or broadband delivery as low churn rates approximate those experienced by operators before the recession. Continued growth of the global media and broadcast industries coupled with a resilient consumer desire to be entertained, informed, and educated through various communications and broadcast means, the continued opening of global markets, and increasing re-regulation of the financial sector are all factors contributing to the global economic recovery.

Established FSS and DBS/DTH satellite systems operators are maintaining very healthy balance sheets anchored by high satellite use rates, long-term contracts, and large backlogs. Small-fleet regional and newer operators face some risk in obtaining reasonably priced credit facilities going forward since they do not have the revenue streams of the global players. This situation has increased demand for alternative project financing for spacecraft construction and launch services such as vendor-financing and government-backed financing from export credit agencies such as the U.S. Export-Import Bank and European-based Coface insurance company. Coface in particular has been very active in providing trade receivables financing and management to GSO satellite operators such as SES Global, Shin Satellite, Star One, Avanti Communications, and Gazprom and NGSO operators GlobalStar and O3b Networks among others.

Growth prospects for MSS operators other than Inmarsat are less promising as most have requirements to fund the build-out of expensive new satellite-terrestrial hybrid networks for service provision. The success of these operators is more dependent upon the state of global credit markets for continued access to working capital and to vagaries of consumer market demand.

Given the extended planning, budgeting, manufacturing, and launch lead-times associated with deploying GSO spacecraft assets on orbit, continued access to affordable capital will remain vital for all operators. Barring a major downturn in the global recovery, the increasing stability of the financial markets will help provide confidence for existing operators to move forward with planned satellite orders for system recapitalization and expansion, and for new operators to proceed with system introductions.

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 may impact service provider's 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 2009 COMSTAC report.

	Significant Negative Impact	Some Negative Impact	No Effect	Some Positive Impact	Significant Positive Impact	Compared to 2009
Regional or global economic conditions	0%	45%	45%	9%	0%	↑
Demand for satellite services	0%	18%	27%	27%	27%	↑
Ability to compete with terrestrial services	0%	18%	82%	0%	0%	↑
Availability of financing	0%	18%	45%	18%	18%	↑
Availability of affordable insurance	0%	18%	36%	45%	0%	↑
Consolidation of service providers	0%	0%	73%	27%	0%	↑
Increasing satellite life times	0%	45%	45%	9%	0%	↓
Availability of satellite systems that meet your requirements	0%	0%	55%	36%	9%	↓
Reliability of satellite systems	0%	9%	55%	27%	9%	↑
Availability of launch vehicles that meet your requirements	9%	9%	64%	18%	0%	↓
Reliability of launch systems	9%	0%	18%	64%	9%	↑
Ability to obtain required export licenses	0%	45%	45%	9%	0%	↓
Ability to obtain required operating licenses	0%	9%	73%	18%	0%	↑

Table 6. 2010 COMSTAC Survey Questionnaire Summary

↑ More positive nompared to 2009
↓ More negative compared to 2009

The following 11 satellite and launch services providers responded to the supplementary questionnaires. The Working Group would like to offer special thanks to these companies for providing this additional input:

Arianespace
Asiasat
Boeing Launch Services
Hisdesat Servicios Estrategicos, S. A.*
Intelsat
Orbital Sciences
SES Americom
Sirius XM
SkyPerfect JSAT Corporation*
Space Exploration Technologies
ViaSat

* Indicates 2009 survey respondent

The Supplementary Questionnaire inquiries can be broken down into three main categories: financial, technical, and regulatory. The 2010 survey reflects a generally positive perception of the industry, although the respondents indicated that their ability to obtain the required export licenses had deteriorated from last year. There was a significant decrease in the percentage of respondents who felt that global economic conditions were having a negative impact on their business plans. An increasing percentage of respondents were satisfied with the satellite component of their business, and there was a decrease in concern about the reliability and availability of launch vehicles. It should be noted that only two of the eleven 2010 respondents had submitted a survey response in 2009, so some of the changed perceptions could be related to the individual experiences of the 2010 respondents.

Despite continuing global economic woes, the trend in the financial category was overwhelmingly positive. The percentage of respondents who said they experienced some or significant negative impact due to global or regional economic conditions decreased from 77% in 2009 to 45% in 2010. The availability of financing improved significantly for our respondents, with only 18% reporting some or significant negative impact in 2010 versus 69% in 2009. 82% of the respondents saw an improvement in demand for satellite services compared with only 69% in 2009. Positive 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 per cent of positive responses to these questions were much smaller.

Operators continue to be satisfied with the variety and reliability of satellite systems available to them. 45% of the respondents in 2010 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 38% of the 2009 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. Operator optimism seems to extend to launch vehicles as well. Only 18% of the 2010 respondents said that the availability of launch vehicles had some or significant negative impact on their plans compared to 23% of 2009 respondents. Perception of launch vehicle reliability has improved dramatically, with only 9% of the 2010 respondents citing this as a negative factor compared with almost one-third (31%) of the 2009 respondents. This could be a reflection of the fact that there were no commercial launch vehicle failures in 2009 compared with one commercial launch vehicle failure in 2008 (ProtonM/AMC-14).

The only survey area to show some degradation from 2009 to 2010 was the regulatory category. Forty-five per cent of the 2010 respondents experienced some or significant negative impact as a result of their ability to obtain the required export licenses compared to 15% of the 2009 respondents. Some improvement was seen in the ability to obtain the required operating licenses, with 9% of 2010 respondents experiencing some or significant negative impact versus 23% in 2009.

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 2009, with a projection for 2010 based on the near-term manifest shown in Table 4. Peaks in total number of transponders launched

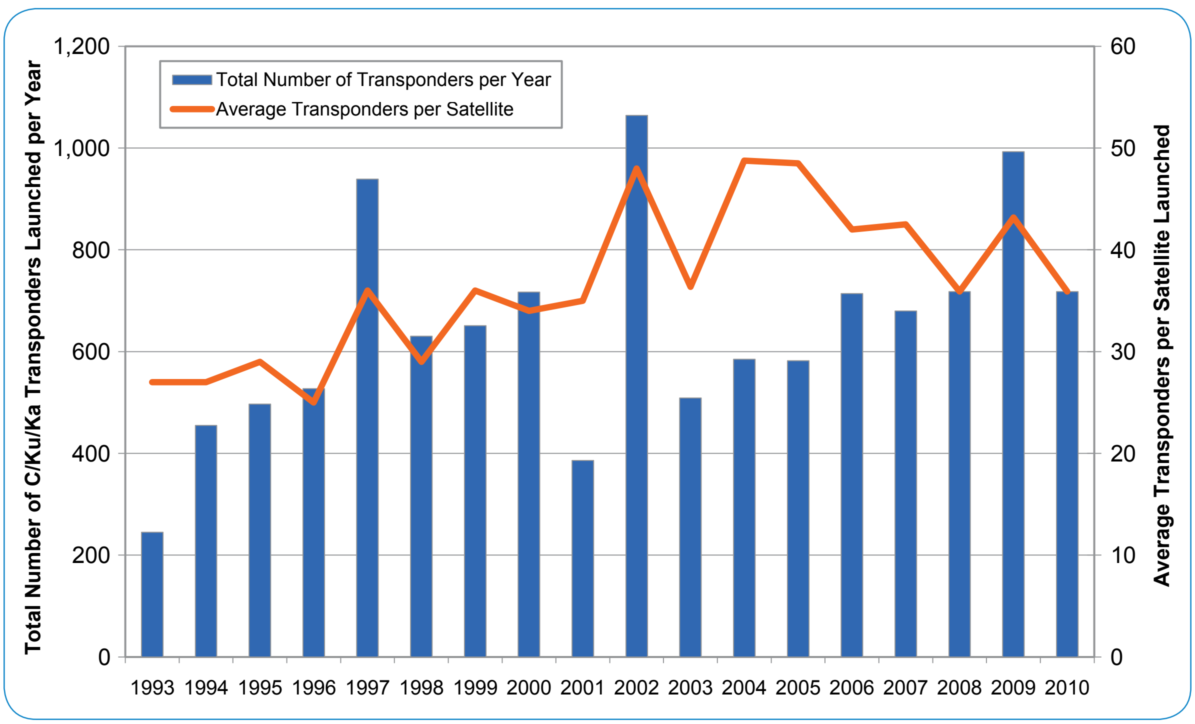

Figure 10. Total C/Ku/Ka Transponders Launched per Year and Average Transponders per Satellite

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Number of Transponders per Year	245	455	497	527	939	630	651	717	386	1,064	509	585	582	714	680	718	993	718
Average Transponders per Satellite	27	27	29	25	36	29	36	34	35	48	36	49	49	42	43	36	43	36

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

correspond to peaks in number of satellites launched for a given year. The average 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 2010 is expected decline slightly and future growth is expected to be relatively incremental.

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 and 2006 and rose again in 2009. The average mass in 2010 is expected to decrease slightly and growth trends in the

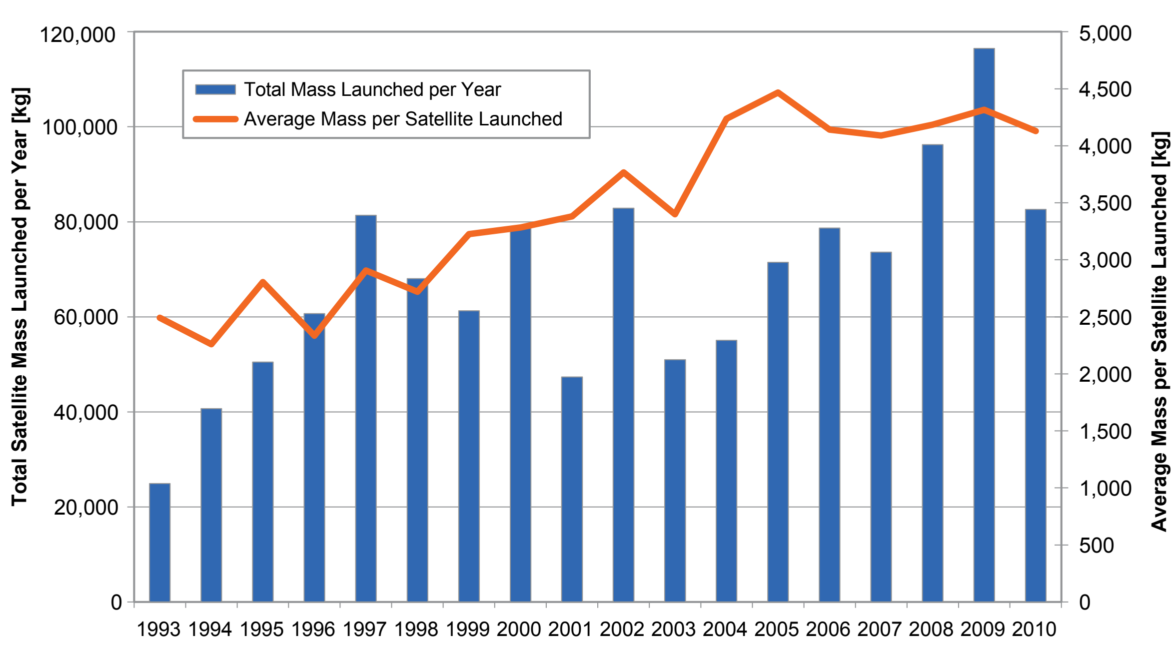

Figure 11. Total Satellite Mass Launched per Year and Average Mass per Satellite

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Mass Launched per Year [kg]	24,910	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	82,590
Average Mass per Satellite [kg]	2,491	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	4,130

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

future are also expected to be incremental. The last seven years have averaged 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 2010 is over 82,000 kilograms.

Summary

The 2010 COMSTAC Commercial GSO Launch Demand Forecast projects an average annual demand of 20.7 satellites to be launched from 2010 through 2019, nearly identical to the 2009 forecast of 20.8 and down slightly from the 2008 forecast of 21.8 satellites per year. Actual launches per year fell below 20 in 2009 with 18 launches accomplished.

The Working Group forecasts 20 total satellites launched (including five that will be dual-manifest) in 2010, increasing to 25 total satellites (including five that will be dual-manifest) launches in 2011, and a slight decrease to 23 satellites (including five that will be dual-manifest) launches expected in 2012. The long term forecast of average annual single-manifest launches over the ten-year period spanning 2010 through 2019 is 10.6 launches per year. The average annual dual-manifest launches during 2010 through 2019 are forecasted to be 5.1. The 2010 Commercial GSO Launch Demand Forecast averages 15.7 launches per year from 2010 through 2019—unchanged 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 average mass in 2010 is expected to decrease slightly from last year. Growth trends in the future are expected to be incremental. The last seven years have seen an average mass of over 4,000 kilograms and the expectation is that the next several years will be similar. The projected total mass to be launched in 2010 is over 82,000 kilograms. 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 2010 is expected to decline slightly; future growth is expected to be incremental.

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 and has successfully delivered 3 more satellites in 2009; Falcon 9 plans to launch in 2010; and Soyuz, launched from Kourou, also plans to conduct its initial launch late in 2010. The Taurus II, currently in development, will also add launch capacity to support medium class payloads. Sea Launch's emergence from bankruptcy is critical to maintaining sufficient launch capacity at the medium, large and extra large mass classes. Ariane 5 and Proton together have the capacity to meet the current demand. However, should one of these two systems stand down for some period of time, affordable launch capacity and commercial access to space will become a significant issue.

Table 9. Historical Addressable Commercial GSO Satellites Launched (1993–2009)

	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	
	Astra 1C	Ariane 42L	Astra 1D	Ariane 42P	Astra 1E	Ariane 42L	DM3 Arabsat 2A	Ariane 44L
	DM2 DBS 1	Ariane 44L	Intelsat 702	Ariane 44LP	DBS 3	Ariane 42P	DM4 Arabsat 2B	Ariane 44L
	Galaxy 4	Ariane 42P	DM2 PAS 2	Ariane 44L	Intelsat 706A	Ariane 44LP	EchoStar 2	Ariane 42P
	Intelsat 701	Ariane 44LP	PAS 3	Ariane 42P	N-Star a	Ariane 44P	Intelsat 707A	Ariane 44LP
	DMN Solidaridad 1	Ariane 44LP	DM4 Solidaridad 2	Ariane 44L	PAS 4	Ariane 42L	Intelsat 709	Ariane 44P
	Telstar 401	Atlas IIAS	Telstar 402	Ariane 42L	Telstar 402R	Ariane 42L	MSAT 1	Ariane 42P
			DBS 2	Atlas IIA	AMSC 1	Atlas IIA	N-Star b	Ariane 44P
			Intelsat 703	Atlas IIAS	Galaxy 3R	Atlas IIA	DM2 Palapa C2	Ariane 44L
			Optus B3	Long March 2E	Intelsat 704	Atlas IIAS	DM1 PAS 3R	Ariane 44L
					Intelsat 705	Atlas IIAS	AMC 1	Atlas IIA
					JCSat 3	Atlas IIAS	Hot Bird 2	Atlas IIA
					APStar 2	Long March 2E	Palapa C1	Atlas IIAS
					ASIASAT 2	Long March 2E	Intelsat 708A	Long March 3B
					EchoStar 1	Long March 2E	Astra 1F	Proton K/DM
Below 2,500 kg (<5,510 lbm)	4		9		4		11	
	DM1 Insat 2B	Ariane 44L	DM3 Brazilsat B1	Ariane 44LP	DM1 Brazilsat B2	Ariane 44LP	DM2 Amos 1	Ariane 44L
	DM1 Hispasat 1B	Ariane 44L	DM2 BS-3N	Ariane 44L	DM1 Hot Bird 1	Ariane 44LP	DMN Italsat 2	Ariane 44L
	DM2 Thaicom 1	Ariane 44L	DM1 Eutelsat II F5	Ariane 44LP	DMN Insat 2C	Ariane 44L	DM1 Measat 1	Ariane 44L
	NATO 4B	Delta II	DM4 Thaicom 2	Ariane 44L	Koreasat 1	Delta II	DM4 Measat 2	Ariane 44L
			DM1 TurkSat 1A	Ariane 44LP			DM3 TurkSat 1C	Ariane 44L
			DM3 TurkSat 1B	Ariane 44LP			Inmarsat 3F1	Atlas IIA
			Orion 1	Atlas IIA			Inmarsat 3F3	Atlas IIA
			Galaxy 1RS	Delta II			Galaxy 9	Delta II
			APStar 1	Long March 3			Koreasat 2	Delta II
							APStar 1A	Long March 3
							Inmarsat 3F2	Proton K/DM

= 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 (1993–2009) 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	Anik F1	Ariane 44L
					Orion 3	Delta III	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	DM4 Afristar	Ariane 44L	AMC 4	Ariane 44L	DM1 Asiastar 1	Ariane 5G
	Intelsat 801	Ariane 44P	DM3 Eutelsat W2	Ariane 44L	DM1 Arabsat 3A	Ariane 44L	DM3 Astra 2B	Ariane 5G
	Intelsat 802	Ariane 44P	Hot Bird 4	Ariane 42P	Insat 2E	Ariane 42P	Europe*Star 1	Ariane 44LP
	Intelsat 803	Ariane 42L	PAS 6B	Ariane 42L	Koreasat 3	Ariane 42P	Eutelsat W1R	Ariane 44P
	Intelsat 804	Ariane 42L	PAS 7	Ariane 44LP	Orion 2	Ariane 44LP	Galaxy 10R	Ariane 42L
	JCSat 5	Ariane 44P	Satmex 5	Ariane 42L	Telkom	Ariane 42P	Galaxy IVR	Ariane 42L
	PAS 6	Ariane 44P	ST-1	Ariane 44P	Telstar 7	Ariane 44LP	N-Sat-110	Ariane 42L
	DM4 Sirius 2	Ariane 44L	Hot Bird 5	Atlas IIA	Echostar V	Atlas IIAS	Superbird 4	Ariane 44LP
	DM2 Thaicom 3	Ariane 44LP	Intelsat 805A	Atlas IIAS	Eutelsat W3	Atlas IIAS	Echostar VI	Atlas IIAS
	AMC 3	Atlas IIAS	Intelsat 806A	Atlas IIAS	JCSat 6	Atlas IIAS	Eutelsat W4	Atlas IIIA
	DirecTV 6	Atlas IIA	Galaxy 10	Delta III	Asiasat 3S	Proton K/DM	Hispasat 1C	Atlas IIAS
	EchoStar 3	Atlas IIAS	Astra 2A	Proton K/DM	Astra 1H	Proton K/DM	AAP 1	Proton K/DM
	Galaxy 8i	Atlas IIAS	EchoStar 4	Proton K/DM	LMI 1	Proton K/DM	AMC 6	Proton K/DM
	JCSat 4	Atlas IIAS	PAS 8	Proton K/DM	Nimiq	Proton K/DM	PAS 9	Sea Launch
	Superbird C	Atlas IIAS			Telstar 6	Proton K/DM		
	Agila II	Long March 3B			DirecTV 1R	Sea Launch		
	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						
Below 2,500 kg (<5,510 lbm)	7		9		1		6	
	DM1 AMC 2	Ariane 44L	DM4 AMC 5	Ariane 44L	DM1 Skynet 4E	Ariane 44L	DM3 AMC 7	Ariane 5G
	DM2 BSat 1A	Ariane 44LP	DM1 Brazilsat B3	Ariane 44LP			DM4 AMC 8	Ariane 5G
	DM4 Cakrawarta 1	Ariane 44L	DM2 BSat 1B	Ariane 44P			DM4 Astra 2D	Ariane 5G
	DM3 Inmarsat 3F4	Ariane 44LP	DM1 Inmarsat 3F5	Ariane 44LP			DM2 Brazilsat B4	Ariane 44LP
	DM3 Insat 2D	Ariane 44LP	DM2 NileSat 101	Ariane 44P			DM1 Insat 3B	Ariane 5G
	DM1 Nahuel 1A	Ariane 44L	DM3 Sirius 3	Ariane 44L			DM2 Nilesat 102	Ariane 44LP
	Thor II	Delta II	Bonum-1	Delta II				
			Skynet 4D	Delta II				
			Thor III	Delta II				

(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 (1993–2009) Cont'd

	2001		2002		2003		2004		2005	
Total Launches	12		20		12		13		15	
Total Satellites	14		22		15		13		16	
Over 5,400 kg (>11,905 lbm)	0		0		0		3		6	
							Anik F2	Ariane 5G+	DM1 Spaceway 2	Ariane 5ECA
							Intelsat X	Proton M/M	Thaicom 4	Ariane 5G+
							DirecTV 7S	Sea Launch	Inmarsat 4F1	Atlas V 431
									IA-8	Sea Launch
									Inmarsat 4F2	Sea Launch
									Spaceway 1	Sea Launch
4,200 - 5,400 kg (9,260 - 11,905 lbm)	5		9		5		4		4	
	DirecTV 4S	Ariane 44LP	Intelsat 904	Ariane 44L	Intelsat 907	Ariane 44L	Eutelsat W3A	Proton M/M	AMC-12	Proton M/M
	Intelsat 901	Ariane 44L	Intelsat 905	Ariane 44L	DM2 Optus C1	Ariane 5G	Amazonas	Proton M/M	Anik F1R	Proton M/M
	Intelsat 902	Ariane 44L	Intelsat 906	Ariane 44L	Rainbow 1	Atlas V 521	Estrela do Sul	Sea Launch	AMC-23	Proton M/M
	XM Rock	Sea Launch	NSS-6	Ariane 44L	EchoStar 9	Sea Launch	APStar V	Sea Launch	XM-3	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		3	
	DM2 Artemis	Ariane 5G	DMN Atlantic Bird 1	Ariane 5G	DM1 Insat 3A	Ariane 5G	Superbird 6	Atlas IIAS	DMN XTAR-EUR	Ariane 5ECA
	Atlantic Bird 2	Ariane 44P	DMN Hotbird 7	Ariane 5ECA	DM3 Insat 3E	Ariane 5G	MBSat	Atlas IIIA	Insat 4A	Ariane 5G+
	DM1 Eurobird	Ariane 5G	Insat 3C	Ariane 42L	Asiasat 4	Atlas IIIB	AMC-16	Atlas V 521	DirecTV 8	Proton M/M
	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		3	
	DM1 BSat 2A	Ariane 5G	DM1 Astra 3A	Ariane 44L	DM2 Bsat 2C	Ariane 5G	AMC-10	Atlas IIAS	DM1 Telkom 2	Ariane 5ECA
	DM2 BSat 2B	Ariane 5G	DM2 N-Star c	Ariane 5G	DM3 e-Bird 1	Ariane 5G	AMC-11	Atlas IIAS	DMN Galaxy 15	Ariane 5G+
	DMN Skynet 4F	Ariane 44L			DM1 Galaxy XII	Ariane 5G			Galaxy 14	Soyuz
					Amos 2	Soyuz				

= 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 (1993–2009) Cont'd

	2006		2007		2008		2009	
Total Launches	15		12		18		18	
Total Satellites	19		18		23		22	
Over 5,400 kg (>11,905 lbm)	2		3		5		8	
	DM2 Satmex 6	Ariane 5ECA	DM3 Spaceway 3	Ariane 5ECS	Inmarsat 4F3	Proton M	Eutelsat W2A	Proton M
	DM3 DirecTV 9S	Ariane 5ECA	DirecTV 10	Proton M/M	DirecTV 11	Sea Launch	Sirius FM5	Proton M
			NSS-8	Sea Launch	ICO G-1	Atlas V	Terrestar 1	Ariane 5 ECA
					Echostar 11	Sea Launch	DM1 Amazonas 2	Ariane 5 ECA
					Ciel 2	Proton M	DM2 NSS-12	Ariane 5 ECA
							Intelsat 14	Atlas V
							Eutelsat W7	Proton M
							DirecTV 12	Proton M
4,200 - 5,400 kg (9,260 - 11,905 lbm)	9		6		8		2	
	DM4 Wildblue 1	Ariane 5ECA	DM1 Skynet 5A	Ariane 5ECA	DM1 Skynet 5C	Ariane 5G	DM3 Hotbird 10	Ariane 5 ECA
	Astra 1KR	Atlas V 411	DM2 Astra 1L	Ariane 5ECA	Astra 1M	Proton M	Nimiq 5	Proton M
	Hotbird 8	Proton M/M	DM5 Skynet 5B	Ariane 5ECA	Nimiq 4	Proton M		
	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)	6		5		8		9	
	DM1 Hotbird 7A	Ariane 5ECA	DM1 Insat 4B	Ariane 5ECA	DM2 BADR 6	Ariane 5G	DM1 Satcom BW1	Ariane 5 ECA
	DM1 Spainsat	Ariane 5ECA	DM2 Galxy 17	Ariane 5ECA	DM3 Eutelsat W2M	Ariane 5G	DM2 Thor 6	Ariane 5 ECA
	DM2 Thaicom 5	Ariane 5ECA	DM5 Star One C1	Ariane 5ECA	AMC 14	Proton M	Telstar 11N	Land Launch
	DMN JCSat 10	Ariane 5ECA	DM6 RASCOM 1	Ariane 5G+	DM4 Vinasat	Ariane 5G	Sicral 1B	Sea Launch
	Arabsat 4A	Proton M/M	JCSat 11	Proton M/M	DM2 Protostar 1	Ariane 5G	Protostar II	Proton M
	Arabsat 4B	Proton M/M			DM5 AMC 21	Ariane 5G	Asiasat 5	Proton M
					DM1 Turksat 3A	Ariane 5G	DM4 JCSat 12	Ariane 5 ECA
					DM4 StarOne C2	Ariane 5G	Palapa D	Long March
							Intelsat 15	Land Launch
Below 2,500 kg (<5,510 lbm)	2		4		2		3	
	DM4 AMC-18	Ariane 5ECA	DM3 Bsat 3A	Ariane 5ECA	AMOS 3	Land Launch	DM3 NSS-9	Ariane 5 ECA
	DM3 Optus D1	Ariane 5ECA	DM4 Intelsat 11	Ariane 5G+	Thor 5	Proton M	Measat 3A	Land Launch
			DM4 Optus D2	Ariane 5G+			DM4 Optus D3	Ariane 5 ECA
			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 (1993–2009)

	1993		1994		1995	
Total Launches	3		4		1	
Total Spacecraft	3		4		2	
	Gorizont	Proton K/DM	DFH 3-1	Long March 3A	DMC Telecom - 2C	Ariane 44L
	Gorizont 40	Proton K/DM	Express	Proton K/DM	Gals 2	Proton K/DM
	Gorizont 41	Proton K/DM	Gals-1	Proton K/DM		
			Gorizont 42	Proton K/DM		
	1996		**1997**		**1998**	
Total Launches	4		1		9	
Total Spacecraft	5		1		2	
	DMC Telecom 2D	Ariane 44L	Chinasat 6	Long March 3A	ChinaStar-1	Long March 3B
	Chinasat 7	Long March 3A			Sinosat-1	Long March 3C
	Express 2	Proton K/DM				
	Gorizont 43	Proton K/DM				
	Gorizont 44	Proton K/DM				
	1999		**2000**		**2001**	
Total Launches	8		15		7	
Total Spacecraft	3		4		1	
	Express A1	Proton K/DM	Express A2	Proton K/DM	Ekran M	Proton M/M
	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		
	2002		**2003**		**2004**	
Total Launches	6		3		2	
Total Spacecraft	1		4		2	
	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**	
Total Launches	3		2		0	
Total Spacecraft	3		2		2	
	Express AM 2	Proton K/DM	Kazsat	Proton K/DM	Sinosat 3	Long March 3B
	Express AM 3	Proton K/DM	Sinosat 2	Long March 4B	Chinasat 6B	Long March 3B
	Apstar 6	Long March 3B				
	2008		**2009**			
Total Launches	2		4			
Total Spacecraft	2		4			
	Venesat 1	Long March 3B	DM1 Express MD-1	Proton M		
	Chinasat 9	Long March 3B	DM1 Express AM44	Proton M		
			Raduga 1	Proton K/DM		
			Feng Yun 2C	Long March 3A		

(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

2010 COMMERCIAL SPACE TRANSPORTATION FORECAST FOR NON-GEOSYNCHRONOUS ORBITS

Introduction

The *2010 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, 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. Commercial launch, as defined for this forecast, include payloads that are internationally competed for launch services or will be licensed for launch by the FAA.

Forecast Purpose

The 2010 NGSO forecast is developed for the following purposes:
- To assist the FAA/AST in its planning for licensing and efforts to foster a healthy commercial space launch capability in the United States
- To raise public awareness of the scope and trajectory of commercial spaceflight demand

Commercial NGSO Launch Industry Map

The commercial space launch industry is depicted in Figure 12. Demand for commercial space launch flows from top to bottom through the various industry components, which include:

SATELLITE AND TRANSPORTATION SERVICE SEGMENTS

These segments, defined by the type of service the spacecraft is designed to offer, attract users including private companies, militaries, national space programs, universities, and the general public. The launch demand discussed in this forecast is categorized by spacecraft service sectors which include international science and other applications, commercial remote sensing, telecommunications, and transportation services grouped within orbital facility assembly and services (OFAS).

SATELLITE OPERATORS

Satellite operators are spacecraft owners which satisfy demand for satellite and transportation services by purchasing and operating spacecraft to provide those services. Satellite operators can take many forms including private enterprises, government agencies, public-private partnerships, universities, and non-profit entities. Private sector satellite operators typically focus on a particular service segment, for example DigitalGlobe and GeoEye in the remote sensing segment and

Iridium and ORBCOMM in the communications segment. However, government agencies generally operate a range of different satellite systems across multiple service segments. OFAS is a new segment of launch demand with the first related flights expected in 2010.

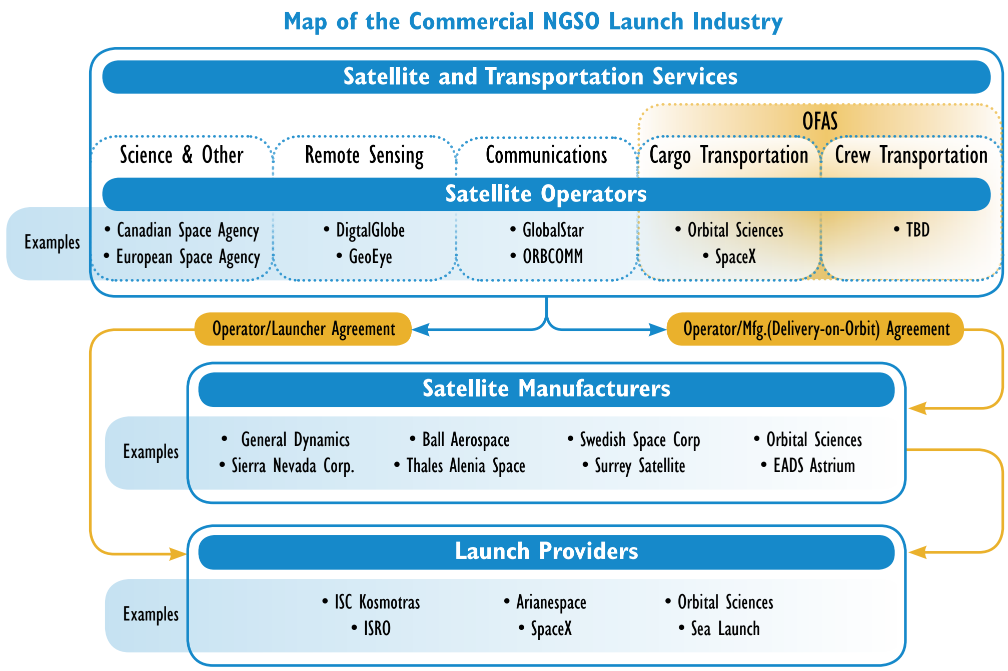

Figure 12. NGSO Launch Industry Map

SATELLITE MANUFACTURERS

These are the organizations, typically private companies but also universities and governments, which construct new satellites purchased by satellite operators. Manufacturers typically are capable of manufacturing spacecraft in multiple service sectors, although some manufacturers may specialize in a particular segment. Spacecraft often include components and/or instruments manufactured by multiple manufacturers. In these cases a manufacturer will be contracted as the prime or lead manufacturer for the spacecraft, and will hold responsibility for ensuring effective integration of all components.

LAUNCH PROVIDERS

These are the companies which provide launch services for spacecraft under agreements or contracts signed primarily with satellite operators, although sometimes these contracts are signed with satellite manufacturers (in arrangements known as delivery-on-orbit).

These industry components have been presented as distinct from each other. However, in some cases a company (such as Orbital Sciences or SpaceX) may be vertically integrated and conduct its own spacecraft manufacturing, provide launch using its own vehicle, operate the spacecraft once on orbit, and directly interface with the market to provide services derived from the spacecraft.

Figure 12 does not depict government regulators, finance sources, and some additional industry components. It is important to note that these components exist, and do influence demand within the commercial NGSO launch market.

Basic Forecast 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 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.

Forecast Summary

The FAA/AST forecasts an average demand of 11.9 worldwide launches per year during 2010–2019 with some sustained activity over the first eight years, followed by a drop in activity around 2018 due to the conclusion of demand for deployment of large NGSO satellite constellations. However, significant opportunity for growth in commercial NGSO space launch could occur as new capabilities and markets emerge such as commercial human orbital spaceflight and new low cost microsatellite launch systems.

Today's NGSO Launch Market Is Characterized by

- Large deployments of telecommunications constellations
- A steady demand for launch of international science and other satellites
- The new and promising sector of orbital facility assembly and services
- A small but steady launch demand for commercial remote sensing satellites

Launch demand is divided into two vehicle size classes with an average of 9.1 medium-to-heavy launch vehicles per year and about 2.8 small vehicle launches per year during the forecast period. The number of medium-to-heavy launches increased compared to last year's forecast, but the number of small launches held steady. Figure 13 depicts the distribution of the number of satellites seeking launch by service type and the associated number of launches. Telecommunications makes up almost half of the satellite market but only about 18 percent of the launch market because of multiple-manifesting; each launch for the second-generation Iridium, Globalstar, ORBCOMM, and O3b fleets are expected to be multi-manifested.

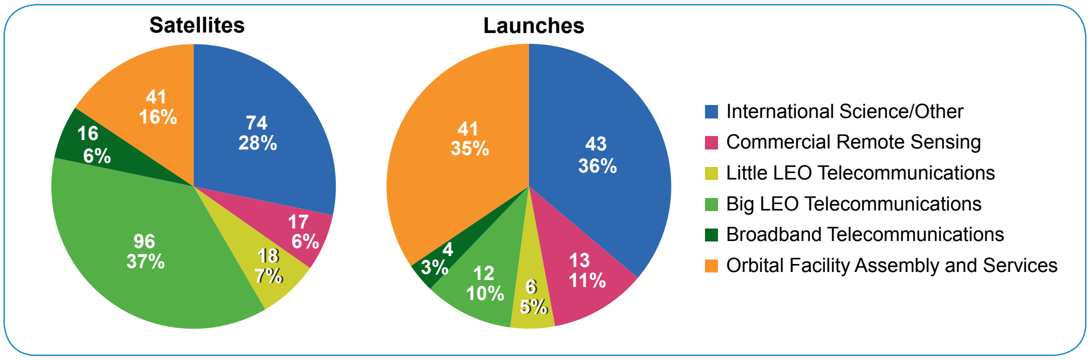

Figure 13: Number of Satellites Seeking Launch and the Associated Launches from 2010–2019

About 28 percent of the satellite market is comprised of international science and other satellites, such as technology demonstrations. This translates to 36 percent of the launch market. The new orbital facilities assembly and services category accounts for 34 percent of the launch market. Commercial remote sensing satellites account for about 11 percent of the launch demand market.

The 2010 non-geosynchronous orbits forecast (see Figure 14) shows a dramatic increase in the annual launch rate during the next ten years when compared with the previous decade. This increase is driven by telecommunications replenishments and the emergence of OFAS. We assume these replenishments are likely to occur as investor confidence in space services remains steady despite the economic downturn that began in 2008. Financial status of the communications organization is discussed in detail in the section of this chapter covering telecommunications systems.

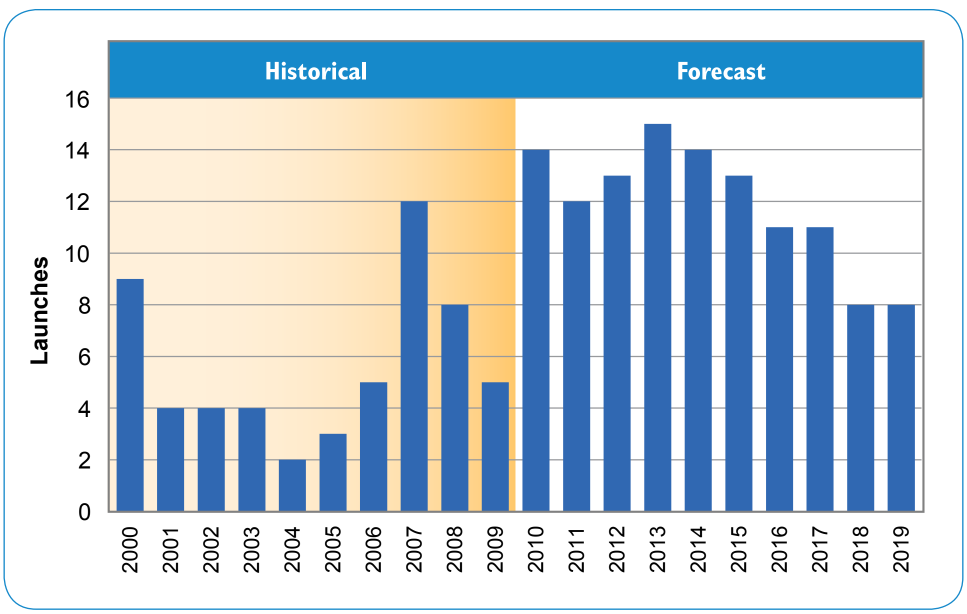

Figure 14. Commercial NGSO Launch History and Forecast

Report Structure
2010 Commercial Space Transportation Forecast for NonGeosynchronous Orbits

- The 1st section discusses sources of demand for launch services
- The 2nd section identifies emerging markets for launch services
- The 3rd section analyzes the sources of uncertainty that affect launch demand
- The 4th section provides an in depth review of forecasted launch demand
- Appendix 1 details the forecast methodology
- Appendix 2 reviews historical forecast data
- Appendix 3 is a list of acronyms

The launch rate in 2009 missed its estimate, demonstrating the challenge in projecting launch rates in this sector. The near-term manifest projects announced launch demand for the first four years of the forecast period as depicted in Table 19 (page 68). The 2009 near-term forecast estimated that 8-10 would occur in 2009 but only five occurred. A large portion of commercial launch services is tied to developmental systems both on the satellite and launch vehicles sides of the industry. The 2010 realization estimate is 8-10 as well with 14 launches announced by launch providers. The 2010 demand includes two maiden flights of new rockets and four multi-manifested launches. These types of missions have a greater than normal chance of slipping into the next year. Sources of forecast uncertainty are discussed in detail within a dedicated section of this report.

NGSO Spacecraft Service Segments

The following sections provide an in detail analysis of the sources of demand for commercial launch services within the various spacecraft service segments including international science and other, commercial remote sensing, telecommunications, and orbital facilities and services.

International Science and Other Satellites

Government Earth observation programs, technology development missions, and other scientific missions are 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 without domestic launch capabilities. For technology demonstration missions, most involve small satellites on modest budgets, so the demand leans toward low-cost, small launch vehicles.

Methodology

The International Science and Other Satellites segment of demand included in this forecast is composed of several sub-segments. These sub-segments are:

- International Science and Technology Demonstration, including commercially launched government operated earth observation satellites, commercially launched science spacecraft, and technology demonstration spacecraft (including those with intended downstream commercial application).
- Digital Audio Radio Services, commonly known as satellite radio.
- Other Commercial Payloads, including FAA-licensed demonstration flights of new launch vehicles and commercial orbital research platforms.
- Other Non-Commercial Payloads, including commercial launches of military satellites.

Within the International Science and Technology Demonstration component, a baseline forecast is employed. Future spacecraft and launches are estimated based on historical activity levels. Known and likely satellite systems to be launched are noted within the baseline; and if in a given year the total number of known and/or likely spacecraft exceeds the baseline that total is used in the forecast.

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, United Kingdom, and the United States.

INTERNATIONAL SCIENCE AND TECHNOLOGY DEMONSTRATION

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 built or launched by commercial firms in other countries. The imagery products generated from these satellites are usually offered for free or are used for government purposes. Examples of missions falling into this category within the near-term manifest considered by this forecast are described below.

- South Korea's **Kompsat-5** satellite is a 1,280-kilogram (2,816-pound) Synthetic Aperture Radar (SAR) imaging spacecraft scheduled for launch in 2010 aboard a Dnepr vehicle operated by ISC Kosmotras. Kompsat-5 will provide imagery of up to 1-meter resolution to the South Korean government for use in geographic information applications and for monitoring and responding to natural and environmental disasters. As a SAR satellite Kompsat-5 will be capable of producing imagery in all weather conditions, both day and night. The satellite was manufactured jointly by the South Korean space agency KARI and European manufacturer Thales Alenia Space, with Alcatel Alenia Space being responsible for the production of the X-band SAR sensor.

- The **NigeriaSat-2** and **NX** optical earth observation satellites were manufactured for the Nigerian government by the British company Surrey Satellite Technology Limited (SSTL). NigeriaSat-2 will provide high resolution imagery and operate as part of the Disaster Monitoring Constellation (DMC), an international constellation of remote sensing systems that provides multispectral imaging in support of disaster relief operations. NX, which will also operate as part of the DMC, will provide imagery at a lower resolution and was manufactured as part of a training program for Nigerian engineers. Both NigeriaSat-2 and NX will launch in 2010 as secondary payloads aboard a Dnepr vehicle operated by ISC Kosmotras. The primary payload on this launch is the Ukrainian government earth observation satellite **Sich-2**, which was manufactured in the Ukraine by state-owned PA Yuzhmash.

- Argentina's National Commission on Space Activity (CONAE) is developing the **SAOCOM 1A** and **1B** radar based remote sensing satellites that will provide imagery for natural resources monitoring, as well as for emergency and disaster management. The satellites will carry an L-band SAR. CONAE has contracted U.S. launch services provider SpaceX to launch these spacecraft. Launch of SAOCOM 1A is currently scheduled for 2012 with the launch of SAOCOM 1B to follow in 2013, both using SpaceX's Falcon 9 launch vehicle. Once operational the SAOCOM satellites are expected to be integrated with the Italian Cosmo-Skymed series of SAR satellites to form the Italian-Argentine System of Satellites for Emergency Management constellation.

A second class of satellites includes spacecraft designed to carry out scientific work in space, ranging from specialized Earth sciences research to planetary missions. Many of these missions are government-operated satellites launched on government launch vehicles, and as such are not included in this forecast. However, some missions of this type do launch using commercially procured services. Examples of missions falling into this category within the near-term manifest considered by this forecast include the following:

- The European Space Agency's (ESA) **Cyrosat-2**, a 750-kilogram (1,652-pound) spacecraft designed to precisely monitor changes in the thickness of marine ice in the Arctic and Antarctic regions. The spacecraft launched on a Dnepr vehicle operated by ISC Kosmotras in April 2010.

- The **EnMAP** spacecraft, a project of the German space agency DLR, is planned to launch in 2013. EnMAP is a hyperspectral imager designed to study a range of ecological parameters including agriculture, forestry, soil and geology. A specific launch vehicle for EnMAP has not yet been identified.

Piggyback Satellites

Many satellites in the International Science and Other category launch as what is commonly referred to as piggyback or secondary payloads, a practice also known as co-manifesting. A piggyback payload is a spacecraft or satellite which is carried into space utilizing excess launch capacity on a rocket being used to launch a primary payload. Examples of piggyback payloads within the forecast timeframe include the French Picard satellite launching as a secondary payload on a Dnepr vehicle in 2010 carrying the Swedish Prisma system as a primary payload and the South Korean Kompsat 3 satellite launching as secondary payload on a Japanese government H2A rocket launch vehicle in 2012. Launching as a piggyback payload can allow operators to place their spacecraft into orbit at significantly lower cost than as a primary. As such piggyback payloads do not create launch demand in this forecast. However, these payloads may in some cases represent cases where piggyback capacity has replaced potential demand for a small launch vehicle.

The third class of satellites feature spacecraft designed to perform technology demonstrations. Examples of missions falling into this category within the near term manifest considered by this forecast include the following:

- The Swedish Space Corporation is conducting 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 2010 on a Dnepr vehicle operated by ISC Kosmotras.

- The Japanese **SERVIS-2** spacecraft, managed by the Institute for Unmanned Space Experiment Free Flyer (USEF), is scheduled for launch in 2010 onboard a Rockot launch vehicle operated by Eurockot Launch Services GmbH, a joint German-Russian company. Servis-2 will provide verification of the operation of selected commercial-off-the-shelf components in the space environment.

- The **Cascade, Smallsat, and Ionospheric Polar Explorer (CASSIOPE)** spacecraft, manufactured by the Canadian company MacDonald, Dettwiler and Associates Ltd. (MDA) is scheduled for launch in 2011 onboard a Falcon 9 launch vehicle operated by SpaceX. A prime objective of the CASSIOPE mission, is to space-qualify high-performance payload components that will be used in the CASCADE mission currently under development at MDA. The CASCADE mission will enable a service business that will offer users in remote areas the ability to move potentially thousands of gigabits of data on a daily basis to and from anywhere on Earth. MDA expects to launch the first two CASCADE satellites in 2016.

- MDA also plans a mission to demonstrate on-orbit servicing capability that may test refueling or repair capabilities. This mission, planned for launch in 2013, is projected to require a heavy-class launch vehicle.

OTHER COMMERCIAL

Other commercial demand for launches included in the NGSO forecast originate from three sources: satellite digital audio radio services (DARS), demonstration flights, and commercial orbital research platforms. Provision of DARS, commonly referred to as satellite radio, is dominated in the United States by Sirius XM. There has been uncertainty as to the number and timing of future NGSO DARS satellites in the U.S. as Sirius XM continues to harmonize operating procedures following the 2008 merger of Sirius and XM. Previous editions of this forecast have included plans for the launch of a Sirius XM DARS satellite, Sirius FM-6, into an NGSO orbit in 2011. However, current Sirius XM planning indicates that Sirius FM-6 will be launched into a GSO orbit. Accordingly this satellite has been removed from the NGSO forecast and no U.S. DARS satellites are currently included in the forecast.

In Europe, Ondas Media is making the strongest movement towards an NGSO DARS system. Ondas currently plans an operational service to be available at some point in 2012. In 2008, the company signed an authorization to proceed with Space Systems/Loral for the design and development of their system, which would include three highly-elliptical orbit (ELI) satellites launched around 2012. The company has announced agreements with automobile manufacturers, including Nissan-Infiniti and BMW, to install receivers in their automobiles and has signed content licensing agreements with several radio content providers. 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. As a result, no European DARS satellite systems are included in the forecast.

A special sub-class of demonstration flights includes the demonstration not of spacecraft or components but of new launch vehicles. Within the near-term manifest considered by this forecast, two launch vehicles are scheduled to fly demonstration flights. These are:

- The maiden flight of the SpaceX Falcon 9 launch vehicle, currently scheduled for the second quarter of 2010. This launch will not transport a satellite to orbit but will be used to test the new launch system.
- The inaugural flight of SpaceX's Falcon 1e, an updated version of the Falcon 1, also planned for 2010.

Other launch vehicle operators may plan demonstration flights for new vehicles (for example under the auspices of NASA's Commercial Orbital Transportation Services program) within the forecast timeframe, however these flights will be included in different subsections of the NGSO Forecast, and not as part of the International Science and Other demand.

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 October 2009, SpaceX hosted their second workshop to present DragonLab's capabilities to potential users. The first five DragonLab missions are expected to launch in 2012, 2013, 2015, 2017, and 2019.

OTHER NON-COMMERCIAL

Commercial launches are sometimes procured by governments for primarily non-commercial purposes. These are minority cases, however examples of missions falling into this category within the near-term manifest considered by this forecast include the following:

- 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). The first three satellites were launched individually by Delta II vehicles in 2007 and 2008. The fourth satellite is planned to launch in 2010 on a Delta II.
- 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). SAPPHIRE is currently planned to launch in 2010 as a secondary (piggyback) payload on a Polar Satellite Launch Vehicle (PSLV) operated by the Indian Space Research Organization (ISRO). Follow-on SAPPHIRE missions are possible but not currently confirmed.
- The Turkish Ministry of Defense has contracted the Italian firm Telespazio to manufacture an electro optical earth observation satellite, to be known as **Gokturk**, for intelligence and surveillance purposes. The satellite is projected to have a mass of up to 5,000 kilograms (11,000 pounds) and therefore will require a medium-to-heavy launch vehicle when launched, currently expected in 2013. Turkey plans to commercially sell imagery obtained by Gokturk and follow-on satellites are under consideration.

INTERNATIONAL SCIENCE AND OTHER LAUNCH DEMAND SUMMARY

This segment of launch demand is relatively stable with a twenty year average of just under four launches per year. Launch demand is forecasted to average four launches a year during the forecast period as compared with an average of three during the previous ten years. Figure 15 provides a representation of the international science and other launch history and forecast demand.

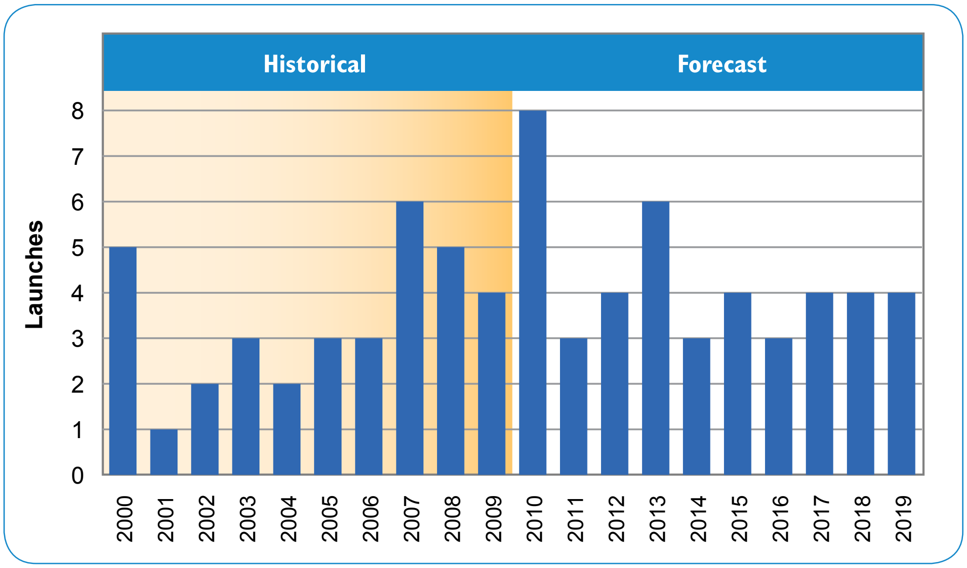

Figure 15. International Science and Other Launch History and Forecast

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.

NGA EnhancedView

The National Geospatial-Intelligence Agency (NGA) EnhancedView procurement is the contract vehicle through which the Agency will purchase future high resolution electro-optical imagery from commercial providers. Through the EnhancedView program NGA will issue multiyear contracts for imagery purchases at a resolution of 0.25m — a higher resolution level than currently provided by commercial systems. Awards under the EnhancedView program and expected in early summer 2010, with imagery delivery to commence two to three years later. Both GeoEye and DigitalGlobe are competing for this award. In a notable departure from the previous contract vehicle, the NextView program, the NGA will not be co-financing the manufacture of the necessary satellites under this award. Instead, the agency has required that bidders obtain a private or commercial letter of credit to match the amount of funding towards manufacture of satellites that would have been expected to be co-financed by the government under the previous contract model.

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

The National Oceanic and Atmospheric Administration (NOAA) is the U.S. agency with authority to license commercial remote sensing systems. Currently there are 16 active remote sensing licenses. Ten of these have been granted to either GeoEye and DigitalGlobe, or their predecessor companies (see Table 11).

Licensee	Date License Granted or Updated	Remarks
DigitalGlobe	1/4/1993	Originally issued to WorldView for EarlyBird satellte.
ORBIMAGE (d/b/a GeoEye)	5/5/1994	Originally issued to Orbital Sciences Corp. (OrbView-3).
DigitalGlobe	9/6/1994	QuickBird-1 and QuickBird-2.
AstroVision	1/23/1995	First license issued for a commercial GSO system.
Ball Aerospace/Technologies	11/21/2000	License for commerical SAR system.
DigitalGlobe	12/6/2000	First licenses issued to commercial operators for 0.5 meter resolution.
DigitalGlobe	12/14/2000	QuickBird Follow-on.
ORBIMAGE (d/b/a GeoEye)	6/17/2003	Update to license for SeaStar satellite, changing name to Orbview-2. Originally issued to Orbital Sciences Corp.
DigitalGlobe	9/29/2003	License for four-satellite high-resolution system (Worldview satellites).
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, for OrbView-5, now GeoEye-1.
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.
Northrop Grumman	8/24/2009	License for commerical SAR system.
GeoEye Inc	1/14/2010	Amendment of IKONOS Block II license to change system name to GeoEye 2 & 3.
DISH Operating LLC	2/2/2010	GSO satellite with television camera for low-resolution images; license transfer from to Echostar to DISH.

Table 11. NOAA Remote Sensing Licenses

In 2009 NOAA announced it had loosened licensing restrictions on commercial radar imaging satellites. Under the new regime NOAA permits the sale of commercial radar imagery with a resolution of up to 1 meter, compared to the previous limit of 3 meters. The aim of the restriction adjustment is to foster the development of a domestic market for radar imagery. In August of 2009 Northrop Grumman became the first company to receive a license for a SAR satellite under the new regime. Northrop has licensed technology used in the Israeli military TecSAR satellites and has plans to use that technology to develop a commercial SAR satellite platform known as Trinidad. However, the company has stated that it will not build and operate the system without a firm government commitment to purchase imagery. No such commitment has been made, and for this reason the Trinidad system is not included in the launch demand in this forecast.

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.

The major companies operating or actively developing remote sensing satellites across the globe are profiled below. These companies sell land imaging data on the commercial market for applications such as natural resource mapping, urban planning, agriculture and others. Most commercial remote sensing companies are public-private partnerships where the majority of data is purchased by national governments. A summary of commercial remote sensing systems is provided in Table 12.

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	Both WorldView 1 and 2 are operational. WorldView 2 will operates in a higher orbit than WorldView 1 and takes imagery in additional spectral bands.
GeoEye	GeoEye	General Dynamics Advanced Info. Systems	GeoEye-1	907 (2,000)	0.41	2008	GeoEye 1 is operational, providing high-resolution imagery.
GeoEye	GeoEye	Lockheed Martin	GeoEye-2	TBD	0.25	2012	GeoEye 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	A string of five satellites.

Table 12. Commercial Satellite Remote Sensing Systems

DIGITALGLOBE

DigitalGlobe is a U.S. commercial remote sensing data provider, based in Longmont, Colorado. The company was established in 1993 and went public in May of 2009. DigitalGlobe has three remote sensing satellites on orbit with its Quickbird and WorldView-1 and 2 systems. DigitalGlobe sells imagery on the commercial market but its anchor customer is the NGA. 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 the second quarter of 2012. A higher-capability generation of satellites, consisting of WorldView-1 and WorldView-2, is also now operational. WorldView-1, launched via a Boeing Delta II in 2007, is expected to reach the end of its operational life in the second quarter of 2018. WorldView-2, launched via a Boeing Delta II in 2009, is expected to reach the end of its operational life in the first quarter of 2021. The schedule for the development of the next generation of DigitalGlobe satellites is uncertain and likely to be impacted by the outcome of the NGA EnhancedView procurement. This forecast includes projected demand for the launch of two next-generation WorldView satellites, based on the 7.25-year design life of both WorldView-1 and WorldView-2.

GEOEYE

GeoEye, Inc., based in Dulles, Virginia, is a publicly-traded U.S. commercial remote sensing data provider. Data from GeoEye satellites is sold on the commercial market to private organizations and governments globally. The NGA is GeoEye's anchor customer. GeoEye currently operates three satellites capable of providing usable imagery. The IKONOS satellite was launched in 1999 onboard a Lockheed-Martin Athena II launch vehicle; the Orbview-2 satellite launched in 1997 via an Orbital Sciences Pegasus launch vehicle; and the next-generation GeoEye-1 satellite launched in 2009 using a Boeing Delta II launch vehicle. The GeoEye-1 satellite has a planned operational lifetime of seven years or longer. A fourth satellite, Orbview-3, is currently in orbit but has ceased to be capable of producing useful imagery. 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. In March 2010 GeoEye announced that Lockheed Martin had won the contract to build the GeoEye-2 spacecraft itself. GeoEye-2 could be launched as soon as late 2012, however the outcome of the NGA EnhancedView procurement will influence the development schedule for GeoEye and launch of satellite could occur as late as 2017. This forecast currently includes demand for launch of two GeoEye next-generation satellites: a 2012 launch for GeoEye-2 and a 2017 launch for a nominal GeoEye-3 as an end-of-life replacement for GeoEye-1.

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. Imagesat sells imagery on the open market with the Israeli government as an anchor client. 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 in December 2000 on a Start-1 launch vehicle operated by the Russian company and is expected to operate until 2012 or later. EROS B, also launched on a Start-1 in 2006, 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, as is a projected replacement of EROS B in the 2017 timeframe.

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 marketing and sales of commercial imagery, while DLR is responsible for science missions using the satellite. Infoterra partners with SPOT Image to co-market commercial imagery data. 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 operational lifetime of at last five years, 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 similar lifetime. The satellite is scheduled to launch on a Dnepr in 2010. Two future satellites are planned to continue Infoterra's mission, including TerraSAR-X2 in 2012 and TerraSAR-X3 in 2017.

MACDONALD, DETTWILER AND ASSOCIATES

MDA is a commercial provider of radar satellite remote sensing data collected by 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. MDA sells RADARSAT data commercially with national governments as its anchor customers. 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 Mission (RCM) as follow-on to RADARSAT-2. In March 2010 MDA was authorized by the CSA to start the design phase of the RCM, to be complete by June 2011. The 2010 Canadian government budget includes planned funding to complete the RCM. The RADARSAT Constellation Mission 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. A Dnepr rocket launched the five RapidEye satellites in August 2008. 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 revenues come from both commercial and government clients within these markets. Among others, MDA's Geospatial Services and U.S.-based MDA Federal Inc. provide support to RapidEye by marketing and selling its products. 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.

COMMERCIAL REMOTE SENSING LAUNCH DEMAND SUMMARY

Demand for launch by commercial remote sensing satellite will remain steady at approximately one launch per year during the forecast period. The commercial remote sensing industry is characterized by stable satellite replacement schedules that occur on a roughly seven year cycle. Figure 16 provides a representation of commercial remote sensing launch history and forecast demand.

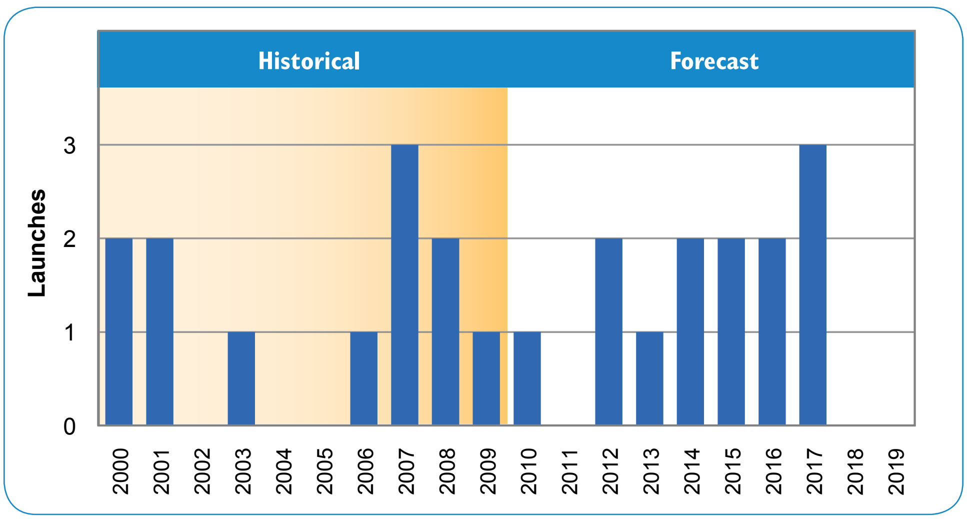

Figure 16. Commercial Remote Sensing Launch History and Forecast

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, which represents satellite systems residing in NGSO and providing high-speed data services at Ka- and Ku-band frequencies. Past proposed Broadband systems have not made it to fruition. However, O3b Networks proposes to deploy a Broadband system in 2012 that will provide Internet links and 3G cellular backhaul to underserved regions.

Big LEO systems are summarized in Table 13, Little LEO systems in Table 14, and Broadband in Table 15.

System	Operator	Prime Contractor	Satellites: Number	Satellites: Mass kg (lbm)	Orbit Type	First Launch	Status
OPERTIONAL							
Globalstar	Globalstar Inc.	Thales Alenia Space	60/44 (in orbit/ operational)	447 (985)	LEO	1998	Constellation on-orbit and operational, with technical anomolies. Eight replacement satellites launched in 2007. Next-generation system planned for launch starting in 2010.
Iridium	Iridium Communications Inc.	Motorola	90/73 (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 13. 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.	41/29 (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	6/4 (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 14. 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 (1,540)	LEO	2012	The first eight satellites of the constellation are planned to launch in 2012.

Table 15. Broadband 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 Initial Public Offering in 2006, and is in the process of updating its on-orbit satellite constellation that is currently suffering from partial technical failures. Globalstar provides low-bandwidth voice and data services to commercial clients globally.

Globalstar's first-generation satellite constellation consisted of 52 satellites—48 operational satellites plus four on-orbit spares. Globalstar's original constellation began experiencing problems with its S-band amplifier in 2001. The company announced in February 2007 that the S-band problem 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. 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.

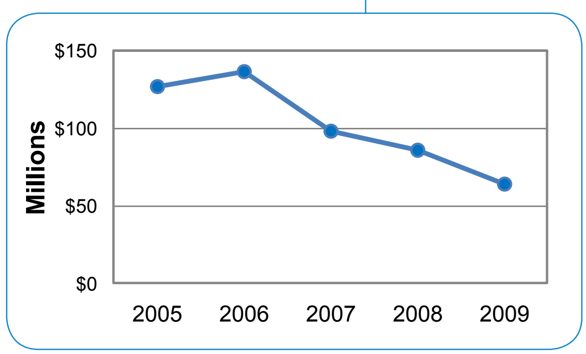

Figure 17. Publicly Reported Globalstar Annual Revenue

Globalstar's revenues have continued to slip as a result of the S-band problems and Globalstar's move to slash prices in order to keep customers during the transition to the renewed constellation. Figure 17 shows the decline in Globalstar's revenues since 2006. Globalstar has developed a simplex service product called the SPOT satellite GPS messenger. This device is designed for recreational and commercial customers who require personal tracking, emergency location, and messaging solutions that operate beyond the range of traditional terrestrial and wireless communications. In July 2009, Globalstar unveiled their second generation SPOT satellite GPS messenger. Globalstar plans on introducing additional duplex and simplex products and services.

In addition to these two launches, the company plans to launch a second-generation system beginning in late 2010. Globalstar has contracted with Arianespace to launch the first 24 satellites on four Soyuz launches, with an option for an additional launch. The company intends to use the four launches in 2010 and 2011 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. 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.

IRIDIUM

Iridium Communications Inc. is the successor to the original Iridium LLC that built and launched the 66-spacecraft Iridium satellite constellation in the late 1990s. Iridium 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 seven functioning spare satellites in orbit. In February 2009, a non-operational Russian satellite collided with an operational Iridium 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.

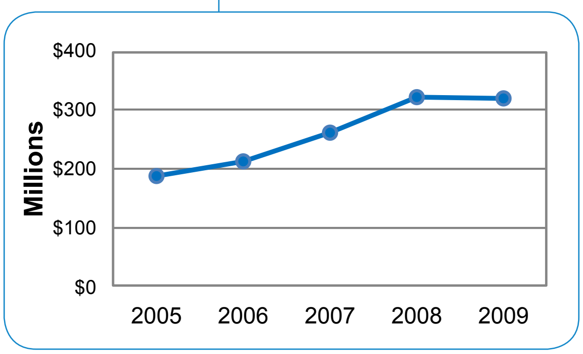

Figure 18. Publicly Reported Iridium Annual Revenue

A total of 95 Iridium satellites have been launched as a part of the first-generation system. These satellites comprise a fully-operational system that is expected to provide service until at least 2014. Iridium is taking the first steps to develop and launch a second-generation satellite constellation, named Iridium NEXT. Iridium selected Lockheed Martin and Thales Alenia Space in August 2008 to proceed into the system development phase. A prime contractor will be selected in the summer of 2010. The satellites in the new constellation may include hosted payloads in addition to the primary communications payload.

Iridium has not announced a launch provider for Iridium NEXT. The company's current notional launch plans call for launching 72 satellites with approximately 8 launches of 9 spacecraft each. Those launches would be spread over a three-year period, beginning in 2014. Iridium is considering a number of launch vehicle options.

Iridium revenue for 2009 decreased slightly from 2008 as represented in Figure 18. Iridium indicates that the decrease is due principally to a significant decrease in sales of subscriber equipment, offset by increased sales of commercial and government services. The company indicated that subscriber growth slowed due to the economic environment.

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 companies. The transaction leaves Iridium debt free and financially prepared to develop and deploy Iridium NEXT. Iridium became listed on the NASDAQ Global Market on September 24, 2009.

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. ORBCOMM focuses on providing data services for machine-to-machine applications.

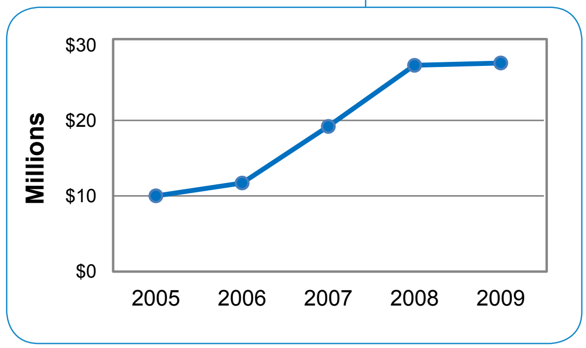

Figure 19. Publicly Reported ORBCOMM Annual Revenue

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 Automatic Identification System (AIS) payload designed to help track marine vessels. 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.

During 2009 the new "QuickLaunch" satellites began experiencing failures. By the end of 2009 only two of the quick-launch satellites were partially operational and provide AIS service. If these last two satellites fail, then AIS service will be suspended until the launch of the next-generation satellites.

ORBCOMM service revenue, which accounts for approximately 98.5 percent of total revenues, increased 14 percent to 27.1 million in 2009. The increase is due primarily to an increase in the number of billable subscriber communicators activated, and an increase in AIS revenue. The last five years of ORBCOMM revenue is plotted in Figure 19.

ORBCOMM received Federal Communications Commission (FCC) authorization for these new satellite and launch plans in March 2008 to deploy and operate a next-generation satellite system. In May 2008, ORBCOMM chose Sierra Nevada Corporation with subcontractors Boeing, ITT to build 18 next-generation satellites, which all include the AIS payload. The projected plans are to launch these satellites in 2010-2013. In 2009 ORBCOMM contracted with SpaceX to launch its next generation constellation on a number of Falcon 1e launch vehicles. The new ORBCOMM constellation will operate in four orbital planes, each in 750-kilometer circular orbits at an inclination of 48.5 degrees.

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 megabyte per second to 10 gigabyte per second 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 degrees of latitude around all 360 degrees of the Equator, and additional satellites can be added as need to meet demand. 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 lifetime of ten years. Design of the satellites began by Thales Alenia Space in 2007 and the preliminary design review was competed in February 2009. In March 2010, O3b also announced a launch services agreement with Arianespace for two launches in 2012.

In September 2009, O3b announced that France's Coface export-credit agency will provide the company with a $465-million loan to support the company's plans. As of September 2009 O3b has raised roughly $611 million of an estimated $750 million to complete the project's financial package that includes the cost of building, launching, and insuring the first eight satellites.

APRIZE SATELLITE

Aprize Satellite, Inc. plans to deploy a 30 satellite system depending on funding opportunities and customer demand for additional data-communication capacity and frequency of contact. A total of six AprizeStar (also known by its International Telecommunications Union registration as LatinSat) satellites weighing 10 kilograms (22 pounds) each were launched as secondary payloads on a Russian Dnepr rocket, two in 2002, two in 2004, and two in 2009. 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.

TELECOMMUNICATIONS LAUNCH DEMAND SUMMARY

Demand for launch of telecommunications satellites will drive the uptake in launch demand during the forecast period but drop off again after 2017. An average of just over two launches per year will occur during the forecast period. Figure 20 provides a representation of telecommunications launch history and forecast demand.

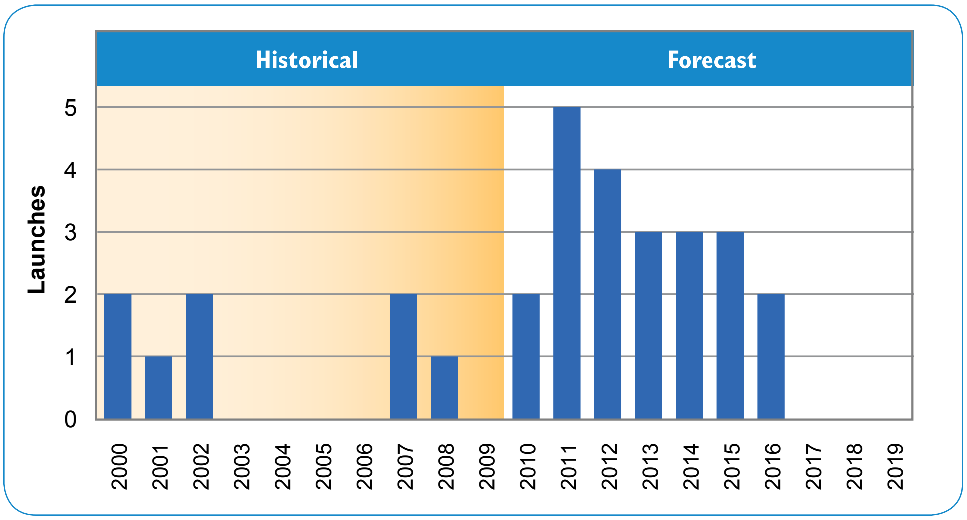

Figure 20. Telecommunications Launch History and Forecast

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 third year that the OFAS market category has existed within the forecast. Orbital facility launches were previously part of the "other" market category.

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 for 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. Following the retirement of the Space Shuttle the United States will face a shortfall in transportation capability to the ISS. Procuring U.S. commercial services is part of the solution to meet station cargo supply demand along with the use of foreign orbital vehicles. NASA will depend on the cargo capability of the European Automated Transfer Vehicle (ATV) and Japanese H-II Transfer Vehicle (HTV) and rely on pre-positioned spares, delivered by the Shuttle before its scheduled retirement, 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.

Uncertainty in OFAS Demand

Given the developmental nature of demand for OFAS launch services, the 2010 forecast excludes specific sources of launch demand from the quantitative forecast until sufficient technological, financial, or political uncertainty is resolved.

- Launch demand generated by Bigelow Aerospace and Excalibur Almaz are discussed within the text but excluded from quantitative forecast.
- OFAS demand from the NASA COTS and NASA CRS contracts are included within the text and quantitative forecast.

The ISS is a continuing market for cargo supply mission. The President's Fiscal Year 2011 Budget proposes to extend U.S. use of the ISS until at least 2020. Therefore demand for commercial service could possibly continue after 2015, the last year under the Request for Proposals, depending on the success of the first CRS contracts and other factors. This forecast includes a continuation of commercial ISS resupply missions at a nominal demand rate of four launches a year from 2016 to 2019.

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. Beyond Genesis, Bigelow is developing larger stations that could be deployed during the forecast period.

Station #1: 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 is estimated for 2014 but 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 four cargo flights and three crew transfer vehicle (CTV) flights to deploy.

Station #2: Bigelow proposes the launch of a second, larger station could occur in the 2016 time period. This larger station would consist of four BA-330 habitat connected by two busses and would generate significantly greater launch demand.

These new stations could create significant additional demand for commercial launches: in excess of 150 launches through 2020 according to company projections.

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. Given the uncertainty in CTV development, launch demand associated with a Bigelow space complex is not included in the forecast.

EXCALIBUR ALMAZ

Excalibur Almaz (EA) is an international space exploration company formed in 2005. EA is based in the British Isles in Isle of Man and was created to provide routine, affordable access to and from space for customers around the globe. The company plans to use elements of a legacy Soviet spacecraft program known as "Almaz." The flight tested Almaz spacecraft consists of a reusable re-entry vehicle and a support module that will provide crewmembers room to operate in space. The reusable re-entry vehicle was tested during unmanned orbital and suborbital flights between 1977 and 1985. EA plans to modernize and upgrade the Excalibur Almaz spacecraft and make it compatible with a variety of launch vehicles and launch from a number of launch sites around the globe.

EA has partnered with the Almaz program creator JSC MIC NPO Mashinostroyenia (NPOM) and other aerospace organizations such as Space Flight Operations, a subsidiary of United Space Alliance in the United States. Other partners include EADS Astrium Space Transportation in Europe and Japan

Manned Space Systems in Japan. The company plans to begin flight test of the Almaz hardware by 2012 and to launch its first revenue flight as early as 2013.

EA plans to offer space transportation for purposes of exploration, research, and science. Customers could include private enterprises, educational organizations, and international governments. EA is considering offering transportation services to Lunar orbits.

If EA's plans come to fruition on its current schedule, it could create additional demand for commercial launches: in excess of 10 launches through 2020. EA launch demand is not currently represented within the forecast model.

ORBITAL FACILITIES ASSEMBLY AND SERVICE LAUNCH DEMAND SUMMARY

Demand for launch OFAS payloads will begin during the forecast period with an average annual launch rate of four launches. Delays in development of OFAS launch services could push uptake further into the future. Alternatively, around 2014, developed of a commercial crew transfer vehicle could lead to an increasing launch rate. Figure 21 provides a representation of OFAS launch history and forecast demand.

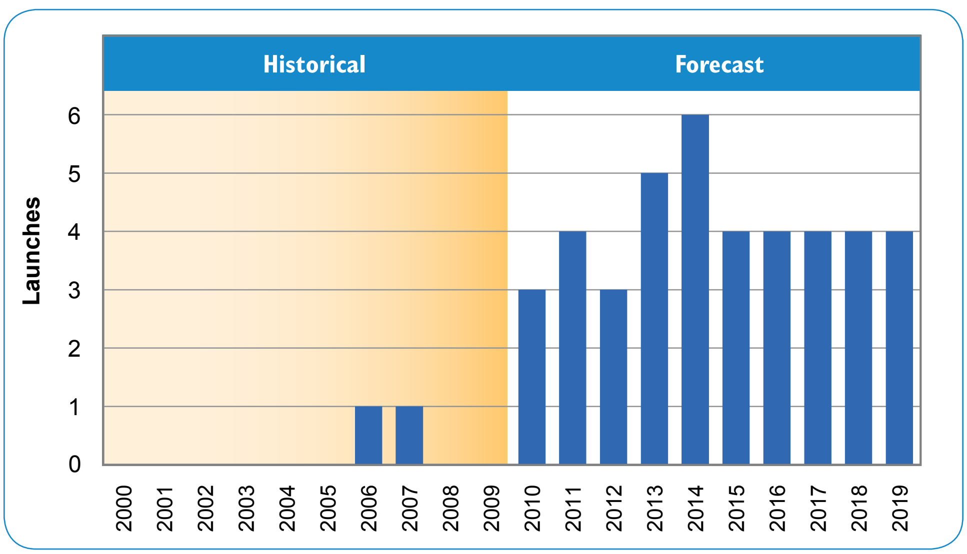

Figure 21. OFAS Launch History and Forecast

Emerging 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 OFAS activities were considered to be future markets in previous years' forecasts. Development of a commercial CTV could generate new launch demand and possibly lead to the deployment of private space stations that require a large number of human and cargo supply flights. The emergence of a low-cost, reliable microsatellite launch vehicle may also significantly increase launch demand as satellite operators would likely move away from multi-manifesting to dedicated microsatellite launch systems. Finally, lunar exploration, science, and development may be spurred by private space competitions and government investment.

Commercial Human Orbital Spaceflight

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 next five years. Excalibur Almaz also plans to provide a crew transportation capability based on flight proven technology starting in 2013.

The United States government has taken steps to develop a U.S. commercial crew transportation capability. In August 2009, NASA announced that the Commercial Crew and Cargo Program Office planned to spend up to $50 million in federal stimulus money to finance development of commercial crew transport concepts. This initiative, referred to as CCDev, solicited proposals in August 2009. NASA announced the award of CCDev Space Act Agreements in February 2010 to Blue Origin, The Boeing Company, Paragon Space Development Corporation, Sierra Nevada Corporation, and United Launch Alliance. The CCDev contracts could help begin the process of developing a commercial crew transport capability for NASA. Development of a commercial crew capability for NASA is a major element of the President's fiscal year 2011 budget proposal for NASA.

Orbital Microsatellite Launch

Launch rates may increase beyond forecasted levels if a new microsatellite launch capability emerges. Microsatellites, spacecraft with a mass of less than 100 kilograms, are typically grouped together with a larger primary payload and placed in orbit on a shared launch vehicle (multi-manifesting). The emergence of a micro-satellite launch vehicle, with competitive launch costs, may cause microsatellite payloads to shift from the multi-manifest approach to individual launch on these new vehicles. This would result in a larger number of launches.

Historical launch data from 2000 through projected 2010, for launches to all inclinations in LEO, indicates that an average of six spacecraft in the 50-99 kilogram range have launched per year. There is also a median of three spacecraft in the

20-49 kilogram payload range launched per year in the same timeframe including both internationally competed launches (mainly composed of spacecraft launching commercially as secondary payloads on a commercially launched vehicle) and non-competed launches (mainly composed of academic or government research spacecraft launching as secondary payloads on government procured launches). These figures provide a baseline for estimating the amount of launch demand which might be accessed by microsatellite launch vehicles under development. Therefore six launches of spacecraft in the 50-99 kilogram range and one launch carrying co-manifested 20-49 kilogram range payloads, for a total of seven launches per year, could serve as an initial estimate of the launch demand to be served by microsatellite launch vehicles.

Nanosatellites—satellites with masses of ten kilograms or less—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 51 nanosatellites have been successfully launched from 2005 through 2009. 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 have not historically stimulated commercial launch demand on their own an often fly as secondary payloads. Emergence of an affordable launcher may find a niche for dedicated nanosatellite class launch.

In recent years a number of organizations have initiated development of launch vehicle concepts targeting the orbital launch of microsatellites (e.g. spacecraft with a mass of less than 100 kilograms) These concepts include:

- Virgin Galactic's plans to use the White Knight Two vehicle as a platform for a small satellite launch vehicle.
- The Canadian Space Agency's expressed interest in developing a microsatellite launch vehicle.
- Small launch vehicles in various stages of development at companies such as Interorbital Systems and Microcosm Inc.

The possibility of this market emerging is a potential uncertainty that may affect the number of launches that occur during the forecast period. If a new microsatellite vehicle is developed and sufficient customer demand is demonstrated, launch projections for this segment will incorporated into the forecast.

Lunar Transportation

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 itself, participants may develop the technology and experience necessary to support affordable private and governmental lunar exploration missions that will generate demand for additional launch services.

Risk Factors That Affect Satellite and Launch Demand

A large number of financial, political, and technical factors could negatively or positively impact the NGSO forecast. The emergence of new markets, such as orbital public space travel, can be difficult to forecast with certainty. The NASA COTS program is an example of government promotion of a new commercial market that may not have been imaginable a decade ago. Launch failures are a prime example of an uncertainty factor that can dramatically impact launch rates. This section will qualitatively discuss the sources of uncertainty affecting the launch forecast.

Financial Uncertainty

- 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, as the dollar rises in value, this trend will reverse.

- Investor confidence—After investors suffered large losses from the bankruptcies of high-profile NGSO systems in the early 2000s, confidence in future and follow-on NGSO telecommunications systems plummeted. There are signs of renewed investor confidence in this market.

- 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.

- 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.

Political Uncertainty

- 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. The DOD also continues to be a major customer of Iridium and has made extensive use of its services in Afghanistan and Iraq.

- 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.

- 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.

Technical Uncertainty

- 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.

- 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.

- Introduction of lower price launch vehicle—Although low priced Russian vehicles have been available for years, the emergence of the lower-price SpaceX Falcon 1e 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 systems could stimulate the development of a market for commercial human transportation to NGSO. This is a trend identified in the 2003 NASA ASCENT Study Final Report.

Satellite and Launch Forecast

In the 2010 forecast, 262 satellites are seeking future commercial launch, creating demand for 119 launches after multi-manifesting. These numbers are slightly higher than those in the 2009 forecast, which predicted 260 satellites to be launched on 110 vehicles in the 2009–2018 timeframe. Primary drivers of the difference between the forecasts include:

- Delayed timetables for deploying large telecommunications constellations.
- New plans for deployment of large constellations that leverage a greater number of launches than expected (ORBCOMM); or fewer (Iridium)
- Delay in the initial NASA COTS demonstration flights and the extension of ISS CRS beyond 2016 also contributed to the difference.

A comparison of the launch demand in the 2010 forecast versus the 2009 forecast is made in Figure 22. Table 16 and Figures 23 and 24 show the satellites and launches forecasted between 2010 and 2019.

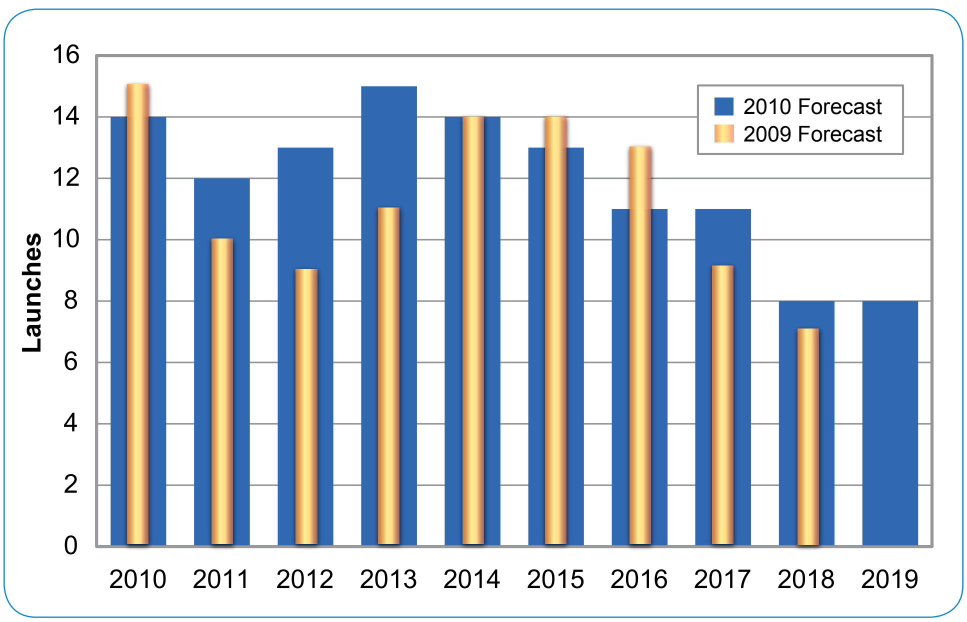

Figure 22. Comparison of Past Baseline Launch Demand Forecasts

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	TOTAL	Avg
SATELLITES												
International Science/Other	11	7	7	8	6	7	6	7	8	7	74	7.4
Commercial Remote Sensing	1	0	2	1	2	6	2	3	0	0	17	1.7
Little LEO Telecom	3	6	6	3	0	0	0	0	0	0	18	1.8
Big LEO Telecom	6	18	0	0	27	27	18	0	0	0	96	9.6
Broadband Telecom	0	0	8	8	0	0	0	0	0	0	16	1.6
Orbital Facility Assembly & Services	3	4	3	5	6	4	4	4	4	4	41	4.1
Total Satellites	24	35	26	25	41	44	30	14	12	11	262	26.2
LAUNCH DEMAND												
Medium-to-Heavy Vehicles	11	8	9	11	13	12	11	8	6	6	95	9.5
Small Vehicles	3	4	4	4	2	2	2	3	2	2	28	2.8
Total Launches	14	12	13	15	15	14	13	11	8	8	123	12.3

Table 16. Satellite and Launch Demand Forecast

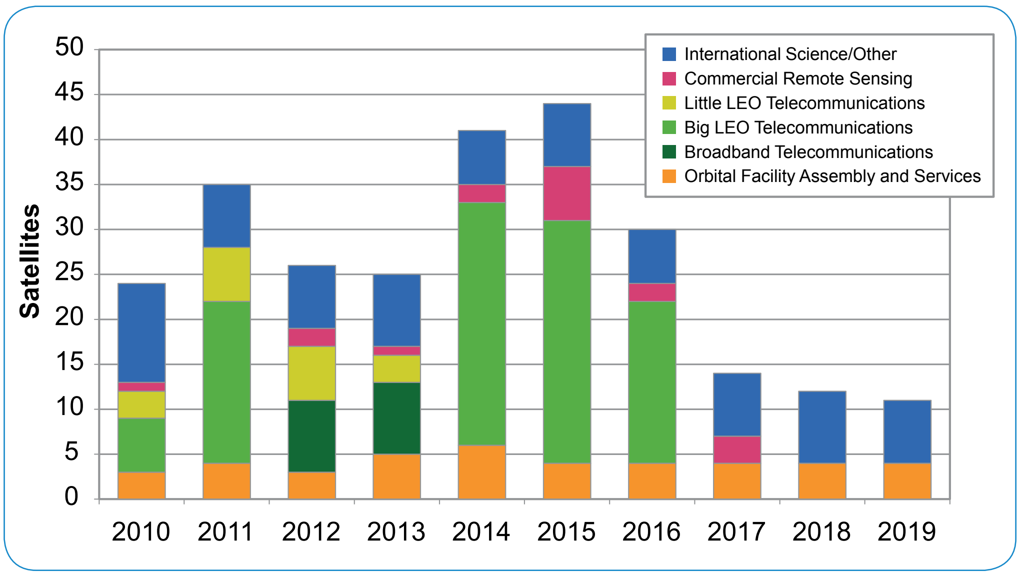

Figure 23. Satellite Forecast

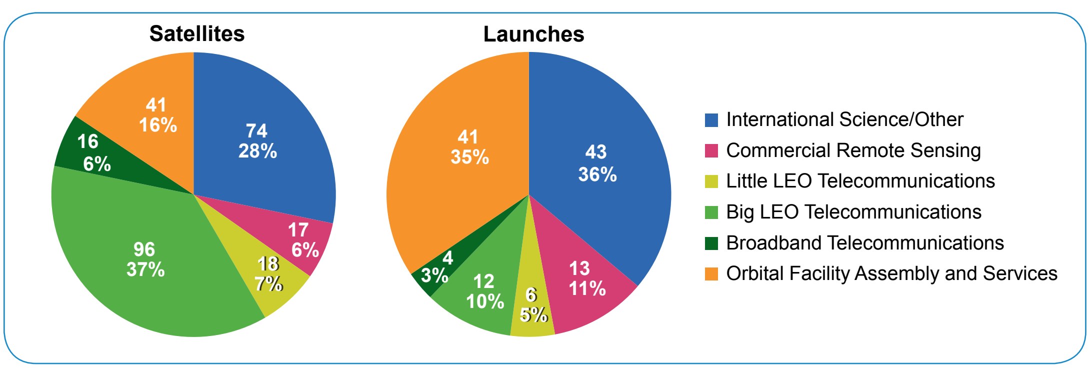

Figure 24. Number of Satellites Seeking Launch and the Associated Launches from 2010–2019

The 2010 forecast anticipates the following satellite market characteristics from 2010–2019:

- Telecommunications satellites account for about 50 percent of the market with 130 satellites, a decrease from the 132 satellites in last year's forecast.

- 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 2009 and 2008 forecasts.

- Orbital facility assembly and service satellites account for 16 percent of the 2010 forecast with 41 spacecraft. This is a new market category in its third year of inclusion within the NGSO forecast and is poised for growth dependant on successful demonstration of commercial transportation capability.

- Commercial remote sensing satellites encompass 6 percent of the 2010 forecast with 17 satellites. This compares with a 7 percent share in the 2009 forecast.

Table 17 shows the mass distributions of known manifested payloads over the next four years. Most of the categories of satellite mass remained stable with the exception of the largest spacecraft mass. Satellite with mass in excess of 1,200 kilograms (2,646 pounds) increased from 18 to 25 in this year's forecast. This increase can be attributed primarily to a compression and extension of NASA resupply services manifest.

Note: Table 17 includes only satellites with known mass. Therefore the total number of satellites examined in a year differs from the forecast.

	2009	2010	2011	2012	Total	Percent of Total
< 200 kg (< 441 lbm)	8	8	6	3	25	24%
200-600 kg (441-1,323 lbm)	1	2	3	1	7	7%
601-1,200 kg (1,324-2,646 lbm)	10	19	10	10	49	46%
> 1,200 kg (> 2,646 lbm)	6	4	6	9	25	24%
Total	25	33	25	23	106	100%

Table 17. Distribution of Satellite Masses in Near-Term Manifest

The launch forecast of 119 launches is comprised of 28 small vehicle and 91 medium-to-heavy vehicle launches. This demand breaks down to an average of approximately three launches annually on small launch vehicles and about 10 launches annually on medium-to-heavy launch vehicles. The 2009 forecast included 110 total launches composed of 27 small and 83 medium-to-heavy launches.

The forecast starts with a total of 24 satellites demanding 14 launches in 2010. 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 2009. Therefore, the FAA expects 10 to 15 launches to occur in 2010. The largest amount of satellite seeking launch occurs in 2015 when a total of 41 satellites are expected to require 14 launches. The highest demand for launches occurs in 2013 when 15 launches are expected. Launch demand divided among launch vehicle mass classes is depicted in Figure 25.

Launcher Use Distribution 2009 vs. 2010 Forecast

- Telecommunications constellations will increase usage of small and medium-to-heavy launchers
- International science/other will use less small launchers and more medium-to-heavy launchers
- Commercial remote sensing shows little change
- Orbital facility assembly and services shows a continued use of only medium-to-heavy launchers

As usual the telecommunications market, led by Big LEO systems, dominates the forecasted satellite market. The projected number of launches for the international science plus other and the OFAS market categories are relatively even. However, as can be seen in Table 18, OFAS spacecraft all require medium-to-heavy launch vehicles whereas international science plus other will use a mix of medium-to-heavy and small launches. Commercial remote sensing satellites are projected to launch on 11 medium-to-heavy launch vehicles and 2 small launch vehicles.

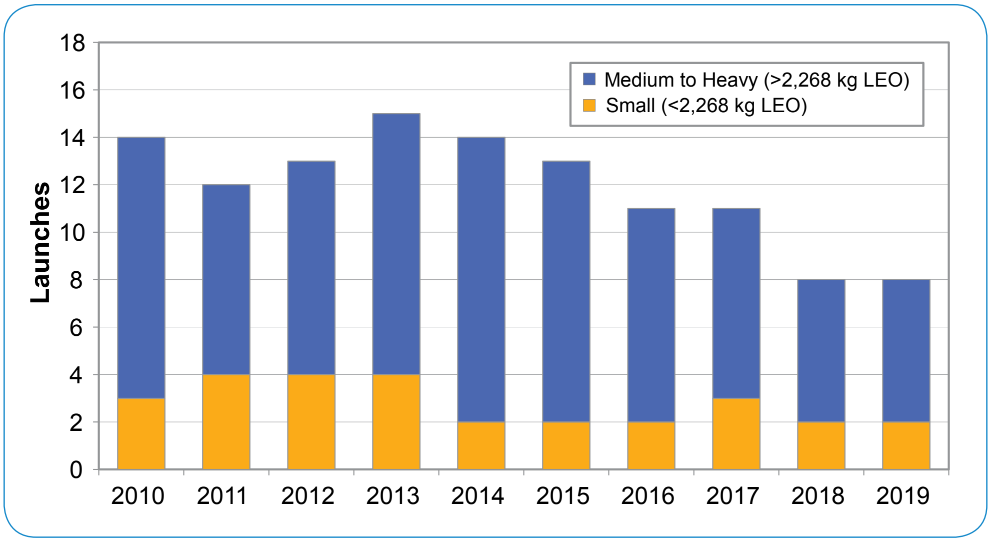

Figure 25. Launch Demand Forecast

		Launch Demand		
	Satellites	Small	Medium to Heavy	Total
International Science/Other	74	20	23	43
Commercial Remote Sensing	17	2	11	13
Little LEO Telecommunications	18	6	0	6
Big LEO Telecommunications	96	0	12	12
Broadband Telecommunications	16	0	4	4
Orbital Facility Assembly and Services	41	0	41	41
Total	262	28	91	119

Table 18. Distribution of Launches Among Market Sectors

Appendix 1: Detailed Description of Forecast 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 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, which 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 19 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 2010.

Service Type	2010	2011	2012	2013
International Science	Kompsat 5 - Dnepr	Microscope - TBA	Kompsat 3 - H2A (Piggy)	Kompsat 3A - TBA
	SERVIS 2* - Rockot	ASNARO- TBA	SWARM (3) - Rockot	EnMap - TBA
	Cryosat 2* - Dnepr	NEOSSAT - TBA	SAOCOM 1A - Falcon 9	MDA On-Orbit Servicing Demo - TBA (Heavy)
	Sich-2 - Dnepr NigeriaSat-2 NX RASAT	CASSIOPE - Falcon 9		SAOCOM 1B - Falcon 9
	PRISMA 1 and 2* - Dnepr Picard*			
Other	Cosmo-Skymed 4 - Delta II	SAPPHIRE -PSLV (Piggy)	DragonLAB 1 - Falcon 9	DragonLAB 2 - Falcon 9
	Falcon 9 Maiden Flight*			Gokturk - TBA
	Falcon 1e Maiden Flight			
Commercial Remote Sensing			TerraSar-X2 - TBA	
Telecommunications	Globalstar (6) - Soyuz 2	ORBCOMM (3) - Falcon 1e	ORBCOMM (3) - Falcon 1e	ORBCOMM (3) - Falcon 1e
	ORBCOMM (3) - Falcon 1e	ORBCOMM (3) - Falcon 1e	ORBCOMM (3) - Falcon 1e	O3b (4) - Soyuz 2
		Globalstar (6) - Soyuz 2	O3b (4) - Soyuz 2	O3b (4) - Soyuz 2
		Globalstar (6) - Soyuz 2	O3b (4) - Soyuz 2	
		Globalstar (6) - Soyuz 2		
Orbital Facility Assembly and Services	Dragon COTS Demo 1- Falcon 9	Cygnus COTS Demo - Taurus II	ISS Re-supply - Taurus II	ISS Re-supply - Taurus II
	Dragon COTS Demo 2- Falcon 9	ISS Re-supply - Taurus II	ISS Re-supply - Falcon 9	ISS Re-supply - Taurus II
	Dragon COTS Demo 3- Falcon 9	ISS Re-supply - Falcon 9	ISS Re-supply - Falcon 9	ISS Re-supply - Falcon 9
		ISS Re-supply - Falcon 9		ISS Re-supply - Falcon 9
				ISS Re-supply - Falcon 9
Total Payloads	24	32	24	22
Total Launches	14	12	11	14
FAA Launch Realization Estimate	8-10			

Table 19. Near-Term Identified NGSO Satellite Manifest

* Carryover from 2009
Note: Chart includes only those payloads announced as of April 21, 2010. Near-term manifest includes only announced payloads and launches. Therefore the total number of satellites and launches examined in a year differs from the forecast.

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 ELI orbits 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.

Appendix 2: Historical NGSO Market Assessments

The 2010 FAA/AST forecast of commercial NGSO launches and payloads for 2010–2019 shows less variability than the 2009 forecast with spikes in launch demand leveling out as telecommunications constellation deployments have solidified further. The 2010 forecast, like the 2009 forecast, shows a greater long-term stability in the sector compared with earlier forecasts depicted in Figure 26.

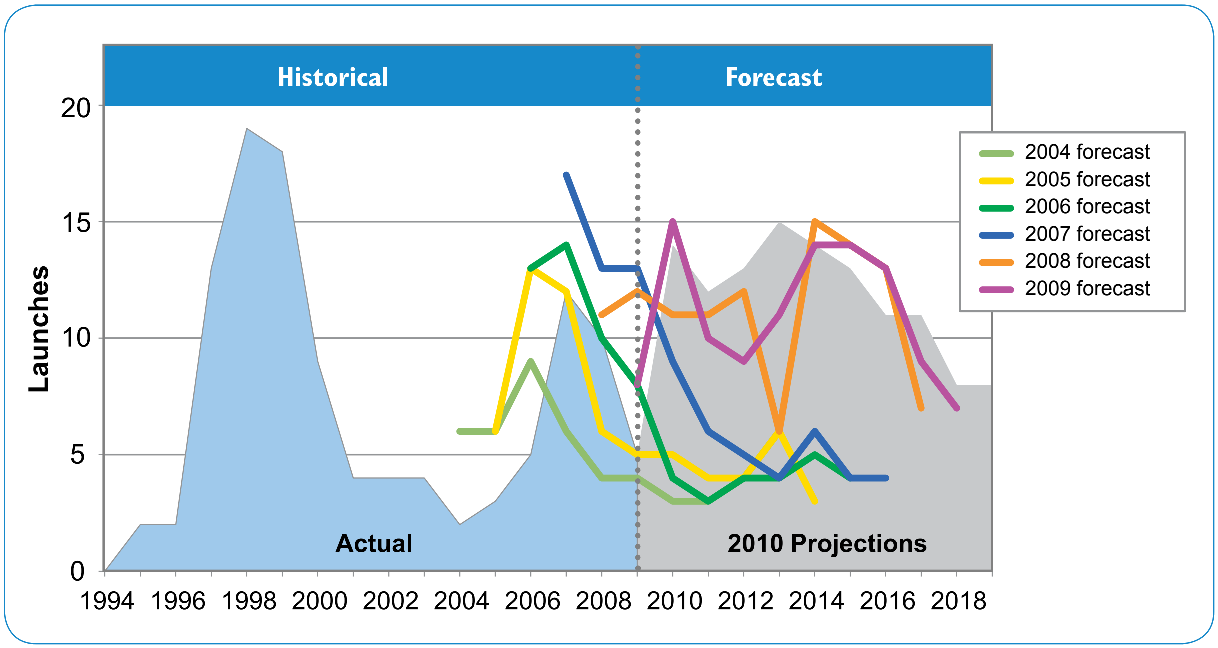

Figure 26. Comparison of Past Baseline Launch Demand Forecasts

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 2010 forecast, though, begins with a spike in demand around 2010 and again around 2014. Overall the forecast 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. 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.

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 constellations 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 six years with zero satellites launched, while there have been ten years with at least one satellite launched from this market.

The number of payloads launched by market sector and total commercial launches that were internationally competed or commercially sponsored from 1994–2009 is provided in Table 20. Small vehicles performed 53 launches during this period, while medium-to-heavy vehicles conducted 59 launches. At the end of 2006, 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 2010 forecast estimates that the larger vehicle class will continue to conduct the most launches.

A comparison of past baseline launch demand is represented in Figure 27. A large space between the max and average indicates high variability in the launch rate over the ten year period. The closing of the max and average in the 2010 forecast indicates a general stabilization of launch demand.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
SATELLITES																	
International Science/Other	0	0	2	1	4	5	11	1	6	1	7	8	4	14	8	8	80
Commercial Remote Sensing	0	1	0	2	0	2	2	2	0	8	0	0	1	3	6	1	28
Big LEO	0	0	0	46	60	42	5	1	7	0	0	0	0	8	0	0	169
Little LEO	0	3	0	8	18	7	0	0	2	0	2	0	0	0	6	2	48
Orbital Facility Assembly & Services	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2
Total Satellites	0	4	2	57	82	56	18	4	15	9	9	8	6	26	20	11	327
LAUNCHES																	
Medium-to-Heavy Vehicles	0	0	1	8	9	11	6	2	2	1	1	0	2	10	4	2	59
Small Vehicles	0	2	1	5	10	7	3	2	2	3	1	3	3	2	6	3	53
Total Launches	0	2	2	13	19	18	9	4	4	4	2	3	5	12	10	5	112

Table 20. Historical Satellite and Launch Demand

*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.

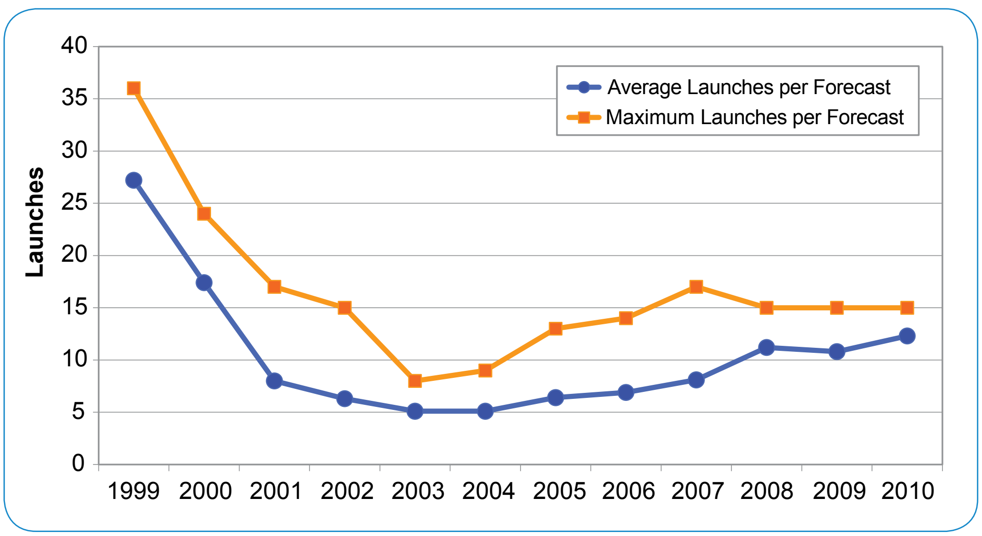

Figure 27. Average and Maximum Launches per Forecast from NGSO Forecasts 1999–2009

Historical satellite and launch data from 1994–2009 are shown in Table 21. Secondary and piggyback payloads on launches with larger primary payloads were not included in the payload or launch tabulations.

Table 21. Historical NGSO Satellite and Launch Activities (1994–2009)

Summary	Market Segment	Date	Satellite	Launch Vehicle	
2009					
11 Satellites	Little LEO		AprizeStar 3-4[#]		
2 Little LEO Telecom	Remote Sensing	10/8/09	WorldView 2	Delta II	Medium-to-Heavy
1 Remote Sensing	International Science	7/13/09	RazakSAT	Falcon 1	Small
8 Int'l Science		7/29/09	DubaiSat 1	Dnepr	Medium-to-Heavy
0 Other			DEIMOS		
			UK DMC 2		
5 Launches			Nanosat 1B		
2 Medium-to-Heavy		3/17/09	GOCE	Rockot	Small
3 Small		11/2/09	SMOS	Rockot	Small
			Proba 2		
2008					
20 Satellites	Little LEO	6/19/08	Orbcomm Replacement 1-5	Cosmos 3M	Small
			Orbcomm CDS-3		
6 Little LEO Telecom	Remote Sensing	8/29/08	RapidEye 1-5	Dnepr 1	Medium-to-Heavy
6 Remote Sensing		9/6/08	GeoEye-1	Delta II	Medium-to-Heavy
2 Int'l Science	International Science	10/1/08	THEOS	Dnepr 1	Medium-to-Heavy
6 Other		6/19/08	UGATUSAT		
10 Launches	Other	3/27/08	SAR Lupe 4	Cosmos 3M	Small
4 Medium-to-Heavy		4/16/08	C/NOFS	Pegasus XL	Small
6 Small		7/22/08	SAR Lupe 5	Cosmos 3M	Small
		8/3/08	Trailblazer[F]	Falcon 1	Small
		9/28/08	Falcon 1 Mass Simulator	Falcon 1	Small
		10/24/08	Cosmo-Skymed 3	Delta II	Medium-to-Heavy
2007					
25 Satellites	Big LEO	5/30/07	Globalstar Replacement 1-4	Soyuz	Medium-to-Heavy
8 Big LEO Telecom		10/21/07	Globalstar Replacement 5-8	Soyuz	Medium-to-Heavy
3 Remote Sensing	Remote Sensing	6/15/07	TerraSAR-X	Dnepr	Medium-to-Heavy
9 Int'l Science		9/18/07	WorldView 1	Delta II	Medium-to-Heavy
5 Other		12/14/07	RADARSAT 2	Soyuz	Medium-to-Heavy
12 Launches	International Science	4/17/07	Egyptsat	Dnepr	Medium-to-Heavy
10 Medium-to-Heavy			SaudiComsat 3-7	PSLV	Medium-to-Heavy
2 Small			Saudisat 3		
		4/23/07	AGILE		
			AAM		
	Other	6/7/07	Cosmo-Skymed 1	Delta II	Medium-to-Heavy
		6/28/07	Genesis II	Dnepr	Medium-to-Heavy
		7/2/07	SAR Lupe 2	Cosmos 3M	Small
		11/1/07	SAR Lupe 3	Cosmos 3M	Small
		12/8/07	Cosmo-Skymed 2	Delta II	Medium-to-Heavy
2006					
5 Satellites	Remote Sensing	4/25/06	EROS B	START 1	Small
1 Remote Sensing					
2 Int'l Science	International Science	7/28/06	Kompsat 2	Rockot	Small
2 Other		12/27/06	Corot	Soyuz 2 1B	Medium-to-Heavy
5 Launches	Other	7/12/06	Genesis 1	Dnepr	Medium-to-Heavy
2 Medium-to-Heavy		12/19/06	SAR Lupe 1	Cosmos	Small
3 Small					

[#] AprizeStar 3-4 deployed on launch with DubaiSat 1
[F] Launch failure

Table 21. Historical NGSO Satellite and Launch Activities (1994–2009) Cont'd

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

Table 21. Historical NGSO Satellite and Launch Activities (1994–2009) Cont'd

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

[F] Launch failure

Table 21. Historical NGSO Satellite and Launch Activities (1994–2009) Cont'd

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 I[F]	Small Small
	International Science	4/3/95	OrbView 1 (Microlab)	Pegasus	Small
1994					
0 Satellites 0 Launches					

[F] Launch failure

APPENDIX 3: ACRONYMS

AIS	Automatic Identification System
ASI	Italian Space Agency
ATV	Automated Transfer Vehicle
CASSIOPE	Cascade, Smallsat, and Ionospheric Polar Explorer
CNC	National Communications Commission (Argentina)
CONAE	National Commission on Space Activity (Argentina)
COTS	Commercial Orbital Transportation Services
CRS	Commercial Resupply Services
CTV	Crew Transfer Vehicle
DARS	Digital Audio Radio Services
DLR	German Aerospace Center
DMC	Disaster Monitoring Constellation
EA	Excalibur Almaz
ELI	Highly-Elliptical Orbit
EROS	Earth Remote Observation Satellite
ESA	European Space Agency
EXT	External or Non-Geocentric Orbits
FAA/AST	Federal Aviation Administration, Office of Commercial Space Transportation
FCC	Federal Communications Commission
GIS	Geospatial Information Systems
HTV	H-II Transfer Vehicle
ISRO	Indian Space Research Organization
ISS	International Space Station
LEO	Low Earth orbits
LRF	Lloyd's Register – Fairplay
MDA	MacDonald, Dettwiler and Associates Ltd.
MEO	Medium Earth Orbits
NASA	National Aeronautics and Space Administration
NGA	National Geospatial-Intelligence Agency
NGSO	Non-Geosynchronous Orbits
NOAA	National Oceanic and Atmospheric Administration
NPOM	JSC MIC NPO Mashinostroyenia
OFAS	Orbital Facility Assembly and Services
PSLV	Polar Satellite Launch Vehicle
RCM	RADARSAT Constellation Mission
SAR	Synthetic Aperture Radar
SSTL	Surrey Satellite Technology Limited
TBD	To Be Determined
USAF	United States Air Force
USEF	Institute for Unmanned Space Experiment Free Flyer