Federal Aviation Administration

2011 Commercial Space Transportation Forecasts

May 2011

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 the Commercial Space Launch Act, 51 U.S.C. Ch. 509, §§ 50901-23 (2011).

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://www.faa.gov/about/office_org/headquarters_offices/ast/.

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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 2011 through 2020.

The *2011 Commercial Space Transportation Forecasts* report includes:

- The COMSTAC *2011 Commercial Geosynchronous Orbit (GSO) Launch Demand Forecast*, which projects demand for commercial satellites that operate in GSO and the resulting commercial launch demand to geosynchronous transfer orbit (GTO); and
- The FAA's *2011 Commercial Space Transportation Forecast for Non-Geosynchronous Orbits (NGSO)*, which projects commercial launch demand for satellites to NGSO, such as low Earth orbit (LEO), medium Earth orbit (MEO), elliptical (ELI) orbits, and external (EXT) orbits beyond the Earth.

Together, the COMSTAC and FAA forecasts project an average annual demand of 28.6 commercial space launches worldwide from 2011 through 2020. The combined forecasts are an increase of 3.6 percent compared to the 2010 forecast of 27.6 launches per year. The *2011 Commercial Space Transportation Forecasts* report 22 commercial launches occurred worldwide in 2010 (14 GSO and 8 NGSO). The forecasts project a launch demand of 25 launches during 2011 (14 GSO and 11 NGSO).

In the GSO market, demand averaged 20.5 satellites per year, compared to 20.7 satellites in the 2010 forecast. The resulting demand for launches, after accounting for dual-manifested missions, averaged 15.6 launches per year, compared to 15.7 launches in the 2010 forecast.

In the NGSO market, the number of satellites per year averages 27.6 per year compared to 26.2 per year in last year's forecast. After calculating the number of satellites that are multiple-manifested, launch demand increased to an average of 13 launches per year compared with 11.9 launches per year forecasted in 2010.

COMSTAC and FAA project an average annual demand for:

- 15.6 launches of medium-to-heavy launch vehicles to GSO;
- 11.1 launches of medium-to-heavy launch vehicles to NGSO; and
- 1.9 launches of small launch vehicles to NGSO.

Table 1 shows the totals for the 2011 forecast. Figures 1, 2, and 3 compare historical activity in GSO and NGSO to the 2011 forecast.

Table 1. Commercial Space Transportation Payload and Launch Forecasts

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	Average
Payloads												
GSO Forecast (COMSTAC)	18	26	23	20	20	20	19	20	20	19	205	20.5
NGSO Forecast (FAA)	37	31	22	15	45	41	39	15	16	15	276	27.6
Total Satellites	55	57	45	35	65	61	58	35	36	34	481	48.1
Launches												
GSO Medium-to-Heavy	14	21	18	15	15	15	14	15	15	14	156	15.6
NGSO Medium-to-Heavy	11	11	9	9	15	15	13	9	10	9	111	11.1
NGSO Small	0	2	3	2	2	2	2	2	2	2	19	1.9
Total Launches	25	34	30	26	32	32	29	26	27	25	286	28.6

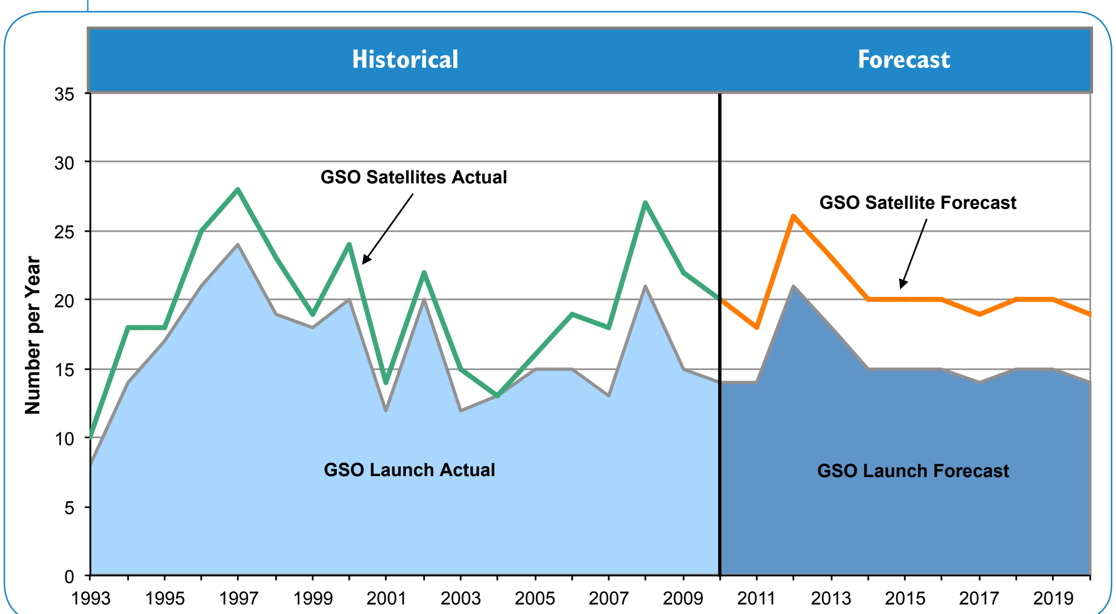

Figure 1. 2011 and Historical GSO Payloads and Launches

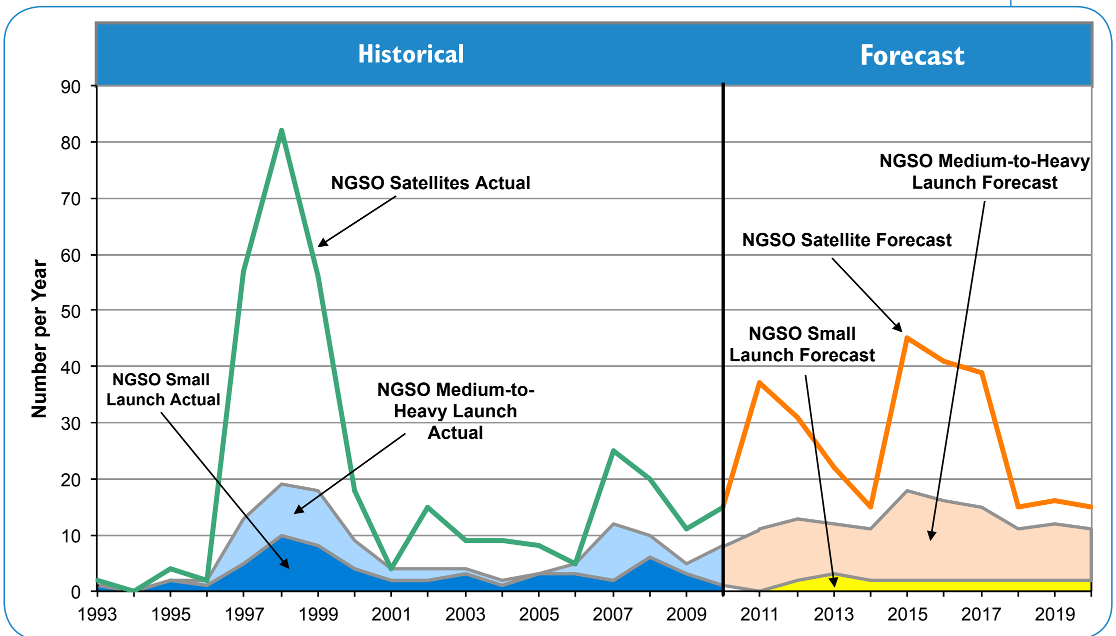

Figure 2. 2011 and Historical NGSO Payloads and Launches

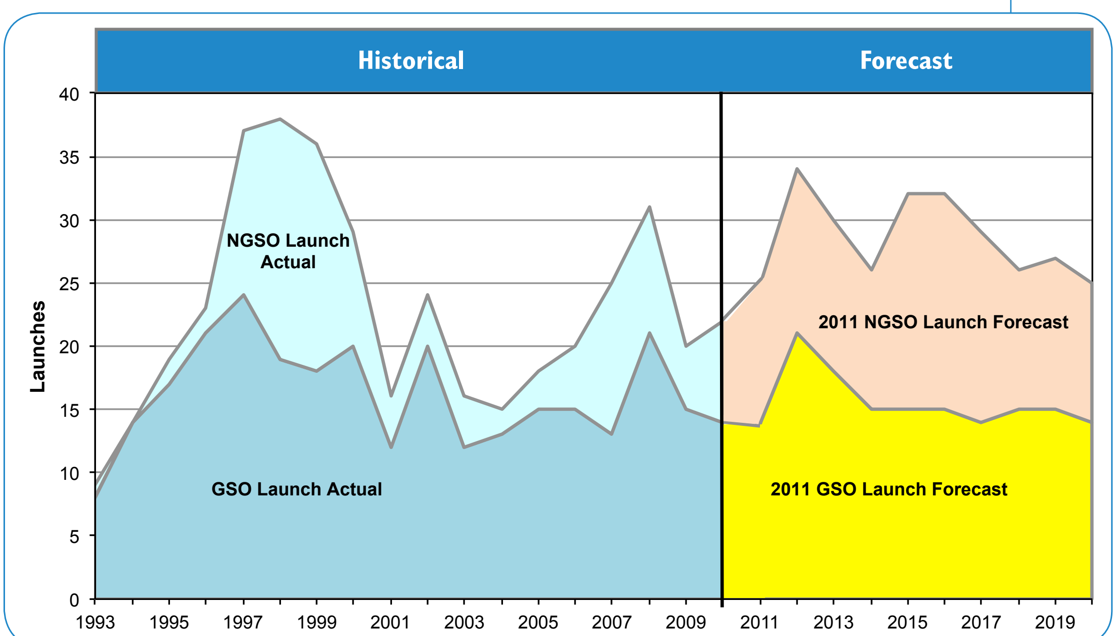

Figure 3. Combined 2011 GSO and NGSO Historical Launches and Launch Forecasts

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 *2011 Commercial Space Transportation Forecasts* report covers the period from 2011 through 2020 and includes two separate forecasts: one for launches to geosynchronous orbit (GSO) and one for launches to non-geosynchronous orbits (NGSO).

About the COMSTAC GSO Forecast

The COMSTAC *2011 Commercial Geosynchronous Orbit Launch Demand Forecast* projects demand for commercial satellites operating in GSO and the resulting commercial launch demand to geosynchronous transfer orbit (GTO).

Established in 1993, the COMSTAC *Commercial 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 included a projection of launch vehicle demand derived from payload demand and takes into account dual-manifesting of satellites on a single launch vehicle. The forecast also provides comparisons to previous forecasts, including analyses of demand projections verses realized launches, and factors that may affect future launch and satellite trends. COMSTAC comprises representatives from the U.S. satellite and launch industry.

About the FAA NGSO Forecast

The FAA's *2011 Commercial Space Transportation Forecast for Non-Geosynchronous Orbits* projects commercial launch demand for all space systems to be deployed in NGSO, including low Earth orbit (LEO), medium Earth orbit (MEO), elliptical (ELI) orbits, and external (EXT) 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 forecast considers five payload segments, defined by the type of service the spacecraft are designed to offer: commercial telecommunications; commercial remote sensing; science and engineering; commercial cargo and crew transportation services; and other payloads launched commercially. The forecast projects satellites and launch demand for each payload segment, and provides an examination of satellite and launch forecast trends, including risk factors that affect satellite and launch demand.

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 is directly affected by activity in the global satellite market ranging from customer needs and the 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. 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.

Demand Forecasts

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.

The GSO and NGSO reports contain 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.

COMSTAC 2011 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) within the Department of Transportation (DOT). The *2011 Commercial Geosynchronous Orbit (GSO) Launch Demand Forecast* is the 19th annual forecast of 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. Launch demand is determined by adjusting satellite demand by the number of satellites projected to launch 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 *2011 Commercial GSO Launch Demand Forecast* for 2011 through 2020 is shown in Figure 4. Table 2 provides the corresponding values of satellites forecasted to launch, 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.

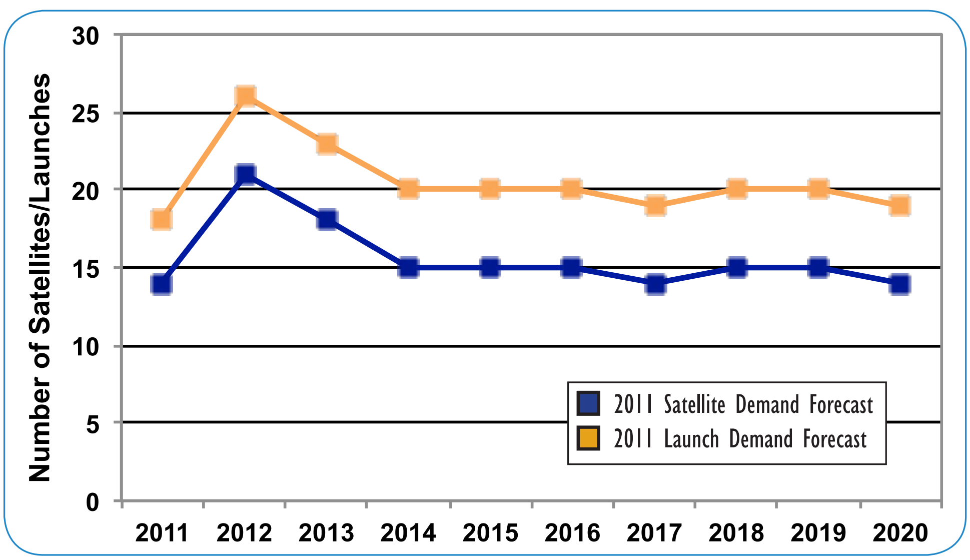

Figure 4. Commercial GSO Satellite and Launch Demand

Table 2. Commercial GSO Satellite and Launch Demand Forecast Data

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	Average 2011 to 2020
Satellite Demand	18	26	23	20	20	20	19	20	20	19	205	20.5
Dual Launch Forecast	4	5	5	5	5	5	5	5	5	5	49	4.9
Launch Demand	14	21	18	15	15	15	14	15	15	14	156	15.6

For the last three years, there has been a small but steady decline in the forecast number of satellite launches. The 2011 forecast shows an average demand for 20.5 satellites to launch annually in the ten-year time frame from 2011 through 2020. The associated launch demand for the same period is almost unchanged from last year at 15.6 launches per year. An average of 20.7 satellites launched per year was forecast in 2010, and 20.8 satellites launched per year in 2009. The near-term forecast, which is based on specific existing and anticipated satellite programs for 2011 through 2013, shows demand for 18 launches in 2011, 26 in 2012, and 23 in 2013. Last year's forecast predicted 20 launches in 2011, 18 in 2012, and 16 in 2013.

It is important to distinguish between forecasted demand and the number of satellites that are actually launched. Space related projects, like most high-technology projects, are susceptible to delays, which tend to make the forecasted demand an upper limit of the number of satellites that might actually be launched. To attempt to account for these differences, a "launch realization factor" has been devised. This factor is based on historical data of actual satellites launched versus predicted satellite demand from previous commercial GSO forecasts. This factor has been applied to the near-term forecast in order to provide an idea of the actual number of satellites that may reasonably launch. For example, the demand forecast for satellites to launch in 2011 is 18, applying the realization factor discounts this to a range of 14 to 18.

Over the 19 years this report has been published, predicted demand in the first year of the forecast period has almost always 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 2010, 20 commercial GSO satellites were launched, a decrease of 2 from the 22 commercial satellites launched in 2009. The 2010 forecast projected 20 satellites to launch in 2010, with a realization range from 15 to 17.

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 (11,023 pounds) and the expectation is that the next several years will be similar. The projected total satellite mass to launch in 2011 is almost 84,000 kilograms (185,188 pounds).

BACKGROUND

FAA/AST is interested in fostering a healthy commercial space launch capability in the United States. In 1993, the DOT requested that its industry advisory group, COMSTAC, annually prepare a 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 through 2010. The following year, the major U.S. satellite manufacturers and the satellite service providers began to contribute to the demand forecast. In 1995, the Technology and Innovation Working Group (the Working Group) was formally chartered by 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 2011 through 2020. This year the committee received inputs from 22 satellite service providers, satellite manufacturers, and launch service providers; up from 15 inputs in 2010. COMSTAC would like to thank all of the participants in the *2011 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 2011 through 2020; and
- 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 "Unaddressable" 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 unaddressable 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.

The *2011 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.

Table 3. Satellite Mass Class Categorization

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

This year, the following 22 organizations (noted with the country in which their headquarters are located) responded with data used in developing the 2011 report:

- APT Satellite Holdings Limited (Hong Kong)
- Arab Satellite Communications Organization (Saudi Arabia)
- Arianespace (France)
- The Boeing Company (U.S.)*
- Eutelsat Communications (France)
- Hisdesat (Spain)
- Hispasat (Spain)
- Measat Satellite Systems (Malaysia)
- Mitsubishi H-II Launch Services (Japan)
- NEC Toshiba Space Systems (Japan)
- PT Indosat (Indonesia)
- Sea Launch (U.S.)*
- Sirius XM Radio Inc (U.S.)*
- SkyPerfect JSAT Corporation (Japan)
- Space Exploration Technologies Corp. (U.S.)*
- Space Systems/Loral (U.S.)*

- Star One (Brazil)
- Telenor Satellite Broadcasting (Norway)
- Telesat Canada (Canada)
- Terrestar Networks (U. S.)*
- Thales Alenia Space (France)
- Thuraya Satellite Telecommunciations Co (UAE)

*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 early 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 for 2014 through 2020. 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 (2011 through 2013) 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 announced plans of International Launch Services' (ILS) 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 and ILS manifests.

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 2011 through 2013.

Table 4. Commercial GSO Near-Term Manifest

	2011		2012		2013	
Total	18		26		23	
Below 2,500 kg	0		0		1	
(<5,510 lbm)					SES 8	TBD
2,500 - 4,200 kg	6		9		5	
(5,510 - 9,260 lbm)	Asiasat-7	Proton M	Anik G1	Proton M	Hispasat AG-1	TBD
	Bsat 3C	Ariane 5	Arsat 1	Ariane 5/Soyuz	AMOS 4	Falcon 9
	Intelsat 18	Land Launch	Azersat/Africasat	Ariane 5	Arsat 2	TBD
	New Dawn	Ariane 5	Hylas-2	Ariane 5/Soyuz	Optus 10	TBD
	SES-2	Ariane 5	Intelsat 23	Proton M	Thor 7	TBD
	SES-3	Proton M	Mexsat 3	TBD		
			OHO-1	Ariane 5/Soyuz		
			Star One C3	Ariane 5		
			Vinasat 2	Ariane 5		
4,200 - 5,400 kg	4		7		10	
(9,260 - 11,905 lbm)	Arabsat 5C	Ariane 5	Arabsat 6B	Ariane 5	Astra 2E	Ariane 5
	Atlantic Bird 7	Sea Launch	Astra 2-F	TBD	AMOS 6	TBD
	ST-2	Ariane 5	Eutelsat W5A	TBD	Astra 5B	TBD
	Telstar 14R	Proton M	Eutelsat W6A	TBD	Intelsat-28	TBD
			Intelsat-27	TBD	JCSAT 13	Ariane 5
			Nimiq 6	Proton M	Measat 3B	TBD
			Yamal 402	Proton M	Sicral 2	Ariane 5
					Skynet 5D	Ariane 5
					Turksat 4A	Ariane 5
					W3D	TBD
Over 5,400 kg	8		10		7	
	Astra 1N	Ariane 5	Alphasat I-XL	Ariane 5	ABS-2	Ariane 5
	Eutelsat W3C	Long March	Astra 4B	Proton M	Amazonas 3	TBD
	Intelsat 19	TBD	Echostar 16	TBD	DTV 14	TBD
	Quetzsat	Proton M	Intelsat 20	Ariane 5	Eurobird 2A	TBD
	SES-4	Proton M	Intelsat 21	Sea Launch	Inmarsat 5-F1	TBD
	SkyTerra 2	Proton M	Intelsat 22	Proton M	Mexsat 1	TBD
	Viasat 1	Proton M	Jupiter 1	Ariane 5	SES 6	TBD
	Yahsat 1A	Ariane 5	SatMex 8	Proton M		
			Sirius FM-6	Proton M		
			Yahsat 1B	Proton M		

Satellite Launch Forecast Mass Class Trend

Figure 5 and Table 5 show the trends in annual GSO satellite mass distribution. Actual data are presented for 1993 through 2010, followed by the distribution projected in this year's demand forecast.

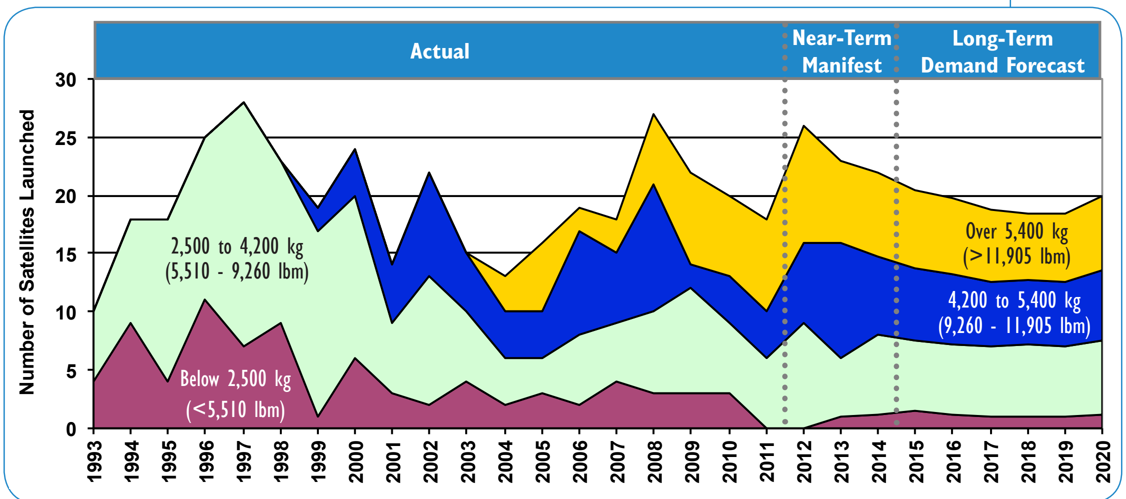

Figure 5. Trends in GSO Satellite Mass Distribution

The smallest mass class group was changed in 2008 to include satellites up to 2,500 kilograms (5,512 pounds) from a maximum of up to 2,200 kilograms (4,850 pounds) analyzed in prior years. This adjustment was made to capture the recent growth in the mass of the smallest satellites being manufactured. Orbital's Starbus can be configured to bring its mass close to the 2,500-kilogram (5,512-pound) range, within the small mass class category.

Table 5. Trends in GSO Satellite Mass Distribution

	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	2020	Total 2011 to 2020	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	0	0	1	1	2	1	1	1	1	1	9	0.9	5%
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	6	6	9	5	7	6	6	6	6	6	6	63	6.3	31%
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	4	4	7	10	7	6	6	6	6	6	6	63	6.3	30%
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	8	10	7	7	7	7	6	6	6	7	70	7.0	34%
Total	10	18	18	25	28	23	19	24	14	22	15	13	16	19	18	27	22	20	18	26	23	22	21	20	19	19	19	20	205	21	100%

The 2010 forecast predicted three launches of satellites in the smallest of the mass classes in 2010, and in fact, three satellites in the smallest mass class launched. The forecast for 2011 indicates there are no satellites of this mass class scheduled to launch in 2011 or 2012, and one in 2013. The trend for this mass class has been declining over the past decade. This trend continues with an average of one per year expected from 2014 forward.

The trend in satellite mass classes in the 2011 forecast is similar to that in 2010. The average number of satellites in the largest mass class has increased from 6.6 in the 2010 forecast to 7.0 in the 2011 forecast. This trend continues throughout the forecast, with six to seven satellites per year in the largest mass class forecast from 2014 through 2020.

Comparison with Previous COMSTAC Demand Forecasts

The 2011 forecast, for commercial GSO satellites launched, is compared to the 2008 through 2010 forecasts in Figure 6. The total number of satellites to launch during the rolling ten-year forecast period has declined on a yearly basis from 218 in 2008, 208 in 2009, and 207 in 2010, to 205 in 2011. The near-term forecast beginning in 2011 reflects a dip in planned launches followed by an uptick in 2012 and 2013. In comparison to previous COMSTAC demand forecasts, this indicates a prolongation of the current replacement cycle through 2013, followed by a decline in the out-years when the forecasted number of satellites to launch averages approximately 19 to 20 satellites per year.

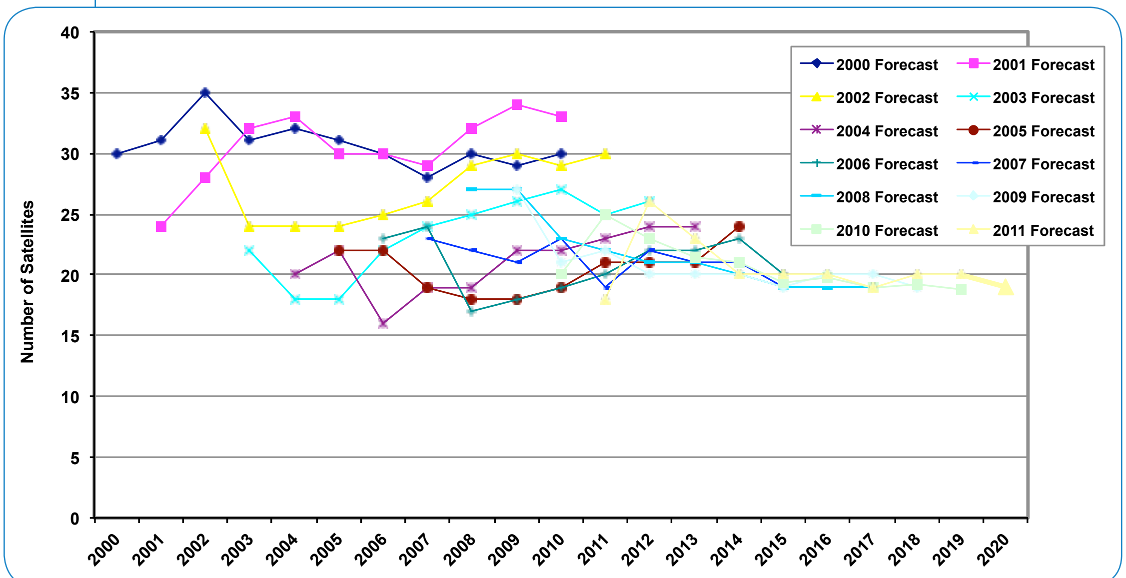

Figure 6. 2000 Through 2010 vs. 2011 Commercial GSO Satellite Demand Forecast

The 2010 Commercial GSO Launch Demand Forecast forecasted a 2011 satellite launch rate of 25. In this year's report, the 2011 launch rate has been adjusted downward to a total of 18. This is due to the following reasons:

- A slip in launch schedules for satellites from prior years into 2011;
- An advancement of a launch schedule for one satellite from 2012 into 2011; and
- Delays or cancellation of planned satellite orders that would otherwise have been available for launch in 2011.

In terms of mass classes, the most noticeable difference from previous COMSTAC demand forecasts is that satellites in the small mass class range are projected to decline from nine percent of total missions in 2009 and 2010, to four percent of total launches in 2011.

Comparison to International Comprehensive Inputs

This year, the Working Group received comprehensive inputs from two international launch service providers (Arianespace and Mitsubishi Heavy Industries) and one international satellite manufacturer (Thales Alenia Space). The combined average of these international inputs is slightly lower in the near term than the combined 2011 demand forecast based on U.S. satellite and launch vehicle manufacturer inputs. The lower near term prediction drives the international input average annual demand downward for 2011 through 2019, at 19.2 satellites per year; the U.S.-based average annual demand forecast is 20.5 satellites per year. The differential in forecast values between mass classes is highest in the intermediate mass class where the percentage of total satellites is only 20 percent for aggregate international inputs versus 30 percent for aggregate U.S. inputs. The differential is less pronounced in the large class where the percentage of total satellites is 43 percent for international inputs verses 34 percent for U.S. inputs. The small satellite mass class reflects the least disparity in the 2011 forecast where the international inputs are five percent verses six percent for U.S. inputs.

Launch Vehicle Demand

The 2011 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 were 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 2010, ILS introduced its "shared launch" concept to customers whereby the Proton M vehicle would launch "one customer, two spacecraft" on a given mission. While this service has been announced, it has yet to demonstrate its capability to incorporate and launch two commercial western spacecraft. The Proton M vehicle does fly dual-manifest missions, typically partnered with a Russian Federation or unaddressable satellite coupled with commercial co-passengers. 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 utilization of their dual-manifest capabilities, and their projected manifests.

In 2010, Arianespace launched 6 Ariane 5 vehicles, orbiting 12 commercial satellites destined for GSO. A similar utilization is expected for Ariane 5 launches in 2011 and 2012, 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 non-commercial or otherwise unaddressable satellites (e.g., European government satellites), and zero to one commercial mission will 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 2011 through 2020 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, a subset of which is suitable from a performance perspective for a "shared launch" Proton mission, as well as practical constraints associated with a "one customer, two launch" limitation, we project that "shared launch" or other commercial dual-manifest missions will occasionally take place during the forecast period.

The ratio or absolute number of "single" launches verses "dual manifest" or "shared launch" launches may increase during the forecast period through the return to operations of the Sea Launch Zenit 3SL launch system in 2011, the ramp-up of the Falcon 9 vehicle or introduction of new vehicles such as the Geosynchronous Satellite Launch Vehicle (GSLV) Mk-III, or variants of existing dedicated launch services such as the Soyuz ST-A/B/Fregat (late 2011). See the "Factors Affecting Launch Demand" section for more information.

Figure 7 presents the 2011 satellite and launch demand forecast through 2020 as well as actual launch statistics for 1993 through 2010.

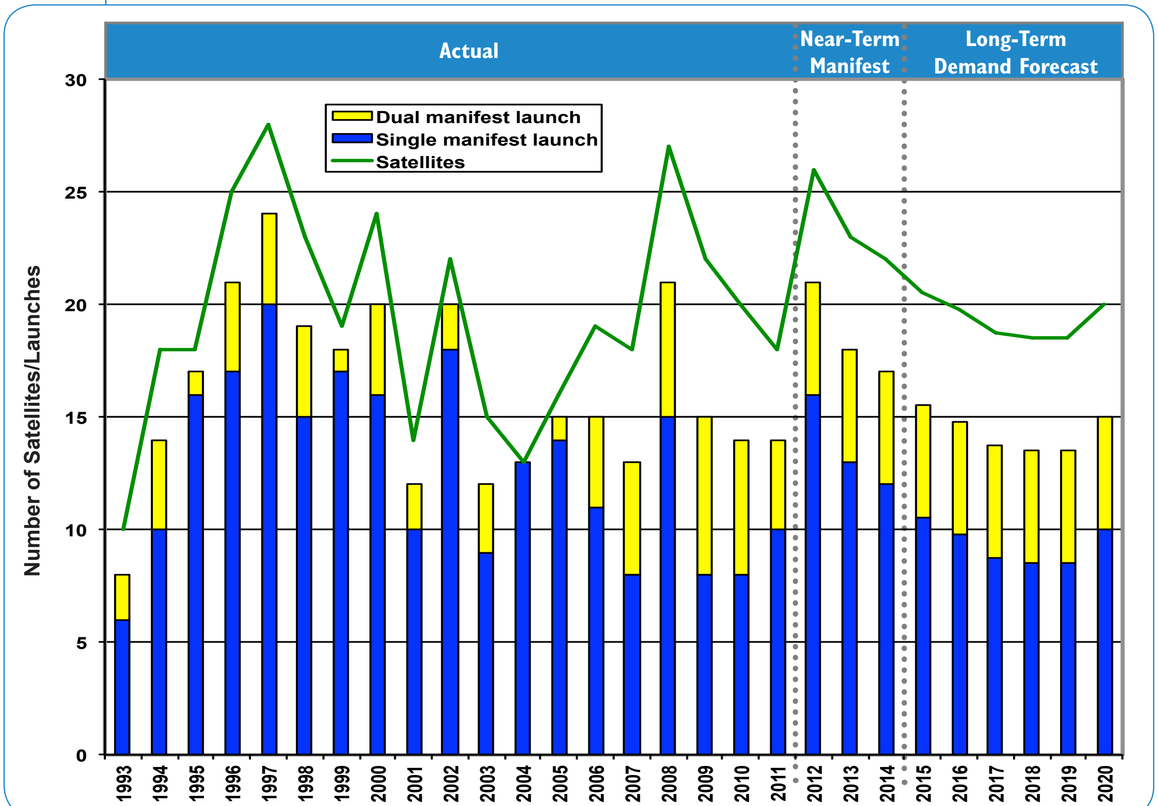

Figure 7. COMSTAC GSO Satellite and Launch Demand Forecast

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 forecasted 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, on the ground or in orbit, can affect the delivery of other 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, 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 benefit of freeing up launch slots for other customers seeking launches.

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

Regulatory issues: Export compliance, Federal Communications Commission 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 number of satellites and launches actually launched in the first three years of a forecast. In order to better estimate the number of near-term satellites reasonably expected to launch, the near-term demand is adjusted by a "realization factor." This factor is based on forecasted verses actual launches in the five years prior to the year projected in the report.

The range of expected satellites 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 preceding five years.

Since the GSO forecast was originally produced in 1993, the number of satellites projected to launch in the first year of the forecast has generally been greater than the number of satellites actually launched in that year. The actual number of satellites has been 58 percent to 100 percent of the forecast number, with an average of 78 percent. For the past five years, the range has been 78 percent to 100 percent, with an average of 89 percent.

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 2011 is 14 to 18 satellites. For the second out-year, the calculation becomes less clear. The forecast has always overestimated the actual launches two years hence, except for the 2007 report, which underestimated the number of satellites (22 forecasted verses 23 actual for 2008) for the first time. Since 1993, the actual realization for the second out-year has ranged from 45 percent to 105 percent, with an average of 76 percent. For the past five years, the range has been 72 percent to 105 percent, with an average of 88 percent. Using the same methodology, the expected realization for 2012 is 19 to 27 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, demonstrating the robustness of the realization factor methodology.

Forecasted Satellite Demand vs. Actual Satellite Launches in 2010

As represented in Figure 8, the 2010 report forecasted 20 satellites for launch in 2010. In fact, 20 satellites were launched last year, although one that was included in the 2010 near-term demand model was reclassified this year as unaddressable (Insat 4G). Making up for this reduction in the 2010 near-term demand model was Intelsat 17. In 2010, Intelsat 17 was included as a 2011 launch, but in fact it launched in late 2010.

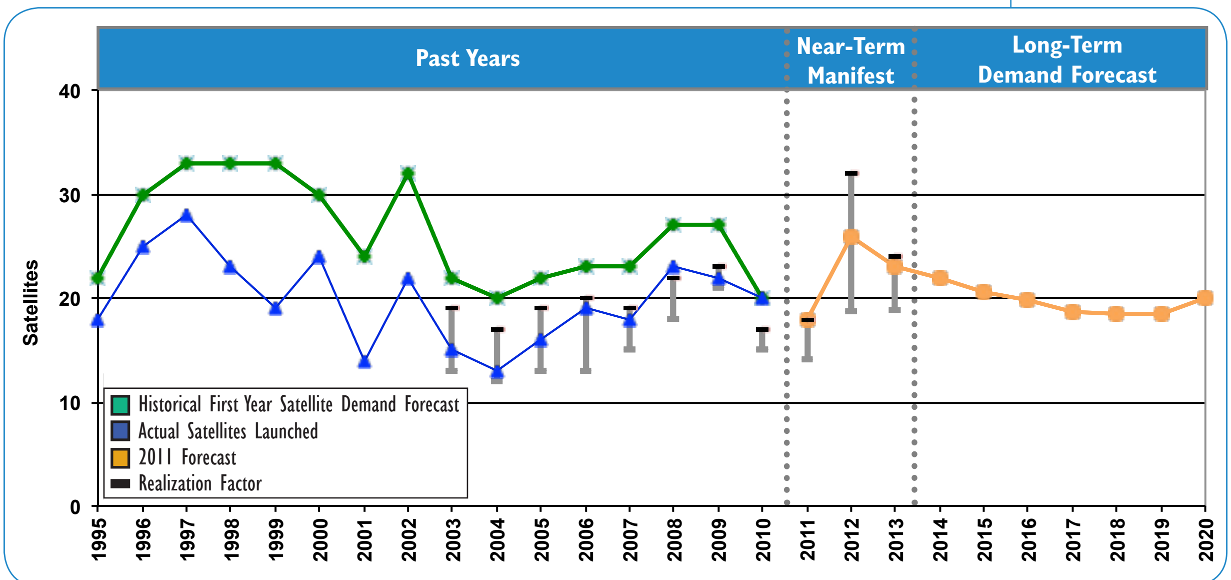

Figure 8. Commercial GSO Satellite Demand: Historical, Near-Term, and Long-Term Forecasts

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.

Despite the lingering effects of the global economic recession, the demand for satellite services world-wide continues to be quite strong. This is due to a variety of factors not limited to, but including the increased globalization of the customer base particularly in business and enterprise segments; technological advances in end-user equipment, software, and applications; continued trend in deregulation with entry of new services providers and landing rights access for signal broadcasting in previously closed countries; and continued economic growth in second- and third-tier developing countries.

Globalization in the telecommunications and broadcasting markets is realized due to the growing number of companies operating internationally, and due to the expansion of content provision into new markets, translated into local languages, and provided to households via cable head-ends in tiered services packages. Satellite and ground systems and end-user equipment have continuously improved in terms of capability, lower cost, and lower consumer pricing, which in turn allows new services to expand further, driving demand. Of long-term concern, however, is the continued expansion of fiber-optic networks to the curb for households and businesses in urban areas. This may reduce the demand over time for delivery of fixed services such as direct broadcasting by satellite to consumers, much as it impacted the demand for transponder utilization in the past two decades for intercontinental delivery of voice, data, and trunking services, which were once the sole purview of satellite systems. However, fiber optic expansion will not impact the growing demand for mobile connectivity in vehicles and portable systems.

Deregulation continues to move apace as countries open their markets to foreign services providers and as privatization of national telephone, television broadcasting, and Internet monopolies results in the emergence of a competitive service delivery marketplace. New domestic and regional satellite operators such as Azerbaijan Fixed Satellite Services (FSS) operator Azersat, Bulgarian Direct-to-Home (DTH) operator Bulsatcom, and U.S./Swedish mobile broadband operator OverHorizon, are entering the marketplace. Despite the economic slowdown, which has impacted the U.S. in particular, economic growth continues in developing and developed countries. Economic activity remains strong particularly across Asia, led by China and India, although the recent tragedy in Japan will limit recovery there for at least several years. Eastern Europe, the Middle East, and South America continue to invest to improve their telecommunications infrastructures. This includes exercising national rights with the International Telecommunications Union for frequency spectrum and orbital slot allocation for delivery of services by satellite. It is anticipated that over the next ten years these regions will account for more than 60 percent of new transponder and bandwidth demand globally.

In general all satellite services markets continue to experience decent growth and solid revenues for operators. The global FSS market continues to perform well with global and regional operators reporting high transponder utilization rates and relatively stable transponder leasing pricing. Asia has taken the lead due to increasing demand for business Very Small Aperture Terminal (VSAT) services and expansion of high definition television services and Internet connectivity. Demand in western Europe remains strong with solid growth in central and eastern Europe, Russia, and Latin America. The North American market has experienced some transponder pricing weakness due to the prolonged impact of the economic recession. Nevertheless, FSS satellite operators will deploy a number of satellites this year with increased transponder counts to meet the growing demand for bandwidth around the globe. Another reason for this is the increased demand by governments for utilization of FSS transponder capacity to support civil service applications and military operations communications. The U.S. Department of Defense (DOD), for example, has increased its demand for bandwidth eight fold in recent years. Intelsat, Eutelsat, Hispasat, and other operators expect to derive significant revenues from national governments for the provision of transponder capacity.

The Direct Broadcasting Services (DBS) business has been under some pressure in the U.S. due to the lethargic economy and increasing competition from fiber-to-the-curb in urban areas, but opportunities to expand into European and Asian markets, due to relaxed regulatory regimes and growing demand for high definition digital content provision, provide a strong potential for DBS growth this decade. Demand remains strong in Canada given geography and high cost to install fiber optics.

The demand for direct Broadband Services continues to build globally as business and consumer appetite for mobile connectivity drives investments in new high-capacity satellite systems provided by Viasat, Hughes Network Systems, and INMARSAT. LightSquared continues to move forward in rolling out its high-speed 4G wireless broadband network with its SkyTerra satellite system coupled with an extensive auxiliary terrestrial network of transmitter stations. INMARSAT is developing its Global Express system to provide broadband connectivity in land mobile, aeronautical, and maritime market segments. Broadband demand in Asia is led by South Korea, China, and India. 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.

The geosynchronous Mobile Satellite Systems (MSS) market segment continues to be in flux. Terrestar Networks entered bankruptcy following in the footsteps of ICO in an attempt to rearrange financing and to acquire new investors. These MSS systems require significant investment to build out the needed ancillary terrestrial component network to attract business and consumer users in urban areas. INMARSAT continues to perform strongly with steady demand in its vertical enterprise markets. Europe and Japan have been contemplating dedicated MSS services to build on capabilities currently provided through FSS systems, but coordination across European nations remains an issue and the recent disaster in Japan has likely put their plans on hold for now.

The Digital Audio Radio (DARS) market is now stable in North America following the merger of XM Satellite Radio and Sirius Satellite Radio. This service has yet to attract global attention, although South Korea and Japan, as principal automobile manufacturers, are including service capability in most models going forward, as are U.S. automobile manufacturers. It would stand to reason that DARS satellite systems would debut beyond North America, likely in Asia first, then Western Europe, and beyond.

In summary, business and consumer demand for connectivity via satellite is expected to increase significantly over the next decade. Despite inroads by fiber optic cabling in some applications such as FSS and fixed broadband, the overall outlook for satellite services from GSO remains strong. As the global economic recession wanes, particularly in North America, expectations are that economic recovery will lead to a return to economic growth by mid-decade with robust demand from business, consumers, and governments for commercial bandwidth for existing and potentially new services delivered by satellite.

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. The current National Space Policy directs the use of hosted payload solutions to maximize reliability, affordability, and responsiveness.

There are a variety of potential hosted payload types including: experimental, new technology demonstration, scientific, remote sensing, weather and climate monitoring, FAA (Wide Area Augmentation System), Global Positioning System (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 to 36 months) and fairly predictable compared to a shared launch with other government missions. There is a ready supply of commercial satellite launches that are willing and eager to accommodate hosted payloads.

The number of hosted payload launches and awards continues to increase.

- The DOD and Joint Capabilities Technology Demonstration, 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 agreed to purchase a specialized ultra-high frequency (UHF) communications payload for the Australian military from Intelsat. This payload will be hosted aboard Intelsat 22 (built by Boeing Space and Intelligence Systems) and is scheduled to launch in 2012. Boeing is building a second UHF payload for Intelsat. This second system is designed to meet the needs of the U.S. government and its allies. Most recently INMARSAT has added hosted payloads to three of its Ka-band satellites.
- The European Commission contracted with SES Astra to host two Satellite-Based Augmentation Systems 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 will host an experimental Air Force sensor on SES Worldskies SES-2 satellite (under construction by Orbital). This Third Generation Infrared Surveillance 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. Commercial satellite owners and 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 and customers, the spacecraft owner and operators, and the launch vehicle providers into agreement on standardized hosted payload processes to make this a routine part of the commercial satellite business.

Seven satellite industry companies have recently agreed to form an industry alliance to increase awareness of the benefits of hosted government payloads on commercial satellites. The Hosted Payload Alliance (HPA) will serve as a bridge between government and private industry to foster open communication between potential users and providers of hosted payload capabilities. The HPA Steering Committee members are Boeing Space and Intelligence Systems, Intelsat General Corporation, Iridium Communications Inc., Lockheed Martin Space Systems, Orbital Sciences Corporation, SES Worldskies U.S. Government Solutions, and Space Systems/ Loral.

New commercial launch services providers are entering or are contemplating entering the market to launch commercial communications satellites to GTO. These operators are seeking to reshape the landscape through increased competition with very competitive launch services pricing, streamlined commercial practices, improved schedule assurance, and expanded choices of launch sites. New entrants include Space Exploration Technologies Corporation's (SpaceX) Falcon 9 and Falcon 9 Heavy, and the Orbital Sciences Corporation's (Orbital) Taurus II and Taurus II Enhanced launch vehicles.

SpaceX's Falcon 9 launch vehicle made its inaugural flight from Cape Canaveral Air Force Station (CCAFS) in Florida, in June 2010, followed in December 2010, by the inaugural launch of Falcon 9 carrying the Dragon space capsule. Falcon 9 is an Evolved Expendable Launch Vehicle (EELV)-class vehicle featuring a 5.2-meter fairing capable of lofting a 4,540-kilogram (10,009 pound) payload to GTO from CCAFS. Falcon 9 will provide transport for cargo to the International Space Station (ISS) under SpaceX's Commercial Orbital Transportation Services and Commercial Resupply Services contracts with NASA. SpaceX plans to demonstrate reusability of the first stage in the future as a means to lower launch costs. SpaceX has already been successful in capturing business in the commercial market with announcements for launches from operators SES of Luxembourg and Spacecom of Israel. SpaceX is developing the larger Falcon 9 Heavy vehicle, which can loft 19,500 kilograms (42,990 pounds) to GTO from CCAFS to address the intermediate and heavy segments of the commercial marketplace.

Orbital's Taurus II medium launch vehicle is expected to debut in the third quarter of 2011, assuming funding is available from NASA for a demonstration flight prior to conducting its first commercial resupply mission to the ISS by year-end. This vehicle features a 3.9-meter fairing and can loft ~1,900 kilograms (4,189 pounds) to GTO from Wallops Island, Virginia, or ~2,200 kilograms (5,850 pounds) from CCAFS using an enhanced second stage now under study. While this is likely to be insufficient for commercial launches except for the smallest of payloads, it is more likely that Orbital will attempt to enter the commercial market with its Taurus II Enhanced version scheduled to debut in 2014 with a new second stage and larger payload fairing to improve performance up to ~3,500 kilograms (7,716 pounds), which is the range of Orbital's popular Starbus spacecraft bus.

The Europeanized Soyuz-2 ST launch vehicle debut from Kourou in French Guiana is planned for the third quarter of 2011. This modified Soyuz features a 4.1-meter fairing and will provide medium-lift capability of 3,150 kilograms (6,945 pounds) to GTO. The near-equatorial launch location significantly increases the capacity of the upgraded Soyuz over the launch capacity from Baikonur. However, for the near term through 2013 it appears booked to fly European civil science payloads and commercial communications constellations to low Earth orbit.

Existing launch services providers are improving their capabilities to become more competitive.

- Arianespace is seeking additional pricing supports through the European Space Agency, while the 18-member organization moves towards funding the Ariane 5 Midlife Extension Program, which would include a new cryogenic upper stage to boost lift capacity from the current ~9,000 kilograms (19,842 pounds) to ~11,500 kilograms (25,353 pounds) by 2017.
- ILS is upgrading 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 kilograms (15,256 pounds) into GTO under its Phase III upgrade program. A 5-meter fairing is being studied which would be capable of placing a 5,850-kilogram (12,897-pound) satellite into GTO. ILS is also working with Orbital to offer a dual launch capability for small/medium spacecraft based on Orbital's Starbus platform.
- Sea Launch has emerged from bankruptcy as a newly reconstituted recapitalized competitor now 95 percent owned by Russia's Energia Corporation. The company plans to replace the existing DM-SL upper stage with the Block DM upper stage from the Russian Proton K launch vehicle to boost performance from the current 6,100 kilograms (13,448 pounds) to 6,400 kilograms (14,110 pounds). Sea Launch plans to reenter the market in the second half of 2011.

Indigenous launch vehicles will modestly reduce the demand to fly internationally-competed commercial launches over the decade as certain emerging countries build and successfully launch domestic rockets to fly these satellites as well as their countries' government payloads. For the purposes of this report these commercial satellites will no longer be considered addressable and up for capture under open, competitive launch services solicitations by commercial launch services providers. An example is the Indian Insat communications spacecraft, which has historically been launched by Arianespace. The newer Indian GSAT satellites are being designed to be compatible with the Indian GSLV Mark III launch vehicle. Use of this launcher will have the impact of removing about one previously open-for-competition commercial launch services contract every other year or so. Another example is China, which through its ownership of satellite operator APT Holdings has flown its commercial broadcasting satellites on domestic Long March-3 (CZ-3) series launch vehicles.

On the other hand, some of the new indigenous launchers are planning to enter or expand their presence in the commercially competed launch services marketplace. India would like to offer the new GSLV Mark III launch vehicle to satellite operators to fly their medium-sized commercial satellites. China is seeking to expand its presence in the market to fly medium- and heavy-sized commercial satellites using its Long March-3B (CZ-3B) launch vehicle and soon its new Long March-5 (CZ-5) series. The Chinese ability to fly externally-manufactured commercial payloads is constrained by U.S. ITAR regulations, but satellite manufacturers such as Thales Alenia Space and Astrium Satellites are producing more payloads without U.S.-made components for operators who can then include China Great Wall Industry Corporation (CGWIC) in their portfolio of launch services providers. A recent example of this is the Eutelsat W3C satellite built by Thales Alenia Space and Astrium Services, which has been contracted to fly on a CZ-3 in 2011. This spacecraft would previously been considered addressable and open for capture by commercial launch service providers such as Arianespace and ILS, which Eutelsat has favored in recent procurements. Additionally, the "Big Three" global satellite operators, Intelsat, SES, and Eutelsat, have encouraged the entry of CGWIC into the market as an alternative to existing launch services providers to constrain rising prices through increased competition and to expand manifest launch slot opportunities.

Indigenous launch vehicles include the Indian Space Research Organization (ISRO) GSLVs, the Japanese Aerospace Exploration Agency (JAXA) H-IIA, the CGWIC Long March family, and the emerging Korea Aerospace Research Institute (KARI) Korean Space Launch Vehicle (KSLV).

The ISRO GSLV Mark II features a 3.4-meter fairing and has a lift capacity of 2,500 kilograms to GTO. It is currently used to launch domestic communications satellites previously flown by Arianespace. Unfortunately the GSLV Mark II suffered two launch failures in 2010, resulting in the loss of the GSAT-4 and GSAT-5P (Insat-4D) communications satellites. ISRO has contracted to fly its next communications satellite, GSAT-8 (Insat-4G), again with Arianespace while its works through the failure investigation process. The GSLV Mark III featuring a 5-meter fairing with a lift capacity to GTO of >4,500 kilograms (9,921 pounds) is expected to debut in 2012. Planned lower launch pricing for the commercial market may be offset by higher insurance premiums until the new vehicle has established a successful track record of launches.

The JAXA/Mitsubishi Heavy Industries H-IIA features a 4-meter fairing and has lift capacity of 4,000 kilograms (8,818 pounds) to GTO in standard configuration and up to 6,000 kilograms (13,228 pounds) to GTO with solid strap-ons. The H-IIA successfully conducted two missions in 2010, launching government payloads and recently launched the JAXA H-II Transfer Vehicle cargo resupply module to the ISS. The vehicle currently has a manifest of domestic government payloads through 2013. The Mitsubishi conglomerate through affiliate MELCO also builds the DS series of spacecraft platforms. Though the H-IIA has yet to sign a commercially-competed launch services contract, the DS platform has successfully entered the commercial market most recently with the notable contract for Turksat 4A. It is possible that once the H-IIA flies successfully and more frequently, pricing could be lowered to make it compete more effectively in the marketplace. With a possible bundled offering with the DS platform, H-IIA could see its first capture of a commercial launch services award.

CGWIC's CZ-3B features a 4.2-meter fairing and has lift capacity of 5,500 kilograms (12,125 pounds) to GTO. The Long March series had a successful 2010, with the launch of several domestic communications satellites for domestic operator China Satcom, including Sinosat 6 and Chinasat 20A. The near-term manifest of communications satellites includes: in 2011, Eutelsat W3C, Nigcomsat-1R for Nigeria, Paksat-1R for Pakistan, and Sinosat 5 featuring an ITAR-free Thales Alenia Space payload; in 2012, Apstar 7 and possibly 7B for domestic operator APT; and in 2013, Laosat-1 for Laos and Tupac Katari-1 for Bolivia. All but Eutelsat W3C are directed procurements from national operators to CGWIC in return for financing, technical assistance, and/or political considerations. China is engaged in an ambitious launch vehicle development program to produce the new CZ-5 and CZ-6 series, which are similar to the U.S. EELV, offering a broader range of lift capabilities from medium to intermediate to heavy. These vehicles will feature a 5-meter fairing, a common core stage and various strap-on boosters and upper stages. A new spaceport is also being built on Hainan Island to accommodate these vehicles and to take advantage of the island's closer location to the equator to help increase payload capability. The new spaceport and CZ-5 are planned for operation in 2014. As noted "ITAR-free" satellites (see next section) have provided CGWIC with the opportunity to increase its presence in the overall commercial launch market.

KARI is working towards establishing its domestic launch services capability with the testing of its KSLV-1 launch vehicle, which uses the Russian Angara booster as its first stage. Unfortunately the vehicle suffered a launch failure in 2010 resulting in the loss of the STSAT-2B satellite. This followed the loss of the STSAT-2A satellite in 2009. KARI is working through the failure investigation process before determining a launch date for the next test flight. It is unlikely that domestic satellite operator Korea Telecom will shift from existing commercial launch services providers for the foreseeable future until a more advanced, capable domestic launcher has proven itself reliable.

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, by enabling launch opportunities to be awarded to launch services providers such as CGWIC that are not permitted to launch satellites with ITAR-restricted 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 still not fully recovered from the recession of 2008, but significant funding for commercial space projects is available for those companies who can demonstrate sound business planning. Established GSO operators are pursuing replenishment of their constellations with access to traditional sources of corporate credit, although terms and conditions are still more restrictive than previously, and may vary significantly from one financial institution to the next. Financing must be structured carefully, and more creatively, and assembled on a global basis with consideration of the unique requirements of each lending institution. Access to funds from private equity firms is increasing, as business plans are scrutinized for closure and for high probability of return on invested capital, and as the private equity firms themselves look for opportunities.

Global economic lending conditions continue to impact the growth opportunities for many satellite operators, but the underlying fundamentals of FSS and DBS segments of the satellite services industry remain strong. Customer demand in both market segments is evolving as users adopt IP-based services and require greater control over content provision, but operators are responding with flexibility and cautious optimism as they develop spacecraft capable of providing new service offerings to compete with other established and emerging distribution channels. Current operator transponder usage rates are high, often in the range of 80 percent to 85 percent, and as the world economy improves significant growth is expected in the mobile, VSAT, and DTH business areas, especially in emerging markets. The need by existing consumers to reduce discretionary spending has not impacted the desire for satellite provided information and entertainment as severely as other budget areas. Demand from the U.S. and foreign governments for commercial satellite communications is expected to continue to increase; approximately 80 percent of the U.S. government's current satellite communications are provided by commercial operators through long-term leases, and new applications for such services are continually emerging. Taken together, these factors are projected to produce a growth in channels, transponders, and subscribers of 20 percent to 30 percent over the next ten years, to be met with more flexible spacecraft launched to provide both replacement and new capabilities.

Established FSS and DBS/DTH satellite operators continue to maintain healthy balance sheets anchored by high satellite use rates, sustained consumer demand, long-term contracts and large backlogs. Small-fleet regional and newer operators continue to experience some difficulty in obtaining reasonably priced credit facilities since they do not have the revenue streams of the larger players, although this has eased somewhat in the past year. Such operators continue to explore alternative project financing for both spacecraft construction and launch services, with a particular emphasis on government-backed financing, such as through Export Credit Agencies (ECAs), as governments worldwide continue to work to stimulate economic recovery. The U.S. Export-Import Bank (EXIM) and the French insurance company for foreign trade (Coface) have both been active in providing trade receivables financing and management support. The EXIM Bank has been involved in recent financing of the QuetzSat-1 satellite construction and launch insurance to SES Global (for lease to EchoStar Corporation/Dish Mexico), and of the Azerbaijan Azerspace/Africasat-1A satellite. Coface in particular has been very active in providing financing to GSO satellite operators such as SES Global, Avanti Communications, and Russia's Gazprom, as well as Hughes Communications' Jupiter spacecraft. Coface has also structured financing for NGSO operators Globalstar, O3b Networks, and Iridium Corporation. Indeed, Coface is now considered a major source of potential project financing by many satellite operators.

MSS operators other than INMARSAT have less certain growth prospects, as they face challenges from terrestrial mobile broadband providers who desire a re-allocation of the MSS spectrum to high data rate wireless services. These companies also continue to face the financial demands of building-out expensive new satellite-terrestrial hybrids networks for expanded service provision. ICO DBSB North America, owner of the ICO G1 MSS satellite, filed for bankruptcy protection and reorganization in 2009. MSS providers are responding with efforts to solidify their military communications market segments and expand their offerings to new commercial mobile users, including larger penetration of the maritime and airline industries. The success of these operators remains dependent on the state of global credit markets for continued access to working capital and to the vagaries of consumer market demand.

As in the past, the multi-year planning, budgeting, manufacturing, and launch lead-times associated with the development and deployment of both GSO and NGSO spacecraft means that continued access to affordable capital will remain a critical factor to the success of all operators. The increasing stability of the financial markets, combined with a greater involvement of the world's ECAs, has increased the confidence of existing operators to move forward with planned satellite orders for system recapitalization and expansion, and for new operators to proceed with system introductions.

Insurance of commercial satellite launches is a specialized line of insurance characterized by low frequency/high severity of losses, small number of insured events, highly complex technical issues, unique risks and exposures, manuscript policy wordings, and volatile underwriting results. As a result, the number of insurance companies willing to commit capital to space insurance has always been limited; there are currently about 30 companies worldwide providing such coverage. The business cycle of space insurers, and, indeed, of insurance companies in general, is influenced by worldwide catastrophe losses and by investment returns, among other factors. Due to recent good experience in space insurance, as well as recovery in the financial markets, there is currently an abundance of available capacity for insuring satellite launches. This has pushed pricing to low levels, facilitating the insurance of satellite projects. When the business cycle does eventually turn, and adverse experience reduces available capacity, pricing will increase, and insurance for space programs may become constrained. While this may have an effect on the scheduling of launches, there is generally sufficient time between insurance policy placement and launch to allow for such contingencies.

SUPPLEMENTARY QUESTIONNAIRE RESULTS

As part of the COMSTAC request for inputs from industry participants, a supplementary questionnaire was provided to satellite service providers. The questions focused 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 2010 COMSTAC report.

Table 6. COMSTAC Survey Questionnaire Summary

	Significant Negative Impact	Some Negative Impact	No Effect	Some Positive Impact	Significant Positive Impact	Compared to 2010
Regional or global economic conditions	14%	29%	21%	29%	7%	→
Demand for satellite services	0%	14%	7%	50%	29%	→
Ability to compete with terrestrial services	0%	29%	64%	7%	0%	↓
Availability of financing	14%	14%	50%	21%	0%	↓
Availability of affordable insurance	0%	14%	50%	36%	0%	→
Consolidation of service providers	0%	0%	86%	14%	0%	→
Increasing satellite life times	0%	14%	64%	21%	0%	↑
Availability of satellite systems that meet your requirements	0%	7%	29%	57%	7%	↓
Reliability of satellite systems	0%	7%	43%	43%	7%	→
Availability of launch vehicles that meet your requirements	0%	29%	43%	29%	0%	↓
Reliability of launch systems	0%	14%	50%	36%	0%	↓
Ability to obtain required export licenses	0%	43%	57%	0%	0%	→
Ability to obtain required operating licenses	0%	7%	64%	21%	7%	→

↑ More positive compared to 2010
↓ More negative compared to 2010
No changed compared to 2010

The following 14 satellite service providers responded to the supplementary questionnaires. The Working Group would like to offer special thanks to these companies for providing this additional input:

- APT Satellite Holdings Limited
- Arab Satellite Communication Organization
- Eutelsat Communications
- Hisdesat Servicios Estrategicos, S.A.*
- Hispasat
- Measat
- PT Indosat Tbk
- SiriusXM
- SkyPerfect JSAT Corporation*
- Star One
- Telenor Group
- Telesat
- Thuraya
- Terrestar Networks

* Indicates 2010 survey respondent

The Supplementary Questionnaire inquiries can be broken down into three main categories: financial, technical, and regulatory. The 2011 survey reflects a generally positive perception of the industry, although there was some indication that operators were more concerned about the reliability of launch vehicles. 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. It should be noted that only 2 of the 14 2011 respondents submitted a survey response in 2010, so some of the changed perceptions could be related to the individual experiences of the 2011 respondents.

Reflecting continuing global economic woes, the overall trend in the financial category was somewhat negative. The availability of financing was a significant concern for our 2011 respondents, with 28 percent reporting a negative impact compared with 18 percent reporting some or significant negative impact in 2010. However, it should be noted that the 69 percent of the 2009 survey respondents said that the inability to obtain financing had a negative impact on their business, so there has been a noticeable improvement over the last two years. The number of respondents who said that it was more difficult to compete with terrestrial services increased significantly from 18 percent in 2010 to 29 percent in 2011. There was little or no change in the respondents' perceptions of demand for satellite services, impact of consolidation among service providers, and availability of affordable insurance.

Operators continue to be satisfied with the variety and reliability of satellite systems available to them. Fourteen percent of the respondents in 2011 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 45 percent of the 2010 respondents. Operators are less optimistic when it comes to launch vehicles, however; 29 percent of the 2011 respondents said that the availability of launch vehicles had some or significant negative impact on their plans compared to 18 percent of 2010 respondents. This could have been influenced by the absence of Sea Launch from the commercial market due to their bankruptcy. Perception of launch vehicle reliability has decreased somewhat, with 14 percent of the 2011 responses indicating a negative impact compared to 9 percent of the 2010 respondents. This is still a significant improvement over the 2009 responses, when almost one-third (31 percent) of the respondents stated that launch vehicle reliability had some or significant negative impact on their business plans.

The regulatory category reflected the same trends in 2011 as were reported in 2010. Forty-three percent of the 2011 respondents experienced some or significant negative impact as a result of their inability to obtain the required export licenses compared to 45 percent of the 2010 respondents. This compares with only 15 percent of the 2009 responses that reported a negative impact. Some improvement was seen in the ability to obtain the required operating licenses, with seven percent of 2011 respondents experiencing some or significant negative impact versus nine percent in 2010. Again, this is a significant improvement over the 2009 survey, when 23 percent of the respondents indicated that they had trouble obtaining operating licenses.

COMMERCIAL GSO SATELLITE TRENDS

Trends in Number of Transponders per Satellite

Figure 9 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 through 2010, with a projection for 2011 based on the near-term manifest shown in Table 4. Peaks in total number of transponders launched correspond to peaks in number of satellites launched for a given year. The average 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 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 2011 is expected to rise slightly and future growth is expected to be incremental.

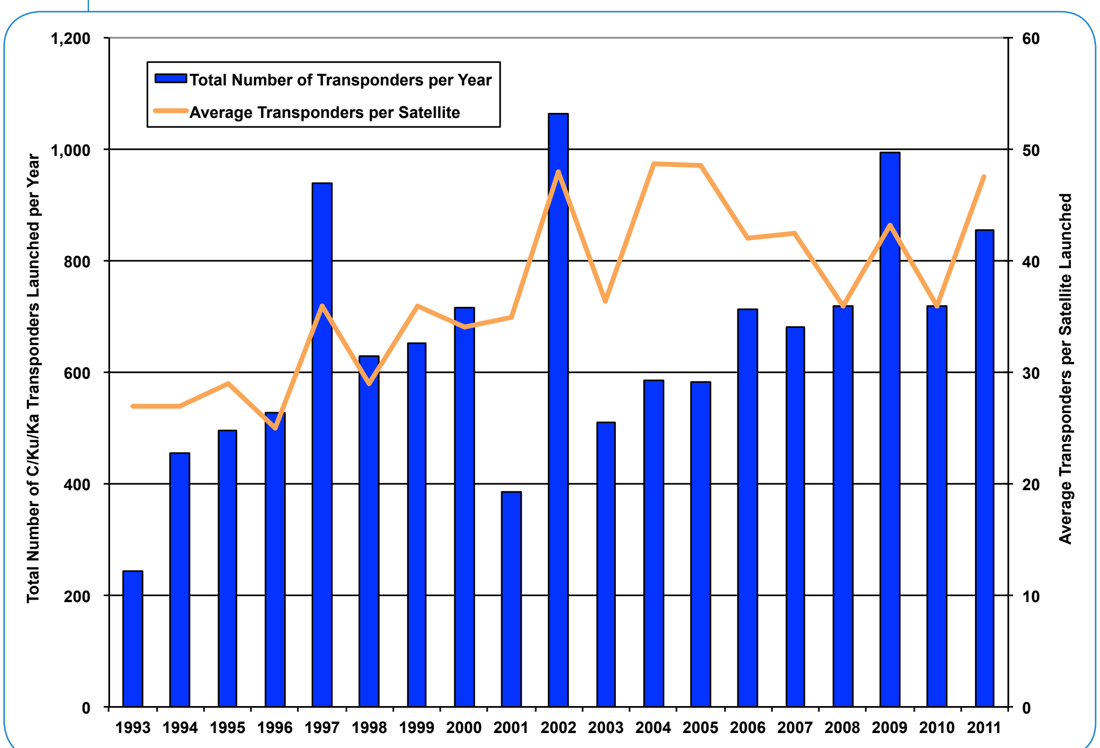

Figure 9. Total C/Ku/Ka Transponders Launched per Year and Average Transponders per Satellite

Table 7. 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	2011
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	855
Average Transponders per Satellite	27	27	29	25	36	29	36	34	35	48	36	49	49	42	43	36	43	36	48

Trends in Average Satellite Mass

Figure 10 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 rose again in 2009. The average mass in 2011 is expected to increase greatly to the highest average mass on record and growth trends in the future are expected to be incremental. The last eight years have averaged well over 4,000 kilograms (8,818 pounds) and the expectation is that the next several years that the average will continue to increase. This again correlates to stabilizing the shift to heavier, higher-power satellites. The projected total mass to launch in 2011 is over 83,000 kilograms (182,984 pounds) with an expected average satellite mass of over 4,660 kilograms (10,274 pounds).

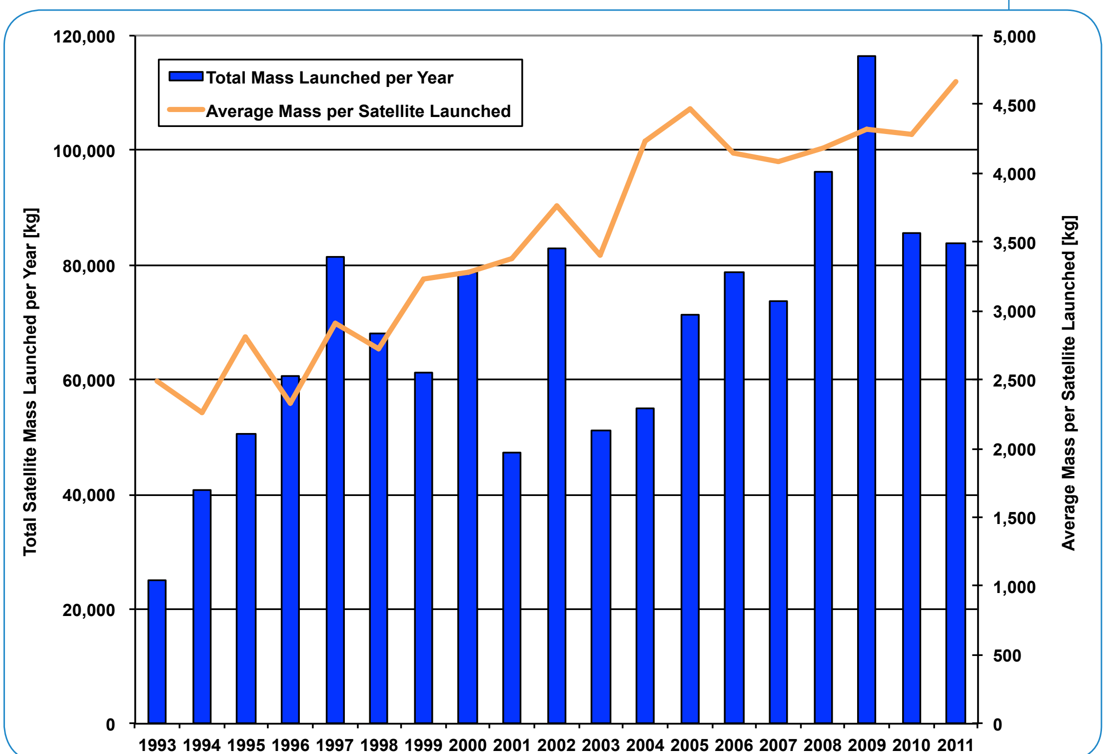

Figure 10. Total Satellite Mass Launched per Year and Average Mass per Satellite

Table 8. 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	2011
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	85,638	83,928
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	4,282	4,663

SUMMARY

The *2011 COMSTAC Commercial GSO Launch Demand Forecast* projects an average annual demand of 20.5 satellites to launch from 2011 through 2020, nearly identical to the 2010 forecast of 20.7.

The Working Group forecasts 18 total satellites launched (including 4 that will be dual-manifest) in 2011, increasing to 26 total satellites (including 5 that will be dual-manifest) launches in 2012, and a slight decrease to 23 satellites (including 5 that will be dual-manifest) launches expected in 2013. The long term forecast of average annual single-manifest launches over the ten-year period spanning 2011 through 2020 is 15.6 launches per year. The average annual dual-manifest launches during 2011 through 2020 are forecasted to be 4.9.

There has been steady growth in satellite mass since 1993 and the trend continues toward and beyond the 2005 peak level of 4,500 kilograms (9,921 pounds). The average mass in 2011 is expected to increase greatly from last year. Growth trends in the future are expected to be incremental however. The last seven years have seen an average mass of over 4,000 kilograms (8,818 pounds) and the expectation is that the next several years will be similar. The projected total mass to launch in 2011 is over 83,000 kilograms (182,984 pounds). The average satellite mass in 2011 is expected to rise to over 4,600 kilograms (10,141 pounds); 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 did not have a launch in 2010, but plans on being back launching in 2011; Falcon 9 plans its commercial launch of Amos-4 in 2013. Sea Launch's emergence from bankruptcy is complete and is planning to commence launches in 2011. While Ariane 5 and Proton together have the theoretical capacity to meet the current demand, 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 (1993–2010)

	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 Manfiested Launch with Non-Addressable Satellite. DMN missions are counted as a single launch in the launch count.

Table 9. Historical Addressable Commercial GSO Satellites Launched (1993–2010) (Continued)

	1997	1998	1999	2000	2001
Total Launches	24	19	18	20	12
Total Satellites	28	23	19	24	14
Over 5,400 kg (>11,905 lbm)	0	0	0	0	0
4,200 - 5,400 kg (9,260 - 11,905 lbm)	0	0	2 Galaxy 11 Ariane 44L Orion 3 Delta III	4 Anik F1 Ariane 44L PAS 1R Ariane 5G Garuda 1 Proton K/DM Thuraya 1 Sea Launch	5 DirecTV 4S Ariane 44LP Intelsat 901 Ariane 44L Intelsat 902 Ariane 44L XM Rock Sea Launch XM Roll Sea Launch
2,500 - 4,200 kg (5,510 - 9,260 lbm)	21 DMN Hot Bird 3 Ariane 44LP Intelsat 801 Ariane 44P Intelsat 802 Ariane 44P Intelsat 803 Ariane 42L Intelsat 804 Ariane 42L JCSat 5 Ariane 44P PAS 6 Ariane 44P DM4 Sirius 2 Ariane 44L DM2 Thaicom 3 Ariane 44LP AMC 3 Atlas IIAS DirecTV 6 Atlas IIA EchoStar 3 Atlas IIAS Galaxy 8i Atlas IIAS JCSat 4 Atlas IIAS Superbird C Atlas IIAS Agila II Long March 3B APStar 2R Long March 3B Aatra 1G Proton K/DM Asiasat 3 Proton K/DM PAS 5 Proton K/DM Telstar 5 Proton K/DM	14 DM4 Afristar Ariane 44L DM3 Eutelsat W2 Ariane 44L Hot Bird 4 Ariane 42P PAS 6B Ariane 42L PAS 7 Ariane 44LP Satmex 5 Ariane 42L ST-1 Ariane 44P Hot Bird 5 Atlas IIA Intelsat 805A Atlas IIAS Intelsat 806A Atlas IIAS Galaxy 10 Delta III Astra 2A Proton K/DM EchoStar 4 Proton K/DM PAS 8 Proton K/DM	16 AMC 4 Ariane 44L DM1 Arabsat 3A Ariane 44L Insat 2E Ariane 42P Koreasat 3 Ariane 42P Orion 2 Ariane 44LP Telkom Ariane 42P Telstar 7 Ariane 44LP Echostar V Atlas IIAS Eutelsat W3 Atlas IIAS JCSat 6 Atlas IIAS Asiasat 3S Proton K/DM Astra 1H Proton K/DM LMI 1 Proton K/DM Nimiq Proton K/DM Telstar 6 Proton K/DM DirecTV 1R Sea Launch	14 DM1 Asiastar 1 Ariane 5G DM3 Astra 2B Ariane 5G Europe*Star 1 Ariane 44LP Eutelsat W1R Ariane 44P Galaxy 10R Ariane 42L Galaxy IVR Ariane 42L N-Sat-110 Ariane 42L Superbird 4 Ariane 44LP Echostar VI Atlas IIAS Eutelsat W4 Atlas IIIA Hispasat 1C Atlas IIAS AAP 1 Proton K/DM AMC 6 Proton K/DM PAS 9 Sea Launch	6 DM2 Artemis Ariane 5G Atlantic Bird 2 Ariane 44P DM1 Eurobird Ariane 5G Turksat 2A Ariane 44P Astra 2C Proton K/DM PAS 10 Proton K/DM
Below 2,500 kg (<5,510 lbm)	7 DM1 AMC 2 Ariane 44L DM2 BSat 1A Ariane 44LP DM4 Cakrawarta 1 Ariane 44L DM3 Inmarsat 3F4 Ariane 44LP DM3 Insat 2D Ariane 44LP DM1 Nahuel 1A Ariane 44L Thor II Delta II	9 DM4 AMC 5 Ariane 44L DM1 Brazilsat B3 Ariane 44LP DM2 BSat 1B Ariane 44P DM1 Inmarsat 3F5 Ariane 44LP DM2 NileSat 101 Ariane 44P DM3 Sirius 3 Ariane 44L Bonum-1 Delta II Skynet 4D Delta II Thor III Delta II	1 DM1 Skynet 4E Ariane 44L	6 DM3 AMC 7 Ariane 5G DM4 AMC 8 Ariane 5G DM4 Astra 2D Ariane 5G DM2 Brazilsat B4 Ariane 44LP DM1 Insat 3B Ariane 5G DM2 Nilesat 102 Ariane 44LP	3 DM1 BSat 2A Ariane 5G DM2 BSat 2B Ariane 5G DMN Skynet 4F Ariane 44L

(Grey shading) = Launch Failure

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

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

Table 9. Historical Addressable Commercial GSO Satellites Launched (1993–2010) (Continued)

	2002			2003			2004			2005			2006		
Total Launches	20			12			13			15			15		
Total Satellites	22			15			13			16			19		
Over 5,400 kg (>11,905 lbm)	0			0			3			6			2		
								Anik F2	Ariane 5G+	DM1	Spaceway 2	Ariane 5ECA	DM2	Satmex 6	Ariane 5ECA
								Intelsat X	Proton M/M		Thaicom 4	Ariane 5G+	DM3	DirecTV 9S	Ariane 5ECA
								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)	9			5			4			4			9		
		Intelsat 904	Ariane 44L		Intelsat 907	Ariane 44L		Eutelsat W3A	Proton M/M		AMC-12	Proton M/M	DM4	Wildblue 1	Ariane 5ECA
		Intelsat 905	Ariane 44L	DM2	Optus C1	Ariane 5G		Amazonas	Proton M/M		Anik F1R	Proton M/M		Astra 1KR	Atlas V 411
		Intelsat 906	Ariane 44L		Rainbow 1	Atlas V 521		Estrela do Sul	Sea Launch		AMC-23	Proton M/M		Hotbird 8	Proton M/M
		NSS-6	Ariane 44L		EchoStar 9	Sea Launch		APStar V	Sea Launch		XM-3	Sea Launch		Measat 3	Proton M/M
		NSS-7	Ariane 44L		Thuraya 2	Sea Launch								Echostar X	Sea Launch
		Astra 1K	Proton K/DM											JCSat 9	Sea Launch
		Echostar 8	Proton K/DM											Galaxy 16	Sea Launch
		Intelsat 903	Proton K/DM											Koreasat 5	Sea Launch
		Galaxy IIIC	Sea Launch											XM-4	Sea Launch
2,500 - 4,200 kg (5,510 - 9,260 lbm)	11			6			4			3			6		
	DMN	Atlantic Bird 1	Ariane 5G	DM1	Insat 3A	Ariane 5G		Superbird 6	Atlas IIAS	DMN	XTAR-EUR	Ariane 5ECA	DM1	Hotbird 7A	Ariane 5ECA
	DMN	Hotbird 7	Ariane 5ECA	DM3	Insat 3E	Ariane 5G		MBSat	Atlas IIIA		Insat 4A	Ariane 5G+	DM1	Spainsat	Ariane 5ECA
		Insat 3C	Ariane 42L		Asiasat 4	Atlas IIIB		AMC-16	Atlas V 521		DirecTV 8	Proton M/M	DM2	Thaicom 5	Ariane 5ECA
	DM1	JCSat 8	Ariane 44L		Hellas-sat	Atlas V 401		AMC-15	Proton M/M				DMN	JCSat 10	Ariane 5ECA
	DM2	Stellat 5	Ariane 5G		AMC-9	Proton K/M								Arabsat 4A	Proton M/M
		Echostar 7	Atlas IIIB		Galaxy XIII	Sea Launch								Arabsat 4B	Proton M/M
		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)	2			4			2			3			2		
	DM1	Astra 3A	Ariane 44L	DM2	Bsat 2C	Ariane 5G		AMC-10	Atlas IIAS	DM1	Telkom 2	Ariane 5ECA	DM4	AMC-18	Ariane 5ECA
	DM2	N-Star c	Ariane 5G	DM3	e-Bird 1	Ariane 5G		AMC-11	Atlas IIAS	DMN	Galaxy 15	Ariane 5G+	DM3	Optus D1	Ariane 5ECA
				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 Manfiested Launch with Non-Addressable Satellite. DMN missions are counted as a single launch in the launch count.

Table 9. Historical Addressable Commercial GSO Satellites Launched (1993–2010) (Continued)

	2007		2008		2009		2010	
Total Launches	12		18		18		14	
Total Satellites	18		23		22		20	
Over 5,400 kg	3		5		8		7	
(>11,905 lbm)	DM3 Spaceway 3	Ariane 5ECS	Inmarsat 4F3	Proton M	Eutelsat W2A	Proton M	Echostar 14	Proton M
	DirecTV 10	Proton M/M	DirecTV 11	Sea Launch	Sirius FM 5	Proton M	Arabsat 5B	Proton M
	NSS-8 (launch failure)	Sea Launch	ICO G-1	Atlas V	Terrestar 1	Ariane 5 ECA	Echostar 15	Proton M
			Echostar 11	Sea Launch	DM1 Amazonas 2	Ariane 5 ECA	XM-5	Proton M
			Ciel 2	Proton M	DM2 NSS-12	Ariane 5 ECA	DM4 Eutelsat W3B	Ariane 5 ECA
					Intelsat 14	Atlas V	SkyTerra 1	Proton M
					Eutelsat W7	Proton M	KA-Sat	Proton M
					DirecTV 12	Proton M		
4,200 - 5,400 kg	6		8		2		4	
(9,260 - 11,905 lbm)	DM1 Skynet 5A	Ariane 5ECA	DM1 Skynet 5C	Ariane 5G	DM3 Hotbird 10	Ariane 5 ECA	DM1 Astra 3B	Ariane 5 ECA
	DM2 Astra 1L	Ariane 5ECA	Astra 1M	Proton M	Nimiq 5	Proton M	DM2 Arabsat 5A	Ariane 5 ECA
	DM5 Skynet 5B	Ariane 5ECA	Nimiq 4	Proton M			DM5 Intelsat 17	Ariane 5 ECA
	Nigcomsat	Long March 3B	DM3 HotBird 9	Ariane 5G			DM6 Hispasat 1E	Ariane 5 ECA
	Anik F3	Proton M/M	Thuraya 3	Sea Launch				
	SES Sirius 4	Proton M/M	Galaxy 18	Sea Launch				
			Galaxy 19	Sea Launch				
			DM5 Superbird 7	Ariane 5G				
2,500 - 4,200 kg	5		8		9		6	
(5,510 - 9,260 lbm)	DM1 Insat 4B	Ariane 5ECA	DM2 BADR 6	Ariane 5G	DM1 Satcom BW1	Ariane 5 ECA	SES-1	Proton M
	DM2 Galxy 17	Ariane 5ECA	DM3 Eutelsat W2M	Ariane 5G	DM2 Thor 6	Ariane 5 ECA	DM1 Satcom BW-2	Ariane 5 ECA
	DM5 Star One C1	Ariane 5ECA	AMC 14 (launch failure)	Proton M	Telstar 1N	Land Launch	DM3 Nilesat 201	Ariane 5 ECA
	DM6 RASCOM 1	Ariane 5G+	DM4 Vinasat	Ariane 5G	Sicral 1B	Sea Launch	DM3 RASCOM 1R	Ariane 5 ECA
	JCSat 11 (launch failure)	Proton M/M	DM2 Protostar 1	Ariane 5G	Protostar II	Proton M	DM5 Hylas	Ariane 5 ECA
			DM5 AMC 21	Ariane 5G	Asiasat 5	Proton M	DM6 Koreasat 6	Ariane 5 ECA
			DM1 Turksat 3A	Ariane 5G	DM4 JCSat 12	Ariane 5 ECA		
			DM4 StarOne C2	Ariane 5G	Palap D	Long March		
					Intelsat 15	Long March		
Below 2,500 kg	4		2		3		3	
(<5,510 lbm)	DM3 Bsat 3A	Ariane 5ECA	AMOS 3	Land Launch	DM3 NSS-9	Ariane 5 ECA	Intelsat 16	Proton M
	DM4 Intelsat 11	Ariane 5G+	Thor 5	Proton M	Measat 3A	Land Launch	DM2 COMS 1	Ariane 5 ECA
	DM4 Optus D2	Ariane 5G+			DM4 Optus D3	Ariane 5 ECA	DM4 BSAT 3B	Ariane 5 ECA
	DM6 Horizons	Ariane 5G+						

[grey box] = Launch Failure

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

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

Table 10. Historical Non-Addressable Commercial GSO Satellites Launched (1993–2010)

		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			2	
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		3			5			1	
Total Spacecraft		3			5			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			
					Chinasat 22	Long March 3A			
		2002			2003			2004	
Total Launches		1			4			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			4			4	
Total Spacecraft		3			4			4	
		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		Chinasat 22A	Long March 3A		Nigcomsat 1	Long March 3B
					Insat 4C	GSLV		Insat 4CR	GSLV
		2008			2009			2010	
Total Launches		3			3			3	
Total Spacecraft		3			3			3	
		Venesat 1	Long March 3B	DM1	Express MD-1	Proton M		ChinaSat 6A	Long March 3B
		Chinasat 9	Long March 3B	DM1	Express AM44	Proton M		ChinaSat 20A	Long March 3A
		Express AM33	Proton		Palapa D1	Long March 3B		Insat 4D	GSLV

= Launch Failure

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

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

2011 COMMERCIAL SPACE TRANSPORTATION FORECAST FOR NON-GEOSYNCHRONOUS ORBITS (NGSO)

INTRODUCTION

The *2011 Commercial Space Transportation Forecast for Non-Geosynchronous Orbits (NGSO)* is developed by the Federal Aviation Administration Office of Commercial Space Transportation (FAA/AST). The NGSO forecast projects commercial launch demand for all space systems to be deployed to non-geosynchronous orbits, including low Earth orbit (LEO), medium Earth orbit (MEO), elliptical orbits (ELI), and external trajectories (EXT) to the Moon or other solar system destinations. First compiled in 1994, the FAA NGSO forecast assesses payloads most likely to seek commercial launch services during the next 10 years. Commercial launches, as defined for this forecast, include those whose services are sought on the international market. They also include U.S. domestic commercial launch services that are licensed by the FAA, for example, commercial launches to the International Space Station (ISS).

Forecast Purpose and Methodology

The 2011 NGSO forecast helps U.S industry, as well as the U.S. Government, understand the scope and trends of commercial spaceflight demand. It also assists FAA/AST in its licensing and planning.

This report is based on FAA/AST research and discussions with industry, including satellite service providers, spacecraft manufacturers, launch service providers, system operators, government offices, and independent analysts. The forecast examines progress for publicly announced payloads (satellites, space vehicles, and other spacecraft) 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

The forecast also considers five payload segments, defined by the type of service the spacecraft are designed to offer.

Future deployments of payloads that have not yet been announced are projected based on market trends, the status of payloads currently deployed in orbit, and the economic conditions of potential payload developers and operators.

Commercial NGSO Payload Service Segments

I Commercial Telecommunications
II Commercial Remote Sensing
III Science and Engineering
    a. Basic and Applied Research
    b. Space Technology Test and Demonstration
IV Commercial Cargo and Crew Transportation Services
    a. Cargo
    b. Human Spaceflight
V Other Payloads Launched Commercially

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. For the science and engineering market, near-term primary payloads generating individual commercial launches were used in the model, while future years were estimated based on historical activity. For commercial cargo and human spaceflight, the National Aeronautics and Space Administration (NASA) 2012 ISS traffic model was used to estimate future launches of crew and cargo.

Commercial NGSO Launch Industry Components

The commercial space launch industry is depicted in Figure 11. Demand for commercial space launch flows from top to bottom through the various industry components: satellite and commercial transportation service operators, satellite manufacturers, launch providers, and launch vehicle manufacturers.

SATELLITE AND COMMERCIAL TRANSPORTATION SERVICE OPERATORS

Operators purchase and operate payloads (spacecraft) that provide services such as commercial telecommunications, commercial remote sensing, science and engineering, and commercial transportation services. Their customers include private companies, militaries, national space programs, universities, and the general public.

Operators include private companies, government agencies, public-private partnerships, universities, and non-profit entities. Private sector payload 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. Government agencies operate a range of satellite systems and other types of payloads across multiple service segments.

SPACECRAFT MANUFACTURERS

These organizations include private companies, universities, and occasionally government organizations that construct satellites for satellite operators. Most manufacturers can produce spacecraft for multiple service sectors, although some specialize in a particular segment. Spacecraft often include components

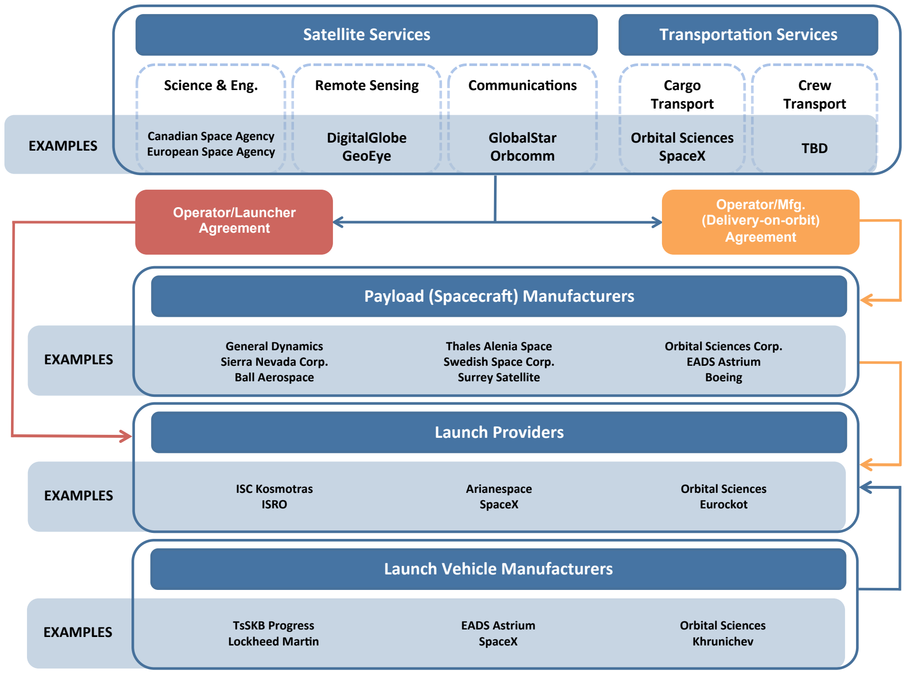

Figure 11. NGSO Launch Industry Components

or instruments obtained from multiple suppliers. Typically, one manufacturer serves as the prime contractor for a spacecraft and is responsible for integrating its components.

LAUNCH PROVIDERS

These companies provide launch services for spacecraft under contracts signed with payload operators, although sometimes these contracts are signed with spacecraft manufacturers (in arrangements known as delivery-in-orbit).

LAUNCH VEHICLE MANUFACTURERS

These organizations include private companies, government organizations, and mixed publicly-privately owned entities that design and build rocket launch vehicles for launching payloads, including satellites, crew vehicles, and other spacecraft. Launch vehicle manufacturers may be the same entities as launch providers, partial owners of launch provider companies, or market their launch vehicles through launch providers under agreements or contracts.

Although these industry components are distinct, many companies are active in more than one of them. For example, companies such as Orbital Sciences Corporation (Orbital) or Space Exploration Technologies Corporation (SpaceX) are vertically integrated: they build and launch their own rockets, and they manufacture and operate spacecraft.

Figure 11 does not depict government regulators, finance sources, insurers, and some additional industry components. It is important to note that these components exist and do influence demand within the commercial NGSO launch market.

FORECAST SUMMARY

The FAA/AST forecasts a demand for 13 launches per year worldwide, on average, during 2011 through 2020. The launch demand peaks in 2015 and 2016, with 17 launches each year, due to overlap in the replacement of the Iridium constellation and frequent commercial crew and cargo launches to the ISS. The forecast predicts a drop in launch demand after 2017, when telecommunication constellations, including Iridium, finish deployment. However, there is a significant amount of uncertainty in the out years of the forecast. Commercial crew transportation and resupply of the ISS are planned for vehicles that are yet to be proven. Technical or financial issues could delay ISS resupply launches. Furthermore, it is still too early to predict with accuracy new and emerging markets. If NASA's needs for commercial crew and cargo to station grow, Bigelow Aerospace launches its space stations, the space tourist market matures, and commercial companies launch payloads to the Moon, there can be significant growth in NGSO launches in 2016 and beyond.

Launch demand is divided into two vehicle size classes, with an average of 11.1 medium-to-heavy vehicle launches per year and 1.9 small vehicle launches per year during the forecast period. The number of medium-to-heavy launches increased since last year's forecast, but the number of small launches remains unchanged. Figure 12 depicts the distribution of the number of satellites seeking launch by service type and the associated number of launches. Telecommunications makes up 43 percent of the satellite market but only 15 percent of the launch market because of multiple-manifesting. All upcoming launches for the Iridium, Globalstar, ORBCOMM, and O3b fleets are expected to be multi-manifested.

Science and engineering payloads, which include basic and applied research and space technology test and demonstration spacecraft, constitute 30 percent of the satellite market and 31 percent of the launch market. Commercial remote sensing satellites account for about 5 percent of the payload market and 8 percent of the launch demand market.

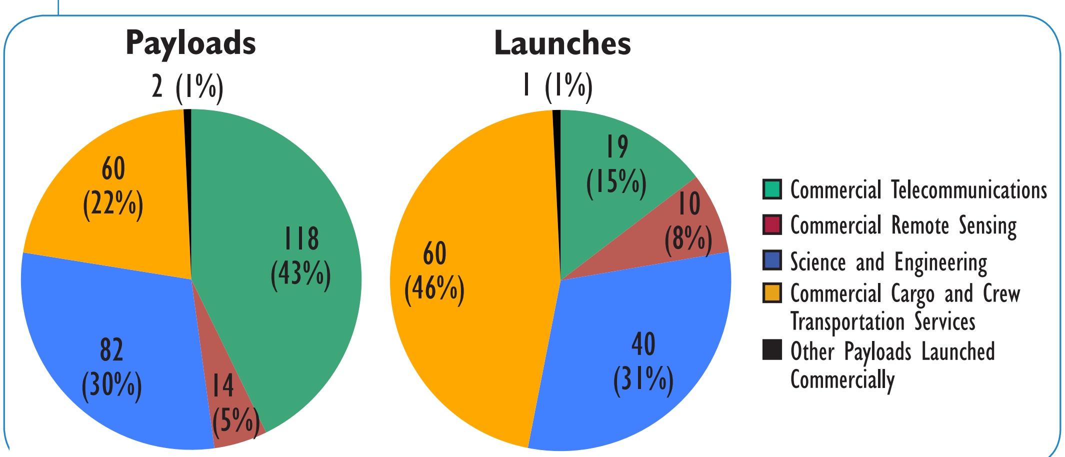

Figure 12. Number of Payloads Seeking Launch and Associated Launches in 2011-2020

The 2011 NGSO launch forecast shows a significant increase in the commercial cargo and crew transportation services segment launch share. This corresponds with the orbital facilities and assembly services (OFAS) and the commercial human orbital spaceflight category in the previous years' forecasts. The commercial cargo and crew transportation services segment accounts for 46 percent of the launch market, an increase from 34 percent projected in the 2010 forecast. This increase is primarily due to including commercial crew launches to the ISS in the forecast. The annual launch rate during the next 10 years is considerably higher than the previous decade (see Figure 13). Commercial space transportation and telecommunications constellation replenishments drive this increase.

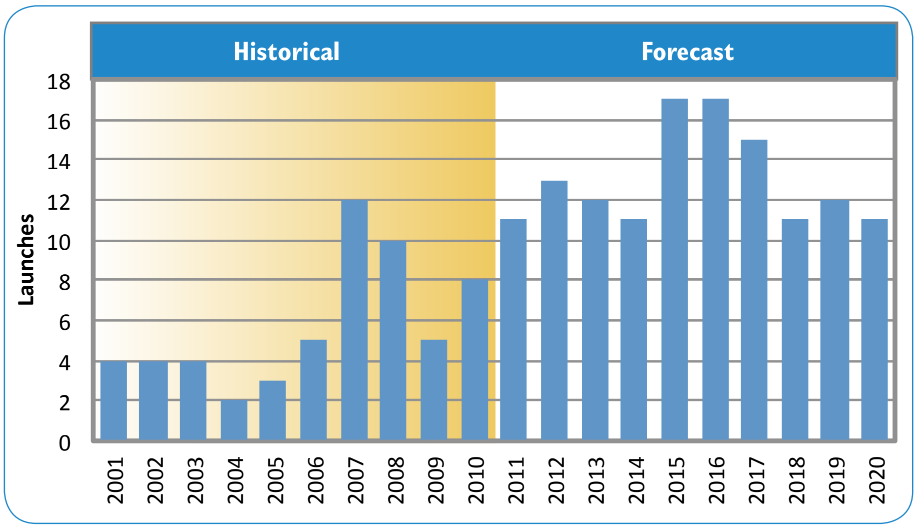

Figure 13 Commercial NGSO Launch History and Forecast

Last year's NGSO forecast predicted 14 launches for 2010, however, only 8 occurred. This demonstrates the challenge of projecting launch rates across all segments. The near-term manifest projects announced launch demand for the first four years of the forecast period. Table 11 identifies all NGSO satellites manifested for 2011-2014. A large portion of commercial launch services is tied to development and launch of new systems both on the payload and launch vehicle sides of the industry.

Based on published manifests, the forecast predicts 11 NGSO launches for 2011 and 13 launches for 2012. However, applying a realization factor, the actual NGSO launches are more likely to be between 6 and 8 in 2011, and 8 to 10 in 2012. This factor is based on the difference between forecast launches and actual launches in the five years before the year of the report, and is only applied to 2011 and 2012. The 2011 demand includes one maiden flight of a new rocket, the first cargo mission to dock with the ISS, and six multi-manifested launches. The 2012 demand includes six cargo resupply missions to the ISS on two new vehicles and spacecraft. Maiden flights, new vehicles, and multi-manifested missions have a greater than normal chance of slipping into the next year. The Risk Factors section of this report discusses forecast uncertainty in detail on page 77.

Table 11. Near-Term Identified NGSO Payload Manifest

Service Type	2011	2012	2013	2014
Commercial Telecommunications Systems	Globalstar (6) - Soyuz 2	ORBCOMM (8) - Falcon 9	O3b (4) - Soyuz 2	
	Globalstar (6) - Soyuz 2	ORBCOMM (8) - Falcon 9	O3b (4) - Soyuz 2	
	Globalstar (6) - Soyuz 2			
	AprizeStar (2)			
	ORBCOMM (2)			
Commercial Remote Sensing		GeoEye 2 - Atlas V	EROS C - TBD	WorldView 3 - TBD
Science and Engineering	Taurus II inaugural launch - Taurus II	SAOCOM 1A - Falcon 9	DragonLAB 1 - Falcon 9	DragonLAB 2 - Falcon 9
	Kompsat 5 - Dnepr STSAT-3	DubaiSat-2 - Dnepr Tugsat-1	SAOCOM 1B - Falcon 9	
	Sich-2 - Dnepr Nigeriasat-2 NX Rasat	SWARM (3) - Rockot	EnMap - Vega	
			Kompsat 3A - Dnepr	
Commercial Cargo and Crew Transportation Services	Dragon COTS Demo 2 - Falcon 9	Cygnus ISS Resupply - Taurus II	Cygnus ISS Resupply - Taurus II	Cygnus ISS Resupply - Taurus II
	Dragon COTS Demo 3 - Falcon 9	Cygnus ISS Resupply - Taurus II	Cygnus ISS Resupply - Taurus II	Cygnus ISS Resupply - Taurus II
	Dragon ISS Resupply - Falcon 9	Dragon ISS Resupply - Falcon 9	Dragon ISS Resupply - Falcon 9	Dragon ISS Resupply - Falcon 9
	Cygnus COTS Demo - Taurus II	Dragon ISS Resupply - Falcon 9	Dragon ISS Resupply - Falcon 9	Dragon ISS Resupply - Falcon 9
		Dragon ISS Resupply - Falcon 9		Dragon ISS Resupply - Falcon 9
		Dragon ISS Resupply - Falcon 9		Dragon ISS Resupply - Falcon 9
Other Payloads Launched Commercially	Sapphire (piggyback)		Göktürk - Dnepr	
Total Payloads	37	33	12	11
Total Launches	11	13	16	12
FAA Launch Realization Factor	6-8	8-10		

Note: Eight science and engineering payloads, with four launches, are projected for each year based on historical trend analysis. It is not always possible to name which satellites will be launched.

NGSO PAYLOAD SEGMENTS

Commercial Telecommunication Satellites

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 can be divided into three major categories, based on the frequencies that the satellites use: narrowband (historically also known as Little LEO), wideband (also known as Big LEO), and broadband. In this year's forecast, the telecommunications satellite market also includes digital audio radio services (DARS). Previous forecasts included DARS as part of the international science and other satellites segment.

Narrowband LEO systems (Table 12) operate at frequencies below 1 GHz. These 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. There is one operational narrowband system, ORBCOMM, and another system, AprizeStar (LatinSat), under deployment.

Table 12. Narrowband Systems

System/ Operator	Prime Contractor	Satellites		Orbit Type	First Launch	Status
		Number	Mass kg (lb)			
Operational						
ORBCOMM/ ORBCOMM Global LP	Orbital Sciences Corp.; Sierra Nevada Corp. (2nd Generation)	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 2011.
Under Development						
AprizeStar (LatinSat)/ Aprize Satellite	SpaceQuest	4/2 (in orbit/ operational)	10 (22)	LEO	2002	Planned 12-satellite system, with intermittent launches based on availability of funding. Licensed by Argentine CNC in 1995. Two more satellites are planned to launch in 2011.

Wideband LEO systems (Table 13) use frequencies in the range of 1.6–2.5 GHz (L- and S-band frequencies). Wideband systems provide mobile voice telephony and data services. The two wideband systems, Globalstar and Iridium, are currently on orbit and operational.

ORBCOMM, Globalstar, and Iridium are in different stages of planning, development, and deployment of their new generation of satellites.

Table 13. Wideband Systems

System/ Operator	Prime Contractor	Satellites		Orbit Type	First Launch	Status
		Number	Mass kg (lb)			
Operational						
Globalstar/ Globalstar Inc.	SS/Loral; Thales Alenia Space (2nd Generation)	66/50 (in orbit/ operational)	447 (985) 1st Gen; 700 (1,543) 2nd Gen	LEO	1998	Constellation on orbit and operational, with technical anomalies. Eight replacement satellites launched in 2007. Next-generation system launches started in 2010 with six satellites launched by a Soyuz rocket. Remaining 18 satellites are planned for three Soyuz launches in 2011.
Iridium/ Iridium Communications Inc.	Motorola, Thales Alenia Space (Iridium NEXT)	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 is under development at Thales Alenia Space. Multiple launches of the Iridium NEXT constellation satellites by the Falcon 9 rocket are planned to begin in 2015.

The third category is broadband (Table 14)—satellite systems that reside in NGSO and provide high-speed data services at Ka- and Ku-band frequencies. Past proposed broadband systems have not made it to fruition. However, O3b Networks proposes initial deployment of a broadband system in 2013 that will provide Internet links and cellular backhaul to underserved regions.

Table 14. Broadband Systems

System/ Operator	Prime Contractor	Satellites		Orbit Type	First Launch	Status
		Number	Mass kg (lb)			
Under Development						
O3b/O3b Networks Ltd.	Thales Alenia Space	0/0 (in orbit/ operational)	700 (1540)	MEO	2013	The first eight satellites of the constellation are planned to launch in 2013.

Table 15 shows FCC telecommunications licenses issued to the commercial NGSO telecommunications satellites operators.

Table 15. FCC Telecommunication Licenses

Licensee	Date License Granted or Updated	Remarks
ORBCOMM	3/31/1998	Authorized Orbital Communications Corporation to modify its non-voice, non-geostationary mobile satellite service system authorized in the first processing round.
Iridium Satellite LLC	7/17/2001	Authorized Iridium to operate feeder uplinks in the 29.1-29.25 Mobile-Satellite Service (MSS).
Globalstar	7/17/2001	Authorized Globalstar, L.P. to use spectrum in the 2 GHz band to provide Mobile-Satellite Service (MSS) from non-geostationary satellite orbit (NGS) and geostationary satellite orbit (GSO) satellites.
Iridium Satellite LLC	2/8/2002	Granted assignment of licenses and authorizations pertaining to the operation of the IRIDIUM Mobile Satellite Service System.
Globalstar	1/30/2003	Denied Globalstar's "Application for Modification of License" and its "Request for Waiver and Modification of Implementation Milestones for 2 GHz MSS System".
Iridium Satellite LLC	6/24/2003	Modified the authorization currently held by Iridium 2 GHz LLC to use spectrum in the 2 GHz band to provide Mobile-Satellite Service.
Iridium Satellite LLC	10/7/2003	Modified the licenses of Iridium Constellation, LLC and Iridium, US LP (collectively "Iridium") and authorized Iridium to operate satellites in the "Big LEO" mobile-satellite service (MSS) system in the 1620.10-1621.35 MHz frequency band.
Globalstar	3/8/2004	International authorizations granted.
Globalstar	6/24/2004	Denied the Application for Review filed by Globalstar, L.P.
Iridium Satellite LLC	9/3/2004	Modified the authorizations of Iridium to operate space and earth stations in the "Big Leo" mobile-satellite service.

Globalstar

Globalstar, Inc. is a publicly traded wideband system operator primarily serving the global satellite voice and data markets. Their full service offering began in 2000. Now the company is in the process of updating its on-orbit satellite constellation that suffers from partial technical failures. Globalstar provides voice and data services to commercial clients globally.

Globalstar's first-generation satellite constellation consisted of 52 satellites—48 operational satellites plus 4 on-orbit spares. Globalstar's original constellation began experiencing problems with its S-band amplifier in 2001. In 2007, the S-band problem began affecting the company's voice and two-way data services. The simplex one-way L-band data services, also provided by these 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 have not suffered from the technical anomalies of the other operational satellites.

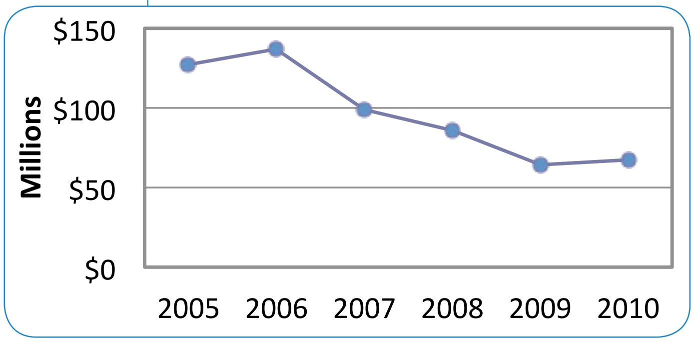

Figure 14. Publicly Reported Globalstar Annual Revenue

Globalstar's revenues continued to slip as a result of the S-band problems, and Globalstar lowered prices to keep customers during the transition to the renewed constellation. 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. Figure 14 shows the decline in Globalstar's revenues from 2006 to 2009 and a slight upturn in 2010, due to higher revenues from the SPOT satellite GPS messenger and simplex data services. Globalstar plans to introduce additional duplex and simplex products and services.

Globalstar contracted with Arianespace to launch the first 24 second-generation satellites on 4 Soyuz launches, 6 spacecraft per launch, with an option for an additional launch. Thales Alenia Space is constructing the satellites. Financing for Globalstar's new satellites and their launches gained a boost in March of 2009, when France's export credit agency stated it was supplying the company with $574 million in loan guarantees. The first six satellites of the new constellation launched in 2010 on a Soyuz vehicle. The remaining 18 second-generation satellites are planned to launch in 2011 on 3 more Soyuz vehicles. Together with the 8 replacement satellites that launched in 2007, Globalstar will create a 32-satellite system as the initial deployment of its new constellation.

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 commercial communications services using the satellite system a few months later. In addition to the 66 operational spacecraft, there are 7 functioning spare satellites in orbit. In February 2009, a non-operational Russian satellite collided with an operational Iridium satellite, causing the destruction of both spacecraft. The Iridium constellation recovered as the company replaced the lost satellite with a spare.

A total of 95 Iridium satellites have been launched as a part of the first-generation system. 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. In 2010 Iridium selected Thales Alenia Space as the prime contractor for the system development. The satellites in the new constellation may include hosted payloads in addition to the primary communications payload.

Iridium has announced SpaceX, the manufacturer and operator of the Falcon 9 launch vehicle, as the primary launch provider for Iridium NEXT. The company is planning to launch 72 satellites (66 to enter active service and 6 in-orbit spares) during a 2 to 3 year period, beginning in 2015. Nine more Iridium NEXT satellites will be kept in storage as ground spares. The number of satellites per launch and the number of launches has not yet been finalized.

Iridium revenue for 2010 grew again after a slight decrease in 2009, as represented in Figure 15.

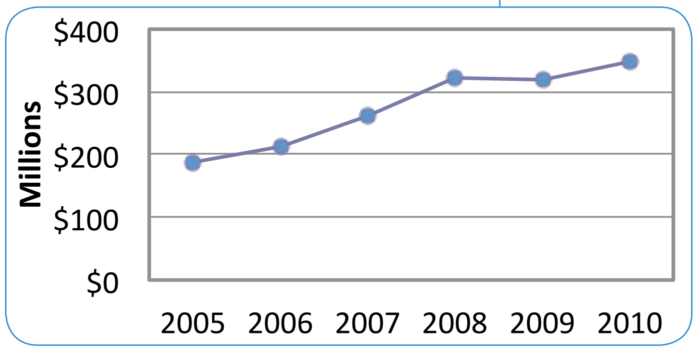

Figure 15. Publicly Reported Iridium Annual Revenue

In September 2008, Iridium and GHL Acquisition Corp., a special purpose acquisition company sponsored by Greenhill & Co., announced 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 Select Market on September 24, 2009.

ORBCOMM

Between 1995 and 1999, ORBCOMM deployed a narrowband constellation of 35 satellites, 27 of which are operational as of March 2011. 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.

ORBCOMM launched 6 satellites on a Cosmos 3M vehicle in June 2008, as the first step in replenishing its 29-satellite constellation with 24 new satellites. Five of the six satellites launched in June 2008 are the company's QuickLaunch spacecraft, originally scheduled for launch in 2007, but reportedly 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 to help track marine vessels. ORBCOMM signed a global AIS distribution agreement for commercial purposes with Lloyd's Register–Fairplay (LRF) in January 2009. LRF will use the AIS system to validate the position of the world's merchant fleet.

During 2009 the new QuickLaunch satellites experienced failures. By the end of 2009, only two of the QuickLaunch satellites were partially operational and providing AIS service. By the end of 2010, all the QuickLaunch satellites failed, and the AIS service was suspended until the launch of the next-generation satellites. As partial compensation, the prime contractor of the six satellites, OHB Technology, agreed to provide two AIS payloads and AIS terminals to ORBCOMM before the next-generation ORBCOMM satellites are in service.

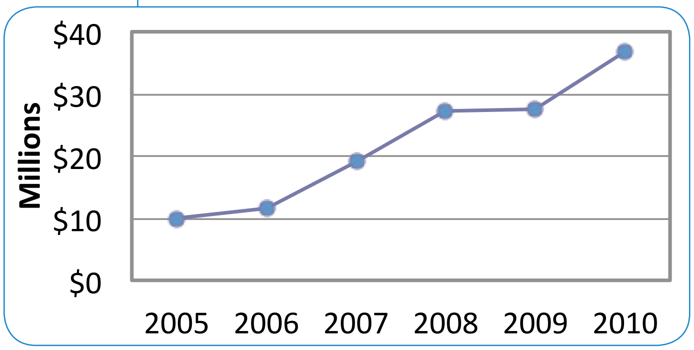

Figure 16. Publicly Reported ORBCOMM Annual Revenue

ORBCOMM service revenue increased in 2010, reaching $36.7 million, a 33 percent increase from $27.6 million in 2009. Excluding the AIS Coast Guard payment of $5.9 million, total revenues were 11.6 percent above the previous year. The last six years of ORBCOMM revenue is plotted in Figure 16.

ORBCOMM received Federal Communications Commission (FCC) authorization for its new satellite and launch plans in March 2008. In May 2008, ORBCOMM chose Sierra Nevada Corporation, with subcontractors Boeing and ITT, to build 18 next-generation satellites, all of which include AIS payloads. The projected plans are to launch these satellites in 2011 and 2012. In 2009, ORBCOMM contracted with SpaceX to launch its next-generation constellation on several Falcon 1e launch vehicles. By March 2011, the new launch plans that include using the Falcon 9 vehicle became public. The first two ORBCOMM satellites will be secondary payloads on a Falcon 9 launching a Dragon cargo capsule to the ISS in 2011. In 2012, two Falcon 9 launches will carry the remaining satellites in the constellation. The new ORBCOMM constellation will operate in four orbital planes at an inclination of 52 degrees.

Aprize Satellite

Aprize Satellite, Inc. plans to deploy a 12-satellite system depending on funding opportunities and customer demand for additional data communication and AIS data service capacity. A total of six AprizeStar (also known by its International Telecommunications Union registration as LatinSat) satellites weighing 10 kilograms (22 pounds) each launched as secondary payloads on a Russian Dnepr vehicle: two in 2002, two in 2004, and two in 2009. Two more satellites will launch as secondary payloads on a Dnepr vehicle in 2011. Deployment of these satellites does not generate demand for an individual launch. Aprize received an experimental license from the FCC for the two satellites launched in 2004. The systems also received licenses from the Argentine National Communications Commission (CNC) in 1995 and Industry Canada in 2003.

O3b

O3b Networks, headquartered in St. John, Jersey, Channel Islands, is a new company that plans to provide bandwidth access to underserved parts of the world. The O3b constellation will 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. Additional satellites can be added as needed to meet demand. Although the Ka-band spectrum allows for higher throughput than that of wideband and narrowband systems, it is more susceptible to weather interference, requires large tracking antennas, and is not suited for mobile receivers.

Thales Alenia Space is under contract to build 16 communications satellites. The satellites are expected to have an on-orbit lifetime of 10 years. In March 2010, O3b announced a launch services agreement with Arianespace for two Soyuz vehicle launches for a total of eight satellites in 2012 from Kourou in French Guiana. The launch has since moved to 2013. Each Soyuz vehicle is planned to deploy four O3b satellites in the equatorial plane in MEO.

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 March 2011, O3b has raised a total of $1.2 billion to cover the construction, launch, and insurance of the first eight satellites.

Digital Audio Radio Services (DARS)

Provision of DARS, commonly referred to as satellite radio, is dominated in the U.S. by Sirius XM. The number and timing of future NGSO DARS satellites in the U.S. is uncertain, as Sirius XM continues to harmonize operating procedures after the 2008 merger of Sirius and XM. The launch of a Sirius XM DARS satellite, Sirius FM-6, to GSO is scheduled for 2011 and included in the *2011 COMSTAC GSO Forecast*. This 10-year commercial NGSO launch forecast does not include U.S. DARS satellites.

In Europe, Ondas Media is making the strongest movement towards an NGSO DARS system. Ondas projects operational service will be available in 2012. In 2008, the company authorized Space Systems/Loral to proceed with the design and development of the Ondas system, which includes three ELI satellites to launch around 2012. The company announced agreements with automobile manufacturers, including Nissan-Infiniti and BMW, to install receivers in their automobiles and signed content licensing agreements with several radio content providers. Ondas is in the financing phase, and because significant investment has not been announced, the Ondas satellite launch demand is not included in this forecast. As a result, no European DARS satellite systems are included in this forecast.

Telecommunications Launch Demand Summary

In this forecast period, an average of just under two telecommunication launches per year will occur. There will be an uptick in 2015-2017 as Iridium replaces its satellites. Figure 17 provides a representation of telecommunications launch history and forecast demand.

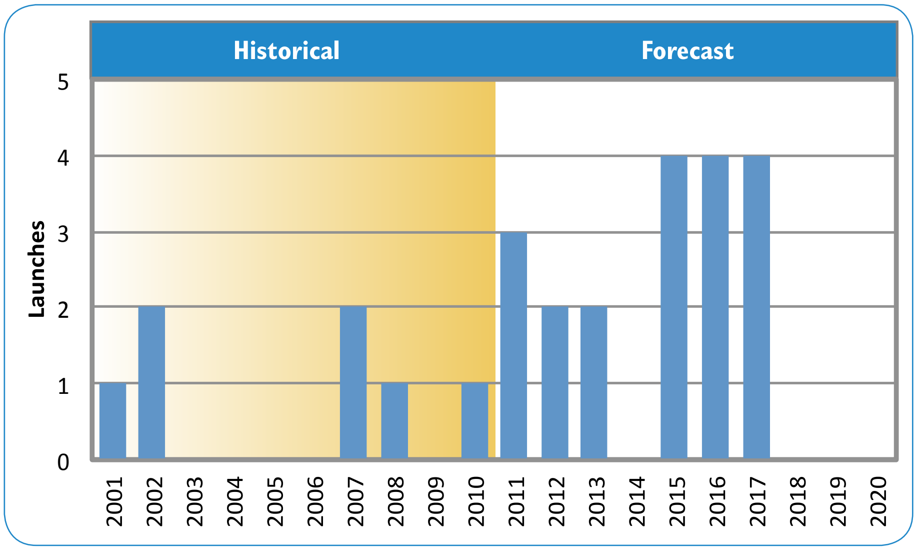

Figure 17. Commercial Telecommunications Launch History and Forecast

COMMERCIAL REMOTE SENSING SATELLITES

Remote sensing refers to any orbital platform with optical or radar sensors trained on Earth to gather data for geographic analysis, military use, meteorology, or climatology. The remote sensing industry comprises three parts: aerial imagery, satellite imagery, and geographic information systems (GIS). GIS consists of the products developed using images obtained from aircraft or satellites. GIS constitutes the largest part of the industry both in terms of demand and revenue generation.

Commercial satellite remote sensing consists of companies that operate satellites with optical or radar sensors trained on Earth to generate revenue. This contrasts with remote sensing satellites funded by governments for military use or science missions. However, governments often serve as the largest customers of commercial remote satellite companies and are often key partners in developing and operating expensive satellites. To generate profits and produce a return on investment, companies that operate remote sensing satellites also provide GIS services.

Government support is a major factor in commercial remote sensing systems development. Companies often depend on governments as anchor tenants. The U.S. National Geospatial-Intelligence Agency (NGA) partially funded the development of the current generation of GeoEye and DigitalGlobe satellites, through NextView Contracts awarded in 2008 and purchases of imagery from both of those operators. In August 2010, both companies won NGA contracts totaling $7.35 billion, extending NGA's ability to tap imagery from the private sector and virtually guaranteeing that GeoEye and DigitalGlobe will provide remote sensing products well into the decade. In Europe, both the French and German governments strongly support commercial remote sensing systems. For example, Germany and Infoterra partnered to develop and operate the TerraSAR system.

The U.S. National Oceanic and Atmospheric Administration (NOAA) licenses U.S. commercial remote sensing systems in accordance with the Land Remote Sensing Policy Act of 1992. There are now 20 active remote sensing licenses. Ten of these have been granted to DigitalGlobe, GeoEye, or their predecessor companies (see Table 16).

In 2010, NOAA amended one existing license, transferred a license to a new operator, and issued four new licenses. GeoEye's license was amended to change the system name from IKONOS Block II to GeoEye 2 and GeoEye 3. NOAA transferred an operating license to DISH Operating LLC for an imaging sensor used on the company's EchoStar 11 satellite. This license was previously issued on March 7, 2007, under a different corporation name (EchoStar). NOAA issued licenses to Skybox Imaging, Inc., GeoMetWatch, the University of Kentucky (KySat-1), and the University of California (UCISAT-1). KySat-1 and UCISAT-1 are not commercial satellites; these systems will be operated by non-profit organizations and require a NOAA license.

Table 16. NOAA Remote Sensing Licenses

Licensee	Date License Granted or Updated	Remarks
DigitalGlobe	1/4/93	Originally issued to WorldView for EarlyBird satellite.
ORBIMAGE (d/b/a GeoEye)	5/5/94	Originally issued to Orbital Sciences Corp. for OrbView-3 (304 kg).
DigitalGlobe	9/6/94	QuickBird-1 (815 kg) and QuickBird-2 (909 kg).
AstroVision	1/23/95	First license issued for a commercial GSO system.
Ball Aerospace/ Technologies	11/21/00	License for commercial SAR system.
DigitalGlobe	12/6/00	First licenses issued to commercial operators for 0.5-meter resolution.
DigitalGlobe	12/14/00	QuickBird follow-on.
ORBIMAGE (d/b/a GeoEye)	6/17/03	Update to license for SeaStar satellite, changing name to Orbview-2 (372 kg). Originally issued to Orbital Sciences Corp.
DigitalGlobe	9/29/03	License for four-satellite high-resolution system (Worldview satellites).
Northrop Grumman	2/20/04	MEO system with 0.5-meter resolution.
ORBIMAGE (d/b/a GeoEye)	8/12/04	Originally issued to ORBIMAGE Inc, for OrbView-5, now GeoEye-1 (907 kg).
Technica	12/8/05	Planned four-satellite EagleEye system.
ORBIMAGE (d/b/a GeoEye)	1/10/06	IKONOS system license transfer from Space Imaging to ORBIMAGE.
Northrop Grumman	8/24/09	License for commercial SAR system.
GeoEye Inc	1/14/10	Amendment of IKONOS Block II license to change system name to GeoEye 2 and 3.
DISH Operating LLC	2/2/10	GSO satellite with television camera for low-resolution images; license transfer from Echostar to DISH.
Skybox Imaging, Inc.	4/20/10	Issued for LEO satellite SkySat-1. Application for amendment to include SkySat-2 submitted in 2011.
GeoMetWatch	9/15/10	Issued for GSO satellite GMW-1.
Kentucky Space	10/19/10	Issued for LEO satellite KySat-1 (~10 kg).
University of California	11/17/10	Issued for use of cell phone camera in cubesat UCISAT-1 (~10 kg)

Note: A NOAA license granted for a particular commercial remote sensing system is in force for the duration that the satellite remains in service, as long as such service is consistent with licensing terms. NOAA may also withdraw a license for a new commercial remote sensing system if sufficient progress is not being made on the development of the satellite or satellites. See 15 CFR Part 969, Subpart B, Section 980.9.

Much of the demand for commercial remote sensing consists of cyclical replenishment of commercial remote sensing satellites. Commercial remote sensing currently generates an average of one to two launches per year. Advances in imaging and satellite technology allow commercial remote sensing satellites to provide more capability with less mass. This trend may result in a shift towards demand for smaller launch vehicles or multi-manifested launch options. Most satellites during the forecast period, however, will have masses that require using a medium- to heavy-class vehicle.

The major companies operating or actively developing remote sensing satellites across the globe are profiled below. A summary of commercial remote sensing systems is provided in Table 17.

Table 17. Commercial Satellite Remote Sensing Systems

System	Operator	Manufacturer	Satellites	Mass kg (lb)	Highest Resolution (m)	Launch Year	Status
Operational & Under Development							
DMC3	DMC International Imaging Ltd.	SSTL	DMC3-1 DMC3-2 DMC3-3	TBD TBD TBD	1 1 1	2013 2013 2013	Newly announced constellation. Launch planned for 2013, but details about provider and number of vehicles unclear.
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.
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.
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 (MDA)	RADARSAT-1 RADARSAT-2 RCM	2,750 (6,050) 2,195 (4,840) 1,200 (2,645)	8 3 TBD	1995 2007 2015-16	RADARSAT-1 and -2 are operational. RCM is the future three-satellite RADARSAT Constellation Mission.
RapidEye	RapidEye AG	MDA	RapidEye 1-5	150 (330)	6.5	2008	A string of five satellites.
TerraSAR-X and TanDEM-X	Infoterra GmbH	Astrium	TerraSAR-X TanDEM-X TerraSAR-X2	1,023 (2,255) 1,023 (2,255) TBD	3 0.5 TBD	2007 2010 2016	TerraSAR-X and TanDEM-X represent the TSX-1 generation of satellites. The first of the TSX-2 generation will be launched in 2015. A third generation, TSX-3, is under discussion.
WorldView	DigitalGlobe	Ball Aerospace	WorldView 1 WorldView 2 WorldView 3	2,500 (5,510) 2,800 (6,175) 2,800 (6,175)	0.5 0.5 0.5	2007 2009 2014	Both WorldView 1 and 2 are operational. WorldView 2 operates in a higher orbit than WorldView 1 and takes imagery in additional spectral bands.

DigitalGlobe

Established in 1993, DigitalGlobe is a commercial sub-meter remote sensing satellite operator and GIS provider based in Longmont, Colorado. The company operates imaging satellites and provides GIS products using satellite and aerial imagery. DigitalGlobe currently operates three remote sensing satellites, including Quickbird, WorldView-1, and WorldView-2. The company's main customer is NGA.

On October 18, 2001, a Boeing Delta II launched DigitalGlobe's first operational satellite, Quickbird, which continues to operate with a projected operational lifetime lasting until mid-2012. DigitalGlobe's next-generation satellites, consisting of WorldView-1 and WorldView-2, launched aboard Delta II vehicles in 2007 and 2009, respectively. WorldView-1 is expected to reach the end of its operational life in the second quarter of 2018. WorldView-2 is expected to reach the end of its operational life in the first quarter of 2021. The company announced that WorldView-3 will be built by Ball Aerospace, with a launch projected for 2014.

This forecast includes projected demand for the launch of one next-generation WorldView satellite, WorldView-3, in 2014. This satellite will likely launch aboard a medium- to heavy-class vehicle.

DMC International Imaging

DMC International Imaging, Ltd. (DMCii), based in the United Kingdom, operates the Disaster Monitoring Constellation (DMC). DMCii is a wholly owned subsidiary of Surrey Satellite Technology Ltd. (SSTL).

DMC is composed of SSTL-built satellites from Algeria, China, Nigeria, Spain, Turkey, and the United Kingdom. The constellation's primary purpose is to distribute imagery for commercial and humanitarian purposes.

DMC became fully operational in 2006, with each satellite evenly distributed in a single sun-synchronous orbit (SSO). It currently consists of five satellites, each owned and controlled by the contributing nation. Nigeria's civil satellites Nigeriasat-2 and NX, described later in this report in the Science and Engineering section, are projected to launch in 2011 as contributing members of the DMC constellation.

DMCii is profiled here because the company is planning to field a three-satellite constellation called DMC3. The system will be funded by SSTL and is slated for launch in late 2013. The satellites will feature optical sensors with a one-meter resolution, and the constellation will be a commercial system. However, unlike other commercial remote sensing systems, DMCii will lease capacity on the satellites, rather than depend on the sales of imagery and GIS products.

The DMC3 constellation is not included in this year's forecast, because a contract for launch services has not been announced, and details regarding whether the satellites will launch together or separately are unavailable.

Infoterra GmbH

Infoterra GmbH is a commercial remote sensing company based in Germany. Under a public-private partnership (PPP) arrangement, Infoterra (a subsidiary of Astrium GmbH) has an exclusive contract with German civil space agency DLR to provide the commercial sector with radar imagery and data products obtained from DLR-operated TerraSAR-X and TanDEM-X satellites. DLR uses the data for scientific purposes, and imagery obtained from the satellites is available to researchers worldwide through the European Global Monitoring for Environment and Security (GMES) and the international Global Earth Observation System of Systems (GEOSS). Through the PPP, Infoterra provides GIS products to the commercial marketplace directly and through Astrium Geo-Information Services, which markets GIS data, data products, and services (from SPOT Image and future Pleiades satellites) commercially.

TerraSAR-X, launched aboard a Russian Dnepr vehicle in 2007, provides one-meter resolution X-band radar imagery for government and commercial use. It is the first of Germany's TSX-1 generation of synthetic aperture radar (SAR) satellites. Using a sun-synchronous orbit with an altitude of about 520 kilometers, it revisits the same swath of land every 11 days. The satellite is expected to remain in service beyond its five-year service life. The TerraSAR-X Add-On for Digital Elevation Measurement (TanDEM-X) satellite was launched in 2010, also aboard a Dnepr vehicle. This TSX-1 generation satellite is designed to provide government and commercial clients with digital elevation model (DEM) data. DEM data captures the raw surface structure of the Earth, without vegetation and artificial objects. A completed DEM of the planet is expected to be available in 2014. Like its sister TerraSAR-X, TanDEM-X is expected to remain operational beyond its five-year lifespan.

Work is currently underway at DLR on a second generation of SAR satellites, called TSX-2. The TSX-2 generation will consist of at least one DLR-operated satellite, planned for launch in 2016. The launch vehicle has not yet been selected, but leading contenders include the Dnepr and Indian PSLV. As part of its strategic planning, DLR is also projecting a TSX-3 generation of satellites beyond the 2018 timeframe. These are not included in the forecast because system definition is years from complete. As in the case of TerraSAR-X and TanDEM-X, imagery from these future satellites is expected to be commercially available.

GeoEye

GeoEye, Inc., based in Dulles, Virginia, is a publicly traded commercial sub-meter remote sensing satellite operator and GIS provider. GeoEye was formed in 2006 by the merger of Space Imaging and ORBIMAGE, a subsidiary of Orbital. Data from GeoEye satellites are sold on the commercial market to private organizations and governments worldwide. As with DigitalGlobe, NGA is the company's largest customer.

GeoEye currently operates three satellites. IKONOS was launched aboard a Lockheed Martin Athena vehicle in 1999. OrbView-2, formerly operated by ORBIMAGE, launched aboard a small-class Orbital Pegasus XL vehicle in 1997. GeoEye-1 launched in 2009 aboard a Boeing Delta II vehicle. GeoEye-1 has a planned operational lifetime of at least seven years.

IKONOS and OrbView-2 continue to operate well, and they have far exceeded their design lives. Before the merger, Space Imaging planned to field IKONOS Block II satellites. After the merger, these satellites formed the basis for the company's next-generation GeoEye system, beginning with GeoEye-1. GeoEye has begun developing its next satellite, GeoEye-2, due for launch in 2012 aboard a United Launch Alliance Atlas V. The satellite is manufactured by Lockheed Martin, with an imaging system by ITT.

The schedule for developing future GeoEye satellites is uncertain, but because the company won an NGA EnhancedView contract valued at $3.8 billion in August 2010, the sustainability of the constellation through the forecast period is likely. This forecast includes projected demand for launching two next-generation GeoEye satellites, based on the 7.25-year design life of GeoEye-1 (2015) and GeoEye-2 (2019). Each of these satellites will likely launch aboard medium- to heavy-class vehicles.

ImageSat International NV

Israel-based ImageSat, founded as West Indian Space in 1997, and officially a Netherlands Antilles company, provides commercial sub-meter resolution imagery using its Earth Remote Observation Satellite (EROS) family of satellites. Like the previous profiled companies, ImageSat's major customers are governments. The EROS satellites are manufactured by Israel Aerospace Industries Ltd. (IAI), with an imaging system by ELBIT-Electro Optics Industries.

ImageSat currently operates two satellites, EROS A and EROS B. EROS A (2-meter resolution) launched in December 2000 aboard a Russian Start-1 launch vehicle and is expected to operate until at least 2014, four years beyond its projected service life. EROS B (0.7-meter resolution) launched aboard a Start-1 in 2006, and is expected to operate until 2020. ImageSat plans to develop a third satellite, EROS C (0.5-meter resolution), projected to launch around 2013 as a replacement for EROS A. EROS C is expected to launch aboard a small-class vehicle. ImageSat does not plan to launch any other satellites during the forecast period.

MacDonald, Dettwiler and Associates

Canada-based MacDonald, Dettwiler and Associates, Ltd. (MDA) is a commercial provider of radar satellite remote sensing data collected by the RADARSAT series of satellites. The company distributes data and information derived from many satellites, including RADARSAT-1 and RADARSAT-2. The Canadian Space Agency (CSA) operates RADARSAT-1, while RADARSAT-2 is operated by MDA in a partnership between the Government of Canada and MDA. MDA sells

RADARSAT data commercially, with governments as its largest customers. On November 4, 1995, the first RADARSAT satellite launched aboard a Delta II, and the second launched aboard a Starsem Soyuz vehicle on December 14, 2007.

To continue the radar data missions, the Government of Canada through the CSA proposed a three-satellite RADARSAT Constellation Mission (RCM) as a follow-on to RADARSAT-2. In March 2010, the CSA authorized the MDA to start the design phase (Phase C) of the RCM, to be completed in 2016 when the last satellite is launched. The 2010 Canadian government budget includes planned funding for the build phase (Phase D) of RCM. The RCM satellites are projected to weigh approximately 1,200 kilograms (2,600 pounds) each and are planned to launch individually. RCM-1 is projected for launch in 2015, with RCM-2 and RCM-3 launched in 2016. Based on the mass of the satellites, they will likely launch aboard medium- to heavy-class vehicles.

Northrop Grumman

In 2009, NOAA announced that it loosened its three-meter resolution licensing restriction on commercial radar imaging satellites, allowing for commercial systems with one-meter resolution capability. The purpose of this change is to boost U.S. market share in commercial radar imagery sales.

In August of 2009, Northrop Grumman became the first, and thus far the only company, to receive a license for a synthetic aperture radar (SAR) system under the new regime. Northrop Grumman licensed technology used in the Israeli military TecSAR satellite (also known as Ofeq-8), with plans to use the technology to develop a commercial SAR satellite platform known as Trinidad. However, the company stated that it will not build and operate the system without a firm government commitment to purchase imagery. No such commitment has been made, so the Trinidad system is not included in the launch demand forecast.

RapidEye AG

RapidEye AG, headquartered in Germany, developed a five-satellite multispectral remote sensing constellation to provide data for customers interested in agricultural and cartographic applications, among other possible markets. RapidEye revenues are generated through commercial and government clients within these markets. Among others, MDA's Geospatial Services and U.S.-based MDA Federal Inc. support RapidEye by marketing and selling its products.

The RapidEye constellation launched aboard a Dnepr vehicle on August 29, 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 7 years. RapidEye intends to maintain the constellation beyond the projected lifetime, though detailed planning for a next-generation system has not been announced. Based on the health of the company and growing demand for remote sensing products, this forecast includes a replacement constellation of five satellites in 2015, based on a service life of seven years. The forecast assumes that the 2015 constellation will launch aboard a medium- to heavy-class vehicle.

Skybox Imaging

Skybox Imaging, Inc., based in Mountain View, California, is a new entrant to the commercial satellite remote sensing industry. The company was awarded a NOAA license for SkySat-1 on April 20, 2010, and has applied to amend the license to include a second satellite, SkySat-2. Both satellites are designed for a polar orbit, but details regarding specifications are not publicly available. Initial funding for the system has been secured.

Due to a lack of certainty regarding the nature of the satellites, specifics of the business plan, and a projected SkySat-1 launch date, the SkySat system is not included in the launch demand forecast.

Commercial Remote Sensing Launch Demand Summary

The commercial remote sensing industry is characterized by stable satellite replacement schedules that occur on a roughly seven-year cycle. Commercial remote sensing satellite launch demand will fluctuate between zero to four per year, with an annual average of one launch per year during the forecast period. A peak in the number of launches can be seen in 2015 and 2016, reflecting projected deployments of satellites operated by Astrium (Infoterra), DigitalGlobe, GeoEye, MDA, and RapidEye. Figure 18 provides a launch history and forecast demand for commercial remote sensing satellites.

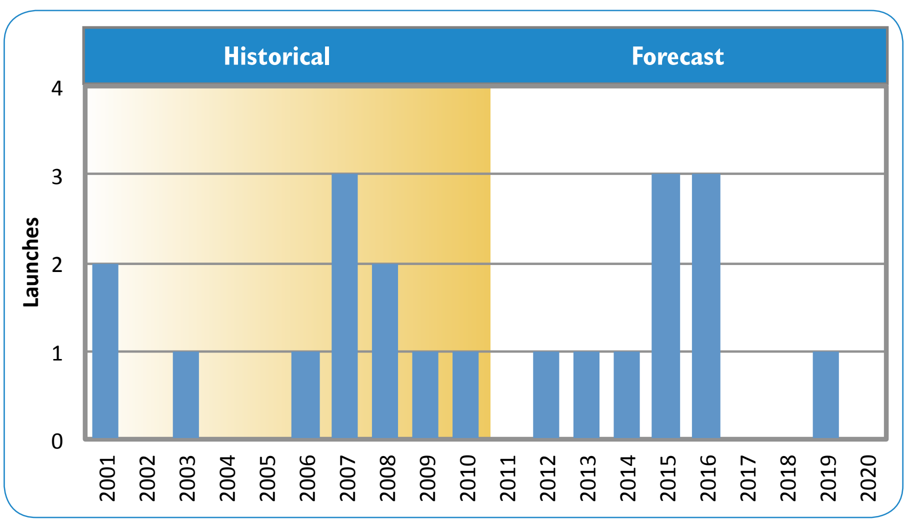

Figure 18. Commercial Remote Sensing Launch History and Forecast

SCIENCE AND ENGINEERING

In previous reports, science and engineering payloads were discussed in the section "International Science and Other Satellites."

For this report, science and engineering includes payloads related to basic and applied research and those with missions related to space technology test and demonstration. The forecast only includes these payloads if they drive demand for commercial launches. For example, if a country without an indigenous launch capability wants to launch a science payload, it must seek launch services from another country.

Payloads with basic research missions include biological and physical research, space science, Earth science, and related fields. Payloads with applied research missions are designed to solve practical problems and are usually driven by government or industry needs.

Payloads with missions focused on space technology test and demonstration are designed to address engineering questions. This includes using a telemetry package aboard a launch vehicle to determine performance, or a satellite to evaluate an optical communications system.

Basic and Applied Research

During the past 10 years, more countries developed and operated basic and applied research payloads. Malaysia, Nigeria, South Korea, and the United Arab Emirates (UAE) have launched research satellites commercially. In general, these payloads are launched as clusters, often on Russian vehicles, like the small-class Rockot and medium-class Dnepr. Though it is difficult to predict exactly which cluster of payloads drive a launch, we do know that basic and applied research payloads from countries that do not have indigenous launch capability drive a small, but steady number of commercial launches per year.

Examples of missions in this category and within the near-term manifest of this forecast include:

- **DragonLAB**: SpaceX expects to introduce its DragonLAB platform in 2013. DragonLAB is the same spacecraft used for cargo delivery to ISS, but configured for crew occupancy. DragonLAB will provide customers with access to a temporary orbital laboratory that can host pressurized and unpressurized experiments. The company projects one DragonLab flight per year, each time generating demand for a Falcon 9 vehicle.
- **DubaiSat-2**: DubaiSat-2 is a remote sensing satellite constructed by the Emirates Institution for Advanced Science and Technology based in Dubai, UAE. It will launch as a secondary payload aboard a Dnepr vehicle in 2012, joining its sister satellite, DubaiSat-1, launched in 2009.
- **EnMAP**: 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.

- **Kompsat-3A**: Korea Aerospace Research Institute's (KARI) Kompsat-3A is a remote sensing satellite capable of capturing high-resolution panchromatic images of the Earth. It will also host a suite of infrared sensors. The satellite will be operated by KARI and is manufactured by Germany-based AIM INFRAROT-MODULE GmbH. Launch is expected in 2013.
- **Kompsat-5:** KARI's's Kompsat-5 satellite is a 1,280-kilogram (2,816-pound) SAR imaging spacecraft scheduled to launch in 2011 aboard a Dnepr vehicle. Kompsat-5 will provide imagery of up to one-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 able to produce imagery in all weather conditions, both day and night. The satellite was manufactured jointly by KARI and European manufacturer Thales Alenia Space, with Alcatel Alenia Space responsible for producing the X-band SAR sensor.
- **NigeriaSat-2**: The NigeriaSat-2 optical earth observation satellite was manufactured for the Nigerian government by the British company SSTL. NigeriaSat-2 will provide high-resolution imagery and operate as part of the Disaster Monitoring Constellation, an international constellation of remote sensing systems that provides multispectral imaging to support disaster relief operations. NigeriaSat-2 will launch in 2011, as a secondary payload aboard a Dnepr vehicle operated by ISC Kosmotras. It will go up with its sister satellite, NX (discussed in the section on Space Technology Test and Demonstration). 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.
- **RASAT**: RASAT is a small-class remote sensing satellite developed by the Scientific and Technological Research Council of Turkey - Space Technologies Research Institute. RASAT will feature panchromatic sensors with a resolution of between 7.5 and 15 meters. It will launch in 2011 aboard a Dnepr vehicle as a secondary payload with Sich-2.
- **SAOCOM 1A** and **SAOCOM 1B**: Argentina's National Commission on Space Activity (CONAE) develops the SAOCOM 1A and 1B radar-based remote sensing satellites. These satellites will provide imagery for natural resources monitoring, as well as for emergency and disaster management, and will carry an L-band SAR. CONAE contracted U.S. launch services provider SpaceX to launch these spacecraft. The launch of SAOCOM 1A is 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 will be integrated with the Italian Cosmo-Skymed series of SAR satellites, forming the Italian-Argentine System of Satellites for Emergency Management constellation.
- **Swarm**: The European Space Agency's (ESA) Swarm mission is designed to facilitate study of the Earth's magnetic field. Swarm is a constellation of three satellites in three different polar orbits. These satellites will launch together aboard a Rockot vehicle in 2012.

Piggyback Payloads

A piggyback or secondary payload is a spacecraft or satellite that is carried into space using excess launch capacity on a rocket. Small spacecraft (<100 kg) are often launched as piggyback payloads. Examples of piggyback payloads within the forecast timeframe include the satellites ORBCOMM 2F1 and ORBCOMM 2F2, launching as secondary payloads on a Falcon 9, and Aprizesat 5 and Aprizesat 6, launching as secondary payloads on a Dnepr rocket in 2011. Piggyback launching can allow operators to place their spacecraft into orbit at significantly lower cost than as a primary payload. As such, piggyback payloads do not create launch demand in this forecast. However, sometimes these payloads represent cases where piggyback capacity replaces potential demand for a small launch vehicle.

Space Technology Test and Demonstration

Payloads in this category relate to demonstrating communications and remote sensing technologies. Universities and governments new to satellite development often launch such a satellite to gain experience before embarking on more ambitious projects. Also included in this category are telemetry packages or "dummy" payloads that gain performance data for new launch vehicles or reusable capsules. SpaceX's inaugural launch of the Falcon 9, in June 2010, was such a test.

Examples of missions in this category and within the near-term manifest of this forecast include:

- **Taurus II Test Launch**: Planned for October 2011, this is the inaugural test launch of the Orbital Taurus II vehicle. The flight will take place with NASA funding, but is not officially considered a COTS mission. Orbital will conduct the required COTS flight later in the year.
- **CASSIOPE**: The Cascade, Smallsat, and Ionospheric Polar Explorer (CASSIOPE) spacecraft, manufactured by the Canadian company MDA, is scheduled to launch in 2011, as a secondary payload aboard a SpaceX Falcon 9 vehicle. A prime objective of the CASSIOPE mission is to space-qualify high-performance payload components that will be used in the CASCADE mission under development at MDA. The CASCADE mission will enable a service business that offers users in remote areas the ability to move 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; however, due to lack of financial and scheduling details, these satellites are not included in this year's NGSO telecommunication satellite forecast.
- **NX**: NX is an optical earth observation satellite manufactured for the Nigerian government by SSTL and as part of a training program for Nigerian engineers. NX will provide imagery at a lower resolution than its sister satellite Nigeriasat-2. NX and Nigeriasat-2 will be part of the DMC and will launch aboard a Dnepr as secondary payloads to Sich-2 in 2011.
- **STSAT-3**: STSAT-3, developed by KARI, is a 150-kg microsatellite to test technologies related to the bus structure, battery, and onboard computer. It will launch into a sun-synchronous Earth orbit and conduct limited earth observation. STSAT-3 will launch aboard a Dnepr vehicle in 2011 as a secondary payload to Kompsat-5.

- **TugSat-1**: TugSat-1, also called BRITE-AUSTRIA, is a microsatellite designed to give technicians experience in developing a satellite, as this is Austria's first indigenously developed payload. It will have a secondary astronomy mission. TugSat-1 will launch aboard an Indian PSLV vehicle in 2013 as a secondary payload.

MDA plans a mission to demonstrate on-orbit servicing capability that may test refueling or repair capabilities. This mission was included in the 2010 NGSO Forecast but was removed from this forecast, since MDA announced a contract to provide on-orbit servicing to a GSO satellite operated by Intelsat.

Hosted Payloads

Unlike piggyback payloads, hosted payloads are not standalone spacecraft. Whereas a piggyback payload uses excess launch capacity on a rocket, a hosted payload uses space on a spacecraft dedicated to another mission. Payloads that are too small to justify a dedicated mission, due to their size, government budgets, or potential revenues, constitute the hosted payload market. A commercial satellite operator potentially can accommodate a hosted payload on a commercial satellite to offset launch and operating costs or to add to revenue. Hosted payloads can be used for the types of commercial and non-commercial activities similar to the payload service segments addressed in this forecast report, such as science and engineering (including technology test and demonstration), remote sensing, civil and military communications, navigation, and weather and climate monitoring.

By their definition, hosted payloads do not generate launch demand.

There are benefits to flying hosted payloads and payload hosting:

- Satellite and launch services costs are shared.
- Generally speaking, the government procurement process takes longer, so there may be benefits to putting a hosted payload on a commercially launched spacecraft.

There are also constraints with using hosted payloads:

- Ordering a spacecraft for two or more parties is a more complex process.
- Adding a hosted payload after the host spacecraft is ordered from a manufacturer can be difficult.
- Adding a hosted payload may impact delivery deadlines and the spacecraft cost and schedule.

There is a broad and growing interest in developing, launching, and operating hosted payloads on commercial GSO satellites. This is addressed in the COMSTAC GSO Forecast.

Commercial NGSO satellite operators have also explored opportunities to put hosted payloads on their spacecraft. Within the 10-year forecast timeframe, commercial NGSO satellite operator Iridium plans to launch 72 satellites to LEO and is offering to government and scientific organizations space for a 50-kilogram hosted payload on each Iridium NEXT satellite.

Science and Engineering Launch Demand Summary

This segment of launch demand is relatively stable, with a 20 year average of about four launches per year. Figure 19 provides a launch history and forecast demand for science and engineering payloads.

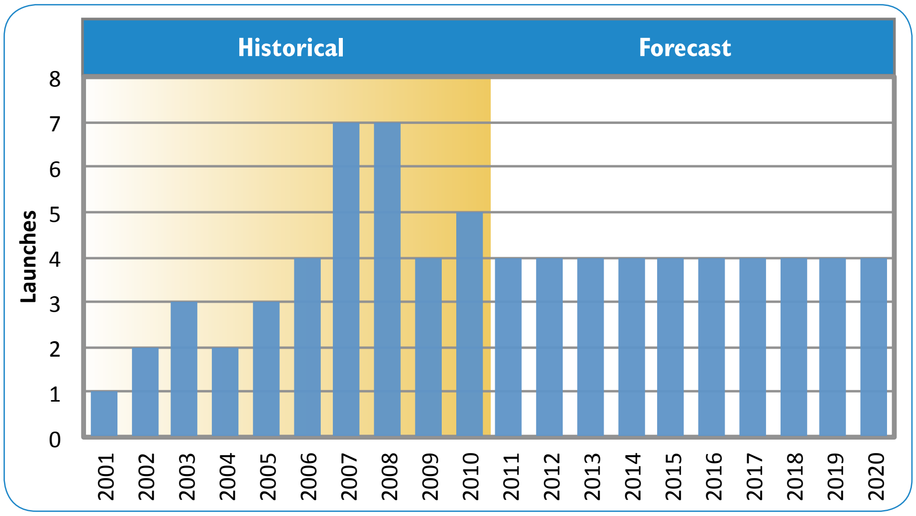

Figure 19. Science and Engineering Launch History and Forecast

COMMERCIAL CARGO AND CREW TRANSPORTATION SERVICES

Commercial cargo and crew transportation services includes commercial launches of cargo and humans to NGSO, and is a new section in the annual forecast report. Due to recent industry developments, and to clarify the nature of these emerging commercial activities, this section combines two sections described in previous editions of the forecast: OFAS and Commercial Human Orbital Spaceflight (from the Emerging Markets section).

Specifically, commercial cargo and crew transportation services covers NASA's Commercial Orbital Transportation Services (COTS), Commercial Resupply Services (CRS) to the ISS, and commercial crew flights to ISS. This section also describes non-ISS commercial human spaceflight and emerging activities related to Bigelow orbital facilities and Excalibur Almaz.

Table 18 describes NASA COTS, CRS, and Commercial Crew Development (CCDev) awards.

Table 18. NASA Commercial Crew and Cargo Awards

Program	Year of Space Act Agreement	Value of Space Act Agreement	Companies	Vehicles and Technologies
COTS	2006	$278 million	SpaceX	Dragon
COTS	2006	$207 million	Kistler	K-1
COTS	2007	$175 million	Orbital	Cygnus
CRS	2008	$1.5 billion	SpaceX	Dragon (12 flights)
CRS	2008	$1.9 billion	Orbital	Cygnus (8 flights)
CCDev 1	2010	$20 million	Sierra Nevada Corp.	Dream Chaser
CCDev 1	2010	$18 million	Boeing	CST-100
CCDev 1	2010	$6.7 million	United Launch Alliance	Atlas/Delta crew certification
CCDev 1	2010	$3.7 million	Blue Origin	Launch abort systems
CCDev 1	2010	$1.4 million	Paragon Space	Life support
CCDev 2	2011	$92.3 million	Boeing	CST-100 design maturation
CCDev 2	2011	$80 million	Sierra Nevada Corp.	Dream Chaser design maturation
CCDev 2	2011	$75 million	SpaceX	Crewed Dragon development
CCDev 2	2011	$22 million	Blue Origin	Launch abort systems
FY 2012 NASA request*				
CCDev Follow-on	2012	$850 million	TBD	TBD

* From http://www.nasa.gov/pdf/516674main_FY12Budget_Estimates_Overview.pdf

NASA COTS

In 2006, NASA announced the $500 million COTS program. COTS focuses exclusively on the design and development of commercial cargo services to the ISS. Under COTS, SpaceX developed the intermediate-class Falcon 9 vehicle and the Dragon cargo capsule, and Orbital developed the intermediate-class Taurus II vehicle and the Cygnus capsule.

This forecast includes three COTS flights. One SpaceX flight flew successfully on December 8, 2010, and two SpaceX flights are scheduled for 2011. One COTS flight is planned for Orbital's Taurus II late in 2011.

NASA CRS

In 2008, NASA awarded two CRS contracts to SpaceX and Orbital. SpaceX won a contract valued at $1.6 billion for 12 flights through 2015, and Orbital won a $1.9 billion contract for 8 flights during the same period. Operational flights under these contracts are expected to begin in 2011, after the COTS flights finish.

For this forecast, annual CRS flights are derived from a traffic model in NASA's FY 2012 budget request dated February 11, 2011. Between four and six commercial cargo flights are expected through the forecast period, beginning with one SpaceX Dragon CRS flight in late 2011.

NASA Commercial Crew

For crew delivery and return to the ISS, NASA initiated the CCDev program in 2010 with $50 million, funded through the 2009 American Recovery and Reinvestment Act. Like COTS, CCDev focuses exclusively on developing systems to send people to the ISS. The CCDev program does not include actual crew transportation services. In 2010, NASA awarded CCDev contracts to Sierra Nevada Corporation ($20 million, for the Dream Chaser vehicle proposal), Boeing ($18 million, for the CST-100 vehicle proposal), United Launch Alliance ($6.7 million, for human rating the Atlas V and Delta IV), Blue Origin ($3.7 million, for a launch abort system and other components), and Paragon Space Development Corporation ($1.4 million, for a modular life-support system).

On October 11, 2010, NASA announced that it was seeking proposals for a second round of CCDev awards (CCDev II). CCDev II is a continuation of NASA's 2009 CCDev initiatives, designed to stimulate efforts within the private sector to develop and demonstrate human spaceflight capabilities. Awards totaling $269.3 million were awarded on April 18, 2011. Boeing received $92.3 million for continuing to develop its CST-100 vehicle, including launch vehicle integration and development of a launch abort engine. Sierra Nevada Corporation received $80 million to continue work on its Dream Chaser vehicle. SpaceX received $75 million to develop a crewed version of Dragon, including a side-mounted launch abort system. Finally, Blue Origin received $22 million to continue work on its launch abort system. NASA also announced it is working on an acquisition strategy for follow-on CCDev work.

Figure 20 shows the distribution of ISS commercial cargo and crew flights during the forecast period. Three SpaceX COTS flights, one NASA-funded test flight of Orbital's Taurus II, and one Taurus II COTS flight are also included. The inaugural flight of Taurus II is not funded under the COTS program, and is considered a technology demonstration mission, therefore, it is located in the science and engineering section of the forecast.

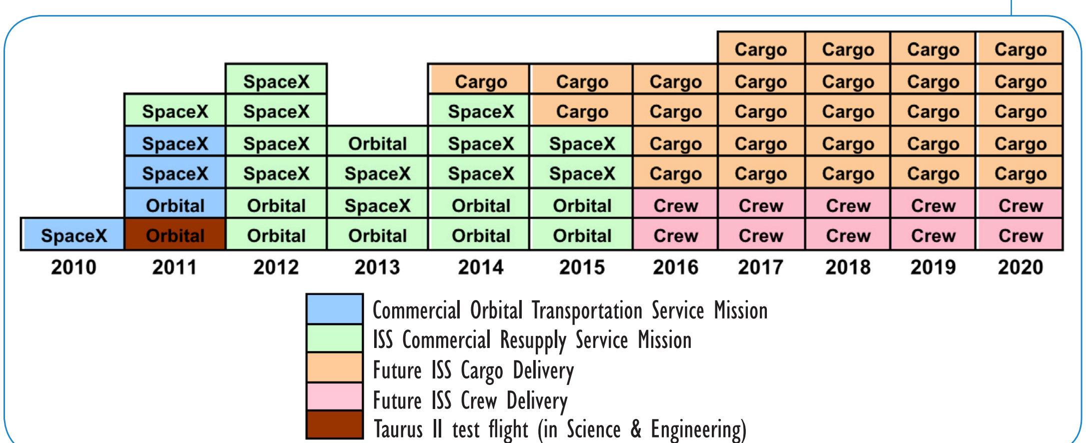

Figure 20. Forecast of COTS, CRS, and commercial crew flights to ISS.

Beginning in 2016, NASA's current plan calls for not relying on a single provider for commercial crew services. NASA's FY 2012 traffic model shows two commercial crewed flights to the ISS each year beginning in 2016. These flights are included in this year's forecast.

Bigelow Aerospace

Nevada-based Bigelow Aerospace develops next-generation expandable space habitats and related technology. The purpose is to construct and deploy a low-cost, private-sector space station. Bigelow launched two prototype spacecraft, Genesis I and Genesis II, on separate Russian Dnepr vehicles in 2006 and 2007, respectively. Bigelow used these missions to validate habitat designs. Bigelow is now in the process of developing full-scale habitats to support a human presence on orbit. The first of these is Sundancer, an expandable habitat to sustain a crew of three. The habitat has a usable volume of 180 cubic meters (6,200 cubic feet). The company is also developing the BA-330, which will offer nearly twice the usable volume of Sundancer. The BA-330 will be able to sustain a crew of six for long-duration missions.

In regard to crew transportation, Bigelow Aerospace became a member of the Boeing CCDev team working on the CST-100 reusable in-space crew transport vehicle, although the company maintains a relationship with SpaceX as well.

Bigelow has begun preliminary international outreach efforts. The company has signed memorandums of understanding with national space agencies, companies, and governmental entities in the UAE, Netherlands, Sweden, Singapore, Japan, United Kingdom, and Australia. Bigelow has also initiated a substantial expansion to its north Las Vegas manufacturing plant, adding 17,187 square meters (185,000 square feet). The company has spent about $200 million so far.

Although Bigelow Aerospace has ambitious plans, no launch contracts have been publicly announced. These likely will not be announced until the company can secure viable crew transportation, such as the Boeing CST-100 or SpaceX Dragon capsules. As a result, launch demand associated with Bigelow Aerospace is not included in the forecast.

Excalibur Almaz

Excalibur Almaz Limited (EA) formed in 2005 and is incorporated on the British Isles, Isle of Man. EA uses elements of a legacy Soviet military space program known as Almaz. The system includes a three-person reusable return vehicle and a service module that can stay on orbit autonomously for one week or dock with the ISS.

EA works to modernize and upgrade the Almaz spacecraft and make it compatible with a number of launch vehicles (the baseline vehicle is a Zenit variant). EA intends to begin flight tests of the Almaz hardware by 2013 and to launch its first revenue-generating flight as early as 2014. EA's key partners are NPO Mashinostroyenia (the original developer of Almaz), United Space Alliance, EADS Astrium, and Japan Manned Space Systems Corporation.

If EA's plans come to fruition on its current schedule, it can create additional demand for commercial launches. However, details regarding financing have not been provided publicly. In addition, no launch contracts have been publicly announced. As a result, launch demand associated with EA is not included in this forecast.

Lunar Transportation

The Moon, as Earth's closest celestial body, is a possible destination for future science and exploration missions. Specifically, the Google Lunar X Prize may create demand for commercial launch services.

The $30 million prize was announced in 2007. The objective of the competition is to launch a rover to the Moon. After landing, the rover must traverse the surface for a distance of at least 500 meters (1,640 feet) and transmit high-definition images and video to Earth. Teams that are 90-percent privately financed may compete. Twenty-nine teams from around the world have registered for the competition.

As part of its Innovative Lunar Demonstrations Data program, NASA awarded contracts to six of the Google Lunar X Prize teams for data on lunar mission technical component demonstrations.

Commercial Cargo and Crew Transportation Services Launch Demand Summary

Demand for commercial cargo and crew transportation services is a new forecast segment, and consequently there is no historical trend available for comparative analysis. However, because launch contracts have been signed and a NASA traffic model for the ISS has been published, it is possible to develop a reasonable forecast. Demand for medium- to heavy-class launches will remain steady at about six per year during the forecast period, dominated by commercial cargo and crew access to ISS. Figure 21 provides a launch history (one COTS flight) and forecast demand for commercial transportation services.

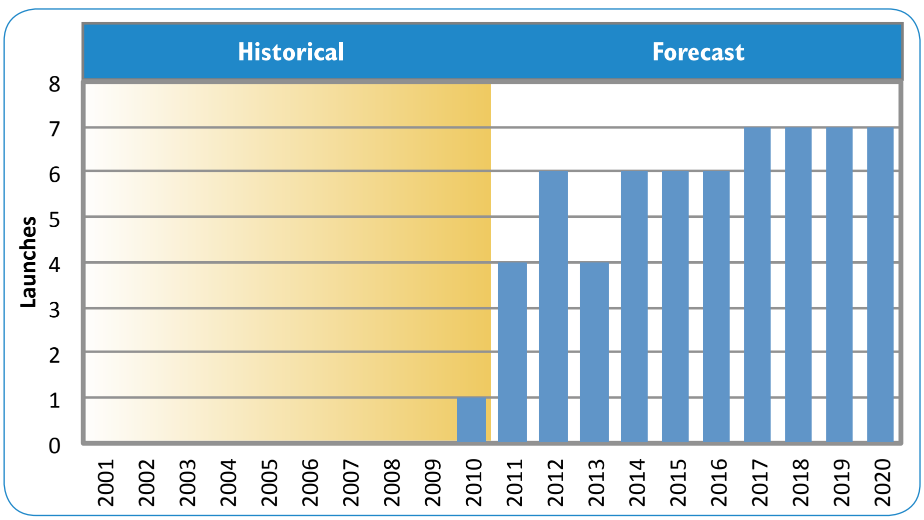

Figure 21. Commercial Cargo and Crew Transportation Services Launch History and Forecast

It is likely that ISS commercial crew providers would seek to offer commercial flights beyond those for NASA. If these commercial providers can find additional customers beyond NASA, there could be an increase in potentially adding to the numbers shown in Figure 21. There is not enough information available at this time to make a reasonable estimate of those missions, but FAA/AST will continue to assess the issue over the next year.

OTHER PAYLOADS LAUNCHED COMMERCIALLY

Other payloads launched commercially primarily include NGSO military payloads from countries that do not have an indigenous launch capability or payloads that do not fit into any other category. There are now only two payloads in this segment, and only one payload that drives a launch. Missions in this category within the near-term manifest of this forecast include:

- **Sapphire**: The small-class Sapphire satellite mission is developed by MDA and 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 planned to launch in 2011, as a secondary payload on a Polar Satellite Launch Vehicle (PSLV) operated by the Indian Space Research Organization (ISRO).
- **Göktürk**: Göktürk is an electro optical earth observation satellite for the Turkish Ministry of Defense. Italian firm Telespazio is the manufacturer. 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. It is expected to launch in 2013. Turkey plans to commercially sell imagery obtained by Göktürk. Follow-on satellites are under consideration.

SATELLITE AND LAUNCH FORECAST TRENDS

In the 2011 forecast, 276 payloads seek future commercial launch, creating demand for 130 launches after multi-manifesting. These payload numbers are higher than those in the 2010 forecast, which predicted 262 satellites to launch on 119 vehicles in the 2010 through 2019 timeframe. Primary drivers of the difference between the forecasts include:

- Delayed timetables for deploying large telecommunications constellations.
- New plans for deploying large constellations, requiring a greater number of launches than expected (Iridium).
- Successful initial NASA COTS demonstration flights, launch contracts signed, and the NASA ISS traffic model published in 2011.

A comparison of the launch demand in the 2011 forecast against the 2010 forecast is shown in Figure 22. Table 19 and Figure 23 show the satellites and launches forecasted between 2011 and 2020.

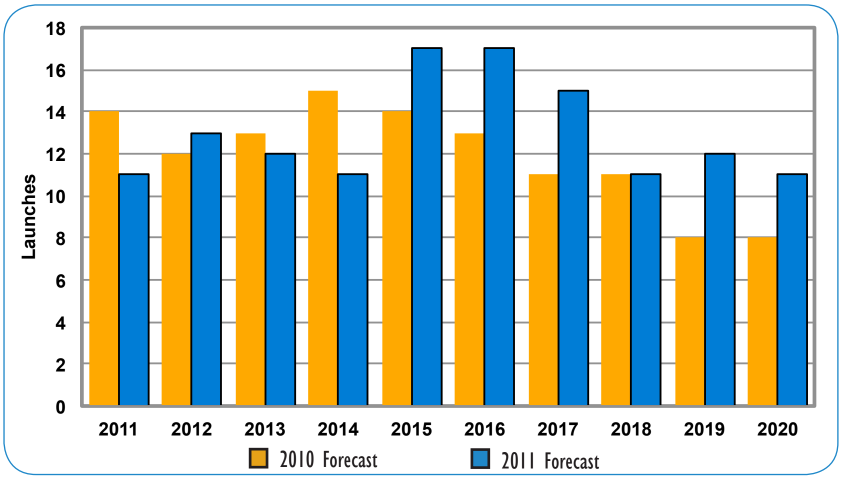

Figure 22. Comparison of Past Launch Forecasts

Table 19. Payload and Launch Forecast

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	Avg.
Payloads												
Commercial Telecommunications	22	16	8	0	24	24	24	0	0	0	118	11.8
Commercial Remote Sensing	0	1	1	1	7	3	0	0	1	0	14	1.4
Science and Engineering	10	8	8	8	8	8	8	8	8	8	82	8.2
Commercial Cargo and Crew Transportation Services	4	6	4	6	6	6	7	7	7	7	60	6.0
Other Payloads Launched Commercially	1	0	1	0	0	0	0	0	0	0	2	0.2
Total Satellites	37	31	22	15	45	41	39	15	16	15	276	27.6
Launches												
Medium-to-Heavy Vehicles	11	11	9	9	15	15	13	9	10	9	111	11.1
Small Vehicles	0	2	3	2	2	2	2	2	2	2	19	1.9
Total Launches	11	13	12	11	17	17	15	11	12	11	130	13.0

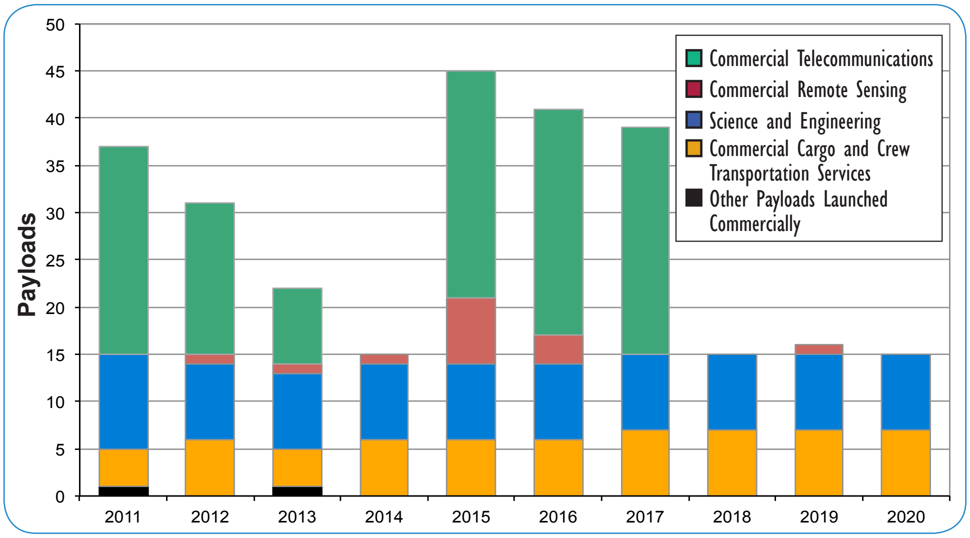

Figure 23. Payload Forecast

The 2011 forecast anticipates the following satellite market characteristics from 2011 through 2020:

- Commercial telecommunications satellites account for about 43 percent of the market with 118 satellites, a decrease from the 130 satellites in last year's forecast. Globalstar deployed its first set of six second-generation satellites in 2010, and only eight satellites are forecasted for the initial deployment of the O3b constellation.
- Commercial remote sensing satellites account for 5 percent of the payload market with 14 satellites, similar to last year's forecast.
- Science and engineering payloads comprise about 30 percent of the NGSO satellite market with 82 payloads, a slight increase from last year's forecast.
- Commercial cargo and crew transportation services payloads account for 22 percent of the 2011 forecast with 60 spacecraft. This new market segment, largely corresponding to the OFAS category of the previous years' forecasts, demonstrates growth after successful demonstration of commercial transportation capability.

Table 20 shows the mass distributions of known manifested payloads over the next four years. Most of the categories of satellite mass remain stable, with the exception of the largest spacecraft mass. The number of payloads with mass of 201 to 600 kilograms (443 to 1,323 pounds) increased from 7 to 26 in this year's forecast, while the number of those below 200 kg (441 pounds) dropped from 25 to 7. This change is attributed to finalizing the design and mass characteristics of the ORBCOMM satellites, placing them in a heavier category.

The launch forecast of 130 launches is comprised of 19 small vehicles and 111 medium-to-heavy vehicles. This demand breaks down to an average of approximately 2 launches annually on small launch vehicles and about 11 launches annually on medium-to-heavy launch vehicles. The 2010 forecast included 119 total launches composed of 28 small and 91 medium-to-heavy launches. The growth in forecasted medium-to-heavy launches is driven by the inclusion of ISS commercial launches to the forecast. These additional launches also create an additional supply of space on medium-to-heavy launch vehicles for secondary payloads, less expensive than a stand-alone small vehicle launch that could limit the demand for small launch vehicles. At least one medium-to-heavy launch vehicle provider (SpaceX) has demonstrated interest in launching secondary payloads on its rockets.

Table 20. Distribution of Payload Masses in Near-Term Manifest

	2011	2012	2013	2014	Total	Percent of Total
< 200 kg (<441 lbm)	9	1	0	0	10	11%
201-600 kg (441-1,323 lbm)	5	20	1	0	26	29%
601-1,200 kg (1,324-2,646 lbm)	18	1	11	0	30	34%
> 1,200 kg (> 2,646 lbm)	4	6	5	8	23	26%
Total	36	28	17	8	89	100%

Note: Table 20 includes only satellites with known mass. Therefore the total number of satellites examined in a year differs from the forecast.

The forecast starts with a total of 37 satellites demanding 11 launches in 2011. Due to launch vehicle and satellite schedule delays, as described in the Methodology section, a realization factor was applied to the number of launches planned for 2011 and 2012. Therefore, the FAA expects 6 to 8 launches to occur in 2011 and 8 to 10 in 2012. The largest number of satellites that need launches is in 2015, when a total of 45 payloads are forecasted to require 17 launches, 2 launches less than 19 in 1998, the most commercial NGSO launches in a single year so far. As 2015 approaches, it is likely that launches will slip, and the actual number of launches will be less. Launch demand divided among launch vehicle mass classes is depicted in Figure 24.

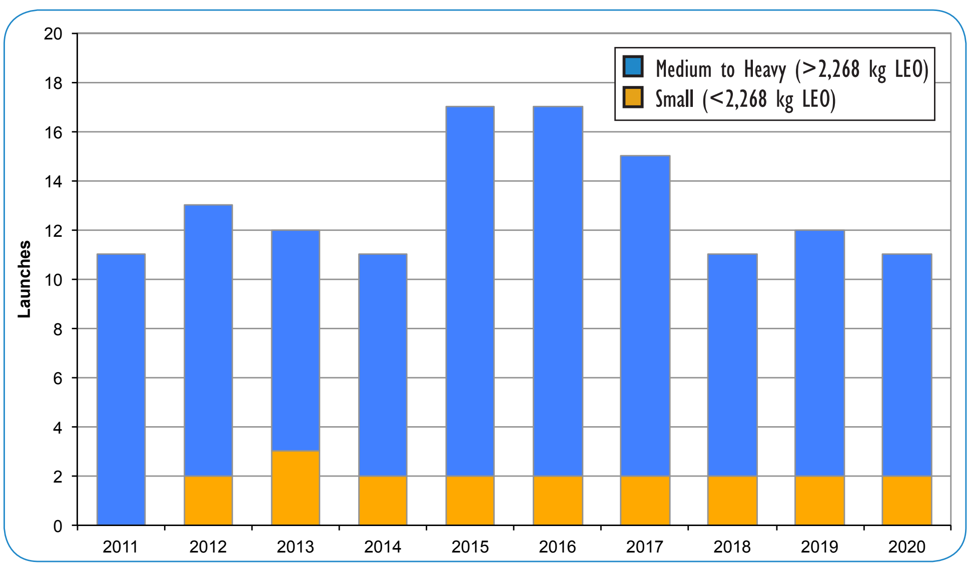

Figure 24. Launch Forecast

Consistent with previous years, the Commercial Telecommunications segment, led by wideband LEO systems, dominates the forecasted payload market. One hundred-eighteen telecommunication payloads are forecasted to require 19 multiple-manifest launches in the next 10 years. The projected number of launches for the science and engineering and commercial transportation services market segments are 40 and 60, respectively. Commercial transportation spacecraft all require medium-to-heavy launch vehicles and almost always are single-payload manifests. Science and engineering uses a mix of medium-to-heavy and small launches, and multiple payloads frequently co-manifest on the same launch. Commercial remote sensing satellites are projected to launch on nine medium-to-heavy launch vehicles and one small launch vehicle.

Table 21. Distribution of Launches among Market Segments

		Launch Demand		
	Payloads	Small	Medium-to-Heavy	Total
Commercial Telecommunications	118	0	19	19
Commercial Remote Sensing	14	1	9	10
Science and Engineering	82	18	22	40
Commercial Cargo and Crew Tranportation Services	60	0	60	60
Other Payloads Launched Commercially	2	0	1	1
Total	276	19	111	130

Microsatellite Launch

Microsatellites are defined as payloads with a mass of less than 91 kg (200 lbs), but the industry often uses the 100 kg threshold. These satellites are typically grouped together with a larger primary payload and placed in orbit on a shared launch vehicle (multi-manifesting).

Payloads of this mass class alone normally do not generate demand for a launch; however, a large cluster of microsatellites can justify a launch independently from a larger mass class payload.

The emergence of a microsatellite launch vehicle, with competitive launch costs, may cause microsatellite payloads to shift from the multi-manifest approach to individual launch. This would result in a larger number of launches.

Emergence of an affordable launch vehicle may find a niche for dedicated launches of satellites on the lower end of the microsatellite category—nanosatellites (satellites with masses of 10 kg or less).

In recent years a number of organizations initiated development of launch vehicle concepts targeting the orbital launch of microsatellites (such as Virgin Galactic, the Canadian Space Agency, Interorbital Systems, and Microcosm Inc.)

Emergence of this market is uncertain and may affect the number of launches during the forecast period. If a new microsatellite vehicle is developed and sufficient demand is demonstrated, launch projections for this segment can be included in future editions of the NGSO forecast.

RISK FACTORS THAT AFFECT SATELLITE AND LAUNCH DEMAND

A large number of financial, political, and technical factors can impact the NGSO forecast. The emergence of new markets, such as commercial human spaceflight, 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 an example of an uncertainty factor that can dramatically impact launch rates.

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 forecasted and realized launches include:

Financial Uncertainty

- **U.S. national and global economy**: Strong overall economic conditions historically foster growth and expansion in satellite markets. Similarly, relatively weak 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.
- **Business case changes**: The satellite owner or operator can experience budget shortfalls, change strategies, or request technology upgrades late in the manufacturing stage, all of which can contribute to schedule delay. An infusion of cash from new investors can 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 occurred otherwise.
- **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 might 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 Department of Defense (DOD) continues to purchase significant remote sensing data from commercial providers.
- **Regulatory and political changes**: Export compliance, FCC licensing, NOAA licensing, or international licensing requirements can delay 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 working with international customers. This causes delays as well as cancellations of satellite programs. Changes in FCC or NOAA processes, export control issues associated with space technology, and political relations between countries can all affect demand.
- **Increase in government missions open to launch services competition**: Some governments keep launch services contracts within their borders to support domestic launch industries. However, the ESA has held international launch competitions for some of its small science missions, and some remote sensing satellite launches have been 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 slowly increases.

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 will be needed. Lifespan estimates are critical for timing the replacements of existing NGSO satellite systems, given the high capital investment required to deploy a replacement system.
- **Need for replacement satellites**: Although a satellite might have a long lifespan, it can be replaced early if it is no longer cost-effective to maintain; or an opportunity might arise that allows a satellite owner or operator to exceed the competition with a technological advancement. Higher-resolution commercial remote sensing satellites are an example of this factor.
- **Launch vehicle technical issues**: Launch vehicle manufacturers and operators may have manufacturing, supplier, or component issues or experience launch anomalies or failures. Any of these issues 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 (for example, science windows), which, if missed, may result in lengthy delays.
- **Satellite technical issues**: Satellite manufacturers may have factory, supplier, or component issues that delay the delivery of a satellite. The likelihood of delays due to technical issues rises as satellite systems become more complex. Anomalies, whether on the ground or in orbit, can affect the delivery of satellites until potential fleet issues (for example, 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.

- **Multi-manifesting**: Multi-manifesting, while limited to a few launch vehicles, is dependent on several 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 (on the order of days).
- **Failure of orbiting satellites**: From the launch services perspective, failure of orbiting satellites can require that ground spares are launched or new satellites are ordered. This only amounts 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.
- **Orbital debris and collision avoidance**: Though relatively rare, launch delays can also occur when conjunction analysis determines that orbital debris has a high probability of introducing risk to the mission.

APPENDIX 1: VEHICLE SIZES AND ORBITS

Small launch vehicles are defined as those with a payload capacity of less than 2,268 kilograms (5,000 pounds) at 185 kilometers (100 nautical miles) altitude and a 28.5 degree inclination. Medium-to-heavy launch vehicles are capable of carrying more than 2,269 kilograms at 185 kilometers altitude and a 28.5 degree inclination.

Commercial NGSO systems use a variety of orbits, including:

- Low Earth orbits (LEO) range from 160-2,400 kilometers (100–1,500 miles) in altitude, varying between a 0 degree inclination for equatorial coverage and a 101 degree inclination for global coverage.
- Medium Earth orbits (MEO) begin at 2,400 kilometers (1,500 miles) in altitude and are typically at a 45 degree inclination to allow global coverage with 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 a 116.5 degree inclination, allowing satellites to “hang” over certain regions on Earth, such as North America.
- 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 (for example, the Moon).

APPENDIX 2: HISTORICAL NGSO MARKET ASSESSMENTS

In the last decade of launch activity, there have been significant changes in the amount of payloads and launches forecasted each year, with payloads and launches remaining steady from 2001 to 2006, then beginning to increase in 2007. Overall, the 2011 forecast projects demand consistently higher than the 6 launches per year average of the last 10 years.

In the last decade of 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, launched. The 2011 forecast shows a slightly more compressed schedule of launches, as each of these systems is replaced with new satellites. Also, the new O3b constellation will launch at the same time that Globalstar and ORBCOMM plan major launch campaigns. The Iridium NEXT deployment schedule does not fully overlap with the other constellations as it did in the late 1990s.

The science and engineering and commercial remote sensing satellite markets create consistent launch demand according to historical figures. Since 1996, there always has been at least one science and engineering 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 science and engineering. Since 1994 there have been six years with no commercial remote sensing satellites launched.

The number of payloads launched by market sector and the total commercial launches that were internationally competed or commercially sponsored from 2001 through 2010 are provided in Table 22. Small vehicles performed 26 launches during this period, while medium-to-heavy vehicles conducted 31 launches. From 1994 to the end of 2006, the historical number of launches between vehicle classes was roughly equal. This roughly even split is not expected to continue, as an increasing number of launches use medium-to-heavy vehicles. The 2011 forecast estimates that the larger vehicle class will continue to conduct the most launches.

Table 22. Historical Payloads and Launches*

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Payloads											
Commercial Telecommunication	1	9	0	2	0	0	8	6	2	6	34
Commercial Remote Sensing	2	0	1	0	0	1	3	6	1	1	15
Science and Engineering	1	6	8	7	8	4	14	8	8	7	71
Commercial Cargo and Crew Transportation Services	0	0	0	0	0	0	0	0	0	1	1
Other Payloads Launched Commercially	0	0	0	0	0	0	0	0	0	0	0
Total Satellites	4	15	9	9	8	5	25	20	11	15	121
Launches											
Medium-to-Heavy Vehicles	2	2	1	1	0	2	10	4	2	7	31
Small Vehicles	2	2	3	1	3	3	2	6	3	1	26
Total Launches	4	4	4	2	3	5	12	10	5	8	57

*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.

A comparison of past baseline launch demand is represented in Figure 25. A large space between the maximum and average launches per forecast indicates high variability in the launch rate over the ten-year period. The closing of the maximum and average in the 2010 forecast indicates a general stabilization of launch demand.

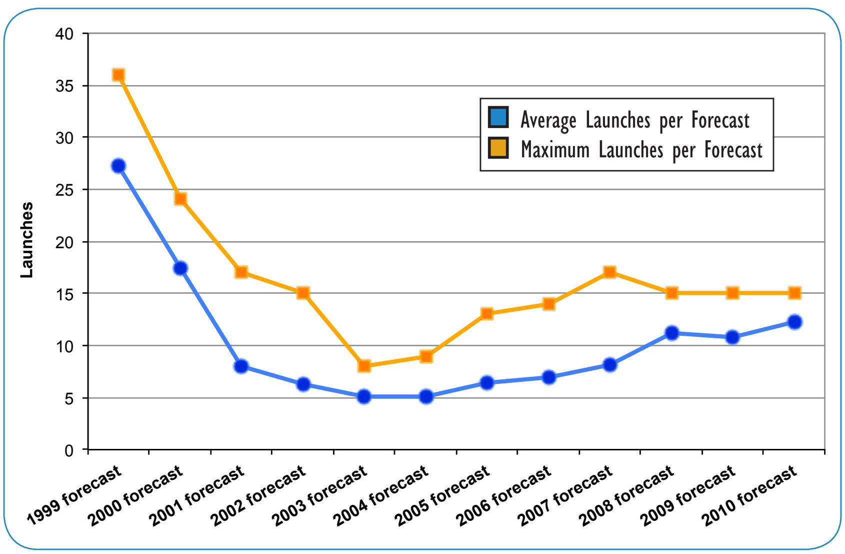

Figure 25. Average and Maximum Launches per Forecast from NGSO Forecasts 1999-2010

Historical satellite and launch data from 2001 through 2010 are shown in Table 23. Secondary and piggyback payloads on launches with larger primary payloads were not included in the payload or launch tabulations.

Table 23. Historical NGSO Payload and Launch Activities (2001-2010)

Summary	Market Segment	Date	Satellite	Launch Vehicle	
			2010		
15 Satellites 6 Telecommunication 1 Remote Sensing 7 Science & Engineering 1 Transportation 8 Launches 7 Medium-to-Heavy 1 Small	Telecommunication	10/19/10	Globalstar 2nd Gen. 1-6 (6 sats)	Soyuz 2	Medium-to-Heavy
	Remote Sensing	6/20/10	TanDEM X	Dnepr M	Medium-to-Heavy
	Science & Engineering	4/7/10	Cryosat 2	Dnepr M	Medium-to-Heavy
		6/1/10	SERVIS 2	Rockot	Small
		6/9/10	Falcon 9 Demo Flight	Falcon 9	Medium-to-Heavy
		6/14/10	Prisma (2 sats)	Dnepr M	Medium-to-Heavy
			Picard[1]		
		11/5/10	Cosmos-SkyMed 4	Delta II	Medium-to-Heavy
	Transportation	12/8/10	Dragon COTS Demo 1	Falcon 9	Medium-to-Heavy
			2009		
11 Satellites 2 Telecommunication 1 Remote Sensing 8 Science & Engineering 5 Launches 2 Medium-to-Heavy 3 Small	Telecommunication		AprizeStar 3-4[2]		
	Remote Sensing	10/8/09	Worldview 2	Delta II	Medium-to-Heavy
	Science & Engineering	7/13/09	RazakSat	Falcon 1	Small
		7/29/09	DubaiSat 1	Dnepr	Medium-to-Heavy
			DEIMOS		
			UK DMC 2		
			Nanosat 1B		
		3/17/09	GOCE	Rockot	Small
		11/2/09	SMOS	Rockot	Small
			Proba 2		
			2008		
20 Satellites 6 Telecommunication 6 Remote Sensing 8 Science & Engineering 10 Launches 4 Medium-to-Heavy 6 Small	Telecommunication	6/19/08	Orbcomm Replacement 1-5	Cosmos 3M	Small
			Orbcomm CDS-3		
	Remote Sensing	8/29/08	RapidEye 1-5	Dnepr 1	Medium-to-Heavy
		9/6/08	GeoEye-1	Delta II	Medium-to-Heavy
	Science & Engineering	3/27/08	SAR Lupe 4	Cosmos 3M	Small
		4/16/08	C/NOFS	Pegasus XL	Small
		6/19/08	UGATUSAT		
		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
		10/1/08	THEOS	Dnepr 1	Medium-to-Heavy
		10/24/08	Cosmo-SkyMed 3	Delta II	Medium-to-Heavy
			2007		
25 Satellites 8 Telecommunication 3 Remote Sensing 14 Science & Engineering 12 Launches 10 Medium-to-Heavy 2 Small	Telecommunication	5/30/07	Globalstar Replacement 1-4	Soyuz	Medium-to Heavy
		10/21/0	Globalstar Replacement 5-8	Soyuz	Medium-to-Heavy
	Remote Sensing	6/15/07	TerraSAR-X	Dnepr	Medium-to-Heavy
		9/18/07	WorldView 1	Delta II	Medium-to-Heavy
		12/14/07	RADARSAT 2	Soyuz	Medium-to-Heavy
	Science & Engineering	4/17/07	Egyptsat	Dnepr	Medium-to-Heavy
			SaudiComsat 3-7		
			Saudisat 3		
		4/23/07	AGILE	PSLV	Medium-to-Heavy
			AAM		
		6/7/07	Cosmos-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

F Launch Failure

1 Picard deployed on launch with Prisma Main & Target

2 AprizeStar 3-4 deployed on launch with DubaiSat 1

Table 23. Historical NGSO Satellite and Payload Activities (2001-2010) (Continued)

Summary	Market Segment	Date	Satellite	Launch Vehicle	
2006					
5 Satellites	Remote Sensing	4/25/06	EROS B	START 1	Small
1 Remote Sensing	Science & Engineering	7/28/06	Kompsat 2	Rockot	Small
4 Science & Engineering		12/27/06	Corot	Soyuz 2 1B	Medium-to-Heavy
5 Launches		7/12/06	Genesis 1	Dnepr	Medium-to-Heavy
2 Medium-to-Heavy		12/19/06	SAR Lupe 1	Cosmos	Small
3 Small					
2005					
8 Satellites	Science & Engineering	6/21/05	Cosmos 1	Volna[F]	Small
8 Science & Engineering		10/8/08	Cryosat	Rockot[F]	Small
3 Launches		10/27/05	Beijing 1	Cosmos	Small
3 Small			Mozhayets 5		
			Rubin 5		
			Sinah 1		
			SSETI Express		
			Topsat		
2004					
9 Satellites	Telecommunication		LatinSat (2 sats)[3]		
2 Telecommunication	Science & Engineering	5/20/04	Rocsat 2	Taurus	Small
7 Science & Engineering		6/29/04	Demeter	Dnepr	Medium-to-Heavy
2 Launches			AMSat-Echo		
1 Medium-to-Heavy			SaudiComSat 1-2		
1 Small			SaudiSat 2		
			Unisat 3		
2003					
9 Satellites	Remote Sensing	6/26/03	OrbView 3	Pegasus XL	Small
1 Remote Sensing	Science & Engineering	6/2/03	Mars Express	Soyuz	Medium-to-Heavy
8 Science & Engineering			Beagle 2		
4 Launches		9/27/03	BilSat 1	Cosmos	Small
1 Medium-to-Heavy			BNSCSat		
3 Small			KaistSat 4		
			NigeriaSat 1		
			Rubin 4-DSI		
		10/30/03	SERVIS 1	Rockot	Small
2002					
15 Satellites	Telecommunication	2/11/02	2002	Delta II	Medium-to-Heavy
9 Telecommunication		6/20/02	Iridium (5 sats)	Rockot	Small
6 Science & Engineering			Iridium (2 sats)		
4 Launches			LatinSat (2 sats)[4]		
2 Medium-to-Heavy	Science & Engineering	3/17/02	GRACE (2 Sats)	Rockot	Small
2 Small		12/20/02	SaudiSat 1C	Dnepr	Medium-to-Heavy
			Unisat 2		
			RUBIN 2		
			Trailblazer Structural Test Article		
2001					
4 Satellites	Telecommunication	6/19/01	ICO F-2	Atlas 2AS	Medium-to-Heavy
1 Telecommunication	Remote Sensing	9/21/01	OrbView 4	Taurus[F]	Small
2 Remote Sensing		10/18/01	QuickBird 2	Delta II	Medium-to-Heavy
1 Science & Engineering	Science & Engineering	2/20/01	Odin	START 1	Small
4 Launches					
2 Medium-to-Heavy					
2 Small					

F Launch Failure

3 Launched on same mission as Demeter et al.

4 Launched on same mission as SaudiSat 2 et al.

APPENDIX 3: ACRONYMS

3GIRS	Third Generation Infrared Surveillance
ADF	Australian Defence Force
AGS	Americom Government Services
AIS	Automatic Identification System
ASI	Italian Space Agency
ATV	Automated Transfer Vehicle
BA	Bigelow Aerospace
BB	Broadband services
BMW	Bayerische Motoren Werke AG
CASSIOPE	Cascade, Smallsat, and Ionospheric Polar Explorer
CCAFS	Cape Canaveral Air Force Station
CCDev	Commercial Crew Development
CGWIC	China Great Wall Industry Corporation
CNC	Comisión Nacional de Comunicaciones (Argentina)
CNES	Centre National d'Études Spatiales (French space agency)
COMSTAC	Commercial Space Transportation Advisory Committee
CONAE	National Commission on Space Activity (Argentinian space agency)
COTS	Commercial Orbital Transportation Services
CRS	Commercial Resupply Services
CSA	Canadian Space Agency
CST-100	Crew Space Transportation – 100 kilometers
CTV	Crew Transfer Vehicle
CZ	Chang Zheng (Long March)
DARS	Digital Audio Radio Services
DBS	Direct Broadcasting Services
DLR	Deutsches Zentrum für Luft- und Raumfahrt (German space agency)
DMC	Disaster Monitoring Constellation
DOD	Department of Defense
DOT	Department of Transportation
DTH	Direct-To-Home
EA	Excalibur Almaz
EADS	European Aeronautic Defence and Space Company
EC	European Commission
EELV	Evolved Expendable Launch Vehicle
EGNOS	European Geostationary Navigation Overlay Service
ELI	Highly Elliptical Orbit

EROS	Earth Remote Observation Satellite
ESA	European Space Agency
EU	European Union
EXT	External or Non-Geocentric Orbit
FAA/AST	Federal Aviation Administration, Office of Commercial Space Transportation
FCC	Federal Communications Commission
FSS	Fixed Satellite Services
FY	Fiscal Year
GEOSS	Global Earth Observation System of Systems
GHz	Gigahertz
GIS	Geographic Information Systems
GmbH	Gesellschaft mit beschränkter Haftung (German LLC)
GMES	Global Monitoring for Environment and Security
GPS	Global Positioning System
GSAT	Geo-Stationary Satellite (India)
GSLV	Geosynchronous Satellite Launch Vehicle
GSO	Geosynchronous Orbit
GTO	Geosynchronous Transfer Orbit
HDTV	High Definition Television
HPA	Hosted Payload Alliance
HTV	H-II Transfer Vehicle
IAI	Israel Aerospace Industries Ltd.
ILS	International Launch Services
IRIS	Internet Router in Space
ISC	International Space Company
ISRO	Indian Space Research Organization
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
ITT	International Telephone & Telegraph
ITU	International Telecommunications Union
JAXA	Japan Aerospace Exploration Agency
JCTD	Joint Capabilities Technology Demonstration
KARI	Korea Aerospace Research Institute
KSLV	Korean Space Launch Vehicle
LEO	Low Earth Orbit
LLC	Limited Liability Company
LRF	Lloyd's Register – Fairplay
MDA	MacDonald, Dettwiler and Associates Ltd.

MEO	Medium Earth Orbit
MSS	Mobile Satellite Services
NASA	National Aeronautics and Space Administration
NASDAQ	National Association of Securities Dealers Automated Quotations
NGA	National Geospatial-Intelligence Agency
NGSO	Non-Geosynchronous Orbits
NOAA	National Oceanic and Atmospheric Administration
NPOM	JSC MIC Mashinostroyenia (successor to NPO Mashinostroyenia)
O3b	Other Three Billion Networks, Ltd.
OFAS	Orbital Facility Assembly and Services
OHB	Orbitale Hochtechnologie Bremen
Orbital	Orbital Sciences Corporation
PPP	Public-Private Partnership
PSLV	Polar Satellite Launch Vehicle
RCM	RADARSAT Constellation Mission
SAOCOM	SAtélite Argentino de Observación COn Microondas
SAR	Synthetic Aperture Radar
SBAS	Satellite-Based Augmentation Systems
SpaceX	Space Exploration Technologies Corporation
SPOT	Satellite Pour l'Observation de la Terre
SS/L	Space Systems/Loral
SSTL	Surrey Satellite Technology Limited
STSAT	Science and Technology Satellite
TanDEM-X	TerraSAR Digital Elevation Measurement X-band
TBD	To Be Determined
TSX	TerraSAR X-band
UAE	United Arab Emirates
UCISAT	University of California, Irvine Satellite
UHF	Ultra-High Frequency
USAF	United States Air Force
USEF	Institute for Unmanned Space Experiment Free Flyer
VSAT	Very Small Aperture Terminal
WAAS	Wide Area Augmentation System