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FREE EXTRACT

Prospects for the Small Satellite Market

A global supply and demand analysis of government, commercial and academic satellites up to 500 kg

A Novaspace Report

December 2024
10th Edition

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ABOUT THIS MARKET INTELLIGENCE REPORT

Scope

Prospects for the Small Satellite Market provides an in-depth analysis of market drivers, supply and demand and provides information on seven different smallsat applications, six types of orbits and five mass categories with an additional focus on constellations. The report includes a comprehensive review of all smallsat (<500 kg) constellations and operators, including but not limited to a review of all telecom mega-constellations and of the various Space Development Agency's Proliferated Warfighter Space Architecture layers, among many other constellations and smallsat projects. Key smallsat trends are presented including the impact of recent geopolitical tensions as well as their consequences e.g., high inflation and supply chains disruption affecting not only the smallsat market, but the global space sector and world economy.

Extensive figures & analysis for the coming decade

This report contains the following information:

- Updated Smallsat Database for the past (2014-2023) and future decades (2024-2033)
- Consolidated data in three metrics (units, mass, value) over two decades by application, orbit, operator type, mass category, operator/integrator/launcher region/country, etc.
- Chapters dedicated to manufacturing & launch supply and supply & demand equilibrium
- Smallsat market drivers covering industry trends, constellation rationale and challenges, sustainability of demand, policy, technology, and financial aspects of the smallsat sector
- Improved content on performance improvements enabled by the smallsat form factor
- Focus on vertical integration and market shares that are open or captive of an integrator or launch provider due to vertical integration (in-house manufacturing or launch)
- Detailed analysis of smallsat demand with specific content on each market segment: by mass category, by application, by region of the operator, by status of the operator
- Regional distribution of past manufacturing and launch supply and demand

ABOUT THIS MARKET INTELLIGENCE REPORT

Choose your plan

Classic		Premium	
*Single Team	**Corporate Unlimited users	*Single Team	**Corporate Unlimited users
€ 6,000	€ 13,500	€ 8,500	€ 16,000

In-depth analysis of small satellite market drivers, supply and demand with information on seven applications, six orbit types and five mass categories with a major review of telecom mega-constellations.

Smallsat database covering historical data from the past 10 years and forecasts for the next 10 years, with details on units, mass, and market value.

Forecast for the next decade broken down by application, orbit, operator type, mass category, operator region, as well as integrator and launch provider, type of integrator, type of launcher and more.

All classic options

Smallsat constellation database includes more than 440 projects tracked individually, featuring many parameters such as mass, orbit, number of satellites to be launched, type and region of operator and prime integrator, funding status, etc.

Dedicated presentation session by Novaspace expert.

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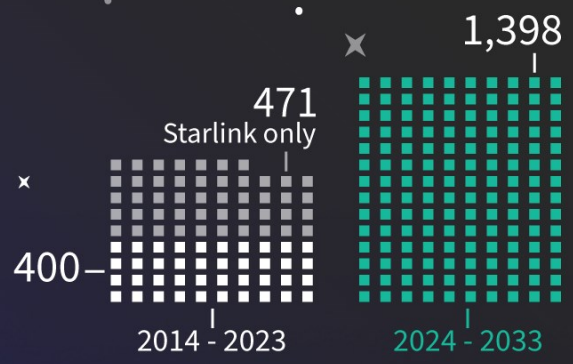
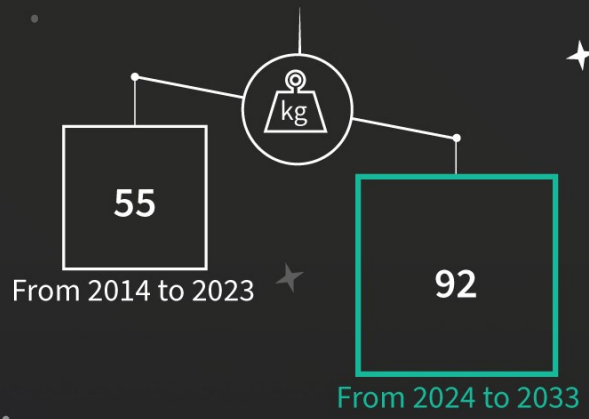
Smallsat Market By 2033

Starlink transition to larger satellites does not prevent Smallsat sector growth, in all metrics (units, mass, value)

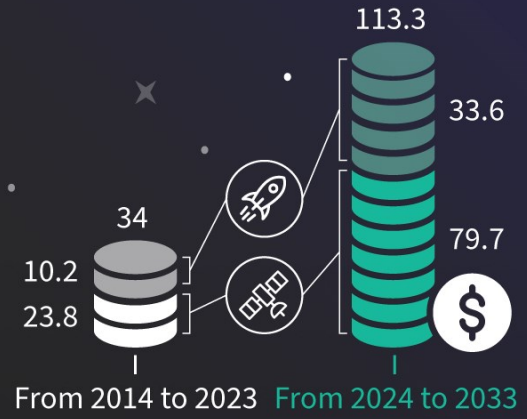
Average number of smallsats launched per year



Average launch mass per satellite (mega-constellations excluded, in kg)

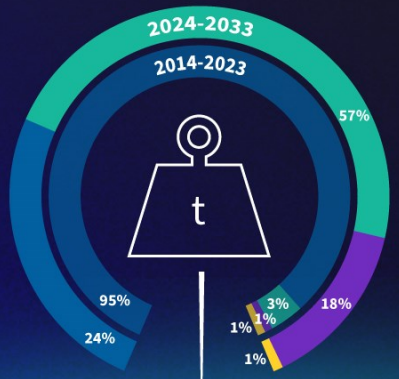


Manufacturing and launch value (in billion USD)



Governments' adoption of smallsats grows

Smallsats by operator status (in mass)



Commercial
424 tons (2024-33)

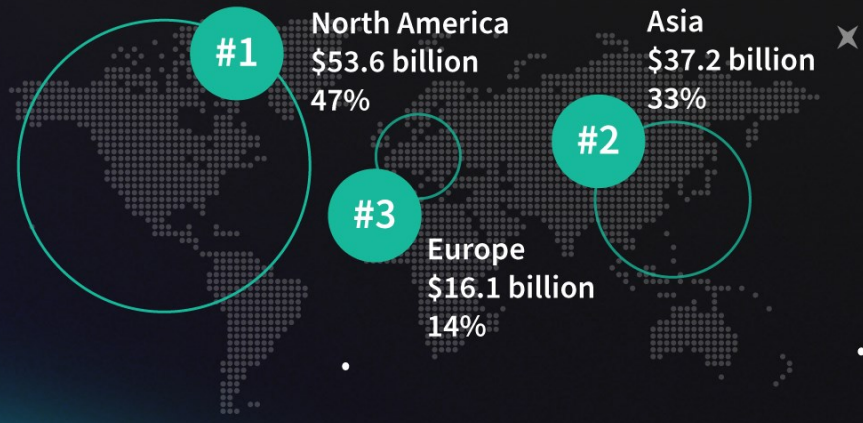
Civil Government
1,000 tons (2024-33)

Defense
324 tons (2024-33)

Academia
19 tons (2024-33)

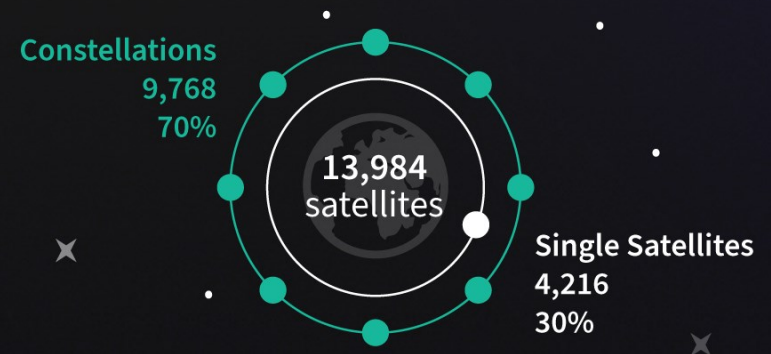
North America at half of market value

Top 3 over 2024-2033 by operator region (in value)



A constellation driven-market

Mission type over 2024-2033 (in units)



Smallsats: satellites below 500 kg of launch mass

Source: Novaspace's Prospects for the Small Satellite Market, 10th edition, 2024

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TABLE OF CONTENTS (1/2)

Introduction

01. Strategic Issues and Forecast for the Smallsat Market

02. Smallsat Demand

02. Smallsat Demand *(continued)*

03. Smallsat Supply - Manufacturing

04. Smallsat Supply - Launch

EXECUTIVE SUMMARY (1/5)

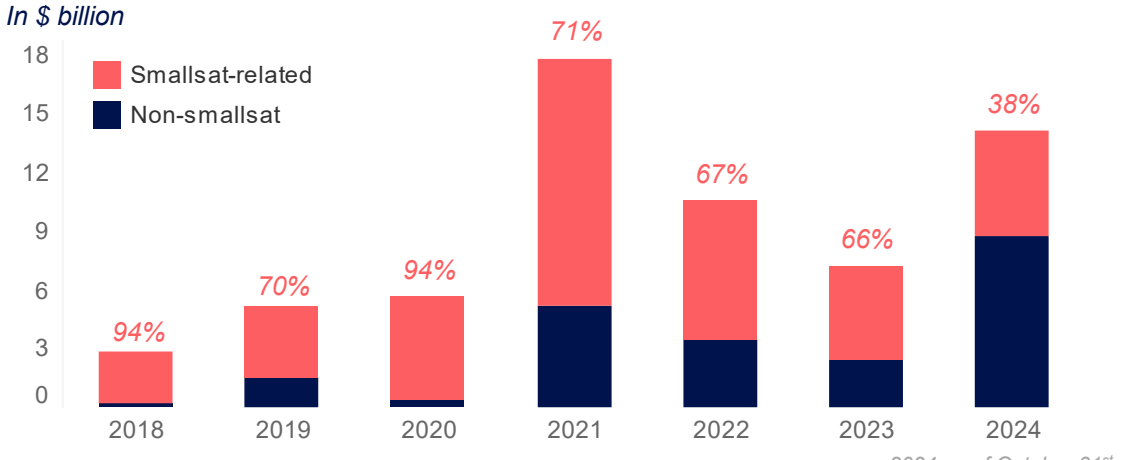
Smallsat market still dynamic despite supply challenges and Starlink outgrowing the smallsat form factor

Novaspace anticipates that about 13,984 smallsats (i.e., satellites <500 kg) will launch over 2024-2033, or about 177 tons per year, i.e., close to half a ton per day on average over the next 10 years. Yet, the smallsat market keeps presenting a number of challenges such as limited market addressability for suppliers, challenging profitability, clear oversupply risks, concentration of the commercial market by a few established players, and pricing pressure, among others. Of note, this smallsat growth happens despite many players considering constellations beyond the scope of this report with >500 kg satellites (most notably Starlink, Project Kuiper, Telesat Lightspeed, Rivada, Intelsat MEO, O3b mPower, among others.).

The removal of Starlink from the scope of the report translates into a much smaller total market compared to last year's edition's forecast of about 26k smallsats to be launched over 2023-2032. The difference is largely due to ~13k Starlinks outgrowing the scope of the report as it transitions to larger satellites in a quest for more performance to bring down the cost base of its capacity and deliver more throughput to meet demand. Starlink excepted, our forecast for the smallsat market is nonetheless steadily growing from 13,135 satellites in the previous edition (2023-2032) to 13,984 smallsats in this year's edition (2024-2033), a growth of +7% as both constellations and single satellite projects multiply (not representative of growth in mass/value), numbers reflecting relative stability/consistency between editions.

Looking forward, the report will be "Starlink-free" over next decade and the data sets, charts and tables presented hereby will be less skewed by the "Starlink effect" which was evident in previous editions of the report. Free of the influence of Starlink, the data shall therefore be more representative of the actual smallsat market over next decade, although the "*Starlink effect*" still exists to a lower extent with China's GuoWang and Qianfan constellations.

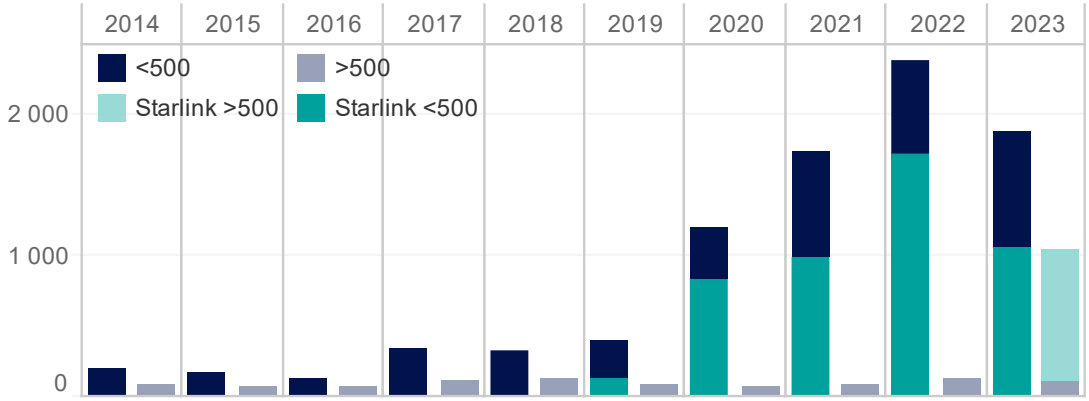
Investments (debt included) in the space sector since 2018*



2024 as of October 31st

**Smallsats launched over 2014-2023 vs. non-smallsats*

In number of satellites



*Smallsat-related investments exclude investments in downstream service providers and include launch companies.

EXECUTIVE SUMMARY (2/5)

Constellations as the leading smallsat growth driver

The next decade will be defined primarily by the rollout of multiple constellations, which will account for 70% of smallsats. Constellation demand is cyclical by nature and features strong cyclical variations due to the need for deployment in batches within a short period of time, followed years later by replenishment or expansion of existing systems. The growth of single satellites will be slower but more stable over the following decade. While the technical feasibility and market acceptance of mega-constellations appears to be demonstrated with Starlink's breakeven/profitability claims, it remains to be seen whether it can be replicated by other players which lack SpaceX's vertical integration capability and low-cost reusable launchers. Full deployment is expected within the coming years for the most advanced projects (pressed by deadlines set by licensing authorities), yet the OneWeb bankruptcy and launch hiatus due to the war in Ukraine are important reminders of challenges remaining including massive upfront CAPEX requirements, intense competition, uncertain business models and a complicated legal and macro-economic context with high inflation and uncertain returns still affecting investors' willingness to commit funding.

China's mega-constellations still favor smallsat form factor

The GuoWang and Qianfan mega-constellations, like Starlink before them, will dominate the smallsat market in terms of numbers and mass, largely skewing overall market data. However, such constellations are not representative of the smallsat industry, a highly diverse market with numerous operators, start-ups, universities and emerging countries sometimes accessing space for the first time thanks to the growing affordability and lower barriers to entry of smallsats. Such massive constellation projects favor vertical integration due to of the needs for mass production enabling economies of scale, faster innovation cycles and better supply chain control. This model results of a trade-off between internal and external efficiencies, as 3rd-party solutions are not available, adapted to requirements, or affordable.

SpaceX steamroller keeps diversifying into new verticals, holds the potential to disrupt additional market segments

Despite being a key growth enabler for the smallsat market with its affordable Transporter missions to SSO, which have enabled access to space to many new entrants, SpaceX also presents competitive risks for numerous suppliers of smallsat hardware and services both upstream and downstream of the value chain. The scale of the Starlink constellation enables never-seen-before economies of scale for the traditionally low-volume spacecraft markets, potentially threatening not only launch providers but also satellite operators, prime integrators and even subsystem manufacturers shall they have activities overlapping with SpaceX's ambitions and vertically-integrated capabilities. Most notably, SpaceX has hinted that it could decide to enter the market for electric thrusters or optical communications terminals, shall it find a rationale to do so. It remains unclear whether any established or upcoming supplier could match SpaceX's costs and lead times considering the unequaled economies of scale enabled by its own Starlink constellation.

After launch and satcom, SpaceX now has the potential to disrupt the EO market with its Starshield constellation for the U.S. NRO. While SpaceX appears to be a platform provider for Starshield rather than a full-fledged Earth observation operator seeking to enter and disrupt EO markets (the data presumably belonging to the end customer, the NRO, rather than SpaceX), this new source of imagery and data may possibly reduce U.S. (and allies) government demand and procurements for imagery and data previously provided by other commercial sources and/or NRO satellites. Starshield also comes with better revisits (no EO constellation to date plans the scale of Starshield's hundreds of satellites, even Planet's SuperDove cubesats) and higher resolutions (Starshield are "non-smallsats" at an estimated 800kg). Thus, Starshield represents a net negative for existing/upcoming EO players, unless they can position themselves in Starshield's supply chain e.g., Northrop with payloads.

EXECUTIVE SUMMARY (5/5)

Challenging profitability to drive supply consolidation, diversification, and search for government anchor clients

Following the wave of SPAC listings and IPOs that occurred over the past few years, many smallsat players must now file for annual reports which publicly confirm previous warnings of challenging revenue generation and profitability in a highly competitive, low-margin business environment, a situation that is aggravated by high inflation and supply chain issues linked to the pandemic and war in Ukraine. Yet, public companies only are the tip of the iceberg as many private entities and smallsat flagships (e.g., OneWeb, Planet) also have yet to become profitable despite significant revenue growth and positive customer feedback.

Several emerging launch providers now seek to diversify into subsystems, manufacturing or space logistics, as well as into operations and downstream services in some cases, which have proven to be higher margin businesses than the challenging launch business. The long-awaited consolidation phase is starting to materialize with business failures and M&A in the launch sector but is also spreading to other segments e.g., manufacturing. Similarly, in manufacturing, prime integrators increasingly move from classic procurement models towards the *Satellite/Data as a Service* business model in an effort to grow margins and reach new types of customers, including some that are new to the space sector. With this model, companies now have access to lease or pay-as-you-go services without the need to invest the upfront capex to acquire the hardware they require to generate the service.

Upstream or downstream, securing government agencies as anchor customers is and will remain key to the newspace sector, most notably via long-term contracts (e.g., NRO multi-billion EOCL 10-year contracts with Maxar, Planet and BlackSky, ESA's commercial constellation additions to its Copernicus program, Starlink U.S. government support) to give visibility to investors and demonstrate that smallsats are here to stay over the long term.

Ukraine War showcases smallsat constellation use cases

While the war has had severe consequences on players that had part of their supply chains in Russia or Ukraine (e.g., OneWeb with Soyuz and Fakel), it has demonstrated the value of smallsat applications, enabling commercial operators to showcase their capabilities and value proposition. Resiliency and responsiveness are key in the conflict, as SpaceX demonstrated by rapidly shipping Starlink terminals to Ukrainian armed forces and NGOs. In EO, demand for images with a focus on SAR (due to cloud coverage) has drastically increased since the beginning of the conflict. Security constellations have also demonstrated their value proposition with regards to RF monitoring, jamming detection, and early warning. Consequently, a growing number of government agencies (driven by defense users) consider investing in their own smallsat systems or dedicating a budget to the commercial procurement of third-party smallsat-based services, supporting growth of the sector.

Quest for performance means continuous growth in mass

Despite miniaturization and growth in the number of cubesats, the quest for performance and the addition of sensors, thrusters and hardware results in steady growth in average smallsat mass. Following initial demonstration missions with cubesats, many smallsat operators move to larger smallsats to improve their value proposition via increased performance or a longer lifetime. Satellite lifetime is essential in defining constellation replenishment and launch cycles, with more propellant delaying the capex for replacement satellites. As an example, Starlinks have grown in mass with the addition of optical laser links and larger payloads, and masses of 1 to 2 tons for next-generation Starlinks have been mentioned by Elon Musk, aiming for better economics and to make the most of Starship's launch capacity and diameter. We anticipate the average smallsat mass (Starlink, GuoWang & Qianfan excluded) to grow from 55 kg over 2014-2023 to 92 kg over 2024-2033.

2023 FOR THE SMALLSAT INDUSTRY

1.3x more
Smallsats launched in 2023 (824) versus 2022 (648) **excluding Starlink**

85% (down from 90% in 2022)
of smallsats launched were for **constellations**

28% (down from 30% in 2022) excl. Starlink
of demand in # came from **U.S.-based operators**

Falcon 9
1st smallsat launcher:
- **83% of smallsats** in #
- **94% of mass**

(stable from 2022)

Falcon 9
Highest launch rate (33 launches with at least 1 smallsat, down from 42, reflecting the Starlink transition to >500kg sats)

SpaceX
is the **largest operator** with 1,048 Starlinks launched in 2023 *(vs. 1,720 in 2022, 989 in 2021)*

36% of units
Earth Observation is the leading smallsat application since 2022 *excluding Starlink*

1,872 smallsats
smallsats launched in 2023 including Starlink
down 21% vs. 2022 due to Starlink transition to larger satellites

7% of smallsats launched in 2023 were for government operators
(incl. defense and civil government)

373 tons *(down 34% vs. 2022)*
of **mass launched**, i.e., 28% of the total satellite mass* launched in 2023
* Including >500 kg satellites, but excluding human spaceflight missions

1,555 smallsats
launched by SpaceX, the leading launch service provider at 83% of smallsat launch supply in units in 2023
- of which 1,048 Starlink satellites

26 launchers
launched smallsats, globally, down from 33 in 2022

94 launches
(106 in 2022, 78 in 2021)
carried smallsats (i.e., 46% of total launches across the world in 2023)

94%
of the **smallsat mass** was launched into LEO (352 t)

$6.9 billion
of **market value** generated in 2023 by smallsats for manufacturing (74%) and launch (26%) *excluding Starlink*

62 kg average smallsat launch mass (up from 56kg in 2022) *- excluding Starlink*
At 500 kg the heaviest was a Shiyan satellite (China), and an Innova Space 0.20 kg PocketQube was the lightest

NOVA SPACE

SCOPE AND DEFINITIONS (1/2)

Methodology

The objective of this report is to provide a better understanding of the small satellite market, a specific segment of the space industry that is experiencing significant and rapid change. *Prospects for the Small Satellite Market* presents Novaspace's views of the various factors that will drive/inhibit growth in smallsat demand and supply over the next 10 years.

All demand drivers have been considered:

- Applications and missions of smallsat systems;
- Operators and users of smallsats;
- Technology changes affecting both platforms and payloads;
- Implications for the manufacturing and the launch businesses.

Novaspace's forecast of smallsats to be launched over the next decade (2024 to 2033) has been developed from a qualitative and quantitative analysis conducted with three sources :

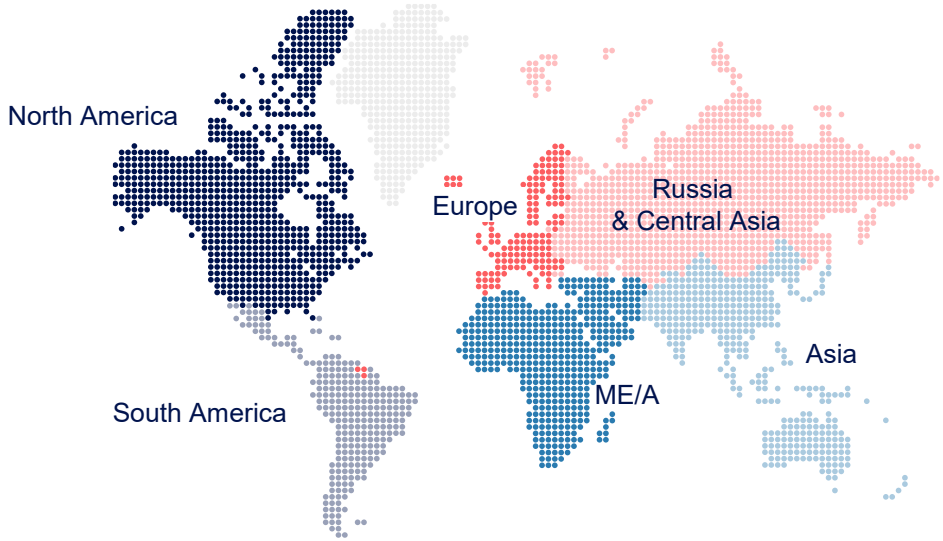
- A database of all satellites from 0 kg to 500 kg of launch mass that were launched from 2014 to 2023. The database also nominatively includes satellites now in development for launch in the coming years, i.e., a forecast of those due to be launched over 2024-2033, including unnamed "generic" forecasted satellites in addition to nominative missions.
- A combination of primary and secondary research to characterize the changes that have occurred and may occur at two levels: the demand side of the market (i.e., the owners and operators of the satellites), and the supply side of the market (i.e., the industries, agencies and companies that manufacture and launch the satellites and subsystems).
- Comprehensive exchanges with industry stakeholders and customer feedback.

Segmentation

The report considers satellites across five mass categories, six regions, seven applications, and four types of operators. Analysis per orbit, contract status, type of manufacturer and launch provider, country/region of operator and launch provider are also featured. The four categories of operators are:

- **Commercial**: private sector companies selling satellite-based services
- **Civil government**: civilian government organizations (e.g., space agencies)
- **Defense**: military government organizations (e.g., space forces and MoDs)
- **Academic**: research and education organizations (e.g., universities)

The six regions of the report



SCOPE AND DEFINITIONS (2/2)

Seven smallsat applications

Application	Definition
Satcom	Satcom satellite systems funded by civil or defense government agencies for broadband and MSS communications services including internet, broadcasting, direct to device and data relay/cloud storage applications.
Earth Observation	Satellites for electro-optical and radar observation of the Earth, as well as for meteorology, both for operational and Earth-science research purposes. It also includes GNSS radio occultation (GNSS-RO), GHG monitoring, etc.
Information	Smallsats providing narrowband communications services (IoT & M2M) and data collection from ground, aerial and atmospheric sensors (e.g., AIS, ADS-B, VDES).
Technology	Technology development satellites built for IOD/IOV i.e., to test new technologies or platform/payload components; some technology satellites may serve other satellite applications on a non-operational basis.
Safety & Security	Satellites for space surveillance and tracking, SSA, missile early warning, near-Earth object monitoring, electrical intelligence (ELINT), and space weather. It also includes SIGINT, of which RF monitoring applications.
Science, Exploration	Small satellites for astrophysics and astronomy, planetary science (including Earth science and Moon/Mars missions), heliophysics, and solar-terrestrial interactions.
Space Logistics	This application features four parts : In-Orbit Servicing (IOS) i.e., satellites designed to repair, refurbish, refuel or take-over station-keeping; Active Debris Removal; Last Mile Logistics; In-Orbit Manufacturing (IOM).

Six types of orbits

- **LEO:** Low Earth Orbit with altitudes up to 2,000 km
- **SSO:** Sun-Synchronous Orbit, near-polar, synchronous with the Sun
- **MEO:** Medium Earth Orbit, altitudes between 2,000 km to 20,000 km
- **GEO:** Geostationary Earth Orbit, 35,786 km
- **HEO:** Highly Elliptical Orbit
- **ESC:** Deep space, Lagrange points, anything beyond Earth orbit

Five mass categories

- **<10 kg:** Cubesats 1U, 3U, 6U such as Planet, Spire, PocketQubes
- **11-50 kg:** Cubesats >6U, Satellogic, PlanetIQ
- **51-200 kg:** Constellations e.g., OneWeb 1G, SkySats, Capella
- **201-300 kg:** Mid-size smallsats e.g., early Starlinks, CO3D, Gonets-M, Vigoride
- **301-500 kg:** Larger smallsats e.g., Astranis Arcturus, Starlink 1G, SDA Transport T2

Four types of satellite manufacturers

- **Large integrators:** also integrates >500 kg satellites (non-smallsats)
- **Pure smallsat manufacturer:** purely focused on smallsats
- **In-house:** operator building its own smallsats (vertical integration)
- **Academia:** research or education institute, predominantly integrating COTS hardware

Five types of launchers *(Defined by payload capability to LEO)*

- **Micro:** <500 kg
- **Small:** 500 kg to 2 tons
- **Medium:** 2 to 9 tons
- **Heavy**: 9 to 30 tons
- **Super heavy**: >30 tons

Civil government and defense demand

Future demand for government satellites begins with social needs, as expressed through political priorities for space and related expenditures for civilian as well as military space systems. The “social demand” for space translates differently in established space countries and in emerging space countries. For the countries now committing to space technology development, national prestige and socio-economic development remain the two main priorities. Smallsats are easier to finance for emerging space countries than traditional satellites which are larger and more capable but also more costly. Thus, they often represent a low-cost entry point for emerging countries seeking to enter the space sector.

Commercial demand

Future demand for commercial satellites starts from end users’ needs, takes into account the different stages of the value chain, and ends with requirements for satellites and launches. The competitiveness of satellite systems with respect to terrestrial alternatives changes over time, as satellite technology always must innovate to allow satellite systems to do more than fill gaps where terrestrial systems are non-existent or inadequate to fullfill demand.

In recent years, numerous companies have developed smallsat systems, largely as part of constellations, to deliver better services and reach out to new users. These systems are supported by new ventures, with entrepreneurs investing in the so-called “new space” or “adaptive space” environment, but also increasingly by established players and governments alike. The backlog of satellites claimed to be under construction by commercial satellite operators is not representative of the future, as it overestimates the short term and underestimates the long term: no commercial LEO satellite is under construction for launch beyond five years from now, and some of the satellites planned for launch in the next two to three years will not be launched in that timeframe.

We expect that many of these new ventures will not come to fruition. Most still require additional financing to fund their projects, and many remain at an early conceptual stage. Numerous projects are just concepts or filings to capture spectrum that could later be monetized without necessarily launching an actual constellation. There is a risk that the failure of some flagship constellations could scare off future investors amid COVID and geopolitical and macro-economic uncertainty as well as high levels of inflation.

Pricing assumptions

Future satellite manufacturing and launch prices have been estimated based on historical price data points, allowing the correlation of a given mass and price to derive specific prices for smallsats (i.e., price per kg). Price trends have been extrapolated according to regression laws specific to the relevant market segments, regions, suppliers and user categories.

Satellite manufacturing prices differ according to the application of the satellite system and the origin of the satellite integrator. Satellite launch prices differ according to satellite mass, orbit and origin of the launch provider. The origin of the supplier and the mass category are also considered, as is the launch configuration (rideshare, batch, dual, single launch, etc.).

The impact of vertical integration and economies of scale on pricing assumptions is also considered, most notably in the case of Starlink which combines both, but also for numerous other stakeholders. Smallsat operators that favor in-house manufacturing rather than procurement have a significant impact on average satellite market value as well as on market accessibility to third parties. Unlike vertical integration which is favored by a multitude of players including new entrants and small constellations, the benefits of economies of scale are limited to large-scale mega-constellations with significant resources.

GOVERNMENT SPACE


Government Space Programs


Space Defense & Security

SATELLITE COMMUNICATIONS


Satellite Connectivity and Video Market


FSS Capacity Pricing Trends


Prospects for Maritime Satellite Communications

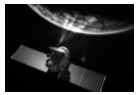

FSS Operators: Benchmarks and Performance Review


Prospects for Direct to Handheld and IoT Markets


Prospects for In-Flight Connectivity

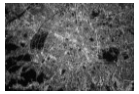

NGSO Tracker

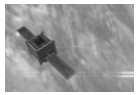

Optical Communications Market


High Throughput Satellites

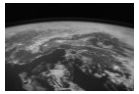
SPACE INDUSTRY


Satellites to be Built and Launched

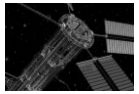

Space Market Monitoring


Prospects for the Small Satellite Market


Ground Segment Market Prospects

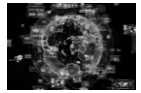

The Space Economy Report

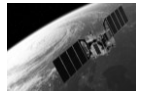

Financing & Transactions Database


Space Logistics Markets


Space Situational Awareness

EARTH OBSERVATION


Earth Observation Data & Services Market


Earth Observation Satellite Systems

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