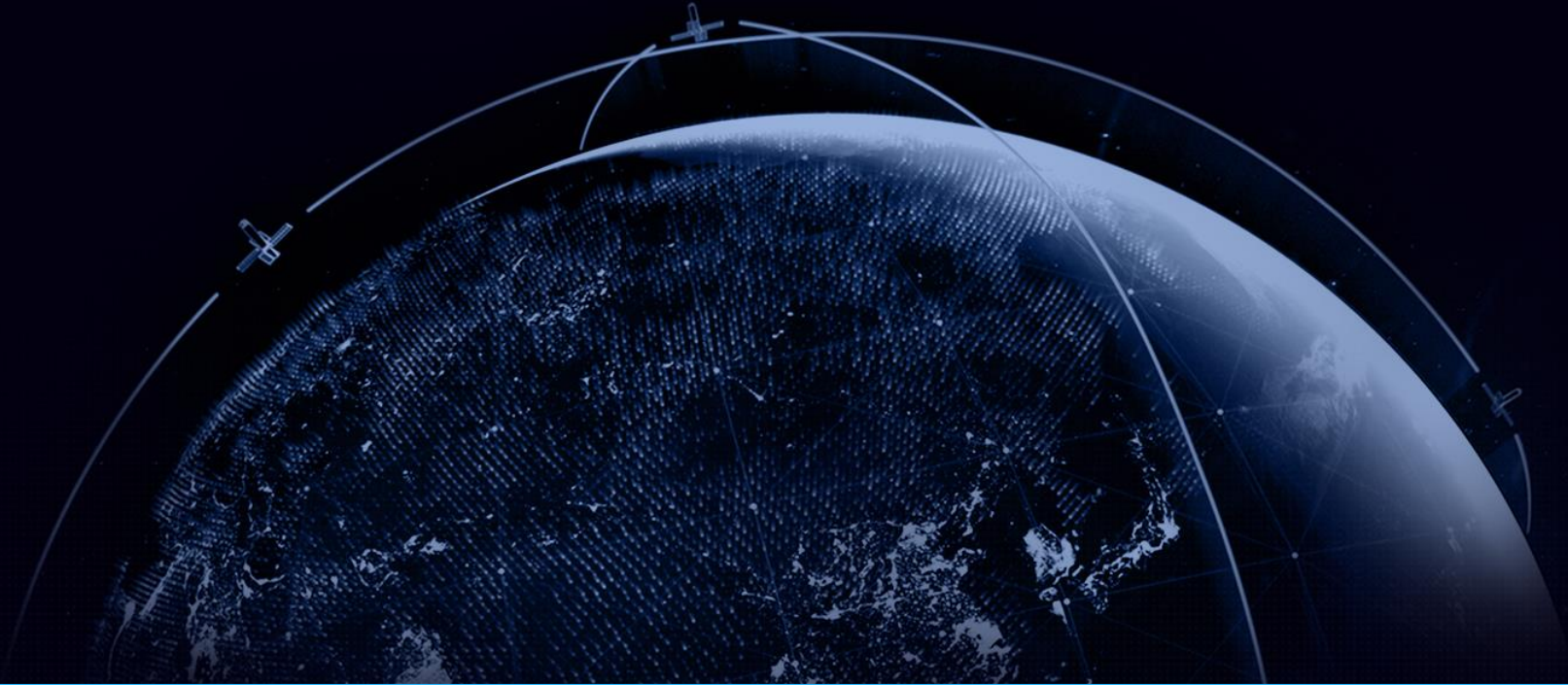


2020

NANO/MICROSATELLITE MARKET FORECAST, 10TH EDITION



QUANTITATIVE MODELING + MARKET EXPERTISE



STRATEGIC INSIGHTS



COST ESTIMATION &
ECONOMIC ANALYSIS



MARKET FORECASTING &
COMPETITIVE INTELLIGENCE



STRATEGIC ADVISORY &
CONSULTING SERVICES

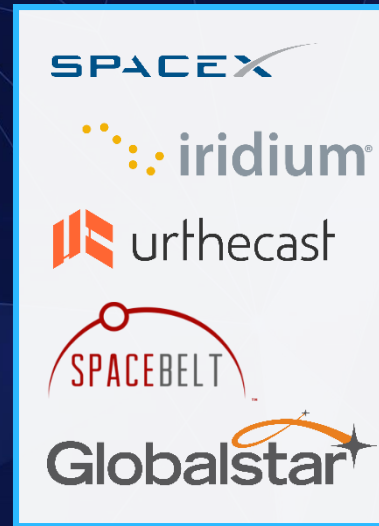
Since 2008, SpaceWorks has actively monitored companies and economic activity across both the satellite and launch sectors



0 - 50 kg



50 – 250 kg



250 - 1,000 kg



1,000 - 2,000 kg



2,000 kg+

Custom market assessments are available for all mass classes

NANO/MICROSATELLITE DEFINITION



Picosatellite
(0.1 – 0.99 kg)



Nanosatellite
(1 – 10 kg)



Microsatellite
(10 – 100 kg)



Small/Medium Satellite
(100 – 1000 kg)



This report bounds the upper range of interest in microsatellites at 50 kg given the relatively large amount of satellite development activity in the 1 – 50 kg range

THE END OF AN ERA



John Bradford,
President & CTO



Caleb Williams,
Lead Economic Analyst



Stephanie DelPozzo,
Economic Analyst

Dear Reader,

Nearly 10 years ago, SpaceWorks began monitoring a small, but growing, portion of the market known as nanosatellites. At the time, only about 20 to 30 such satellites were launching each year, but the industry was abuzz with discussions and claims about the future potential of these small spacecraft. On November 22nd, 2011, SpaceWorks debuted the first ever dedicated small satellite market research report, entitled 'SpaceWorks' Nano/Microsatellite Launch Demand Assessment'. In our earliest report, we predicted that as many as 100 nano/microsatellite per year would launch in 2020.

A decade later the industry is almost un-recognizable. From industry giants such as Lockheed Martin and Boeing, to companies like Cosmogia (Planet Labs) and Nanosatisfi (Spire), small satellite platforms have become a staple of their product portfolios. Dedicated launch options are no longer a dream of the future, but a reality of the present. And not only are a hundred nano/microsatellites launching each year, but hundreds.

For our part, what started as a limited-release technical report has grown to the most popular small satellite forecast in the world, with over 5,000 readers representing some 30+ countries. Our insights into the small satellite market have been featured in Forbes, Aviation Week, WIRED, and SpaceNews, not to mention countless pitch decks and conference presentations from around the world.

However, all good things must come to an end. Today, we announce the SpaceWorks 2020 Nano/Microsatellite Market Forecast, will be our last. As SpaceWorks continues to strive to be the number one strategic resource for executives and investors across the space industry, we have made the conscious decision to move to a more continuous model of content delivery. This will allow us to better respond to changing market dynamics and customer interests. Rest assured, there will be plenty of interesting analysis on the small satellite industry, but we also plan to include new markets and topics such as satellite servicing, the future LEO economy, orbital debris, and much, much more.

We would like to thank each and every one of you for being loyal readers of the SpaceWorks Nano/Microsatellite Market Forecast, and we hope that you will join us as we continue to enable executives to navigate the changing space market landscape, envision the impact of future technologies, understand the cost and feasibility of proposed systems, and make sound strategic investment decisions regarding the future of space markets.

Sincerely,

John Bradford, PhD

and the entire SpaceWorks Commercial Team

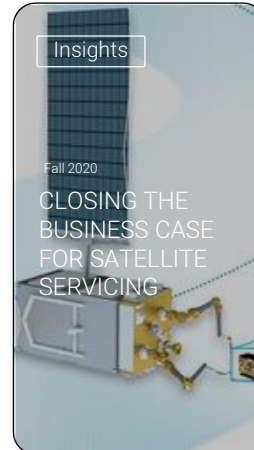
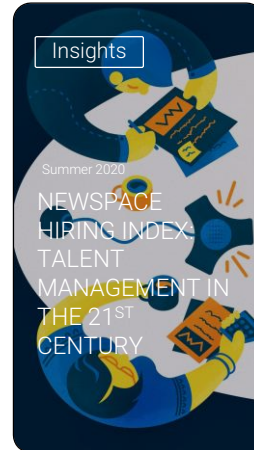


INTRODUCING SPACEWORKS INSIGHTS

2019



2020



SpaceWorks Insights explores some of the most challenging issues facing space industry executives today – visit www.spaceworks.aero/insights to learn more!





2010 – 2019

The past ten years have seen the nano/microsatellite segment grow by a factor of 10x, from as few as 20 satellites in 2011 to nearly 200 in 2019. Key segment players, such as Spire and Planet, have historically been responsible for a significant number of satellites launched, but new operators continue to gain traction and prove-out new business models, paving the way for future growth. Initially favored for technology demonstration missions, the industry has matured rapidly and nano/microsatellites are increasingly being used for commercial applications in earth observation, remote sensing, communications, and more.

2020+

SpaceWorks' 2020 projections have been revised downward by ~15% to account for the slower-than-expected roll-out of new IOT/M2M constellations and ongoing concerns about the longevity of small satellite business models. As operators continue to strike the balance between capability and affordability, future growth may also be split between the traditional nano/microsatellite segment (<50 kg) and larger satellite form-factors, creating questions about the future of the 1 – 50 kg mass class. Overall, SpaceWorks expects the industry to rebound from a down year in 2019 and predicts 298 satellites to launch in 2020.



2012

The Von Karman Institute Issues RFPs for the ambitious QB50 international CubeSat program.

2011

ExactEarth begins procuring their own small satellites for commercial maritime applications.

2010

QbX 1 & 2 become the first of the NRO's Colony-1 program CubeSats to reach orbit.

2010

SpaceX's Falcon 9 launches for the first time creating a new era of space accessibility.

2013

NanoRacks becomes the first commercial platform to deploy satellites from the ISS.



2017

Satellite production reaches new heights as OneWeb opens its state-of-the-art manufacturing facility.

2017

The ISRO's PSLV-37 deploys a record-setting 104 small satellites in a single launch.

2016

The White House announces its "Harnessing the Small Satellite Revolution" initiative.

2015

Google acquires Skybox Imaging for \$500M in one of the first successful small satellite company exits.



2020

2019

Capella Space launches the world's first sub-50kg SAR satellite (Denali).

2019

AstroDigital launches the world's first 16U CubeSat (Palisade).

2013

Planet Labs (then Cosmogia) launches its first Dove pathfinder satellite (Dove 1).

2014

Spire Global (then Nanosatfi) launches its first Lemur pathfinder satellite (Lemur 1).

2014

Just one year after launching their first demonstration satellite, Planet lofts 93 more satellites into orbit.

2015

Northrop Grumman (then Orbital ATK) launches 20+ small satellites with its first ISS resupply mission.



2017

AAC Microtec acquires Clyde Space for \$35M+ as consolidation in the manufacturing sector begins.

2018

Two of the most expensive CubeSats ever built, MarCO A & B, begin their journey to Mars.

2018

Spaceflight Industries' long-awaited SSO-A carries 64 satellites from 30+ countries to orbit.



MarCO

MarCO

THE EVOLUTION OF THE SMALL SATELLITE SECTOR



2019 HIGHLIGHTS

Rocket Lab began routine commercial operations this year, launching six times and lofting 10 nano/microsatellites (1-50 kg) to orbit

- China's Kuaizhou dedicated small satellite launch vehicle also launched four times and carried 11 nano/microsatellites (1-50 kg) to orbit

Capella Space became the first company to operate a sub-50 kg SAR (Synthetic Aperture Radar) satellite with the launch of Denalia (Capella 1)

- This comes at a time when Earth Observation providers are increasingly looking to diversify from low resolution, multi-spectral imaging

After a flurry of communications satellites were launched in 2018, many operators were notably silent in 2019, with only 17 satellites put into orbit

- Blink Astro & Lacuna Space joined a growing list of IOT/M2M service providers with the launch of the M6P satellite in early March

The number of satellites launched by civil operators was greater than that of commercial operators for the first time in the last five years (89 vs. 87)

- Although still a decline from last year, the civil segment showed greater resiliency with a decline of only 17% vs. 25% for the market overall



FORECASTING METHODOLOGY

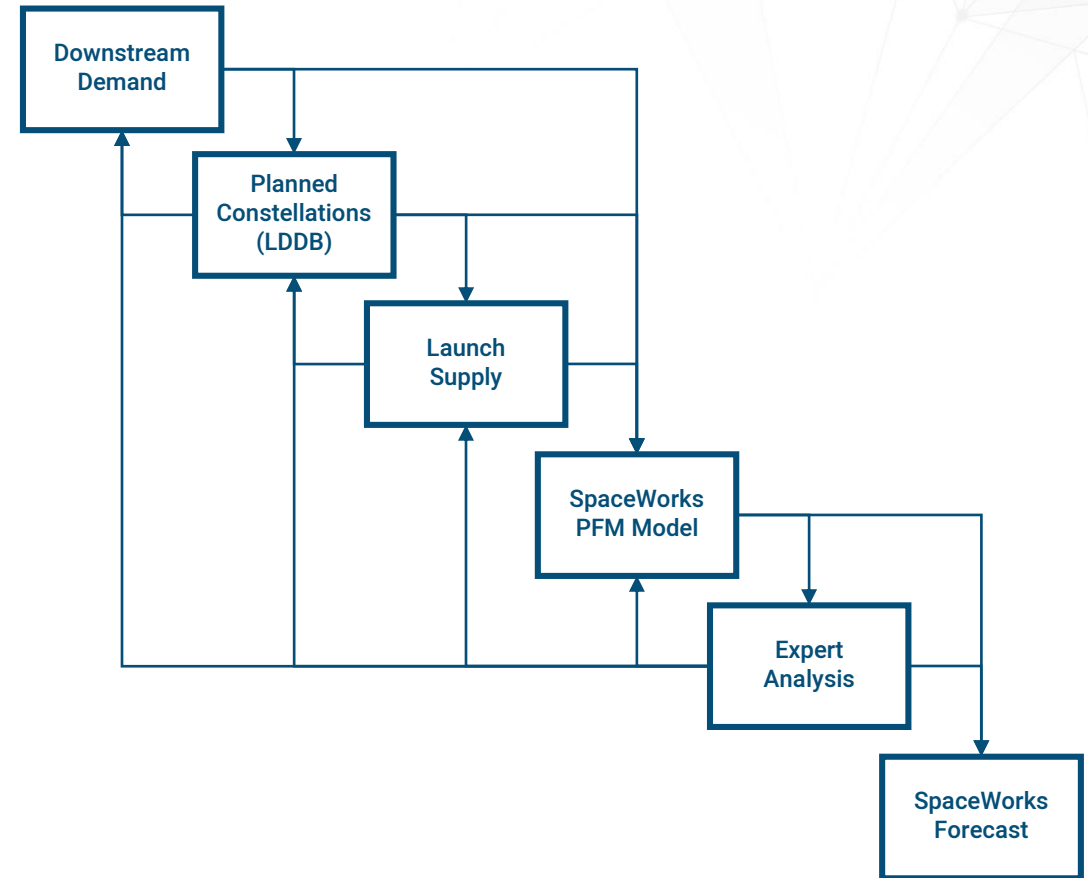
SpaceWorks' proprietary Launch Demand Database (LDDDB) serves as the data source for all satellite market assessments

- The LDDDB is a catalogue of over 10,000+ historical and future satellites containing both public and non-public satellite programs

SpaceWorks newly updated Probabilistic Forecast Model (PFM) is used to generate future market potential

- The PFM considers down-stream demand, announced/planned satellite constellations, and supply-side dynamics, among other relevant factors

The team of expert industry analysts at SpaceWorks further interprets and refines the PFM results to create accurate market forecasts

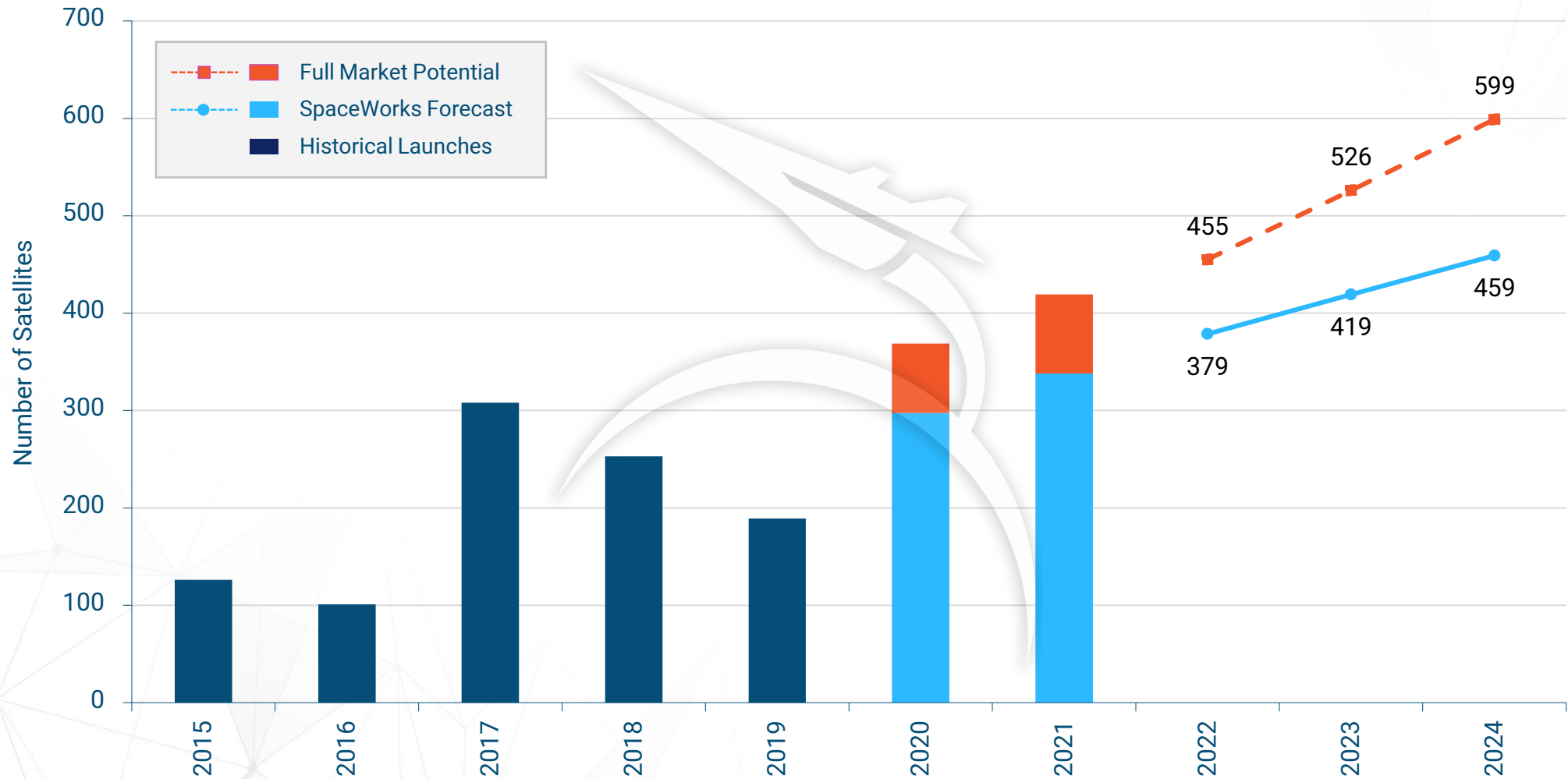


Methodology at a Glance



SATELLITE LAUNCH HISTORY & MARKET FORECAST

Nano/Microsatellites (1 – 50 kg)





**SpaceWorks estimates 1,800 – 2,400 nano/
microsatellites will require launch over the next 5 years**

OPERATORS & ASSOCIATED EXAMPLES

Nano/Microsatellites (1 – 50 kg)

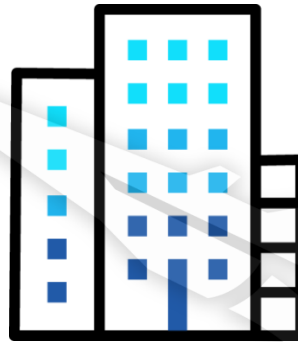


Military

Operators whose primary satellite purpose is to support national defense activities.

Examples

US Naval Research Laboratory
DARPA
Colombian Air Force

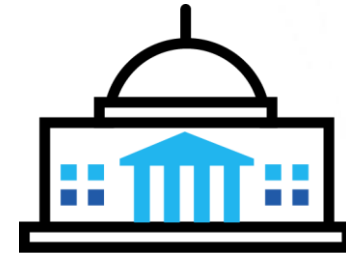


Commercial

Operators whose primary satellite purpose is for-profit revenue generating activities.

Examples

Planet Labs
Spire
Astro Digital



Civil

Operators whose primary satellite purpose is non-military or non-profit activities.

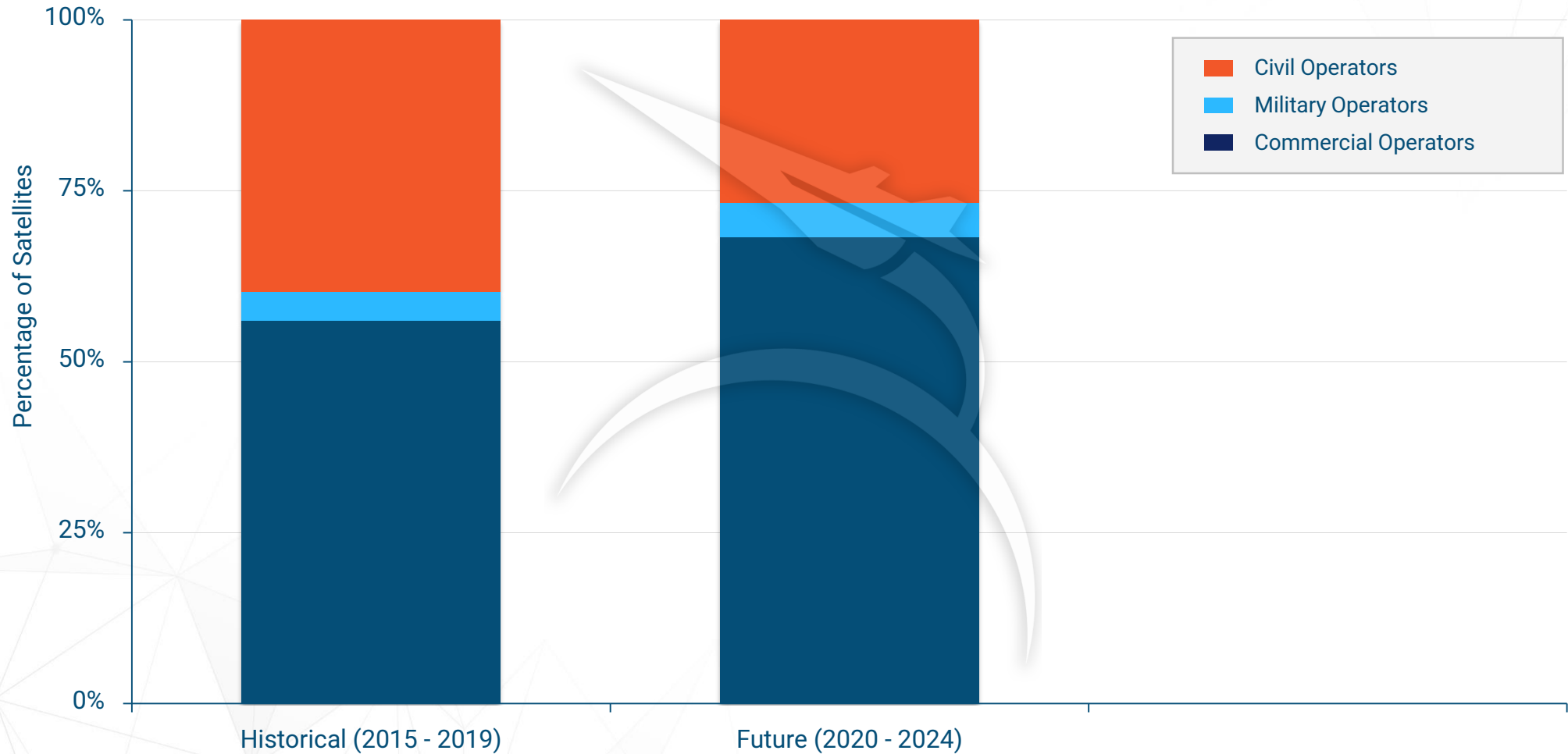
Examples

NASA
Kyushu Institute of Technology
The Aerospace Corporation



SATELLITE OPERATOR TRENDS

Nano/Microsatellites (1 – 50 kg)

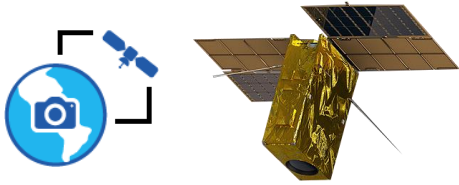




Civil operators launched more satellites in 2019 than any other segment, but future market growth is expected to be driven primarily by Commercial operators

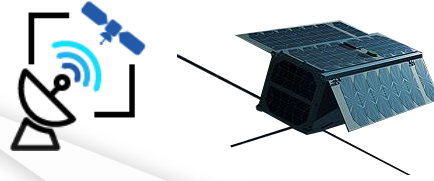
INDUSTRY VERTICALS & APPLICATIONS

Nano/Microsatellites (1 – 50 kg)



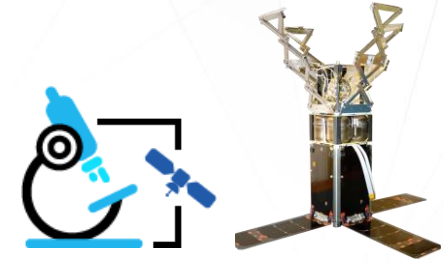
Earth Observation/ Remote Sensing

Ex. Lingque 1A (ZeroG Lab)



Communications

Ex. Hawaii (Astrocast)



Scientific

Ex. CryoCube (NASA KSC)



Technology

Ex. Pony Express 1 (Tyvak)



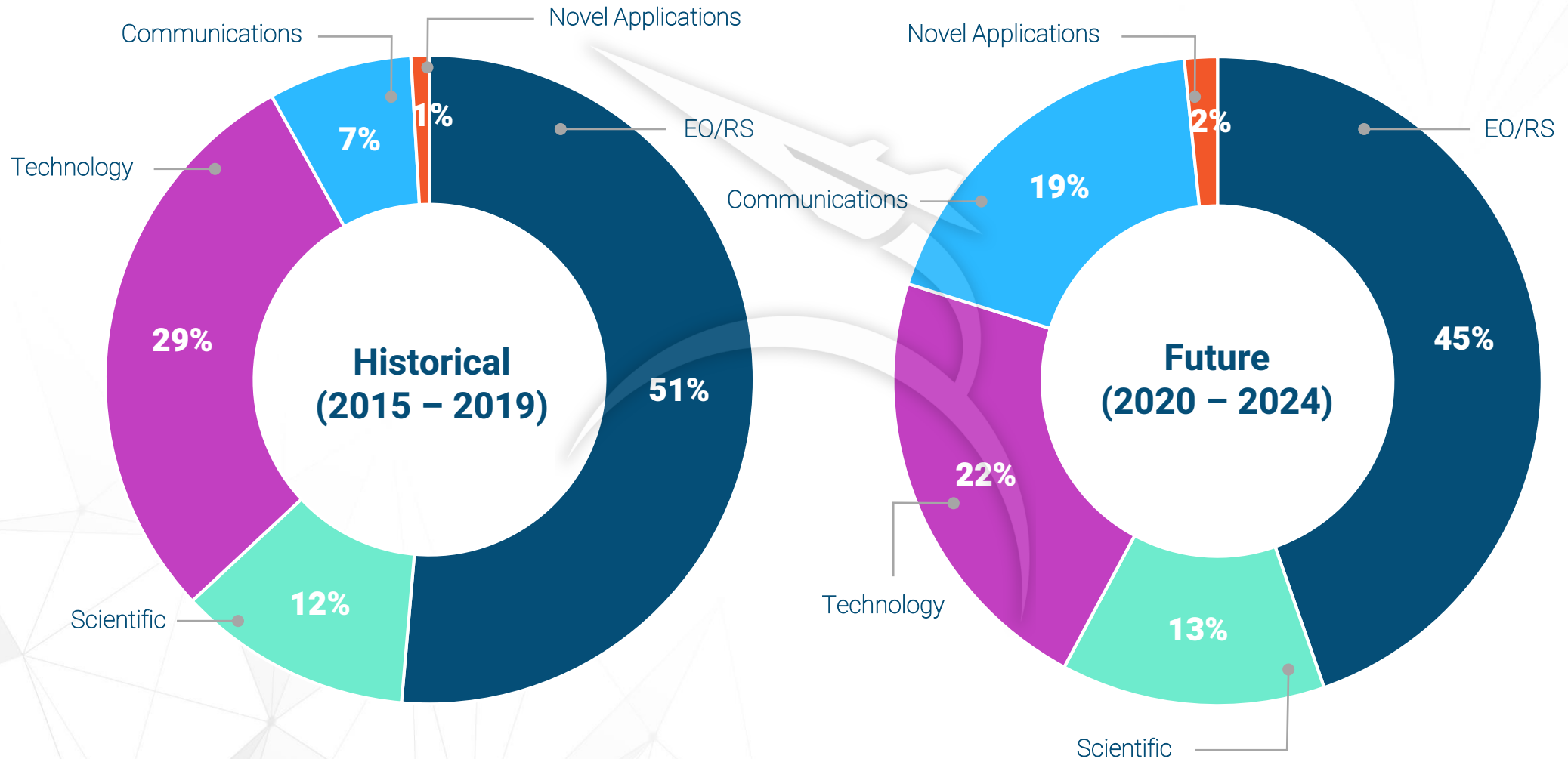
Novel Applications

Ex. El Camino Real (Momentus)



SATELLITE APPLICATION TRENDS

Nano/Microsatellites (1 – 50 kg)

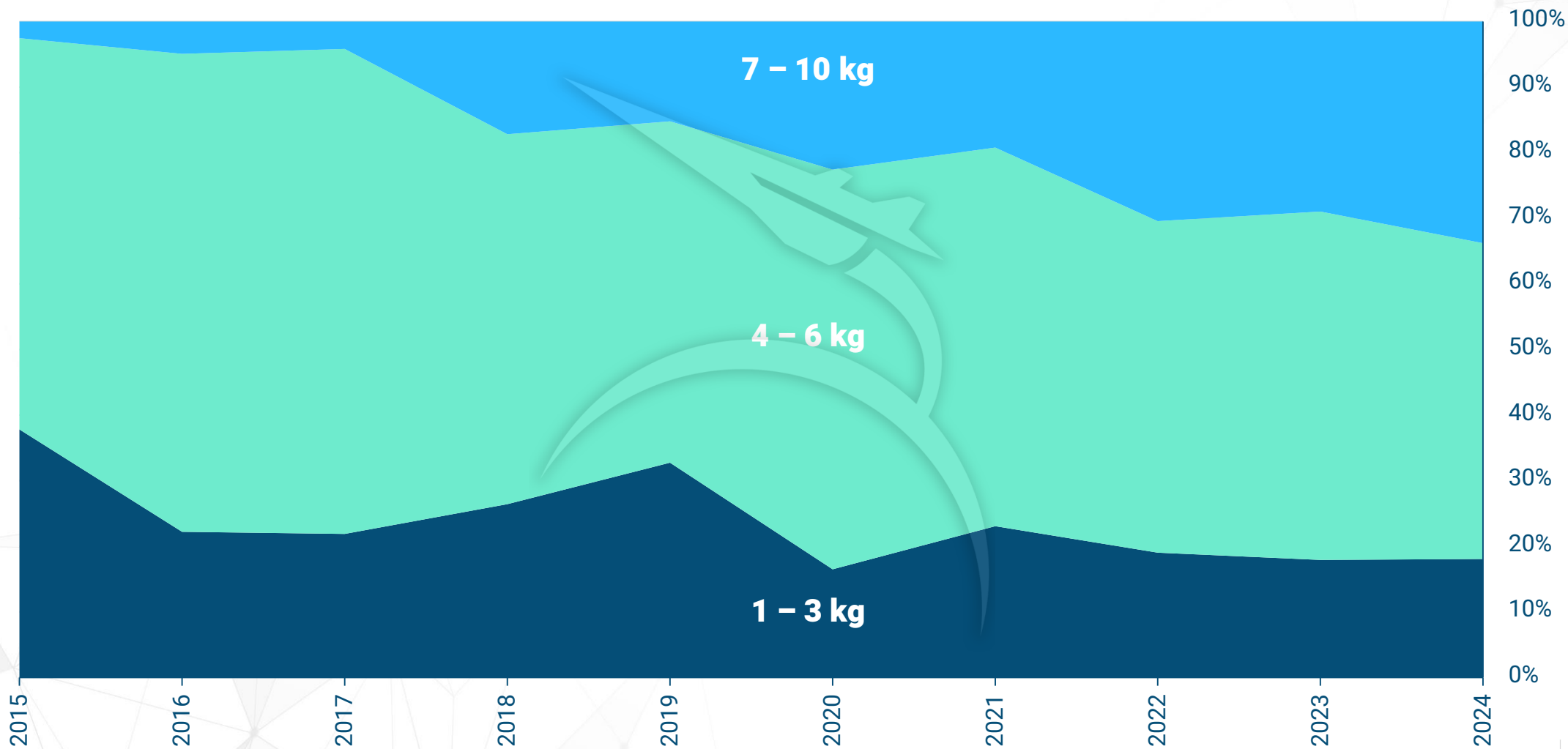


An aerial view of Earth from space, showing a blue and white planet with a network of thin, light blue lines overlaid on it, suggesting a global communication or data network. The lines form a complex web of triangles and polygons across the globe.

After a massive surge in 2018, Communications operators were notably absent in 2019, raising questions about their role in the future of the market

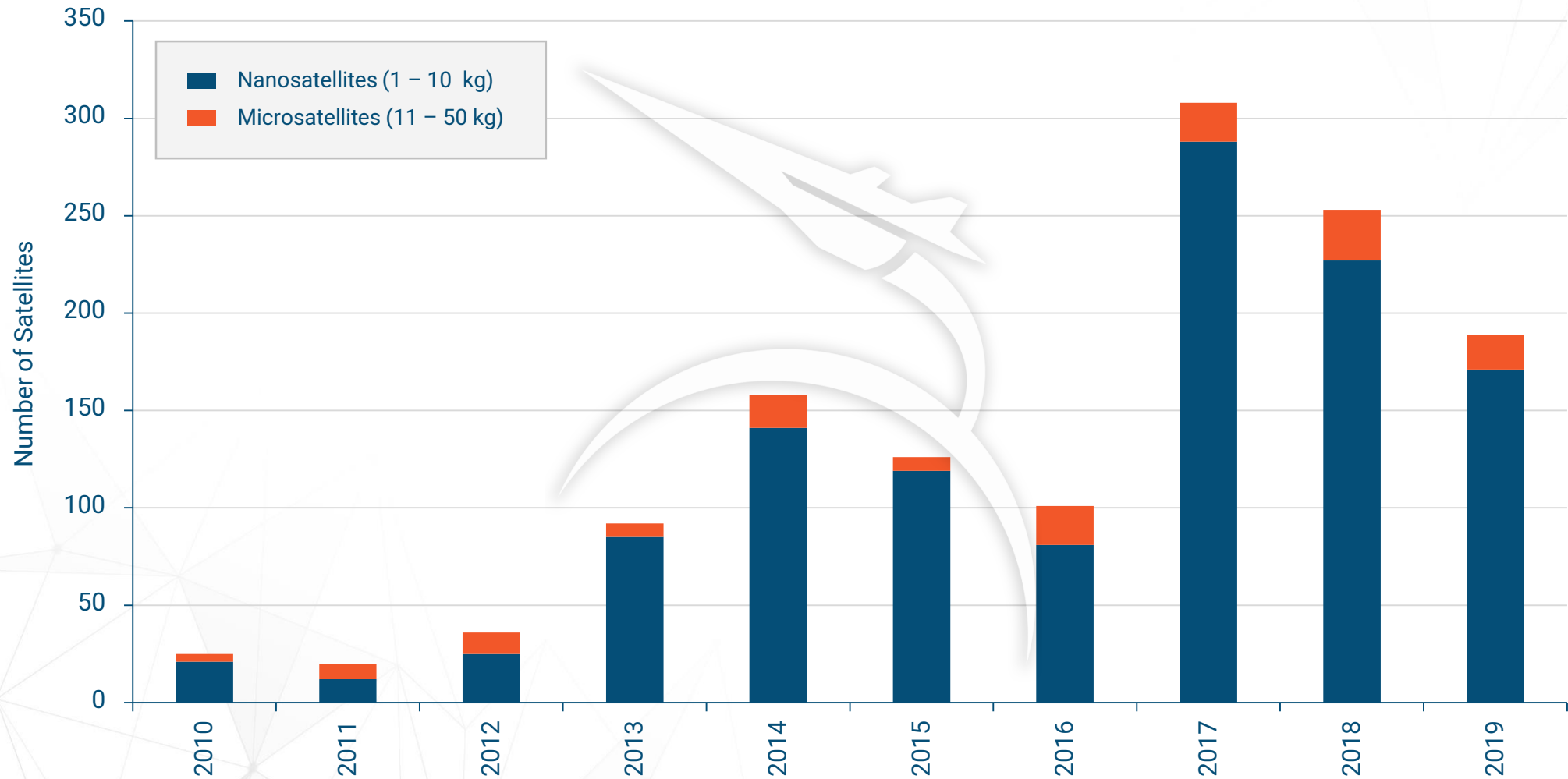
SATELLITE SIZE TRENDS

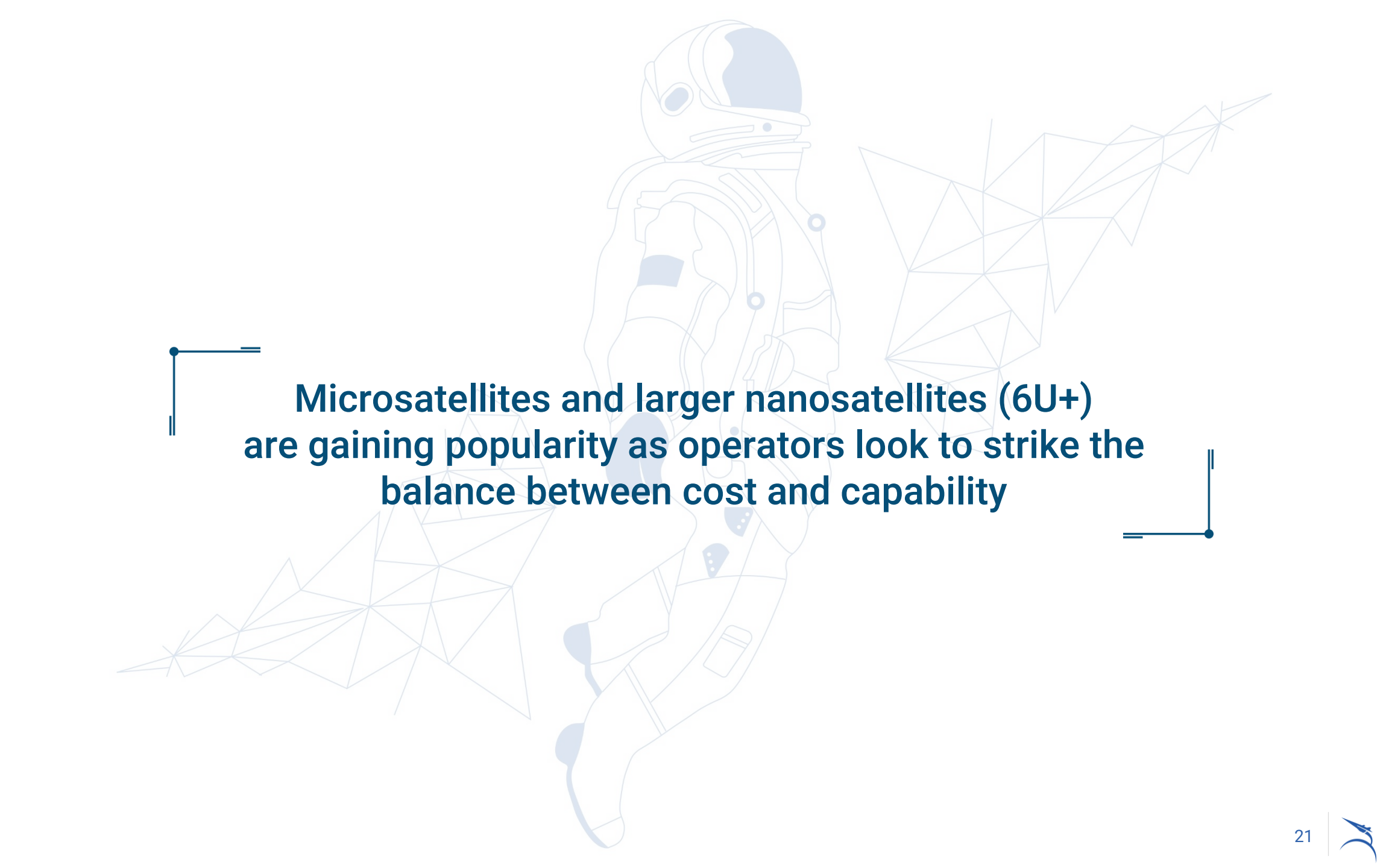
Nanosatellites (1 – 10 kg)



HISTORICAL SATELLITE SIZE TRENDS

Nano vs. Microsatellites (2010 – 2019)

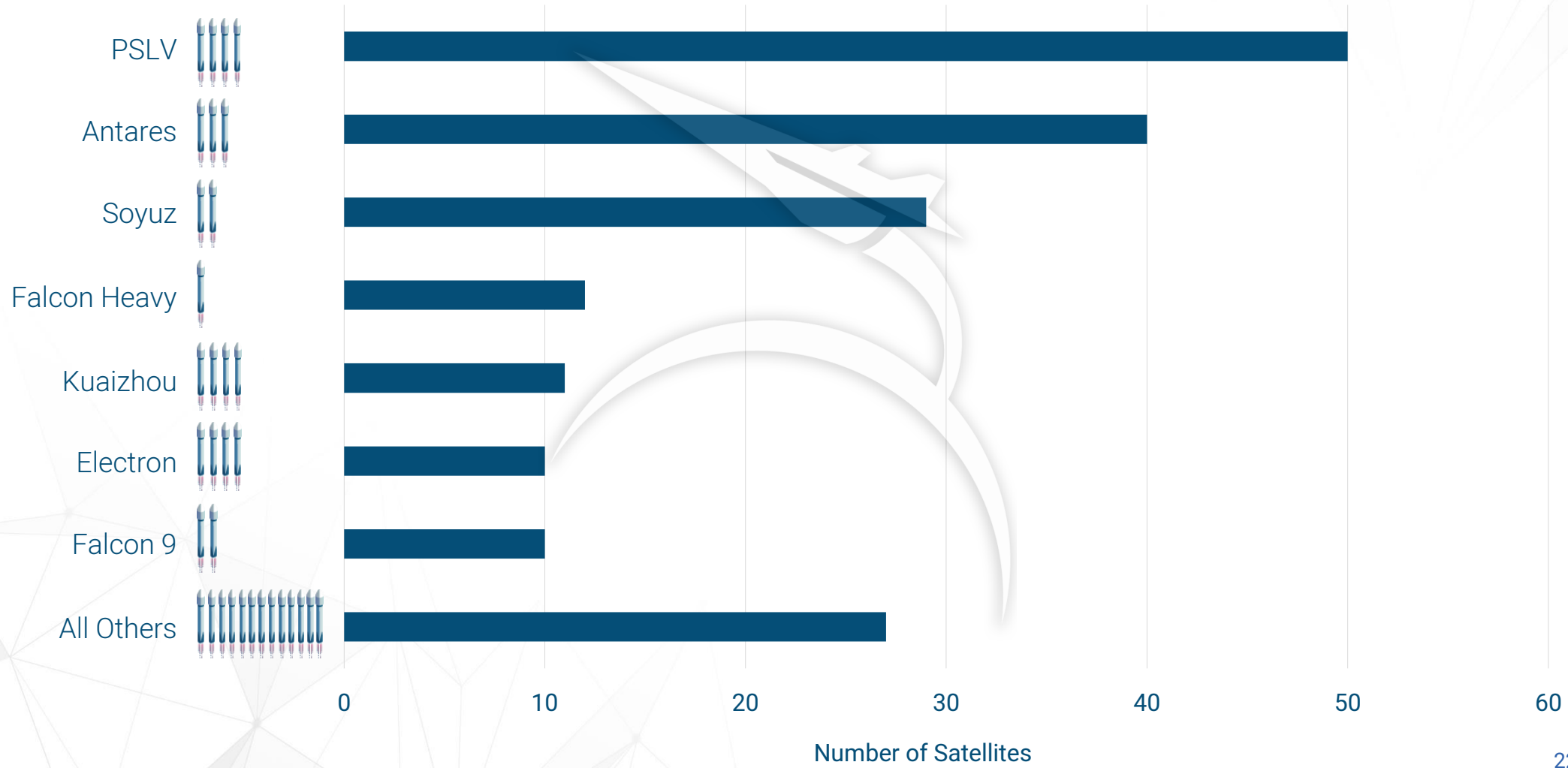


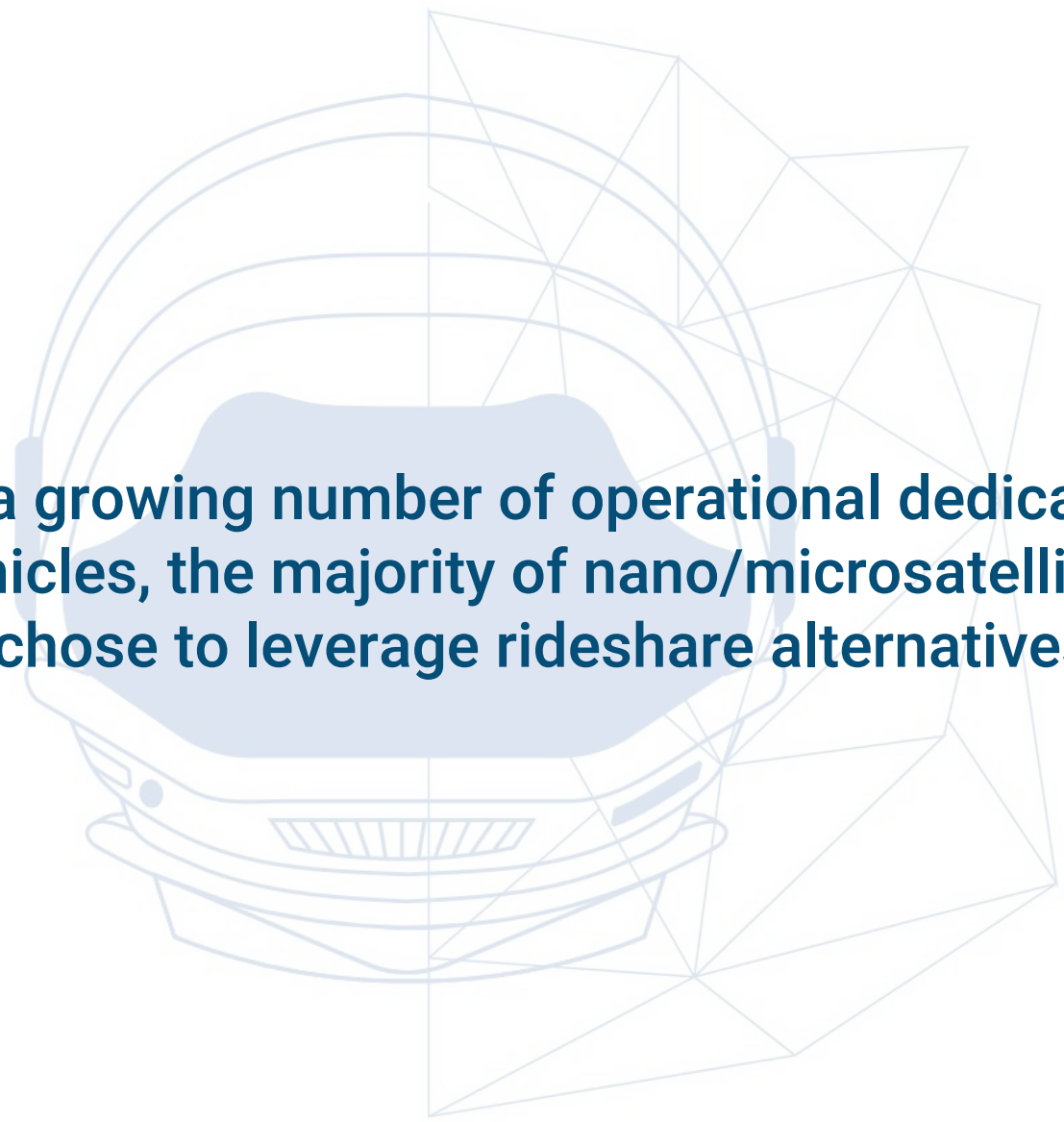
The background features a light blue line-art illustration of an astronaut in a full space suit, floating in space. To the right of the astronaut is a large, complex geometric structure representing a satellite constellation, composed of numerous interconnected triangles and lines. The overall aesthetic is clean and technical.

**Microsatellites and larger nanosatellites (6U+)
are gaining popularity as operators look to strike the
balance between cost and capability**

2019 RIDES TO SPACE

Nano/Microsatellites (1 – 50 kg)














Despite a growing number of operational dedicated launch vehicles, the majority of nano/microsatellites in 2019 chose to leverage rideshare alternatives

SMALL SATELLITE LAUNCH VEHICLE LEADERBOARD

2020 CASE STUDY #1

Rank ¹	Name	Stated IOC	Estimated Payload to SSO (kg) ²	Target Launch Price ³	Major Recent Milestone(s)
1	 Electron	2018	150	\$33K/kg	Six successful launches to orbit in 2019
2	 Kuaizhou 1A 	2017	250	\$57K/kg	Five successful launches to orbit in 2019
3	 Launcher One	2019	300	\$40K/kg	Successful drop test
4	 Alpha 	2021	630	\$24K/kg	Hot fire attempt
5	 Astra 	2020	135	\$18K/kg	Two attempted flights to orbit
6	 Small Satellite Launch Vehicle (SSLV)	2019	700	\$12K/kg	First commercial launch bought by Spaceflight Industries

¹ Rankings based on SpaceWorks' Launcher Maturity Index, a subjective assessment of launch vehicle operators based on a variety of factors – please see end notes ² SSO payload estimated and normalized from available data when necessary ³ Estimated



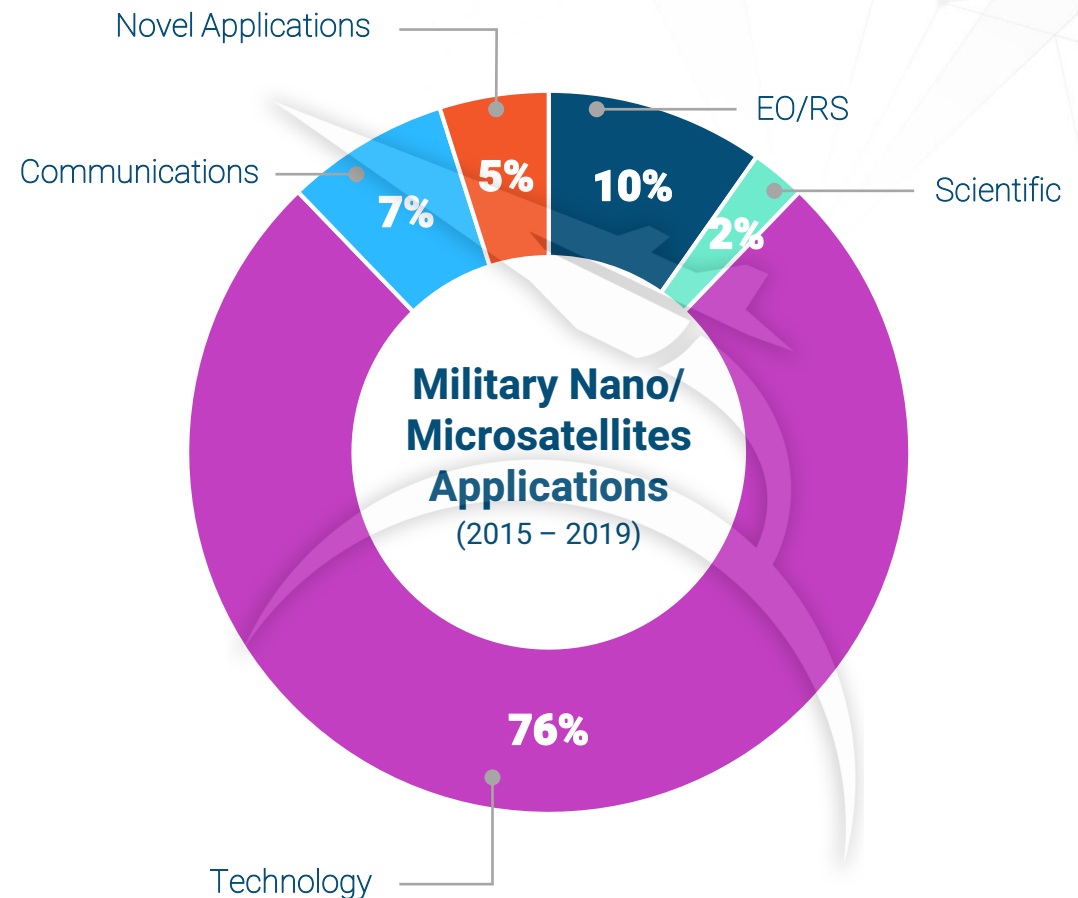
SPOTLIGHT ON MILITARY INTEREST

2020 CASE STUDY #2

The military was one of the earliest adopters of the nanosatellite form factor with their Colony I & Colony II programs in the early 2010s. Nearly ten years later, however, their interest has largely failed to materialize. In a given year, military small satellites only represent about 15% of total nano/microsatellites launched.

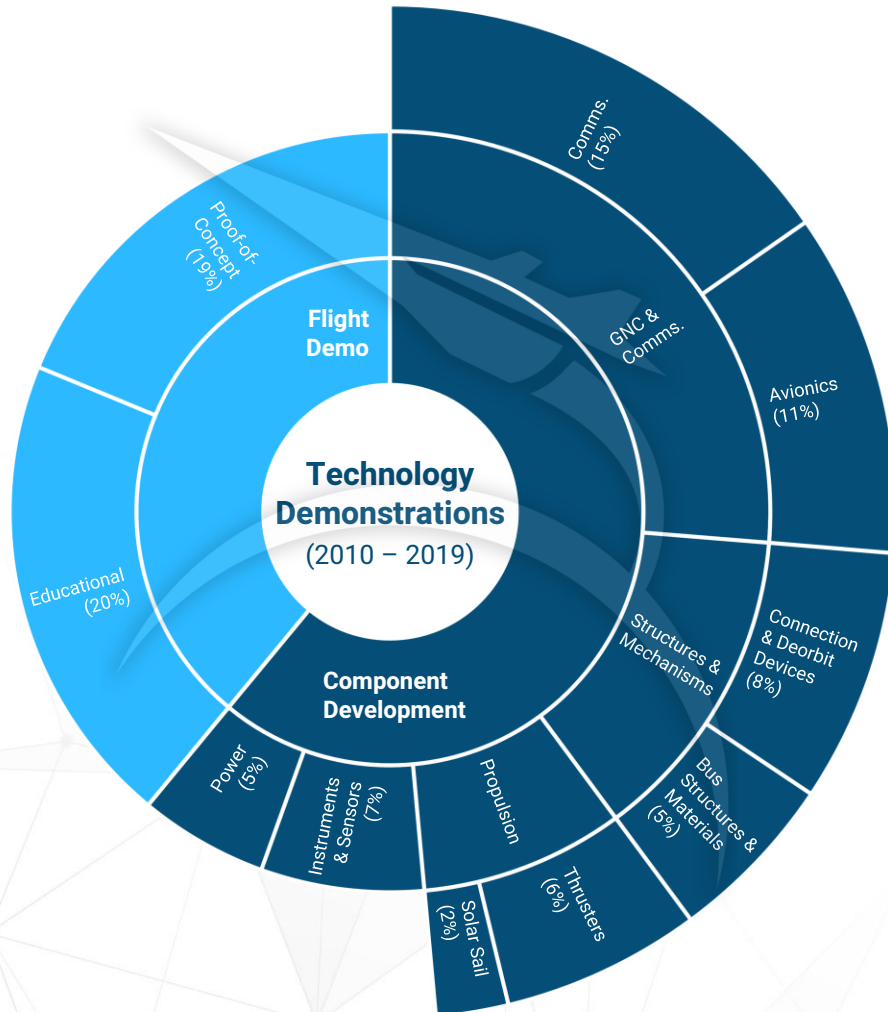
When taking a closer look at the data, SpaceWorks finds that of those military small satellites launched, less than 25% are used to complete operational sorties; the vast majority are used only for technology demonstration purposes. This stands in stark contrast to the rest of the market, where 70%+ of satellites are used for operational missions.

SpaceWorks' research in this area suggests that military operators historically have lacked confidence in the capabilities of small satellites and preferred to leave the 'real work' to their larger, more sophisticated assets. Breaking out of the 'technology demonstration box' will require small satellites to demonstrate that they are, indeed, capable of executing mission critical objectives at a lower price point.



MATURING TECHNOLOGIES

2020 CASE STUDY #3



The military segment isn't alone in its appetite for technology demonstration satellites – both civil and commercial operators have launched their fair share in the past decade, too. Recent examples, such as Astro Digital's Palisade, highlight the critical role of technology demonstrations in risk reduction.

The majority of these missions, however, aren't just risk-reduction for the sake of risk-reduction. SpaceWorks research finds that nearly 60% of technology demonstration missions are explicitly for the purpose of maturing specific components or subsystems. Communications and Avionics components commanded the bulk of investment to-date, but Structures & Mechanisms and Propulsion components also registered significant interest.

Moving forward, it is expected that technology demonstration missions will decline as the industry shifts towards routine commercial operations. Still, strong military demand and a number of new interest areas (such as Connection & Deorbit Devices) may be enough to protect the market share of the technology segment for at least the near-term.



2020 FORECAST CONCLUSIONS

A total of 189 nano/microsatellites were launched in 2019, a decrease of 25% as compared to last year

- As major operators such as Planet and Spire begin to enter the constellation replenishment phase, new operators will be needed to maintain sector growth

The communications segment was noticeably quiet in 2019 as many operators pursued fundraising rounds after their initial technology demonstrations

- AstroCast and Fleet Space were two of the big winners in the segment, securing almost \$10M each in additional funding last year

Despite the long-awaited arrival of dedicated small satellite launch vehicles, more than 75% of nano/microsatellites opted for rideshare launches

- With increasing competition from SpaceX and Arianespace, dedicated small satellite launch providers will need to rapidly find ways to differentiate themselves

The sector is beginning to see the rewards of early investments in technology maturation for key satellite subsystems

- Companies like NSLComm are capitalizing on these development efforts and creating enabling technologies for new small satellite business models



SPACEWORKS COMMERCIAL SERVICES

Our economic consultants monitor global economic activity across the space sector and combine quantitative modeling with deep industry expertise to answer critical business questions. Our work helps clients to navigate the changing space market landscape, envision the impact of future technologies, understand the cost and feasibility of proposed systems, and make sound strategic investment decisions regarding the future of space markets.

Single-Stage-to-Orbit (SSTO)
Market Addressability Study

Hypersonic Point-to-Point
Transportation Market Survey

Small Satellite Launch Vehicle
Operators Report

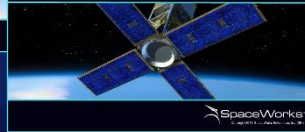


SpaceWorks
Economic & Market Research

Orbital Platforms
Market Assessment

Satellite Industry
Value Chain Report

Satellite Communications
Market Assessment



SpaceWorks
Economic & Market Research

Small Satellite Industry
Macro Economic Trends Report

Top Small Satellite
Operators Report

Satellite IOT/M2M
Market Assessment

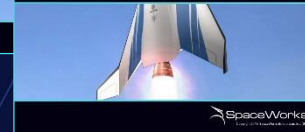


SpaceWorks
Economic & Market Research

Government Funding
Mechanisms Report

Satellite Ground Stations
Market Assessment

Spaceport
Field Guide



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Interested in how we can help your business? Contact us today:

Caleb Williams | Lead Economic Analyst | 770-379-8017

caleb.williams@spaceworks.aero

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MARKET FORECASTING &
COMPETITIVE INTELLIGENCE



STRATEGIC ADVISORY &
CONSULTING SERVICES

END NOTES

1. The number of satellites may not equal the number of launches since many small satellites are multiple-manifested (i.e., more than one satellite co-manifested on a particular launch vehicle). Historical data includes failed launch attempts.
2. The data used throughout this presentation (both historical and future) may not represent all global nano/microsatellites
3. The SpaceWorks Forecast and Full Market Potential datasets include some known nano/microsatellite programs for which a specific launch date has not been announced. The satellites belonging to these programs are distributed across the period (date range) for launches according to the announced program objectives and expected launch schedule.
4. Future projects are determined by "best fit" regression with a set market saturation point based on expected downstream demand.
5. The Full Market Potential dataset contains all currently known past and future nano/microsatellites from the SpaceWorks LDDDB, with the addition of inflating factor for known unknowns plus assumed sustainment of certain projects and programs and the continued emergence and growth of numerous existing commercial companies. The SpaceWorks Forecast dataset reflects SpaceWorks' expert value judgement on the likely market outcome.
6. Graphs are based on the SpaceWorks Forecast dataset only, and do not include the additional satellites contained in the Full Market Potential dataset
7. Nanosatellites are binned by rounding mass to the nearest whole number. Picosatellites less than 1 kg are not included
8. SpaceWorks' Launcher Maturity Index is a qualitative assessment of Small Satellite Launch Vehicle operators based on a number of factors, including historical performance, funding and licensing status, team composition and completeness, operator potential to capture global market share, and SpaceWorks' overall expert judgement of the operator's credibility for executing their launch plans within their stated IOC targets.
9. SpaceWorks wishes to attribute image credits for images not cited inline to the following entities: Planet Labs, Astrocast, Capella Space, Aerial & Maritime Ltd., Satellogic, HawkEye360, Spire Global, SpaceQuest, Astro Digital, OneWeb, EarthI, Iceye, Axelspace, SpaceX, Iridium, Urthecast, SpaceBelt, Globalstar, AMOS, SES, ABS, Intelsat, Echostar, ArabSat, Hispasat, ViaSat, Turksat, Inmarsat, Digital Globe, RocketLabs, China Great Wall Industries, Virgin Orbit, Indian Space Research Organization, Vector Space Systems, PLD Space, US Department of Transportation, US Department of Commerce, and US Director of the Office of National Intelligence

Developed by:

Stephanie DelPozzo

Economic Analyst

Caleb Williams

Lead Economic Analyst

Illustrations by:

Lorena Carapaica & Davin Gerber

