

Defying Gravity

Challenges, opportunities, and innovations in the space tech industry

eBook



INTRODUCTION

Challenges, Opportunities, and Innovations in the Space Tech Industry

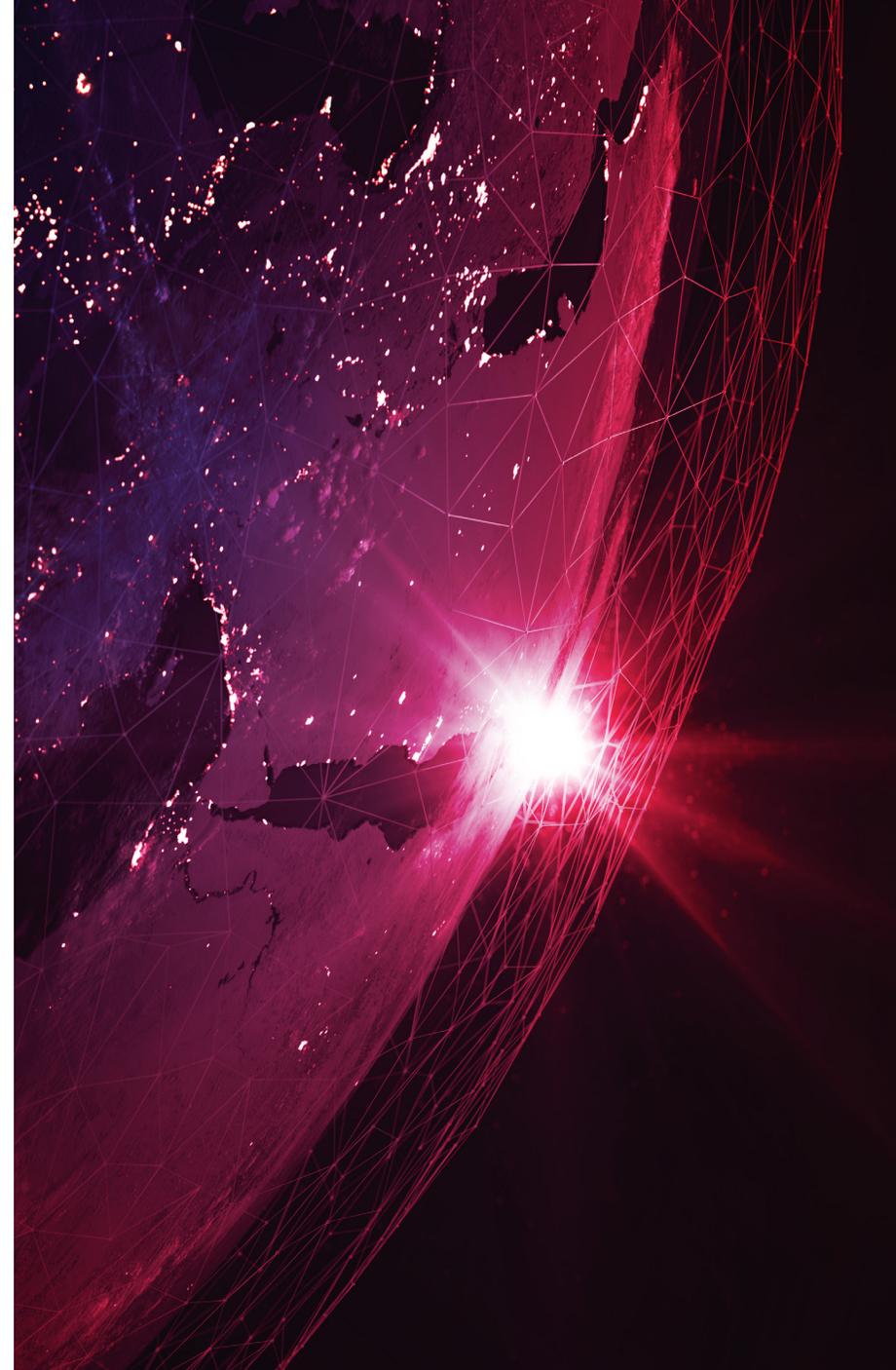
All eyes are on the sky, it seems. The space tech industry is a collective effort to defy gravity both literally and figuratively—taming physics and driving innovation into soaring new realms.

Companies and governments around the globe are racing to make their mark in space. New technologies are emerging rapidly and new use cases are being discovered daily. Established players and start-ups alike are disrupting the space industry as never before.

To help you and others in—or contemplating joining—the industry, we commissioned Coleman-Parkes Research to conduct an in-depth survey of current and future trends in the industry. This report shares the results of that primary research study along with a broad overview of industry analysis that provides essential context to the survey findings.

The space and satellite industry is adopting increasingly advanced technologies and turning out new designs with vastly reduced cycle times. We intend to help you identify the drivers of this growth and acceleration, the enabling technology trends, and the pain points you will face along the way.

Initial secondary research compiled a “survey of surveys” to form a consolidated picture of the industry. In addition, during 2022, we conducted original research covering companies in the ecosystem, satellite payloads, and the ground equipment used by the industry over the full life cycle, from development through operation.



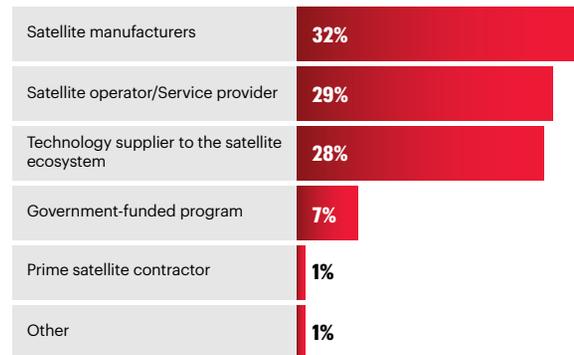
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Space tech primary research study methodology

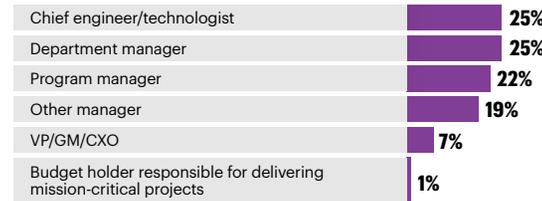
In partnership with Coleman-Parkes Research, we interviewed several space and satellite ecosystem players across the Americas, Asia Pacific and EMEA, including satellite developers, manufacturers, subsystem suppliers, operators, and service providers. Our methodology used phone screening in combination with a web-based survey form to solicit responses from everyone from CXOs to managers within the industry.

The results of the combined secondary research and primary survey reveal an industry that’s expanding and evolving rapidly and in multiple directions. The scope and nature of those changes and trends—and what they mean for your business—may surprise you. They certainly changed our thinking. We hope you find this research helpful as you consider your future moves and strategies.

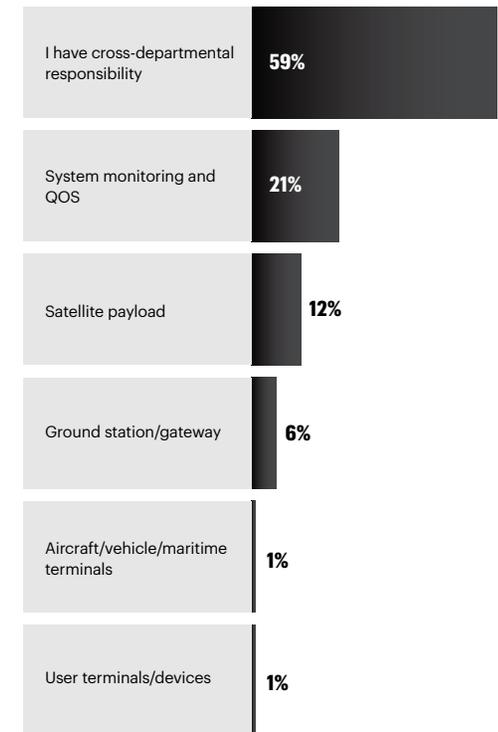
Organization type (self declared)



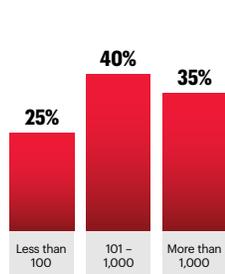
Role/title of the respondents



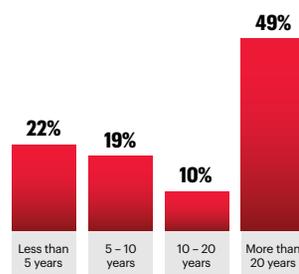
Department responsibility matrix



Number of employees



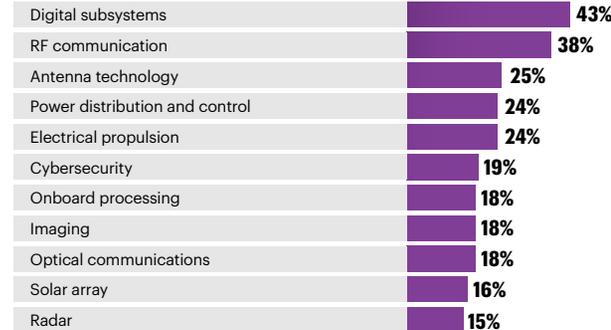
Number of years in operation



Responsibility for decision making around sourcing suppliers of design, verification, monitoring, and maintenance solutions



Areas of involvement



INTRODUCTION

Implications of the research

Historically, the vast majority of Keysight's space business has been highly concentrated on the satellite manufacturers, defense-oriented as well as commercial. Our solutions have revolved mostly around testing of satellite payloads (communications and GPS satellites) and their RF and Power subsystems. The survey findings validated our strategic planning assumptions that Keysight could provide value more broadly by including the end-to-end needs of the larger satellite communications (SATCOM) market. We focus on two major axes: the project life cycle from design to operations of satellites and all their subsystems, and the ground segment including ground stations as well as user terminals and SATCOM operators themselves.

With the potential adoption—or at least the adaptation—of 3GPP 5G-NTN, 5G-related design and test solutions as well as network simulation and software testing will be increasingly valuable to the industry.



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CHAPTER 1

Market Landscape



Growth Is Rocketing

Along with our primary research survey, we conducted extensive secondary research, collating and cross-checking a large amount of published data on the growth and drivers for the satellite industry. We look at current and future market value, examine the leading technological and growth trends and challenges facing the industry, and who the key players are in both the private and government sectors.

Market value and projections

The global SATCOM market is expected to grow significantly over the next five-to-ten years. Estimates for current value and projected growth rates vary across sources and depend on how the sector is defined and the time period covered. Market value of the global space industry is estimated currently to be between USD 380–388 billion and is forecasted to grow as high as USD 540 billion by 2025–26. The SATCOM sector is projected to expand even faster than the overall global space industry, nearly doubling in size in the same time frame.

Global space economy market



Source: Business Wire

Global space tech economy



Source: SpaceTech Analytics

Global SATCOM market



Source: Research and Markets

5G SATCOM market



Source: BIS Research

Key Drivers of Market Growth

Of the array of factors driving the development of SATCOM, we've identified six leading drivers of market growth.

1 Defense industry

The growing adoption rate of small satellites in the defense industry for applications, including geospace and atmospheric research, tactical communication, and medium resolution imagery, is anticipated to propel market growth. Large constellation systems in LEO (Low Earth Orbit) are attracting much interest and early tech development spending. The US Space Development Agency, for instance, is working with leading military contractors, commercial satellite operators, and technology companies to demonstrate the feasibility of a proliferated constellation of satellites in LEO.





2 5G

As demand for wireless connectivity increases exponentially, service providers are boosting their investments in 5G and infrastructure development. For the high bandwidth required for the deployment of 5G, they are looking more and more to SATCOM.

North America dominated the market share in 2020; however, [according to Benzinga](#), the APAC region is expected to grow at the highest rate during the forecast period due to an initial lag in adoption of 5G combined with the current increase in implementation of 5G for mobile broadband.

In 2019, China rolled out one of the world's largest 5G networks to become a global technology leader. It has also launched Yinhe-1 commercial LEO 5G satellite to propel the 5G market deployment in the country.

For the deployment of 5G, SpaceX has received approval to launch nearly 12,000 Starlink internet satellites. Therefore, the launch of these satellites is set to drive the SATCOM market.

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3 Media and entertainment

Media and Entertainment takes a significant part of the SATCOM market owing to the rising demand from a growing population. This is mainly attributed to the increasing demand for the internet and online streaming/Direct-to-Home (DTH) services such as Amazon Prime Video, Netflix, and Hulu.

Analysts also predict that rising demand for various applications (such as audio broadcasting and voice communications in end-user industries) will fuel the growth of the SATCOM industry, [reports Benzinga](#). Key applications for space tech such as high throughput satellites in GEO include broadband services to underserved rural communities and maritime users (such as cruise ships and offshore operations) and in-flight connectivity.

In addition, the significant adoption of Direct-to-Home in media and entertainment applications will positively impact the growth of the market since SATCOM plays a crucial role in providing subscribers with high-quality content.



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4 Broadband for underserved communities

The pandemic brought to the fore the disparities in broadband data services between different communities—and the effect of the digital divide on education, employment, healthcare, and many other societal factors. Closing the digital divide has become a major objective of nations around the world.

In 2021, Amazon's Project Kuiper and Verizon joined forces to focus on rural communities and other regions that are currently underserved when it comes to broadband data services. [Yahoo Finance](#) reports that the two parties will collaborate on connectivity solutions that capitalize on Kuiper's future broadband satellite constellation as well as Verizon's terrestrial 4G/LTE and 5G data networks.



5 Aviation sector

The escalating demand for SATCOM solutions in the aviation sector for better airline operations and air traffic management is expected to boost the market growth in the forthcoming years, [predicts Research and Markets](#).

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6 Other communications approaches

There is increasing interest in alternative communications approaches such as VoIP. In fact, VoIP is becoming another major driver for the growth of the space tech market. Satellite internet providers ViaSat and HughesNet both offer proprietary VoIP service as an add-on with internet plans. These providers offer unlimited calls in the United States without using any of the user's internet plan data.

Additionally, in 2021, [The Independent](#) reported that filings submitted to the Federal Communications Commission (FCC) revealed that Elon Musk's Starlink space internet service could be expanded into a dedicated phone service, as well as a more affordable internet service for low-income customers. According to [Ooma](#), Starlink subscribers can now use the service's mobile app, available for iOS and Android, to track connectivity statistics over time. This can indicate whether the connection at the subscriber's location is steady enough for VoIP phone calls.

[Benzinga](#) predicts that alongside VoIP, High-throughput Satellite (HTS) and Low Earth Orbit (LEO) satellite technologies are enabling high-speed broadcasting satellite services, cellular backhaul, and other value-added services such as video conferencing.

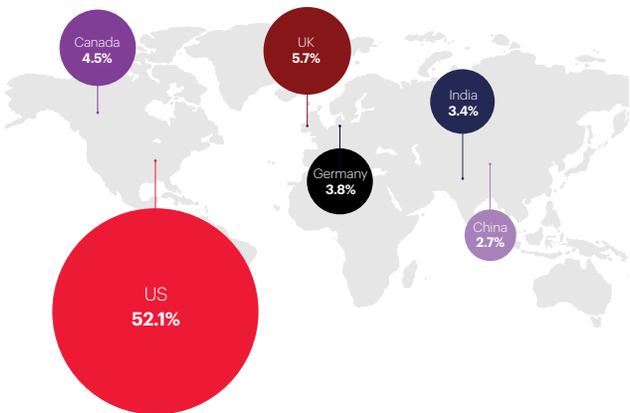


Space Tech Industry

Regional distribution

More and more countries are entering the space tech race, with the United States dominating in terms of the number of space tech companies and the amount of investment they receive. Asia, however, is confidently gaining momentum in the financing of companies in the industry. The United Arab Emirates also announced new space goals, putting the Middle East in the competition as well.

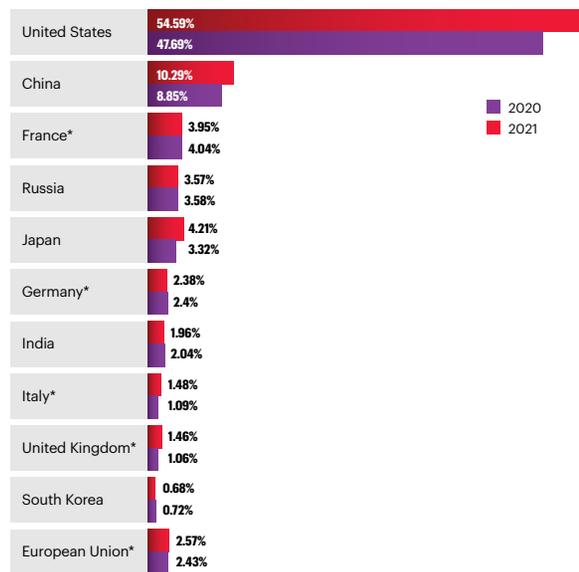
Company regional distribution (by number of companies) in 2021



The US is still firmly in the lead in terms of the number of space tech companies (52.1%). The UK ranks second (5.7%), while Canada, Germany, India, and China are in the third place (with 4.5%, 3.8%, 3.4%, and 2.7% respectively).

Source: Forbes

Government expenditure on space programs (by major country) in 2020–2021 (in billions USD)



Source: Statista

USA, Russia, and China lead in satellites launched



500–3,000



30–499



10–29



2–9

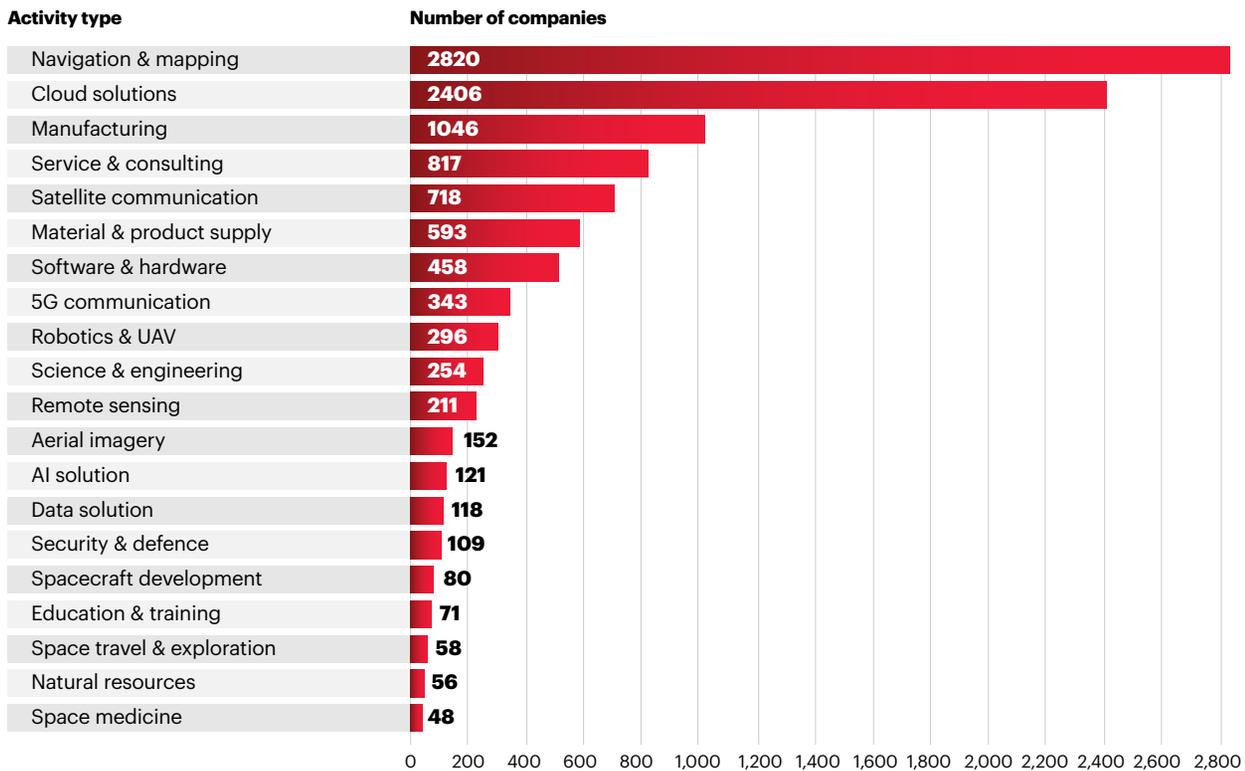
Number of satellites either owned or launched by country used here as an approximate space tech development

Source: SpaceTech Analytics

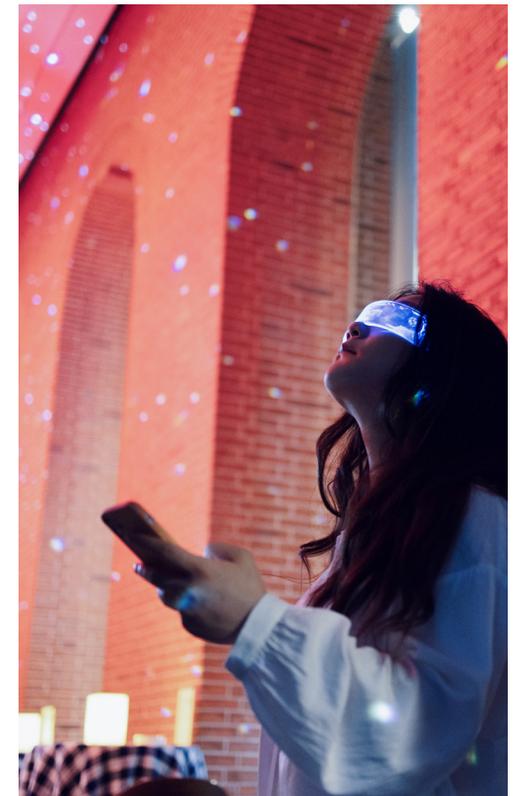
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Sector ecosystem by types of activity

The space tech sector involves a diverse range of activities. SpaceTech Analytics (2021) classified more than 10,000 space tech companies according to 20 categories. They found that Navigation and mapping, Cloud solutions, and Manufacturing are the three largest sectors in the space industry.



Source: SpaceTech Analytics



Sector ecosystem by types of organization

The major players in the space tech industry can be grouped into four main types of organizations – **government-driven space programs, primes, large commercial players, and space tech start-ups.**

Government-driven space programs

Government-driven space programs refer to space exploration initiatives that are primarily funded, managed, and operated by national agencies. These programs are typically aimed at advancing scientific research, developing space technologies, and exploring the solar system and beyond. Besides driving the programs of their respective countries, these agencies also collaborate to jointly drive a few global programs. The programs are summarized below in order of region.

Americas	Europe	Asia and ANZ
<ul style="list-style-type: none">• National Aeronautics and Space Administration (NASA)• Comisión Nacional de Actividades Espaciales (Argentina)• Bolivian Space Agency• Brazilian Space Agency• Canadian Space Agency• Colombian Space Commission• Mexican Space Agency• National Commission for Aerospace Research and Development (Peru)	<ul style="list-style-type: none">• European Space Agency• Austrian Space Agency• Belgian Institute for Space Aeronomy• European Union Agency for the Space Programme• Centre National d'Etudes Spatiales (France)• German Aerospace Center• Hellenic Space Centre (Greece)• Italian Space Agency• Netherlands Institute for Space Research• Norwegian Space Agency• Polish Space Agency• Portugal Space• Agencia Espacial Española• United Kingdom Space Agency	<ul style="list-style-type: none">• Indian Space Research Organisation (ISRO)• Japan Aerospace Exploration Agency (JAXA)• Australian Space Agency• China National Space Administration• Israeli Space Agency• Korea Aerospace Research Institute• Malaysian Space Agency• New Zealand Space Agency• Saudi Space Commission• Turkish Space Agency• Vietnam National Space Center

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The United States

The United States continues to have an ambitious space program with several ongoing projects and future missions. Some of the latest space programs in the USA are:

Artemis Program: The Artemis program aims to return astronauts to the Moon by 2024, with the goal of establishing a sustainable human presence on the Moon. NASA plans to achieve this by developing new spacecraft and technology, including the Space Launch System (SLS) rocket and the Orion spacecraft. The Lunar Gateway is a key component of the Artemis Program. NASA's upcoming lunar space station will orbit the Moon and serve as a hub for lunar exploration and research.

Commercial Lunar Payload Services: The program has been initiated by NASA to partner with private companies to deliver science and technology payloads to the surface of the Moon. In 2019, NASA awarded contracts to several private companies to deliver science and technology payloads to the Moon. Some of the proposed payloads include a lunar seismometer, a lunar rover, and a system to produce oxygen from the lunar soil. These missions will help support the Artemis program's goal of sustainable lunar exploration.

Commercial Crew Program: This program aims to launch American astronauts to the International Space Station (ISS) using privately built spacecraft. In 2020, SpaceX's Crew Dragon spacecraft became the first commercial spacecraft to carry astronauts to the ISS. Boeing's Starliner spacecraft is also under development as part of the program.

Mars Exploration Program: The Mars Sample Return mission is a joint effort between NASA and the European Space Agency (ESA) to collect samples from the Martian surface and bring them back to Earth for analysis. In February 2021, NASA's Perseverance rover landed on Mars to search for signs of ancient life and collect samples for eventual return to Earth. The Mars Sample Return mission is planned for the 2030s. This ambitious program is expected to provide important insights into the Martian environment and the feasibility of human missions to the planet.

The US government is seeking to increase NASA's 2024 budget to \$27.2 billion next year, which is an increase of 7%. **CNBC reported** that, in addition to \$8.1 billion for NASA's lunar Artemis program, the administration aims to allocate \$949 million for a mission to return Mars rock and soil samples.



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The European Union (EU)

The European Union (EU) has ambitious plans to provide innovative space technology, data, and services that are indispensable in the lives of Europeans. Between 2014 and 2020, EU investment in space was €11 billion; **it's projected to grow** to €14,668 billion between 2021 and 2027. The EU space program provides critical infrastructure for digital transformation, relying on space data to enable digital innovations such as autonomous vehicles, smart solutions, and 5G wireless networks. The EU is focusing on three missions: Earth Observation (EO), Navigation, Protection and Secure Communications. Here are the details of the EU's key programs:

Copernicus is the EU's Earth observation system using satellites and ground-based sensors. The system provides data on the environment, climate, and security. The program is served by the constellation of Sentinel satellites and the satellites run by various commercial and national agencies. Since the launch of Sentinel-1A in 2014, the EU set in motion a process to place a constellation of almost 20 more satellites in orbit before 2030.

Galileo is the EU's global navigation satellite system (GNSS), providing positioning, navigation, and timing services to users worldwide. The current Galileo system consists of 28 satellites in all. Currently, 26 satellites are operational and positioned in three circular Medium Earth Orbit (MEO) planes at 23,222 km altitude above the Earth.

Space Situational Awareness (SSA) is an essential component of the EU Space Program. It aims to monitor space debris and near-Earth objects that could pose a threat to satellites and human activities in space. SSA covers Space weather monitoring & forecast and Near-Earth Objects (NEO) monitoring. The program includes the development of ground-based sensors, space-based telescopes, and data analysis tools.

Horizon Europe is the EU's research and innovation program until 2027. This includes funding for research and innovation of space-related projects in areas such as Earth observation, SATCOM, and space exploration.



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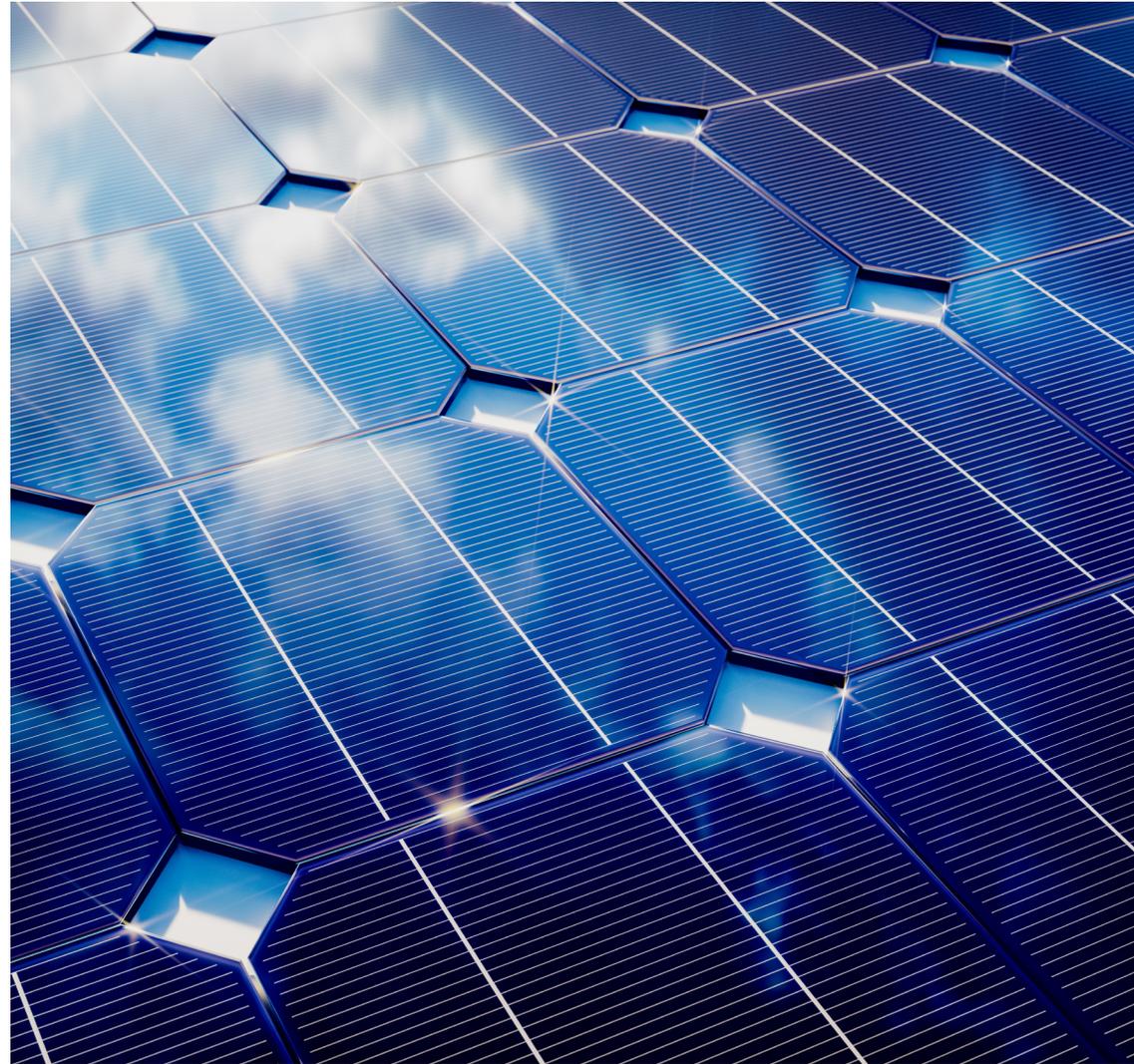
India

India's Space initiatives are driven by Indian Space Research Organization (ISRO). ISRO has signed several MoUs internally within India and other regions for various space missions. ISRO is heavily promoting private participation in the space segment as well and some of these companies have raised around \$245M USD in funding. Here are some of the key space programs:

Gaganyaan is India's human spaceflight program, which aims to send astronauts into space by the end 2023. The program consists of three phases, including testing of crewed and uncrewed spacecraft, crew training, and the actual spaceflight.

Chandrayaan-3 is India's third lunar mission, which is set to launch in mid-2023. The mission will include a lander and rover, which will explore the south pole of the Moon and collect data on its surface and subsurface.

Aditya-L1 is India's first solar mission, which aims to study the Sun's corona, solar winds, and magnetic field. The mission is set to launch in 2023 and will place a spacecraft in a halo orbit around the Lagrangian point L1, which is a stable point between the Earth and the Sun.



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Japan

Japan's space agency, JAXA, is currently working on several space programs. JAXA's space program is focused on a variety of areas, including scientific research, Earth observation, SATCOM, and human spaceflight. Some of its notable programs include:

Martian Moons Exploration (MMX) aims to send spacecraft to explore the Martian moons Phobos and Deimos, with the goal of studying their origin and evolution. The mission is scheduled for launch in 2024 and is expected to return to Earth with samples from the moons in 2029.

Space Solar Power Systems (SSPS) aims to explore the development of space-based solar power systems that could potentially provide renewable energy to Earth. JAXA hopes to have a demonstration system in orbit by the mid-2020s.

Quasi-Zenith Satellite System (QZSS) is a regional satellite navigation system developed by JAXA to supplement and enhance the capabilities of the Global Positioning System (GPS). The QZSS system is designed to provide precise positioning and timing information to users in Japan and other parts of the Asia-Pacific region.



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South Korea

South Korea's space agency, the Korea Aerospace Research Institute (KARI), is currently working on several space mission programs, including:

The Korea Pathfinder Lunar Orbiter, called Danuri, was launched in Aug 2022 and entered its orbit 100 km above the moon in December 2022.

Korea Space Launch Vehicle (KSLV-II's) performance test satellite was launched into Earth's orbit successfully in Jun 2022. The country will stage four more rockets, called Nuri, by 2027.

KASS (Korea Augmentation Satellite System) is the country's first precision GPS location augmentation system. It is expected to be fully operational by 2024.

Space-based Optical Telescope for Ultraviolet Astronomy (STU) will observe the universe in the ultraviolet spectrum. It is expected to be launched in the mid-2020s.

Next-Generation Small Satellite (NEXTSat): NEXTSat-1 was launched in December 2018. This will be followed by the second NEXTSat-2 in May 2023, and the third NEXTSat-3 in 2027, reports [Next Spaceflight](#).



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The United Kingdom

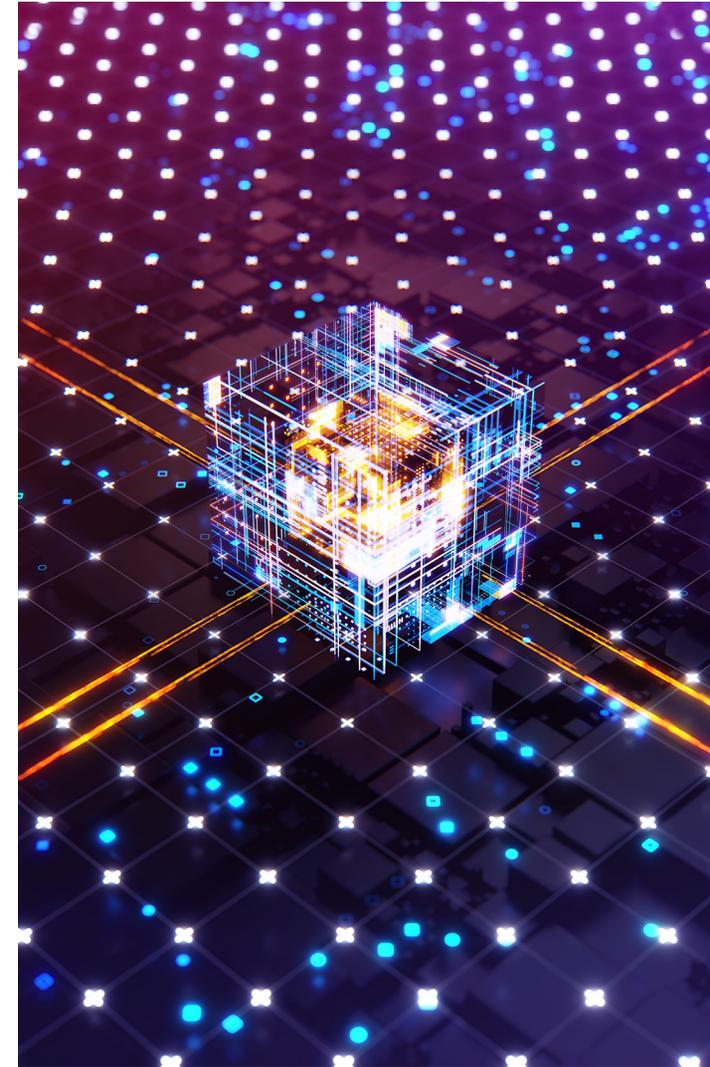
The United Kingdom's satellite launch program is helping to grow the UK space sector's small satellite and sub-orbital flight markets. The agency is running the National Space Innovation Program, the Enabling Technologies Program, the General Support Technology Program, and the Navigation Innovation Support Program. As part of the Discovery program, the agency is funding the Space Science Program and the Space Exploration Program. In addition to these, the UK has a few other programs namely Earth Observation, ESA Technology harmonization, Space-based Positioning, Navigation and Timing program, and Advanced Research in **Telecommunications Systems (ARTES) Program**.

Singapore

Singapore's space agency, the Singapore Space and Technology Association (SSTA), is engaged in several space programs, which include TeLEOS-2 (Singapore's second Earth observation satellite), VELOX-C1 microsatellite, and Galassia-2 small satellite to provide IoT services. In addition, Singapore has a microsatellite program in collaboration with universities and institutes, and several other international collaborations with various space agencies.

Australia

Australia's space agency is involved in several space programs in Australia. The agency is collaborating with NASA for the Artemis program by providing support to NASA's Deep Space Network, which enables communication with spacecraft and missions in deep space. It has developed a new Space Discovery Centre in Adelaide, South Australia, which will showcase Australia's space capabilities and provide educational opportunities for the public.



CHAPTER 1

Primes

Space primes play a critical role in the space industry by bringing together the necessary expertise and resources to develop and deliver complex space systems and missions. These companies are leaders in the satellite industry and continue to develop new technologies and solutions to meet the growing demand for satellite services. They work closely with government agencies, such as NASA and the European Space Agency, as well as commercial customers, to develop and deliver space systems that meet their specific requirements.

Boeing Satellite Systems

Boeing Satellite Systems is a division of the American multinational aerospace company. Boeing designs and manufactures advanced space and communications systems for military, commercial, and scientific applications. These include advanced digital payload, communications and navigation systems, all-electric propulsion, and 3D manufacturing capabilities for spacecrafts operating in the GEO, MEO, or LEO orbital planes. Boeing has been engaged with several research and development activities for the International Space Station, space launch systems, the CST-100 Starliner commercial spacecraft with the United Launch Alliance (ULA), building heavy-lift propulsion to deep space with the Space Launch System (the rocket that will launch missions on a path to the Gateway cislunar outpost, the Moon's surface and Mars). Boeing's Tracking and Data Relay Satellites (TDRS) provide high-bandwidth communications between Earth-orbiting spacecraft and facilities on the ground.



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Raytheon Intelligence & Space

Raytheon Intelligence & Space specializes in developing advanced sensors, cyber services, and software solutions. It is one of the four business segments of the US-based Raytheon Technologies, one of the largest aerospace and defense manufacturers in the world. Raytheon has a set of end-to-end space solutions to help deliver mission breakthroughs. These include advanced weather interactive processing systems, constellation management through their command-and-control system, missile warning defense systems, and sensing technologies for earth observation. Blue Canyon Technologies (a leading provider of small satellites and spacecraft systems components) and SEAKR Engineering (producer of space-qualified electronics and processors) are also wholly owned subsidiaries of Raytheon.



Lockheed Martin Space

Lockheed Martin Space is a division of the American aerospace and defense company. The company specializes in the development and manufacture of satellites for a range of applications including earth observation, communications, and navigation. The company is engaged in the development of commercial and government satellites, strategic missiles, mission solutions, and deep space exploration lines of business. Lockheed Martin has built satellites that give early warning of severe weather, connect troops on the battlefield and deliver GPS directions to millions of people worldwide. The company has built 11 Mars-bound orbiters and landers and has been part of several NASA missions to Mars. Currently, they are building NASA's Orion spaceship to take the first woman and the next man to the Moon by 2024.

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Northrop Grumman Space Systems

Northrop Grumman Space Systems is an American aerospace and defense company. It is engaged in design and manufacturing of various spacecrafts, ground stations, space platforms and revolutionary launch vehicles, which are used for civil and military applications. Northrop Grumman's GEOSTar™ geostationary Earth orbit (GEO) commercial satellites are among the industry's best small- and medium-class communications satellites for 2-8 kW missions. The company's ESPASar platform provides a modular, cost-effective, and highly capable infrastructure for hosting technology development and operational payloads.



Airbus Defense and Space

Airbus Defense and Space is a division of the European multinational aerospace corporation, Airbus, which develops and manufactures satellites for various applications including earth observation, communications, and navigation. Some of the ongoing projects include the **Syracuse IV** (a joint design of Airbus and Thales), which is a French MoD-owned satellite-based telecommunications program aimed to equip the French armed forces with secure means of communication that are accessible in all scenarios including crises, major disasters, and other events. Airbus is also developing and building **JUICE** (JUperiter ICy moons Explorer spacecraft for the European Space Agency, which will study Jupiter and its icy moons. As prime contractor, Airbus will lead a consortium of more than 60 companies during the project.

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Thales Alenia Space

Thales Alenia Space is the largest satellite manufacturer in Europe. It is a joint venture by French prime contractor, Thales Group, and Italian defense conglomerate, Leonardo. Thales Alenia Space designs and builds various space-related products, including satellites for telecommunications, navigation, earth observation, and space exploration purposes. Thales Alenia along with Telespazio has formed the Space Alliance, which offers a complete range of solutions including services.



Honeywell Aerospace

Honeywell develops and manufactures satellite hardware to meet the high-performance demands of space missions. The majority of the satellites in orbit have Honeywell products on board. Honeywell Aerospace has three focus areas in the satellite market which are flight and ground system operations, science data processing, and mission support. In 2021, **Honeywell** released three new product lines for the commercial satellite market segment, including a new downlink transmitter and Optical Communication Terminal, which enable high-bandwidth data to be transmitted both down to Earth and between satellites.

Large commercial players

There are several large satellite operators in the world, each with its own fleet of satellites and services. These companies are engaged in providing satellite-based internet services, broadcast services, defense applications, launch services, and space tourism.

Starlink

Starlink is a satellite internet service provider by SpaceX. The company offers high-speed (50–500 Mbps), and low-latency (around 25 ms) internet services in parts of North America, South America, Europe, and Australia. Starlink has a constellation of more than 3,700 operational satellites that orbit the planet at about 550 km above the earth and cover the entire globe. The company is planning to launch an additional 42,000 in the next 3-5 years, with clearance to deploy 12,000 Starlink crafts in orbit and waiting for approval for an additional 30,000. They offer services to residential and enterprise customers, with a Direct-to-Customer business model.

Kuiper

Kuiper is a satellite internet initiative by Amazon, aiming to provide high-speed broadband internet services. The name refers to the Kuiper Belt, a region of the solar system that exists beyond the eight major planets. The project plans to launch a constellation of 3,236 Low Earth Orbit (LEO) satellites to provide global coverage. As per FCC license conditions, the company plans to deploy and operate at least half of the satellite constellation by July 2026. The company is planning to launch its commercial services by the end of 2024. The satellites will orbit between 590 and 630 kilometers, enabling effective connectivity for applications like video calls, gaming, and high-definition streaming.

ViaSat

ViaSat operates five high-capacity GEO satellites around 35,000 km above the surface of the Earth: ViaSat-1 satellite, ViaSat-2 satellite, and ViaSat-3 constellation consisting of three high-capacity Ka-band satellites. ViaSat provides a range of services including home internet, small business internet, in-flight Wi-Fi solutions for commercial and business aviation, and secure defense communication. ViaSat has been selected by NASA to support its Communications Services Project (CSP), which seeks to accelerate the development of near-Earth communications by partnering with commercial satellite communications (SATCOM) providers.

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HughesNet

HughesNet is one of the largest satellite internet providers in the US. The company provides high-quality satellite internet powered by high-capacity satellites EchoStar XIX and EchoStar XVII. JUPITER 1 (EchoStar XVII), placed in an orbital slot 35,000 km above the equator, is a fourth-generation Ka-band satellite providing high-speed internet services in North America. JUPITER 2 (EchoStar XIX) doubled the Ka-band capacity of JUPITER 1 and increased the availability of HughesNet high-speed satellite internet service coast-to-coast across the continental United States, as well as Mexico and Canada. JUPITER 3 (EchoStar XXIV) is planned for launch in the first half of 2023 and will expand the overall reach and capacity of the JUPITER fleet across the Americas. JUPITER 3 is expected to be the world's largest commercial communications satellite, bringing the total capacity of the JUPITER fleet to more than 1 Tbps.

OneWeb

OneWeb (UK) is developing a constellation of Low Earth Orbit (LEO) satellites to provide high-speed internet access to people around the world. OneWeb's satellite communications network has got 648 satellites in 18 synchronized polar orbits of 1,200 km above the earth in Low Earth Orbit. The company is offering services to carriers, enterprises, government departments (armed forces, intelligence, and security agencies), commercial airlines (for in-flight connectivity), vessel connectivity for smart shipping, and the land mobility sector.

Eutelsat

Eutelsat (France) is providing services for video broadcasting, content streaming, connectivity services to consumers and businesses worldwide, and IoT connectivity for assets via satellite. It has 36 GEO satellites providing broadband, data, government, mobility, and video services worldwide. The company has planned the launch of three additional satellites from 2023 to 2026, for enhancing high-speed broadband services. Flexsat, scheduled to be launched in 2026, will be a new generation high-throughput, software-defined satellite, for flexibility and instant reconfigurability.

CHAPTER 1

Telesat

Telesat (Canada) provides satellite-based communication services to customers around the world. The company's satellite fleet includes a mix of geostationary and Low Earth Orbit (LEO) satellites, which provide a range of services, including broadband internet access, backhaul services, and satellite television broadcasting. Telesat has developed its LEO satellite constellation, called Lightspeed, which is comprised of 188 state-of-the-art Low Earth Orbit (LEO) satellites, seamlessly integrated with on-ground data networks. Telesat's global GEO network has a 14 satellite fleet providing coverage and connectivity solutions in C-, Ku- and Ka-bands.

SpaceX

SpaceX is primarily focused on developing and launching rockets for satellite launches and resupply missions to the International Space Station (ISS). It has also announced plans to enter the space tourism market. The company manufactures heavy lift launch vehicles (Falcon 9, Falcon Heavy, and Starship), four families of rocket engines (Merlin, Kestrel, Draco, and SuperDraco), reusable spacecraft (Cargo Dragon and Crew Dragon), and Starlink communications satellites. Its satellite internet constellation Starlink provides commercial internet service. SpaceX has announced plans to offer suborbital space tourism flights on its Crew Dragon spacecraft.

Virgin Galactic

Virgin Galactic aims to provide suborbital flights for tourists who want to experience spaceflight. Virgin Galactic's spacecraft, called SpaceShipTwo, is designed to carry six passengers and two pilots to an altitude of over 80 kilometers) above the Earth's surface, where they can experience weightlessness and see the curvature of the Earth. In July 2022, the company announced the opening of a new spaceship manufacturing facility in Mesa, Phoenix, for the final assembly of its next-generation Delta class spaceships. This is Virgin Galactic's production vehicle that is designed to fly weekly, supporting the company's target of 400 flights per year from Spaceport America.

Blue Origin

Blue Origin's goal is to develop technologies that enable human access to space. Blue Origin's focus is on developing reusable launch vehicles and spacecraft that can be used for a variety of missions, including suborbital space tourism, orbital launches, and deep space exploration. Both of its rockets, New Shepard and New Glenn, have been designed with reusability in mind from the beginning. Their vertical take-off, vertical landing architecture enables to reuse the first stage of its launch vehicles 25 times with minimal refurbishment, resulting in 25 times less waste because there is no need to throw the hardware away.

CHAPTER 1

Space tech start-ups

Space technology has been a rapidly growing industry in recent years, with a significant number of start-ups emerging in this field. Many of these start-ups are focused on developing small satellites, reusable rockets, satellite constellations, satellite imagery, and various in-orbit services. In recent years, there has been a surge in the number of space tech start-ups, fueled by the growth of private space companies and increasing investment in space exploration.

Small satellites

Pixxel

Pixxel (USA and India) is building a constellation of cutting-edge hyperspectral small satellites. The company has launched its first satellite TD-2 in April last year. They plan to have a hyperspectral constellation of six satellites flown in a sun-synchronous orbit.

Relativity Space

Relativity Space (USA) is working on developing 3D printing technology for reusable rocket manufacturing. The company's goal is to use 3D printing to produce rockets that are cheaper, faster, and more flexible than traditional rocket manufacturing methods.

NanoAvionics

NanoAvionics (Lithuania) designs and manufactures small satellites and components for the space industry. The company's products include communication satellites, Earth observation satellites, and mission control software.

Ephemersys

Ephemersys (Hungary) is a provider of cloud-based space mission management software. It offers a cloud-based analysis tool that allows users to design, manage, and analyze nano-satellite missions. Its features include cube satellite designing, as well as analysis of data, power, cosmic radiation, thermal, the lifetime of satellites, and space debris.

DcubeD

DcubeD (Germany) develops and manufactures actuators, mechanisms, and deployable structures tailored for nanosatellites and the commercial space industry.

Blue Canyon Technologies

Blue Canyon Technologies (USA) designs and manufactures small satellites (CubeSats, microsatellites) for a variety of applications, including communication and Earth observation. The company's satellites can be customized to meet specific customer needs and are built using advanced manufacturing techniques. Blue Canyon Technologies is now a wholly owned subsidiary of Raytheon Technologies.

EnduroSat

EnduroSat (Bulgaria) specializes in the design, development, and manufacturing of small satellite systems. EnduroSat offers a range of services and products, including CubeSat platforms, communication systems, and ground stations. Their CubeSat platforms come in various sizes and can be customized to meet the specific needs of their customers.

CHAPTER 1

Launch vehicles

DhruvaSpace

DhruvaSpace (India) offers satellites coupled with Earth stations and launch services as an integrated solution or individually as a technology solution. It provides full-stack space-engineering solutions across launch, space, and ground segments.

Skyroot Aerospace

Skyroot Aerospace (India) is engaged in the manufacturing of satellite launch vehicles. The company is developing its suite of launch vehicles Vikram I, Vikram II, and Vikram III. These vehicles will support the launch of payloads of different weights to Low Inclination Orbit and Sun-synchronous polar orbits.

The Exploration Company

The Exploration Company (Germany) is working to make space exploration affordable, available, and open. The company has developed a modular and reusable orbital vehicle that can be refuelled in orbit.

Rocket Lab

Rocket Lab (USA) is focused on providing affordable and reliable access to space for small satellites. The company has developed a launch vehicle called Electron. It has completed 35 launches and has plans for 17 more missions focused on Earth Imaging, IoT Constellation, and deep space exploration.

Agnikul Cosmos

Agnikul Cosmos (India) is developing a highly customizable, two-stage launch vehicle Agnibaan, which can take up to 100 kg to orbits around 700 km high. Agnibaan can access both low and high-inclination orbits and is completely mobile.

CHAPTER 1

Propulsion systems

Bellatrix Aerospace

Bellatrix Aerospace (India) specializes in providing in-space propulsion systems for heavy, micro, and nanosatellite space navigation and orbital launch vehicles. This will enable the space industry to have access to space navigation tools for deep space exploration.

Ienai Space

Ienai Space (Spain) develops efficient ionic-liquid electric propulsion systems and mission analysis for nanosatellites. The company provides maneuvering as-a-service, for streamlining propulsive phases in satellites under 300 kg. Its fully customizable onboard electric propulsion system is based on electrospray technology, wherein, the thrusters can be tailored to the requirements and constraints of any mission and platform.

Aliena

Aliena (Singapore) has developed electric propulsion technology that will spearhead market creation in Very Low Earth Orbits (VLEO) for small satellites. The company's electric propulsion systems provide agility in space to satellite operators and access to unprecedented orbits working with constellations.



CHAPTER 1

In-orbit services

Obruta Space Solutions

Obruta Space Solutions (Canada) has developed autonomous spacecraft docking for on-orbit servicing and logistics. This will enable services like inspection, orbital refuelling, and orbital replacement units.

Atomos

Atomos (USA) provides “last mile” transportation services for satellite operators. The company’s orbital transfer vehicles (OTVs) change the rocket equation and hence providing unprecedented maneuverability, maintaining a sustainable orbital environment, and reducing the cost for satellite operators to get to their place in space.

Solstorm

Solstorm (Norway) is developing a Space Disposal System that de-orbits satellites after end-of-mission, preventing satellites from becoming space debris.

Astroscale

Astroscale (Japan) is developing technologies to address the problem of space debris. The company is working on developing spacecraft that can capture and remove debris from orbit, helping to reduce the risk of collisions and other hazards in space. The company also provides services for the life extension of GEO satellites.

CHAPTER 1

Constellations for providing actionable insights

Planet

Planet (USA) is focused on using satellite imagery and data analytics to provide insights into the Earth's environment and natural resources. The company's satellite constellation provides daily imaging of the entire planet, allowing customers to track changes in land use, natural disasters, and other phenomena.

Fossa Systems

Fossa Systems (Spain) provides cost-effective and secure IoT solutions to companies with assets in remote areas through satellite connectivity. The company is developing a flexible and integrated 2P picosatellite, designed for LEO constellations, will provide affordable near real-time access to IoT data everywhere on Earth.

Spire Global

Spire Global (USA) provides data and analytics services using a constellation of small satellites. The company's satellites collect data on weather, maritime traffic, and other environmental factors, which are then used to provide insights and predictions for customers in a variety of industries.



CHAPTER 1

Satellite imagery

Iceye

Iceye (Finland) specializes in synthetic-aperture radar (SAR) imaging. The technology allows for high-resolution imaging regardless of weather conditions, or time of day, making it particularly useful for maritime surveillance, disaster response, and environmental monitoring applications. Iceye has launched several SAR satellites into orbit and has partnerships with government agencies and commercial companies.

Capella Space

Capella Space (USA) provides SAR (Synthetic Aperture Radar) imagery from space to help organizations make critical decisions. They utilize AI and machine learning to automate the process of SAR imagery analysis and interpretation.

Descartes Labs

Descartes Labs (USA) provides solutions for satellite imagery analysis. The company's platform includes machine learning algorithms that can identify and classify objects in satellite imagery, as well as tools for data management and analysis. It automates the analysis of geospatial data to analyze and provide actionable insights.

Orbital Insight

Orbital Insight (USA) provides solutions for satellite imagery analysis, with applications ranging from agriculture and energy to defense and finance. The company's platform includes machine learning algorithms that can analyze satellite imagery to provide insights on topics such as crop yields, oil reserves, and construction activity.

Spaceknow

Spaceknow (USA) provides AI solutions for satellite imagery analysis, with applications in areas such as urban planning, transportation, and environmental monitoring. The company provides actionable intelligence by fusing satellite imagery data with advanced statistics, machine learning, and industry expertise.

CHAPTER 1

Space observation and weather

Mission Space

Mission Space (Latvia) is a space observation company offering solutions for space weather monitoring. This will help satellite operators and agencies to quantify the risks of space weather and solve the problem of data deficit and lack of warning tools. With custom sensors in LEO and advanced models on the ground, Mission Space processes raw data into real-time, actionable insights.

Leaf Space

Leaf Space (Italy) is developing a solution for offering Ground Segment as a Service. The company provides three different GSaaS solutions for (Leaf Line, Leaf Key, and Leaf Track) which are focused on operators needing high flexibility, operators with medium/large constellations, and Launch Vehicles tracking respectively.

SatSure

Satsure (India) produces data from remote sensing satellites. The start-up's open innovation platform, SPARTA, combines IoT, economic, and weather datasets with data gathered from EO satellites. It also uses machine learning algorithms and big data analysis for this purpose.

AIKO Space

AIKO Space (Italy) provides artificial intelligence for space applications, focusing on mission autonomy and autonomous operations. The start-up utilizes AI for creating custom algorithms for autonomous mission command and data handling.

CHAPTER 1

Communication systems

CesiumAstro

CesiumAstro (USA) offers a suite of scalable products from discrete modules to complete software-defined payloads for satellites, launch vehicles, and other space platforms. The integrated product line ranges from single-beam downlink solutions to multi-beam, full-duplex communications payloads.

Oxford Space Systems

Oxford Space Systems (UK) provides deployable antennas, that stow into a compact volume for launch and unfold to an accurate form when deployed in orbit. The company's helical antennas on CubeSats support the commissioning of IoT constellation.





CHAPTER 2

Space Tech Primary Market Study

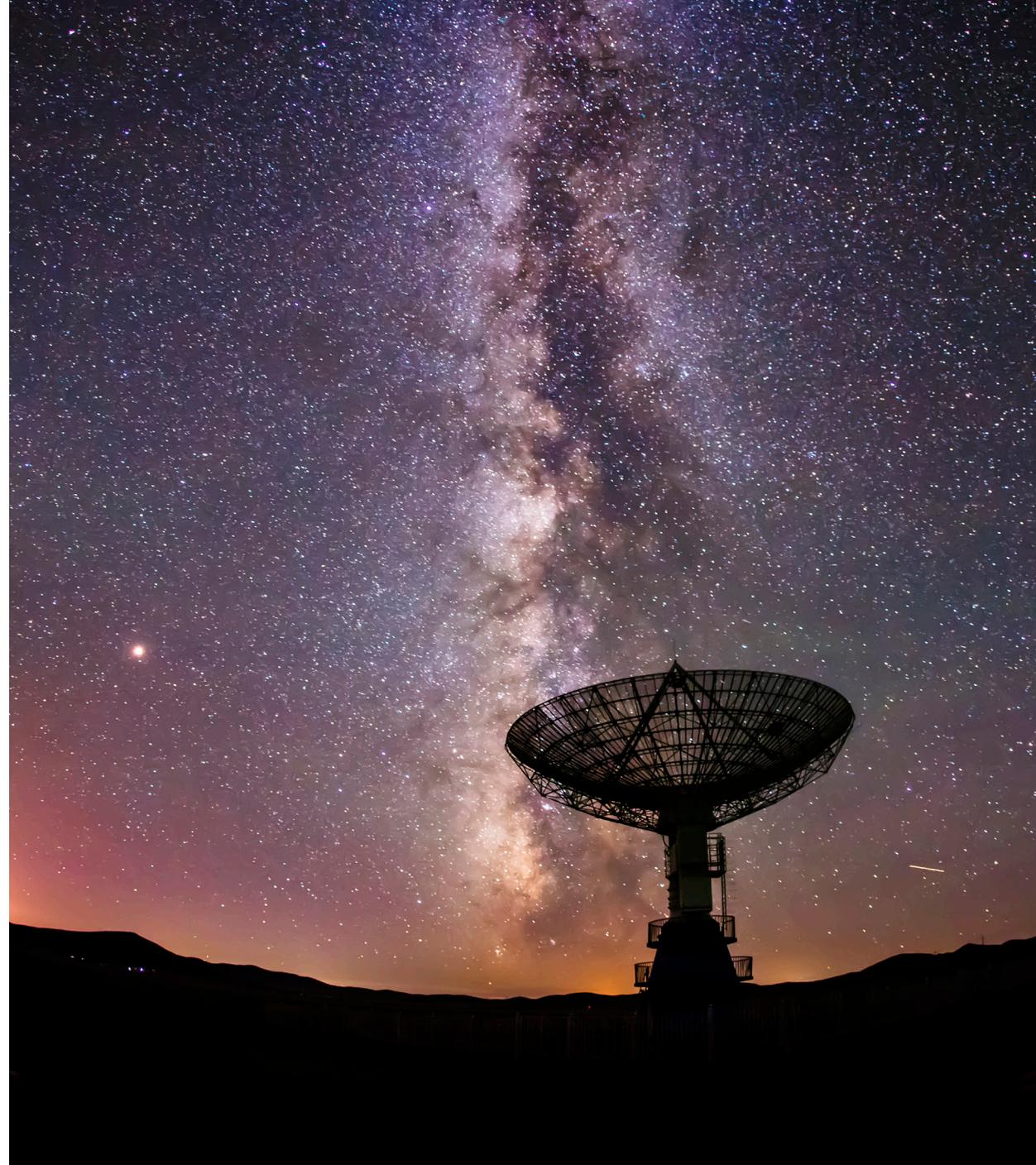
Trends, applications,
challenges and barriers, and
choosing a supplier



CHAPTER 2

To provide deeper insight into the current and future state of the space tech industry, Keysight and Coleman-Parks Research conducted an original survey of decision makers at all levels, from Chief Engineer to VP/GM/CXO, at companies involved in nearly every aspect of the industry. The findings we share here cover the key trends, applications, and challenges and opportunities in space tech now and in the near future. We also inquired into the major factors space tech organizations consider when choosing a supplier.

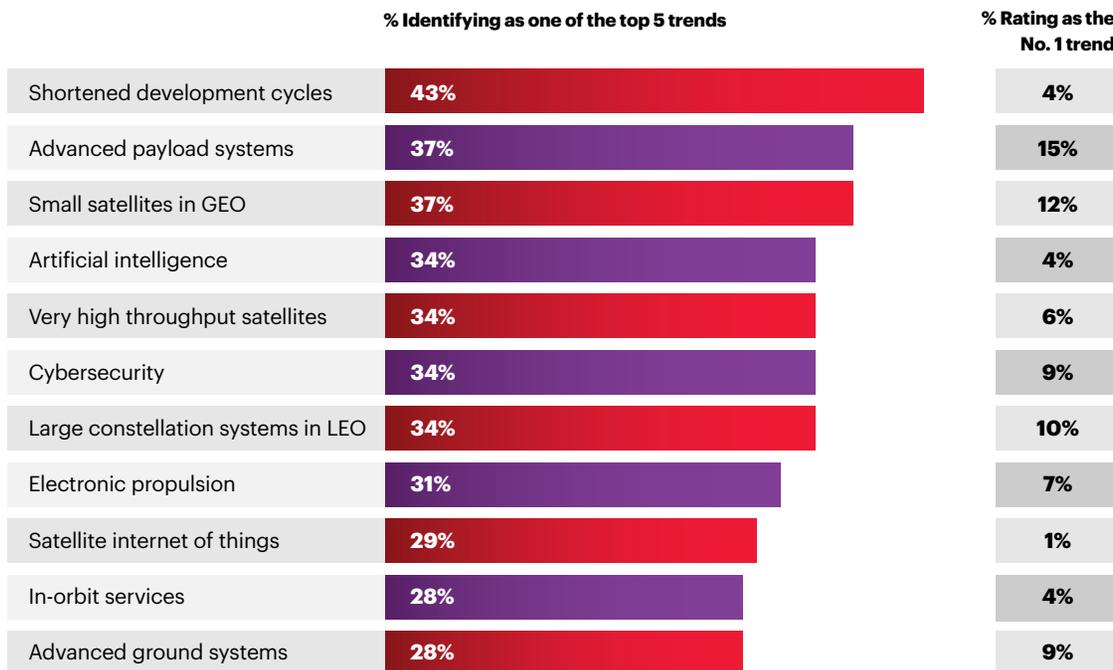
By identifying the drivers of space tech growth and acceleration, the enabling technology trends, and the pain points you will face along the way, we hope the survey findings expand your understanding of the industry and enable you to create a successful strategy for your organization's future in space tech.



Trends

The most important current trends in the satellite industry

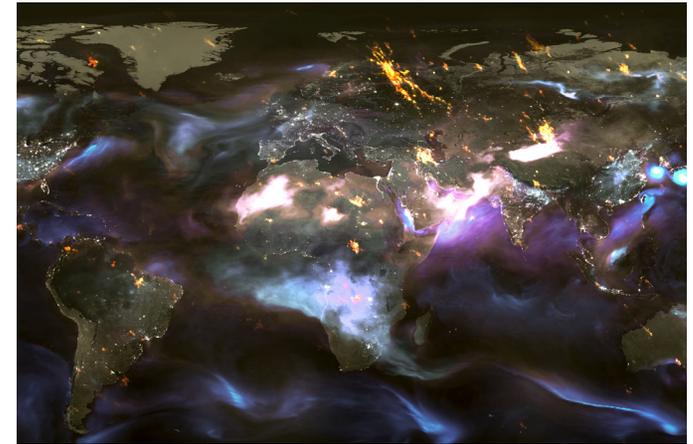
More than one in four space tech decision-makers see shortened development cycles as one of the top trends affecting the industry currently. Advanced payload systems and small satellites in GEO are also seen as particularly important, with around one in seven identifying each of these areas as the number one current trend.



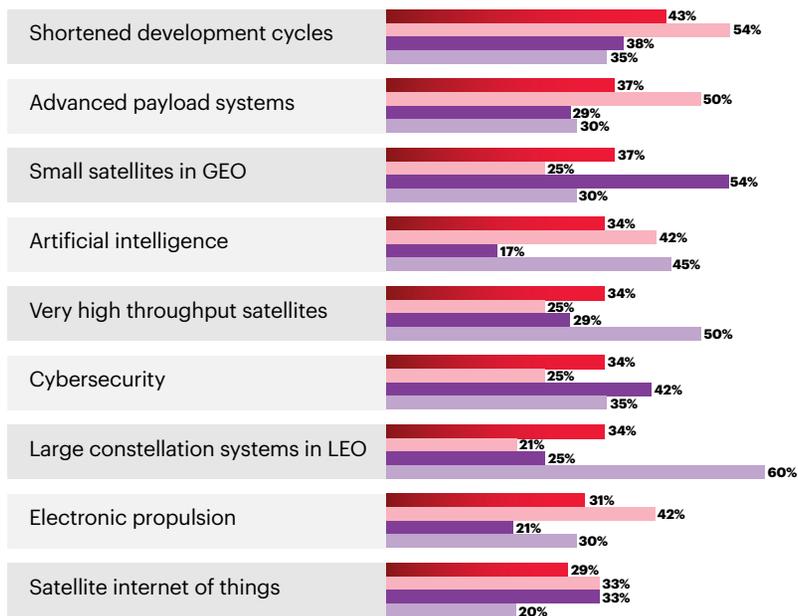
Trends

The most important current trends in the satellite industry by region

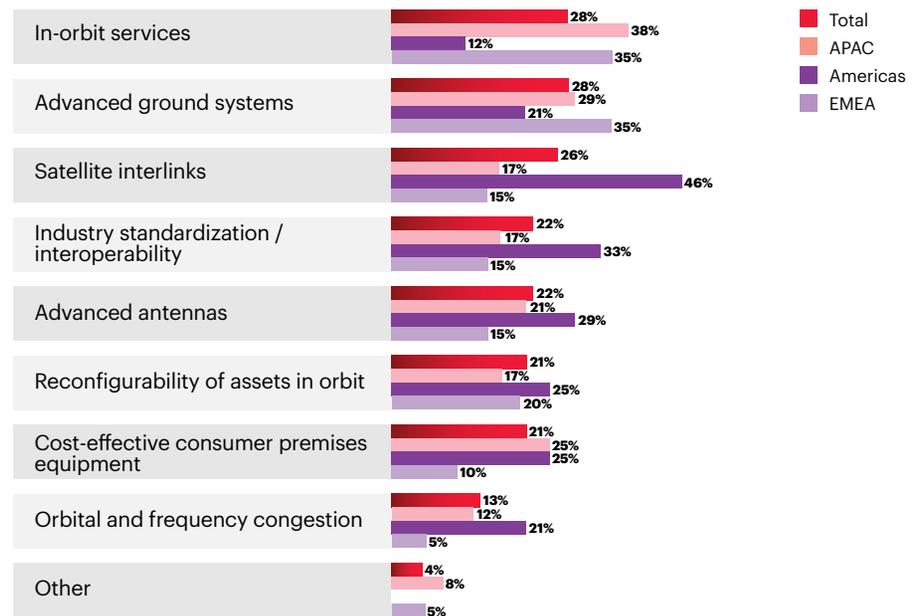
Large constellation systems in LEO and very high throughput satellites are seen as particularly important trends in EMEA, with small satellites in GEO and satellite interlinks particularly important in the Americas.



% Identifying as one of the top 5 trends



% Identifying as one of the top 5 trends

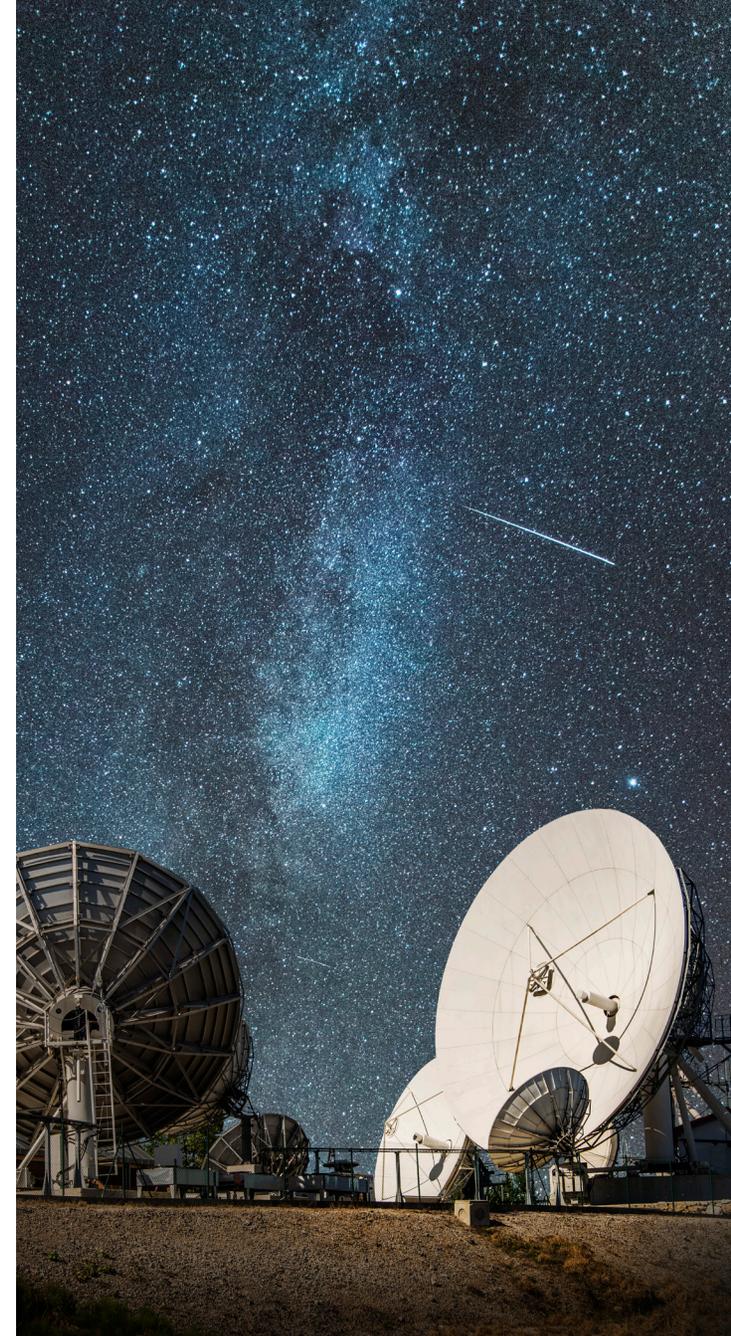
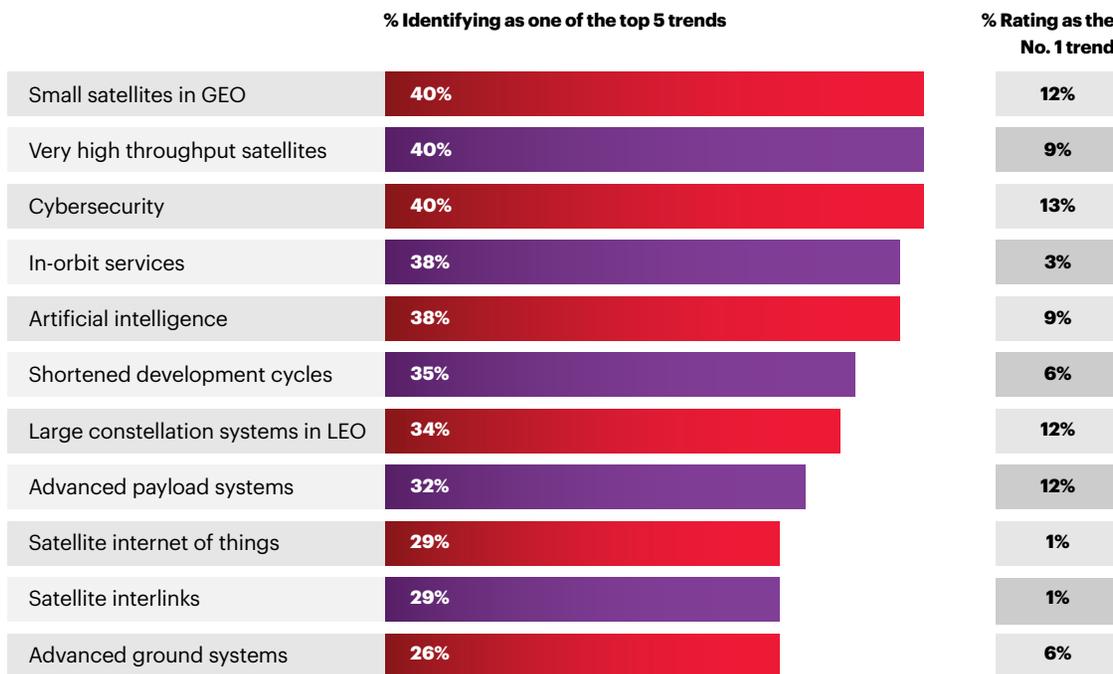


■ Total
■ APAC
■ Americas
■ EMEA

Trends

The most important trends in the satellite industry in three years' time

Small satellites in GEO is also seen as a key trend for the short/medium term, alongside very high throughput satellites and cybersecurity.



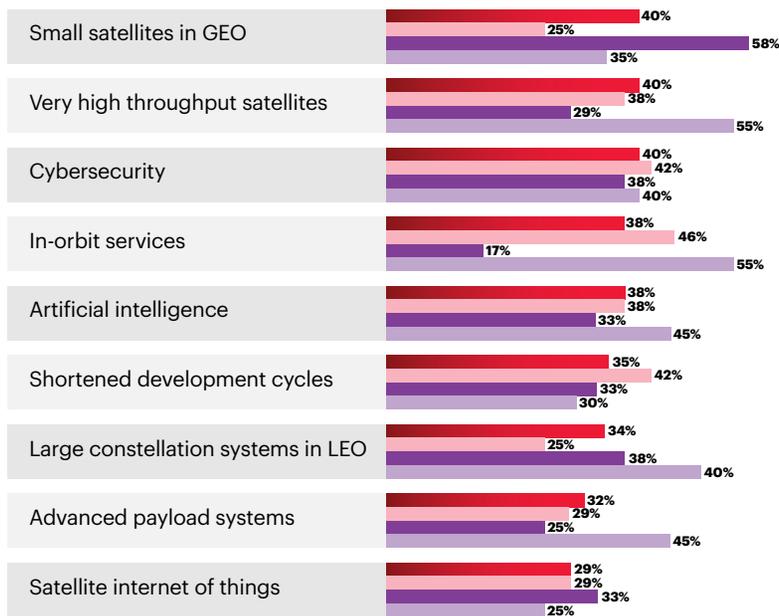
Trends

The most important trends in the satellite industry in three years' time by region

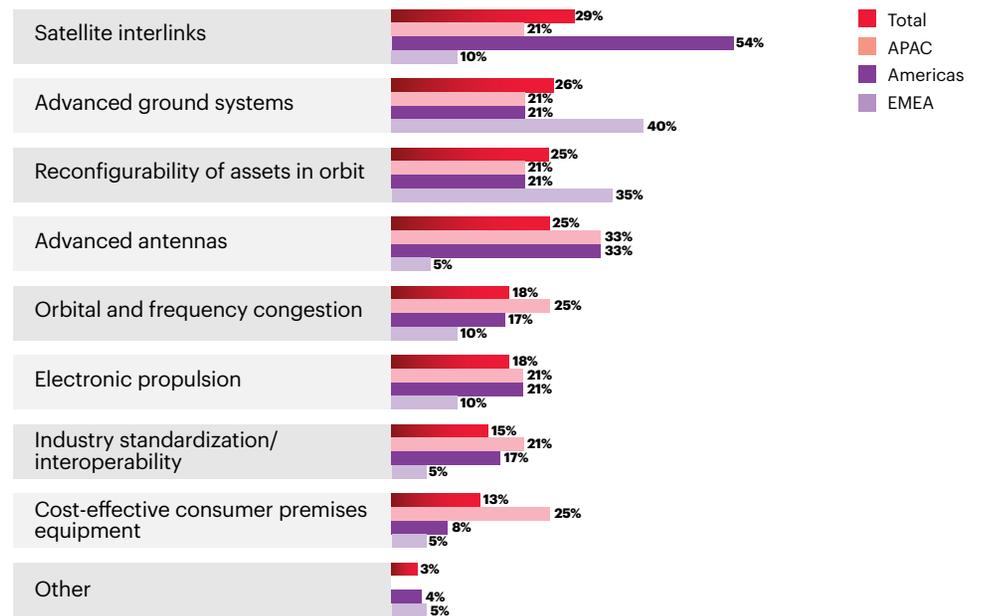
Those in the Americas are particularly likely to see small satellites in GEO and satellite interlinks as key trends for the next three years. The importance of cybersecurity and AI is similar across all regions.



% Identifying as one of the top 5 trends



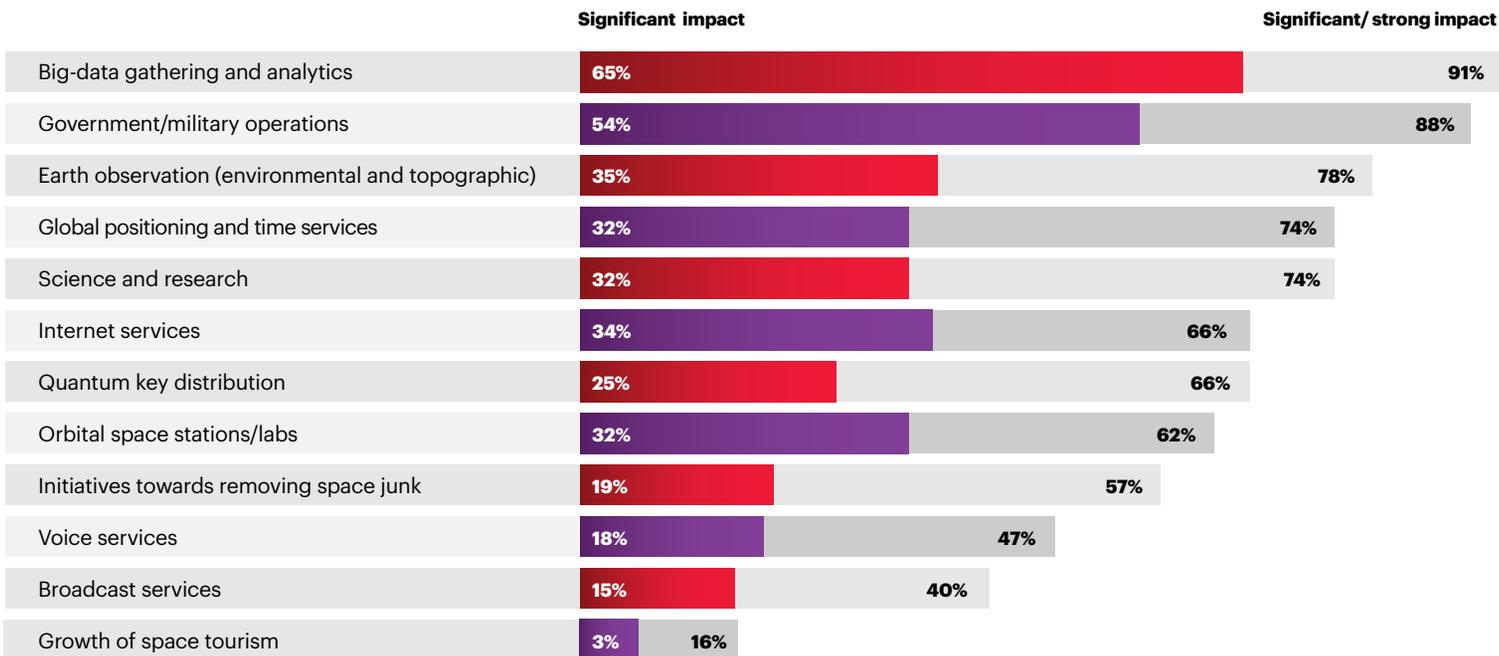
% Identifying as one of the top 5 trends



Applications

Applications with the greatest impact on the space tech industry in the next three years

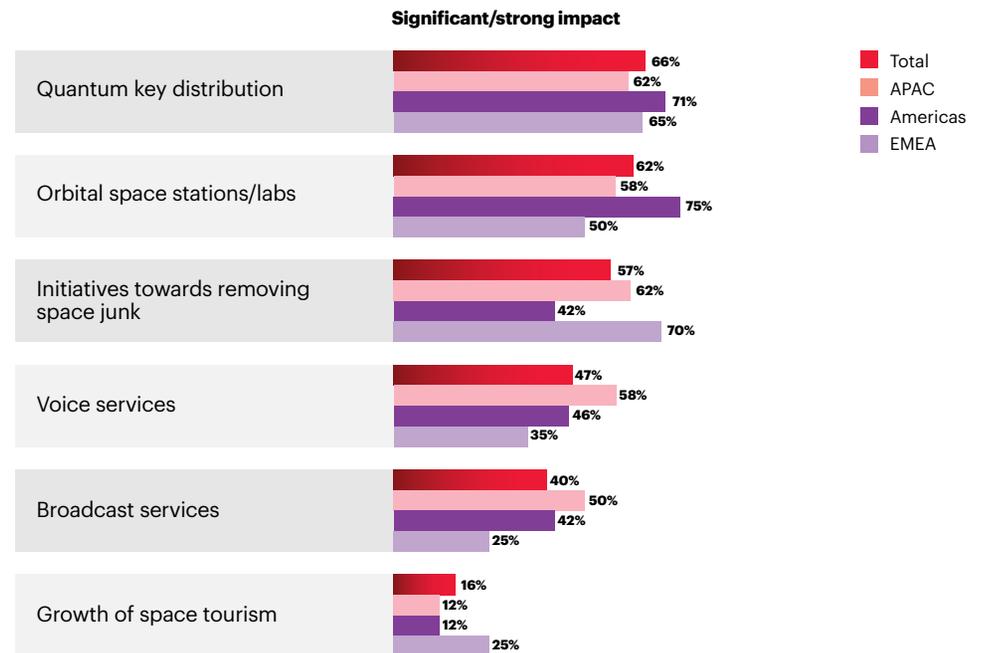
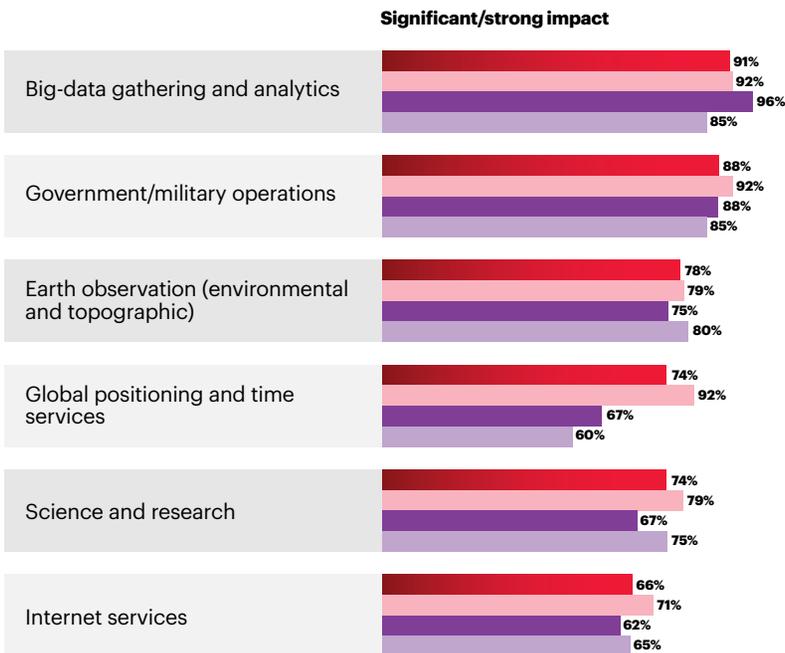
More than 90% of space tech industry professionals believe big-data gathering and analytics and government/military operations will have a strong or significant impact on the industry in the short/medium term. Earth observation, global positioning/timing services and science/research are also seen as important areas.



Applications

Applications with the greatest impact on the space tech industry in the next three years by region

Views in this area are broadly similar across regions, although those in APAC expect a greater impact from global positioning/time services and those in the Americas from orbital space stations/labs.



Applications

Other applications believed to have a significant impact on the space tech industry in the next three years

The professionals surveyed also suggested a range of other areas they felt would have a significant impact on the industry going forward. They are:



Space exploration



Nanosatellites



Electronically steerable flat panel antennas



Advanced surveillance solutions



Telemetry



Urban air mobility vehicles



Data compression and frequency modulation



Orbital positioning and orbital space management



Autonomous robotics and 3D printing



Machine learning and big data analytics



5G evolution and 6G



Commercial flights



Secure and sustainable digital systems



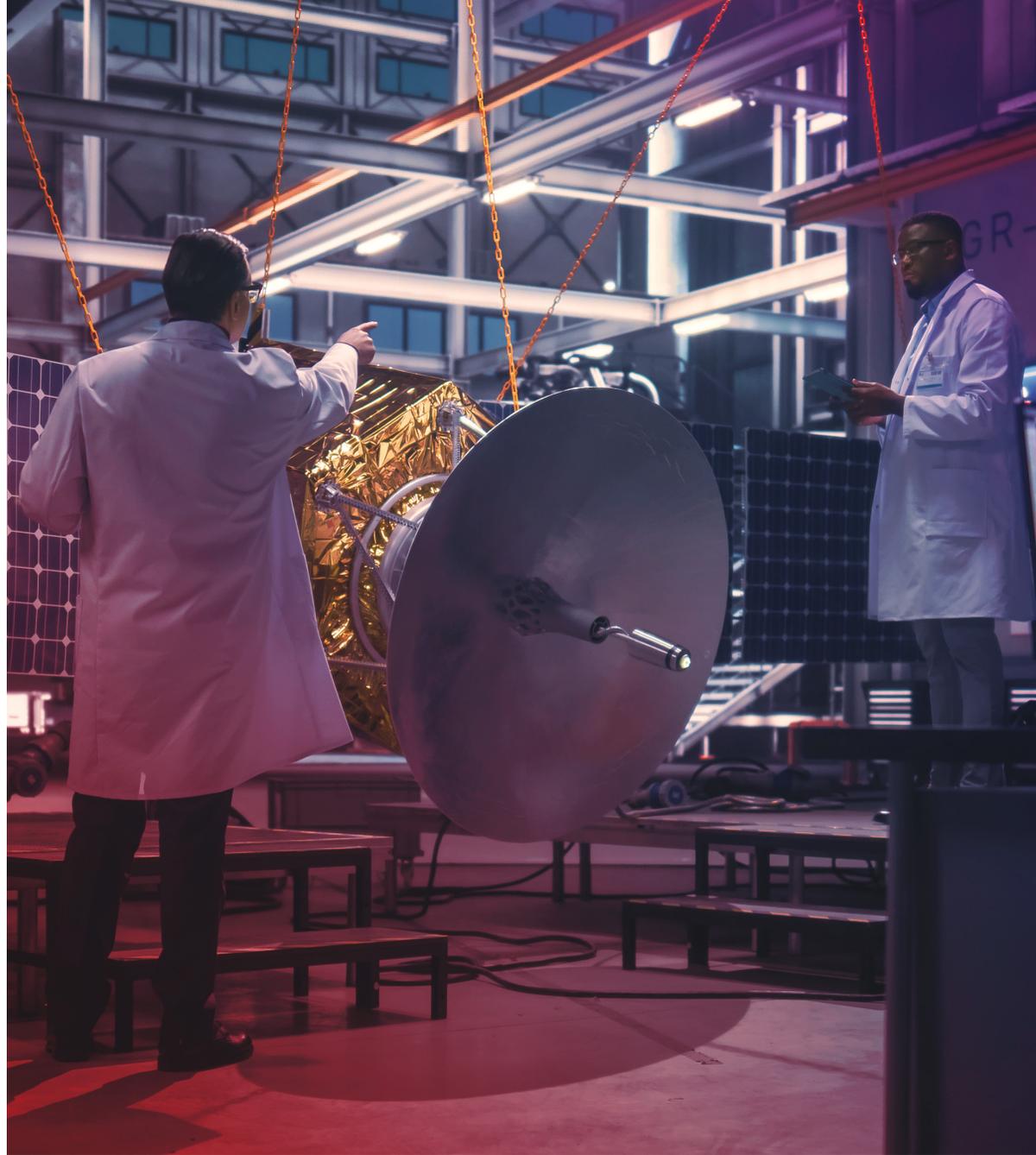
Advanced avionic systems



AI and robotics automation

Trends and Applications— State of the Industry Today

Our survey findings indicate that a series of ongoing and predicted trends are driving the evolution of the space tech industry. Some of these trends are focused on extending and improving the present technology, while others focus on exploring novel solutions in specialized niche areas. We conducted further analysis of the ecosystem to augment our primary market study with some live examples that underscore what our study indicates.



Small satellites

Commercial satellite operators deploy constellations of small satellites for connectivity services in LEO to provide global coverage with low latency. Due to their smaller and lighter footprint, smallsats are launched with less expensive launch vehicles.

- Blue Canyon Technologies designs and manufactures small satellites for a variety of applications, including communication and Earth observation.
- **SAAB** and AOS partners (AAC-Clyde Space, ORBCOMM, SABBB) are collaborating on a global maritime communication system that adds the space-based capability to the VHF Data Exchange System (VDES). LEO nanosatellites will enable ship-to-ship and ship-to-shore communication everywhere on the globe.
- Galaxy Space from China produces small satellites with modular components and miniaturized structures. It has deployed 1,000 small satellites, equipped with innovative communication payloads.
- Terran Orbital is manufacturing small satellites under a contract with the Pentagon's Space Development Agency.
- NanoAvionics designs is manufacturing small satellites and components for the space industry.





Very high throughput satellites (VHTS)

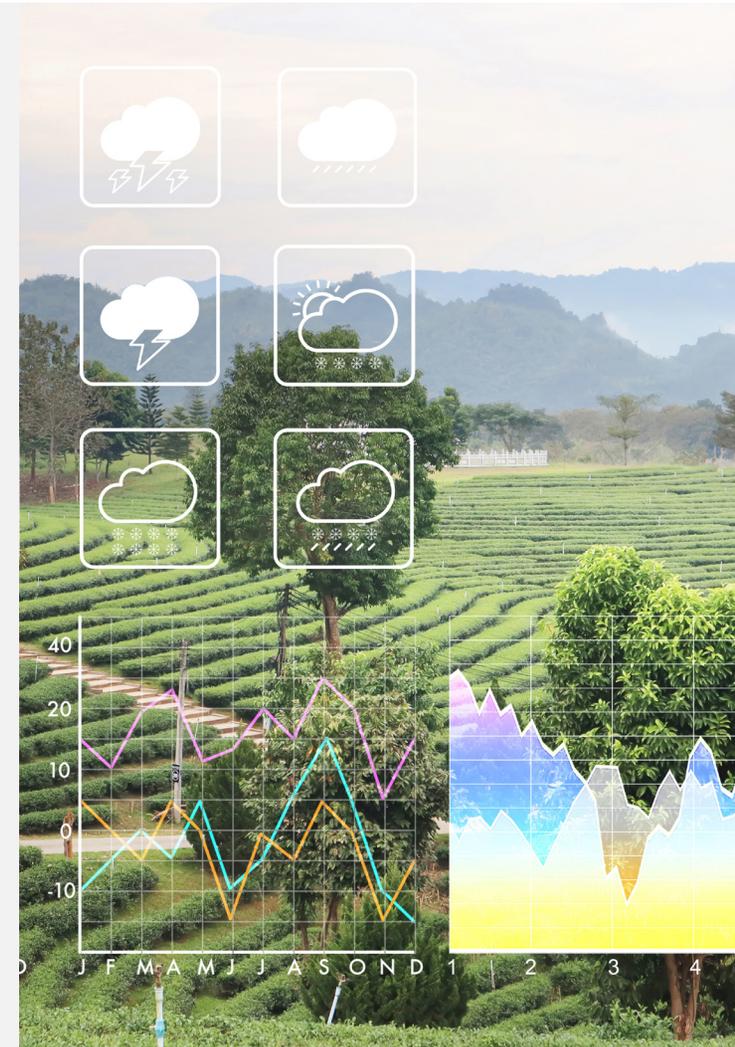
Very high throughput satellites (VHTS) are designed to provide significantly higher data transfer rates.

- CesiumAstro (USA) facilitates throughput payloads by providing high throughput capabilities as well as control over power consumption, beam hopping, beam-weight storage, and constellation performance.
- EUTELSAT KONNECT VHTS has a Ka-band instantaneous capacity of 500 Gbps and provides high-speed internet access across the European region. The satellite, built by **Thales Alenia Space**, has powerful onboard processing to optimize wideband connectivity with the best spectral efficiency.
- Novo Space's (USA) radiation-tolerant components include onboard computers, signal processors, carriers, and mass memories with 10x Gbps high-throughput interfaces.
- SSL (Space Systems Loral) has manufactured several high-throughput satellites, including the Jupiter 2/EchoStar XIX satellite.

Artificial intelligence (AI)

Artificial intelligence (AI) has become an increasingly important technology for satellite networks. Ground stations utilize ML and AI to enable the analysis of satellite data from earth observation, global navigation satellite system (GNSS), infrastructure monitoring, remote sensing, and ground-based space situational awareness for course correction or resource optimization.

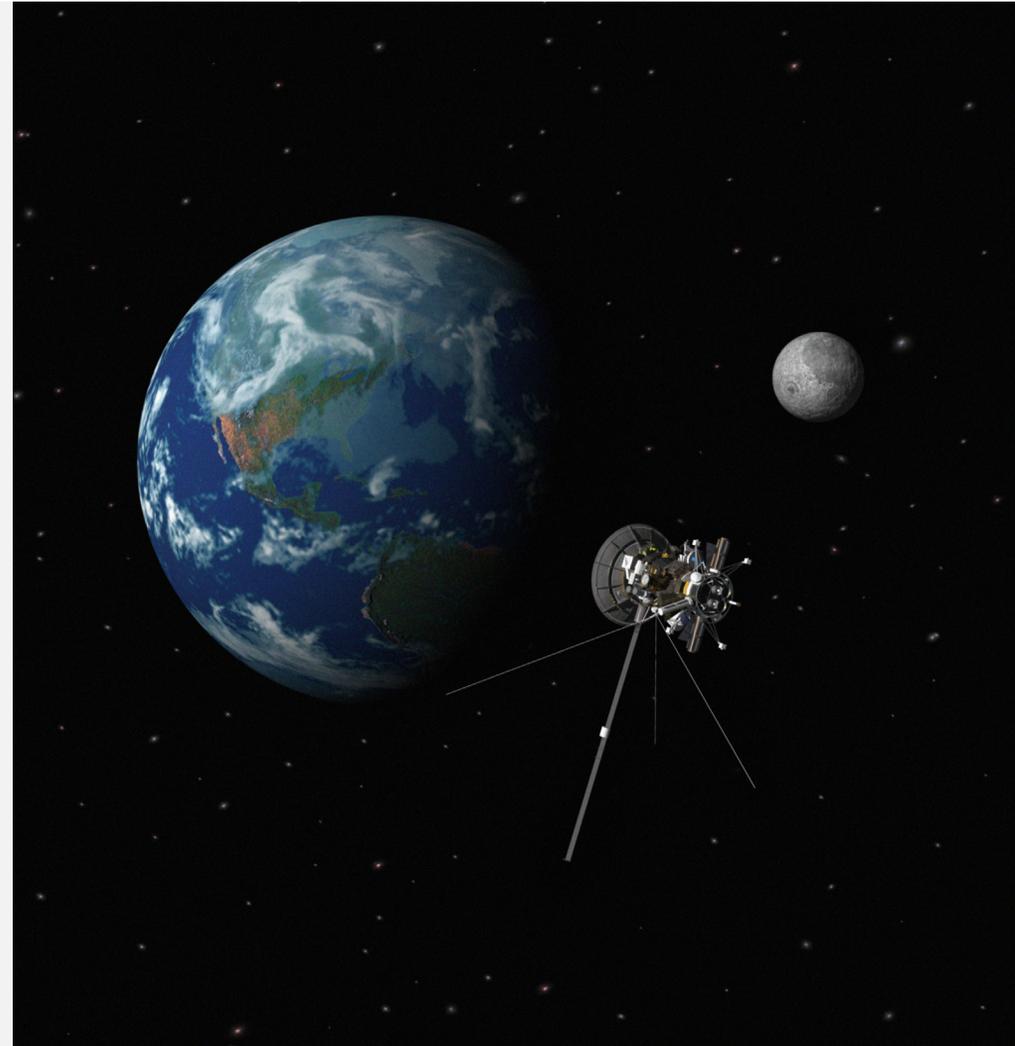
- SatSure produces data from remote sensing satellites. The start-up’s open innovation platform, SPARTA, combines IoT, economic, and weather datasets with data gathered from EO satellites. It also uses machine learning algorithms and big data analysis for this purpose.
- AIKO provides E-4-level autonomy in satellites through its advanced flight software for both onboard and ground systems. The start-up utilizes AI for creating custom algorithms for autonomous mission command and data handling. It also engages AI for detection and reconfiguration of mission-critical events in satellites providing failure detection, data selection, and mission replanning.
- Analytical Graphics Inc. (AGI) provides AI solutions for autonomous maneuver planning, anomaly detection, and machine learning-based prediction and analysis. Their solutions are used by satellite operators to optimize satellite performance and reduce operational costs.
- Capella Space provides SAR (Synthetic Aperture Radar) imagery from space to help organizations make critical decisions. It utilizes AI and ML to automate the process of image analysis and interpretation.
- Descartes Labs provides AI solutions for satellite imagery analysis, data management, and analysis.
- Orbital Insight offers the same services as Descartes Labs with applications ranging from agriculture to energy.



In-orbit services

Space tech companies are trying to solve a couple of key challenges impacting satellite performance—servicing an orbiting satellite, deploying space situational awareness solutions to detect and clean space debris, and decluttering space by increasing the lifespan of existing satellites.

- Canadian start-up Obruta uses its service pods and systems to perform satellite servicing while in orbit.
- Atomos (USA) uses its Orbital Transfer Vehicle or space tugs for custom last-mile orbit insertion of satellites.
- Northrop Grumman subsidiary, [SpaceLogistics](#), anticipates a new era for in-orbit servicing to sustain satellites in orbit. Their Mission Robotic Vehicle and Mission Extension Pods can offer several years of life extension.
- Effective Space Solutions provides in-orbit servicing services including life extension, relocation, and de-orbiting of satellites. It is planning to launch its first servicing spacecraft in 2023.
- Astroscale provides in-orbit debris removal and satellite servicing solutions. The company's spacecraft, called End-of-Life Services by Astroscale-demonstration (ELSA-d), is designed to capture, and remove space debris, as well as provide servicing capabilities to other satellites.





Satellite IoT

Significant investments in satellite technology for connected systems are driving the advancements in satellite IoT. These solutions deploy IoT sensors and devices for satellite-based, precise, and real-time asset tracking, monitoring, and remote surveillance around the world.

- Spanish start-up Fossa Systems brings secure and optimized satellite IoT communications at a low cost.
- Fleet Space Australia uses the LoRaWAN protocol of the low-power wide-area network (LPWAN) and LEO satellite constellations to provide bi-directional industrial IoT solutions.
- SpaceX acquired satellite Internet-of-Things connectivity provider Swarm. The access to SpaceX's launch capabilities enabled Swarm to guarantee latency at under one hour.
- There are several companies such as Orbcomm, Inmarsat, Iridium Communications, Globalstar, and Skywave which provide satellite IoT services to a range of industries, including transportation, logistics, and agriculture.

Electronic propulsion

High-capacity propulsion systems enable satellites to travel deep into space and perform complex maneuvers. As a result, high-power solar arrays, miniaturized fuel sources, and onboard sustainable propulsion systems are being incorporated into new satellites.

- Ienai Space (Spain) employs ionic propulsion for providing adjustable total and high specific impulses, 360-degree altitude control, and reaction wheel desaturation.
- Aliena (Singapore) manufactures miniaturized green propulsion systems for SmallSat mobility in space. The start-up's plasma thrusters are built with a high power-to-thrust ratio, specifically designed for low-power small satellites.
- Accion Systems is developing an electric propulsion system for small satellites. The company's propulsion technology uses tiny ion thrusters that are efficient, reliable, and low cost.
- Relativity Space is developing a 3D-printed rocket engine called the Aeon engine. The engine uses liquid oxygen and methane as fuel and is designed to be highly efficient and cost-effective.
- Phase Four is developing a new type of electric propulsion system called Radio Frequency (RF) plasma thrusters, which are designed to be more efficient and reliable.

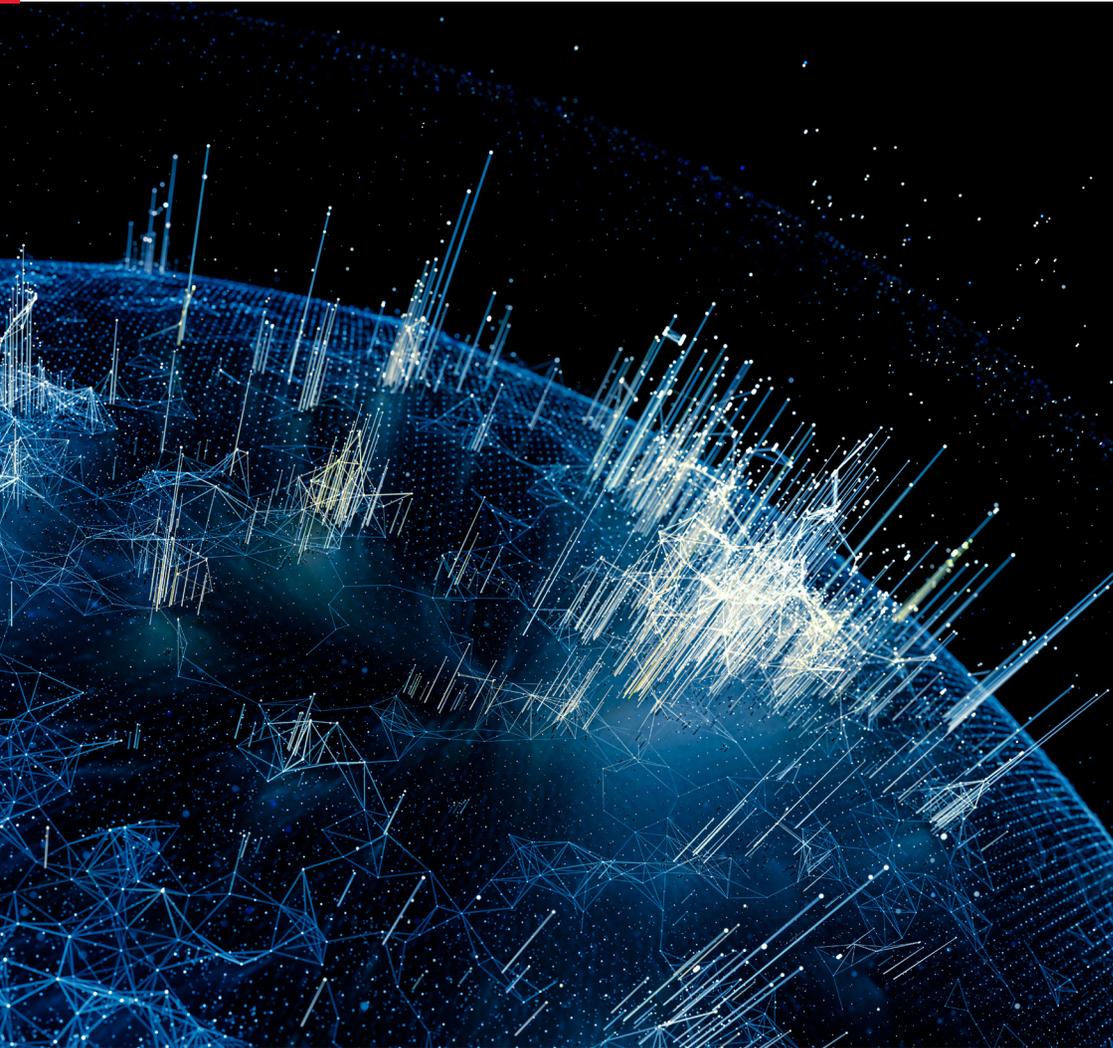




Advanced ground systems

Advancements and innovation in communication networks, telemetry, tracking, network management, and command-to-control systems make advanced ground systems a top trend.

- Inmarsat has successfully connected its satellite to new ground stations in Western Australia, allowing them to reach the fast-growing APAC region.
- Arctic SpaceTech (Sweden), offers secure downstream satellite data handling by digitizing ground stations.
- Spaceit (Estonia) utilizes its platform to integrate existing ground stations with satellite missions using telemetry, tracking, and command (TTC) protocols for real-time monitoring.
- Kratos Defense & Security Solutions provides advanced ground systems for communication networks, command and control systems, and data processing and analysis systems.



Advanced payload systems

Payloads are the backbone of satellite missions and play a critical role in a range of applications, including remote sensing, weather forecasting, and communication.

- BAE Systems subsidiary is planning a cluster of multi-sensor satellites with on-board machine learning to process and deliver actionable intelligence within moments of detection. The cluster of software-defined satellites can be fully reconfigured to future-mission needs, according to [In-Space Missions](#).
- The Bulgarian start-up Endurosat has adopted a software-driven approach in its CubeSats modules to make multiple redundancies of data.
- Anywaves (France) builds custom and off-the-shelf miniature antennas for satellite constellations. These antennas support the frequency bands ranging from S- and X-bands to all bands for GNSS.
- Harris Corporation, Airbus, Thales Alenia Space, Bell Aerospace and Maxar Technologies provide imaging and sensing systems, communication systems, and space-based robotics.

Large constellations in LEO

As the demand for global connectivity and satellite-based services continues to grow, several companies are offering large constellation services in Low Earth Orbit (LEO).

- SpaceX Starlink's is a satellite internet constellation aims to provide high-speed internet to underserved areas around the world. The company plans to launch tens of thousands of satellites into LEO.
- OneWeb is deploying a constellation of LEO satellites to provide high-speed internet access, particularly to remote and underserved areas.
- Amazon Kuiper plans to deploy a constellation of over 3,000 satellites into LEO.
- LeoSat Enterprises aims to provide enterprise-grade data connectivity anywhere in the world. The company plans to deploy a constellation of LEO satellites to provide secure, low-latency communications services to businesses and governments around the world.
- Telesat (Canada) is developing a LEO constellation of satellites called Telesat LEO, which aims to provide high-speed, low-latency connectivity for applications such as IoT, 5G mobile networks, and government communications.





Cybersecurity

Cybersecurity for satellite systems is becoming increasingly important as more and more satellites are launched into orbit and as the dependence on space-based assets continues to grow.

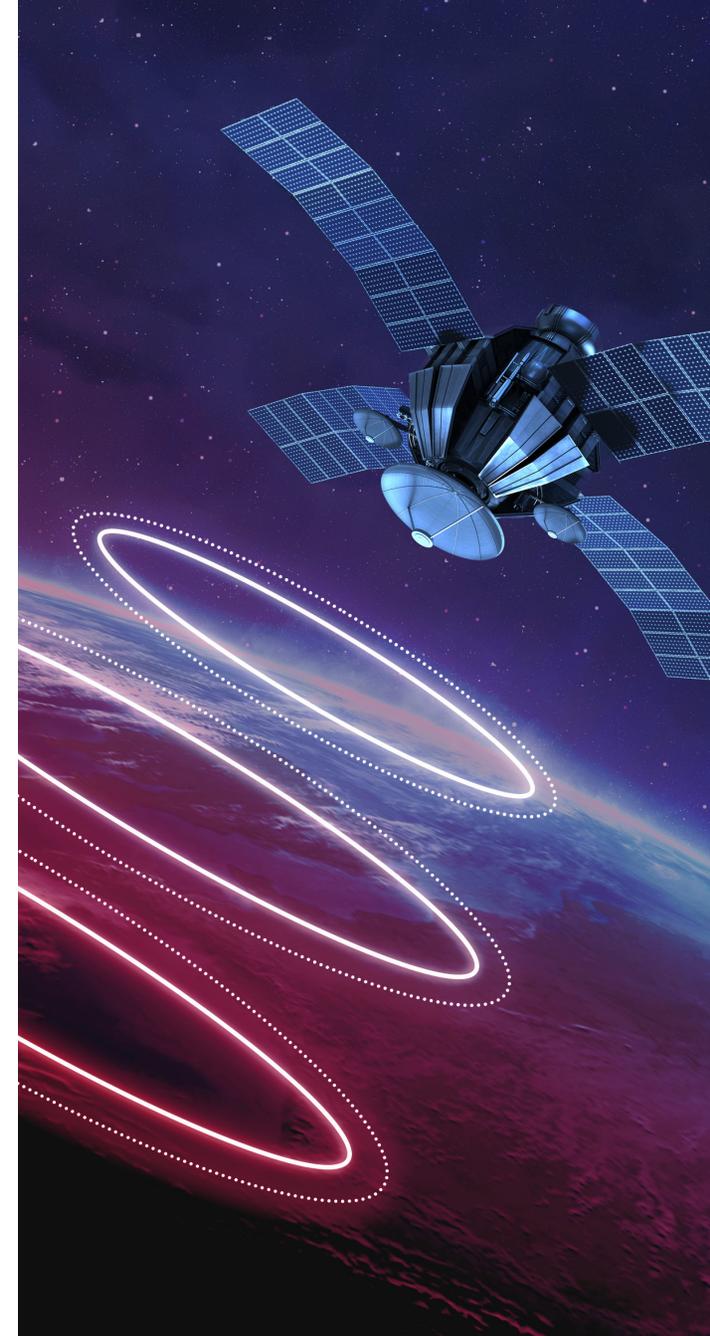
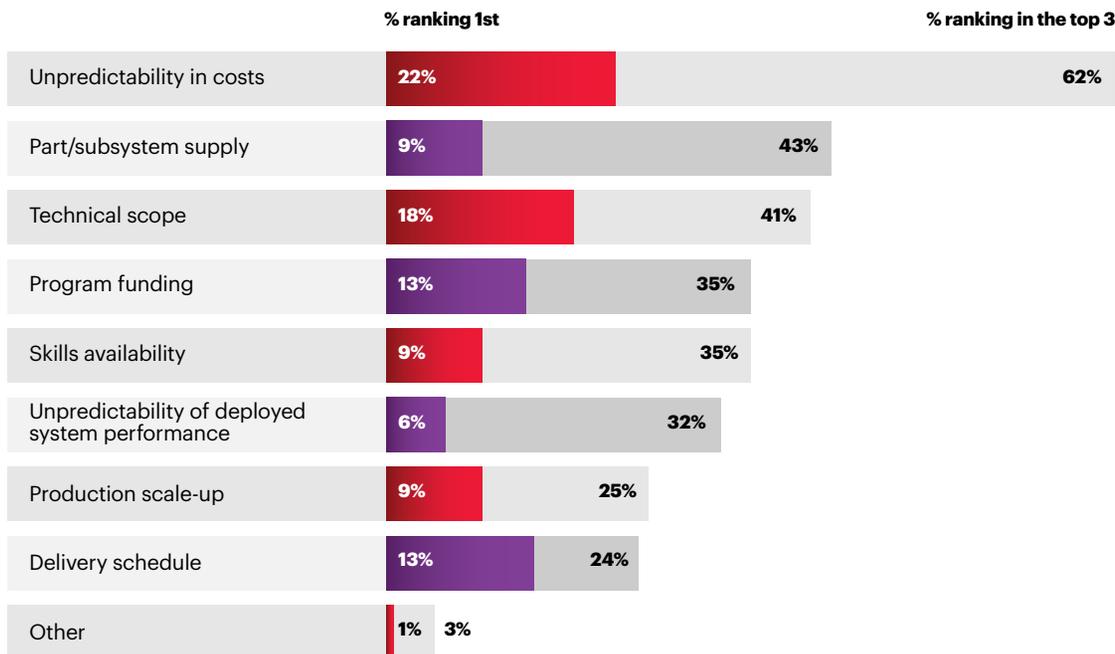
- Lockheed Martin, Raytheon, Boeing, Northrop Grumman, Thales Alenia Space, and Space Systems/Loral offer a range of cybersecurity solutions, including secure satellite communication systems and cyber threat intelligence services.
- SES offers secure communication services for government and military customers, including encryption and cybersecurity solutions.

Challenges and Barriers

Greatest sources of risk to projects

Six in ten of those surveyed identify unpredictability in costs as one of the top three greatest sources of risk for their project, with almost a quarter identifying this as the number one risk.

Greatest sources of risk to projects

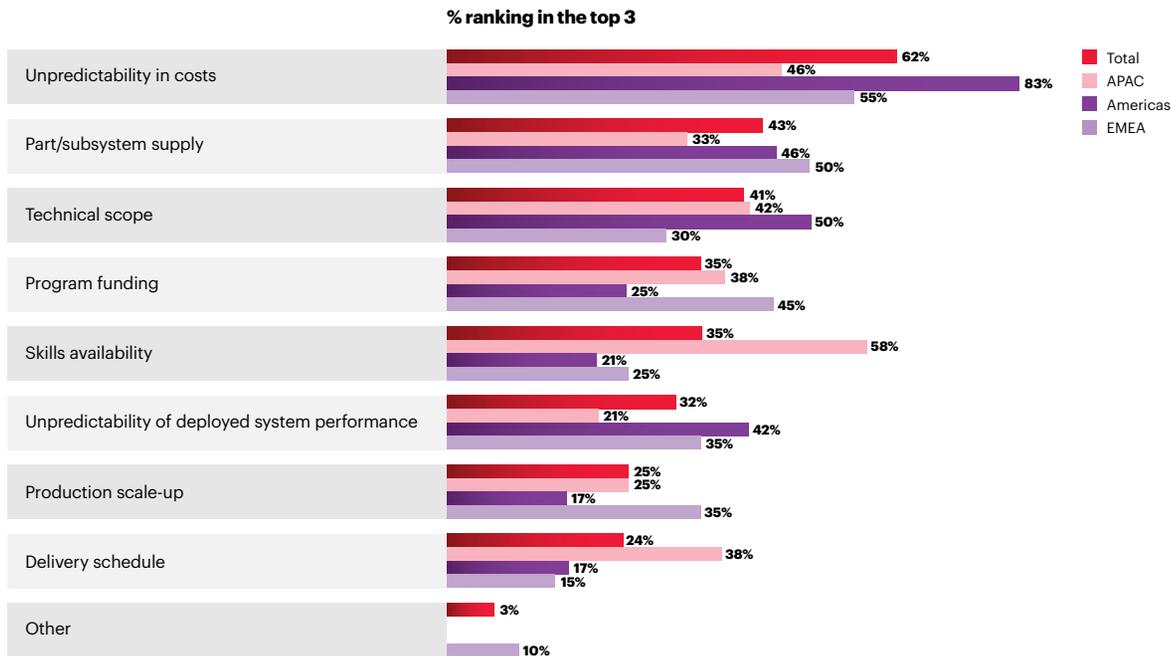


Challenges and Barriers

Greatest sources of risk to projects by region

Unpredictability in costs is a particular issue in the Americas, with skills availability seen as a greater risk in APAC than in other regions.

Greatest sources of risk to projects by region



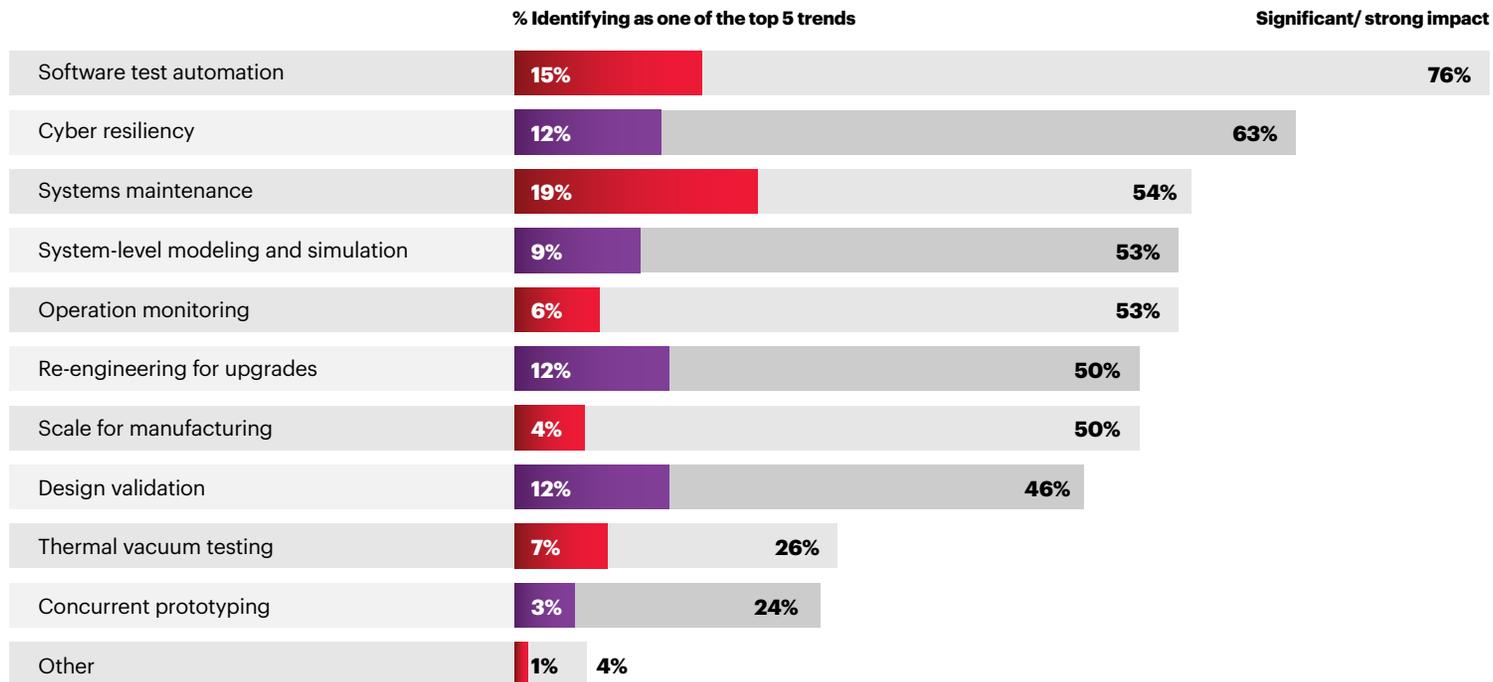
Challenges and Barriers

The most important technical challenges

Software test automation and cyber resiliency represent key technical challenges, followed by systems maintenance and system-level modeling and simulation.



The most important technical challenges

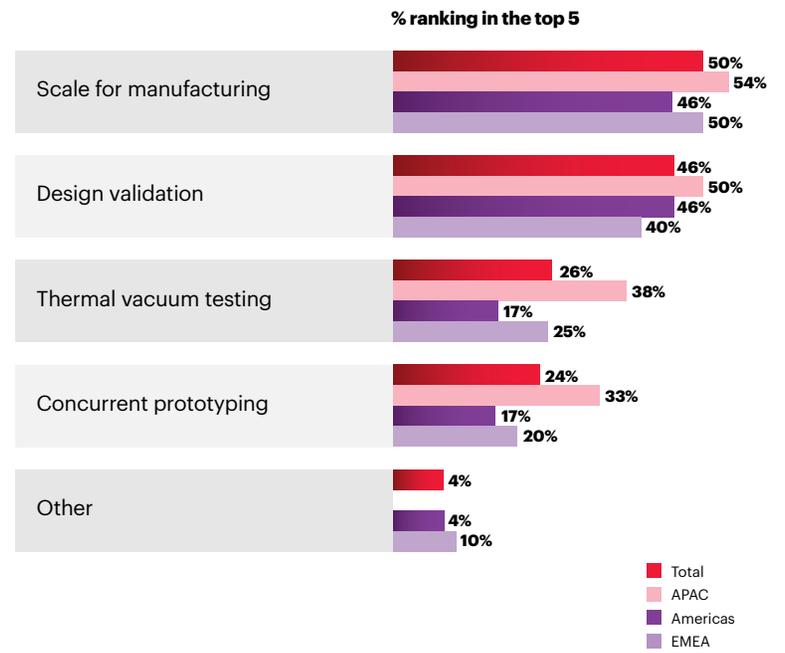
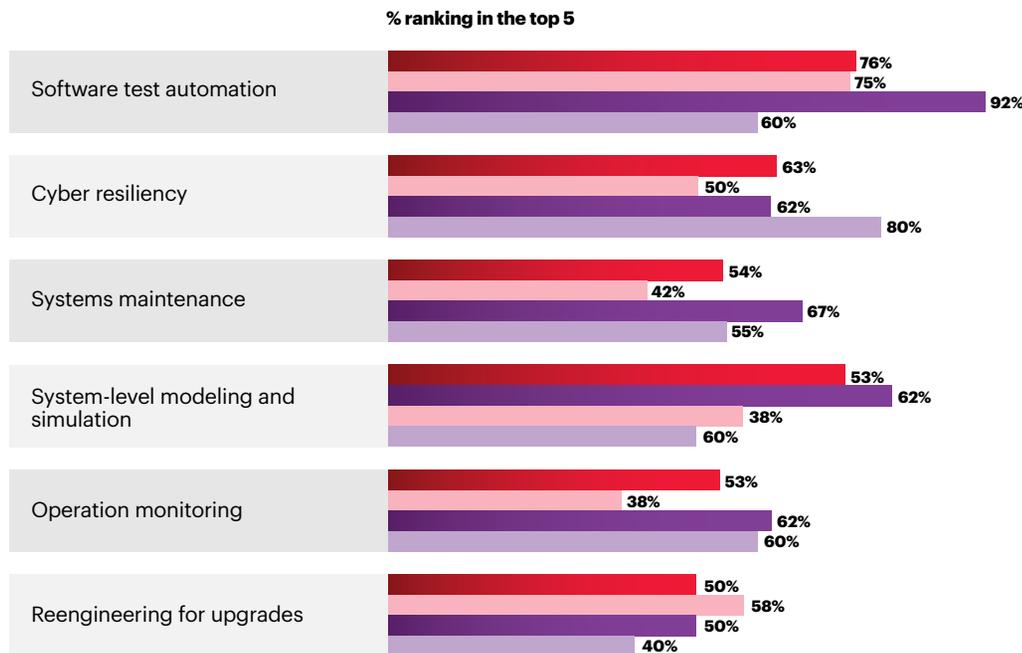


Challenges and Barriers

The most important technical challenges by region



The most important technical challenges by region



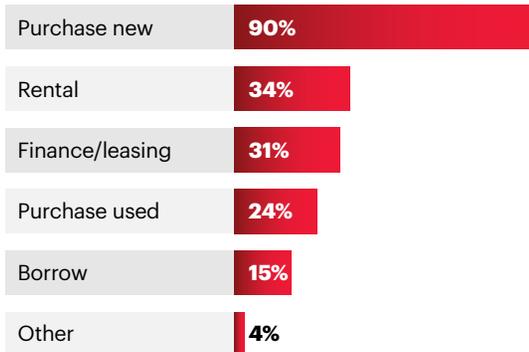
Choosing a Supplier

Typical approach to funding design, emulation, and test tools

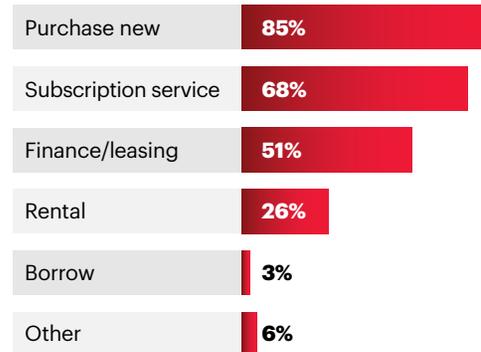
Space tech organizations are most likely to fulfill both hardware and software needs by purchasing new. However, for software, subscription services and finance/leasing are also important.

Typical approach to funding design, emulation, and test tools

Hardware



Software



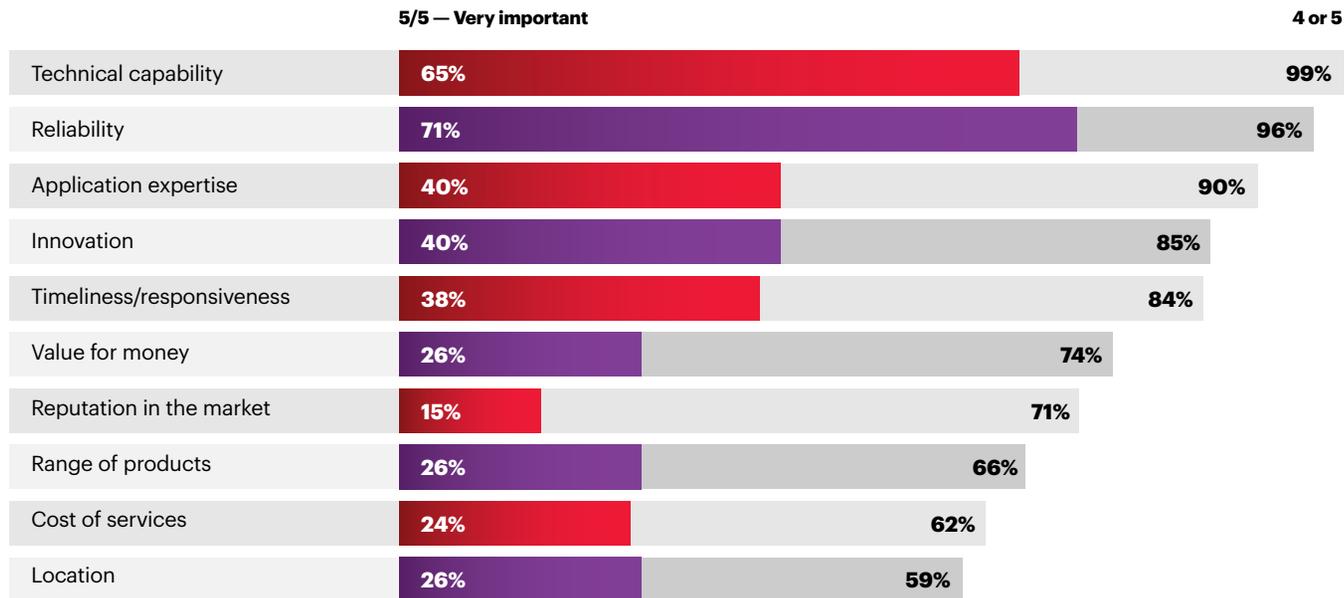
Choosing a Supplier

The most important factors in selecting a provider

The importance of technical capability when selecting a satellite provider is revealed by the responses to this question. Both reliability and innovation are nearly as important, as is application expertise. Value for money and cost are lesser concerns.



The most important factors in selecting a provider

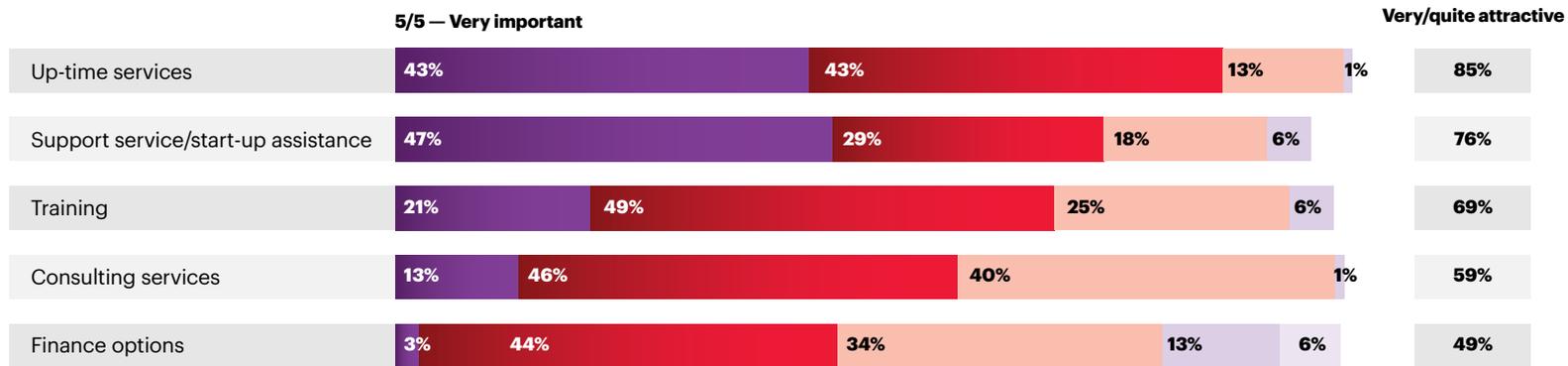


Choosing a Supplier

Attractiveness of potential services

Which services are space-tech decision-makers looking for most? The survey shows that they would find the offer of up-time services particularly attractive. Support service/start-up assistance and training are also high on decision-makers' priorities. There are some regional differences. For instance, consulting services are in much more demand in the Americas than elsewhere.

Attractiveness of potential services



- 5 Very attractive
- 4 Quite attractive
- 3 Neither attractive nor unattractive
- 2 Net very attractive
- 1 Not at all attractive

CONCLUSION

The Space Tech Future Is Looking up

We are seeing tremendous change in the space and satellite industries. The cost of launching payloads to orbit has been reduced 10-fold to 100-fold, thanks to firms like SpaceX and Blue Origin that have developed and matured highly reusable rockets. Lowering launch costs, in turn, has opened up opportunities for smaller start-ups to enter the market. Firms such as OneWeb and Starlink are developing Low Earth Orbit (LEO) constellations of satellites while others are testing GEOSAT business models.

These developments are enabled by and coupled with technology advancements in digital processing and beam steering with active phased array antennas, higher operating frequencies that allow much wider bandwidths to bring RF spectrum to the satellites, and optical links that facilitate high-efficiency data connectivity between satellites and even back to the ground.

The rapid commercialization of space—with private investment funding the creation of new business models—has also augmented the funds that governments have traditionally spent on tech development for national defense and scientific manned and unmanned exploration of space. This trend is driving a shift in thinking on the part of governments. Security is a major concern as threats to commercial satellites, national security (both cyber and kinetic), and orbital safety rise.

As national interests extend to space, space is becoming the newest domain of “deterrence.” There’s an increased emphasis on leveraging commercial space technologies and commercial capabilities for national security purposes and for scientific missions—projects that had previously been entirely funded by governments, and thus the taxpayers.

Finally, we are seeing a convergence of terrestrial-only communication networks with satellite communications networks, mainly to provide reliable broadband internet access to anyone (or anything), anywhere on the globe, and eventually even in cislunar space and beyond. Recent press announcements reported specific partnerships being formed between the major terrestrial carriers and SATCOM companies (Qualcomm with Iridium, SpaceX with T-Mobile, and Apple with Globalstar to name a few). Companies are also pursuing dedicated chipsets for satellite-enabled direct-to-phone messaging services.



CONCLUSION

To conquer the skies with confidence,

▶ start here

It is an exciting time in the space and satellite world, and we expect this trend to continue for years to come. Like all new technologies, space tech brings its own set of challenges. As data requirements are pushing bandwidths, satellite links at RF are moving to μ Wave and optical frequencies. Growing networks of small LEO satellites require complex ground support equipment, intersatellite links and security. Some predict that the next big thing will be software-defined satellites—flexible satellites that can refresh and reconfigure themselves on-demand.

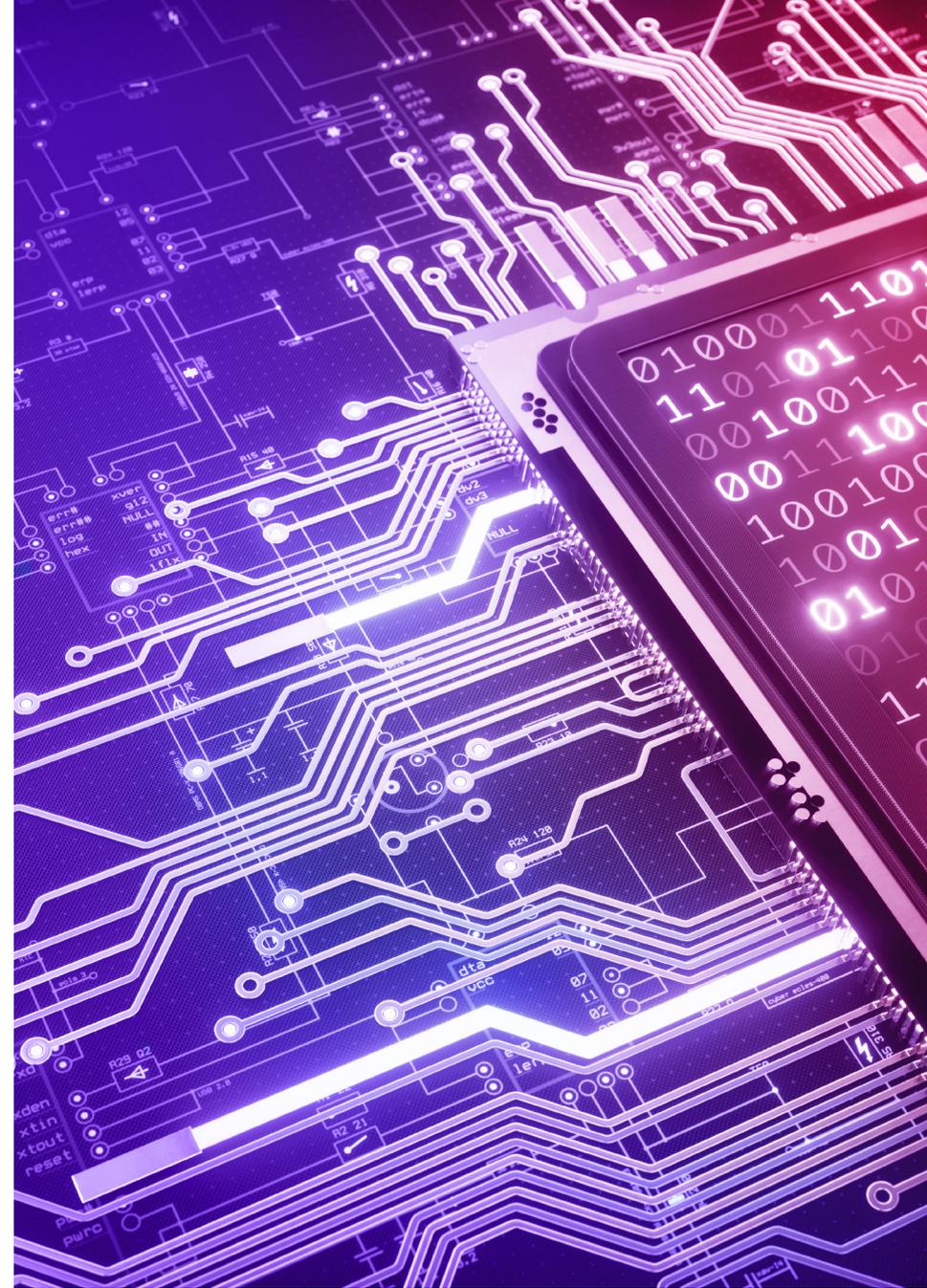
To make all this happen will require ramping up production volumes of assemblies and satellites and designing and building power systems, including E-propulsion, to support these new payloads. All while delivering the fast ROI on the test equipment that start-up companies and existing players require.

Keysight space tech solutions

To take advantage of these opportunities, testing and validation must be assured at every step. Start with Keysight for the end-to-end solutions you need. From guidance and power systems to satellite payloads and telemetry, tracking, and control (TT&C), to ground station and data transmission, Keysight's design and validation tools provide greater assurance that your satellite and its subsystems work the first time, every time, throughout the duration of the mission.

Keysight's unique fusion of technology leadership, measurement expertise, and tailored solutions help you innovate with confidence for today's agile, fast-paced, and vibrant new space economy.

[Learn more about our space tech solutions](#)





Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.

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