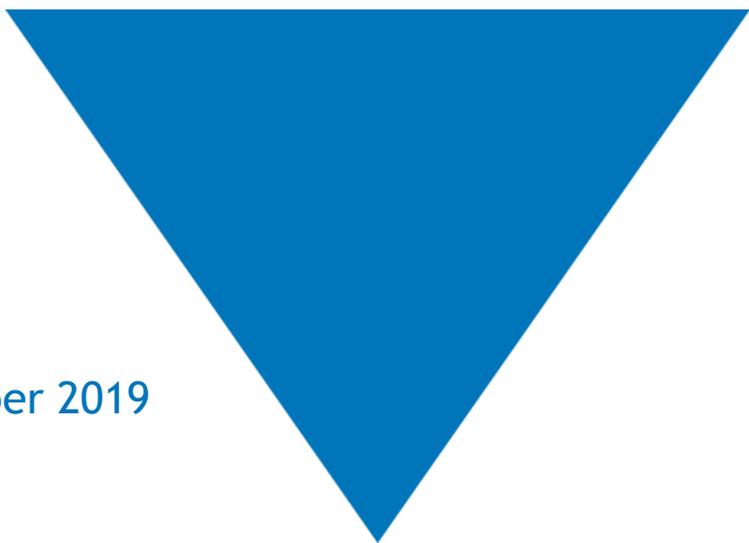


# ESPInsights

The Global Space Activity Monitor



Issue 4  
October-December 2019

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# FOCUS

## ESA Ministerial Council Space19+ concludes with biggest ever financial contribution

Undoubtedly the most important development for ESA in the year 2019 was the ESA Council Meeting at Ministerial Level – Space19+ – which took place in Seville, Spain in November 2019. ESA Council Meetings at Ministerial Level (also called Ministerial Councils) take place every two to three years and bring together European Ministers in charge of Space and observers to make decisions on programme proposals and the funding for ESA. The last Council Meeting at Ministerial Level took place in Switzerland under the vision of a *United Space in Europe in the era of Space 4.0* and resulted in the allocation of €10.3B for ESA’s space activities and programs.

This year’s ESA Council at Ministerial Level was held under the motto *Space19+* with the aim to “approve a comprehensive set of programs to secure Europe’s independent access to and use of space in the 2020s, boost Europe’s growing space economy, and make breakthrough discoveries about Earth, our Solar System and the Universe beyond, all the while making the responsible choice to strengthen the efforts we are making to secure and protect our planet”. Three resolutions were passed as a result of the Ministerial Council and a detailed break-down of Member State contributions was published as well. Indeed, the ministers committed the biggest ever budget with total subscriptions amounting to €14.4B. Particularly the science program received the most “significant boost in funding” in 25 years and ESA Space Exploration activities received their biggest funding ever.

The outcome of the Ministerial Council shows a clear expression by the Member States, that there is a need for ESA and that they value the pooling of resources to achieve their ambitions in space in an intergovernmental setting. Contrary to some pessimistic predictions of a reduced funding towards ESA in light of a strengthened EU Commission, ESA came up with a comprehensive set of programmes and proposals. Through the substantial subscriptions of member states, most requests were supported and led to the funding inter alia of space safety & security programmes – signalling a clear recognition by Member States of the role of ESA in these matters, going beyond the well-acknowledged indispensable role of ESA’s role in science, exploration and launchers.

ESA Member State	Subscription (€M)	Share % per contributor
Austria	190	1.3%
Belgium	816	5.7%
Czech Republic	150	1.0%
Denmark	128	0.9%
Estonia	9	0.1%
Finland	110	0.8%
France	2,664	18.5%
Germany	3,294	22.9%
Greece	84	0.6%
Hungary	97	0.7%
Ireland	81	0.6%
Italy	2,282	15.9%
Luxembourg	129	0.9%
Netherlands	345	2.4%
Norway	284	2.0%
Poland	166	1.2%
Portugal	102	0.7%
Romania	44	0.3%
Spain	852	5.9%
Sweden	244	1.7%
Switzerland	542	3.8%
United Kingdom	1,655	11.5%
Slovenia	5	0.0%
Canada	114	0.8%
Total contributions	14,388	100.00%

Programme	Subscription (€M)
<b>Applications</b>	
Earth Observation	2,541
Telecommunications	1,511
Navigation	72
<b>Science and Exploration</b>	
Science	1,671 (+1,152)*
Human and Robotic Exploration	1,953
<b>Enabling and Support</b>	
Basic Activities	825 (+585)*
Technology	561
Spaceport (CSG)	309 (+203)*
<b>Safety and Security</b>	
Space Safety	432
Safety and Security Applications	109
<b>Prodex (PROgramme de Développement d'Expériences scientifiques)</b>	
	229

\* Including the subscriptions part of the mandatory programmes over the total volume of 5 years.

# SPACE POLICY AND PROGRAMMES

## EUROPE

### European GSA and World Geospatial Industry Council sign agreement

The European GNSS Agency (GSA) and the World Geospatial Industry Council (WGIC) have signed a [cooperation agreement](#) in Stuttgart in September, as reported by the GSA on 11 October 2019. The agreement covers the joint use of geospatial technology and the European satellite navigation systems and the joint contribution to various projects - which relate to “sustainable development and achieving global development agendas, including the SDGs”. According to GSA Chief Operating Officer Pascal Claudel, the cooperation with the WGIC “will be instrumental in leveraging the collective technical capabilities of geospatial information and space technology across different sectors, professional services and applications.”

### Ariane 6 on track for first launch in 2020

Updates on the [development of the Ariane 6 launch system](#) were released at the International Astronautical Congress in October and subsequently published by ESA on 26 November. The report reflects on the development of the Ariane 6 since its inception in 2014 by a decision at the ESA Council at Ministerial level and reiterates the governance and framework for the Ariane 6 including its connection to the Vega-C launch vehicle. After the “successful completion of the launch system Critical Design Review in September 2019”, what remains are a third test of the P120C (to be conducted in 2020) and the completion of the new Ariane 6 launch complex (technical qualification review began in September 2019). According to the report, the development of the Ariane 6 Launch System is on track for its first flight in the second half of 2020.

### World’s first space debris removal mission commissioned by ESA

At the ESA Ministerial Council in November 2019, Ministers agreed on a mission to task a commercial provider with the “[safe removal of an inactive ESA-owned object from low-Earth orbit](#)” - as part of ESA’s new Space Safety programme and in line with ESA’s [Clean Space](#) initiative. The consortium led by the Swiss start-up ClearSpace has been selected to submit a final proposal before the project’s launch in March 2020. The space object targeted for the ClearSpace-1 mission will be “the Vespa (Vega Secondary Payload Adapter) upper stage left in an approximate 800km by 660km altitude orbit after the second flight of ESA’s Vega launcher” in 2013 - at



Picture 1: Credit: ESA

100kg a relatively small satellite deemed well suited for the experiment. The ClearSpace-1 spacecraft dubbed a “chaser” will rendezvous with the object using four robotic arms and then de-orbit with Vespa to burn up in the atmosphere. The total mission will cost €117 million; ESA is currently funding €70 million for the first three years by paying for spacecraft development and launch costs. ClearSpace aims at launching the spacecraft in 2024 or 2025.

### ESA signs contract for new version of EGNOS system

On 5 December, Thales Alenia Space announced the signing of a contract with ESA on behalf of the European Commission for the [development of a new version of the European Geostationary Navigation Overlay System \(EGNOS\)](#). The contract worth €78M for the new version (version V242B) will include:

- “the expansion of the EGNOS SBAS coverage zone;
- Installation of a new generation of reference stations (RIMS);
- Improved algorithms in the computation centre (CPF) to boost system performance;
- Enhanced system security.”

The certification and commissioning of this version is projected for 2023.

## Initial tests completed for Europe's next generation weather forecasting system

ESA announced on 25 November that the initial test campaign for [MetOp Second Generation](#) (MetOp-SG) was completed at ESA's ESTEC Test Centre in the Netherlands. A successor of the MetOP satellites, the MetOP Second Generation is Europe's contribution to the Joint Polar System - a collaboration with the US. The system is meant to enter into service in 2023 and provide weather forecasting and climate change data from polar orbit, providing information inter alia on air quality, sea ice, wind, temperatures in the atmosphere, as well as atmospheric chemistry. According to ESA the MetOp Second Generation is the "future of European weather forecasting".



Picture 2: Credit: ESA-SJM Photography

## ESA and Luxembourg Space Agency sign Memorandum of Cooperation

At the ESA Ministerial Council Space19+ in Seville, Spain, ESA and the Luxembourg Space Agency (LSA) signed a Memorandum of Cooperation pertaining to space resources and innovation. The cooperation agreement foresees the participation of ESA as a strategic partner in the [European Space Resources Innovation Centre](#), established by the LSA with the focus on "space resource extraction, processing and manufacturing to advance sustainable space exploration". The LSA and ESA will establish facilities for ground-based space resources research by private and public researchers. Moreover, the "cooperation will include research, business support and incubation, knowledge management and competence concentration and community management."

## CNES signs agreement with ESA on interoperability of mission control centres

The French space agency CNES has signed an Memorandum of Cooperation with the European Space Agency to improve interoperability of mission control facilities on ground by establishing the European "[Network of Operations Centres](#)". The aim is to create "opportunities for joint action, knowledge sharing and technical interchange, and allow engineers and other professionals to benefit from crossed exchanges and mobility" - thus reducing the burden on European taxpayers by optimising capabilities and capacity and avoiding the duplication of efforts.

## Declaration of Intent signed between France and USA on SSA and STM

The Declaration signed by CNES and the [Department of Commerce of the USA](#) on 23 October 2019 reflects on the importance of [Space Situational Awareness \(SSA\)](#) and [Space Traffic Management \(STM\)](#) for the safe pursuit of space commerce and exploration. While acknowledging that France and the USA already share many priorities and objectives regarding both SSA and STM - the Declaration states both countries' intent to further cooperate on these matters, including inter alia through the exchange of scientific and technological information, discussions and dialogues, as well as through the formalisation of a Memorandum of Understanding. Notably, the Declaration states that "international regulation in space traffic management is neither necessary nor desirable in the short term".

## Construction of Scottish Spaceport reported to begin within next year

After the "local Scottish government economic and community development agency" Highlands and Islands Enterprise (HIE) signed a 75-year option to lease land in the North of Scotland for the purpose of building a spaceport in August, the project director Roy Kirk announced in October that upon approval by the local authority, construction can begin in 2020. Should HIE receive consent to build the so-called [Space Hub Sutherland](#), the first launches could happen in the early 2020s, according to Kirk, and would "enable vertical rockets to launch small satellites into low Earth polar and sun-synchronous orbits". The projected cost of the spaceport's development is \$20.77M, towards which the UK Space Agency has contributed \$3M in July 2018.

## German Aerospace Centre signs cooperation agreement with UNDP

On the topic of the UN 2030 Agenda for Sustainable Development, Prof. Dr. Pascale Ehrenfreund, Chair of the DLR Executive Board, attended a meeting with representatives of the United Nations Development Programme (UNDP), where a [Memorandum of Understanding was signed between DLR and UNDP](#) in attendance of the Assistant Secretary-General to the United Nations, Angelique Crumbly. The cooperation aims to focus on research and development of digital tools and services and innovative technological solutions for the effective contribution to the UN 2030 Agenda.

## Germany and Luxembourg sign Letter of Intent at 70<sup>th</sup> IAC

At the 70<sup>th</sup> International Aeronautical Congress in Washington DC in October 2019, the Chair of the Executive Board of DLR, Prof. Dr. Pascale Ehrenfreund, and Prof. Dr. Hansjörg Dittus, Member of the Executive Board for Space Research and Technology, signed a [Letter of Intent](#) with Marc Serres, CEO of the Luxembourg Space Agency. The signing is meant to “further formalise and enhance the cooperation on space activities”, such as “navigation, satellite communications, space exploration and space resources, including robotics and in-orbit services”.

## A resolute approach to space from the new Italian government

As part of the new government agenda, the Ministry of Economic Development gave a boost to the ITAL-GovSatCom programme; the [decree](#) approved at the end of September provided for €100M with the goal to expand the ambitions of the programme, in particular for what concerns industrial and innovative developments coming also from SMEs.



Picture 3: Credit: Thales Alenia Space

## Continuity of the Italian dual use observation programme

On 18 December, the first satellite of the flagship Italian EO programme CosmoSkyMed Second Generation (CSG) was [launched](#) from Kourou as the primary passenger on a Soyuz vector. The CSG consists of two satellites that will eventually replace part of the original constellation and then be followed by the Third Generation (CTG).

## Italy consolidating international cooperation at global level

On the occasion of the 74<sup>th</sup> session of the UN General Assembly in September, AVIO and UNOOSA signed an [agreement to foster space cooperation](#) in the framework of the Access to Space 4 All initiative. The agreement offers developing and emerging space countries the opportunity to fly to space, free of charge, selected CubeSats projects, starting from October 2020 on a Vega rocket launch.

The Italian Air Force signed an [contract with Virgin Galactic](#) on 2 October in Washington for a SpaceShipTwo suborbital spaceflight, expected by the end of 2020. The agreement is the first signed by a governmental institution for a human flight of this kind on a commercial vehicle.

At the International Astronautic Congress in October, the President of ASI signed a [Joint Statement for Cooperation in Space Exploration](#) with NASA Administrator to facilitate the cooperation with NASA on the Artemis Programme, particularly regarding the development of habitat modules. Italy thus became the first European country to officially join the US-led Lunar programme.

ASI further consolidated its cooperative activities with Kenya and Latin America, firstly through the Italy-Kenya [intergovernmental agreement](#) approved in November concerning the Broglio Space Centre; secondly, with a [cooperation agreement](#) signed with the Italian-Latin American International Organisation (IILA), on scientific and education activities and on the promotion of space diplomacy in the whole Latin America region.

## Establishment of the U.S. Space Force

On 9 December, [the National Defence Authorization Act \(NDAA\)](#) received bipartisan approval from both the House and Senate Armed Services Committees and was adopted as the defence policy bill for the Fiscal Year 2020. The Committees agreed upon the establishment of the [U.S. Space Force](#) as the sixth Armed Service of the United States, established within the Department of the Air Force and led by the newly created Chief of Space Operations (CSO). On 20 December, President Trump [signed into law the FY2020 NDAA](#) and officially inaugurated the Space Force. The U.S. Space Force is provided with \$40M (€35.9M) in operations and maintenance funds and 16,000 military and civilian personnel from the disestablished Air Force Space Command.

## NASA and Artemis between advancements and standoffs

With the official start of the FY2020 on 1 October 2019 and until 20 December 2019 with the approval of the new appropriation bill, NASA operated on a Continuing Resolution based on the 2019 funding levels. During last months, the Senate and the House continued negotiations to reconcile the different previously approved budget proposal to achieve a shared version and proceed to the vote in Congress, considered [essential to respect the timeline for the Artemis Programme](#). Eventually, on December 17 the Congress passed the [appropriation bill for 2020](#) providing NASA with \$22.63B (€20.25B) signed by the White House on 20 December; the bill represents an increase of 5% compared to the 2019 budget level. The bill includes \$600M (€537M) for the development of the human lunar lander, still falling short of the NASA requirement of \$1B; overall, it allocated an amount of \$1.3B (€1.16B) to the Artemis Programme.



Picture 4: Credit: NASA

On 23 September, [NASA awarded Lockheed Martin](#) with the Orion Production and Operation Contract, securing a minimum of six - and a maximum of twelve - Orion spacecrafts by 2030 for the Artemis Missions from III to VIII, for a total amount of \$4.6B (€4.1B). On 18 November, NASA announced five more companies - SpaceX, Blue Origin, Sierra Nevada Corporation, Ceres Robotics and Tyvak Nano-Satellites System - are to [join the Commercial Lunar Payload Services \(CLPS\) contracts](#).

In October, alongside the 70th IAC in Washington DC, NASA signed two Joint Statement with the [Italian Space Agency](#) and the [Polish Space Agency](#), on cooperation on the Artemis Programme and on space exploration, respectively.

In the middle of audits conducted by NASA regarding commercial crew delays that could potentially create [risks of losing independent access to the ISS](#), on 13 November the Senate Commerce Committee approved the NASA Authorization Act of 2019 that expand the U.S. long-term [engagement to the ISS to 2030](#).

## Reorganisation of the Commercial Space Office

On 3 December, the Federal Aviation Administration announced the conclusive [reorganisation of the Office of Commercial Space Transportation](#), in charge of regulating the U.S. commercial space transportation industry as well as facilitating the private commercial launches. The Office is currently discussing a possible revision of commercial launch regulations, and welcomed the measure as an improvement to the overall efficiency in dealing with the increasing launch activities.

## Cooperation on defence and space safety and security

On 10 October, the [Defense Advanced Research Projects Agency \(DARPA\)](#) awarded Seakr Engineering with a Pit Boss contract to deliver the processing systems to the Blackjack Proliferated Low-Earth Orbit Demonstration programme. The DARPA Blackjack programme is based on the goal to integrate commercial satellite technologies into defence projects. On the same day, the U.S. Air Force announced the selection

of eight companies for a nine-year [competitive procurement totalling to \\$986M of launch services](#); the measures are meant to take advantage of the US small to medium launch industry as the eight companies are: SpaceX, Xbow Launch Systems, Northrop Grumman, Firefly Aerospace, United Launch Alliance, Aevum, Vox Space and Rocket Lab. On 15 November, [USAF awarded Lockheed Martin with a \\$3.3B\(€2.9B\) ten-year contract](#) for support services and orbital operations logistics on the military communication satellites programme "Advanced Extremely High Frequency (AEHF), Milstar and Defense Satellite Communications System (DSCS) III", for which the company manufactured five of the six satellites procured by the Air Force.

The [Missile Defence Agency](#) announced on 29 October the selection of Northrop Grumman, Raytheon, Leidos and L3Harris for a \$20M (€18M) contract to each company for the development of a prototype for the Hypersonic and Ballistic Tracking Space Sensor programme.

In the realms of space safety, on 4 November the [US Space Command signed a MoU with the Finnish Air Force](#) on cooperation focused on space situational awareness, expanding the network of nations and agencies collaborating on transparency of space operations. On 9 December, after a revision process occurred during November, the [update to the US government Orbital Debris Mitigation Standard Practices \(ODMSP\)](#) was made available, as the first amendment to the guidelines since their publication in 2001. The update consists in limits to the number of debris, imposed as new standard practices and necessary to address the increased number of debris in orbit.

## Launch Vehicles progresses



Picture 5: Credit: NASA/Bill Ingalls

On 3 November, SpaceX completed the 13th consecutive successful [test of the parachutes for the Crew Dragon](#) spacecraft, while experiencing on 20 November a [setback for the Starship](#) reusable launch system first prototype during a pressurisation test.

On 20 December, an Atlas V rocket launched the [uncrewed test flight of the Boeing CST-100 Starliner to the ISS](#), but due to a timing anomaly that caused a failed insertion in orbit, the spacecraft had to complete an [early re-entry](#) on 22 December, successfully landing in New Mexico. On 14 December, NASA announced the [completion of the core stage of the SLS](#), declared ready for launch in 2021 for the Artemis

I mission, that will be shipped to the Stennis Space Centre for static-fire tests to the engines.

## CANADA

### Continuity at government level and participation in Space19+

After the federal elections held on 21 October, Navdeep Singh Bains was confirmed as [Minister of Innovation, Science and Industry](#) receiving in his mandate letter the encouragement to support Canada's aerospace industries.

Canada participated in the ESA Ministerial Council Space19+ and [subscribed an overall amount of €114M](#); the investments are focused to programmes in the domains of Earth observation, satellite communications, exploration and technology development, in line with the priorities outlined in the Space Strategy for Canada released in March 2019.

## Revealed sample collection site for OSIRIS-REx

On 12 December, the NASA OSIRIS-REx mission team announced the selected [sample collection site on the asteroid Bennu](#); the OSIRIS-REx Laser Altimeter (OLA), developed by the Canadian Space Agency (CSA), scanned Bennu's surface and created high-resolution 3D maps. Canada will receive part of the collected samples at their return to Earth expected in 2023.

**OSIRIS-REx**  
OLA: CANADA'S CONTRIBUTION

**WHAT IS OLA?**  
The OSIRIS-REx Laser Altimeter (OLA) is a scanning lidar (light detection and ranging) instrument that uses infrared light to measure distances.

**WHAT IT WILL DO**  
OLA will scan the entire surface of the asteroid Bennu to create a highly accurate 3D model of the asteroid, and provide mission scientists with unprecedented information on the asteroid's shape, topography, distribution of boulders, rocks, and other surface features.

**HOW OLA WORKS**  
SIMILAR TO A POLICE RADAR  
OLA is a time-of-flight system, whereby scientists measure the round-trip time of laser pulses travelling from OLA to millions of points on the surface of Bennu and back. This will allow scientists to determine the topography of the asteroid.

**OLA IN NUMBERS**

- Mass: 22.9 kg
- 4,000 mechanical parts
- 3,000 electrical parts
- 30 optical parts
- 15 circuit cards
- 2 lasers
- 1 scanning mirror

OLA only uses the power of a 75 W light bulb!

Canadian Space Agency / Agence spatiale canadienne

Canada

Picture 6: Credit: © Canadian Space Agency.

## RUSSIA

### Russia announces web portal for Russian space products and rockets

General Dmitry Loskutov - Director General of the Roscosmos subsidiary Glavkosmos - announced a new [“Unified Product and Component Portal” for Russian space products](#) and rockets at the Space Tech Expo Europe in Bremen, Germany, in November 2019. The web-portal compiles information on over 480 space products from 75+ companies, which include detailed technical specifications, facilitating the “search, selection, analysis and ordering of products”. The portal is an attempt of Russia to be [“more client oriented”](#) - as Glavkosmos Director General Dmitry Loskutov said in Bremen in November 2019, adding “this is not something revolutionary but the Russian space industry is pretty difficult for clients who want to buy something”.

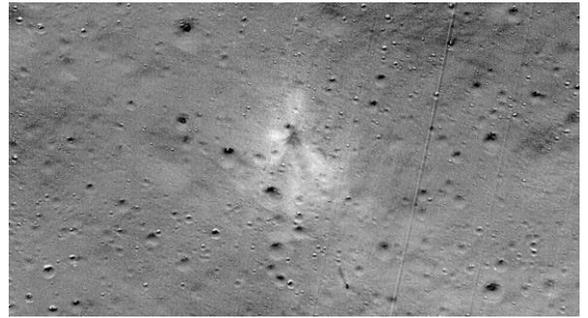
### Russia expands human spaceflight cooperation with emerging space nations

In line with its human spaceflight cooperation endeavours of 2019 as exemplified by U.A.E citizen Hazzaa al-Mansoori flying to the ISS in September, Russia is showing openness to similar endeavours. Following a meeting between Roscosmos CEO Dmitry Rogozin and the Ambassador of Turkey to Russia Mehmet Samsar in October, Turkey has [“confirmed its intention to send astronauts to Russia for training”](#), mirroring a statement made earlier in 2019 by Roscosmos CEO about the potential flight of a Turkish astronaut to the ISS in 2021-2023. In November, Roscosmos CEO confirmed [similar talks with Saudi Arabia, Egypt](#) “and many other countries”. Moreover, on the sidelines of the ESA Ministerial Council in Seville in November 2019, the Hungarian Minister of Foreign Affairs and Trade Peter Szijjarto confirmed ongoing talks with Roscosmos on sending the second [Hungarian astronaut to the ISS](#) by the year 2024.

## INDIA

### ISRO seeks funding for Chandrayaan-3 mission

Amidst news of the confirmation of the [Vikram lander's crash site location](#) on the Moon, reports have been released that the Indian Space Research Organisation (ISRO) is seeking funding for the [Chandrayaan-3 mission](#). According to the Times of India, ISRO “has sought Rs 75 crore from the Centre specifically for the mission as an addition to its existing budget” (equivalent to €9.5M, at exchange rate of 8 Dec 2019). Initial plans indicate that Chandrayaan-3 will comprise a lander, a rover, as well as “a detachable propulsion module to carry fuel”. The [Chandrayaan-3 plans were officially confirmed](#) on 1 January 2020 by the head of ISRO. In the



Picture 7: Credit: NASA/Goddard/Arizona State University

meantime, the Union Minister of State for Atomic Energy and Space - Jitendra Singh - stresses that the [Chandrayaan-2 orbiter](#) functions well and will carry out its designed mission for the next 7 years.

### ISRO increased turnover through commercial customers

According to Jitendra Singh (Union Minister of State for Atomic Energy and Space), ISRO has earned approximately [Rs 1245 crore \(equivalent to €158M, at exchange rate of 13 Dec 2019\)](#) since 2014 through [launching other countries' satellites](#) - with the fiscal year 2018-2019 contributing the highest amount with Rs 324.19 crore (equivalent to €41M, at exchange rate of 13 Dec 2019). In the last five fiscal years, India has launched around 284 commercial satellites and generally has launched satellites of 26 countries - signing commercial contracts with 10 countries in the last five years including the USA, UK, Germany, Canada and France. All commercial launches were completed through the PSLV - the Indian launch vehicle enabling India to provide cheap rideshare services for small satellites.

## JAPAN

### Asteroid Explorer Hayabusa2 commences return to Earth

Tasked with studying “the origin and evolution of the solar system”, the Asteroid Explorer Hayabusa2 was launched from Tanegashima Space Centre in 2014 and reached the asteroid Ryugu in June 2018. It successfully completed its mission of landing on and collecting samples from Ryugu and JAXA announced that as of its [departure from the asteroid](#) on 13 November 2019 has commenced its return to Earth. The return is planned for [December 2020](#).

### JAXA seeks to expand demand for small sat piggyback launch opportunities

On 4 December, the Japanese Aerospace Exploration Agency (JAXA) announced the [signing of an agreement with Space BD Inc.](#) after selecting the company following a public solicitation process. Space BD Inc. “provides private companies and universities with piggyback launch opportunities for their small satellites” and through the agreement will do so for JAXA satellite launches on the H-IIA and H3 launch vehicles. Through the agreement JAXA “aims to further increase demand for small satellite launching and create new launching services, while also maximising its research and development performance by capitalising on the vitality of the private sector”.

### China Commercial Space Alliance formed

On 11 December 2019, the [China Commercial Space Alliance](#) was officially launched as an alliance of space industry entities as well as “state-owned defence and space contractors”, such as the China Aerospace Science and Technology Corporation (CASC) and the China Aerospace Science and Industry Corporation (CASIC). The alliance aims to aid in the promotion and regulation of the country’s growing private space sector inter alia through industry research, the promotion of innovation and international cooperation as well as “upstream and downstream integration of the industrial chain”.

### China announces ambitious plan for space programme in 2020

The chief engineer of the China Aerospace Science and Technology Corporation (CASC), Zhuang Jingguo, revealed new [plans for the upcoming year of the Chinese space programme](#). The 30 rocket launches currently planned for 2020 are “expected to include missions to Mars, the Moon, test flights of new launch vehicles, and the completion of the BeiDou navigation system”, and do not account yet for additional commercial launch activity. Notable missions include the Chang’e-5 lunar sample return and China’s first interplanetary mission to Mars, and the test flight of the Long March 5B variant of the Long March 5 launch vehicle. On 14<sup>th</sup> November, China presented the [progress for its Mars mission](#) to international observers by demonstrating the “hovering, obstacle avoidance and deceleration capabilities” of its Mars spacecraft in the Hebei province.



Picture 8: Credit: AP Photo/Andy Wong

## EMERGING SPACE NATIONS

### Turkey formally established the Turkish Space Agency

On 21 November 2019, the Turkish President Recep Tayyip Erdogan formally established the [Turkish Space Agency](#) via presidential decree published by the Turkish government. The new body will “organise, coordinate and manage”, and carry out the Turkish space programme in line with its mandate set by the president and have “financial and administrative autonomy as well as a special budget”. The agency will have its headquarters in Ankara and report to the Ministry of Industry and Technology, while conducting additional coordination with other ministries and agencies as it pertains to its mission.

### New Zealand adopts new principles on payloads to protect national interests

The Minister for Economic Development Phil Twyford announced on 17 December the approval of a [new set of principles on payload permits](#). In addition to the existing regulatory framework, the principles aim “to strengthen the New Zealand’s Space Agency regulatory function and ensure decisions about payload permits are made in the national interest”. According to the new principles approved by the Cabinet, the following launch activities will not be allowed:

- “payloads that contribute to nuclear weapons programmes or capabilities,
- payloads with the intended end use of harming, interfering with, or destroying other spacecraft, or space systems on Earth,
- payloads with the intended end use of supporting or enabling specific defence, securing or intelligence operations that are contrary to government policy,
- and payloads where the intended use is likely to cause serious or irreversible harm to the environment.”

## Nigeria approves substantial budget for national space programme

With the approval of a [record national budget](#) equivalent of \$35B US dollars for 2020, the President of Nigeria, Muhammadu Buhari, also approved a substantial allocation of budget to the Ministry of Science and Technology and thus the space programme. According to the breakdown, the total approved budget for the space programme is \$54.67M allocated to the National Space Research and Development Agency (NASRDA) and its associated centres, the Nigerian Communications Satellite Limited (NigComSat) as well as the Nigerian Defence Space Administration. The centres associated with the NASRDA are responsible for a range of topics from space science, remote sensing to space technology application and space education.

## Ukraine passes law on state regulation of space activities

With the signature of Ukrainian President Zelensky on 30 October 2019, the law “On amendments to certain laws of Ukraine on the state regulation of space activities” has been passed, therefore amending the Law of Ukraine. According to the report of the parliament’s press service, the [new legal framework](#) now considers “enterprises, institutions and organisations of any form of ownership and legal organisation” to be able to be considered subjects of space activities. The new law lays out the basic principles of Ukrainian space activities, which include, inter alia:



The aim of the passing of the law is to “maintain the scientific and technological potential of the Ukrainian space industry and attract private capital to the latest technological developments”.

## Australia expanding its space network

Alongside the 70th IAC in Washington DC in October, the Australian Space Agency at the presence of the Minister for Industry, Science and Technology, Karen Andrews, signed [three cooperation agreements with the German, Italian and New Zealand space agencies](#). The agreements indicate the efforts from Australia to expand its network and encourage investments in the space sector. In particular, the LoI signed with DLR focuses on quantum technologies and medical research in space; the MoU with ASI includes projects and activities on space education, space weather and space law; the arrangement with the New Zealand Ministry of Business, Innovation and Employment aims to build a “trans-Tasman space innovation ecosystem” through cooperation on launch and ground segment networks operations.

At the same occasion in Washington, the Australian Space Agency signed a [Statement of Strategic Intent and Cooperation with Maxar Technologies](#), to explore the opportunities in the field of EO and space infrastructure as well as education and training activities. On 3 December, the Australian Space Agency signed an [agreement with Thales](#) aimed to “mutually identify key areas of investment as well as potential research, development and commercial opportunities”.

## UK-Australia partnership for the Pacific

On 6 November, as part of the “Space Bridge” initiative signed in September, the Australian Space Agency and the UK Space Agency announced a [partnership on satellite monitoring activities in the Pacific](#) area, with a special focus on small islands, with the participation of the Commonwealth Scientific Industrial Research Organisation (CSIRO) Australia’s national science research agency.

## Growing ties between the Australian Space Agency and national private space sector

The Australian Space Agency signed Statement of Intent and Cooperation with three private national industry actors, also in view of the Australian National Civil Space Priority Areas: on 19 November with EM Solutions, for the development of [space communications](#) capabilities; on 2 December with EOS Space

Systems, focused on [SSA and debris monitoring systems](#) on 11 December with Gilmour Space, specialised in rocket technologies, intended to verify the opportunities to work on common areas of strategic interests, specifically on [launch capabilities and manufacturing facilities](#).

Furthermore, on 9 December Lux and ResearchSat, [two start-ups part of the University of South Australia incubator programme launched a space balloon](#) to conduct research experiments and prepare future rocket launches. The incubator programme is part of the Innovation and Collaboration Centre's Venture Catalyst Space, a strategic partnership between the University and the South Australian government.

## MULTILATERAL ORGANISATIONS

### ITU Member States reach agreement on new regulatory regime

At the World Radiocommunication Conference (WRC-19) in Sharm el-Sheikh, Egypt, in November 2019, delegates of the International Telecommunication Union (ITU) adopted a [new regulatory regime](#) for “the deployment of non-geostationary satellite (NGSO) systems in specific radio-frequency bands and services”, including LEO mega-constellations. These regulatory procedures establish a “milestone-based approach” to reflect the ongoing and rapid innovation in satellite development and deployment. More specifically, the agreement sets out to “strike a balance between the prevention of radio-frequency spectrum warehousing, the proper functioning of coordination mechanisms, and the operational requirements related to the deployment of NGSO systems.”

### Three resolutions adopted by UNGA related to space security

The First Committee (Disarmament and International Security) of the United Nations General Assembly [adopted three resolutions related to the militarisation of outer space](#) in November 2019. The first resolution “No first placement of weapons in outer space” (A/C.1/74/L.59) was approved with 123 in favour, 14 against and 40 abstentions. The resolution proposed by a group of countries including inter alia Russia, China, Cuba, North Korea and Syria was met with concern by some delegations, including Germany, as being insufficient to “respond to the objectives of maintaining and strengthening trust” while also including “ambiguities and shortcomings” regarding the issue of anti-satellite capabilities and a clear definition of space weapons. A second resolution “Further practical measures for the prevention of an arms race in outer space” (A/C.1/74/L.58/Rev.1) was approved with 124 in favour, 41 against and 10 abstentions. Lastly, the resolution “Transparency and confidence-building measures in outer space activities” (A/C.1/74/L.60) was approved with 166 in favour, 2 against and 5 abstentions.

### UNOOSA and Luxembourg launch “Space Law for New Space Actors” project

Director of the United Nations Office for Outer Space Affairs (UNOOSA), Simonetta di Pippo, and Minister for Development Cooperation and Humanitarian Affairs of Luxembourg, Paulette Lenert, signed a funding agreement in November 2019 for UNOOSA's [“Space Law for New Space Actors”](#) project. The project aims to “offer UN Member States tailored capacity building to facilitate their drafting of national space legislation and/or national space policy in line with international space law”. Beyond supporting new and emerging space nations in their space activities, the project aims to promote the long-term sustainability of outer space activities and adherence to the existing international normative framework for space activities - shared priorities of the Government of Luxembourg.



Picture 9: Credit: ©Marie De Decker 2018

### NATO declares space an operational domain

After the approval by the Defence Ministers in June of an [“overarching space policy”](#), the support received both from the [Military Committee](#) in October and the decision of the [Foreign Ministers](#) in November, on 4 December at the London Summit NATO officially declared [space as an operational domain](#), the fifth after air, land, sea and cyber.

# SPACE ECONOMY AND FINANCE

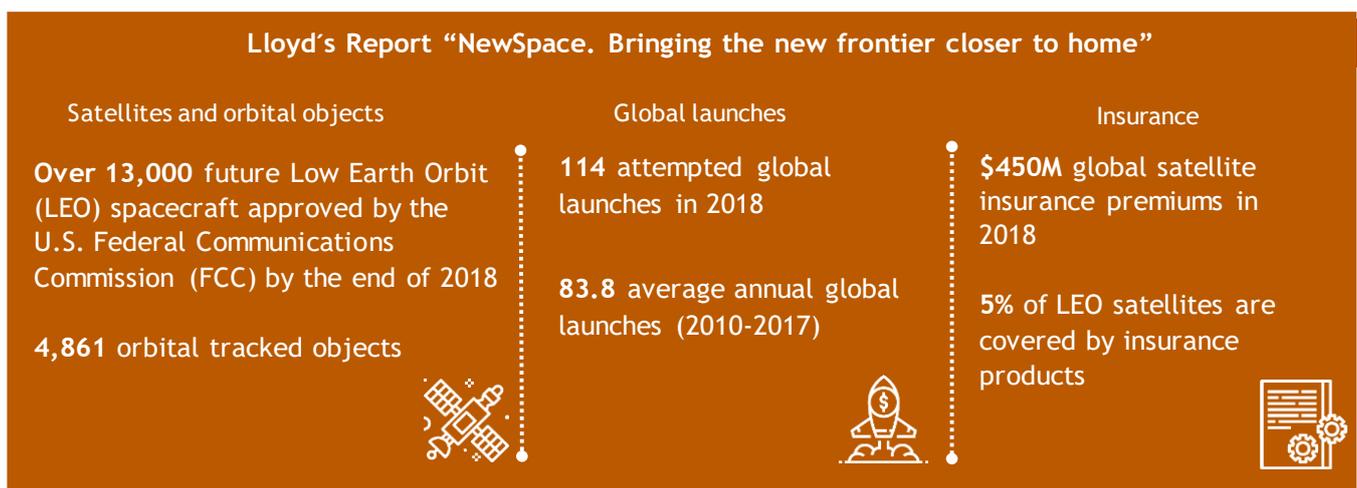
## SPACE ECONOMY

### Lloyd's report on the relationships between new space and the insurance market

At the beginning of December, the insurance market's specialist Lloyd's published a [report on the trends and risks of the space sector](#). Produced with the policy consultancy London Economics, the report assesses the risks associated with the traditional and new space sector and aims to analyse the potential impacts and opportunities for businesses. The study highlights the complementary role of the insurance market to each aspect of a space mission since its inception. It suggests that business opportunities and technological innovations offered by new space to a variety of markets come with new and rising risks. Since the report envisages a potential consolidation of these trends in the future, it points to the need to understand and manage risks and reducing the overall vulnerability. Lloyd's introduces the insurance policy "Llift", a product "needed to support the sustainable development of the new frontier" and tailored to meet the requirements of the new space. The report addresses four main features of the new space sector considered of concern for the insurance market:

- democratisation of space: potentially leading to lack of risk transfers to the insurance market by the new space entities, resulting often to risk-taking on themselves;
- rise of small satellites constellations and increasing launch frequency
- space as a resource: emphasis on the nature of space as a high-risk environment, considering the developments around manufacturing in orbit, commercial human spaceflight and resource mining;
- innovative mission concepts: especially the emergence of in-orbit servicing and proactive risk mitigation in space can lead to a change of the perception of risks.

The report aims to raise awareness around the increasing implications related to risks for the new space and to illustrate how the insurance market can meet the uncommon, flexible and individual needs of the new space community.



<sup>1</sup> Credit to: Lloyd's and London Economics. *Emerging Risks Report 2019. Understanding Risk (December 2019)*

### GSA GNSS Market Report - Issue 6

On 15 October the European Global Navigation Satellite Systems Agency GSA released the [6th edition of its GNSS Market Report](#). According to the Report the overall GNSS market, comprising both devices such as receivers, transponders, antennas, etc. and services; is poised to grow in the coming years.

## SPACE ECONOMY AND FINANCE

Today, the installed base of GNSS devices is estimated in 6.4 billion units worldwide, about 0.8 units per capita, generating a turnover of €150.7B just for 2019.



2 Icon credit to: freepik and prettycons from flaticon.com

Smartphones is the device category incorporating the total highest number of GNSS chipsets worldwide, while smart wearables recently stepped up to the second place. Beside consumer devices and automotive, the drone sector now represents the third market for GNSS technology. Health-related silver economy may also be a driver for GNSS devices' shipment growth in the future.

Currently the Asia-Pacific region (comprising Greater China, Japan and South Korea) represents nowadays 30.5% of global GNSS market, USA 26.7% and Europe 25.5%.

In just a decade, by 2029 the revenues are estimated to more than double reaching €325B, for an installed base of 9.5 billion units, approximately 1.1 device per person worldwide. Added value services will increase their relative share over total GNSS market to account for 51% of sales in 2029, for a total of €166B.

The mid-end receivers (price ranging between 5 to 150 euros) are set to lead the GNSS market revenue growth beside augmentation services, which will go from €23 to €65B. High-end receivers are forecasted to contribute to over 10% of receiver revenue although representing less than 1% of shipments.

Today, the vast majority of GNSS device shipments are receivers costing less than 5 euros (embedded in consumer tech).

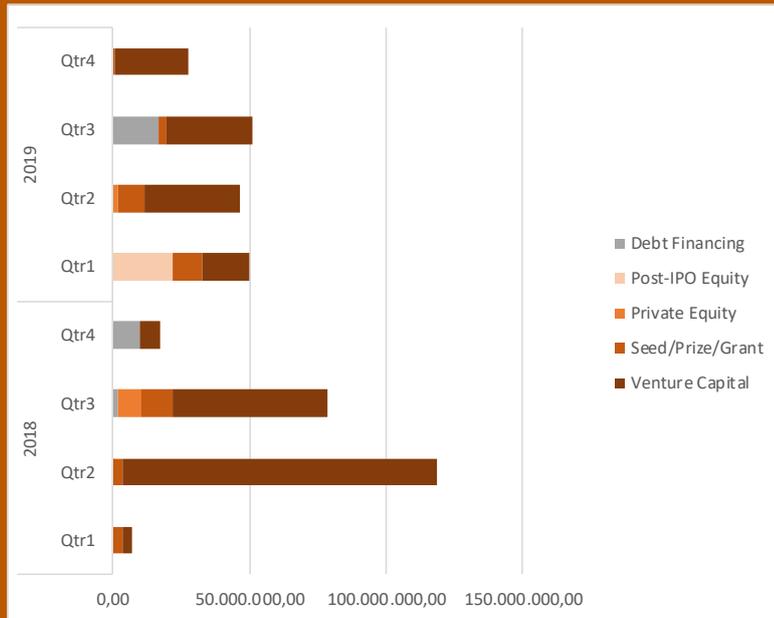
## SPACE FINANCE

### ESPI Space Venture Europe Q4 2019

#### METHODOLOGY NOTE

The assessment of private investments provided in this report is based on the ESPI dataset including exclusively publicly available data on announced operations and deals. Information is collected by screening a high number of sources including investment firms', incubators' and accelerators' portfolios, articles and specialised news outlets or specialised sources such as CrunchBase. Cross checking was systematically performed. ESPI database includes deals for the period 2014-2019. The following definitions were applied to delineate the perimeter of the analysis:

- Start-up: is a company younger than 10 years and who has not yet reached business maturity (defined according to business stage: Public Offering and or Acquisition, annual turnover <€50M, or number of employees <250);
- Space company: is a company which main business (in revenue share) is part of the space value chain;
- European company: is a company for which the headquarters, or the majority of its business operations are conducted in Europe (EU Member States + ESA Member States).
- More detailed information on definitions applied and investors and investment categories used for the purposes of this research, are available in the [Space Venture Europe 2018 Report](#) free for download here.

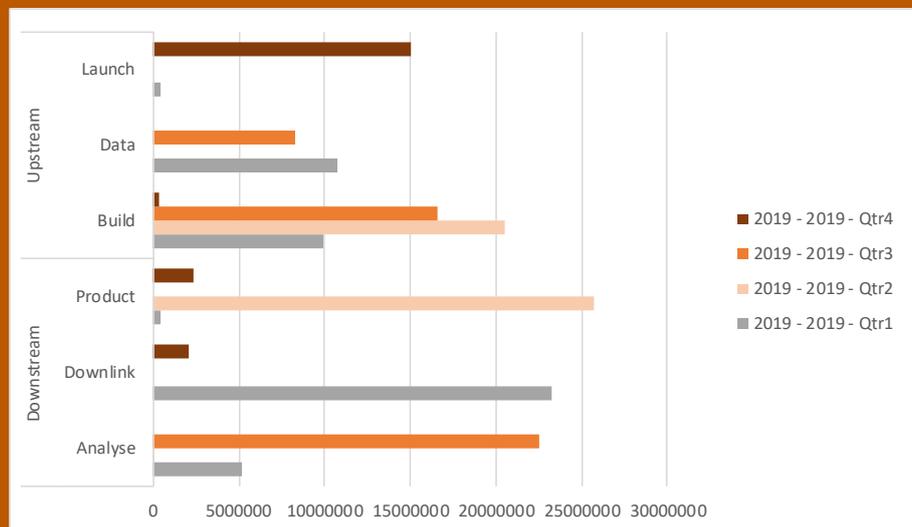


## Q4 private investments in European space start-ups

In Q4 2019, the total amount of private investments in European space and space-related start-ups amounts to €27.75M, marking the lowest result for the current year but a €10M increase compared to the overall amount of private investments in the Q4 2018.

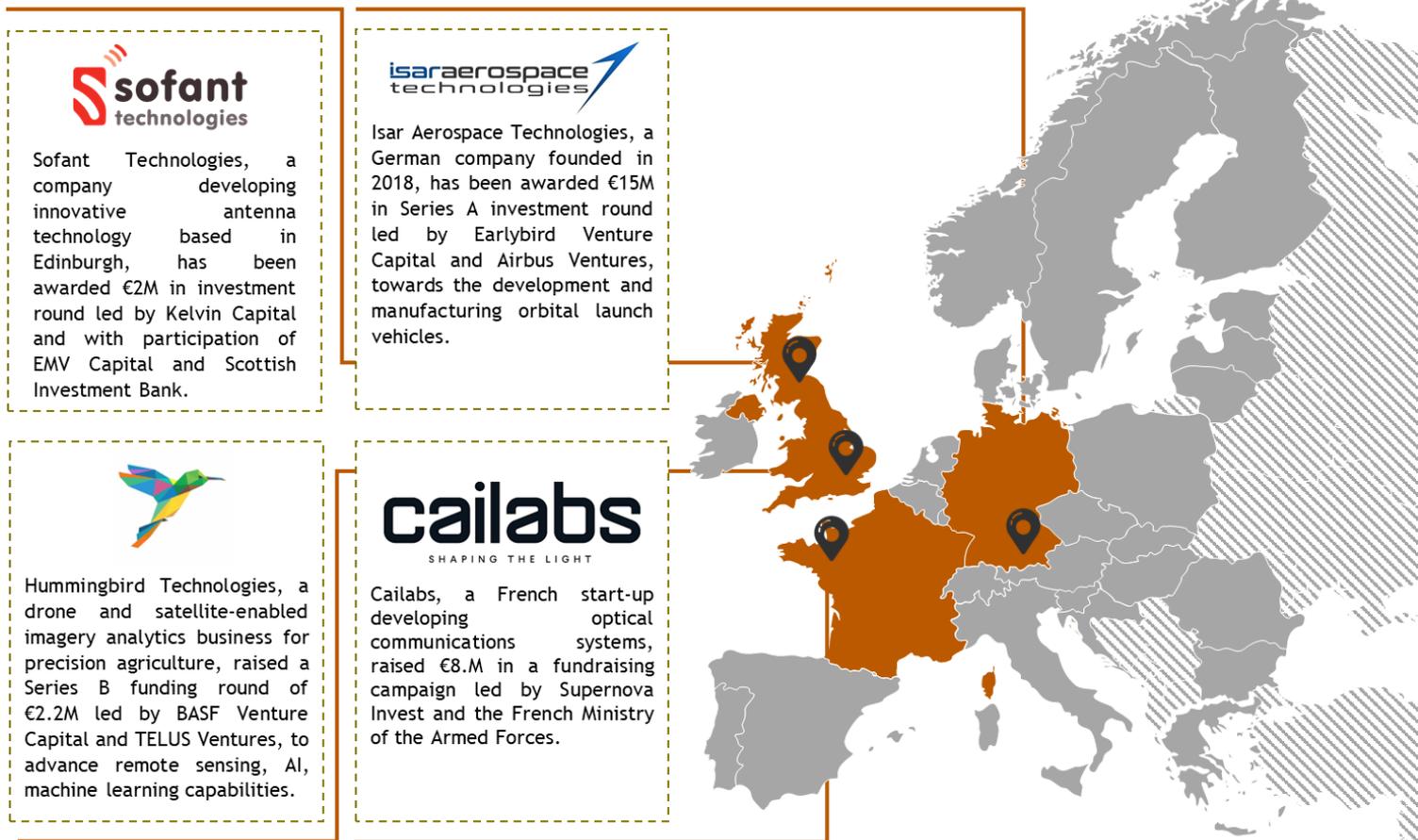
Consistently with the previous quarters, the main source of private funding has been Venture Capital - corresponding to €27.3M and 97% of the total investment volume for the period in Europe.

## Q4 2019 private investments across the space value chain



In Q4 2019, the distribution of private investments across the space value chain is inclined toward the upstream sector, corresponding to 77% of the total investments in the quarter. The scene is dominated by the investments in the launch activities. Overall, the downstream companies received in Q4 a total of approx. €4.4M.

Distribution of Top 4 Transaction in Europe



Space Angels: Space Investment Quarterly Q4 2019 released

The U.S. Venture Capital firm Space Angels released its [Space Investment Quarterly Q4 2019](#). The report provides insights of the global investments in the Space sector. Analysis and statistics are provided by region, source of funding, industry segmentation. It also features the evolution of investment activity over time (since 2009).

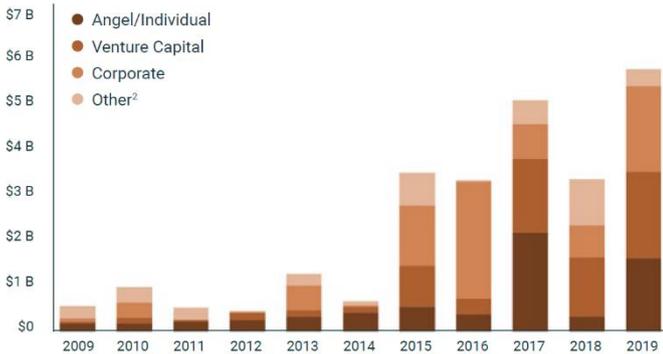
It should be noted that the report includes in its scope all space companies without any distinction made on the size and maturity of the companies encompassing for instance Space X, Blue Origin among other mature companies.

According to Space Angels, \$767M (€898B) have been invested worldwide into Space companies for the third quarter 2019. Although U.S. companies continued to be the primary recipients of the vast majority of the investments, this quarter was also particularly active for non-U.S. company namely for Chinese ones reaching a good 34% of funding in the quarter.

Summing up the amounts invested in previous quarters the total funding would reach \$5.8B (€6.79M) making 2019 the record year with the largest amount ever invested in space companies since 2009.

Overall in 2019 the majority of the recorded deals entailed large and later-stage rounds such as the Series C+ of Relativity Space(\$140M), Orbital Insights (\$50M) and Spire (\$40M). As pointed out in the Report this shows a healthy maturation of the ecosystem.

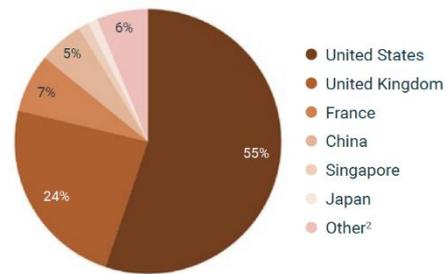
## Annual Investment Source



Funding in 2019 increased 73% Y/Y and surpassed 2017 as the largest year on record for Space investment by nearly \$700M. Capital was evenly distributed among Angel/Individual, Corporate, and Venture Capital, with each contributing about a third of total investment.

1. Cumulative non-governmental equity investment  
2. Other includes Foundations, Private Equity, Sovereign Wealth Funds, Mutual Funds, Crowd Platforms, etc.

## Cumulative Investment Location



The U.S. continues to lead global investment in Space, receiving 55% of investment since 2009. However, China was particularly active in Q4, receiving 34% of total investment in the quarter. Capital in China went primarily to the Satellite and Launch industries.

## SPACE BUSINESS

### Announced Investment Deals

- ▶ **Aliena**, a Singapore-based start-up designing low power propulsion systems for satellites to perform advanced manoeuvres in space raised S\$1.5M (\$1.1M) in a funding round led by Cap Vista Private Ltd, the strategic venture investment arm of Singapore's Defense Science and Technology Agency.
- ▶ **Iridium Communications Inc.** announced the closing of a \$1.45B seven-year term loan to complete its financial transformation.
- ▶ **Ursa Space Systems**, a U.S. geospatial analytics company specializing in applications for synthetic aperture radar (SAR) data, raised \$15M in a Series B funding round led by Razor's Edge Ventures.
- ▶ **BlackSky**, geospatial data provider announced it has secured a \$50M loan from Intelsat establishing a commercial partnership to jointly develop data and imagery products to be distributed via Intelsat's communications services.
- ▶ **GalaxySpace**, a Chinese private micro-satellites manufacturer, announced it secured an undisclosed amount of Series B funding led by JIC Technology Investment.
- ▶ **Weina Star Technology**, a Beijing-based also known as MinoSpace, announced it received an undisclosed investment in a Serie A+ funding.
- ▶ **Relativity Space**, a U.S. company building 3D printed rockets, raised \$140M in a Series C funding round led by Bond and Tribe Capital.
- ▶ **SenSat**, a UK company developing AI digital twins, raised \$10M in a Series A round led by internet giant Tencent.
- ▶ **Orbit Fab**, a U.S. start-up focused on orbital refuelling technology, raised \$3M in a seed round led from Type 1 Ventures.
- ▶ **Cailabs**, a French start-up developing optical communications systems, raised \$8.8M in a fundraising campaign led by Supernova Invest and the French Ministry of the Armed Forces.
- ▶ **Virgin Galactic** received a \$20M investments from Boeing HorizonX Ventures.
- ▶ **Satelles**, a U.S. provider of PNT services, raised \$26M in a Series C funding led by C5 Capital.
- ▶ **Descartes Labs**, a U.S. company developing an AI-based geospatial imagery platform, raised \$20M in a Series B-2 funding led by Union Grove Venture Partners.
- ▶ **Sofant Technologies**, a UK company developing antenna technology, raised \$2.2M in funding led by Kelvin Capital.
- ▶ **Launcher Inc.**, a U.S. start-up developing rockets with 3D printing technologies, announced it received \$1.5 funding from the U.S. Air Force to accelerate the development of its E-2 engine.

## SPACE ECONOMY AND FINANCE

- ▶ [Loft Orbital](#), a San Francisco-based start-up satellite manufacturer, raised \$13M in a Serie A funding led by Foundation Capital.
- ▶ [Orbital Insight](#), a California-based company specialised in geospatial analytics, completed a \$50M Series D funding led by Sequoia Capital and Clearvision Ventures.
- ▶ [Kacific Broadband Satellites](#), a Singaporean satellite operator, secured a \$160M refinancing loan to repay the facilities used for the construction of the Kacific1 satellite.
- ▶ [Landspace](#), a Chinese private launch provider, raised \$71M in a Series C funding led by Country Garden Venture Capital to finance the development of a new medium-scale rocket.
- ▶ [Isar Aerospace](#), a German start-up developing small launchers, raised \$17M in a Series A funding led by Earlybird Venture Capital.
- ▶ [D-Orbit](#), an Italian satellite manufacturer and operator, secured an undisclosed amount investment led by Seraphim Capital.
- ▶ [Leidos](#), a U.S. defence contractor announced the acquisition of Dynetics for \$1.65B as it seeks growth opportunities in hypersonic, space solutions, autonomy and advanced sensors.
- ▶ [Globalstar](#) announced the completion of a refinance process with a six-year second lien term loan for the value of \$199M led by Thermo and EchoStar Corporation.
- ▶ [Satellogic](#), a Buenos Aires-based EO imagery company, raised \$50M in a funding round led by Tencent and Pitanga.



### Major contracts

- ▶ [Maxar](#), a leading U.S. company in Earth Intelligence and Space Infrastructure, has been awarded a \$14.2M contract to develop Red Wing, an automated, cloud-based geospatial intelligence (GEOINT) analysis architecture for the Air Force Research Laboratory.
- ▶ [Deployable Space Systems](#), has been awarded a contract by Maxar for an undisclosed amount of money to manufacture flexible solar arrays for the Power and Propulsion Element of the Gateway. DSS tested its Roll Out Solar Array, or ROSA - 1.6 meters by six meters - on the ISS in 2017.
- ▶ [Intuitive Machine](#), one of three companies selected by NASA in May to carry government-sponsored science instruments to the moon through the CLPS program, after a fully open competition among several launch service providers signed a contract with SpaceX to lift-off on a Falcon 9 its NOVA-C mission in July 2021.
- ▶ [Kepler Communication](#), placed a contract to launch its two first fully commercial satellites through Innovative Space Logistics, its launch broker. The two six-unit cubesats will be launched on a Russian Soyuz rocket operated by GK Launch Services in mid-2020.
- ▶ [Raytheon](#), currently managing the NASA JPL's data systems, testing and developing software, has been awarded a new five-year contract worth \$150M.
- ▶ [Planet Labs Inc.](#) (Planet) signed a commercial imagery contract with the National Reconnaissance Office (NRO) for an undisclosed amount of money. NRO is purchasing daily, large-area, three- to five-meter resolution commercial imagery gathered by Planet's Dove constellation.



- ▶ [Telespazio](#) signed a contract with Hughes Europe to boost services ranging from fixed- and rotary-wing mobility solutions to SATCOM for government emergency services, and from Software-Defined Wide-Area-Networks (SD-WAN) for enterprises to broadband Internet access to their European Customers.
- ▶ [SES](#) secured a contract agreement with Indonesian media group Surya Citra Media (SCM), and its satellite direct-to-home TV provider Nex Parabola to provide coverage of the UEFA Champions League and UEFA Europa League soccer tournaments this season.

## SPACE ECONOMY AND FINANCE

- ▶ [National Reconnaissance Office](#) announced it has awarded imagery study contracts to Capella Space and HawkEye 360 to potentially incorporate data from private companies into the government's geospatial intelligence architecture. This contract follows four commercial imagery studies previously awarded by the NRO to BlackSky, HySpecIQ, Maxar Technologies, and Planet.
- ▶ [ClearSpace](#), a swiss start-up, has been awarded by ESA of a debris-removal contract to deorbit a substantial piece of a Vega rocket left in orbit in 2013. The total mission ClearSpace-1 will cost around €117M of which have been already allocated €70M covering the first three years of the program.
- ▶ [Made In Space Europe](#) won a Luxembourg Space Agency (LSA) contract managed by the European Space Agency (ESA) to develop the first robotic arm designed specifically for low-cost space mission.
- ▶ Sydney-based [Saber Astronautics](#) has confirmed a \$2.1M contract with the Australian Department of Defence and Defence Innovation Hub to provide an intelligent data fusion network to process a large number of space objects. The contract will use new and existing sensor networks to provide advanced insights in space domain awareness and democratise access to spacecraft location data.
- ▶ The U.S. [Missile Defense Agency](#) awarded Northrop Grumman, Raytheon, Leidos and L3Harris a \$20M contract each to design space sensors that can track hypersonic and ballistic missiles. Each company must provide the prototype of a sensor payload by 31 October 2020.
- ▶ Green bi-propellant propulsion developer [Dawn Aerospace](#) and IoT provider Hiber have announced a contract for the Hiber-3 and Hiber-4 satellites. Both satellites are scheduled for launch in early 2020. The deal was backed by the European Space Agency (ESA) and the Netherlands Space Office via the ARTES programme.
- ▶ [OneWeb has awarded a subcontract](#) to D-Orbit SpA for the development of an active debris removal (ADR) mission in the frame of European Space Agency (ESA) Project Sunrise. Another contract had already been awarded to Astroscale in July.
- ▶ [D-Orbit](#), under the €10M NOCTUA Landscape Monitoring contract, has been selected by Lombardia region in Northern Italy to lead a consortium for the development, in two and half years' time, of an end-to-end territorial monitoring service based on a SAR satellite.
- ▶ [Gilat Satellite Networks Ltd](#) a satellite networking technology, solutions and services provider has been awarded a \$10m five-year project for 3G/4G backhaul services in Peru.
- ▶ [QinetiQ's](#) has been awarded a three-year contract for the total amount of €9M with the European Space Agency (ESA) for the development of the Heat Transfer Host 2 (HOST2), a hosting facility and experiment modules expected to be launched to the ISS in 2023.
- ▶ [Lockheed Martin](#) secured a contract with NASA for the production of six Orion spacecrafts, three for the Artemis missions III to V for \$2.7B and a planned order for additional three spacecrafts for the Artemis missions VI to VIII for \$1.9B.
- ▶ [General Dynamics Mission Systems](#) has been awarded a ten-year sustainment contract for the amount of \$731.8M with the U.S. Navy for the integrated ground segments of the Mobile User Objective System (MUOS), a satellite communications system for U.S. armies.
- ▶ [Capella Space](#) won a contract with the U.S. Air Force to provide analytics service and adapt the high-resolution SAR Earth observation imagery to military missions' needs.
- ▶ [Peraton](#) has been awarded a 20-month contact with the U.S. Air Force Space and Missile Center Space Enterprise Consortium (SpEC), of an undisclosed amount, for the development of a Satellite Ground Terminal Prototype system for future low-earth orbiting satellites.
- ▶ [TriSept Corporation](#) announced it has been selected as preferred provider for a five-year \$18M contract with NASA for mission integration services and dispenser hardware in support to a third round of CubeSat missions.

## SPACE ECONOMY AND FINANCE

- ▶ [Thales Alenia Space](#) won a contract with the European Space Agency (ESA) for the development of a new version of EGNOS, including the expansion the Satellite-based Augmentation Systems coverage zone, for €78M.
- ▶ [Thales Alenia Space](#) has been awarded a contract with Nilesat, an Egyptian operator, to build the Nilesat-301 geostationary communications satellite, scheduled for launch in 2022.
- ▶ [Sypris Electronics](#) secured a contract with Collins Aerospace to manufacture and test the electronic hardware for the environmental control & life support as well as the power management & distribution systems of the Orion spacecraft.
- ▶ [Eutelsat Communications](#) signed a multiyear contract with Oraq Telecom Congo for video capacity aboard one of its satellites, including service to Eutelsat CIRRUS.
- ▶ [Envistacom](#) has been awarded a three-year \$47.8M task order with the U.S. Army's Product Manager Satellite Communications (PDM SATCOM) to support the development of the Deployable Ku Band Earth Terminal (DKET) programme.
- ▶ [Speedcast](#) has been awarded a multi-year contract with Aurora Expeditions to provide remote communications connectivity and value-added services to the Greg Mortimer expedition ship and its crew.
- ▶ [Aerojet Rocketdyne](#) has been awarded a contract of approx. \$19M by the Missile Defence Agency (MDA) to develop Axial Upper Stage (AUS) component technologies.
- ▶ SES announced the selection of [Hughes Network System](#) for the utilisation of the Hughes JUPITER System platform to operate its SES-17 satellite.
- ▶ The Canadian Space Agency (CSA) awarded two contracts to [Magellan Aerospace](#) for the amount of approx. \$2.1M for a for a RADARSAT Constellation Mission bus simulator and sustaining engineering work. The CSA awarded also [MDA](#) for a RADARSAT Constellation Mission Payload Sustaining Engineering contract for the value of \$393,263.94.
- ▶ [Centurum Information Technology](#) has been awarded a \$89.9M contract with the U.S. Department of Defense concerning communication services and various technical and engineering support for integrated and non-integrated shipboard and ashore installations of satcom systems.

### Other Major announcements

- ▶ [Maxar](#) announced the establishment of a cutting-edge facility in the historical Globe Building in St. Louis, Missouri. This new branch will employ approximately 50 people to support growth in several U.S. National Geospatial-Intelligence Agency (NGA) programs
- ▶ [Iceye](#), the Finnish start-up providing commercially SAR imagery with a resolution of less than one meter ([Spotlight mode](#)), signed a partnership agreement with the Singapore based ST Engineering Geo-Insights Pte Ltd., a technology, defence and engineering firm, to expand the South East Asia market.
- ▶ [Iceye](#), announced an agreement with RS Metrics, a satellite imagery and geospatial analytics company, to provide data on iron ore inventories to the commodities market.
- ▶ [Intelsat](#) renewed its longstanding partnership with the Oslo based leading provider of end-to-end managed connectivity and IT solutions, Marlink group.
- ▶ Denver-based [Voyager Space Holdings](#), seeks to back the development of space industry start-ups providing both permanent, long-term capital and shared infrastructure for its portfolio of companies. Soon after the formal establishment, Voyager acquired [Altius](#) focused on satellite servicing systems (Bulldog).
- ▶ Maxar and Thales Alenia Space, previously teaming up against Airbus Defence and Space to build [Telesat's LEO broadband constellation](#), finally decided to split up. Each one of them will compete



## SPACE ECONOMY AND FINANCE

separately for this contract, which would lead to the building of 300 satellites for an amount of \$3 billion. Telesat postponed the final decision on the selected manufacturer in early 2020.

- ▶ [Telenor Group](#) and Nordic Entertainment Group (NENT Group) announced the formation of a new company combining Canal Digital and Viasat Consumer. This will create a Nordic TV distribution business in a maturing Direct-to-Home (DTH) segment. Telenor and NENT Group will each hold 50 percent of the new company.
- ▶ [Social Capital Hedosophia \(SCH\)](#), a special-purpose acquisition company, after approval of its shareholders merged with Virgin Galactic to start trading under the Virgin Galactic name and the ticker symbol SPCE. The merger will make Virgin Galactic the first publicly traded company whose primary line of business is human spaceflight.
- ▶ [Eutelsat](#) and Thales Alenia Space signed a "letter of agreement" for the production of Eutelsat-10B, an all-electric satellite. The satellite will provide continued coverage to the EMEA area and two high-throughput payloads will enable to cover air and sea routes over two other regions. Gogo, an in-flight wi-fi provider based in Chicago, agreed to lease through put on the new satellite. The launch is expected for 2022.
- ▶ [Gilat Satellite Networks Ltd](#) strengthened the strategic partnership with China Satellite Communications Co., Ltd. to deploy Gilat's DVB-S2X technologies providing advanced satellite communication services covering aero, land and maritime fixed and mobility applications.
- ▶ [Soar](#), a digital mapping and imagery company, revealed a strategic partnership with the China Siwei Surveying and Mapping Technology, a subsidy of China Aerospace Science and Technology Corporation (CASC), securing access to high-resolution imagery from the SuperView and Geofen satellites.
- ▶ [Astrocast](#) and D-Orbit signed an agreement for the launch and deployment of ten Astrocast nanosatellites into Low Earth Orbit (LEO), through D-Orbit 's InOrbit NOW Launch Service. The agreement calls for the Astrocast nanosatellites to be launched onboard an Arianespace Vega or Vega C vehicle from Kourou, French Guiana, in the first quarter of 2022.
- ▶ [Leaf Space](#), an Italian company delivering complete ground segment expertise for microsatellites, announced the conclusion of a partnership agreement with Pixxel, India's first private Earth imaging company.
- ▶ [SES](#) announced an agreement with the Luxembourg government to renew for 20 years the company's concessions to operate the satellites flying in orbit under Luxembourg jurisdiction, starting from January 2022; as part of the agreement, SES will contribute with an annual fee of €1M, from 2025 onwards, and with a maximum of €7M per year into a fund to support the national space sector.
- ▶ Northrop Grumman announced that [Saturn Satellite Networks](#) selected the Omega vehicle for the launch of two satellites, expected for the inaugural launch of the rocket in 2021.
- ▶ [TriSept Corp.](#), a U.S. launch integration company, announced the opening of a new office in the Harwell Space Cluster, U.K., as part of an agreement with Satellite Applications Catapult.
- ▶ [Capella Space](#) announced the Indian company Remote Sensing Instruments (RSI) to be its marketing partner in India and South-East Asia.
- ▶ The satellite manufacturer and operator [York Space Systems](#) announced the opening of a mission operations centre based in Arlington.
- ▶ [CropX](#), an agriculture analytics company, announced partnership with the agroforestry equipment provider FarmAgro from Costa Rica to provide satellite data and analytics tools to farmers in Central America.



## SPACE ECONOMY AND FINANCE

- ▶ [Maxar Technologies](#) announced an agreement to sell the Canadian subsidiary MDA to a consortium of financial sponsors led by Northern Private Capital for \$765M.
- ▶ JAXA announced [Mitsubishi Electric](#) as the prime contractor of the satellite for the Innovative Satellite Technology Demonstration-2 programme of the Japanese government.
- ▶ Six Chinese space industry entities announced the establishment of the [China Commercial Space Alliance](#) with the aim to strengthen policy advocacy and regulation, promote innovation and upstream and downstream integration of the space value chain as well as international cooperation. The partnering entities include the China Aerospace Science and Technology Corporation (CASC), the China Aerospace Science and Industry Corporation (CASIC), the China Space Foundation and the Chinese Academy of Sciences.
- ▶ [Hispasat and the Hispatec Group](#), a provider of solutions for the agricultural sector, announced a partnership to cooperate on the use of shared technologies and provide management solutions for agricultural farms in Europe, the Americas and North Africa.
- ▶ The [Luxembourg government and the Canadian NorthStar Earth&Space](#) signed a Letter of Intent (LoI) to create a Centre of Excellence for Clean Space, operated by NorthStar, providing Space Traffic Management and Space Situational Awareness information services.
- ▶ [Comtech Telecommunications Corp.](#) announced the acquisition of UHP Networks, a provider of satellite ground station technology solutions, for approx. \$40M.
- ▶ [CGI](#), a Canadian IT services company, announced the acquisition of the Irish ground segment infrastructure provider SCISYS.
- ▶ [Virtex](#), a U.S. electronic manufacturing services provider, announced the acquisition of Precision Technology (PTI). The acquisition will expand the company's capabilities in the assembly and test in the aerospace and defence domains.

# SPACE INDUSTRY AND INNOVATION

## LAUNCHERS

### NASA renews its confidence in the SLS

[NASA](#) opened discussions to extend its contract with Boeing for the SLS beyond the Artemis I and II missions. The core stage of the rocket of Artemis III, which will land an astronaut on the Moon, is expected to also be built by Boeing. The contract further includes permission for Boeing to place orders for key “long-lead materials” to be used in the building of future SLS core rockets, including as many as ten to be used in missions beyond Artemis III, and up to eight Exploration Upper Stages.

### Virgin Orbit gets financial support for its establishment in the United Kingdom

Virgin Orbit UK Ltd., the UK branch of Virgin Orbit, [will receive £7.35M](#) from the UK Space Agency in order to develop horizontal launch capabilities for small satellites at Cornwall Airport Newquay. The space agency’s funding is part of a broader funding package of nearly £20M to allow Virgin Orbit to operate from the airport in southwestern England. Virgin Orbit will also make its own contribution of around £2.5M to the project. The local government in Cornwall also voted to provide [£10.3M](#) to the spaceport project, in addition to the £1.8M it had already spent in the project.

### OHB wants to provide launch services

The CEO of the German firm OHB, [announced](#) that OHB will provide launch services from 2023. The company will focus on small satellites with a launcher able to send around 200 kg in LEO. OHB is looking for a European spaceport to conduct its operations. Development of the rocket will be self-funded by the company, without government funding.

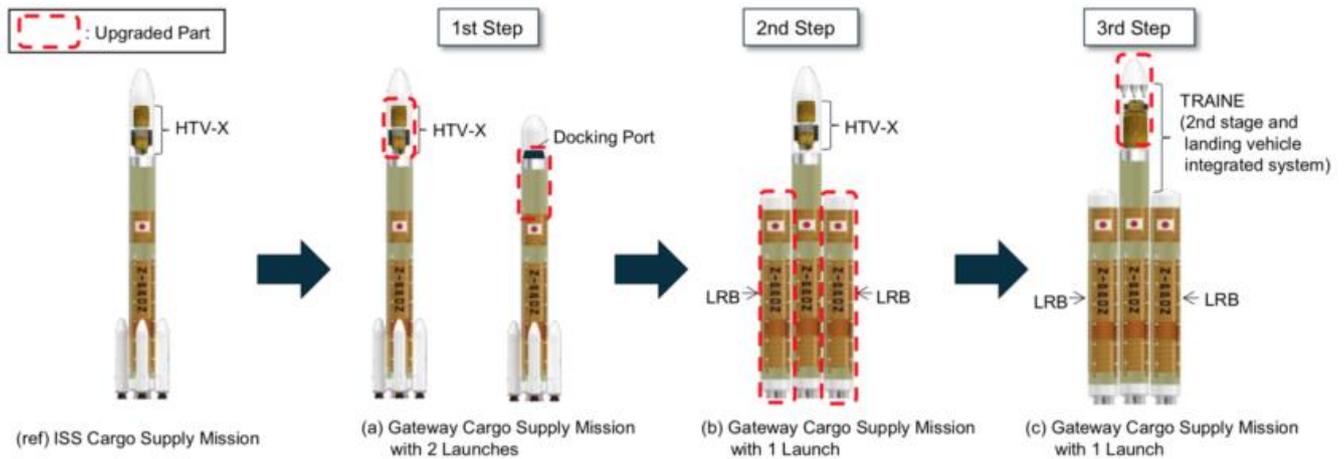
### Russia prepares new rockets

The design of Russia’s Angara-A5P rocket, which will put Russia’s Oryol manned spacecraft into orbit, has been [revealed](#) in November. It will be more reliable and safer than the Angara-A5 and will carry the manned spacecraft on its top. “In 2023, the expendable version of the Oryol spacecraft will blast off while its reusable model will travel to outer space in 2024 and its crewed modification in 2025. The Angara-A5P will be ready by 2024,” the Roscosmos chief [said](#). The serial production will allow to reduce costs.

In addition, Russia’s Scientific and Technical Council [approved](#) the conceptual design of a super-heavy carrier rocket, called Yenisei. Each part of the launcher will be an independent flight element, thus enabling to have a technological “building kit”. The rocket should be able to deliver more than 70 tons of cargo to LEO, and its first flight is expected to take place in 2028. Russia intends to use the new rocket for missions to the Moon, including the landing of Russian cosmonauts. In Roscosmos’ estimates, the Yenisei will be able to deliver a 27-tonne payload to the Moon’s orbit. [Preparatory work](#) for the launch pad at the Vostochny spaceport will start in 2022, and assembly and testing facilities as well as pallet warehouse will be constructed in 2027.

### More information on the new Mitsubishi’s rocket

[Mitsubishi Heavy Industries](#) is preparing the next generation of its rockets, the H3, for a maiden launch in 2020. The H3 will launch the HTV-X, a new Japanese cargo vessel, to the ISS, but Mitsubishi is reflecting on developing two variants in order to support the Lunar Gateway from 2025. This more powerful version of the H3 would be in development by 2030.



Picture 10: Credit: MHI

## Stratolaunch gets a new owner

Stratolaunch, an air-launch company which built the biggest airplane in the world, was bought by a new owner, the private equity fund Cerberus Capital Management. Therefore, the company is continuing its regular operations despite previous financial difficulties. Stratolaunch's near-term launch vehicle development strategy focuses on testing reusable rocket-powered vehicles and associated flight services. The activity of the company has thus apparently changed from launch services to high-speed flight test services, especially for technology development. Testing and operation of the plane will now take place in house, contrary to what was done previously.

## A first customer announced for Northrop Grumman's Omega rocket

The customer of the first Omega launch, the new rocket developed by Northrop Grumman in the frame of the U.S. Air Force National Security Space Launch Phase 2 Launch Service Procurement, will be Saturn Satellite Networks. The company will fly one or two of its NationSat small GEO satellites on this first launch but is still seeking customers for them.

## A new partner for Firefly Aerospace

Firefly Aerospace and Aerojet Rocketdyne announced that they will collaborate on Firefly's launchers. The partnership aims at increasing the performance of Firefly's Alpha vehicle, for instance through the use of additive manufacturing for the engine propelling the first stage (Reaver). Moreover, Aerojet Rocketdyne's AR1 engine could potentially be used for the next launcher of Firefly, called Beta. The two companies will also collaborate on the Orbital Transfer Vehicle that Firefly is building and to address commercial and government markets, including national security ones.

## Rocket Lab expands its activity

Rocket Lab opened its second launch complex (LC-2), which is located in the United States. The launch pad is similar to the one in New Zealand, with additional features, for instance increased security. The first customer launched from this complex will be the U.S. Air Force. LC-2 is designed to handle up to 12 launches per year. The company also started the construction of a second launch pad in its New Zealand's launch complex. Indeed, the company is anticipating an increase in its launch rate, and this new pad will give it more flexibility.



Picture 11: Credit: Rocket Lab

### Skyrora opens a facility in Europe

[Skyrora](#), a Scottish launch company, announced the opening of a test facility in a European undisclosed location as well as the completion of the first round of tests for its rocket engine. The company will propose suborbital and orbital launches. Skyrora is part of a lively space ecosystem in Scotland.

### Chinese private launch companies announce their plans for the future

Hyperbola 2, a reusable rocket developed by the Chinese private firm iSpace, [will be launched](#) for the first time in 2021. It will use liquid oxygen-methane propellants. The rocket will enable iSpace to meet the growing demand for small and medium-sized satellite launches but also to provide emergency and ride-share launches. Likewise, the company [China Rocket](#) will conduct test flights for the next two models of rocket in the Jielong (or Smart Dragon) series in 2020 and 2021. Jielong-2 will be able to send 500 kg at an altitude of 500 km, while Jielong-3 could put in orbit payloads weighing 1.5 ton. China Rocket is planning a launch cadence of about 8-10 launches per year for Jielong 2 and 5-8 for Jielong 3. The company is also developing a medium-lift reusable rocket, with a test flight planned in 2021. The objective of China Rocket is to reach a price of \$5000 per kilogram. Finally, other private companies are making progress on their first launcher: Beijing Deep Blue Aerospace Technology successfully tested the engine that will power its Nebula-1 and-2 launchers, while S-Motor managed to separate the stages of its launcher in October.

## EARTH OBSERVATION

### Planet scales up the quality of its images

Planet [announced](#) that it will offer a better resolution to customers of its SkySat constellation (from 72 cm to 50 cm), by moving the satellites to a lower altitude and improving the image process. Moreover, the company will update its Dove spacecraft so that they are able to gather imagery in eight spectral bands. The data could be used for new applications, such as the development of machine learning.

### The NRO diversifies its sources of imagery

The U.S. National Reconnaissance Office announced [it has awarded imagery study contracts](#) to Capella Space and HawkEye 360, which provide information respectively through radar images and radio-frequency transmissions surveillance. They will study how the data of these two companies can be integrated into the geospatial intelligence architecture of the government.

### NASA maintains its trust in commercial providers

NASA [announced](#) that it wants to continue acquiring Earth observation data from Maxar and Planet, due to the quality and utility of the information provided by these commercial companies. The agency is still evaluating data offered by Spire. Moreover, NASA is establishing a process to bring additional vendors into the Commercial Smallsat Data Acquisition program.

### Hawkeye 360 expands its capacities

In December, [Hawkeye 360](#) received the authorization from the Federal Communications Commission to launch its constellation of 15 satellites. The company had previously [revealed](#) that its RFGeo product, which identifies and geolocates Radio Frequency signals to provide precise mapping of radio frequency emissions, will map an expanded range of signals. Beyond Very-High and X-band frequencies, Ultra-High and L-band frequencies will now be included in RFGeo signals. The objective of the company is to address new markets.

## TELECOMMUNICATIONS

**New information on some LEO mega-constellations...**

The [filings](#) of OneWeb and Amazon for the Federal Communications Commission allow a better understanding of their plans for their future constellations. OneWeb is seeking FCC approval for up to 1.5 million ground terminals that customers would use to receive and transmit satellite data, while the design of Amazon's Project Kuiper's satellites seems to still be subject to change. However, the company has provided the FCC with some answer on its projects (e.g. the altitude for the satellites, willingness to remove the risk of orbital debris, etc.).

For instance, Amazon has provided the FCC with [data](#) showing that if one out of ten of its Kuiper satellites is unable to dodge other space objects, there is a risk of 12% that one of them will collide with a piece of debris bigger than 10 cm. If only 5% of the satellites fail (as was the case with the first launch of SpaceX's Starlink satellites), the probability is of 6%. Amazon announced that it would do all the necessary tests to reach a failure rate well below 5%.

**...and demise of some others**

[LeoSat](#), one of the companies planning to put a mega-constellation in orbit for telecommunication purposes, announced the suspension of its operations due to a lack of investment. Indeed, Hispasat and Sky Perfect JSAT, the main backers of the company, have decided not to further fund the start-up. All employees' contracts have been terminated.

**SpaceX wants 30 000 more satellites for Starlink and creates concern**

SpaceX [asked the ITU](#) to allocate radio spectrum rights for 30 000 additional Starlink satellites. With the 12 000 satellites already planned by the company, the megaconstellation would increase to 42 000 spacecraft, in order to "responsibly" meet the anticipated demand, according to the company. The new satellites will be launched in an orbit between 328 and 580 km. SpaceX will now have seven years to launch at least one satellite and operate it during 90 days in the requested frequency: only at this point will it receive the associated spectrum rights. But SpaceX's constellation also faces reluctance from its competitors. Kepler Communications [petitioned](#) the Federal Communications Commission to reconsider its order and authorization request from SpaceX to lower the altitude of 1,584 of its satellites to 550 km. Other operators, such as OneWeb and SES, also expressed concern over the interference risks posed by this modification. However, the FCC [approved](#) the change. Finally, the submission of papers by SpaceX to be able to deploy 30 000 more satellites also worried these operators about the viability of low Earth orbit.



Picture 12: Credit: SpaceX

**Apple supposedly works on satellites**

According to [Bloomberg](#), Apple has set up a secret team to work on satellite technology, maybe in order to establish a direct internet connection with its devices or to link them together, without the need to use wireless networks. The team is led by Michael Trela and John Fenwick, former aerospace engineers who helped lead satellite imaging company Skybox Imaging before it sold to Google in 2014. Software and hardware experts were also recruited. However, the project remains vague even if Tim Cook has defined it as a priority.

### Positive expectations on IoT for the satellite industry

According to [Quilty Analytics](#), the satellite industry could capture 2% of the Internet-of-Things market, compared to less than 1% currently. To reach this goal, some barriers have to be overcome, pertaining to terminals, spectrum issues and the design of business strategies.

### Eutelsat enters the IoT market...

Eutelsat Communications [announced](#) that it will launch a new connectivity service dedicated to Internet-of-Things devices. The service will be called Eutelsat IoT First and will use the operator's geostationary satellite fleet. It will complement the upcoming Eutelsat LEO for Objects, a constellation of 25 small satellites and hosted payloads in LEO, whose launch is expected to start in 2020. The geostationary Eutelsat IoT First service will link "large fixed assets" in Ku-band that need to move hundreds of megabits of data via the internet, while the LEO constellation will use ISM frequencies to connect smaller devices. The service was activated over the Americas, Europe, the Middle East and Northern Africa at the end of October.

### ...and announces restructuring, like Airbus

Eutelsat [announced](#) that it will lay off 100 of its employees (out of 1000) outside of France, freeze wages and stop hiring. The initiative is called LEAP-2 and should save between 20 and 25 million euros by the end of Eutelsat's FY 2022. The objective is to save money that could be invested in the connectivity business in order to reignite growth. The conjuncture is indeed difficult for Eutelsat, with the newly launched Eutelsat 5 West B suffering from technical problems, and the decline of the company's revenues. Similarly, [Airbus](#) has started discussions with employees to restructure the Defence & Space unit. Indeed, orders have fallen over the past three years, and the short-term performance threatens the long-term perspective of the company.

### Maxar takes several steps towards a brighter future



A **MAXAR** COMPANY

Picture 13: Credit: Maxar

[Maxar](#) received a contract for a GEO satellite from an undisclosed customer. It was the first and only GEO SATCOM order for the company in 2019 and will be based on the 1300 platform. Moreover, it sold a property for \$291M, thus providing money to help the company to reduce its debt but will continue to use facilities on the property by renting them. A private offering of \$1.25 billion of senior secured notes due in 2023 will also take place in order to reduce the debt, and the Canadian subsidiary MDA was [sold](#) to a consortium of financial funds for \$770M. Finally, Maxar CEO announced that the WorldView Legion constellation will be

composed of six satellites; it will enable the receipt of images from a single location more than 15 times a day. Yet, this investment will reduce the capacity of the company to reimburse its debt during the next two years.

### Inmarsat becomes private

Inmarsat was officially [bought](#) by a consortium, Connect Bidco, and delisted from the London Stock Exchange. It is the third satellite operator to delist from public market this year, after AsiaSat and Avanti.

### After reprogrammable satellites, multi-shared satellites are promoted

[GEOshare](#), a subsidiary of Lockheed Martin, wants to build geostationary communication satellites that could host payloads for up to five operators, in order to strongly reduce the price for a gigabit-per-second. The bus which will be used is the Lockheed Martin LM2100. According to GEOshare, the kind of satellite

## SPACE INDUSTRY AND INNOVATION

which raises the most interest is an all Ka-band satellite that it calls the “Mondo Condo”. The company considers Africa and Asia-Pacific as top markets, as operators of these regions do not always have the means to operate their own satellites. GEOshare is also marketing variants of the Mondo Condo, including a “hybrid” version that can carry Ka- and Ku-band payloads, and a “Mondo Condo Lite” optimized for three operators to share.

### SES demonstrates interoperability between MEO and GEO assets

In October, SES [announced](#) that it had demonstrated the interoperability between its GEO satellites and its O3b MEO satellites, by switching between them on a flight from Florida to Nicaragua. Dozens of switches between MEO and GEO satellites were completed, as well as between various MEO satellites within a beam. The test took place in collaboration with Thales. SES expects to offer higher connectivity speeds, especially for commercial and business aviation.

### Operators want to use the cloud

Satellite communications operators are now interested in the [cloud](#). This year, Intelsat, SES, Inmarsat and Viasat all announced partnerships with Microsoft, and its Azure cloud service. The cloud could be used to make teleports, which allow operators to distribute and control their services, more efficient. However, even if ground infrastructure companies agree on the principle of using the cloud, they are divided on whether satellite companies should build their own data centers or rely on “public” servers like those of Microsoft, Amazon and Google.

### Airbus presents a new antenna

Airbus, ESA, and Eutelsat [presented](#) the new multibeam active antenna payload at Airbus in Madrid. Airbus’ ELSA+ (ELectronically Steerable Antenna+) is a first for commercial satellite communications in Europe, and will be installed on Eutelsat’s Quantum satellite. The antenna is electronically steerable and works in Ku-band with eight independent reconfigurable beams. It enables the spacecraft to be flexible and to adapt to customers’ business cases. The antenna is also able to mitigate interference.

### Iridium de-orbited its first-generation constellation

Iridium [completed the deorbit](#) of 65 satellites of its first-generation constellation. Yet, the company launched 95 satellites between 1997 and 2002, and 30 of them remain stuck in orbit because of malfunction. Some are too high to be caught by the atmospheric drag and would remain in orbit for at least 100 years. Iridium’s CEO declared that it was ready to use the services of a debris-removal company for a price of approximately \$10 000 per kilogram. While it is unclear whether companies are able and willing to meet this expectation, deorbiting firms nonetheless replied that they are working on an acceptable price point for their services.

## GNSS

### India’s GNSS is going to market

Antrix, the commercial arm of ISRO, [will commercialize NavIC](#), the Indian GNSS. The company is currently identifying suitable device manufacturers on the one side and comprehensive integrators of NavIC-based systems (SIs) on the other side. The selected companies will then be able to bid for government projects. Actors from the sector of resource transportation could be among the first customers. This decision is part of a set of positive developments for the adoption of the Indian system by users.

### Galileo can be used to make cars autonomous

The University of Technology of Compiègne, France, [hosted in November a live demonstration](#) of the first autonomous vehicle powered by Galileo. The vehicle was driven both on tracks and on public roads. Representatives from the GSA, the European Commission, as well as French and Spanish authorities participated in the demonstration.

## SSA

## LeoLabs heads towards global coverage to improve its products

LeoLabs, a company using radar sites to track satellites and space debris in low Earth orbit, plans to [increase its number of sites](#) from two to six over the next few years, with new ones being located near the equator, in the far north and in the far south to ensure global coverage. The objective is to be able to track the mega-constellations that will be launched in the upcoming years (by SpaceX, OneWeb, Telesat...). The number of objects tracked by LeoLabs will grow from 13 000 to around 250 000 and it will be able to detect objects as small as 2 cm (against 10 cm today).



Picture 14: Credit: LeoLabs

Indeed, the company [announced](#) the initial operation of the Kiwi Space Radar, located in New Zealand. It is the first radar of the firm in the South Hemisphere and the first commercial radar able to track objects as small as 2 cm in LEO. Due to its location, the Kiwi Space Radar allows an improved frequency of revisit as well as a better orbit assessment. LeoLabs can track up to 1,000 space objects per hour, and then give the information to other radars which will more closely examine areas of interest. The data of the Kiwi Space Radar started to be integrated in LeoLabs' services and products by the end of the year. LeoLabs also offers navigation data through a monthly subscription to operators owning between one and

five satellites, and works with the New Zealand government on its ambitious SSA and space traffic management programme.

## An app to allow crowd-sourced SSA

ConsenSys Space, which took over the assets of Planetary Resources in 2018, [unveiled](#) its first project: TruSat, an app-based system that makes use of amateur observers and Ethereum blockchain technology to keep track of satellites. People will fill the app with their observations of satellites in order to provide accurate information on orbits of thousands of satellites. TruSat will serve as an experiment to see whether such observations could form the basis of a trusted, decentralized data management system for space applications.

## Towards a more precise detection of space debris

In December, Chinese researchers from the Chinese Academy of Surveying and Mapping in Beijing have developed a set of algorithms [enabling](#) to improve the success rate of space debris detection from laser ranging telescopes, which based on the application of neural networks to these technologies. These algorithms allow to improve the accuracy of the telescope sufficiently enough to detect space debris with a cross sectional area of 1 meter squared and a distance of 1,500 kilometers.

## HUMAN SPACEFLIGHT

### The Dream Chaser is on track

[Sierra Nevada Corporation](#) announced it was ready to proceed with the final assembly and testing of its Dream Chaser spacecraft, as it took possession of the primary structure which was built by Lockheed Martin. The all-composite structure used for the spacecraft is the most complex ever created by the aerospace industry, and other components, such as the wings, were expected to be delivered to SNC facilities at the beginning of 2020. The objective is to have the vehicle fully assembled and tested by April 2021, while the first launch should take place in September 2021. The Dream Chaser will then be used by NASA to resupply the ISS. The company also hopes to be able to carry crews in the future.

### A U.S. national team to compete for a lunar lander

Blue Origin [teamed up](#) with Lockheed Martin, Northrop Grumman and Draper to propose an unmanned lunar lander to NASA, in the framework of the Human Landing Services competition. The prime contractor will be Blue Origin, which will also provide a descent stage developed for its Blue Moon lunar lander. Lockheed Martin will be responsible for the ascent stage, and use its experience with the development of the Orion spacecraft. Northrop Grumman is in charge of the transfer stage, which will move the lander from the Lunar Gateway to low lunar orbit; it expects to base it on its Cygnus cargo spacecraft. Draper will provide guidance systems and avionics to provide navigation for the lander.

### Boeing invests in Virgin Galactic and eyes hypersonic travel

Boeing [invested](#) \$20M in Virgin Galactic, through its HorizonX Ventures start-up investment instrument. The investment has come into effect from the end of 2019, when Virgin Galactic became public due to its merger with the Social Capital Hedosophia cash shell. The investment starts a partnership between the two companies, which could lead to point-to-point high-speed passenger transportation.

### Arianespace will push for European missions to the Moon

Stéphane Israel, CEO of Arianespace, [announced](#) that his company was planning a rideshare mission to the Moon in 2023. The mission would use Ariane 6 to deliver 8500 kg into a lunar transfer orbit. He also revealed that Arianespace will push for a European crewed spaceflight program at the European Space Agency's 2022 ministerial meeting, in order to send European astronauts with a European launcher.

### ESA wants industry to improve Columbus

ESA [called](#) the industry to extend the capabilities of Columbus, Europe's research facility on the ISS. With the lifetime of the ISS expected to be extended until 2030, there is the possibility to modernize and enhance the laboratory. When it comes to the Columbus upgrades, ESA sees industry playing a leading role in the provision of solutions that target both institutional requirements and commercial needs. To this end, an industry workshop took place in November.

## ROBOTIC EXPLORATION

### Private companies offer their countries their first lunar rovers...



Picture 15: Credit: James Winspear

The [first-ever UK lunar rover](#) will be sent by the company SpaceBit. SpaceBit signed a contract with the U.S. company Astrobotic to send its rover onboard an Astrobotic launcher in 2021. The rover, which will use legs and not wheels, is the smallest lunar rover ever. It is also low-cost, as parts of it are composed of off-the-shelf technologies. SpaceBit aims at building the rover in mass production in the future to explore the solar system and run low-cost missions. In October, a [partnership](#) with the International Astronautical Federation Regional Group for Latin America and the Caribbean has been announced, in order to enhance the development of robotic technology for the lunar mission. Finally, the rover will be tested in the UAE before its launch in 2021.

In parallel, Astrobotic and the Japanese start-up Dyson [announced](#) that they partnered to send Dyson's rover on the Moon. Dyson's lunar rover will be launched onboard Astrobotic's Peregrine lunar lander in 2021. Dyson's rover, called Yaoki, will be the first Japanese lunar rover.

### ...and landers

In addition to its lunar rover, Spacebit unveiled [the first UK lunar lander](#) during the Dubai Airshow in November: the Lunar-Lander Hopper. The lander will have the possibility to hop from one landing site to the other, which is an entirely new feature. The multi destination lunar lander will be designed to deliver 150 kg or more of payload to one landing point on the lunar surface or 50 kg or more of payload to up to three remote landing points on the lunar surface with a distance of up to 20 km.

## TECHNOLOGY DEMONSTRATION

### Some progress for Reaction Engine's SABRE

[Reaction Engine](#), a UK company which is developing an air-breathing engine called SABRE, has successfully tested a precooler heat exchanger in temperature conditions equivalent to five times the speed of sound. This achievement is a significant milestone for the development of SABRE, which is supported by ESA (with an amount of €10M). Indeed, in the future, SABRE could serve as the basis of a reusable launch vehicle that operates like an aircraft.

### Test of an extremely powerful computer on a nanosatellite

ESA launched [OPS-SAT](#), a nanosatellite which is the world's first orbiting software laboratory, available to test novel methods of operating missions in actual space conditions. The satellite harnesses more flight computing power than any previous ESA spacecraft. Teams exploiting the Cubesat will have direct access to it through Internet.

### NASA gives a helping hand to new technologies

NASA [has selected](#) 25 space technologies in the frame of its Flight Opportunities programme. This programme gives them the possibility to be launched aboard an aircraft, a balloon or a suborbital rocket in order to test them and speed up the time before their actual launch in orbit. Blue Origin will launch 11 of the chosen technologies.

### Test of a very low altitude satellite

The Japanese Super Low Altitude Test Satellite (Tsubame) [tested](#) by JAXA over the past three years re-entered the atmosphere in October. The satellite managed to collect high-resolution images at an altitude as small as 181 km; it escaped the atmospheric drag thanks to an ion thruster, powered by electricity and fueled by xenon gas. Tsubame is the first satellite to test an Earth observation instrument at such a low orbit.



Picture 16: Credit: JAXA

### Nanoracks will slice metal in orbit

[Nanoracks](#) announced an agreement with Maritime Launch Services in order to transform a spent upper stage of the company into a Nanoracks Orbital Outpost, an in-space habitat which is envisioned to serve as hotels, research parks, fuel depots, storage centers and more. Nanoracks also announced that it will conduct a critical test in orbit, in partnership with Maxar and launched by SpaceX. The company plans to robotically cut a material representative of an upper stage in a self-contained hosted payload without creating space debris.

## INNOVATION

## ESA expresses interest for cheap robotic arms

ESA awarded a contract to [Made in Space Europe](#) and the Luxembourg Space Agency to develop a robotic arm for space applications, designed for low-cost space missions. A demonstration mission could occur in 2021.

## An innovative way to create solar panels

The University of California and NASA have partnered to create [spray-on solar cells](#) that will allow them to produce solar panels in space. The process involves a substance called perovskite ink, which is sprayed on a surface and creates a thin film that harvests light. It is far cheaper than creating traditional solar panels and enables them to be produced directly in space, rather than having to launch them from Earth. The efficiency of these panels is also more important.

## RUAG's new product for rockets' fairings

[RUAG Space](#), a leading supplier to the space industry, has successfully developed and tested a new low shock jettison system for payload fairings. This new separation and jettison system for payload fairings has been developed as part of the Future Launchers Preparatory Programme (FLPP) of ESA. The new system will avoid excessive shocks to the payload and is scalable, thus enabling its adoption by various categories of launchers.

## China hopes to make satellite data easier to access

The China Aerospace Science and Industry Corporation (CASIC) [presented](#) a new satellite platform aiming at making satellite resources more accessible to users. To that end, a more user-friendly ground system allows customers to get information without requiring considerable knowledge and expertise to access it.

## Rocket launch from a balloon

The startup Leo Aerospace, based in Los Angeles, [is developing a system](#) that will loft cubesats using a rocket dropped from a giant hot-air balloon about 18 km above Earth's surface. The balloon, called Regulus, is equipped with three thrusters to improve its stability and orientation. The rocket will be able to launch a payload between 30 and 60 kg, depending on the orbit. The system is mobile, as the launch pad is actually a semi-truck. Leo Aerospace aims to start providing suborbital launches in 2021 and orbital missions by the end of the following year.



Picture 17: Credit: Leo Aerospace

## Electric propulsion for interplanetary missions?

[GomSpace's](#) subsidiary in Sweden and ESA have signed a contract to develop a miniaturized electric propulsion system suitable for small spacecrafts going on interplanetary missions. The contract will be carried out under ESA's General Support Technology Program during the next 18 months, and the value is €700,000.

## ESA's mission to the Sun prepares for launch



Picture 18: Credit: Airbus

[Solar Orbiter](#), an ESA mission dedicated to study the Sun activity, has completed its tests and is ready for launch in February 2020. It was sent to the launch site at the end of October. The probe will be very close to the Sun (42 million km), equipped with technologies able to protect it against the high temperature. Moreover, it will take the [first detailed images of the Sun's poles](#). The mission cost €1.5B.

## A new milestone for the James Webb Space Telescope

The five-layer sunshield which will protect the James Webb Space Telescope from the heat and light of the Sun has [passed a critical test](#) verifying its ability to be correctly deployed. This sunshield is one of the most challenging technologies among the revolutionary ones which will be integrated in the telescope.

## An innovative telescope to track dark matter...

The U.S. [Dark Energy Spectroscopic Instrument \(DESI\)](#) has completed its first test run in November. The telescope is composed of 5000 fiber-optic cables the width of a human hair and will scan the cosmos for dark energy, beginning early next year. Thanks to its technology, DESI is able to analyze 5,000 galaxies every 20 minutes and is expected to scan 35 million galaxies and 2.4 million quasars in five years.

## ...and another one to detect gravitational waves

The Chinese-built [Five-hundred-meter Aperture Spherical Telescope](#), the largest single-dish radio-telescope in the world, has finished its testing phase, which has been carried out since September 2016. In these three years, the telescope has identified 99 rapidly spinning neutron stars. It will also be used to directly detect gravitational waves.

# SPACE ACTIVITY OVERVIEW

## KEY INDICATORS AND GRAPHS

### Methodology note

ESPI is tracking all launch events and related data since 2000. The ESPI Space Launch Activity Database encloses those worldwide data allowing for detailed quantitative analysis rendered into graphs and charts. The database is a repository of publicly available information on global space activity such as:

- Launch events: date, launch site, outcome, launcher, spacecraft and service provider;
- Spacecraft: customer, orbit, mass, manufacturer, payloads, mission and market.

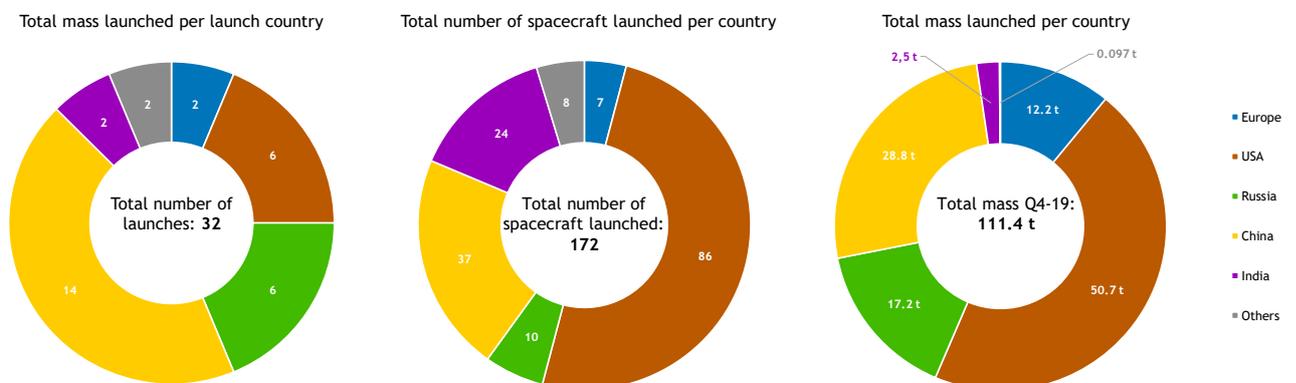
The database architecture allows the user to create dedicated field and categories to tailor specific analysis. In order to provide the reader with a spacecraft's categorization taking into account both the capacity of the launchers and the different sizes of satellites, ESPI team defined and applied to the dataset the following categories:

Large spacecraft >500kg	Extra heavy-class	>8,000kg
	Heavy-class	2,000-8,000kg
	Medium-class	500-2,000kg
Small spacecraft <500kg	Mini-class	100-500kg
	Micro-class	10-100kg
	Nano-class	<10kg

Detailed information about all the satellites deployed are available in the Launch Log section.

### Launch activity by country

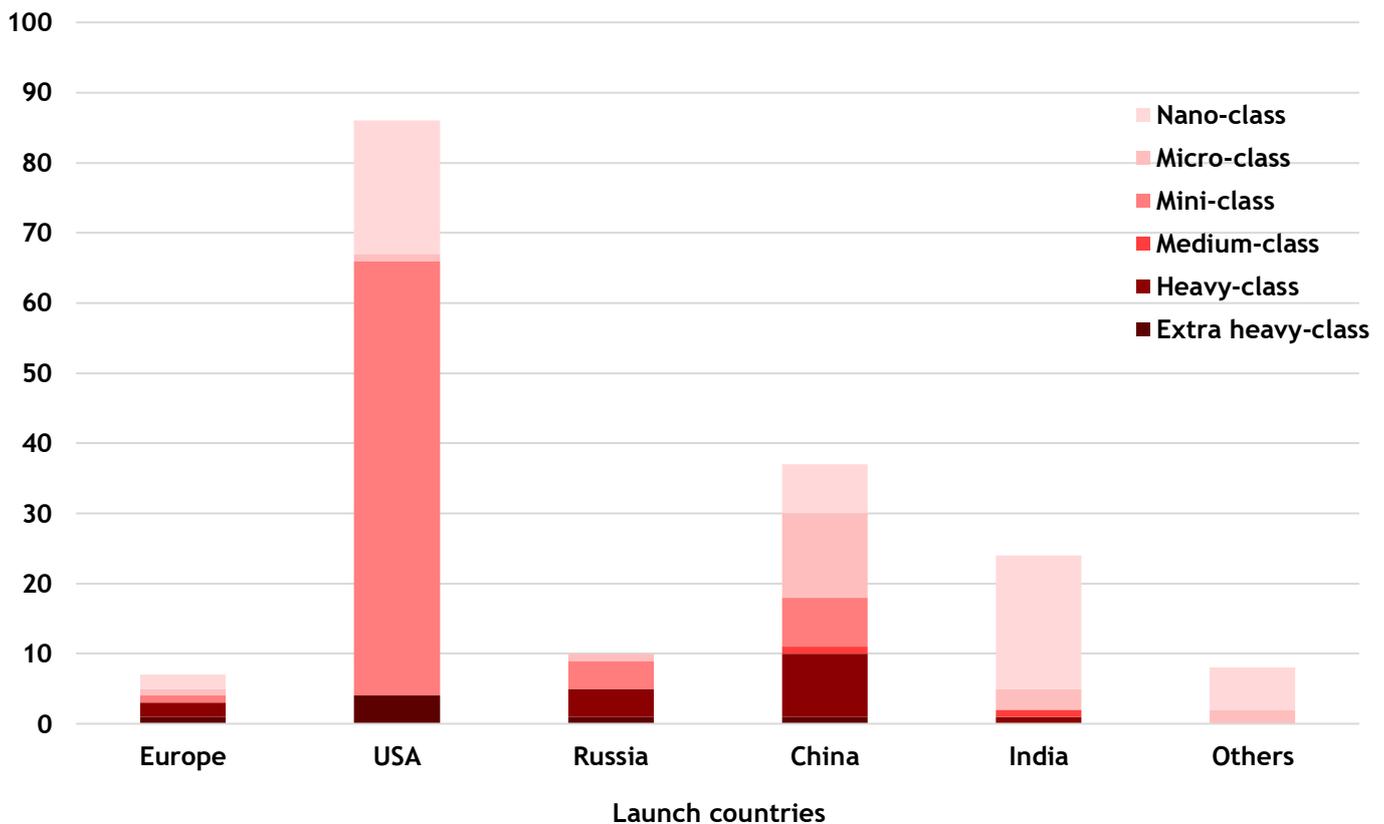
With 14 launches, China is the country which performed the most launches in Q4 2019 by contributing to 45% of all of them. However, it lies far behind the United States in terms of the number of spacecraft and total mass launched as, with 86 spacecraft launched weighing 50.7 tons, the latter represents almost 50% of these two categories. With the same number of launches as Europe (2), India launched more than three times more spacecraft and more than the double of the mass launched by Europe. Finally, in comparison to Q3 2019, Russian activity was significantly reduced this quarter, partly due to the absence of any human spaceflight-related mission.



## Spacecraft classes

Most of the spacecraft launched this quarter belong to the small spacecraft category. For instance, out of the 86 satellites launched by the United States, only four were large spacecraft (mostly linked to human spaceflight activity with the Cygnus, Dragon and Starliner spacecraft) while 62 were mini-class (representing 72% of the spacecraft launched by the country) and 19 nano-class (22%). On the contrary, in China, 24% of the spacecraft launched were heavy class (they are in large part dedicated to military missions) even if a majority remains in the small spacecraft category (e.g. 32.5% of all spacecraft launched by China are micro-class). Similarly, India focused on small spacecraft, especially on nano-satellites, which represented 80% of its launches. An exception is Europe, where the spacecraft launched spread in a balanced way across almost all mass categories.

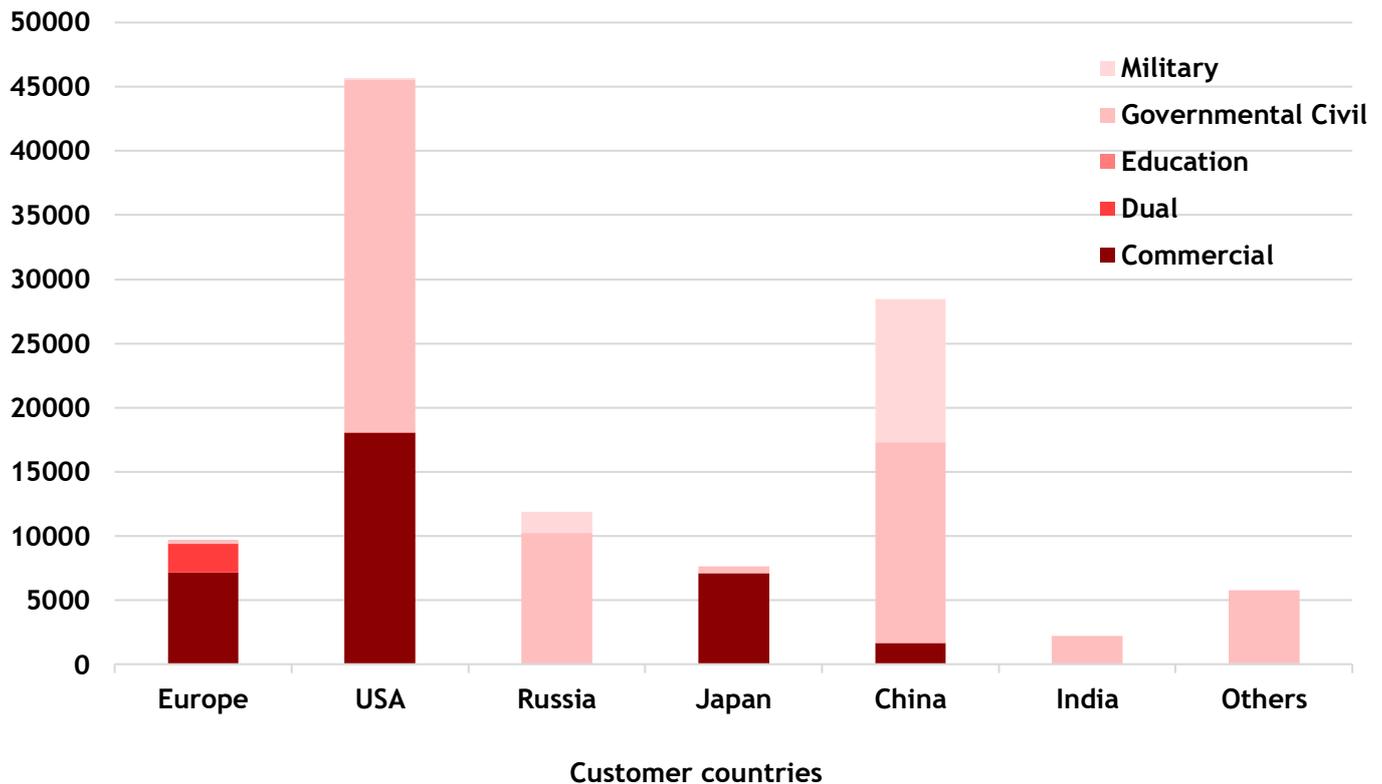
Number of spacecraft launched by class and country



## Spacecraft markets

While spacecraft launched for European and Japanese customers served mostly commercial purposes, and while this market represented 39.5% of the mass launched for the United States, most of the mass launched in Q4 2019 targets institutional purposes. Thus, almost all spacecraft launched for Russia, India and “other” countries are going to be used by governmental civil actors. In the United States and China, this proportion is a bit less important but still represents respectively 60% (especially because of the mass of human spaceflight missions) and 55% of the mass launched for these countries. Finally, military market is a significant part of the mass launched for Russia and China, as these two countries continue to deploy satellites for their navigation systems, GLONASS and Beidou.

Total mass of spacecraft (kg) launched by market and by customer country



### Spacecraft missions

In Q4 2019, 32% of the mass launched performed telecommunications missions, 22% technology and demonstration and 19% human spaceflight. The unusual higher mass for technology and demonstration can be, in a large part, explained by the weight of the Chinese ShiJian 20 satellite (around 8 tons) and of the U.S. Starliner capsule (around 13 tons). The majority of the mass launched for Europe and Japan serves telecommunication purposes, and is quite identical to the mass launched for the commercial market. Indeed, in this quarter, the mass launched for these countries was mainly for commercial SATCOM operators (Eutelsat, Inmarsat and Sky Perfect JSAT). China and the United States both got spacecraft for three main missions: for telecommunications, human spaceflight and technology/demonstration for the United States; remote sensing, navigation and technology/demonstration for China. They represented respectively 94.1% and 99.6% of the total mass launched for these countries. Finally, all spacecraft launched for India have Earth observation purposes, a mission which also represents a significant share (22.8%) of the mass launched for Europe.



ESPI LAUNCH LOG

Launch date	Launch country	Launcher	Spacecraft name	Main customer	Customer country	Prime manufacturer	Manufacturer country	Mass (kg)	Mission	Market
04/10/2019	China	CZ-4C	Gaofen 10R	CNSA	China	CAST	China	805,00	Earth Observation	Governmental Civil
09/10/2019	Russia	Proton-M Briz-M (Ph-4)	Eutelsat 5 West B	Eutelsat	France	Northrop Grumman Innovation Systems	USA	3000,00	Telecommunication	Commercial
			MEV-1	SpaceLogistics	USA	Northrop Grumman Innovation Systems	USA	2326,00	In-Orbit Servicing	Commercial
11/10/2019	USA	Pegasus-XL	ICON	NASA	USA	Northrop Grumman Innovation Systems	USA	288,00	Earth Science	Governmental Civil
17/10/2019	New Zealand	Electron KS	Palisade	Astro Digital	USA	Astro Digital	USA	20,00	Technology / Demonstration	Commercial
17/10/2019	China	CZ-3B/G2	Tongxin Jishu Shiyao 4	People's Liberation Army	China	SAST	China	2700,00	Technology / Demonstration	Military
02/11/2019	USA	Antares-230+	AeroCube 14A	The Aerospace Corporation	USA	The Aerospace Corporation	USA	3,50	Technology / Demonstration	Governmental Civil
			AeroCube 14B	The Aerospace Corporation	USA	The Aerospace Corporation	USA	3,50	Technology / Demonstration	Governmental Civil
			AeroCube 15A	The Aerospace Corporation	USA	The Aerospace Corporation	USA	3,70	Technology / Demonstration	Governmental Civil
			AeroCube 15B	The Aerospace Corporation	USA	The Aerospace Corporation	USA	3,70	Technology / Demonstration	Governmental Civil
			Argus-02	Saint Louis University	USA	Saint Louis University	USA	1,00	Technology / Demonstration	Education
			Cygnus CRS-12	NASA	USA	Northrop Grumman Innovation Systems	USA	7492,00	Cargo Transfer	Governmental Civil
			HARP	University of Maryland	USA	Space Dynamics Laboratory	USA	5,00	Technology / Demonstration	Education
			HuskySat-1	University of Washington	USA	University of Washington	USA	5,00	Technology / Demonstration	Education
			Orbital Factory 2	University of Texas at El Paso	USA	University of Texas at El Paso	USA	1,00	Technology / Demonstration	Education
			Phoenix (Arizona State University)	Arizona State University	USA	Arizona State University	USA	4,00	Technology / Demonstration	Education
			RadSat-u	Montana State University	USA	Montana State University	USA	4,00	Technology / Demonstration	Education
			SOCRATES (University of Minnesota)	University of Minnesota	USA	University of Minnesota	USA	4,20	Technology / Demonstration	Education
			STPSat 4	USAF	USA	USAF	USA	100,00	Technology / Demonstration	Military
			SwampSat 2	University of Florida	USA	University of Florida	USA	5,00	Technology / Demonstration	Education
03/11/2019	China	CZ-4B	Gaofen 7	CNSA	China	CAST	China	2400,00	Earth Observation	Governmental Civil
			Huangpu 1	Dawan District Research Institute	China	SAST	China	75,00	Technology / Demonstration	Education
			SRSS-1	Government of Sudan	Sudan	Shenzhou Aerospace Technology Co.	China	75,00	Earth Observation	Dual
			Xiaoxiang 1-08	SpaceCo.	China	SpaceCo.	China	8,00	Technology / Demonstration	Commercial
04/11/2019	China	CZ-3B/G2	Beidou 3 I3	People's Liberation Army	China	CAST	China	4200,00	Navigation	Military
11/11/2019	USA	Falcon-9 v1.2	Starlink 1-1	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-10	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-11	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-12	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-13	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-14	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-15	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-16	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-17	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-18	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-19	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-2	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-20	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-21	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-22	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-23	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-24	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-25	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-26	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-27	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-28	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-29	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-3	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-30	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-31	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-32	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-33	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-34	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-35	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-36	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-37	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-38	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-39	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-4	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-40	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-41	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-42	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-43	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-44	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial

# SPACE ACTIVITY OVERVIEW

			Starlink 1-50	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-51	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-52	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-53	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-54	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-55	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-56	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-57	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-58	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-59	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-6	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-60	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-7	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-8	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
			Starlink 1-9	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
13/11/2019	China	Kuaizhou-1A	Jilin-1 Gaofen-02A	Chang Guang Satellite Technology Co.	China	Chang Guang Satellite Technology Co.	China	230,00	Earth Observation	Commercial
13/11/2019	China	CZ-6	Ningxia-1 01	Ningxia Jingui Information Technology Co. Ltd.	China	DFH Satellite Co.	China	180,00	Earth Observation	Commercial
			Ningxia-1 02	Ningxia Jingui Information Technology Co. Ltd.	China	DFH Satellite Co.	China	180,00	Earth Observation	Commercial
			Ningxia-1 03	Ningxia Jingui Information Technology Co. Ltd.	China	DFH Satellite Co.	China	180,00	Earth Observation	Commercial
			Ningxia-1 04	Ningxia Jingui Information Technology Co. Ltd.	China	DFH Satellite Co.	China	180,00	Earth Observation	Commercial
			Ningxia-1 05	Ningxia Jingui Information Technology Co. Ltd.	China	DFH Satellite Co.	China	180,00	Earth Observation	Commercial
17/11/2019	China	Kuaizhou-1A	KL-Alpha A	KLEO Connect	Germany	CAS	China	70,00	Technology / Demonstration	Commercial
			KL-Alpha B	KLEO Connect	Germany	CAS	China	90,00	Technology / Demonstration	Commercial
23/11/2019	China	CZ-3B/YZ1	Beidou 3 M21	People's Liberation Army	China	CAS	China	1060,00	Navigation	Military
			Beidou 3 M22	People's Liberation Army	China	CAS	China	1060,00	Navigation	Military
25/11/2019	Russia	Soyuz-2-1v Volga	Kosmos 2542	Ministry of Defense of the Russian Federation	Russia	Lavochkin	Russia	250,00	Space Situational Awareness	Military
26/11/2019	France	Ariane-5ECA	Inmarsat-5 F5	Inmarsat	United Kingdom	Thales Alenia Space	France	4007,00	Telecommunication	Commercial
			TIBA-1	Government of Egypt	Egypt	Thales Alenia Space	France	5640,00	Telecommunication	Governmental Civil
27/11/2019	India	PSLV-XL	Cartosat 3	ISRO	India	ISRO	India	1625,00	Earth Observation	Governmental Civil
			Flock-4p 1	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Flock-4p 10	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Flock-4p 11	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Flock-4p 12	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Flock-4p 2	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Flock-4p 3	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Flock-4p 4	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Flock-4p 5	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Flock-4p 6	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Flock-4p 7	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Flock-4p 8	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Flock-4p 9	Planet	USA	Planet	USA	5,00	Earth Observation	Commercial
			Meshbed	Analytical Space	USA	Analytical Space	USA	3,00	Technology / Demonstration	Commercial
27/11/2019	China	CZ-4C	Gaofen 12	CNSA	China	SAST	China	2400,00	Earth Observation	Governmental Civil
05/12/2019	USA	Falcon-9 v1.2	AztechSat 1	UPAEP	Mexico	UPAEP	Mexico	1,00	Technology / Demonstration	Education
			CIRIS	Utah State University	USA	Ball Aerospace	USA	6,00	Technology / Demonstration	Education
			CryoCube 1	NASA	USA	NASA	USA	4,00	Technology / Demonstration	Education
			Dragon CRS-19	NASA	USA	SpaceX	USA	6650,00	Cargo Transfer	Governmental civil
			EdgeCube	Sonoma State University	USA	Sonoma State University	USA	1,00	Technology / Demonstration	Education
			HISUI	METI	Japan	METI	Japan	500,00	Earth Observation	Governmental civil
			MakerSat 1	Northwest Nazarene University	USA	Northwest Nazarene University	USA	1,00	Technology / Demonstration	Education
			QARMAN	Von Karman Institute	Belgium	Von Karman Institute	Belgium	4,00	Technology / Demonstration	Education
			SORTIE	ASTRA LLC	USA	COSMIAC	USA	6,00	Earth Science	Education

# SPACE ACTIVITY OVERVIEW

06/12/2019	Russia	Soyuz-2-1a	Progress-MS 13	Roscosmos	Russia	RKK Energia	Russia	7280,00	Cargo Transfer	Governmental Civil
06/12/2019	New Zealand	Electron KS	ALE 2	Astro Live Experiences	Japan	Astro Live Experiences	Japan	75,00	Technology / Demonstration	Commercial
			ATL 1	ATL Ltd.	Hungary	ATL Ltd.	Hungary	0,25	Technology / Demonstration	Commercial
			FossaSat 1	Fossa Systems	Spain	Fossa Systems	Spain	0,20	Technology / Demonstration	Education
			NOOR 1A	Stara Space	USA	Alba Orbital	United Kingdom	0,75	Technology / Demonstration	Commercial
			NOOR 1B	Stara Space	USA	Alba Orbital	United Kingdom	0,75	Technology / Demonstration	Commercial
			SMOG-P	Budapest University of Technology and Economics	Hungary	Budapest University of Technology and Economics	Hungary	0,20	Technology / Demonstration	Education
07/12/2019	China	Kuaizhou-1A	HEAD 2A	HEAD Aerospace	China	SAST	China	45,00	Automatic Identification System	Commercial
			HEAD 2B	HEAD Aerospace	China	SAST	China	45,00	Automatic Identification System	Commercial
			Tianqi 4A	Guodian Gaoke	China	Guodian Gaoke	China	8,00	Technology / Demonstration	Commercial
			Tianqi 4B	Guodian Gaoke	China	Guodian Gaoke	China	8,00	Technology / Demonstration	Commercial
			Tianyi-16	Spacety Co.	China	Spacety Co.	China	8,00	Earth Observation	Commercial
Tianyi-17	Spacety Co.	China	Spacety Co.	China	8,00	Earth Observation	Commercial			
07/12/2019	China	Kuaizhou-1A	Jilin-1 Gaofen-02B	Chang Guang Satellite Technology Co.	China	Chang Guang Satellite Technology Co.	China	230,00	Earth Observation	Commercial
11/12/2019	Russia	Soyuz-2-1b Fregat-M	Glonass-M 50	Roscosmos	Russia	ISS Reshetnev	Russia	1415,00	Navigation	Military
11/12/2019	India	PSLV-QL	1HOPSat TD	Hera Systems	USA	Hera Systems	USA	22,00	Technology / Demonstration	Commercial
			COMMTRAIL	Unknown	Unknown	Tyvak Nano-Satellite Systems	USA	4,00	Technology / Demonstration	Commercial
			Duchifat-3	Herzliya Science Center	Israel	Herzliya Science Center	Israel	4,00	Technology / Demonstration	Education
			Lemur-2 108	Spire	USA	Spire	USA	4,00	Earth Observation	Commercial
			Lemur-2 109	Spire	USA	Spire	USA	4,00	Earth Observation	Commercial
			Lemur-2 110	Spire	USA	Spire	USA	4,00	Earth Observation	Commercial
			Lemur-2 111	Spire	USA	Spire	USA	4,00	Earth Observation	Commercial
			Pathfinder Risk Reduction	Tyvak Nano-Satellite Systems	USA	Tyvak Nano-Satellite Systems	USA	11,00	Technology / Demonstration	Governmental Civil
			QPS-SAR 1	iQPS	Japan	iQPS	Japan	100,00	Earth Observation	Commercial
			RISAT-2BR1	ISRO	India	ISRO	India	628,00	Earth Observation	Governmental Civil
16/12/2019	USA	Falcon-9 v1.2	JCSat 18/Kacific 1	SKY Perfect JSAT Corporation	Japan	Boeing	USA	6956,00	Telecommunication	Commercial
16/12/2019	China	CZ-3B/YZ1	Beidou 3 M 19	People's Liberation Army	China	CAS	China	1014,00	Navigation	Military
			Beidou 3 M 20	People's Liberation Army	China	CAS	China	1014,00	Navigation	Military
18/12/2019	France	Soyuz-ST-A Fregat-M	ANGELS (CNES)	CNES	France	CNES	France	27,00	Technology / Demonstration	Governmental Civil
			CHEOPS	ESA	Europe	Airbus	France	273,00	Astronomy	Governmental Civil
			CSG 1	ASI	Italy	Thales Alenia Space	France	2205,00	Earth Observation	Dual
			Eye-Sat	CNES	France	CNES	France	7,00	Technology / Demonstration	Education
			OPS-SAT	ESA	Europe	GOMSpace	Denmark	7,00	Technology / Demonstration	Governmental Civil
20/12/2019	USA	Atlas-5(N22)	Starliner 1	NASA	USA	Boeing	USA	13000,00	Technology / Demonstration	Governmental Civil
20/12/2019	China	CZ-4B	CBERS 4A	CRESDA	China	CAST	China	1980,00	Earth Observation	Governmental Civil
			ETRSS 1	Ethiopian Space Science and Technology Institute	Ethiopia	CAST	China	70,00	Earth Observation	Governmental Civil
			FloripaSat 1	Universidade Federal de Santa Catarina	Brazil	Universidade Federal de Santa Catarina	Brazil	1,00	Technology / Demonstration	Education
			Shuntian	National University of Defense Technology	China	National University of Defense Technology	China	35,00	Technology / Demonstration	Military
			Tianqin 1 / CAS 6	Sun Yat-Sen University	China	DFH Satellite Co.	China	35,00	Radio Amateur	Education
			Tianyan 01	China Satellite Space Remote Sensing (Jiangsu) Satellite Technology Services Co Ltd.	China	MinoSpace Technology	China	72,00	Earth Observation	Commercial
			Tianyan 02	ADA Space	China	MinoSpace Technology	China	10,00	Earth Observation	Commercial
			Weilai 1R	GZH-NHK BDS AHR Co. Ltd	China	MinoSpace Technology	China	65,00	Technology / Demonstration	Commercial
			Yuheng	National University of Defense Technology	China	National University of Defense Technology	China	35,00	Technology / Demonstration	Military
24/12/2019	Russia	Proton-M Blok-DM-3	Elektro-L 3	Roscosmos	Russia	Lavochkin	Russia	2094,00	Meteorology	Governmental Civil
26/12/2019	Russia	Rokot-KM	BLITS-M 1	NIIPP	Russia	NIIPP	Russia	16,70	Technology / Demonstration	Governmental Civil
			Gonets-M 14	Roscosmos	Russia	ISS Reshetnev	Russia	280,00	Telecommunication	Governmental Civil
			Gonets-M 15	Roscosmos	Russia	ISS Reshetnev	Russia	280,00	Telecommunication	Governmental Civil
			Gonets-M 16	Roscosmos	Russia	ISS Reshetnev	Russia	280,00	Telecommunication	Governmental Civil
27/12/2019	China	CZ-5	ShiJian 20	CAST	China	CAST	China	8000,00	Technology / Demonstration	Governmental Civil

## LAUNCH HIGHLIGHTS

### Launch of the first commercial in-orbit servicing mission



Picture 19: Credit: Nathan Koga/SpaceFlight Insider

The Mission Extension Vehicle 1 (MEV-1), developed by Northrop Grumman and operated by SpaceLogistics, one of its subsidiaries, **was launched** at the start of October by the only mission of ILS in 2019. This is the first-ever commercial servicing satellite spacecraft to be launched. Once launched, MEV-1 will use its electric propulsion system to reach geostationary orbit, a process that will take up to three and a half months. In January, it will rendezvous there with the Intelsat 901 (the first-ever attempt at a docking near geostationary orbit), in order to extend its lifetime for five years. After this period, the MEV-1 will be available for other satellites.

### Last launches for the Rockot launcher and the Pegasus XL rocket

After 19 years of operation and 31 missions, the Russian carrier Rockot **performed** its last launch by sending three telecommunications satellites and one technology satellite to orbit. The Rockot only failed twice in its career. One of the reasons why Russian authorities decided to retire the launcher is that some components of the vehicle come from Ukraine, with which relations have soured since 2014.

On the U.S. side, NASA's Ionospheric Connection Explorer (ICON) spacecraft, which will study the ionosphere and the interaction between Earth and space weathers, was launched after a delay of two years. These delays were **mostly due to technical issues** with the Pegasus XL rocket which needed time to be repaired. The mission was the 44<sup>th</sup> launch of a Pegasus rocket but also only the fourth in the last ten years. At the time being, no other mission is planned for the air-launch system developed by Northrop Grumman, **even if two rockets are in an advanced state of integration**. The non-competitive launch price of the Pegasus rocket seems to be the primary reason for this situation, despite the growing number of small satellites (the most likely customers) launched.



Picture 20: Credit: Northrop Grumman

### SpaceX launches another batch of Starlink satellites and makes progress on reusability

In November, SpaceX **launched** 60 additional Starlink satellites with a Falcon 9 rocket. The company thus reached a total of 120 Starlink spacecraft in orbit, making Starlink the largest SATCOM constellation in orbit. The new satellites have **improvements** comparing to their predecessors launched in May: they have 400% more throughput, can generate twice as many phased array broadband beams, and possess a new Ka-band antenna system. Also, one of the satellites did not complete its orbit raising in order to assess how it deorbits.

Moreover, the launch marked a new step in SpaceX's quest for reusability for a twofold reason: it is the first time that a first-stage booster is reused for the fourth time, and it is the first time that a payload fairing is reused (it had previously launched on a Falcon Heavy rocket); a step that SpaceX wanted to accomplish in order to fulfill its objective of a fully-reusable launcher.

### Orbital Flight Test of Boeing's Starliner



Picture 21: Credit: Boeing

The first uncrewed orbital flight of the Boeing CST-100 Starliner took place on 20 December, after having been delayed for a few days because of technical issues with the launching pad. The test was a first for the capsule and for the rocket: it was the first flight of a ULA's Atlas V with a dual-engine Centaur upper stage, and without a payload fairing. While the launch performed successfully, the capsule did not act as planned. Because of an error in the mission elapsed timing system, the attitude control thrusters on Starliner did not burn as anticipated. The spacecraft managed to reach a "stable" orbit thanks to electrical power but not the one that was planned. Moreover, this maneuver used too much propellant, preventing the Starliner to dock to the ISS, which was one of the mission's objectives. However, several other systems were tested and approved (space-to-space communications, navigation system, etc.). After two days in orbit (instead of eight), the capsule performed a successful de-orbit and re-entry and landed safely on Earth.

### Return to flight for the Long March 5

On 27 December, China launched a Long March 5 rocket to send a demonstration satellite to geostationary orbit which will allow the development of very high throughput satellites. This was the third launch of the rocket, and the first launch of a Long March 5 since 2017, when it suffered technical problems and failed during its travel to space. The Long March 5 is capable of delivering 14 metric tons to geostationary transfer orbit and 8.2 tons to translunar injection, while the derivative Long March 5B will be able to deliver 25 tons to low Earth orbit. The success of the launch is important for China, as the rocket is a crucial element for its space programme. Indeed, Long March 5 will be used to launch and assemble modules of the upcoming Chinese space station, but also to conduct missions beyond Earth, especially to launch a probe to Mars and a lunar sample return mission (Chang'e 5) in 2020.



Picture 22: Credit: CASC

# About ESPI

The European Space Policy Institute (ESPI) is an independent public think-tank based in Vienna and specialized in international and European space affairs.

ESPI provides decision-makers with an informed view on mid- to long-term issues relevant to Europe's space activities. In this context, ESPI acts as an independent platform for developing positions and strategies. The Institute fulfils its objectives through various multidisciplinary research activities leading to the publication of books, reports, papers, articles, executive briefs, proceedings and position papers, and to the organisation of conferences and events including the annual ESPI Autumn Conference.

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The publication is organised around four thematic sections:

- ▶ **Space Policy and Programmes** outlines important space policy developments in the World by country and region. This includes political decisions, institutional affairs, public budgets and programmatic plans.
- ▶ **Space Economy and Finance** provides statistics and information on space markets and industry results as well as on major investment and contractual deals in the European and global space sector.
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