



**ESPI**

European Space Policy Institute

# ESPI Insights

Space Sector Watch



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# NUCLEAR POWER: THE KEY FOR THE FUTURE OF SPACE EXPLORATION?



Dear Friends of ESPI,

Space Nuclear Power and Propulsion (SNPP) is considered to be a critical technology for future space exploration programmes beyond Earth orbit. In December 2020, the White House issued the **Space Policy Directive 6 “National Strategy for Space Nuclear Power and Propulsion”** to foster the development of SNPP systems. The policy underlined the importance of this technology for space exploration, in particular in environments in which solar and chemical power are inadequate, to enable persistent presence and operations and to shorten space travel times. More recently, on September 9<sup>th</sup>, the **U.S. DoD issued a solicitation to industry** for nuclear-powered engines for small to medium spacecraft. The solicitation asked bidders to show “credible regulatory, manufacturing and licensing paths towards prototype development within 3 to 5 years and a follow-on path to flight based testing”.

Over the years, NASA and U.S. Departments of Defence and Energy (DoD and DoE) have explored different kinds of nuclear power and propulsion in space. SPD-6 calls for developments in both Nuclear Thermal Propulsion (NTP), which is currently more mature, and Nuclear Electric Propulsion (NEP), which is in earlier stages of development. In January 2021, the White House released an **Executive Order on Promoting Small Modular Reactors for National Defense and Space Exploration**, again promoting the use of nuclear power for space missions. Later in April, DARPA selected General Atomics, Blue Origin, and Lockheed Martin as prime contractors to conduct work on NTP in the frame of the DRACO programme (Demonstration Rocket for Agile Cislunar Operations) which aims **to demonstrate an Nuclear Thermal Propulsion system above LEO in 2025**.

Russia and China also have ambitions in the space nuclear field: Russia, that has most heritage in operating nuclear reactors in space, announced that the first mission of **TEM**, a nuclear propulsion spacecraft envisaged to transport large quantities of cargo in deep space, **is scheduled for 2030**. Reportedly, China is also planning to develop nuclear-powered spacecrafts by 2040.

There are serious technological challenges and safety-related concerns ahead of course. A major technical challenge is related to the materials that are used for NTP which need to be able **to withstand high heat and the regular bombardment of high-energy particles**. The main safety drawback of nuclear space propulsion is the risk of a nuclear accident as result of reactor failure, for instance, the risk of radiation exposure to ground personnel during spacecraft integration.

The recent solicitation of the U.S. DoD as well as the previous pushes in the last months to drive forward R&D of space nuclear solutions underline that the United States are striving to press ahead in this domain. The solicitation is running parallel to NASA and other agencies already developing nuclear space systems – which won’t be ready in the near term. Meanwhile, DoD is hoping for a prototype within 3 to 5 years, serving as a stopgap and enabling to put the technology into service relatively quickly. Looking back at the conclusions of the **study report published by the National Academies of Sciences, Engineering, and Medicine** in February 2020, which recommended NASA to accelerate SNPP development “aggressively” to be able to use it for human missions beyond Earth orbit in the next two decades, the recent solicitation of DoD is not a surprising push forward and is a new step for the United States to further speed up the development of nuclear space propulsion for future human spaceflight missions.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'JJ Tortora', written over a white background.

Jean-Jacques Tortora

Director of ESPI



## POLICY & PROGRAMMES

### G20 Space Economy Leaders Meeting takes place at ASI headquarters

On September 20<sup>th</sup> and 21<sup>st</sup>, the Italian Space Agency (ASI) hosted the “**G20 Space Economy Leaders Meeting**” at its headquarters in Rome. Currently at its second edition, the first one was organised by the Saudi Space Commission (SSC) under the Saudi Arabia G20 Presidency in 2020. Participants included Italy’s space leadership, heads of the space agencies of the G20 countries, ESA, the European Commission, UNOOSA, OECD and other international organizations. The event preceded the G20 Summit which will be held in Rome at the end of October and addressed space matters under the three thematic pillars “People, Planet and Prosperity” that Italy chose for the G20 Summit 2021. ASI president, Giorgio Saccoccia, said that “space activities will play a key role in the coming years, in terms of strengthening the foundations of these three pillars” and for this reason “this year’s Space Economy Leaders Meeting was a perfect opportunity to raise the level of attention towards the role that Space and ‘Space Economy’ can provide to the G20 goals”.



*Credit: ASI*

### James Webb Space Telescope to be launched on December 18<sup>th</sup>

On September 8<sup>th</sup>, NASA, ESA, and Arianespace **announced the launch date of James Webb** Space Telescope (JWST) for December 18<sup>th</sup>. JWST, the largest and most powerful telescope ever built, is the product of an international program led by NASA in partnership with ESA and the Canadian Space Agency. The JWST will be launched on board an Ariane 5 rocket from Kourou, French Guiana. In return for the provision of the launch, ESA will be granted a share of the telescope's observation time.

### European Commission, EUSPA and ESA leadership meet for the first time at EUSPA

EUSPA Executive Director Rodrigo da Costa, DG DEFIS’ Director General Timo Pesonen and ESA’s Director General Josef Aschbacher **met for the first time at EUSPA’s headquarters** in Prague on September 23<sup>rd</sup>. During the high-level meeting, the main object of discussion was the respective implementation of the EU Space Programme regulation adopted in April 2021 and of the Financial Framework Partnership Agreement (FFPA) the three entities signed in June 2021. The EU, EUSPA, and ESA Directors underlined the importance of a smooth cooperation between the three organisations for the development of the European Union space programme and recalled their commitment in this domain. Additionally, da Costa, Pesonen and Aschbacher took the opportunity to engage with local entrepreneurs.

### EUMETSAT releases new strategy shaped by extreme weather challenges

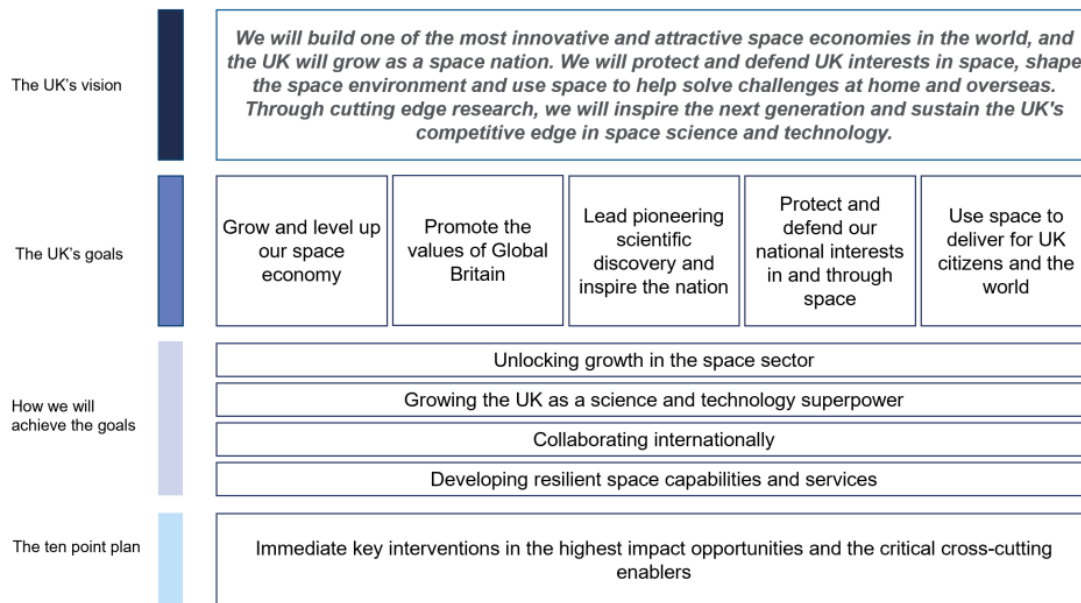
EUMETSAT released **its new long-term strategy** which sets out actions for the agency to provide more and better information about weather and climate and further contribute to protecting lives, livelihoods, and infrastructure. The strategy’s objectives are to deploy the next-generation meteorology satellites in GEO and polar orbits, to continue and strengthen cooperation with the EU and space agencies worldwide allowing access to more data and analysis, and to strengthen EUMETSAT’s flexibility, efficiency, and innovative spirit in order to be ready for the challenges ahead while remaining “an attractive employer”.



### Newly adopted space strategies in Europe

#### UK releases first civil and defence national space strategy

On September 27<sup>th</sup>, the U.K. Department for Business, Energy & Industrial Strategy and the Ministry of Defence released the **first ever National Space Strategy of the United Kingdom**. The new strategy “sets out the government’s ambitions for the U.K. in space, bringing together civil and defence policy for the first time” and “pursues a bold national vision”. This strategy highlights five objectives and identifies four cross-cutting pillars in which the government will take actions to support the strategy’s goals. It also identifies a “ten-point plan setting out the initial focus areas for the coming years” representing the “highest impact opportunities” on which the government will invest resources.



Credit: GOV.UK

The Space Strategy also commits to deliver the first U.K.’s Defence Space Portfolio which will lead the government to **invest an additional £1.4 billion** to enhance the military’s satellite communications.

#### Hungary adopts new national space strategy

Hungary adopted a **new national space strategy** by the Ministry of Foreign Affairs and Trade on August 20<sup>th</sup>. With this new strategy “Hungary has laid out the cornerstones of its opportunities and directions of development in space research”. Hungary’s foreign ministry highlighted the strategy’s priorities:

- Making “Hungary a long-term player in the global value chain of the space industry and a regional leader in certain development areas”
- Ensuring “a constant supply of multidisciplinary specialists” to support the production of “highly innovative and value-added products and services, as well as the development of domestic space competencies”
- Boosting “competitiveness through the space industry” to improve quality of life

The three pillars identified by the government to achieve the strategy’s goals are: fostering innovation and sustainable growth in the economy by exploiting the space sector’s potential; strengthening the international role of the country, broadening its relations, and creating an organisational framework for coordination; “developing the infrastructural background and the social and economic conditions that are essential to the space sector”. In addition, the **government plans to invest up to €100M** in the next five years in order to double the number of the Hungarian space companies by 2025.



## China's taikonauts return to Earth after first space station mission



*Credit: Xinhua News Agency*

The first ever Chinese taikonauts sent to Tianhe **returned to Earth** on September 16<sup>th</sup>. Tianhe is the core module of the Chinese space station Tiangong 3 which is still currently under construction. While in space, the crew carried on different tasks, including two spacewalks, the deployment of a mechanical arm, and the transmission of experiment data back to Earth. The taikonauts spent 90 days onboard Tianhe, marking the longest mission of the country so far.

## Taiwan aims to secure strategic position in space industry's supply chain

Taiwan is currently considering the development of its position in the space sector. In this frame, the country passed a **Space Development Act in May** and is **planning to commit NT\$25.1 billion** (approx. €776M) for the development of its domestic space sector by 2028. On September 14<sup>th</sup>, during a visit to the National Space Organization (NPSO), Taiwan President Tsai Ing-wen declared Taiwan must be proactive in **securing a strategic position in the supply chain of the space industry** and reinforce its role in the New Space Age by exploiting its competitive edge in semiconductors and precision engineering. Tsai then called for public-private-academia cooperation to launch a "local team dedicated to manufacturing satellites and ground station equipment as soon as possible". Taiwan is also planning the development of a second communication satellite in the frame of the "Beyond 5G project", to be launched in 2025/26.

## South Korea plans first solid-fuel space rocket and increase of surveillance capabilities

South Korea is developing its **first solid-fuel space rocket** which is expected to be completed by 2024. The new rocket will actually be the second South Korea manufactures. The first one is a liquid-fuel rocket currently scheduled to launch in October and whose first successful launch happened in 2013. With the new rocket South Korea aims to have faster, easier, and cost-effective launches as well as be able to carry mini-satellites and deploy them into LEO, improving South Korea's military surveillance capabilities. For the rollout of this new engine South Korea is planning to **invest 700 billion won (approx. €500M)** of the total budget that the Ministry of Economy and Finance requested for the space sector for 2022.



*Credit: KoreaTechToday Editor*

Additionally, the Defense Acquisition Program Administration (DAPA), which operates under the Defense Ministry, revealed a project to set up ultra-small spy satellites able to protect the country from external threats by detecting "anomalies" that regular military reconnaissance satellites may miss. The satellite system should have a **value of 11.2 billion won (approx. €8M)**. Additionally, **DAPA signed contracts** with two South Korea-based defence contractors respectively amounting at 214.6 billion won (approx. €155M) and 360 billion won (approx. €260M). The first with LIG Nex1 to secure a communication system with enhanced core performance and security by 2025. The latter with Hanwha Systems to establish a network control system and provide portable and transportable ground terminals by 2024.



### In other news

**U.S. Space Command officially calls for private and public effort to develop space defence capabilities:**

The Director of Operations, Training and Force Development at U.S. Space Command Major General David Miller calls for the space industry to develop better capabilities in monitoring activities carried out in space and in launching satellite constellations able to survive in an armed conflict. Additionally, Miller calls on the U.S. Space Command to find “better ways to integrate military and commercial networks” to improve systems’ resiliency.

**NASA plans to split human space flight directorate into two new mission directions:**

The Human Exploration and Operations Mission Directorate will be divided into the Exploration Systems Development Mission Directorate (ESDMD) and the Space Operations Mission Directorate. The reason behind this choice can be found in an increased number of space operations in LEO and new programmes for deep space exploration.

**An international team meets for an experimental campaign on ESA's Aeolus Wind Mission data:**

The international team of scientists and technicians met in the Cape Verde islands, Atlantic Ocean, and conducted analysis of data provided by the ESA’s mission. Among the other participants, ESA, NASA, CNES and DLR participated as well.

**The outgoing German government supports the North Sea spaceport as "anchor customer":**

The government endorsed the small satellite launch platform located onboard a ship in German territorial waters in the North Sea. However, in line with its small-launch vehicles’ past policy, the government limited its financial involvement to compensate part of the costs sustained to obtain regulatory approval.

**Spaceopal completes new Galileo Sensor Station (GSS) in the Kerguelen Islands on behalf of EUSPA:**

Located in the middle of the Indian Ocean, the new site is part of an update of Galileo Ground Segment’s network needed to allow its Full Operational Capability. Next steps will be the installation of the infrastructure and the integration and testing of its equipment. In May 2022, after the completion of these phases, the new GSS site will become part of the Galileo GSS network.

**China's Tianwen-1 Mars mission goes offline for approximately fifty days starting in mid-September:**

As the distance between Earth, Mars and the Sun will be the farthest due to their alignment in almost a straight line in that period, Tianwen-1 will temporarily suspend operations. The measure was required also to avoid interferences in communications between the rover, the orbiter and the ground control caused by the electromagnetic radiation of the sun. China will resume operation in early November.

**UK and United Arab Emirates partner to enable industrial and technological cooperation in space:**

The UK and the UAE signed a bilateral Memorandum of Cooperation on Industrial and Advanced Technologies Collaboration to enable collaboration in several fields, including space. The implementation of the memorandum will require both public and private efforts.

**DLR sets up Launch Coordination Center (LCC) to coordinate several spacecraft launches and re-**

**entries:** DLR is designing the first LCC in collaboration with potential users from industry and public authorities in order to allow a permanent use of the Center after its pilot mission. DLR intends to demonstrate how the LCC will be able to safely coordinate the automated processes that several launches from different locations and re-entries require.





## INDUSTRY & INNOVATION

### Space sector stakeholders comment on EC Impact Assessment for mega-constellation

Thirteen space sector stakeholders **commented on the Inception Impact Assessment** on the establishment of a EU Space-based Global Secure Connectivity System and its establishment issued by the DG DEFIS. The feedback period opened on August 26<sup>th</sup> and closed on September 23<sup>rd</sup>. The European Commission planned legislative adoption for the third quarter of 2021. Most of the feedback came from companies and business organisations including Telesat, SES, Eutelsat, OneWeb, Hispasat, Intelsat, Arianespace, and Airbus Defence and Space as well as business associations ASD-Eurospace and ESOA.

### European space start-ups launch new association YEESS

Six European space start-ups **introduced the newly founded YEESS**, the Young European Enterprises Syndicate for Space at the Space Forum Luxembourg on September 14<sup>th</sup>. YEESS has five objectives:

- Raising awareness at leadership level regarding the potential of young enterprises in providing “innovative and state-of-the-art solutions and services”
- Advocating “transparency and equilibrium in public effort space contracts”
- Encouraging institutions “to organise direct interfaces and their contractual relationships with young enterprises as they do with legacy enterprises”
- Prompting European institutions on the readiness of young enterprises to be competitive in procurements with long established companies and on “their willingness to individually and collectively contribute to an innovative and agile space sector in Europe”
- Building “mutual trust and confidence between European and young enterprises, and to extend that mutual trust to private and commercial customers”.

Enterprises coming from Belgium, France, Germany, and Spain founded YEESS, namely Aerospacelab, Anywaves, ConstellIR, Exotrail, Pangea Aerospace and Satlantix, but the association aims to expand.

### ESA becomes SSTL Lunar Pathfinder’s primary customer

Surrey Satellite Technology Ltd (SSTL) and ESA signed a **contract which makes ESA the primary customer** of the Lunar Pathfinder relay satellite’s communications services. ESA has been involved in the definition of the satellite purposes for the commercial market from the outset. The Lunar Pathfinder mission aims to ensure continuous communications between humans and robots around the Moon and meets ESA’s Moonlight vision to create a worldwide network to provide sustainable commercial Lunar data-relay services for communication and navigation. The Lunar Pathfinder launch is planned for 2024.

### Space Forge develops commercial space transportation vehicle



*Credit: Space Forge*

Space Forge is developing a **new commercial space vehicle**, ForgeStar, which will offer round-trip transportation services from 2022. Space Forge aims to facilitate in-space manufacturing by allowing companies to bring their payloads back to Earth with a more flexible and responsive transport solution. At first ForgeStar will be able to carry only a few kilograms in return missions, but the company is planning to multiply the vehicle capacity by ten in the future. The UK-based company is operating with ESA support under the Agency’s Boost! Program with a €2M contract lasting two years.



## European companies establish consortia for European Commission's call for tenders

Following complaints regarding the lack of disruptive ideas in the first results of the European consortium working on the European broadband constellation project, the European Commission issued a call for tenders to collect new innovative ideas for the project. The call for tenders will give way to two six-month contracts up to €1.4M each. At least two of these consortia publicly announced their bidding but around 10 consortia are reportedly taking part in the competition. Under UNSEENLABS and EUROCONSULT leadership, twenty-two European space sector companies **established the New Symphonie consortium**. Another consortium, **led by Starburst Aerospace**, also publicly announced it submitted an offer to the European Commission.

## Orolia will develop Galileo Second Generation's atomic clocks

Orolia won two contracts, one from ESA and one from Leonardo for a **total value of approx. €65M** to provide atomic clocks for the first twelve satellites of Galileo Second Generation System (G2S). The French company, which already provided its technology to the first generation of Galileo, will deliver three of its Rubidium Atomic Frequency Standards (RAFS) and two of its atomic clock physics packages. The latter will be integrated with Leonardo's Passive Hydrogen Masers (PHM). Additionally, in May the EC and ESA selected **Orolia to contribute to the G2S radiofrequency constellation simulator** by providing its Skydel GNSS signal simulation core engine.

## Thales Alenia Space wins ESA contract within Horizon 2020 program

Thales Alenia Space has been awarded a contract by ESA **in the context of the Horizon 2020 program** to design and develop NLES-Next (Navigation Land Earth Station). NLES-Next is a prototype of the next-generation of EGNOS' ground station. Thales is planning to deliver a modular, flexible, and scalable prototype, more cybersecure and able to support and unlock new EGNOS services and applications.

## Prestwick Spaceport partners with Astraïus



*Credit: Prestwick Aerospace*

The UK-based company Astraïus and the Scottish Prestwick Spaceport signed a Memorandum of Understanding to **prepare for the orbital launch of small satellites** starting from 2023. Astraïus is planning to develop the capacity to carry out multiple launches per day to contribute to the spaceport's operations while having the possibility to satisfy its customer base. The Scottish and UK governments have welcomed this new collaboration since the deal has the potential to boost the ambitions of the Scottish space industry and create an important strategic asset for the UK.

## Qascom develops dual-frequency and double constellation GNSS receiver

Qascom will develop a **dual-frequency and double constellation GNSS receiver (GPS/Galileo)** to experiment satellite navigation systems on the surface of the Moon based on a contract the Italian company signed with the Italian Space Agency (ASI). The project is named NEIL (Navigation Early Investigation on Lunar surface) and is part of an **agreement between ASI and NASA** connected to the CLPS 19-D mission (NASA's Commercial Lunar Payload Service, Task Order 19). The two Space Agencies' objective is to land the Lunar GNSS Receiver Experiment (LuGRE) to the Moon's "Mare Crisium" basin in 2023. Qascom will develop the receiver for GPS and Galileo's signals as well as the full radiofrequency chain able to support the extreme environmental conditions of the Moon.



## Aerojet Rocketdyne signs contract for Orion Main Engine

Aerojet Rocketdyne has won a NASA contract to **develop Orion Main Engine (OME)** which is the primary propulsion element of the Orion spacecraft. Orion will be employed within the Artemis program and for deep space exploration in other missions. The U.S.-based company has already provided the Orbital Maneuvering System engines (OMS-E) for the first six Orion missions and will use that experience combined with modern manufacturing techniques to build up to 20 new OME engines. NASA's contract is worth a **maximum value of \$600M** will last until 2032. Additionally, the company will also provide other elements for Orion under contract to Lockheed Martin, such as the auxiliary engines on Orion's service module.

## Five U.S. companies contribute to regular manned transportation to the Moon

NASA awarded five firm fixed-price **contracts for a total value of \$146M** to contribute to provide regular transportation of humans from the Moon's orbit to its surface under the Artemis program. The selected U.S. companies are: Blue Origin (\$25.6M), Dynetics (\$40.8M), Lockheed Martin (\$35.2M), Northrop Grumman (\$34.8M) and SpaceX (\$9.4M). In the framework of NASA's General Announcement Next Space Technologies for Exploration Partnerships (NextSTEP-2) Appendix N, the chosen companies will be in charge of developing and evaluating lander design concepts as well as mitigating their risks and will carry on their tasks for 15 months.

## World's first fully civil orbital mission takes place



*Credit: NASA*

Inspiration4, **the first fully civil orbital mission**, orbited Earth from September 15<sup>th</sup> to 18<sup>th</sup>. Members of the crew were medical officer Hayley Arceneaux, mission specialist Chris Sembroski, and mission pilot Sian Proctor. Jared Isaacman, founder and CEO of Shift4 Payments led the mission. SpaceX provided the launch and return to Earth. While in orbit the crew performed research experiments on human health and on the impacts of space flight with the aim of increasing human's

knowledge on the matter. Inspiration4 was part of a fundraising effort to help children with cancer and other life-threatening illnesses, designed by Isaacman for the St. Jude Children's Research Hospital. The \$200M target, including Isaacman's \$100M and Elon Musk's \$50M, has already been exceeded.



### In other news

**Finnish nanosatellite sends first signals on a new high frequency range from space:** W-Cube's signals were successfully received by the ground segment in Graz, Austria, giving a first demonstration of how 75 GHz signals can enter Earth's atmosphere. The new high frequency range could contribute to reduce clutter on radio waves. The Finnish Reaktor Space Lab (RSL) developed and manufactured the satellite platform in the framework of ESA's ARTES project.

**Kinéis selects Rocket Lab for the launch of 25 satellites:** The multi-launch deal will be carried out over five launches projected for the second quarter of 2023. The Internet-of-Things (IoT) satellites, designed and developed with the support of CNES, Thales Alenia Space and HEMERIA, aim to provide new operational services to Kinéis' customers. The value of the multi-launch deal was not disclosed.

**Astroscale Japan selects Rocket Lab to launch its Active Debris Removal spacecraft:** The assembly of the spacecraft should begin in early 2022 and its launch is planned for 2023 on an Electron rocket. Astroscale Japan's spacecraft ADRAS-J was selected by JAXA for Phase I of its Commercial Removal of Debris Demonstration Project (CRD2). In the space debris field, Astroscale also successfully tested its ELSA-d's ability to capture spacecrafts through the servicer's magnetic capture system at the end of August.

**Leonardo obtains recognition of UN Global Compact LEAD for the second time in a row:** The Italy-based company is the only one among the leading global companies operating in the Aerospace and Defense sector to have been nominated. The UN Global Compact LEAD is a title assigned to companies succeeding in promoting the Ten Principles of the Global Compact and contributing to reach the UN's Sustainable Development Goals (SDGs). For 2021-2022, Leonardo is planning to direct 50% of its investment towards SDGs as the company did in 2020.

**Phantom Space Corporation and Ingenu partner to launch constellation of 72 satellites:** The agreement covers production, manufacturing and launch of satellites that Ingenu will use to host its RPMA IoT payloads. With this launch, the U.S.-based company will be able to provide end-to-end solutions globally. Phantom Space Corporation will be responsible for the development of spacecraft buses, for system integration and for launch with its Daytona launch vehicle expected to fly for the first time in 2023.

**Northrop Grumman Corporation wins a contract to develop LEO satellite payload to enhance PNT:** The U.S.-based company is responsible for Phase 2 of a software-defined positioning, navigation, and timing (PNT) payload. The payload will allow military users to have access to a LEO signal non-dependent on existing satellite navigation systems. The contract is part of the Defense Advanced Research Projects Agency (DARPA) Blackjack program.

**Synspective signs launch agreement with Exolaunch to deploy one of its SAR satellites:** "StriX-1" is the third of 30 SAR satellites the Japan-based company is developing and will be launched on a Soyuz-2 in mid-2022. The two companies extended the previous launch partnership which targeted Synspective's second SAR satellite. The LEO SAR constellation will be employed to offer high-speed space-based solutions to track disasters at a global level.

**D-Orbit UK wins ESA contract for a multi-purpose dispositive for space debris removal:** D-Orbit UK will lead a consortium to work on phase 1 of the development and in-orbit demonstration of a "Deorbit Kit" enabler of propulsive deactivation maneuver for space vehicles after a failure or at the end of their mission. In the future, the Deorbit Kit and the know-how might be used for designing active debris removal mission concepts. ESA contract values €2.2M.



## ECONOMY & BUSINESS

### Luxembourg and U.S. based Promus Ventures launches new \$140 million space fund

On September 7<sup>th</sup>, the Luxembourg and U.S.-based company Promus Ventures closed their fifth Venture Capital fund. The new fund is **endowed with \$140 million in capital** and will adopt a sector-specific approach, focused on investing in space and geospatial related companies worldwide. This fund will be called Orbital Ventures and will embrace the same investment strategy currently being implemented in Promus Venture's other deep-tech funds focusing on early-stage companies. Promus Ventures is one of the most active international funds in the space sector, with its portfolio already comprising of companies such as Iceye, Rocket Lab, Spire, Isotropic System and Ellipsis Drive. In addition to the new space fund, the company has also launched a space index which tracks the performance of 26 public companies in the space sector. The Promus Ventures Space Index comprises both New Space and legacy space companies and includes all the space companies having undergone or awaiting the completion of their SPAC mergers.



*Credit: Promus Ventures*

### OneWeb signs new launch insurance agreement worth \$1 billion

OneWeb has renewed its ongoing partnership with leading insurance broker Marsh by **signing a new multi-launch insurance agreement** worth \$1 billion with the company. The insurance programme was placed through Marsh with a suite of leading specialist insurers and will cover all remaining launches of OneWeb's first-generation satellite constellation. The company will be insured during the launch phase for any physical damages or loss of the satellites or launch vehicles used. OneWeb's last multi-launch insurance agreement was arranged with insurance broker Willis but expired last August due to delays caused by the global pandemic and the company's Chapter 11 restructuring efforts. The new agreement represents a renewal of the partnership between Marsh and OneWeb, following the completion of the "Five to 50" launch programme. The "Five to 50" programme was completed following the **launch of 36 satellites by Arianespace last July**, giving the company the number of satellites necessary to begin the introduction of its services in Northern Europe, Canada and the UK by the end of 2021.

### Spire Global consolidates space-based maritime data business with exactEarth acquisition

Spire Global and exactEarth **have entered into a definite agreement** on September 14, which will result in the acquisition of exactEarth for approx. \$160 million. The acquisition represents a significant step in the consolidation of the space-based maritime data and analytics industry. Whereas the two companies previously held **approximately held equal shares of the satellite-AIS** market with Orbcomm, the acquisition means that Orbcomm will now be the only major competitor to Spire Global on this market. Spire Global recently went public on the New York Stock Exchange in August in the wake of their successful SPAC merger with NavSight Holdings, which resulted in the company raising \$265 million in cash.

In addition to consolidating its satellite-AIS business, Spire Global is also aiming to **strengthen its position in the satellite IoT market** as the company formed a partnership with Adelaide-based satellite IoT service provider Myriota. ExactEarth recently acquired a minority stake in Myriota. The partnership aims to enable the company's global service deployment timeline by using Spire's low-earth orbit satellites to expand the Myriota Network. Myriota's service is currently available in North America, Australia and New Zealand but the start-up expects to scale up its network, expanding its coverage also to Europe as Spire progresses with the deployment of new satellites.



## Isotropic Systems antennas development fully funded following €31.6 million Series B



Credit: Isotropic Systems

The UK-based start-up Isotropic Systems **secured over €31 million** in additional Series B funding September 27. The new capital ensures that the company is fully funded ahead of the product launch of its multi-link antennas, currently projected to take place in 2022. The funding round was led by Seraphim Space Investment Trust, which follows **Seraphim Space's IPO in July**, and also included the participation of Promus Ventures through its newly created Luxembourg based Orbital Ventures space fund.

The company's antennas are designed to simultaneously connect to multiple satellites placed on various orbits through a single integrated terminal. Isotropic Systems' technology has received broad interest from members of the industry and the company has now secured over €80 million in capital from equity investments and contracts. Its February **Series B round of funding** was led by SES and also included participation from the UK Government.

## French private equity firm Audacia goes public and prepares creation of space fund

On September 27<sup>th</sup>, the Paris-based private equity firm **Audacia Capital successfully completed its IPO** on the Euronext Growth Paris. The firm aims to raise €8 million in capital through its public offering and has the objective of completing the development of its private equity business. In addition to these objectives, Audacia Capital has created the company GEODESIC with the aim of piloting investments in NewSpace companies, in anticipation of the establishment of its future space sector-focused investment fund.

## BAE System acquires UK start-up In-Space missions

BAE Systems has **acquired the UK start-up In-Space mission** in order to enhance its small satellite manufacturing capacity. In-Space missions was founded in 2015 and is specialized in the development of small satellite systems and the deployment of a satellite rideshare system called the Faraday Service. The company launched their first satellite carrying six payloads for companies such as Airbus, SatixFy and Aeterum as part of the SpaceX Transporter-2 rideshare mission in June. In-Space mission's Faraday Service also allows for the upload of digital payloads through their proprietary RF platform. The company was awarded a GBP 9.5 million contract from the UK Ministry of Defence to develop an experimental satellite aiming to test a space-to-ground laser communication system in 2023.

## South Korean consortium investment in Relativity Space Series E totals \$50 million

A consortium of South Korean companies involved in the space industry including Hanwha Aerospace, Consus Asset Management, and NH investment & Securities **invested a total of \$50 million in Relativity Space** as part of the start-up's June Series E funding round. The investment is part of a series of significant ongoing developments in the South Korean industry and is a further example of Hanwha Group's current expansion strategy. Their participation in Relativity Space's Series E follows their 2020 acquisition of Phasor Systems and their recent investments in Satrec Initiative and OneWeb. These advancements come as the ambition of South Korea, its space industry, and Hanwha Group consolidates, specifically through the undertaking of significant projects such as the development of a 2000 satellite-large satellite constellation and the preparation of **lunar activities involving in-situ resource utilization**. The funding round also included the participation of Qatar and Saudi Arabia's sovereign wealth fund and valued the company at \$4.2 billion.



Credit: Relativity Space



### In other news

**Raytheon Technologies resumes space industry acquisitions with SEAKR:** The major defense contractor is set to continue consolidating its space business with the acquisition of SEAKR, a provider of small satellites and spacecraft systems components. The latest investment follows their acquisition last December of the satellite manufacturer Blue Canyon Technologies. SEAKR was recently awarded a \$60.4 million DARPA contract for the development of a data processing system for Blackjack satellites.

**Terran Orbital and Space Florida sign agreement for the construction of \$300 million facility:** The facility is projected to be one of the biggest satellite manufacturing companies in the world upon completion in 2025. It will be built in collaboration with Florida's aerospace development authority and will include state of the art technology such as an AI-driven supply chain and 3D printing. Terran Orbital expects to build over 1000 satellites per year in the facility. The company is also projecting to develop its own SAR satellite constellation.

**Orbit Fab attracts interest of Northrop Grumman and Lockheed Martin in latest funding round:** The company raised \$10 million in capital in a new funding round led by Asymmetry Ventures, in which Northrop Grumman and Lockheed Martin also participated. The funding round aims to support the commercialization of Orbit Fab's on-orbit refueling systems and services. The company will launch its proprietary fuel tanker on board a Falcon 9 lunar lander mission in 2022.

**Exo-Space updates business line following surge in demand for on-board processing solutions:** The company has launched its new FeatherEdge platform, which includes both a hardware and software component that can be integrated into satellites to provide on-board image processing capabilities. Whereas the company was initially specialized in the manufacture of cubesats, it shifted its business line in the wake of rising demand for on-board processing solutions capable of offering actionable information to customers on-demand.

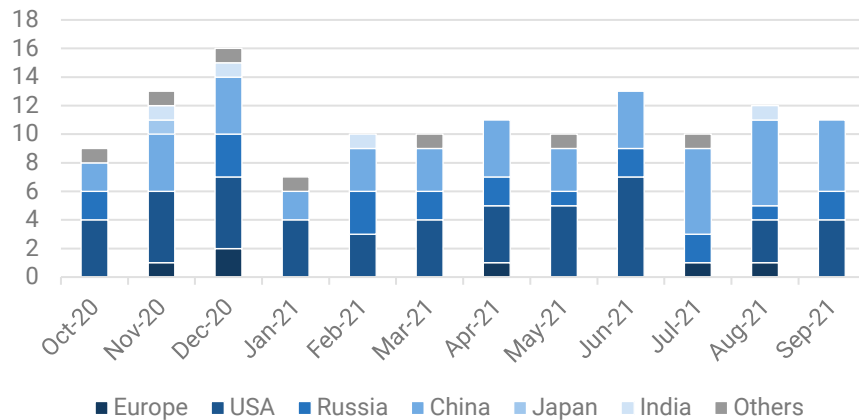


# LAUNCHES & SATELLITES

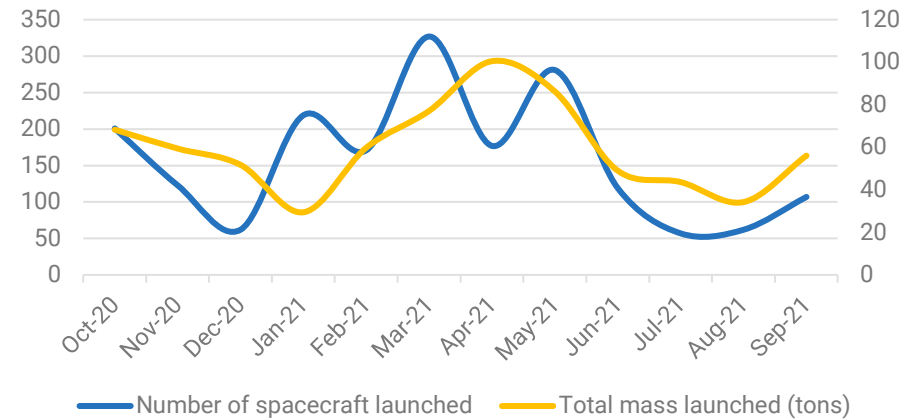
## Global space activity statistics

September 2021	USA	Russia	China	Total
Number of launches	4	2	5	11
Number of spacecrafts launched	67	35	5	107
Mass launched (in kg)	28 238	5148	22 730	56 116

## Launch activity over the year



Evolution of the number of launches per launch country

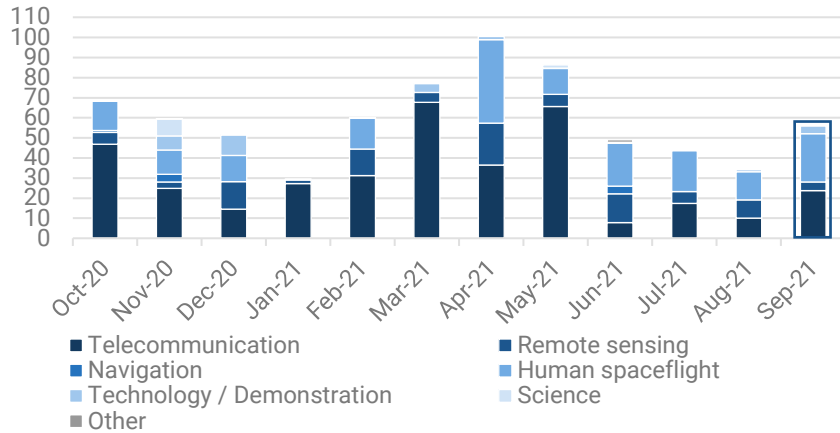


Evolution of launch activity over the year 2020-2021

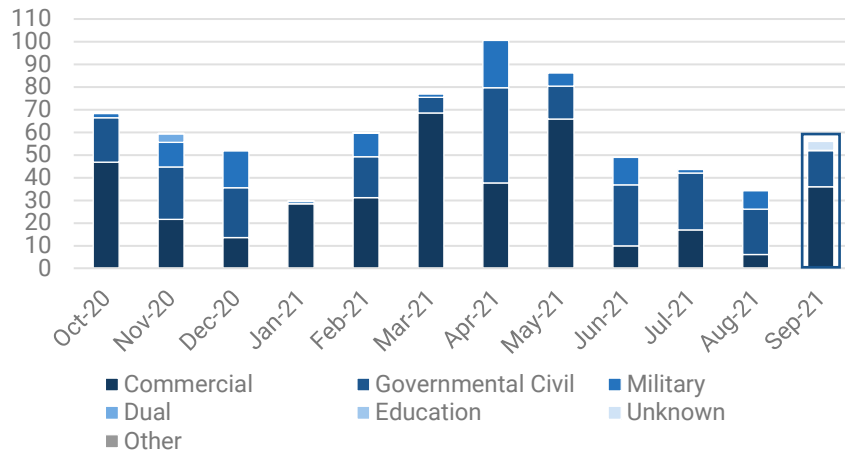




Satellite missions and markets



Evolution of the total mass launched (tons) per mission (Oct. 2020-Sep. 2021)



Evolution of the total mass launched (tons), per market (Oct. 2020-Sep. 2021)

September 2021	Telecom	Remote sensing	Human Spaceflight	Technology/ Demonstration	Science	Other
Europe	4998			1.15		0.8
USA	13 260	2864	12 055	41	12	4
Russia		150				
China	5500	1230	12 000	4000		

Total mass (kg) launched by mission and customer country

September 2021	Commercial	Gov. Civil	Military	Education	Other	Unknown
Europe	4998.75				1.2	
USA	25 330	2901		5		
Russia			150			
China	5730	13 000				4000

Total mass (kg) launched by market and customer country



Launch Log

Launch date	Launch country	Launcher	Spacecraft name	Main customer	Customer country	Prime manufacturer	Manufacturer country	Mass (kg)	Mission	Market
02/09/2021	USA	Firefly Alpha	BSS 1	Benchmark Space Systems	USA	NearSpace Launch	USA	3	Tech / Demo	Commercial
			FossaSat 1b	Fossa Systems	Spain	Fossa Systems	Spain	0,25	Tech / Demo	Commercial
			FossaSat 2	Fossa Systems	Spain	Fossa Systems	Spain	0,5	Tech / Demo	Commercial
			GENESIS (-L & -N)	AMSAT-EA	Spain	AMSAT-EA	Spain	0,4 (each)	Radio Amateur	Amateur
			Hiapo	Hawaii Science and Technology Museum	USA	Hawaii Science and Technology Museum	USA	1	Tech / Demo	Education
			Qubik (1 & 2)	Libre Space Foundation	Greece	Libre Space Foundation	Greece	0,2 each	Tech / Demo	Amateur
			Serenity	Teachers in Space	USA	Teachers in Space	USA	4	Radio Amateur	Education
			Spinnaker-3	Purdue University	USA	Purdue University	USA	25	Tech / Demo	Governmental Civil
07/09/2021	China	CZ-4C	Gaofen 5-02	CNSA	China	SAST	China	1000	Earth Observation	Governmental Civil
09/09/2021	Russia	Soyuz-2-1v	Kosmos 2551 / Razbeg	Ministry of Defense of the Russian Federation	Russia	VNIEM	Russia	150	Earth Observation	Military
09/09/2021	China	CZ-3B/G2(2)	ZX 9B / ChinaSat 9B	China Satcom	China	CAST	China	5500	Telecommunication	Commercial
14/09/2021	Russia	Soyuz-2-1b Fregat	OneWeb L10 (34 satellites)	OneWeb Ltd.	United Kingdom	OneWeb Satellites (USA)	USA	147	Telecommunication	Commercial
14/09/2021	USA	Falcon-9 v1.2 (Block 5)	Starlink G2 (51 satellites)	SpaceX	USA	SpaceX	USA	260	Telecommunication	Commercial
15/09/2021	USA	Falcon-9 v1.2 (Block 5)	Inspiration4	Private individuals (USA)	USA	SpaceX	USA	12055	Space Tourism	Commercial
20/09/2021	China	CZ-7	Tianzhou 3	CMSA	China	CAST	China	12000	Cargo Transfer	Governmental Civil
27/09/2021	China	Kuaizhou-1A	Jilin-1 Gaofen-02D	Chang Guang Satellite Technology Co.	China	Chang Guang Satellite Technology Co.	China	230	Earth Observation	Commercial
27/09/2021	USA	Atlas-5(401)	Cesium Satellite (1 & 2)	CesiumAstro	USA	CesiumAstro	USA	6	Tech / Demo	Commercial
			CuPID	Boston University	USA	Boston University	USA	6	Space Science	Governmental Civil
			CUTE	University of Colorado Boulder	USA	Blue Canyon Technology	USA	6	Astronomy	Governmental Civil
			Landsat 9	NASA	USA	Northrop Grumman	USA	2864	Earth Observation	Governmental Civil
27/09/2021	China	CZ-3B/G2(2)	Shiyan 10	Unknown (China, Public)	China	CAST	China	4000	Tech / Demo	Unknown



## Launch Highlights

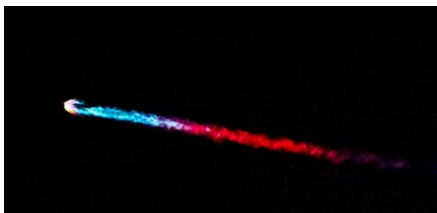
### Firefly Aerospace fails its first launch

On September 2<sup>nd</sup>, Firefly Aerospace conducted the first launch of the rocket it is developing, Alpha, but failed to reach orbit. Indeed, the launcher, which carried ten payloads, went out of control and the flight termination system was eventually activated to avoid casualties on the ground. The failure was traced back to the **premature shutdown** of one of the rocket's four engines, which created issues when the rocket reached supersonic speeds.



*Credit: Reuters/Gene Blevin*

### Satcom mega-constellations continue their deployment



*NasaSpaceflight.com/Jack Beyer*

On September 14<sup>th</sup>, SpaceX launched a new batch of Starlink satellites. These spacecraft are the first of the second generation of Starlink, and they were transported to space in the **first Starlink launch dedicated to polar orbit**. The launch was delayed of several weeks because of issues in getting the components of the laser intersatellite links equipped onboard satellites. This technology will allow to reduce the number of necessary ground

stations in polar regions and over the oceans. Laser links will from now on be equipped on all Starlink satellites. Moreover, the booster used for the launch was the second of the company to have conducted ten flights.

On the same day, the main competitor of Starlink, OneWeb, launched 34 new satellites from the Baikonur Cosmodrome. With this launch, the company reached the number of 322 satellites in orbit, thus having deployed **almost half** of its planned constellation (648 satellites). Commercial services in the upper part of Northern hemisphere are expected for the end of the year. The launch was also a milestone for Arianespace, which put in orbit its 1000<sup>th</sup> satellite during this mission.

### A new step for the Landsat programme

On September 27<sup>th</sup>, an Atlas 5 rocket carried the **Landsat 9 satellite** to space. The spacecraft is the latest of the Landsat programme, thus continuing an effort jointly conducted by NASA and the U.S. Geological Survey for almost fifty years. The imager of Landsat 9 can provide four times more shades in its wavelength bands than its predecessor Landsat 8. The two satellites will be phased in their orbits to provide a revisit rate of eight days. These satellites will also be phased with Copernicus' Sentinel-2 spacecraft to still decrease the revisit time.



*Credit: ULA*

The launch, which was conducted by ULA, also brought to space four CubeSats: two of them will conduct astronomy and space science missions and two other, sponsored by various military organisations, will allow the company **CesiumAstro** to test its phased array antenna technology.

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