



ESPI

European Space Policy Institute

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Space Sector Watch



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THIS MONTH IN THE SPACE SECTOR...

- TOWARDS A SPACE INDUSTRY CONSOLIDATION?..... 1**
- POLICY & PROGRAMMES..... 2**
 - ESA Council of Ministers approves Resolution to accelerate the use of space in Europe..... 2
 - Germany’s traffic light coalition unveils coalition contract..... 2
 - ESA and EU plan to launch new constellation to track greenhouse gas emissions..... 2
 - France and Italy sign Quirinal Treaty 3
 - France and the U.S. aim to expand space cooperation 3
 - ESA and CNES collaborate to create European space transport hub 3
 - Russia launches ASAT missions and triggers reactions from the international community 4
 - NASA leadership announces delays in the Artemis Program..... 4
 - Astrophysics decadal survey recommends NASA on new flagship programs 5
 - China plans two-year long Mars sample return mission for 2028 5
 - South Korea makes plan to develop a reusable rocket..... 6
 - In other news 6
- INDUSTRY & INNOVATION 7**
 - Isotropic Systems validates the first-ever simultaneous multi-orbit antenna 7
 - Rocket Lab plans to attempt aerial capture of its Electron rocket..... 7
 - SpinLaunch successfully tests alternative launch system..... 7
 - Pulsar Fusion successfully tests new high-power chemical rocket..... 8
 - Kinéis obtains FCC approval to offer satellite services in the U.S. market..... 8
 - Lockheed Martin receives a \$737 million order for three GPS 3F satellites..... 8
 - Amazon bets on ABL Space Systems to launch prototypes for its mega-constellation 8
 - Virgin Orbit and ANA Holdings partner to launch 20 orbital flights from Japan 8
 - In other news 9
- ECONOMY & BUSINESS..... 10**
 - EUSPA launches €32.6 million Horizon Europe space-focused call..... 10
 - ESA and European Commission seek to boost purchase of European commercial imagery..... 10
 - Morpheus launches solution combining Software-as-a-Service and Hardware-as-a-Service..... 10
 - Seraphim Space release their Q32021 Venture Capital index report..... 10
 - November sees boom in mega funding rounds 11
 - Mynaric completes IPO on the NASDAQ and becomes a dual-listed company 12
 - In other news 12
- LAUNCHES & SATELLITES 13**

Global space activity statistics	13
Launch activity over the year.....	13
Satellite missions and markets.....	14
Launch Log	15
Launch Highlights.....	17
ABOUT ESPI.....	18

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TOWARDS A CONSOLIDATION OF THE SPACE INDUSTRY?



Dear Friends of ESPI,

On November 8, 2021, in a deal guaranteed to send aftershocks throughout the satellite operators industry, **California-based Viasat entered a definitive agreement to acquire British satellite fleet operator Inmarsat in a transaction valued at \$7.3 billion**. While still pending regulatory approval, the takeover of Inmarsat by Viasat will create the biggest player in the global satellite sector. This potential deal may become a catalyst for further industry consolidation as it is likely to force rivals to compete with the combined company by seeking to scale through mergers and acquisitions. The Viasat/Inmarsat deal followed the €2.8 billion attempted takeover of Eutelsat by Patrick Drahi and his company Altice. While Eutelsat rejected the proposal, **the stringent offer** makes room for potential future interest. This applies notably as the attractiveness of Eutelsat is high following its recent stake in OneWeb, which resulted in its strategic exposure within the LEO broadband market.

One of the primary reasons **behind the prediction of further consolidation** amongst satellite operators is that share and capitalization values have shrunk to all-time lows following the Covid-19 crisis. This is caused by **a declining legacy broadband business (including satellite TV, satellite phones) and coincides with the emergence of LEO broadband constellations** spearheaded by SpaceX and OneWeb but also by the potential Amazon Kuiper and Telesat Lightspeed constellations.

Satellite operators are not the only actors in the space industry that are seeing some form of consolidation. NewSpace players have begun actively consolidating through a new wave of acquisitions. Just recently a number of acquisitions occurred:

- In August 2021, SpaceX **acquired Swarm technologies**, an IoT company.
- In September, **Spire bought Satellite AIS provider exactEarth for \$161million**.
- In October, Rocket Lab USA acquired Advanced Solutions Inc for \$40m. This was followed by a deal on November 15th to **acquire Planetary Systems Corporation for \$42million** plus stock.
- In November, **RedWire purchased Techshot** a leader in space biotechnology.
- In November, **Planet acquired European EO data company VanderSat** for \$28million.

As such, the NewSpace segment is seeing both significant horizontal (merging with competitors) and vertical (merging with companies that have a diverse set of capabilities) consolidation. A common thread behind the latest wave of NewSpace acquisitions is the massive amount of capital that has been raised recently on the private markets through either large investment rounds (for SpaceX) or SPAC listings (RedWire, Rocket Lab, Spire). This significant volume of capital inflows has allowed companies to grow inorganically through acquisitions and highlights a trend likely to continue as long as the market witnesses such large financing rounds and public listings.

For both satellite operators and NewSpace actors, the space landscape is changing fast and long-term success will require both flexibility and adaptability. NewSpace companies with interesting IP and qualified workforce that have not raised significant funds are potential targets for future acquisitions. After a long period of relative stability, legacy satellite operators are now confronted with new economic and market realities which highlight a fragmented ecosystem with high costs and hard-earned profits. In addition, legacy operators will be increasingly subject to the rise of newcomers with deep pockets affecting their future viability on existing business cases.

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

ESA Council of Ministers approves Resolution to accelerate the use of space in Europe

On November 19th, ESA's Council of Ministers at its Intermediate Ministerial Meeting unanimously adopted a **Resolution called "Matosinhos Manifesto"** to accelerate the use of space in Europe to address urgent and unprecedented social, economic and security challenges. The resolution follows a report released by a High-Level Advisory Group to ESA DG Josef Aschbacher in October that recommended three "accelerators" for Europe:

- **Accelerator 1 - Space for a Green Future**, using advanced space data, science & technology for sustainable life on Earth, including the development of digital twins of our planet to support society and decision makers to reach carbon neutrality by 2050.
- **Accelerator 2 - Rapid and Resilient Crisis Response**, for enabling security stakeholders to ensure rapid provision of information, hence allowing quick response to climate-induced and other crises facing Europe.
- **Accelerator 3 - Protection of Space Assets**, to ensure resilient availability and functioning of space infrastructure on which Europe's economy and society relies for day-to-day life.

Additionally, the Resolutions recognizes the icy moon sample return mission and human space exploration as "inspirators" that can reinforce European leadership in science and technology development. The Resolution supports the vision of ESA DG's Agenda 2025 to build excellence in the space sector in Europe for the benefit of all.

Germany's traffic light coalition unveils coalition contract

Germany's traffic light coalition, involving Social Democratic Party (SPD), the Green Party and the Free Democratic Party (FDP), concluded coalition talks and unveiled a **coalition contract for 2021-2025** on November 24th. Negotiation started on October 31st, and confirmation on the coalition and coalition contract should be voted early in December. The traffic light coalition would be the first three-party-alliance government in Germany. The coalition contract sets key priorities regarding climate change, the Covid-19 pandemic and the economic recovery, and digitalization. The section on Aerospace highlights priorities for the space sector:



Credit: dpa

- Space travel and the New Space area as key future technologies.
- Strengthening the National Space Programme and ESA and maintaining independence.
- Developing a new space strategy, with a focus on avoiding and removing space debris.

ESA and EU plan to launch new constellation to track greenhouse gas emissions

During the UN Climate Change Conference COP26, ESA and the EU released information about a new **satellite constellation they are planning to launch** to track human-made greenhouse gas emissions. The new constellation is currently being developed by ESA and EUMETSAT and is expected to be fully operational by 2026. The objective is to have a constellation able to measure concentrations of carbon dioxide and methane, identifying individual sources, providing higher accuracy, a broader coverage, and near real-time data.



France and Italy sign Quirinal Treaty



Credit: La Stampa

On November 26th, French President Emmanuel Macron and Italian Prime Minister Mario Draghi signed a **bilateral treaty at Quirinale Presidential Palace** in Rome, enhancing cooperation between the two countries, with a section specifically dedicated to the space sector. France and Italy recognise the importance of bilateral cooperation for the development of Europe in the space sector, and to strengthen European strategic autonomy and its economic development. The two nations commit to:

- Promote cooperation at industrial, scientific, and technological level, especially in the EU and ESA.
- Support the European preference principle of access to space “through the coordinated, balanced, and sustainable development, evolution, exploitation of Ariane and Vega launchers”.
- “Encourage and develop industrial cooperation in the field of exploration, Earth Observation, telecommunications, navigation, and associated ground segments”.

Additionally, the two nations disclosed information on a **bilateral agreement on launchers** which was signed by the French Minister of the Economy, Finance and the Recovery Bruno Le Maire and the Italian Minister for Technology Innovation and Digital Transition Vittorio Colao after three months of negotiations. The bilateral agreement envisages new investments to strengthen the competitiveness of the Ariane 6 and Vega C launchers, it contributes to increase competitiveness in liquid and solid propulsion through industrial optimisation and enhanced cooperation, addresses plans for technological developments that will enable Ariane to position itself in the market of mega-constellations and acknowledges Italy’s ambitions in Earth Observation.

France and the U.S. aim to expand space cooperation

Following a meeting with French President Emmanuel Macron on November 10th, U.S. Vice President Kamala Harris spoke of the intention of the two countries to **expand cooperation on space matters**:

- Comprehensive Dialogue on Space: The U.S. and France will establish a “regular bilateral dialogue to ensure a whole-of-government approach to space cooperation”, mainly focusing on civil, commercial, and national security, to meet common foreign policy objectives. Additionally, the two delegations committed to enhance the exchange of EO data and joint analysis of climate change-related risks.
- Climate Change: The U.S. committed to join the Space Climate Observatory (SCO) and plans to work with CNES on the finalisation of the SCO Charter.

Furthermore, the U.S. Vice President spoke about a potential interest of France in joining the Artemis Accords. However, the French Presidency did not issue an official press release on the meeting.

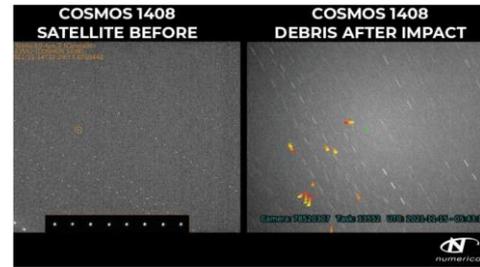
ESA and CNES collaborate to create European space transport hub

ESA and CNES are collaborating to establish a **new European space transport hub** in order to enhance the competitiveness of Europe’s access to space policy. In line with the two agencies expressed intention, the hub aims to be a “flagship center for space and launchers” able to boost the European space transport sector and attract public and private entities. On November 16th, ESA and CNES launched a call for expressions of interest that will be open until December 31st, to determine the scope of the hub and identify potential interested stakeholders. The initiative’s final approval is planned for the end of 2022.



Russia launches ASAT missions and triggers reactions from the international community

The Russian Ministry of Defense **launched an anti-satellite (ASAT) missile** on November 15th which for the first time intercepted a real satellite and destroyed it. As well as other countries, Russia had already conducted tests of this kind, but it always aimed the weapon to an imaginary point in space. This last ASAT test created a cloud of space debris which endangered astronauts on the ISS who had to implement emergency safety procedures and triggered severe reactions



Credit: Numerica

in the international community. The U.S. was the first country to release severe statements against Russia's behavior. France, UK, and Germany followed, as well as other spacefaring nations, including Japan, South Korea, and Australia. China did not release official statements. European space industries have also spoken against Russia's ASAT test, expressing alarm and worries.

EU and ESA also issued official statements regarding Russia's ASAT test:

- Josep Borrell, High Representative of the Union for Foreign Affairs and Security Policy released a **statement** on November 19th, on behalf of the EU stating that "The EU strongly condemns the Russian Federation's conduct [...] as a clear act of irresponsible behaviour in outer space", and against international law principles. DG DEFIS Commissioner Thierry Breton also issued an **official statement**, outlining that "this anti-satellite weapon test has caused the generation of a significant amount of debris of a size that could endanger the EU's space activities as well as those of the Member States", and it reinforces the need for policy actions.
- ESA DG Josef Aschbacher released an **institutional statement** declaring that "space debris has increasingly posed a general risk to all operational satellites in orbit, and to astronauts on the ISS, on the China Space Station", as well as to future ones. "It is vital to immediately use an appropriate mechanism to guarantee free, responsible and safe access to the space for all".

NASA leadership announces delays in the Artemis Program



Credit: SpaceX

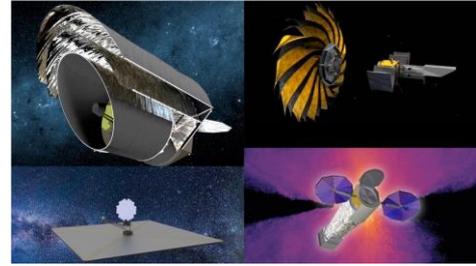
On November 9th, **NASA leadership announced the postponement of the first human lunar landing under the Artemis Program to 2025** at the earliest. NASA also discussed challenges and progress of the Program. The announcement, which is the first major Artemis update provided under the Biden-Harris Administration, follows the U.S. Court of Federal Claims' **decision to dismiss Blue Origin's claim** against NASA filed in August. Due to the litigation, NASA and SpaceX have not been allowed to work on the program for seven months. However, NASA Administrator Bill Nelson explained that even though Blue Origin's lawsuit was a major reason for the delay, it was not the only one. Nelson spoke of the major difference between HLS funds allocated by the Congress (\$850) and NASA's request (\$3.3 billion) in its fiscal year 2021 budget proposal, and of the non-technical feasibility of the 2024 human landing target. NASA's leadership highlighted that these delays will not impact on later Artemis mission schedules. However, NASA's Office of Inspector General (OIG) published a report of the Artemis Program on November 15th where it **challenges some declarations** of the Agency.

Additionally, NASA delayed Artemis 2, scheduled for launch in 2023 **to as late as May 2024**. NASA associate administrator Jim Free explained that the Covid-19 pandemic affected the supply chain of the program and the increasing of Orion spacecraft development costs from an estimation of approx. \$6.7 billion to \$9.3 billion, slowed down the process. Free said there were many changes in requirements, including the addition of a "proxops" demonstration on Artemis 2 to test systems for the HLS dockings.



Astrophysics decadal survey recommends NASA on new flagship programs

The “Pathways to Discovery in Astronomy and Astrophysics for the 2020s” report by the astrophysics decadal survey **recommended NASA on new flagship programs**. The report was released by the National Academies on November 4th, and suggested NASA to establish a Great Observatories Mission and Technology Maturation Program to “oversee initial studies of large flagship astrophysics missions” and invest on new technological developments.



Credit: NASA

Suggested flagship missions are:

- A six meters diameter space telescope designed for observations at ultraviolet, visible, and infrared wavelengths, for an estimated cost of \$11 billion. The telescope could be used to characterise potential habitable exoplanets as well as other astrophysics research. The decadal survey suggested that work on the telescope could start late this decade, and it could be launched in early 2040s.
- Studies on far-infrared and X-ray flagship missions started five years after the telescope and with estimated costs of \$3 billion to \$5 billion each. These concepts are similar to previous NASA’s Lynx X-Ray Observatory and Origins Space Telescope mission studies in support of the decadal survey.

In addition to flagship programs, the decadal survey also recommended other missions. Among them, a line of medium-class “probe” missions that could be launched on a decade basis. In ground-based astronomy, the report suggested that the National Science Foundation (NSF) could finance two extremely large telescopes (ELTs) that have been seeking the NSF support, the Giant Magellan Telescope in Chile and the Thirty Meter Telescope, after resolving legal issues for the latter, and begin studies for the Next Generation Very Large Array.

China plans two-year long Mars sample return mission for 2028



Credit: CNSA

China is planning a **Mars sample return mission for 2028** with the objective of returning the samples back to Earth around 2030. The mission has recently passed a milestone review. From the technological perspective, China is planning to build on its already developed and demonstrated capabilities for two flagship missions, the solar powered Zhurong rover on Mars and the Chang’e- 5 mission to the moon. In a press conference held after Zhurong landing, China’s chief designer of the Tianwen-1 mission Zhang Rongqiao said that the

country will need “two to three years to tackle the core technologies before conducting engineering development” for the new Mars mission. Additionally, it seems like China will carry on two launches within the same launch window using Long March 3B and Long March 5 launch vehicles.

China’s Mars sample return mission is the first of its kind. Both ESA and NASA are currently exploring mission concepts for an international Mars Sample Return mission that will probably be launched no earlier than 2026, with possible samples return in 2031. Each Agency is planning to launch a rover to pick up the samples and send them into orbit around Mars. On the other hand, it seems like China will attempt the mission on its own. Additionally, China will use a lander to extract the samples instead of a rover.



South Korea makes plan to develop a reusable rocket

South Korea is planning to develop a **reusable rocket with liquid-fueled 100-ton thrust engines**. A lawmaker of the ruling Democratic Party of Korea, Cho Seung-rae, disclosed information about the project during a meeting with the Minister of Science and ICT Lim Hye-sook and members of the National Assembly's Science, ICT, Future Planning, Broadcasting and Communications Committee on November 10th. The Korea Aerospace Research Institute (KARI) will be in charge of the rocket's development which should begin in 2022. Plans for a reusable rocket were not included in the government's budget request for 2022 and it remains unclear whether it will replace South Korea's pre-announced **first solid-fuel space rocket** expected to be completed by 2024 or it will be developed together with.

In other news

NASA creates Office of Technology, Policy and Strategy and new leadership positions: The new OTPS was created from the merging of the Office of Strategic Engagements and Assessments with the Office of the Chief Technologist. OTPS will advise NASA leadership on "data- and evidence-driven technology, policy, and strategy" and will be led by Bhavya Lal. Additionally, Tom Cremins will be associate administrator of space security interests, one of NASA's newly created positions in its restructuring phase.

CNES takes up the Chair of the Committee on Earth Observation Satellites (CEOS) alongside ESA: CNES will be responsible for the advocacy of EO's priorities in Europe and will work closely with ESA. CNES was voted unanimously as CEOS Chair by the Committee's agencies in March.

EUMETSAT's governing council approves participation in the EU's project Destination Earth (DestinE): EUMETSAT's involvement in the first phase of the project will be worth €35M. The Agency will be responsible to design, establish, test, and manage the "multi-cloud data lake" underpinning DestinE and incorporating and accessing data from EUMETSAT's satellite system, EU's Copernicus Sentinel missions, ESA missions and so forth. Additionally, EUMETSAT will operate and provide an online inventory.

UK inaugurates the newly formed Spaceflight Safety and Regulatory Council on November 25th: The UK had recently passed regulations enabling launches from national soil. The new Council, comprising government members, industry experts, and the Space Flight Regulator, will be responsible of reviewing spaceflight regulations as well as advising and providing recommendations to government.

NASA selects Intuitive Machines to deliver four payloads to the Moon's surface in 2024: The contract valuing \$77.5M is the third in the framework of NASA's Commercial Lunar Payload Services (CLPS) initiative that the company wins. Intuitive Machines will use its Nova-C lander to deliver the payloads.

For the first time in 13 years JAXA recruits new astronauts to support space exploration missions: JAXA's new astronauts will be assigned to the ISS, the Japanese experiment module "Kibo" attached to ISS, or to the Lunar Gateway. The recruitment process will start on December 20th until March 4th, 2022, and the final selection of candidates is planned for February 2023.

Japan is close to launch its second space defence unit for electromagnetic wave threats monitoring: Japan aims to establish its second Space Operations Squadron at the Hofu Kita Air Base in Yamaguchi Prefecture in the next 18 months to protect its satellites.



INDUSTRY & INNOVATION

Isotropic Systems validates the first-ever simultaneous multi-orbit antenna



Credit: Isotropic Systems

Isotropic Systems and SES successfully tested **the first simultaneous multi-orbit antenna** which allows to simultaneously connect multiple satellites across separate orbits. Isotropic Systems' terminal established link connections with a SES GEO satellite and an O3b MEO satellite simultaneously and at full performance. The UK-based company's objective was to have a technology that would multiply single antenna solutions' performances making satellite connectivity more attractive to

defense and civil customers for land, air, and sea applications, ensuring critical defense communications infrastructure and delivering multiple highly reliable broadband. Isotropic Systems' antenna has been under development for eight years and the UK-based company has worked with major satellite operators to ensure its antenna's compatibility with satellite systems so that end users, such as defence, governments, and enterprises, can connect to multiple operators' satellites simultaneously. Isotropic Systems reported that the antenna should be commercially available in summer 2022.

Additionally, **Isotropic Systems joined the CGI-led consortium** working on the Satellites for Digitalisation of Railways (SODOR) project. The consortium was selected by the UK Department for Digital, Culture, Media and Sport, UKSA and ESA to deliver pilot demonstrations of an improved hybrid satellite communications and terrestrial network for train monitoring and passenger broadband in 2022. Isotropic Systems aims to use its antenna to solve the problem of unreliable and limited coverage terrestrial connectivity on trains.

Rocket Lab plans to attempt aerial capture of its Electron rocket

Rocket Lab is planning to attempt a recovery of its reusable **Electron rocket by catching it midair** with a helicopter in future recovery missions. Confirmation arrived after Rocket Lab's last successful mission that took place on November 18th when Electron's first stage returned to Earth under a parachute and the company conducted a controlled splashdown in the ocean and retrieval, while tracking it with a recovery helicopter. The helicopter that will be used to make the attempts will be larger and equipped with auxiliary fuel tanks, and modifications will also be made to the launch vehicle and the parachute system. During the attempt, Rocket Lab's engineers and recovery vessel will be stationed at sea, but the company's main objective is to have the helicopter carry the booster back to land. Rocket Lab's next recovery mission is scheduled for the first half of 2022.

SpinLaunch successfully tests alternative launch system

SpinLaunch, a California-based start-up, is developing an **alternative launch system using kinetic energy** as its primary method to lift off the ground. SpinLaunch reported that it successfully conducted a first test flight of a prototype on October 22nd at Spaceport America in New Mexico. SpinLaunch was founded in 2014 by Yaney and has raised \$110M to date from investors including Kleiner Perkins, Google Ventures, Airbus Ventures, Catapult Ventures, Lauder Partners and McKinley Capital. SpinLaunch, which is still finalising the design of its launch system, aims to reduce the size, complexity and cost of rockets solving the mass-issue that traditional fuel-carrying rockets face, as well as developing recoverable and reusable vehicles. Additionally, the California-based start-up is planning to conduct approx. 30 suborbital test flights over the next six to eight months and is finalising an agreement on the location of its first orbital launch system.



Credit: SpinLaunch



Pulsar Fusion successfully tests new high-power chemical rocket



Credit: Pulsar Fusion

A UK-based company Pulsar Fusion developed and successfully tested **its first high-power chemical** rocket engine in the UK. Pulsar Fusion's green hybrid rocket engine uses a new combustion technique that enables the company to produce the engines at a much faster rate but with improved safety factors. These rocket engines can both launch people and satellites into space. Pulsar Fusion's goal is to develop a hyper-speed propulsion engine based on nuclear fusion technologies to be used for interplanetary travel.

Kinéis obtains FCC approval to offer satellite services in the U.S. market

On November 18th, Kinéis obtained regulatory approval from the Federal Communications Commission (FCC) to **offer satellite services in the U.S. market**. The France-based company is planning to start launching its constellation of 25 small LEO satellites on the Electron launch vehicle in the second quarter of 2023 based on a **multi-launch contract it signed with Rocket Lab** in September. Kinéis aims to provide connectivity for IoT devices in the U.S. and increase awareness in the maritime domain through the monitoring of maritime communications. The company will operate on the U.S. market using frequencies of the non-voice, non-geostationary (NVNG) mobile-satellite service (MSS) and earth exploration-satellite service (EESS). After the approval, Kinéis disclosed plans to open a subsidiary in Washington in early 2022.

Lockheed Martin receives a \$737 million order for three GPS 3F satellites

Lockheed Martin received an **order worth \$737M to purchase** three of its GPS 3F satellites. The U.S. Space Force exercised an option to order the satellites under a previously awarded contract. In 2018, Lockheed Martin and the U.S. Space Force signed a \$7.2 billion agreement for up to 22 satellites. In the framework of this agreement, the U.S. Space Force has already purchased a \$1.3 billion for two GPS 3Fs in September 2018, and a \$511M contract option for other two satellites in October 2020. GPS 3F is the next generation of U.S. satellites providing global PNT services, equipped with more advanced and secured systems. Object of the contract are Lockheed Martin's GPS 3F space vehicles 15, 16 and 17.

Amazon bets on ABL Space Systems to launch prototypes for its mega-constellation

Amazon and ABL Space Systems **signed a multi-launch deal** for two prototype satellites of Amazon's Project Kuiper broadband mega-constellation in 2022. ABL has been experiencing a rapid growth raising \$170M in a founding round in March and an additional \$200M in October. ABL is currently in the preparation phase for its first launch planned before December 15th. Amazon explained that the speed and flexibility of ABL are among the reasons that led to the selection of the California-based company.

Virgin Orbit and ANA Holdings partner to launch 20 orbital flights from Japan

Virgin Orbit and the Japan-based ANA Holdings signed a Memorandum of Understanding (MoU) to procure 20 flights of the U.S.-based company's **LauncherOne rocket to be launched from the Japanese** prefecture of Oita, as well as to fund and support these orbital missions. ANA Holdings and its partners will have to finance the manufacturing of new mobile ground support equipments to prepare for the launch. While waiting for the necessary regulatory approvals from the U.S. and Japan, the two companies' target is to have Oita ready for launch by the end of 2022, making it the first spaceport in Japan to offer non-ground-based sites for launch services.



Credit: Virgin Orbit



In other news

Nine companies apply to FCC's round of proposals for a total of approx. 38,000 satellites: The companies, including Amazon, Astra, Inmarsat, Intelsat, Hughes Network, OneWeb, SpinLaunch, and Telesat, participated asking access for the V-band spectrum. The request arrives after the Federal Communications Commission approved part of Boeing's request to develop and operate a constellation of 147 non-geostationary (NGSO) broadband satellites nearly five years later.

PLD Space presents in Madrid the first Spanish space rocket MIURA 1: prototype's launch is planned for the second half of 2022, while the company aims to tackle its first real space transport mission with MIURA 5 in 2024. MIURA 1's development has been backed by many national and international entities and PLD Space has currently six contracts in place with world-wide space agencies.

Spaceflight plans to deliver payloads across two distinct orbits for the first time with new space tug: The launch services provider Spaceflight is preparing to deliver the 13 customer payloads next year and it will use its line of orbital transfer vehicles (OTVs) powered with chemical propulsion. Spaceflight's objective is to debut with SpaceX Transporter-3 mission.

Pangea Aerospace and DLR successfully test 3D-printed methalox aerospike engine: The Barcelona-based start-up upgraded its existing aerospike engine with new materials and manufacturing techniques, including its new regenerative cooling system using cryogenic liquid oxygen and liquid methane. Pangea Aerospace reported that its technology will increase efficiency by 15% compared to conventional approaches, also enabling a 15% reduction in fuel consumption.

Twenty Polish companies partner to create the Space Technologies Cluster: The Cluster, including public and private entities, will support initiatives, economic projects, ventures and start-ups to advance the national space industry, and to make the country an active player in the space community. The Cluster's long-term objective is to prepare and launch Microglobe, a constellation of microsatellites, by 2026.

Northrop Grumman selects Mynaric as strategic supplier in a competitive bidding process: Based on the agreement, the U.S.-based company "assures and prefers access" to Mynaric products and services and commit to buy equipment worth at least \$35M over five years. Additionally, they will jointly develop and provide laser communication solutions for U.S. government space programs, and the German-based company will have to guarantee Northrop Grumman the exclusivity in this market segment.

Nanoracks is the first client of the Canadian Spaceport Nova Scotia: Nanoracks will be responsible for the deployment of customer SmallSats and will host demonstrations of spacecraft technology. Maritime Launch Services, owner of Spaceport Nova Scotia which is Canada's first commercial spaceport, reported the news on November 19th.

Linkspace reports successful testing of new engine after almost two years of silence: Fengbao-1 is an electrically pumped methane-LOX engine that the Beijing-based company developed independently. In 2019, Linkspace had entered into an agreement with the rocket engine maker Jiuzhou Yunjian for 10-ton thrust methane-LOX engines to power a larger test vehicle. Linkspace did not disclose information regarding a new timeline for suborbital and orbital launches.

Exotrail and OHB Luxspace sign contract to further integrate ExoMG™ into Triton-X Heavy platform: The co-engineering phase on which the two companies will work on is part of OHB LuxSpace's development of a next generation of multi-mission microsatellite platform in the framework of ESA's ARTES programme.



ECONOMY & BUSINESS

EUSPA launches €32.6 million Horizon Europe space-focused call

On November 4, EUSPA officially **launched a €32.6 million space-focused** Horizon Europe call. The call has the objective of supporting the development of downstream applications that leverage data from the Galileo, EGNOS, and Copernicus programmes. In this regard, funding recipients will be expected to stimulate the EU Space Programme and create commercial value-adding solutions that contribute to the EU's policies and priorities. The call focuses on three main aspects including 1) EGNSS and Copernicus applications fostering the EU Green Deal, 2) EGNSS applications for safety and crisis management, and 3) EGNSS applications for the digital age. The first aspect focuses on the development of space-based applications supporting EU objectives related to the Green Deal and will have an overall budget of €14 million. The second and third aspects covered will each have a €9.3 million budget and will focus on applications supporting the Emergency Management and Security Services of Copernicus and accelerating the adoption of Galileo and EGNOS in mass and professional markets respectively.



Credit: EUSPA

ESA and European Commission seek to boost purchase of European commercial imagery

ESA published a request for information (ROI) on the evolution of the Copernicus Contributing Missions (CCM) seeking industry recommendations on how to increase its non-dependence on foreign imagery and its ability to include new suppliers. The ROI contains a renewed list of priorities regarding the CCM which now include: more technology sovereignty, economic growth, and avoiding dependence on a single European supplier. To this effect, ESA and the European Commission have set the objective of reducing the share of non-European very high resolution (VHR) it will acquire from approx. 40% to 20% of the 2021-2027 space budget. In addition, both organisations seek to boost the inclusion of new suppliers in the CCM and reduce the reliance "on a single company and industrial lock-in situations". The aim would be that of encouraging the participation of European New Space companies, in particular through long-term anchor-tenancy contracts. The current CCM programme is composed of 12 bilateral agreements between ESA and each data provider which will run until 2023. Ikeye recently **became the first European New Space company** to take part in the CCM programme.

Morpheus launches solution combining Software-as-a-Service and Hardware-as-a-Service

The German electric propulsion system-specialist Morpheus Space **launched its SPHERE ecosystem**. The new solution includes various innovative elements and sees the company adopting both a Software-as-a-Service and a Hardware-as-a-Service approach (Haas). The "SPHERE Flow" will act as a mission design service for satellite constellations while the "SPHERE Safe" will enable and on-demand use of active satellite hardware as well as other. Morpheus Space is among the latest propulsion-system companies opting to diversify their business lines and adopt an "as-a-service" approach.

Seraphim Space release their Q32021 Venture Capital index report

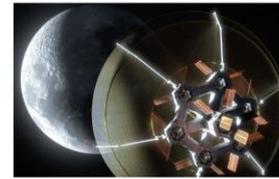


Seraphim Space **released their Q32021 Venture Capital index report** containing information on global investment trends in space companies. The report finds that approx. \$1 billion has been invested in space companies in the last quarter (76 deals). In this regard, Seraphim observes a decrease both in the number of deals and the total volume of capital invested as compared to Q2 2021, which represented an all-time record quarter. European companies ranked highest in terms of average deal size in Q32021, with the top 3 deals going to OneWeb, Isar Aerospace, and Astrocast.



U.S. national organisations release the State of the Space Industrial base 2021 report

On November 18, a group of U.S. national security space organisations released the “**State of the Space Industrial Base 2021**” report summarizing discussions between more than 250 experts from government, industry, and academia. The report was drafted by officials from the U.S. Space Force, the Air Force Research Laboratory, and the Defense Innovation Unit. The report outlined the position of the U.S. space sector as “tactically strong”, but also indicated that the US is lacking long-term foresight and investment. The report indicated that the DoD and intelligence community should support the space industry by purchasing commercial services in the space sector, rather than developing systems in-house. The report also noted that there is significant investment in the launch industry, but little investment in other sectors such as in-space logistics and manufacturing, which are essential in the long-term. NASA endorsed the report.



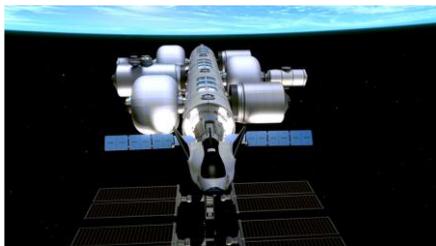
STATE OF THE SPACE INDUSTRIAL BASE 2021
Infrastructure & Services for Economic Growth & National Security
Executive Report by:
J. OLSON, S. BUTOW, E. FELT, T. COOLEY, & J. MOZER
Special thanks go to: Frank, William, Christopher, Daniel, Jay, Steve, Andrew, & Anthony
Edited by:
PETER GARRETSON
November 2021

Credit: Peter Garretson

November sees boom in mega funding rounds

Private investment in space companies continued its upward trend in November with multiple mega funding rounds surpassing \$100 million.

Sierra Space raises \$1.4 billion in Series A funding round



Credit: Sierra Space

On November 19, **Sierra Space raised \$1.4 billion** in its Series A funding round. The new capital injection not only represents the biggest single funding round of 2021 but is also considered to be the second largest private capital raise of all time for a space company. The new funding round was led by General Atlantic, Coatue, and Moore Strategic Ventures and included the participation of various funds managed by BlackRock Private Equity Partners. Sierra Space aims to use the funding to

accelerate the development of its “Dream Chaser” reusable Spaceplane and its expandable Commercial Space Station, dubbed “LIFE”. The Dream Chaser is part of a family of vehicles projected by the company for cargo, crew, and national security applications. Sierra Space signed a multibillion-dollar contract with NASA in 2017 to perform cargo resupply missions to the ISS with the Spaceplane, with the first mission scheduled to take place in 2022. The LIFE habitat is projected to be a modular station in LEO and, together with Dream Chaser, is a critical component for Blue Origin’s planned Orbital Reef space station.

HawkEye 360 closes \$145 million Series D round

The Virginia-based company HawkEye 360 **raised \$145 million in a Series D round** on November 8. The investment was led by Seraphim Space Investment Trust and the New York-based firm insights Partners. The company plans to use the funding to grow its data and analytical services product line, in particular by expanding its satellite constellation to accelerate the expansion of its services to customers. The capital infusion strengthens HawkEye’s leadership position in the commercial Radio Frequency geointelligence market and brings its total funding raised to approx. \$302 million.

Loft Orbital raises \$113 million following private placement

Loft Orbital received a **new capital injection valued at approx. \$113 million**, according to its latest SEC filing. The company, which offers a set of launch services through a Satellite-as-a-service approach, recently carried 10 payloads for customers as part of SpaceX’s rideshare-2 mission. While it has not released further information on the private placement, the company is purportedly **being valued at \$550 million** by Blackrock.



Mynaric completes IPO on the NASDAQ and becomes a dual-listed company

Germany-based Mynaric has raised approx. \$75 million following its **listing on the Nasdaq stock exchange** November 12. This represents the company's second listing on a public market, following its first IPO on the Frankfurt stock exchange market in 2017. Mynaric stated that its decision to list on the NASDAQ was made to increase its access to capital as it accelerates the roll-out of its solution for a customer base which is increasingly established in the U.S. The firm specialises in the design and manufacture of advanced laser-based communications technologies for linking ground-based systems to satellites. The company serves both government and commercial markets. The company currently offers technologies for inter-satellite communications, as well as airplane operation optical communications and has raised at least \$137 million in equity investment since its establishment in 2009.



Credit: Mynaric

In other news

Virgin Galactic resumes ticket sales and adds 100 customers: The firm re-opened its ticket sales for flights on its suborbital vehicles in August 2021 and has announced that approximately 100 tickets had been sold for \$450,000 each. The sale brings the total number of customers having booked suborbital flights with Virgin Galactic to about 700. The company aims to have 1000 customers by the time it begins its commercial service in late 2022.

Astroscale raises \$109 million Series F: The Japanese start-up became the fourth space company to raise over \$100 million this month following the closing of its Series F funding round. The round saw the participation of investment firms such as THE FUND and Seraphim Space and brings the company's total funding to over \$300 million. Astroscale aims to use the additional capital to advance the range of missions developed by the company globally.

CONTEC diversifies its business portfolio and signs contract with NanoAvionics for EO satellite: The Seoul-based ground station services provider has signed a contract with NanoAvionics for an EO satellite to launch in late 2023. The deal is part of the startup's effort to diversify its business portfolio prior to its 2022 Series C funding round, with the company's long-term goal being to develop satellite production capacities on its own.

Special Purpose Acquisition Company "C5 Acquisition" files for \$250 million IPO targeting space: The SPAC was formed by C5 capital and aims to complete a merger with a company in the sector of space, cybersecurity, or the environmental transition. The company is co-led by former Blue Origin CFO David Glickman and plans to list on the New York Stock Exchange.

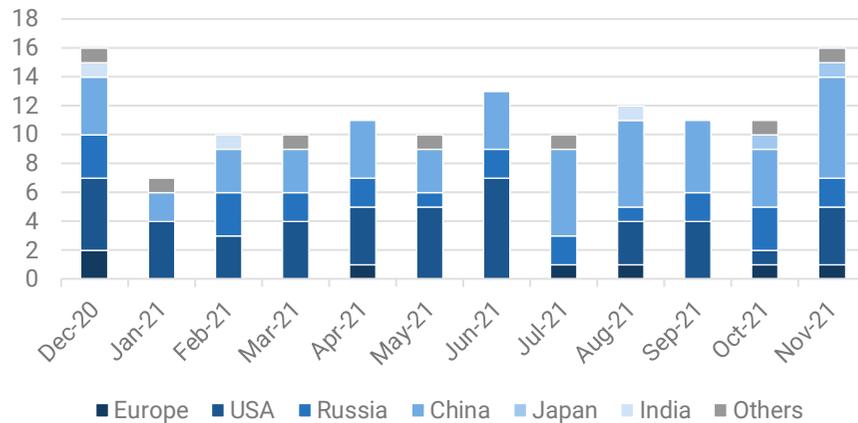


LAUNCHES & SATELLITES

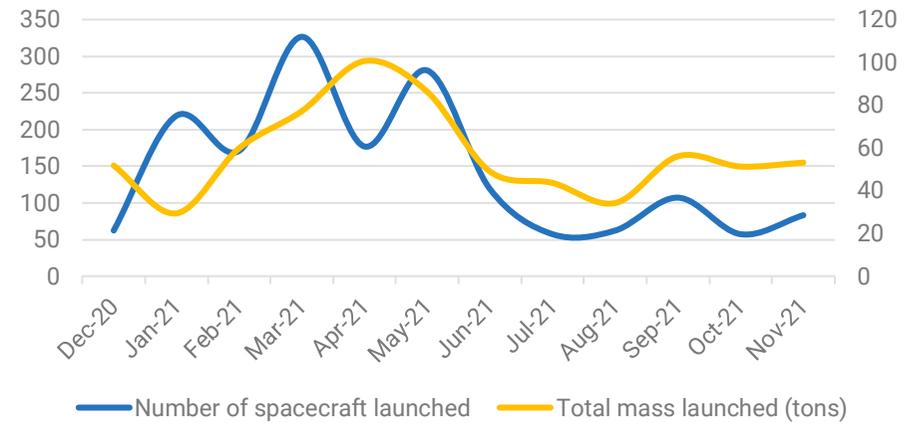
Global space activity statistics

November 2021	Europe	USA	Russia	China	Japan	Others	Total
Number of launches	1	4	2	7	1	1	16
Number of spacecrafts launched	3	57	2	10	9	2	83
Mass launched (in kg)	1338	26 369	9680	15 328	337	112	53 164

Launch activity over the year



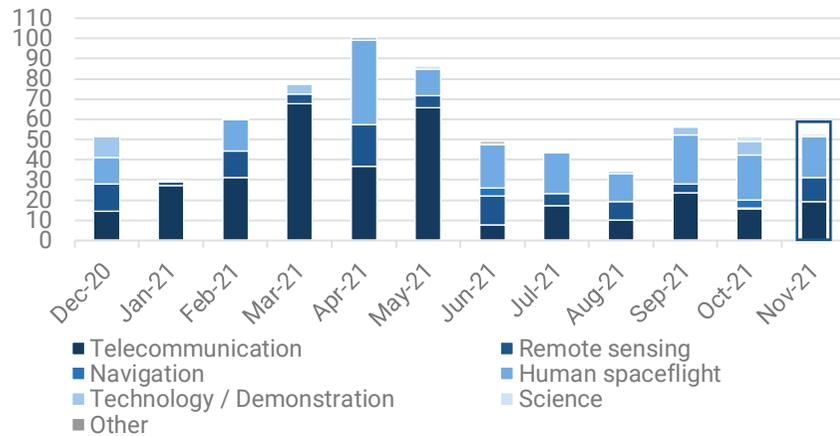
Evolution of the number of launches per launch country



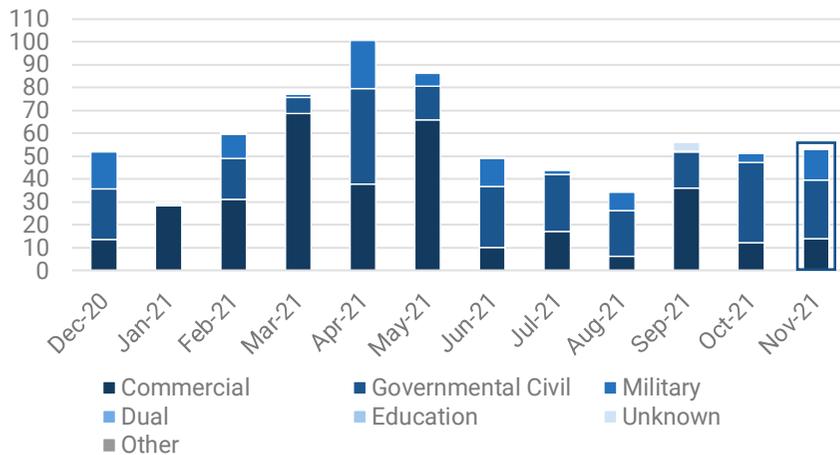
Evolution of launch activity over the year 2020-2021



Satellite missions and markets



Evolution of the total mass launched (tons) per mission (Dec. 2020-Nov. 2021)



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

November 2021	Telecom	Remote sensing	Human Spaceflight	Technology/ Demonstration	Science	Other
Europe		1338			14	
USA	13 780	112	12 055		500	20
Russia		1500	8180			
China	5320	9005		250	753	
Japan				326	7	
Others				4		

Total mass (kg) launched by mission and customer country

November 2021	Commercial	Governmental Civil	Military	Unknown
Europe		14	1338	
USA	13 892	12 555	20	
Russia		8180	1500	
China		4508	10 570	250
Japan	108	225		
Others		4		

Total mass (kg) launched by market and customer country



Launches & Satellites

Launch Log

Launch date	Launch country	Launcher	Spacecraft name	Main customer	Customer country	Prime manufacturer	Manufacturer country	Mass (kg)	Mission	Market
03/11/2021	China	CZ-2C(3)/YZ-1S	Yaogan 32-02 (-01 & -02)	PLA	China	CAST	China	1500 (each)	Signal Intelligence	Military
05/11/2021	China	CZ-6	Guangmu 1 / CASEarth	CAS	China	CAS	China	753	Earth Science	Gov. Civil
06/11/2021	China	CZ-2D(2)	Yaogan 35 (A & B)	PLA	China	DFH Satellite Co.	China	750 (each)	Earth Observation	Military
			Yaogan 35C	PLA	China	SAST	China	750	Earth Observation	Military
09/11/2021	Japan	Epsilon-2 CLPS	ARICA	Aoyama Gakuin University	Japan	Aoyama Gakuin University	Japan	1	Tech / Demo	Gov. Civil
			ASTERISC	Chiba Institute of Technology	Japan	Chiba Institute of Technology	Japan	4	Space Science	Gov. Civil
			DRUMS	Kawasaki Heavy Industries	Japan	Kawasaki Heavy Industries	Japan	62	Tech / Demo	Commercial
			Hibari	Tokyo Institute of Technology	Japan	Tokyo Institute of Technology	Japan	55	Tech / Demo	Gov. Civil
			KOSEN 1	Kochi National College of Technology	Japan	Kochi National College of Technology	Japan	3	Astronomy	Gov. Civil
			NanoDragon	Vietnam National Space Center	Vietnam	Vietnam National Space Center	Vietnam	4	Tech / Demo	Gov. Civil
			RAISE 2	JAXA	Japan	Mitsubishi Electric	Japan	110	Tech / Demo	Gov. Civil
			TeikyoSat 4	Teikyo University	Japan	Teikyo University	Japan	52	Tech / Demo	Gov. Civil
			Z-Sat	Mitsubishi Heavy Industries	Japan	Mitsubishi Heavy Industries	Japan	46	Tech / Demo	Commercial
11/11/2021	USA	Falcon-9 v1.2 (Block 5)	Crew Dragon USCV-3	NASA	USA	SpaceX	USA	12055	Crew Transfer	Gov. Civil
13/11/2021	USA	Falcon-9 v1.2 (Block 5)	Starlink (53 satellites)	SpaceX	USA	SpaceX	USA	260,00	Telecommunication	Commercial
16/11/2021	France	Vega	CERES (1, 2 & 3)	DGA	France	Airbus	France	446 (each)	Signal Intelligence	Military
18/11/2021	New Zealand	Electron KS	BlackSky (10 & 11)	BlackSky Global	USA	LeoStella	USA	56 (each)	Earth Observation	Commercial
20/11/2021	USA	Astra Rocket-3	STP27-AD2	US Space Force	USA	US Space Force	USA	20	Other	Military
20/11/2021	China	CZ-4B	Gaofen 11-03	CNSA	China	CAST	China	805	Earth Observation	Gov. Civil
22/11/2021	China	CZ-4C	Gaofen 3-02	CNSA	China	CAST	China	2950	Earth Observation	Gov. Civil
24/11/2021	Russia	Soyuz-2-1b	UM / Prichal	Roscosmos	Russia	RKK Energia	Russia	8180	Space Station Infrastructure	Gov. Civil
24/11/2021	China	Kuaizhou-1A	Shiyan 11	Unknown	China	CAST	China	250	Tech / Demo	Unknown

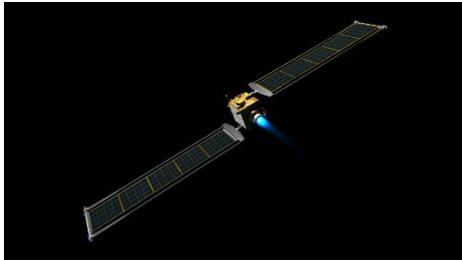


Launches & Satellites

24/11/2021	USA	Falcon-9 v1.2 (Block 5)	DART LICIACube	NASA ASI	USA Italy	NASA Argotec	USA Italy	500 14	Planetary Science Planetary Science	Gov. Civil Gov. Civil
25/11/2021	Russia	Soyuz-2-1b Fregat	Kosmos 2552	Russian Aerospace Forces	Russia	RKK Energia	Russia	1500	Early Warning	Military
26/11/2021	China	CZ-3B/G3	ZhongXing 01D/FengHuo 02D	PLA	China	CAST	China	5320	Telecommunication	Military



Launch Highlights



Credit: NASA

NASA launches first planetary defence mission

On November 24th, NASA launched the **Double Asteroid Redirection Test (DART)** mission onboard a Falcon 9. The objective of the mission will be to impact the moonlet of the Didymos asteroid to measure the deflection that it will create on the trajectory of the space object. The mission will allow to assess if such a technique would be efficient should an asteroid threaten Earth in the future. DART is accompanied by

LICIACube, an ASI contribution built by Argotec, which will take images of the crash. Although the deflection will be measured by terrestrial telescopes, an ESA mission (Hera) is set to launch in November 2024 and to head towards the same asteroid to collect more details on the exact consequences of the DART mission.

Russia launches a new ISS module

On November 24th, Russia launched **a new module** to the ISS, called Prichal, which will provide a new connection for future crew and cargo spacecraft. The module was launched with a modified Progress spacecraft and docked to the Nauka module, which was launched in July after several years of delay. Prichal was the final planned piece of the Russian segment of the space station, which led Dmitry Rogozin, head of Roscosmos, to state that “the formation of the Russian segment of the International Space Station has been completed”.



Credit: Roscosmos



Credit: Wikipedia

France launches three new military SIGINT satellites

After having launched a military telecommunications satellite in October, France sent to orbit **three new military satellites** with a Vega launcher on November 16th. This constellation, called CERES, will perform signal intelligence missions. They are the first operational spacecraft conducting this mission for France, after the launch of several demonstrators in the past decades (Cerise, Clementine, Essaim, Elisa). This is also the first European system able to detect radars and communication means from space. To reach this objective, they will fly in formation (triangle) in order to geolocate the source of the signals.

Fifth launch of an Epsilon rocket

On November 9th, JAXA sent nine small satellites to orbit with **an Epsilon rocket**. It was the first launch of this type of launcher since January 2019 and only its fifth launch altogether (since 2013). So far, the rocket has a 100% success rate. The next Epsilon launch is expected for 2022 or early 2023. Most of the satellites launched in November will conduct technology or demonstration missions for various Japanese institutions but there is also one payload that was built by the Vietnamese National Space Center.

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