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The dual side of the force



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Paola Van Troostenberghe



Paola is the head of CNES's technical skills, coordination and policy office. Spacecraft attitude, orbits and space mission tasking

hold no secrets for her. The expertise acquired since the Telecom2 satellites through to the Pleiades Earth-observation missions is today irrigating military missions like CSO and YODA. She firmly believes that space engineering expertise benefits both the civil and military spheres, and shares her experience in spaceflight dynamics with us in this issue.

Laurent Francillout



From 2011, as flight director for the ATV resupply spacecraft,

Laurent Francillout became familiar with in-orbit service activities for crewed missions. Today, as head of CNES's space surveillance and control sub-directorate, he works day to day with partners like Space Command and the French defence procurement agency. The number of satellites and the amount of orbital debris continues to grow, and space is becoming increasingly adversarial. An active defence posture is therefore crucial to safeguard our vital space assets.

Jean-Youri Marty



A gualified armaments engineer (IGA), Jean-Youri Marty has focused mostly on defence and European cooperation during his 30-year career serving the nation. As the head of CNES's security and defence sub-directorate since 2019, he's now working to promote dual-use space activities. His aim is to pool skills and resources to give civil and military users the best possible solutions. And for that, identifying and leveraging synergies is the watchword, and the very essence of dual use.

Philippe Steininger



A former general and fighter pilot with a long military career to his credit, Philippe Steininger is the very embodiment of the dual-use concept at CNES. As military advisor to the agency's Chairman & CEO since 2018, he firmly believes that dual use is integral to space affairs and a factor of efficiency, and advocates making it a central component of our space policy. His contribution to this issue of CNESMAG illustrates the strong ties that CNES has forged with the defence community.



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CNES







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<u>Horizons</u>



"Strength in dual use"

Marie-Claude Salomé Director of communication

_____CNES has constantly sought to serve science and defence since its inception in 1961. And at a time when conflicts here on Earth are increasingly playing out in space, this distinctive French trait is proving a strategic advantage. Indeed, what could be more "dual use" than a European launcher lifting off from the Guiana Space Centre to send the CSO-3 military satellite into orbit this March? To achieve such results—as they have been doing for more than 60 years now—our teams develop cross-disciplinary expertise for civil and military Earth-observation satellites alike.

And this same expertise is being shared with key partners like French Space Command, which took up residency at our Toulouse Space Centre in 2020. This dual-use vision is a strength that enables a pooling of resources to secure results across a broad sphere while staying within budget.

CNESMAG invites you in this issue to discover the dual side of the force serving France's strategic independence in space.

I hope you enjoy reading the magazine.

PARTNERS

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Tricolour over Toulouse

_ Two and a half years ago, in September 2022, the Alphajets of the Patrouille de France performed a flypast to welcome French Space Command (CDE) to CNES's field centre in Toulouse. Featuring in the first row are General Philippe Adam, Chief of Space Command, Colonel Sébastien Fonlupt, head of military unit 101 at Space Command, and Vincent Toumazou, CDE project leader at CNES.





A civil launcher for the military

_____ This picture of CSO-3, a jewel of technology serving the defence community, under the fairing of Europe's flagship Ariane 6 launcher, symbolizes the strength of CNES's dual-use model. Placed into orbit on 6 March 2025, this third satellite in the CSO series is the culmination of an optical Earth-observation programme delegated to the agency, working in partnership with the French defence procurement agency DGA and French Space Command.

<u> Vision</u>



The power of pictures

Image quality teams are tasked with refining a range of processing parameters—resolution, focal length, brightness, geo-location, micro-vibrations, etc.—to continuously improve imagery from the Pleiades dual-use Earth-observation satellites. Working with calibration images of specific points of interest, they detect flaws, make adjustments and cascade them down to operational processing lines in response to civil and military needs.

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View of Tucson, Arizona, from the Pleaides satellite.

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<u>Space take</u>



Kineis complete

On 18 March, an Electron launcher lifted off from Mahia launch base in New Zealand, carrying the last five Kineis nanosatellites into orbit. The French constellation dedicated to the Internet of Things (IoT) has now reached its final orbital configuration to offer global coverage and a mean revisit time of 15 minutes. Kineis is geared towards both civil and military needs, serving applications such as logistics, maritime surveillance (through processing of AIS signals), and equipment and troop tracking. CNES and its subsidiary CLS, the initiators of the project, have contributed their expertise every step of the way from development to satellite positioning, and today during the final phase transitioning to full operational capability. Our agency's teams in Toulouse performed orbital insertion and initial critical operations, before training Kineis operators and handing over to them. Kineis is a private operator and one of the flagships of French New Space.

Nurturing space vocations



At the Paris International Air Show, in the presence of the CNES Chairman & CEO and the Chief of Staff of the Air and Space Force, 12 space grants each worth €5,000 will be awarded by the Ailes de France Foundation to undergraduate and PhD students selected from a list of 50 candidates. These grants aim to help deserving students to accomplish their projects in the field of space. CNES has partnered this operation since its inception in 2021 and is this year funding four grants.

Full system capability with CSO-3

_ On 6 March, on its first commercial flight, Ariane 6 successfully orbited the CSO-3 satellite to complete France's optical Earth-observation constellation. Combining a high Earth orbit for reconnaissance missions and a low Earth orbit for identification, the CSO system (for Composante Spatiale Optique or optical space component) offers optimal revisit rates and resolution for military intelligence. The result of close cooperation between the French defence procurement agency DGA, CNES and French Space Command, CSO-3 also marks a successful dual-use operation employing a civil launcher for a military mission. CNES was assigned delegated oversight responsibility for this project, keeping track of development, conducting launch operations and positioning the satellite, and will remain in charge of operating and sustaining the system throughout its lifetime.



all set to map the globe in 3D

A joint effort of CNES and Airbus, the CO3D constellation will be launched end July from Kourou by a Vega-C vehicle. Composed of four 300-kilogram mini-satellites, by 2028 it will be generating a 3D model of the globe's land surfaces at an unprecedented cadence of 25 million sq.km a year. CO3D will serve both civil—urban planning, natural disaster and glacier monitoring, etc.—and military applications, for example to help plan missions in complex terrains. It will also offer quick and affordable access to 3D models of the planet from low Earth orbit, at a resolution of 50 centimetres.



CNES boosting space traffic management

Space traffic management (STM) covers a range of missions vital to assuring the safety of orbital missions, from avoiding conjunctions to anticipating atmospheric re-entries and coordinating complex operations. This year CNES is revamping its dedicated STM system, with the intention of incorporating innovative solutions from private players. The request for proposals for the STREAMS project (Space Traffic Evaluation And Management System) has been issued with a view to fielding the solutions in 2026.



Space working to stamp out illegal fishing in French Guiana

______ Illegal fishing has become a scourge in French Guiana, notably along its border with Brazil, where small wooden fishing boats in coastal waters are supplying larger vessels with fish. Alerted by the 9th RIMA naval infantry regiment, the Space for Guiana team at the Guiana Space Centre contributed CNES's expertise to identify space solutions employing radar and optical data and drones, as well as radiofrequency signals from Unseenlabs and identification transmitters from Kineis, two start-ups supported by the agency's Connect by CNES initiative. The aim is to give authorities the means to take action at sea to resolve this major social issue with space technologies.

Cosmoculture

The Cold War through the moviemaker's lens

From science fiction and historical drama to thrillers and comedies, space exploration has long inspired filmmakers and captured the popular imagination. During the Cold War, this fascination extended naturally into the realm of space, offering rich material for storytelling and captivating audiences worldwide.



______ Star Wars, Space Cowboys, You Only Live Twice, Space Force, For All Mankind—

these film and TV productions all share one thing in common: a narrative based around rivalry between nations in space. In the aftermath of World War II, the United States and the USSR entered a space race, driven by their broader arms race and geopolitical rivalry. At the same time, the world of sci-fi movies experienced remarkable growth. Many films metaphorically depicted the struggle between two models of society: democracy and the "dark side" embodied by totalitarianism. This Cold War climate was fuel for the screenwriter's creativity.

Space as dramatic theatre

You Only Live Twice was released in 1967. In this thriller, set at the height of the Cold War, Lewis Gilbert dispatches 007 to Japan to investigate the mysterious disappearance of American and Soviet spacecraft. Each side accuses the other of having hijacked the rival's space capsule in orbit. With the help of Japan's secret services, Bond uncovers a plot orchestrated by a criminal organization to provoke a nuclear war between the superpowers.

Ten years later, Star Wars: A New Hope, the first instalment of George Lucas's saga, was released in cinemas. The story takes place "A long time ago, in a galaxy far, far away...", where humans coexist with alien communities. It follows the coming-of-age journey of Luke, a young farmer, who's unwittingly drawn into a fierce war between the rebels fighting for freedom and the advance of the evil Galactic Empire. In For All Mankind (2019), Ronald D. Moore rewrites the history of the space race. What would have happened if the Russians had been the first to set foot on the Moon? This alternatehistory and geopolitical series blends fiction and historic fact to better reflect on our own time Another adventure film about the space race is Space Cowboys (2000). Clint Eastwood entrusts a group of four retired U.S. Air Force test pilots with repairing a Soviet communications satellite left over from the Cold War, on a collision course for Earth.





A funny kind of cosmic conflict

The space war has also taken a comedic turn. Space Force immerses us in a satirical drama. This series grounded in reality parodies the creation of the U.S. Space Force announced by Donald Trump in 2019, a modern-day comedydrama in the style of Stanley Kubrick's Dr. Strangelove (1964). At a time of rising tensions in space, was cinema right in portraying space as a new stage for conflict?

Insights

Jean-Youri Marty, HEAD OF SECURITY & DEFENCE SUB-DIRECTORATE, CNES



Why has space become a new frontier for power projection?

The ability to design, build, launch and control a satellite in orbit shows a nation has advanced technology. Only a few can do it, which makes it a symbol of power. Space capabilities can also support military operations, giving those nations a real operational edge.

Does *Star Wars* offer a realistic portrayal of military conflict in space?

The idea that space would inevitably become an extension of Earth-based territorial disputes is entirely plausible. As soon as technological advances allow nations to exploit a new environment, they begin to assess its strategic potential. Space is no exception.

Do fictional portrayals of space shape how we think about the future?

While they're not our only influence, these narratives help shape the collective imagination that can inspire influential individuals. Someone fascinated by the images and ideas portrayed in science fiction—especially around humanity's place in the cosmos—might be inspired by this vision when building powerful companies.

L<u>eading light</u>

GENERAL PHILIPPE ADAM

Chief of French Space Command

"It's not about militarizing space, but protecting it."

As tensions mount in space, General Philippe Adam reviews the strategic issues at play in this new theatre of operations. Charting a course between diplomacy, deterrence and innovation, he advocates a model based on civil-military complementarity and cooperation between allies.



_____ What is Space Command's role in space diplomacy?

Space has long been seen as a haven of peace, free from the tensions on Earth. But that's no longer the case today. In response to this paradigm shift, our main mission is clear: to keep the peace. And that means assuring a credible deterrence posture, through concrete detection and action. France is among the first nations, along with the United States, to have stood up a dedicated space command. Most of the world's leading space powers have since followed suit with their own military services tasked with defending their interests in space. This new configuration enables us to combine the two sides of diplomacy, sending clear signals to those with hostile intent while building a coherent cooperation and defence framework with our allies.

_____ What are the main threats in the current geopolitical landscape?

The threats are multiple and are present on Earth and in space. I'm thinking of anti-satellite missiles like those fired by Russia in 2021, of jamming of communications and GNSS signals, as well as the increasing number of unfriendly assets in all orbits. Some of these are a special cause for concern, like "nesting doll" satellites or the "kid brother" of the Russian Luch Olymp satellite. More broadly, we're seeing more and more undeclared missions seeking to go undetected among the 13,000 active satellites currently in orbit.

How are Space Command and CNES working together to surveil and secure space?

We're working hand in hand. We're very complementary, with Space Command on the front line for operations and CNES as our technical partner and subject matter expert. And we both

"A satellite may be classed as military but also serve civil society."

stick to what we do best: we're not seeking to develop science and engineering skills that CNES already has, just as we don't expect CNES to start specializing in military operations. In practice, that means we have people working in integrated teams with CNES and our aim is that in the future we'll be able to replicate the know-how acquired at our own sites, but we'll continue to call on CNES where needed. We also complement one another in space surveillance, with CNES focusing on risks—like conjunction assessments and geomagnetic storms—and us on threats.

What makes this close relationship between Space Command and CNES so strategic?

Quite simply, the fact that space itself has become a strategic domain. But we also want to maintain an effective, pragmatic and agile partnership to enable us to develop concrete solutions at all levels, whether for operating existing assets, developing new systems or designing future technologies. And in that respect, being based at CNES's Toulouse Space Centre, close to such a rich space ecosystem, is a great advantage. It gives us a fast track to innovation and countless opportunities for discussion with space players big and small. For instance, the Toutatis project will orbit two small satellites capable of testing out manoeuvres in low Earth orbit. It's the result of joint efforts with

L<u>eading light</u>



2008 – 2010 Commander of Istres air base

2011-2013

Deputy Chief of Air and Ballistic Missile Defence Branch at NATO International Military Staff

2020-2022

Chief of Future Capabilities division of Joint Chiefs of Staff, in charge of planning procurement of future equipment

Since 1 July 2022

Chief of Space Command within Air and Space Force

"Dual use is central to the future of space."

Toulouse-based start-up USpace, MBDA and the French defence innovation agency AID, in which our LISA¹ space innovation laboratory has played a leading role. This is a concrete illustration of the synergies we're looking for.

_____ Do you see the dual-use model as the way forward for space?

Dual use is central to the future of space. Nearly everything these days is dual use. There will always be dedicated military satellites, of course, but our armed forces employ many civil assets. This dual-use model affords great flexibility in how resources are exploited. It also works both ways: for example, data from an observation satellite like CSO can serve in the event of a natural disaster. And dual use breeds opportunities. Today, so many new technologies are being developed so quickly that they're answering questions we haven't even asked ourselves yet. So it's up to us to maintain adopt a curious mindset.

Have you been inspired in any way by space, history or culture?

Space is everywhere, notably in popular culture, as reflected in the American movie industry. But my first inspirations go back to my childhood, with Méliès, Jules Verne and Hergé, who fired my imagination and that of so many others. When I joined the Air Force, I could easily see myself becoming an astronaut... I'd have liked to have been Yuri Gagarin or to be the first to set foot on Mars.

_____ Space has long been seen as an exclusively peaceful domain. Do we need to do more to raise people's awareness of its strategic import?

Yes, because while awareness is rising, much work remains. Space is still often perceived as an intangible given, whereas it in fact rests on delicate balances. For example, few people realize that services like GPS could one day be taken down. Competition in space could turn into confrontation, so it's vital to guarantee a clear and secure framework, not to militarize space but to be ready to protect it. Only then will it remain a common good, safe and accessible to all.

1. A unit of Space Command

Pointers



Space strengthening maritime surveillance

Maritime surveillance by the French Navy at sea has in the last 15 years been extended through space. Since 2021, CLS has been operating the Trimaran service for the Ministry of Armed Forces, combining optical and radar imagery, and detection of radiofrequency and AIS¹ signals. To further refine this surveillance, the next version of Trimaran is set to employ thermal infrared and hyperspectral data, and above all will provide a strong revisit and response capability. Meanwhile, the Kineis constellation will improve coverage of all the world's seas, even the most remote, through more frequent and precise collection of AIS signals.

1.Automatic Identification System, a tracking system that transmits position, heading, speed and other information to vessels in the vicinity

SSA

Space Situational Awareness

Dual-use capability for surveilling and understanding the space environment that encompasses tracking of objects in orbit, space weather and observation of near-Earth objects. This kind of information is vital to ensure the safety and long-term viability of activities in space.



Space Domain Awareness

Extension of SSA for military purposes: it entails not only observing space, but also analysing behaviours and anticipating intentions. SDA is one of Space Command's missions.



Extension of SSA for civil purposes: it entails coordinating, planning and synchronizing space traffic, and regulating it.



Member states have directed that the EU's civil space capabilities must be available for military applications. This dual-use dimension is present in all components of the European space programme, in Galileo with the secure Public Regulated Service (PRS), in IRIS² set to provide secure connectivity to governmental users, and in the EU's Space Surveillance and Tracking (SST) component. For Copernicus, dual use of the system is under discussion. This pooling of resources strengthens the 27 member states' defence industry base."



Jean-Youri Marty, HEAD OF CNES SECURITY AND DEFENCE SUB-DIRECTORATE

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<u> Planet CNES</u>

The dual-use vision

From the outset, CNES was structured around a single organization combining civil and military purposes. Spanning strategic cooperation with French Space Command to the conduct of the most sensitive operations, this dual-use vision permeates through to all of the agency's missions and strengthens France's sovereignty in the increasingly adversarial domain of space.

> Team at work at the COR COO network operations centre



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Dual use is the future

For more than 60 years now, CNES has embraced an affirmed dual-use approach in which civil and military needs are integral to the agency's strategy and how it operates.

_____CNES is something of an outlier in the world of space. Where many nations have kept their civil and military sectors separate, the French space agency embodies a dual-use model intended to serve both science and defence. "It's both a pragmatic and a political choice, as 95% of the observation, intelligence, surveillance and other technologies flown on satellites are dual-use by nature," notes Lionel Suchet, CNES's Interim Chairman & CEO.

The rationale of the dual-use model, reaffirmed in the 2019 national military space strategy, combines effectiveness with pooling of resources. In the 1980s, France decided to rely on CNES to develop its military space programmes rather than creating an independent service. This foundational decision still permeates the agency's organization today, mobilizing a single community of experts on civil and military projects, thus ensuring a smooth flow of skills. "A CNES engineer may be working on a flight computer for a science observation satellite in the morning before switching to a classified programme in the afternoon," explains Lionel Suchet.

Technical and strategic cooperation

Dual use is founded on reciprocity, meaning that CNES provides its expertise—developing and operating space programmes, and providing its infrastructures, space launch base and network of stations—to the French defence procurement agency DGA and Space Command (CDE). In return, the defence community ensures that CNES is closely involved in its space missions. "We want to be more than just a service provider," says Lionel Suchet. "The dual-use rationale supposes that we're an

Pl<u>anet CNES</u>



CSO-3 is launched atop Ariane 6 from the Guiana Space Centre.

integral part of the system." This partnership taps into a process of cross-fertilization, pooling skills and technologies acquired in the military domain for the benefit of civil projects. Certain technology building blocks developed or operated in a military context thus find applications in the civil sector and vice versa. Lionel Suchet also points to exchanges with DGA's aerospace engineering expertise centre near Toulouse. "This centre can rely on CNES for specific input in highly technical areas, but it could also be called upon in return to contribute to research projects not directly related to military requirements, to help us while at the same time expanding its range of skills."

An operational lever for sovereignty

The dual-use model has already proved its robustness on highly strategic programmes. The recent launch of the CSO-3 military observation satellite on Ariane 6's second flight called on the close coordination of CNES's four field centres: the Guiana Space Centre for launch operations; the Toulouse Space Centre for programme oversight and satellite operations, working with DGA and CDE; the Space Transportation Directorate (DTS) for the launcher ground segment and launch operations planning; and Head Office for the conduct of defence programmes with the Ministry of Armed Forces. The increasing militarization of space underlines more than ever the relevance of CNES's dual-use model, which enables it to do more while maintaining fast, high-quality and sovereign analysis, development and operational capabilities. "The current landscape is pushing us to do things faster with limited resources, and dual use makes that possible," remarks Lionel Suchet.

But the model is not set in stone and is also laying the groundwork for the future. CNES is thus closely involved in shaping the national space strategy through cross-disciplinary work groups where its dual expertise is playing a driving role. In a fast-changing space landscape, this well-established but adaptable model is vital to France's strategic independence.



YODA to surveil space from space

With its two manoeuvrable satellites able to play out different surveillance, tracking and action scenarios in space, the YODA demonstrator will test new capabilities in 2028 in the vicinity of geostationary orbit. It will also enable development of new concepts of operations while building Space Command's skills.



A strategic partnership with Space Command

In Toulouse, CNES is supporting the ramp-up of Space Command.

_____ Resulting from the military space strategy validated by President Macron, the inception of French Space Command (CDE) in 2019 marked a watershed, making space for the first time a theatre of operations in its own right. Now in the process of being deployed in Toulouse, at the heart of the national space ecosystem, it

1700 Number of participants who took part in France's 5th AsterX military space exercise organized by Space Grammend of the Toulous

Space Command at the Toulouse Space Centre in March 2025 (photo above).

naturally calls on the expertise of CNES, the government operator and gold standard in the domain of space systems. "Our role is to support CDE as it ramps up its operations, by helping to

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train its personnel and contributing our expertise," underlines Béatrice Deguine, head of the agency's orbital space system control sub-directorate. A little over five years later, this collaboration has materialized at CNES's field centre, where integrated CNES/CDE teams are conducting all military satellite operations. CDE's operators are being trained to task payloads, analyse spaceflight dynamics and inspect image quality, to be ready to operate future military systems like the YODA demonstrator, its operational version Egide and IRIS². "Moreover, being able to share the challenges facing CDE will fuel CNES's vision of its future civil and military missions. And of course we'll remain at CDE's side in the most sensitive situations," says Béatrice Dequine. In September, the delivery of CDE's facility and the arrival nearby of NATO's Centre of Excellence for space will mark a new milestone in the construction of a cohesive ecosystem open to international cooperation and cross-disciplinary applications.

AsterX, chapter V

In March, Space Command organized France's fifth AsterX military space exercise, involving 170 French and foreign civil and military participants at the Toulouse Space Centre. The objective of the exercise was to train CDE's units to face a simulated but realistic scenario of an attack in outer space. As for previous exercises, CNES's space surveillance, operations and spaceflight dynamics teams took an active part in building the scenario and the paths of the 4,000 simulated space objects. They subsequently helped to lead the exercise, joined by other CNES experts as participants.



Surveillance, alerting and preservation form trifecta for space's future

With space as a common good becoming increasingly adversarial and fragile, CNES is applying an approach that hinges on the three key missions of surveillance, alerting and preservation.

> Surveillance: in close coordination with Space Command (CDE), CNES keeps track of tens of thousands of objects in orbit on a daily basis. Through a network encompassing the GRAVES radar, TAROT telescopes, sensors operated by European partners and commercial sensors, it is constantly updating the national catalogue shared with CDE. This broad picture of the space environment is crucial in guaranteeing safety of civil and military missions.

> Alerting via CAESAR (Conjunction Analysis and Evaluation Service: Alerts and Recommendations). Deployed since 2013, this service assesses in-orbit collision risks every day. The minute a critical threshold is reached, operators are alerted and sent recommended manoeuvres. In 2023, more than 200 such alerts were handled. CAESAR is part of the EU SST¹ initiative, which aims to strengthen Europe's independence at a time when orbits are becoming increasingly crowded.

> Preservation: As the agency in charge of enforcing the French Space Operations Act (FSOA), CNES is committed to combating orbital debris through new end-of-life, de-orbiting and passivation solutions. With this in mind, it is notably leading Tech4SpaceCare, an innovation platform



accompanying start-ups, firms and research laboratories working to develop technologies and services designed to preserve the space environment. CNES is also a member of the Inter-Agency Space Debris Coordination Committee (IADC) and involved in defining international space sustainability standards.

1. EUropean Space Surveillance and Tracking.

Unique regulatory framework

The French Space Operations Act (FSOA) governs space launches and control of space objects, in order to guarantee the safety and sustainability of space activities for which France is responsible. As the government agency with technical expertise in this area. **CNES** assesses conformance of space operations and establishes FSOA regulations. The latest update in 2024 covers new space activities such as in-orbit services and constellations, and provides a stronger framework for space traffic management. This regulatory corpus is the only one of its kind in the world.

<u> Planet CNES</u>



Behind the scenes of space missions

From satellite radio links and orbit control to tasking and image quality, CNES marshals a vast range of skills to ensure space mission success.

Talking to space

To communicate effectively with a satellite, the first thing is to establish a reliable ground-to-space link. For this, CNES relies on a network of seven receiving and transmission stations on French territory or in strategic partner nations: in Aussaguel (outside Toulouse), Kourou (French Guiana), Hartebeesthoek (South Africa), Kiruna (Sweden), Inuvik (Canada), Punta Arenas (Chile) and soon Réunion (see Open Space p.36). These remotely managed stations uplink commands to satellites and receive data from them. Some are dedicated to sensitive missions. "This sovereign network gives us an independent space access capability that's precious not only for military missions, but also for science missions," says Marie-Anne Clair, CNES's Director of Technology & Digital. The network ensures a quick response for civil and military users.

Station choreography

A vital cog in the conduct of missions, the Network Operations Centre (COR) is charged with assigning stations to satellites. It plans communication slots, verifies that access requests don't clash and ensures that communication sessions go smoothly. The COR's experts are on hand 24/7 to keep a check on automatic operations processes, optimize the use of available stations and handle interfaces with mission centres. Alongside this task, they're also laying the groundwork for future missions and concepts of operations. Within the COR, the Orbit Computation Centre (COO) provides support to control centres and stations for orbit tracking, essential for antenna pointing.

Tandem approach

Mission centres are charged with tasking acquisitions in line with users' priorities. "For a project like Pleiades, for example, military users, scientists and civil clients can order imagery of an area of interest. Image acquisitions are then sequenced in accordance with the priority assigned to each request," explains Marie-Anne Clair.

Control centres, meanwhile, translate tasking reguests into telecommands and monitor the satellite's health. They uplink commands during slots assigned by the COR when a satellite is in range, keep track of data reception and verify their integrity. They also estimate and predict the satellite's trajectory, and compute manoeuvres required to maintain its orbit and handle collision risks with other space objects, debris or satellites.

For certain missions, all of these functions are combined within a single centre.

"Operations teams at control centres work extended hours, with several centres on duty. Through this organization, CNES ensures tight coordination of expertise and networking for both civil and dual-use missions," notes Marie-Anne Clair.

Key cross-disciplinary expertise

CNES also has an image expertise centre charged with continuously assessing and maintaining performance for image production processes, working with centres operated by contractors. The agency's teams handle 40 or so calibration images per month, adjusting and refining parameters such as spatial resolution, distortion, noise and focal length stability. These activities benefit civil and military users, and help to prepare future missions.

Certain missions, like Kineis or defence programmes, call on constellations of satellites flying in "swarms" or in "formation". This involves several satellites operating in a coordinated manner, in tightly controlled relative positions, to accomplish cross or synchronized observations. Command transmission and satellite synchronization require highly precise orbit control. Such operations call on cross-disciplinary skills shared between missions, thus assuring service continuity and robustness of space operations.

RECEPTION AND TRANSMISSION STATIONS to remotely control satellites and receive their data.



<u>Back to</u> th<u>e future</u>



Diamant – The crown "dual" of France's space adventure

As France's first space launcher. Diamant has symbolized for 60 years now the alliance of civil ambitions and military strategy.



1959

Inception of "Gemstones" strategic military programme (official name EBB, for Etudes Balistiques de Base or basic ballistic studies)

1961

Inception of CNES, which gradually takes charge of developing incremental

launcher variants for the Diamant programme 1965

Successful first flight of Diamant A orbits Asterix satellite.

1970

First flight of Diamant B. the first more powerful evolution of the rocket, from Kourou 1975

First flight of Diamant BP4, the second evolution End of Diamant programme

On 26 November 1965, at 3.47 p.m., the Diamant A rocket soared skywards from its launch base in Hammaguir, Algeria. A few minutes later, Asterix, an experimental capsule weighing 39 kilograms, was placed into low Earth orbit at an altitude of just over 500 kilometres. Two weeks before the first round of the direct French presidential election, this event received widespread media attention and took on a political dimension, reflecting France's sovereign ambition to control its technology and destiny. With this successful flight, France became the world's third space power, joining the Soviet Union and the United States. It was not only a great feat of engineering, but also the culmination of a prudent and patiently crafted strategy. "Diamant remains one of the finest illustrations of dual use," says space transportation expert Vincent Taponier. "This civil launcher demonstrated the reliability of technologies developed for deterrence purposes while assuring our independent space launch capability." Born out of the military's Gemstones (Pierres Précieuses) ballistic missile programme, Diamant was a civil opportunity that emerged from a military rationale, a welcome result of a strategic defence programme. In return, it confirmed the reliability of key technologies that would subsequently be employed in the strategic vectors of France's deterrence posture. This rationale founded on the principle of an independent capability constantly advocated by France has been a constant thread throughout the history of European launcher development. In orbiting CSO-3 on its first commercial flight, Ariane 6 embodies more than ever this fertile meeting of civil ambitions and strategic requirements.

Talking ethics



Jacques Arnould Science historian and theologian, CNES ethics officer

The sword and the lab bench

From the outset, space has been shaped by a dual alliance of civilian and military. No wonder then, that the line between the two can sometimes be blurred. As we look to the stars, the question isn't just how we explore space, but why.

Like twins, civil and military interests in space look so similar it raises an uncomfortable dilemma: can we ever really tell them apart? Yet we humans love to draw lines and impose order on the world through boundaries, hence the saying born of ancient earthly wisdom: "Good fences make good neighbours". But what kind of boundary can we draw when we're faced with two children from the same womb, so alike they resemble each other more than our own reflection in the mirror? It's a deeply human tendency: not just to divide, but also to rank. But what kind of hierarchy can we establish between them? Should we, as some cultures have done, imagine they have different fathers-one earthly, the other divine—as if we need a story to justify one as superior? Or worse, we provoke a conflict, forcing a rivalry so we might finally tell them apart. Our discomfort with twinship reminds us of the dual nature of space activities. Certainly, the goals, strategies, methods and ethics of the civilian and military domains differ significantly. But can we

ignore the fact that both stood watch at the cradle of astronautics? As the astrophysicist Roger-Maurice Bonnet once put it so memorably, space was born of "the sword and the lab bench". Can we ignore what they have in common, especially their reliance on data collection? When Clément Ader wrote in the late 19th century, "He who commands the skies will command the world," he wasn't speaking only to the military patrons funding his work.

It would be naïve to think space exploration could remain forever untouched by military interests. The worm was likely in the apple from the very first pencil strokes of its inventors. And the apple was far too tempting for the military not to take a bite. Whether civilian or military, political leaders, scientists or purveyors of imagery, all space players ultimately pursue the same goal: the advancement of knowledge and the acquisition of a certain maturity. And this pursuit is far from innocent. War may well be the original sin of space. But it's a sin without which, we must concede, space exploration might never have come of age.

It now seems nearly impossible to choose between the sword and the lab bench: space has bound them too tightly together. What we can choose, however, is how we use this mastery we've acquired. Space is just a means, a destination. The real question is: what are our goals?

C<u>onstellation</u>

MINISTRY OF ARMED FORCES

"There's no longer a clear line between civil and military applications"



"The French defence procurement agency DGA has relied on CNES since the very first space programmes for its engineering expertise and knowledge of the space environment," notes Eva Portier, who contributed to this fertile partnership from 1999 onwards, after graduating as an armaments engineer (IGA) from the Ecole Polytechnique and Ecole des Mines de Paris engineering schools. Her career in space began at Astrium, before she joined DGA to work on the Syracuse programme. In 2002, she was appointed space advisor to Claudie Haigneré, Minister for Research and New Technologies. "I went through the complications with Galileo, launchers and satellites alongside CNES," she recalls. On 6 March 2025, the launch of the CSO-3 military observation

satellite rekindled memories of her involvement in developing the CSO series. "It's one of the great team successes associating CNES, DGA, our armed forces and the French industry base." After a brief stint in the Prime Minister's office as advisor for space affairs, she returned to DGA in 2010, taking on the role of director of intelligence systems and the MUSIS-CSO programme to develop an observation system designed to step up the military's strategic surveillance of Earth. Her portfolio of responsibilities covered CSO, Helios and the CERES signals intelligence satellites, as well as the associated demonstrators and ground segments. In 2016, she became defence systems architect, before being appointed DGA Deputy, Space. Since 2023, she has been coordinating the space actions and strategy of the Ministry of Armed Forces, both internally and with other ministries, as well as interacting with the French aerospace research centre ONERA¹ and CNES. "We establish common roadmaps in certain dual-use domains to ensure we work effectively together and benefit from one another's expertise." Because civil programmes have become strategic for the military too. "Today, it's a continuum, there's no longer a clear line between civil and military applications," explains Eva Portier. In today's shifting and uncertain geopolitical landscape, how do we reorganize our space capabilities in the New Space era to address military and space requirements? "This historic embodiment of dual use is specific to France. The collaboration between DGA and CNES must be allowed to flourish, pursuing our constant dialogue towards shared goals serving France's policy ambitions."

1. Office national d'études et de recherches aérospatiales.



LOOK UP SPACE

"Our mission is to develop a 360° sovereign solution spanning observation to action"

Juan Carlos Dolado Pérez

Co-founder and Chief Technology Officer of Look Up Space

"When I was at CNES, 90% of the data we were using to handle conjunctions between several hundred orbiting satellites came from the United States," recalls Juan Carlos Dolado Pérez, former head of the agency's space surveillance department. To correct this lack of French and European strategic independence, in 2022 he co-founded Look Up Space with General Michel Friedling, former chief of French Space Command, which specializes in surveillance and safety of civil and military space operations. "Our mission is to develop a 360° sovereign solution spanning observation to action." A radar network keeps permanent track of objects in orbit, while a multi-source digital platform provides capacity to process collected data. The firm's first sensor was developed in under two years. Based in Lozère, Southern France, it is set to enter service this summer. The start-up, a spin-off from CNES, is also receiving funding through the space strand of the government's France 2030 investment plan. "CNES is helping us to develop our systems with its expertise. Its critical yet encouraging eye at each step of our projects is key for us," says Juan Carlos Dolado Pérez. The French-Spanish engineer has a long association with CNES. Freshly graduated from the ISAE-Supaero

engineering school, he did an internship with the agency's orbital manoeuvres department in 2008. He was subsequently hired to work in the universe exploration department and two years later joined the orbit determination team. From 2010 to 2022, he managed the space surveillance teams. "There were two of us when I started and 50 by the time I left CNES," he notes to illustrate the growing awareness of the constraints induced by satellite conjunctions, a strategic issue affecting the conduct of operational military missions. At CNES, Juan Carlos Dolado Pérez worked on missile testing in Biscarrosse, Southwest France, and on submarines. And on board the Navy's Monge vessel, he orchestrated a campaign to calibrate space surveillance radars. He also worked with his military counterparts to onboard officers from Space Command in his department. "The challenge facing us is to meet both civil and military safety and sovereignty requirements, thus strengthening the ability of CNES and the Ministry of Armed Forces to carry out their missions more precisely, responsively and independently." A second radar is under construction in French Polynesia and five more sensors will be deployed in France's overseas territories.

C<u>onstellation</u>

HEMERIA

"This public-private partnership created the momentum for New Space in France"

Nicolas Multan

Hemeria CEO



Kourou, December 2019. The first French commercial nanosatellite, ANGELS, is about to lift off atop a Soyuz launcher. Nicolas Multan is keeping an eye on events from Toulouse, where his wife is set to give birth any minute. "My daughter was coming into the world and my other 'baby' was about to take flight. It was like another birth, the culmination of months of effort, only involving tens of people," recalls the CEO of Hemeria (formerly Nexeya). In 2017, his firm joined forces with CNES to fund and develop this precursor nanosatellite. Nicolas Multan was at that time head of the space division of Nexeya, a pioneer in the nanosatellite market. During a meeting with CNES's executive team, "a kind of chemistry" quickly became apparent and a novel way of working was thrashed

out. Eight of the agency's experts joined the firm's teams, combining its technological excellence with Hemeria's profit-driven ethos. "This industrial rationale, where choices are dictated by cost, enabled it to rethink its development process." To build ANGELS, Hemeria turned to regional subcontractors. "This public-private partnership created the momentum for New Space in France and provided the foundation for the entire nanosat sector," says Nicolas Multan with satisfaction. In nearly 10 years now, the partnership has been extended. In 2020, CNES began work on YODA, a patrolling satellite tasked with monitoring the French Syracuse and Athena-Fidus military satellites. The Ministry of Armed Forces and CNES entrusted Hemeria with YODA's development and followed suit in the autumn of 2024 with the BalMan manoeuvring balloon that will serve both scientists for Earth observation and meteorology and military surveillance. Once again, space technologies with a dual use... "They're always closely tied, because whether we're talking about military or civil applications, the constraints of the space environment are the same." In March 2025, following in ANGELS' footsteps, the last five nanosatellites of the Kineis constellation were sent into orbit by an Electron launcher. Conceived under CNES's wing and built by Hemeria, this fleet of 25 microsatellites will acquire and transmit strategic data from all over the globe in near-real time-a useful innovation for armed forces' operational requirements and for environmental monitoring. "Pooling costs, development lead times and certain challenges enables us to move towards making military space cheaper and more agile, while making civil space more robust."



DEFENCE INNOVATION AGENCY AID

"We can imagine all kinds of dual-use applications at low levels of technology readiness"

Patrick Aufort

Head of French defence innovation agency AID

__ "Apart from nuclear deterrence,

electronic warfare to a small extent and stealth technologies, all the rest are dual-use technologies," points out armaments engineer (IGA) Patrick Aufort, at the helm of France's defence innovation agency AID since March 2023. He has devoted his life to the defence of the nation, with aerospace as the backdrop. In 1994, he joined the French defence procurement agency DGA after his military service, working on the Rafale fighter's self-protection system, air surveillance and conduct of air operations, and the refurbishment of maritime patrol aircraft, before heading up the military expertise and test centres. He joined AID in the autumn of 2020 as deputy head, before becoming its director. "One of our agency's main missions is planning the major technology building blocks for our future weapons programmes," he explains. CNES is involved with this mission as the designer of imagery intelligence, signals intelligence and telecommunications satellites vital to the armed forces. AID also seeks out "emerging potential breakthrough technologies" from the civil sphere and tests them for military applications. "We

discuss a lot with CNES to detect emerging New Space players and help this ecosystem to thrive," says Patrick Aufort. Under the responsibility of DGA, the 191 programme feeds into CNES's efforts to develop dual-use solutions. "Every time we use these funds, it's for civil and military applications. For example, for foundational domains like radar imagery of the satellite-based Internet of Things (IoT)," he adds. The NESS project is another good illustration of this civil-military synergy. "The NESS satellites are designed to surveil the electromagnetic spectrum and detect any signals interfering with geolocation systems"-a dual-use space project of value to both civil aviation and the defence community. Yet another joint project is the Mobilex challenge focused on autonomous mobile land vehicles in complex environments. "We're looking to get rovers navigating through a field of operations, where CNES is looking at the same challenges for a lunar mission," notes Patrick Aufort. The terrain may differ, but the technical hurdles are similar. "We can imagine all kinds of dual-use applications at low levels of technological readiness. It's the environment we operate them in that changes."



Harnessing dual use

Ground-based systems and satellites have each embodied in their time the dual-use rationale embraced by CNES. ____ Dual use in space isn't just

about pooling resources; it also provides stakeholders with fertile ground for experimentation and technical progress, where innovation flows both ways. Free of the short-term-profit concerns that weigh on manufacturers, CNES has always been able to test, trial and

SPOT (1986-2014)

France's first military optical reconnaissance programme, Helios incorporated a number of features developed for SPOT, mainly in the image-processing chain and ground segment, while meeting the specific requirements of military intelligence.



A civil Earth-observation programme with agricultural, environmental and mapping applications, SPOT heralded the birth of optical satellite imagery in France. From the outset, it was designed with the aim of pooling technical and organizational resources with Helios.

Helios (1995–2012)

Myriade (2000-2020)



Designed to carry small payloads, the Myriade spacecraft bus is a reusable platform providing power, telecommunications and control for both scientific and military missions. perfect new methods, technologies and applications with a view to optimizing resources, while at the same time ensuring quality of service. This means that the technology building blocks developed for civil programmes also permeate through to defence applications, and vice versa. For instance, control moment gyroscopes (CMGs), like those first used on Pleiades, have since been employed on many other missions. The star tracker pioneered by Helios 1 is now operating on numerous civil satellites. More recently, the high-precision altimetry expertise acquired on SWOT is informing strategic thinking on surveillance of areas of military interest. This dual-use approach also ensures ongoing leverage, with each anomaly resolved, each technical workaround, each validated procedure and each well-honed training course benefiting both sides.

ANGELS (2019)

France's first commercial nanosatellite, Angels has adopted the Myriade family's spirit of standardization but in a more compact form. Cofunded by CNES and Hemeria, it marks the shift to a new generation of agile platforms for both civil and defence missions. Pleiades is a very-high-resolution civil observation system that has set new standards of agility, geometric precision and image quality. Designed for dual use from the outset, it features now-standard technologies such as CMGs and Hydra star trackers.

CSO (2018-)



Pleiades (2011–)

CSO is the military derivative of Pleiades and as such incorporates much of its avionics architecture, flight software and instrumentation. Several components, such as the GNSS LION navigation receiver and the imageprocessing chain, were developed with dual use in mind.

<u>Earth</u> attractions



Exclusive book series

_____ Produced by CNES's teams, Guidebook N°4

is devoted to the subject of defence. Filled with first-hand accounts and stunning colour photographs, this 27-page manual is designed to take you on a voyage of discovery, behind the scenes in the incredible world of space, flagship missions and CNES activities.

Published in both English and French, it will be available at the Paris Air Show from 16 to 22 June 2025!

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_____ The Privacy Kit equips you with five webcam covers, a USB data blocker and a CNES-themed RFID blocking card to protect your bank details.

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The new war of the skies

La ruée vers l'espace. Nouveaux enjeux géopolitiques (The Race for Space: New Geopolitical Stakes) was published by Tallandier in 2024. Written by civil and military space expert Xavier Pasco, also the head of independent French think-tank the Foundation for Strategic Research, the book takes an incisive look at the new forms of competition playing out in space. From New Space newcomers to the militarization of space and the privatization of this common good, what are the stakes of this new 'war of the skies'? $\notin 20,90$



Space revolutions through the wide lens

Philippe Steininger is military advisor to CNES's Chairman and CEO. In 2024, he published his work on *Révolutions spatiales, de von Braun à Elon Musk : la guerre des étoiles a déjà commencé* (Revolutions in Space, from Von Braun to Elon Musk: Star Wars Has Already Begun), in which he explains the space challenges of the 21st century and questions the notion of space powers. Should we take the prospect of military conflict in space seriously? If so, what form might it take? Who are the emerging New Space players? These are just some of the issues addressed in this book, published by L'Archipel. €22



Podcast

The January 2024 episode of the Mardis de l'Espace (Space Tuesdays) podcast looked at cybersecurity and space traffic challenges. Produced by CNES and hosted by science journalist Paul de Brem, the episode features interviews with two CNES experts: Laurent Francillout, head of the Space Surveillance Sub-directorate within the Orbital Systems and Applications Directorate; and Julien Airaud, cybersecurity specialist for Central Industrial Safety and Security at Head Office. The podcast is available on all platforms and on cnes.fr.

DIARY

JULY 2025: LAUNCH OF CO3D (p. 11)



LATE 2025:

BALMAN SECOND TEST FLIGHT Designed and manufactured by Hemeria with oversight from CNES, the BalMan balloon can fly over an area of interest at an altitude of several tens of kilometres. Equipped with a payload of up to 50 kilograms, this pioneering aerostat will have scientific applications in weather forecasting and monitoring of high-risk areas (fire outbreaks, volcanic eruptions, etc.), and serve as a telecommunications relay for the military.

<u>Open space</u>



The global multi-mission antenna network

To configure and task its satellites and collect their data, CNES relies on a network of antennas around the four corners of the globe.

ISSUS-AUSSAGUEL, TOULOUSE

A new-generation 5.5-metre antenna deployed in 2023 tracks satellites in low Earth orbit from the ground. The station's other 11-metre parabolic antenna is used to operate satellites as far out in space as geostationary orbit.

KIRUNA, SWEDEN / INUVIK, CANADA

These two 13-metre polar antennas, developed jointly, serve to operate Earth-observation satellites in low Earth orbit for imaging, signals intelligence, science and defence missions.

KOUROU, FRENCH GUIANA

The antenna here is an identical twin of the 11-metre antenna in Toulouse and is used for tracking all of CNES's institutional missions, like for example the orbiting of the armed forces' Syracuse IV communication satellites.

HARTEBEESTHOEK, SOUTH AFRICA

CNES can also call on this station's 11-metre antenna to support military and science missions, as well as for special operations like decommissioning a satellite at the end of its life.

PUNTA ARENAS -PATAGONIA, CHILE

In service since 2024, this 6.1-metre parabolic antenna is similar to the one at Issus-Aussaguel. CNES employs these antennas to orbit satellites, collect instrument data and decommission satellites in Iow Earth orbit.

NETWORK OPERATIONS CENTRE (COR), TOULOUSE

This multi-mission network is operated from the Network Operations Centre (COR), staffed by a 30-strong team of people in charge of maintenance and operations supporting defence, institutional and science missions. It is the network's "conductor", assigning stations to missions.

