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## From “Space for Defence” to “Defence of Space”

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# TABLE OF CONTENT

# 1 INTRODUCTION

## 1.1 Background and rationale

In 2014, 13.9% of the European institutional space budget was dedicated to military space activities[1]. This substantial share shows that space provides not only economic benefits but also has strategic value for core governmental missions. Indeed, since the First Gulf War in 1990-1991, military operations have increasingly relied on space applications, especially remote sensing, signal intelligence, telecommunications and positioning/navigation. The services that space applications provide constitute a major asset for independent diplomatic actions and military operations but their potential vulnerability is also a major concern given the pervasive dependence on them. Space infrastructures are thus becoming increasingly sensitive since an attack against them would strike a critical blow to the nations that rely on them.

The expanding use of space applications in the conduct of military operations on the ground is mirrored by new ways of operating in space that impact the relationship between civil and military actors: dual-use assets (which serve both civilian, including commercial, as well as security and defence needs) have become common place; military payloads are embedded onboard civil satellites; and some military forces extensively procure services and products from commercial operators, at least for non-sensitive operations. Similarly, to reinforce the resilience of critical space systems, new architecture designs are emerging. For instance, governments are now considering constellations of small dispersed satellites to avoid the concentration of capacity in a few powerful but vulnerable satellites as well as the development of responsive launch capabilities for the quick replenishment of failed assets.

In parallel, threats have multiplied. Beyond the unintentional hazards incurred by the growing congestion of key orbits and to debris, space assets have become potential targets in wartime scenarios. Outside Europe, all major space powers have invested in the elaboration of means to physically disrupt others' space capabilities. Several anti-satellite (ASAT) technologies have been developed and tested in actual conditions over the last few years, including China (2007), the United States (2008) and India (2019). Beyond "Kinetic kill", Rendezvous and Proximity Operations (RPO) technologies are another means of impairing spacecraft. There has been progress in research on directed-energy weapons. Cyber threats to space systems are also rapidly increasing, against ground installations, but against the space segment as well. Facing the multiplicity of such new threats will most likely not rely solely on technical countermeasures but could also include the elaboration of various strategies of deterrence and the establishment of political alliances. Attempts to agree internationally on some "rules of the game" for space operations could aid in complementing the current legal framework.

At the same time, the development of New Space (nanosatellites and small launchers) allows new players (states and other organisations) to get access to space capacities. If the proliferation of launch and CubeSat providers continues to develop, this could increase the risk of losing control on activities in orbit.

All these developments take place in an increasingly tense international context, motivating many nations to reconsider their postures and doctrines regarding space. A global trend resulting in the integration of space as a warfighting domain, comparable to land, sea and air, is emerging. The United States, Japan and France are renewing the place of space in their military organisation; some major powers are challenging the U.S. "space dominance" doctrine, seen as a "space supremacy" goal. Therefore, space increasingly appears as a field of political and technological rivalry that could become an arena of conflict.

[1] PwC (2016). *Socio-economic impacts from Space activities in the EU in 2015 and beyond*. This figure is based on a consolidated budget and includes ESA, EU, EUMETSAT and national space budgets.

Faced with all the measures that most of the major powers have already taken, Europe at large needs to position itself in this environment by embarking on a period of change marked by a stronger emphasis on the need to ensure the security of its current and future space assets.

Several European Member States have acknowledged the current evolution and have begun to investigate the burning issue of space defence. Most of them operate or rely on satellites for military purposes, mostly on a national basis, but also through various bilateral or multilateral agreements. They have openly begun to discuss and reflect on specific strategies to ensure the protection of their interests in space.

However, while the nation state is still the traditional and legitimate actor in defence-related affairs, the ongoing fast pace development of the role of the European Union in the space sector calls for further clarification on the ways and means to ensure the protection of EU space assets. Since the entry into force of the Treaty of Lisbon in 2009, the involvement of the European Union in defence has increased (e.g. through the Common Security and Defence Policy, the Permanent Structured Cooperation, the European Defence Fund…), including through the use of space. Combined with a political will to enhance the strategic autonomy of Europe, this has led the incoming European Commission to create a Directorate-General for Defence Industry and Space, thus reinforcing the connection and emphasizing the synergies between the two domains. The growing awareness of space defence at the European level is also a consequence of the implementation of the flagship programmes Galileo and Copernicus. Indeed, even if they are fully owned and operated as civil infrastructures, their defence-oriented applications are promoted by EU officials[2]. For instance, this applies to Galileo's Public Regulated Service (a secured service useful for sensitive applications that require secured encryption and high availability and reliability) and Copernicus security services, in particular the Service in Support to the EU External Action (SEA), which supports EU missions and operations abroad. Similarly, the European Union wants to enter the field of secured telecommunications with the GOVSATCOM initiative and to improve surveillance capabilities with the EU SST programme. Therefore, since shared assets serve strategic and military purposes, they have to be protected, which creates new stakes at EU level, in particular on the issue of the definition of a European vision and of the modalities of cooperation in the space defence domain.

Thus, the space field is currently undergoing major transformations. The multiplication of active threats, coupled with a change in the perception of space that is increasingly being seen as a warfighting domain, has encouraged member states to look into policies related to the use and protection of strategic space assets. In Europe, national stakes regarding military space are still high, although cooperation in the EU framework has lately become a major driver in the growth of European space operational capabilities. As a consequence, when reacting to international developments, European efforts need to be consistent and coordinated. Therefore, clarity in European plans and ambitions is required. To that end, the purpose of the present study is to contribute to a consensual understanding of the stakes in defence cooperation as well as to the identification of the issues to be tackled to streamline collaboration on sensitive matters at bilateral, multilateral or supranational levels while acknowledging the role of other organisations (notably NATO).

[2] See, for instance, the speech of Thierry Breton, Commissioner for Internal Market, at the 12th European Space Conference in January 2020: https://ec.europa.eu/commission/commissioners/2019-2024/breton/announcements/12th-annual-space-conference-closing-speech_en

## 1.2 Objectives

The first point of this study is to investigate how the changing global situation in space creates new stakes at European level (e.g. in terms of cooperation) and impacts or modifies the role played by the European Union by:

- Investigating current global trends in the space defence domain:
  - Highlighting the intertwining between space and defence
  - Analysing international stances on space defence activities
  - Underlining new capacity developments
- Providing an overview of the space defence landscape in Europe, including:
  - Current strategies, organisations and capabilities of European states
  - Existing and planned cooperation schemes for space defence in Europe
  - Defence-related mechanisms of the European Union and the place given to space within them
- Discussing rising stakes for European stakeholders and possible policy responses:
  - Putting in perspective military, political and industrial stakes
  - Identifying barriers and drivers to cooperation

## 1.3 Scope and methodology

There are two complementary and intertwining aspects underpinning the concept of Space Defence, namely “Defence of Space” and “Space for Defence”. The former emphasizes all means used by states to defend their space assets from space- or ground-based intentional threats whereas the latter stresses the use of space in support of terrestrial military operations (the so-called “militarization” of space), and its consequences (with space being considered as a “force multiplier” and even a “force enabler”). The key features of both dimensions can be synthesized as follows:

| Space for Defence |
| --- |
| • Encompasses various uses of space for military operations and missile defence (early warning) → often called "space support to operations" |
| • Accounts for the main functions of interest to the military: intelligence, surveillance and reconnaissance (which includes Earth observation, signal intelligence, early warning and meteorology); satellite communications; positioning, navigation and timing; space surveillance |
| **Defence of Space** |
| • Accounts for the fight against potential threats against space assets (kinetic, directed-energy, jamming, spoofing, cyber) and existing countermeasures |
| • Includes defence of the space-based, ground-based, down- and uplink segments when the asset is in operation |
| • Ensures protection of the service and/or the system |
| • Underlines the importance of space surveillance through space situational awareness |

*Table 1: The two dimensions of Space Defence*

More precisely, "Space for Defence" gathers the three main utilisations of space for military missions: Intelligence, Surveillance and Reconnaissance (ISR); Satellite Communications (SATCOMs); Positioning, Navigation and Timing (PNT).

- Intelligence, Surveillance and Reconnaissance is defined by the U.S. Department of Defense as "a capability for gathering data and information on an object or in an area of interest (AOI) on a persistent, event-driven, or scheduled basis using imagery, signals, and other collection methods"[3]. In the case of ISR performed through space, three subcategories can be identified:
  - *Earth observation*: These technologies enable the performance of reconnaissance missions, mainly through optical or radar means. This allows for better monitoring, tracking, targeting, and engaging adversarial forces, thus improving the efficiency of operations.
  - *Signal intelligence*: SIGINT aims at gathering intelligence through the interception of signals used for communications (COMINT) or other purposes (ELINT, electronic intelligence). For instance, it enables localisation of anti-aerial systems or radio activities of combat units[4].
  - *Early warning*: This consists of the detection of the launch of a ballistic missile thanks to the heat it produces. Initially planned for intercontinental ballistic missiles (ICBM), this function is also increasingly useful to detect the launch of short-range or tactical ballistic missiles, which is more relevant for soldiers during a conflict. Currently, very few countries possess a developed system of this kind (mainly the United States and Russia).
  - *Meteorology*: This application provides accurate and up to date information about weather and atmospheric conditions that may have consequences on operations. Given the current status of this activity in Europe, the report will not address it.
- Satellite communications are a core competence for military command and control, enabling the quick transmission of orders and critical intelligence, and enhancing the flexibility of modern armies. In this sense, SATCOMs ensure the superiority of space-equipped militaries as they provide communications even in remote areas, where no terrestrial network is available. Moreover, SATCOMs provide other services, such as the reception of information from the payloads of unmanned aerial systems (i.e. drones), and even their control when they fly beyond the line of sight.
- Positioning, Navigation and Timing systems are key facilitators of operations for the armed forces. By providing political and military decision-makers with an enhanced situational awareness, they facilitate the trigger of precise and synchronized operations. PNT is also necessary to launch precision-guided munitions, which can be used in all weather conditions, without support from the ground.
- Space surveillance, as a complement to air surveillance, is required for a military commander to plan its activity and operations knowing when its installations and forces can be observed by the enemy space assets.

On the other side, "Defence of Space" has also been conceptualized by the military, even if with another terminology. For instance, according to the U.S. Joint Publication 3-14 on Space Operations published in April 2018, space defence is a part of space control, called Defensive Space Control. In that sense, "DSC operations consist of all active and passive measures taken to protect friendly space capabilities from attack, interference, or unintentional hazards. DSC safeguards assets from unintentional hazards such as direct or indirect attack, space debris, radio frequency interference, and naturally occurring phenomenon

[3] Draft Broad Agency Announcement on a Time-Sensitive Target Mission Payloads Demonstration (TSTMPD) Solicitation Number: HQ0034-19-BAA-TSTMPD-0001.
[4] Satgé, Vincent (2019). "La France, un challenger majeur de l'espace militaire". Geostrategia. Retrieved from https://www.geostrategia.fr/la-france-un-challenger-majeur-de-lespace-militaire/

such as radiation. DSC measures can apply to defence of any segment of a space system—space, link, or ground"[5]. It can be divided in two categories:

- Active space defence: actions taken to neutralize imminent space control threats to friendly space forces and space capabilities
- Passive space defence: all measures (except active space defence measures) taken to minimize the effectiveness of on-orbit and terrestrial threats to friendly space forces and friendly space capabilities (e.g. camouflage, evasion, dispersal and hardening of space systems, redundancy)

Even if defence of space takes shape through several kinds of actions, they all rely on Space Situational Awareness, which is in turn based on space surveillance. This activity serves thus both "Space for Defence" and "Defence of Space" purposes. Indeed, by detecting and/or tracking objects in orbit, surveillance enables space systems to avoid space-based dangers and to pursue their mission of support to ground forces. As such, this function is crucial for the success of "Defence of Space" missions and forms the basis of military space operations.

To respond to questions raised by the rise of space defence issues, this report will address political (e.g. strategic postures), military (e.g. capabilities developed/to be developed, organisational dimension) and industrial aspects of the topic.

The research will consider the activities of public organisations, as well as the use of national security and dual-use spacecraft. Commercial satellites that are used for defence purposes may be mentioned but will not be studied in detail. European member states' programmes and policies will be studied individually (national level) and collectively (bilateral and multilateral intergovernmental level), including in the frame of NATO, which is a major interlocutor of European states in the field of defence. EU activities (supranational level) will also be considered to cover the full range of possible cooperation schemes. International policies outside Europe (other states and/or UN debates) will also be mentioned to set the stage but will not be at the core of the study. The European dimension will thus be predominant: it is understood as the sum of the individual states and the European Union, and its added-value lies in cooperation.

[5] U.S. Joint Chief of Staff (April 2018). *Joint Publication 3-14: Space Operations*. Retrieved from: https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_14.pdf

# 2 SPACE DEFENCE: A RISING ISSUE ON THE INTERNATIONAL STAGE

Space defence is a topic whose salience has been growing over the past decades, in particular due to the increasing reliance on space systems for the conduct of military operations. This reliance has developed in a context of exacerbated international tensions, including in space matters. As a consequence, space assets are gradually becoming potential targets, obviously in times of war, but also of peace (indeed, several states perform activities taking place in a grey zone), thus prompting states to reconsider their approach to space defence and military space. This evolving stance concretizes in political statements and in the development of counterspace capabilities. While the objective of these capabilities is mostly presented as defensive, by their inherent dual nature, they can be used to undertake actions against others' assets. The multiplication of these technologies paves the way to a new environment for space operations, more contested than before, which creates challenges for Europe.

## 2.1 A changing geopolitical context in space

The relevance of space for military operations, including in space, has been increasingly acknowledged by major space powers over the past decade, and the belief that the next major conflict will either begin in or extend to space has become widespread. Analysis has thus been conducted worldwide on the means to dominate the "ultimate high ground" and the associated need to protect space assets from adversaries and their anti-satellite weapons. At international level, discussions have been organised in various *fora* (Conference on Disarmament, United Nations General Assembly) to prevent an arms race in outer space. However, they have not produced concrete results for the time being because of the disagreement between states promoting the conclusion of a treaty to prevent the placement of weapons in outer space and the threat or use of force against space objects (PPWT), and those favouring the elaboration of non-legally binding norms of responsible behaviour. Therefore, military issues related to space have remained regulated by the 1967 Outer Space Treaty, which promotes peaceful endeavours in space but does not set a specific framework regarding its weaponisation, except the banishment of the placement of weapons of mass destruction in orbit and on celestial bodies.

In parallel, rising tensions and changes in the balance of power are reviving a new era of great power competition, crystallised in the space domain and deeply affecting the global space arena. Indeed, after having been the undisputed leader in space for decades, the United States is now witnessing the emergence of new rivals. Most of them are taking measures to support the strategic objective of being undefeated in space, which contributes to nurturing a general sense of mistrust. A closer look at non-European major space powers policies shows how their positions in these matters have become increasingly assertive over time.

### 2.1.1 The People's Republic of China (PRC)

China's rising interest in space defence is first evidenced by the doctrinal change that has taken place. In 2015, China's Military Strategy stated that "Outer space and cyber space have become new commanding heights in strategic competition among all parties"[6], thus considering space as a military domain. The same year, the defence of China's national interests in space was made legally binding by its inscription

[6] The State Council Information Office of the People's Republic of China (May 2015). *China's Military Strategy*. Retrieved from: http://eng.mod.gov.cn/Press/2015-05/26/content_4586805.htm

into China's National Security Law[7]. With these moves, the PRC exhibited its readiness to respond to threats against its assets even if it was still abiding by its declared vision of the use of space for peaceful purposes[8]. Finally, the 2019 Chinese Defence White Paper recognised space security as one of the eight vital strategic interests of China and reaffirmed that space was a critical domain in international strategic competition[9].

Secondly, **an organisational change at operational level occurred in December 2015 with the creation of the People's Liberation Army Strategic Support Force (PLA SSF)**, which became operational in January 2016. This new Force lies under the direct authority of the Central Military Commission and is independent from the other branches of the military, but is not a service like the Army, Navy, Air Force and Rocket Force. It gathers the units responsible for cyber, electronic warfare and space issues, conducts operations in these domains (including denial operations), and uses them in a combined manner to create military effects and support other Chinese forces. The Support Force's main goal in space is to develop the military space doctrine of China, including the counterspace doctrine[10], to enhance the military power of China and make the country better prepared than the United States to use space assets in wartime.

To this end, the dispersal of space forces was reduced and a Space Systems Department was established within the PLA SSF. It is responsible for PLA space operations, including:

- Space launch and support
- Telemetry, tracking and control
- Intelligence, surveillance and reconnaissance operations
- Space attack and defence[11] (however, the control of operationally deployed anti-satellite weapons may be left to the PLA Rocket Force[12]).

This Department enables China to benefit from a unified structure holding control over many space-based and space-related capabilities[13]. Thanks to these changes, according to Xi Jinping the PLA SSF will be "an important growth point for [China's] military's new-quality combat capabilities"[14].

**In terms of capabilities, China possesses most of the technologies needed to disrupt a space system, from lasers and cyber capabilities to missiles.** The latter have been used in several ASAT tests over the last decade: the first one, in 2007, triggered a huge controversy around the world because of the amount of debris produced. In the United States, it raised concern as it proved that China could become a serious challenger in the future. Other tests, not officially recognised as ASAT and sometimes described as "missile defence interceptor tests", took place between 2010 and 2018. Among them, a 2013 experiment demonstrated that China could likely reach the geosynchronous orbit, thus putting at risk U.S. early warning and telecommunications satellites[15]. Moreover, recent U.S. reports also warn that China is quickly

[7] Secure World Foundation (April 2019). *Global Counterspace Capabilities: An Open Source Assessment*. Retrieved from https://swfound.org/media/206400/swf_global_counterspace_april2019_web.pdf
[8] Atherton, Kelsey D. "Understanding the players, tactics for a possible war in space" (April 2018). C4ISR.net. Retrieved from https://www.c4isrnet.com/c2-comms/satellites/2018/04/17/understanding-the-players-tactics-for-a-possible-war-in-space/
[9] The State Council Information Office of the People's Republic of China. "China's National Defense in the New Era" (July 2019). Retrieved from: http://www.andrewerickson.com/2019/07/full-text-of-defense-white-paper-chinas-national-defense-in-the-new-era-english-chinese-versions/
[10] Davis, Malcolm. "China's space mission (part 1): dominating a contested domain" (April 2019). Australian Strategic Policy Institute. Retrieved from: https://www.aspistrategist.org.au/chinas-space-mission-part-1-dominating-a-contested-domain/
[11] U.S.-China Economic and Security Review Commission (November 2018). *2018 Annual Report* (Chapter 2). Retrieved from: https://www.uscc.gov/Annual_Reports/2018-annual-report
[12] Davis, Malcolm, *op. cit.*
[13] Kania, Elsa B (September 2018). "China has a "Space Force". What are its lessons for the Pentagon?": Defense One. Retrieved from https://www.defenseone.com/ideas/2018/09/china-has-space-force-what-are-its-lessons-pentagon/151665/?oref=d_brief_nl
[14] *Ibid.*
[15] Vasani, Harsh (January 2017). "How China is weaponizing outer space". The Diplomat. Retrieved from https://thediplomat.com/2017/01/how-china-is-weaponizing-outer-space/

developing its laser capabilities, and that a ground-based operational system could be ready by 2020[16]. This succession of initiatives illustrates both:

- Defensive objectives: these technologies would protect Chinese assets in space, ensure the viability of China's missile defence by fighting against space-based interceptors and deter potential adversaries from limiting the freedom of action of the country, in space or on Earth.
- A more offensive position: it demonstrates that Chinese decision-makers are increasingly aware of the pivotal character of space in modern warfare and of the necessity to deny the enemy the use of these systems in case of conflict, especially regarding the strong dependence of their main potential adversary, the United States, on these assets.

### 2.1.2 India

After having ran an exclusively civilian space programme over several decades, India adopted the use of space for military purposes in the 2000s. The evolution of the regional context is the main reason explaining this move. Indeed, skirmishes with Pakistani forces at Kargil in 1999 showed that Indian space assets were ineffective in such a military situation. Above all, the Chinese ASAT test of 2007 was a "wake-up call" for Indian leaders, thus leading to major changes from 2008[17].

At institutional level, an Integrated Space Cell (ISC) within the Headquarters of the Integrated Defence Staff was created. It aims mainly at coordinating India's military space activities, but the ISC is also in charge of a "Defence of Space" mission, as it oversees the security and utilization of India's military and civilian space hardware systems. In 2008 as well, India released the "Defence Space Vision 2020", a new doctrine emphasizing military aspects of space. This document, among other matters, called for the growth of dual-use assets and the establishment of military-run operational space capabilities under the ISC. Moreover, it was decided to establish a Defence Space Agency (DSA) to address the threats to space assets on the policy and strategy side and work closely with the Indian Space Agency (ISRO) and the Defence Research and Development Organisation (DRDO). This agency should form the basis of the future creation of a military Command focusing on space[18]. Under its authority is the Defence Space Research Organisation (DSRO), which provides R&D support to the DSA by developing sophisticated weapon systems and technologies for fighting a war in space.

An evolution also happened on the operational front. In line with the new doctrine previously described, the development of dual-use assets for space-based intelligence collection and regional navigation and communication capacities became a priority for ISRO. Consequently, today the use of space assets for passive military missions focuses on these three dimensions (intelligence, navigation, communication).

The integration of space assets in Indian military thinking has therefore gained strategic priority and political attention since 2008. In 2013, space-based requirements of the armed forces were collected and defined. Moreover, the first satellite exclusively dedicated to the military was launched that same year. Finally, even if India has had for a long time a tradition of promoting space as a peaceful domain, it is nowadays reviewing its position as a consequence of the evolution of technologies and of the 2007 Chinese test. The country is considering developing deterrence means to protect its assets, and for several years has been stating its ability to shoot down a satellite. This capability was demonstrated on 27 March 2019, through the destruction, supervised by DRDO, of an Indian satellite in low Earth orbit. According to

[16] U.S. Defense Intelligence Agency (January 2019). *Challenges to Security in* Space. Retrieved from: https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space_Threat_V14_020119_sm.pdf
[17] Marco Aliberti (2018), *India in Space: Between Utility and Geopolitics*, Springer.
[18] "India's Military To Create Defence Space And Cyber Agencies As Part of Reforms". SpaceWatch Global. Retrieved from: https://spacewatch.global/2018/10/indias-military-to-create-defence-space-and-cyber-agencies-as-part-of-reforms/

the Ministry of External Affairs, this was done "to verify that India has the capability to safeguard [its] space assets"[19]. In the wake of the test, Narendra Modi, Indian Prime Minister, directed the National Security Advisor to create a draft space doctrine[20] and a wargame, called IndSpaceEx, was organised in July 2019.

### 2.1.3 Japan

**Japan has long been one of the staunchest proponents of the vision of space as a peaceful domain.** Indeed, in its 1969 Space Law, it adopted a very restrictive interpretation of the "peaceful use" of outer space described in the Outer Space Treaty, asserting that "peaceful" meant "non-military" and not only "non-aggressive", contrary to the understanding of most other countries. Consequently, space assets and even data emanating from them could not be used by the Japanese military forces.

However, **this radical position evolved over time:**

- In 1985, the Self-Defence Forces were authorized to use data from commercial satellites.
- In 1998, the Information Gathering Satellite (IGS) programme started as a follow-up to a North Korean missile test over Japan. These satellites, dedicated to defence objectives, were launched from 2003 and were complemented and renewed in the following years.
- As in the case of India, 2008 appears as a turning point. Indeed, the Basic Space Law published that year left open the possibility to use space for military purposes. Article 14 only states that "The State shall take necessary measures to promote Space Development and Use to ensure international peace and security as well as to contribute to the national security of Japan"[21].
- Finally, in January 2020 Prime Minister Abe announced that Japan will form a space defence unit to protect the country from potential threats.

**With the Basic Space Law, "Japanese space policy evolved from a science and technology (R&D)-oriented policy to a comprehensive national strategy, which is now built on three pillars: science and technology, industrial vitalization, and national security"**[22]. Once again, the ASAT test of China can be considered as a key factor in this change of posture towards space. The emphasis on the utility of space for national security was reiterated in the 2015 New Basic Plan on Space Policy and was declared a priority in the process of elaboration of space policy. The aim is to make possible the use of space for the operations of the Self-Defence Forces, data collection, PNT… Thus, in order to better ensure its national security, Japan now plans to enhance the IGS system and to experiment on early warning sensors[23]. The existing partnership between the Ministry of Defence and JAXA will also be reinforced[24]. The Japanese military took part in the 2018 Schriever Wargame[25], whose focus is on space and its use in war. Moreover, "[i]n its recent National Defense Program Guidelines for [Fiscal Year] 2019 and beyond, Japan states its plans to "ensure superiority in use of space at all stages from peacetime to armed contingencies" and to "work to strengthen capabilities including mission assurance capability and capability to disrupt opponent's

[19] "Frequently Asked Questions on Mission Shakti". India's Ministry of External Affairs. Retrieved from: https://mea.gov.in/press-releases.htm?dtl/31179/Frequently+Asked+Questions+on+Mission+Shakti+Indias+AntiSatellite+Missile+test+conducted+on+27+March+2019
[20] Goswami, Namrata and Peter Garretson (April 2019). "Critical Shifts in India's Outer Space Policy". The Diplomat. Retrieved from: https://thediplomat.com/2019/04/critical-shifts-in-indias-outer-space-policy/
[21] *Japan Basic Space Law* (2008). Unofficial translation
[22] Japan Strategic Headquarters for Space Policy (2015). *New Basic Plan on Space Policy.* Tentative translation. Retrieved from: https://aerospace.org/sites/default/files/policy_archives/Japan%20Basic%20Plan%209Jan15.pdf
[23] Japan National Space Policy Secretariat (2017). *Implementation Plan of the Basic Plan on Space Policy*. Unofficial Translation.
[24] *Ibid*.
[25] *Ibid*.

command, control, communications and information""[26]. Indeed, to be able to deter threats, Japanese officials consider it necessary to adapt to the new modes of warfare, which combine capabilities in new domains (space, cyberspace and electromagnetic spectrum) and in traditional ones (land, sea and air)[27]. For this reason, budget dedicated to improving outer space capabilities in Fiscal Year 2020 is $462.5 million[28]. Finally, Japan announced that it would assign 100 people to the Space Domain Mission Unit, which will monitor space debris, collect intelligence on foreign space capabilities, especially on "hunter-killer" satellites[29], and conduct satellite-based navigation and communications. It will be created in 2022 and located on a base managed by the Japanese Air Self-Defence Forces. Already from 2020, a preliminary version of the unit will be formed within these Forces. Cooperation with the United States in space defence issues may also be reinforced, with a greater exchange of information and the permanent presence of Japanese officers at the Combined Space Operations Center at Vandenberg Air Force Base. Thus, **in this country that previously adopted a strict pacifistic vision of space, a bold move towards the militarization of this domain in response to a fast-transforming environment is quickly taking shape**.

### 2.1.4 Russia

Russia is a long-established space power, and the use of space for military purposes and its consequences is not a new issue there. During the Cold War, the country already developed anti-satellite weapons; nevertheless, it has also long pushed for a treaty prohibiting the placement of weapons of any kind in space. This dichotomy is still visible today. Even though, since 2008, Russia has co-sponsored with China a draft treaty[30] at the Conference on Disarmament to ban the stationing of weapons in space, **its military doctrine has gradually recognised that space is the Achilles heel of the U.S. military, which should be exploited**.

Thus, Russia's 2010 military doctrine asserts that militarization of outer space is a "main external military danger"[31]. This is reasserted in the 2014 doctrine, in which the issue of Western countries' precise strikes is also raised. **The country has expressed its concerns regarding these space-supported precision-guided strikes and has considered that they justify working on counterspace capabilities.** For instance, in 2013, the Duma (lower house of the Russian Parliament) recommended that Russia resume the research and development of an airborne anti-satellite missile. The country has also developed its electronic warfare means and integrated them in its military apparatus, both to be able to jam U.S. assets in case of conflict and to protect Russian space-enabled capabilities[32]. Russia invests in directed-energy weapons, such as the Peresvet laser cannon. This laser has been deployed since December 2018 and its mission is still unclear, but it could have several uses, from antimissile and anti-satellite defence to the incapacitation of an enemy's surveillance means and the interception of rapid aerial targets. Finally, the behaviour of some Russian satellites is suspicious; some of them have showed weird orbits, creating concern by other states

[26] Center for Strategic and International Studies (April 2019). *Space Threat Assessment 2019*. Retrieved from: https://csis-prod.s3.amazonaws.com/s3fs-public/publication/190404_SpaceThreatAssessment_interior.pdf
[27] *Japan National Defense Program Guidelines for FY 2019 and beyond* (December 2018), p. 10. Provisional translation. Retrieved from: https://www.mod.go.jp/j/approach/agenda/guideline/2019/pdf/20181218_e.pdf
[28] "Japanese defense budget hits new high with focus on space and cyberspace", The Japan Times (December 2019): https://www.japantimes.co.jp/news/2019/12/20/national/japan-defense-budget-hits-new-high/#.XfyJpkdKiUk
[29] "Japan to assign 100 personnel to new satellite monitoring unit" (May 2019). The Japan Times. Retrieved from: https://www.japantimes.co.jp/news/2019/05/14/national/science-health/japan-assign-100-personnel-new-satellite-monitoring-unit/#.XN5onsgzaUl
[30] Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects (PPWT)
[31] U.S. Defense Intelligence Agency (2017). *Russia Military Power*. Retrieved from http://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Russia%20Military%20Power%20Report%202017.pdf
[32] Secure World Foundation (April 2019), *op. cit.*

that these devices could be used as a weapon against their own assets and leading to outright accusations of spying.

Like China, **Russia is preparing for a war in space through the reorganisation of its military setup.** In 2015, the Air Force and the Aerospace Defense Troops merged to give birth to the Russian Federation Aerospace Forces, illustrating the rising interest of the country in military space operations. The new organisation includes the space forces "who have the mission of conducting space launches and maintaining the ballistic missile early warning system, the satellite control network, and the space object surveillance and identification network"[33]. Within this branch, the Space Forces[34]:

- Monitor space objects and identify potential threats to Russia in space and from space, and prevent attacks as needed;
- Carry out spacecraft launches and place into orbit, control satellite systems, including dual-use ones (intended to be used for both military and civilian purposes) in flight, and use exclusively military ones to provide the Russian Armed Forces with the necessary information;
- Maintain both military and integrated satellite systems with launching installations and assets of control in workable order, among other tasks.

As with China, **this reorganisation leads to a grouping and a centralisation of military space actors, with the likely objective of gaining efficiency in warfighting.** Finally, Russia has stated that it will respond with "reciprocal and asymmetrical measures"[35] to the new threats in space allegedly coming from the decision of the United States to set up a Space Force. It therefore assumes that a conflict is possible and wants to demonstrate its readiness to wage it.

### 2.1.5 The United States

The United States recognised quite early the strategic importance of space beyond the single surveillance of Soviet nuclear arsenals. Thus, **space was declared a vital interest at the end of the 1990s.** In 2001, a Commission led by Donald Rumsfeld published a report[36] theorizing the use of all space means, and especially the Global Positioning System (GPS), to support military operations on the ground. Due to this increasing reliance on space in a time of increasing foreign engagement for the United States, the Bush administration adopted the doctrine of "space dominance". According to this, the United States should ensure that no adversary can deny it the use of space assets during a conflict. In this context, a Counterspace Doctrine Document was published in 2004 while the National Space Policy of 2006 stated that "freedom of action in space is as important to the United States as air power and sea power". Moreover, the country responded to the 2007 Chinese ASAT test by shooting down one of its own satellites in 2008, at the same time demonstrating its greater sense of responsibility by avoiding massive generation of debris.

With the coming to power of Barack Obama, the United States opted for a more cooperative stance in space affairs and supported the use of international partnerships. However, the space doctrines of the Air Force Space Command (June 2012) and the U.S. Strategic Command (May 2013) continued to elaborate on the notion of space control, both offensive and defensive[37]. From 2014, the rhetoric became even more

[33] U.S. Defense Intelligence Agency (2017), *op.cit.*
[34] Ministry of Defence of the Russian Federation. "Aerospace Forces". Retrieved from: http://eng.mil.ru/en/structure/forces/cosmic.htm
[35] TASS (March 2019). "US creating pretexts for militarization of space – Russian General Staff". Retrieved from: https://tass.com/defense/1047214
[36] *Report of the Commission to Assess United States National Security, Space management and Organization* (January 2001). Retrieved from: https://fas.org/spp/military/commission/report.htm
[37] Space World Foundation (2019), *op. cit.*

conflict-oriented: at this time, the United States began to talk about war in space and of space as a warfighting field. It then quickly moved from speeches to plans[38]. A Space Strategic Portfolio Review was launched and officials started to explain that a conflict on Earth would inevitably extend to space, and that the country must prepare for this eventuality. In August 2017, General John Raymond, then commander of the U.S. Air Force Space Command explained that, today, "space is a warfighting domain just like air, land and sea"[39]. Over the following years, the budget for counterspace capabilities grew, from $24.1 million in Fiscal Year 2016 to $41.9 million in FY2017, and even $68.38 million in FY2018[40]. Finally, **in 2018, President Donald Trump reasserted the vision of space as a warfighting domain and expressed the will to set up a Space Force that will be in charge of organising, training and equipping military space** forces in order to:

- Defend U.S. space assets;
- Ensure an unfettered access to, and freedom of operations in, space.

The proposal for the establishment of a Space Force was raised in February 2019 and was approved by the Congress in December 2019. The Space Force will thus be a new military service (the sixth branch of the United States Armed Forces), which will stand within the Department of the Air Force. The Congress provided around $40 million in FY2020 for the "operations and maintenance" of the Space Force. The positions of Assistant Secretary of the Air Force for space acquisition and integration and Assistant Secretary of Defense for space policy were also created.

**The Space Force must be understood as part of a broader move of the Trump administration to adapt U.S. Armed Forces to a changing military space landscape and achieve space dominance and control.** Thus, a Space Development Agency (SDA) was created to accelerate innovation, responsiveness and efficiency of the acquisition side of military space programmes, so that the United States can keep its comparative advantage over its adversaries and enhance the resilience of its infrastructures. For instance, the first project of the SDA is a mega-constellation in low Earth orbit which would fulfil communications needs, surveillance purposes (especially focused on hypersonic weapons and missile threats), and provide an alternative to GPS. The Trump administration also decided to revive the U.S. Space Command, which will develop a doctrine, techniques and tactics, and lead space warfighting in case such a war occurs. This Command was reactivated on 29 August 2019, and had a staff of 400 people by the end of the year (with an increase to 500 staffers planned by 2020). It is headed by the General John Raymond, who serves also as the first Space Force's Chief of Space Operations.

These developments preceded the announcement of a new strategy towards space. Stephen Kitay, Deputy Assistant Secretary of Defense for Space Policy, stated in February 2020 that the United States is developing a new defence space strategy to replace the document elaborated in 2011 under Barack Obama. The new version will revolve around three pillars: maintaining space superiority, providing space support to U.S. and allied forces, and ensuring stability in space[41].

**This whole re-foundation of the military space organisation proves that the United States now sees space not only as a support function to its operations in land, sea or air, but also as a war dimension in itself which will have a leading role in the future.** Space war plans have been prepared and, through Operation Olympic Defender, are partly accessible to allies, so that they have more visibility in day-to-day space operations

[38] Atherton, Kelsey D. (April 2018), *op. cit.*
[39] Fabey, Mike (August 2017). "U.S. Space Command develops operational concepts for waging war in orbit". SpaceNews. Retrieved from: http://spacenews.com/u-s-space-command-develops-operational-concepts-for-fighting-war/
[40] Secure World Foundation (April 2019), *op. cit.*
[41] Sandra Erwin (February 2020). "Defense Department drafting new space strategy". SpaceNews. Retrieved from: https://spacenews.com/defense-department-drafting-new-space-strategy/

and can explain where they are able to help and where they cannot[42]. The United Kingdom already joined this initiative. Moreover, the Chief of Staff of the Air Force decided with allies to enhance the interoperability of space systems and the sharing of information regarding space surveillance awareness[43]. In this sense, the Combined Space Operations initiative (CSpO), which gathers the Five Eyes and, since February 2020, France and Germany as full members, was reorganised in 2018 to improve coordination among its participants and with commercial and civil space organisations. Finally, the Commander of the U.S. Space Command explained that working with allies is a big growth area for him, and that it will provide the United States with a big advantage[44]. It shows that, **despite its more assertive stance, the United States does not totally reject cooperation in military space.**

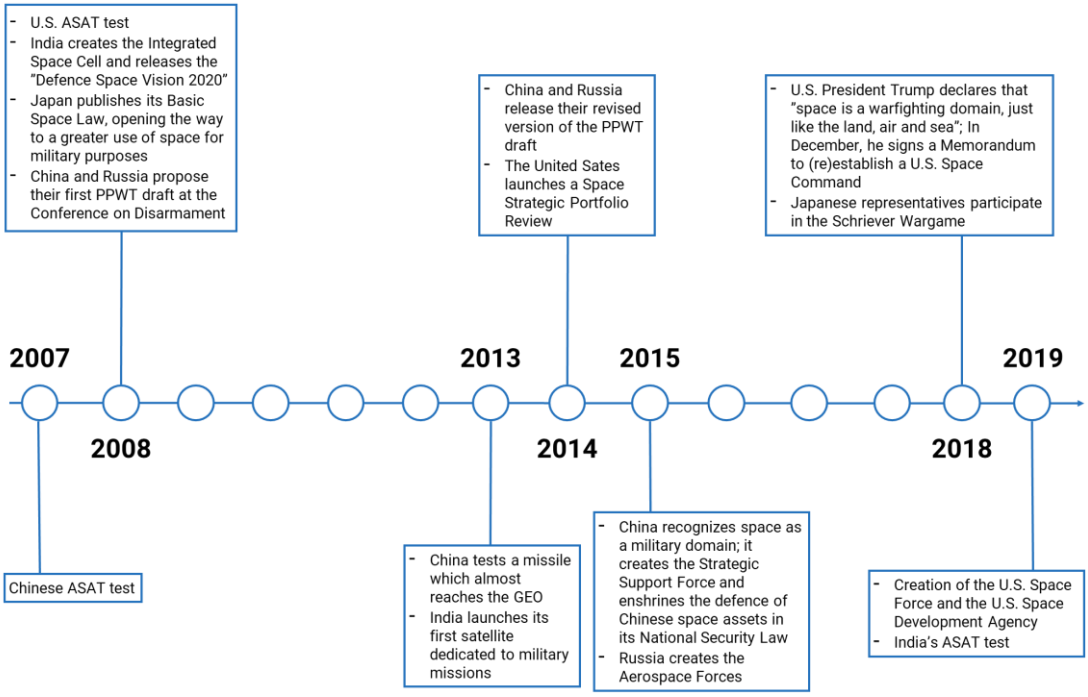


*Figure 1: Major non-European events in space defence between 2007 and 2009*

This synthetic panorama demonstrates that all major space powers have changed their minds over the last decade and have emphasized the higher significance of space in a military context. Thus, "the United States, Russia, and China are all developing counterspace technologies and putting in place the policies and doctrines to use them in future conflicts"[45]. Consequently, **a "security dilemma" is currently occurring**: to defend itself from a perceived threat, each state is improving its armaments, thus increasing the fear of other states and leading them to increase even more their own arsenals.

Indeed, the evolution of states' postures is backed by the development of capacities aimed at disrupting space systems. The intensification of research on counterspace weapons gives governments the means to reach their ends and to apply their threats if necessary, by relying on a diversity of technologies. In this increasingly tense environment, Europe is one of the only major spacefaring actors that has not yet positioned itself on the topic (with the exception of a few of its member states on a purely national basis).

[42] Clark, Colin and Theresa Hitchens (April 2019). "STRATCOM's Hyten Calls for Space Rules After India's ASAT Test: Update". Breaking Defense. Retrieved from: https://breakingdefense.com/2019/04/stratcoms-hyten-calls-for-space-rules-after-indias-asat-test/

[43] Erwin, Sandra (April 2019). "Air Force Chief Goldfein: To win in space, U.S. must work closer with allies". SpaceNews. Retrieved from: https://spacenews.com/air-force-chief-goldfein-to-win-in-space-u-s-must-work-closer-with-allies/

[44] Mehta, Aaron (September 2019). "Increasing allied role in space a "priority" for Space Command head". DefenceNews. Retrieved from: https://www.defensenews.com/space/2019/09/03/increasing-allied-role-in-space-a-priority-for-space-command-head/

[45] Brian Weeden, quoted in Altherton, Kelsey D., "The chicken-and-egg debate about new threats in space" (April 2019). C4ISRnet. Retrieved from: https://www.c4isrnet.com/c2-comms/satellites/2019/04/09/what-new-threats-menace-the-peace-of-space/

| | Strategic evolution | Organisational evolution within the military | Capabilities development and major events |
|---|---|---|---|
| China | • Recognition of space as a military domain<br>• The defence of space assets has become legally binding | • Creation of the Strategic Support Force (PLASSF) to deal with cyber, space and electronic warfare issues<br>• Establishment of a Space Systems Department within the PLASSF | • Test of an ASAT missile in 2007 and other tests in the following years<br>• Likely test of a laser in 2006 to blind a U.S. satellite<br>• Several RPO experiments between 2010 and 2016 |
| India | • Late use of space for military purposes<br>• Publication of the “Defence Space Vision 2020”, calling for more dual-use assets and the development of dedicated military satellites<br>• Work on ASAT technologies to improve its deterrence capacities | • Creation of an Integrated Space Cell within the HQ of the Integrated Defence Staff<br>• Creation of a Defence Space Agency<br>• Reflections on a future Space Command | • Test of an ASAT missile in March 2019 |
| Japan | • Had long defined “peaceful purposes” of space as “non-military”<br>• Gradual change to enable armed forces to use space data<br>• The last Basic Space Law paves the way to a greater use of space for military purposes | • In 2022, 100 people will be assigned to the Space Domain Mission Unit, which performs SSA missions (for instance to collect intelligence on foreign capabilities) and conduct satellite-based navigation and communications. A preliminary version will be set up in 2020. | • Not declared |
| Russia | • Militarisation of outer space recognised as a main external military danger<br>• Recognition of the need to exploit the overreliance of other countries on space in case of conflict | • Creation of the Aerospace Forces through the merging of the Air Force and the Aerospace Defense Troops | • At least six tests of Nudol, an anti-satellite missile, between 2015 and 2018 (according to U.S. sources)<br>• Deployment of the Peresvet laser cannon in military forces from the end of 2018<br>• Close approaches to the French-Italian satellite Athena-Fidus |
| United States | • Space is considered as a vital interest<br>• Space dominance doctrine at the beginning of the 2000s, then “softened” in space control<br>• Return of a more assertive stance by recognising space as a warfighting field, like land, air and sea<br>• Development of a new defence space strategy | • Reactivation of the U.S. Space Command in August 2019<br>• Creation of the Space Development Agency<br>• Creation of the Space Force in December 2019<br>• Willingness to form coalitions to activate if a conflict occurs in space<br>• Development of initiatives to promote international cooperation in space operations (Olympic Defender, CSpO, Schriever Wargames…) | • Test of an ASAT missile in 2008 (among previous other tests)<br>• Reflections on space-to-space weapons<br>• Several test campaigns of the X37-B, a classified space plane programme |

*Table 2: Evolution of the postures of major non-European space powers*

## 2.2 A changing operational context

Actually, space systems are neither invulnerable nor immune to various kinds of dangers. Three categories of threats to security of space assets or their services can be identified: natural threats (especially space weather, e.g. solar flares); unintentional man-made threats (i.e. space debris); and intentional man-made threats (i.e. space weapons). As this report focuses on the defence aspect of space, this section will deal only with intentional man-made threats. Possession of such capacities will allow their operator to put its adversary under pressure, even if the (full) capacity is not exploited. In that sense, international involvement in counterspace activities contributes particularly to the shared impression of a growing vulnerability of critical space systems, and affects the environment in which space operations take place.

Various intentional threats exist in the realm of space. They can be classified in several categories. The typology below does not aim to be exhaustive but seeks to highlight the main types of threats currently faced by space assets. These threats can be characterized by two dimensions: their nature and their potential consequences.

The nature of threats relates to the means they use to reach their goal:

- Kinetic devices are objects that use the energy produced by their speed to destroy their target. This kind of weapon can be Earth-to-space (i.e. a missile launched from the ground and reaching a satellite in orbit) or space-to-space (i.e. using a co-orbital space object which is thrown at the target). Thus, the development of manoeuvrable satellites creates some concern because of their potential use as kinetic weapons. Earth-to-space kinetic threats are similar to the technology used in ballistic missile defence programmes, developed by several countries (e.g. the March 2019 Indian ASAT test used a missile developed for such a programme).
- Electronic warfare refers mainly to jamming and spoofing, which aim at disabling the service provided by the space asset by interfering with its signal so that it is not understandable or gives erroneous information.
- Directed-energy weapons are mostly developed in lasers able to blind a satellite by attacking its sensors (e.g. to make imagery satellites inefficient). High-powered microwaves are another kind of directed-energy weapons, which damage the electronic components of the system.
- Cyber threats can attack data and systems that use these data in space and ground segments through command intrusion, denial of service, malware, hacking or hijacking[46]. The overall objective of cyber-attacks is to enter the network of the infrastructure. This kind of attack can lead to spying, disruption of satellite services (through the corruption of data for instance) and, in the worst case, to the takeover of the hardware.

The consequences of threats describe the effects an attack would have on space assets:

- Physical destruction: Although four countries officially possess this capability (the United States, Russia, China and India), the extensive use of such kind of threat is very unlikely. Indeed, the destruction of a satellite would produce a major amount of debris, which will constitute a danger for the assets of all countries, including the attacker, and will risk making the affected orbit unusable.

[46] National Air and Space Intelligence Center (December 2018), *Competing in Space*. Retrieved from: https://media.defense.gov/2019/Jan/16/2002080386/-1/-1/1/190115-F-NV711-0002.PDF

- Degradation, interruption: In this case, the service provided by space systems is not accessible anymore, that is, the effect is irreversible. Thus, degradation is "the permanent impairment of some or all of a space system's capability to produce results, usually with physical damage"[47].
- Denial, disruption, interference: In this case, services temporarily malfunction (they become non-working or erroneous), meaning that the effect is reversible. Disruption is consequently "the temporary impairment of some or all of a space system's capability to produce effects, usually without physical damage" whereas denial is the temporary "elimination" of this capability to produce effects, also without physical damage[48].

One technology can have various consequences. For instance, the dazzling of a satellite produces a temporary incapacitation, which ceases once the satellite is not targeted anymore, but it can also be so powerful that it overloads its sensors and make them inoperative or damages critical components such as the solar arrays, thus rendering the whole system unusable.

- Interception: this kind of attack is mostly related to spying, and can include the interception of communications or data thanks to cyber-attacks or the use of an eavesdropping satellite. With the development of manoeuvrable technologies, in future it could also include the physical interception of satellites.

| | Physical destruction | Degradation, interruption | Denial, disruption, interference | Interception |
|---|---|---|---|---|
| **Kinetic weapons** (e.g. ASAT missile) | Yes | Yes | No | No |
| **Directed-energy weapons** (e.g. blinding lasers) | No | Yes | Yes | No |
| **Electronic warfare** (e.g. jamming, spoofing) | No | No | Yes | No |
| **Cyber attacks** (e.g. system compromise) | Possible | Possible | Possible | Possible |

*Table 3: Intentional man-made threats constituting a danger for space assets*

The space environment is more uncertain, in part because ASAT technologies are now available to a greater number of players, who could get them thanks to the spread of space and ballistic missile technologies. However, the current trend is primarily towards a growing investment in these weapons by established space powers. For instance, the United States spends $1bn per year on developing the offensive or defensive capacities of its satellites[49]. Russia is said to develop the Rudolph system, a mobile ASAT system, during the state programme for armaments 2018-2025[50]. It is also working on the Tirada-2S[51], which will be used to conduct radio-electronic attacks on satellites. As described above, other countries have also expanded their anti-satellite capabilities over the last ten years. These weapons

[47] U.S. Air Force (August 2004). *Air Force Doctrine Document 2-2.1: Counterspace Operations.* Retrieved from: https://fas.org/irp/doddir/usaf/afdd2_2-1.pdf
[48] *Ibid.*
[49] Public hearing of Xavier Pasco before the National Defence and Armed Forces Committee of the French National Assembly, 25 May 2016. Retrieved from http://www.assemblee-nationale.fr/14/pdf/cr-cdef/15-16/c1516052.pdf
[50] Lagneau Laurent (August 2018). "Pour Washington, le traité sur la militarisation de l'espace proposé par Moscou et Pékin est "hypocrite"". Retrieved from http://www.opex360.com/2018/08/15/washington-traite-militarisation-de-lespace-propose-moscou-pekin-hypocrite/
[51] Gertz, Bill (August 2018). "U.S. Says Small Russian Satellite A Space Weapon". The Washington Free Beacon. Retrieved from https://freebeacon.com/national-security/u-s-says-small-russian-satellite-space-weapon/

**contribute to the destabilization of the global space environment because of their duality, which makes it difficult to decipher the ultimate intent behind their development.** Indeed, even if all of them justify their work on this kind of armament by the will to protect their assets and interests in space, the sheer nature of this domain makes differentiation between technologies developed for defensive or civil goals and those that serve offensive purposes almost impossible.

This issue of dual-use applications, which is central to military thinking on space, is best illustrated by the rise of rendezvous and proximity operation (RPOs) technologies. This technology could be used in the future for in-orbit servicing, as well as active debris removal, which would increase the security of space assets by eliminating the most important unintentional threat facing space systems. On the one hand, RPO technologies thus appear essential to the future of space by making it sustainable, a reason for states to invest in them. However, on the other hand, RPO devices can be quickly repurposed to be used as a weapon against adversary satellites in case of conflict. Therefore, some tests have created concern, be it China with its 2010, 2013-2014 and 2016 experiments, which were publicized as maintenance or active debris removal tests, or the United States with the X37-B project, whose classified missions could range from the repair of satellites in orbit, to the gathering of intelligence, to an attack of other space systems. More recently, a report[52] showed that Russian and U.S. satellites have performed unusual moves close to satellites of other nations in the past years, sometimes deliberately avoiding being spotted (e.g. by moving in the shadow of Earth). Dual-use technologies are thus ambivalent, and, because of their "dormant" military potential, blur the boundaries between a peaceful and a potential hostile activity, thus contributing to the mistrust between already suspicious states.

Today, space activities are occurring in an increasingly complex and unpredictable environment. Two main factors contribute to this trend:

- A *political factor*, with growing tensions between states and an evolution of the balance of power leading to a new stance towards space;
- A *capability factor*, with new threats appearing due to the progress of technologies and the readiness of states to use them for unfriendly purposes.

To recall a famous phrase, space is now *contested* (development of threats to space assets), *congested* (numerous satellites and debris currently in orbit and whose amount will still increase) and *competitive* (presence of more and more public and private actors, and fierce competition for orbital slots and radio frequencies). However, it should be emphasized that the use of space for military purposes is not new. The novelty of the current context lies in the intra-space conflictuality, that is, the use of space for in-space operations allowing to control this dimension[53]. These space-to-space operations represent a new perspective.

Thus, space does not appear as a sanctuary anymore, as was the case during the Cold War and immediately afterwards. Space is now a dimension, that is, in military terms, a domain where forces can manoeuvre, train, and conduct activities[54]. Consequently, space is considered by some countries in the same vein as land, air and sea: an operational domain where a war can be waged. This major evolution creates many concerns and new issues regarding the defence of spacecraft. As spacefaring nations, European actors are impacted by this transformation and face new stakes.

[52] Secure World Foundation (April 2019), *op. cit.*
[53] "La Méthode scientifique: Space Force, le côté obscur de l'espace" (March 2018). France Culture. Retrieved from https://www.franceculture.fr/emissions/la-methode-scientifique/space-force-le-cote-obscur-de-lespace
[54] *Ibid.*

## 2.3 Key takeaways

Due to evolving and more assertive postures, threats in space are becoming increasingly vivid in the current period; likewise, the development of counterspace technologies increases the vulnerability of space assets. Finally, the destruction of space systems would have major consequences for countries extensively relying on them. As a consequence, the current environment is a factor of risk for spacefaring nations.

Several evolutions can be identified:

- Strategic thinking: Reflecting growing geopolitical tensions, all major space powers have modified their military doctrines related to space. They have adopted more assertive postures, in order to improve and exhibit their readiness to act in space and through space, and have emphasized the importance of deterrence as a strategy to face their potential adversaries. Moreover, western countries have taken steps to start reinforcing their cooperation to face threats, avoid casualties in space and quickly recover from an attack thanks to mutual assistance.
- Operational level: All major space powers have, or expect to, reorganise their armed forces, to give a greater place to units dealing with space, especially at operational level. This enhances their capacity to use space for security and defence purposes on Earth (through better integration with other branches of the military, for instance), but also aims at developing the protection of their assets in space (through better space situational awareness, among others).
- Capability development: These developments have led states to envisage other ways to exploit dual-use space assets (e.g. RPO technologies) or to implement technologies that have both offensive and defensive applications (e.g. lasers). It is to be noted that, with the noticeable exception of kinetic weapons, most on-going technological developments are related to capabilities aimed at disrupting, rather than destroying, space assets.

In a context where the geopolitical environment and the bolder development of counterspace technologies have created new threats and vulnerabilities, the broad and extensive reliance on space assets for civil or military purposes makes them potential targets. This inevitably raises the question of the posture to be adopted by Europe in these matters in substantial strategic terms and how to define it as a joint position of all member states or as the conjunction of national individual stances. Indeed, a cooperative approach seems the most appropriate to tackle the challenges associated with space security given the shared interests at stake and the potential leverage of a coordinated and cooperative approach. However, achieving consensus on the vision and management of space defence-related issues remains highly ambitious.

# 3 State of play in Europe

The international environment shapes the context in which European actors develop policy. Thus, any response, national or collaborative, needs to be adapted to the constraints and opportunities of the changing landscape. Military space essentially remains defined and operated on a national basis and each country has its own strategy, governance and programmes to manage this field **(see the full description of these categories for France, Germany, Italy, Spain and the United Kingdom in annex)**. However, cooperation and coordination are also present, and have been instrumental in the setting up of current programmes.

## 3.1 National states

Individual states remain core actors in the realm of space defence: indeed, military strategies are defined at national level, and the development and use of space assets lies mainly in the hands of national organisations. To adapt to the dynamic international context, European states are taking steps in the space defence domain. However, the degree of involvement in these matters is uneven and sensitivities, doctrines or mindsets most often differ. As a consequence, governance structures are diverse with a great disparity regarding the place granted to space agencies and private actors. Only a few countries already possess advanced capabilities addressing the broad spectrum of defence-related space applications. However, organisations depending on the armed forces are systematically part of the management of space defence activities and interest in these issues is increasing in a growing number of states.

**All space powers in Europe acknowledge space as a strategic domain**, similar to other "traditional" domains (land, sea, air and, increasingly, cyber). **However, they do not share the same sense of urgency regarding the protection of space assets and the ways to address it**. This discrepancy is witnessed in the pace of progress of national space strategies: France is immediately implementing a space defence strategy while the United Kingdom has announced it will publish one soon; Italy has recently issued a strategy focused on space security. Others have not yet made significant announcements related to the defence of space (Germany, Spain).

Indeed, **at the political-strategic level there is no coordination mechanism dedicated to space defence among European countries.** Ongoing cooperation mostly takes place at operational level, and in the capability domain, with specific agreements delineating information sharing (see section 3.2).

Thus, advanced Earth observation for defence (and security) purposes is a capability that is addressed by all major space powers in Europe (with the exception of the United Kingdom, which relies on U.S. means) and in which even other countries of the continent, less involved in space, are investing (see Annex F). This convergence of interest creates the opportunity for Europe at large to foster the resilience of operational systems and expand its industrial and technology base in this domain; the plurality of bilateral agreements and multilateral frameworks for the development of Earth observation capabilities illustrates the relevance and acceptation of cooperative or coordinated schemes at European level. Next generation systems will remain managed nationally but bilateral agreements on capacity exchange will likely be continued.

Unlike the "Space for Defence" concept that is broadly shared in Europe with significant geographical distribution of technological and industrial skills, **"Defence of Space" is still in the making**. Indeed, no European state possesses on its own the capabilities to actively protect its assets in space. Although it has recently raised some interest, only France has announced that it will build patrolling nanosatellites and equip its spacecraft with lasers in order to protect them against a potential attack. Yet, a prominent

illustration of the growing interest in "Defence of Space" is the current development of European space surveillance capabilities in the framework of the SST Consortium. Major European space powers agree on the strategic priority to be given to the improvement of capabilities in this matter. Actually, Space Situational Awareness is a prerequisite to any defence activities in space, and a key component of European sovereignty in space.

Currently, there is a shift in the assessment of the situation and in the principles to be adopted to cope with its ongoing development, each state following its own path. This might raise difficulties in the long run to achieve convergence of views.

## 3.2 The provision of military space services through cooperation

While the elaboration of space defence policies remains strictly a national competence, the pooling of space operational capacities for defence purposes in a cooperative framework has been a permanent driver over the past twenty years at European and international levels (especially through NATO). Such cooperative arrangements create an additional layer for the handling of military space issues: the intergovernmental level (through bilateral and/or multilateral arrangements).

### 3.2.1 Intergovernmental cooperation in Europe

The possession of military space systems implies the need to address the issue of their protection and to define a doctrine in this matter. Such assets are generally owned and operated on a national basis although they are most often exploited to the benefit of a broader multinational community. Thus, a key question is to define to what extent their protection should be ensured nationally according to their ownership or whether some kind of multilateral cooperation would be relevant.

Actually, in Europe, intergovernmental cooperation is a frequent model for acquisition of military space services. Indeed, putting in perspective the cost of military space programmes and their increasing importance for defence purposes, states have since long realised the merits of cooperating in these matters, primarily in Earth observation and telecommunications systems. Three types of cooperation can be identified, which differ in the depth of cooperation:

- The exchange of capacities,
- Delegation, when several countries participate in a programme, under the clear leadership of one of them,
- The partnership, that is, two countries managing the programme on an equal footing.

Yet, whatever the cooperation model, full interoperability is not the rule since each state receives the data it needs but does not necessarily share it with all partners.

#### Exchange of capacities

The "exchange of capacities model" is perfectly illustrated by the Torino agreement signed between France and Italy in 2001, and the 2002 French-German Schwerin agreements. In this setting, the capacities of national satellites are exchanged through the concession of tasking rights (that is, the right to formulate a certain number of requests regarding the configuration of the sensor), but each country possesses its own ground segment, thus making it the only one receiving the images it requests.

- Torino agreement (2001): pursuant to this agreement, Italy and France have developed in parallel the Pleiades and COSMO-SkyMed systems from which both countries benefit. In addition, Italy can access the capacities of Spot 5 (a civil system) and a greater share of the images that it is entitled to receive as a participant in the Helios 2 programme. Yet, its tasking rights remain limited to defence

purposes. As a counterpart, France has a right to 75 images per day from COSMO-SkyMed, the Italian SAR (Synthetic Aperture Radar) capacity[55].

- Schwerin agreements (2002): they rely on two principles: each country funds the ground segment necessary to access the other partner's system; and exchange of resources between the systems take place as soon as countries have access to them. France and Germany then exchange tasking rights to their SAR-Lupe and Helios 2 constellations. With this agreement, France has benefited from a very high-resolution radar capability since 2009 while Germany has been granted access to 5% of the capacity of Helios 2[56].

These agreements are advantageous for states since they enable them to benefit from the whole range of Earth observation means and associated advantages. Indeed, optical (Helios 2, Pleiades) and radar (SAR-Lupe, COSMO-SkyMed) assets are complementary technologies. The former is usable only with daylight but requires less energy; the latter is particularly useful when the area of interest is clouded or dark but it produces images that are more difficult to analyse. As such, these agreements reflect relative specialization as each country develops a technology and then puts it as the disposal of others in exchange for access to their capacities. Yet, it is to be noted that they do not always lead to an exchange of images but only of tasking rights[57], meaning that the operating country does not have access to the images delivered to the partner. However, **they represent a first significant step in cooperation on space defence issues and can strengthen the links between partners by fostering interdependence.** Therefore, issues faced by the owner of the satellite are also of interest to the partner.

In the field of Earth observation, a multinational programme, MUSIS, was planned to replace the current generation of satellites. However, because of disagreements among states, the project ended in partial failure and the idea of getting a common and generic user-ground segment for all participating countries was abandoned. Nevertheless, MUSIS was continued in a new form, through the exchange of capacities of the next generations of satellites (especially, CSO for France, SARah for Germany and COSMO-SkyMed Second Generation (CSG) for Italy). In addition, in the frame of MUSIS, France and Italy are developing a Common Interoperability Layer (CIL) to link French optical and Italian radar systems. It will coordinate CSO and CSG platforms at the user ground segment level "in order to provide ways of mutual access to both optical and SAR capabilities while respecting confidentiality requirements and remaining consistent and compatible with the national programs in general"[58]. Such a common ground segment will greatly enhance the interoperability of the systems and consequently be one of the most advanced cooperative initiatives in the domain in Europe. OCCAr, the Organisation for Joint Armament Cooperation, which facilitates and manages collaborative armament programmes for several states (Belgium, France, Germany, Italy, Spain, and the United Kingdom), and was the former manager of MUSIS, will be in charge of the overall management of this project. Therefore, the CIL initiative "remains open to other partners and space components of the cooperation"[59] (SARah, Ingenio).

### Delegation

**In the "delegation model", one country manages the programme, but receives support (mostly financial) from various partners.** This kind of cooperation has been implemented for the Helios 2 and Pleiades systems. France conducted both programmes but other countries contributed financially in exchange for tasking rights to the satellites. Access granted to participating countries is proportional to their financial

[55] French National Assembly, National Defence and Armed Forces Committee (October 2008). "Opinion on the project of Finance Law for 2009". Retrieved from: http://www.assemblee-nationale.fr/13/budget/plf2009/a1202-tVII.asp#P167_10324
[56] *Ibid.*
[57] Lancesseur, Bruno (June 2005). "Helios 2A, déclencheur de la défense spatiale européenne". Les Echos. Retrieved from: https://www.lesechos.fr/2005/06/helios-2a-declencheur-de-la-defense-spatiale-europeenne-609074
[58] Schrogl, Kai-Uwe, Hays, Peter L., Robinson Jana & *al.* (eds.) (2015). *Handbook of Space Security*. Springer.
[59] *Ibid.*

participation. **With this model, a community of interests is emerging, leading to common work and discussions among all partners.**

The Helios 2 system is composed of two optical and infrared satellites. Five countries became part of the programme between 2001 and 2003: France funded 90% of it and Belgium, Spain, Italy and Greece each contributed 2.5%. In exchange, they received a compatible ground station and a proportional part of tasking rights. An exception was made for Italy which, thanks to the Torino agreement on exchange capacities, gained 6% extra tasking rights on top of its 2.5%, and is thus receiving 7 images per day[60]. Helios 2 satellites are being replaced by the CSO programme, whose first satellite was launched in December 2018. Yet, CSO is mostly a national effort; cooperation with other states does not rely on a multinational endeavour but on bilateral agreements between France and its partners. For the time being, France has collaborated with Belgium, Sweden (which puts its polar ground station in Kiruna at the disposal of the programme) and Germany (which funds a large part of the third satellite of the constellation, for €210 million), but partners of France do not directly cooperate with each other in the frame of CSO.

Delegation also applies to Pleiades, a programme of two optical satellites launched in 2011 and 2012. Pleiades is a dual-use system, meaning that part of its images can be commercialized by a private company (Airbus D&S Geo). Yet, the civil and defence ground segments are separated and military users retain priority on tasking rights: each day, the first 50 images of Pleiades are reserved to them, thus guaranteeing militaries that they will get a view on the areas of interest to them. Moreover, communication networks and ground segment centres are protected according to specific rules. France benefited from the cooperation of Austria, Belgium, Spain and Sweden. Here again, access to tasking rights and to the system's archives is granted depending on the participation in the programme's development. In addition, the French space agency, CNES, developed all the components of the ground segment that are operated by several entities. CNES is also responsible for key functions and services. Even if partnering countries possess mission centres on their territory, CNES manages the dual control centre, which is at the core of the system. This centre operates the satellite (command and control), hosts the defence coordination function, plans all tasking requests (following the resources-sharing rule), and ensures that the satellite and its instrument calibration function correctly (e.g. by managing image quality)[61].

Therefore, the example of Pleiades strikingly illustrates **the centralisation inherent in the "delegation model":** one country is in the driving seat and controls the satellites, while the others are mainly able to request it to program the system according to their demands and within the limits of their rights. **Despite the "community of interests" that this model entails, each partner possesses its own ground segment and the leading country does not have access to the images they get (this is the principle of "national eyes only"). There is one exception: states can proceed to an "international request"**, meaning that several countries can collectively request the image of an area of interest to them. This was planned to be the core principle of MUSIS (while it represents about 10% of the images in current systems) but has finally not been implemented.

Centralisation is thus a key feature of the "delegation model". It is at the same time a strength in terms of effectiveness of the management and a weakness given the limited interoperability that it offers. The failure of MUSIS, which emphasized operational transparency, clearly demonstrates that **building trust among partners is a strong prerequisite**, without which this cooperation model might be limited to financial or opportunistic considerations.

[60] Procaccia, Catherine and Bruno Sido (2012). *Report n°114 for the Parliamentary Office for the assessment of scientific and technological choices*. Retrieved from: http://www.senat.fr/rap/r12-114/r12-114.html
[61] CNES (August 2016). "Pleiades: Ground Segment". Retrieved from: https://pleiades.cnes.fr/en/PLEIADES/GP_segment_sol.htm

### Partnership

The third model goes one step further in cooperation as compared to delegation. It may be called "partnership" and is characterized by a more balanced relationship between (for the time being) two partners. It is today implemented in the telecommunications field, namely with the Italian-French Athena-Fidus and Sicral 2 satellites. Both systems are more or less equally funded: Athena-Fidus was 50%-50% funded whereas in the case of Sicral 2, Italy contributed 62% and France 38%. Athena-Fidus is a military-governmental dual-use system (and not military-commercial, contrary to Pleiades) and has applications for armed forces (communications, drones) but also for police forces, emergency management, and remote surveillance of critical areas. Sicral 2 is also dual, since Telespazio retained a share of the satellite's transmission capacity; however, this share is used to provide communication services to NATO allies and the final purpose remains military. Governmental third parties can get access to these assets even if they did not take part in their development. Thus, Belgian armed forces benefit from the services of Athena-Fidus while Sicral 2 is used to provide capabilities to NATO and allied forces.

Each country is responsible for the control of one satellite: Athena-Fidus for France and Sicral 2 for Italy. As such, they must ensure the continued operations of the satellite on its orbit and configure it in accordance with the needs of the French or Italian end-user. Nevertheless, even if the programme is implemented in a cooperative scheme, the satellites carry both French and Italian payloads (one French and one Italian in the case of Athena-Fidus, two Italian and one French for Sicral 2) and both countries possess their own ground segments. Therefore, the cooperation does have some limits, as there is no direct sharing of the payloads.

| | Programmes |
|---|---|
| Exchange of capacities | • Helios 2 (FR) – SAR-Lupe (DE)<br>• Pleiades/Helios 2 (FR) – COSMO-SkyMed (IT)<br>• CSO (FR) – SARah (DE) (upcoming)<br>• CSO (FR) – CSG (IT) (upcoming) (+ possibly CIL) |
| Delegation | • Helios 2 (FR, IT, ES, GR, BE)<br>• Pleiades (FR, ES, BE, AT, SE) |
| Partnership | • Athena-Fidus (FR, IT)<br>• Sicral 2 (IT, FR) |

*Table 4: European programmes according to their model of cooperation*

Multilateral cooperation among a few countries (minilateral cooperation) in the use and development of military space assets is thus a practice that makes sense in Europe. It could be a first step towards a space defence policy at a broader multinational level by acclimatising states to work together on this topic and making them aware of the common issues to tackle. However, this cooperation is still governed by specific frameworks with specific limits, in particular the lack of knowledge of states regarding what their partners get from the system. This situation demonstrates that states have still to increase mutual trust and to progress on the sharing of information they see as vital or relevant to their national interests.

## 3.2.2 Cooperation in the framework of NATO

The North Atlantic Treaty Organization (NATO) is an intergovernmental organisation whose interest in space defence is growing and where some space defence assets are shared. NATO is a key issue in any discussion on the European space defence because it remains the foundation of its European member

countries' collective defence and the vehicle where it is implemented. This situation is recognised in European treaties. Yet, while it previously owned systems, since 2010, NATO has not owned[62], nor directly operated, in-orbit assets, and has instead relied on national (or commercial) capabilities put at its disposal by some of its members, especially in the realm of SATCOMs. However, NATO owns and operates ground segments (e.g. anchor stations and terminals that receive SATCOMs information to support its operations) and user interfaces, thanks to the NATO Communications and Information Agency, which acquires, deploys and defends these systems.

Therefore, the benefits that NATO draws from space stem from national satellites. For instance, Luxembourg contributes mainly to NATO not through support staff but through the supply of SATCOMs (and, soon, ISR) services, thanks to its GovSat-1 satellite. Thus, in 2016, NATO awarded a contract to the company GovSat to support the operational phase of the Alliance Ground Surveillance System (AGS). Since then, the firm has delivered satellite capacity to make sure that the UAVs used for the AGS can securely communicate with their ground segment[63].

This kind of services provision to the Alliance can also take place in the frame of institutionalized programmes. Thus, through the NSP2K programme, France, Italy and the United Kingdom have provided advanced communications capabilities to NATO between 2005 and 2019 by selling the overcapacity of their own national SATCOMs (Syracuse 3 for France, Skynet 4 and 5 for the United Kingdom, and Sicral 1 and 1B for Italy) to the Organisation. Sicral 2 has also been used, since one of the Italian payloads was a back-up for Sicral 1B, while the French payload was used as a support to Syracuse 3. In addition, Telespazio retained a share of the satellite's transmission capacity to offer bandwidth to other NATO countries outside of the NSP2K framework. These capabilities replaced the two NATO IV satellites, which were owned and operated by NATO, but whose services stopped respectively in 2007 and 2010.

The cooperation between NATO and its member countries is structured through a Memorandum of Understanding supported by a Service Level Agreement, with the following distribution of tasks:

- The satellites are controlled by the supplier nations, which own them and retain sovereignty (including command and control);
- The payload is controlled by states but under the direction of NATO;
- The user segment is managed by NATO.


*Figure 2: NATO SATCOM command and control relationships*[64]

[62] Lt. Col. Console, Andrea (2016). "Looking Up Together: Multinational Space Surveillance and Tracking Initiatives from a NATO Perspective". *The Journal of the JAPCC*, n°23, Autumn/Winter 2016, pp. 45-50.
[63] NATO Parliamentary Assembly (October 2017). *The Space Domain and Allied Defence*. Retrieved from: https://www.nato-pa.int/download-file?filename=sites/default/files/2017-11/2017%20-%20162%20DSCFC%2017%20E%20rev%201%20fin%20-%20SPACE%20-%20MOON%20REPORT.pdf
[64] Source: NATO (April 2016). *Allied Joint Publication 3.3: Allied Joint Doctrine for Air and Space Operations*

In the future, this sharing of capabilities will be renewed with the CP130 programme (2020-2034). France, Italy, the United Kingdom and the United States formed a consortium to respond to NATO's bid and signed a Memorandum of Understanding with NATO, which authorized €1bn for these services for 15 years[65]. The contract requests leased and managed capacities (i.e. "the customer gives the provider responsibility for managing the contract as a service and not a simple lease of capacity on a given satellite"[66]).

Similarly, in terms of ISR, NATO also needs the assets of its member countries. In the case of imagery, NATO relies on individual states to provide this capacity, through national assets or commercial vendors. For instance, from 2022, Luxembourg intends to contribute more actively to meet NATO needs with its National Advanced Optical System (NAOS). In the past, the Alliance also used the database of commercial imagery maintained by the EU Satellite Centre[67]. Cooperation also takes place through shared processing, exploitation and interpretation of data in a common centre, the NATO Intelligence Fusion Centre.

**Even if national assets are used, the Alliance as a whole relies on the services they provide, thus making NATO a relevant forum for a multilateral discussion on space defence issues.** This need is recognised by the NATO Parliamentary Assembly, which asserts that, at strategic level, "NATO's collective defence and economic prosperity rely on space-based infrastructure, and an attack on the space assets of one Ally would impact the security of all. As such, NATO needs a whole-of-alliance approach to protect its interests in space to enhance resilience and deter any threat to its space-based capabilities"[68]. The burning nature of this topic is thus increasingly acknowledged, and NATO member countries approved an overarching space policy in June 2019. Indeed, according to Jens Stoltenberg, NATO Secretary General, NATO "can play an important role as a forum to share information, increase interoperability, and ensure that our missions and operations can call on the support they need"[69]. The policy approved by member countries creates a framework for further debate on space issues within the Alliance and on the means that it can use to respond to space threats. These latter include the definition of conditions to trigger Article 5 consecutive to a hostile action in space and the management of national assets during operations. Finally, space was officially recognised as a domain of operations in December 2019, during a summit in London.

Military space systems are sensitive programmes in which cooperation between European member states is sought whenever possible and deemed relevant, be it through bilateral or multilateral agreements or within the frame of intergovernmental organisations. The motives can be diverse, including mutual financial contributions and strategic agreements. Actually, space defence seems a fertile terrain for further multilateral and intergovernmental cooperation given the interdependence created by current cooperative programmes.

**Cooperation is particularly relevant with the emergence of the European Union as a key player in space defence issues:** indeed, the EU now owns the assets of two flagship programmes, Copernicus and Galileo. As such, and regarding the benefits provided by these programmes to EU member states and citizens, it has a responsibility to ensure their proper protection against all kinds of threats, including military. **Therefore, all member states, even those that are not keen on military space matters, are getting involved in this area and have to face stakes, if only financial.** Discussions confronting the points of view of various EU member states are currently taking place and a joint reflection to initiate convergence will shortly become a necessity.

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[65] NCIA (February 2020). "NATO begins using enhanced satellite services". Retrieved from: https://www.ncia.nato.int/NewsRoom/Pages/20200212-NATO-begins-using-enhanced-satellite-services.aspx

[66] De Selding, Peter B. (November 2016). "NATO behind schedule on satellite capacity order, now hopes for 2017 decision". SpaceNews. Retrieved from: https://spacenews.com/nato-behind-schedule-on-satellite-capacity-order-now-hopes-for-2017-decision/

[67] The Joint Air Power Competence Centre (revised January 2009). *NATO Space Operations Assessment*. Retrieved from: https://www.japcc.org/wp-content/uploads/NATO-Space-Ops-Assessment-Jan-09.pdf

[68] NATO Parliamentary Assembly (October 2017), *op. cit.*

[69] NATO (June 2019). "NATO Defence Ministers approve new space policy, discuss readiness and mission in Afghanistan": https://www.nato.int/cps/en/natohq/news_167181.htm

## 3.3 The European Union: a new dynamic actor in space- and defence-related issues

The European Union level has become a relevant forum to discuss space defence matters. Indeed, the 2007 Lisbon Treaty made space a shared competency between the EU and member states (art. 189 TFEU). In order to tackle space defence issues, the European Union, is gradually supporting Research and Development in a variety of space capabilities that potentially serve space defence purposes.

Moreover, the European Commission is also willing to develop EU competences in the defence sector and is setting up a framework to address these issues, in order to strengthen the Common Security and Defence Policy (CSDP), that is, the defence component of the Common Foreign and Security Policy (CFSP). Thus, in defence-related initiatives, "more has been achieved in the last ten months [in 2016] than in the last ten years" [70]. This growing emphasis on defence has consequences in the space domain.

### 3.3.1 The European Union as a catalyst for defence initiatives

After the aborted attempt to create the European Defence Community in 1954, European defence seems today to be gaining momentum again. This situation is the continuation of a long process towards a European defence. In 1996, NATO authorized the Western European Union to develop a European Security and Defence Identity (ESDI), which became the European Security and Defence Policy (ESDP) in 1999 when it was transferred to the EU. The 2009 Treaty of Lisbon is often considered as a watershed moment for European defence. Indeed, it established the Common Security and Defence Policy (CSDP) and the EEAS (European External Action Service, the European Union's diplomatic service) as well as the "mutual assistance clause" (art. 42.7).

The aim of the CSDP is to provide the Union with an operational capacity drawing on civil and military assets (relying on capabilities provided by member states) and to frame a policy for the common defence of the Union in order to lead, ultimately, to a common defence (art. 42). Therefore, an EU defence framework is being set up, with many different organisations. This landscape is relatively fragmented, with some key bodies and mechanisms heavily dominated by member states (PESCO, EDA, SatCen) whereas other programmes closer to EU institutions are or will also be determining actors (EDF).

Yet, the European Union has endorsed policies and mechanisms enhancing common foreign and defence initiatives. These complementary initiatives enable the EU to provide a coherent framework for defence activities taking place under its auspices.

[70] European External Action Service (January 2017). From Shared Vision to Common Action: Implementing the EU Global Strategy – Year 1. Retrieved from: https://eeas.europa.eu/sites/eeas/files/full_brochure_year_1_0.pdf

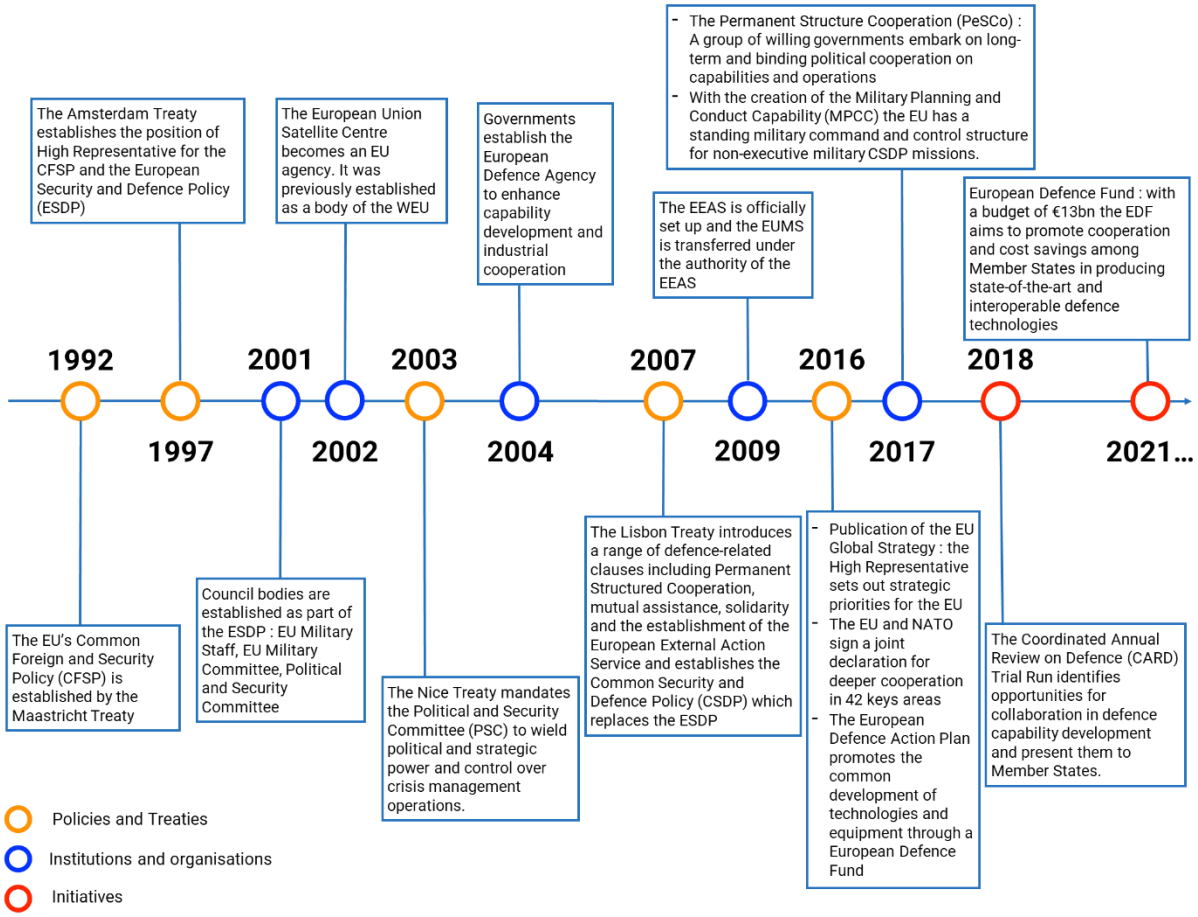


*Figure 3: Major EU initiatives in defence since 1992*

## Key policies

- The Common Foreign and Security Policy (CFSP): The CFSP was established in 1993 by the Maastricht Treaty to foster international security, peace and multilateralism. The Treaty of Amsterdam in 1997 and then the 2003 Treaty of Nice introduced further changes. The former put in place a more efficient decision-making process, while the latter mandated the Political and Security Committee (PSC) to wield political and strategic power and control over crisis management operations. The High Representative of the Union for Foreign Affairs and Security Policy (HR/VP) – a major CFSP actor created by the Treaty of Amsterdam, now Vice-President of the European Commission and Head of the EEAS – must consult Parliament on a regular basis "on the principal aspects of and choices made under the CFSP and to inform Parliament of the policy's evolution"[71]. The Parliament has also access to classified information related to the CFSP/CSDP through a "special committee". Furthermore, it has to approve the CFSP yearly budget and its approval is needed to conclude international agreements.
- The Common Security and Defence Policy (CSDP): The CSDP is an integral part of the Union's Common Foreign and Security Policy. The CSDP sets the framework for EU political and military structures, as well as for military and civilian missions and operations abroad. The European Council and the Council of the European Union take the decisions related to the CSDP, mainly by unanimity. The CSDP is currently evolving swiftly, with several initiatives being presented by the European Union

[71] European Parliament (April 2019). *Foreign policy: aims, instruments and achievements*. Retrieved from: http://www.europarl.europa.eu/ftu/pdf/en/FTU_5.1.1.pdf

between 2016 and 2019. CSDP also contributes to the relationship with NATO and leads to statements such as the EU-NATO declaration in Warsaw. This declaration gave a new impetus to the strategic partnership between the two organisations with, for instance, the setting up of hybrid crisis management exercises.

  - *The Political and Security Committee (PSC)*: The PSC meets at the ambassadorial level as a preparatory body for the Council of the EU. The Committee helps to define policies within the CFSP. The PSC, under the authority of the Council, exercises the political central and strategic direction of EU-led military CSDP operations and missions, with advice from the EUMC (the European Union Military Committee composed of the Chiefs of Staff of EU Member States).

- The Global Strategy for the European Union's Foreign and Security Policy (EUGS): In 2015, the HR/VP was mandated to assess the impacts of international changes on the EU's environment. It gave birth to the EUGS, which sets five strategic priorities for the EU External Action: the security of the Union; the state and societal resilience of the Eastern and Southern neighbourhood; an integrated approach to conflicts; cooperative regional order; and the promotion of a rule-based global governance. Member states welcomed the Strategy in June 2016 and agreed to move to its implementation, which has to be reviewed annually in consultation with the Council, the Commission and Parliament. In November 2016, the Council was presented with, and adopted, an "Implementation Plan on Security and Defence", which aims at operationalizing the vision set out in the EUGS on defence and security issues. The Plan puts forward 13 proposals, including the establishment of a Coordinated Annual Review on Defence (CARD); a more-efficient EU rapid response with the EU Battlegroups; and a new Permanent Structured Cooperation (PESCO).
- The European Defence Action Plan (EDAP): The EDAP, adopted in November 2016, promotes the common development of technologies and equipment by pooling national resources and increasing cooperation between member states. The Commission will support capability development along the entire cycle of defence (from R&D to production) and will promote the contribution of sectoral policies, such as EU space programmes, to common security and defence priorities. The main goal of the EU in supporting cooperation between states is to reduce unnecessary duplications of capabilities. The EDAP is the strategy promoting the creation of a European Defence Fund.

### Key mechanisms and organisations

#### At the stage of capability development

- The Permanent Structured Cooperation (PESCO): PESCO was established in December 2017 and gathers 25 participating member states in a voluntary intergovernmental cooperation on the basis of articles 42.6 and 46 as well as Protocol 10 of the Lisbon Treaty. Its goal is to allow "willing and able Member States to jointly plan, develop and invest in shared capability projects, and enhance the operational readiness and contribution of their armed forces"[72]. 47 cooperative projects have thus been approved since 2018. However, even if this cooperation takes place in the frame of the European Union, the identification of the capabilities to develop as well as their ownership and control remain with member states. Finally, the capabilities could be made available for EU military operations, but also in the context of NATO or the United Nations.

  The peculiarity of this framework is that commitments made by participants are legally binding. Each year, states must inform their partners on their contribution to the fulfilment of their commitments and this compliance is assessed by the Council of the EU. The Council also takes decisions regarding PESCO, and both EEAS and EDA constitute its Secretariat. The European Commission can be included as an observer in some projects.

[72] European Defence Agency. "Permanent Structured Cooperation". Retrieved from: https://www.eda.europa.eu/what-we-do/our-current-priorities/permanent-structured-cooperation

PESCO is a core structure of the EU defence landscape and can even be linked to projects implemented outside of the EU framework. Thus, in June 2018, nine EU member states created the European Intervention Initiative (EI2) in order to emphasize their will to foster a common strategic culture and to consolidate European strategic autonomy. In its declared objective, the French-initiated EI2 aims to develop rapid engagement of military capabilities and forces. Synergies with PESCO will be sought, as EI2 participants will "strive to ensure that EI2 serves the objectives and projects of PESCO to the maximum extent possible"[73].

- The European Defence Agency (EDA): The EDA is an agency set up in 2004 under the authority of the Council of the EU and headed by the High Representative of the Union. EDA's role is to foster cooperation between member states in developing defence capabilities, at both research and development levels. In order to reach this goal, the EDA contributes to the definition of military needs in specific capabilities and publishes three main documents that form a guideline for member states and make proposals for cooperation:
  - *Capability Development Plan (CDP)*: The CDP defines the future capability needs from the short to long term in close cooperation with member states and identifies priorities on which states should cooperate to develop their military capabilities. The last version of this document was released in 2018.

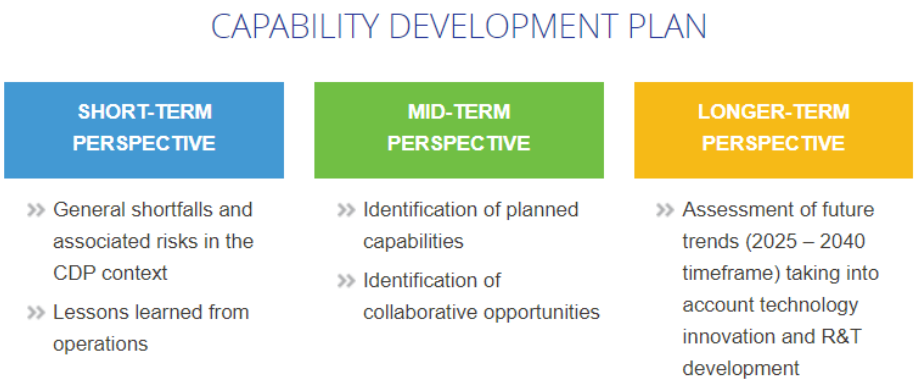


*Figure 4: Objectives of the Capability Development Plan*[74]

  - *Strategic context cases (SCC)*: The SCC are a follow-up to the CDP that should be developed by the EDA They were endorsed by member states in 2019. They are structured in two parts: the first assesses the. capability landscape and defines rising challenges for the short, mid and long term, in close cooperation and dialogue with member states. This results in the description of approaches to overcome these challenges. The second part identifies EDA's ongoing activities that can support member states in implementing these approaches.
  - *Coordinated Annual Review on Defence (CARD)*: In May 2017, the Council of the EU endorsed the conditions to create the Coordinated Annual Review on Defence, for which EDA acts as Secretariat. CARD provides a description of the capability landscape and identifies opportunities for cooperation between member states. A CARD Trial Run took place in 2018 and implementation of its first full cycle started in autumn 2019.

### At the stage of capability funding

The European Defence Action Plan acknowledged in 2016 that "the lack of synchronisation of individual budget contributions leads to considerable delays in the launch and conduct of collaborative

[73] *Letter of Intent Concerning The Development of The European Intervention Initiative (EI2)* (June 2018)
[74] Source: https://www.eda.europa.eu/what-we-do/our-current-priorities/capability-development-plan

programmes. Finally, the increasing costs of complex defence capabilities may be prohibitive for Member States investing alone and therefore the pooling of national resources for capabilities would lead to budgetary savings and maximise the value for money of defence investments"[75]. Consequently, the EDAP raised the idea of a European Defence Fund (EDF), which has the following characteristics:

- *Preparation phase*: The EDF will only start from 2021. To prepare, work programmes to co-finance joint defence industrial projects and collaborative defence research projects have been implemented, namely, the European Defence Industrial Development Programme (EDIDP) and the Preparatory Action on Defence Research (PADR). On the one hand, the EDIDP, with €500 million for 2019-2020, co-finances the "joint industrial development of defence equipment and technologies in all domains (air, land, sea, cyber and space)"[76]. On the other, the PADR, launched by the Commission in 2017 and provided with €90 million for 2017-2019, paves the way to a substantial defence research programme.
- *Goal*: The EDF aims at stimulating the defence industrial base in order to contribute actively to EU's strategic autonomy. Its goal is "to promote cooperation and cost savings among Member States in producing state-of-the-art and interoperable defence technology and equipment"[77]. EDF aims to prevent that a project is abandoned because of a lack of funds, to avoid the current fragmentation and waste of resources, and to improve the competitiveness of European defence industry.
- *Functioning*: The EDF will be provided with €13bn for 2021-2027, which will be organised in two parts: a research window (€4.1bn) and a capability window (€8.9bn). Only collaborative projects will be funded, and projects developed in the frame of PESCO could get a bonus. Moreover, to be financed in the frame of the EDF, projects need to contribute to priorities agreed in the framework of CFSP or NATO (thus demonstrating the EU's will to continue to work with NATO).

**The various initiatives on defence taken at EU level aim at forming a coherent landscape. Indeed, PESCO, EDA and EDF, which form the basis of the European defence framework, are complementary and mutually reinforcing tools.** Thus, "In a somewhat simplistic manner, we could say that the CDP tells us what to focus our common efforts on, the CARD gives us an overview of where we stand and identifies next steps, PESCO in turn gives us options on how to do it in a collaborative manner, while the EDF could provide the funds to support the implementation of cooperative defence projects in general, but with a bonus, if in PESCO"[78].

[75] European Commission (November 2016). *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions – European Defence Action Plan*, p. 9. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0950&from=en
[76] European Commission. "European Defence Action Plan – Stepping Up the EU's Role as a Security and Defence Provider"
[77] European Commission (May 2018). "EU Budget for the Future (Defence)". Retrieved from: https://ec.europa.eu/commission/sites/beta-political/files/budget-proposals-defence-may2018_en.pdf
[78] European Defence Agency. "Factsheet: Coordinated Annual Review on Defence (CARD)". Retrieved from: https://eda.europa.eu/docs/default-source/eda-factsheets/2018-11-26-factsheet_card

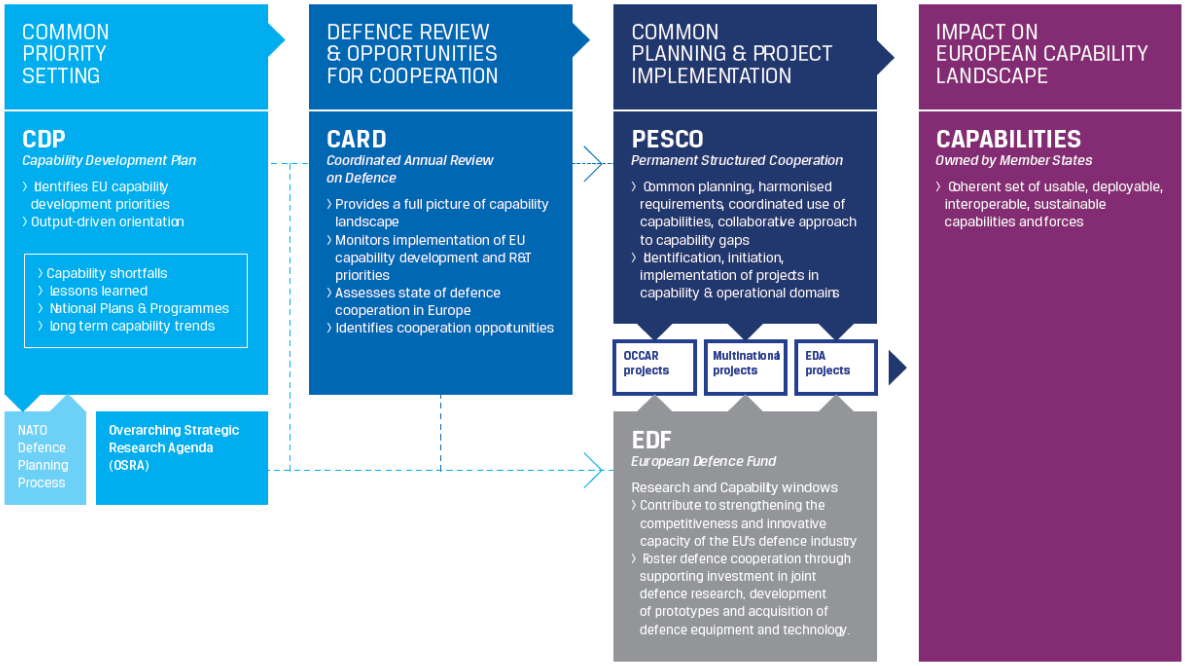


*Figure 5: The coherent framework of European defence initiatives*[79]

### At the stage of capability use

- The European Union Military Staff (EUMS): The EUMS is a team that works under the direction of the EU Military Council and under the authority of the High Representative; it is the source of military expertise within the EEAS. The EUMS coordinates the military instrument of the EU, with particular focus on missions (both military and those requiring military support) and the creation of military capability. As such, one of its roles is to oversee operations under the CSDP. Within the EUMS, a Military Planning and Conduct Capability was established in 2017 to manage the operational planning and conduct of the EU's non-executive CSDP military missions and, from 2020, to take responsibilities for one executive military CSDP operation of up to one EU Battlegroup-Size if so decided by the Council. The EUMS is also included in the Secretary role of EEAS in PESCO, where it in particular assesses the contribution of participating member states as well as the compliance of projects' proposals with operational needs.
- The European Satellite Centre (SatCen): The SatCen is an actor involved in both space and defence issues and, like the EDA, is an agency of the CFSP. As such, it is under the supervision of the Council of the EU; yet, it remains under the operational direction of the High Representative.

  The SatCen was created in 1992 by the Western European Union and incorporated as an EU agency on 1 January 2002. Its role is to provide high-level geospatial analyses to EU institutions and operational actors (e.g. EU missions and operations), member states and other international organisations. More specifically, it contributes to support the decision-making process leading to the definition of EU's actions in the field of the CFSP and CSDP by providing an autonomous intelligence gathering capability.

  To that end, the SatCen uses images acquired from open sources, commercial sources (mostly) or national assets, purchased from its own budget and/or obtained through the signature of agreements with member states possessing space assets. Thus, the SatCen receives images from Helios 2 and

[79] Source: European Defence Agency. "Factsheet: Coordinated Annual Review on Defence (CARD)"

classified direct links have been established with COSMO-SkyMed and SAR-Lupe ground segments. The next generation of space systems (CSO, SARah, CSG) will also be available to the SatCen.

Moreover, the SatCen is linked to EU flagship programmes, as it contributes to provide the Copernicus Service in Support to EU External Action (SEA), which is one of the three security-related missions of Copernicus. The SatCen uses and operationally manages Copernicus images exclusively for the SEA, which helps EU officials conducting the CSDP, but also national Ministries of Defence and Foreign Affairs if they request it.

To improve its services, the SatCen also engages in R&D activities, particularly for the use of artificial intelligence and machine learning in the field of image analysis. These endeavours are often conducted in collaboration with other organisations, such as EDA, ESA or the European Commission.

Finally, the SatCen has expanded its missions by playing a role in space situational awareness: it is indeed the Front Desk of the EU SST initiative, delivering services to users, helping them in case of need, and trying to expand the outreach of space surveillance and tracking.

The following figure is a representation of the European defence framework, including the relationships between the various institutions:

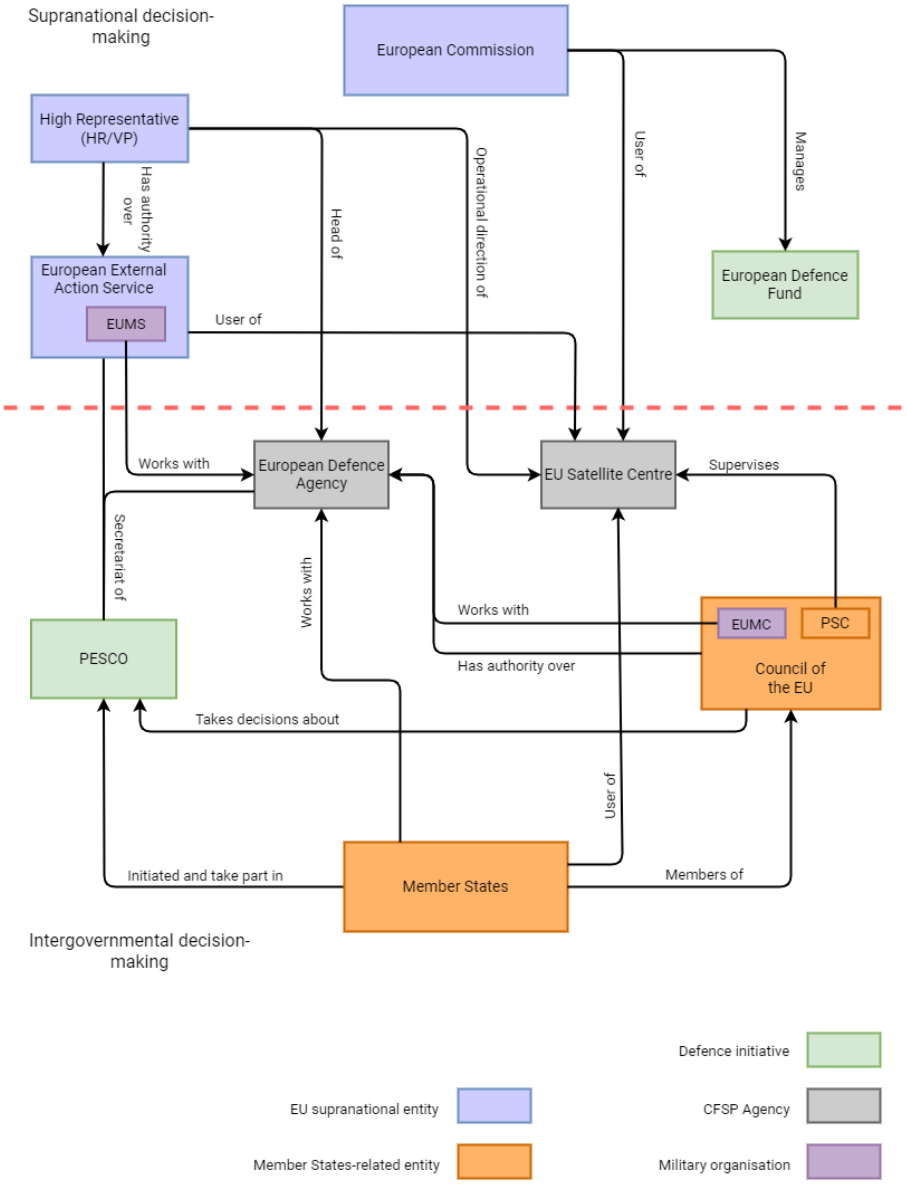


*Figure 6: The EU Security & Defence framework*

Since 2016, the European Union has launched or implemented a fairly complete and coherent framework to manage defence affairs, especially to help states develop common capabilities. However, the role of the EU has to be defined. Defence is not a Community competence and its management will not necessarily apply through supranational channels. Actually, the EU itself does not define its role as a leader but as a facilitator, acknowledging that it "cannot substitute Member States' efforts in defence, but it can encourage their collaboration in developing and acquiring the technologies and equipment needed to address common security and defence challenges"[80]. It is to be seen if the same logic will apply to space defence matters, given the new role of the EU in the space field.

### 3.3.2 The European Union, provider of a new impetus for space ambitions

The European Union framework for space is mainly based on four programmes at various stages of development or definition. Galileo, Copernicus, GOVSATCOM and the EU Space Surveillance and Tracking System are dual-use programmes that constitute the heart of the European initiatives regarding space. Practically, Copernicus has been operational since 2014 and Galileo since 2016. Furthermore, the European Union has adopted a Space Strategy for European and is debating on a European Space Programme to complete its space capabilities and develop its own vision and goals. Further enhancement and progress have been made possible by important and growing investment that could not be reached by one member state alone. For instance, €12.84bn was dedicated to the space budget of the EU over the period 2014-2020 while the European Commission proposes to devote €16bn between 2021 and 2027 (this is yet to be confirmed by the Council of the EU and the European Parliament). Similarly, the sales of the European space industry to the European Commission increased by 177% between 2017 and 2018, thus reaching €177 million. In comparison, the sales of the space industry to the European Space Agency increased by 7% over the same period[81].

#### Key policies and programmes

- Space Strategy for Europe (2016): Building on Article 189 of the TFEU, the Commission proposed a Space Strategy for Europe focused on four strategic goals:
  - Maximising the benefits of space for society and the EU economy,
  - Fostering a globally competitive and innovative European space sector,
  - Reinforcing Europe's autonomy in accessing and using space in a secure and safe environment,
  - Strengthening Europe's role as a global actor and promoting international cooperation.

One of the goals of the Space Strategy for Europe is to meet the need for Europe to ensure its freedom of action and autonomy, highlighting the strategic value of EU space assets. It is meant to be a tool to foster the role of the EU as a global player and an asset for its security and defence. The relevance of synergies between space and defence as well as the duality of space systems are especially emphasized. Thus, it is stated that "most space technologies, infrastructure and services can serve both civilian and defence objectives. Although some space capabilities have to remain under exclusive national and/or military control, in a number of areas synergies between civilian and defence can reduce costs, increase resilience and improve efficiency. The EU needs to better exploit these synergies" [82]. To this end, the role of the Commission is underlined: it is described as the appropriate actor to address the challenges linking space and security and defence issues.

[80] European Commission. "Factsheet: the European Defence Fund".
[81] ASD-Eurospace (June 2019). "Facts and Figures press release". Retrieved from: https://eurospace.org/wp-content/uploads/2019/06/eurospace-facts-and-figures-2019-press-release-final-19-june.pdf
[82] European Commission (October 2016). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Space Strategy for Europe*, p. 10. Retrieved from: https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/COM-2016-705-F1-EN-MAIN.PDF

- Regulation establishing the space programme of the Union and the European Union Agency for the Space Programme (in progress): First proposed in 2018 and currently under negotiation, this regulation sets the objectives and conditions for the implementation of space activities conducted by the European Union, and proposes a budget for them (to be confirmed in the Multiannual Financial Framework 2021-2027). Its goal is to simplify and streamline EU efforts in space and to harmonize existing rules. In this document, the EU acknowledges that space "play[s] an essential role in preserving many strategic interests"[83] and that it is "crucial that the Union remains a leading international player with extensive freedom of action in the space domain"[84]. Therefore, the permanence of EU initiatives should be ensured and the services they provide should be improved, so that they meet the new needs of users and are able to "meet political priorities" such as security and defence. In addition, the Impact Assessment of the EU Space Programme highlights the importance of space for the European economy as well as the existing synergies between space and security and defence to justify the importance given to the space sector, notably in the current global security context.

### Key initiatives of the European Union

The Union has been developing its own space initiatives and programmes since the end of the 1990s, namely the European Geostationary Navigation Overlay Service (EGNOS) and then Galileo and Copernicus, with the aim to satisfy the needs of EU citizens and the requirements of public policies. The European Union has heavily invested in the two flagship programmes, both financially and politically. Moreover, the EU is the owner of these constellations and, as such, Copernicus and Galileo are game-changers as they have been instrumental in initiating a supranational approach to space in Europe. Yet, even if they are fully owned and managed by civil institutions, security and defence-related applications have been envisaged since the inception of the programmes and are even increasingly encouraged by EU officials. The four main programmes of the EU in the realm of space are thus dual-use. They are synthetized below, with a highlight on their potential military applications.

- Positioning, Navigation and Timing: Galileo and EGNOS are two satellite navigation systems owned by the European Union. European independent access to a reliable positioning satellite signal is ensured by Galileo and, legally, relies on article 170 of the TFEU. The system will become fully operational in 2020, but the exploitation phase was launched in 2016. Galileo will offer four different services: an open, a commercial, a public regulated, and a search and rescue service. Moreover, the budget dedicated to Galileo/EGNOS has increased over time: €7.07bn over the period 2014-2020, while €9.7bn should be spent between 2021 and 2027. The European Commission is the programme manager and is responsible for its security and operations. At operational level, Galileo/EGNOS is managed by the European GNSS Agency (GSA), a coordinator body preserving public interests related to European GNSS programmes. The GSA is also responsible for the implementation of security requirements and consolidates the overall statement of compliance with the security requirements.

  Despite the definition of Galileo as a civil system under civil control both politically and operationally, one service provided by Galileo, the Public Regulated Service (PRS), is designed for sensitive applications and might thus be used for military purposes. PRS use is restricted to government-authorised users and duly authorised Union agencies. Yet, the way it is employed remains a national decision. Therefore, the military use of Galileo depends on the will of national leaders and will not necessarily be adopted by all EU member states.

[83] European Commission (June 2018). *Proposal for a Regulation of the European Parliament and of the Council establishing the space programme of the Union and the European Union Agency for the Space Programme and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013, (EU) No 377/2014 and Decision 541/2014/EU*, p. 1. Retrieved from: https://eur-lex.europa.eu/resource.html?uri=cellar:33f7d93e-6af6-11e8-9483-01aa75ed71a1.0003.03/DOC_1&format=PDF
[84] *Ibid.*

Due to the strategic dimension of Galileo, the European Union set up a procedure agreed upon in 2014 (Council decision 2014/496/CFSP, which updates the Council Joint Action 2004/552/CFSP) to protect the system in case of threats endangering the EU's or member states' security or essential interests. In this situation, the GSA must execute instructions coming from the Council (normal procedure) or the High Representative (if he/she decides that the situation requires an emergency decision)[85]. This procedure strengthens the supranational level, as the HR/VP gets important powers to implement its decisions, even if they remain provisional until their validation by the Council. In addition, a partial consensus has been reached to extend the scope of the decision 2014/496. All elements of the Space Programme defined as "security sensitive" could be affected by this decision and reactions to threats would rely upon pre-decided agreements on patterns of response varying according to the crisis scenario.

- Intelligence, surveillance and reconnaissance: Copernicus is the EU's Earth observation and monitoring programme and is partly owned by the European Union. Indeed, it is a programme building on existing national ("Contributing Missions") and European (Sentinel satellites) capacities. Like Galileo, this programme is completely under civil control and €5.8bn should be dedicated to it in the MFF 2021-2027. All Copernicus services are operational today. The programme performs three activities contributing to security and defence: border surveillance, maritime surveillance and support to EU External Action. The latter consists in the provision of a better assessment of the situation for EU officials but it can also be used to take decisions before or during EU military operations. One of its goals is to support the CFSP objectives and actions such as "surveillance of the Union and its external borders". Moreover, the European Commission and the EDA have led reflections on the use of Copernicus to improve the support to military operations.
- Satellite Communications: GOVSATCOM is a programme involving the European Commission, EDA and ESA and is crucial for civil and military missions/operations. Indeed, this project will enable member states to share the overcapacities of their governmental (non-military) satellites of communication in order to "ensure reliable, secured and cost-effective satellite communications services for EU and national public authorities managing security critical missions and infrastructures"[86]. Governmental satellites provide guaranteed and assured access to authorized users (including defence users) by offering resilient and robust security traits, even if they are less protected than purely sovereign military systems (MILSATCOM).

  In the frame of GOVSATCOM, the Commission stated its determination to cooperate with EEAS, EDA (which acts as a facilitator), SatCen, member states and ESA "to explore possible dual-use synergies in the space programmes"[87], thus enabling civil satellites to be used for military purposes and encouraging cooperation at EU level on space defence programmes.

  Before the current EU programme, EDA had already worked on a GovSatCom service for EU member states, with 15 participating countries. In this frame, EDA gathered and defined operational defence needs and has acted as a facilitator in support of the Ministries of Defence. Moreover, its Pooling & Sharing Demonstration Project entered its execution phase in January 2019.
- Space Surveillance: The EU Space Surveillance and Tracking initiative (EU SST) refers to the ability to detect, catalogue and predict movements of space objects orbiting the Earth. A Space Surveillance and Tracking (SST) Support Framework was established by the European Commission in 2014, which has encouraged collaboration between telescopes and radars of various countries to endow Europe with an autonomous SST capability. The latter is indeed essential for the long-term protection of

[85] For more detail on this procedure, see Annex G
[86] European Commission. "Space". Retrieved from: https://ec.europa.eu/growth/sectors/space_en
[87] European Commission (October 2016). *Space Strategy for Europe.*

European and national infrastructures in space as it enables seeing space debris threatening these assets, but also other satellites which could get too close to space systems.

An SST Consortium of five EU member states (France, Germany, Italy, Spain, and the United Kingdom) was formed in 2015. They were joined in 2019 by Poland, Portugal and Romania. States taking part in the Consortium provide data on the space situation, which are then used to supply three types of services (conjunction analysis, re-entry analysis and information, and in-orbit fragmentations data) through the EU SatCen, which acts as Front Desk and provides a common portal. The European Commission finances the services provision, the networking of national assets and their upgrades. Thus, the EU SST falls within the proposal of the EU budget for the period 2021-2027 (less than €500 million is requested). In addition, the Commission monitors the implementation of the SST foundational Decision. However, the governance of the Consortium is ensured by member states.

The duality of the project is illustrated by the fact that national delegates and experts come from both space agencies and Ministries of Defence. This dual-use character may be a hurdle to more cooperation. Indeed, each state operates and controls its own sensors because of the sensitivity of SST assets and data, which can be used for civil and military uses.

The European Union is thus increasingly present both in defence and space sectors. Synergies between both domains have been implemented since the beginning of the Space Age. Therefore, it is relevant to consider how space – especially the EU flagship programmes – is integrated in the emerging EU defence framework.

### 3.3.3 Synergies: the integration of space issues into the European security and defence mechanisms

The will of the European Union to exploit synergies between space and defence has been clearly emphasized by the establishment of a Directorate-General dedicated to Defence Industry and Space within the Commission for the years 2019-2024. Even if the role of the European Union in these two domains is different, the creation of this DG will facilitate the use of European capabilities for security and defence purposes. In industrial matters, it could foster cross-fertilization and strengthen the capacity of supply in Europe.

This step builds on the current overall linkage between space and defence in the European Union framework. Indeed, the two sectors are already quite intertwined, especially through the incorporation of space in several defence-related mechanisms, while the new DG will raise questions on the further integration of defence-oriented applications and operations in the EU space programme its impact on the EU space agenda and priorities, for example with regards to strategic autonomy and defence doctrine.

| | CFSP | | CSDP |
|---|---|---|---|
| | EUGS | EEAS | PSC |
| POLICIES | ● Considers space as a strategic field<br>● Identifies surveillance, reconnaissance, satellite communications, autonomous access to space and permanent earth observation as defence capability priorities in which investment is needed.<br>● Underlines the need to further enhance governmental satellite communications as a need to ensure the Union's credibility and capability as a security actor<br>● Promotes the "full use of the EU SATCEN"<br>● *Implementation Plan on Security and Defence* (November 2016): the EU acknowledges that it could "contribute from a security and defence perspective to (…) ensuring stable access to and use of the global commons, including the high seas and space" and that "existing EU policies in these areas should be taken forward in a comprehensive manner"<br>● Space considered as an enabler to achieve CSDP missions and goals<br>● In the document entitled "Implementing EU Global Strategy Year 3" : space mentioned as a means for resilience against natural catastrophes | ● Set up a Space Task Force in 2015, which is increasingly wiling to deal with security and defence-related issues. The Special Envoy for space (Head of the Task Force) advises the EEAS Secretary General on all space matters of EU interest. | ● Endorsed the document on the High Level Civil-Military User Needs for Governmental Satellite Communications in 2017<br>● Gives an opinion on Council instructions to GSA in case of a crisis affecting Galileo |

*Table 5: Space and defence synergies at the policy level*

| | PESCO | EDA | | | | EDF | |
|---|---|---|---|---|---|---|---|
| | | Definition of military requirements | CDP | SCC | CARD | PADR | EDIDP |
| CAPABILITY DEVELOPMENT AND FUNDING | ● 34 projects of cooperation under ownership and control of participating member states. 2 projects are related to the space field :<br>1. *EU radio navigation solution (EURAS)* : The project aims at promoting development of EU military PNT capabilities and future cooperation taking advantage of Galileo and the PRS.<br>Project Members : Germany, Belgium, Spain, Italy, France<br>Coordinator : France<br>2. *European Military Space Surveillance Awareness Network (EU-SSA-N)* : The main scope of this project is to develop an autonomous, sovereign EU military SSA capability that is interoperable, integrated and harmonized with the EU SST Framework initiative for the protection of European member states space assets and services. It will also enable appropriate response to natural and man-made threats.<br>Project Members : France and Italie<br>Coordinator : Italy<br><br>→ these two projects have a strong impact on the symbolic significance of cooperating in space defence | ● Common Staff Target : definition of harmonized military user needs<br>→ realized and approved for governmental SATCOMs (November 2014), Earth observation (June 2017) and PNT (June 2018) capabilities<br><br>● Common Staff Requirements: analyse the requirements and recommend implementing options<br>→ realized and approved for governmental SATCOMs (March 2017), ongoing for Earth observation and PNT (should be presented at the end of 2020) capabilities<br><br>● Facilitator to the MoDs for the development of capabilities<br>→ ongoing for governmental SATCOMs (mandate granted in March 2018) and PNT (mandate granted in September 2018) capabilities | ● Among the 11 categories of Priorities identified, one is focused on "Space-based information and communication services". It includes :<br>→ Earth observation<br>→ Positioning, Navigation and Timing<br>→ Space Situational Awareness<br>→ Satellite communication<br><br>● Other Priorities can make use of, or concern, space assets :<br>→ Information superiority (radio spectrum management, tactical communications and information systems, information management, and ISR capabilities);<br>→ Air Superiority (e.g. Ballistic Missile Defence);<br>→ Cyber defence, including in space | ● Out of the 11 upcoming publications (one SCC per Priority category), one will be dedicated to space. It will present the main characteristics, opportunities and challenges of the space priorities category<br>→ basis of the future space-related capability activities at EDA. | ● One of the collaborative opportunities put forward and retaining Member States' interest is the need for secure and state-of-the-art satellite communication. | ● Call for proposals on the topic of an "autonomous positioning, navigation and timing" → goal: to counterbalance the risk of operating in a GNSS denied/contested environment or the current physical limitations and developing a complementary device that "can be used without the need for position or timing updates" | ● Calls for proposals launched in the frame of the EDIDP :<br>- European Protected Waveform (EPW) → goal: to ensure more secure satellite communications. The EPW will be a critical enabler for CSDP operations and missions in providing secure and resilient communications in peacetime and during operations<br>→ it will increase EU's autonomy in access to SATCOMs for defence users.<br>- Operational EU military PRS receivers → goal: to ensure robust, secure and resilient EU military PNT capabilities and the development of military standardized Galileo PRS receiver capabilities and interface compatible with GPS/PRS solution for military purposes.<br>- Space surveillance awareness and early warning: some of the topics the proposals are invited to focus on are "European defence space surveillance network for standardized and secure exchange of SSA data among Member States", "Early warning against ballistic missile threats" and "Enhanced SSA sensors for accurate identification and characterization of existing GEO and LEO public and private assets"<br>- Persistent Earth observation from space with automated interpretation of data and information, including artificial intelligence, cloud solutions and real time on-board processing by sensors |

*Table 6: Space and defence synergies at the capability development and funding level*

| | SatCen | EUMS |
|---|---|---|
| USERS | ● Gathers images from national military space assets and from European programmes<br>● Produces analyses based on these images<br>● Contributes to implement the security and defence dimension of Copernicus, especially the Support to EU External Action (SEA) service. In the frame of the SEA, SatCen :<br>→ Operationally manages the service<br>→ Issues industrial service contracts<br>→ Monitors the quality of the service<br>→ Is the focal point for service's Authorised Users<br>● Cooperates with the SST Consortium acting as Front Desk for the provision of SST Services | ● EUMS can have a say in military space affairs :<br>→ Contributes to EDA endeavours in defining military user requirements, including for space capabilities<br>→ Big user of space and of the European organisations dealing with this domain (e.g. in 2013, EUMS requests represented 42% of SatCen activities) |

*Table 7: Space and defence synergies at the user level*

## 3.4 Key takeaways

The space defence landscape in Europe is a complex intermingling between national, intergovernmental and supranational actors with multiple levels of interaction. Yet, nation states remain the central actors and have a say at all three levels. Their activities and the depth of cooperation vary according to the dimension considered.

### Strategic thinking

- The conceptualisation of security and defence strategies remains the privilege of nation states, reflecting the variety of their specific interests and objectives. Yet, all main space powers in Europe converge on the acknowledgement of space as a strategic domain, thus facilitating a shared understanding of the challenges faced by European actors. For instance, all European member states agree on setting space surveillance as a priority for future capability development. However, there is no consensus on the ways to implement and to handle space defence issues and no mechanisms to ensure convergence in these matters. Yet, it does not prevent states from coordinating at the operational level of capability development and information sharing.
- At the European Union level, the four flagship programmes currently implemented or under development all address military applications even if they are managed by civil institutions. Duality is a core aspect of the space policy conducted by the European Union and paves the way to the further involvement of EU institutions in space defence issues. The heavy reliance on EU assets for civil and potential military purposes also raises concerns regarding their security, availability, and vulnerability, which need to be tackled.

### Operational level

- The participation of European states in international organisations, especially in NATO, is one of the pillars of European defence at large. The contribution of Europe to such organisations is the addition of the individual contributions of its member states, consisting in the provision of national capabilities, mainly controlled nationally, but whose services are put at the disposal of NATO forces. In a context of tense international relations, a key issue for Europe might thus be to be able to weigh in on the discussions, negotiations and decisions to be made. Therefore, the representation of European states in international space *fora* could be a question to consider, specifically whether it should continue on a purely individual basis or if some formal mechanism should be sought to reach an optimal coordination of their policies.
- Despite the supranational nature of the European Union, some of its initiatives are managed on an intergovernmental basis. The balance between these two pillars of cooperation is intrinsically part of the functioning of the EU, and is thus visible in space and defence initiatives. On the one hand, GOVSATCOM and EU SST projects are proposed by the EU as a pooling and sharing of national assets. In the case of the EU SST, the management of the initiative is even formally the responsibility of participating member states. In contrast, Galileo and Copernicus constellations are owned and operated by the European Union. On the other hand, the EDF and the EDIDP are initiatives from the European Commission, which enable the supranational level to get a foothold in defence issues, but the projects funded, for instance in the frame of PESCO, will be managed by intergovernmental means. This situation adds a layer of complexity that may need clarification to streamline the actions of European actors.
- Balance is a requirement for successful cooperation. Space and defence initiatives outside and within the frame of the European Union do not always involve the same countries. Each kind of cooperation ("restricted" or "extensive") has its own merits but they both need to be balanced among partners to

work properly. With the extension of cooperation, three specific issues arise: states have to converge on the objectives they want to reach; the character of the contribution of each state has to be agreed upon; and the nature and amount of the return on investment for each state has to be defined. In addition, the governance scheme regulating interactions and responsibilities between states must be clear and accepted by all participants. If involved states agree on these prerequisites, cooperation will be facilitated, especially if the number of participants is important.

### Capability development

- Countries involved in space defence issues are prone to consider bilateral or intergovernmental cooperation in the realm of military space activities. Such cooperation follows different models but national states have never given up their capacity to develop national programmes. Similarly, information sharing is framed by various agreements negotiated between partners and delineating precisely their rights and obligations. However, involvement in such programmes does not necessarily mirror a fully shared vision on space defence issues among partners, sometimes driven by opportunistic financial considerations. Mutual trust between states is yet a prerequisite to the operational implementation of a military space strategy at European level (either intergovernmental or supranational), as well as to the setting up of space defence as a key EU objective in its own right.
- When addressing European cooperation, industrial issues are major concerns to member states. The EU has a clear role to play in strengthening the further integration of member states’ industrial capabilities into a space defence framework. At the same time, the development of national capabilities to foster domestic industry may lead to duplications in Europe. This, for instance, is the case in the Earth Observation domain: Germany and France both develop optical means, while Spain and Italy are developing (or interested in) national optical and radar systems. While a certain degree of duplication of capacities across Europe is desirable to stimulate competition among industrial players, excessive or unnecessary duplications may adversely affect the overall competitiveness of the European industry as well as the cohesion among states.

# 4 Towards a European Space Security & Defence Policy

## 4.1 Wrap-up and stakes for Europe in space defence

The space environment has evolved over the past ten to fifteen years, increasingly becoming an area of competition and confrontation. Even if the use of space for military purposes has not fundamentally evolved besides technical progress, the defence of assets in space has grown in importance. Indeed, major space powers are being more assertive and recent developments in the use of space technologies create new risks to space systems. In Europe, both national projects and intergovernmental cooperation coexist, with the latter taking many different forms. In addition, the involvement of the European Union in the space defence field is growing.

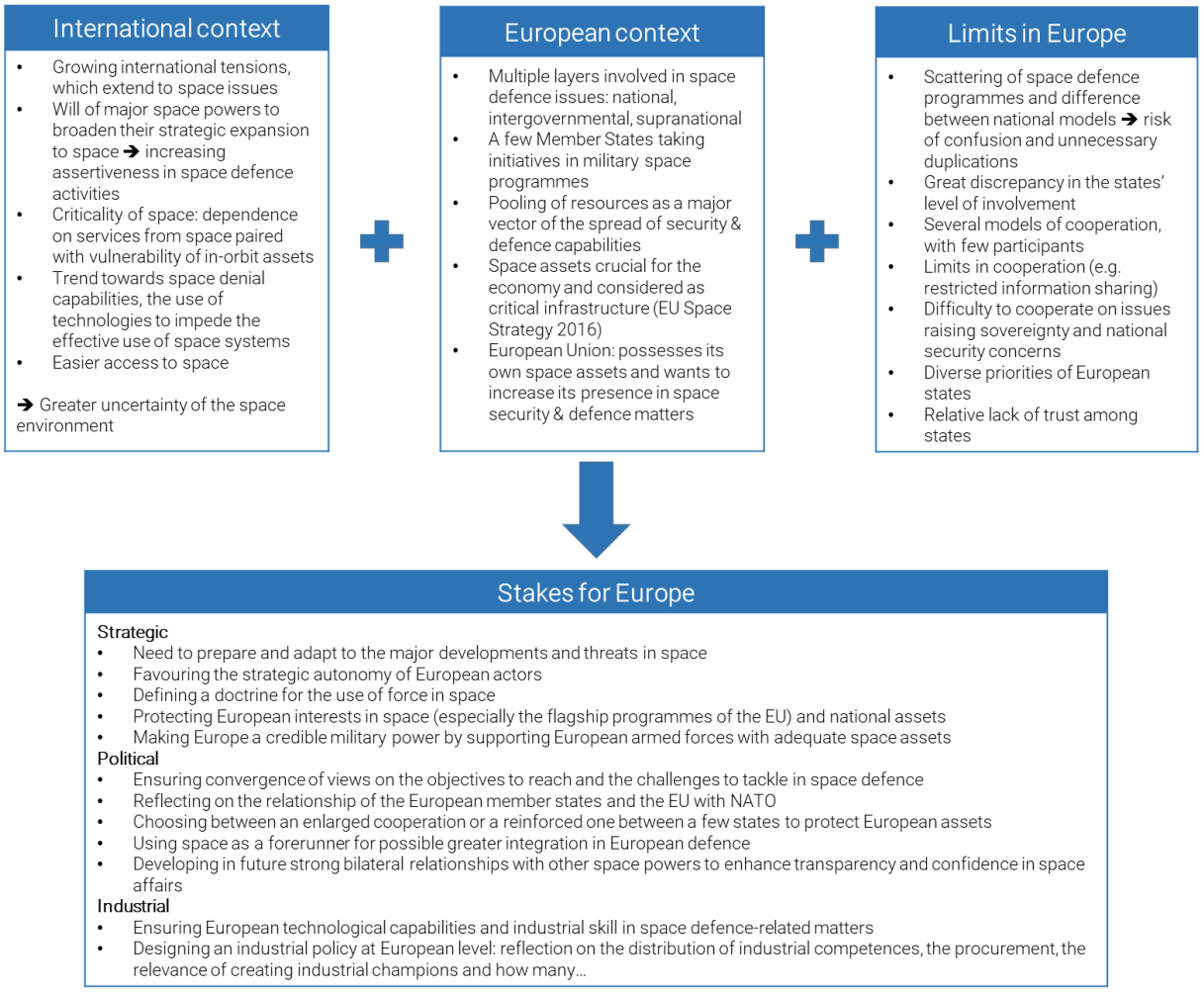


*Figure 7: Stakes for Europe in the space defence field*

**Addressing these stakes is essential to ensure the position of Europe in space in the long run, able to weigh in on the international scene (and not only to react to what others do) and to maintain capacity to act in full autonomy as well as in the framework of global cooperative schemes.** To this end, the elaboration of a joint European Space Security & Defence Policy could be a step forward for European actors to set common positions in this matter and not be left out on this highly critical issue.

One of the key drivers, as well as one of the major challenges in the drafting of such document is to devise to what extent and under which conditions European member states might be willing to set up a collaborative framework for space defence.

Indeed, the history of Europe in space is much about how member states have been able to find appropriate frameworks to join efforts and pool resources:

- Through ESA for Science & Exploration, space technology development, support to the industrial base, development of civil operational systems, etc…,
- Through the EU for the deployment and exploitation of critical infrastructures.

Space defence certainly is the next step. However, for the time being, several specificities concur to make it highly challenging:

- Owing to national sovereignty considerations, there is no doubt that national programmes and nation states will continue to play a major and structural role in this domain,
- There is no shared vision on the objectives to be set in terms of space defence operational capacities,
- There is no consensus on the degree of autonomy to be achieved by Europe in this matter,
- The current gap in industrial and technological capabilities related to military space activities throughout Europe makes it difficult to envisage the broad integration of a vast majority of member states within such programmes.

In this respect, cooperation should thus be considered here in its broader sense since it can be implemented at various levels as synthesised in the chart below that ranks various options along the depth of arrangements or agreements incurred.

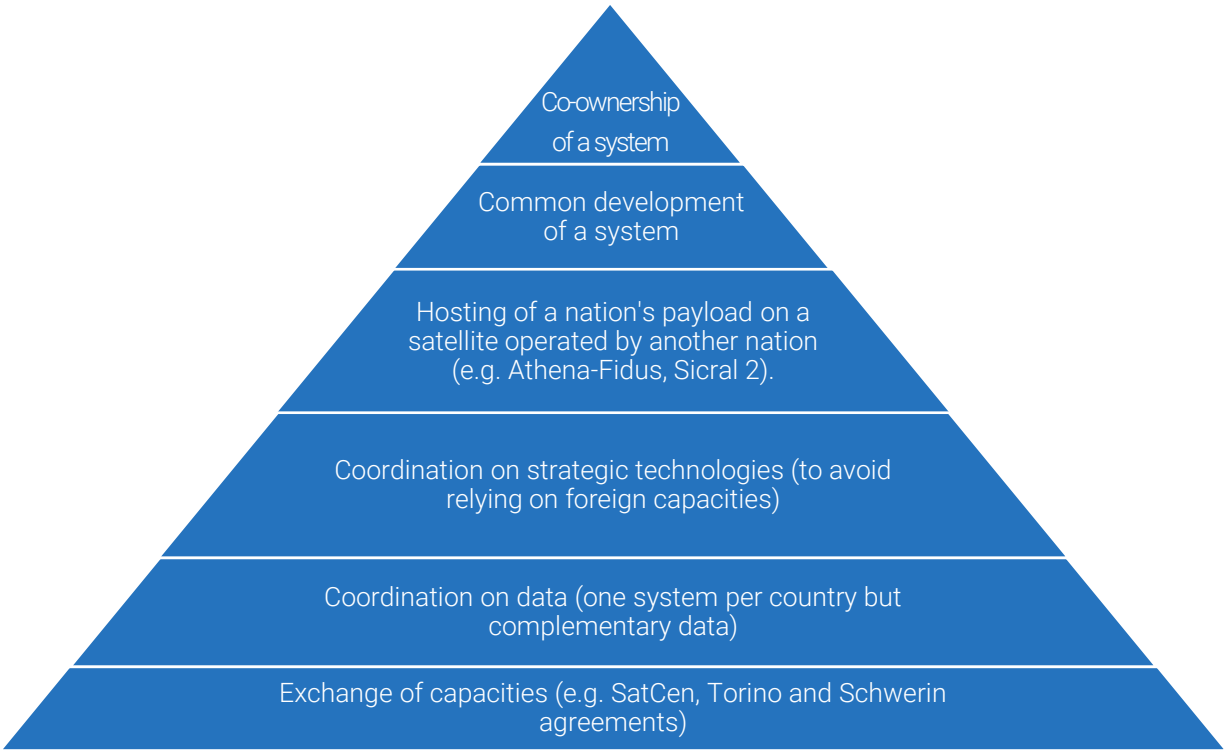


*Figure 8: Possible levels of European cooperation in space defence*

## 4.2 Necessary conditions for a European Space Security & Defence Policy

More concretely, designing a Space Security & Defence Policy for Europe can only be conceived in a step-wise approach given the long way ahead in order to achieve the desirable degree of convergence. In particular, several key topics must be thought through at political, operational/military and industrial levels.


*Figure 9: Key conditions before implementing a European Space Security & Defence Policy*

### 4.2.1 Agreeing on a shared global vision

European actors first need to find a common ground on their perception of the international environment in the space sector as well as a joint understanding of the key challenges facing Europe. This is an obvious prerequisite before considering any joint approach to space defence issues. This is also a necessary step before looking into the respective roles and ambitions of states and of the European Union vis-a-vis the rest of the world.

Several European space countries are increasingly acknowledging space as a strategic domain, sometimes for different reasons. Therefore, in order to achieve a sufficient degree of convergence in space defence, broader geopolitical visions should be harmonized. As Mr. Tomas Husak, Ms. Elżbieta Bieńkowska's chief of cabinet put it: "To be able to produce together, to agree on the integration of certain capacities and to deal with the problem of mutual dependence, we must have the same strategic perception"[88]. European states must thus acknowledge that they face common threats and challenges at the global level[89]. This work is currently being undertaken within NATO, and the proposals of EU Member States in the realm of European defence aim at providing balanced, complementary and coordinated efforts with the Alliance.

In the non-space military context, it should be recalled that some initiatives have been taken outside of the EU framework with the aim of harmonizing points of view. For instance, the ultimate declared goal of the European Intervention Initiative, set up in 2018, is to "develop a shared strategic culture"[90] that will

[88] "Defence: national sovereignty and/or Europe?" (June 2019). Debate organised by La Tribune. Retrieved from: https://www.youtube.com/watch?v=SEeFvNSWdG0
[89] *Ibid.*
[90] *Letter of Intent Concerning The Development of The European Intervention Initiative (EI2)* (June 2018)

enable European states "to carry out military missions and operations under the framework of the EU, NATO, the UN and/or ad hoc coalitions"[91].

Regarding NATO, this organisation is certainly the right framework to share information and opinions on how to envisage NATO-wide initiatives in a global context, but it might not be the most appropriate for the building up of a European vision supporting the protection of European interests.

Within Europe itself, differing perceptions might lead states to adopt differing, if not contradictory, answers. A key concern in this respect, for instance, is the notion of European autonomy since some countries have no reservation in relying on non-European solutions to ensure their security, while others clearly prioritize the development of indigenous solutions. Therefore, any European initiative must be ambitious enough to ensure a credible "guaranteed security" level so as to provide incentives for further political and financial investment in common projects at European level.

### 4.2.2 Ensuring complementarity between national, intergovernmental and supranational responsibilities

In Europe, the current approach to space security and defence functions builds upon a multi-layered structure of diverse frameworks and activities. Organised at national, intergovernmental and European levels, institutional efforts span the spectrum of capacity-building programmes, legal and regulatory measures, cooperation arrangements and diplomatic initiatives.

Moreover, within the EU framework, institutions have different focuses. For instance, the European Commission mostly adopts an economic standpoint while EDA addresses capability issues.

This complex setup makes it necessary – as well as highly challenging – to ensure coordination and complementarity of activities among the multiplicity of actors so as to avoid unnecessary duplications, especially in times of scarce resources. Cooperative schemes across the continent should be implemented to the largest extent in order to gather contributions from all European states, to foster joint policies and decisions, and to favour the spreading of capacities.

This requires a clarification of roles and responsibilities, as well as the definition of adequate mechanisms for decision-making among European actors. Activities will continue to be structured at three different levels:

- At supranational level through the EU wherever necessary. This necessity should be assessed along formally agreed upon criteria since it implies some kind of transfer of sovereignty by national states. This might result in the setting up of one additional flagship programme dedicated to space security issues in which the EU would be given a leading political role and the ability to take decisions regarding the management and protection of European space systems.
- At intergovernmental level whenever possible, based on the will of member states. The EU here plays the role of "facilitator", backing intergovernmental cooperation and promoting the pooling of national resources, especially through financial incentives. This model is witnessed in initiatives such as the EU SST and, despite some weaknesses, it produces benefits by creating interest in these questions in states and by enabling discussions among them on this topic.
- At national level when sovereignty concerns prevail.

[91] *Ibid.*

| | Benefits | Limits/Drawbacks |
|---|---|---|
| National level | • Full autonomy in the management of programmes<br>• Quicker development of assets<br>• Easy set up of quick operational processes to operate and protect the assets | • Limited resources while expensive programmes<br>• Difficulty to get the full spectrum of space assets (optical, radar, SIGINT…)<br>• No interoperability, which is a drawback for potential multinational military operations<br>• Difficulty to protect a large amount of satellites |
| Cooperation at intergovernmental level | • Reduction of costs<br>• Access to other capabilities<br>• Strong basis for common work thanks to smaller cooperation<br>• "Division of labour" among states to avoid industrial concerns | • Need to design and agree on specific interstate arrangements<br>• Requires a certain amount of trust<br>• Possibility to end the cooperation and come back to a national basis<br>• Exclusion of other countries, which can thus prefer to rely on NATO, the United States… It can broaden the differences among EU countries |
| Cooperation at European Union level | • EU funding<br>• Reaching an appropriate scale to face international rivals (both politically and industrially)<br>• Guarantee of an autonomy of decision for all European countries<br>• Raises the interest of "non-traditional" countries for space defence issues<br>• Protection of space assets of European member states and the European Union<br>• Quick operational processes achievable if the supranational level is involved<br>• Possibility to choose the level of cooperation (intergovernmental or supranational) | • Risk of slowing down initiatives because of large/inclusive cooperation<br>• Requires transfer of competences if not sovereignty to a certain extent<br>• Heterogeneous point of view among European institutions (European Commission, EDA…)<br>• Creates issues regarding the distribution of industrial competences on an EU-wide basis |

*Table 8: Benefits and limits of addressing space defence issues at national, intergovernmental and European level*

### 4.2.3 Increasing trust in military matters among cooperating partners

When it comes to cooperation in security & defence matters, trust among partners is a prerequisite. It has to be built up at the same time at the political level, but also at the operational level among military actors and national security communities.

Among European member states, the level of trust is obviously high enough given the strong community of interests, but national concerns might still be a source of limitation in mutual trust. It can currently be observed in the limitations applied to the sharing of data and information delivered by joint observation systems: partners in Helios 2 or Pleiades do not have access to the images requested by the others, especially at the moment the request is made. Indeed, countries do not want their partners to know what is of interest to them at a certain point in time. Similarly, at another level, when data from national capacities are put at the disposal of the EU (e.g. through the SatCen), member states remain in control of tasking processes and keep them sealed from other countries.

Several factors contribute to this state of play. At the stage of programme elaboration and management, there are:

- Leadership considerations at political level
- Industrial competitiveness is also at stake, especially in the framework of joint development of capacities.

When it comes to the exploitation of data, additional matters come into play:

- National diplomacy, which creates different areas of interest strongly shaped by the specific historical links of each individual country,

- Economics is another one given the fact that the EU regulations favour competition among member states as a driver for progress.

It is likely that these elements will continue to play a role. Further progress can be reasonably expected, along with the continued move towards the building up of a European defence. Space has always been at the forefront of this trend given the long-established tradition of cooperation among European member states in civil programmes. Major concrete achievements have also been achieved in the space-based defence-oriented applications. However, the setting-up of a European space defence will not emerge before the conditions are met at the political level.

Yet, progress at this level is not sufficient. **Political leaders must ensure that their cooperation agreements are fully implemented on the operational side.** Indeed, because of a lack of culture and habit to cooperate between intelligence communities, especially on a multilateral basis, operational actors may tend to express reluctance at sharing information with several other countries. To solve this issue, continuous political control over military actors is required; evolution of their training, which would stress more the benefits of European cooperation, could be reflected upon; finally, an incremental approach encompassing active cooperation through concrete operations may contribute to enhancing trust among operational actors.

Once trust will be strong enough, reflections may start to take place on the setting up of a clear command and control chain at European level, which would be activated without further discussion among member states when operations to protect common space assets will have to be launched.

### 4.2.4 Reflecting on a military doctrine for space

One of the major issues to overcome along this path is certainly the elaboration of a doctrine on the use of force in space. This issue is highly controversial on the international stage and reactions to the recent announcements made in particular by the United States have been very vivid. This topic is divisive among European nations that are on very different lines. At the moment, France is the only European nation having expressed its readiness to consider the use of active defence capabilities in orbit.

Whether or not the development of active weaponry in space is inevitable is a main concern and a key question for the future of the sector. The answer to this question will depend on the strategy of the major space powers, namely the United States, Russia and China, and to a lesser extent India. For the time being, there are many reasons to believe that the current trend will continue since the U.S. decision seems irreversible and will trigger some reactions from its rivals.

In military terms, defence can be either "passive" or "active". In the former, measures are taken to "reduce the probability of and to minimize the effects of damage caused by hostile action without the intention of taking the initiative"[92] whereas the latter describes "the employment of limited offensive action and counterattacks to deny a contested area or position to the enemy"[93].

An offensive doctrine is unlikely, but putting aside legal considerations regarding the Outer Space Treaty, that have been amply addressed in the literature, **Europe will have to define its own vision, which cannot be restricted to a yes or no about the use of active systems in space. On the contrary, some joint reflections should be shortly undertaken to consider under which conditions the use of force in space could be envisaged or not, and the kind of actions that could be executed to prevent it.** Such reflections should avoid being generic, but concretely adapted to the reality of the situation of European space assets (in particular, their level of resilience) and of their strategic, political or economic value.

[92] U.S. Joint Chiefs of Staff (June 2019). *DOD Dictionary of Military and Associated Terms*. Retrieved from: https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/dictionary.pdf
[93] *Ibid.*

A strategic driver could be to ensure "deterrence" to avoid aggression on European space assets. However, exploring this dimension entails that a clear definition of what constitutes a hostile act in space must be provided: the threshold of war has to be delimitated and stated to other states so that they become aware of which actions would prompt a reply from European actors. It could be complemented by a reflection on the application of the right of self-defence to space. These are highly sensitive issues that have many legal and political implications. This is probably the reason why a unified European position in these matters will take time and Europe, more than any other space power given its diversity, will have difficulties in coming up with a shared vision.

Yet, can Europe afford to remain singularly out of this game? Will a few European member states take over the defence of EU space assets? Or should a common defence under the direct responsibility of the EU be implemented? This remains to be seen.

Whatever the decision finally approved, national and European decision-makers will have to keep in mind the main topics currently debated in the space defence field when devising the future doctrine:

- The ability to anticipate and prepare for a conflict;
- Deterrence measures;
- The improvement of resilience.

All of them rely on a diversity of activities, but intergovernmental cooperation is a real added value to facilitate their actual implementation.

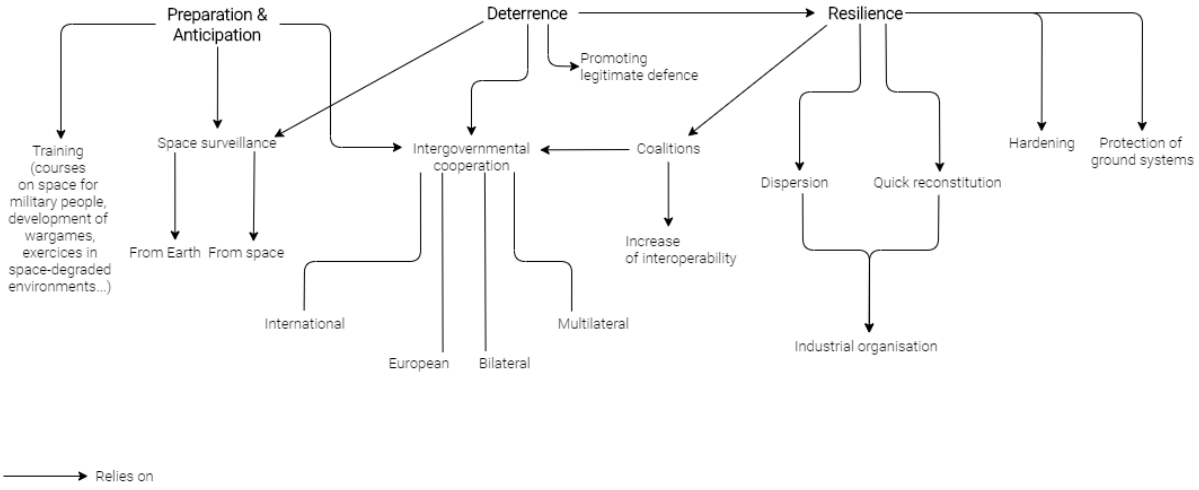


*Figure 10: Core elements of a future doctrine on space defence*

### 4.2.5 Safeguarding the sustainability of European space industry

The rise of private actors in space over the last few years has raised commercial ambitions and expectations worldwide. In this context, the European space industry is facing global competition fiercer than ever.

Yet, maintaining the broader space industry is required if Europe wants to be able to develop a space defence sector. Indeed, "[t]he industrial capabilities of a state or a community of states like the EU is the basis of the credibility of its defence"[94]. The military is currently contributing to this industry. Indeed, "military institutions sales are participating to a large amount to the European institutional market

[94] Brachet, Gérard and Bernard Deloffre. "Space for defence: A European vision". *Space Policy* 22, 2006, pp. 92-99

demand"[95] and sales of the industry for military programmes to military institutions have almost continuously grown since 2009 to reach €661 million in 2018, that is, an increase of 117% between 2009 and 2018[96]. However, military applications of space remain under-developed in Europe[97] and broader measures could be taken to support the European space industry, such as the reinforcement of European investment (through institutional demand or subsidies) and adaptation of the industry to help it become more competitive.

In this respect, the space civil and military sectors are intertwined, and **European space policy or strategy should encompass both of the areas that cannot be considered separately or, more precisely, that need each other to be commercially viable, and therefore affordable to European institutions.** Such approach has never been implemented in Europe, since both ESA, which has been instrumental in the shaping of the European space manufacturing sector, and the EU, have mostly focused on civil applications, while member states have dealt with military programmes nationally.

### 4.2.6 Contemplating a potential European space industrial policy

The development of industrial capabilities is one of the major reasons for member states to invest in space programmes. This has been the recipe for the success of ESA in an intergovernmental model. In the military domain, not limited to space, this kind of complementarity among partners is much more difficult to implement since it implies a high degree of interdependence. Therefore, the distribution of space defence-related industrial capabilities across Europe is a critical issue that needs to be addressed, potentially in the framework of the setting up of a dedicated industrial policy. The stakes are high in this matter:

- Availability of critical industrial capabilities directly conditions the level of autonomy of Europe once it has been set (see section 4.2.1). Autonomy "is unachievable if it does not rely on capabilities and, therefore, on a critical mass in the industrial field"[98]. Therefore, supporting existing champions and consolidation of, or cooperation on, programmes might be required.
- Stability and predictability in a substantial domestic market is an enabling factor to ensure the sustainability of industry (see section 4.2.5).
- The key conditions to be met for establishing a sound market are the following, that need of course to be further considered on a case by case basis:
    - Ensure the availability of critical technologies in design and manufacturing,
    - Maintain multiple sourcing whenever desirable for reliability and/or competitive procurement purposes,
    - Avoid unnecessary duplications.

**Were development of industrial capacities to remain a key driver for states to contribute to a common effort in space defence, major redistribution of competences would become necessary given the discrepancies between European states regarding their progress in space defence matters.** Thus, some states already have a well-working defence space industry, or are developing it, while others have no existing capabilities and would need to massively invest in the framework of a traditional intergovernmental cooperation model to replicate competences already available in some other countries. Moreover, if an incremental approach were adopted to progressively involve a greater number of European nations in such

[95] ASD-Eurospace (June 2019). "Facts and Figures press release". Retrieved from: https://eurospace.org/wp-content/uploads/2019/06/eurospace-facts-and-figures-2019-press-release-final-19-june.pdf
[96] *Ibid*.
[97] ASD-Eurospace (June 2018). *Facts & Figures, 22nd edition: The European space industry in 2017*.
[98] Laporte, Natasa (June 2019). "Défense : souveraineté nationale et/ou Europe ?". La Tribune. Retrieved from: https://www.latribune.fr/entreprises-finance/industrie/aeronautique-defense/defense-souverainete-nationale-et-ou-europe-821345.html

programmes, integration of newcomers might be even more difficult since industry would primarily develop in states taking part in early-formed reinforced cooperation schemes. Therefore, an ESA-like broad intergovernmental model might not be the most appropriate or realistic.

Then, two alternatives might be considered:

- Either an immediate supranational model under the authority of the EU, with all the above-mentioned concerns related to the difficulty of member states in converging in the short term on general principles of action in space,
- Or a restricted intergovernmental model around a handful of the most motivated member states taking charge of the protection of EU space infrastructures along with their national assets. Such a deal among European member states obviously has many deep political implications, but it would greatly improve the prospect for a space collective security in Europe in the short or medium term.

### 4.2.7 Recognising the crucial nature of political will

Any progress on space defence is conditional on a strong political will from European states (to accept change leading to a modification of governance) and from the European Union (to come up with a joint vision compelling enough for member states). Unlike the civil space domain, which started on technological grounds and progressively gained political momentum thanks to the scientific, operational and commercial successes of ESA and national space initiatives, cooperation in space defence needs to be initiated at political level given its interrelatedness with sovereignty and national security concerns. A political impetus is thus necessary to address the aforementioned issues, since:

1. Joint political will is necessary to understand the geopolitical vision of other nations and agree on compromises.
2. Joint political will is necessary to give concrete meaning to the notion of European sovereignty.
3. Joint political will is necessary to reinforce trust among European partners, including at the operational level.
4. Joint political will is necessary to elaborate a doctrine for collective action in space.
5. Joint political will is necessary to ensure sustainability of the European space defence industry.
6. Joint political will is necessary to tackle industrial policy-related issues.


*Figure 11: The key role of political will*

## 4.3 Way forward to a European Space Security & Defence Policy

The setting up of a European Space Security & Defence policy relies on three key components: the ends (what needs to be achieved); the ways (how it should be achieved); and the means (with which resources it should be achieved).

In the case of a European Space Security & Defence Policy, these elements can be expressed in three levels: policy (ends); systems operations (ways) and capability development (means). At each stage, several issues must be raised and answered. The table below summarizes the main elements to be reflected upon by national and European stakeholders.

| POLICY | |
|---|---|
| Nature of the European Space Security and Defence Policy | • Should we have one European defence policy with a dedicated Space focus or a self-standing European Space Security & Defence policy? |
| Ways and ends of the European Space Security & Defence Policy | • What are the objectives of Europe in the space defence field?<br>  ○ Explaining why Europe is exploring this topic can contribute to reducing reluctance<br>• How to reach these objectives?<br>  ○ What kind of cooperation: extensive (with as many countries as possible) or restricted (starting with a few countries willing and able to contribute)<br>  · Given that small cooperation seems favoured at present<br>  · Risk of **"free rider" behaviour**<br>  ○ What level of cooperation: dialogue, coordination, cooperation, integration…<br>  · Favouring an **incremental approach** seems more accepted, even if it has weaknesses<br>• What conditions for common action: when and how should a collective reaction to a hostile action against one country take place?<br>• **Need to elaborate a military doctrine on the use of force in space** |
| Relations with non-European countries | • What should be the position of European actors towards the United States and NATO?<br>• How should this position be determined and represented in international space *fora*: on a national basis, through an established coordination mechanism?<br>• How to ensure consistency with NATO space policy?<br>• Following Brexit, should the UK and the EU set up a particular bilateral relationship for space?<br>• How to make Europe-wide cooperation more attractive than current bilateral partnerships? |

| SYSTEMS OPERATIONS | |
|---|---|
| Defence of space | • What are the responsibilities in case of crisis: who is in charge of detecting and responding to threats?<br>  ○ At EU level: roles of the EC, EEAS, GSA, member states<br>  ○ At intergovernmental level: one leading country which has a delegated authority or multinational management?<br>• What means should be used to protect space assets: national means, common means, both?<br>• Should commercial assets be protected by military organisations, due to their importance for economy and society?<br>• What processes could be implemented? What could be the chain of command?<br>  ○ There is a **need to define quick operational processes**<br>• Possibility of drawing on existing mechanisms at national or EU level (e.g. Decision 2014/496 on Galileo protection) |
| Space for defence | • How to implement and streamline the use of common assets for military purposes, including national and multinational operations?<br>• How to coordinate the use of national assets for military purposes, including national and multinational operations?<br>  ○ **Bi- and multilateral agreements on capacities** (data exchange) to get operational synergies<br>• **Pre-negotiated agreements triggered in case of crisis** and putting at disposal the satellites of another nation |
| **CAPABILITY DEVELOPMENT** | |
| Nature of the capabilities to be developed | • Which technologies should be given development priority to defend space (military-focused surveillance, counterspace, "bodyguard" satellites…) and to use space for defence?<br>  ○ Role of the EDA in defining the military requirements for specific capabilities<br>• What requirements for the systems (resilience, cybersecurity, agility…)?<br>• How to ensure resilience of the systems: hardening of the systems; redundancy of the systems; interoperability with non-European systems…? |
| Development of capabilities | • How should these capabilities be financed?<br>  ○ Role of the European Defence Fund<br>• How should they be developed: development through collaboration or through national development but assets put at the disposal of other nations…?<br>  ○ Role of the European initiatives (PESCO, EDF) in promoting collaborative development |

| | |
|---|---|
| | • If cooperation, what kind of cooperation should be implemented?<br>  ○ What size?<br>  ○ Balanced or unbalanced (with one major leading state) cooperation?<br>  ○ Division of labour between states (with, therefore, "mutually agreed dependencies") or development by each of them of the ability to build several types of satellites?<br>• How should a European industrial policy related to space defence look?<br>  ○ Need to consider the issues of competitiveness and intra-European competition<br>• Could a European big project in space (perhaps promoted by the EU) help to gather the European industry (e.g. a space plane)? |

*Table 9: Key questions for a European Space Security & Defence Policy*

## 4.4 Conclusion

Faced with an increasingly tense global space landscape, European actors have started to take measures related to space defence. These measures are at the moment decided at national level but, given that several military systems are already the result of multinational cooperation, collaborative work at other layers seems worth being explored. The growing interest of EU institutions in this domain and the creation of a Directorate-General for Defence Industry and Space are also opportunities that member states can seize to improve the defence of their assets and extend communication between them on these matters, that are of importance for the future of European autonomy of decision and action. Moreover, the current role of facilitator played by the EU might change, as the Union now possesses its own assets with defence applications. Thus, the question of whether the EU must be granted a political role in this domain, or not, must be raised.

Actually, the multiplicity of organisations involved and the difference of advancement and positions in space defence endeavours will make difficult the path towards a European Space Security & Defence Policy. However, the strategic necessity of space, the increasing involvement of European institutions, as well as the history of space as a vector of cooperation on the continent make this field a relevant domain to raise questions and test potential solutions on the governance of defence activities in a European framework. In order to find acceptable schemes, a calculation has to be made that balances the demands for sovereignty from member states, industrial concerns, and the benefits that can be drawn from intergovernmental or supranational European cooperation.

# ANNEXES

## Annex A – The space defence landscape in France

### Strategy

France first identified space as a sector of vital importance in 2006[99]. The military consequences were then drawn in the 2008 and 2013 White Papers on Defence and National Security; the 2012 French Space Strategy (briefly); the 2017 Strategic Review; and the 2019 Defence Space Strategy. These documents stress:

- The need for space surveillance, of LEO and GEO, including through a European cooperation that pools national resources
- The need to leverage dual-use assets, and the risks of these technologies (e.g. RPOs)
- The need to protect French space assets, which is clearly expressed in the latest documents, the 2017 Strategic Review and the 2019 Defence Space Strategy

| Document | Main statements on outer space |
|---|---|
| White Paper (2008) | • Recognises space as a strategic domain<br>• Emphasizes the need to oversee it because only the United States and Russia (to a lesser extent) are able to monitor objects in space; encourages the creation of a European capability |
| French Space Strategy (2012) | • Declares that maintaining the autonomy of military space capabilities is a priority<br>• Encourages defence to leverage to the maximum the dual-use aspect of space assets<br>• Defines high resolution optical observation, secure communications, SIGINT and early warning as the main axes of development for defence<br>• Recalls the will to develop a European surveillance capability |
| White Paper (2013) | • Stresses the need for surveillance, which would enable France to benefit from an independent assessment of the situation<br>• Asserts that space capabilities in Europe should be pooled and that France is willing to apply an approach based on mutual interdependencies in the field of space intelligence |
| Strategic Review (2017) | • Expresses the need to modernize and reinforce surveillance means of space (in LEO *and* GEO) and from space (early warning)<br>• Highlights the need to enhance the resilience of French space assets<br>• Acknowledges the risk that some states may deny access to space or damage its components. Expresses concern regarding the development of RPO technologies that can be used as ASAT systems |

*Table 10: The involvement of space in French strategic documents (before 2019)*

[99] "Arrêté du 2 juin 2006 fixant la liste des secteurs d'activités d'importance vitale et désignant les ministres coordonnateurs desdits secteurs" (June 2006). Journal Officiel de la République française. Retrieved from: https://www.legifrance.gouv.fr/jo_pdf.do?id=JORFTEXT000000423259

In July 2018, French President Emmanuel Macron announced that a Defence Space Strategy would be prepared. In July 2019, this strategy was released and presented by the Minister of the Armed Forces. Three axes are prioritised:

- Creating a Space Command under the authority of the Air Force, which will eventually become the Air and Space Force. This Command was set up in September 2019, with its headquarters in Paris. The Air brigade for space will be positioned in Toulouse from 2025. The Space Command currently hosts around 220 people, and is expected to grow with time (to around 500 people in 2025). By 2030, it is likely to gather the means currently spread in the various branches of the military and which contribute to the good use of space means. It has three objectives: reinforcing French capacities regarding space support to operations; developing autonomy in the field of space situational awareness in all orbits; and developing capabilities for active defence in space. This Command embodies the will of France to switch between the logic of space as a domain supporting operations and the logic of space as a warfighting domain, similar to the other operating domains.

- Adapting the law to differentiate the rules applying to military space operations and to space operations from private actors. Two principles will direct the proposal: first, freeing the capacity of action of the armies so that they have greater leeway to defend national interests. Therefore, the Ministry of Armed Forces wants to develop its capability to operate its assets, in close collaboration with CNES. The second principle is to protect French space capacities, military or civil, of a strategic nature.

- Improving space defence capabilities through a new armament programme called "Maîtrise de l'espace" (Space Control) encompassing two dimensions: active defence and surveillance. On the one hand, means and networks of surveillance (GRAVES, SATAM, Tarot, GEOTracker) will be enhanced or developed, cameras could be installed on Syracuse satellites and patrolling nanosatellites ("space bodyguard") will be deployed around the most valuable satellites, the demonstrator of a very long-range radar will be experimented; finally, France promotes the creation of a future European Space Surveillance and Tracking (SST) capacity. On the other hand, active defence means self-defence to reply in an adapted and proportional manner when a hostile act has been detected, characterized and attributed. Measures envisaged are the use of power lasers from French satellites to blind the adversary. The military planning law (LPM) 2019-2025 dedicates €3.6bn to the space domain: recently €700 million was added. By its end, it must provide the armed forces with initial capabilities to conduct space operations. The efforts made during the LPM 2019-2025 should allow full capability by 2030. Finally, France is also interested in responsive launch, as it increasingly appears as a technology useful to help maintain the continuous provision of space services.

However, France indicates that it does not want to be involved in an arms race and sets as a priority the pursuit of its diplomatic efforts to guarantee the peaceful use of space. Moreover, to reduce the costs of the announced measures, the Minister said that the capabilities could also be bought to entrusted operators or by the pooling of means with European partners.

## Governance

The governance scheme presented here is the one following the reorganisation triggered by the Defence Space Strategy announced in July 2019 and implemented in September. Three main organisations take part in the military aspects of space in France:

- The Ministry of the Armed Forces, including the French Procurement Agency (DGA) and the Space Command (CDE)

- The National Centre for Space Studies (CNES), France's space agency
- The Secretariat-General for National Defence and Security (SGDSN), an inter-ministerial body under the Prime Minister

The following figure outlines French space defence governance:

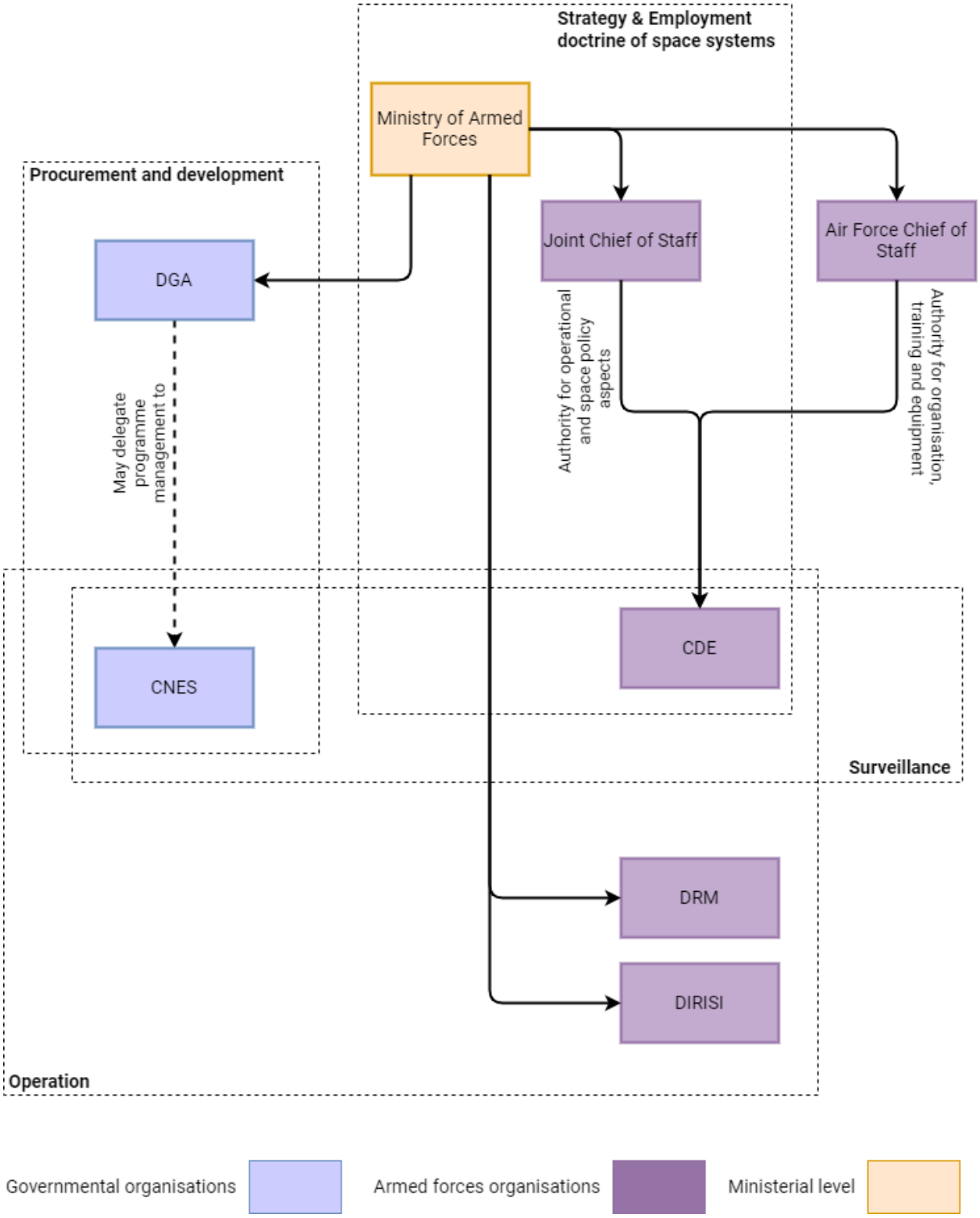


*Figure 12: Governance scheme of military space activities in France*

**The Ministry of Armed Forces is a key actor, especially organisations under the authority of the Joint Chief of Staff and DGA, the French Procurement Agency.** DGA currently has a role in the governance of CNES, on behalf of the Ministry of Armed Forces[100]. Indeed, CNES, which designs, proposes and executes the French civilian space programme, is under the supervision of the Ministry of Higher Education, Research and Innovation and the Ministry of Armed Forces. As such, it works closely with the armed forces and DGA. For instance, CNES contributes to the R&T of military space programmes and is one of the interlocutors of DGA for these programmes; in addition, DGA sometimes delegates their management to CNES. The agency also contributes to the funding and implementation of dual-use systems (with civil and military purposes). Finally, it operates most of the satellites of the defence forces[101]. In the future, this task will be accomplished in close collaboration with the Space Command.

**Regarding the armed forces, the newly-created Space Command, which replaces the Joint Space Command established in 2010, is the central actor.** It has three missions:

- Reinforcing French capacities regarding space support to operations
- Developing autonomy in the field of space situational awareness in all orbits
- Developing capabilities for active defence in space.

To conduct these missions, the Space Command (CDE) gathers the means of the various branches of the military contributing to the good use of space means. For instance, it has integrated the joint assessment team as well as two units that were formerly under the Air Defence and Air Operations Command (CDAOA) of the Air Force: the Operational Centre for the Military Surveillance of Space Objects (COSMOS) and the Military Centre for Satellite Observation (CMOS, which controlled the orientation of Earth observation satellites' sensors and implemented the French Ground User Segment of Helios, Pleiades, CSO, SAR-Lupe and COSMO-SkyMed[102]).

The CDE is a joint organisation under the authority of both the Joint Chief of Staff (JCS) and the Air Force Chief of Staff:

- It lies under the Joint Chief of Staff for what concerns the operational domain (actions taken during an actual conflict) and the "space policy" domain, which includes cooperation, strategy (monitoring and prospective) and capability (development of capabilities, innovation) aspects
- The Air Force Chief of Staff has authority over the CDE in organisation, training and equipment (OT&E) matters. Thus, it deals with force combat-readiness (i.e. both means and staff) in terms of theoretical and operational training

As for capability programs, the CDE is the interlocutor for all branches of the military for everything related to space and can propose to the JCS, if necessary, a prioritization of tasks to be conducted. Moreover, it manages the space operations domain through the identification of the needs in space matters. This identification includes requirements for support to space operations (e.g. launchers), but also for other activities such as space situational awareness. Thus, the CDE is also in charge of expressing the needs of the military forces for actual warfighting.

[100] Public hearing of General Jean-Pascal Breton, former Joint Space Command Commander, before the National Defence and Armed Forces Committee of the French National Assembly, 20 December 2017. Retrieved from: http://www.assemblee-nationale.fr/15/cr-cdef/17-18/c1718024.asp

[101] French Ministry of Defence (March 2012). "Le CNES et le ministère de la Défense". Retrieved from: https://www.defense.gouv.fr/english/portail-defense/dossiers/l-espace-au-profit-des-operations-militaires/cooperation-internationale-et-avenir-recherche-et-developpement/developpement-et-programmes-futurs/le-cnes-et-le-ministere-de-la-defense

[102] French Ministry of Defence (March 2012). "Le Centre militaire d'observation par satellites". Retrieved from: https://www.defense.gouv.fr/portail/dossiers/l-espace-au-profit-des-operations-militaires/fiches-techniques/cmos

The CDE also coordinates other national actors of military space:

- The Directorate of Military Intelligence (DRM) which is responsible for the orientation of intelligence satellites' sensors (that is, of the operational control of imagery and SIGINT satellites, including for the cooperation agreements with Italy and Germany)
- The Joint Directorate of Infrastructure Networks and Information Systems (DIRISI) which is the operator for SATCOMs capabilities.
- Surveillance means (e.g. operation of the GRAVES radar) are now under the direct responsibility of the CDE.

Finally, the Secretariat-General for Defence and National Security (SGDSN), under the Prime Minister, gives advice on the design and implementation of security and defence policies. In the realm of space, the SGDSN has the function of inter-ministerial coordinator for the security of European space programmes. As such, it elaborates the synthesis of national positions regarding the security of European satellite navigation and Earth observation programmes[103]. Moreover, the SGDSN is France's PRS Competent National Authority (CPA), and ensures the interoperability of the Galileo Public Regulated Service (PRS) with military GPS for the French Ministry of the Armed Forces[104].

## Programmes

France is the only European country that possesses or has tested all space applications for military purposes, except a PNT system. Moreover, the investment in space will still increase as the military planning law for 2019-2025 endorsed the decision to dedicate €3.6bn to the renewal of French military space means over this period. In addition, €700 million has been announced for the same period to fulfil the capacity requirements of the Defence Space Strategy. Studies will also be conducted for the next generation of optical reconnaissance satellites (Iris, which will follow CSO) and electronic intelligence satellites (Céleste, which will follow CERES).

### Earth observation

France relies mainly on international programmes in which it has the lead, such as Helios 2 (two optical satellites) and Pleiades (two optical satellites). In these programmes, other countries contribute financially and receive a compatible ground station and a part of tasking rights proportional to their contribution. However, the successor of Helios 2, CSO, will be more national-oriented. France will finance the satellites (except for CSO 3 where Germany will fund two thirds of the satellite) and will then conclude agreements with other countries to exchange images. Such partnerships have already been concluded with Belgium and Sweden (in order to access the ground station of Kiruna). CSO 1 was launched in December 2018 and all satellites should be in operation by 2021. Two other dual-use constellations are currently being developed on a commercial basis and planned for launch in the 2020s: Pleiades Neo, which will replace the current Pleiades constellation but will only be on a commercial model (militaries can buy images but do not have any priority); and CO3D, which will complete Pleiades Neo and where French Defence will be one of the users. Finally, France has bilateral agreements with Germany and Italy and is thus able to benefit from the capacities of their radar satellites. It enables France to get access to the whole spectrum of observation means.

[103] SGDSN Missions. "Sécuriser des programmes spatiaux européens". Retrieved from: http://www.sgdsn.gouv.fr/missions/securite-des-programmes-spatiaux-europeens/
[104] European GNSS Agency (March 2017). "Galileo Public Regulated Service ready for action". Retrieved from: https://www.gsa.europa.eu/newsroom/news/galileo-public-regulated-service-ready-action

### Signal intelligence

France is the only European country investing in this technology. Indeed, it has already launched two demonstrators: Essaim (not active anymore) and ELISA (a constellation of four satellites). A fully operational programme with three satellites, called CERES, is on track. It will be able to locate and characterize electromagnetic emitters. The first launch is planned for 2021.

### Early warning

France was also interested in early warning capabilities with the demonstrator SPIRALE. It was composed of two microsatellites which were launched in 2009 and ended their mission in 2011.

### Satellite communications

France has a category of national encrypted SATCOMs, Syracuse 3, whose overcapacity is sold to NATO in the frame of the NSP2K programme. Its successor, Syracuse 4, is planned for launch in 2020-2021 (two satellites, complemented by another one in 2030); their overcapacities will also be sold to allied governments. Yet France has also relied on international cooperation to build military or dual-use satellites. Thus, a French-Italian partnership has been established to build the satellites Sicral 2 and Athena-Fidus.

### Surveillance

Following the desire expressed by officials to acquire a national capability for space surveillance, France developed the GRAVES radar, a system dedicated to monitoring and detecting objects in LEO. It was put in operation in 2005 and will be renovated under the current military planning 2019-2025, and its successor is planned for after 2025. The four SATAM radars, belonging to the Air Force, are also used to follow satellites in the lower layers of space[105], especially in tracking debris for management of collision risks and predicting atmospheric re-entry[106]. They should be replaced between 2025 and 2030. Finally, the authorities also use systems the Ministry of the Armed Forces does not own, such as TAROT (belonging to CNES, around 15% of the time of the telescope is used to detect space debris) and GEOTracker (ArianeGroup) telescopes. These systems are especially used to monitor the geostationary orbit. Surveillance is emphasized in the Defence Space Strategy and several measures will be taken to reinforce it: surveillance from Earth (enhancement of the existing means and experimentation of a very long-range radar); surveillance from space (cameras on Syracuse, patrolling nanosatellites, and a surveillance constellation). The setting up of a European capability is also promoted. At this level, France is currently part of the EU SST Consortium set up by the European Commission.

[105] Public hearing of General Philippe Lavigne, Air Force Chief of Staff, before the National Defence and Armed Forces Committee of the French National Assembly, 15 May 2019. Retrieved from: http://www.assemblee-nationale.fr/15/pdf/cr-cdef/18-19/c1819035.pdf

[106] CNES. "Ground-based assets". Retrieved from: https://debris-spatiaux.cnes.fr/en/node/187

| | Earth observation | SIGINT | Early warning | Satellite communications | Surveillance |
|---|---|---|---|---|---|
| National capacities | • CSO 1<br>• CSO 2 and 3 (upcoming) | • ELISA<br>• CERES (upcoming) | • SPIRALE (not active anymore) | • Syracuse 3 (3A and 3B)<br>• Syracuse 4 (upcoming) | • GRAVES<br>• SATAM |
| European multilateral cooperative programmes | • Helios 2<br>• Pleiades | | | • Athena-Fidus<br>• Sicral 2 | |
| European cooperation agreements | • Torino agreement (2001): Pleiades/Helios 2 – COSMO-SkyMed<br>• Schwerin agreements (2002): Helios 2 – SAR-Lupe<br>• CSO – SARah (upcoming)<br>• CSO – CSG (upcoming) | | | | • GRAVES-TIRA arrangement |

*Table 11: National and multinational military and dual-use space capacities of France*

# Annex B – The space defence landscape in Germany

## Strategy

The importance of the military benefits provided by space have been recognised in recent German strategic papers. This has led the country to assert the need to be able to provide space-based services in a more and more contested space environment, and to develop the ability to protect and defend critical space infrastructure starting with the enhancement of its space surveillance capabilities.

| Document | Main statements on outer space defence |
|---|---|
| Space Strategy of the German Federal Government (2010) | • Underlines the necessity of space-based communications, navigation and Earth observation for military operations<br>• Asserts that these capabilities are a prerequisite for promoting Germany's role in global politics and military operations<br>• Emphasises the will to use synergies with civil and dual-use technologies<br>• Defines space security to be a whole-of government task that cannot be completed with solely military means<br>• Recommends addressing comparable civil and military needs in a cost-effective way<br>• Underlines the importance of free access to space and avoiding the malfunctioning of space systems because of natural or human threats<br>• Encourages the building of a national capacity for SSA |
| White Paper on Security Policy and the Future of the Bundeswehr (2016) | • Recognises that denial of access to space would create high risks to the functioning of the state and the welfare of the population<br>• Describes space applications and systems as critical infrastructure<br>• Commits Germany to work to ensure the unhindered use of space and includes space in the security policy horizon of Germany<br>• Tasks the Bundeswehr with monitoring of critical space infrastructure<br>• Points out the need to develop arms control mechanisms and instruments addressing evolving technologies, including space, and the promotion of increased transparency in space, as well as the introduction of trust and confidence building measures for space |
| Strategic Guidelines for Space[107] (2017) | • Defines MoD positions and goals for the implementation of space security within the ministry of defence and the Bundeswehr<br>• Addresses the Bundeswehr contribution to the whole-of government approach on space security: contribution to space situational awareness and development of the ability to conduct space operations to protect critical space infrastructure<br>• Highlights the importance of space as a field of foreign and security policy<br>• Describes the need for autonomous space capabilities for the political and military ability to create situational awareness and act on an international level |

[107] Ministry of Defence of Germany (March 2017). "BMVg legt "Strategische Leitlinie Weltraum" fest". Retrieved from: https://www.bmvg.de/de/aktuelles/bmvg-legt-strategische-leitlinie-weltraum-fest-11148

| | |
|---|---|
| Conception of the Bundeswehr (2018) | • Asserts that the political, legal and organisational foundations are to be created so that the Bundeswehr guarantees situational awareness and capacity of action independently and/or in association with other NATO and EU member states as well as public and private partners<br>• Expresses the need to ensure constant military control over military systems in order to be able to respond promptly, independently and confidently to crisis developments<br>• States the need to protect space systems through the surveillance and reconnaissance of space objects, the ability to contribute to situational awareness for political or military decision-making and, ultimately, the ability to take effective countermeasures against attack or interference attempts on space systems or space services<br>• Expresses the will to improve the training and expertise of space personnel and improve and maintain competences of specialists in the area of space security |

*Table 12: The involvement of space in German strategic documents*

## Governance

The Ministry of Defence is a central actor for space security in Germany. As in other countries, departments from the Ministry as well as from branches of the armed forces deal with space. However, the German specificity is that the importance of Ministry's departments is quite developed, compared to other states, as well as their independence.

Governmental side: The Directorate General for Forces Policy (FüSK) has an office (FüSK I 6) responsible for space operations. Within the Directorate General of Security and Defence Policy (Pol), the office for Strategy Development (Pol II 1) prepares the military part of the space policy designed by the government, while within the Directorate General of Legal Affairs (R), Office R I 2 is charged with all tasks concerning space law. In the Directorate General for Planning, the division for Strategic Defence Planning (Plg I) encompasses an office (Plg I 3) which deals with the overall capability portfolio of the armed forces. Office Plg II 3, within the division for Bundeswehr Capability Development (Plg II), is in charge of the development of space capabilities. Within the Directorate General for Equipment (A), the office A IV 3, for example, manages the procurement of air and space reconnaissance systems in the Bundeswehr; other space capabilities lie within other offices, depending on their purpose (i.e. communication). Office A II 6 leads the coordination of science and technology development efforts for space. Finally, other offices in the Directorate General for Cyber and Information Technology (CIT) are responsible for Space Support to Operations, such as Geospatial Support (CIT II 8) or Communications (CIT II 4). Within the Directorate General for Strategy and Operations (SE), Office SE I 2 provides space-based reconnaissance support to the armed forces[108].

Moreover, a transversal working group dedicated to space has been created within the Ministry (Arbeitsgruppe Weltraum) tasked with the coordination of the different space-related work streams. This group associates the aforementioned Departments, is managed by FüSK I 6, and is headed by the Director General for Forces Policy, who, in a dual hatted function, is the ministry's commissioner for space. This working group constitutes a major coordination mechanism for space-related issues within the Ministry of Defence.

[108] Organisation chart of the German Ministry of Defence (updated October 2019). Retrieved from: https://www.bmvg.de/resource/blob/11902/86f5adb4c371e5b3f8003a4f1f57809e/a-03-download-organigramm-data.pdf

Finally, the Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw) is Germany's military procurement organisation below the Ministry of Defence and, as such, deals with the acquisition of military space systems.

Armed forces side: The Bundeswehr has an important role in military space and a greater empowerment could even take place. At the time being, two of its missions are of particular interest for "Defence of Space". Indeed, the Bundeswehr ensures[109]:

- Situation awareness and action capacity in space for the state
- The surveillance and protection of critical space infrastructure

These missions are implemented by the German Space Situational Awareness Centre (WRLageZ), which falls under the Air Force Operations Centre. The WRLageZ is the result of a civil-military cooperation, and has been commanded since 2011 by the Air Force and DLR, Germany's space agency. Around 80% of the personnel come from the Air Force and 20% from the DLR. It deals with space surveillance missions. However, the surveillance means do not belong to the military, but to civil organisations such as the Fraunhofer FHR and the DLR. In addition to national data, the WRLageZ uses data from partners, civil and military, national and international, especially the United States and France. The role of the WRLageZ is to protect SATCOM-Bw and SAR-Lupe systems, but also the civil satellite TanDem-X, which extends the capacities of TerraSAR-X. More generally, the WRLageZ advises decision-makers on the space situation, protects satellites by avoiding collisions and analysing the data on systems' lifetime, provides re-entry forecasts and works on the field of space armament and ballistic missiles[110]. Therefore, it provides operational support to satellite operators and national crisis management. WRLageZ's services and products are provided on a national, European and international level[111].

Within the Armed Forces, the Cyber and Information Domain Service was established in April 2017. It is the youngest branch of the Bundeswehr, along with the Army, Navy, Air Force, Joint Support Service and Joint Medical Service. It includes the Geoinformation Service, which analyses the impact of environmental and geospatial factors on the planning and conduct of operations; the Strategic Reconnaissance Command, which is responsible for ISR operations and operates the user segment of SAR-Lupe (the satellites are operated by OHB GmbH); and the IT Command, in charge of SATCOMs capabilities. In addition, the firm MilSat Services GmbH, from Airbus Group, is responsible for the design, integration and delivery of the two German SATCOMs satellites[112].

Regarding the Galileo PRS, the Ministry of Transport and Digital Infrastructure has been designated as the competent national authority.

The following figure outlines German space defence governance:

[109] Ministry of Defence of Germany (July 2018). *Konzeption der Bundeswehr*. Retrieved from: https://www.bmvg.de/resource/blob/26544/9ceddf6df2f48ca87aa0e3ce2826348d/20180731-konzeption-der-bundeswehr-data.pdf

[110] German Air Force (November 2017). "Weltraumlagezentrum – Der Auftrag". Retrieved from: https://www.luftwaffe.de/portal/a/luftwaffe/start/org/fuelw/kdopfuelw/auf/!ut/p/z1/hZDBTsMwDIafptc4LVtJubWaNgqlIDq2NReUNaYNlKTKsoIQD0_QpB0Q03ywZP_fb1sGDhvgWoyqFU4ZLXpf1zx-zlixLKIkiopVMqN5eHc7TZIsf7yOYAXrcwj3Mj0RKYVKItR-xuWJGemymkAFHPirGMUnGYx1PToimt8boe6Elj0-mCY9NDwokTRGe8Znh9opn1srnLFHd7O31itESahpOMtofLwp_Gbx04ltQsbycn4PN8Db3mwP30j19oK1wC2-oEVL9ta3O-eG3VVAA-o3f6g3NaBUghjbBvQ_U2d2DjZ_WRje56wsp-NXgesfBuFmkA!!/dz/d5/L2dBISEvZ0FBIS9nQSEh/#Z7_B8LTL2922LV9D0I1MK599BATS4

[111] Ministry of Defence of Germany (July 2018). *Konzeption der Bundeswehr*.

[112] MilSatServices. "Über uns". Retrieved from: http://www.milsatservices.de/home/ueber-uns

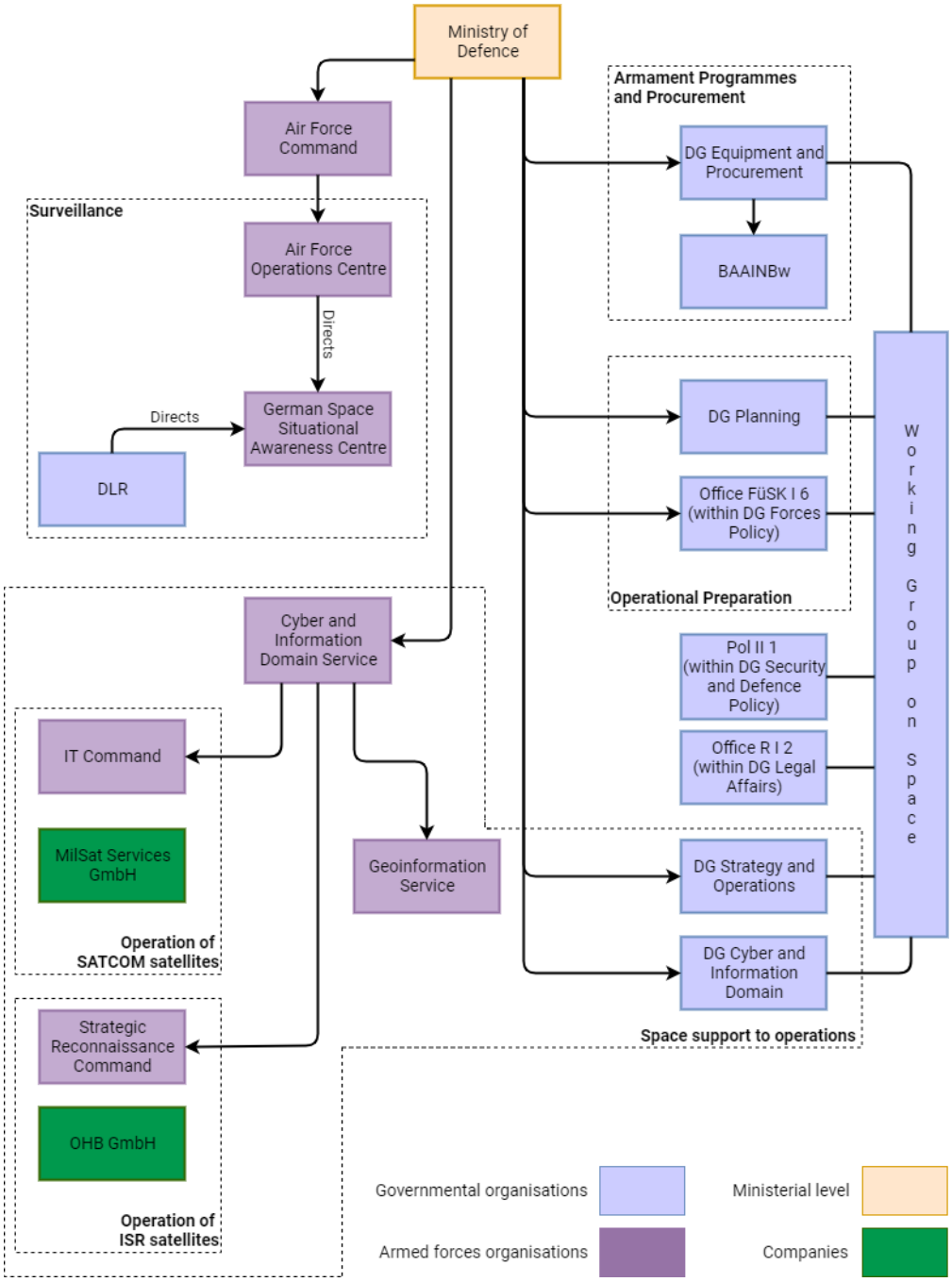


*Figure 13: Governance scheme of military space activities in Germany*

## Programmes

### Earth observation

In 2002, Germany and France signed the Schwerin agreements, thereby accepting to coordinate capabilities with regard to Earth observation in exchange for access to satellite products of the other country. Therefore, German military capabilities are focused on synthetic aperture radar (SAR) imagery. Germany owns a SAR-Lupe satellite constellation, which will soon be replaced by the next generation SARah. In exchange, it has received tasking rights to Helios 2, thus granting access to optical images. This kind of agreement has been renewed for the CSO and SARah programmes. In parallel, Germany is developing the optical satellite Georg.

### Satellite communications

The Bundeswehr has its own SATCOMs within the programme SATCOMBw. This programme is currently in its second phase of expansion, with the satellites COMSATBw-1 and -2. The third generation is already in advanced project phase[113]. Civil-military cooperation on Heinrich-Hertz-Sat (H2Sat), which is expected to launch in 2021, will grant further available bandwidth.

### Surveillance

In terms of surveillance means, Germany possesses the TIRA system, which enables identifying and tracking space objects; indeed, it is able to determine precise measurements and the orbital parameters of a single target. TIRA is run by the Fraunhofer Institute for High Frequency Physics and Radar Techniques Surveillance (Fraunhofer FHR). Germany and France have agreed to cooperate regarding the use of their TIRA and GRAVES systems: thus, when GRAVES detects an object in space, it can request TIRA to identify it in more detail. In addition, Germany is developing a new high-performance space surveillance radar, GESTRA, which will enable the observation of satellites and space debris with small object sizes, for the build-up of a space object catalogue. GESTRA is a modular, deployable system that can be transported to any required location. The first prototype set is to be run by the DLR and put into operation for the German Space Situational Awareness Centre at the end of 2019[114]. More radar sets are planned to follow later in order to enhance worldwide coverage.

Finally, Germany is part of the EU SST Consortium. In 2019, it agreed with France to attempt to coordinate SSA sensor developments in an effort to create a cornerstone for coordinated capabilities to enhance services for EU SST.

| | Earth observation | SIGINT | Early warning | Satellite communications | Surveillance |
|---|---|---|---|---|---|
| National capacities | • SAR-Lupe<br>• SARah (upcoming)<br>• Georg (upcoming) | | | • SATCOMBw (COMSATBw-1 and -2)<br>• Heinrich-Hertz (upcoming) | • TIRA<br>• GESTRA (upcoming) |
| European multilateral cooperative programmes | | | | | |
| European cooperation agreements | • Schwerin agreements (2002): Helios 2 – SAR-Lupe<br>• CSO – SARah (upcoming) | | | | • GRAVES-TIRA arrangement |

*Table 13: National and multinational military and dual-use space capacities of Germany*

[113] Winter, Gaëlle (March 2019), "La "mue" de la politique spatiale allemande : organisation et trajectoire d'une affirmation nationale", *Recherches & Documents*, n°4/2019, Fondation pour la recherche stratégique. Retrieved from: https://www.frstrategie.org/sites/default/files/documents/publications/recherches-et-documents/2019/201904.pdf
[114] Fraunhofer FHR (April 2018). "Press release: GESTRA – New Surveillance Capabilities in Germany". Retrieved from: https://www.fhr.fraunhofer.de/en/press-media/press-releases/gestra-new-space-surveillance-capabilities-in-germany.html

# Annex C – The space defence landscape in Italy

## Strategy

Various strategic documents are available on Italy's positioning in the military space domain. In 2015, a White Paper for International Security and Defence was published, whereas the previous one was released in 2002 (as a consolidation of the 1985 White Paper). The document of 2015 sets an ambitious strategy for Italy, which stresses the importance of international cooperation in the frame of NATO, the United Nations (UN), and the European Union (EU). Nevertheless, the need to maintain sovereign competences is also highlighted. With respect to space, it asserts that the Defence "will contribute more effectively to safeguarding the freedom of access to space"[115], considering the space experience matured and the knowledge consolidated over the time at national and international level. It considers that the extension of operations to the Space Domain is one of the major changes in the modes and tools that are used in a conventional conflict. As a consequence, "specific defensive operational capabilities must be dedicated to these areas, in order to preserve the safety of the "national system" and increase the solidity of the political, economic and social structures"[116]. The use of space assets for dual-use purposes is a relevant aspect in the Italian strategy, which includes also security and defence applications, especially with respect to SATCOM, Earth Observation and Space Surveillance and Tracking. As a consequence, the Italian Defence can benefit from a consolidated cooperation with the Italian Space Agency (ASI) and other relevant institutional actors for the development of space programmes and related capabilities.

In July 2019, Italy published a National Security Strategy for Space. This document will constitute the reference for the development of future planning, programming, acquisitions and operations. The document recognises that the balance of the space environment is gradually affected by asymmetric threats and the effects of the commercialisation of space. Thus, in order to face unintentional and intentional threats appropriately, the development of SSA/SST capabilities, including in a multinational cooperation context, becomes strategic. The strategy calls for the protection of all national interests by adopting a comprehensive approach but also asserts that it is part of a European Space Strategy aimed at preserving the leading position of the European Union in this sector. It sets five strategic objectives[117] to pursue for the growth and the strengthening of the national space sector:

- To ensure the safety and security of space infrastructures;
- To safeguard national security, including through space, by ensuring access to and use of national security capabilities in any situation;
- To strengthen and protect the institutional, industrial and scientific sectors;
- To promote a space governance capable of ensuring sustainable, safe and secure space operations at international level;
- To ensure that the development of private initiatives in the space sector (upstream and downstream) is consistent with the country's overriding interests.

The strategy puts the emphasis on international cooperation and diplomacy as they ensure a more stable space environment and thus reduce threats. Therefore, bilateral (especially among G7 countries) and multilateral (with ESA, NATO or the EU) cooperation are seen as essential to get political support in the international debate on the governance of space. Similarly, diplomatic backing is seen as a key element

[115] Ministry of Defence of Italy (July 2015). *White Paper for international security and defence*. Retrieved from: https://www.difesa.it/Primo_Piano/Documents/2015/07_Luglio/White%20book.pdf
[116] *Ibid*.
[117] Presidency of the Council of Ministers (July 2019). *Strategia nazionale di sicurezza per lo spazio*. http://presidenza.governo.it/AmministrazioneTrasparente/Organizzazione/ArticolazioneUffici/UfficiDirettaPresidente/UfficiDiretta_CONTE/COMINT/Strategia_spazio_20190718.pdf

to prevent, deter and defend against hostile behaviour, as it enables to promote international standards for the responsible use of space, to anchor Italy to NATO and its framework of collective security, and to strengthen strategic cooperation (on a governmental, industrial or scientific basis) with spacefaring nations and international organisations.

## Governance

The Inter-Ministerial Committee for Space and Aerospace Policies (COMINT) was established in 2018. This is a top-level permanent national committee under the President of the Council of Ministers (i.e. Prime Minister's Office) which aims at developing, overseeing and coordinating the national space policy and activities. Twelve ministries are represented in the Committee. The COMINT finalised and approved the Government's Guidelines for Space and Aerospace Policies to foster synergies across Italian institutions, industry and research entities. In particular, the Committee promotes the development of programmes involving national security and dual security aspects, with particular reference to civil security and military applications, and in connection to strategic international and European programmes[118]. The Military Advisor (MA) to the President of the Council of Ministers has been appointed as Secretary of the Inter-Ministerial Committee, in order to support and coordinate its activities, as well as the activities aiming to promote the development of dual-use technologies[119]. The MA Office is also the national authority competent for Galileo Public Regulated Service (PRS), which has the power to provide authorisations for PRS receivers' and security modules production and which manages, nationally, the access rights to the PRS.

Apart from the COMINT, the national-level decision-making body for the Space Domain, the Ministry of Defence currently manages military activities related to space through:

- The Defence General Staff;
- The Secretariat General of Defence and National Armaments Directorate (SGD/DNA);
- The Air Force

In addition, the Ministry of Defence (MoD) cooperates with ASI for the development and procurement of dual-use space systems (e.g. COSMO-SkyMed, Athena-Fidus).

The Defence General Staff organisation, within the MoD, defines the overall military policy and therefore determines the joint needs in terms of space-based assets and their employment[120]. It is thus a key contributor to space operations because of its role as a planner, supervisor and coordinator of many sectors of Italian Defence. The latest update of its governance established a General Office for Space as the single Defence's front-end for space-related activities with the initial aim to drive the operational development in the Space Domain across the entire DOTMLPF-I[121] spectrum. Currently, the Defence organisation at the operational level consists of two military joint satellite centres, one for the Command and Control (C2) of military space systems (SATCOM and Earth observation) and for SATCOM services, and one focused on the mission planning and the exploitation of satellites for remote sensing (military and dual). Both centres are under military control and employ military personnel.

[118] Presidency of the Republic (January 2018). "Legge 11 gennaio 2018, n. 7: Misure per il coordinamento della politica spaziale e aerospaziale e disposizioni concernenti l'organizzazione e il funzionamento dell'Agenzia spaziale italiana". Retrieved from: https://www.altalex.com/documents/leggi/2018/02/14/misure-per-il-coordinamento-della-politica-spaziale

[119] Presidency of the Council of Ministers. "Ufficio del Consigliere Militare". Retrieved from: http://presidenza.governo.it/AmministrazioneTrasparente/Organizzazione/ArticolazioneUffici/UfficiDirettaPresidente/ufficio_militare.html

[120] Istituto Affari Internazionali (November 2003). *Space and Security Policy in Europe*. Retrieved from: http://www.iai.it/sites/default/files/2003_space-and-security-in-europe.pdf

[121] Doctrine, Organisation, Training, Materiel, Leadership And Education, Personnel, Facilities And Interoperability.

The Secretariat General of Defence and National Armament Directorate "directs, controls and coordinates the activities of the Ministry's General Directorates"[122], but is also active in the promotion and coordination of research for armament material, and in the industrial area through its procurement mission and its support to the defence industry. Some of its units are competent for space (e.g. the Programme Office for space systems, applications and cooperation) and others are dealing with this field; for instance, the Technical Directorate of Information, Communications and Advanced Technology (TELEDIFE) is in charge of acquiring satellite telecommunications, navigation and Earth observation systems[123], SST/SSA/space weather sensors and related infrastructures.

Finally, the Air Force has specific duties relevant to human flight in space – including medical aspects – space weather, sub-orbital activities and it is currently managing some national projects and international cooperation related to Space Surveillance and Tracking.

The following figure outlines Italian space defence governance:

[122] Ministry of Defence of Italy. "The Secretariat General of Defence/National Armaments Directorate". Retrieved from: https://www.difesa.it/EN/SGD-DNA/Pagine/default.html
[123] Ministry of Defence of Italy. "Direzione Informatica, Telematica e Tecnologie Avanzate (TELEDIFE)". Retrieved from: https://www.difesa.it/SGD-DNA/Staff/DT/TELEDIFE/Pagine/default.aspx

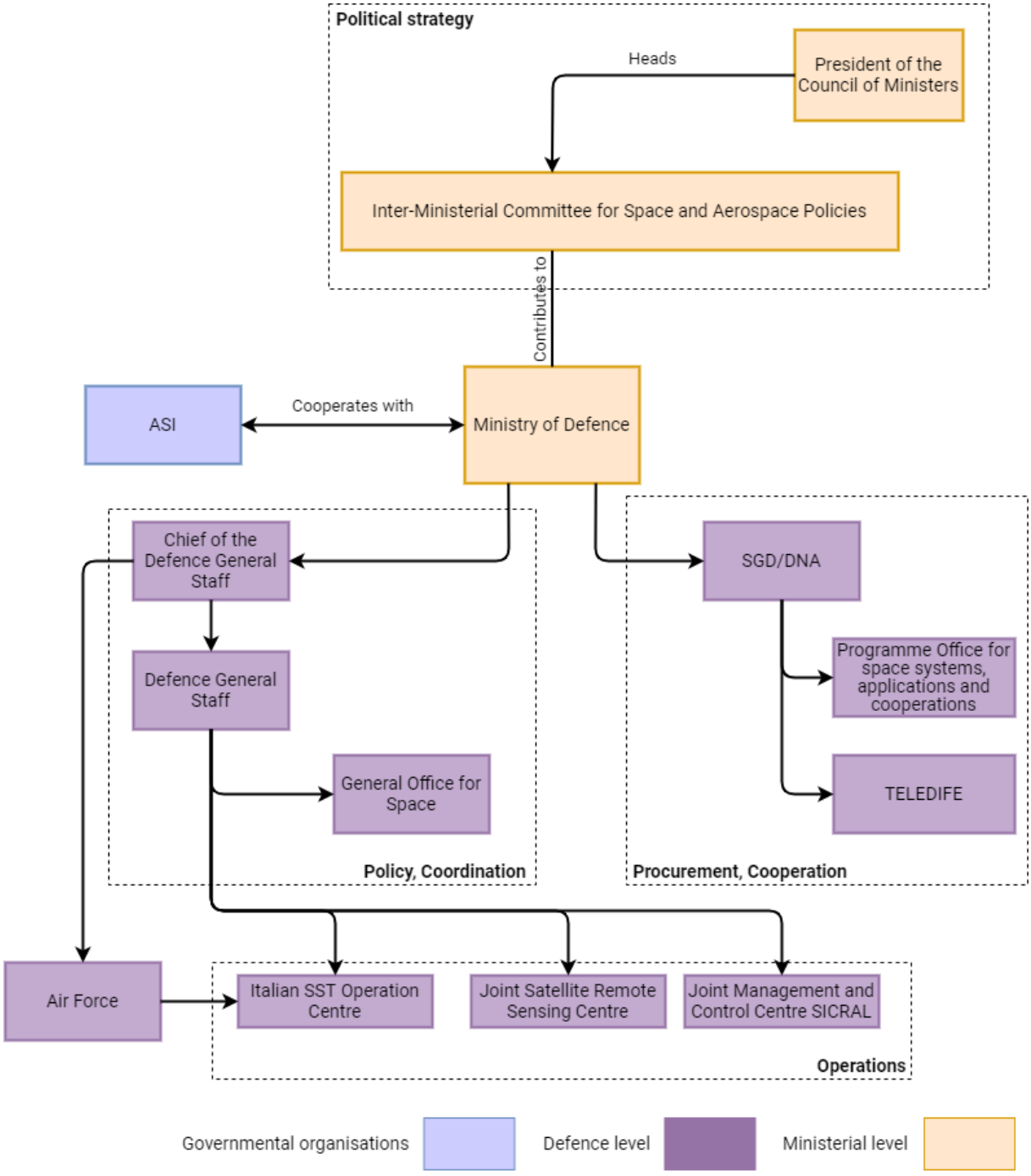


*Figure 14: Governance scheme of military space activities in Italy*

## Programmes

In the field of military space, Italy relies on military and dual-use systems developed through national and multinational programmes.

### Earth observation

From an operational point of view, Italy pursues a multi-sensor approach to develop an effective space-based Earth observation (EO) capability. Consequently, Italy developed the COSMO-SkyMed constellation, composed of four SAR (Synthetic Aperture Radar) satellites which are dual-use systems, thus serving

both civil and military needs. A new generation of radar EO satellites, COSMO-SkyMed 2nd Generation, is planned to be in the Full Operational Capability (FOC) by the end of 2021. The military satellite OPTSAT-3000[124], operational since 2017, complements the Italian Defence EO capability with a global space-based electro-optical EO capability. Italy also takes part in the Pleiades programme and signed the "Torino agreement" with France in 2001, thus receiving Helios 2 tasking rights and increasing them in Pleiades (6% in addition to the already hold 2.5%) in exchange of images from COSMO-SkyMed.

### Satellite communications

Italian Defence owns the national satellites Sicral 1 and 1B, the latter being also used to deliver services to NATO within the NSP2K programme. Italy also relied on international cooperation, and built Sicral 2 and Athena-Fidus through partnerships with France, the latter being a dual-use system. Italian initiatives for the future rely on the development of the military Sicral 3 and the ITAL-GOVSATCOM satellites.

### Surveillance

Italy has processing, radar, laser and optical sensor capabilities and is implementing a complete network of optical and radar sensors for surveillance and tracking, covering LEO, MEO and GEO[125]. It is also a founding member of the EU SST Consortium, further emphasising its "tradition" of cooperation.

| | Earth observation | SIGINT | Early warning | Satellite communications | Surveillance |
|---|---|---|---|---|---|
| National capacities | • COSMO-SkyMed<br>• OPTSAT-3000<br>• COSMO-SkyMed 2nd Generation (upcoming) | | | • Sicral 1 (1 and 1B)<br>• Sicral 3 (upcoming)<br>• ITAL-GOVSATCOM (upcoming) | • Optical, radar, and laser sensors |
| European multilateral cooperative programmes | • Helios 2 | | | • Sicral 2<br>• Athena-Fidus | |
| European cooperation agreements | • Torino agreement (2001): Helios 2 – COSMO-SkyMed<br>• MUSIS-CIL: CSO – COSMO-SkyMed 2nd Generation (upcoming) | | | | |

*Table 14: National and multinational military and dual-use space capacities of Italy*

[124] This satellite was manufactured by an Israeli company.
[125] Lt. Col. Console, Andrea (2016). "Looking Up Together: Multinational Space Surveillance and Tracking Initiatives from a NATO Perspective". The Journal of the JAPCC, n°23, Autumn/Winter 2016, pp. 45-50.

# Annex D – The space defence landscape in Spain

## Strategy

In 2013 Spain released its National Security Strategy, which examined risk multipliers, that is, factors which may trigger or worsen conflicts: one of them is the spread of the misuse of new technologies (and can thus apply to space). The necessity of adapting to the changing nature of conflicts is also stated, with outer space recognised as a domain where confrontation is possible[126]. In the National Security Law of 2015, space, among others, is declared a field of special interest to national security because it is necessary to preserve rights and freedoms, as well as to ensure the welfare of citizens and the supply of essential services and resources[127]. Spain is therefore aware of the importance of space but neither assessment makes it a priority.

However, in 2015, the National Armaments Directorate (DGAM) released a Master Plan for Space Systems that demonstrates how much space systems are important for the development of military operations. The document:

- Stresses the need for Spain to maintain effective coordination between public and private actors and avoid the waste of resources
- Emphasizes the importance of international cooperation to enhance Spanish influence in international organisations of which Spain is a member

It also reflects the need to address the generational changes of current satellites, as well as to complete the spatial capabilities for defence[128].

## Governance

In Spain, the main actors in the space defence field are both public bodies and firms linked to the public sphere.

The public administrations involved are:

- The Ministry of Defence, through DGAM and INTA
- The Ministry of Science, Innovation and Universities, through CDTI

The firms involved are:

- Hisdesat
- ISDEFE

The following figure outlines Spanish space defence governance:

[126] Presidency of the Government (2013). *The National Security Strategy: Sharing a Common Project*. Retrieved from: http://www.lamoncloa.gob.es/documents/estrategiaseguridad_baja_julio.pdf
[127] *National Security Law* (2015), Article 10. Retrieved from: https://www.global-regulation.com/translation/spain/615537/law-36-2015%252c-28-september%252c-national-security.html
[128] National Armaments Directorate (October 2015). *Plan Director de Sistemas Especiales*. Retrieved from: http://www.defensa.gob.es/Galerias/dgamdocs/plan-director-sistemas-espaciales.pdf

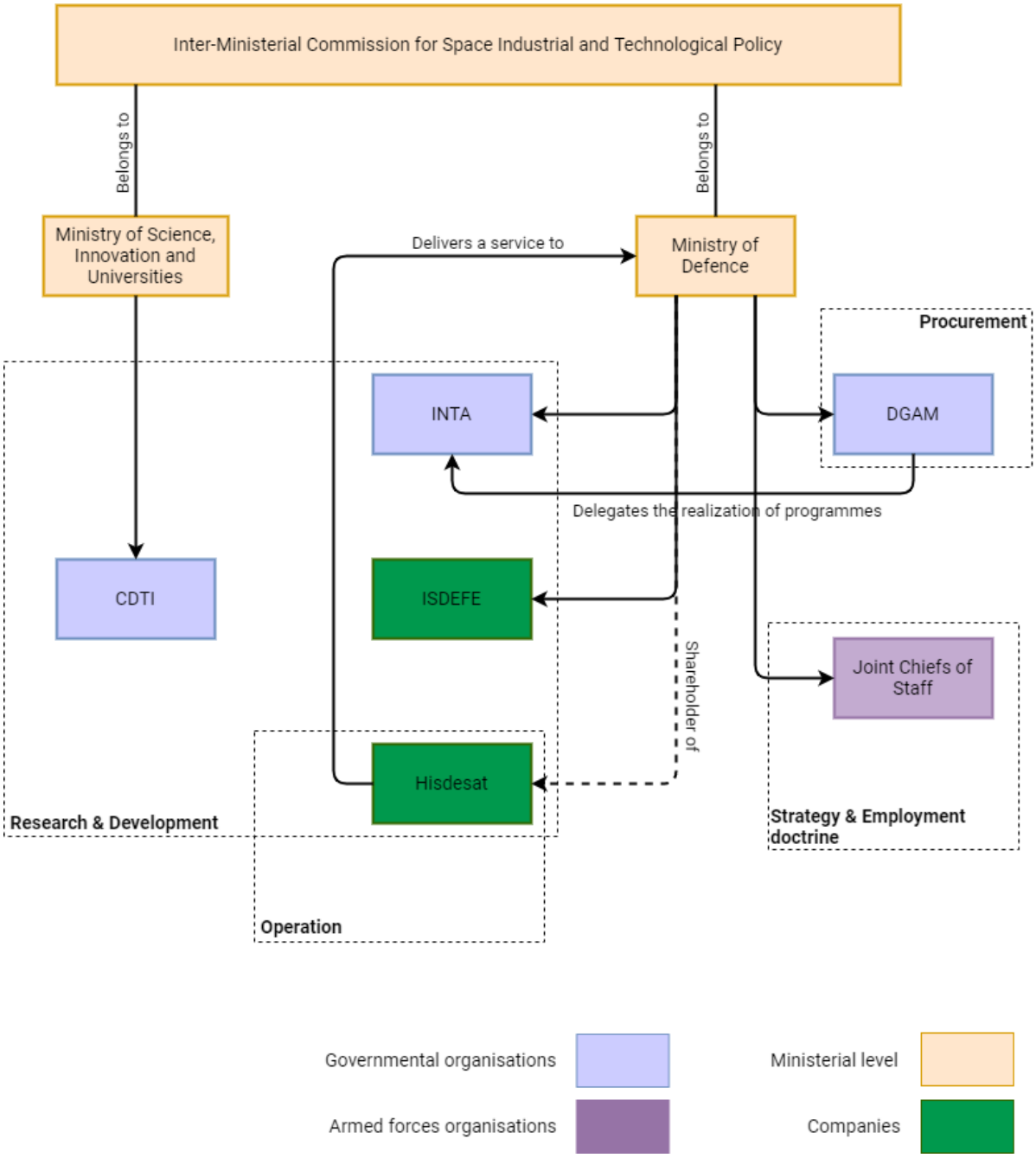


*Figure 15: Governance scheme of military space activities in Spain*

In 2014, Spanish authorities created the "Inter-ministerial Commission for Space Industrial and Technological Policy", which has coordinated the actions of ministries dealing with space issues since 2015.

In this Commission, the Ministry of Defence is represented by the DGAM, Spain's defence procurement agency. The DGAM runs its own SATCOM programme and supports the Earth observation programme. Moreover, it has a role in the country's SST programme (S3T), as it helps to select the location for radars and to deal with data and information security policies[129]. The Operations Centre for S3T is located in the

[129] National Armaments Directorate (October 2015). *Plan Director de Sistemas Especiales*.

Military Air Base of Torrejón de Ardoz. However, this centre is managed by another organisation, the Centre for the Development of Industrial Technology (CDTI).

The National Institute of Aerospace Technology (INTA) is another organisation falling under the authority of the MoD: it mainly deals with research and development, and certification and testing activities. INTA is a promoter of duality as it specializes in R&D for aerospace, aeronautics and hydrodynamics, but also in security and defence technologies[130]. As such, it can support some specific programmes delegated by DGAM, especially in military policy. In that case, the DGAM establishes the contents and INTA contributes to the technical conception and even to the development of the systems[131]. INTA is the technological centre for the MoD and has a General Subdirectorate of Space Systems. In 2012, INTA was designated as the competent national authority for the Galileo PRS. Moreover, its responsibilities in Galileo are expanding as, following Brexit, Spain will host the back-up Galileo Security Monitoring Centre (GSMC), previously located in the United Kingdom, in INTA facilities in Torrejón.

Several offices in the MoD are potential users of space assets (Armed Forces, the Joint Chiefs of Defence, which are responsible for designing the military strategy of Spain and conducting the operations of the Armed Forces, the National Intelligence Centre and the Armed Forces Intelligence Centre.). The way the Spanish MoD is using space systems is quite different from previously described countries. Indeed, it is based on obtaining services through framework contracts with a national operator of government services, of which the Ministry is a reference shareholder, and through collaboration agreements in international programs. The operational mode is the following:

- The Ministry does not own satellites in property but agrees with the company that meeting the needs is guaranteed
- The Ministry assumes the costs of the services contracted as well as the adequacy or maintenance of the user ground segments corresponding to each capacity

In the case of satellite communications systems, the provider of this service to the MoD is the operator Hisdesat, which owns TT&C stations and is responsible for the whole lifecycle of the system, from its design to its maintenance after the launch, including its development and construction, as well as its placing and operation in orbit. The single task undertaken by the Ministry is the operation and maintenance of the user ground segment. Regarding Earth observation systems, the model agreed for the Earth observation satellite PAZ is a bit different, as the MoD has developed the radar component whereas Hisdesat operates and exploits the satellite and the ground segment. The MoD, through the INTA, has responsibility for and ownership of the Defence Centre of the PAZ ground segment, which includes monitoring and control centres[132].

Under the authority of the Ministry of Economy and Competitiveness, CDTI has major responsibilities in space affairs. Indeed, it "fosters technological development and innovation activities of Spanish companies. It is the entity that channels the funding and supports applications for national and international R&D&I projects of Spanish companies"[133]. Therefore, CDTI manages, either directly or in collaboration with other entities, most of Spain's technical, scientific and industrial interests in European and national space initiatives and programmes[134]. In particular, CDTI is in charge of Spanish participation

[130] Instituto Nacional de Técnica Aerospacial. « About us ». Retrieved from: http://www.inta.es/opencms/export/sites/default/INTA/en/quienes-somos/
[131] Istituto Affari Internazionali (November 2003). *Space and Security Policy in Europe*.
[132] National Armaments Directorate (October 2015). *Plan Director de Sistemas Especiales*.
[133] Centro para el Desarrollo Tecnológico Industrial. "Presentation". Retrieved from: https://www.cdti.es/index.asp?MP=14&MS=59&MN=1
[134] Lomba, Jorge (May 2011). "Spanish Strategy for ESA and EU Space Programmes". Retrieved from: https://www.cdti.es/recursos/doc/Programas/Aeronautica_espacio_retornos_industriales/Espacio/29437_101110112011135137.pdf

in ESA with an associated annual budget of €202 million. It is also involved in military space projects such as PAZ and Ingenio. For instance, in 2007, CDTI signed a contract with the MoD related to the Spanish Earth observation programme, and has launched the Ingenio satellite programme with a total budget of over €200 million. Regarding SATCOMs, the MoD sets up the requirements and, then CDTI finances part of the development of the systems (especially that related to technology). It is also this organisation that steers the Spanish SST programme, managing both national and EU funds (currently CDTI is leading a European SST consortium). Within CDTI, there is a dedicated Directorate to Space, Large Research Infrastructures and Dual Programmes, with a unit specialized on space[135].

Finally, another player in the Spanish military space field is the state-owned consulting and engineering firm ISDEFE, which is the in-house technical services provider of the General State Administration and falls under the MoD. In the realm of space, ISDEFE "performs engineering activities and provides services related to the definition, design, development, management, operation and maintenance of space complexes"[136] (mostly for civil purposes) and provides satellite applications solutions, including to meet the needs of the military. Thus, ISDEFE has been involved in defining the ground segment requirements for PAZ and Ingenio[137]. The firm has national and international public customers and, in the case of Spain, deals with civil and military organisations. For instance, INTA and Hisdesat are some of its customers and the company has agreements with CDTI.

## Programmes

Spanish space programmes for defence are almost exclusively dual-use, meaning they serve both civil and military uses. In the case of Spain, civil uses are rarely commercial and benefit mostly institutional (including governmental) actors. For instance, current Spanish SATCOM capabilities are described by an MoD's official as "a dual use solution between Military and GOVSATCOM"[138].

### Earth observation

Spain has long relied on its participation in international programmes to get access to images in the visible and infrared spectrum. Thus, the country contributes 2.5% of the Helios 2 programme and receives a proportional part in programming rights. As well, Spain funds 3% of Pleiades, but has negotiated access to the defence high priority programming and the development of its reception and processing means. Despite this cooperative habit, Spain is also developing its own national Earth observation systems. These are the radar satellite PAZ, launched in 2018 and whose main users are military personnel, and the optical system Ingenio, which has not been launched yet and is mainly aimed at civil (especially institutional) users[139]. Both satellites constitute the governmental programme PNOTS (the Spanish acronym for National Earth Observation Satellite Programme), which is the first institutional Earth observation satellite programme in Europe combining optical and SAR capacities.

### Satellite communications

Currently, Spain has invested in Hispasat 1D and the SECOMSAT programme. SECOMSAT is the name of a network gathering two satellites, Spainsat and XTAR-EUR. Spainsat is fully dedicated to the Spanish Ministry of Defence but its remaining capacity can provide services to allied nations (e.g. the United States,

[135] CDTI Organisation chart. Retrieved from: https://www.cdti.es/index.asp?MP=14&MS=60&MN=2
[136] ISDEFE. "Space". Retrieved from: https://www.isdefe.es/space?language=en
[137] ISDEFE (February 2018). "ISDEFE takes part in the ground segment for the PAZ satellite". Retrieve from: https://www.isdefe.es/noticias/isdefe-takes-part-ground-segment-paz-satellite?language=en
[138] Peláez, Roberto (November 2015). "SECOMSAT: Spanish approach present and future satcom for defense purposes". Retrieved from: http://www.eu2015lu.eu/en/agenda/2015/11/25-seminaire-SatCom/7_Roberto-PELAEZ-HERRERO.pdf
[139] eoPortal Directory. "SEOSat/Ingenio – Earth Observation Satellite of Spain". Retrieved from: https://directory.eoportal.org/web/eoportal/satellite-missions/s/seosat

Denmark, Belgium) and partners defence customers through the U.S. private company XTAR[140]. With respect to XTAR-EUR, this satellite is fully owned and operated by XTAR, but provides services to the Spanish Armed Forces. These two satellites will be replaced by SpainSAT NG 1 and SpainSAT NG 2, which should be launched no later than 2023 to ensure continuity of services to the Spanish Ministry of Defence. Both satellites will have advanced protection for anti-jamming and anti-spoofing, plus hardened protection against nuclear radiation[141].

Spain is also willing to take part in the NATO CP130 programme, which will be the successor to the NSP2K programme from 2020, as the participation of Spanish industry will have a positive effect on the international relations of the country[142]. Finally, at European level, Spain is the lead state of GovSatCom, an EDA initiative that aims at pooling and sharing governmental SATCOM capacities of European states.

### Surveillance

Spain possesses both optical and radar sensors and has an SST programme with an SST Operations Centre. The country is part of ESA's SSA project and is one of the founding members of the EU SST Consortium.

| | Earth observation | SIGINT | Early warning | Satellite communications | Surveillance |
|---|---|---|---|---|---|
| National capacities | • PAZ<br>• Ingenio (upcoming) | | | • Hispasat 1D<br>• Spainsat<br>• XTAR-EUR<br>• SpainSAT NG (upcoming) | • Several sensors |
| European multilateral cooperative programmes | • Helios 2<br>• Pleiades | | | | |
| European cooperation agreements | | | | | |

*Table 15: National and multinational military and dual-use space capacities of Spain*

[140] Gunter's Space Page (May 2019). "Spainsat 1/XTAR-LANT". Retrieved from: https://space.skyrocket.de/doc_sdat/spainsat-1.htm
[141] Erwin, Sandra (May 2019). "Airbus inks two-satellite deal with Spain's satellite operator Hisdesat". SpaceNews. Retrieved from: https://spacenews.com/airbus-inks-two-satellite-deal-with-spains-satellite-operator-hisdesat/
[142] National Armaments Directorate (October 2015). *Plan Director de Sistemas Especiales*.

# Annex E – The space defence landscape in the United Kingdom

## Strategy

Several strategic documents show that for several years the United Kingdom has taken seriously the issues related to space defence. In February 2015, it decided to identify space as a Critical Sector[143], in large part because other Critical Sectors (communications, transport, energy infrastructure) heavily rely on space services[144]. This decision led to an obligatory reflection on the means to defend space assets, with the annual production of a Sector Resilience Plan dedicated to space.

| Document | Main statements on outer space |
|---|---|
| National Space Security Policy (2014) | • Emphasises the need for the UK to enhance its resilience in space, especially against space weather<br>• Stresses the will to develop a more coherent national approach to space situational awareness |
| National Space Policy (2015) | • States that space is a cross-cutting domain, useful for many Departments of the UK government<br>• Recognises space as essential to national security, the prosperity of the economy and the delivery of public services<br>• Commits the government to tackle threats to space assets, malicious or not |
| Strategic Defence and Security Review (2015) | • Declares it will work to mitigate threats in space through information exchange (especially on space weather) and the development of space surveillance<br>• Declares that the United Kingdom will work with international partners, including the Five Eyes Combined Space Operations initiative and the EU, to contribute to global efforts to ensure a safe and secure space environment<br>• Insists on the need to make space systems more resilient |
| Joint Doctrine Publication on UK Air and Space Power (2017) | • Defines space power as the ability to exert influence in, from, or through space<br>• Underlines that space power contributes importantly to UK military power as an enabling environment and, increasingly, as an operating environment<br>• Asserts that space is "the domain which makes the most significant contribution to the effectiveness of all the instruments of national power"<br>• Identifies four space power roles: space situational awareness, space control (offensive and defensive measures to assure access and freedom of action in space), space support to operations, and space service support (launch operations and support to space assets) |

[143] Cabinet Office (2016). "Summary of the 2015-2016 Sector Resilience Plan". Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/526351/2015_16_summary_of_the_srp.pdf

[144] United Kingdom Space Agency (May 2018). "Critical National Infrastructure Overview".

| | |
|---|---|
| Mobilising, Modernising & Transforming Defence: A report on the Modernising Defence Programme (2018) | • For the first time, officially classifies space as one of the five military domains (with land, air, sea and cyberspace)<br>• Considers space as a new domain of warfare |

*Table 16: The involvement of space in UK strategic documents*

The United Kingdom is thus part of the broader trend considering space as an operational domain and it wants to prepare for potential future conflicts. To deter threats and defend national interests, the Ministry of Defence announced its intention to publish a Defence Space Strategy (DSS) in June 2018 with three strategic objectives[145]:

- Enhancing space resilience and operational effectiveness: it will be achieved through the development of plans, capabilities, skills and relationships, and reliance on international cooperation
- Optimizing space support to the front line by integrating space issues in more military activities, such as operational planning doctrine, capability development and training
- Supporting wider government activities: among them, the Ministry of Defence wants to work with owners and operators of the space Critical National Infrastructure in order to enhance their resilience (e.g. by coordinating plans to respond to threats and hazards)

In June 2019, officials announced that a National Space Council would be established to enhance the governance of UK space activities and improve coordination of its various aspects. Finally, in July 2019, the Secretary of State for Defence announced a bunch of measures to make the United Kingdom a leading power in space defence. Some of these measures rely on cooperation with the United States or private firms[146]:

- An investment of £30 million in a constellation of small satellites, to be launched within a year, to provide "live high-resolution video beamed directly into the cockpit of [UK] aircraft providing pilots with unprecedented levels of battle awareness". The project will be led by a UK-U.S. defence personnel team, the Team ARTEMIS.
- The United Kingdom becomes the first formal partner of the United States in the Operation Olympic Defender, a multinational coalition led by the Americans and formed to strengthen deterrence against hostile actors in space and reduce the spreading of debris in orbit. The United Kingdom will send eight personnel over the next 18 months to the Combined Space Operations Center, in California.
- The Joint Forces Command has been transformed into a Strategic Command to deal with evolving "grey zone" threats. The Command has a greater strategic role and leads integration across the five warfighting domains: land, air, sea, cyber and space. It also improves strategic thinking.
- RAF staff became involved with Virgin Orbit, a company launching small satellites into space from the wing of an aircraft. A Test Pilot has been integrated into the Virgin Orbit programme so that, in the future, RAF aviators can win their astronaut's wings thanks to this collaboration.
- A competition will be organised by the Defence and Security Accelerator to find new technology designed to boost the surveillance capability of UK satellites and identify potentially hostile actors in space
- A new Satellite Ground Control Station will be set up to operate satellites in LEO and GEO

[145] UK Ministry of Defence (2018). "Towards a Defence Space Strategy". Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/712376/MOD_Pocket_Tri-Fold_-_Defence_Space_Strategy_Headlines.pdf

[146] Channon, Max (July 2019). "Royal Navy, RAF and Army in new space race against Russia and China". Plymouth Live. Retrieved from: https://www.plymouthherald.co.uk/news/local-news/royal-navy-raf-british-army-3106538. Speech: UK Ministry of Defence (July 2019). "Defence Secretary keynote speech at the Air and Space Power Conference 2019". Retrieved from: https://www.gov.uk/government/speeches/defence-secretary-keynote-speech-at-the-air-and-space-power-conference-2019

## Governance

Due to its close partnership with the United States, the United Kingdom benefits from many services from U.S. space assets. Moreover, the country relies strongly on private firms for its space systems. Therefore, only a few organisations are relevant in the management of military space in the United Kingdom. The main public organisations responsible for these activities fall under the Ministry of Defence:

- The Royal Air Force (RAF)
- The UK Strategic Command

The following figure outlines British space defence governance:

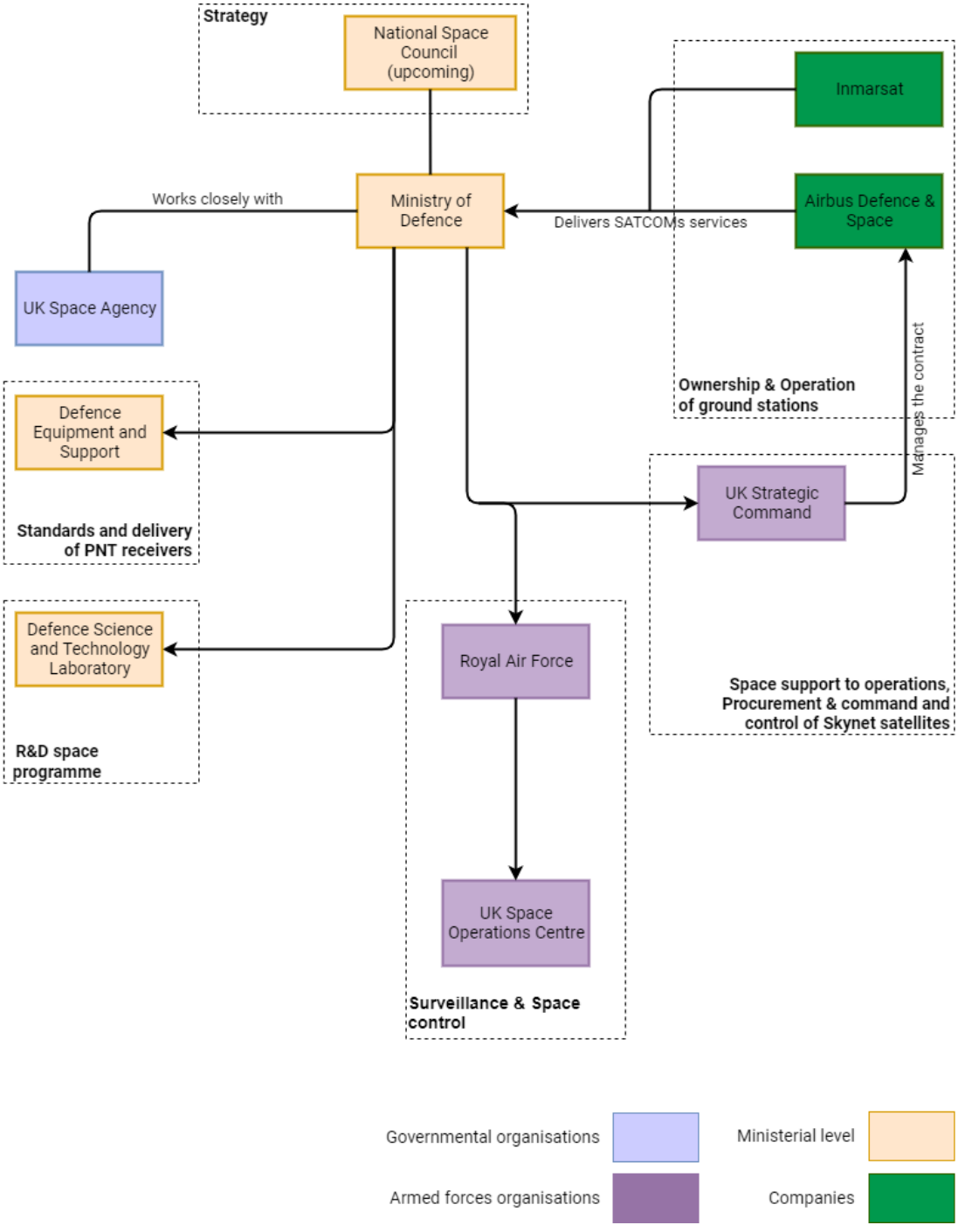


*Figure 16: Governance scheme of military space issues in the United Kingdom*

**The RAF is the Ministry of Defence lead in what regards space operations as it possesses strong expertise and manages key UK space assets.** Its facilities (especially the Air Command) provide various services and missions such as space control and space situational awareness. For instance, in July 2019, the head of the Air Force announced that the 23rd Squadron will be reformed as a space squadron responsible for day-to-day space command and control, including the flying of satellites and coordination with allies[147]. Yet, for the time being, the most important actor within the RAF is the UK Space Operations Centre, which "serves as the operational focal point for most UK military space operations"[148]. It has a warning mission (i.e. monitoring overflight of the UK by potentially hostile satellites, collision risks, re-entry of missiles and space objects), establishes attribution of activities in space, is an advisor on space-related matters and verifies the compliance of the UK with treaties. It also contributes to the planning and implementation of military operations through weather forecasts and assessment of GPS predictions. Nonetheless, the currently designed Defence Space Strategy recommends centralising all British space activities in a new National Space Operations Centre.

**The UK Strategic Command (UKSC) plays a key role in the coordination and delivery of UK space capabilities, especially by focusing more precisely on space support to operations.** Indeed, this command deals with ISR, SATCOMs and PNT capabilities. Thus, it coordinates the UK ISR capabilities and manages the Skynet programme. SATCOMs command and control is provided by the Permanent Joint Headquarters Global Operations and Security Control Centre, which is part of the Strategic Command. The UKSC is also in contact with the United States on PNT issues and to get ISR support from U.S. components[149]. Under the UKSC, Defence Intelligence, the military intelligence organisation, uses information from various sources such as signals, geospatial information or imagery, to feed the decision-making process on defence issues. After the implementation of the Defence Space Strategy, it should get a bigger role in monitoring threats[150].

The UK Space Agency (UKSA), established in 2010, is responsible for civil space policy as well as civil programmes. Yet, it licenses the launch and operation of all UK satellites, including military systems. As space assets are dual-use and space is increasingly important, the MoD works closely with the UKSA. **The agency is the UK Government lead for the National Space Security Policy and is responsible for the space sector as Critical National Infrastructure.** The competent national authority responsibilities for Galileo PRS are assumed by the UKSA, but the actual authority is the Secretary of State for Business, Energy and Industrial Strategy (under which the UKSA falls). However, with Brexit, access to Galileo PRS will not be possible anymore. Therefore, as the UKSA is currently responsible for the delivery of UK space launch and GNSS programmes, it will have a role to play in a future national GNSS.

Finally, **within the Ministry of Defence, Defence Equipment and Support, the procurement agency for the UK armed forces is responsible for standards and delivery of Position Navigation and Timing receivers. The Defence Science and Technology Laboratory (Dstl) runs an R&D space programme to inform capability choices.** In terms of satellite operations, the Ministry depends on commercial providers, "demonstrating that military ownership is not necessarily required to deliver space capabilities"[151]. Thus, the operation of several UK assets is outsourced to a private firm, namely Airbus Defence & Space (which is the new owner of the previous firm, Paradigm): this is the case for the Skynet 4 & 5 SATCOMs programmes. In this

[147] Chuter, Andrew (July 2019). "UK, US militaries join forces to keep the upper hand in space". DefenseNews. Retrieved from: https://www.defensenews.com/global/europe/2019/07/18/uk-us-militaries-join-forces-to-keep-the-upper-hand-in-space/
[148] UK Ministry of Defence (December 2017). *Joint Doctrine Publication 0-30: UK Air and Space Power*. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/668710/doctrine_uk_air_space_power_jdp_0_30.pdf
[149] *Ibid*.
[150] Fisher, Lucy (May 2019). "MoD boosts space defence as threat to satellites grows". The Times. Retrieved from: https://www.thetimes.co.uk/edition/news/mod-boosts-space-defence-as-threat-to-satellites-grows-wslqhlkht
[151] UK Ministry of Defence (December 2017). *Joint Doctrine Publication 0-30: UK Air and Space Power*. p. 106.

framework, the MoD is only a "consumer", which purchases services offered by Airbus. The company can then provide the capacity not required by the MoD to NATO or other countries[152]. The agreement between the Ministry and the firm is managed by the UK Strategic Command.

## Programmes

Due to its access to U.S. systems, the United Kingdom has almost only focused on SATCOMs for the development of its military space assets.

### Earth observation

The Carbonite 2 satellite is a prototype that was launched in January 2018. One of its instruments enables acquiring images through a full colour HD video camera. Apparently, the RAF is the exclusive customer for the images provided by the satellite, which is owned and operated by Surrey Satellite Technology[153]. The new Defence Space Strategy explains that the Air Force will create a contingent of small satellites on the model of Carbonite 2 to enhance its surveillance capabilities. The UKSC also has a project of surveillance and reconnaissance satellites[154]. Finally, the Defence Science and Technology Laboratory partnered with Airbus on Project Oberon, which aims at developing and deploying "a cluster of ultra-high-resolution Synthetic Aperture Radar (SAR) satellites as early as 2025"[155] that would also be able to sense and geolocate the source of radio-frequency transmissions.

### Satellite communications

The Skynet 4 and 5 systems are currently in operation, totalling seven satellites. Skynet 5 is nuclear hardened and fully encrypted. Planning for the next generation, Skynet 6, is under way. This system will be formed of three parts: one satellite in geostationary orbit to extend the life of the Skynet 5 constellation; a new hardware solution (which has still to be confirmed); and a service delivery wrap, that is, the services that deliver the programme in its entirety.

Skynet 5 has an original framework, because it results from a private finance initiative (PFI) with EADS Astrium and its subsidiary company Paradigm (both now belonging to Airbus Defence and Space), which is managed by the UK Strategic Command. As a consequence, military forces are not the owner of these satellites, but the private firm, which has invested through the provision of the spacecraft and the purchase of ground terminals, and operates ground stations[156], delivers a paying service to them. Skynet 4 & 5 are used by the United Kingdom to respect its pledges towards NATO through the NSP2K programme.

This strong commitment to SATCOMs capacities is reinforced by the plan for future acquisitions that shows an emphasis on Information Systems and Services (£22.9bn planned spending for the period 2021-2027) but also on ISTAR equipment (£5bn for the same period)[157]. In addition, the key investments

[152] Army Technology (January 2008). "Skynet – A New Saviour in the Sky". Retrieved from: https://www.army-technology.com/features/feature1527/
[153] Chuter, Andrew (November 2017). "British military to test space-based intelligence gathering". DefenseNews. Retrieved from: https://www.defensenews.com/breaking-news/2017/11/29/british-military-to-test-space-based-intelligence-gathering/?utm_source=Sailthru&utm_medium=email&utm_campaign=Exclusive%2011.29.17&utm_term=%20Breaking%20News
[154] Fisher, Lucy (May 2019). "MoD boosts space defence as threat to satellites grows". The Times.
[155] Lye, Harry (September 2019). "Dstl announces future ground vehicle and SAR satellite programmes". Army Technology. Retrieved from: https://www.army-technology.com/news/dstl-vehicles-satellites/
[156] Chuter, Andrew (April 2017). "Airbus D&S could lose out on satellite deal if UK seeks competition". DefenseNews. Retrieved from: https://www.defensenews.com/digital-show-dailies/space-symposium/2017/04/18/airbus-d-s-could-lose-out-on-satellite-deal-if-uk-seeks-competition/
[157] UK Ministry of Defence (January 2018). *The Defence Equipment Plan 2017*. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/677999/20180125-EP17_Final.pdf

of the Strategic Defence and Security Review 2015 include the establishment of a Space Operations Control Centre and its upgrade, as well as Skynet 5 Beyond line of sight satellite communications (the former name of Skynet 6) and an investment in the next generation of strategic secure communications. The UK Strategic Command will "provide new satellite communications and "future proof" the navigation and targeting services based on space assets"[158].

### Surveillance

The RAF plans to improve its Space Surveillance Network. Moreover, the MoD is currently designing a defence radar that may be used to track ballistic missiles in space. However, Ballistic Missile Warning (BMW) and SSA remain capabilities that are different; for instance, BMW may not necessarily meet Defence requirements for space surveillance. Moreover, the MoD is working with the UK Space Agency on a potential National Space Operations Centre to deliver the UK's need for SSA, both civil and military. This project is still in its infancy and will be subject to future funding decisions. The UK is also one of the founding members of the EU SST Consortium, but Brexit raises questions about its future participation.

### Positioning, Navigation and Timing

The MoD provides technical expertise and security advice to the UK Space Agency's Global Navigation Satellite System programme. Moreover, it also runs the Robust Global Navigation System programme, which aims at developing multi-signal military satellite navigation receivers to increase the resilience of UK access to PNT data. Finally, due to Brexit and its consequences on UK's access to Galileo PRS, UK decision-makers are envisioning the implementation of a national Global Navigation Satellite System.

| | Earth observation | SIGINT | Early warning | Satellite communications | Surveillance |
|---|---|---|---|---|---|
| National capacities | • Carbonite 2 | | | • Skynet 4 (4C, 4E, 4F)<br>• Skynet 5 (5A, 5B, 5C, 5D)<br>• Skynet 6 (upcoming) | • Several sensors |
| European multilateral cooperative programmes | | | | | |
| European cooperation agreements | | | | | |

*Table 17: National and multinational military and dual-use space capacities of the United Kingdom*

[158] UK Ministry of Defence (2016). *SDSR 2015: Defence Fact Sheets*. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492800/20150118-SDSR_Factsheets_1_to_17_ver_13.pdf

# Annex F – The participation of other countries in space defence programmes

Even though France, Germany, Italy, Spain and the United Kingdom are the five most important European countries dealing with space defence issues and possessing national assets, other states are also involved in military space, especially through participation in international programmes. Even if not exclusively, most of their activity focuses on Earth observation systems. However, it is noteworthy that these investments do not mean that they have designed a strategy on military space issues.

- Austria is part of the Pleiades programme, with the Austrian space agency contributing 1% of the cost of the whole programme. Some of its sensors contribute to the EU SST initiative even if Austria is not a member of the Consortium[159].
- Belgium is also a partner of Pleiades; the Belgian space agency funded 3% of the cost of the whole programme. Belgium also contributes 2.5% of the Helios programme. Finally, Belgium has signed an agreement with France to get access to the upcoming CSO capability and will contribute €45.7 million on this programme between 2018 and 2021[160].
- Due to its vast Arctic territories, Denmark has invested in an observation satellite. GOMX-4A, launched in 2018, is sponsored by the Danish Defence Acquisition and Logistics Organization, part of the Danish MoD. This is its first satellite intended to contribute to surveillance of the Arctic. The GOMX-4A demonstration is part of an analysis seeking to identify best practice and future efforts reinforcing the Danish Defence's surveillance of the Arctic within the Kingdom[161].
- Greece participates in Helios 2, with a 2.5% share.
- Luxembourg launched in 2018 its first dual-use SATCOM, GovSat-1, which will provide services for governments and armed forces, especially to NATO. The project relies on a public-private joint venture between the Luxembourg government and SES.
- Poland has an agreement with Italy to get images from COSMO-SkyMed (including the next generation) and OPTSAT-3000 satellites. The Polish Space Agency (POLSA) also signed in April 2019 an agreement with USSTRATCOM for the sharing of SSA services and information (in Europe, this agreement has already been signed by the five major countries, the Netherlands, Belgium and Denmark). Moreover, Poland integrated the EU SST Consortium in February 2019 and will contribute to the initiative by using telescopes belonging to public and private entities. The importance of space for defence is well understood in Poland as the priority task of POLSA is "to take care of the security of the country and its citizens and to increase Polish defence capabilities through the use of satellite systems"[162].
- Portugal is part of the EU SST Consortium.
- Romania is part of the EU SST Consortium. The Romanian Space Agency has also signed the SSA agreement with the USSTRATCOM.
- Sweden pays for 3% of the costs of the Pleiades systems; in addition, it ensures, through its station network, services for data reception and the telemetry and telecommand of satellites. Similarly, the Kiruna station will be used by CSO satellites in future.

[159] European Commission (May 2018). *Report from the Commission to the European Parliament and the Council on the implementation of the Space Surveillance and Tracking (SST) support framework (2014-2017)*. Retrieved from:http://www.europarl.europa.eu/RegData/docs_autres_institutions/commission_europeenne/com/2018/0256/COM_COM(2018)0256_EN.pdf

[160] Belgian Ministry of Defence (June 2016). *The Strategic Vision for Defence*. Retrieved from: https://www.mil.be/sites/mil.be/files/pdf/strategic-vision-belgian-defense-en.pdf

[161] GomSpace. "GomX-4 by GomSpace". Retrieved from: https://gomspace.com/gomx-4.aspx

[162] "About POLSA" (2018). Polish Space Agency. Retrieved from: https://polsa.gov.pl/en/about-polsa/about-polsa

# Annex G – Galileo's protection schemes

The protection of Galileo takes place in two ways, depending on the situation: the "routine" management of the security of the system, and a specific procedure to protect it in case of crisis.

On a routine basis, three offices are especially important[163]:

- The Central Security Office establishes security policies for physical security, personnel security and for EU-consequent information handled through the programme. The Security Requirements and Standards section is responsible for the cybersecurity of the programme.
- The GSA's Crypto Distribution Authority works on cryptographic elements.
- The Galileo Security Monitoring Centre (GSMC) is a GSA entity, independent of the operator, which monitors the operational status of system components and takes measures to address security threats and alerts. Sections of the GSA dedicated to PRS activities, in coordination with the GSMC, oversee the engineering, evolution, operations and services provision of the Galileo PRS. In the future, the GSMC will become the single access point for member states regarding PRS issues.
- Finally, member states are responsible for the security of the ground-based segment elements of the various EU space programmes (Galileo, but also Copernicus) present on their territory.

However, in the event of threats to the EU or member states security or essential interests, the European Union has set up a procedure whereby the GSA must execute instructions coming from the Council (normal procedure) or the High Representative (if he/she decides that the situation requires an emergency decision). Pursuant to the Council Joint Action 2004/552/CFSP[164] in 2004, the Council and the High Representative already had responsibilities regarding answering threats to Galileo. These responsibilities were updated ten years later with the decision 2014/496/CFSP. More precisely, the procedure to implement is the following[165]:

1. When the threat appears, the member states, the Commission or the GSA, must inform the Council and the HR/VP of the elements they dispose of and they consider as relevant.
2. Then, the Council decides the necessary instructions to the GSA and, more precisely, to the GSMC. In this process, the Council is advised by the GSA and the Commission, which explain the consequences that the implementation of instructions would have on the system. Finally, the Political and Security Committee provides an opinion to the Council on the instructions proposed.
3. If the situation is too urgent and the Council does not have time to take a decision, the HR/VP is authorised to issue the necessary provisional instructions to the GSA/GSMC. In that case, he/she must inform the Commission and the Council of the instructions given. These instructions are provisional and should be confirmed, modified or revoked by the Council. In any event, the provisional instructions expire four weeks after issue.

[163] Gutierrez, Peter (March 2019). "European Space Sector Gets Defensive". Inside GNSS. Retrieved from: https://insidegnss.com/european-space-sector-gets-defensive/

[164] Council of the European Union (July 2004). "Council Joint Action 2004/552/CFSP of 12 July 2004 on aspects of the operation of the European satellite radio-navigation system affecting the security of the European Union". Retrieved from: eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32004E0552&from=EN

[165] Council of the European Union (July 2014). "Council Decision 2014/496/CFSP of 22 July 2014 on aspects of the deployment, operation and use of the European Global Navigation Satellite System affecting the security of the European Union and repealing Joint Action 2004/552/CFSP". Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014D0496&from=EN

To be able to manage this kind of situation and to fulfil its mission, the EEAS has had to prepare early operational procedures. It has thus organised itself by setting up a GNSS Threat Response Architecture (GTRA)[166]. During the "normal" procedure when a threat is detected, the GTRA transmits the instructions of the Council of the EU and the HR/VP to the GSA and, especially, to the GSMC. In case of emergency, the GTRA prepares the provisional instructions delivered by the HR/VP to the GSMC.

The following figure describes the procedures which are implemented if a threat towards Galileo is detected:

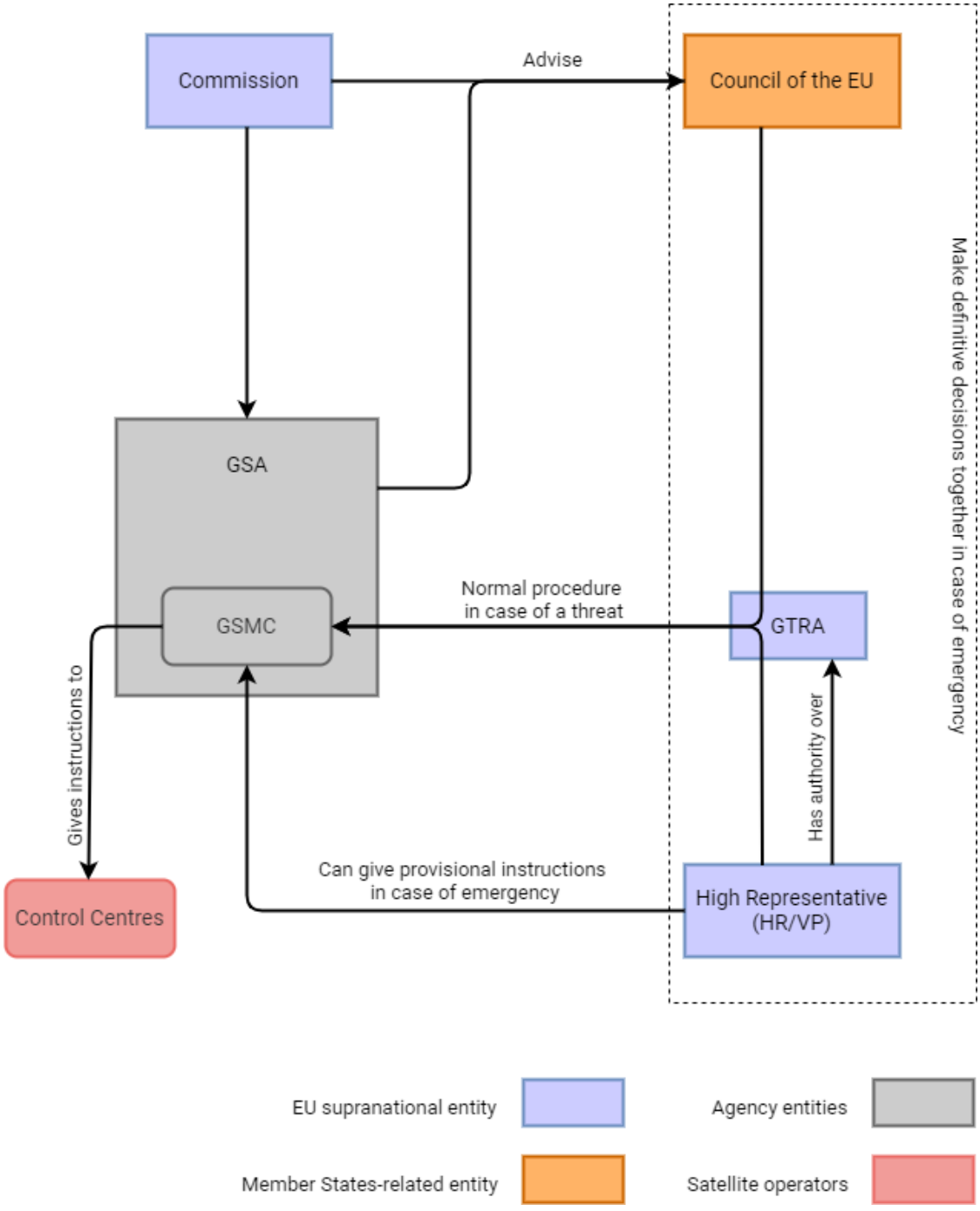


*Figure 17: Galileo security framework in case of crisis*

[166] Plattard, Serge and Amiel Sitruk (January 2017). "The Governance of Galileo". ESPI Report n°62. Retrieved from: https://espi.or.at/publications/espi-public-reports

# Annex H – List of Acronyms

| Acronym | Explanation |
|---|---|
| A | |
| AGS | Alliance Ground Surveillance System |
| ASAT | Anti-satellite |
| ASI | Agenzia Spaziale Italiana (Italian Space Agency) |
| AOI | Area of interest |
| B | |
| BAAINBw | Bundesamt für Ausrüstung, Informationstechnik und Nutzung der Bundeswehr (Federal Office for Bundeswehr Equipment, Information Technology and In-Service Support, Germany) |
| BDA | Battle damage assessment |
| BMW | Ballistic Missile Warning |
| C | |
| CARD | Coordinated Annual Review on Defence |
| CDAOA | Commandement de la défense aérienne et des opérations aériennes (Air Defence and Air Operations Command, France) |
| CDE | Commandement de l'espace (Space Command, France) |
| CDP | Capability Development Plan |
| CDTI | Centro para el Desarrollo Tecnólogico Industrial (Centre for the Development of Industrial Technology, Spain) |
| CIL | Common Interoperability Layer |
| CMOS | Centre militaire d'observation par satellites (Military Centre for Satellite Observation, France) |
| CNES | Centre National d'études spatiales (French Space Agency) |
| COMINT | Communication Intelligence |
| COSMOS | Centre opérationnel de surveillance militaire des objets spatiaux (Operational Centre for the military surveillance of space objects, France) |

| | |
|---|---|
| CPA | Competent PRS Authority |
| CSDP | Common Security and Defence Policy |
| CSG | COSMO-SkyMed Second Generation |
| CSO | Composante spatiale optique (Optical Space Component) |
| CSpO | Combined Space Operations initiative |
| D | |
| DGA | Direction Générale de l’Armement (General Directorate for Armaments, France) |
| DGAM | Dirección General de Armamento y Material (National Armaments Directorate, Spain) |
| DIRISI | Direction Interarmées des Réseaux d'Infrastructure et des Systèmes d'Information (Joint Directorate of Infrastructure Networks and Information Systems, France) |
| DLR | Deutsches Zentrum für Luft- und Raumfahrt (German Space Agency) |
| DRDO | Defence Research and Development Organisation |
| DRM | Direction du Renseignement Militaire (Directorate of Military Intelligence, France) |
| DSA | Defence Space Agency |
| DSC | Defensive Space Control |
| DSRO | Defence Space Research Organisation |
| DSS | Defence Space Strategy |
| E | |
| EC | European Commission |
| EDAP | European Defence Action Plan |
| EDF | European Defence Fund |
| EDIDP | European Defence Industrial Development Programme |
| EEAS | European External Action Service |
| EGNOS | European Geostationary Navigation Overlay Service |
| EI2 | European Intervention Initiative |

| | |
|---|---|
| ELINT | Electronic Intelligence |
| EO | Earth Observation |
| ESA | European Space Agency |
| ESDI | European Security and Defence Identity |
| ESDP | European Security and Defence Policy |
| EU | European Union |
| EUGS | Global Strategy for the European Union's Foreign and Security Policy |
| EUMC | European Union Military Committee |
| EUMS | European Union Military Staff |
| G | |
| GEO | Geostationary Earth Orbit |
| GNSS | Global Navigation Satellite Systems |
| GOVSATCOM | Governmental Satellite Communication |
| GPS | Global Positioning System |
| GSA | European GNSS Agency |
| H | |
| HR/VP | High Representative of the Union for Foreign Affairs and Security Policy |
| I | |
| ICBM | Intercontinental Ballistic Missile |
| IGS | Information Gathering Satellite |
| INTA | Instituto Nacional de Técnica Aerospacial (National Institute of Aerospace Technology, Spain) |
| ISC | Integrated Space Cell |
| ISR | Intelligence, Surveillance and Reconnaissance |
| ISRO | Indian Space Agency |
| J | |

| | |
|---|---|
| JAXA | Japan Aerospace Exploration Agency (Japanese Space Agency) |
| JFC | Joint Forces Command |
| L | |
| LEO | Low Earth Orbit |
| M | |
| MFF | Multiannual Financial Framework |
| MILSATCOM | Military Satellite Communications |
| MoD | Ministry of Defence |
| MPCC | Military Planning and Conduct Capability |
| MUSIS | Multinational Space-based Imaging System for Surveillance, Reconnaissance and Observation |
| N | |
| NATO | North Atlantic Treaty Organisation |
| O | |
| OCCar | Organisation for Joint Armament Cooperation |
| P | |
| PADR | Preparatory Action on Defence Research |
| PESCO | Permanent Structured Cooperation |
| PLA | People’s Liberation Army |
| PLA SSF | People’s Liberation Army Strategic Support Force |
| PNT | Positioning, Navigation and Timing |
| PPWT | Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects |
| PRS | Galileo Public Regulated Service |
| PSC | Political and Security Committee |
| R | |

| | |
|---|---|
| RAF | Royal Air Force |
| RPO | Rendezvous and proximity operation |
| R&T | Research and Technology |
| S | |
| SAR | Synthetic-Aperture radar |
| SatCen | EU Satellite Centre |
| SCC | Strategy Context Cases |
| SDA | Space Development Agency |
| SEA | Copernicus service in Support to EU External Action |
| SGD/DNA | Segretario Generale della Difesa/Direzioni Nazionale degli Armamenti (Secretariat General of Defence/National Armaments Directorate, Italy) |
| SGDSN | Secrétariat Général de la défense et de la sécurité nationale (General Secretariat for Defence and National Security, France) |
| SIGINT | Signal Intelligence |
| SSA | Space Situational Awareness |
| SST | Space Surveillance and Tracking |
| T | |
| TFEU | Treaty on the Functioning of the European Union |
| U | |
| USSTRATCOM | U.S. Strategic Command |
| W | |
| WRLageZ | Weltraumlagezentrum (Space Situational Awareness Centre, Germany) |

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| List of interviewees | |
|---|---|
| Marek Banaszkiewicz | Former Head of the Polish Space Agency (POLSA) |
| Vito Casagrande (Col.) | Director of the Space Office of the Italian General Defence Staff, Italian Defence General Staff |
| Carine Claeys | Special Envoy for Space, Head of the Space Task Force, European External Action Service (EEAS) |
| Juan Carlos Cortés Pulido | Director, Directorate of Space, Large Infrastructures and Dual Programmes, Centre for the Development of Industrial Technology (CDTI) |
| Sorin Ducaru (Amb.) | Director, EU Satellite Centre |
| Jean-Paul Granier | Space Deputy Director, General Armament Directorate (DGA) |
| Gerd Gruppe | Former Member of the DLR Executive Board, German Space Agency (DLR) |
| Pascal Legai (Gen.) | Senior Advisor – Earth Observation, European Space Agency (ESA) |
| Jérôme de Lespinois (Lt. Col.) | Chief of Studies Department, French Air Force |
| Christophe Morand | Deputy Director of the Space Task Force, European External Action Service (EEAS) |
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| Wolfang Roehrig | Head of Unit Information Superiority, European Defence Agency (EDA) |
| Kai-Uwe Schrogl | German Ministry for Economic Affairs and Energy |
| Giuseppe Sgamba (Brig. Gen.) | Assistant Director, Joint Air Power Competence Centre (JAPCC) |

| | |
|---|---|
| Nicolas Stassin | Policy Officer in the Space Task Force, European External Action Service (EEAS) |
| Philippe Steininger (Gen.) | Military Advisor to the President, French Space Agency (CNES) |
| Lionel Suchet | Chief Operating Officer, French Space Agency (CNES) |
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