

# Space Capabilities to Support Military Operations in the European Theatre

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## Cover

*Attendees take part in a public screening projection of the takeoff of the Ariane 6 rocket at the Cite de l’Espace, in Toulouse, south-western France, on 9 July, 2024. (Photo by Valentine Chapuis/AFP via Getty Images)*

# List of Abbreviations

<b>ARES</b>	<i>Action et résilience spatiale</i> [French space action and resilience plan]	<b>GRAVES</b>	<i>Grand Réseau Adapté à la VEille Spatiale</i> [Large array for space surveillance]
<b>C2</b>	command and control	<b>GOVSATCOM</b>	government satellite communication
<b>C3</b>	command, control and communications	<b>IRIS<sup>2</sup></b>	Infrastructure for Resilience, Interconnectivity and Security by Satellite
<b>CDE</b>	<i>Commandement de l'Espace</i> [French Space Command]	<b>ISOC</b>	Italian Space Operations Centre
<b>COS</b>	<i>Comando delle Operazioni Spaziali</i> [Italian Space Operations Command]	<b>ISR</b>	intelligence, surveillance, reconnaissance
<b>CSDP</b>	[European Union] Common Security and Defence Policy	<b>PNT</b>	positioning, navigation, timing
<b>CSO</b>	Composante Spatiale Optique	<b>RPO</b>	rendezvous and proximity operations
<b>DA/ASAT</b>	direct-ascent anti-satellite	<b>SatCen</b>	European Union Satellite Centre
<b>DGA</b>	<i>Direction générale de l'armement</i> [French defence procurement agency]	<b>SATCOM</b>	satellite communication
<b>DG DEFIS</b>	Directorate General for Defence Industry and Space	<b>SCA</b>	<i>Service du commissariat des armées</i> [French joint forces logistics department]
<b>DLR</b>	<i>Deutsches Zentrum für Luft- und Raumfahrt</i> [German Aerospace Centre]	<b>SDA</b>	space domain awareness
<b>EDA</b>	European Defence Agency	<b>SIGINT</b>	signals intelligence
<b>EDF</b>	European Defence Fund	<b>SSA</b>	space situational awareness
<b>EEAS</b>	European External Action Service	<b>STM</b>	space traffic management
<b>EGNOS</b>	European Geostationary Navigation Overlay Service	<b>NSS6G</b>	SATCOM Services 6th Generation
<b>EO</b>	Earth observation	<b>PESCO</b>	Permanent Structured Cooperation
<b>ESA</b>	European Space Agency	<b>TIRA</b>	Tracking and Imaging Radar
<b>EUSPA</b>	European Union Agency for the Space Programme	<b>UGS</b>	<i>Ufficio Generale Spazio</i> [Italian General Space Office]
		<b>YODA</b>	<i>Yeux en Orbite pour une Démonstration Agile</i> [Eyes in Orbit for an Agile Demonstration]

# Executive Summary

The war in Ukraine has underscored the strategic utility of space in modern conflict. Satellite-based assets have proven critical for intelligence, surveillance and reconnaissance (ISR), communications and cyber operations. Russia's pre-emptive cyber attack on Ukraine's Viasat system demonstrated the extension of conflict in space and the vulnerability of space-based systems to non-kinetic threats, emphasising the need for resilience and redundancy in space capabilities. This research report analyses selected European national defence policies and plans to advance their approaches to space and space capability in support of terrestrial military operations, and reveals disparities in ambition and capacity across the continent. It further examines the limited but growing role of international partnerships and cooperation through the European Union and NATO, as well as individual national approaches to integrating commercial space capabilities for military uses. A comparison with the United States highlights gaps in European capabilities and coordination and shows that the examined national approaches to space are aimed at the incremental creation and improvement of sovereign space capabilities.

## Key Takeaways

**Commercial and defensive drivers of growth.** Individual national space capabilities are growing in response to

national military operational needs and threat perceptions informed by the lessons from the war in Ukraine, expectations of the centrality of space to future economic and technological development, and national prestige. However, regulatory hurdles and fragmented policies as well as security risks hinder the full utilisation of commercial space assets in support of military activities.

**Sovereign capabilities as a primary goal.** At the European Union level, member states are working towards the development of common capabilities. Nonetheless, the primary focus of individual national policies is more centred on the development and strengthening of national defence capabilities, particularly for countries that already have sovereign capabilities and space industries.

**Intergovernmental cooperation.** The most active and substantial inter-European and transatlantic cooperation involves space data exchanges from national and European satellites. Efforts to better harmonise European space activities are hampered by fragmentation and competing national interests. Initiatives such as the European Union's Space Programme and NATO's space-related frameworks provide a foundation for collaboration, but more streamlined coordination is needed to address common threats and leverage shared resources effectively.

# 1. Lessons From Ukraine for Europe's Military Use of Space

Space data and services are increasingly an integral part of modern warfare. Earth observation (EO), intelligence, surveillance and reconnaissance (ISR), positioning, navigation and timing (PNT), and satellite communication (SATCOM) can assist a broad range of military tasks, supporting geolocation, targeting and battle-damage assessment, among others. Space further enables other military actions that rely on space-based data and services, such as the use of GPS-guided weapons. The growing military importance of space is also reflected by the growing number of space-related organisations focused on national security or defence tasks. NATO recognised space as a military domain in 2019, implying that conflicts might affect both ground- and space-based space capabilities and that an attack in the space domain may lead to the invocation of the Alliance's Article 5 collective-defence clause.<sup>1</sup>

The targeting of satellite networks has been prominent in Russia's war against Ukraine and represents a major change in the way space has been regarded as it pertains to military operations. Since *Operation Desert Storm* space systems have played an important role in supporting military operations, but in the last decade or so it has become a domain in which military operations can be performed.<sup>2</sup> This means that in addition to supporting the military in the collection of ISR, EO, PNT and SATCOM, militaries can target space and space-based capabilities of adversaries to disable their use of space. An initial example of the use of space to perform military operations is the GPS interferences registered in Syria.<sup>3</sup>

Similar uses of space occurred months before the start of Russia's invasion, when Ukraine was subject to GPS interferences.<sup>4</sup> Additionally, Russia conducted a preemptive non-kinetic attack against a Viasat service used for command and control (C2) by the Ukrainian military.<sup>5</sup> The attack disabled ground-based terminals and damaged communication channels for the Ukrainian military.<sup>6</sup> This attack demonstrates the modern use of cyber and space capabilities in military operations, and how a conventional military attack can be anticipated by the denial of

cyber and space services.<sup>7</sup> It also highlights the importance of having redundant data and resilient systems to try to ensure continuity of service in case of an attack.<sup>8</sup>

Ground- and space-based segments add to the list of potential targets and require proper physical and cyber protection.<sup>9</sup> Ground-based terminals of private companies providing services to Ukraine have been targeted by cyber attacks showing the advanced nature of Russian military capabilities in the field.<sup>10</sup> Nonetheless, a fast software update of the private infrastructure allowed for the maintenance of service even under attack.<sup>11</sup> Thus, the war in Ukraine demonstrates the necessity of maintaining an agile and innovative development ecosystem, to keep pace with the rapid cycle of offensive and defensive advances in the electronic-warfare and cyber domain. The use of space as an operational domain – and not just as a support domain for terrestrial military operations – has caused many states to question their own structures and capacity to conduct speedy procurement, constant updates and upgrades to capabilities.<sup>12</sup>

The way satellite data has been used in Ukraine suggests a further change in the organisation and management of forces on the ground, where Ukrainian deployed units have had the capacity to assess data and integrate it into their C2 software, transitioning from a hierarchical to a distributed C2 structure.<sup>13</sup>

Providing security for space capabilities requires the protection of assets in orbit from threats such as potential rendezvous and proximity operations (RPO), direct-ascent anti-satellite (DA/ASAT) weapons, or a collision with space debris. An appropriate space domain awareness and a functional space traffic management (STM) system can improve chances of better detection and threat reduction. Although RPOs and DA/ASAT weapons have not been used in the war in Ukraine, the use of these capabilities cannot be ruled out in future conflicts, even if the UN is looking to restrict development of these capabilities with its 2022 resolution calling for states not to commit destructive DA/ASAT missile tests.<sup>14</sup> For instance, exo-atmospheric missile-defence

interceptors that feature strong technological overlaps with DA/ASAT weapons have been recently employed by Israel. If mega-constellations can be considered more secure by design, as the damage of a limited number of satellites does not affect the functionality of the constellation, their increasing use could lead to new types of anti-satellite weapons.<sup>15</sup>

Experiences in the Russia–Ukraine war have exemplified the military utility of both civil and commercial space. Since the beginning of the war, private actors such as Starlink, Maxar or Iceye and international agencies have provided satellite services to Ukraine.<sup>16</sup> These were also possibly used to support Ukrainian forces in organising responses to Russian attacks. This shows the necessity of developing an integrated and comprehensive approach in the way warfare is understood and conducted, to render the provision of inputs from commercial and civil domains to military actors possible whenever appropriate.<sup>17</sup> In granting or denying access to satellite support information that could enable Ukraine, private companies have played a notable role in the war. It will be increasingly important to develop proper regulation and management of private facilities, to ensure a proper and secure continuation of the provision of services.<sup>18</sup>

The role played by electronic warfare in Ukraine against space networks demonstrates how relevant space has become for the support and performance of military operations in any warfare domain. In response to lessons drawn from Ukraine, the United States is now

modifying its national strategies to better exploit space services. Part of this effort is related to a better delineation of the strategic objectives and development of the US Space Force,<sup>19</sup> the development of ad hoc strategies for the integration of commercial space data in support of the development of a military situational picture,<sup>20</sup> and the space vision of armed services to improve the support from space to multidomain operations.<sup>21</sup> This change in approach towards space from the most powerful actor in the sector also requires a European paradigm shift on how to integrate space, space-based data and military operations, to keep pace with technological advancement and different usage of space.

Have European spacefaring nations adopted and adapted space strategies capable of operating effectively in the current (and future) security environment? The next section addresses this question for France, Germany, Italy and Sweden to assess if national strategic priorities are being translated into tangible military space structures and capabilities. Section Three of the report examines areas of cooperation between European Union member states, non-EU countries and private companies. In consideration of the increasing relevance of commercial actors, Section Four investigates how European countries are fostering commercial space industries and using them to build up space capabilities. The report concludes with a comparison of approaches between Europe and the US and identifies the main areas for improvement in Europe.

## 2. Evolving National Military Space Capabilities in Europe

The contested, congested and competitive nature of the space security ecosystem has prompted European spacefaring nations to reevaluate their military space strategies and capabilities. This section looks at what selected EU member states are doing to develop military space doctrines and build up physical space assets and their protection to address evolving threats. The creation of national space commands among European countries indicates a shift in perspective, treating space as a strategic and operational domain rather than just a support mission to other war-fighting domains.<sup>22</sup>

Access to sovereign space situational awareness data is becoming a priority, driven by concerns over the over-reliance on data sharing from multilateral and bilateral partnerships, commercial and international providers, and limitations to sharing access with multiple parties, such as bandwidth. Moreover, many member states consider civilian-military partnerships, and particularly the use of national technological and industrial bases, essential in filling defensive and offensive gaps to augment national capacities. The EU itself is a spacefaring organisation, owning its own assets and providing data to its members and partners.<sup>23</sup>

The 22 member states of the European Space Agency (ESA) support its various programmes and activities financially and intellectually.<sup>24</sup> In addition to high levels of collaboration and interoperability, for the most part, member states are hoping to either create or procure their own robust and resilient space systems. Some of the notable expanding national space programmes among ESA member states include those of Belgium,<sup>25</sup> France,<sup>26</sup> Germany,<sup>27</sup> Italy,<sup>28</sup> Spain<sup>29</sup> and the United Kingdom.<sup>30</sup> Conversations over the creation of national space programmes are advancing in Poland,<sup>31</sup> Portugal<sup>32</sup> and Romania.<sup>33</sup>

The following subsections consider the national programmes of France, Germany, Italy and Sweden. The selection of these four countries was guided by their substantial investments and variegated advancements in space systems for military use, the establishment of space commands, law and doctrines and near-future

development plans which will substantially add to the European space domain's credibility, competitiveness and overall security.

### Selected Advancements in European Military Space Programmes

#### France

Space operations have been in the purview of the French Space Agency since the 1960s. In 2019, space security became a more solidified strategic mission when the Space Force officially merged with the Air Force. The French Space Command (*Commandement de l'Espace*, CDE), formed in 2019, consists of members across air, space, army and naval branches, in addition to members from the defence procurement agency (*Direction générale de l'armement*, DGA) and joint forces logistics department (*Service du commissariat des armées*, SCA), accenting its multi-domain orientation.<sup>34</sup> Its establishing document, the 2019 Space Defence Strategy, places emphasis on creating an adaptable model for French space defence and control.<sup>35</sup>

The current space defence programme includes signals intelligence (SIGINT), ISR, SATCOMs, space situational awareness (SSA) and space domain awareness (SDA) capabilities. France has a competitive and advanced programme owing to its advanced capabilities such as its satellite-based SIGINT, setting it apart from other European military space programmes. Current projections for building out the CDE illustrate substantial growth in the mission: it is expected to reach 500 employees in 2025 from an original 220 personnel.<sup>36</sup>

France conducts its own SSA, with capabilities developed primarily by the ArianeGroup alongside other established companies and start-ups.<sup>37</sup> It has made the most critical contributions in the development of a launch capacity, its latest launch for the ESA taking place at the Guiana Space Centre in Kourou, French Guiana with an *Ariane 6* heavy-lift rocket in July 2024.<sup>38</sup>

The *Ariane 6* rocket is expected to launch an intelligence satellite in early 2025 as a part of the French military observation satellites replacement system, the Composante Spatiale Optique (CSO) constellation.<sup>39</sup> The launch capacity also offers Europe independent access to space and capability to launch payloads in both geostationary and low Earth orbits.

By 2030, France intends to have a full-fledged space defence capability, stressing the need for an active defence posture, substantial national capability and ease of access to systems and data. Space-based assets have additional importance to France as a nuclear-weapons state. ISR is a key supporting element to the French nuclear deterrent, particularly to its command, control and communications (C3) system. Technological advancements such as automation and artificial intelligence (AI) for data processing are of interest to facilitate more rapid exploitation. The future use of small satellite constellations for defence purposes is of interest to bolster active defence capabilities.

Plans are in place to further develop sovereign space capabilities through SSA-satellite development such as the Toutatis and YODA (*Yeux en Orbite pour une Démonstration Agile*) programmes, both included in the nation's overall space modernisation plan known as ARES (*Action et résilience spatiale*).<sup>40</sup> The modernisation plan is governed by the Military Programming Law 2024–30, and aims to deliver updated systems to assist space options for the French Air and Space Force.<sup>41</sup> Legal strategies will need to take into consideration how to incorporate commercial actors and private data into military space operations, above all in combatting governance issues. The first satellite tranche of the YODA demonstrator is planned for launch in 2025.<sup>42</sup>

As Minister of the Armed Forces Sébastien Lecornu said in 2023, 'space [...] is fundamental if we want to remain [...] capable of maintaining sovereign intelligence [and] observational means'.<sup>43</sup> A noticeable feature in upcoming developments is the growing number of commercial and start-up contracts, such as the contracting of new entrant U-Space under the Toutatis programme which will assist in the preliminary study, construction and operational support of next-generation nanosatellites.<sup>44</sup> Another collaborative effort between contractors – Unseenlabs and Cailabs – established a stable laser link for high-speed optical

SATCOMs between a nanosatellite in low orbit and a commercial optical ground station in a project funded by the French Defence Innovation Agency.<sup>45</sup>

## Italy

Similarly, the Italian Space Operations Command (*Comando delle Operazioni Spaziali*, COS), formed in 2020, was conceived as a strategic priority in the 2019 National Security Strategy for Space and reports to the Joint Forces Operations Command.<sup>46</sup> In the first year of operation, the command began with around 50 personnel. The General Space Office (*Ufficio Generale Spazio*, UGS) under the Defence General Staff complements the COS and is responsible for policy planning, space programmes and international cooperation of the military.<sup>47</sup>

The Italian space strategy in the security domain calls for protecting national interests, safeguarding industrial and commercial activities and developing the means to prevent, deter and defend against hostile actions in space. The strategy emphasises technological innovation, international collaboration, national security and economic growth.<sup>48</sup> The government guidelines on space and aerospace matters were approved in December 2024. They emphasise the need to adopt security strategies throughout the entire lifecycle of space programmes. The government's approach to space and aerospace matters is driven largely by a desire to position the nation as a leader in the global space community.

As illustrated in the 2022 Chief of Defence Strategic Concept, Italy is in the process of developing a space defence plan that makes the case for a greater national capability in the space domain.<sup>49</sup> The Italian Armed Forces are implementing an ISR programme in addition to SATCOM capabilities. Avio, an Italian aerospace company, is the primary contractor of another ESA launch capability, the *Vega-C* rocket.<sup>50</sup> After a two-year gap, the European *Vega-C* launched the *Sentinel-1C* satellite of the Copernicus constellation from French Guiana on 5 December 2024.<sup>51</sup>

The Italian Space Agency's technological advancement plans promote public-private collaboration, such as an agency-led effort with OHB-Italia to develop an optical sensor designed for SSA and SST for use by the ESA.<sup>52</sup> The Italian Space Operations Centre (ISOC), developed with research entities and private companies and integrated

within the aerospace operations command of the air force, acts as the software of the Ministry of Defence for the provision of SSA.<sup>53</sup> The COS is overseeing a development programme for new and updated satellites to enhance Italy's capabilities in communication, remote sensing and EO. The launch of Italy's geostationary SATCOM, the *SICRAL 3* programme, is planned for 2026.<sup>54</sup> Italy's planning also includes the pursuit of in-orbit servicing capabilities and a possibility to reopen its collaborative Kenya-based launch facility at the Luigi Broglio Malindi Space Center.<sup>55</sup>

## Germany

While France and Italy may have a larger variety and number of military space assets compared to Germany and Sweden, the latter are also undertaking significant initiatives to strengthen their space capabilities, including through international cooperation. The Bundeswehr Space Command, established under the German Air Force in 2021, is tasked with homeland security, including the surveillance and protection of critical space infrastructure. The command is planned to consist of up to 250 positions.<sup>56</sup> A space security strategy intended to be published in 2025, however, was scuppered by the collapse of the coalition government in late 2024.

Germany, like France and Italy, has access to ISR and SATCOM systems and data. The expansion of these systems is exemplified by plans to launch the next-generation secure military satellite system, SATCOMBw 3, in collaboration with Airbus by the end of the decade.<sup>57</sup> The system is also set to contribute to NATO efforts. In 2021, the civilian German Space Agency selected Lockheed Martin to advance their space command-and-control systems.<sup>58</sup> While this is an example of civil-military partnerships, it also illustrates the expanding role of US support and collaboration in the development of national space capabilities across Europe. Alongside France, Germany also became a member of the US Space Command-led multinational force *Operation Olympic Defender* in October 2024.<sup>59</sup> The project aims to deter and defend against malicious space behaviour, and to provide SSA through the pooling of national capabilities.

According to Federal Space Commissioner, Anna Christmann, Berlin aspires to replace the *Ariane* rocket and is advocating for a paradigm shift in the procurement of launch vehicles.<sup>60</sup> Despite national and

collaborative ambitions, lengthy military procurement processes and decreasing national defence budgets present challenges.<sup>61</sup> While federal defence spending has typically been on the rise over the past decade, the national space programme has had a decrease in funding from EUR371 million in 2023 to EUR333m in 2024, with a proposed further 12% cut in 2025.<sup>62</sup>

## Sweden

Sweden, in the process of standing up its space command, published a Defence and Security Space Strategy in 2024.<sup>63</sup> It emphasises maintaining freedom of action, creating a portfolio of space capabilities and becoming an active and responsible partner in the international space arena. Due to its location, Sweden is an especially important member to both the EU and NATO as it affords access to and competitiveness in the Arctic, and in addition can provide more resilient intelligence capability for the Baltic region. Upcoming plans for the development and indigenous launch of its ISR Earth-observation capability, as well as its contract with Ovzon, a Swedish company specialising in mobile SATCOM services, to further support military SATCOMs, demonstrate Stockholm's commitment to developing its military space programme.<sup>64</sup>

Sweden's Esrange Space Center is set to become the first orbital launch site on mainland EU territory, establishing greater autonomous access to space.<sup>65</sup> The Arctic spaceport will be used to conduct orbital satellite launches and could bridge EU and NATO space defence efforts further by offering a space for collaboration and cohesion of effort to close the launch gap.<sup>66</sup> The European launch gap illustrates a discrepancy between ambitions in space exploration and satellite deployment and the current capacity to independently launch payloads into space.

In the US, for example, the access to launch vehicles is facilitated by commercial providers – which is less the case in Europe where launches have historically relied on developing government-supported programmes for *Ariane* and *Vega* rockets. Esrange has established a partnership with South Korean rocket manufacturer Perigee Aerospace to supply the launch vehicle for the first launch in 2024 – an initial launch date that has now been delayed to early 2025.<sup>67</sup> Perigee's BW1 microlauncher

integrated with ESRANGE's new orbital launch infrastructure will be able to place payloads up to 200 kilograms into a 500-kilometre sun-synchronous orbit.<sup>68</sup>

## Growth of European Military Space Programmes Versus Space-domain Threats





The growing emphasis on military space structures across Europe reflects the recognition that it is a critical domain for defence and security. However, challenges remain, such as the lack of a fully operational spaceport on the European continent (though initiatives exist), the risk of overreliance on joint programmes and the need for better management of kinetic and non-kinetic threats through improved space systems and their protective layers.<sup>69</sup>

As threats advance, so do planning efforts to increase access to space. One area where this is occurring is in

discussions to invest in and develop nano- and small-satellite launchers to support European dual-use needs – both civil and military applications.<sup>70</sup> Continued collaboration within the EU and NATO will be an area where allies could fill each other's intelligence gaps, strengthening Europe's overall resilience and ensuring robust awareness of objects in outer space.

Geopolitical tensions – ignited and exacerbated by Russia's war against Ukraine – and the financial strain of the cost of research and development for defensive space capabilities have driven ongoing collaborative security efforts in the military space domain. The EU's 2022 Space Strategy for Security and Defence identifies key threat areas facing EU member states and calls for greater contribution and collaboration to combat them.<sup>71</sup> The next section will detail some of these collaborative efforts within and outside of the EU context.

**Table 1: Selected military satellite systems and ground segments**

Country	Selected military space satellites (national and partnerships)	SIGINT and SSA ground capabilities (radar and laser capabilities)
 France	<p>SIGINT: <i>CERES</i> 1, 2 and 3</p> <p>ISR: CSO-1 and -2; CSO-3 from February 2025; <i>Helios</i> 2A and 2B; <i>Pleiades</i> 1A and 1B (dual role)</p> <p>ISR/SSA: YODA – proximity operations demonstrator; launch of two satellites in 2025</p> <p>COMMS: <i>Athena-Fidus</i>; <i>Sicral</i> 2; <i>Syracuse</i> 3A, 3B, 4A, 5B; <i>Syracuse</i> 4C by 2030</p>	<p>GRAVES – Large Array for Space Survey; SSA by 2027</p> <p>SATAM – Dual-role radar sensors and data processing that can be adapted for SSA</p> <p>French Transportable Laser Ranging Station (FTLRS)</p> <p>MeO Laser Ranging Station</p> <p>CNES Optical Ground Station Demonstrator (FrOGS)</p> <p>OGS Technologies optical ground stations</p> <p>Safran Data Systems optical ground stations</p>
 Germany	<p>ISR: SARah 1, 2 and 3; SAR-<i>Lupe</i> 1, 2, 3, 4 and 5</p> <p>COMMS: COMSATBw 1 and 2, COMSATBw 3 from 2028–29</p>	<p>GESTRA – German Experimental Space Surveillance and Tracking Radar</p> <p>miniSLR laser ranging station</p> <p>Satellite Laser Ranging Station Potsdam</p> <p>DLR Optical Ground Station in Oberpfaffenhofen</p> <p>Laser-Bodenstation optical ground station in Trauen</p> <p>University of the Bundeswehr Munich optical ground station</p>
 Italy	<p>ISR: <i>Cosmo</i> (<i>SkyMed</i>) – 3 operational first generation and two second generation; <i>Cosmo</i> SG 3 and 4 starting 2025; launch of IRIDE constellation by 2025–26; OPTSAT-3000</p> <p>COMMS: <i>Athena-Fidus</i>; <i>Sicral</i> 2; <i>Sicral</i> 3A and 3B by 2026–27; <i>Sicral</i> R1, estimated in 2025</p>	<p>BIRALES – Bistatic Radar for LEO Survey</p> <p>Matera Laser Ranging Observatory (MLRO)</p> <p>GeoDAF (Geodetic Data Archiving Facility) laser ranging station</p> <p>Officina Stellare Optical Ground Stations (OGS)</p>
 Sweden	<p>ISR: Heimdall 0-C by 2027–28</p> <p>COMMS: Osvon 3</p>	<p>Thales SMART-L Multi Mission (MM/F) radar</p> <p>ESRANGE Space Center laser ranging station</p> <p>NODES – Network of Optical Stations for Data Transfer to Earth from Space optical ground network in development</p>

Source: IISS analysis

# 3. Intergovernmental Cooperation

## Selected Bilateral and Minilateral Cooperative Frameworks

The development and use of space capabilities is an area in which several cooperative frameworks have been developed at the technological, technical, legal and military level.

Cooperative frameworks can be structured around more comprehensive agreements, such as the Quirinal Treaty between France and Italy,<sup>72</sup> or be limited to ad hoc activities such as joint use of capabilities, the sharing of parts of capabilities, or their joint development.<sup>73</sup> For example, in 2002 Belgium, France, Germany, Italy and Spain began cooperating on common operational requirements for a European space-based observation system. Joined by Greece in 2003, the aim of the cooperation was to harmonise national programmes on EO and to identify the systems required for ensuring the security of the military domain.<sup>74</sup> It was considered a reference activity for the identification of European priorities on ground segments and infrastructures, and the initiative was incorporated into the Global Monitoring for Environment and Security programme (now called Copernicus).<sup>75</sup>

Other examples of cooperation include the development of the Common Interoperability Layer linkage of French optical systems and Italian radars, the co-development of the *Athena-Fidus* and *Sicral 2* satellites, and the reciprocal tasking rights between the French *Pleiades* and the Italian *Cosmo (SkyMed)* systems.<sup>76</sup> On reciprocal tasking rights, similar cooperation has been conducted between France and Germany since 2009. France further cooperates on its CSO military reconnaissance satellites with several European countries.<sup>77</sup> Work with Germany, for instance, focuses on improved detection of space objects through the GRAVES–TIRA arrangement.<sup>78</sup> Poland, meanwhile, entered into an agreement with Italy for the provision of *Cosmo (SkyMed)* and OPTSAT-3000 satellite images,<sup>79</sup> while further

capability-development cooperation on new satellites is expected to materialise between Germany and Norway.<sup>80</sup>

Cooperative efforts are not limited to the ground and space segments but extend to access to space. Led by France, 13 European countries have been working together on *Ariane 6* launchers to renew Europe's capacity to perform medium-to-heavy-lift launches.<sup>81</sup> The necessity to retain and improve autonomous access to space is a key lesson from the conflict in Ukraine as the use of Russian Roscosmos' *Soyuz* launchers from the European launch site in French Guiana has been suspended since the start of the war. This has caused a stronger European reliance on SpaceX's *Falcon 9* for launches.<sup>82</sup> European launch capacity for smaller payloads is complemented by the Italy-led cooperation on *Vega-C* and the future *Vega-E*.<sup>83</sup> Questions remain, however, on the capacity of *Ariane 6* and *Vega-C* to fully satisfy the European demand for access to space.<sup>84</sup>

## Main Policies and Cooperative Activities at EU Level

The first EU space policy was agreed by member states in 2007.<sup>85</sup> The document defined a path for the EU to become a prominent actor in space and was further confirmed in the 2009 Lisbon Treaties. Article 189 of the Treaty on the Functioning of the EU (TFEU) called for the development of an EU space policy to foster technological and scientific development.<sup>86</sup> In the process of strengthening the EU role on space, the EU agreed on its Space Strategy in 2016.<sup>87</sup>

The first cooperative frameworks among EU countries, however, had already developed in the 1990s with the publication of the initial communication on the development of Galileo – the EU's global satellite navigation system that provides global

positioning services mainly from medium Earth orbit.<sup>88</sup> The development of Galileo was shortly followed by Copernicus. While Copernicus and Galileo reached initial operating capability in 2014 and 2016 respectively, neither of the programmes have reached full operational capacity.<sup>89</sup> The range of EU capabilities is complemented by the European Geostationary Navigation Overlay Service (EGNOS) which provides navigation support.<sup>90</sup>

Since 2021, the European Union Agency for the Space Programme (EUSPA) under the management of the Directorate General for Defence Industry and Space (DG DEFIS) in the European Commission has streamlined the management of different activities and exploited synergies. EUSPA is responsible for Galileo, EGNOS and Copernicus and has introduced new initiatives, such as the collection of SSA data – including STM – to track, monitor and identify objects and debris in space; government satellite communication (GOVSATCOM) to monitor and manage space risks; and the secure connectivity programme (Infrastructure for Resilience, Interconnectivity and Security by Satellite, IRIS<sup>2</sup>) to provide secure broadband communication.<sup>91</sup> The latter programme stems from requirements identified by the EU and its member states to improve the resilience, security and protection of uninterrupted space-based communication, currently insufficient at the European level.<sup>92</sup>

Similarly to the Galileo programme, IRIS<sup>2</sup> will offer a governmental service to be used for security and defence purposes.<sup>93</sup> However, the development of this new constellation, expected to provide full governmental satellite-connectivity services by 2030, risks being inadequately funded.<sup>94</sup> Moreover, questions remain on the attractiveness of the programme, and on security requirements and usage of data for spacefaring nations with secure SATCOM access.<sup>95</sup> Under the management of EUSPA and as part of the SSA work strand, 15 EU member states share SST data through the EU SST Partnership with EU institutions, countries, spacecraft owners and operators, and other public and private entities to reduce the risk of in-orbit collisions.<sup>96</sup> In this partnership, data provided by military sensors are

particularly important as they represented 95% of the entire dataset shared under the EU SST framework in 2022.<sup>97</sup>

Satellite data and analysis is also provided by the European Union Satellite Centre (SatCen), which supplies EU institutions, member states, partners and other EU agencies with data in support of decision-making and activities under the EU's Common Security and Defence Policy (CSDP). In 2023, SatCen substantially increased its support to CSDP missions and operations, also providing for the first time classified geospatial intelligence services to member states and improving the use of data from 'new space' actors.<sup>98</sup>

At the military level, the European Defence Agency (EDA) has pursued several activities such as the GOVSATCOM cooperation in support of CSDP deployments, and research and technology projects under development as part of the CapTech Space.<sup>99</sup> Interagency cooperation has also been fostered through ad hoc activities such as the ESA and EDA's joint project, Cyber Defence for Space.<sup>100</sup> Furthermore, the EU's Space Threat Response Architecture (STRA) will manage space threats or attacks against the EU, and related exercises will help identify any necessary improvements for security and defence cooperation.<sup>101</sup> The current priorities of the European External Action Service (EEAS) include a further delineation of potential EU responses to space threats and attacks to potentially include sanctions or other mechanisms from dialogue to proactive responses to attacks, similarly to what is included in the EU Cyber Diplomacy Toolbox.<sup>102</sup>

The 2023 EU Strategy for Space Security and Defence calls for the development of resilient space capabilities and security of supply, and aspires to exploit and coordinate activities under different cooperative frameworks, such as the Permanent Structured Cooperation (PESCO) and the European Defence Fund (EDF).<sup>103</sup> The type of projects that fall under PESCO and EDF range from the improvement of SSA through EO and the development of interceptors for early warning, to the enhancement of GOVSATCOM and its reaction capability to operations in space.

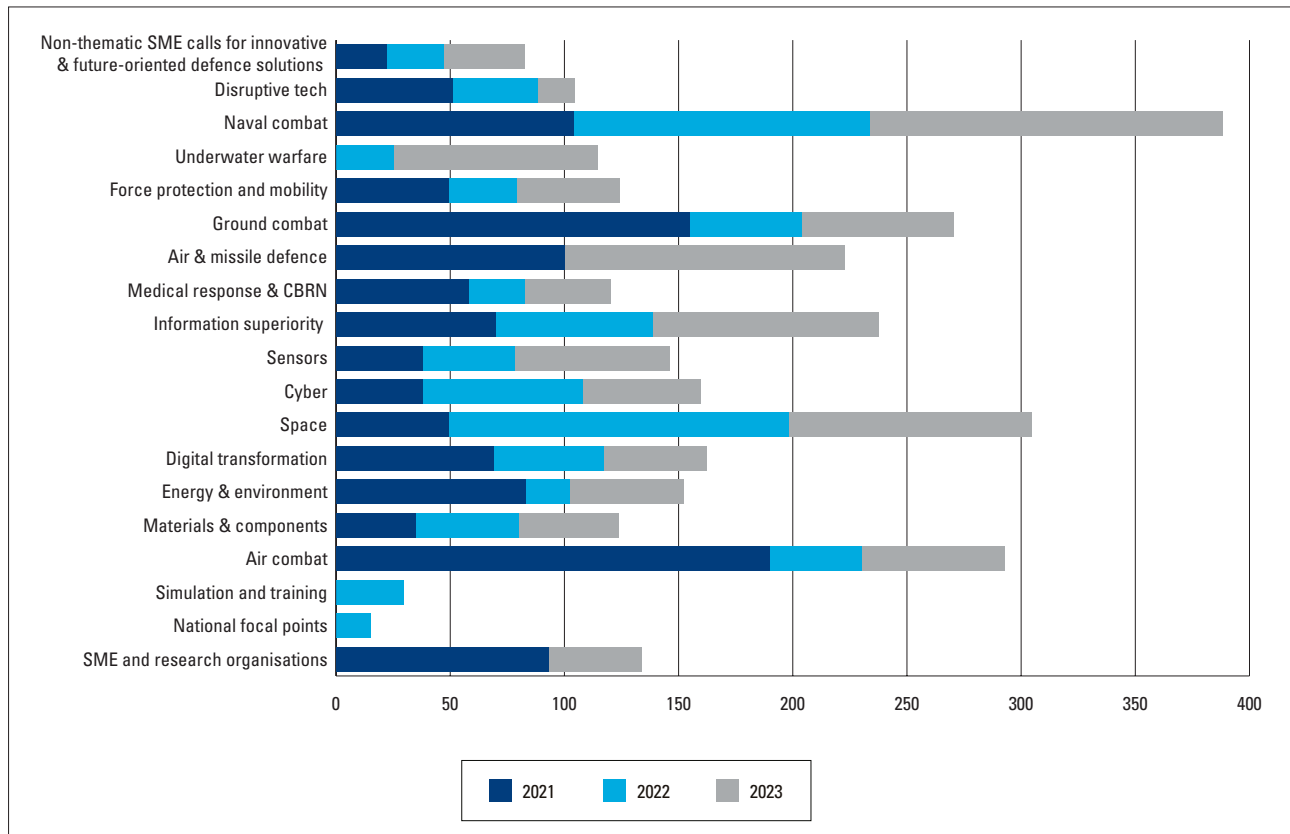
Table 2: Selected cooperative projects on space per cooperative framework			
PESCO (since 2017)	EDF (2021–23 calls)	EDIDP (2019–20)	PADR (2017–19)
European Military Space Surveillance Awareness Network (EU-SSA-N)	European Protected Waveform (EPW)	Innovative and interoperable Technologies for space Global Recognition and Alert (INTEGRAL)	Quantum Secure Communication and Navigation for European Defence (QuantaQuest)
EU Radio Navigation Solution (EURAS)	Advanced Galileo PRS resilience for EU Defence (NAVGUARD)	Sensors for Advanced Usage & Reconnaissance of Outerspace situation (SAURON)	innovative Positioning system for defence in GNSS-denied areas (OPTIMISE)
Defence of Space Assets (DoSA)	multinational Development Initiative for a Space-based missile early-warning architecture II (ODIN'S EYE II)	Galileo for EU Defence (GEODE)	
Common Hub for Governmental Imagery (CoHGI)	Space Response to Risk and Integration with Ground segment (SPRING)	multinational Development Initiative for a Space-based missile early-warning architecture (ODIN'S EYE)	
Timely Warning and Interception with Space-based Theater surveillance (TWISTER)	Space-based Persistent ISR for Defence and Europe Reinforcement (SPIDER)	Novel Earth and Maritime Observation Satellite (NEMOS)	
Geo-meteorological and Oceanographic (GeoMETOC) Support Coordination Element (GMSCE)	Responsive European Architecture for Space (REACTS)	Very high resolution Optical payload for Small Satellites for defence applications (OPTISSE)	
	Autonomous SSA Bodyguard Onboard Satellite (BODYGUARD)	Persistent Earth Observation for actionable intelligence surveillance and Reconnaissance (PEONEER)	
	European Military Integrated Space Situational Awareness and Recognition capability (EMISSARY)		
	RF Interference Removal for Military Services based on Spaces Link (RFSHIELD)		
	Microsatellite for Geostationary Orbit Surveillance and Intelligence (NAUCRATES)		
	Quantum-based Simultaneous inertial Navigator and vector Gravimeter (Q'SING)		
	Platform to Platform Free Space Optical link (P2P-FSO)		
	European Hypersonic Defence Interceptor (EU HYDEF)		
	Space Threats Analysis based on Automated real-time in-situ capabilities and Onboard processing decentralized Network (STAALION)		
	Satellite Detection, Analysis and Measurement system for Proactive and Reactive Defence (SDAM4PRD)		
	GNSS-free navigation and geolocation of objects based on satellite imagery maps and other sensor data (BadB)		
	Proactive automatic imagery intelligence powered by artificial intelligence exploiting European space assets (IntSen2)		

Sources: PESCO, European Commission, EDIDP and PADR websites

The relevance of space as a strategic domain for the EU and its member states is also evidenced by the level of spending for joint development of space capabilities. Projects for joint development are not to be understood as alternatives to national efforts, but as complementary to national plans. Among the EU-sponsored activities, generally limited in

terms of available EU funding, military space-capability-development projects represent the second category per provision of EDF funding allocated in the period 2021–23 (see Table 2) with a total of EUR304.5m (or 14% of the total EDF 2021–23 allocation) for EDF research and development actions (see Figure 1).<sup>104</sup>

Figure 1: EDF allocated funds by category of action, 2021–23 (EURm)



Source: *The Military Balance 2025*

In future, the EU is expected to put forward additional initiatives and regulations starting with the EU space law, expected to be agreed on in 2025. This law will focus on improving capacity, standardising approaches and coordinating mechanisms on information exchange, safety, sustainability and licencing requirements, amongst others.<sup>105</sup> Throughout this regulatory process, EU policymakers should consider the potential implications of regulations on cooperation with non-EU countries. For instance, EU member states are required by the ‘Network and Information System 2’ and the ‘Critical Entities Resilience’ directives to satisfy certain requirements for specific sectors, including space.<sup>106</sup> The application of such directives supports the strengthening and resilience of the space sector, but it could also cause difficulties in multilateral cooperations when it comes to requirements for system integration, as European-wide standards might differ from those of other international partners, potentially leading to the inability to share data.<sup>107</sup> To avoid such cases, it might be beneficial for European policymakers to strengthen the dialogue with international partners.

## Main Cooperative Activities with the US and at NATO Level

The development and improvement of space capabilities has been high on the agenda of European countries and can be expected to increase in prevalence in the near future. Cooperation between European countries and the US has been particularly relevant in the acquisition of space knowledge and data. Beyond the bilateral level, cooperation is also occurring at minilateral and international levels, including through cooperation within NATO and within an EU–US framework.

The most advanced bilateral frameworks for cooperation between the US and EU countries are with France, Germany and Italy, each of which has a comprehensive bilateral space dialogue in place with Washington.<sup>108</sup> US cooperation with other countries involves memoranda of understanding for the sharing of SSA data each with Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Poland, Romania, Spain, Sweden and the United Kingdom, thus contributing to a safer use of space.<sup>109</sup> The US-led Combined Space Operations Initiative – in which France, Germany,

Italy and Norway are the only European participating countries – stresses interoperability and cooperation.<sup>110</sup> Washington also has agreements in place with Denmark, Luxembourg, the Netherlands, Norway and Poland to improve SATCOM capabilities.<sup>111</sup>

At NATO level, coordination of information, products and services is performed by the space centre at NATO's Allied Air Command in Ramstein.<sup>112</sup> Cooperation on space and the sharing of space data in NATO occurs on a voluntary basis and the Alliance does not currently plan to acquire any space capability. Therefore, SSA, ISR, SATCOM, PNT and early warning in NATO are provided by individual allies and by private entities.<sup>113</sup>

Among European NATO allies, France, Italy, Luxembourg, Spain and the UK actively contribute to

NATO initiatives such as the SATCOM Services 6th Generation (NSS6G), while Belgium and Greece are upgrading ground stations to allow for better integration of data for NATO use.<sup>114</sup> Although improving, the NSS6G faces a lack of capabilities among NATO countries, as only five European Alliance countries are able to provide data. The Alliance Persistent Surveillance from Space initiative integrates ISR data from national and commercial assets to facilitate a more constant operational picture.<sup>115</sup> NATO is looking to exploit commercial data on a larger scale and is conducting a feasibility study to select companies sufficiently aligned with operational requirements. The prospect highlights the prominent role private actors play in the sector.<sup>116</sup>

## 4. Integrating Commercial Providers

In Western market economies, human activity in space has evolved from being driven by governments to propelled by private commercial actors. In the civilian sector, SpaceX has pioneered transformations in space-faring with advances in reusability, cost reductions, and speed of innovation, with companies like Blue Origin and the United Launch Alliance following in its path.<sup>117</sup>

The commercialisation of space also provides further opportunities for the military community.<sup>118</sup> Integrating commercial space capabilities allows for diverse systems that improve resilience against adversarial interference. For instance, commercially operated satellite constellations enhance communication and observation capabilities, minimising reliance on single points of failure.<sup>119</sup> However, shifting these assets from commercial to military use poses challenges. Issues of interoperability, regulatory alignment, classification of data and national security complications hinder integration, especially in Europe, where fragmented policies create additional barriers.<sup>120</sup>

### The US Model: Big Market, Big Budget

The US has established itself as the global leader in integrating commercial space assets into its outer-space military activities. This success is rooted in a large domestic technology sector and investment infrastructure. In 2023, US-based space-technology startups secured over USD6 billion in venture-capital funding.<sup>121</sup> Proactive government policy has fostered public-private collaboration that leverages the country's commercial space-technology ecosystem to build up state capabilities.

The US Department of Defense (US DoD) has partnered with companies like SpaceX, leveraging programs like Starshield – publicly announced in 2022 – to enhance secure communications and missile-tracking capabilities in the military sector.<sup>122</sup> Innovative procurement mechanisms, such as middle-tier acquisition pathways and the enablement of existing commercial and government off-the-shelf and free or open-source software, further streamline the integration of commercial goods and services.<sup>123</sup> US policymakers

have also recognised weaknesses in the current approach, including with the US DoD contracting and award processes, and are seeking to address these problems.<sup>124</sup> US plans also emphasise deepening collaborations, particularly with small and medium-sized enterprises, to drive innovation and address gaps in resilience and redundancy.

### The European Market: Still a Cottage Industry?

Compared with the US, Europe's commercial space industry is smaller and less successful in selling its goods and services to governments. This is not due to a lack of innovative private-sector companies. Market leaders like Thales Alenia Space, Airbus and Isar Aerospace provide dual-use technologies, including EO and SATCOM.<sup>125</sup>

The European commercial space sector has experienced significant growth in recent years, supported by public initiatives and private investments. The ESA and the EUSPA have backed over 5,100 companies, including over 3,000 startups since 2016.<sup>126</sup> These startups, collectively valued at USD35bn, have raised nearly USD7bn in venture-capital funding.<sup>127</sup> Companies like Reflex Aerospace,<sup>128</sup> which specialises in payload-centric small satellites, and Morpheus Space,<sup>129</sup> which provides electric propulsion systems for satellites, are examples of European firms making advancements in dual-use technologies. The European Commission has played a central role as an anchor sponsor and customer in projects such as the IRIS<sup>2</sup> SATCOMs mega-constellation, which is planned to deploy over 290 satellites by 2030 with an estimated cost of EUR10 billion.<sup>130</sup>

European companies are working across various specialised areas in the space sector. Firms like ClearSpace<sup>131</sup> in Switzerland and DARK<sup>132</sup> in France are addressing space-debris removal, an emerging area of concern due to increasing orbital congestion. Launch-vehicle manufacturers, including Isar Aerospace<sup>133</sup> and Rocket Factory Augsburg<sup>134</sup> in Germany, aim to provide launch services for small and medium-sized satellite operators. Other firms include Avio<sup>135</sup> in Italy, which designs and manufactures launch systems like *Vega-C*, and SES<sup>136</sup>

in Luxembourg, which operates a fleet of 70 satellites for global communication and connectivity services. Vyoma,<sup>137</sup> based in Munich, is developing space-traffic-management solutions, including real-time collision-avoidance systems and orbital data analysis.

Investment in European space technology remains strong, attracting considerable venture capital despite global economic challenges. In 2023, global funding for space startups hit USD6.2bn, with European firms securing around 25% of investments.<sup>138</sup> The NATO Innovation Fund, a EUR1bn initiative from 24 NATO allies, supports early-stage deep-tech companies addressing defence and security, including space technology. Beneficiaries include Space Forge,<sup>139</sup> which develops semiconductor manufacturing technologies in space, and Isar Aerospace.<sup>140</sup> The ESA has also revised its procurement to foster industry growth through contracts rather than direct ownership. These trends demonstrate the increasing financial and institutional backing for Europe's commercial space ecosystem, featuring a range of companies and technologies across the region.

## Collective European Approaches

At the EU level, programmes such as IRIS<sup>2</sup> and initiatives led by the ESA aim to foster collaboration across member states. However, the challenges of fragmentation persist. The governance of IRIS<sup>2</sup>, plagued by competing national interests and industrial rivalries, underscores the difficulties of coordinating a unified European approach.<sup>141</sup> Additionally, the integration of commercial space technologies raises export-control concerns, particularly regarding dual-use capabilities. Policymakers are concerned with ensuring that private-sector innovations do not inadvertently benefit adversaries, complicating efforts to streamline collaboration.

NATO's contributions, including its Space Centre of Excellence in Toulouse and its Innovation Fund, seek to encourage cross-border collaboration and dual-use technology development.<sup>142</sup> However, NATO's lack of direct space assets limits its ability to drive integration.

Divergent national priorities, inconsistent regulatory frameworks and industrial competition between member states have created a patchwork of strategies rather than a cohesive vision. The governance of the IRIS<sup>2</sup> programme exemplifies these challenges. Despite its ambition

to establish a secure, sovereign communication satellite constellation, IRIS<sup>2</sup> has encountered issues of industrial competition between France, Germany and Italy which have delayed progress and hindered collaboration. Furthermore, the division between civilian and military uses within IRIS<sup>2</sup> remains unclear, raising concerns about whether the programme can effectively meet Europe's strategic goals and ensure security standards.

In addition to governance hurdles, the lack of a clear integration strategy for commercial space data into military operations exacerbates fragmentation. While countries like France are exploring frameworks that distinguish between sovereign, European and commercial data-integration circles, no unified approach exists among European countries. This gap limits Europe's ability to leverage the commercial sector's innovations.

Individual European countries demonstrate varying levels of success in integrating commercial providers into their military space strategies. Germany's defence ministry recognises the importance of enhancing resilience through commercial partnerships but has struggled with budget constraints that limit the development of sovereign capabilities.<sup>143</sup> Efforts to establish a centralised space policy and integrate ministries are still in their early stages. Despite these limitations, the German Aerospace Centre (DLR) is an example of successful public-private collaboration through its mission to further scientific innovation through joint research initiatives.<sup>144</sup>

France has prioritised national space resilience since adopting its 2019 strategy, which focuses on governance reforms and capability development.<sup>145</sup> However, the country remains concerned about its overreliance on commercial actors, particularly its vulnerability to cyberattacks and possible alignment with adversaries.<sup>146</sup> France's strategy incorporates commercial providers into a layered data-sharing framework but faces resistance from entrenched procurement practices due to national security concerns leading to overclassification challenges and thereby complicating implementation.

Italy's IRIDE programme highlights a promising public-private partnership for EO capabilities, supported by investments in space situational awareness and space traffic management.<sup>147</sup> Italy's engagement with commercial operators and its focus on dual-use technologies position it as one of the most ambitious European space actors.

# Conclusion

National approaches articulated in strategy documents and budget allocations suggest that qualitative advances in European space capability can be expected in a mid- to long-term timeline. If current national plans are realised and national budgets are adequately dedicated to space, progress will be steady and incremental.

Existing intergovernmental mechanisms, such as the European Union's Space Programme and NATO's space-related initiatives, provide a platform for collaboration but often lack the cohesion needed to address shared threats effectively. European space cooperation, nonetheless, has been fruitful. The most active and substantial inter-European and transatlantic cooperation involves space data exchanges from national and European satellite systems. Space remains the only sector in which the EU and its agencies own capabilities, and its further development is being pursued. This success, however, is predominantly in the civil and space science realms and less so regarding military exploitation, despite plans to improve space capabilities for military uses.

European military space capabilities rest on a few European countries, with a resulting lack of resilience. Given the time and cost of development of military space programmes, simply increasing cooperation would provide greater resources, both financial and human. This, however, would require agreement between participating nations on operational requirements and, for example, guarantees on access and tasking, when it comes to the sharing of EU proprietary space capabilities. A streamlined governance structure and aligned policies between the EU and NATO would further support cooperative efforts. Creating standardised practices among the organisations would also benefit interoperability.

The Russia–Ukraine war, as emphasised above, illustrates the need for resilience and redundancy within space systems. European space actors are concerned

with creating secure and adaptable infrastructure that can endure electronic warfare, cyber threats and other evolving dangers. Mega-constellations and distributed architectures present valuable opportunities for bolstering resilience particularly if lessons learned are pulled across to different roles and orbits. Nonetheless, the speed of technological advancement requires a revision of the way states conduct the upgrade and protection of infrastructures, eventually foreseeing the development of specialised teams that operate round the clock to implement infrastructural upgrades to ensure security.

European space capabilities benefit from transatlantic cooperation. The US provides substantial SSA data to European countries and is a source of lessons learned on fostering and integrating commercial actors. European integration of data from commercial providers remains limited compared to the US which leads in integrating commercial space data into the development of military projects. Its approach includes the incorporation of commercial products and services, supported by a large domestic market, streamlined procurement processes and robust public-private partnerships.

European nations can do more to leverage expertise and assets within their commercial space sectors. The dual-use nature of programmes like Galileo, GOVSATCOM and the future IRIS<sup>2</sup> constellation are examples pointing to the utility of civilian programmes for security and defence purposes. These programmes have further enhanced the creation of partnerships with private companies, laying the ground for further collaboration. The Russia–Ukraine war has also highlighted the potential benefit countries may derive from the use of commercial resources for defence purposes. Proper regulation for the structured and secured exploitation of commercial actors could be beneficial for European countries, who could further consider fostering more inclusive and innovative procurement practices.

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