



Ministry
of Defence

Defence Space Strategy: Operationalising the Space Domain

February 2022

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Ministerial Foreword



The importance of space to Defence is irrefutable. It affords us operational advantage against potential adversaries and, as a nation, we depend on it for resilience and our way of life. The recent publication of the UK's first integrated National Space Strategy and this Defence Space Strategy reflects our commitment to ensuring the UK maintains freedom of action in this critical domain and can protect and defend the UK's interests at home and overseas.

For hundreds of years, the UK Armed Forces have defended the nation's interests across the land and maritime domains and, for over a century now, also done so within the air domain. However, as the Integrated Review made clear, we live in a more intensely competitive world and we must modernise to meet new and future challenges. Space and Cyber have now been recognised as operational domains in their own right and Defence must take advantage of this, integrating our capabilities so that they work together seamlessly across all domains.

Space has brought unprecedented advantages and new threats. Daily life is reliant on space and, for the Armed Forces, space underpins vital, battle-winning technologies. From space we can deliver global command & control, communications, intelligence, surveillance and reconnaissance, precision navigation, and more. Adversaries understand this reliance and are increasingly able to exploit vulnerabilities, threatening our strategic stability and security.

The UK has also long been at the forefront of building international consensus for measures to avoid an arms race in space and has achieved success in pursuit of this goal. As in other domains, it is vital that we continue to work within key alliances, including international partners, industry and academia, to achieve success and make the most of opportunities. We will deepen our close work with the US and will seek to collaborate further with Five Eyes partners, the Combined Space Operations (CSpO) partner nations, NATO and other like-minded powers, as we develop our Defence space capabilities.

Capability development will be guided by the 'own-collaborate-access' framework first laid out in the Integrated Review. There will be areas where we need dedicated sovereign capability, but also cases where we will access technology from elsewhere or utilise collaborations and partnerships to broaden capabilities and deepen resilience.

This is a pivotal moment for Defence as it seeks to operationalise the space domain at pace. This strategy sets out how Defence will support national efforts to become a meaningful actor in space, able to secure UK interests alongside those of our allies and partners, to preserve strategic advantage, and contribute to a safe, sustainable, secure and accessible environment, now and in the years to come.

Rt Hon Ben Wallace MP
Secretary of State for Defence

Executive Summary

“We will make the UK a meaningful actor in space, with an integrated space strategy which brings together military and civil space policy for the first time.”

Rt Hon Boris Johnson MP,
Prime Minister, Integrated
Review, 16th March 2021

This Defence Space Strategy directly supports the integrated **National Space Strategy**.¹ It sets out our vision for Defence as a global actor in the space domain and articulates how MOD will deliver the **Protect and Defend** goal through space-related capabilities, operations and partnerships, delivering against the ambition to become a meaningful actor in space. Its themes and principles also align with and support the broader goals and key interventions in the national strategy, including the need to nurture and grow talent. It supports all four of the Integrated Review’s (IR)² objectives to: strengthen security and defence at home and overseas; build resilience; sustain strategic advantage through science and technology; and shape the international order of the future.

1. National Space Strategy, dated September 2021.

2. **Integrated Review of Security, Defence, Development and Foreign Policy**, dated March 2021.

As the National Space Strategy makes clear, we already rely heavily on space for critical services that impact daily on civil, commercial and military sectors. These include, but are by no means limited to, global communications, secure banking transactions, transport, meteorology and navigation. Space is a key enabler for Defence operations and is now an operational domain in its own right (alongside cyber, maritime, air and land). It is also fundamental to our aspiration to integrate across those five domains. Space enables our ability to command and control globally, provide surveillance, intelligence and missile warning, as well as support deployed Joint forces, including activity such as the delivery of precision weapons from the UK Carrier Strike Group with embarked F35, mine clearance and humanitarian operations.

In a harsh and **increasingly competitive domain**, space capabilities and activities are continually subject to threats and hazards. Most are environmental: the natural hazards of space weather, radiation and meteoroid showers. Some are man-made hazards, such as space debris, collisions, and human error. Others are nefarious, as hostile actors and competitors seek to maximise their relative advantage in the domain. We must therefore work to both protect and defend the UK's equities in space and the services derived from space assets.

UK Defence will be **at the heart of Allied space efforts**, providing resilience and complementarity in our joint pursuit for a safe and secure space domain. Our unique global presence and close cooperation with allies and partners – including with Five Eyes partners³ and through NATO – mean we are well-placed to drive international efforts to integrate space as one of the five operational domains. By doing so we will help to prevent conflict, deter escalation, optimise resources and enhance mission assurance and resilience. We will preserve our strategic advantage.

The Ministry of Defence (MOD) **Space Directorate** will engage cross-government and with our allies and partners to shape and develop Defence policy and strategy relating to the space domain. The Directorate will also continue to enhance our existing close relationships within Defence, particularly with the single Service Front-Line Commands and UK Strategic Command, to ensure that activity within the domain is integrated and effective, whilst leveraging synergies and capabilities in the other domains.

3. Australia, Canada, New Zealand, UK, US.

UK Space Command will lead our approach to space operations, Force Generation and capability programmes, supporting the government and Joint Commanders in standing Defence tasks, overseas operations and contingent functions. It will harness the energy and adaptability of UK's space sector, drive space capability development across the Front-Line Commands, lead integration, deliver leading edge capabilities, generate the Force and conduct day-to-day space operations, all under a single, joint command.

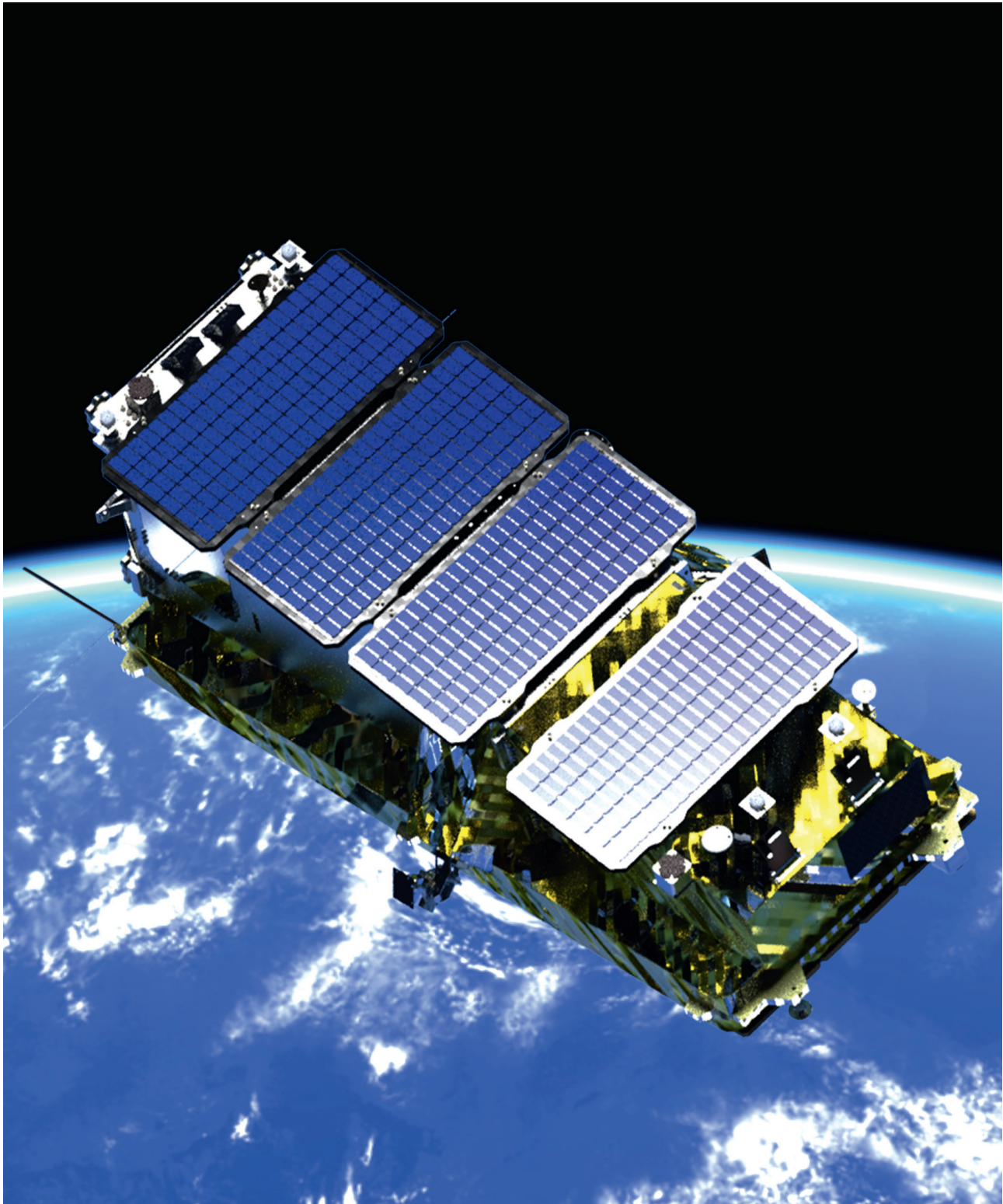
As tangible demonstration of our ambition in space, we are investing a further £1.4Bn in space over the next 10 years, in addition to existing commitments. We will continue to develop new capabilities fit for the information age within a balanced **Defence Space Portfolio**. We will exploit the current and future opportunities offered by space technologies and UK industrial strength, as well as identifying opportunities for military/civil dual use. We will deliver the Skynet 6 programme, for which we are already investing more than £5Bn over the next 10 years, to further enhance the UK's secure **Satellite Communications** capability and ensure the continued capacity to move large volumes of data to support Defence tasks and government activities. Space-based **Intelligence, Surveillance and Reconnaissance** capabilities will form a large part of the portfolio, given its criticality to all military operations and other capability investments. We will develop a cutting-edge suite of on-orbit sensors,

such as Synthetic Aperture Radar constellations, underpinned by a novel and secure ground architecture to extend the digital backbone into space. We will also invest in a **Space Domain Awareness** programme and in **Space Control**. We will invest in **Command and Control** and work with the UK Space Agency (UKSA) to establish a combined military and civilian **National Space Operations Centre**.

We will ensure that we embed **dual use** at the heart of our capability management processes, considering how we can share Defence space capabilities and outputs with other government departments, including the security and intelligence services, as well as potentially, with commercial users. In order to get best value for money, we will critically assess what capabilities we must own on a sovereign basis, those for which we can collaborate with our allies and partners (with the added benefits of generating mass and burden sharing), and those we can access via the commercial market. This '**own, collaborate or access**' framework will be used to define the UK approach to every aspect of space capability, remaining coherent with the approach detailed in the IR.⁴

Through the implementation of this Strategy, in direct support of the National Space Strategy, Defence will play a critical role in ensuring the UK becomes a meaningful player in space.

4 . Integrated Review, Section IV Strategic Framework, Chapter 1, page 38, para 10.



Space-based SAR – NovaSAR⁵

5. Source: Dstl.

1. Context

Space – An Operational Domain

1.1. As the National Space Strategy makes clear, access to space is of vital national importance. It plays an integral role in our daily lives and ensures military operations can deliver across the spectrum of national security tasks. We live in an era of persistent competition and confrontation, in which long-held assumptions are challenged daily. Our adversaries exploit the ambiguity below the threshold of armed conflict to seek advantage, exploiting our vulnerabilities by seeking to deny us access to space-derived services or threatening our satellites. This is further exacerbated by a lack of internationally accepted responsible space behaviours.

1.2. The growth of the space industry and the rapid acceleration and proliferation of technology has seen commercial products that are increasingly sophisticated. Access to space has become easier due to cheaper and more frequent launch opportunities, the deployment of mega-constellations,

re-usable capabilities and emerging life extension services. We are seeing the space domain become more competitive, congested and contested.

1.3. For these reasons, space is now our fifth operational domain. It includes the satellites in space, supporting ground infrastructure, and the information layer connecting ground and space. All of this enables our Armed Forces to compete in the Information Age.^{6,7} To address constant competition in the future, we must set a precedent for space behaviours that will increase the transparency, predictability and security of all space systems and enable us to operate and, if necessary, compete in and through space. A comprehensive understanding of activity in the space domain and an ability to protect, defend and integrate, as we have for the other domains, will be crucial in enabling our Armed Forces to respond to future global challenges.

6. Joint Doctrine Publication 0–30: UK Air and Space Power, dated December 2017, states that “Space power makes a pivotal contribution to the potency of UK military power, both as an enabling domain and, increasingly, as an operating domain in its own right.”

7. AP3002 Air and Space Warfare, 4th Edition, dated October 2020, states that “What has changed is the emergence of the space and cyber & electromagnetic domains as war fighting domains within the contemporary operating environment, where they were previously treated as enablers of land, maritime and air.”

1.4. Defence investment through a blend of assured commercial and military grade solutions will continue to increase flexibility, adaptability, tempo, resilience and overall agility of the Armed Forces. We will, therefore, maintain the UK’s position as a leading military power and support UK prosperity by enabling a safer, more secure and sustainable operating environment, helping the UK space industry to continue to flourish. This increased investment in, and oversight of, space endeavours will help the UK meet the goals outlined in the National Space Strategy, namely to; grow and level up our space economy, promote the values of Global Britain, lead pioneering scientific discovery and inspire the nation, use space to deliver for UK citizens and the world, and protect and defend our national interests in and through space.

Threats and Hazards

1.5. The international security context, characterised by persistent, aggressive state competition, has led to the development of capabilities that threaten our access to, and use of, space. The space domain could be disrupted (either temporarily or long-term and potentially at critical moments) or targeted by threats ranging from non-kinetic effects and electronic warfare to kinetic attack (Figure 1).

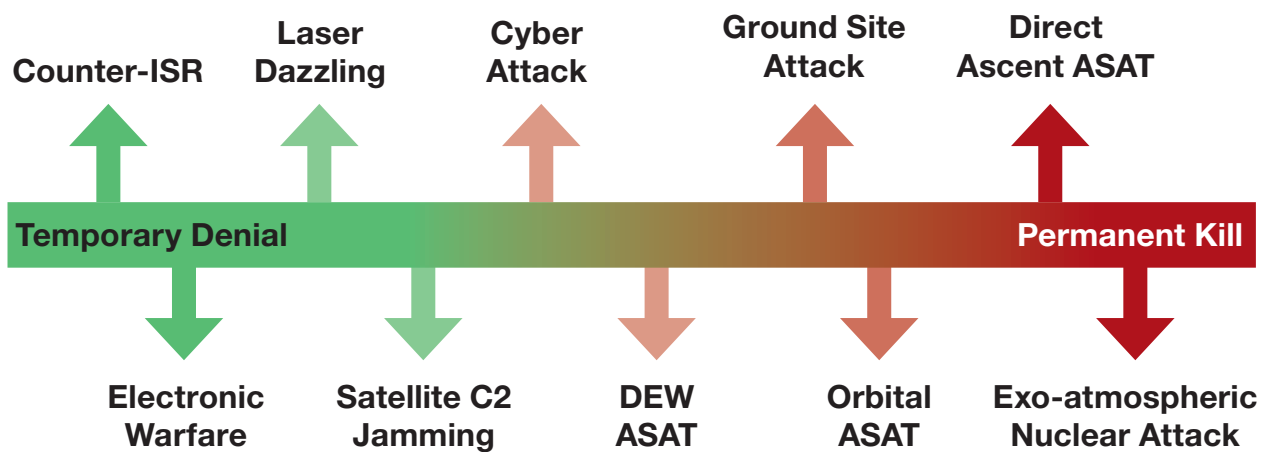


Figure 1: The Counterspace Continuum

1.6. Adversaries understand our reliance on space services and major powers are increasingly able to exploit the vulnerability of satellites and degrade the UK's access to space, threatening our strategic stability and security. They can employ a wide range of capabilities, including the use of Electronic Warfare (EW), cyber capabilities, Directed Energy Weapons (DEW), Co-orbital Anti-Satellite (ASAT) weapons and Direct-Ascent ASAT (DA-ASAT) missiles to intercept and exploit satellite communications and threaten and potentially destroy our space systems.

1.7. In particular, cyber threats have the potential to deny, disrupt or deceive satellite data, and the increasingly pervasive nature of adversarial space-based Intelligence, Surveillance and Reconnaissance (ISR) is affecting how we conduct military operations more than ever. Our inaction risks undermining the significant investments we have made in capabilities reliant upon the space domain and we need to improve

our national sovereign resilience and competitiveness in this congested and contested environment.

1.8. We will continue to support ongoing cross-government work, particularly with the security and intelligence services, to collate collective understanding of the risks to space-based services and supply chains and ensure that these are represented correctly in national strategic documentation.

Examples of International Threats – Russia

Russia has conducted a number of on-orbit activities that have drawn attention and concern from allies and partners across the globe. These include contesting the electromagnetic spectrum, targeting the vital link between satellites and ground segments, as well as satellites in orbit that can release smaller secondary and even tertiary devices (like a Russian doll), with the possibility that some may have a destructive capability. Twice in 2020, Russia continued with its series of test-launches of Direct Ascent Anti-Satellite weapons and in 2021 Russia conducted a destructive test that resulted in at least 1500 trackable pieces of debris in low earth orbit that was condemned by many.

“This destructive anti-satellite missile test by Russia shows a complete disregard for the security, safety and sustainability of space. The debris resulting from this test will remain in orbit, putting satellites and human spaceflight at risk, for years to come.”

Rt Hon Ben Wallace MP, Secretary of State for Defence, DefenceHQ Twitter
16th November 2021.

Examples of International Threats – China

“China has a robust direct-ascent anti-satellite (DA-ASAT) programme, multi-use capabilities on orbit that are necessary for Co-orbital ASAT weapons, and widely used electronic and cyber counterspace capabilities.”

“China continues to conduct tests of its operational... DA-ASAT system. However, China no longer needs to use kinetic tests to prove that its DA-ASAT capabilities can threaten any... satellite in Low Earth Orbit (LEO), and likely Medium Earth Orbit (MEO) and Geostationary Earth Orbit (GEO) as well.”

Space Threat Assessment 2021, Centre for Strategic and International Studies, April 2021

1.9. As well as threats, there are numerous environmental hazards that have significant potential to disrupt our capabilities both in space and on the ground. There are millions of pieces of debris orbiting the Earth, from satellite collisions, defunct satellites and launcher upper stages, and this raises the risk of further collisions. Space weather, in addition to energetic particle storms produced by solar flares and major changes to the solar wind, directly impacts the Earth’s magnetic field, which could reduce the effectiveness of satellites or induce undesirable effects on the ground. A Severe Space Weather Preparedness Strategy is due to be published by the Department for Business, Energy and Industrial Strategy (BEIS).

who are committed to the peaceful use of space is highly valuable. It will reinforce our global presence, building on the unique advantages offered by our extensive footprint of overseas territories, enabling us to lead pioneering scientific technology development and promote the values of Global Britain; all of which are critical in achieving strategic stability and sustaining military advantage.

International Allies and Partners

1.10. Many nations are finding ways to bolster their global posture and develop space capabilities to advance their national agendas and to improve and protect civilian uses of space services. Our continued engagement, strengthening long-standing and mutually beneficial alliances on space operations, capability and policy, with nations

1.11. We are able to build on our strengths in intelligence analysis, space diplomacy, leading edge science and strong industrial innovation, making us a key ally. As a founding member of the Combined Space Operations (CSpO) Initiative,⁸ we are able to deepen international collaboration and cooperation on space policy, capability development, intelligence and operations with like-minded nations, exchanging data, ideas and activity within a co-dependent construct. As well as continued close engagement with our Five Eyes partners, we will further enhance our cooperation with NATO and continue to seek opportunities for other bilateral relationships.

1.12. We are at the forefront of multinational space operations, working alongside some of the finest space operators across the world at the US-led Combined Space Operations Center. We were also first to publicly join the US in Operation OLYMPIC DEFENDER,⁹ which enables us to share information, data, and resources as well as synchronise space efforts across partner nations.

1.13. Working with our allies and partners, we will continue to monitor, seek to understand and, where appropriate, call out and respond to actions that are contrary to

our interests in space (see Section 3). The MOD is engaging closely with the Foreign, Commonwealth and Development Office, who are leading the way with first-class diplomacy and thought-provoking policy initiatives such as the landmark UN General Assembly Resolution on Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours, which saw overwhelming support.¹⁰ We must ensure that the UK has the capability to underpin these soft-power initiatives to reduce space threats and ensure continued access to the space domain.

Industry and Commercial Ventures

1.14. Space-related activity¹¹ was once solely the preserve of governments; launching satellites into space relied on the same technologies as ballistic missiles. Today though, investment is driven by private investors and the UK space industry primary income is from commercial ventures.^{12,13} This has led to a growth in UK income within the space sector and a greater number of UK companies in recent years,¹⁴ extending from start-ups to multinational conglomerates.

8. Current participation includes Australia, Canada, France, Germany, New Zealand, the United Kingdom and the United States.

9. A US-led multinational effort intended to optimise space operations, improve mission assurance, enhance resilience and synchronise US efforts with some of its closest allies.

10. 2020 saw the first iteration of the new approach with the UNGA Plenary vote result of 164 in favour to 12 against, with 6 abstentions

11. Including Space operations, Space applications and ancillary services, as defined within the report 'Size and Health of the UK Space Industry', dated May 2021 (page 6).

12. Investing in Space is no longer limited to governments, high net-worth individuals and niche specialists ('Size and Health of the UK Space Industry', dated May 2021, page 21).

13. 81.3% of total income is commercial. Of the remainder, the Defence contribution is 8.6% ('Size and Health of the UK Space Industry', dated May 2021, page 10).

14. There were over 1200 organisations in the UK Space industry in 2019, including 95 new incorporations in the previous two years, and the global industry continues to grow at the same rate as the UK's.

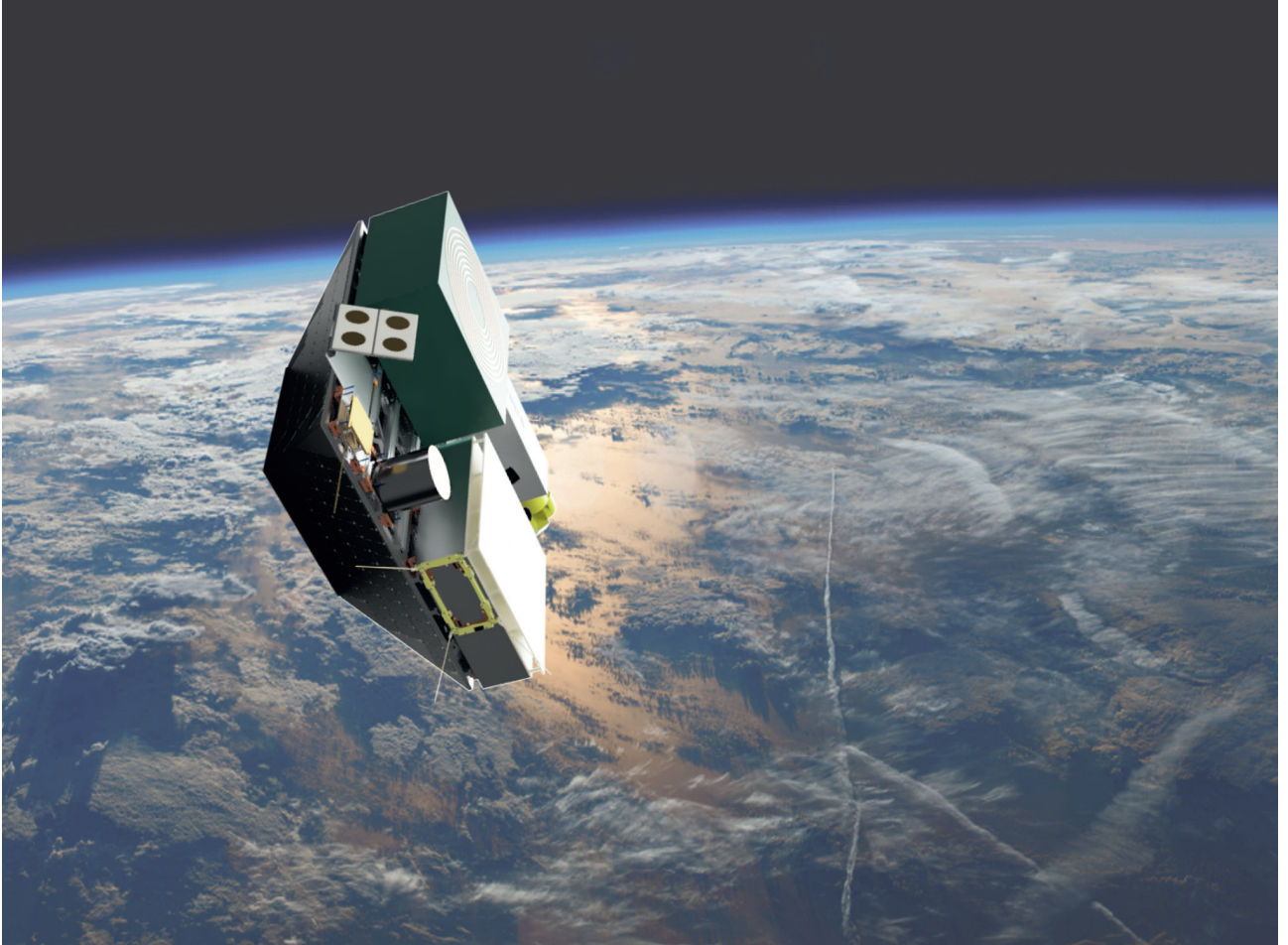
1.15. The diverse selection of companies and organisations offers access to a range of commercial technological developments with the potential for dual-use application, which Defence may wish to simultaneously utilise and protect from proliferation. As a high-growth, high-skills sector, there are opportunities for Defence to redefine its procurement processes to maximise collaboration to improve recruitment and retention of scarce skills across the sector. In addition, with so much private investment and more governments aspiring to deliver ambitious space programmes, there will be opportunities to maintain strategic advantage through development of fast-paced, emerging technologies.

1.16. Building on these changes, and the drive to stimulate economic growth and national security outlined in the Defence and Security Industrial Strategy (DSIS),¹⁵ Defence has much to contribute to the continued growth and levelling up of our space economy across the whole of the UK. Besides the headline investment of more than £5Bn over the next ten years to recapitalise and enhance our satellite communications capabilities, Defence anticipates using targeted projects that can exploit novel technologies and provide capability to the user faster than traditional procurement methods. As we develop our Defence Space Portfolio, we will provide

industry with clear guidance regarding the technologies and industrial capabilities we need to maintain within Defence (i.e. to be an intelligent customer), what should be maintained on shore for national security reasons, and what can be procured as assured capability from a broader range of suppliers. We will secure access to, and sufficient rights of use in, technical data relating to our Defence space Portfolio in order to achieve the long term aims of UK Space Command operationally, industrially and in our international partnerships with allies.

1.17. In addition, we will explore use of the National Security Strategic Investment Fund, the government's corporate venturing arm for dual-use advanced technologies, as a vehicle to shape commercial space development for Defence needs and generate additional return on the investment.

15. Defence and Security Industrial Strategy, dated March 2021.



Laser Communications – Titania¹⁶

16. Source: Dstl.

2. Strategic Intent

Construct

2.1. This Defence Strategy directly supports the goals and vision of the National Space Strategy, with particular focus on how we protect and defend our national interests in and through space. It also supports the key interventions in the national strategy, including its stated aim for the UK to become a partner of choice in space activities. It contributes to all four strategic objectives set out in the Integrated Review and articulates Defence’s approach to space activity out to 2030.

2.2. Integration is core to this strategy as it is to the Integrated Review and the National Space Strategy. It highlights the importance of integration between domains and across Defence, and across government, with

international partners and the commercial, research and scientific sectors. This integration ensures we make the most of UK’s finite resources and bring maximum coherence to our national space ambition.

2.3. UK Defence will be at the heart of Allied space efforts, providing resilience and complementarity in our joint pursuit for a safe and secure space domain. Our unique global presence, geographic advantage and close cooperation with allies and partners means we are well-placed to drive international efforts to integrate space as one of the five operational domains. By doing so we will help to prevent conflict, deter escalation, optimise resources and enhance mission assurance and resilience.

2.4. The construct of the Strategy is shown at Figure 2.

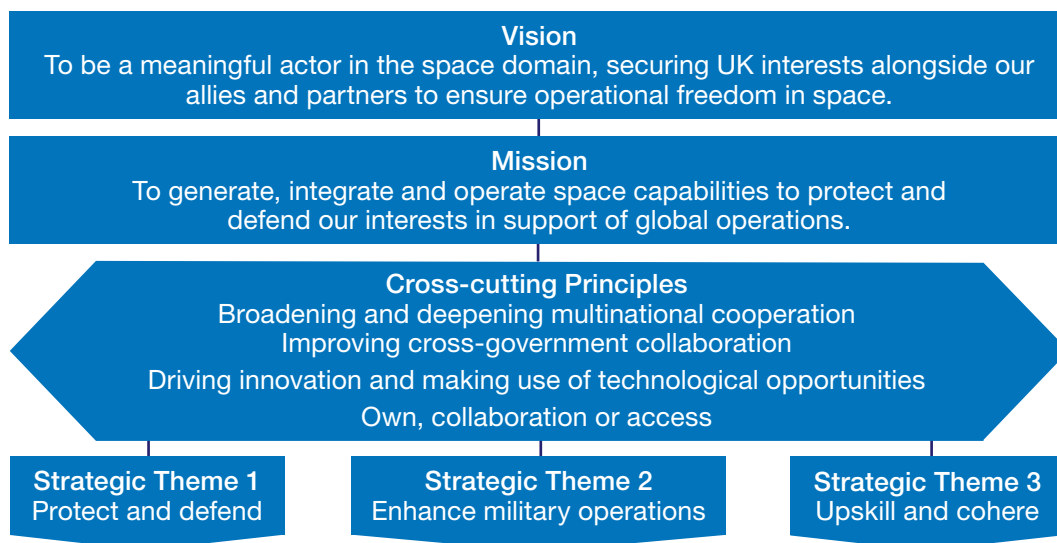


Figure 2 – The Defence Space Strategy Construct

Cross-Cutting Principles

2.5. The Cross-Cutting Principles underpinning this strategy are as follows:

a. Broadening and deepening multinational cooperation. Achieving Defence's space ambition will require the closest possible international cooperation. We will deepen our strategic relationships, shaping perspectives on the space domain and promoting its safe and secure use. We will strengthen bilateral and multilateral relations with our Five Eyes partners (particularly the US as our primary partner), NATO¹⁷ and other allies, adopting an 'international by design' mindset. This will help protect our space interests, build stability, increase resilience and deter conflict from extending into space. Additional benefits will include learning from those nations that are more advanced in certain areas of space-related activity, in order to more quickly develop UK expertise. We will also support other government departments, capitalising on our established global partnerships.

b. Improving cross-government collaboration. In support of government's integrated approach to space activity, we will further develop our relationships with other departments, working closely with BEIS, to improve the way we deliver space policy and programmes, as well as the security and intelligence services, to support domestic and foreign security. We will support the National Space Council to

ensure that the space agenda is coordinated across government, ensuring the mutual support necessary to maximise national resources through delivery of cohesive cross-government space plans. In particular, we will draw upon existing arrangements to deliver a more coherent military/civil approach to research and development and international responsibilities.

c. Driving innovation and making use of technological opportunities. We will exploit the UK's industrial strength to ensure that we deliver a robust, credible, modern, agile and affordable force. We will ensure that space is considered in Defence's innovation initiatives and that BEIS remains a key partner in driving space innovation to tackle challenges faced globally. To harness the significant innovation and industry-driven opportunities existing across the private sector, we will improve our transparency and foster closer working relations with a broad range of technology companies and developers. We will also support scientific collaboration, research development and further enhance our engagement with academia.

17. Including the NATO Bi-Strategic Command Space Working Group and the NATO Space Centre (Allied Air Command, Ramstein, Germany).

d. **Own, Collaborate or Access.** In line with the approach signalled in the National Space Strategy and the Integrated Review, technologies and services will be identified, developed and generated depending on the level of ownership and control required, ensuring our activity complies with the Assured Capability Framework.¹⁸ The terms are defined in the Integrated Review¹⁹ as follows:

- (1) **Own.** Where the UK has leadership and ownership of new developments, from discovery to large-scale manufacture and commercialisation. This will always involve elements of collaboration and access.
- (2) **Collaborate.** Where the UK can provide unique contributions that allow us to collaborate with others to achieve our goals.
- (3) **Access.** Where the UK will seek to acquire critical science and technology from elsewhere, through options, deals and relationships. This will always be conducted within the bounds of the MOD's Assured Capability Framework, cognisant of the fact that there will be differing national levels of assured access requirements.

Strategic Themes

2.6. Our space ambitions and planned outputs will be met through three Strategic Themes:

- a. **Protect and defend.** Protect and defend our national interests in and through space by developing space capabilities to deliver effective military outcomes; identify and attribute threats to space systems; respond to hostile activities in a proportionate and coordinated manner.
- b. **Enhance military operations.** Integrate space into all relevant aspects of Defence business; deliver resilient assured space services crucial to military operations; enhance Multi-Domain Integration and architectures.

c. **Upskill and cohere.** Produce clear space policies, plans and concepts; develop a skilled and sustainable space workforce; recruit, train and retain talented individuals.

Integrated Review (IR) 2021

We will support the UK space sector to realise the economic benefits from this dynamic and rapidly expanding market, extending the UK's influence in the space domain.

As part of building the UK's strategic advantage through science and technology, the government will build the enabling environment for a thriving UK space industry developing space – and ground-based technologies.

We will promote a 'whole-of-life' offer from research and development through finance to satellite operations, launch capability, data applications and end-of-life services.

We will carry out more space-related science activity, research and development, and operational concept demonstrators.

18. Assured access to Space and associated industrial capability is vital to our operational independence – the ability to conduct military operations as we choose without external political interference, and to protect the sensitive technologies that underpin those capabilities. This is aligned with intent articulated in the Defence and Security Industrial Strategy, dated March 2021.

19. Integrated Review, Section IV Strategic Framework, Chapter 1, page 38, para 10. global industry continues to grow at the same rate as the UK's.

3. Strategic Theme 1

Protect and Defend

Develop Space capabilities to deliver effective operational outcomes

Identify and attribute threats to Space systems

Respond to hostile activities in a proportionate and coordinated manner

3.1. In response to our adversaries' increasing offensive capabilities in space, we require credible **deterrence and response** options to protect and defend our national interests in and through space. This includes a coherent and responsive intelligence-focussed strategy, effective operational Space Control capability and resilient on-orbit, terrestrial and cyber infrastructure. We understand that our credibility is not simply limited to capability; it must include our international alliances, commercial partnerships and the way in which we operate in the domain.

3.2. Deterrence is fundamental to our national security and our ability to protect our national interests and preserve operational independence in space. We will continue to monitor, seek to understand and, where appropriate, respond to actions that are contrary to our interests in space. We welcome NATO's recognition that attacks to, from or within space represent a clear challenge to the security of the Alliance and could lead to the invocation of Article 5 of the North Atlantic Treaty. We will seek appropriate responses in accordance with international and domestic law.

3.3. As in other domains, we must first develop a **comprehensive understanding** of the environment in which we operate, compatible with our allies and partners, to deliver accurate information at the speed of relevance and drive agile decision-making. We will enhance our ability to provide coherent Space Domain Awareness in order to anticipate, seek out, identify, analyse, attribute and thus understand threats. This will improve our ability to generate appropriate measures to protect and defend our critical space capabilities. This suite of integrated, high-tech capabilities that can collect, process, exploit and transmit data, information and intelligence activity in space will help meet our military objectives.

3.4. We will develop, test safely and deliver ambitious protection and defensive capabilities, alongside effects in and through space, coordinated and integrated with all other domains. We will ensure that we are using the most innovative solutions in protecting sovereign and allied space systems, including on-orbit infrastructure, terrestrial space infrastructure, the ElectroMagnetic (EM) spectrum and cyber vulnerabilities. We will uphold international norms and responsible behaviours, supporting cross-government and international efforts on this issue.

3.5. We will strengthen our contribution to Operation OLYMPIC DEFENDER through

UK Space Command, including operational level space Command and Control, missile warning and increased Space Domain Awareness, as well as exploring further opportunities within NATO and bilaterally where required. We will continue to support other government departments such as the Foreign, Commonwealth and Development Office, to enhance space diplomacy, leveraging existing alliances and partnerships to establish norms of behaviour for the space domain. Our partnership with operators and owners of the UK's space critical national infrastructure will be further matured to respond to the growing threat.

The UK Space Operations Centre (SpOC)

Before we can act, we must have the ability to see or sense activity in space, so that we may understand it, attribute nefarious activity when required, make risk-balanced decisions and take appropriate action.

We will therefore continue to develop Space Domain Awareness capabilities, including those provided by RAF Fylingdales, to enhance our ability to detect, track, characterise and attribute objects in space and build agility into our space Command and Control mechanisms and decision making. This will also include new Space Domain Awareness capabilities, nationally and with partners, whether that be from the Earth or from space

We will work closely with commercial partners to integrate staff alongside Defence staff in the UK SpOC. In partnership with UKSA, we will help establish the National Space Operations Centre that will be fully integrated with our allies and partners, as well as across government.



Dstl Hermes Ground Station, Portsmouth West, Hampshire²⁰

20. Source: Defence Images.

4. Strategic Theme 2

Enhance Military Operations

Integrate Space into all relevant aspects of Defence business

Deliver resilient Space services crucial to military operations

Enhance Multi-Domain Integration and architectures

4.1. Our Armed Forces must seek out and seize the enduring strategic advantage opportunities offered by space. This means **integrating space capabilities and services** across the whole spectrum of multi-domain departmental activity, including operational planning, doctrine, capability development, training and education. It also means improving the process of integrating intelligence products and using space technology in our core business to attain information advantage and enhance operational effectiveness. Space will be a fundamental component in meeting the Integrated Operating Concept 2025 vision, moving beyond joint operations to true Multi-Domain Integration.

4.2. We must be able to send accurate, secure data and information rapidly and in a format that is easily digestible by the user, facilitating decision-makers' access to the information they need, wherever they are on the globe, more quickly than our adversaries can react. It is why we will explore ways to improve our ability to command, control and co-ordinate space systems, including the ability to task, access and analyse data and information effectively, alongside our allies and partners.

4.3. We will develop secure, assured and resilient systems and infrastructure, exploiting the very best from the UK space and Defence sectors to modernise platforms and capabilities, including those that enable Space Control, missile warning and other integrated operations in space. We will also champion UK-led science research and development and emerging space services technology to enhance our operations in other domains, and that is coordinated with capabilities developed in other domains.

4.4. We will explore and develop the concepts for Defence-led resilient global navigation and alternative means to navigate and synchronise timing. This will include continuing to develop our relationship with the Five Eyes community with regard to Navigation Warfare and also the protection and resilience of Position, Navigation and Timing (PNT) capabilities.

4.5. We will enhance and exploit the UK's world-renowned satellite communications capability, Skynet, to enable us to better deliver our military objectives, support government activities and provide NATO with satellite communication provisions alongside France, Italy and the US until 2035. In addition, we will become more resilient through close integration of allied capability as well as commercial satellite communications providers, which increasingly include military features.

4.6. As the UK seeks to develop its own small satellite capabilities, we will continue to explore the Defence benefits offered by this emerging market and consider potential opportunities for:

- a. Quantum field sensors.
- b. Secondary payloads for Skynet.
- c. Space-based ISR utilising multi-sensor capabilities.
- d. Novel discrimination and exploitation of sensitive EM targets.

Novel Sensors and ISR Satellites

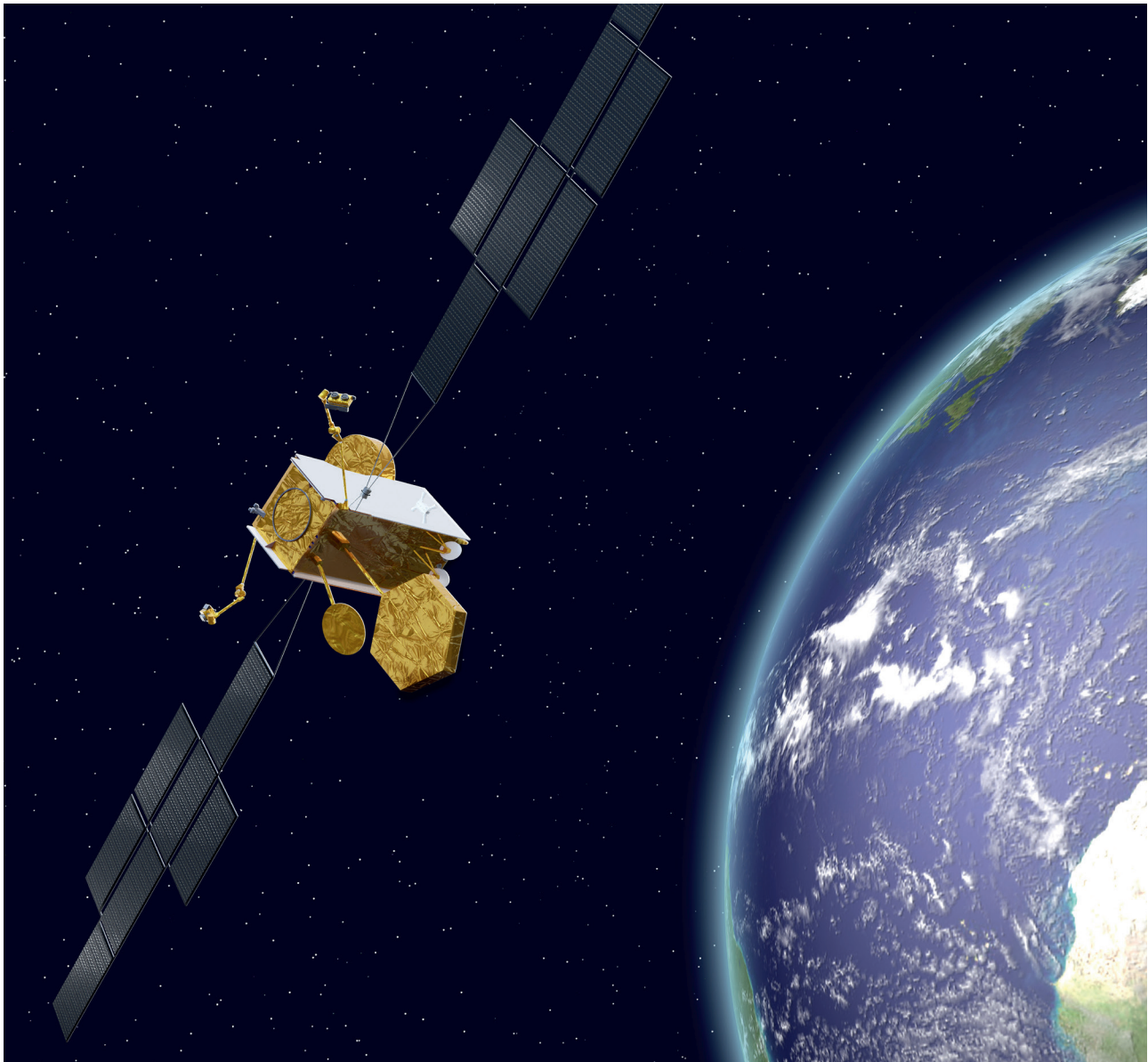
The space domain provides unparalleled ubiquity, along with the ability to rapidly change between outputs from different sensors to allow focus to be moved from one area of the world to another. This flexibility and breadth of coverage allows Defence to invest in multi-sensor, wide-area surveillance capabilities that will provide vital protection and decision-supporting information to our terrestrial forces, whilst burden-sharing responsibilities with manned surveillance systems and our allies and partners, reducing the risk we expose our people to and increasing collaboration with our valued partners.

The nature of the environment will also allow Defence to contribute surveillance data and information to our partners across government, for vital tasks such as terrestrial environmental monitoring, disaster relief and infrastructure development.

We will advance terrestrial sensors and novel battle-winning space-based ISR, such as hyperspectral imaging, Electro-Optical and Infra-Red, as well as Synthetic Aperture Radar constellations to position the UK as a leading nation amongst our allies and partners.

Skynet

Skynet is a multi-billion pound strategic Defence satellite communications capability. It supports national prosperity and resilience through the provision of data to enable the full range of Defence tasks and support to government activities, at home and abroad. As threats and associated vulnerabilities increase, we must consider how we monitor the environment around Skynet, ensuring we protect the capability and have the ability to respond when needed.



Skynet 6A²¹

21. Source: Defence Images.

5. Strategic Theme 3

Upskill and Cohere

Produce coherent
Space policies
and plans

Develop a skilled and
sustainable Space
workforce

Recruit, train and
retain talented
individuals

5.1. As signalled in the National Space Strategy, we have established a UK Space Command as a Joint organisation delivering the strategic direction set by the MOD's Space Directorate. Staffed by personnel from the Whole Force (comprising Regular and Reserve personnel from all three Services, as well as Civil Service and contracted staff), UK Space Command will produce coherent plans and manage activity at the operational to tactical level. Its priorities will be to: support operations, be they standing Defence tasks, overseas operations or contingent functions; lead an agile approach to our space capability development and delivery; and generate a skilled Defence space workforce (training, education and growth). It will harness the energy and adaptability of the UK's space sector, to ensure the rapid delivery of leading-edge space capability, and deliver Command and Control of our space operations.

UK Space Command

Mission: To protect and defend the UK and allies' interests in, from and to space, delivering decisive space power, enabling operational independence, and contributing to global security.

Purpose: UK Space Command will deliver the UK's command and control of space. It will receive policy and strategy direction from the National Space Council and MOD Space Directorate, coalesce and cohere space capability delivery and operations, and provide unity of effort to deliver a space enterprise that will:

1. Protect and defend the UK and allies' interests in space.
2. Enable operational independence for UK and allies' use of space.
3. Enable integrated action through the provision of space-based services.
4. Promote, monitor and uphold global security and the responsible use of space.
5. Deliver world-renowned, technologically-advanced capabilities.
6. Exploit novel and innovative approaches to organisational and capability processes.
7. Recognise and harness the talent of our military, civilian and commercial space workforce.

5.2. The National Space Strategy is clear that a skilled workforce is vital to the success of space businesses and the growth of the sector. This is also fundamental to delivery of the Defence vision. The need to continue to generate and grow a space workforce, by investing in skills and people, will require Defence to harness the Whole Force approach, encompassing military, Civil Service and contractor staff. We will build experience and expertise across Defence, as well as further integrating space effectively into exercises and war games conducted for the maritime, land, air and cyber-electromagnetic domains.

5.3. We will actively contribute and work with other government departments, remaining deeply interactive with industry and sponsored reserves, to nurture talent and improve training for all those involved in the UK space sector, in particular, looking at opportunities for combined military and civil training. We will also continue to improve and expand Defence staff education and training, making best use of our access to international courses in addition to the Defence Academy and the Air and Space Warfare School.

5.4. To attract and retain a talented and diverse set of individuals, equipped with the specialist skills required for operational success, we will continue development through recognised and leading expert level operator qualifications and we will introduce lateral entry with specialist education and training to give individuals access to exciting and rewarding job opportunities. This will help grow our Defence space workforce, enhance our knowledge and reputation, as well as ensuring we remain intelligent customers and users. Options considered will include the potential for Reserve space squadrons, alongside Regular Service formations. We will also ensure that we have access to expertise ranging from specialists in emerging technology, with examples such as quantum technology and autonomy, to satellite systems and service procurement.

5.5. The growing space workforce will be managed and delivered through structured career paths. We will consider adopting the Unified Career Management approach, as pioneered with the cyber workforce. As part of this approach, we will develop novel and innovative partnerships with the commercial sector to ensure we unlock the full potential of our UK expertise. This will include commercial staff embedded within the UK Space Operations Centre (SpOC) Commercial Integration Cell as well as further enhancement to the established joint Partnership Agreement with the UKSA to fully integrate them into the UK SpOC.

Defence Space Workforce

We will set the conditions for space education and training by conducting a detailed Training Needs Analysis to understand the totality of the requirements for the provision of training for the space workforce, both in Defence and across Government. Subject to the results of the Training Needs Analysis, we will enable the growth of the Defence space workforce by integrating with other Government departments and seeking collaborative training and education opportunities, including any potential for a Space Academy.

6. Capability Management

Approach

6.1. To deliver on our vision, and the Defence contribution to the National Space Strategy, we will:

- a. Enhance our Space Domain Awareness to understand the risks to the integrated force in, from, or through space.
- b. Deliver key elements of the Defence Digital Backbone that will process, analyse, fuse, attribute and disseminate high quality information and intelligence in real time to the warfighter.
- c. Deliver the first in a series of constellations of novel and multi-spectral sensors to sense, track and attribute challenging targets on Earth.
- d. Understand, design and field technologies to protect and defend UK interests in or from space, above or below the threshold of armed conflict.
- e. Enabling operational freedom by securing access to, and sufficient rights of use in, technical data to enable innovation and continuous improvement of our information advantage.

6.2. To support this approach, we have undertaken a focused, science and technology-led analysis to examine whether, and how, space domain capabilities can provide a cost-effective solution to Defence's force structure. This has resulted in the continued development of existing

capabilities such as Skynet and the UK Space Operations Centre (SpOC), as well as informing the capability management and investment priorities articulated within the National Space Strategy and detailed further here. This evidence will enable the creation of a detailed and prioritised capability plan out to 2030, tailored initially to reflect the Defence IR funding apportionment out to 2025. It will be developed by incorporating the assured capability requirements to strike the right balance between capabilities we own, collaborate on, or access.

6.3. We will invest a further £1.4Bn in space over the next 10 years within a single, coherent space capability pillar. UK Strategic Command, the Defence Joint User, Integrated User and Sponsor for pan-Defence capabilities, will use agile acquisition and supplier management approaches to increase our experimentation with industry and rapidly evolve high-tech demonstrators into fast-paced capability programmes: from design to on-orbit output at a much faster pace than traditional procurement activities, delivering transformational change for our Armed Forces. We will also ensure that we can work with our allies and partners to maintain resilient operational effectiveness in the face of increasing sub-threshold competition.

6.4. Consistent with the MOD Science and Technology Strategy 2020,²² we will capitalise on the UK's world-renowned science and technology community, which

includes research and development, as it has a major role to play in transforming the way we operate. From providing specialist advice on space threats and hazards, to the design and development of inventive space concepts and technologies. Experimentation and demonstration within the MOD, working closely with partners across government, in industry and academia, will drive innovation within the UK. Defence R&D will work with the civil sector to deliver new capabilities and grow our strategic advantage in S&T. Stronger oversight and coherence of experimentation will guide plans and investment towards rapid exploitation of space technology in pursuit of better capability decisions.

Science & Technology

Delivered by the Defence Science and Technology Laboratory (Dstl) and working across the MOD, wider Government, industry, academia and internationally, the MOD space science and technology programme (which includes research and development) will grow to support the delivery of Defence ambitions set out in the IR. Projects range from observing, characterising and cataloguing space objects, to developing novel radar concepts and a new generation of deployable satellite antennas.

We will utilise elements of the Defence Space Portfolio funding to further support space science and technology, alongside existing funding from a variety of sources including the Chief Scientific Advisor and the Defence Innovation Unit.

Defence Space Portfolio

6.5. The MOD Space Directorate will provide oversight and coherence across Defence and with wider government objectives. As we maintain and review our existing capability management processes, we will take into consideration the civil and military needs of multiple government departments wherever possible, and maximise the use of existing development pipelines, as well as the proposed Joint Space Innovation Portal.

6.6. Our prioritised ambitions within the space domain will be delivered through the establishment of a balanced **Defence Space Portfolio**, generated and maintained by UK Space Command. This will incorporate the existing space-related capability planning activities across Defence, enabling all space capability development and delivery, but with mechanisms in place to protect UK Strategic Command equity. Embracing the enormous expertise and innovative technology that exists in the UK and particularly the space sector, the Defence Space Portfolio will incorporate the existing space capability management activity, currently managed by UK Strategic Command, with exciting new initiatives:

a. Programme of Record. An existing sub-portfolio of core programmes, some already mature, committed to a multi-generational backbone of capabilities, able to deliver and enable enduring operations and support the National Space Strategy ambition. Those core programmes include Satellite Communications (enabled by the Skynet programme and currently delivered by UK Strategic Command), Space Domain Awareness (enabled by the UK SpOC within UK Space Command) and missile warning (enabled by RAF Fylingdales and managed by the UK SpOC).

b. **New initiatives.** We will take an agile approach to capability development and acquisition by pulling through advanced S&T, through R&D, into the hands of the operator. The technical specifications of such capabilities are not articulated here, due to the classification of the document, but will form the core of space capability management within UK Space Command.

Priorities

6.7. As space capability matures in line with developing policies, the ability to support and integrate with other operational domains will be fundamental. Alongside UK Strategic Command, the Defence lead for Multi-Domain Integration, military activity within the space domain will be continually assessed, in order to enable effective and coherent integration. This will underpin comprehensive standards of interoperability with our allies and partners, and ensure that our ability to **understand, decide** and **act** is reinforced through accurate, timely and reliable data from a comprehensive suite of sources. This integrated Defence space capability management activity will be conducted in accordance with the following seven prioritised capability themes:

a. **Secure Satellite Communication (SATCOM).** Global SATCOM that is secure and resilient, exchanging information via satellite to enable enhanced strategic capabilities, is essential for our operational independence. It enables global operations and discreet passage of the information at a variety of sensitivities and classifications. We are already investing over £5Bn over the next 10 years in our world-renowned Skynet satellite system, delivered by UK Strategic Command, and will now invest nearly £60M of additional funding in Skynet and other SATCOM capabilities. This will enhance

our ability to transfer large volumes of data globally, rapidly and securely, connecting the modern battlefield and integrating the force.

b. **Space Domain Awareness (SDA).** The detection, tracking, characterisation and attribution of space systems provides an increased understanding of the space domain and threats to our critical systems. A fundamental enabler of all other space capabilities, and critical to our ability to protect our interests in space in the years to come, SDA combines data from a variety of capabilities with intelligence source outputs. The UK SpOC acts as a hub for data received from RAF Fylingdales, as the lead contributing sensor, as well as ground-based telescopes, sensor networks and on-orbit space-monitoring satellites, both UK and foreign. The Defence SDA programme, which will be boosted by an addition of over £85M over the next 10 years, will augment and contribute to existing allied and commercial data sources using assured sensor capabilities required for national object classification and attribution. We will coordinate information and intelligence across all domains to build a richer understanding of the environment we see ourselves operating in, enhancing this using innovative and emergent technology that can also be used by our partners across government. We will ensure that the Defence SDA programme works in conjunction with the civil Space Surveillance and Tracking programme, led by the UKSA, to bring together the best possible data and analysis from civil, commercial and classified sources.

c. Intelligence, Surveillance and Reconnaissance (ISR). ISR comprises those elements of Earth Observation (EO) primarily utilised by Defence and Intelligence and can be both Earth-facing and space-facing. The EO elements primarily for civil use include Earth information systems²³ and other Earth-facing capabilities. Military and civil requirements for EO frequently overlap; as such, EO/ISR has dual use at its core. EO provides spectral data (imagery) and electronic intelligence over a wide area or over a specific point of interest, anywhere on the planet. ISR, which includes signals characterisation and spectral data, can be used for environmental monitoring, border monitoring, maritime surveillance, disaster relief and civil contingency planning. We will invest over £970M in additional funding over the next 10 years to develop a complementary range of cutting-edge technologies to generate a flexible, resilient suite of on-orbit sensors, extending the digital backbone into space and Synthetic Aperture Radar constellations, all underpinned by a novel and secure ground architecture. We will deliver a combined series of on-orbit and ground-based demonstrators over the next four years that provide the foundation for a space-based ISR constellation. We will deliver the optimal cost-effective multi-sensor ISR capability through coherent delivery of a number of operational concept demonstrators that prove and de-risk technologies for Defence use. This will include integration with Five Eyes partners to demonstrate an integrated system by 2025, as well as delivery of satellites with advanced sensor capabilities, achieving an Initial Operating Capability in

2025. In addition, tasking and processing, exploitation and dissemination capabilities will be developed that are coherent with the existing Defence ISR enterprise, compatible with existing architectures and inter-operable for the benefit of both the UK and our allies and partners.

d. Space Command and Control. A comprehensive understanding of data from multiple sources will enable balanced, risk-aware decision-making, exploitation of opportunities, and control of activities in or through space. To develop and deliver related space capabilities, generate an expert and experienced workforce, and operate seamlessly across Defence, government, industry and with our allies and partners, we will invest over £135M in additional funding over the next 10 years, in order to:

- 1) Build on the establishment of UK Space Command and support its development into a coherent Joint command.
- 2) Continue to enhance the UK SpOC, in partnership with the UKSA, to support the government ambition of creating a sophisticated combined military, civilian and National Space Operations Centre.
- 3) Conduct an extensive Training Needs Analysis to determine how to best to grow our expertise and ensure we remain at the forefront of Defence space endeavours in the years to come. The Training Needs Analysis will explore requirements for future training provision, including the scope and nature of any Space Academy.

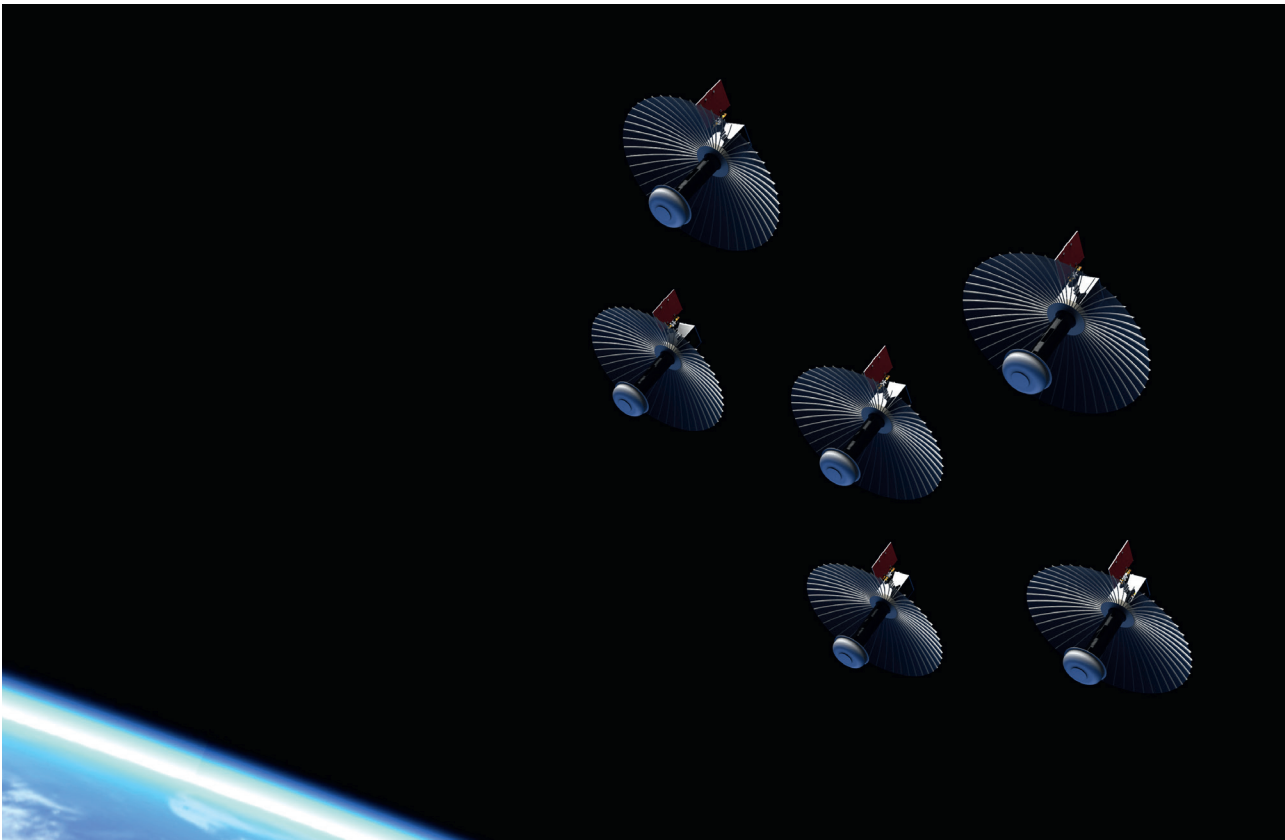
23. Primarily the Earth Observing System (EOS) Data and Information System (EOSDIS), operated by NASA.

e. **Space Control.** To protect and defend our interests within the space domain, deter hostile acts and ensure our space capabilities have adequate resilience to disruption from adversarial activity, we will invest over £145M in additional funding over the next 10 years. We will investigate mechanisms to deliver carefully calibrated effects to assure our access to, and operational independence in, space.

f. **Position, Navigation and Timing (PNT).** PNT signals underpin almost every military activity, delivering critical Defence capabilities, including precise navigation and targeting across the globe. However, PNT systems are inherently vulnerable to interference and nefarious activity. We

therefore continue to support an extensive cross-government ‘system of systems’ approach to develop secure and resilient PNT to meet wider societal requirements in line with the stated IR intent to “strengthen the resilience of the PNT services on which our critical national infrastructure and economy depend.”

g. **Launch.** We maintain a requirement for assured access to commercially developed launch capabilities. Though we will not develop our own independent launch systems, we will continue to support the UKSA in the advancement of UK-based space launch activities, both vertical and horizontal, and work closely with our allies and partners to assure appropriate and timely access to space.

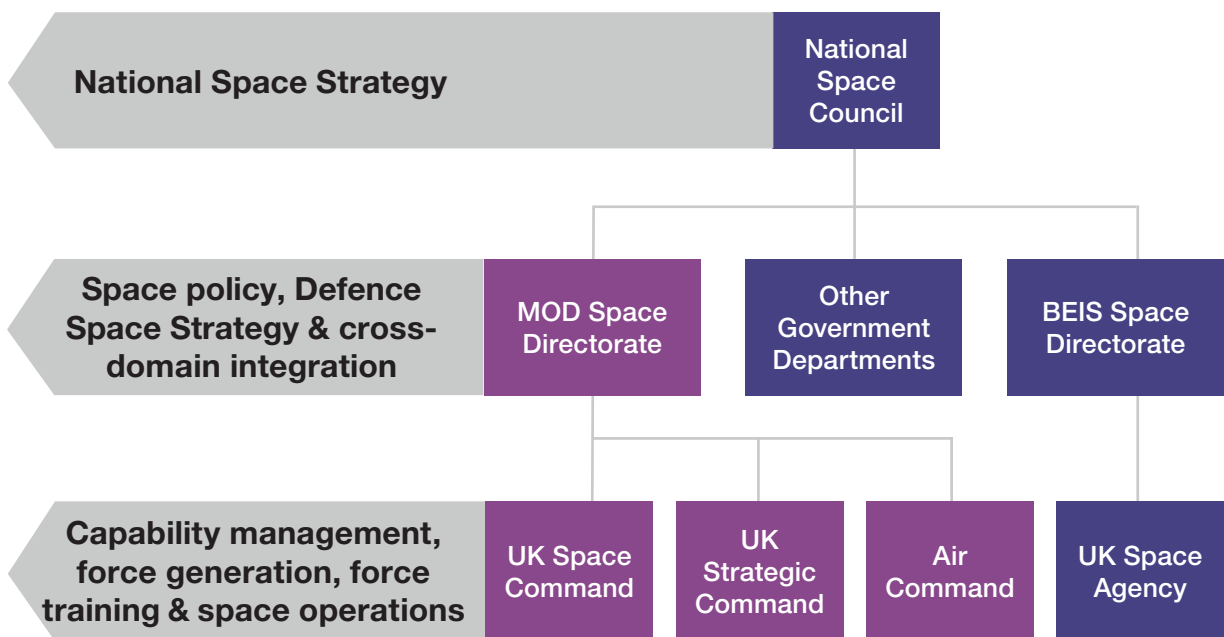


Space-based Synthetic Aperture Radar (SAR) – Oberon²⁴

24. Source: Dstl.

7. Governance

Hierarchy



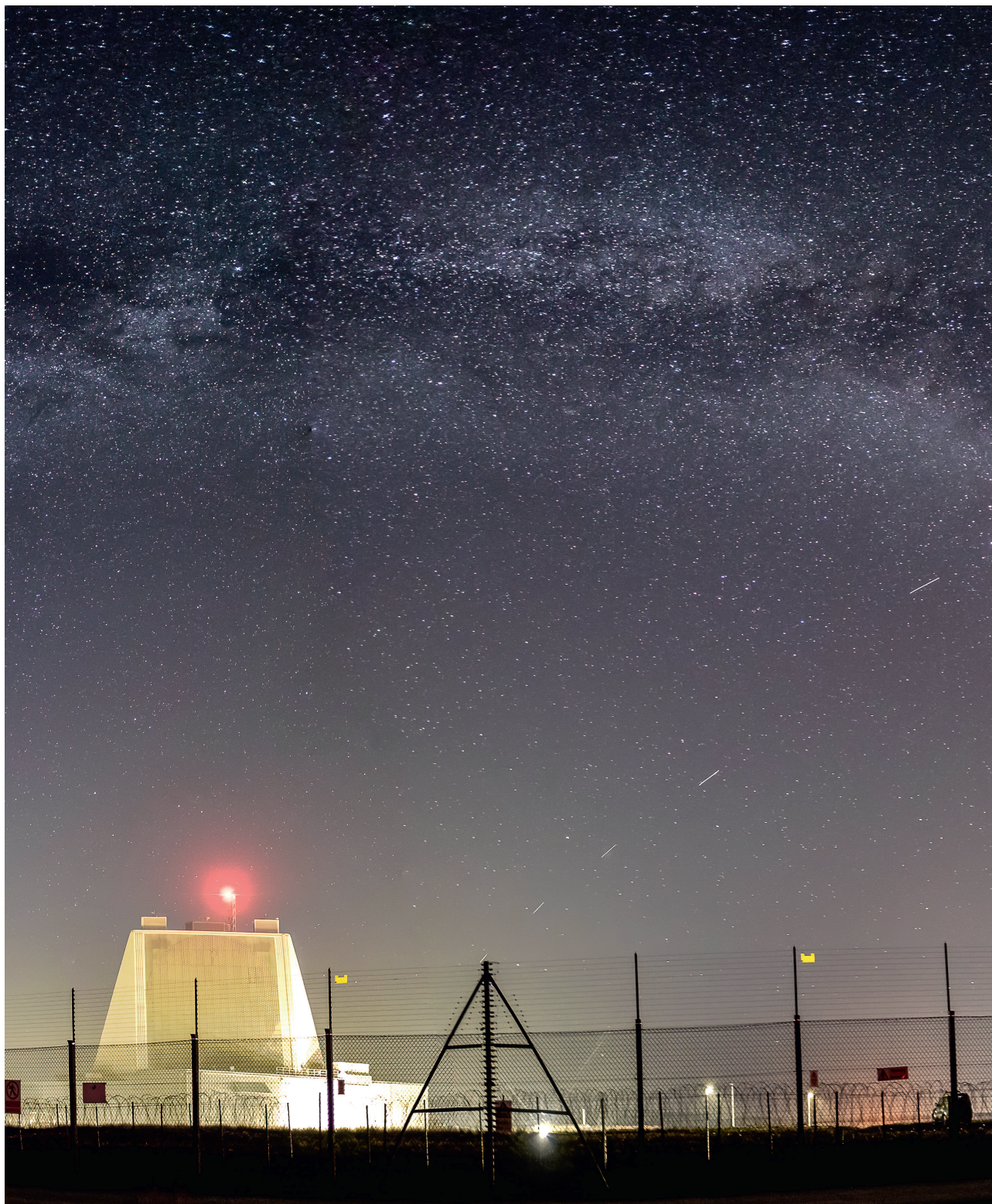
Note: Lines denote governance relationships, not command structure.

Figure 3 – UK strategic space hierarchy and core outputs.

7.1. As set out in the National Space Strategy, we will work to ensure that there is a clear cross-government approach to national space policy, governance and delivery. Figure 3 reflects the UK strategic structure in relation to the National Space Council and other government departments, as well as its core outputs. The National Space Council,²⁵ a Cabinet Committee chaired by the Prime Minister, sets direction for cross-government activity within the

space domain and has approved the UK’s first National Space Strategy. The resulting UK space policies are cohered collaboratively by Space Directorates within both the MOD and BEIS.

25. The Terms of Reference of the National Space Council are to consider issues concerning prosperity, diplomacy and national security in, through and from space, as part of coordinating overall Government policy.



RAF Fylingdales Night Sky, North Yorkshire²⁶

26. Source: Dstl.

7.2. Defence space responsibilities have been aligned with the Defence Operating Model²⁷. The Direct activity is the responsibility of MOD Head Office, with the Space Directorate, under leadership of the 2-star Director Space, cohering MOD Defence space governance, policy, strategy planning and international engagement in support of the National Space Council. Defence space Generate²⁸ and Operate²⁹ activities are the responsibility of the 2-star Commander of UK Space Command, who is also responsible for space-based capability development and delivery. UK Strategic Command will remain the capability sponsor for SATCOM, PNT and ISR, with Air Command the capability sponsor for Protect and Defend capabilities.

7.3. To provide oversight and coordination of the totality of Defence's space business, at least until Space Command's capability management processes are fully established, we have developed a governance model that seeks to provide assurance, protect UK Strategic Command equities and mitigate the risk of incoherence in Defence. The MOD Space Directorate will be held to account by a 4-Star level Defence Space Executive Board, which will set the strategic direction and provide oversight, alignment and prioritisation below the Ministerial threshold. In turn, we will be held to account by the Defence Programme Assurance Group, chaired by the National Security Advisor. A 2-Star level Space Alignment Group has also been established to provide a forum for coordination and alignment.

7.4. To ensure that we integrate effectively, we will work closely with other government partners to meet the government's ambition and priorities. In particular, we will work directly with BEIS and the UKSA to deliver the national ambition, fusing civil and military requirements where we can, to exploit one capability for many uses.

27. There are 7 core Defence activities: Policy, Strategy, Planning, Governance, Enable, Generate and Operate. Of these, Policy, Strategy, Planning and Governance are collectively referred to as the Direct activity.

28. The generation of Military Capability from currently available assets and the delivery of projects and other activity to create future Military Capability.

29. The day-to-day business of space operations.

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