



# FOR HEAVEN'S SAKE

Examining the UK's  
Militarisation of Space

DRONE  
WARS

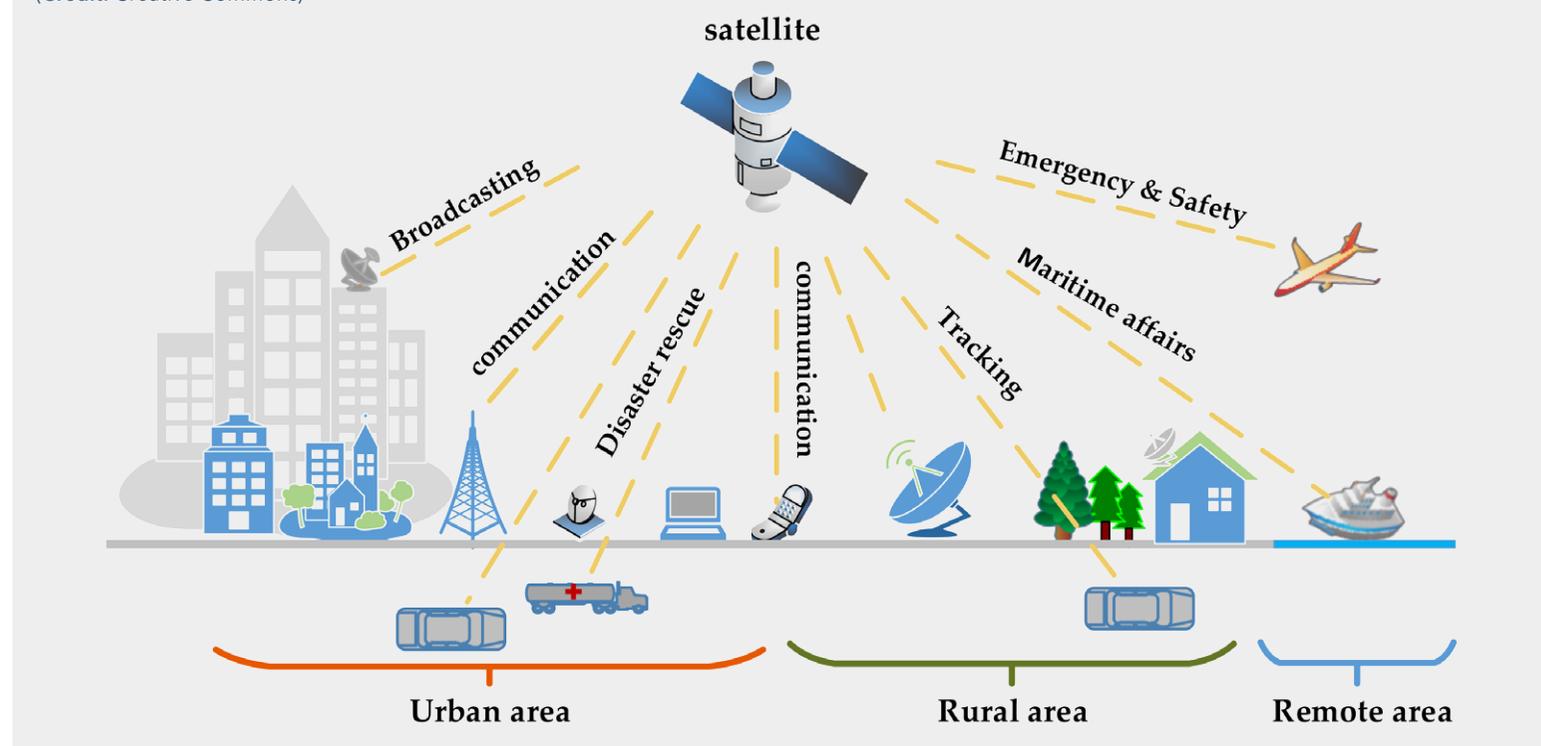
# Introduction

Space based operations affect many aspects of modern life and commerce. The global economy relies heavily on satellites in orbit to provide communication services for a variety of services including mobile phones, the internet, television, and financial trading systems. Global

positioning system (GPS) satellites play a key role in transport networks, while earth observation satellites provide information for weather forecasting, climate monitoring, and crop observation.

**Figure 1: Examples of civilian and military use of space technology**

(Credit: Creative Commons)



Cover image: UK Space Agency

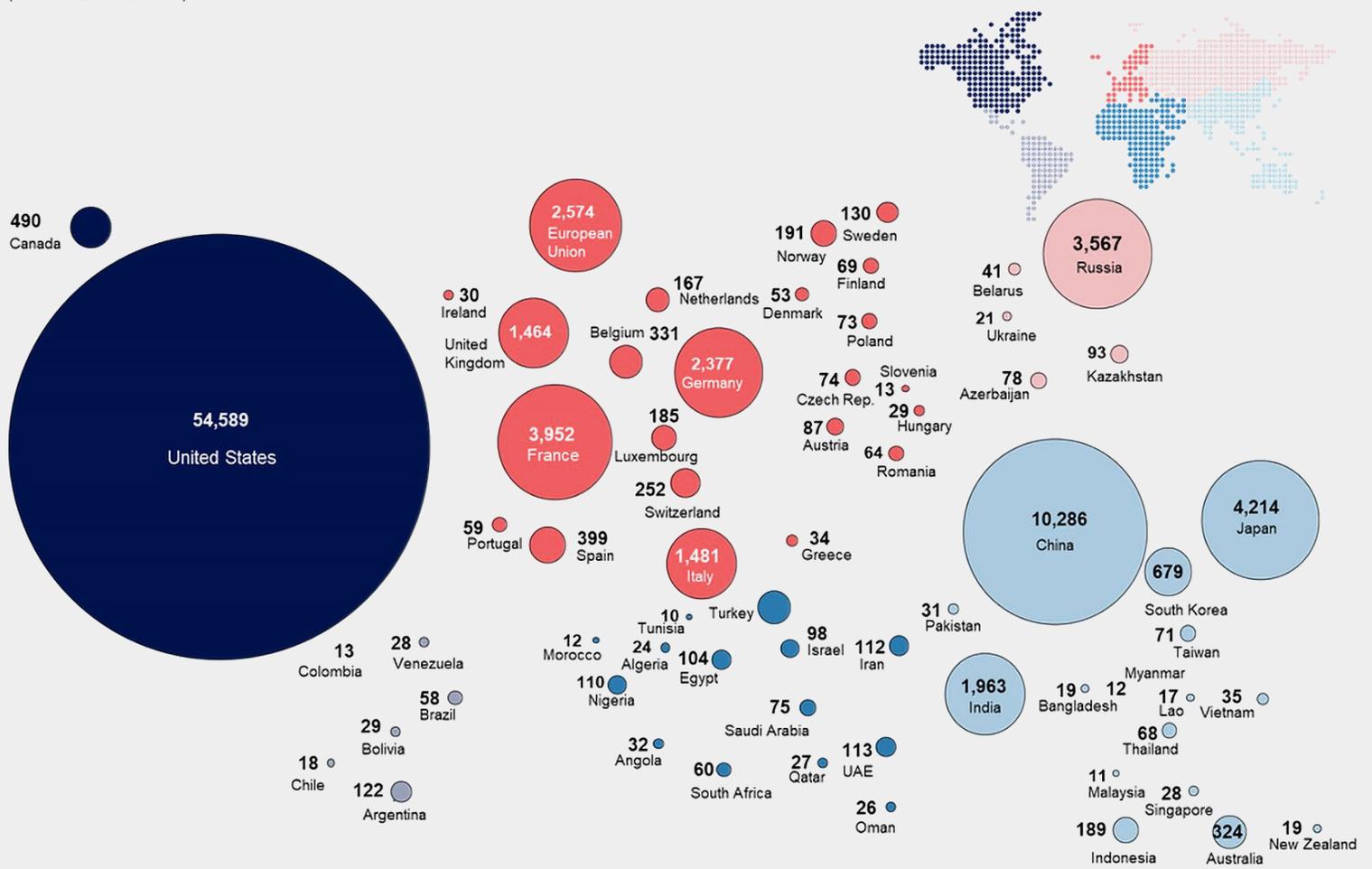
- 1 'Space Exploration a Future \$1 Trillion Market, Stallmer Says'. Bloomberg TV, 1 March 2018. <https://www.bloomberg.com/news/videos/2018-03-01/eric-stallmer-sees-space-exploration-being-1-trillion-dollars-a-year-business-in-the-near-future-video>
- 2 Charles Hendry and Jamie Horton: 'OPINION: The UK has a massive opportunity in space'. Helmsley Partners, 26 April 2021. <https://www.helmsleypartners.com/post/opinion-the-uk-has-a-massive-opportunity-in-space>
- 3 'Government space budgets driven by space exploration and militarization hit record \$92 billion investment in 2021 despite covid, with \$1 trillion forecast over the decade'. Euroconsult, 6 January 2022. <https://www.euroconsult-ec.com/press-release/government-space-budgets-driven-by-space-exploration-and-militarization-hit-record-92-billion-investment-in-2021-despite-covid-with-1-trillion-forecast-over-the-decade/>

Space is now big business and forecasts suggest the global space market could be worth over \$1 trillion by 2040.<sup>1</sup> The UK aims to capture 10 per cent of this market

by 2030<sup>2</sup>, although it is a relatively small player compared to China, France, Japan, Russia, and the US, who have larger and more advanced space programmes (see Figure 2).

**Figure 2: Government expenditures on space programmes 2021**

(Credit: Euroconsult)<sup>3</sup>



Budgets indicated for European countries include their contributions to ESA and Eumesat. Only countries with a budget of at least \$10million appear on the map.

Space is also, unfortunately, a key domain for military operations. Modern military engagements rely heavily on space-based assets. Space systems are used for command and control globally; surveillance, intelligence and reconnaissance; missile warning; and in support of forces deployed overseas. Satellites also provide secure communications links for military and security forces, including communications needed to fly armed drones remotely. Many precision-guided munitions use information provided by space-based assets to correct their positioning in order to hit a target.

Satellite systems are defenceless and extremely vulnerable and losing an important satellite could have severe consequences. The loss of a key military or dual use satellite (such as one used for early warning of missile attack) - through an accident, impact of debris or a meteorite, technical failure, or a cyber-attack or similar on critical ground-based infrastructure - at a time of international tension could inadvertently lead to a military exchange, with major consequences.

This briefing therefore outlines how the UK is involved in the militarisation of space and explores the consequences and risks of this involvement.

**Many commercial and government actors [are] keen to capitalise on the economic and strategic advantages offered by the exploitation of space. However this is creating conditions for conflict**

# The UK military and space

Although the UK's space programme began in 1952, until recently it has experienced limited success. The first UK satellite, Ariel 1,<sup>4</sup> was launched in 1962, but efforts to develop an indigenous satellite launch capability were unsuccessful. A single British satellite, Prospero, launched from Australia in 1971, remains the only UK satellite to have been placed into orbit using a UK rocket. The British National Space Centre was established in 1985 to co-ordinate participation in the growing international market for satellite development and launches, and by 2010 had evolved into the UK Space Agency.

As the commercial space sector has expanded and the cost of launches has decreased, the UK government is now treating space as an area of serious interest. In September 2021 the government published a National Space Strategy, prepared jointly by the Department for Business, Energy and Industrial Strategy and Ministry of Defence (MoD), aimed at developing the space economy and protecting the UK's interests in space. The strategy set out a ten point plan for achieving the government's civil and military ambitions in space.<sup>5</sup>

Despite this, the UK remains a small space power and is relatively new to the sector, and space is an expensive and complicated area of operations. As a result the UK cannot expect to become a leader in the space field in

the foreseeable future, although it may be able to provide significant contributions to collaborations with partners and allies.

The Ministry of Defence has a Space Directorate, which works closely with the UK Space Agency and is responsible for the MoD's space policy and international coordination. UK Space Command, established in April 2021 will command and control the UK's military space programme. Although under the auspices of the Royal Air Force (RAF), Space Command is staffed jointly by personnel from the RAF, Royal Navy, Army, and civil service, with representation from the commercial space sector.<sup>6</sup> It is intended to provide command and control for all the UK's military space capabilities, linking closely with US Space Command and US Space Force, and acting as a focus for investment and capacity development on space operations. Describing Space Command's role, Air Chief Marshal Mike Wigston, the head of the Royal Air Force, said: "We're there to understand what some of our potential adversaries, some malign actors, are doing, to understand and to protect what's our critical national infrastructure in space, and to be ready to defend it".<sup>7</sup> While the UK regularly frames military developments as being for defensive purposes, they are equally capable of offensive use.

4 The UK government has a tradition of naming space projects and satellites after characters from William Shakespeare's plays.

5 'National space strategy'. Department for Business, Energy & Industrial Strategy and Ministry of Defence, 27 September 2021. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1034313/national-space-strategy.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1034313/national-space-strategy.pdf)

6 UK Space Command. <https://www.gov.uk/guidance/uk-space-command>

7 Aaron Mehta: 'British Royal Air Force invests in space capabilities'. C4ISR Net, 15 May 2021. <https://www.c4isrnet.com/battlefield-tech/space/2021/05/14/british-royal-air-force-invests-in-space-capabilities/>

8 Gareth Jennings and William Lloyd: 'RAF announces AEW&C, space, 'drone' test squadrons'. Jane's Defence Weekly, 17 July 2019. <https://www.janes.com/article/89925/raf-announces-aew-c-space-drone-test-squadrons>

9 'No. 11 Group'. Royal Air Force. <https://www.raf.mod.uk/our-organisation/groups/no-11-group/>

10 UK cutting-edge space defence backed by £1.4 billion. Ministry of Defence and Defence Science and Technology Laboratory. 1 February 2022. <https://www.gov.uk/government/news/uk-cutting-edge-space-defence-backed-by-14-billion>

11 'Defence Space Strategy: Operationalising the Space Domain'. Ministry of Defence, 1 February 2022. <https://www.gov.uk/government/publications/defence-space-strategy-operationalising-the-space-domain>

In January 2021 the Royal Air Force reformed 23 Squadron as its space squadron, responsible for day-to-day space command and control including the flying of satellites and co-ordination with allies with a presence in space: the US, France, and Italy.<sup>8</sup> The RAF's 11 Group, reformed in 2018, operates the National Air and Space Operations Centre (NASOC), with responsibilities including space surveillance.<sup>9</sup> The RAF has seconded personnel to commercial sector operators such as Surrey Satellite Technology Ltd and Virgin Orbit to help gain further insight into space operations and perhaps influence future developments.

In February 2022 the Ministry of Defence published its Defence Space Strategy, outlining "how Defence will protect the UK's national interests in space in an era of ever-growing threats".<sup>10</sup> The strategy announced funding for a portfolio of programmes for developing space assets and infrastructure (see below) and set out the following priorities for the UK military's space capabilities:

- Enhance our understanding of the threats and hazards in, from, or through space.
- Deliver high-quality information and intelligence in real time from space to the military.
- Deliver the first in a series of constellations of novel sensors to track targets on Earth.
- Understand, design and field technologies to protect and defend UK interests in or from space.<sup>11</sup>

**While the UK regularly frames military developments as being for defensive purposes, they are equally capable of offensive use**

# UK military space capabilities – present and planned

## Skynet

Skynet is the UK's military communications satellites network, currently operated by Airbus Defence and Space on behalf of the MoD. The network provides secure communication services to the UK armed forces and government departments and agencies, and offers near global coverage. Bandwidth can also be offered to NATO and allied governments, including the Five Eyes intelligence alliance. The first Skynet satellite was launched in 1969 and the system has developed incrementally since then. The system has two satellite ground stations, one at Oakhanger in Hampshire and one at Colerne in Wiltshire. Skynet is controlled from a dedicated centre in Hawthorn, Wiltshire.

As well as having its own sovereign satellite capability, the MoD also uses systems owned by the UK's NATO allies, notably the US, and also buys 'airtime' from commercial satellite service providers such as Inmarsat and Iridium.<sup>12</sup>

The MoD is now specifying the Skynet 6 framework to replace the current Skynet 5 system when the current operating contract with Airbus ends in August 2022. Skynet 6 is intended to operate through a more flexible

architecture that combines the use of a new satellite, the current Skynet 5 constellation, and other allied and commercial satellites.<sup>13</sup>

In July 2020 the MoD awarded a contract worth over £500 million to Airbus for the development and launch of the new Skynet 6A satellite by 2025. In the longer term £5 billion has been budgeted over the next 10 years to recapitalise and enhance the UK's military satellite communication capabilities, which will take place as part of the MoD's Future Beyond Line of Sight Communications programme (FBLOS) which extends to 2041.

## Small satellites

The UK has significant expertise in small satellite technology, with the Airbus-owned company Surrey Satellite Technology Ltd (SSTL) alone accounting for 40 percent of the market share worldwide.

In 2018 the Carbonite 2 demonstrator satellite, built by SSTL with collaboration from the RAF's Rapid Capability Office, MoD's Chief Scientific Advisor, and the Defence Science and Technology Laboratory (DSTL) successfully delivered full motion colour video imagery from a low

<sup>12</sup> 'Joint Enterprise'. Drone Wars UK, June 2020. <https://dronewars.net/wp-content/uploads/2020/06/JointEnterprise.pdf>

<sup>13</sup> 'Airbus signs contract with UK Ministry of Defence for Skynet 6A satellite.' Airbus, 19 July 2020. <https://www.airbus.com/en/newsroom/press-releases/2020-07-airbus-signs-contract-with-uk-ministry-of-defence-for-skynet-6a>

14 'Lift-off: Satellite launched into space on RAF mission'. Ministry of Defence, UK Space Agency, Defence Science and Technology Laboratory, and Guto Bebb. 1 March 2018. <https://www.gov.uk/government/news/lift-off-satellite-launched-into-space-on-raf-mission>

15 'Defence Secretary outlines ambitious space programme'. Ministry of Defence, 18 July 2019. <https://www.gov.uk/government/news/defence-secretary-outlines-ambitious-space-programme>

16 'Space: defence science and technology capability'. Defence Science and Technology Laboratory, 5 January 2018. <https://www.gov.uk/guidance/space-programme>

17 Rosie Laydon: 'Inside HERMES: The DSTL Ground Station Communicating With Space'. Forces Net, 20 Nov 2020. <https://www.forces.net/news/inside-hermes-ground-station-communicating-space>

earth orbit. The 100kg satellite, roughly the size of a washing machine, carries an off-the-shelf telescope and high-definition video camera. The imaging system is designed to deliver high-resolution images and colour HD video clips with a swath width of 5km. The MoD provided funding of £4.5m for the programme.<sup>14</sup>

In July 2019 MoD announced it had committed £30 million to fast-track the launch of a small satellite demonstrator, supposedly to take place within a year. A project team comprised of both UK and US personnel, Team Artemis, was established to undertake research into military uses of small satellites to support a sovereign UK satellite imagery capability, and eventually deliver the launch of a low earth orbit small satellite constellation.<sup>15</sup> Industry partners for Team Artemis are CIS, Raytheon UK, SSTL and Virgin Orbit. Through the programme MoD hopes to develop a flexible satellite system with options for selecting the payload, role, and position of the satellites and the ability to launch them rapidly.

## DSTL programmes

The Defence Science and Technology Laboratory (DSTL) provides MoD with space science and technology services, research, and advice. DSTL has set up its own Space Science and Technology Hub to act as a centre of excellence in space-related work for MoD and the wider government.<sup>16</sup>

DSTL has spent over £1.5m on space facilities at Portsmouth West, Hampshire, with the installation of a relocatable new satellite ground control station and mission operations centre to support future space research activities for the MoD. The terminal downloads imagery from the Carbonite 2 satellite and will be able to direct satellites in both low-

Earth and geosynchronous orbits. The facility will play a key role in MoD's planned in-orbit research and concept demonstrator missions.<sup>17</sup>

DSTL has also worked with Oxford Space Systems to develop space antenna technology which would permit all-weather Earth observation at fine resolution and allow more detailed and frequent satellite imaging.

In September 2019 DSTL awarded a design study to Airbus for a cluster of ultra-high-resolution Synthetic Aperture Radar satellites for the MoD. Known as Project Oberon, the satellite cluster would give greater accuracy of data and finer resolution compared to a single satellite. DSTL is heavily involved in a number of programmes for developing small satellites which were announced at the launch of the Defence Space Strategy (see next section). These are intended to trial prototype systems and technologies for future space operations to support the government's ambition to form a 'digital backbone' for communications in space. This includes the 'Minerva' programme, described as DSTL's 'keystone future project', for developing architecture to allow any space-borne satellites to communicate with each other autonomously.

A range of smaller research projects in the defence space portfolio are delivered by DSTL including projects to observe, characterise, and catalogue space objects; develop novel radar concepts; and develop satellite communications and surveillance capabilities. This includes the £2 million 'Space to Innovate' programme, part of the Defence and Security Accelerator (DASA) initiative to develop new military technologies, which aims to develop novel sensing and intelligence, surveillance, and reconnaissance (ISR) technologies and improve signal-

- 18 'Competition: Space to Innovate Campaign - Bravo Drop'. Defence and Security Accelerator, 14 September 2021. <https://www.gov.uk/government/publications/competition-space-to-innovate-campaign-bravo-drop>
- 19 'Defence Procurement Minister launches Defence Space Strategy'. Ministry of Defence and Jeremy Quin MP, 1 February 2022. <https://www.gov.uk/government/speeches/defence-procurement-minister-launches-defence-space-strategy>
- 20 Juliana Suess: 'The UK Defence Space Strategy'. RUSI Commentary, 11 February 2022. <https://rusi.org/explore-our-research/publications/commentary/uk-defence-space-strategy>
- 21 Rounded. Details of individual projects mentioned in the text have been aggregated in the headings.

to-noise performance of space-related communications and sensors.<sup>18</sup>

Much of DSTL's work is undertaken in collaboration with UK Space Command and the UK Space Agency, as well as academic partners and international partners such as the US Air Force Research Agency and the Japanese Aerospace Exploration Agency. DSTL has also hosted an officer on secondment from the US Space Force.

## Defence Space Strategy programmes

At the launch of the Defence Space Strategy MoD announced funding for a number of space programmes which will be taken forward over the next decade<sup>19</sup> (see Table 1). Not all of these were new initiatives, and in addition to the programmes which have been announced publicly, there will doubtlessly be further secret programmes which the government has not revealed.

**Table 1: Defence Space Strategy spending commitments, 2022-32<sup>20</sup>**

**£968 million** for ISTARI intelligence, surveillance and reconnaissance system.

**£145 million** for space control.

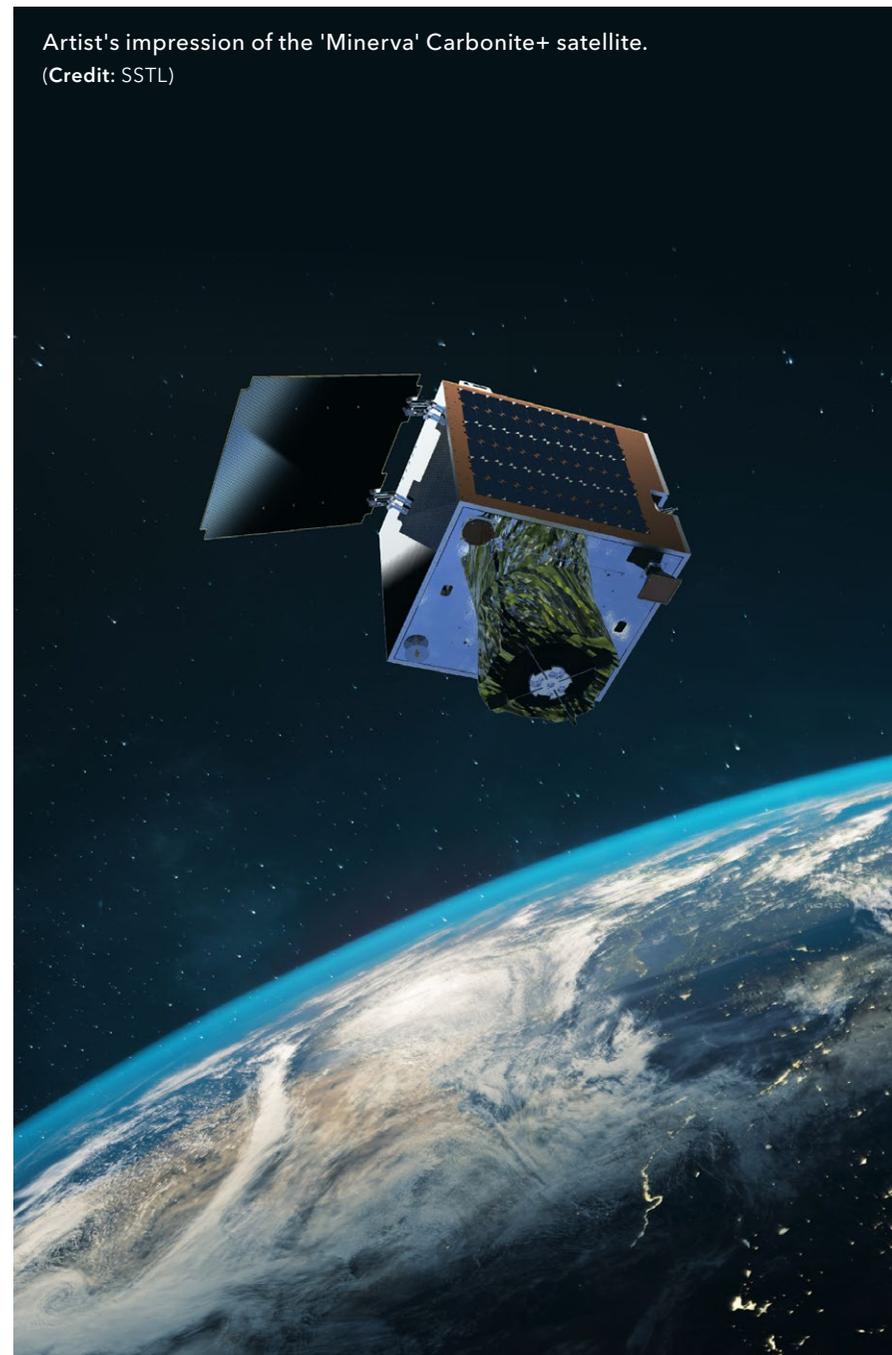
**£135 million** for space command and control, including developing and enhancing UK Space Command and developing the Space Operations Centre.

**£85 million** for Space Domain Awareness (SDA).

**£60 million** for Skynet 6 satellite communications, representing additional funding over and above £5 billion previously allocated over the next 10 years.

**Total: £6.4 billion<sup>21</sup>**

Artist's impression of the 'Minerva' Carbonite+ satellite.  
(Credit: SSTL)



22 First UK satellite launch in summer 2022'. Ministry of Defence, 10 May 2022. <https://www.gov.uk/government/news/first-uk-satellite-launch-in-summer-2022>

MoD has pledged to commit £968 million over the next ten years to deliver a multi-satellite system, known as the ISTARI programme, to support greater global surveillance and intelligence for military operations. Over the next four years £127 million has been allocated to develop an operational concept demonstrator, Minerva which will build on work done during the Artemis programme and is intended to autonomously collect, process and share data from UK and allied satellites to support military decision-making.

DSTL has awarded a £9.5m contract to Hampshire-based In-Space Missions to build a new satellite, 'Titania', which will undertake research on next generation communications technology. £61 million has been budgeted for the Titania programme to explore the use of optical laser communications technology to deliver data from space to Earth at high speeds. Titania will communicate with 'Puck', a new DSTL optical ground station.

MoD also intends to develop a test platform for monitoring GPS, radio signals and imaging, paving the way for more collaborative space communication with allies. The platform, known as Prometheus 2, consists of two nanosatellites designed by Airbus Defence and Space and assembled by

In-Space Missions Ltd, a subsidiary of BAE Systems, with support from DSTL and the US National Reconnaissance Office. Prometheus 2's payloads will include a hyperspectral imager, GPS receivers, a wide field-of-view imager, and multiple software-defined-radios. The satellites will be a test platform for monitoring radio signals and enhanced imaging, as well as a connected space communication system for the UK's military allies. The satellites are scheduled to be launched in summer 2022 using Virgin Orbit's Launcher One service from Spaceport Cornwall in Newquay.<sup>22</sup>

£135 million has been allocated to boost Command and Control capabilities over the next decade. This cash will support the establishment of the UK Space Command and deliver the 'Aurora' digital architecture programme.

£85 million is destined to develop Space Domain Awareness capabilities for understanding and monitoring activities in space by detecting and tracking objects in orbit. This includes money to support the Deep Space Advanced Radar Capability programme (see below).

Prior to the launch of the Defence Space Strategy, in September 2019, MoD awarded a contract worth almost £70 million to QinetiQ to develop enhanced satellite receivers.

# The UK's military space partnerships

23 'UKSpace and RAF to establish Commercial Integration Cell for greater military and commercial space collaboration.' UKSpace, 23 July 2020. <https://www.ukspace.org/ukspace-raf-establish-cic-for-greater-military-and-commercial-space-collaboration/>

24 'Defence Secretary outlines ambitious space programme'. Ministry of Defence, 18 July 2019. <https://www.gov.uk/government/news/defence-secretary-outlines-ambitious-space-programme>

25 Tyler Whiting: 'Coalition Partners, US and UK agree to share technical foundation for space operations'. Space War, 16 August 2020. [https://www.spacewar.com/reports/Coalition\\_Partners\\_US\\_and\\_UK\\_agree\\_to\\_share\\_technical\\_foundation\\_for\\_space\\_operations\\_999.html](https://www.spacewar.com/reports/Coalition_Partners_US_and_UK_agree_to_share_technical_foundation_for_space_operations_999.html)

26 'Menwith Hill'. Yorkshire Campaign for Nuclear Disarmament. <https://yorkshirecnd.org.uk/campaigns/menwith-hill/>

27 'Combined Space Operations Vision 2031'. Ministry of Defence, 22 February 2013. <https://www.gov.uk/government/publications/combined-space-operations-vision-2031>

28 Gareth Jennings: 'NATO to found Space centre of excellence'. Janes Defence News, 5 February 2021. <https://www.janes.com/defence-news/news-detail/nato-to-found-space-centre-of-excellence>

'UK Space Command officially launched'. Ministry of Defence and Jeremy Quin MP, 30 July 2021. <https://www.gov.uk/government/news/uk-space-command-officially-launched>

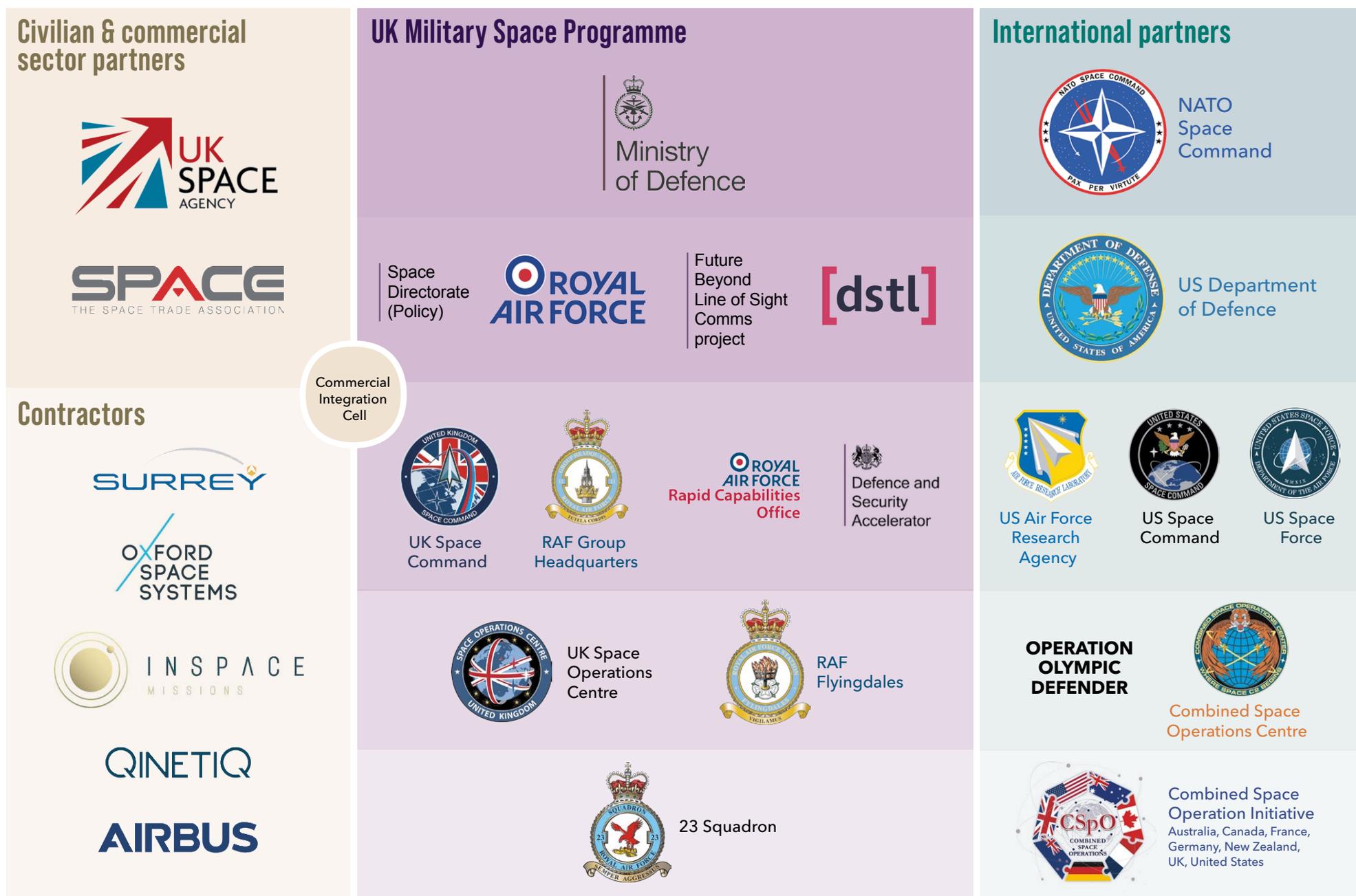
Space activities are usually presented to the public as having significant commercial value and the promise of creating new jobs, but behind the positive spin, the military dark side is always present. Space operations are often useful to both commercial and military sectors and UK Space Command works with the UK Space Agency, when required, to deliver joint national space capability. UKSpace, the trade association of the British space industry, works closely with the RAF through the Commercial Integration Cell at the MoD's Space Operations Centre in High Wycombe<sup>23</sup>. A similar set up in the US sees the Space Force and the Combined Space Operations Centre at Vandenberg Air Force Base working to improve interoperability between member nations of Operation Olympic Defender. Olympic Defender was established to build international partnerships to 'deter adversaries and hostile acts in space' and the UK was the first to join the programme in 2019, seconding eight UK personnel to Vandenberg.<sup>24</sup> The UK was also the first to gain access to the US Space Force's Standardized Astrodynamics Algorithm Library (SAAL) which contains information to help predict the locations and trajectories of satellites and objects in orbit. Access to SAAL enables the streamlining of multinational military operations across the globe and will also increase the ability of the UK Space Operations Centre to collaborate and share data with the US Space Force.<sup>25</sup>

Not surprisingly, the MoD works closely with US forces on space issues. Menwith Hill, the huge US National Security Agency base near Harrogate in North Yorkshire, has operated as a down link station for US signals intelligence and surveillance satellites since the 1970s. It operates as part of the Five Eyes alliance and supplies US and UK intelligence agencies with information used to identify low-visibility targets and inform the use of special forces and remote control technologies such as drones.<sup>26</sup>

The UK is also represented at the NATO Space Centre at Ramstein Air Base in Germany, and UK Space Command carries the UK's commitment in the Combined Space Operations initiative, comprising of seven nations: Australia, Canada, France, Germany, New Zealand, UK and the US. The initiative seeks to "promote the free, responsible, and sustainable use of space, while upholding national sovereignty and international law"<sup>27</sup> by improving cooperation, coordination, and interoperability opportunities between the partners in space.<sup>28</sup>

Although the UK is not currently developing its own anti-satellite capabilities, in February 2021 senior officials told the Daily Express that British pilots are training to use American anti-satellite weapons on British aircraft. The newspaper report claimed that "...pilots have been selected for training missions aimed at combating Chinese and Russian military and communication satellites in times of war.

Figure 3: Key units in the UK military space programme



29 Marco Giannangeli: 'Britain's Space Command training to send fighter jets to space to destroy enemy satellites'. Daily Express, 21 February 2021. <https://www.express.co.uk/news/world/1400652/space-latest-command-britain-fighter-jet-enemy-satellites>

30 Jonathan Beale: 'US wants giant radar in UK to track space objects'. BBC News, 16 July 2021. <https://www.bbc.co.uk/news/uk-57866734>

31 Courtney Albon: 'US Space Force awards contract for deep-space radar'. Defense News, 23 February 2022. <https://www.defensenews.com/battlefield-tech/space/2022/02/23/us-space-force-awards-contract-for-deep-space-radar/>

32 Ibid.

Simulated exercises are set to get under way before flying training exercises take place. Training flights without missiles would see Typhoon pilots fly to 40,000ft before embarking on a 20,000ft vertical climb. During a real-life attack they would target enemy satellites and release anti-satellite (ASAT) missiles at 60,000ft, before returning."<sup>29</sup>

## The DARC side

As the number of objects in orbit increases, growing importance is being attached to surveillance of the space domain. Developing 'space domain awareness' is important for both civil and military space programmes, and involves the detection, tracking, and identification of objects in orbit, including active and inactive satellites, spent rocket bodies, meteorites and fragmentation debris.

Space domain awareness requires charting the position of space objects and plotting their expected orbits. This is of assistance for:

- Predicting when and where an object in a decaying orbit will re-enter the Earth's atmosphere.
- Detecting new human-made objects in space and maintaining a catalogue of man-made space objects.
- Determining who owns and is responsible for a re-entering space object.

In addition, space domain awareness supports a number of military functions:

- Identifying whether space objects may interfere with satellites in orbit.
- Preventing a returning space object from triggering a false alarm in missile-attack warning systems.
- Providing data for potential anti-satellite weapons systems.

In July 2021 the BBC reported that the US wants to locate a giant new radar in the UK, part of a global system to track objects in deep space.<sup>30</sup> The US Space Force is developing the system to identify potential threats to satellite and debris in areas of deep space where a lot of military satellites are positioned. US Space Force hopes to build three radar bases around the world, with one potentially in Scotland or the south of England, and at other sites in the USA and the Indo-Pacific region. The system would be an enhancement to current space surveillance systems which include the powerful radar at Fylingdales in North Yorkshire. The new 'Deep Space Advanced Radar Capability' (DARC) system will be able to 'see' much further into space than Fylingdales, and can reportedly detect an object the size of a football up to 36,000 km away. Its purpose is to "detect, track, identify and characterize objects in GEO to protect and defend our most valued space assets against adversarial action."<sup>31</sup>

In February 2022 the US Space Force awarded Northrop Grumman a \$341 million contract to develop the first of the three DARC radar sites. The site will be located in the Indo-Pacific region, with a more precise location yet to be determined, and is scheduled for delivery in 2025. Development of the second site is expected to begin in 2024 and the third in 2025.

DARC's space domain awareness capabilities will join a broader network of in-orbit and ground-based sensors and radars that provide US Space Force with a picture of the space environment. Unlike the existing network, which is said to be susceptible to adverse weather conditions, DARC is intended to provide all-weather, 24/7 coverage of objects in geosynchronous orbit. DARC is also intended to be "resilient against contested space operations".<sup>32</sup>

33 'UK Space Command'. Royal Air Force. <https://www.raf.mod.uk/what-we-do/uk-space-command/>

34 'Defence Procurement Minister launches Defence Space Strategy'. Ministry of Defence and Jeremy Quin MP, 1 February 2022. <https://www.gov.uk/government/speeches/defence-procurement-minister-launches-defence-space-strategy>

RAF Fylingdales in North Yorkshire, which is operated by UK Space Command, provides a ballistic missile early warning service to the UK and US Governments. The Solid-State Phased Array Radar at Fylingdales is a joint enterprise between the US and the UK. This three-faced radar provides 360° coverage within the space surveillance network and can track objects the size of a drinks can 3,000 miles into space. Fylingdales is the leading contributing sensor for the UK's space domain awareness network along with other ground based and in-orbit sensors and telescopes. As part of the Allied Space Surveillance Network, it monitors objects re-entering the atmosphere as part of the US ballistic missile defence system.<sup>33</sup>

The national Space Operations Centre (SpOC) within UK Space Command, operating in partnership with the UK Space Agency, has the role of helping to enhance space domain awareness and track objects and activities in space. The MoD has allocated £85 million to further develop its space domain awareness capabilities, allowing for development of the capabilities provided by Fylingdales and further collaboration with US and Australian partners on the DARC programme.<sup>34</sup>

# UK spaceports – supporting the further militarisation of space

<sup>35</sup> The government has provided two separate grants to Lockheed Martin: £13.5 million to establish launch operations on Unst and £10 million to develop an orbital manoeuvring vehicle for deployment of small satellites.

'Lockheed Martin and Orbex to launch UK into new space age'. UK Space Agency, Department for Transport, Civil Aviation Authority, and The Rt Hon Greg Clark MP. 16 July 2018. <https://www.gov.uk/government/news/lockheed-martin-and-orbex-to-launch-uk-into-new-space-age>

'Lockheed Martin and Virgin Orbit'. Parliamentary Question UIN HL2257, tabled on 21 July 2021. <https://questions-statements.parliament.uk/written-questions/detail/2021-07-21/HL2257>

<sup>36</sup> 'First' commercial rocket launched from Scotland'. BBC News, 31 August 2018. <https://www.bbc.co.uk/news/uk-scotland-highlands-islands-45367640>

<sup>37</sup> 'UK space launch startup Orbex raises \$24 million for its reusable rockets', Yahoo! News, 10 December 2020. <https://uk.news.yahoo.com/uk-space-launch-startup-orbex-122638975.html>

<sup>38</sup> 'Spaceport Cornwall still on course for Virgin Orbit rocket launch in 2022'. Cornwall Live, 21 Jan 2022. <https://www.cornwalllive.com/news/cornwall-news/spaceport-cornwall-still-course-virgin-6503227>

<sup>39</sup> 'Spaceport Alliance'. Space Scotland. <https://scottishspace.org/spaceport-alliance/>

Miniature satellites are relatively cheap to produce, launch and place in low earth orbit and are being increasingly deployed for commercial and military purposes. Government grants totalling nearly £40 million have been awarded to enable the launch of small satellites from locations in the UK, and Lockheed Martin has received £23.5 million to take forward plans to launch satellites from UK spaceports.<sup>35</sup> Scotland is well positioned geographically for the launch of satellites into orbits suitable for communications and earth observation, and rockets were intended to be launched from Scotland by 2022. The Edinburgh based company S kyrora Ltd carried out the first successful test launch of its Skylark nano-rocket from the Scottish Highlands in August 2018 and is keen to become the go-to UK launch company<sup>36</sup>.

The UK Space Agency is currently supporting the development of three space launch sites in the UK. The proposed sites for these spaceports are as follows:

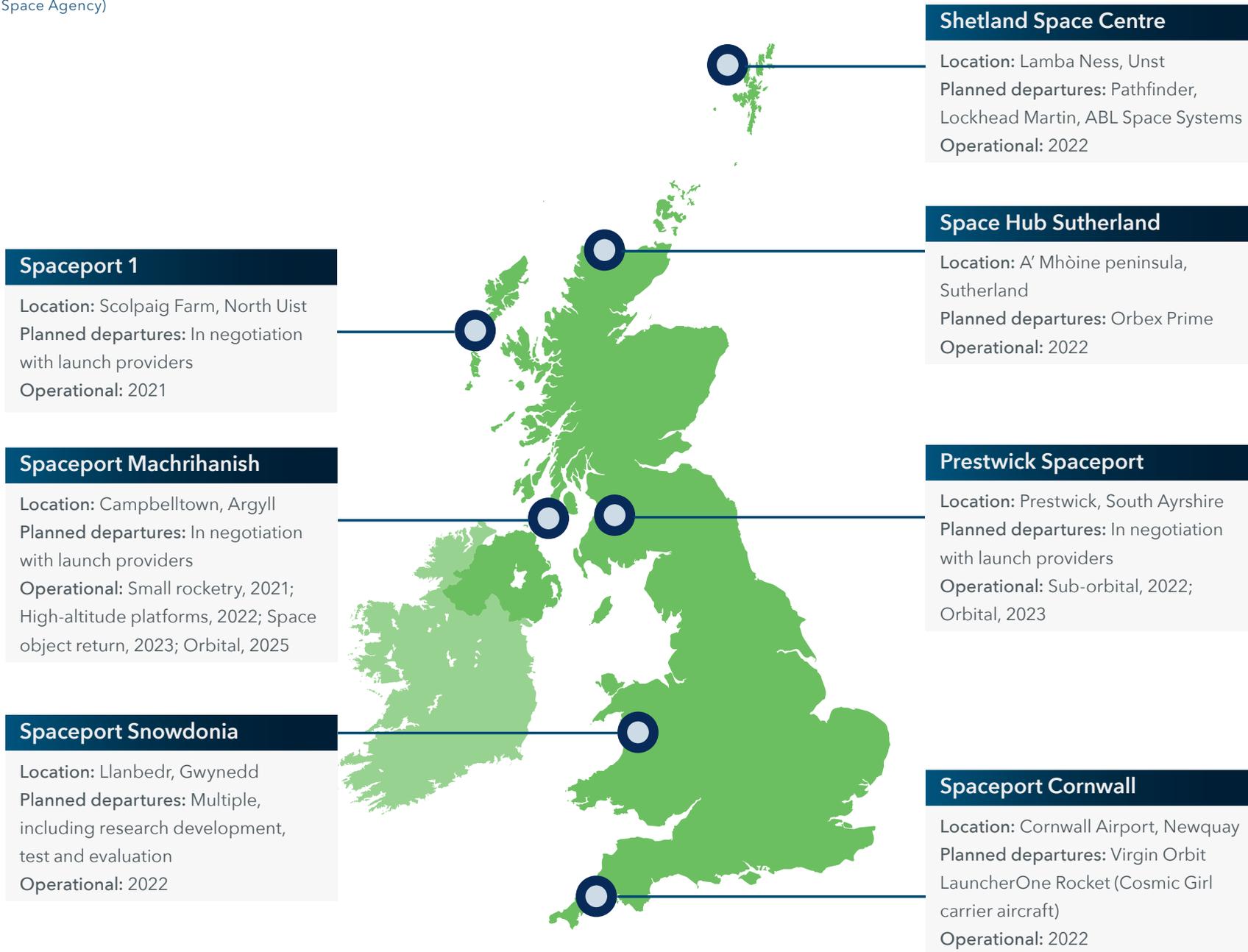
- SaxaVord Spaceport (previously known as Shetland Space Centre) – Unst, Shetland Islands.
- Space Hub Sutherland – Sutherland.
- Spaceport Cornwall – Newquay Airport, Cornwall.

Various other sites for the development of space ports in the UK have also been proposed (see Figure 4). The SaxaVord Spaceport is being developed by Lockheed Martin, the world's largest arms company, for vertical launch operations. Space Hub Sutherland on the A'Mhoine peninsula is backed by Highlands and Islands Enterprise, the UK Space Agency and the Scottish private launch services company Orbex, who have already secured contracts for six launches of its 'Prime' vertical launch vehicle from the site<sup>37</sup>. Virgin orbit is planning to use the Newquay airport spaceport for a horizontal launch service, in which its LauncherOne rocket is launched from under the wing of an airborne Boeing 747 aircraft.<sup>38</sup>

There are plans for more spaceports in Scotland in the Outer Hebrides and at Prestwick and Argyll. All of these spaceports have joined together under the Scottish Space Leadership Council to form the Spaceports Alliance<sup>39</sup>, and other UK spaceports planned for Cornwall and Wales also look likely to become members of the Alliance in the near future. These moves have been promoted by Highlands and Islands Enterprise and the UK Space Agency and welcomed by Scotland's Minister for Trade, Investment and Innovation. The UK Space Agency sees the Shetland spaceport as boosting the UK's plans for becoming the

**Figure 4: Map of UK showing locations of proposed spaceports.**

(Credit: UK Space Agency)



40 Tim Robinson: 'UK Defence Space Strategy finally blasts-off'. Royal Aeronautical Society, 4 Feb 2022. <https://www.aerosociety.com/news/uk-defence-space-strategy-finally-blasts-off/>

41 George Block: 'Rocket Lab: Peter Beck defends spy satellite work, ex-director speaks of leaving'. Stuff, 28 July 2020. <https://www.stuff.co.nz/business/300063842/rocket-lab-peter-beck-defends-spy-satellite-work-ex-director-speaks-of-leaving>

42 Rob Edwards: 'Spy satellites destined for Scottish spaceports'. The Ferret, 6 September 2020. <https://thoferret.scot/spaceports-scotland-military-spy-satellites/>

"European small satellite launch destination of choice" and exploiting the UK specialism in the development of small satellites.

Although launches from the spaceports will be undertaken by commercial companies, it appears that many of them will be for military or dual use purposes. The MoD envisages that its planned network of future satellites could be dual use, undertaking commercial civilian tasking during normal times but reverting to military use in the event of a crisis.<sup>40</sup> Space use has evolved into a fuzzy military/commercial collaboration. In New Zealand the

Rocket Lab spaceport on the Mahia peninsula spaceport, which its founder said in 2008 would not undertake military work, has since been mostly used for military launches, including launches of US spy satellites.<sup>41</sup> The change reportedly prompted Mark Rocket, one of the original investors in Rocket Lab, to pull out of the project in 2011. Arms companies have played a leading role in the Scottish Space Leadership Council, with Leonardo, Raytheon, BAE Systems, and Chemring Energetics UK all represented on the Council, which is chaired by Leonardo's John Innes.

According to Alexandra Stickings, a space policy and security analyst at the Royal United Services Institute think-tank in London, the Shetland and Sutherland spaceports will need military contracts to be viable. "I am of the opinion that the proposed spaceports would need the MoD as a customer to survive as well as securing contracts with companies such as Lockheed," she said. "Militaries are likely to want to diversify their launch capabilities, so the Scottish locations could provide an option for certain future missions." She warned that: "There is also a possibility that if these sites become a reality, there will be pressure on the MoD to support them even if the cost is more than other providers."<sup>42</sup>



# Space governance and its challenges

The Outer Space Treaty “on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies” was developed at the United Nations in 1967.<sup>43</sup> The treaty recognises outer space as a Global Commons to be used for peaceful purposes, stating that: “the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all [hu]mankind.” It was an attempt to prevent “a new form of colonial competition” and the possible damage that self-seeking exploitation might cause, although these ideals are not without practical difficulties.

However, economic dependency on space and the rapid development of space technologies are now running out of control. Military domination, commercial competition and money have become controlling factors and we are experiencing a ‘Tragedy of the Commons’, where major users with open access to space and who are unconcerned about any rules that govern access and use, are acting according to their own self-interests and contrary to the common good of all.

The Outer Space Treaty and other treaties that govern behaviour in space date back to the 1960s and lack enforcement mechanisms. Much has changed since they came into force, and there is now less of a consensus than

there once was about the rules and norms governing outer space and what to do if they are not followed. The increased presence of the private sector in space also needs to be addressed. At present there is a serious governance and collective action problem to address if space is to remain a Global Commons. Existing treaties need to be supported and new measures need to be developed to address the new situation, and a new set of rules for space behaviour is needed.

A positive step forward would be negotiation of a treaty for Prevention of an Arms Race in Outer Space (PAROS) which would build on the Outer Space Treaty and would prevent any nation from placing objects carrying any type of weapon into orbit.

<sup>43</sup> United Nations Office for Outer Space Affairs: ‘Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies’. <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html>

# Conclusion and recommendations

The militarisation of space endangers global peace and security, betrays contempt for decades of arms control efforts, and will inevitably contribute significantly to a new arms race. Wars may not begin in space or be decided by what happens in orbit alone, and space technology, for all its glamour, is not going to provide simple solutions to long-standing strategic problems relating to relationships between nations. On the other hand, the risk of misinterpreting a complex and unforeseen situation in space may have the potential to escalate into a serious crisis. As Beyza Unal from Chatham House has pointed out, there is a lot at stake: "Irresponsible behaviour and disregard for the rules of outer space, especially when there is universal agreement on what those rules should be, endanger not only the space-based assets on which we all depend, but also the global system of international peace and security".<sup>44</sup>

Drone Wars UK make the following recommendations to address some of the current gaps in space policy.

- **More public discussion and debate is needed about the commercial and military use of space and its benefits and downsides.** At present decisions with significant implications are being made by a small elite of wealthy entrepreneurs and government policymakers. Journalists and non-government organisations should scrutinise space policy in greater detail and help the public look critically at policy decisions, rather than just regurgitating announcements by government and corporations.
- **The UK Space Agency and Ministry of Defence should develop codes of good ethical practice for their space operations and associated ground based developments.** There should be wide consultation with the public and interested stakeholders, including civil society, in developing these codes. A formal ethical assessment should be undertaken at an early stage as part of the development of space projects, with external scrutiny and input from affected communities and outside experts.
- **Further research into the environmental effects of space operations, both short term and long term and on earth and in space, is needed.** The UK Space Agency should fund an independent research programme to identify and investigate such impacts.

<sup>44</sup> Beyza Unal: 'Responsible behaviour in outer space protects everyone'. Chatham House, 5 March 2021. <https://www.chathamhouse.org/2021/03/responsible-behaviour-outer-space-protects-everyone>

Artist's impression of MoD's planned 'Titania' satellite  
(Credit: Ministry of Defence)



- **The UK Space Agency should not provide funding or support for projects where high ethical and environmental risks can be foreseen**, such as nuclear space propulsion.
- **Meaningful environmental impact assessments, including a space impact assessment, should be conducted** before the development of spaceports and other major ground based infrastructure projects are approved. Local and affected communities should be involved in the governance and operation of such sites.
- **The UK government should continue work to promote responsible behaviour in space, whilst ensuring its own conduct in space is beyond reproach.** The government should support the early negotiation of a PAROS Treaty and lobby the US administration to support such a move. The government should give an unambiguous commitment to reaffirm that space must be a global commons and reserved for peaceful and sustainable uses, and must not become a war fighting domain.

# Glossary

<b>ASAT</b>	Anti-satellite
<b>CD</b>	Conference on Disarmament
<b>DARC</b>	Deep Space Advanced Radar Capability
<b>DASA</b>	Defence and Security Accelerator
<b>DSTL</b>	Defence Science and Technology Laboratory
<b>FBLOS</b>	Future Beyond Line of Sight communications
<b>GEO</b>	Geostationary Orbit
<b>GPS</b>	Global Positioning System
<b>HD</b>	High Definition
<b>ISR</b>	Intelligence, Surveillance and Reconnaissance
<b>MoD</b>	Ministry of Defence
<b>NASA</b>	National Aeronautics and Space Administration
<b>NASOC</b>	National Air and Space Operations Centre
<b>NATO</b>	North Atlantic Treaty Organisation
<b>OST</b>	Outer Space Treaty
<b>PAROS</b>	Prevention of an Arms Race in Space
<b>PPWT</b>	Prevention of the Placement of Weapons in Outer Space Treaty
<b>PSCA</b>	Pacific Spaceport Complex - Alaska
<b>RAF</b>	Royal Air Force
<b>SAAL</b>	Standardized Astrodynamics Algorithm Library
<b>SpOC</b>	Space Operations Centre
<b>SSTL</b>	Surrey Satellite Technology Limited
<b>UK</b>	United Kingdom
<b>UN</b>	United Nations
<b>UNCOPUOS</b>	United Nations Committee on the Peaceful Uses of Outer Space
<b>US</b>	United States



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on military drones

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