

# HOW SPACE DATA IS KEEPING THE UK SAFE:

Why Off-Planet Capabilities  
are Critical to UK Defence



**WIRED**

 Microsoft

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**he influx of private capital and entrepreneurial thinking** has radically transformed the space domain over the past decade.

Some of the changes that have come to commercial space have captured global attention. Early forays into space tourism have been bankrolled by the super-rich, with lucky ticket-holders being revealed to the public with much fanfare.

But most of the sweeping transformation has occurred with considerably less attention from the world's press. Hundreds, and then thousands of satellites have been launched into space in recent years. According to US-based space and technology analysis firm BryceTech, this growth is fuelled by a multitude of different companies, with more than 1,700 units launched between 2012 and 2019. Planet is one such company driving this growth – since its first satellite launch in April 2013, it has grown its constellation of small Earth-observing satellites to more than 200 active spacecraft. The company now images the entire land mass of Earth, every single day. And it is just one of many commercial providers selling a dizzying array of data.

“It once took a billion dollars to build and launch a constellation of satellites,” said Steve Kitay, senior director of Azure Space at Microsoft. “In some cases, that

**“Companies like SpaceX, Blue Origin, Rocket Lab and Virgin Orbit are bringing down the cost of launch. It makes space accessible to everyone”**

**Air Vice-Marshal Paul Godfrey, OBE**  
First commander of United Kingdom Space Command



# The Evolution and Importance of Off-Planet Capabilities

**The commercial space ecosystem is becoming more vibrant every year**

can now be done at a much lower cost because of private sector advances, which are enabling more companies and organisations to get involved in space and leverage its benefits.”

Affordable satellite construction and reduced launch costs have led to the rapid expansion of small satellite constellations. Satellites have become smaller as their electronics have undergone miniaturization. This, in turn, has decreased their power consumption while often increasing their observational capabilities.

Such innovation has led to expanding telecom capacity, significant increases in the resolution of commercially available satellite imagery, and detailed observations across the spectrum. And, as the number of satellite launches have increased, so too has the volume of data transmitted to and from space. This, in turn, has driven the need for increasingly capable software to manage the flow of data and, more importantly, to make sense of it.

As Artificial Intelligence has advanced, it too has gone to space. This data analysis is happening both on the ground and off-planet. “These remote-sensing constellations are generating huge amounts of data,” said Kitay. “So, it’s not just a good idea but necessary to do much of the satellite processing using AI or an algorithm. This identifies the data most important to you, which is then sent to Earth for further processing.”

Even so, there is now an avalanche of data cascading back to the planet. As companies collect observations, seeking to sell them to commercial and government customers, the question becomes how can those customers access the data they need, when they need it?

So, what is to be done? The rise of new space hardware, in the form of less expensive rockets, lower-cost satellites and in-space connectivity, has necessitated innovation in software to both manage data and deliver it securely.

**Above: the space economy is rapidly changing**

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or nations and their defence agencies, this new data presents both challenges and opportunities. This is something Kitay understands, having served as the US Deputy Assistant Secretary of Defense for Space Policy from 2017 to 2020 before joining Microsoft. "It's a tremendous opportunity for the UK Ministry of Defence and its allies to use innovative capabilities to assist their missions," Kitay said.

Historically, militaries have used space to observe countries and independent actors' activities, command and control their defence systems, and communicate among their forces. This critical ability was often accomplished through expensive, vertically integrated satellite development and launch capabilities.

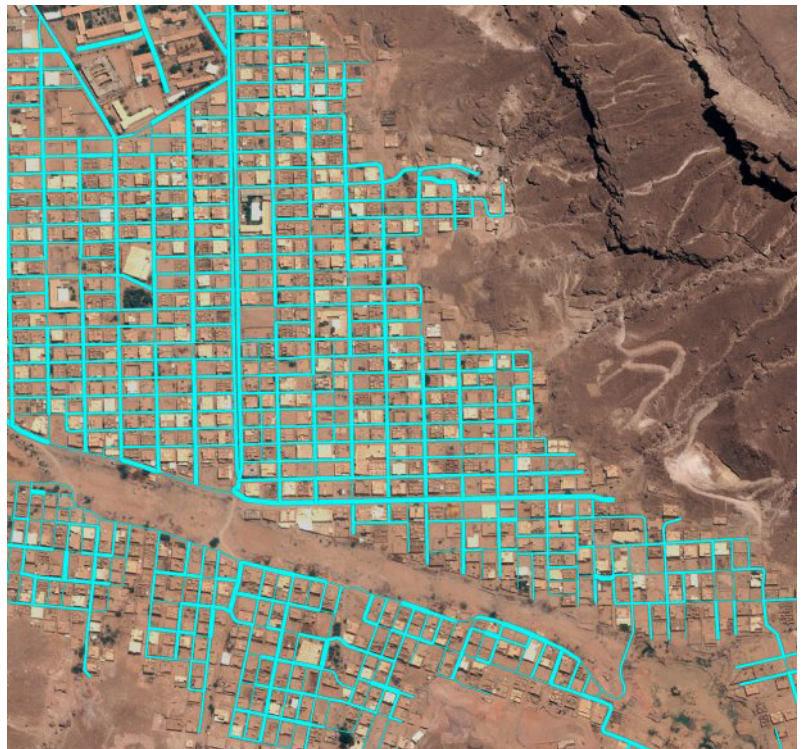
Commercial space is changing the game. Companies are stepping in with private funding, often but not exclusively raised through venture capital, to build their space capabilities on spec. Accordingly, national defence agencies must now decide whether to continue solely with the government's capabilities or to buy some services from the commercial sector.

"I believe that the future is hybrid architectures, leveraging commercial and government capabilities," Kitay said. "The government may have unique requirements for missile event warning satellites, for example. There may not be a commercial analogue to providing command and control and missile warning, but some systems can augment what they're doing to provide additional capacity, greater resilience and more systems in space so they're not reliant on a small number and leverage the rapidly accelerating technology." Essentially, the government wants tried-and-true

**Above: satellites can provide critical information**

# Commercial and Government: A Partnership Made in Space

**The future of space will fuse commercial innovation with government capability to create cutting-edge systems based on hybrid architectures**



systems it knows it can rely on, but it also needs to tap into the commercial sector's vibrancy and leverage the private investments that are being made in space.

This also presents a challenge, because some of the observational capabilities once solely available to nations are now available from private companies.

"It creates a level of transparency, both in space and on the ground, for governments to be aware of, and change or modify their operations as appropriate, recognising the high number of systems always watching what's happening around the globe," Kitay said. "So that's something they understand, and they're taking steps to ensure they're prepared."

Air Vice-Marshal Paul Godfrey, first commander of United Kingdom Space Command, is among those navigating this rapidly changing environment. Even as new space companies were expanding business opportunities in low-Earth orbit in recent years, governments were formalising their recognition of space as a national defence domain. In 2019, the US established the US Space Force as an independent branch of the US military. That same year, NATO recognised space as a new operational domain, alongside air, land, sea and cyberspace.

The UK followed suit in April 2021, establishing Space Command and putting Godfrey into a leadership role. From what he has learned so far, Godfrey believes





the opportunities heavily outweigh the challenges for national defence.

“There’s a real opportunity with companies like Blue Origin, Rocket Lab and Virgin Orbit lowering launch costs, which makes space accessible to more people,” Godfrey said.

Perhaps the biggest challenge is that of developing a strategy flexible enough to bring all the new ideas of commercial space, and its advancements, into the UK space programme. Finding ways to connect to those commercial systems, and make sense of the new data, is key to his new position, Godfrey added.

Governments are starting to have some success with merging commercial and proprietary data, including in areas formerly seen as exclusive to government assets. Even systems including early missile warnings are changing as a greater number of commercial companies offer services and the information is processed in real time.

As part of a recent agreement between Microsoft and Ball Aerospace, the two companies demonstrated cloud processing capabilities on the ground to support US Space Force. Telesat satellites relayed infrared data typically associated with missile launches or similar events and transferred it to Microsoft’s cloud computing service, Azure.

**Above:  
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accelerated**

That data was also sent to a tactical vehicle equipped with Azure Stack Edge, essentially an AI-enabled device that connects to Azure services. Both services then used machine learning to process the images, detect certain activities, and disseminate relevant information to multiple users.

With this programme, Microsoft and Ball seek to capture, process and produce actionable information five times faster than current speeds. The companies also plan to showcase the power of building this “infrastructure” as code within the Azure cloud computing platform.

One strength of this approach is that a cloud-based network could not only assess data from Telesat satellites but also from other commercial satellites. As a result, data from multiple providers could be knitted with a country’s classified assets to provide more holistic coverage. For example, one satellite company might offer higher-resolution synthetic aperture radar data for one continent, while another company offers better optical imagery, and so on.

In the United Kingdom, OneWeb is marketing such a service to governments. Now partly owned by the British government, OneWeb is currently building a network of more than 650 satellites in low-Earth orbit which will deliver broadband internet around the globe.

“OneWeb is not focused on consumer applications – the network is built for enterprise applications,” said Dylan Browne, head of Government Services for OneWeb. “It’s built for Wi-Fi on aircraft, maritime vessels and cruise ships. There are a multitude of use cases, but it has some exquisite elements that support national security missions and in particular cloud computing in GovCloud or tactical cloud in the battlespace.”

Browne noted that hypersonic vehicles render conventional radar tracking less effective by several orders of magnitude because of their high closing velocity and the ionisation fields they create from hypersonic flights. One potential solution is to feed raw data sets from multiple detection sites into the cloud, and a tactical cloud on a vessel supported by Azure technology. OneWeb’s role is to keep this tactical cloud updated with low latency data, bringing in onshore cloud computing resources. From within this mesh of data on the vessel, which includes spatial awareness of commercial flights, shipping traffic and many other insightful sources of data, the cloud can process a tracking solution almost instantaneously.

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Head of Government Services, One Web



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**In 2020, Microsoft took the leap to invest** in bringing cloud computing into space. The goal is not to build the best satellites or collect the best data about planet Earth. Rather, Microsoft seeks to become the connective tissue between space and the ground, a conduit for getting the right data to the right people at the right time.

There is not only a proliferation of satellites and data but also an unprecedented ability to move data around the planet instantly. With broadband internet constellations such as OneWeb, as well as SpaceX and its rapidly growing Starlink network (Microsoft has a partnership with SpaceX to access this high-speed, low-latency broadband network to move data into and out of the cloud), data can move at speed from any point on Earth to another point through satellite links.

“Space is changing, and technology is really propelling us forward,” Kitay said. “Microsoft is getting involved in space because new frontiers are opening. Microsoft recognises the importance of this domain to both our public and private sector customers. Microsoft’s mission is to empower every person and organisation – both on and off the planet – to achieve more. We are taking a strong, differentiated partnership approach to enable an ecosystem.”

Recognising the innovation in orbit, Microsoft has sought to bring its expertise in software and cloud computing to facilitate other space companies in this sector. And one of the most vibrant areas for this is in Europe and the United Kingdom, said Jeremy Poulter, a former Royal Air Force navigator and now a London-based solutions director at Microsoft for Defence and National Security.



## Innovation in Orbit: Shifting the Cloud to Space

**The boundaries between Earth, space, and cyberspace continue to blur**

“Space is becoming democratised, particularly things such as low-Earth orbit satellite communications, small sats and CubeSats, so the UK now realises that things previously out of reach, particularly if you rely on external launch capabilities, are suddenly possible,” Poulter said.

Poulter cited Virgin Orbit, founded by Virgin magnate Sir Richard Branson, as a leading example of this. The company’s LauncherOne rocket launched from a modified 747 aircraft, and it has a deal to launch from a spaceport in Cornwall, England. This offers both a lower cost of access to space and Britain the capability to launch its satellites from British soil.

Initiatives such as Virgin Orbit make space feel “closer”, Poulter said. And while the UK may not want a full-spectrum space programme like the US, its space leaders are keen to make the most of what they have. This means merging data from both commercial and military satellite sources. Microsoft views its role as helping the UK and other governments understand the convergence of these disruptive technologies, especially those traditionally seen as independent, such as launch, satellites, data collection, artificial intelligence, predictive analytics and internet connectivity.

“Our conversations are far more joined up, like how you can combine your battlespace tactical 5G with satellite communication and apply artificial intelligence on top of that to make better sense of the whole,” Poulter said. “Or even to combine that to hand off a satellite-based tracking solution through to

**Above:  
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an atmospheric-tracking capability. If all that is running in the same cloud infrastructure, that's a far easier handoff than going through vertical stovepipes."

As Microsoft works to make sense of these new technologies, it is partnering with an array of companies in the commercial space sector, from larger, well established ones such as SpaceX and OneWeb to smaller ones such as Preligens and Swim.ai. Essentially, Microsoft is pushing toward the virtualisation of space, with software defining future space-based capabilities through the disaggregation of supply chains.

In the 1990s, when Poulter served as a front-line Tornado F3 fighter navigator, space was "on the radar," particularly in terms of supporting broader situational awareness or communications. But it had little direct effect on flying long-range interceptor jets designed to detect intruding aircraft.

Godfrey, the new head of the UK Space Command, explained that he'd had a similar experience. He likened the evolution of technology in the cockpit to that of mobile phone technology.

"In the 1990s, on the Harrier jet I flew, it was a bit like the Nokia 3310," Godfrey said. "You can phone on it. You can text on it, although not until the late 1990s. You can maybe play a game on it."

Then, as Godfrey flew the F-16 fighter in the 2000s, such handsets evolved into Motorola flip-top phones with basic internet access. But still, when situational awareness data was fed into the cockpit, Godfrey had to fuse that information in his head to make decisions. The Typhoon fighter was a bit more like an early iPhone, he said, and the F-35 was like a modern iPhone.

"The F-35 is a fusion of all the data, so the airplane itself gives a single picture of the situational awareness, and you could combine all that into a helmet-mounted display," Godfrey said. "I think the progression into the future will be more and more about data, and the fusion of that data so that everyone sees the same picture. Ultimately, it's about increasing your decision-making speed."

Mobile phone technology and connectivity have rapidly evolved over the past two decades, from basic devices that simply make phone calls to powerful



pocket-sized computers. But now this revolution is expanding vertically, into space. One can be far from a cell tower but still have access to the power of the internet, the cloud and thousands of satellites watching the world.

As governments and their commercial partners continue to develop new capabilities and harness ever expanding volumes of data from space, ongoing disruption at the new digital frontier is inevitable – and this means that the opportunities for "new space" are immense. Humans may have launched into space for the first time more than six decades ago, but we are only just beginning to tap it, and its potential as a resource, here on Earth.

**Above: space is becoming more democratised**

# About Microsoft

Microsoft helps defence and intelligence agencies advance their missions to promote stability and security for citizens, nations and multinational alliances. We do this by focusing on trust, innovation, security and compliance, all powered by our extensive global partner ecosystem.

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