Space Solutions

Innovation in space for advantage on Earth



Digital Intelligence

BAE SYSTEMS

BAE SYSTEMS

Our space mission

Our mission in space is to deliver space-enabled solutions for security and prosperity.

Space has become crucial to our customers' current and future requirements. That's why our space strategy is focused on turning innovation into operational capability – combining our technical heritage with our experience in delivering large, complex defence programmes to add capacity and resilience to the UK's sovereign space offering.

We support defence and national security by driving multi-domain innovation from space to subsea – leveraging space assets to protect our critical infrastructure and way of life. We are also committed to powering economic growth, investing in our own space capabilities and in the UK supply chain to deliver for UK and international partners.





Operationalising innovation

We are combining our vast technical expertise with best practice methodologies and lifecycle management to put space innovation into the hands of operators



Connecting domains

We enable multi-domain integration and improve communication between land, sea, air, cyber and space. Our dual-use technology can be used for military and civil purposes



Ecosystem approach

We forge partnerships, grow talent and harness specialist knowledge and capabilities from across the industry to deliver the most effective solutions while fostering a healthy space ecosystem



Space sovereignty

BAE Systems has been at the forefront of UK space innovation for 30+ years, with specialist technologies in waveforms, electronics, antennas, digital signal processing and analytics

Our core capabilities

We can help enable the digital backbone that will provide actionable intelligence at the edge. Our technology supports our customers' communications, intelligence, imaging and positioning needs in bold and innovative ways.

RF Missions and payload



RF Missions:
Delivering high-quality information and intelligence in near real-time from space to end users



Ground station expertise:
From our UK site, we have the ability to securely send and receive data to our satellites in orbit



Software-defined RF payloads:
Satellites that can be upgraded while in orbit for an enhanced lifespan and greater mission flexibility



Secure space:
Assured RF capabilities that connect domains while enabling space control, secure comms and operational effects

Data missions and services



Intelligence analytics:
Using machine learning and artificial intelligence to interpret data and deliver GEOINT and SIGINT solutions



ISR solutions:
Data platforms for collecting, processing and disseminating sensor data across multiple domains via an open architecture

Mission prime and systems integration



Small satellites:
High performance, secure and assured satellite platforms built on a modular and scalable architecture



Space operations:
Space mission delivery and in-orbit operations



Hosted payload service:
Making it easier and more cost-effective than ever to launch payloads into orbit



Low Earth Orbit satellite clusters:
Innovative multi-sensor systems that deliver a step change in ISR capabilities

Innovation in space is at the heart of achieving a

global, 360° perspective of Earth

Our space capabilities are

secured, assured and resilient



Azalea™



Azalea is our programme to launch a multi-sensor, multi-role satellite system with powerful RF capabilities into low Earth orbit. The Azalea concept involves gathering a wide range of data and analysing this information in-orbit, using on-board machine learning to deliver intelligence wherever it's needed.

The technology provided by Azalea will enable us to deliver advanced **Intelligence, Surveillance and Reconnaissance (ISR) capabilities.** The satellites will collect multiple sources of data - including wideband radio frequency and **Synthetic Aperture Radar (SAR)** - at one moment in time for a target scene. The system will provide a unique perspective, day and night and through cloud - giving military, civil or commercial users enriched information and insight for decision making.

We have the in-house capability to create and operate end-to-end space missions. We are also collaborating with and investing in the space ecosystem to develop Azalea. Through our open architecture, future Azalea clusters will be interoperable with different sensor types - such as electro-optical, hyperspectral and infrared - and allied nations' programmes.

Azalea Cluster I

The first Azalea cluster includes three satellites that fly in formation, each carrying the **BAE Systems Software Defined Radio (SDR),** known as Azalea Enhanced SDR, developed by BAE Systems.

The satellites are capable of gathering, analysing and securely communicating RF signals, with inter-satellite links and widebrand coverage providing a unique perspective of Earth.

RF Mapping

One example of Azalea's multi-role capability is **Radio Frequency (RF) Mapping.** This can be used to detect, identify and geo-locate radio signals from Earth over wide areas of interest across land and sea.

Satellite constellation capacity is tasked to collect RF signals and determine their location with high accuracy for a range of applications such as military threat detection or illegal shipping identification. This capability can then be used to tip and cue other assets to enhance intelligence.

Secure Space



With the space domain now crucial to Defence and National Security, assuring access to operate in, from and through space is vital. Our heritage in cyber security, secure communications, software defined radios and antennas makes us ideally positioned to protect and secure space systems.

We develop secure capabilities across four key pillars:

- **Space control:** supporting and enabling freedom of action in space, covering space domain awareness and space-based effects
- **Secure communications:** ensuring that all communications between satellites and ground systems are encrypted and protected
- **Effects:** leveraging space assets to enable operational effects on the ground, in the air, at sea or in cyberspace
- **ISR:** collecting and analysing RF signals to provide detection, geolocation and fingerprinting capabilities as part of multi-domain operations

As part of BAE Systems, **security is ingrained in our DNA** – enabling us to deliver assured solutions to help Defence and National Security customers deter threats, enhance the resilience of assets and infrastructure, and protect their interests in space.

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Space to Subsea



Central to our Secure Space offering is the ability to securely connect land, air, sea, cyber and space as part of a Multi-Domain Integration approach – thereby ensuring that intelligence gets to where it is needed for operational advantage.

This is enabled through active and passive regenerative RF capabilities over a very large area. Serving as the connective tissue across domains, the collection, analysis and secure distribution of RF data gives customers the insights to optimise the effectiveness and survivability of their assets and link operations from space to the seabed.

Data & Digital Insights



Space-based data collection is becoming increasingly crucial to a number of sectors. Using various different sensors, data collected from space can help to identify advanced threats - everything from illegal activity at sea, to missing people and suspicious activity amassing at a border.

Generating intelligence by combining space-derived data with analytics on the ground is at the core of our space offering. We follow an open data architecture approach and use a common language to describe geospatial information. This means customers and partners can access data on our platform in a standardised format, enabling it to be integrated into customers' systems or for applications to be developed and deployed on our platform. This increases system utility across multiple sectors.

Example use cases include:

- **Maritime intelligence:** overviews of port infrastructure and capacity using SAR and RF sensors; automatic detection and classification of vessels using AI and ML technologies; geo-location of RF emissions
- **Tracking illegal mining activity:** wide area overviews to detect areas of suspicious deforestation or land clearance; SAR imagery for change detection and machinery identification; the fusion of RF data to identify increases in RF transmissions
- **Global targeting and tracking:** 'fingerprinting' the unique electromagnetic signature from RF emitters to enhance tracking and surveillance capabilities

Hosted Payload Service



Our Hosted Payload Service is designed to provide 'Space as a Service' to customers by offering a reliable and cost-efficient route to orbit. This enables customers to focus on developing, demonstrating and testing payloads and business models while BAE Systems delivers and operates the satellite in space.

The missions fly multiple payloads for regional space players including government, commercial, financial, research and educational organisations.

Our 'turnkey' service includes payload development support, testing and integrating customer furnished items into satellite buses, procuring launch and insurance, commissioning, on-orbit operations, and securely disseminating data.

Hosted payload capacities

- Payload mass up to 60kg
- Payload peak power 200W
- Payload data downlink up to 1.5GB/day typical

For more information, contact **space@baesystems.com**

Satellite Platforms & Missions



We offer a high-performance, customisable and flexible mission architecture – delivering bespoke missions into defence, national security and commercial customers through a platform that is designed to meet performance and mission objectives.

Our open hardware architecture accommodates different standards, requirements and price points while our open software architecture can be modified depending on specific requirements.

- 5+ year mission lifetime
- Payload peak power up to 1KW
- Secure and assured platform

The platform can be used for a range of payload types and use cases including Earth observation, ISR and RF communications. Customers can choose a full end-to-end service from concept through to payload that includes payload operations support, satellite bus operations, payload tasking and download of data via a Customer Data Portal.

Customers can even choose to use our multi-vendor supply chain or their own to ensure best performance at the right price.

Innovative technologies



Tracking, Telemetry and Command Processor (TTCP)

- Our **Tracking, Telemetry and Command Processor (TTCP)** is next-generation technology for ground station signal processing. It offers high precision, is extremely fast and highly flexible and is designed to support current and future missions operating in near-earth and deep-space
- TTCP can communicate with spacecraft travelling away from the Earth at up to 180,00km/h
- Using stations positioned in key locations on the Earth's surface, TTCP can triangulate the position of spacecraft with an accuracy of 0.2 millionths of a degree
- The system can measure the distance of a spacecraft to within 10cm anywhere in the solar system
- The system can download information with data rates of up to 75 Mbps from 1.5 million km away

TTCP is playing a vital role in the European Space Agency's (ESA) Euclid mission. The spacecraft launched in July 2024 to expand our knowledge of dark energy and dark matter in the universe, with our TTCP technology allowing ESA to track the mission and receive data back from the spacecraft.

Software Defined Radios

The **Azalea Enhanced Software Defined Radio (SDR)** is a low Size, Weight and Power (SWaP) payload that can be integrated onto a wide range of platforms and is capable of supporting multiple operational applications. It leverages a range of advanced processing resources to:

- Collect RF data through multiple channels at high bandwidth
- Coordinate actions by utilising its Chip Scale Atomic Clock (CSAC) for precision time transfer and ranging
- Process data on-board using powerful digital signal processing and machine learning capabilities
- Disseminate the resulting intelligence to the end user through in-built RF communications interfaces

The SDR can be configured for a wide range of Cyber and Electromagnetic Activities (CEMA), with low and deterministic radio path latency. Multiple technical functions can also be implemented such as IQ record, RF geolocation, direction finding, specific emitter identification, protocol decode and advanced communications waveforms.

And, being remotely reconfigurable, the payload's operation can evolve over time to deliver enhanced lifespan and greater mission flexibility.

Our work in space



Empowering our armed forces

- We have built Titania, a small operational concept demonstrator satellite, for the Defence Science and Technology Laboratory (DSTL).
- The Titania mission will help give our armed forces the ability to operate in an increasingly contested environment

Faraday Phoenix hosted payload mission

- **Faraday Phoenix** was developed by In-Space Missions in less than eight months and was the world's first commercial rideshare satellite mission when it launched in July 2021 on Spaceflight's SXRS5 Transporter 2 mission from Cape Canaveral, USA
- The spacecraft carries payloads for six customers, as well as In-Space Mission's own Babel payload – the company's first incarnation of a future digital, uploadable payload offering

Supporting ESA's Jupiter mission

- Our TTCP technology - a powerful, multi-function tracking, telemetry and command system - is supporting the European Space Agency's **Jupiter Icy Moons Explorer** on its mission to observe Jupiter and its three large ocean-bearing moons
- It is providing vital uplink and downlink communication services. The uplink transmits commands to control the spacecraft, while the downlink receives Juice's spacecraft and sensor data
- This enables ESA operation centres to communicate with Juice, track its whereabouts in deep space, and receive crucial data that could enable the next scientific breakthrough

Taking Rosetta to comet 67P

- Our **Intermediate Frequency Modem System (IFMS)** gave the ESA the capability to communicate with and control the Rosetta probe on its mission to the Jupiter-family comet 67P/Churyumov-Gerasimenko
- IFMS was used to measure the position and speed of the spacecraft on its journey to comet 67P, as well as receive the signals from Rosetta to help produce the amazing images seen from the mission



Watch our video to learn more about our space capabilities

For more information

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We are Digital Intelligence

Digital Intelligence is home to over 4,500 digital, cyber and intelligence experts across 13 countries. We operate at the cutting edge of digital innovation and at the heart of organisations that keep vital infrastructure running, national security protected and armed forces prepared. Digital Intelligence is part of BAE Systems, which has a rich heritage in delivering technology today to protect our tomorrow. BAE Systems partners with governments, communities and companies large and small to design, build and maintain advanced defence and security solutions.

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