BOREALIS

Industry Day

12 July 2023

Housekeeping

- All questions asked via the Multi User email address: DESSpace-DT@mod.gov.uk will be shared with everyone

- Deadline for all questions will be 17:00, 26 July 2023

Commercial Disclaimer

- It should be noted that some elements of document are subject to change given this Industry Day is part of the early market engagement for Project BOREALIS .
- As part of the early market engagement the Authority is setting out its initial thinking on routes to market.
- Attendees should note that this presentation is setting out the Authority's early vision. The information shared does not represent a fully formed or finalised picture of the Project or any specific requirement.
- The aim of the Authority's early market engagement is to offer Industry the opportunity to hear from and engage with the Authority and to provide feedback on the initial proposals. It does not represent a formal commitment by the Authority to enter into any contractual arrangement and the Authority reserves the right to make changes as it deems appropriate, including to the intended routes to market following this briefing.
- Industry partners are responsible for their own costs for participating in this event.

Agenda

- Welcome & Introductions
- Background Information & Programme Overview
- Aims & Objectives of this Engagement
- Project Roadmap & Requirements
- Engineering Management
- Project Management
- Commercial Procedures

Opening Remarks

UK Space Agency: Space Surveillance and Tracking (SST)

Current SST Vision:

To reduce risk to UK civilian interests in space and on Earth from **re-entry**, **collision** and **fragmentation** incidents.

Key drivers:

- UK is currently 3rd biggest operator of satellites behind US and Russia
- National Space Strategy
- Defence Space Strategy

{ Civ/Mil - ensure a joined-up government Space Domain Awareness capability aka NSpOC

- Department of Science, Innovation and Technology
- UKSA priority: Space safety and sustainability

UKSA SST Operational Service

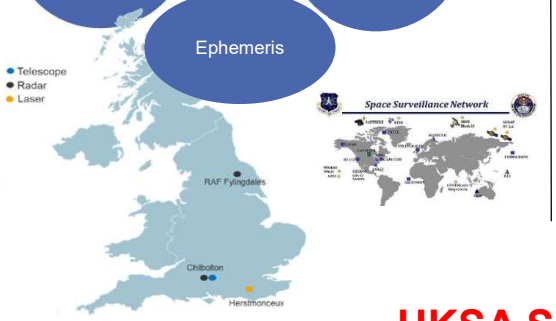
Observe

US Space Track

UK sovereign

Commercial Data

Ephemeris



Analyse

Orbital Analysts

Commercial /Specialist SDA Software

Aurora & Borealis

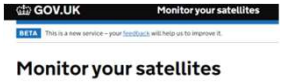
Alert

Govt Alerts

Industry Alerts

Licensing Compliance

1. Re-entry
2. Conjunction (collision)
3. Fragmentation

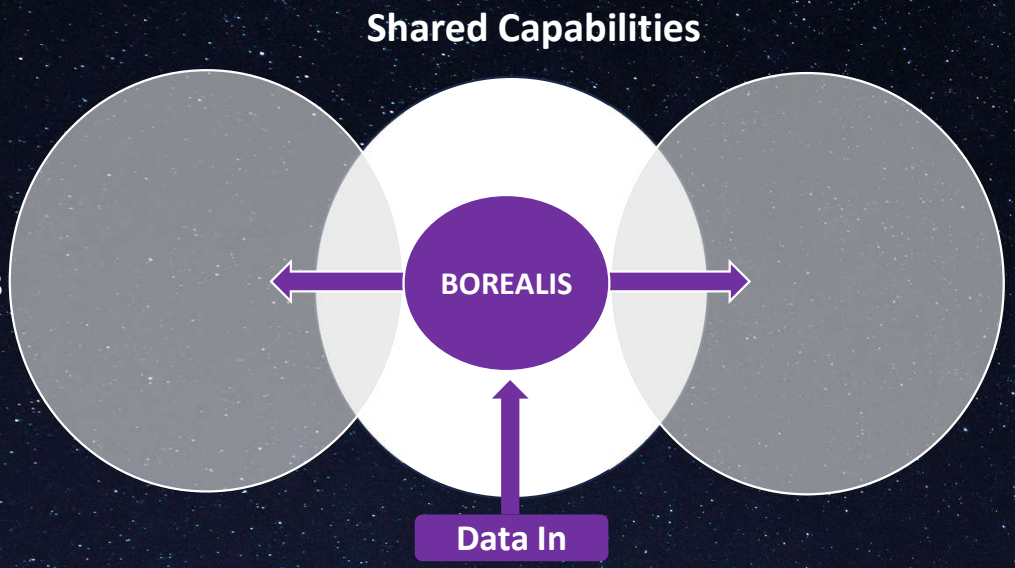


UKSA SST service runs 365 days a year

Programme Overview

National Space Operations Centre

- UK National Space Strategy: We will launch a National Space Operations Centre, fusing civil and defence expertise to monitor, protect, defend, and promote UK interests in Space.
- Draft NSpOC Mission Statement: The National Space Operations Centre will combine and coordinate civilian and military SDA capabilities to enable operations and protect UK interests from relevant space-related threats, risks and hazards.
- Outline NSpOC Concept:



Current UK Space Operations Centre

- Predominantly military pers although some UKSA embeds
  Numerous disparate systems at various classifications
- Many air-gapped/manual processes
- Unable to conduct full range of required missions and tasks
- Heavy reliance on the US
- Recent growth and evolution reaching limits of what can be achieved without investment
- 24/7 Ops Centre

- Rapidly Changing domain
  - Critical / Contested / Congested / Competed

Vision

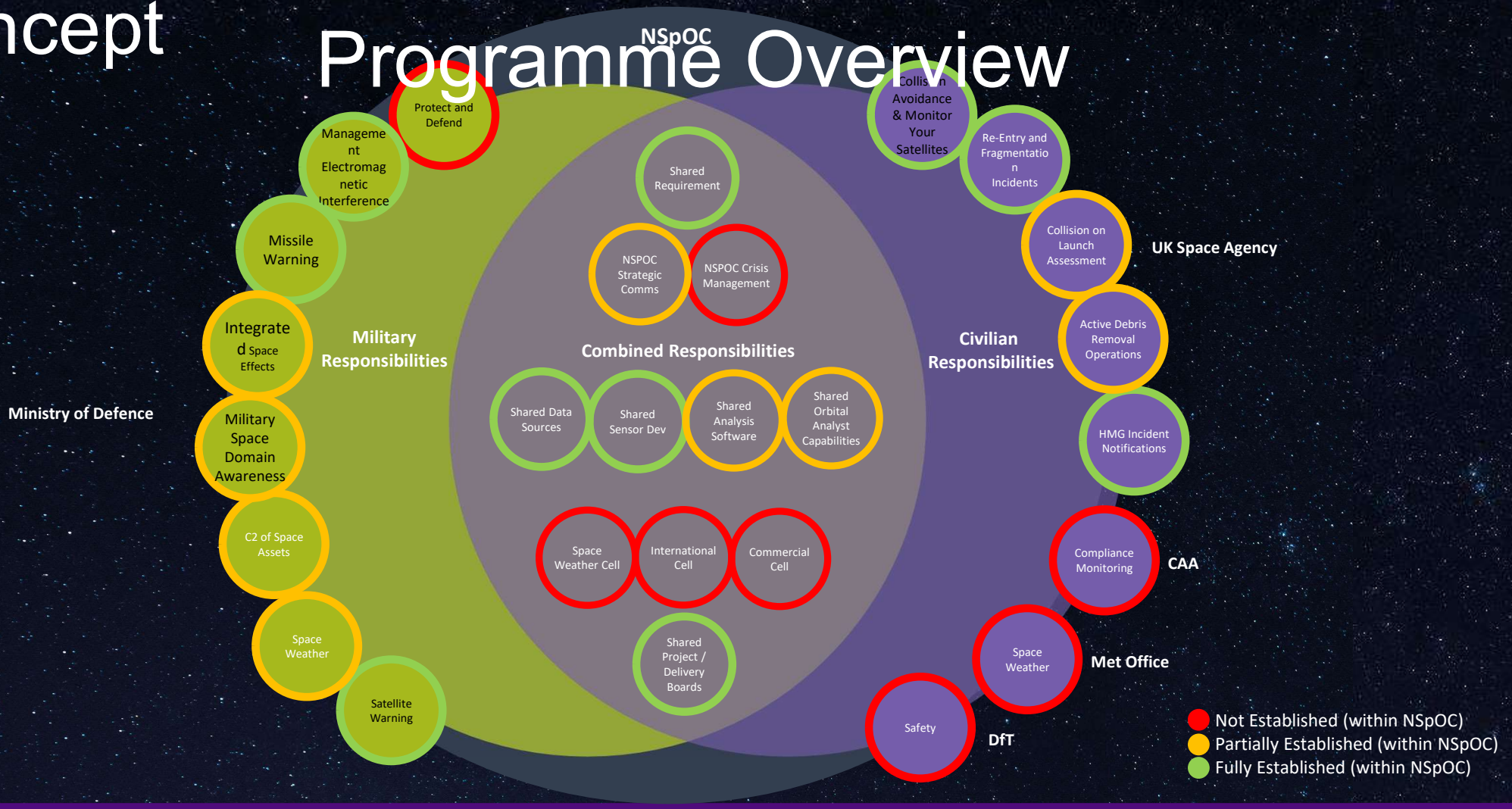
The National Space Operations Centre (NSpOC) Programme ASTERIA will develop and deliver a dual use civilian-military NSpOC in partnership with the UK Space Agency. The programme will generate Space Domain Awareness (SDA) and Space Command and Control (C2) to underpin all other Space Power roles and civilian operations.

Project BOREALIS will deliver the core software elements of Programme ASTERIA via an Agile methodology to achieve systems integration, maintenance of existing functionality and delivery of broader space domain awareness and C2 functions.

Operational capability is needed **now** therefore, an approach to acquisition which makes best use of balancing development of new software and utilisation of existing capabilities will be taken.

Concept

Programme Overview



National Space Operations Centre
Programme ASTERIA

FY20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31	31/32+

Programme ASTERIA

Form programme and programme team
Form and progress non-acquisition projects, with ABC Options / Business Cases as required

Continued programme governance and leadership of 'spiral development' activities

Project BOREALIS (Software)

★ Competition

- Develop initial AURORA
- Establish Project BOREALIS

Operate initial AURORA

Requirements capture and procurement

Agile delivery of BOREALIS software

Project: PANOPTES (Sensors and Data)

- CROSS-GOVERNMENT requirements
- System of Systems Design – OWN, COLLABORATE, ACCESS
- Dual-use Sensor procurement Overseas Territory
- Commercial Sensor Data Procurements
- DSTL Technology Development

Benefits

- **Protection of National Assets**
- **Resilient Cross-Government SDA**
- **Integrated Cross-Government Command and Control**
- **Efficient use of information**
- **Utilisation of Overseas territories**
- **Development and utilisation of UK expertise**

Ministry of Defence

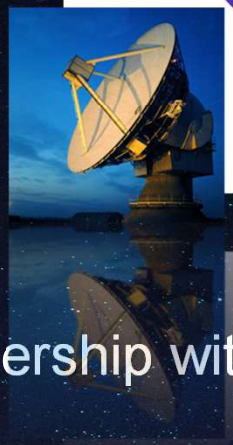
de&s

UK SPACE AGENCY

AURORA Capability to Date

- UK SpOC / UKSA SDA Tool
- Case management
- Orbital analysis
- Catalogue/database maintenance
- 2D/3D visualisation
- Sensor tasking

- Incremental delivery of capability
- Co-funded and developed in partnership with UKSA



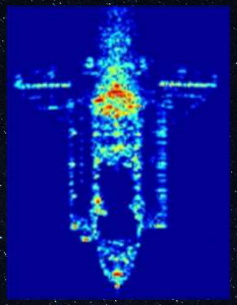
Project BOREALIS – NSpOC C2 System

"An IT system to deliver a national civil-military hub for trusted expertise and information to understand the space domain, conduct space operations and support timely decision making in collaboration with allies and partners in support of the UK's security and prosperity interests in space."

- Heart of NSpOC C2 System – Data engine across classifications
  – Modules for different functions
- Integration of disparate systems
- Incremental delivery of capability (Agile methodology)
- Continuation and evolution of existing capability
- Increased functionality for evolving mission set
- Integration of new and existing applications – bolt on third party apps
- 24/7 Ops Centre

Project PANOPTES – Sensors and Data

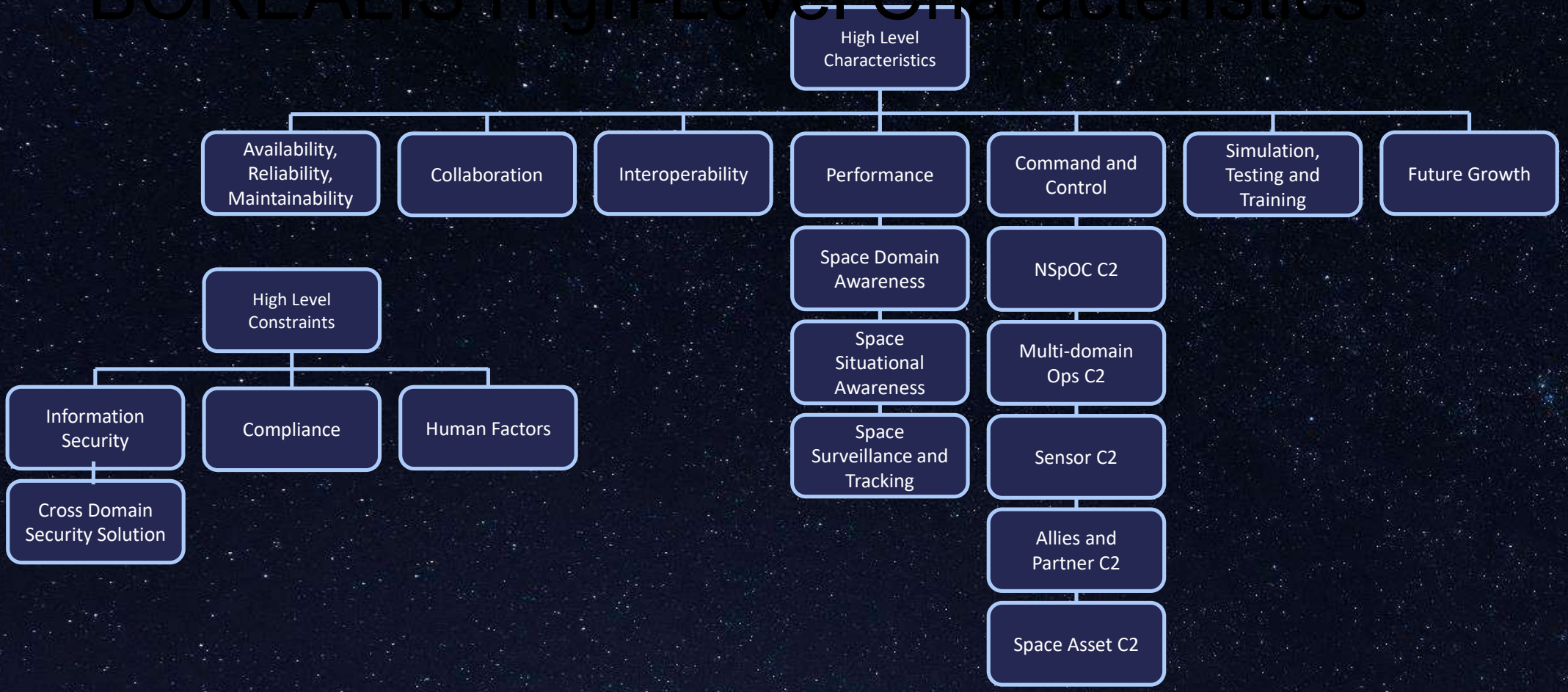
- Sensor/Data Project to feed BOREALIS
- System of Systems approach to SDA
- Range of options for sensors and data
  - From Commercial SST/SSA/SDA data to sovereign sensors
  - Own, collaborate, access
- Data will be ingested and processed within BOREALIS/associated bolt-ons



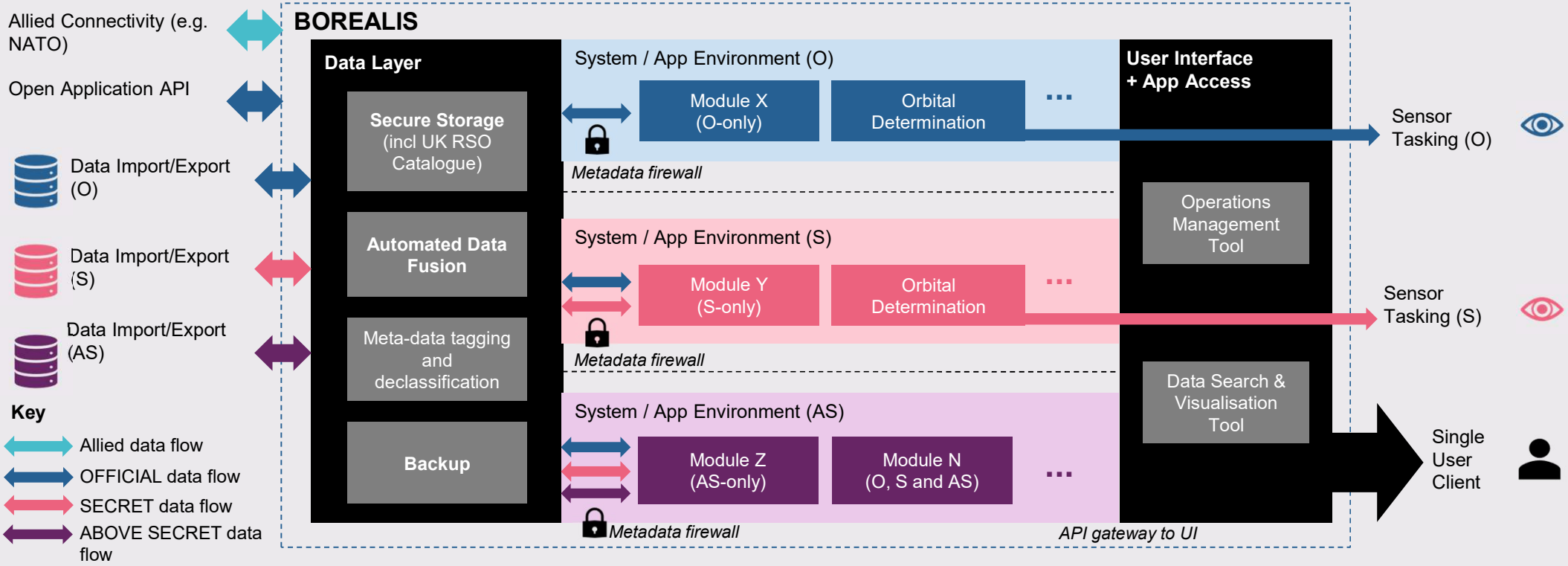
Images (clockwise from top-left): *Anthony Holloway, MOD, Uni. Warwick*

The Requirement

BOREALIS High-Level Characteristics

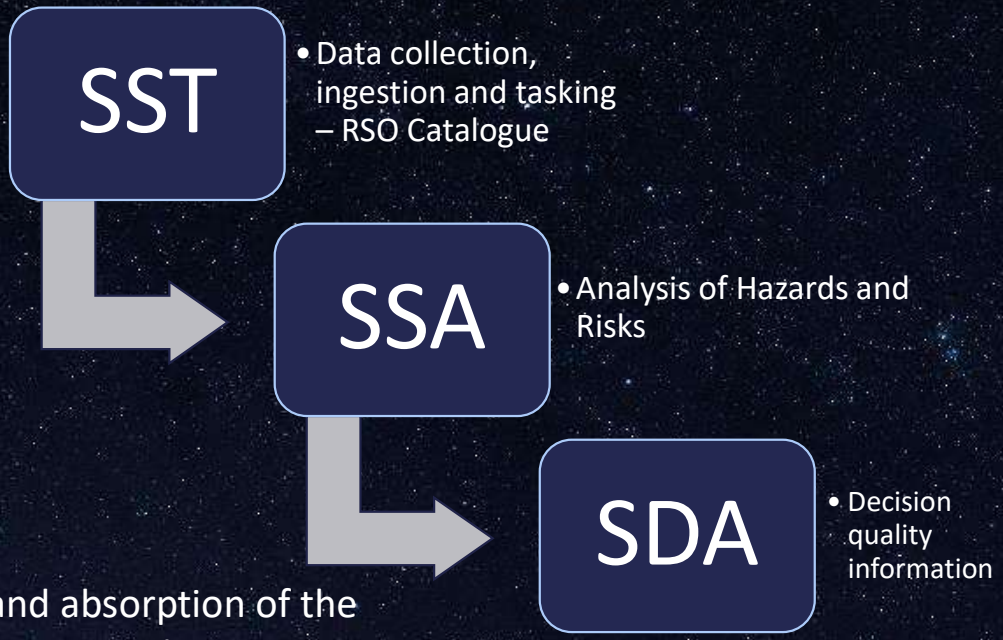


BOREALIS Vision



BOREALIS Vision

- **BOREALIS User Capability Key Driving Outcomes**
  - Performance – Enhance the performance of the UK SpOC and NSpOC through the iterative and incremental, delivery and integration of tools in the following mission areas:
    - Space Surveillance and Tracking (SST) – The ability to ingest and task collection of data, maintain a Registered Space Object Catalogue and support SSA and SDA data requirements.
    - Space Situational Awareness (SSA) – The ability to identify, characterise and alert against hazards and risks; conduct Orbital Determination (Initial and Continuous) and analysis through internal or via a third-party capabilities.
    - Space Domain Awareness - The integration, development and absorption of the sovereign SDA capability AURORA. The ability to produce, present and disseminate decision-quality information to a Commander.



- Performance KDO - Space Surveillance and Tracking (SST)
  - Ingestion of data to fuel SDA and SSA; sources include:
    - Allied Sensors and Sources, including the US Space Surveillance Network & Unified Data Library; Combined Space Operations Community (5EYES + FR, DE) and the ability to add new Allied data sources for ingestion,
    - Commercial Data Providers, via Project PANOPTES,
    - Sovereign Sensors and Data Sources.
  - The ability to create, maintain and update a Registered Space Object Catalogue:
    - Layered from Unclassified to Above Secret, as a 'single source of truth' for the UK Space Community. Ability to share with Allies, Partners and the public, at the appropriate classification,
    - The ability to modularly upgrade the size of the catalogue as required, to adapt with the growing number of objects in Space and advances in detection capability.
  - Automated data collection and sensor tasking, in support of SSA and SDA.

BOREALIS Vision

- Performance KDO - Space Situational Awareness (SSA)
  - The ability to identify, characterise and alert against hazards and risks to UK Space Operations and Launch activities, through the development of the nascent AURORA analysis capability or by integrating bolt-on capabilities:
    - Orbital Determination (Initial and in-flight), based on SST data,
    - Predictive and Retrospective Analysis, for planning validation,
    - Event Analysis, including Conjunction, Fragmentation and Weather/EM spectrum effects; ability to add new events for monitoring and analysis.
  - Integration, consolidation and the ability to control third-party applications that offer bespoke SSA capabilities:
    - Quick integration of newly identified tools
    - Ability to integrate commercially available, Sovereign and Allied Partner applications.

BOREALIS Vision

- Performance KDO - SSA - The ability to identify, characterise and alert against hazards and risks to UK Space Operations.
  - Automated alerting of hazards and risks to UK Space Operations based on Predictive and Event Analysis:
    - Alerting to NSpOC Operators of real-time hazards and risks:
      - Physical hazards and risks to Space Objects,
      - Electromagnetic and Space Weather effects that could impact Space communications and hardware,
      - Operational risks such as re-entry, orbit deviation and Space Object manoeuvre detection.
  - Automated dissemination of alerts to the UK Space Community, including spacecraft operators, via multiple communication channels, with confidence levels,
  - A platform for data-driven decision-making tools, that provide AI generated response options.

BOREALIS Vision

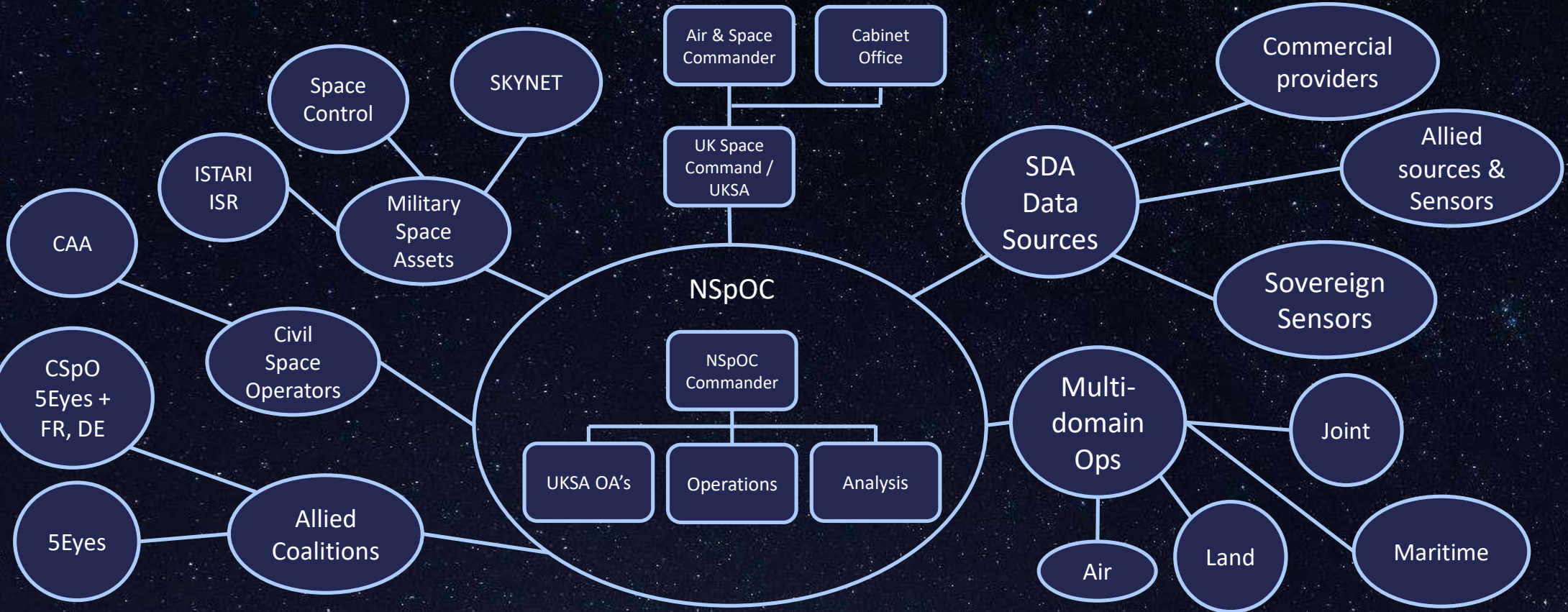
- Performance KDO – Space Domain Awareness
  - The ability to produce, present and disseminate **decision-quality** information to a Joint Commander.
  - Mission management and decision-making support
    - Layering SSA with Intelligence to **understand** the operational implications of Space activity,
    - Multi-source data fusion & Retrospective and Predictive Analysis to inform & validate decision making,
    - Presenting information to the Commander and other stakeholders in manner that is:
      - Easy to understand, intuitive –visualisation of Space activity alongside Air, Land, Maritime & Cyber domains,
      - Optimised information delivery across classifications – avoid information overload,
      - Holistic – an SDA dashboard that coheres NSpOC activity.
  - The ability for the Commander to conduct operational planning, simulation, wargaming and decision making:
    - Via internal capability or through third party applications.

BOREALIS Vision

- Capability KDO – Command and Control
- The ability to plan, direct, coordinate and control prioritised missions and tasks, including Automated Sensor Tasking (Commercial, Allied and Sovereign), Information Exchange and the ability to share NSpOC products with Military and Civilian customers.
- The unified C2 system for Military and Civil Space Activity, across the five levels of C2:
  - NSpOC C2 – Mission management and SDA within the NSpOC, with delegated authority to make decisions for military Space activities,
  - Space Sensor C2 – the focal point for ingesting and issue tasking for Space Surveillance and Tracking sensors/data,
  - Multi-Domain Operations C2 – Coherence across the domains of warfare and activity, informing and influencing activity with critical dependencies on Space, by meeting the NSpOC information exchange requirement,
  - C2 with Allies and Partners – Federated Mission Sharing with the 5 Eyes and CSpO Community, to enable combined Space operations; providing the technical support to meet the IER,
  - C2 of future Space assets – e.g. sending/receiving data from spacecraft ground control stations if required.

BOREALIS Vision

- NSpOC C2 – Multi Domain Operations, Allies and Partners, Space Assets, Space Sensor network



BOREALIS Vision

- Capability KDO's – Technology as an Enabler

  - Collaboration – the ability to work real-time with civil and Allied partners on Space operations, activities and products, facilitated by an open architecture and federated connectivity.

  - Interoperability - The ability to communicate share data with broader Defence, X-Gov and with International Allies and Partners, to enable federated mission sharing. The integration of UK SpOC / UKSA IT systems into an NSpOC digital backbone, to enable seamless, secure data transfer and simultaneous working between systems.

  - Information Assurance – Enable working, storage and Information Exchange from Unclassified to Above Secret. Systems integration through a Cross Domain Security solution that removes stovepipes and increases the ability of the operator to fuse multi-source, multi-classification data.

BOREALIS Vision

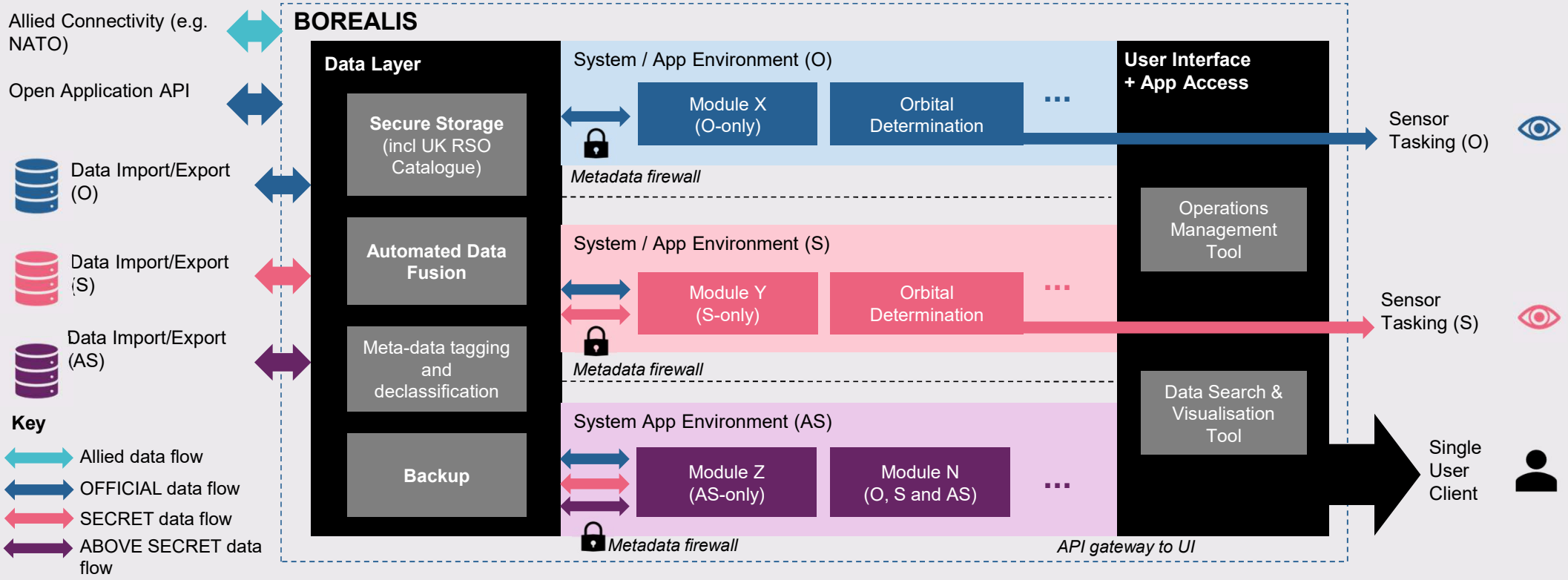
- Capability KDOs – In-service Development and Support

  - Simulation, Testing and Training - The ability to use real data to simulate Space events and operations, conduct system testing and evaluation and a training environment to facilitate initial training and currency maintenance for NSpOC personnel.

  - Availability, Reliability and Maintainability – Through life support of the capability to minimise the impact of downtime on operations, whilst enabling maintenance, patching and upgrade as and when available.

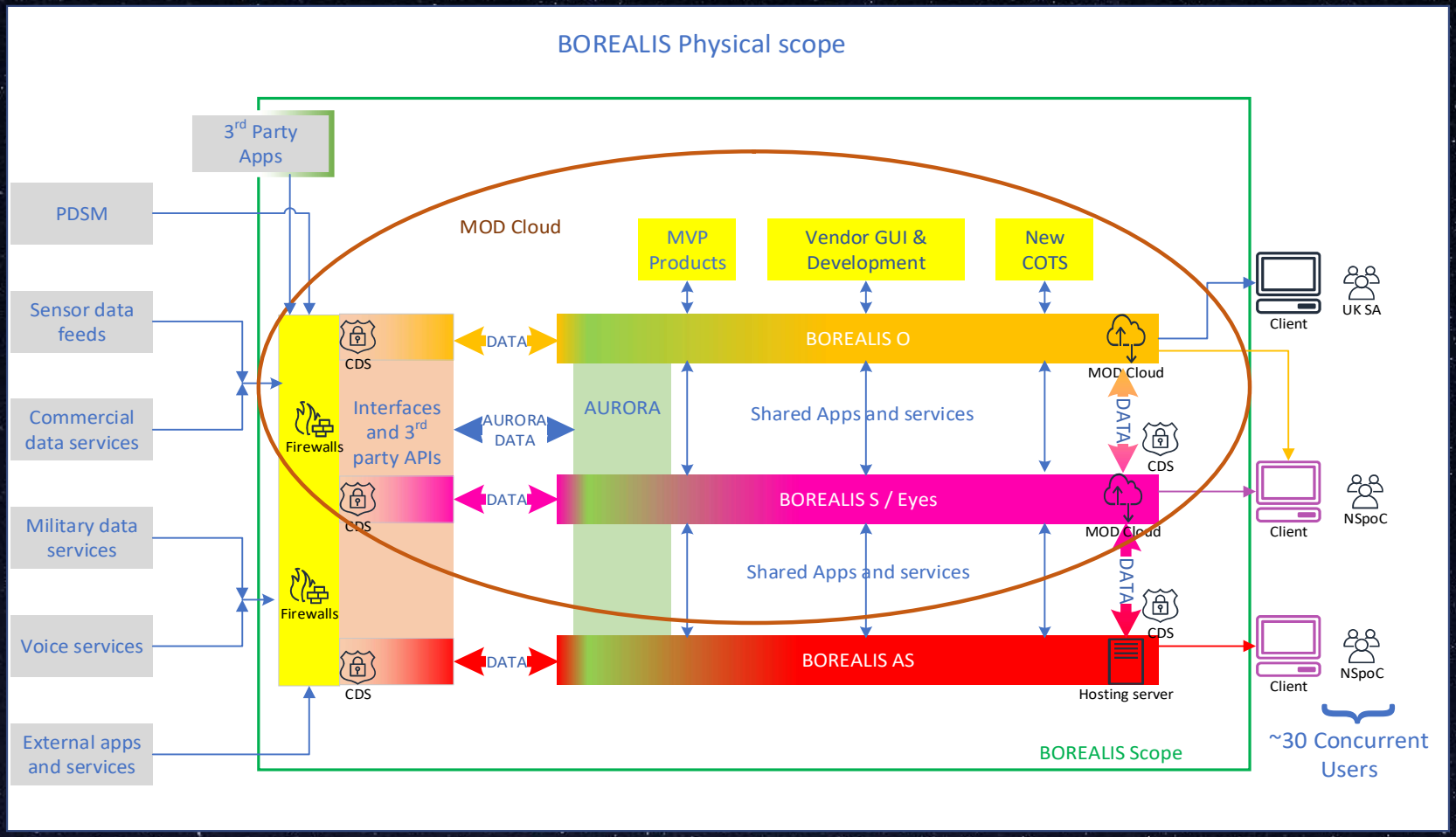
  - Future Growth, DevSecOps and Agile Delivery – incremental and iterative delivery of capability backlog items, as they become available; integration of support and maintenance to minimise the impact on operations.

BOREALIS Vision



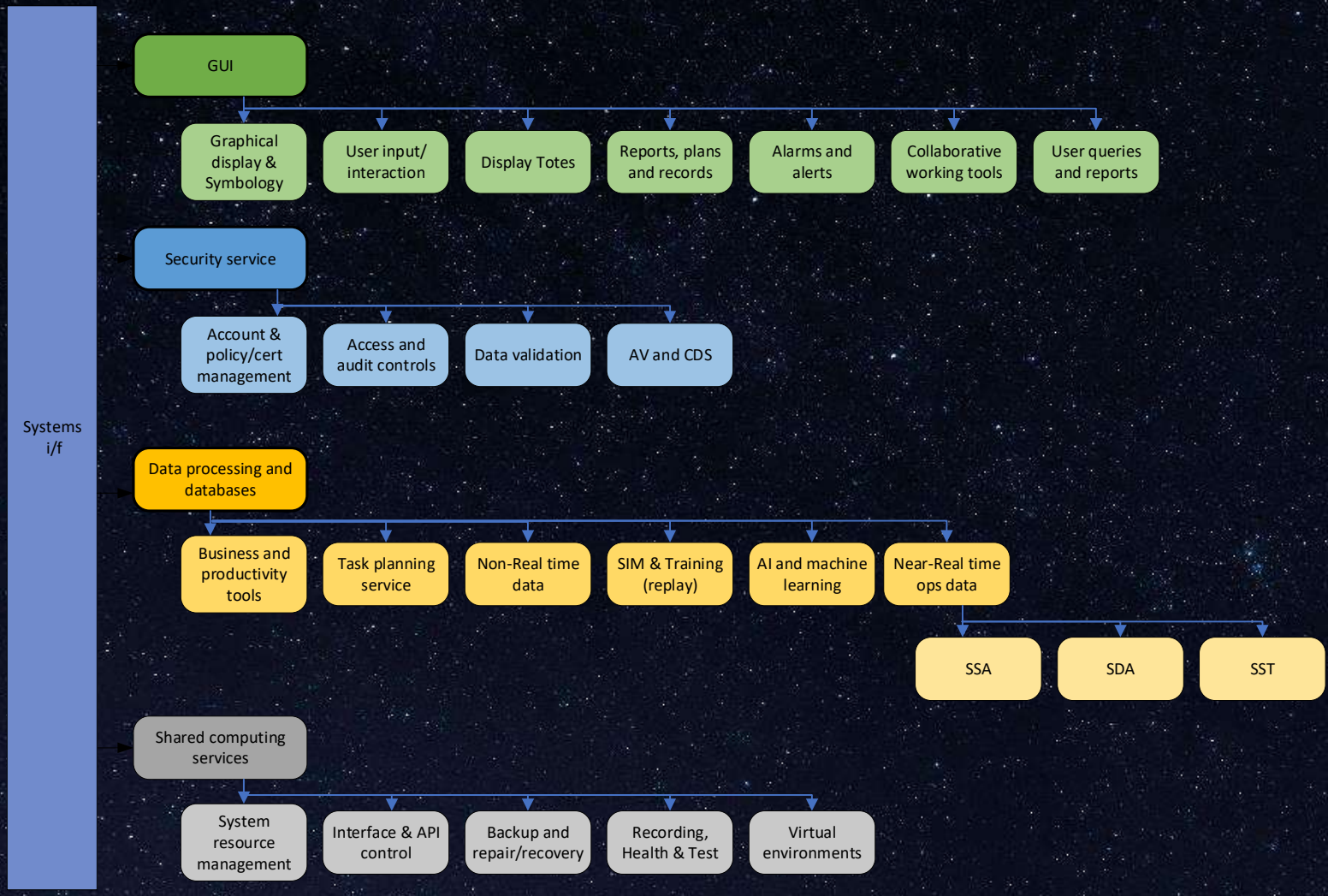
Engineering Considerations

Envisioned Architectures



BOREALIS

BOREALIS Logical System Architecture



DE&S Eng key product considerations

- Software development; safety & quality
  - Safety: Def Stan 00-055 (software) and Def Stan 00-056 (Management)
  - Human factors: workload optimisation, allied and stakeholder info exchange
  - Configuration control & change management,
  - Test and acceptance
  - Quality: ISO 9001:2015 and ISO 90003:2018 (Standard for Computer software development; application of ISO 9001:2015 in computer software)
    - Good coding practices to be demonstrated at unit level as well as good architectural and design at the Technology and System level.
- Environmental (Def Stan 00-051)
- Product Sustainment/Support
  - Obsolescence management & interoperability
  - Availability – 24/7, low downtime required
  - User training – training/development rigs, training delivery
  - Horizon scanning/tech watch role – future growth

BOREALIS Security Objective:

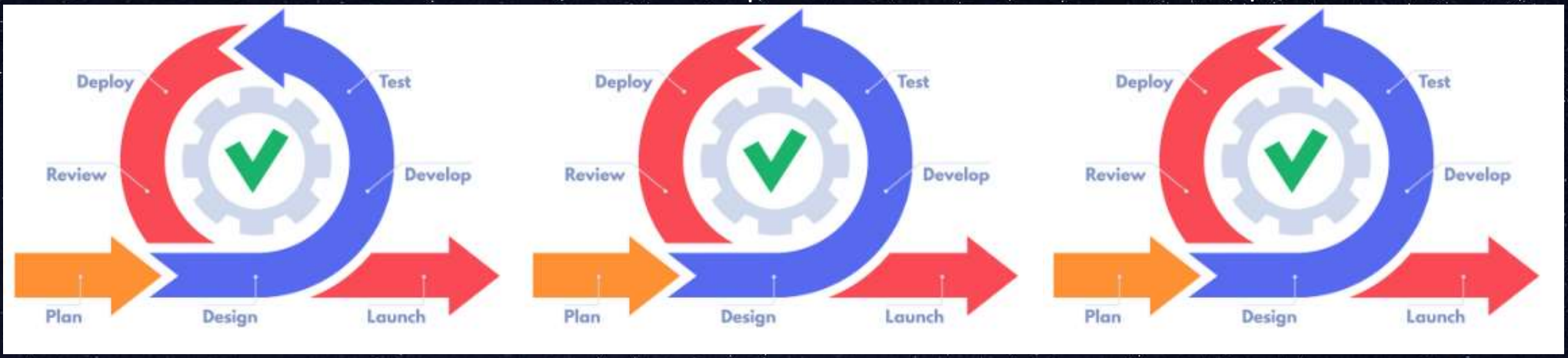
- **Secure by Design (SbD)** – A continuous reassessment of capability risks against, changing vulnerabilities and threats e.g. MODCerts. The MOD SRO is accountable for the delivery of Cyber security, giving a credible & reliable chain of accountability.
- **Security threat/ risk context**
  - Emerging cyber threats, vulnerabilities, data integrity and availability, Cross Domain Solutions, Interfaces, APIs, Human factors
  - Development / operational environment, accredited MODNet equipment and Codes of Connection
- **Security Guidance standards and good practice:**
  - Defence network joining rules guidance via Defence networks governance (JSP 604) - GOV.UK (www.gov.uk).
  - Wider standards, e.g. UK HMG, NIST etc.
- **MOD/GOV security driven by:**
  - JSP 440 Defence Manual of Security, Leaflet 5C, directs the security requirements.

Managing the Project

Managing the Project – Agile

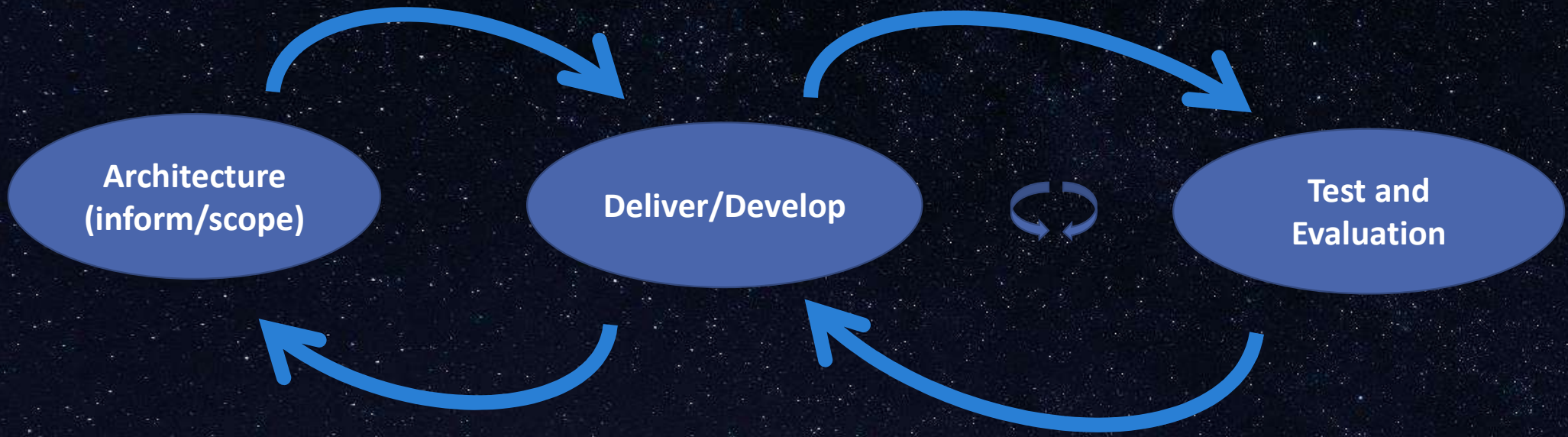
- We will be using the Agile Methodology to develop BOREALIS:
  - Effective method for developing software
  - Rapidly changing operating environment
- Agile allows for iterative development through sprints
- The sprints will be overseen by DE&S, the work will be assigned by Space Command and UK Space Agency

Sprint 1 Sprint 2 Sprint 3



Developments to be immediately launched

Managing the Delivery



- Key stakeholders inc Industry
- Review and understand regulations/constraints
- To ensure future developments can be incorporated

- Scrum team: Industry - scrum master, SpCmd/UKSA - Product owner, other key stakeholders inc DE&S, T&E
- Review of user stories, agree on: backlog, bug-fix, MODCerts, 3rd party apps etc

- Key stakeholders inc Industry, domain MOD/Civ SMEs, users
- Acceptance of sprint outputs against agreed metrics
- Defect prioritisation
- Security

Commercial Procedures

- The Commercial Model is yet to be finalised, however there are 3 options the Authority is considering:
  - Option 1: Prime (with subcontractors)
  - Option 2: Consortium (Prime + Partners)
  - Option 3: Multi-Supplier Environment

  - With regard to these options, the Authority is exploring all commercial models at the moment but recognises the vibrant market and wants to ensure we are able to optimise innovation in the supply chain.
  - We do not want to implement a model without consideration of the wider supply chain, and therefore recognise that it may in fact be a 'hybrid' of the options and invite Industry to support our decision making.

Commercial Procedures

- It is anticipated that the requirement will be run via restricted competition under DSPCR
  - Pre-Qualification Questionnaire (PQQ)
  - Invitation to Negotiate (ITN) for those who successfully pass PQQ.
  - Social Value will form part of the evaluation criteria at ITN and will account for a minimum of 10% of the overall technical score.
- Procurement Timescales – These dates are indicative and subject to change.
  - Contract Notice/PQQ - Sept/Oct 23
  - ITN Jan 24
  - Contract Award (CA) no later than Dec 24.
- **Contract duration** – anticipated 3 years (plus 2 option years (1 + 1))
- All communications for this requirement will be via the Defence Sourcing Portal (DSP)
- Link for suppliers to register: Defence Sourcing Portal (DSP) (mod.uk) (scroll down to 'Supplier Registration)

Commercial Considerations

- **The BOREALIS requirement** will follow an Agile methodology, allowing for flexibility and a collaborative, **joint working approach between the Authority, Customer and the Contractor**, to reach a desired output. This procedure allows for refinement of the solution, maximising the experience of industry in Agile development and provides opportunity for innovation.
- **Terms & Condition's –** DEFCONs will still be included where appropriate which will be familiar, however some the differences are highlighted below:
- **Key Delivery Outcomes (KDOs) not a Statement Of Requirements (SOR)**
- **Performance Management**
- **Governance and Control**
- **IPR**

Closing Remarks

- All questions asked via the Multi User email address: DESSpace-DT@mod.gov.uk will be shared with everyone

- Deadline for all questions will be 17:00, 26 July 2023