

# **An update on the UK Cross-Government SDA Requirements, in Support of the UK's SDA Strategy**

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## **ABSTRACT**

The UK's second set of Space Domain Awareness (SDA) Requirements has recently (August 2024) been published as a cross-government initiative, designed to underpin the UK's strategy and ambitions for SDA. The publication outlines the requirements for a system of systems which will provide for the UK's current and future SDA needs. A redacted copy of the second iteration was publicly released, closely followed by an update including further information. The major addition to Version 2.0 was the inclusion of priorities against the requirements, and the following Version 2.1 then also included some threshold values denoting the minimum acceptable performance that is needed against specific requirements. This release was designed to inform industry and academia of the UK's direction and most importantly a steer on the values to go along with the requirements. This paper discusses these developments, how the requirements are being and will be utilized in practice, and the future work to be done.

## **1. INTRODUCTION**

The UK has both civil and military agencies dedicated to Space, including Space Domain Awareness (SDA), and the UK government has directed these various agencies to coordinate activities in order to get best value for the UK people. The National Space Strategy, published in 2021, lists SDA as a key civil and defense capability priority, and high growth area [1]. The Defence Space Strategy, published in 2022, lists SDA as a priority and a 'fundamental enabler of all other space capabilities, and critical to our ability to protect our interests in space...' [2]. Finally, more recently the UK Space Industrial Plan, published in March 2024, lists SDA as an action area for "...additional support, a more ambitious approach, or an accelerated plan in the short term..." [3]. In light of these policies and strategy directives, stakeholders across UK government are working to deliver UK SDA.

The UK strives to be a responsible and safe space actor, in order to do this effectively it was decided to develop a framework of requirements for Space Domain Awareness that could be used to support procurement, research and development and policy and/or decision making. The UK's first set of Space Domain Awareness Requirements were developed as a cross-government initiative, pulling in experience and knowledge from both civil and military agencies.

At AMOS 2023, these requirements were presented for the first time, endorsed by UK Space Command and UK Space Agency. This paper provides an update, discussing the progress made in the past year (including further endorsement), describing how the requirements have been used to underpin and support ongoing and new government initiatives, programmes and projects, and the future for the requirements.

The Requirements were established to inform the development of a system of systems, including the entire SDA chain from sensors and data processing through to readouts for policy makers. This system of systems approach means that eventually the Requirements can be used to underpin all research, procurement and policy decisions made by UK agencies for SDA.

## **2. REQUIREMENTS HISTORY & UPDATES**

The Requirements were initiated under a UK Space Agency (UKSA) study into UKSA's Space Surveillance and Tracking (SST) needs, but have since expanded through work by a cross-government SDA working group to include requirements such as space object characterization, which sit outside SST but within the wider SDA envelope. In the year since these were last presented publicly, further development has been done to expand and refine the requirement set and make them more robust. Finally, and most critically the second revision sets out key priorities within the requirement set.

The second iteration of the requirements has now been endorsed by the original signatories UK Space Agency and UK Space Command, but additionally by Defence Science Technology Laboratory (Dstl), the Civil Aviation Authority (CAA), and the UK Meteorological Office (Met Office). These additional signatories signal a step forward in UK government collaboration in SDA. While the aforementioned agencies were involved in the development of the original requirement set the endorsement signals formal support and a pledge to use the Requirements in practice.

### 3. REQUIREMENTS CONTENT

The requirements are split into; User and System Requirements. The user requirements are the high level key capabilities that UK government seeks to have within the system of systems. The System Requirements go down a level to the detail of how the system of systems will achieve the user requirements. The Requirements are then mapped with forward and backward traceability, such that every system requirement can be traced back to a user requirement and a user can see every system requirement that derives from each user requirement.

As mentioned in Section 3, the second iteration of the requirements has additional information that was not included in the first iteration. Initially, Version 2.0 included an additional column in the User and System Requirements titled 'Priority', this column denotes the prioritization of the requirements. This column should not be taken to mean that any requirements are less important, more that there are some requirements that are more urgently needed to be fulfilled than others. This prioritization remains live, and will be updated along with the requirements in future iterations.

The recently (August 2024) published Version 2.1 brought the most notable advance in the requirement set, the addition of threshold values for certain requirements. These numbers have been available since prior to Version 1 publication, but were held within government only. It was decided to declassify as far as we could in order to provide as much direction to industry and academia as possible. Some threshold values remain too sensitive to be shared publicly however, and not all requirements have a numerical value associated, so some of this column will always remain blank. Further, it should be noted that the 'Threshold' values denote the minimum viable product, 'Objective' values are sensitive and so are held in the unredacted requirement set within government.

In addition to the additional columns, some new requirements were introduced in Version 2.0, most notably the addition of several requirements to cover Space Weather, SRs 8500 and 8600 were introduced to note what data and systems are required to satisfy the UK's Space Weather needs. Another key addition was SR-8700 specifying that the system of systems shall include appropriate training materials to ensure users can get the full value out of the system of systems. Extra detail was also added to clarify requirements, such as SR-300 on defining orbital events, particularly in this case sub-requirements were added to note what types of events the UK is interested in capturing. These sub-requirements are especially useful when performing a gap analysis on the requirements as discussed in Section 4.

Further to the additions in Version 2.0 and 2.1, there were also some requirements which were retired for various reasons, most commonly to ensure the requirements were solution agnostic. Examples of these are SR-5800-6900, which covered various aspects of RF data for SDA, as these were solution specific answers to other requirements, these have now been retired. This move ensures that the requirements are not biased towards certain systems or solutions.

Due to the sensitive nature of some of the information contained in the Requirements, some information has been redacted from the publicly available version. Beyond the five columns in the redacted requirement document, the classified version of the Requirements also contains the following columns:

- Requirement Category – used to group the requirements into broad themes.
- Measures of Performance (MoP): Civil Threshold and Objective, MOD Threshold and Objective - detailing the acceptable (threshold) and desirable (objective) levels of performance.
- MoP Status (Civil and MOD) – denoting whether the threshold or objective is yet to be defined (an indicator for updates).
- Justification – reasoning for the content of the requirements and their MoPs.
- Validation Method – method to test whether the MoP has been met.
- Requirement Status – whether the requirement is candidate (unendorsed), active (endorsed), or retired (no longer valid).

- Fulfillment Status – whether the requirement has been met or partially met, used to trigger review of MoP
- Resilience Required – whether the requirement needs to be met by redundant systems.
- Priority (Civil, MOD, Consolidated) – denotes how important the requirement is to the relevant stakeholder group.
- Delivery Timeline – indicator for how urgently the capability is needed.
- Stakeholders – indicating which organizations have a stake in the requirement, including who is the key/owner stakeholder.
- Additional Notes – any notes, or additional information that is not captured in the preceding columns.

#### 4. REQUIREMENTS USE IN PRACTICE

The Requirements are being currently being used across UK government to underpin ongoing and future procurements, such as the recent procurement of a ground-based Infrared Technology Demonstration (procured via Dstl’s R-Cloud framework).

It is unnecessary for the UK government to own an entirely sovereign system of systems, therefore the UK government intends to use the requirements to allocate resources effectively and use available funding most efficiently to buy, develop and/or collaborate as appropriate to ensure the most promising technologies, research etc. are captured in the system of systems to meet the requirements. To facilitate this, a requirements mapping exercise is underway which will provide a systematic understanding of the current state of play and identify gaps in the system of systems.

This analysis is in early stages, but will require input from industry and academia to facilitate government understanding of where existing techniques and technologies exist to meet the requirements.

Table 1. Requirement Map Example. Color coding (right column): Green = objective met; Yellow = threshold met; Orange = partial capability, but not meeting threshold; Red = no capability. Letter coding (right column), L=Low, M=Medium, H=High, VH=Very High.

Req. ID	Req.	MOD/Civil MoP		Tech 1	Tech 2	...	Tech X
		Threshold	Objective				
Req. 1	Requirement text	A km	B m	Red	L	Yellow	M
Req. 2	Requirement text	C hours	D minutes	Green	VH	Yellow	L
...							
Req. X	Requirement text	One Location	Multiple Locations	Yellow	H	Red	VH

The confidence column in addition to the color coding ensures that a user is aware of any limitation on the scoring, for example a solution may have a green color coding but Low confidence meaning that it might meet the requirement objective value, however the assessment was made with little or no supporting evidence. Note Medium confidence is used to denote where anecdotal evidence or subject matter expert judgment has been applied; High confidence denotes where some evidence or calculation based assessment is available and; Very High confidence denotes where a solution has been judged based on measurement of performance assessment of the capability in practice. Beyond the RAYG and confidence charting in Table 1, evidence is captured in a second sheet to support the assessment and ensure the assessment can be traced and updated as needed.

As may be imagined this map is not a small piece of work, and to capture every available system, technology and technique which could be used for SDA would likely be impossible, however, as a starting point the map is being used to derive market understanding of SDA data and sensors. This will provide the basis for government procurement of sensors and data, via the Space Command project PANOPTES among others.

This map will likely remain as a live document providing a focal point for government to capture it’s understanding of the current state of the art. As mentioned it has initially be used to capture sensors and data, however, it could also be used to capture other things such as apps and data processing, and may be employed in the future to support the development of the BOREALIS project (the UK’s sovereign C2 system).

## 5. CONCLUSION & FUTURE WORK

The second endorsement is not the end of the road, development of the Requirements is ongoing with significant work planned to expand their scope and utility. It is envisaged that the Requirements will remain as a living document, to be revised on at least an annual basis. Currently, the requirements are heavily skewed towards the space segment, with some cross-over into ground and link segment, however work is ongoing to cover these areas more effectively, along with expanding the current requirements on Space Command and Control (C2). Work will also continue on developing the requirements map.

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## 7. REFERENCES

- [1] UK Space Agency, Department for Science, Innovation and Technology, Ministry of Defence and Department for Business, Energy & Industrial Strategy. National Space Strategy, 2021. Available at: <https://www.gov.uk/government/publications/national-space-strategy>
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