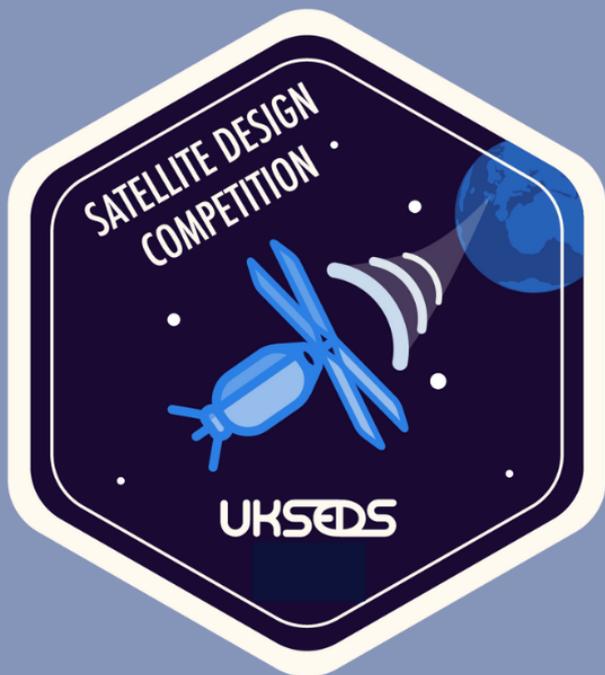


# SATELLITE DESIGN COMPETITION 2023-24

## Competition Overview



**UKSEDS**  
COMPETITIONS

SUPPORTED BY

**SSPI**

**OPEN  
COSMOS**

**OXFORD  
SPACE  
SYSTEMS**

**AIRBUS**

**nano  
avionics**

**inmarsat**

**Astroscale**

# UKSEDS and SSPI Satellite Design Competition 2023–24

## Rules and Requirements



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## 1. Purpose of this document

This document is designed as a prelude to the fully-developed rules and requirements document that will be released upon registration closure. It is to give an introduction to the competition and explain this year's focus. A more detailed description of the contents of this document will be provided in the rules and requirements document, and this document is not intended to be used as the main statement of work for teams to use.

## 2. Introduction

The 2023-2024 Satellite Design Competition invites students to design, construct and operate a nanosatellite payload system with the aim of developing a payload subsystem focused around Earth Observation. Students shall create a payload concept, trade off performance parameters and pass through a rigorous review process with panels of experts within the space industry before getting the opportunity to build their CubeSat designs. The competition aims to reach out to students from multiple scientific fields, including, but not limited to, aerospace engineers, computer science engineers, electrical engineers, mechanical engineers and physicists.

The competition aims to:

- Challenge students to perform a complex, systems engineering task for the development of a payload to meet a set of real space mission requirements
- Gain exposure and experience of the typical design processes and protocols in industry projects, including multiple project reviews
- Enable students to apply taught technical skills and learn new ones relevant to a job in the space industry in an applicable project environment
- Provide students with an opportunity to develop and practise other important and transferable skills, such as teamwork, leadership and project management
- Provide students with support and advice from leading industry experts

Teams will spend roughly 9 months developing their designs to compete in a 'mystery room' environment. This is a mock-space environment that will simulate a real mission, where teams can demonstrate their CubeSats capabilities in a series of challenges.



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The competition is currently in its seventh year, and previous years have had teams tasked with identifying lunar landmarks, capturing mock space debris objects, and performing data collection on a number of orbiting debris objects.

### 3. Team Structure

**The competition is open to any UKSEDS member, which extends to students from UK universities, apprentices, as well as any students on Internships or those who have graduated within the last 3 years.** It has been designed to be carried out as a group project towards a degree, or by a UKSEDS branch team. If you have any queries about potential eligibility, please email [satellites@ukseds.org](mailto:satellites@ukseds.org) to enquire.

There is a limit of **15 team members per team**. The names of the team members should be provided to UKSEDS in a team roster and should be kept up to date if there are any changes. There may be an additional limit on the number of attendees to the competition event. Additionally, the work should be demonstrable as being done by the team members, and not academic supervisors or other advisers.

### 4. Competition Overview

This section provides a description of all the major components of the competition, and includes references to additional material where necessary.

#### 4.1. Mission Background and Scenario

Wildfires, often referred to as nature's infernos, pose a significant and growing threat to both human communities and the environment. In recent years, the world has witnessed catastrophic wildfires that serve as alarming reminders of their destructive potential. The 2020 wildfires in Australia, colloquially known as the "Black Summer," burned more than 46 million acres and destroyed thousands of homes. The smoke from these fires had far-reaching consequences, affecting air quality as far away as South America. Similarly, in the United States, the 2020 wildfire season saw unprecedented blazes in California, Oregon, and Washington, scorching millions of acres, displacing residents, and causing significant economic losses. These devastating events underscore the urgency of addressing the dangers of wildfires.



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One critical tool in the fight against wildfires is the use of Earth observation satellites. These advanced satellites provide crucial real-time data and imagery that can help detect and monitor wildfires with remarkable precision. They can identify hotspots and track the spread of fires, allowing for timely evacuation of at-risk populations and the allocation of firefighting resources. Furthermore, satellites equipped with infrared sensors can detect heat signatures, even in remote or densely forested areas, aiding in early detection efforts. In an era where climate change is contributing to more frequent and severe wildfires, the utilisation of Earth observation satellites is paramount to enhance our ability to predict, respond to, and mitigate the devastating consequences of these infernos, ultimately safeguarding both human lives and the natural world.

Therefore, this year's competition aims to address the pressing issue of wildfires and explore innovative solutions in Earth Observation technology. One promising avenue centres around the use of 3U CubeSats, and how they could play a pivotal role in improving our ability to detect wildfires as they develop. Equipped with the right equipment, a CubeSat could provide near-real-time data on temperature variations and wildfire movements. Teams will therefore be challenged to develop a CubeSat design that could aid in the fight against wildfires.

### 4.2. Mission Tasks

The overall challenge is to design a 3U CubeSat that can measure temperature variations in heat sources and determine the movement of such heat signatures.

Additional testing will require teams to locate and track such sources autonomously using an AOCs system. More details on this will be released in the Rules and Requirements document on competition registration close.

Figure 1 - Satellite image of a wildfire (credit: Space.com)

In general, the competition is separated into two main phases: a **research & design phase, which is split into a PDR phase and a CDR phase**, and a **build & test phase**. Teams will have to submit a Preliminary Design Review, followed by a Critical Design Review.

### 4.3. Competition Day

The competition day consists of **two** components; an attempt to complete the objectives inside a mystery room and a 10-15 minute presentation. Teams shall be tested inside a **mystery room** that shall simulate the different phases of the mission, from pre-launch to end of life. The objectives will be split into **three** parts, which are as follows:



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- Pre-launch (structural testing)
- In-orbit state of health check of subsystems
- Science experimentation

More details on these phases will follow in the rules and requirements document.

## 7. Description of Work during PDR Phase

This section contains a brief description of the work that is expected to be carried out by teams during the PDR phase of the competition which runs from October to December. Each is split into the objectives of the work, the inputs, outputs and a description of the task. This can be used at the top level by a team to devise its work process, in line with the deadlines given in the competition schedule.

### 7.1. Conception and Requirements Definition

#### Objectives

- Consolidate satellite requirements
- Define the system-level configuration for the satellite
- Create a satellite design concept

#### We provide

- Competition Statement of Work (The rules and requirements document)
- PDR template

#### Outputs

- Satellite concept design
- PDR presentation

In this task, teams will create an initial concept for their satellite and mission design. This stage is expected to last 1 - 1.5 months and concludes with the Preliminary Design Review (PDR). **The PDR submission will be through a presentation, and a submitted appendix document.** Written feedback will be provided to teams by a review panel.

This phase details how each of the functional requirements are going to be verified and gives a framework for performing this testing during the Build and



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Test phase. Tests do not need to be comprehensive or fully defined in the PDR, but they must cover the whole scope of the satellite (i.e. be broad rather than deep).

The PDR phase will then follow on to the CDR phase, which will entail a comprehensive examination of your PDR concept, where design decisions will be thoroughly substantiated and analysed.

More details on guidance can be found in the PDR template document which will be released along with the rules and requirements document.

### C.1 Plagiarism

Teams shall endeavour to use appropriate citations for all work that is not their own. Should any team be found to have plagiarised portions of other bodies of work, UKSEDS reserves the right to penalise or even remove teams from the competition. This is not something that is done lightly but is necessary to ensure the integrity of the competition. A detailed description of what is judged as plagiarism and possible consequences are outlined in the [UKSEDS Competitions Plagiarism Guidelines](#).

### C.2 Costs and Funding

There is no fee to enter the competition. Teams should source funding for the project themselves, via grants from their universities, student unions or departments or sponsorship. There are two types of financial support available through UKSEDS: a competition grant and diversity grant.

#### Competition Grant

Teams who pass their CDR are eligible to apply for a grant through the competition sponsors' grant pool. This grant operates on a cost-match basis. The grant will match external funding (i.e. from universities, sponsors etc.) up to £250, for example:

**Table C-2: Example of how the competition grant is structured**

Source	Amount
Department	£100
Universities' Student Union	£150
Maximum Match Funding from UKSEDS	£250



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<b>Total</b>	<b>£500</b>
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Competition grants have a rolling application deadline, no later than June 20, 2023. Teams can only apply for funding once. If teams are ready to submit earlier in the competition phase, the application can be processed quickly and the funds reimbursed at an earlier date. Teams will receive a Google form to which they must attach a bill of materials on an excel spreadsheet and copy of receipts. The following terms and conditions are attached to this funding:

1. The grant can be applied for only after passing the CDR
2. The grant shall not exceed funding raised from other sources
3. The grant shall not exceed £250
4. The grant shall only be used for components or the construction of the satellite.
5. If you receive more than 50% of costs from the university funding or otherwise, the grant shall only reimburse the remainder of the costs.
6. The grant will be paid in arrears after the competition day upon receiving:
  - a. A completed claim form (will be distributed at a later date)
  - b. A satellite Bill of Materials
  - c. Receipts demonstrating the spend on components or construction
  - d. Evidence of matched funding

### Gender Diversity Grant

Following the recent announcement of Orbex becoming title sponsor of the National Rocketry Championship, we are pleased to also announce the Orbex Gender Diversity Grant, a new funding source for teams in our Rocket, Satellite, and Rover competitions with 50%+ women or non-binary members.

If your team has 50% or more women or non-binary members taking part in the competition, and your team passes the CDR report, you will be able to apply for a £250 grant from Orbex. The Orbex Gender Diversity Grant has a rolling application deadline, no later than June 20, 2023. Teams can only apply for funding once. The team structure can meet the criteria at the PDR, CDR or TRR/EDR Stage. Additionally, this grant qualifies as external funding and could be listed as such for the competition match-funding (see example below).

**Table C-3: Example of how the diversity grant is structured**

Source	Amount
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Orbex Gender Diversity Grant	£250
Match Funding from UKSEDS	£250
<b>Total</b>	<b>£500</b>

If you qualify for this grant, please send an email to [satellites@ukseds.org](mailto:satellites@ukseds.org). Similarly to the competition grant, teams will receive a Google form to complete. The following terms and conditions are attached to this funding:

1. The grant can be applied for only after passing the CDR
2. The team has 50% or more women or non-binary members at the PDR, CDR or TRR stages
3. The grant shall not exceed £250
4. The grant shall only be used for components or the construction of the satellite
5. Representation on the competition day should reflect the diversity of your team

### C.3 Competition Day

The competition finale is the challenge day hosted by UKSEDS and Airbus. All competing teams shall bring their satellite so that the functionality of their hard work can be tested. The final date, location and travel arrangements will be released at a later date. We encourage all teams to design their own team patches, we would love to see your own personal touches to the competition!

#### Presentation

Teams shall present their work throughout the competition for 10-15 minutes, focusing on the method and process for deciding on the final payload design, what could be improved and what the next steps will be. Furthermore, we advise teams to aim for a slide a minute to stay concise and engaging to the audience.

#### Prizes

Table C-4 provides a full description of the prizes available for this year's competition. Once the competition has finished, SSPI are interested in publishing the five best CDR reports, accompanied with a brief write-up on each team and their members. Furthermore, there will be the opportunity for up to 3 teams to be invited to speak on the SSPI podcast, sharing your experiences throughout the competition.

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**Table C-4: Full List of Prizes**

<b>Prize</b>	<b>Description</b>
<b>Best Satellite</b>	Prize for best satellite that achieved the highest score by the judges
<b>Best Innovation</b>	Awarded to the team with the best innovative engineering solution (decided by the judges)
<b>Best Outreach</b>	Prize for the team with the best outreach programme connected to their satellite payload (decided by the judges)
<b>Best CDR</b>	Judges will decide which CDR from all teams was the best (taking into account the following parameters: quality of the report, matching the design to the mission requirements, performance during the review meeting in addressing any comments raised by the reviewer, simplicity and achievability)
<b>Best Presentation</b>	Judges will decide on the best presentation based on parameters found in Appendix C.10

# END OF DOCUMENT