

# **HAPS Challenge**

# **Guidelines**

## Table of Contents

[**High Altitude Pseudo Satellite (HAPS) Challenge Guidelines** 1](#_Toc67496750)

[1. Introduction 2](#_Toc67496751)

[1.1 Background 2](#_Toc67496752)

[1.2 HAPS Challenge Aim 3](#_Toc67496753)

[2. HAPS Challenge Scope and Budget 4](#_Toc67496754)

[2.1 HAPS Challenge Budget 4](#_Toc67496755)

[2.2 HAPS Challenge Execution 5](#_Toc67496756)

[Phase 1: Concept Phase 5](#_Toc67496757)

[Phase 2: Engineering Development and Documentation 5](#_Toc67496758)

[Phase 3: Prototype Development and Demonstration 6](#_Toc67496759)

[3. What Next? 6](#_Toc67496760)

[4. Application 6](#_Toc67496761)

[4.1 Eligibility 6](#_Toc67496762)

[4.2 Intellectual Property 7](#_Toc67496763)

[4.3 Assessment of Applications 7](#_Toc67496764)

[Evaluation criteria 7](#_Toc67496765)

[Stream 1 7](#_Toc67496766)

[Stream 2 8](#_Toc67496767)

[4.4 Application Forms 8](#_Toc67496768)

[4.5 Terms and Conditions of Entry 8](#_Toc67496769)

[5. HAPS Challenge Schedule 9](#_Toc67496770)

[6. Supporting Material 9](#_Toc67496771)

[7. Help 10](#_Toc67496772)

## Introduction

This document sets out the Guidelines for the High-Altitude Pseudo Satellite (**HAPS**) Challenge (**Guidelines**). The HAPS Challenge is intended to support Australian sovereign industry development of a HAPS capability with accurate station-keeping capability and the long-endurance capacity needed to allow deployment over an area of operations for a period of days to weeks and beyond.

The HAPS Challenge and call for submissions is governed by these Guidelines and the applicable HAPS Challenge terms and conditions of entry for each Phase. The terms and conditions for Phase 1 of the HAPS Challenge (**Phase 1** **T&Cs of Entry**) are set out on the HAPS Challenge website <https://www.rmit.edu.au/defence-aerospace/haps-challenge>. The terms and conditions of entry for subsequent Phases will be available on the website prior to the opening date for submissions for those Phases.

The HAPS Challenge is jointly hosted by the Trusted Autonomous Systems Defence CRC (**TAS DCRC**), RMIT University (**RMIT**), **SmartSat CRC** and the Australian Department of Defence (**Defence**).

### 1.1 Background

High [altitude platforms](https://www.sciencedirect.com/topics/engineering/platform-altitude), or pseudo-satellites (HAPS), are uninhabited vehicles that take advantage of weak stratospheric winds and solar energy to operate without interfering with current [commercial aviation](https://www.sciencedirect.com/topics/engineering/civil-aviation) and with enough endurance to provide long-term services to terrestrial users, much as satellites do. Target applications for HAPS include communications, earth observation, positioning-navigation and science with potential for more applications in other disciplines.

HAPS (60,000ft+)1 represent a unique opportunity, if appropriately deployed and controlled, to provide persistent, comparatively low-cost intelligence, surveillance, and reconnaissance (ISR) and communications services across a wide operational area for Defence and National Security. The development of an Australian sovereign HAPS solution would provide Defence with a secure capability supply chain to service tactical, operational and strategic command, control, communications, intelligence, surveillance and reconnaissance (C3ISR) and boost Australian exports.

Several challenges must be overcome if Defence is to effectively exploit high altitude pseudo satellites, including:

* ability of the platform to be launched from and recovered to varied terrain, including potentially at sea;2
* ability of the platform to keep station and manoeuvre accurately at altitude;3
* appropriate payload capacity and capability to support key mission requirements including sufficiently stable attitude determination and control for a range of payloads;
* ability of the platform to operate for long durations of days to weeks;
* ability of the platform to cooperate and coordinate activity as a collective to provide persistent coverage across a large area of operations (AO) and/or to deploy strategically;
* managing the costs of the platform systems and sub-systems;
* ability of the system as a whole to use distributed and intelligent edge sensing and processing to maximise utility and minimise data bandwidth and the need for ground control station(s);
* durability and thermal management of the system and subsystems in the extreme environments at altitude;
* effective integration and recovery/disposal of the platform and its payloads during operation; and
* detailed models of dynamic atmospheric conditions, the systems and the payloads to enable simulation and experimentation.

Defence (through Jericho, Defence Artificial Intelligence (DAI) and TAS DCRC) is addressing a number of these challenges already:

* Project Firefly, under DAI and TAS DCRC, is developing a capability for HAPS balloons to work in autonomous, self-organising constellations to support wide area ISR and communications. This project is also testing specific payload technologies, applying distributed and edge sensing, and engineering in system durability for sustainable operations at high altitude.
* RAAF Jericho is investing in edge sensing technologies that can be carried by, amongst other things, stratospheric balloons and deployable payloads at altitude to support the ISR mission.

However, no current effort is underway in Australia to develop sovereign HAPS platforms with the capabilities outlined above. The HAPS Challenge is intended to address this particular technology gap by providing impetus and support to Australian companies to develop the required technology and build a viable supply chain model.

### 1.2 HAPS Challenge Aim

The aim of the HAPS Challenge is to energise local Australian development of key technologies needed to realise the vision outlined above. The HAPS Challenge is divided into two Streams, summarised below and detailed in the next sections.

**Stream 1**: a prototype persistent, high-altitude, low-cost, station-keeping and responsive-manoeuvre pseudo-satellite system4 capable of being launched from varied terrain (including at sea) and recovered accurately to varying terrain (including at sea).

**Stream 2**: a prototype payload attitude determination and correction system or sub-system that can provide sufficient accuracy, responsiveness and stability to operate a range of communication and sensor payloads attached to the HAPS platform.



*Figure 1 Functional diagram illustrating distinction between Stream 1 and Stream 2*

Figure 1 shows the elements of a generic HAPS system architecture, divided up between those relevant to Stream 1 and 2 respectively. Outside the scope of this Challenge are the other elements that would be present on the full envisioned HAPS system, namely the sensors, sensor processing and the AI reasoning system.

## HAPS Challenge Scope and Budget

The two HAPS Challenge Streams are each made up of three Phases, as detailed below.

Applications must be made individually to each Stream. Regardless of which of the two Streams an applicant enters, the HAPS Challenge will be conducted through three Phases. Progression through each Phase will be subject to continuing reduction in technical risk and progress towards the relevant Stream objectives and to the terms and conditions of entry for the applicable Phase.

**Stream 1: Automated or Autonomous HAPS Platform Station-keeping and Constellation Maintenance**

The Stream 1 challenge is provided by TAS DCRC and is focussed on the development of a HAPS system capable of exhibiting position control and endurance relevant to supporting persistent presence in an area of operations.

**Stream 2: Automated or Autonomous Attitude Determination and Correction of payload support structure**

The Stream 2 challenge is provided by SmartSat CRC and is interested in technologies that can provide a stable interface structure for a range of payloads deployed to the stratosphere as a precursor or augmentation to space-based solutions.

### 2.1 HAPS Challenge Budget

Funding available from the HAPS Challenge to successful applicants is set out below for each Stream.

Stream1 – A total of up to $200,000.00 across all Phases and irrespective of the number of successful applications, as follows:

* Phase 1 - $0
* Phase 2 – Up to $20,000.00
* Phase 3 – Up to $180,000.00

The payment schedule for Stream 1, Phase 3 will be:

* 20% - Commencement
* 50% - Agreed Milestone
* 30% - Final Demonstration

Stream 2 – The total funding across all Phases and irrespective of the number of successful applications, is as follows:

* Phase 1 - $0
* Phase 2 – Up to $20,000 total
* Phase 3 – Up to $100,000 per collaborative research project

Payment Schedule for Stream 2, Phase 3 will be:

* 20% - Commencement
* 50% - Agreed Milestones
* 30% - Final Demonstration
* SmartSat CRC is open to single proposals spanning Phase 2/ Phase 3with a “go/no-go” decision at the end of Phase2. This needs to be within the Phase 3 funding limit

The funding available for each successful applicant will be determined at the HAPS Challenge organisers’ discretion based on the number of successful applicants and up to the maximum total available for each Phase.

### 2.2 HAPS Challenge Execution

#### Phase 1: Concept Phase

(Stream 1 and Stream 2: Duration two months)

Phase 1 is an open call for the submission of an initial concept. The submission involves a short proposal using the HAPS Challenge application forms to address the following:

* A system concept or concepts, describing the basics of the proposed solution, its technical feasibility and its novelty;
* A partner statement, outlining who is involved in the proposal, the approach to collaboration, their track record and what competencies they offer;
* A Phase 2 plan covering:
	+ Budget;
	+ Operational test and evaluation program consistent with regulatory compliance for Phase 2;
	+ Technical performance indicators/measures;
	+ Key deliverables & milestones in Phase 2; and
	+ Expected outcomes.
* High-level technology transition plan that identifies key business opportunities and risks for the capability; and
* A statement of requirements to progress beyond Phase 2 to a full prototype in Phase 3.

#### Phase 2: Engineering Development and Documentation

(Stream 1 and Stream 2: Duration four months; Funding as outlined above)

Phase 2 involves a submission in the required format of a detailed concept for the system, including:

* A detailed design study that provides system configuration, appropriate design diagrams (functional and system) and materials analysis for balloon and gondola relevant to:
	+ Platform endurance;
	+ Platform mobility, guidance, navigation and control;
	+ Power and thermal management;
	+ Payload integration and management architecture; and
	+ Communications;
* Manufacturing study, covering supply chain and manufacturing strategy;
* Preliminary performance analysis appropriate to operation under the defined operating conditions outlined below;
* Support requirements, including range access requirements, regulatory advice/CASA advice, needed to support Phase 3;
* Evidence of regulatory consideration; and
* A Phase 3 plan covering:
	+ Budget for Phase 3;
	+ Test and evaluation program consistent with regulatory compliance for Phase 3;
	+ Key deliverables & milestones in Phase 3; and
	+ Expected outcomes.

#### Phase 3: Prototype Development and Demonstration

(Stream 1 and 2: Duration six months; Funding as outlined above)

Phase 3 involves:

* Monthly progress reporting including evidence of test and evaluation activity;
* A final physical demonstration of an initial prototype at an agreed location and in accordance with regulation; and
* A statement of requirements to progress to a mature prototype, including:
	+ Budget;
	+ Timeline;
	+ Technical support; and
	+ Trials/evaluation support.

In Phase 3, successful applicants are required to provide monthly progress reporting via virtual webinar. The reporting requirements will be specified prior to Phase 3 commencement.

## What Next?

At the end of Phase 3, one or more successful applicants may be invited to apply for further funding to continue development of their system through a suitable Defence innovation program (such as the Defence Innovation Hub, or as a project funded through TAS DCRC or SmartSatCRC), following the established procedures for the program of choice.

Participation in Phase 3 does not guarantee that an applicant will be invited to apply for further funding and the invitation to apply does not mean that the application will be successful but does constitute strong support for the application from the HAPS Challenge panel.

## Application

### 4.1 Eligibility

Application under the HAPS Challenge is open to businesses based in Australia and with an Australian ABN, and to Australian publicly funded research agencies (PFRAs) and organisations.

Applicants must adhere to Australian Export Control Legislation (*Defence Trade Controls Act 2012*).

Technology developed in response to the HAPS Challenge that is covered by the Defence and Strategic Goods List (<https://dsgl.defence.gov.au/Pages/Home.aspx>) must be appropriately documented and managed in accordance with Government guidelines.

Overseas or U.S. International Traffic in Arms Regulations (ITAR) encumbrances on the proposed technology are not permitted.

Applicants may enter the HAPS Challenge as a consortium.

Applicants must declare any foreign interest.

Applications must be made individually to each Stream (provided the submissions do not share any intellectual property) but an applicant must submit separate applications in each Stream.

Stream 1: To be eligible to participate in Stream 1, Phase 3, a successful applicant must also apply and be accepted as a participant in TAS DCRC (if not already a participant). An annual fee is payable by all participants in TAS DCRC. Further details are available at upon request, info@tasdcrc.com.au

Stream 2: To be eligible to participate in either Phase 2 or Phase 3 applicants must be:

* A SmartSat CRC Participant; or
* A Member of the Aurora Space Cluster5, that meets the definition of a new or emerging Australian business operating in the space sector; or
* An entity that is collaborating with a SmartSat CRC Participant.

Applications may be made at Phase 1, Phase 2 or Phase 3. Acceptance of applications for a later Phase without successfully applying for an earlier Phase is at the sole discretion of the HAPS Challenge organisers. Priority will be given to applications from applicants who were successful in the preceding Phase.

All applications will be assessed in accordance with the timeline for the relevant Phase.

Additional eligibility criteria may apply for Phases 2 and 3 at the discretion of the HAPS Challenge organisers, including that a security clearance may be required for staff participating in those Phases of the Challenge. Additional criteria will be detailed in the applicable terms and conditions of entry for those Phases.

### 4.2 Intellectual Property

The terms regarding intellectual property rights and licensing that govern applications vary according to the Phase and will be set out in the applicable terms and conditions of entry for each Phase. The terms that apply to Phase 1 are set out in the Phase 1 T&Cs of Entry.

In summary, applicants in Phase 1 will continue to own the copyright in their submission. In Phases 2 and 3 intellectual property rights will be outlined in the funding agreement and successful applicants should note that they may be required to grant an intellectual property licence to Defence relating to the Phase 2 and Phase 3 outcomes. Applicants should refer to the full terms and conditions of entry for the relevant Phase for further details.

### 4.3 Assessment of Applications

All eligible HAPS Challenge applications will be assessed against the evaluation criteria for the applicable Phase by a selection panel convened by the HAPS Challenge organisers, and in accordance with the applicable terms and conditions of entry for each Phase.

#### Evaluation criteria

Proposed solutions will be assessed based on how closely they meet the following performance benchmarks, detailed for each Stream separately. These represent performance goals.

#### Stream 1

* Runway independent launch and recovery;
* Target mission sensor payload take-off weight of 10 kg using a Defence defined payload suite6;
* Target platform endurance 7+ days at altitude over area of interest (size of box?);
* Target operating altitude 50-80k+ ft;
* Modularised system for scalable and flexible integration (plug and play);
* Capability to station-keep, with the ability to hold position above a target with an agreed radial deviation of no more than 100km for a minimum of 72 hours continuous operation;
* Capacity to operate payload suite (supply power and temperature control) in a defined profile over a five-day simulated period and actual demonstration period for a minimum of 3 hours per day;
* Capability to collect, distribute, store and recover flight model data/telemetry to support real-time and post-collection analysis;
* Redundant communications architecture to support data and telemetry capture;
* Robust lost-link protocol to ensure safe disposal and/or recovery following lost-link;
* Environmental sensing; and
* Cost model to target <$50,000 per system prototype, with a projected stable production cost of <$30,000 per system.

#### Stream 2

* Attitude determination in at least three dimensions (x, y, z or roll, pitch, yaw) with the following accuracy and speed:
	+ 0.1 degree root mean square (RMS) error; and
	+ 10 Hz measurement rate;
* Attitude control in at least three dimensions (x, y, z or roll, pitch, yaw) with the following accuracy and stability:
	+ 1 degree root mean square (RMS) error; and
	+ Maintain attitude within error limits for up to 10 seconds;
* Responsive to environmental induced steps in platform attitude:
	+ Recover from loss on controlled attitude within 10 seconds;
* Data interface system that can support station keeping of HAPS platform through provision of the following data:
	+ Velocity in three dimensions;
	+ Accelerations in three dimensions; and
	+ <1 second update rate; and
* An application programming interface (API) to support sensor based, software enabled precision attitude control with the following accuracy:
	+ Position – 0.1 degree (RMS) in each axis.

### 4.4 Application Forms

Applications for each Phase must be made in the form prescribed on the HAPS Challenge website and using the appropriate application forms.

### 4.5 Terms and Conditions of Entry

All applications are subject to the terms and conditions of entry that apply to the applicable Phase of the HAPS Challenge. These terms and conditions will be available on the HAPS Challenge website prior to the opening date for submissions for each Phase.

Applicants must read the applicable terms and conditions of entry before submitting an application in each Phase. Applicants that submit an application agree to the applicable terms and conditions of entry.

## HAPS Challenge Schedule

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| **Activity** | **Date** |
| **HAPS Challenge Announcement**HAPS Challenge is open. Information is available from the HAPS Challenge website. Conduct information seminars to support applicants in April 2021. | 29th March 2021 |
| **Phase 1 Submission Due Date**Applicants must complete Form A, Form B and Form C, and submit their application by close of business to be considered for Phase 2. | 24th May 2021 |
| **Phase 1 Shortlist for Phase 2 completed**Applicants are shortlisted for Phase 2. All applicants are notified of the outcome. | 25th June 2021 |
| **Phase 2 Commencement**Phase 2 officially commences. Funding support available under Phase 2 is provided in line with these Guidelines and the applicable terms and conditions of entry.  | 28th June 2021 |
| **Phase 2 Submission Due Date**Applicants must provide their Phase 2 submissions in the required form by close of business. Applicants who did not enter Phase 2 via Phase 1 must also complete Form A and include it with their Phase 2 submission. | 8th October 2021 |
| **Phase 2 Shortlist for Phase 3 completed**Applicants are shortlisted for Phase 3. All applicants are notified of the outcome. | 12th November 2021 |
| **Phase 3 Commencement**Phase 3 officially commences. Funding support available under Phase 3 is provided in line with these Guidelines and the applicable terms and conditions of entry. Applicants who did not enter Phase 3 via Phase 2 must also complete Form A and include it with their Phase 3 submission. | 15th November 2021 |
| **Phase 3 completion and demonstration**Successful applicants conduct demonstration and submit documentation to complete Phase 3. | 20th May 2022 |

## Supporting Material

The HAPS Challenge website includes supporting material that applicants may access for planning and development purposes. The website includes information on regulations that may impact trials and demonstrations, the full terms and conditions for each Phase, application forms and other material of relevance.

Supporting material such as in relation to regulatory and safety requirements is provided for information and guidance only. Applicants are responsible for ensuring that their submissions meet all applicable laws and regulations.

For Stream 2, representative data sets that describe the platform motion for a limited number of different categories of HAPS can be provided on request.

The HAPS Challenge organisers will provide a series of HAPS Challenge seminars after the Challenge opens to enable prospective applicants to seek clarification and ask questions. These seminars will be provided on-line and will be advertised on the HAPS Challenge website.

## Help

If applicants have any questions about the HAPS Challenge and what is required to make an application for each Stream and Phase, please consult the HAPS Challenge website in the first instance. If an issue is not addressed on the website, applicants may email the HAPS Challenge organisers at HAPS.Challenge@tasdcrc.com.au Please note that all unsolicited contact with the HAPS Challenge organisers must be via this email address. Responses to questions will be made available to all applicants on the FAQs section of the HAPS Challenge website.