

# CDE Competition document: many drones make light work

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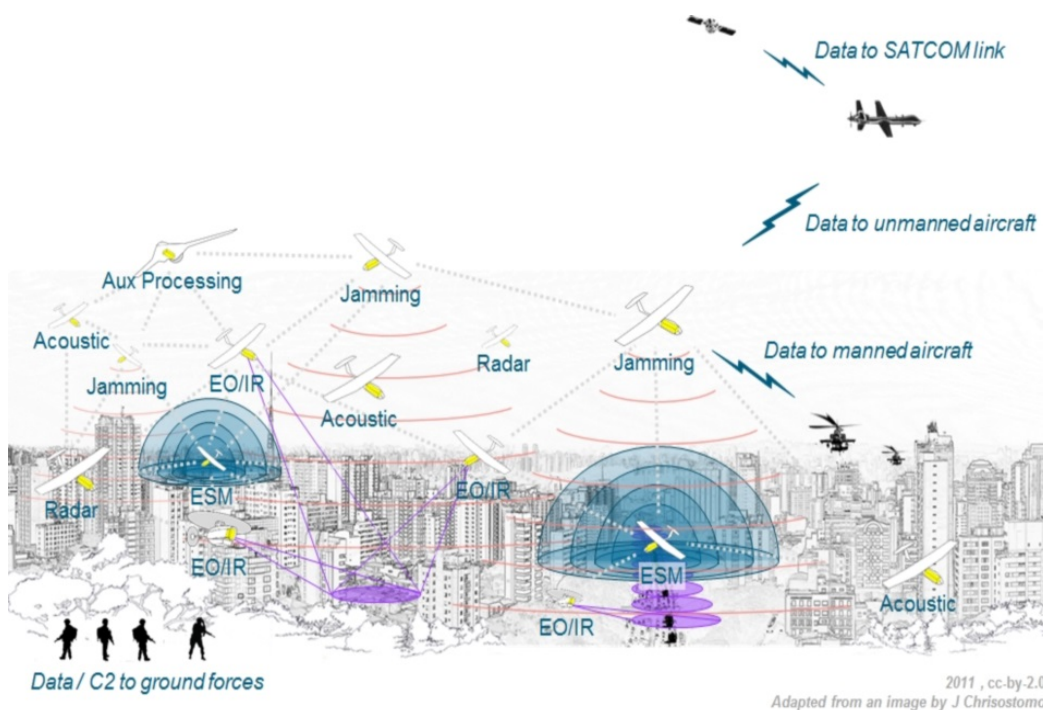
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## 1. Many drones make light work

This [Centre for Defence Enterprise \(CDE\)](#) themed competition seeks to demonstrate and evaluate the benefit that Unmanned Air System (UAS) swarms could bring to defence.

This competition will be briefed at the [CDE Innovation Network event on 22 September 2016](#) and at a [webinar on 3 October 2016](#).

Your proposal must be received by CDE by 5pm on Thursday 3 November 2016. Your proposal [must be submitted to CDE online](#).



EO/IR: Electro optic/Infrared : Command and Control ESM: Electronic support measures SATCOM: Satellite communications.

## 2. Background

UAS are currently in use with a range of defence and security users around the world. These systems typically require at least one operator to either directly pilot the aircraft or closely manage the mission flown by an individual aircraft.

The ability to employ a swarm of UAS (considered to be 10 to 20 aircraft, and potentially more, in this competition) operating in a co-ordinated and closely coupled fashion to achieve a common goal could be of great benefit to defence and security. This could help in terms of operating costs, system efficiency and effectiveness.

Through this CDE themed competition, we're seeking new and emerging technologies, systems and techniques to enable militarily useful swarming UAS. We want this competition to demonstrate how UK industry (particularly small and medium enterprises (SMEs) working with academia and primes where appropriate) working in partnership with the Defence Science and Technology Laboratory (Dstl) could rapidly deliver new military capability by exploiting emerging and innovative technologies. As well as developing component technologies, we also want to go on to demonstrate integrated system solutions by using components from a number of suppliers.

## 3. Technology challenges



Ultimately, we want more than 10 UAS to operate in a co-ordinated and closely coupled way to achieve military effect across the electro-magnetic (EM) spectrum (in other words ranging from visible frequencies through to low frequency radio waves), in a contested environment, and all managed by a single operator.

We're interested in the application of swarming UAS to missions in complex urban and littoral environments. For example:

- tracking individuals
- tracking vehicles
- area mapping
- area surveillance
- communications relay

Proposals will need to demonstrate how your concept will contribute to overcoming the technical challenges described here.

This is a demanding objective which we have split into the following challenge areas.

### **3.1 Challenge 1: open, modular UAS platforms**

We want proposals for designing modular UAS platforms that use common open systems architectures to enable rapid integration of technology components from across a wide supplier base.

We're looking for concepts that allow different platforms, with different performance characteristics, to be assembled just before a mission.

We think it's unlikely that a single size of air vehicle platform can cost-effectively provide the solution. Our initial investigations indicate that at least 2 air vehicle platform types will be required to undertake the type of missions we've described. We anticipate these will be:

- ~2Kgs
- ~20Kgs

Off-the-shelf airframes could offer a practical solution, however the mission systems shall be common between air vehicles and use known open standards wherever possible.

Swarming UAS as a concept is only viable if the platform costs are very low. You'll need to demonstrate how these platforms can be supplied and operated at a low cost and how they can integrate technologies from other suppliers in a cost-effective way. Your proposal will also need to show how you'll develop indicative costs for supplying 10, 15 and 20 platforms for subsequent demonstrations in a phase-2 contract.

Within the phase-2 activities we're planning to use a number of platforms as carriers for successful technologies developed in the other phase 1 competition challenges and undertake integrated live flight events of system solutions.

Therefore previous experience of collaborative working and proposed approaches to rapidly integrate technologies from across the supply chain will support successful bids.

### **3.2 Challenge 2: mission management of UAS swarms**

We're looking for proposals to demonstrate how a single operator could manage and command a swarm in excess of 20 UAS of different capabilities undertaking military relevant tasks in an integrated way.

The swarm may be composed of a number of sub-teams or squads, which have their own mission sub-goals. Due to the nature of the task you'll need to develop approaches that will support varying levels of platform autonomy.

Phase-1 proposals should define how the system could be used and commanded and demonstrate mission management approaches for systems employing sensors across the EM spectrum. Phase-1 proposals will be

expected to define the system in broad terms and, critically, to define mission system and architecture interfaces between components of the proposed system. The number and size of vehicles should be appropriate to the missions envisaged. Proof-of-concept demonstrations are encouraged in phase 1.

In phase 2, successful bidders will be expected to provide more representative demonstrations and evaluations in a representative synthetic environment and/or live trial evaluations. You will also have to demonstrate how the Command and Control (C2) concepts can be integrated with UAS platforms and technologies developed in the other competition challenges.

This challenge is looking for phase-1 proposals that consider:

- human autonomy teaming concepts and associated human machine interface for a large number of platforms and considering a range of strategic and tactical users
  - mission co-ordination tools
  - mission planners
- delivering military effect with a swarm of UAS
- autonomous behaviours of swarming UAS, including how to make use of emergent behaviours and tactics
- information fusion and exploitation approaches
- verification and validation approaches for swarming concepts

### **3.3 Challenge 3: developing technology enablers for UAS swarms**

We want proposals for projects to help us understand the utility of UAS swarms and the potential value of fractionation.

Fractionation is when you split up a capability or system normally carried by a single platform across multiple platforms, to reduce the size of the required platforms and achieve enhanced system-of-systems effects.

We're looking for proposals to develop sensing concepts and associated outline concepts of how these systems may be employed by the military across the EM spectrum including:

- communications relay
- electronic surveillance
- jamming/electronic attack
- novel low size and weight and power sensing solutions suitable for swarming concepts

These could include for example:

- low-cost sensing techniques
- novel multi-platform sensing techniques
- sense and avoid
- more accurate navigation due to swarming
- multi-platform co-ordination
- multi-source, multi-modal data fusion
- low-cost novel power sources
- low-cost secure data storage

## 4. What we want

We'll favour projects that consider a system approach and include technology demonstration over projects that only produce a written report.

All proposals need to consider the system integration aspects and how components can be integrated into system solutions.

To help subsequent integration within Phase 2 activities, you should consider using elements of the [European Component Oriented Architecture](#) (ECO) software standard. You should design your solution to be modular through following a [functional separation of concerns design principle](#). This will make any future integration to an ECOA-based system easier, as it will facilitate the wrapping of the modular product to provide a service-based interface. This approach should also enable any future development into a fully ECOA product to be achieved with greater efficiency.

We're looking for innovative proposals, but you should state clearly the technology developments needed to realise the innovation and the expected timescale for technology maturation.

We're interested in the application of technologies ranging from low to high maturity, including commercial-off-the-shelf (COTS) technologies that can be integrated into novel systems to provide low-cost military capability.

You don't have to provide a whole solution. Your proposed technology could offer part of, or an important step towards, the solution to the challenge. We'll encourage you to collaborate in any follow-on phase-2 projects.

## 5. What we don't want

For this competition we're not interested in proposals for:

- consultancy
- demonstrations of off-the-shelf products
- paper-based studies or literature reviews
- solutions that don't offer significant benefit to defence
- incremental improvements
- projects that can't demonstrate feasibility within the phase 1 timescale

We're not interested in the development of purely generic swarming models or algorithms. We want to see specific developments to support our particular challenges.

We won't fund projects that have little innovation, but we'll consider proposals for research into a novel approach to exploiting existing technology.

We don't want proposals for PhD projects as the timescale for delivery is too constrained.

## 6. Exploitation

This work is part of a wider Dstl Disruptive Capability research project, and we'll be contracting in parallel with other organisations via other contracting routes.

All projects funded at phase 1 through this competition will be expected to take part in a number of networking events and a presentation day together with the other funded organisations. These events will provide an invaluable opportunity to meet other participants and discuss potential collaboration, with the intention of

enabling a viable system demonstration at the end of the phase-2 activity. You should cost attendance at these events into your proposal.

The first event will take place in February/March 2017 at or near a Dstl site where you will have the opportunity to meet the other project teams that were successfully funded at phase 1 and start to develop a collaborative community. You'll give a short presentation (just a few slides) describing your project, what you hope to achieve during phase 1 and outline what you think your phase-2 work will look like. We're really keen to promote collaborative bids for phase 2 so that you consider how your technology needs to integrate with other solutions to deliver a final system.

The second event will also take place at or near a Dstl site in May/June 2017. We aim to provide even more opportunity for you to collaborate by introducing you to other organisations that Dstl think could provide support to the successfully funded phase 1 organisations in developing their phase-2 projects. These may be identified via the wider Dstl Disruptive Capability research project. We want to do this because a phase-2 proposal may need you to consider the requirement to collaborate with other technology providers in order to deliver a demonstrable system.

The final stakeholder event will take place in July 2017 when bidders will demonstrate the successful outputs of phase-1 projects to stakeholders.

As a deliverable of the phase-1 project, successful bidders will be expected to produce a fully costed proposal for a phase-2 project which must be submitted using the [CDE online submission service](#) by 5pm on 1 August 2017.

We aim to take forward a number of the most successful outputs from phase-1 projects for phase-2 funding. Only bidders funded at phase 1 qualify for entry into phase 2 of this competition where up to an additional £2 million of funding will be made available. Phase-2 funding will be awarded on a per-project basis. Phase-2 projects can last up to 12 months.

Outputs of funded work may be exposed to international government partners in [The Technical Cooperation Program \(TTCP\)](#) and [NATO](#) communities ([full rights version only](#)). This is to promote international collaboration and to give projects the best chance of exploitation through exposure to a larger scope of defence requirements.

There will be an opportunity for projects funded at phase 2 to participate in the TTCP Littoral Autonomy Strategic Challenge trials planned at Cardigan Bay in September 2017. You should cost for attendance at these trials in your phase-2 proposal.

## **7. Important information**

This competition will be supported by presentations given at the [CDE Innovation Network event on 22 September 2016](#), and at a [webinar](#) on 3 October 2016.

Your proposal must be received by CDE by 5pm on Thursday 3 November 2016. Proposals [must be submitted to CDE online](#).

We won't accept proposals over £100,000 and it's more likely at this stage that a larger number of lower-value proposals (for example, £40,000 to £80,000) will be funded than a small number of higher-value proposals. Total funding available for phase 1 of this competition is £1 million.

Proposals should focus on a short, sharp, proof-of-concept research phase up to 6 months in duration, with deliverables completed by 30 June 2017

[Read important information about how to submit a proposal to CDE.](#)

Proposals should include a descriptive scoping for a longer programme (phase-2 onwards) of any duration, but the proposal should be clearly partitioned with a costed proof-of-concept stage, which is the focus of the first phase of this CDE themed competition.

Phase-2 work will only be considered after the phase-1 proof-of-concept has delivered. The understanding gained in phase-1 will allow Dstl to make an informed decision about funding for future work.

Proposals will be assessed by subject matter experts from across the MOD. [Read about how your proposal is assessed.](#)

Dstl will be available to provide advice and/or guidance via an appointed technical partner throughout the project and act as the interface with Dstl, MOD and the wider government stakeholder community.

Deliverables from contracts will be made available to technical partners and subject to review by UK MOD.

## **8. Ethical considerations and The Regulation of Investigatory Power Act (2000)**

### **8.1 MOD Research Ethics Committees**

All research involving human participation conducted or sponsored by MOD is subject to ethical review under MOD procedures as outlined in [Joint Service Publication 536 'Ministry of Defence Policy for Research Involving Human Participants'](#), irrespective of any separate ethical procedures (for example from universities or other organisations). This ensures that acceptable ethical standards are met, upheld and recorded, adhering to nationally and internationally accepted principles and guidance.

The following definitions explain the areas of research that require approval:

- clinical: conducting research on a human participant, including (but not limited to) administering substances, taking blood or urine samples, removing biological tissue, radiological investigations, or obtaining responses to an imposed stress or experimental situation
- non-clinical: conducting research to collect data on an identifiable individual's behaviour, either directly or indirectly (such as by questionnaire or observation)

All proposals should declare if there are potential ethical issues.

Securing ethical approval through the MOD process can take up to 3 months. In this CDE themed competition, proof-of-concept projects must be completed by 30 June 2017 and obtaining ethical approval could take your proposal beyond the timeline for completion of phase 1. We, therefore, recommend that you only include research in phase 1 that doesn't require ethical approval. Work that might require ethical approval should be planned for future phases of work which are likely to have longer and more flexible timescales.

However, if you think that your phase-1 proposal may require ethical approval, please ensure that you take an approach in your submission as follows (noting that projects must still complete by 30 June 2017):

- milestone 1: gaining ethics approval for the project, including delivery of the research protocols (the protocol will need to be detailed by [completing the ethics application form](#))

- milestone 2: proposed research that will be carried out subject to gaining ethics approval (optional phases to be formally invoked, where appropriate)

A contractual break point should be included after milestone 1.

[Read more on the MOD Research Ethics Committees.](#)

The requirement for ethical approval isn't a barrier to funding; proposals are assessed on technical merit and potential for exploitation. Successful proposals will be supported through the ethical review process; however, an outline of your research methods must be included in your proposal to help this process.

## 8.2 The Regulation of Investigatory Power Act (2000) considerations

The Regulation of Investigatory Power Act (RIPA) is an act of the Parliament of the United Kingdom, regulating the powers of public bodies to carry out surveillance and investigation, and covering the interception of communications. You should ensure that your proposal or the work you're proposing to undertake doesn't cause a breach of these regulations.

## 9. Dates

22 September 2016	Competition briefing at <a href="#">Innovation Network event</a>
3 October 2016	<a href="#">Webinar</a>
3 November 2016	Competition closes at 5pm
January 2017	Contract placement initiated and feedback provided
February/March 2017 (date to be confirmed)	Collaboration networking event
May/June 2017 (date to be confirmed)	Collaboration networking event
30 June 2017	Latest date for the delivery of phase-1 proof-of-concept research
July 2017(date to be confirmed)	Phase 1 stakeholder event
1 August 2017	Phase 2 competition closes to submission of phase-2 bids at 5pm
Mid-September 2017	Phase-2 funding decisions made
October 2017	Phase-2 contracts placed
October 2018	Latest date for delivery of phase 2 projects

## 10. Queries and help

While you're preparing your proposals, you can contact us if you have any queries:

Technical queries about this competition should be sent to: [swarming@dstl.gov.uk](mailto:swarming@dstl.gov.uk)

Capacity to answer these queries is limited in terms of volume and scope. Queries should be limited to a few simple questions or if provided with a short (few paragraphs) description of your proposal, the technical team will provide, without commitment or prejudice, broad yes/no answers. This query facility is not to be used for extensive technical discussions, detailed review of proposals or supporting the iterative development of ideas. While all reasonable efforts will be made to answer queries, CDE and Dstl reserves the right to impose management controls when higher than average volumes of queries or resource demands restrict fair access to all potential proposal submitters.

General queries should be sent directly to CDE at: [cde@dstl.gov.uk](mailto:cde@dstl.gov.uk)