RCloud Tasking Form – Part B: Statement of Requirement (SoR)

Title of Requirement	Fast Acquisition GPS Location (FAGL)
Requisition No.	**1000166318**
SoR Version	**0.1**

1.	**Statement of Requirements**
1.1	**Summary and Background Information**
	Dstl has a requirement to develop a miniature, ultra-low power, self-contained device that will provide the means to capture high accuracy Global Positioning System (GPS) geo-locations, even when physical exposure to overhead GPS satellites is extremely short term, often limited to less than a second. Unfortunately to conserve battery resources, reduce power consumption and hence prolong mission life, the extensive range of standard commercially available GPS receivers operate in a 'cold start' configuration where a Time To First Fix (TTFF) can typically take between 2 to 4 minutes to correlate a location from initial powering-up, consequently they cannot respond quickly enough to fulfil this challenging requirement. A novel technique and approach to overcome this limitation is established and known to the Authority. The Supplier will be expected to extensively investigate and explore previous work on the technique/concept, assess the feasibility to deliver against the requirement and recommend improvements and/or new approaches to enhance the potential of the capability. The assembly of a proof of concept demonstrator will be required by the Authority to provide evidence that the requirement is achievable, and will be ultimately followed by a complete miniaturised prototype version if considered by the Authority to be both viable and within available budget. The novel technique identified by the Authority has the potential when activated to effectively obtain raw GPS satellite data in less than 100ms. Its approach is to capture GPS satellite Radio Frequency (RF) signals transmitted by overhead GPS satellites in view, record the observed satellites ID via their unique Pseudo Random Numbers (PRNs), and simultaneously archive an accurate correlation timestamp.

	Limited local correlation calculations on the captured pseudo-ranges are implemented without any ephemeris or satellite almanac data and each captured location is compressed into smaller data sets which can either be locally stored and/or egressed via narrow bandwidth commercial satellite communication systems such as ARGOS-1 (24 kHz uplink), and Short Burst Data (SBD) Iridium services (31.5kHz). Individual GPS location points have to be post processed by a custom developed software tool running on a computer to generate a physical location on the Earth. The tool must be provided with a rough estimate of location, as well as information about satellite ephemerides (GPS satellite positions in the sky) when the GPS location point was captured using archived GPS constellation archives maintained by NASA. REDACTED UNDER A FOIA EXEMPTION
1.2	**Requirement**

	The Authority has a requirement to provide a new capability to capture GPS quality geo-location data in challenging operational environments where traditional GPS receivers are too slow to respond. A complete system would include: • **Location Module:** developed as a miniature bare board printed circuit board (PCB) design for integration into other projects to include:- a. 50Ω connector to connect a commercial GPS passive antenna b. Ultra-low noise GPS front end receiver. c. I/O connector to initiate GPS capture via an external input d. On board three axis accelerometer to initiate GPS capture via motion e. Microprocessor for GPS capture & archive memory storage f. ata compression software (ideally developed using commercially available software g. Micro USB connector to enable manual data extraction when recovered h. Serial peripheral interface (SPI) digital interface to facilitate satellite communication systems data egress. i. Battery connections to off-board Lithium power source • **Processing Module:** developed as a post processing PC/laptop software tool to include:- a. Constructed within a Windows 10 operating system environment b. Manual data download from a recovered location module (via Micro USB connector) c. Secure server access for NASA post processing d. Custom developed post processing software e. Server access for satellite modem services REDACTED UNDER A FOIA EXEMPTION f. Graphical User Interface (GUI) to present post processed GPS locations via CSV and KMZ - compressed Google Earth file formats

To deliver this new capability, development will be broken into three work packages (WP):

- WP1 System Design;
- WP2 Benchtop demonstrator;
- WP3 Prototype development.

A **firm price costed proposal** is required which includes WPs 1-3 stated below. Each WP must be costed individually.

Deliverables required for the below tasks can be found in section 1.6 of this document.

There will be a contract option between each WP with a Go/No-Go Decision Point.

WP 1

Technical literature search: During this initial phase, the supplier must conduct a detailed technical literature review (published literature and papers related to the concept) and explore operational aspects of the suggested technique including any historical or current applications.

System Architecture: The supplier is to build upon the initial literature search and generate a system architecture best suited to meet the user requirements as specified at the end of this section. The Supplier must capture and derive a set of System Requirements to meet all mandatory requirements stipulated in this document. The Supplier must also host a System Requirements Review (SRR) with the Authority for endorsement. Documents[1] that shall be available prior to the SRR include:

- System use cases;
- System requirements document (SRD);

The Supplier must then proceed to derive the system design, based upon the endorsed SRD. It is expected that the Supplier will conduct any necessary trade-offs to maximise the compliance of the proposed solution with the SRD, with a focus on size, weight and power (SWaP) and reliability. All trade-offs must be mutually agreed with the Authority.

All design decisions and accompanying assumptions, cost and risk must be captured by the Supplier, leading to a system design review. The design review will involve a presentation to the Authority of design options and recommendations for an approach which best meets the SRD. Documents that must be available prior to the review include:

- System Design Document;

[1] The Supplier should also determine the most appropriate deliverables from this (and subsequent) WP's according to their own internal System Engineering System (SES) and Quality Management System (QMS).

- System Interface Control Document;
- System Architecture Description;
- Test Concept and Draft Test Plan.

These documents may be included as sections within a single document and will be used as the reference point for the remainder of the development. Contract option

WP2

Large Scale Demonstrator: WP2 must result in the production of a demonstrable proof of concept model of the system based on the System Design agreed in WP1. The Supplier is expected to produce the model using large scale laboratory hardware, Commercial Off The Shelf (COTS) development boards, breadboards and accompanying software/firmware. The system model must demonstrate all functionality and capability of the design (location module and processing module) to the Authority and should (as close as can be reasonably expected) represent the performance of a miniaturised final design.

The Supplier must hold a Preliminary Design Review (PDR) prior to build to agree the design with the Authority. The PDR must capture any deviation from the design agreed in WP1. Documents that must be made available prior to the PDR include any updates to the strategic design review documents from WP1, plus:

- PowerPoint presentation pack for the PDR; □ System Test Specification.

The Supplier must build the model and validate compliance against the system requirements. A demonstration to the Authority must be held at the Supplier's premises. Documents to be made available prior to the demonstration event include any updates to the PDR documentation plus:

- Test Report; including explanation of any significant deviations from expectations, lessons identified and recommendations for improvements. Contract option

WP3

Prototype Development: WP3 will design, build and test 5 location modules and 1 processing module based on the WP2 output. Testing on the location module must include environmental

(temperature, vibration, shock) and specification validation, as well as Radio Frequency Interference (RFI) susceptibility and false operation validation tests.

The Supplier must hold a Critical Design Review (CDR) prior to build to present the design for the location and processor module to the Authority. Documents that must be available prior to the CDR include any updates to the PDR documentation plus:

- System Test Specification; this document must be structured such that the Authority can independently replicate testing. The Authority may wish to provide additional test serials;
- Equipment breakdown structure (list of components);
- Assembly drawings (physical and logical assembly); □ Production plan.

The Supplier must build the prototypes and validate their compliance against system and user requirements. The Authority may wish to be present for aspects of this testing. Any discrepancies or failures must be assessed and a remediation plan put into effect. Once all tests have been passed according to mutual agreement of the Supplier and Authority, the Supplier must hold a demonstration and handover event. Documents that must be available prior to the event include any updates to the CDR documents plus:

- System Test Report; this will evidence all tests being passed;
- Technical Data Pack (TDP); this must support potential future manufacturing of duplicate prototypes by the Authority. The TDP must include (as a minimum): ○ All developed operational firmware for the location module; ○ All developed operational software for the processor module; ○ All circuit diagrams; ○ All PCB diagrams; ○ PCB layout plot files; ○ Component listings;
  - ○ Any accompanying configuration tools;
  - ○ Mechanical assembly drawings; ○ User guide.

Mandated User Requirements

1. The location module shall meet or exceed current commercial GPS receiver sensitivities at 1575.42 MHz (L1 frequency) at a power level of ~125 dBm
2. Fully processed GPS location accuracy shall be between 20 and 100m
3. The location module shall be fitted with a standard 50Ω miniature connector to facilitate the use of commercially available passive GPS antennas

4. Three sources of activation shall be included to prompt the location module into capturing a GPS location point,
    a. Single I/O input (to facilitate activation via an external sensor)
    b. User defined time (configurable from 1 hour to 24 in 1 hour intervals)
    c. Motion (three axis accelerometer to detect movement) and include a user configuration capability to adjust activation sensitivity
5. The location module shall function in three modes:
    a. Quiescent (non-activated); Average quiescent current: objective: not to exceed 100nA. Mandated; not to exceed 2uA
    b. Activated (capturing a GPS capture, processing data and memory archive):- Average activated current: not to exceed 150mA
    c. Data egress of GPS capture data archive via a satellite communication system: - subject to satellite modem current requirements.
6. The location module shall also include an accurate internal clock to timestamp all of its captured locations. Error in the clock, and therefore the timestamps, can cause an error in the calculated locations:-
    a. A timing accuracy of 1PPM or better is required.
7. The location module shall operate with a range of standard commercially available lithium battery power sources. Therefore the operational voltage range will be equivalent or wider than:
    a. 3.0 to 4.2 V.
8. Operational temperature ranges for deployable location modules shall meet or exceed: a. -15^{o}C to +70^{o}C
9. Storage temperature ranges for location modules shall meet or exceed: a. -20°C to 85°C
10. The location module shall be fitted with non-volatile memory for location data set archive with a storage capacity to provide a minimum of:
    a. 500 individual location points
11. To ensure only successful locations are recorded by the location module, the supplier shall develop an efficient data validation processing technique prior to archiving and/or egressing data.
12. The location module data compression for satellite communication egress shall be compatible with:-
13. REDACTED UNDER A FOIA EXEMPTION
14. The bare board location module dimensions shall not exceed:

	a. 30mm(L) x 20mm(W) x 15mm(H) With an objective board size of: b. 25mm(L) x 15mm(W) x 10mm(H) 15. The location module shall withstand impact equivalent to a 1 metre drop on to a hard surface. a. No formal defence standard needs to be followed for this development. 16. Location modules shall have inherent resilience against RFI susceptibility and false operation caused by REDACTED UNDER A FOIA EXEMPTION 17. REDACTED UNDER A FOIA EXEMPTION 18. The processing module software shall enable clock errors to be corrected if a measure of the error is known. For satellite egress data, the current capture time can be compared with the satellite's clock. However for recovered location modules, any known clock error measurements will need to be entered manually via the GUI. The GUI operating in the processing module for selecting functions should be simple and intuitive for military operator use. A minimum number of menu layers and key presses should be required to achieve the desired function.
1.3	**Options or follow on work**
	For information purposes only at this stage. Not to be addressed during the competitive ITT.process.**WP4** • **4a:** Explore the development of a location module manufactured entirely on a flexi-PCB substrate to enable greater future operational potential. • **4b:** Investigate additional software tools to enhance the fundamental capability and provide users with an informed statistical movement model or location smoothing for deployed location modules. • **4c:** Explore techniques for maximising efficiency by determining when a capture will be successful (i.e. in view of sky) **4d:** Investigate alternative activation techniques and technologies to determine when an location module should record a GPS capture
1.4	**Contract Management Activities**
	Managed by the project manager with a technical partner delegated who will be responsible for ensuring that regular progress conversations will take place. Formal meetings at each deliverable stage.

1.5	**Health & Safety, Environmental, Social, Ethical, Regulatory or Legislative aspects of the requirement**
	Please list any relevant experience qualifications in your proposal.

1.6	Deliverables & Intellectual Property Rights (IPR)					
Ref.	**Title**	**Due by**	**Format**	**Expected classification (subject to change)**	**What information is required in the deliverable**	**IPR Condition**
D1	WP1 System Requirements Review and presentation	T0+8 weeks	Presentation (.pptx) Documentation (Excel/Word)	O	Documentation to be available at least 5 days prior, including: □ System use cases System requirements document	
D2	End of WP1 System design review and presentation	T0+16 weeks	Presentation (.pptx) Documentation (Word)	O	Updated documents to be available at least 5 days prior, including: • System design document • System interface control document • System architecture description • Test concept and draft test plan The above can be contained in individual or a combined document.	

D3	WP2 Preliminary design review and presentation	T0+24 weeks	Presentation (.pptx) Documentation (Word)	O	Updated documents to be available at least 5 days prior, including: System test specification	
D4	End of WP2 demonstration and presentation	T0+32 weeks	Presentation (.pptx) Documentation (Word)	O	Updated documents to be available at least 5 days prior, including: Test report Demonstration at Supplier's premises	
D5	WP3 Critical design review and presentation	T0+38 weeks	Presentation (.pptx) Documentation (Word)	O	Updated documents to be available at least 5 days prior, including: • System test specification • Equipment breakdown structure(list of components) • Assembly drawings (physical and logical assembly) Production plan	

1.7	**Deliverable Acceptance Criteria**
	As per R-Cloud T&Cs. • Technical data pack including all information required to allow future third-party manufacture of additional units. • Successful demonstration of all 5 location modules and 1 processor module, functioning as per the mandatory requirements and agreed System Test Report. • The Authority to successfully operate one of the prototype location modules using the user guide supplied as part of the delivery process.

2	**Evaluation Criteria**
2.1	Method Explanation
	The VFM index will produce a score will be a division of technical score and price. **1. Technical Total score will be out of 110** **2. The price will be divided by 1000 to give a better score prior to dividing technical score by the price.** **3. Total technical score is then divided by the price:** **For example if the price is 70,000 it will be divided by 1000 to 70, eg. 100/ 70 would give a score of 1.428 or 100/60 gives a score of 1.666- The highest score wins and demonstrates the best value both technically and financially.**
2.2	Technical Evaluation Criteria

ID	Technical Evaluation Criteria	Score	Weighting
1	Proposal clearly demonstrates through the provision of evidence that the contractor is experienced with the design and implementation of LF circuitry and products.	0-10	2

		2	Proposal clearly demonstrate through the provision of evidence that the contractor is experienced with producing software required to run the system.	0-10	2	

		3	Proposal clearly demonstrates through the provision of evidence that the contractor understands similar systems.	0-10	2	
		4	Proposal demonstrate with evidence that it has addressed all of the outlined technical requirements within the SOR.	0-10	1	
		5	Proposal demonstrates with evidence that the Contractor has necessary assets and expertise to successfully undertake the work package stated within the SOR.	0-10	1	
		6	Contractor demonstrates successfully completing the work package within the required timescales in accordance with deliverable dates within the SOR.	0-10	1	
		7	Proposal demonstrates a willingness to engage with 3rd party organisations where appropriate.	0-10	1	
		8	Proposal indicates that the Contractor takes a flexible and innovative approach and is keen to help Dstl shape its requirement and provide the best possible solution.	0-10	1	
			Total available score		**110**	

The following scoring guide will be used to evaluate against each criteria

The scoring range shall apply the following definitions:

Excellent	The response addresses all elements of the Requirement and provides a comprehensive, unambiguous and thorough explanation of how the Requirement will be fulfilled.	10
Good	The response addresses all elements of the Requirement and provides sufficient detail and explanation of how the Requirement will be fulfilled.	7
Adequate	The response addresses the majority of elements of the Requirement but is weak in some areas and does not fully detail or explain how the Requirement will be fulfilled.	3
Inadequate	The response does not address or explain how the Requirement will be fulfilled and fails to demonstrate the ability to meet the Requirement.	0

2.3 Commercial Evaluation Criteria

Serial	Question	Marking
1	Does the proposal for WP1 only, fall within the specified maximum budget (£75k)	Pass / Fail
2	Has the proposal been submitted against a Firm Price	Pass / Fail
3	One full technical proposal, excluding all price detail has been submitted	Pass / Fail
4	One full Technical and Commercial proposal, including all price detail, has been submitted	Pass / Fail
5	A completed RCloud Part C Task Response Form has been completed and submitted	Pass / Fail
6	A completed Cyber Risk Profile form has been completed and submitted	Pass/Fail