Serapis Tasking Form

Tasking Form Part 1: *(to be completed by the Authority's Project Manager)*

To:	Lot 4 QinetiQ Plc	**From:**	The Authority
Any Task placed as a result of your quotation will be subject to the Terms and Conditions of Framework Agreement Number: LOT 4 DSTL/AGR/SERAPIS/AII/01			
VERSION CONTROL			
1.2			
REQUIREMENT			
Proposal Required by:	13/08/21	**Task ID Number:**	AII57
The Authority Project Manager:	[REDACTED-PERSONAL INFORMATION]	**The Authority Technical Point of Contact:**	[REDACTED-PERSONAL INFORMATION]
Task Title:	Agile Radio Resilient Control Plane Mechanisms		
Required Start Date:	23/08/21	**Required End Date:**	T0+18weeks
Requisition No:	1000165399	**Budget Range**	£150k
TASK DESCRIPTION AND SPECIFICATION			
Serapis Framework Lot	☐ Lot 1: Collect ☐ Lot 2: Space systems ☐ Lot 3: Decide ☒ Lot 4: Assured information infrastructure ☐ Lot 5: Synthetic environment and simulation ☐ Lot 6: Understand		

Statement of Requirements (SOR)

Introduction

The development of an Agile Radio promises to provide resilient communications within a Denied and Degraded Electromagnetic Environment (D2EME) with the benefits of mitigating evolving Electronic Warfare (EW) threats posed by CEMA challenges. Agility, when focussed on the radio, requires that it autonomously modify aspects of its capability, such as waveforms, frequency, emissions i.e. Effective Isotropic Radiated Power (EIRP) in response to external influences and defined controls based upon its radio network's capabilities and the users' information services that it needs to support.

The control plane mechanism is a key enabler for the control of agile radio functions which provide the resilience. The key challenge, therefore, is how to implement the control in a such a way that the communication of control information is itself resilient, secure and interoperable with other systems. This challenge is further compounded by mobility of the radio node in a potentially time and spatially varying signal environment. In such an environment, radio links may connect and disconnect numerous times (due to fading) and the control mechanism must manage ongoing continuity of communications as efficiently as possible.

The control plane mechanisms are required throughout the communications protocol stack. For example:

- Physical Layer mechanisms may include Adaptive Modulation and Coding (AMC), power control or even PHY types (e.g. OFDM / DSSS switching) and intelligent antenna techniques.
- Datalink / Radio Resource Layer mechanism to manage channel allocations.
- Network Layer mechanisms to manage routing algorithms (e.g. to avoid local disruption).
- Transport / Session layers to manage multiple bearer types where available.

The focus of the work in this SoR will be the control mechanisms for the Physical and Datalink Layers (Layers 1 and 2).

A Technology and Market Assessment Report [1] considered technology shortfalls and highlighted a technology shortfall of robust and resilient Rendezvous Protocols. Additionally, although a basic control mechanism for channel allocations was integrated in the Dynamic Spectrum Access and Management (DSpX) radio demonstration [2], the work highlighted the need for further research on generalised approaches to control mechanisms as well as the development of specific experimental implementations to inform future directions for DSpX systems.

The Agile Radio work follows a Track 1/Track 2 development approach where Track 1 focuses on near term implementations/experimentation concentrated around current MOTS/COTS radio technologies. Track 2 considers the wider technology landscape of the Intelligent Bearer and how these may evolve into future Agile Radio capabilities. This is a Track 2 study that we hope will inform both future Track 2 and Track 1 activities.

Benefits of the work

The expectation of the task is that it will:

- Increase Technical Readiness Level of resilient control plane mechanisms, identifying those with near term exploitation potential (Track 1) and those with lower maturity (Track 2)

It is expected that the task will take as inputs:

- Previous work considering the control resilience in the higher layers [3]
- General theory or concepts such as general COTS methods and techniques and models
- Industrial background IP

It is expected that the task exploitation will be via:

- Knowledge or capability in UK industrial base
- Being better prepared to respond to future opportunities and threats thus providing;
- Improved speed of decision making when adapting radio parameters
- Increasing the technology options for MORPHEUS BEARERS (‘BEARERS’) project, which is, tasked with delivery of a replacement communication system for the British Army. The BEARERS communications capability needs to deliver improvements in Capacity, Flexibility, Resilience and Interoperability.
- Contribute to future agile control plane tasks

Statement of Requirements

This work seeks to de-risk resilient control plane techniques and approaches as a mitigation-response of a Radio Frequency based radio communications system when operating in the Cyber and Electromagnetic Affects (CEMA) environment against an adversary acting with hostile intent. The techniques and approaches studied should build on those concepts developed under Dstl’s Resilient Deployed Communications (RDC) Intelligent Bearers project, the Agile Radio Concept (ARC).

Outline requirement

It is proposed that the work will be conducted in three stages:

1. Stage 1: Technical Review of literature and prior art
2. Stage 2: Technical Research of candidate concepts
3. Stage 3: Experimentation and technique evaluation Ideas

The research performed in this task should be considered against the illustrative radio use case scenarios below, namely operations in a:

A. An Uncontested and Uncongested EM environment with a large radio network with little to no changes in connectivity,and stable demand for services within a steady or minimally varying physical environment. Eg a static deployment for training.

B. Dynamic network in a congested and contested EM environment experiencing connectivity changes in the order of minutes and increased demand for services depending on mission phase along with demand for resilience and LPI/LPD. Eg a network deployment experiencing EM threat and environmental fragmentation

C. [OPTIONAL] High mobility platform environment (i.e. one that experiences multiple outages e.g. due to fading, small size network up to 20 nodes)

In addition, the research shall consider the impact of the control plane mechanism on the following themes, identifying areas of high risk or significant intervention:

i. Security and associated accreditation
ii. Interoperability with legacy and coalition systems
iii. Coexistence and platform integration

The anticipated Stages of work and *potential* activities are described in the sections below

Stage 1: Technical Review of literature and prior art (The estimated duration is 6 weeks)

The objective of Stage 1 is to establish the state of the art for resilient control plane mechanisms and define the boundaries of scope for the research analysis in Stage 2.

Specifically, the steps in this stage are envisaged to be:

1. Boundary definitions
    a. Definition of at least three Layer 1 agile functions (e.g. adaptive modulation and coding, power control, an adaptive antenna mechanism) and the associated requirements for control (data requirements, control BW, latency etc).
    b. Definition of at least two Layer 2 agile functions (e.g. adaptive channel allocations, [slow] frequency hopping) and the associated requirements for control.
    c. Definition of a basic metric for resilience of the control plane. Note that this definition will be considered in more detail as part of a different work stream and a simple definition can be provided if required.
2. Literature review to establish the state of the art for resilient control mechanisms. Review material is expected to include:
    a. Academic publications
    b. Established air interface protocols
    c. Prior MoD funded work (to be provided as GFI[4])
3. Definition and agreement of activities for Stage 2

Stage 2: Technical Research of candidate concepts (**The estimated duration is 12 weeks)**

The objective of Stage 2 is to identify candidate methodologies for the control plane mechanisms and provide performance (estimated, modelled or simulated) information for the identified use cases using the defined agile functions and metrics.

Specifically, the research questions are:

1. What control mechanisms would be appropriate for each scenario outlining the benefits and drawbacks? For example, considering:
    - Is a single control mechanism possible for all scenarios, or is optimum performance (e.g. network availability/latency) gained from a bespoke approach to each?
    - When should a particular control mechanism not be used?
    - How could it operate with asymmetric data channels and a local EM Situational Awareness (SA) picture?
    - How does the control mechanism negatively impact attributes of the Agile Radio e.g. excess use of radio resources, physical performance via higher power?
    - If multiple techniques are determined necessary for optimal performance and consequently integrated onto a signal radio/network, how is the switching between different control mechanisms managed?
    - How is the behaviour of the control mechanism protected against common forms of inhibition waveform?
    - How can control mechanisms be augmented using additional data sources (e.g. Geographic Intelligence (GEOINT), or Inertial Measurement Unit (IMU), accurate clock)?
2. Consider how could the control mechanisms be emulated/simulated or modelled?
3. Consider how and what aspects of the control mechanisms could be demonstrated on a research SDR radio platform?

Stage 2 Questions 2 & 3 align with planned simulation of Agile Radio Concepts in a different work-package.

Stage 3: Experimentation and technique evaluation ideas (**The estimated duration is 4 weeks)**

The objective of the final stage is to provide tangible demonstration ideas, of the concept(s) building on Question 2 and 3 considerations in stage 2. The motivation for the concept demonstration is to provide:

1. Futher confidence/evidence in the concepts being considered;
2. A demonstration for the wider stakeholder community to promote understanding of the benefit of the work.

The demonstration could range from being quite simple in their form (e.g. Matlab programme) through to extending existing functionality through simulation or software defined hardware functionality. It is not expected that the demonstration will be conducted under this task, just recommendations for demonstration ideas to be captured in the final report.

Logistics

This task has been generated as an output of the Lot 4 AII27 Intelligent Bearers System Engineering Team (SET) Task. In order to support continued engagement with task AII27, Dstl require a member of the SET to support technical partner activities for this task. The budget for this time will need to be available within the given budget range highlighted above. The Intelligent Bearers Systems Engineering Team (IB-SET) will contribute to the overall management and direction of the task in collaboration with Dstl. It is estimated that the level of SET support required for this SoR will be 2 days per month and this effort will need to be accounted for within the available budget for this task. Monthly outputs will be required to inform the IB-SET activities.

Procurement Strategy

☒ Lot Lead to recommend ☐Single Source / Direct Award

Pricing:

☒ Firm Pricing ☐ Ascertained Costs* ☐ Other*

Firm Pricing shall be in accordance with DEFCON 127 and DEFCON 643

Ascertained Costs shall be in accordance with DEFCON 653 or DEFCON 802.

*only at Authority's discretion

Task IP Conditions

Task IP Conditions (Follow the NIPPY guide to identify your information and IP requirements for each deliverable)	**Summary of the Authority's rights in foreground IP (IP generated by the supplier in performance of the contract)**
DEFCON 703 ☒	Vests ownership with the Authority
DEFCON 705 Full Rights ☐	Enables MOD to share in confidence as GFI or IRC under certain types of agreements. Can be shared in confidence within UK Government.
OTHER IP DEFCONS: 14* ☐, 15* ☐, 16* ☐, 90* ☐, 91* ☐, 126* ☐	Generally only suitable for deliverables at TRL 6 and above.
BESPOKE IP Clause ☐ *	Details to be added and agreed by IP Group
* Do not use without IPG advice and approval	
It is intended that this task is carried out under DEFCON 703. However, if there is background IP associated with any aspect of this task then it should be declared from the outset.	

DELIVERABLES

Monthly progress reports as an email summarising progress and the next steps.

Deliverable 1: Interim Report / Presentation. Initial Review of Control Plane Mechanisms at CA + 6 weeks. Summary of the boundary conditions defined and control plane mechanisms intentified through the literature search and proposed way forward.

Deliverable 2: Final Report / presentation at CA + 18 weeks. Summary of the proposed Control Plane Mechanisms(s) and proposed plan for a way forward. The report will specifically distinguish the way forward for low TRL (2-3) Track 2 and medium TRL (4-5) Track 1 activities.

DELIVERABLE: ACCEPTANCE / REJECTION CRITERIA

Unless otherwise stated below, Standard Deliverable Acceptance / Rejection applies. This is 30 business days, in accordance with DEFCON 524 Rejection, and DEFCON 525 Acceptance.

Standard Deliverable Acceptance / Rejection:-

Yes ☒ (DEFCON 524 Rejection, and DEFCON 525 Acceptance)

No ☐ (if no, please state details of applicable criteria below)

Deliverable Acceptance / Rejection Criteria:-

If there are any other specific acceptance/rejection criteria you would like to apply to any of the deliverables, please state them here.

Government Furnished Assets (GFA)

ISSUE OF EQUIPMENT/RESOURCES/INFORMATION/FACILITIES (*if not applicable, delete table and insert "None" in this text box)*

Unique Identifier/ Serial No	Description	Classification	Type	Available Date	Issued by	Return or Disposal Date	Any restrictions?
QINETIQ/19/00442	CSIIS 2-1-68: WP2 Intelligent Radio Assessment Study, Technology and Market Assessment Report	*Official-Sensitive*	Report	T0	CB-C	T0+16wks	*Include details here*
QINETIQ/19/01921	CSIIS 2-1-68: WP3 Dynamic Spectrum Access and Management (DSpX) Phase II Final	*Official-Sensitive*	Report	T0	CB-C	T0+16wks	
	AII23 Control Plane Resilience final report	*Official-Sensitive*	Report	T0	CB-C	T0+16wks	
	AII27 Intellgent Bearers Technolgy Literature Review	*Official*	Report	T0	CB-C	T0+16wks	

QUALITY STANDARDS

☐ **ISO9001** (Quality Management Systems)

☐ **ISO14001** (Environment Management Systems)

☐ **ISO12207** (Systems and software engineering — software life cycle)

☐ **TickITPlus** (Integrated approach to software and IT development)

☐ **Other:** (Please specify in free text below)

SECURITY CLASSIFICATION OF THE WORK

The highest classification of this SOR

OFFICIAL ☒ OFFICIAL-SENSITIVE ☐ SECRET ☐ TOP SECRET ☐ STRAP ☐ SAP ☐

The highest expected classification of the work carried out by the contractor

OFFICIAL ☐ OFFICIAL-SENSITIVE ☒ SECRET ☐ TOP SECRET ☐ STRAP ☐ SAP ☐

The highest expected classification of Deliverables/Output

OFFICIAL ☐ OFFICIAL-SENSITIVE ☒ SECRET ☐ TOP SECRET ☐ STRAP ☐ SAP ☐

Is a Security Aspects Letter (SAL) required? *(A Security Aspects Letter (SAL) will be required for each Task above Official-Sensitive and above)*

Yes ☐ No ☒

TASK CYBER RISK ASSESSMENT. *(In accordance with DEF STAN 05-138 and the* Risk Assessment Workflow)

Cyber Risk Level	Very Low
Risk Assessment Reference	RAR-SUR72RYY

ADDITIONAL TERMS AND CONDITIONS APPLICABLE TO THIS CONTRACT

Please ensure all completed forms are copied to DSTLSERAPIS@dstl.gov.uk when sending to the Lot Lead.

Tasking Form Part 2: *(To be completed by the Lot Lead)*

To: The Authority	From: The Lot Lead

Serapis Proposal AII57 Control Plane Mechanisms V1.3 O

Proposal Reference QINETIQ/21/03469 **(attached)**

Delivery of the requirement:

The proposal <u>shall</u> include, but not be limited to:

- A full technical proposal that meets the individual activities that are detailed in Statement of Requirements (Part 1 to Tasking Form).
- Breakdown of individual Deliverables, with corresponding Intellectual Property rights applied.
- Breakdown of Interim Milestone Payments, with corresponding due dates.
- A work breakdown structure/project plan with key dates and deliverables identified.
- A list of required Government Furnished Assets from the Authority, including required delivery dates.
- A clear identification of Dependencies, Assumptions, Risks and Exclusions which underpin your Technical Proposal.
- Sub-Contractors Personnel Particulars Research Worker Form and security clearances (if applicable)

COMMERCIAL

As per the Serapis Limitation of Liability Discussion Paper Agreement, this task will fall under the band of a cap on liabilities of £500,000.

PRICE BREAKDOWN

Firm price quotation of £171,421.91 (One Hundred Seventy-One Thousand Four Hundred Twenty-One and Ninety-One pence) (ex VAT) is submitted for Task AII57 and broken down as shown in the tables below.

Offer of Contract: *(to be completed and signed by the Contractor's Commercial or Contract Manager)*

Total Proposal Price in £	£171,421.91		(ex VAT)
Start Date:	20/10/2021	**End Date:**	13/03/2022

Lot Leads Representative	Name	[REDACTED-PERSONAL INFORMATION]
	Tel	[REDACTED-PERSONAL INFORMATION]
	Email	[REDACTED-PERSONAL INFORMATION]
	Date	7th October 2021
Position in Company	Assistant Commercial Manager	
Signature	[REDACTED-PERSONAL INFORMATION]	

Core Work – Breakdown

[PRICING TABLES REDACTED IN ENTIRETY-COMMERCIAL INTERESTS]

[PRICING TABLES REDACTED IN ENTIRETY-COMMERCIAL INTERESTS]

[SUB CONTRACTOR PRICING TABLES REDACTED IN ENTIRETY-COMMERCIAL INTERESTS]

[T&S PRICING TABLES REDACTED IN ENTIRETY-COMMERCIAL INTERESTS]

Core Work – Milestone breakdown costs

Proposed Milestones Payments

Your TMS bid costs shall be included in milestone 1.

The final Milestone must reflect the actual cost of the deliverable, and be greater than 20% of the Task value, unless otherwise agreed with your Commercial POC

Please duplicate the template per milestone table format below as necessary, and rename milestone number accordingly.

[MILESTONE PRICING TABLES REDACTED IN ENTIRETY-COMMERCIAL INTERESTS]

TOTAL		**£171,421.91**

Tasking Form Part 3:

To be completed by the Authority's Commercial Officer and copied to the Authority's Project Manager.

1. **Acceptance of Contract:**		
Authority's Commercial Officer	Name	[REDACTED-PERSONAL INFORMATION]
	Tel	[REDACTED-PERSONAL INFORMATION]
	Email	[REDACTED-PERSONAL INFORMATION]
	Date	18/10/2021
Requisition Number		R1000165399
Contractor's Proposal Number		QINETIQ/21/03469
Purchase Order Number		DSTLX-1000163933
Signature		[REDACTED-PERSONAL INFORMATION]
Please Note: Task authorisation to be issued by the Authority's Commercial Officer or Contract Manager. Any work carried out prior to authorisation is at the Contractor's own risk.		