SERAPIS TASKING FORM

COMPLETE SQUARE BRACKETS AND REMOVE COMMENTS BEFORE SENDING TO THE SUPPLIER

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

To:	Lot 4 QinetiQ Plc	**From:**	Dstl

VERSION CONTROL
Version control please ensure this is kept up to date 04/02/2022 v1.0 Subco wording + [REDACTED] comments addressed 03/02/2022: v0.8 [REDACTED] Updates to the Options for FY2,3 & 4 22/23, 23/24 & 24/25 18/01/2022: v0.7 [REDACTED] Updates to PM details and minor changes 20/10/2021: v0.6 [REDACTED] 13/10/2021: v05

REQUIREMENT:			
Proposal Required by:	TBD 2021	**Task ID Number:**	A1163
Project Manager:	[REDACTED]	**Technical Point of Contact:**	[REDACTED]
Task Title:	DCEAT WP4.2 Novel Networking Protocols - Agile Networks and Cross Stack Functionality	**New Task ☒**	**Change ☐**
Required Start Date:	01 Feb 2022	**Required End Date:**	T0 + 16 weeks (Feb '22)
Requisition No:	RQ0000001799	**Budget Range**	210k-£230k (exc TMS Costs)

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

This work package seeks to explore requirements for how an Agile Network provides a mitigation response for a Radio Frequency (RF) based radio communications system operating in a Cyber and Electromagnetic Activity (CEMA) environment against an adversary acting with hostile intent. The work looks at architectures for the "goal-based" configuration of networks and bearers to support these deployment conditions using concepts developed under Dstl's Resilient Deployed Comms (RDC) Intelligent Bearers project, the Agile Radio Concept (ARC).

It is recognised a single solution may not be applicable and the multiple solutions may be required for a range of deployment scenarios.

Introduction

The activities undertaken by this research activity can be subdivided into two areas:

Agile Metrics

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 transmit power, modulation waveform, frequency etc. 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.

Reference [1] provides a description of the ARC where "action to evolve" is based on a set of decisions that are derived from sensing the environment to meet a defined set of performance goals. The diagram below (reproduced from [1]) shows the concept.

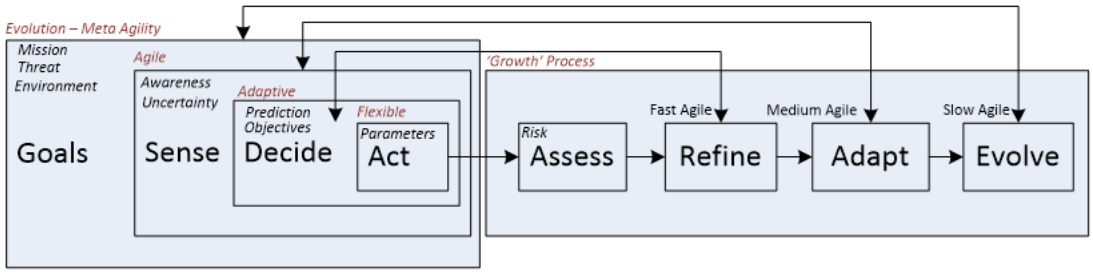

Figure 1 Agile Radio Concept (ARC)

The intention is to explore the application of this Agile Radio Concept to a MANET radio system in order to realise the resilience benefits stated in the requirements.

Programmable MANET Architectures

Currently, there are a large number of MANET radio solutions that exist, but these solutions tend to be application specific and tailored to defined use cases, mission phases and scenarios. Simply switching between solutions, even by switching waveforms within the radio architecture may not be enough to meet the complex challenges faced in deployed environments and as such, it is advantageous to be able to influence the radios behaviour up the higher layers of the protocol stack. This could be achieved using concepts from developments in programmable networking (such as a Software Defined Networking approach) which could allow dynamic configuration of core / specialist functionality as missions transition between phases. The figure below illustrates the concept.

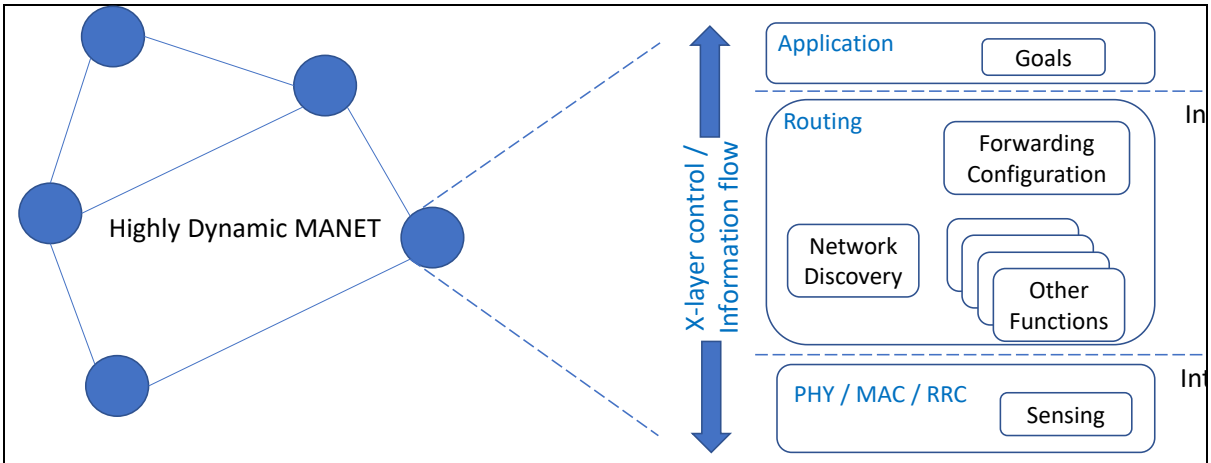

Figure 2 Dynamic MANET with conceptual protocol stack

The work defined in this task has emphasis on the multi-hop routing functionality, but also considers how the entire system operates with goal-specific algorithms, plug & play modules and the underlying support functions that are required to provide system operation. Specifically, the work seeks to explore the following questions:

1. How can agility be introduced into a MANET network?
    a. What functional components are required?
    b. How is the intelligent decision making partitioned in the protocol layers?
    c. What information needs to flow through the protocol stack (and network) and what cross layer behaviours is require in response to disruptive events?
    d. What interfaces could be defined through the system and how can they be standardised and made open within future radios to enable portability of algorithms?

2. How does the system operate and add benefit when integrated?
    a. What prospective goals for the system could be conceived?
    b. What control measurements / sensing is required to support a set of prospective goals and how do we process that information?
    c. What metrics for success can be applied to the routing and ARC and how do these fulfil the prospective goals?
    d. What is the benefit of the system as measured by metrics for the goals and resilience?

In answering these questions, an innovative approach with unconstrained thinking is very much encouraged, starting with a “blank sheet” approach.

The task brings together the conceptual thinking behind the ARC and programmable networking, applies some real dimensions to a set of system types and uses derived metrics to demonstrate the effectiveness of the behaviour. The related topics of the Rendezvous Protocols (Task AII55) and resilient control mechanisms (Task AII57) are being addressed in separate tasks and that work is expected to interact closely with the work defined in this task. Similarly, control plane resilience concepts from SDN technology should be included.

This work is to follow 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 sudy covers both Track 1 for the defined Task and Track 2 for the defined Task 3 and therefore will inform both Track 1 and Track 2 activities.

Benefits of the work

The expectation of the task is that it will:

- Increase Technical Readiness Level of the wider Agile Radio Concept (ARC), identifying 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 Agile Radio performance, control and metrics
- Previous work from WP5 on metrics and MANET algorithms [5]
- General theory or concepts such as general COTS methods and techniques and models
- Industrial background IP (e.g. CPRI, e-CPRI), noting the IP condition associated with the task.

It is expected that the task exploitation will be via:

- Knowledge or capability in UK industrial base by highlighting what API exposure or standardisation might be required to achieve the programmable concepts.
- 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.
- Defining future work for Track 1 or Track 2 activities (e.g. via TTCP, TP43)

Outline requirement

It is proposed that the work will be conducted with three tasks:

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

Note that Tasks 2 and Tasks 3 could be sequential or concurrent.

The research performed in this work should be considered against the illustrative vignettes below, namely operations in a:

1. **Simple:** Benign EM environment with a radio network (e.g. Training mode)
2. **Medium:** Contested and congested EM environment with a demand for resilience and As Low As Reasonably Possible (ALARP) Intercept/Detection attributes.
3. [OPTIONAL] **Challenging**: Highly contested / congested with high mobility.

Additional detail on these vignettes has been developed and will be provided as GFI in the task.

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

- Security and associated accreditation
- Interoperability with legacy and coalition systems
- Coexistence and platform integration

The Tasks and potential activities are described in the sections below.

Task 1: Review of literature and prior art

The objective of Stage 1 is to summarise the state of the art in the field.

Specifically, the activities are envisaged to be (but not limited to):

1. Literature review to establish the state of the art primarily for metrics associated with agile behaviour (e.g. resilience) although any other relevant work in the field relating to Agile system behaviour would be useful. A review of publications [4] and documentation on previous work [5] will be available and as such it is very likely that the review will be limited to the material provided as GFI. However, the review should not be constrained if there is other material provides a contribution.
2. Definition of workplan for Stage 2

Task 2: Technical Research of candidate concepts

The objective of task 2 to show how agility can be introduced into a MANET network, such that the system can be programmable (or re-programmable) to adapt to evolving environments in the immediate, medium and long term.

Specifically, the research questions are:

1. What functional components are required to manage highly dynamic networks? These include functions for peer discovery, exchange of routing information, route calculation etc. This should include identification of which functional elements are core and those that are "goal specific" (areas of functionality we may want to be able to change to specialise the behaviour of the infrastructure).

2. How is the intelligent decision making partitioned in the protocol layers (e.g. between layers 2 and 3)? Are these independent mechanisms (with distributed intelligence) or do they rely on centralised control? What are the challenges associated with developing and deploying more programmable systems at the tactical edge.

3. What information needs to flow through the protocol stack (and network)? To understand this the sensing / measurement requirements need to be considered through the protocol stack (e.g. spectral measurements at the physical layer, QoS measurements at network layer).
4. What interfaces could be defined through the system? How can the interfaces align with the decision making partitioning?

The research should consider existing and future technologies identifying challenges and shortfalls with recommendations for further intervention as appropriate.

Task 3: Develop Illustrative System Design(s)

The objective of Task 3 is to consider the architecture components and concepts developed in Task 2 and construct an example/illustrative design using the ARC principles that shows how the system operates and adds benefit when integrated.

Specifically, the research questions are:

1. What prospective goals for the system could be conceived? Examples might be maximum coverage, maximum throughput, throughput fairness, optimum recovery time or resilience of priority communications. For each of the goals consider:
    a. The definition and how the definition could be used in practice;
    b. The benefits achieved and any disadvantages;
    c. The compatibility with other defined goals (if multiple goals were used).
    d. Wider implications on the system

2. What control measurements / metrics sensing is required to support a set of prospective goals and how do we process that information? Specifically:

a. What measurements for control are required for the identified goals?
b. What sensing might be required and what is the expected impact on SWaP and data transport requirements (measurement periods, data BW, latency etc.)? Is there opportunity for pre-processing to minimise impact on the communications network?
c. How do we collate / derive decisions for actions based on the measurements?

3. What metrics for success can be applied to the ARC and how do these fulfil the prospective goals (for example, how do we measure resilience immunity, availability or recovery time)?

4. What is the benefit of the system as measured by metrics for the goals and resilience?

Ideally, this task would develop a system design, possibly supported with simple simulation. Development of quantitative analysis as part of the design (e.g. data volumes / latency requirements for metrics distribution) should be included.

A key output from the work is a view on any aspects of the technology that require further intervention particularly around the system modularity, distribution of intelligence and routing dissemination.

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

All deliverables need to specifically cite any background IP.

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 ☐	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	

DELIVERABLES

The table below defines the deliverables for the task

Ref.	Title	Format	Required Content	Estimated Timing
D01	Monthly progress report	Powerpoint	Single Slide summary	Monthly
D02	Literature review report	Word	Summary report describing literature review and prior art and plan for Task 2 and 3	T0 + 6weeks
D03	Task 2 and 3 Report	Word	Report documenting the finding of the research for Tasks 2 and 3. Specifically - What functional components are required to manage highly dynamic networks - How is the intelligent decision making partitioned in the protocol layers? - What information needs to flow through the protocol stack (and network - What interfaces could be defined through the system? - What prospective goals for the system could be conceived? - What control measurements / metrics sensing is required to support a set of prospective goals and how do we process that information?	T0 + 20 weeks (TBC)

D04	Task 2 and 3 Presentation Report	Powerpoint	Presentation report suitable for workshop / briefing sessions summarising the content in D03.	T0 + 20 weeks (TBC)

Deliverable: Acceptance / Rejection Criteria *(30 business days unless agreed otherwise)*

DEFCON 524 Rejection ☒ period [30] days DEFCON 525 Acceptance ☒ period [30] days

ISSUE OF EQUIPMENT/MATERIAL/INFORMATION

References

1. "Agile Systems" – Dstl Document, [REDACTED]
2. CSIIS 2-1-68: WP2 "Intelligent Radio Assessment Study, Technology and Market Assessment Report" QINETIQ/19/00442 Issue 2.0, August 2019
3. CSIIS 2-1-68: WP3 "Dynamic Spectrum Access and Management (DSpX)" Phase II Final. QINETIQ/19/01921 Issue 1.0 Report 30th March 2020
4. SERAPIS AII27 –" Intelligent Bearers Technology Literature Review", Mar 2021. (In review)
5. Reference TBC – "Assessment of Software Defined Networking within Mobile Ad-hoc Networks"

QUALITY STANDARDS

SECURITY CLASSIFICATION OF THE WORK *(A Security Aspects Letter (SAL) will be required for each Task above Official-Sensitive, Quotes are covered by the Framework SAL)*

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 ☐

SAL Attached ☐

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

Cyber Risk Level	[REDACTED]	Risk Assessment Reference	[REDACTED]

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.

Any Task placed as a result of your quotation will be subject to the Terms and Conditions of Framework Agreement Number:

Choose an item.

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

To:	The Authority FAO: Tel:	**From:**	The Lot Lead

Proposal Reference **Serapis Proposal AII63** **(attached)**

[REDACTED]

Delivery of the requirement:

The proposal shall 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 Deliverables and Interim Payments (Milestone/stage) due dates.
- A work breakdown structure/project plan with key dates and Deliverables identified including required delivery dates for Government Furnished Assets.
- 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

In regard to the sub-contractors, each individual research worker is only allowed to start work on this task once DSTL has confirmed that they have passed their security checks. If DSTL deem a Researcher can't work on this task an alternative will need to be found or we may need to de-scope as a result.

[REDACTED]

At the Authority's request we have included a Limit of Liability for years 2 and 3. Each Firm Price created (that draws on the Limit of Liability) shall be undertaken via a mutually agreed Contract Amendment Form. Whilst these individual Contract Amendment Forms detail a separate package of work, it is linked to (and shall reference) this Tasking Form. It is understood that the scope of the work being undertaken using the LOL is not yet defined, and will be done so at the time of each Contract Amendment Form.

[REDACTED]

PRICE BREAKDOWN

You are to use the costs detailed in Item 2 Table I in the Schedule of Requirement and at Annex E Table 2 of the Serapis Framework Agreement. Please also provide a price breakdown which should include, but is not limited to: Lot Lead Rates, Sub-contractors costs and rates, travel and subsistence. In support of your Proposal you are requested to provide clear details of all Dependencies, Assumptions, Risks and Exclusions that underpin your price.

Total Proposal Price in £	£215,108.34 for the Core Work in FY21/22 Year 2: £429,646.68 Limit of Liability Work in FY22/23 Year 3: £494,093.68 Limit of Liability Work in FY23/24	(ex VAT)

	Year 4: £285,715.05 Limit of Liability Work in FY24/24 Years 2-4 are listed as options			
Start Date:	17/01/2022		**End Date:**	**31/03/2022**
Lot Leads Representative	Name	[REDACTED]		
	Tel	[REDACTED]		
	Email	[REDACTED]		
	Date	4th February 2022		
Position in Company	Assistant Commercial Manager			
Signature	[REDACTED]			

Contractor's Price Breakdown

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

Sub-Contractors Price Breakdown by Work Package

[REDACTED]

[REDACTED]

Proposed Milestones Deliverables and Payments *(The final Milestone must reflect the actual cost of the deliverable and be greater than 20% of the total price unless otherwise agreed with your Commercial POC)*

TOTAL	**£215,108.34**

Future Tasks – Summary

[REDACTED]

Tasking Form Part 3:

1. **Offer of Contract:** *(to be completed by the Authority's Commercial Officer or Contract Manager and copied to the Authority's Project Manager)*		
Authority's Commercial Officer	Name	[REDACTED]
	Tel	[REDACTED]
	Email	[REDACTED]
	Date	04/02/2022
Requisition Number		RQ0000001799
Contractor's Proposal Number		Serapis Proposal_AII63- O_v2
Purchase Order Number		DSTL0000000363
Signature		[REDACTED]
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.		