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Statement of Requirement for the R-Cloud Homeland Security and Counter-Terrorism Systems Strategic Capability

Introduction:

The Defence Science and Technology Laboratory (Dstl), which is part of the UK Ministry of Defence (MOD), is refreshing its commercial agreement for Science and Technology (S&T) research contracts, known as R-Cloud (Research Cloud).

MOD places extensive fundamental, experimental and applied research with industry and academic suppliers and wants to broaden access for this supply base, reducing the cost of trading with MOD and enabling agile contracting. R-Cloud complements MOD's other contracting mechanisms and academic and industry suppliers of S&T research are now invited to apply to join MOD's research supplier community within the Homeland Security and Counter-Terrorism Systems Strategic Capability.

This statement of requirement relates to suppliers joining R-Cloud within the Homeland Security and Counter-Terrorism Systems capability area. R-Cloud provides a low barrier to entry for potential suppliers and offers direct access to MOD's current and future research requirements. Academic and industrial suppliers of Homeland Security and Counter-Terrorism Systems research are invited to apply to R-Cloud if you are a supplier of Science and Technology Research and/or Services in this area.

Homeland Security and Counter-Terrorism Systems encompasses a broad range of technical areas, these are summarised here:

Statement of Requirement

1   Counter-Terrorism Techniques

1.1   Technical research and analysis may be required to develop soldier systems to improve defence security personnel effectiveness. Technical research required may include, but is not limited to:

  a)   Delivery of Enhanced Lethal and Non-lethal Effects (e.g. weapons development)
  b)   Delivery of remote effects (e.g. Tactical Remote Effects Delivery from AI-enabled UAS, stabilised weapon stations, etc)
  c)   Enhanced operator-mounted detection and tactical awareness (e.g. night vision, head-up displays, fused tactical picture, etc)
  d)   Enabling an understanding of the vision augmentation systems, weapon and head-mounted, that could mature over the next 5-10 years which improve

situational awareness and target acquisition in all conditions (all weathers day and night, and in zero light environments such as buildings and caves).

    d) Enabling an understanding of the weapon systems that could mature over the next 5-10 years which increase hit probability and improve terminal effect.

    e) Integrating technologies and sub-systems reliably, e.g. onto a soldier or weapon system platform.

This may include, but is not limited to:
- Development of lightweight high-performance night vision
- Development of digital processing and display technologies
- Development of test-beds and prototypes for demonstration and evaluation purposes
- Development of integration, modularity and burden reduction techniques

1.2 Technical research and analysis may be required to improve soldier systems' survivability and agility. Technical research required may include, but is not limited to:

    a) Integrated systems (night vision, body armour, helmet and overall soldier system) to enable an operator to command Effects On Demand.

    b) Mobility systems to enable operators to insert/extract to targets in hostile conditions with low signature/risk of compromise.

    c) Protection systems that could reduce the vulnerability of operators to kinetic attack.

    d) Modular soldier systems that provide an operator with mission-reconfigurable capability and reduce burden.

    e) Methods for non-lethally warning or deterring threats from a course of action.

    f) Effects that distract, deceive or confuse a threat, thereby degrading his effectiveness.

    g) Methods for breaching through barriers with low collateral damage.

This may include the development and demonstration of technologies in the following areas:
- Armour materials to improve protection levels and reduce weight, including flexible armour.
- Whole body suits, with integrated thermal protection systems (heating and cooling).
- Burden reduction systems, such as exoskeletons, power assistance, health monitoring.
- Integrated helmets, combining night vision, protection, comms, hearing protection.
- Laser dazzle or warning systems.
- Technologies which can have a non-lethal effect over a distance (eg, RF, acoustic, etc).
- Technologies which can non-lethally effect a threat (eg, sticky nets, impact rounds, etc).
- Mechanical and explosive breaching technologies.
- High power technologies to defeat electronic devices.

1.3 Technical research and analysis may be required to develop land mobility capabilities. Research required may include, but is not limited to:

    a) Methods for inserting and extracting operators in the land environment

b) Methods for protecting operators during transit, from kinetic effects
c) Systems that are fully modular and mission-configurable, allowing vehicles to be configured fit-for-task
d) Weight reduction and efficiency capabilities, to maximise payload, range and endurance
e) Systems that could reduce the signature of the vehicle to threat sensor capabilities

This may include the development and demonstration of technologies in the following areas:
- Improved efficiency power plants and propulsion systems
- Novel vehicle designs and materials to optimise for performance against weight
- Materials to improve protection
- Multi-spectral signature reduction techniques, including acoustic
- Modular / rapidly reconfigurable systems

1.4   Technical research and analysis may be required to develop maritime mobility capabilities. Research required may include, but is not limited to:

a) Methods for inserting and extracting operators in the Maritime environment, both above and below water, for short, medium and long range transits.
b) Methods for protecting operators during transit, from kinetic effects, and environmental effects such as shock and vibration and sea spray.
c) Systems that are fully modular and mission-configurable, allowing boats and Under Water (UW) systems to be configured fit-for-task.
d) Weight reduction and efficiency capabilities, to maximise payload, range and endurance.
e) Systems that could improve system power, range, payload, lethality, protection.
f) Enables an understanding of systems that could reduce the signature of the boats and UW systems to threat sensor capabilities.

This may include the development and demonstration of technologies in the following areas:
- Improved efficiency power plants and propulsion systems
- Novel boat hullform designs and materials to optimise for performance against weight
- Materials and novel concepts to improve protection
- Multi-spectral signature reduction techniques
- Modular / rapidly reconfigurable systems

1.5   Technical research and analysis may be required to understand and develop techniques and options for surveillance. Research required may include, but is not limited to, that which:

a) Enables discreet sensing systems
b) Enables all weather/all environment imaging of designated target areas on land or at sea from maximum stand-off range
c) Enables integrated command and control of disparate sensing systems
d) Enables end-to-end surveillance in areas of sparse to zero commercial/military communications networks , including the maritime and air environments

This may include, but is not limited to:
- Development of intelligent, miniature sensing systems.
- Development of advanced imaging techniques, including video analytics with objective metrics.
- Development of common architectures and protocols for integrated receiving systems.
- Development of multi-modal, software reconfigurable/defined surveillance solutions.
- Development of enhanced power management techniques and improved power source options for surveillance equipment and sensors.
- Development of novel techniques for geolocation of events and targets.

1.6   Technical research and analysis may be required to support the development and assessment of concepts and technologies to deliver a more fully integrated and effective Command, Control, Communications, Computer, Intelligence, Surveillance and Reconnaissance (C4ISR) Enterprise. This will encompass fixed, transportable and mobile elements fit for global use. Technical research may include, but is not limited to, concepts that:

   a) Enable communications to operate over ranges of 10s of metres to 1,000s of kilometres.
   b) Enable the seamless and timely transfer of information between all locations/Users.
   c) Enable innovative approaches to security solutions.
   d) Are robust to detection and/or localisation by opposing forces.

   Specific interests include but are not be limited to:
   - Targeted evolution of communication bearers that operate at frequencies ranging from VLF radio to optical and beyond, with improved balance between performance and Size, Weight and Power (SWaP) and ability to be fitted to tactical platforms.
   - Concepts to harness pervasive civilian CIS systems for military and security purposes, recognising security, electronic footprint, likely deployment densities and geometries and critical performance drivers such as latency.
   - Evolution of approaches for intelligent, multi-bearer, traffic flow management.
   - Improved techniques to consolidate a disparate range of time varying data sources, identify meaningful information that which is most relevant to the recipient and display in a manner that aids for better comprehension.
   - Tools to enable more efficient working with non-English speaking allies, including speech, text, imagery and video.
   - Evolution of innovative approaches to data reduction and compression schemes.
   - Wired IT-type networks, including software defined networking, enterprise architectures, tactical processing.
   - Techniques to better understand, specify, evaluate and predict the performance and inform the evolution of complex C4ISR architectures.

1.7   Technical research and analysis may be required to support general technical capabilities, including but not limited to:

   - RF engineering (radio design and implementation, SDR techniques, waveform design, antennas, power sources)

- Advanced and novel materials, such as 0D, 1D,2D, metamaterials and heterostructures.
- Computer modelling: high-energy physics; electromagnetics; optical; RF propagation; circuit simulation.
- Ideas Generation: Technology Watch; Literature surveys.
- Systems Approach: Scientific method; Technology Readiness Level (TRL) planning; Requirements analysis; Operational analysis; Systems analysis / engineering (including Defence Lines of Development (DLODs) analysis and Human Factors analysis).
- Design Engineering: Industrial design and planning; prototyping.
- Technology Evaluation: Testing, assessment and trials.
- Trials and test Facilities: RF screened rooms; mine lanes; laser facilities; ionising radiation shielded enclosures.
- Systems engineering
- Equipment development and sub-component integration
- Signal processing
- Data analysis and tools to improve the management and exploitation of data
- Statistical analysis
- Engineering and software development.
- Operational analysis
- Mathematical modelling
- Equipment design
- Equipment manufacture and test
- Integrated systems design
- Component characterisation, including mechanical, electrical and energetics
- Measurement and instrumentation including, techniques, RF and thermal
- Electro Magnetic Compatibility (EMC)
- Circuit simulation
- Safety and risk analysis
- Understanding the potential opportunities, risks and threats offered by new and emerging technologies, for example in data processing and visual analytics.
- Improved methods or tools for processing large volumes of mixed data, including non-English sources.
- Methods and techniques for the visualisation of information and presentation to the human user.
- Methods for the collection, processing and analysis of data from personnel and materiel.
- Improved tools, techniques and methods to collect and analyse data from a wide range of sources, including biometric data, such as fingerprints and face recognition and physical data such as documents and electronic media. Some of these data sources may not be currently available but may be in the future through the use of novel technologies.
- The fusion of different data types to extract additional information.
- Improved speed, throughput and ease of operation of existing equipment and reductions in size, weight and power consumption.
- Understanding and incorporating the needs of the human user in the design of new equipment and in the future development of existing kit and equipment.

2 Operational Support

2.1 Research and analysis may be required to provide Decision Support and Threat Analysis. Decision making predominantly focuses on assessing the impact of changes to stakeholder capability across Defence Lines Of Development (DLODs). In order to support this decision making, research and analysis may be required in a number of areas including, but not limited to:

a) The application of evidence-based operational analysis and consultancy techniques to inform, support or challenge capability and force development decisions.
b) Analysis of the likely future-threat and operating environment for exploitation by stakeholders and the science and technology programmes.

This may include, but is not limited to, the following tools and techniques:
a) Soft systems methods and other qualitative techniques.
b) Methods for conducting balance of investment and cost-effectiveness assessments of potential mitigation measures.
c) Modelling, simulation and wargaming supporting situations ranging from operational decision making to supporting procurement for defence equipment.
d) Mission, vignette and scenario development.
e) Methods for identifying and predicting threats to the above capability areas.
f) Database development.

2.2 Research may be required to understand issues relating to using a variety of techniques to augment human physical or cognitive performance; this could be through training or technology-based augmentation. Research may be required in, but not limited to, the following areas:

a) Use of visual techniques, such as feed-forward eye movement training, to enhance operator training on a range of tasks.
b) Techniques for training operators to handle high loads of visual information.
c) Methods to speed-up acclimatisation to the operating environment, for example, to overcome or reduce the impact of jet lag when transferring between time zones.
d) Team assessment techniques for evaluating team performance on a range of tasks.
e) Use of physical training and nutritional advice to develop individual performance plans.
f) Modelling of the impact of physical load on performance.

3 Sensors and Electronic Countermeasures

3.1 Technical research may be required to support the development of sensing systems including research for innovative means to Detect, Locate and Identify (DLI) concealed terrorist weapons including Improvised Explosive Devices (IEDs). This may include, but is not limited to:

a) The Searching of Open Ground - Sensing technologies capable of the DLI of terrorist weapons concealed in or on open ground, including along routes (e.g. paths, tracks, roads) and within defined open areas (e.g. an area of beach,

dockside, or compound) and in any geographical setting from forest to desert to city.

b) The Searching of Structures and Large Vehicles - Sensing technologies capable of the DLI of terrorist weapons concealed within a structure or vehicle, including buildings (from rural dwellings in developing countries to office buildings in modern cities), railway tunnels (e.g. EuroTunnel), ships, and aircraft. In some cases the vehicle may be moving.

c) The Searching of People - Sensing technologies capable of the DLI of terrorist weapons (including guns and knives) concealed on a person, either covertly or overtly at an operationally useful range.

d) The interrogation of designated target objects / volumes of interest with sensing technologies to support the 'render safe process'.

Sensing Techniques of interest include, but are not limited to:

- Radio Frequency Techniques: Passive RF sensing including 'direction finding' and 'spectral analysis' techniques; inductive and capacitive sensing techniques.
- Magnetic Resonance Techniques: Nuclear Magnetic Resonance (NMR); Nuclear Quadrupole Resonance (NQR); Electron Spin Resonance (ESR).
- RADAR Techniques: Ground Penetrating Radar (GPR); Frequency Modulated Continuous Wave (FMCW); Homodyne / heterodyne; Harmonic / Intermodulation; Coherent arrays; Phased arrays; Synthetic Aperture Radar (SAR).
- Sub-mm Techniques: Passive imaging; Active imaging; Ranging.
- Infra-red Techniques: LW / MW/ SW / N-IR bands; Multi-spectral techniques.
- High-energy Techniques: X-ray transmission imaging; X-ray diffraction; X-ray fluorescence; X-ray backscatter; Passive gamma-ray imaging and spectroscopy; Neutron activated gamma-ray techniques; Laser-induced high-energy techniques.
- Novel concealed object sensing technologies.
- Sensor data processing techniques including AI and ML.
- Multi-sensor fusion and management for improved target DLI, including real-time tracking of moving targets.
- Integration of sensing technologies with robotic vehicle platforms for forward deployment.

3.2 Technical research may be required to support the development of Electronic Countermeasures, including, but not limited to:

a) Countermeasures techniques.
b) Detection, Identification and Location of IEDs and associated electronics, including active and passive triggers.
c) RF electronics, filtering, transmitters, receivers and antennas.
d) Digital signal processing.
e) Software Defined Radio technology.
f) Electro magnetic compatibility.
g) Electro magnetic environment sensing.
h) Signal classification, data fusion and decision making.
i) Smart and collaborative ECM and broader Electronic Warfare systems.
j) RF techniques and waveforms to neutralise threat technologies.
k) Laboratory alternatives to field trials.
l) Modelling and simulation.
m) Hardware in the Loop system performance evaluation.

n) Antenna design, modelling, integration and RF architecture.
o) System architectures (inside box sub-system and vehicle integration).
p) Data security, Information Assurance (IA) and Information Security (IS).
q) Technology watch, horizon scanning and technology investigation.
r) Commercial trends analysis in personal communications technology and radio standards.
s) System concepts and deployment option development.

3.3 Technical research may be required to support the development of neutralise techniques using directed energy, including, but not limited to:

a) High power pulsed and CW Radio frequency electronics, high Voltage electronics, energy storage, high power laser etc.
b) Underpinning S&T to apply physics to operational scenarios.
c) Modelling and simulation, including statistical analysis, static and dynamic (operational) aspects.
d) Concept system integration onto test platforms.
e) Platform hardening to accommodate high power RF systems.
f) High capacity power supplies.
g) Instrumentation to verify performance of systems at field trials.
h) Development of lab and field concept demonstrators.
i) Small-scale (low power, small size) practical proof of concepts.

4 Defence Exploitation

4.1 Research may be required to improve the understanding of terrorist networks and non-state threats to the UK military, this may include, but is not limited to:

a) Tools, techniques and approaches to represent the terrorist enterprise and to understand and explore its nature.
b) Tools, techniques and approaches to illustrate and understand aspects of a terrorist organisation such as finance, communications, social and materiel/supply.
c) Tools, techniques and approaches to understand the ideology and drivers behind terrorist organisations and what factors move groups towards the use of violence.

4.2 Research may be needed to identify future signatures/observables to aid the UK military in locating terrorist/threat groups or activity, these observables may be physical or behavioural and may be detected using sensor or data processing techniques. This may include, but is not limited to:

a) A sensor agnostic approach to understanding the range of observables associated with terrorist activity. Some of these observables may not currently be detectable but could be in the future through the use of novel technologies or the fusion of different sensor outputs
b) Continued development of signature libraries and sensing/processing capabilities and the identification of gaps in libraries and capabilities
c) Work to understand the benefits and potential methodologies to generate non-sensor based signatures such as patterns of movement associated with certain terrorist activities

4.3 Research may be required to improve the Collection, Collation and Analysis of Battlefield weapons-related Intelligence, including but not limited to:

a) Optical photography and scanning technologies and practices for the acquisition of data from a hostile environment
b) Electronic data gathering and transmission, including via mobile devices, of information from a hostile environment
c) Software and methods for the construction and extraction of geometries from photography and/or scanning of a hostile environment
d) Software and methods for the visualisation and manipulation of geometries gathered from photography and/or scanning of a hostile environment

This may include, but is not limited to:
- Pure and applied research into: photography and scanning; hardware and software for data collection and transmission; geometry extraction, manipulation and visualisation.

4.4 Research may be required into the signatures created as a consequence of weapon-target interaction, including but not limited to:

a) Direct fire systems.
b) Explosive devices buried in various media.
c) Large above-ground explosions.
d) Artillery and other major combat operation effects.

This may include, but is not limited to:
- The physical testing of a range of weapon systems against various witness items and targets.

5 Digital Forensics (for Law Enforcement)

5.1 Research may be required into methods and techniques to assist law enforcement with the recovery, processing and analysis of all forms of digital data for use as evidence or intelligence in both CT and mainstream policing investigations. This may include, but is not limited to:

a) All types of digital data, including text, multimedia, and metadata in both common and proprietary formats, and which may be recovered from both physical devices and online sources.
b) The scope also includes all stages of the evidential chain: preservation, extraction, processing, analysis, interpretation, reporting and archiving.

This may include but is not limited to:
- Development of novel tools and techniques for the recovery, processing or analysis of digital data from common devices (such as phones and computers), from any other digital devices that may be found at scenes of crime and from online sources.
- Methods for the quality assurance of the data obtained from such sources, to provide confidence in the information when used as evidence in court.
- Technologies suitable for use by technical specialists in a laboratory and technologies suitable for use in a frontline deployment by non-specialists.

- Application of novel technologies that may have been developed for other markets to law enforcement use case scenarios. Evaluation of novel technologies in realistic scenarios and development of representative datasets to assist with evaluation.

6   Biometrics (Identity)

6.1   Research may be required to support identity assurance through the use of multi-biometric modalities, e.g. face, voice, fingerprint, iris, scent, gait etc. Areas of interest include but are not limited to:

a) Novel technologies for the capture of biometrics.
b) Systems integration of capturing multi-biometrics.
c) Understanding the limitation and effectiveness of biometric detection algorithms in the context of Defence and Security use cases.
d) Novel technologies and solutions for object detection.
e) Novel approaches to data science/data processing to facilitate triage of large data sets.

7   Forensic Research

7.1   Research may be required to support the recovery, processing, analysis and interpretation of materiel in support of UK Defence exploitation needs and / or the UK Criminal Justice System relating to any potential forensic markers including, but not limited to, DNA and fingerprints, which may include but is no limited to:

a) Novel technologies for the analysis of forensic evidence types both at a scene and in the laboratory.
b) Developments leading to improvements in speed and accuracy of analysis of forensic evidence types.
c) Enhance or novel sampling techniques to aid the recovery of evidence types and maximise the potential opportunity to analyse.
d) Development of reliable models to support research and validation studies for the purposes of quality assurance.
e) Early identification of threats to processes for fingerprint development as a result of legislation changes and mitigate through the identity suitable replacements or alternative methods.
f) Application of novel technologies that may have been developed for other markets to forensic science use cases.

8   Crime, Policing and National Security

8.1   Research may be required to enable Policing, Borders and Security Services to discharge their public duty by ensuring that they are appropriately protected, equipped and trained. Areas of particular interest include but are not limited to:

a) Body armour, especially technologies to improve protection and reduce weight, size and physiological burden.
b) Personal weaponry, especially less lethal technologies.
c) Vehicle and vessel stopping technologies.

d) Novel training methods and environments.

8.2 Research may be required to develop and de-risk revolutionary sensing technologies to detect, classify, identify, track, monitor and/or disrupt targets and criminal activity across the full spectrum of operational, cluttered, contested and denied environments. Areas of particular interest include but are not limited to:

a) Novel sensing technologies for the stand-off detection of concealed weapons, drugs, explosives, contraband, chemicals, and people, including reducing the size, weight and power, and increasing the stand-off range.
b) Technologies for the detection and identification of narcotics and corrosive substances, to evidential standards in non-laboratory settings. See also requirements under 'Explosives and Energetics, Explosives Detection and Forensic Analysis'.
c) Technologies for covert surveillance and tracking, including managing the signatures of own sensors.
d) Systems for monitoring pattern of life, behavioural analytics and crown dynamics.

8.3 Research may be required to protect the UK population, society and economy from the impact of crime and terrorism through the development of technology to target organised crime, secure our public places and enforce public order. Areas of interest include but are not limited to:

a) Protect critical infrastructure, including transport infrastructure and public places.
b) Preventing and countering marauding terrorist attacks.
c) Offender management technologies.
d) Techniques for monitoring and disrupting criminal networks.

8.4 Research may be required to understand the threats and exploit the opportunities offered by digital society through the interrogation, protection, management and sharing of new and existing data, data sources and information. Harness advances in data science, artificial intelligence and machine learning to enable policing and security capabilities. Areas of particular interest include but are not limited to:

a) Collection, management and sharing of data.
b) Development of algorithms for data mining, interrogation and exploitation.
c) Development of networked systems to provide timely information to those who need it.

8.5 Research may be required to exploit human-machine teaming to augment and enhance human capability and performance. Understand the role of autonomy in Policing and Security and develop solutions that improve safety, situational awareness and reduce workload. Areas of interest include but are not limited to:

a) Wearable technologies for situational awareness and health monitoring.
b) Development of autonomous technologies to support or enable policing and security operations.
c) The use of virtual or augmented reality.

8.6   Research may be required to develop novel and certified solutions and equipment that support policy implementation, law enforcement and prosecution. Areas of interest include but are not limited to:

     a) Type approval and equipment certification.
     b) Facility and method accreditation.
     c) Collision reduction and roadside safety cameras.
     d) Roadside drug and breath-alcohol testing.
     e) Weapon and Personal Protective Equipment testing and evaluation.