A254-P026: xTechPacific Open Topic

ADDITIONAL INFORMATION

N/A

TECHNOLOGY AREAS:

Electronics | Human Systems | Information Systems | Materials | Sensors

MODERNIZATION PRIORITIES:

Advanced Computing and Software | Advanced Materials | Human-Machine Interfaces | Integrated Network Systems-of-Systems | Integrated Sensing and Cyber | Microelectronics | Trusted AI and Autonomy

KEYWORDS:

xTech; Special Forces Command; ATAK; GPS; Autonomy; Counter UxS; PSYOP; Air Delivery Vehicle; Radio; PLI; SFC; Radio Frequency; Electronic Warfare; Sensors; AI/ML; Signal Detection; Systems

OBJECTIVE:

The U.S. Army Pacific (USARPAC) is interested in finding and developing capabilities that work for the Warfighter by experimenting early, often, and in-theater. USARPAC integrates experimentation to develop and test future capabilities and formations while concentrating on training forward. The Indo-Pacific is the most consequential region in modern history and this region contains the most rugged, distributed, and diverse terrain in the world; from hot, humid rainforests, low-lying coral atolls, to artic plateaus and mountain ranges. USARPAC is interested in cutting-edge technology solutions that will drive significant advances in military capabilities while addressing complex challenges specific to the Indo-Pacific's geographical uniqueness and enabling technologies that could help overcome the tyranny of distance. The capabilities and technologies proposed should be able to operate everywhere from tropics, jungle, archipelagos to extreme cold weather and high-altitude arctic conditions. The xTech competition and experimentation seek technological solutions that address these topic areas but are not limited to:

- Detection of Buried Explosives and Unexploded Ordnance (UXO) in Complex Soils and Magnetically Complex Environments: The U.S. Army seeks innovative detection technologies that should be designed for various operational scales, from small, portable, and easy-to-use systems to more advanced solutions that can detect deeply buried explosives/munitions and UXO in high ferrous content and volcanic soils.
- Advanced Defensive and Deterrent Capabilities for Army and Commercial Watercraft: The U.S. Army seeks innovative, affordable, non-exquisite solutions to enhance the protection of Army and commercial watercraft against modern threats, including uncrewed surface vessels (USVs) and harassing less than lethal, escalation of force effects and emerging aerial UxS threats. The desired solutions should provide defensive and deterrent capabilities, be modular and scalable, and operate effectively in various maritime environments, with a focus on five key areas: interceptor systems, non-lethal repellent systems, ramming protection systems, anti-floating barrier technologies, and water cannon defense systems.

Electronic Warfare (EW) Domain Awareness and Sensing: The US Army seeks innovative, affordable and widespread EW domain awareness and RF sensing capabilities for operations in the Indo-Pacific region. The solution should provide persistent situational awareness using modular, platform-agnostic sensor payloads that can operate unattended for extended periods or user operated with minimal training and maintenance. The payloads should be designed to integrate seamlessly with existing ground, maritime, and aerial platforms, and function reliably in diverse Indo-Pacific environments, including tropical, high altitude, article, and dense urban areas/megacities.

DESCRIPTION:

Topic 1: Detection of Buried Explosives and Unexploded Ordnance (UXO) in Magnetically Complex Environments

Throughout the Indo-Pacific, volcanic islands feature iron-rich soil, which makes magnetic detection of buried metals and unexploded ordnance (UXO) extremely challenging. This environment allows threat actors to conceal munitions, improvised explosive devices (IEDs), and other hazardous materials with relative ease. Additionally,

many areas, such as Papua New Guinea and the Philippines, still contain legacy UXO, further complicating detection efforts. To address these challenges, novel detection technologies must be developed that are effective in magnetically complex environments, adaptable to diverse operational conditions, and deployable across multiple platforms. Proposed detection technologies should be designed for various operational scales, from small, portable, and easy-to-use systems requiring minimal maintenance to more advanced solutions that can be integrated with Class 1 or 2 UAV systems. Prototype solutions can initially be developed for ground or aerial use cases but must have the foundational capability to scan large areas in the future, with additional funding and development. Capabilities should emphasize high detection accuracy with low probably of false alarms in environments with iron-rich soils and other geological interferences. The prototype should demonstrate minimal viable product (MVP) capability to detect representative inert munitions/UXO surrogates in relevant environment in Hawaii. Minimum threshold accuracy p(d) and other attributes, p(fa) and requirements can be determined during demonstration, evaluation, and development based on SWAP and technical readiness.

General Requirements:

1. Detection Performance:
    - Solutions should detect deeply buried explosives, munitions, and UXO such as; 60-mm and 80-mm high explosive mortars, 75-mm, 105-mm, and 155-mm projectiles, 2.36-inch rocket propelled anti-tank rounds, US MK II hand grenades, Rockets, M1 anti-tank land mines, and WWII era ordnance.
    - Solutions must detect buried explosives and UXO with a minimum detection accuracy of <90% in magnetically complex environments and at a depth of at least >1 feet.
2. Testing in High-Iron Soils:
    - Proposed technologies must demonstrate effectiveness in representative volcanic soils. The most extensive soil type in Hawaii are Andisols, derived from volcanic ejecta followed by Histosols, formed on recent lava flows, Oxisols, and Mollisols. Solutions should demonstrate high probability of detection across several types of complex soil examples as seen in Hawaii and other representative soil samples from around the INDO-Pacific containing high iron or iron-like minerals, which can interfere with traditional magnetic-based detection.
3. Data Processing and Analysis:
    - Multimodal data fusion solutions are ideal and can enhance the effectiveness of identifying UXOs by integrating inputs from multiple sensors. However, solutions do not necessarily need to include data fusion to be successful.
    - AI/ML-based analytics to enhance detection accuracy and reduce false positives would strengthen proposals and improve performance, but their inclusion is not required for a successful solution.

Potential Sensor/Detection Ecosystems and Considerations:

1. Non-Magnetic Detection Technologies
    - Example technologies include, but are not limited to, those that leverage alternative properties (e.g., electrical, acoustic, spectroscopic, or seismic) to detect buried objects.
    - Must be able to detect threats in high iron soil with a minimum detection accuracy of >90% at a depth of >1 feet.
2. Spectroscopic Detection Technologies
    - The detection range should be standoff range from the target area.
    - Systems should operate effectively in environments with high humidity, high mineral content, and variable lighting conditions.
3. Acoustic Detection Technologies
    - Systems should function effectively in varying terrain types (e.g., coastal, jungle, and urban environments).
    - Must be capable of penetrating representative volcanic soil and detecting buried threats at a minimum depth of >1 feet.
    - Must mitigate background noise to maintain a false positive rate.
4. Chemical Detection Technologies
    - Must be able to identify explosive residues at trace levels (ppb).

Topic 2: Advanced Defensive and Deterrent Capabilities for Army and Commercial Watercraft

The U.S. Army seeks affordable, non-exquisite, innovative solutions to enhance the protection of Army and commercial watercraft. These solutions should add defensive and deterrent capabilities to increase survivability and help surface vessels counter modern threats, including uncrewed surface vessels (USVs) and harassing less than lethal, escalation of force effects and emerging aerial UxS threats.
The Army is interested in modular and scalable technologies that provide a range of defense options, from non-lethal deterrents to low-cost weapons that neutralize threats. Companies can propose solutions in any of the five

key areas listed below—they do not need to combine multiple functions into one system. Proposed solutions should work on a variety of maritime platforms, including Army and commercial long-haul ships (such as Logistic Support Vessels – LSVs), surrogate or commercial maritime surface vessels, and be effective even on unarmored vessels.

Potential Specifications and Key Performance Parameters:

1. Cost-Effective Interceptor Systems for Hard-Kill or Soft-Kill Defense Against UxS and USVs
    - Able to detect, classify, and potentially engage and neutralize aerial UxS and USVs at a range sufficient to prevent fragmentation damage to the host vessel.
    - Low-cost threshold per effect, interceptor, or system kill for target system neutralization.
    - Production capacity must support a minimum production rate of 100 effects/interceptors per day.
    - Fire-and-forget capability with a COTS seeker.
    - Solutions may alternatively employ novel non-kinetic interceptors
    - Must sense and track multiple threats simultaneously and prioritize engagements.
2. Non-Lethal Repellent and Disruption Systems for Vessel Protection
    - Non-lethal deterrent systems must be effective at a minimum standoff range of at least 50 feet.
    - Potential non-lethal solutions may include microwave or acoustic deterrence devices, prop fouling systems, engine disruption technologies, and autonomous-targeting water cannons.
    - Non-lethal materials for degrading enemy vessel performance and mobility must be safe for operators and environmentally compliant.
3. Ramming Protection Systems
    - Physical countermeasures must minimize damage to friendly vessels while maximizing damage to aggressor vessels.
    - Must be applique-based and not require extensive vessel modifications or significant weight increase.
    - Solutions may include inflatable airbag systems for impact absorption and damage mitigation.
4. Anti-Floating Barrier Technologies
    - Must prevent propeller fouling and entanglement from floating barriers while maintaining normal propulsion performance.
    - Stopping to clear entanglements or slowing on contact is acceptable, but the system must not require diver deployment.
5. Water Cannon Defense Systems
    - Must protect the vessel (like a shield) or degrade hostile water cannon performance by at least 50% to prevent personnel/human harm
    - Countermeasures may include technologies to obstruct or redirect high-pressure water streams and protect critical vessel components and personnel.
    - Solutions may include systems to block water cannon intakes or deflective shields.
6. General Key Performance Parameters:
    - All systems must function effectively in day and night conditions.
    - Must maintain operational performance in at least Sea State 4 conditions.
    - Systems must be modular, scalable, and capable of integration across at least three classes of Army and commercial watercraft.

Topic 3: Electronic Warfare (EW) Domain Awareness and Sensing

The United States Army seeks low-cost and ubiquitous Electronic Warfare (EW) domain awareness and sensing capabilities for multi-domain operations against peer and near-peer threats in the Indo-Pacific Area of Responsibility (AOR). These capabilities should provide persistent situational awareness, leveraging attritable and modular/platform-agnostic sensor payloads for terrestrial sensing. The sensors should operate unattended with extended power life or soldier carried, ensuring reliable functionality in austere environments with minimal sustainment support. Additionally, the solution must seamlessly integrate with existing ground, maritime, and aerial platforms using standardized interfaces and open architectures while being robust enough to function across the Indo-Pacific's diverse operational landscapes, including desert, tropical, and megacity environments. The proposed solutions should focus on developing modular, platform-agnostic sensor payloads designed for seamless integration with various military platforms. These payloads should feature long-duration, unattended operation capabilities, leveraging advanced battery technologies, energy harvesting, and low-power electronics to extend operational life. Solutions must be designed to be compatible with existing interface standards and open architecture(s) across multiple domains.
Minimum threshold accuracy and other attributes and requirements can be determined during demonstration, evaluation, and development based on SWAP and technical readiness.

Key Requirements

1. Modular and Attritable Sensor Payloads: Design modular, platform-agnostic payloads that can be easily integrated with various ground, maritime, and aerial platforms.
2. Unattended and Low-Power Operation: Develop payloads that can operate unattended with long battery life, using energy harvesting, low-power electronics, and advanced battery technologies.
3. Platform-Agnostic Interfaces: Ensure payloads can communicate with various platforms using standardized interfaces, open architecture, and software-defined interfaces. Ability for software ecosystem to integrate with Android Team Awareness Kit (ATAK)
4. Environmental Hardening: Design payloads to operate in diverse environments, including desert, tropical, and megacity areas, with ruggedized designs, weatherproofing, and thermal management.
5. Autonomous Operation and Edge Computing: Enable autonomous operation using artificial intelligence (AI), machine learning (ML), and edge computing, with local data storage and processing to minimize latency and dependence on cloud connectivity.
6. Multi-Function and Multi-Band Capabilities: Develop payloads with multi-band antennas, multi-function capabilities, and frequency-agile designs to provide comprehensive EW domain awareness.
7. Cybersecurity and Information Assurance: Ensure payload security and integrity using encryption, secure communication protocols, intrusion detection and prevention systems.

Technology Areas and Components Include but not limited to:
To address these requirements, the following technology areas may be relevant:

1. Software-Defined Radios (SDRs): Modular, reconfigurable radios for flexible payload design, supporting multi-band and frequency-agile operations.
2. Cognitive RF Sensing and Adaptive Filtering: AI-driven RF signal analysis to detect, classify, and mitigate interference in congested or contested electromagnetic environments.
3. Advanced Passive RF Sensing Technologies: Leveraging low-power, passive RF detection techniques to monitor electromagnetic activity without emitting detectable signals.
4. AI-Enhanced Signal Processing: Using machine learning algorithms to improve the identification and classification of electromagnetic signals in real-time.
5. Low-SWaP (Size, Weight, and Power) Sensor Technologies: Miniaturized sensor components that maintain high-performance capabilities while reducing the burden on host platforms.
6. NDA compliant extremely low cost sensor technologies.
7. Energy Harvesting and Advanced Power Management: Technologies that extend operational endurance through energy harvesting, smart power management, and low-power design principles.
8. Distributed and Collaborative Sensor Networks: Swarm-based, networked sensing architectures that share and process EW data across multiple platforms for enhanced situational awareness.
9. Secure and Resilient Communications: Advanced encryption techniques, frequency hopping, and anti-jamming capabilities to ensure robust and secure data transmission.
10. Miniaturized Multiband Antennas: Compact, frequency-agile antenna solutions designed for multi-domain operations with enhanced directionality and efficiency.
11. Hyperspectral and Multispectral RF Sensing: Leveraging advanced spectral analysis techniques to detect and classify electromagnetic emissions with greater precision.

PHASE I:

This topic is for Direct to Phase II (DP2) submission. Department of the Army will accept Direct to Phase II proposals for the cost of up to $2,000,000 for an 18-month period of performance.
In order for proposers to submit a DP2 proposal, they must provide the justification documentation to substantiate that the scientific and technical merit and feasibility described above has been met and describes the potential military and/or commercial applications. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results.

PHASE II:

Produce prototype solutions that will be easy to operate by a Soldier. These products will be provided to select Army units for further evaluation by the soldiers. In addition, companies will provide a technology transition and commercialization plan for DOD and commercial markets.

PHASE III DUAL USE APPLICATIONS:

Complete the maturation of the company's technology developed in Phase II to TRL 6/7 and produce prototypes to support further development and commercialization. The Army will evaluate each product in a realistic field

environment and provide small solutions to stakeholders for further evaluation. Based on soldier evaluations in the field, companies will be requested to update the previously delivered prototypes to meet final design configuration.

REFERENCES:

1. https://www.xtech.army.mil/competitions/

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