AFNWC Pitch Day 22.2 Technical Focus Areas

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AFNWC Directorate: ND

1. Digital Transformation for Air Delivered Capabilities

Problem Description:

The Air Force and DoD are moving towards a model-based systems engineering approach for future acquisition programs. Current programs in the sustainment phase, or moving into the sustainment phase, still rely upon a document-based systems engineering approach. Common tools exist already that use SysML for model building. The problem is that the computer networks these tools can be used on are restricted. The bulk of sustainment programs require some form of classified system due to design information classifications. The problem space should focus on ways to incorporate common digital modeling software into a classified network and methods on how to transition sustainment programs from a document-based to models-based system.

Summary:

We seek a method to incorporate digital engineering tools into our sustainment programs. Using SysML and common digital engineering tools, we need a digital environment that can be used across the spectrum of our sustainment portfolio.

Focus Area: General Warfighting Requirements

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 5

Available resources (i.e. Government data, additional money, government equipment, etc.): N/A

Linked ideas (if applicable): N/A

AFNWC Directorate: EN

1. Advanced Parts Management System

Problem Description:

Seeking technology to track parts to support inventory optimization for the Nuclear Enterprise. Including Supply Chain Management (SCM) among others: providing supplies to the military services and supporting the acquisition of weapons, fuel, repair parts, and other materials. There is a need for methods to predict the future state of a supply chain to optimize the flow of parts while maintaining the inventory. We strongly anticipate this will involve Artificial Intelligence (AI) and Machine Learning (ML) algorithms – looking at historical data and statistics to predict optimal stock levels. AI/ML algorithms are capable of analyzing large, multi-variable, and diverse data sets quickly, improving demand forecasting accuracy. This tool would save time and money and improve efficiency, while ensuring the availability of parts to military programs and operations. Some examples may include:

- Identify top ten worst parts
- Identify which vendors are out of business (how do we adjust accordingly)
- Identify vendors historical delivery trends

Summary:

AFNWC is seeking a parts management tool that can predict demand and obsolescence problems and optimize inventory levels to ensure availability of parts to improve weapon system readiness.

Focus Area: Microelectronics

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 5

Available resources (i.e. Government data, additional money, government equipment, etc.): Example real-world data might be available.
Linked ideas (if applicable): N/A

2. Digitization and Management of Authoritative Resources

Problem Description:
Many documents developed during the procurement of Air Force systems provide technical and operational instructions/policies that evolve throughout time. It is often difficult to determine which document is the authoritative resource (the most current policy/guide). Effectively managing authoritative resources is a key step in developing and integrating tools and infrastructure and facilitates the adoption of Digital Engineering.

We are seeking solutions to digitize and manage our tools and practices. This will require resource models and a general way to provide precise descriptions of how to manage such resources. Digital Engineering also requires that a document and its elements be distributable, but still authoritative. The theme may include published reports, patents and lessons-learned materials. The mechanisms, including distributed versioning and tagging and security levels, need to be specified and be part of the resource model. Tool should allow business rules to be defined around the resource model to establish best practices while maintaining the resource lifecycle.

Some examples include:

- Solutions that update information across multiple systems/domains
    - Validity check of the analytical information to verify consistency with authoritative truth
    - Automated data crawler (machine learning) such as DAEMON
    - Query data can be inserted in the new program from source information with source identified
- Graphical User Interface (GUI) of system-of-systems with multiple overlays for levels from warfighter, System Program Office (SPO) engineers to leadership
    - Automating source of truth update across multiple systems and across distinct and multiple domains
    - Innovative solutions that can adopt modern human factors concepts with a modular design that can integrate them to the Air Force's existing digital infrastructure and future developments

Summary:
Many documents developed during the procurement of Air Force systems are not in digital format and provide technical and operational instructions/policies that evolve throughout time. In some cases, it is difficult to determine which document is authoritative (the most current policy/guide). We need a tool to establish digitization and management of authoritative resources as we transition to a digital engineering environment.
Focus Area: Nuclear
Solution's Limitations and Constraints (i.e. nuclear certification): N/A
Minimum Desired technology readiness level (TRL): TRL 5
Available resources (i.e. Government data, additional money, government equipment, etc.): N/A
Linked ideas (if applicable): N/A

3. Stakeholder Concern-Directed Modeling

Problem Description:

Current modeling practice has architects developing models and then showing stakeholders their concerns by back-fitting statically defined viewpoints and views of that model. It is recognized that this static process performed by architects (as current "best practice") does not satisfy the needs of stakeholders. Stakeholders desire to dynamically query requirements or architectural models to satisfy their concerns over the system(s) being defined by those models.

This agility in the modeling practice is desired, but at this time is not present. One obstacle to overcome is the development of a naturalistic language that can be used by stakeholders to define such queries. Models that an architect has developed to date may only be able to answer such queries in part. Such queries should be able to be used to guide architects as to what must be further developed in the precise model description to allow a complete answer to a stakeholders' concern. This will help to remove the extra modeling efforts carried out by architects (with best intentions) but not answering the precise concerns of stakeholders.

Summary:

We need improved modeling practices to allow Stakeholders to dynamically query requirements or architectural models in order to satisfy their concerns over the system(s) being defined by those models.

Focus Area: Nuclear

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 5

Available resources (i.e. Government data, additional money, government equipment, etc.): N/A

Linked ideas (if applicable): N/A

4. Alternative to GPS-based Navigation

Problem Description:

Global Positioning System (GPS) technology could potentially fail or become unavailable in a hostile environment. A navigational system is desired that can provide position awareness in the absence of GPS. Application requires high stability in an extreme shock and vibe environment, high precision, and a rapid refresh rate. Low size, weight, and power (SWAP) solutions are desired. The desired system could function either as a complete solution (e.g., provide absolute position) or complement other solutions (e.g., be a source to update attitude/position to remove drift in an inertial guidance system, as does a star tracker).

Summary:

A low size, weight, and power navigational solution is needed that can provide accurate navigational data in the absence of GPS.

Focus Area: Autonomy

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 4

Available resources (i.e. Government data, additional money, government equipment, etc.): Preliminary Government data

Linked ideas (if applicable): N/A

5. Robotics

Problem Description:

Robotic technology is a growing tool that has the potential to advance efficiency in system upgrades and maintenance with the USAF/AFNWC. We are seeking an application and development of robotic technology with the USAF/AFNWC. Advance the integration of robotic tools within programs to improve efficiency and overcome challenges, such as test prep, handling heavy or delicate hardware, or performing tasks in hazardous environments. Examples such as nuclear silos to perform environmental scans for maintenance, handling of delicate or radiated materials that can be dangerous to human users. Robotic involvement to increase efficiency in projects.

Summary:

Develop a robotic application that can approach the challenges of general maintenance of nuclear facilities, project test preparation and such applications of value to nuclear weapon systems or infrastructure that can improve performance or overcome challenges.

Focus Area: Artificial Intelligence / Machine Learning

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 3

Available resources (i.e. Government data, additional money, government equipment, etc.): N/A

Linked ideas (if applicable): N/A

6. Hybrid Ceramic Throats for High-Temperature Propellants

Problem Description:

Mature and scale-up materiel solutions to non-eroding hybrid ceramic throats for contemporary or disruptive high-temperature (boost, min-smoke, no-smoke) propellants to enhance range, speed, and size, weight, and power (SWAP) efficiency of missile systems. Results of this work would be enhanced designs and an accompanying understanding required to scale non-eroding throats for future missile systems with the option to test delivered configuration to validate proposed designs.

Demonstrate and/or scale existing materials to the next logical size increment. Develop assembly techniques for integrating materials that mitigate erosion. Conduct modeling of throat design to optimize performance. Deliver throat assemblies for test. Small-scale testing and planning for larger scale testing is encouraged.

Summary:

Technology for hybrid ceramic throats needs to be developed and matured to enhance range, speed, and size, weight, and power (SWAP) efficiency of missile systems.

Focus Area: Nuclear

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 6

Available resources (i.e. Government data, additional money, government equipment, etc.): N/A

Linked ideas (if applicable): N/A

7. Nuclear Protection of Carbon-Carbon Composites

Problem Description:

Enhanced nuclear protection of carbon-carbon aeroshells and motor components is desirable for future systems. The process for manufacturing carbon-carbon is extreme and limits additions to the material that would enhance its nuclear protection capability. Innovative processing trials and technique developments are necessary to realize this technology. Results of this work will enable system-level enhancements in nuclear protection to future missiles.

Develop, adapt or modify existing nuclear hardening techniques and materials for low and intermediate temperature composites to 2D and 3D carbon-carbon processing routes. Characterize and optimize resulting materials and processes. Identify and optimize compatibility with standard industrial carbon-carbon processes. Demonstrate manufacturing at coupon and/or sub-element level.

Summary:

We need to develop innovative processing trials and techniques to enhance nuclear protection of carbon-carbon aeroshells and motor components for future systems.

Focus Area: Nuclear

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 5

Available resources (i.e. Government data, additional money, government equipment, etc.): N/A

Linked ideas (if applicable): N/A

8. Scale-Up and Testing of Hardened Aeroshells to Thermo-Mechanical Effects

Problem Description:

Technologies for hardened aeroshells will enable system-level enhancements to future missiles and subsystems. These technologies need to be scaled to the sub-element and component level to continue maturation and demonstrate feasibility. Results of this work will mature a capability and either demonstrate feasibility or identify risks for future system enhancements in nuclear protection of future missiles and sub-systems.

Hardened aeroshell materials and properties need to be characterized at the sub-element and component level. Thermo-mechanical properties should be characterized. Tests in flight-relevant environments (vibration, aerothermal loading) are desirable. Functional properties relevant to nuclear effects testing should be characterized, but also should be tested at scale in a relevant environment.

Summary:

We need to characterize, scale-up, and test hardened aeroshell material technologies to enable system level enhancements to future missiles and subsystems.

Focus Area: Nuclear

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 5

Available resources (i.e. Government data, additional money, government equipment, etc.):

Linked ideas (if applicable): N/A

9. Artificial Intelligence for Counterfeit Parts

Problem Description:

An Artificial Intelligence tool is needed to aid in identifying potential military counterfeit parts; this will allow AFNWC programs involved with the Fraudulent Working Group to potentially save time in scanning parts, documents, materials, etc., in their counterfeit parts identification process. For example, high end retailers such as Nordstrom, uses a smart-phone sized camera from a company called "Entrupy" for scanning goods. We are interested in leveraging similar COTS / retailer solutions for AFNWC programs.

Summary:

We need an AI solution to aid in identifying potential military counterfeit parts.

Focus Area: Artificial Intelligence / Machine Learning

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 6

Available resources (i.e. Government data, additional money, government equipment, etc.): N/A

Linked ideas (if applicable): N/A

AFNWC Directorate: NT

1. Advanced Automated Analysis Methods for Critical System Evaluations

Problem Description:

As system complexity increases, the various modes of failure also become more complex and often the inter-system dependencies and system states necessary to create failure conditions are not well understood. In the nuclear safety and effectiveness domains this uncertainty must be reduced to an absolute minimum. As such, the capability to create realistic virtual models and expeditiously simulate various system states (and their associated combinations and permutations that might occur) in order to generate a system state condition of interest is needed. Additionally, the virtual system must adapt, with minimal/no user interface to the various sub-system and component states that drive the system, in order to explore all possible weapon system states. The architecture of this capability needs to be able to interface with digital models/digital twins of weapon systems to automatically import, process, and assess system failure states.

Summary:

Develop a capability to automatically import, process, and assess system states that lead to a user defined end-state. Output digital state diagrams that lead to user defined system end state conditions and identify common/singular nodes that are critical to achieve user defined end-state.

Focus Area: Artificial Intelligence / Machine Learning

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 5

Available resources (i.e. Government data, additional money, government equipment, etc.): Limited government data

Linked ideas (if applicable): N/A

AFNWC Directorate: NM

1. Missile Field Real-time "Health of Fleet" Capability

Problem Description:

"Critical enhancements to the Missile Field digital toolset are needed for the Minuteman III (MMII) weapon system. Every day in the missile field a plan is set up between security forces (SF), Maintenance, and Operations to address the myriad of tasks necessary to keep the MMIII on alert. That plan involves thousands of personnel and hundreds of vehicles. As the plan unfolds and changes occur, leadership needs an accurate sight picture to adjust to the changes and still accomplish the daily mission. A reliable full level of real-time situational awareness at all levels of the Command Structure is necessary to prioritize resources, operations, and maintenance activities for effective management of rapidly changing mission risks." (Paraphrased statement from AFGSC's Force Development Concept document, published in 2017.)

MMIII currently utilizes archaic, disparate, stove-piped digital tools/data that do not allow efficient, integrated, and agile management of mission risk. The current system is costly, inefficient, prone to data loss, and lacks the ability to holistically and responsively manage weapon system technical data across disciplines, directorates, and throughout the supply chain, sustainment, and field organizations.

AFGSC has funded deployment and sustainment of a transformative digital architecture called "Watchtower". Watchtower is an open and scalable digital foundation that ingests any form of data in its native format, and then metatags, fuses, ties it to physical assets, and visualizes it on a geo-earth kind of map. This environment can be leveraged by the small business community to affordably add much needed functions via analytical tools and applications. Watchtower's initial incarnation focused on delivering a real-time, tailorable common operating picture for missile field operations. The nuclear enterprise solicits help from the Small Business community for development of innovative applications that could leverage this open architecture framework by adding critical functions/capabilities that revolutionize Nuclear Enterprise efficiency/effectiveness.

While the possibility for added functional computational products is only limited by imagination, the focus of this topic is to mature the digital tools/applications required for timely, dynamic assessment and management of risks to the health of the ICBM fleet. A threshold objective is to better automate assessment of the health of the fleet. An objective requirement would possibly include machine learning, or AI technologies to interpret and help manage assessed risks.

While the Watchtower environment is available for efficient leverage to the ends described herein, the USAF will consider other approaches for delivering alternative modernized, and coveted Nuclear Enterprise digital capabilities. In the interest of the government, these other approaches would have to be both life-cycle cost and schedule competitive when compared to building on Watchtower's proven foundation.

Summary:

Watchtower, the MFs' current Real-Time Common Operating Picture framework, fuses and visualizes missile field data, but lacks a tool/application for Real-Time "Health of the Fleet" assessment. This topic seeks the innovative power of small businesses to develop, demonstrate, and deliver tools/applications that are suitable for integration, and operational use for agilely and reliably assessing ICBM fleet health and informing resource optimization for fleet health risk management.

Focus Area: Artificial Intelligence / Machine Learning / Network Command, Control and Communications

Solution's Limitations and Constraints (i.e. nuclear certification): N/A
Minimum Desired technology readiness level (TRL): TRL 7
Available resources (i.e. Government data, additional money, government equipment, etc.):
Seeking potential S&T investment from AFRL's Center for Rapid Innovation, AFGSC has already POM's for sustainment of the Watchtower environment, and it can be made available to allow responding small businesses to focus on application development (instead of on the harder and more expense proposition of simultaneously development the digital environment to support the application/tools). Our partnership with AFRL also delivers subject matter experts to help the team successfully deliver employable, and suitable tools. AFRL's knowledge in the area of Accreditation, ATOs and ATCs will reduce the risk of products not getting approved for operational use.
Linked ideas (if applicable): N/A

2. Digital Environment Tools Development

Problem Description:
A new, updated digital toolset is needed for the Minuteman III (MMIII) weapon system. MMIII currently utilizes archaic, disparate, compartmentalized digital environments that do not allow efficient, consolidated, single product-focused data management. The current system is costly, inefficient, prone to data loss, and lacks the ability to holistically manage weapon system technical data across disciplines, directorates, and throughout the supply chain, sustainment, and field organizations. GBSD, the MMIII replacement, manages the weapon system technical baseline in an established digital environment but MMIII is incapable of efficiently interfacing with it and transferring data between the two weapon systems.
Summary:
Minuteman III uses outdated tools incapable of consolidating technical data across disciplines and associated supporting organizations. MMIII requires updated digital tools to manage weapon system technical data and transfer years of MMIII data to the replacement of the weapon system (GBSD).
Focus Area: Cybersecurity / Nuclear
Solution's Limitations and Constraints (i.e. nuclear certification): N/A
Minimum Desired technology readiness level (TRL): TRL 6
Available resources (i.e. Government data, additional money, government equipment, etc.):
Additional RDT&E funding sources are being sought, but not currently approved until FY23 but will fund other digital environment tools that will complement this effort. Some workstations, all Nuclear Weapons Center office IT equipment such as computers, networks, software, etc will and can be utlitized and connected to the digital tools and digital space. Additional software licenses, and some existing network infrastructure across bases and facilities will be leveraged to expedite the capability and reduce overall costs.
Linked ideas (if applicable):
Multiple software licenses, cloud computing, and server capabilities can be used to transition from old digital networks and tools to new platforms and tools.

AFNWC Directorate: NX

1. Strategic Radiation Hardened (Rad-Hard) Microelectronics (ME)

Problem Description:

The ability to design radiation hardened systems depends on a set of special technologies, especially for systems that have the highest level of reliability requirements. One of the most significant of these required technologies is rad-hard microelectronics (Rad-Hard ME), which are manufactured by a small and rapidly declining set of niche manufacturers and are based on older technology nodes. Microelectronic systems can be upset or permanently damaged by exposure to radiation environments via multiple different types of effects. Special manufacturing techniques and/or designs are typically required in Rad-Hard MEs to mitigate the effects of and/or reduce the sensitivity to radiation in order for them to meet strategic radiation hardness requirements.

Areas of interest for Rad-Hard MEs:

- Advanced radiation effects modeling tools capable of simulating the mechanisms of different types of radiation effects from gamma and neutron radiation
- Rigorous radiation hardness design rules for development of advanced Rad-Hard ME circuits
- Development of Rad-Hard enabling technologies for advanced information processing including sensor fusion, autonomy, artificial intelligence, etc., including
    - Application Specific Integrated Circuits (ASICs)
    - Field Programmable Gate Arrays (FPGAs) and embedded FPGAs (eFPGAs)
    - Structured ASICs (one-time programmable FPGAs)
    - Non-Volatile Memory (NVM)
- Heterogeneous Integration techniques for advanced system in package ME designs
- Radiation hardness assurance test methods for assessing the performance of MEs and other key electronics in strategic neutron and gamma radiation environments
    - Dose-rate testing with variable pulse width
    - Neutron Single Event Effect testing
- Hardness surveillance protocols for assessing ME/packaging hardness as they evolve and age

Expected Collaboration:

- Team must be able to collaborate with AFNWC teams to include UARCs, FFRDCs and industry partners, as well as other DoD mission partner teams (MPTs) as needed throughout the SBIR program

Summary:

The nuclear enterprise requires a trusted supply of advanced strategic radiation-hardened microelectronics (Rad-Hard ME). Radiation effects modeling tools, Rad-Hard ME design rules, enabling technologies, hardness assurance test methods and hardness surveillance protocols are needed to support current AFNWC systems and future needs.

Focus Area: Microelectronics

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 5

Available resources (i.e. Government data, additional money, government equipment, etc.): Limited data may be available for this topic

Linked ideas (if applicable): N/A

2. Novel Utility Corridor Trenching/Trenchless Methods

Problem Description:

Current traditional trenching/trenchless methods for installing utilities such as fiber optic cables at depths of up to 8 feet are significantly limited by environmental, real estate, and soil types. Significant cost and schedule impacts are realized due to these limitations.

- Example: Low-cost Plowing method currently seems limited to 4-5 foot depth in various soil types.

Additionally, there are areas with significant environmental and real estate obstacles in the identified utility corridor path while there is limited/no ability to reroute around the obstacles. This also limits the size of easements for laydown that is allowed/available.

- Example: Significant road slope limits laydown area, size of equipment, method of trenching/trenchless installation of fiber optic cables

The sheer volume (400+ miles) of trenching that will be completed highlights the magnitude and importance of cost and schedule for trenching/trenchless methods and equipment which has a compounding effect. If a technically feasible method is cost and/or schedule prohibitive then it's effectively not executable.

Desired Capabilities:

- Develop an economical capability for trenching/trenchless methods for installing fiber optics at depths of up to 8 feet with minimal environmental and real estate impacts
    - The capability must have minimal required temporary laydown area (25 feet or less) for equipment and soil segregation
    - The capability must be able to operate through various soil types
    - The capability must be able operate in constrained areas such as roads with significant slope
    - Example: Upgrade plowing method/equipment to allow operation at a depth of up to 8 feet through various soil types and road conditions using a temporary laydown area of up to 25 feet for equipment and soil segregation.

Expected Collaboration:

- Team must be able to collaborate with AFNWC teams to include UARCs, FFRDCs and industry partners as needed throughout the SBIR program

Summary:

Current traditional trenching/trenchless methods for installing fiber optic cables at depths of up to 8 feet are significantly limited by soil types and environmental/real estate constraints. An economical trenching/trenchless method is needed for installing fiber optics at depths of up to 8 feet with minimal environmental and real estate impacts.

Focus Area: Network Command, Control and Communications

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 5

Available resources (i.e. Government data, additional money, government equipment, etc.): Limited data may be available for this topic

Linked ideas (if applicable): N/A

3. Sea-Based Platform System for Testing

Problem Description:

- We are interested in pursuing a sea-based platform to replace legacy systems to meet evolving testing needs for ICBMs.
    - SBIR effort would be for a design study to select a COTS vessel to retrofit for this mission. Study would include command and control architecture, test instrumentation requirements (Size, weight, power, etc.) and a concept of operations.
- The platform must be able to support instrumentation suites to provide terminal area scoring information for a re-entry vehicle targeted for the broad ocean area
    - Proposed concept and design may consider more than one vehicle to meet the requirement
- The sea-based platform must have semi- or fully- autonomous capabilities to be controlled by a land based unit with varying modes of operation
    - Operations may be conducted in remote locations with limited connectivity and power sources
- Must be able to use different telemetry and instrumentation packages provided by the government as Government Furnished Equipment (GFE) or developed by different organizations. Formal requirements to be defined with the user at award
    - Examples – telemetry antennas can range approximately 10-15 ft. diameter

The requirements below were identified based on needs. Proposal should address how it will meet the identified below:

- Must securely communicate with a land based control station for purpose of controlling the platform and monitoring system status
- Must operate in the Broad Ocean Area up to a sea state five (Platform will have to maneuver around more severe weather)
- Minimum of 3,000 with a preferred 4,000 nautical mile range (2,000 nautical miles out and back)
- Minimum of 24 hour loiter time at the BOA target with a preferred of 72 hours prior to returning to port

Expected Collaboration:

- Team must be able to collaborate with AFNWC teams to include UARCs, FFRDCs and industry partners as needed throughout the SBIR program

Summary:

ICBM test launches verify the accuracy and reliability of the weapon system and provide valuable data to ensure a continued safe, secure and effective nuclear deterrent. However, current flight test tracking and scoring systems have limited capabilities and are hard to sustain. A replacement sea-based scoring platform is needed.

See https://www.afnwc.af.mil/News/Article/2398073/afnwc-team-supports-icbm-test-launch/ for background info.

Focus Area: Autonomy

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 4

Available resources (i.e. Government data, additional money, government equipment, etc.): Limited Government data is available for this topic.

Linked ideas (if applicable): N/A

4. Telemetry Package (Receiver) for Tracking and Terminal Scoring

Problem Description:

We need a telemetry system that operates with a center frequency within the S or L bands

- The telemetry package will be used with an air- or sea-based platform
- Interested in a system that is self-sufficient
    - The platform housing the telemetry package may or may not support power requirements

Telemetry Requirements

- Must be programmable to receive (download) a telemetry signal with an S or L band center frequency
    - No upload telemetry requirements for the system
- Must be able to receive time, space, and position information transmitted by military ranges to point instrumentation to acquire and/or track desired targets
- Must provide control station situational awareness video
- Must be able to encrypt and transmit data back to land-based control station

Expected Collaboration:

- Team must be able to collaborate with AFNWC teams to include UARCs, FFRDCs and industry partners as needed throughout the SBIR program

Summary:

ICBM test launches verify the accuracy and reliability of the weapon system and provide valuable data to ensure a continued safe, secure and effective nuclear deterrent. However, current flight test tracking and scoring systems have limited capabilities are hard to sustain. A telemetry package (operating in S or L band) is needed to receive telemetry data and send encrypted data to land-based control station.
See https://www.afnwc.af.mil/News/Article/2398073/afnwc-team-supports-icbm-test-launch/ for background info.

Focus Area: Nuclear

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 5

Available resources (i.e. Government data, additional money, government equipment, etc.): Limited Government data is available

Linked ideas (if applicable): N/A

5. Digital Engineering Technologies

Problem Description:

Digital Engineering is an integrated approach that uses authoritative sources of system data and models as a continuum across disciplines to support lifecycle activities from concept through their disposal.

Objectives:

- Seeking solutions that provide a hybrid model of code inspection and software check with the combination of automation and targeted human interference
- Seeking solutions that enhance and improve business functions and processes for program managers
- Develop solutions that enable end-to-end weapon system performance modeling/simulation capabilities with the ability to conduct evaluations such as performance data analysis among others
- Seeking solutions to develop data visualization tools such as dashboards and workflows that facilitate timely and accurate completion of cyber security and nuclear surety activities

- Seeking modeling and simulation (M&S) capabilities that are able to integrate with AFNWC systems and develop innovative approaches and solutions
- Develop solutions that can support the government's developed architecture representing the weapon system enterprise as well as the external interfaces

Summary:
We are seeking digital engineering solutions (methods, processes, and tools) to transform the engineering, research, requirements, acquisition, test, cost, and sustainment communities. Examples include code inspection, business tools, modeling/simulation/analysis, and data analysis/validation/visualization tools to facilitate cyber security and nuclear surety certification activities.
Focus Area: Artificial Intelligence/Machine Learning
Solution's Limitations and Constraints (i.e. nuclear certification): N/A
Minimum Desired technology readiness level (TRL): TRL 5
Available resources (i.e. Government data, additional money, government equipment, etc.): Limited data may be available for this topic
Linked ideas (if applicable): N/A

6. Kubernetes Day 1/Day 2 Service Improvement at the Tactical Edge

Problem Description:
Kubernetes based applications have historically required significant technical experience to manage. Employing Kubernetes in disconnected/tactical edge environments, which are very common for weapon systems, significantly increases the complexity and currently requires deep domain experience to successfully Deploy and Operate. A service is needed to simplify and automate common Deploy and Operate (aka Day 1/Day 2) operations to enable missions to execute without requiring teams to be deep experts in the underlying technology. To maintain mission relevancy this service must leverage Platform One Big Bang technologies.

Expected Collaboration:

- Team must be able to collaborate with AFNWC teams to include UARCs, FFRDCs and industry partners as needed throughout the SBIR program

Summary:
We need a service that enables an operator with minimal training to manage Day 1/Day 2 operations for Platform One Kubernetes based mission applications and Kubernetes environments for disconnected clusters/at the tactical edge.

- Day 1: Tasks required to deploy
- Day 2: Tasks required to operate and maintain

Focus Area: Cybersecurity
Solution's Limitations and Constraints (i.e. nuclear certification): N/A
Minimum Desired technology readiness level (TRL): TRL 5
Available resources (i.e. Government data, additional money, government equipment, etc.): Limited data and access to government networks may be available for this topic
Linked ideas (if applicable): N/A

7. Software Bill of Material (SBOM) Integration with DOD Platform One

Problem Description:

Software Bill of Material (SBOM) is evolving into an essential technology for modern software assurance program to understand the full pedigree of software utilized in deployed applications and their environments. An ability to generate a SPDX (https://spdx.dev/) manifest across all tooling in Iron Bank (https://ironbank.dso.mil/) and mission apps using Big Bang or Party Services would provide significant improvements to managing software pedigree. This effort would need to negotiate across Iron Brank vendors/project leads to include an SPDX based SBOM and coordinate with the Platform One team to provide a consistent vision for SBOM in Platform Big Bang or Party Services.

Expected Collaboration:

- Team must be able to collaborate with AFNWC teams to include UARCs, FFRDCs and industry partners as needed throughout the SBIR program

Summary:

Establish a consistent approach for DOD Platform One tooling to produce a Software Bill of Material (SBOM).

Focus Area: Cybersecurity

Solution's Limitations and Constraints (i.e. nuclear certification): N/A

Minimum Desired technology readiness level (TRL): TRL 5

Available resources (i.e. Government data, additional money, government equipment, etc.): Limited data and access to government networks may be available for this topic

Linked ideas (if applicable): N/A

8. Technology Database

Problem Description:

Current Challenge:

- The driving pace and competition for leading-edge technology across the Air Force and industry has outpaced AFNWC's ability to track innovation and technology opportunities across the varied industry sectors
- There is no central repository that is able to identify and track technology developments efforts across the government, industry and academia

Desired Capabilities:

- A secure database that is able to provide technology data from existing databases
- Must be able to have the ability to access existing databases such as the United States Patent and Trademark Office (USPTO) and other government sources
- Must have the ability to access commercial R&D databases from academia and industry, as well as other 3rd party as sources as needed
- Use Open Source Software (OSS) and commercial off the shelf (COTS) programs
- Ability to query the data based on different parameters
    - Tech area, technology readiness level (TRL), transition/commercialization information, etc.
- Develop a data-rights construct to determine the rights afforded to the government to access and use the technologies within the database

Additional Requirements:

- Initial work will be done at the UNCLASSIFIED level and the database be able to achieve IL5 or higher as needed by mission need. Additionally, it must be able to meet additional safety and security requirements as needed throughout the SBIR program.

Summary:
The driving pace and competition for leading-edge technology across the Air Force and industry has outpaced our ability to track innovation and technology opportunities across the varied industry sectors. We need a centralized repository that is able to identify and track technology development efforts across the AFNWC, industry and academia.
Focus Area: Artificial Intelligence/Machine Learning
Solution's Limitations and Constraints (i.e. nuclear certification): N/A
Minimum Desired technology readiness level (TRL): TRL 5
Available resources (i.e. Government data, additional money, government equipment, etc.): Limited data and access to government networks may be available for this topic
Linked ideas (if applicable): N/A

9. Digital Solutions for Supply Chain Risk Management (SCRM)

Problem Description:
The Air Force Nuclear Weapons Center (AFNWC) is looking for solutions to develop a supply chain risk management (SCRM) analysis tool that can access big data from open sources to conduct research in support of supplier risk assessments, and continuous monitoring of suppliers/products, as needed. This solution, which is in alignment to Department of Defense (DoD) policy, DoDI 5200.44, will assist to reduce upstream risk by creating greater visibility of the supply chain. Reduced supply chain risk enhances the integrity of components entering weapon systems, promotes quality, hardware reliability, availability, and enduring support in the Department of Defense supply chain. This effort requires the need to develop interconnected solutions that are able to access significant amounts of open source commercial and government data, store these data, piece together useful information about companies and products, and report information in response to user queries. The tool may resemble and operate in the same manner as a search engine with access to large data libraries with the ability to conduct targeted queries based on user need.
Expected Collaboration:

- Team must be able to collaborate with AFNWC teams to include UARCs, FFRDCs and industry partners as needed throughout the SBIR program

Security Requirements:

- Must meet AFNWC security requirements as identified throughout the SBIR effort to include DevSecOps and integration requirements

Summary:
We are interested in a digital tool for managing supply chain risk by identifying susceptibilities, vulnerabilities and threats throughout DoD's "supply chain" and developing mitigation strategies to combat those threats whether presented by the supplier, the supplied product and its subcomponents, or the supply chain (e.g., initial production, packaging, handling, storage, transport, mission operation, and disposal). Proposed software tool must integrate data, enable data visualization, provide data analytic functions, and have the ability to share information between various government organizations, agencies,

and contractors. Enterprise-wide solution must allow individual users to access all appropriate and relevant data in order to make data-driven decisions based on their individual role/function.
Focus Area: Artificial Intelligence/Machine Learning
Solution's Limitations and Constraints (i.e. nuclear certification): N/A
Minimum Desired technology readiness level (TRL): TRL 5
Available resources (i.e. Government data, additional money, government equipment, etc.): Limited data and access to government networks may be available for this topic
Linked ideas (if applicable): N/A

10. AR/VR Technologies

Problem Description:
We wish to utilize augmented reality (AR) and virtual reality (VR) technologies to unify geographically-dispersed expertise and accelerate training and proficiency levels of the U.S. Air Force workforce. These technologies will allow operations and maintenance communities to quickly view, assess, and resolve problems.

- Augmented reality is the placement of digital content within the physical world through the use of technology. It gives 3D experiences to users, resulting in high engagement
- Virtual reality is an immersive computer-generated simulation of a 3D environment

Current Challenge:

- Current VR solutions struggle with realistic omnidirectional locomotion. Current solutions are non-user friendly, unsafe, or awkward to use.
- Interacting with objects and environments in VR are currently unrealistic, and lack a "real-world" feel to the experience.
- Some systems may have a negative effect on users who may suffer from disorientation or nausea while using the system.

Desired Capabilities:

- A realistic omnidirectional locomotion system that can support training needs of the users.
- Software agnostic platforms and solutions that can enhance the immersion and training experience of the users.
    - Interested in the hardware and integration as opposed to the development of VR software.
- Hardware solutions that can provide a realistic interaction with the digital world in order to accomplish the required tasks
    - Interaction with environment and items in the digital world should feel as real as possible.

Summary:
Current VR solutions are non-user friendly, unsafe, or awkward to use. VR objects and environments are currently unrealistic and lack a "real-world" feel. A realistic omnidirectional locomotion system is needed that can support user training needs.
Focus Area: Artificial Intelligence/Machine Learning
Solution's Limitations and Constraints (i.e. nuclear certification): N/A
Minimum Desired technology readiness level (TRL): TRL 5
Available resources (i.e. Government data, additional money, government equipment, etc.): Limited data and access to government networks may be available for this topic.
Linked ideas (if applicable): N/A