TOPICAL BROAD AGENCY ANNOUNCEMENT (BAA) #043224

TITLE: Embedded Instrumentation for Test And Evaluation

PRE-PROPOSAL CONFERENCE

A pre-proposal conference will be held at the Sheraton Providence Airport Hotel 1850 Post Road, Warwick, Rhode Island on Wednesday, 06 October 2004 at 1:00 P.M.(local time) Participants may ask questions relative to the Topical Broad Agency Announcement (BAA).)

A. INTRODUCTION

The Director of Operational Test and Evaluation (DOT&E), Office of the Secretary of Defense, is soliciting advanced technology proposals for the development of components, subsystems, and systems for use as embedded test and evaluation instrumentation under the Test and Evaluation/Science and Technology (T&E/S&T) Program. A one-step sequence is established for offerors contemplating submission of a proposal under this BAA.

Proposals may be for projects or investigations that can be completed within a year of award, or may be for multiple year projects as long as each subsequent phase can be funded as individual options with clearly defined milestones and deliverables. DOT&E strongly encourages well-coordinated, interdisciplinary research and development activities that take into consideration previous and current relevant work, and significant and relevant engineering tradeoffs and optimizations. Projects must have a direct relevance to identified military T&E needs relating to military utility or cost reduction potential. Proposals should indicate potential transition paths to subsequent development or procurement phases. A technology insertion plan is encouraged, and research that holds promise of insertion into DoD T&E is of primary interest.

B. GOALS OF EMBEDDED INSTRUMENTION AND TEST AND EVALUATION

The Chairman of the Joint Chiefs of Staff Instruction (CJCSI 3170.1D) entitled "Joint Capabilities Integration and Development System" directs that Embedded Instrumentation shall be considered in tradeoff studies and design analyses for Capability Development Documents (CDDs) and Capability Production Documents (CPDs) for new systems. EI is an enabling tool for transformation processes in test and training, as well as logistics and maintenance. EI will provide cost savings and an enhanced level of force readiness across DoD."

Embedded instrumentation for the purpose of this BAA is defined as: "Data collection and processing capabilities, integrated into the design of a system for test and evaluation". Embedded instrumentation provides measurement system hardware and/or software that can be fully integrated in military systems. This instrumentation may be non-invasive sensors, innovative power sources, data storage capabilities, data collection, conditioning and transmission methods and network architectures that support the EI system. **For this BAA, the focus is on embedded instrumentation architectures that enable capture, storage and availability of T&E data that supports Developmental T&E, Operational T&E and/or continuous testing throughout the life of the system.** It would be desirable for T&E instrumentation funded under this BAA to leverage or benefit training and battle damage assessment embedded instrumentation efforts. The presence of embedded instrumentation should be transparent to the system user(s) and non-intrusive on military system performance and operation.

The specific science and technology goals of this effort are to accomplish one or more of the following:

a. Develop embedded instrumentation subsystems and components for field experiments and/or tests in a simulated environment appropriate for the proposed system application
b. Integrate embedded instrumentation subsystems and components into prototypes for field experiments and/or tests in a simulated environment appropriate for the proposed system application
c. Demonstrate embedded instrumentation concepts and technologies.

Items may be form, fit and function prototypes or scaled models that serve the same demonstration purpose.

1. Scope of Requirement

EI Architecture is the focus of this BAA, but proposals will also be considered for technology developments, demonstrations, and evaluations in the following nine areas (*not prioritized*):

1. Architecture
2. Sensors
3. Miniaturization of instrumentation
4. Communication networks
5. Data collection, reduction, and storage systems
6. Reliability, durability, maintainability, and in-situ calibration of embedded instrumentation
7. Survivability of embedded instrumentation in harsh environments
8. Manufacturing approaches
9. Potential of T&E instrumentation to support training requirements.

Proposals will be evaluated, in part, by their contribution to one or more of these areas of interest. These do not preclude submission in other areas considered by the offeror to have a high probability of interest to the EI T&E community.

The government is not interested in funding enhancements to proprietary products, architectures or networks that may already exist in the commercial domain. New and novel embedded sensor applications, power technology, innovative data storage techniques are of interest, but packaging, system architectures, data integration and processing and added flexibility of sensor applications in data collection, reduction, processing and storage are more desirable. Proposers are asked to remember that the immediate focus of the EI Program is on acquiring embedded instrumentation to support developmental test and evaluation (DT&E) and operational test and evaluation (OT&E).

2. Projected Characteristics for Future Embedded Instrumentation

The following paragraphs describe some characteristics of future embedded instrumentation focused to the requirements of the warfighter in several areas: including Air and Space Systems, Armaments and Munitions, Land Combat, Sea Combat and Dismounted Soldiers. The Test and Evaluation/Science & Technology Program is interested in ensuring that funded projects are directly related to systems that ensure the success and welfare of the warfighter.

Air and Space Systems: Military air and space systems include weapons systems such as fighters, bombers, unmanned aerial vehicles (UAVs), rotary aircraft, satellites, and space launch systems. Typical test requirements originate from avionics, propulsion, airframe and electronic warfare data mission areas. Typical data requirements include temperature, altitude, airspeed, linear acceleration, attitude, angular rate, angular acceleration, etc.

1. Architecture – An architecture is a description of a system in terms functions and component parts, and how those functions and components relate to each other. These functions and components shall be described in terms of a layered technical reference model—from physical measurement, through electronic and digital representation, to end user—with functional interfaces being specified in terms of open-system standards, and components implement with COTS, to the highest degree possible. As an example, Embedded Instrumentation (EI) is envisioned to be part of standard bus/network architectures found on military air and space systems. These present/future avionics architectures need to employ EI for easy access to their various types of busses/networks incorporated on the systems. EI shall support data mining and Meta data collection for data reduction purposes. An example of one or more layers of an EI compliant architecture would be an ICD-GPS-215 instrumentation port. This port gives the test engineer access to all the data from the host GPS system while not interfering with the host system.

2. Sensors – EI sensors for military air and space systems must operate in a wide range of physical environments (e.g. temperature, altitude, airspeed, linear acceleration, attitude, angular rate, angular acceleration, etc.). The physical environments can range from benign platforms such as cargo aircraft (-20ºC to 60ºC, -1000 feet to 40,000 feet, 0 to 450 knots, ±5g, 0º to 360º, ±45º/sec, ±300º/(sec)^2) to extremely harsh conditions found in hypersonic vehicles.

3. Miniaturization – EI should be miniaturized to provide ease of installation with minimal power and weight penalties while simultaneously not affecting the system under test.

4. Communication Networks – EI communication networks must be compatible with existing military internal and external network standards. These internal standards must be compatible with the host air and/or space system network protocol stack starting from the physical layer (i.e. aircraft wiring) up to the applications layer. The external EI Radio Frequency (RF) networks must be compliant with Joint Tactical Radio System (JTRS), telemetry standards of the Range Commanders Council (RCC), and globally accessible.

5. Data collection, reduction and storage systems – EI data collection, reduction and storage systems must be compatible with non-proprietary COTS standards or RCC standards to ensure interoperability among the DoD test facilities.

6. Reliability, durability, maintainability and in-situ calibration – EI shall exhibit the same or better reliability, durability and maintainability as the host military air and/or space system. EI maintainability will include lifetime calibration stability and/or in-situ calibration capability.

7. Survivability in harsh environments – EI shall exhibit the same or better survivability in harsh natural and man-made (including Electromagnetic Interference (EMI)) environments as the host military air and/or space system. During catastrophic events/system failure, recorded data should be recoverable.

8. Manufacturing approaches – EI can be integral to the host military air and/or space structure as part of the manufacturing approach. Examples include the installation of EI sensors in aircraft skins, canopies, and control surfaces.

9. Training programs – EI for T&E can leverage as well as support training programs in the host military air and/or space system. Training data typically includes time-space-positioning information (TSPI), velocity, angular rates, target geometries, and man/machine interfaces.

Armaments and Munitions: Weapons developers are confronted with increasingly complex munitions, resulting in additional data requirements while constrained by shorter design cycles. The challenge is to design, develop, and embed instrumentation into armaments and munitions. Such instrumentation should remain integral to the item and operational throughout its life cycle (all phases of development, test, storage, loading, firing, and flight.) This instrumentation should remain survivable until impact or detonation. As weapons are required to fly farther with increased accuracy and more lethality, new requirements are being levied on test capabilities. These requirements include the ability to evaluate performance for longer flight times and over increased distances, provide increased data throughput, process data from more analog channels and serial/parallel digital data streams, all while requiring less power. Other test requirements include the ability to reconfigure instrumentation after installation, the ability to design and simulate telemetry links using system parameters and range data, and more accurate sensor readings. Due to the increased complexity of armament and munitions design, there is no volume allotted for "strap-on" instrumentation, as practiced in the past. Therefore, instrumentation systems that are truly embedded have enormous potential to enhance T&E capability. Some projected characteristics are:

1. Architecture – An architecture is a description of a system in terms functions and component parts, and how those functions and components relate to each other. These functions and components shall be described in terms of a layered technical reference model—from physical measurement, through electronic and digital representation, to end user—with functional interfaces being specified in terms of open-system standards, and components implement with COTS, to the highest degree possible. As an example, EI is envisioned to be integral to standard bus/interface architectures found on host armament and munitions systems. These present/future architectures need to employ EI for easy access to various types of data and processing incorporated on the systems. EI shall support data mining and Meta data collection for data reduction purposes. An example of an EI compliant architecture would be instrumentation that allows transporting of data without any external hardware. This gives the test engineer unencumbered access to test data while not interfering with the host system.

2. Sensors – EI sensors for armament and munitions systems must operate in a wide range of physical environments, see Table 1. These sensors must be able to adequately measure the critical flight characteristics. (Note, this is not an all-inclusive list, but information for design purposes.)

3. Miniaturization – EI should be miniaturized to provide ease of installation with minimal power and weight penalties while simultaneously not affecting the system under test. A typical munitions application might require the package (sensors and control electronics) to occupy 1.0 cubic inch.

4. Communication Networks – EI communication networks must be compatible with existing telemetry standards, for example RCC, Telemetry Group, Telemetry Standards, IRIG 106-02, as well as network-capable communications for the Army Future Combat System.

5. Data collection, reduction and storage systems – EI data collection, reduction and storage systems must be compatible with non-proprietary COTS standards or RCC standards to ensure interoperability among the DoD test facilities.

6. Reliability, durability, maintainability and in-situ calibration – EI shall exhibit the same or better reliability, durability and maintainability as the host armament/munitions system. EI maintainability will include lifetime calibration stability and/or in-situ calibration capability.

7. Survivability in harsh environments – EI shall exhibit the same or better survivability in harsh natural and man-made (including EMI) environments as the host armament/munitions system. During system failures, recorded data should be recoverable.

8. Manufacturing approaches – The preferred approach is to have the EI integral to the host armament or munitions as part of the manufacturing approach.

9. Training programs – EI for T&E can leverage as well as support training programs in the host systems.

Table 1. Operational Measurements Requirements (Threshold/Objective)

Measurement	Direct Fire Tank	Medium Caliber	Indirect Fire	Small Missiles
Axial Launch Acceleration - g	75,000 / 100,000	50,000 / 70,000	20,000 / 30,000	100 / 500
Cross Axis Launch Acceleration - g	±7,500 / ±10,000	±2,000 / ±3,000	±2,000 / ±3,000	±10 / ±50
In-Bore Rotational Acceleration - deg/sec^2	N/A	6x10E6 / 10x10E6	1x10E6 / 3x10E6	N/A
Axial Flight Acceleration – g	±1 / ±5	±5 /±10	±5 / ±10	± 10/ ±25
Cross Axis Flight Acceleration - g	±1 / ±5	±10 / ±15	±10 / ±15	±50 / ±100
Propellant Temperature – ^{o}C (Flame Temperature)	3,000 / 4,500	3,000 / 4,000	3,000 / 4,000	3,000 / 4,000
Base Pressure – psi	70,000 / 100,000	40,000 / 50,000	50,000 / 75,000	60
Time of Flight – seconds	5 / 10	50 / 100	420	200 / 1000
Launch Spin Rate – Hz	0	1000 / 1200	300 / 350	25 / 50
Axial Base Flight Pressure - psia (max value at 0 altitude)	<15	20 / 16	20 / 16	20 / 16
Cross Axis Flight Pressure - psi	100 / 150	100 / 150	100 / 150	100 / 150
Temperature - flight – ^{o}C (stagnation temperature – nose)	3,500 / 5000	3,500 / 5000	3,500 / 5000	3,500 / 5000
Trajectory Position error – degrees (about 360 degrees)	1/.1	2/.5	10/2	3/.5
Pitch/Yaw (0.1%) - degrees (about the velocity vector)	<±20	<±20	<±20	<±45
Pitch/Yaw Rate - degrees / sec	5000 / 7500	2500 / 3600	2500 / 3600	100 / 1000
Roll Position accuracy (x 0.1%) (about 360 degrees)	5 / 1	5 / 1	5 / 1	5 / 1
Roll Rate – Hz (along the trajectory)	0-60 / 0-100	600-800 / 800-1000	50-300 /5-350	1-20 / 1-30
Analog Voltages - number /level in volts	N/A	< 5 / ±10	< 40 / ±30	< 50 / ±75

Note: An accuracy of 1% or better is required unless otherwise noted. Measurement bandwidth and signal characteristics are not included in this document; however, definition of these quantities is required prior to full system development.

Land Combat Systems: Land Combat Systems encompass two major segments: tracked vehicles and wheeled vehicles. Tracked vehicles are designed to carry out mission requirements in almost any type of terrain and to survive, within reasonable risk limits, known and projected threats. Wheeled vehicles have traditionally been utilized to support the combat arm by transporting personnel, equipment, petroleum products, critical supply items, ammunition, food, and water. A centerpiece of Army transformation initiatives is an increased emphasis on wheeled

vehicles as weapons systems platforms and as mobile command, control, and communications centers. The wheeled-vehicle fleet (both weapon carriers and support) must be able to traverse similar terrain and distances as other combat forces and move at speeds that allow them to perform the full spectrum of their missions.

Land Combat Systems typically possess integrated command, sensor, and fire control technologies. Typical test requirements originate from fire control, mobility and propulsion control, systems of systems interaction, warfighting effectiveness, and electronic warfare data mission areas. Typical data requirements include targeting, fire control responsiveness, mobility related parameters (torque, traction, power, fuel consumption, steering and handling, stability), drive train performance, acceleration, location, etc.

1. Architecture – An architecture is a description of a system in terms functions and component parts, and how those functions and components relate to each other. These functions and components shall be described in terms of a layered technical reference model—from physical measurement, through electronic and digital representation, to end user—with functional interfaces being specified in terms of open-system standards, and components implement with COTS, to the highest degree possible. As an example, the EI architecture must accommodate both deeply embedded and appliqué instrumentation. Deeply embedded instrumentation shall consist of sensors and recording/processing capabilities designed into and permanently installed in the weapon systems. The deeply embedded capability shall have easy access to various types of busses/networks incorporated on the systems and shall provide the foundation of an instrumentation network. The second category of shallowly embedded appliqué instrumentation shall consist of networked components which can be installed either permanently in a sample of systems or easily added/removed from systems engaged in test activities. The instrumentation network shall employ robust physical bus/network technologies and standard network protocols. In both deeply embedded and appliqué instrumentation, the architecture shall support data mining and Meta data collection for data reduction purposes.

2. Sensors – EI sensors for Land Combat Systems must operate in a wide range of physical environments as described in sub-paragraph 6 below. Sensor requirements span a large spectrum of measurement types (temperature, acceleration, shock, torque, pressure, attitude, location, velocity, pointing direction, etc.)

3. Miniaturization – EI should be miniaturized to provide ease of installation with minimal power and weight penalties while simultaneously not affecting the system under test.

4. Communication Networks – EI communication networks must be compatible with existing and emerging military internal and external network standards. These internal standards must be compatible with the platform network protocol stack starting from the physical up to the applications layer. Any EI specific network added to the platform must conform to Information Technology standard protocols. The external EI RF networks must be compliant with JTRS, telemetry standards of the RCC, and globally accessible.

5. Data collection, reduction and storage systems – EI data collection, reduction and storage systems must be compatible with non-proprietary COTS standards or RCC standards to ensure interoperability among the DoD test facilities.

6. Reliability, durability, maintainability and in-situ calibration – EI shall exhibit the same or better reliability, durability and maintainability as the host system. EI maintainability will include lifetime calibration stability and/or in-situ calibration capability. EI sensors for Land Combat Systems must operate in a wide range of physical environments, such as:

    - Ambient temperatures that range from –65ºC to +85ºC, with temperatures in engine components or exhaust gas streams ranging much higher
    - Road shock levels of up to 50 g's
    - Vibration levels of ±20 g's
    - High levels of dust, dirt, mud, and water
    - Rough handling.

7. Survivability in harsh environments – EI shall exhibit the same or better survivability in harsh natural and man-made (including EMI) environments as the host platform. During catastrophic events/system failure, recorded data should be recoverable.

8. Manufacturing approaches – The preferred approach is to have the EI integral to the host system as part of the manufacturing approach.

9. Training programs – EI for T&E can leverage as well as support training programs in the host military system. Training data typically includes time-space positioning information (TSPI), velocity, angular rates, target geometries, and man/machine interfaces.

Sea Systems: Embedded instrumentation is to be designed into all sea vessels, aircraft and unmanned vehicles that take off and land on the vessels, and armaments and munitions fired or launched from sea vessels. Next generation Sea Combat systems will be smaller, lighter, modular, reconfigurable, more cost efficient, and more effective. In addition, these systems will increasingly automate functions currently undertaken by trained crews in order to reduce personnel risk exposure. Highly adaptable systems, with advanced processing technologies, spatial sampling schemes, and improved environmental sensing will lay the foundation for new intelligent Sea Combat capabilities that sense and adapt to unique local area conditions. The goal is to change the littoral complexity from a detriment to an advantage, because complexity that is managed becomes a tactical advantage. Smaller, lighter systems will include selections of technologies that meet ambitious performance goals, while at the same time exploiting advances in computing, communications, micro-machining, materials, fiber optics, and other opportunities. Emerging and future technology drivers that require testing by Sea Combat include: Low-observable technologies; nanotechnology that may result in miniature, mobile, autonomous sensors; embedded sensors in materials employing polymers and composites; Unmanned Underwater Vehicles (UUVs) and associated sensors/navigation/communications systems; robust undersea telemetry techniques; hypervelocity undersea weapons; non-acoustic systems; integration with shore-based Modeling and Simulation facilities and networking undersea remote sensors into the Network Centric combat information grid.

1. Architecture – An architecture is a description of a system in terms functions and component parts, and how those functions and components relate to each other. These functions and components shall be described in terms of a layered technical reference model—from physical measurement, through electronic and digital representation, to end user—with functional interfaces being specified in terms of open-system standards, and components implement with COTS, to the highest degree possible. As an example, network centric architectures are key to the future of sea systems. Network centric architectures create systems that have inherently longer lifetimes, service a wider variety of users and applications, and provide higher performance and lower total lifetime ownership costs. Network Centric Warfare (NCW) requires systems that automatically adapt to the environment, are integrated across platforms, and support fusion of multiple sensor data. Instrumentation that monitors the performance of the sensor node, interface of the sensor node to the network, and/or storage and transmission of data off the sensor are desired. The architecture shall support data mining and Meta data collection for data reduction purposes.

2. Sensors – Sea systems weapons, platforms and sensors must have increased shallow water capability, countermeasures resistance, stealth in launching systems and operate at extended ranges with precision targeting capability. There is a need for full spectrum acoustic and electromagnetic sensor stimulation; optical testing of next-generation periscopes; undersea non-acoustic test and measurement in littoral waters (i.e., wake, thermal, etc.); air-dropped weapons; splash-localization in littoral areas; and upgraded computational systems to process, merge, and store all sea systems performance data.

3. Miniaturization – Miniaturized data collection instrumentation is required to support evaluation of sea systems under test in a manner that does not impact the performance or signature of the tested system. New ideas for embedding instrumentation into composite materials or by use of appliqués to sample and collect data are needed. Advanced lightweight and non-invasive instrumentation is required to support testing of hypervelocity underwater weapons.

4. Communications Networks – Wireless links between nodes on the network centric network are increasingly more important. These links include blue-green underwater optical links with data rates of 10 megabits per second, underwater acoustic links with data rates of 10 kbits per second, and satellite and radio to vessels, platforms, drifting buoys, autonomous vehicles, etc. Real-time video transmission in shallow water is also an important emerging communication method. High-speed underwater data telemetry is required to support testing connectivity to distributed fields of roving UUVs and future remotely controlled mines and other armed surveillance networks.

5. Data collection, reduction and storage systems – An integrated, comprehensive, top down approach to T&E information collection, management, and ultimate transformation into knowledge is desired. Capability should be enabled as a web-based approach that merges instrumentation and information management technologies, including knowledge engineering, and makes use of modern communications techniques. Innovative techniques in data discovery and retrieval mechanisms, manipulation, storage, processing and delivery of reduced data are essential.

6. Reliability, durability, maintainability and *in-situ* calibration – Power distribution impacts every aspect of underwater networks and systems. Systems design issues that are impacted include: size and weight, reliability, numbers of sensors, data rates, range and coverage. Power is key to reliability and monitoring of systems performance. New battery or fuel cell technology is key to the success of remotely operated systems and support for autonomous sensor nodes on the undersea network.

7. Survivability in harsh environments – Sea systems must function in the harsh ocean environment. Survivability and warfighting effectiveness must be ensured to sea state 5 or higher. Deep ocean systems and instrumentation are required to survive corrosive effects of salt water and withstand and function across wide fluctuations in pressure and temperature. The shallow water multipath environment where acoustic signals bounce off the surface and the bottom as they travel from source to receiver poses one of the most severe environments for testing and data collection.

8. Manufacturing approaches – As in aircraft, embedded instrumentation can become a part of UUV bodies and submarine smart skins. Sensors and systems can adapt to changing environments by using embedded instrumentation at the platform or sensor interface with the environment. Adaptive sensing systems in embedded instrumentation are essential to future health monitoring of remote operated unmanned systems. Embedded sensors may be powered by external sources in the host platform or from movement through the environment. This technique is known as "power harvesting."

9. Training programs – Low cost underwater tracking systems that provide TSPI are essential to support both operational T&E and training on board sea systems platforms. Desired tracking systems must function effectively in the highly dynamic conditions of shallow water and operate effectively to sea state 3. Battery life of > 36 hours is desired. Tracking coverage of 10 nmi^2 and accuracy of 50m Circular Error Probable is desired. Depth accuracy of ± 1% of target depth across a range of 120-1000 feet and a maximum underwater target speed of 100 knots is desired. Tracking ranges usually detect a "pinger" that is onboard the object being tracked. New capabilities and innovations in embedded pinger design are necessary to enhance operability of existing and future underwater tracking ranges.

Dismounted Soldiers: The Dismounted Soldier encompasses the soldier, man-portable equipment, and communications for situational awareness. The focus of EI for dismounted soldiers is the human as a component in the systems of systems approach to warfighting. In many instances in a transformed Army, soldiers will have to function for extended periods of time, days or even weeks, totally detached from any supporting platform. Soldiers will operate in an information-rich environment that will require voice, data, and image transmissions over extended distances.

1. Architecture – An architecture is a description of a system in terms functions and component parts, and how those functions and components relate to each other. These functions and components shall be described in terms of a layered technical reference model—from physical measurement, through electronic and digital representation, to end user—with functional interfaces being specified in terms of open-system standards, and components implement with COTS, to the highest degree possible. As an example, the EI

architecture must accommodate both permanent and appliqué instrumentation. The permanent EI shall consist of sensors and recording/processing capabilities designed into and permanently installed in the soldier's individual equipment. The appliqué capability shall consist of networked components that can be installed either permanently in a sample or easily added/removed from equipment used in test activities. The instrumentation network shall employ robust physical bus/network technologies and standard network protocols. Two critical constraints are: the need to minimize weight and the sparsity of sufficient electrical power to support added instrumentation for extended periods of time, days or even weeks, totally detached from any supporting platform. In both deeply embedded and appliqué instrumentation, the architecture shall support data mining and Meta data collection for data reduction purposes.

2. Sensors – EI sensors for Dismounted Soldiers must operate in a wide range of physical environments as described in subparagraph 6 below. Sensor requirements span a large spectrum of measurement types (body temperature, blood pressure, attitude, location, weapon pointing direction, etc.)

3. Miniaturization – EI should be miniaturized to ensure minimal power and weight penalties.

4. Communication Networks – EI communication networks must be compatible with existing and emerging military network standards. Any EI specific network provided to the soldier must conform to Information Technology standard protocols. The EI RF networks must be compliant with JTRS, telemetry standards of the RCC, and globally accessible.

5. Data collection, reduction and storage systems – EI data collection, reduction and storage systems must be compatible with non-proprietary COTS standards or RCC standards to ensure interoperability among the DoD test facilities.

6. Reliability, durability, maintainability and in-situ calibration – EI shall exhibit the same or better reliability, durability and maintainability as the host system. EI maintainability will include lifetime calibration stability and/or in-situ calibration capability. Embedded Instrumentation sensors in support of Dismounted Soldiers must operate in a wide range of physical environments, such as:

    a. Ambient temperatures that range from –20ºC to +50ºC
    b. High levels of dust, dirt, mud, and water
    c. Rough handling.

7. Survivability in harsh environments – EI shall exhibit the same or better survivability in harsh natural and man-made (including EMI) environments as the soldier. During catastrophic events/system failure, recorded data should be recoverable.

8. Manufacturing approaches – EI can be integral to the individual soldier equipment as part of the manufacturing approach.

9. Training programs – EI for T&E can leverage as well as support training programs.

C. SUBMITTAL INSTRUCTIONS

- Proposals are desired that focus on embedded instrumentation architectures that enable capture, storage and availability of T&E data that supports Developmental T&E, Operational T&E and/or continuous testing throughout the life of the system.
- Offerors must state that their proposals will be valid for 180 days from submission. Any classified information up to the SECRET level should be separated and forwarded to the Naval Undersea Warfare Division, Attn: Pamela Raposa, Code 10C, Building 990/1, 1176 Howell St., Newport, RI 02841-1708.
- Multiple awards may be made in response to this announcement. The Government reserves the right to select for award all, some, portions or none of the proposals received. It is anticipated that an award resulting from this announcement will take the form of one of the following: Contract, Grant,

Cooperative Agreement, Other Transaction Agreement, Project Order, or Economy Act Order as deemed appropriate.

- To be eligible for award a non-federal offeror must be registered in the Central Contractor Registration (CCR) database pursuant to Federal Acquisition Regulation (FAR) 4.11. An Offeror, who is not registered, may register at http://www.ccr.gov/index.cfm. Offerors not registered are highly encouraged to register immediately.
- Government Agencies and universities will be allowed to submit proposals for this effort. If a Government Lab or Government Agency is included in a white paper or proposal as part of a team, any costs associated with the Government Lab or Government Agency will be funded separate and apart from the non-government team members. White papers and proposals may include cost sharing with the Government in cash or in-kind assets, but the proposed technology must have a viable commercial and military application. Care must be taken by Government Agencies to ensure compliance with 18 U.S.C. Sections 203 and 205.
- The evaluation of proposals will be performed by the cognizant Program Officer and other naval and defense activities/agencies personnel, as needed. Offerors are advised that certain individuals from Sakonnet Technology Group, Systems Resource Management Inc. (SRM), the Institue for Defense Analyses (IDA), Scientific Research Corporation (SRC) and the University of Massachusetts may assist the Government as advisors in performing technical evaluations of the abstracts and proposals submitted under this announcement. These advisors will be authorized access to those portions of the proposal data and discussions that are necessary to enable them to provide specific advice on specialized matters or on particular problems. The non-Governmental advisors will not rank offerors' proposals. They also will not have access to offeror privileged commercial or financial data. Any objection to disclosing information to these non-Government advisors should be provided in writing to the Contracting Officer BEFORE the date set for receipt of proposals and shall include a detailed statement for the basis of the objection. The support contractors, experts from certain universities and laboratories, and the Naval Undersea Warfare Center Division, Newport will be bound by appropriate non-disclosure agreement to protect source-selection information.
- Generally, equipment and facilities must be furnished by the contractor/recipient, but the requirement for test ranges, targets, etc. is understandable and must be requested. (Justifications must be provided when Government funding for such items is sought).
- Foreign Participation & Disclosure Restrictions. This acquisition involves technology that has a military or space application. It is anticipated that foreign firms will be excluded from participating as prime contractors on this topic.
- All routine communication concerning this acquisition should be directed to Maria F. Goulart, Contracting Officer, (401) 832-6379, e-mail goulartmf@npt.nuwc.navy.mil. All technical related issues should be directed to George Shoemaker, Ph.D.; email:shoemakergt@npt.nuwc.navy.mil; mail address Naval Undersea Warfare Center, Division Newport, 1176 Howell Street, Code 74, Building 1351, 1st Floor, Newport, RI 02840.
- Organizations wishing to participate should submit proposals consisting of Part I Technical Management Proposal, Part II Price Proposal and Part III Offeror's Statement of Work. Three (3) hard copies of each part shall be submitted along with one CD-ROM containing all three parts to the Commercial Acquisition Department, Building 11, Naval Undersea Warfare Center Division, Newport, Attn: Maria Goulart, Code 5911, Simonpietri Drive, Newport, RI 02841-1708 by 05 November 2004, 2:00 P.M.
- Proposal length, exclusive of cost and pricing data, should not exceed twenty five (25) 8½ x 11 inch typewritten pages and should specify the technical area of concern addressed (i.e.,Air and Space Systems, Armaments and Munitions, Land Combat, Sea Combat and Dismounted Soulders, etc.)
- Each proposal should contain the offeror's Technical Approach and a Statement of Capabilities. Offerors should identify proposed costs with a breakdown of cost elements such as direct labor, overhead, G&A, fee or profit, and any other significant cost factors, with separate pricing provided for each proposed SOW Work Breakdown Structure (WBS). Pricing should be based upon the assumption that work would begin no sooner than 60 days after proposal submission. The proposal should also contain offeror's point of contact information.
- Subcontracting Plan Requirements: Offerors submitting proposals requiring a Subcontracting Plan in accordance with FAR 19.702 shall include a draft plan as an attachment to their price volume. If an offeror has a comprehensive subcontracting plan, the offeror shall so state in their price volume and

provide a copy of the signature page of the Comprehensive Subcontracting Plan and any supplements to the plan, the identification number thereof and any pages identifying the subcontracting goals. Submitted plans must be approved by the PCO prior to contract award.

- Proposals containing data that is not to be disclosed to the public for any purpose or used by the government except for evaluation purposes shall include the following statement on their title pages:

> "The proposal includes data that shall not be disclosed outside the Government and shall not be duplicated, used or disclosed, in whole or in part, for any purpose other than to evaluate this proposal. If however, a contract is awarded to this offeror as a result of, or in connection with, the submission of these data, the government shall have the right to duplicate, use, or disclose these data to the extent provided in the resulting contract. This restriction does not limit the government's right to use the information contained in these data if they are obtained from another source without restriction. The data subject to this restriction are contained on sheets (insert page numbers or otherwise identify the sheets)".

Each restricted data sheet should be marked as follows: "Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal." This statement may be in a small font and should be at the bottom only of each applicable page.

- All material submitted to NUWCDIVNPT under this announcement shall be considered Government property. The Government requires unlimited data rights with regard to any procurement, with the possible exceptions of (1) a negotiated position for data rights to existing concepts that may be further developed under a procurement and (2) for efforts conducted under a procurement with leveraged funds.
- The Government shall analyze proposals received in response to this BAA in order to identify and evaluate potential organizational conflicts of interest. If applicable, Organizational Conflict of Interest clauses shall be included in any resulting contract (see FAR 9.5).
- Specific deliverables, delivery schedule, and other terms will be negotiated with successful offerors. All program participants will be expected to share technical information, subject to non-disclosure requirements, with all other T&E/S&T program participants.
- For purposes of this solicitation, offerors should anticipate that contract awards will require a Contract Data Requirements List (CDRL) that will vary depending on the nature of the contract award. For planning purposes, all awards will require the following data items as a minimum:

DI-MISC-80508A	Scientific and Technical Reports (Contractor format)
DI-MGMT-80368	Status Report (Web-based format per TESTWeb – Government furnished computer program)

Depending on what the contractual end items and deliverables are to be, the following may also be required as applicable:

DI-DRPR-81002A	Developmental Design Drawings and Associated Lists
DI-MCCR-80700	Computer Software Product End Items

Contractor's format and report consolidation are highly encouraged. Although not required, the government would prefer that offerors use electronic/digital media for report draft and publishable submittals. Microsoft Word 6.0 or above will be acceptable for submittal of draft documents, and the use of a CD-ROM is acceptable for the submittal of the final copy except in the use of the TESTWeb for status reports. The use of this media is primarily focused on documents that are to receive wide dissemination, such as final reports, but the offeror should consider proposing the use of electronic/digital media for any report for which this media is appropriate. Submittals on CD-ROM should be in a format that is compatible for any PC or Macintosh user. The government anticipates the web-based TESTWeb Internet site will be used for status of progress and financial reporting. Reporting requirements will be identified per DD Form 1423.

D. PROPOSAL EVALUATION

Evaluation of proposals will be accomplished through a review of each proposal using the criteria below.

- **Technical**

  i) Value of product technology development with respect to the stated goals of this BAA. Proposals must address a relevant DoD Development or Operatinal T&E need, have adequate S&T content and offer a clear transition path for T&E usage.

  ii) Offeror's technical approach is sound with regard to feasibility of the project, transition potential of the technology, and understanding of the scope of the technical effort. Technical merit is easily identifiable. Technical concept is clearly defined and developed.

  iii) Capability of the offeror to successfully accomplish the proposed effort, which includes demonstrated relevant past/present performance, the availability of the necessary resources such as experienced and competent technical and management personnel, and the availability, from any source, of required laboratory, shop, and test facilities. Relevant is defined as research that is considered to be of the type and similar in scope, magnitude and complexity when compared to the research described in this announcement.

- **Price/Cost**

  To be acceptable, an offeror's price must be fair, reasonable and affordable. Offerors may be requested to submit cost or pricing data IAW FAR 15.403-4.

- **Risk**

  Proposal risk will be individually assessed for the technical, cost, and schedule areas. Proposal risk relates to the identification and assessment of the risks associated with an offeror's proposed approach as it relates to accomplishing the proposed effort. Tradeoffs of the assessed risk will be weighed against the potential payoff.

Selection

The Government reserves the right to select for contract award any, all, part or none of the proposals received in response to this announcement. Multiple awards to the same technical area are possible. The selection of the sources for contract award shall consider technical merit and cost/price and available funding. A scientific and engineering evaluation will be conducted on all proposals received. The purpose of this evaluation is to determine the merit of the technical approach proposed in response to this announcement. This evaluation shall consider technical aspects and price as related to technical effort. Organization and clarity of information are critical to all of the evaluation criteria.

E. TECHNICAL/MANAGEMENT PROPOSAL CONTENTS

Format of Part I of the proposal shall be as follows (page limit of 25 single-sided pages):

i Cover Page. The cover page should include the BAA title and reference number, name and telephone number, fax and email for the principal points of contact (both technical and contractual), and the page should also contain the proprietary data disclosure statement, if applicable.

ii Table of Contents. It is highly recommended that the offeror follow this proposal outline format in the table of contents and use it for a final quality-control checklist.

iii List of Illustrations/Tables. This list is a quick reference of charts, graphs, tables, and other important information.

iv Executive Summary. The summary should present an organized progression of the work to be accomplished, without the technical details, so that the reader can grasp the core issues of the proposed program. The Executive Summary should rarely exceed two pages.

1.0 Technical Approach. In this section, the offeror should provide as much technical detail and analysis as is necessary or useful to support the technical approach they are proposing. The offeror must clearly identify the embedded instrumentation issue or challenge being addressed, and the technologies, (basic, applied research or exploratory development) to be leveraged or applied to form the "new and creative" solution(s) proposed. It is not effective to address a variety of possible solutions to the technology problems unless each alternative is described in detail and the selection plan is fully discussed.

1.1 Application and Technical Discussion nature of the work: The preferred technical approach (including the advanced technology development (6.3) nature of the work) should be described in as much detail as is necessary or useful to establish confidence in the approach. Every issue should be identified and compared with the successes/failures of previous approaches. A tradeoff analysis is a good way to make this comparison and should be supported by theory, simulation, modeling, experimental data, or other sound engineering and scientific practices. If the offeror has a "new and creative" solution to the problem(s), that solution should be developed and analyzed in this section such that its feasibility can be assessed.

1.2 Technical Program Summary: This section summarizes the above technical discussion in an orderly progression through the program, emphasizing the strong points of the proposed technical approach, and how the proof of concept will be demonstrated and/or tested.

1.3 Risk Analysis and Alternatives: The proposal evaluator(s) will formulate a risk assessment and it is in the best interest of the offerors to have their own understanding of the risk factors presented. Critical technologies should be identified along with their impact on the overall program as well as risk mitigation strategies.

1.4 Transition or Insertion Plan: Discuss possible uses/users for this technology development, and suggestions for its production and dissemination.

1.5 References: Include the basis for, and reference, the findings cited in the technical discussion.

2.0 Special Technical Factors. In this section, the offeror should describe any capabilities the offeror has that are uniquely supportive of the technology to be pursued. The following items are offered as possible areas to be addressed.

2.1 Capabilities and relevant experience

2.2 Previous or current relevant R&D work and points of contact

2.3 Related contracts and points of contact

2.4 Facilities/resources

3.0 Schedule. The schedule represents the offeror's commitment to perform the program tasks in an orderly, timely manner.

3.1 Time Line Chart by Task: Each major task identified in the SOW should appear as a separate WBS element on the program schedule. Decision gates and planned meetings, such as kick-off, presentations (including final presentation on the effort), design reviews, technical interchange meetings, demonstrations, tests, etc., should be included in the Time Line. The Time Line should also indicate the anticipated meeting sites.

3.2 Identify Milestones: Describe specific one-time events that would occur during the course of the project that would signify a decision point, government review, demonstration or test, or deliverable.

4.0 Program Organization. In this section, the offerors should present how they will be organized to conduct this project, and to address difficult technical issues. Any pertinent or useful information may be included in this section, but a minimum recommended response should address the following:

4.1 Organization Chart(s) with Key Personnel: Include prime offeror and team member organization charts.

4.2 Management and Technical Team: This should specifically identify what tasks will be performed by each party and why each subcontractor or team member, if any, was selected to perform its task(s).

4.2.1 Offeror Responsibilities

4.2.2 Subcontractor(s) or Team Member Responsibilities

4.2.3 Consultant(s) Responsibilities

4.3 Labor Mix Schedules (See http//www.ecraft.npt.nuwc.navy.mil/documents for a list of eCraft labor categories.

4.4 Resumes of Key Personnel: Include the resumes of the Key Personnel, be they offeror, subcontractor, team member, and/or consultant personnel.

5.0 Appendix(es). Appendices may include technical reports, published papers, and referenced material. Submission of commercial product advertising brochures as part of the Appendix(es) is not desirable.

F. OFFEROR'S STATEMENT OF WORK (SOW)

1. It is the intent of the Government to attach the offeror's SOW, as written, into the resulting award document. This will occur only if the offeror's SOW accurately describes the work to be performed, is enforceable, and is void of inconsistencies.

2. The following is offered as a recommended format for the SOW. Please limit your SOW to 5 pages. Begin this section on a new page. Start your SOW at Paragraph 1.0.

1.0 Objective: This section is intended to give a brief overview of the technology effort and should describe why it is being pursued, what you are trying to accomplish, and what aspect of this BAA is being addressed.

2.0 Scope: This section should include the technology area(s) to be investigated, objectives/goals, and major milestones for the effort.

3.0 Background: This section includes any information, explanations, or constraints that are necessary in order to understand the requirements. It may include relationships to previous, current and future operations. It may also include techniques previously tried and found ineffective. The offeror shall identify appropriate specifications, standards, and other documents that are applicable to the effort to be performed.

4.0 Tasks/Technical Requirements:

4.1 The detailed description of tasks which represent the work to be performed, are contractually binding. Thus, this portion of the SOW should be developed in an orderly progression and in enough

detail to establish the feasibility of accomplishing the overall program goals. The work effort should be segregated into major tasks and identified in separately numbered paragraphs according to the decimal system as described herein. Each numbered major task should delineate, by subtask, the work to be performed, deliverables and CDRL items. The SOW must contain every task to be accomplished. The tasks must be definite, realistic, and clearly stated. Use "shall" whenever the work statement expresses a provision that is binding. Use "should" or "may" whenever it is necessary to express a declaration of purpose. Use "will" in cases where no offeror requirement is involved; e.g., power will be supplied by the Government. Use active voice in describing work to be performed.

4.2 If presentations/meetings are identified in your schedule, include the following paragraph in your SOW: "Conduct presentations/meetings at times and places specified in the award document."

5.0 Exit Criteria and Deliverables: Propose criteria for establishing or indicating that a specific milestone or phase has been completed. List the deliverables that result from that milestone or phase.

6.0 Contract Data Requirements List (CDRL) Items: Submit required information per blocks on DD Form 1423.

G. AWARD INFORMATION

1. Expected Award Date: Awards are planned for December 2004.

2. Normal policy is that the Government will fully fund all R&D efforts with appropriated funds. However, there may be occasions where an offeror might anticipate some commercial or other form of additional benefit from participation in a government project and may be willing to share in the costs of the project. In such cases, the offeror will be requested to verify or otherwise substantiate it, and a cost sharing arrangement may be used. If so, a cost-sharing arrangement will be incorporated in the resulting award. No type of federal funding may be used as a source for the contractor's share of the cost.

3. Proposals may represent individual organizations or teams of organizations. Team proposals may include participants at different levels of the technology development efforts. It is anticipated that the contributions of the team members are complementary as well as essential to the critical path of the research and development plan. If an organization or team proposes work in more than one area, separate proposals are required. An organization may propose in any or all of the areas of the required scope. For purposes of this paragraph, an organization is defined as a distinct work group, not as a legal entity. So, for example, different divisions of the same company may be considered to be different organizations for purposes of this paragraph provided that mechanisms are put in place to avoid organizational conflicts of interest.

ATTACHMENT 1

LABOR MIX SCHEDULE BY WBS

Submit a summary table of person loading by WBS/Major Task and by labor category or skill mix in the sample format shown below. These hourly requirements are to include (but separately identify) inter-divisional transfer(s) hours and subcontracted hours. Do not reflect dollar amounts in this schedule. **A separate labor mix schedule by WBS must be provided for each proposed option.** The government fiscal year is 1 Oct – 30 Sep.

WBS/MAJOR TASK	GFY 04	GFY 05	etc.	TOTAL
WBS 1.0 (Title)				
Engineering A - Prime	50 hours	100 hours	0 hrs	150 hours
Engineering A - Interdivisional Xfer	50 hours	0 hours	100 hrs	150 hours
Engineering B	50 hours	50 hours	0 hrs	100 hours
Manufacturing A	0 hours	200 hours	0 hrs	200 hours
Etc.				
WBS 1.1 (Title)				
Engineering B	150 hours	250 hours	10 hrs	410 hours
Manufacturing A	0 hours	200 hours	0 hrs	200 hours
Etc.				
WBS 1.2 (Title)				
Etc.				
Subtotal Engineering A	100 hours	100 hours	100 hrs	300 hours
Subtotal Engineering B	200 hours	300 hours	10 hrs	510 hours
Total Engineering	300 hours	400 hours	110 hrs	810 hours
Manufacturing A	0 hours	400 hours	0 hrs	400 hours
Total Manufacturing	0 hours	400 hours	0 hrs	400 hours
Etc.				
Total Direct Labor Hours	300 hours	800 hours	110 hrs	1210 hours