



## **High-Bandwidth Free-Space Lasercomm**

### **INTRODUCTION:**

This publication constitutes a Broad Agency Announcement (BAA) as contemplated in Federal Acquisition Regulation (FAR) 6.102(d)(2), the Department of Defense Grants and Agreements Regulations (DoDGARS) 22.315(a), and DoD's Other Transaction Guide for Prototypes Projects, USD(AT&L), OT Guide, Jan 2001. A formal Request for Proposals (RFP), other solicitation, or additional information regarding this announcement will not be issued.

The Office of Naval Research (ONR) will not issue paper copies of this announcement. The ONR reserves the right to fund all, some or none of the proposals received under this BAA. ONR provides no funding for direct reimbursement of proposal development costs. Technical and cost proposals (or any other material) submitted in response to this BAA will not be returned. It is the policy of ONR to treat all proposals as sensitive competitive information and to disclose their contents only for the purposes of evaluation.

### **I. GENERAL INFORMATION**

- 1. Agency Name** - Office of Naval Research
- 2. Research Opportunity Title** – High-Bandwidth Free-Space Lasercomm
- 3. Program Name** – Communications and Networking
- 4. Research Opportunity Number** – 09-018
- 5. Response Date** – May 8, 2009 at 2:00 p.m. EDT
- 6. Research Opportunity Description** -

#### **Synopsis:**

The Office of Naval Research (ONR) is seeking innovative solutions for high-bandwidth free-space laser communications (lasercomm) for tactical level digital communications for the United States Marine Corps (USMC) and the United States Navy (USN). Offerors will be asked to develop systems to provide tactical level digital lasercomm systems for integration with USN and USMC networks. Proposed solutions will enable

high-bandwidth, jam-resistant communications with a low probability of intercept and detection (LPI/LPD) between tactical edge platforms and users over non-Radio Frequency (RF) communication paths in order to improve the robustness, security, and timely transmission of USN and USMC communications. All solutions offered should minimize reliance on any RF based communication systems to allow communications during Electronic Emission Control (EMCON), Electromagnetic Radiation to Ordnance (HERO) or other conditions where RF communication systems are unavailable.

The focus of this program is on the development of lasercomm systems capable of connecting to a USN/USMC network and autonomously linking to another USN/USMC network via a lasercomm communication link. Terminals should communicate both in a “direct mode” between two lasercomm terminals (see figure 1) and in a Modulating Retro-reflector (MRR) mode where one end of the link is a lasercomm terminal and the other end of the link is an MRR terminal (see figure 2).

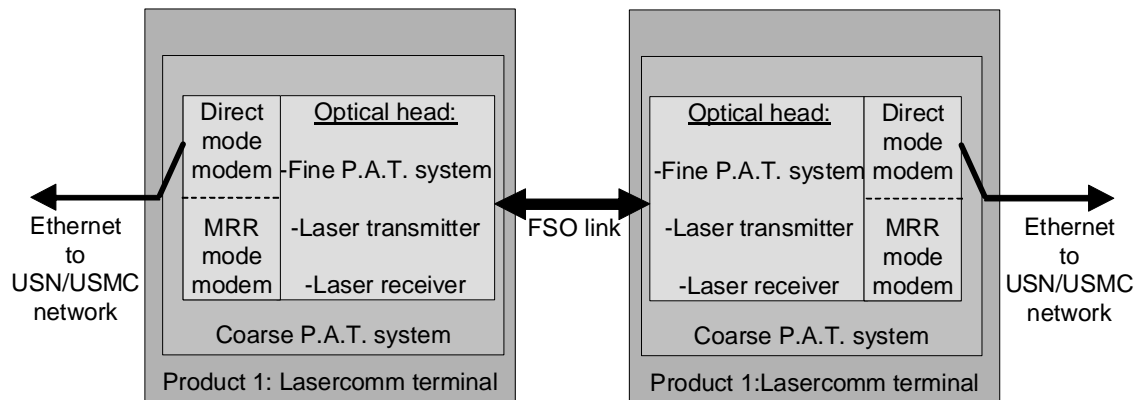


Figure 1: Example of direct mode configuration

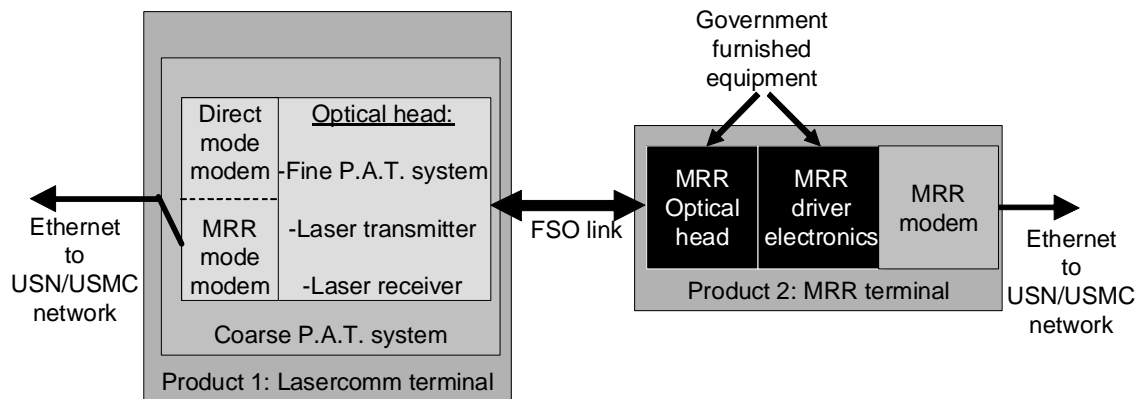


Figure 2: Example of MRR mode configuration

The development of two distinct products is expected for successful completion of this program:

Product 1 – Lasercomm terminals capable of communicating both in direct mode to another lasercomm terminal and in MRR mode to an MRR terminal (product 2).

The lasercomm terminal contains in very general terms:

1. an optical head with a laser transmitter, receiver, and fine pointing, acquisition, and tracking (PAT) system
2. coarse PAT system able to automatically establish and maintain lasercomm links between terminals when provided bearings between terminals from an external (government provided) source
3. modem(s) for communication between the lasercomm link and USN/USMC network consisting of either two separate modems for direct mode and MRR mode communications or a combined modem capable of communicating in both modes.

#### Product 2 – Modulating retro-reflector (MRR) communications terminals

The MRR terminal contains in very general terms:

1. a multiple quantum well (MQW) based MRR (transmitter) and a photodetector (receiver) for two-way communications,
2. MRR driver electronics which take standard electronics communication formats (for example, Transistor-Transistor Logic (TTL) ) and apply proper driver voltages to the MRR device
3. modem for communication between the lasercomm link and USN/USMC network

Items 1 & 2 in Product 2 will be supplied as government furnished equipment (GFE) for integration into lasercomm systems developed in this program. Item 3 will be developed as part of this program.

A description of MQW MRR devices including their principal of operation and capabilities is included in the “Additional Information” section of this document. Publications are also referenced to provide more detail if required.

As part of this program, products 1 & 2 will be demonstrated in three increasingly complex demonstrations throughout the program. The details of these demonstrations are described in the “Government approach section below”. In general, a government team will work with product 1 & 2 vendors to demonstrate:

- Phase 1: Point-to-point non-networked links
- Phase 2: Networked lasercomm links in simulated USN/USMC environment (surface-to-surface & surface-to-air-to-surface)
- Phase 3: Networked lasercomm links in operational USN/USMC environment (surface-to-surface & surface-to-air-to-surface)

Testing of point-to-point non-networked links in phase 1 will primarily be conducted by vendors at government test facilities. Bearing information for link establishment will be provided by government systems. Testing over simulated and operational USN/USMC networks in phases 2 & 3 will be primarily conducted by the government. However, vendor support for integration to these networks and testing is required.

In order to maximize the usefulness and availability of the solutions and technology developed under this BAA, preference will be given to the development/maturation of open standards. Also, non-proprietary solutions are preferred.

### **Operational Requirements:**

It is desired to implement lasercomm links on numerous surface (land or sea) and airborne USN/USMC platforms.

Example scenarios where direct lasercomm links may be implemented are:

- Intra-strike group ship-to-ship communications
- Ship-to-shore communications during amphibious operations
- Line-of-sight (LOS) links between USMC Forward Operating Bases (FOBs)
- Submarine-to-ship communications (with the optical link entirely through the air)
- Air-to-surface communications for Intelligence, Surveillance and Reconnaissance (ISR), Situation Awareness (SA), & Command and Control (C2)
- Surface-to-air-to-surface communications for beyond LOS communications relay
- Pierside communications for ports where permanent install of a pierside lasercomm terminal is possible

Example scenarios where MRR lasercomm links may be implemented are:

- Maritime interdiction operations
- SOF support and/or data exfiltration for submarine-to-shore communications (with the optical link entirely through the air)
- Ship-to-pier communications in ports where permanent install of a pierside terminal is not practical
- Air-to-surface communications for ISR, SA, & C2 on platforms incapable of supporting full size lasercomm terminals
- MRR Submarine terminals where installation of full size terminal in submarine mast is impractical

To ensure operational effectiveness and minimal impact to existing infrastructure, manpower requirements, and cost, a few primary operational goals for systems developed in this Enabling Capability (EC) are:

- Lasercomm link appears to USN/USMC networks as “just another communication link” as seen by applications, routers, etc.
- Automated operation of entire system (for example: acquisition, tracking, laser power, divergence, error handling, data rate, ...)
- Single compact optical head design able to operate in a direct or MRR mode and able to be integrated into one model Commercial-Off-the-Shelf (COTS) gimbal for all surface operations and another model COTS gimbal for all airborne operations (speed  $\leq$  200 knots)
- Small size, weight, and power (SWAP) single man portable MRR terminal able to be rapidly setup and operated
- Low cost
- High system reliability
- Navy Laser Safety Review Board approval for unattended operation in all applicable operational environments

These goals impact numerous design considerations for the terminals that are described extensively in the detailed description of capabilities section below.

Fundamental performance of lasercomm links have been demonstrated in a wide variety of environments (at various levels of Research & Development). The following are notional metrics based on these fundamental level demonstrations. They are meant only as a guide to indicate possibilities and are not meant to be interpreted as requirements:

- Gimbaled surface-to-surface direct lasercomm links operating in good atmospheric conditions from a minimum range of approximately 50 yards to maximum ranges of 20 to 30 Nmi
- Gimbaled surface-to-air\* direct lasercomm links operating in good atmospheric conditions from a minimum range of approximately 100 yards to maximum ranges of 20 to 40 Nmi
- Gimbaled air\*-to-air\* direct lasercomm links operating in good atmospheric conditions from minimum ranges of 500 yards to maximum ranges >40 Nmi
- Gimbaled direct terminal including modem, gimbal, and all associated control electronics SWAP: Size < 1 ft<sup>3</sup>, Weight < 50 lbs, Power < 200 Watts
- Direct lasercomm links with data rates in good atmospheric conditions ≥100 Mbps
- MRR link data rate of 2-45 Mbps from a minimum range of 50 yards to maximum ranges of 3-10 Nmi
- MRR terminal (includes modem) SWAP: size < 10 in<sup>3</sup>, weight < 1 lb, power < 10 Watt
- 360° azimuthal & >120° elevation field-of-regard (FOR) – minimum elevation FOR optimized for platform is: -30 to +90 for ship; -90 to +30 for airborne; etc.
- Initial acquisition time from discovery to link closure: <10 seconds
- Re-acquisition of link after short disruption and loss of tracking: < 1 second
- Modems capable of interfacing links with burst errors with standard Ethernet networks

\*Airborne nodes for this program are expected to be slow flying platforms (~200 knots or less) such as aerostats, balloons, helicopters, slow flying fixed wing aircraft, and small to medium class UAVs. However, designs which allow for future upgrades to operate on higher speed platforms (up to 300 knots) are highly desirable.

These notional metrics exist today individually in limited ways. This BAA seeks to improve upon these capabilities and combine various aspects into generic USN/USMC lasercomm terminals which satisfy the primary operational goals outlined above.

### **Detailed Descriptions of Operational Goals:**

As outlined above, the few primary operational goals for this Enabling Capability (EC) are:

- Lasercomm link appears to USN/USMC networks as “just another communication link” as seen by applications, routers, etc.
- Automated operation of entire system (for example: acquisition, tracking, laser power, divergence, error handling, data rate, ...)

- Single compact optical head design able to operate in a direct or MRR mode and able to be integrated into one model COTS gimbal for all surface operations and another model COTS gimbal for all airborne operations (speed  $\leq$  200 knots)
- Small SWAP single man portable MRR terminal able to be rapidly setup and operated
- Low cost
- High system reliability
- Navy Laser Safety Review Board approval for unattended operation in all applicable operational environments

To expand on these primary operation goals:

**Lasercomm link appears to USN/USMC networks as “just another communication link” as seen by applications, routers, etc.**

Lasercomm links will be directly connected to standard USN/USMC networks. Apparent link quality to USN/USMC networks must indicate a high quality of service information exchange to ensure proper operation of the network. However, data loss and disruptions of varying durations (milliseconds to hours) which are unique to lasercomm links will occur. These losses are due to multiple factors arranged here in increasing duration:

1. Atmospheric scintillation (millisecond data loss)
2. Short duration beam blockages due to objects (birds, aircraft, etc.) moving between terminals (milliseconds to seconds)
3. Atmospheric attenuation due to heavy rain, fog, snow, clouds (for airborne nodes), etc. or operation near maximum range of system (minutes or longer)
4. LOS limitations where physically impossible (beyond horizon, maximum range, etc.) to connect to other lasercomm terminals (minutes or longer)

Items 1 & 2 in this list should be tolerated by the lasercomm system with minimal impact on the user aside from a possible increase in latency and/or a decreased rate of data throughput. This requires a modem which will serve as an interface between the high quality of service USN/USMC network and the potentially low quality of service lasercomm link owing to burst errors and other error sources over the link. Existing techniques (performance enhancing proxy (PEP), packet retransmission, error control coding with interleaving, etc.) and new novel ideas that successfully bridge USN/USMC networks to lasercomm links are acceptable. The only requirement is the net result of transparent data flow to the user with minimal impact on user applications.

Item 3 impacts the lasercomm link in multiple possible ways. The first is degradation in the link margin which increases the error rate over the link. To a point, this decrease in link margin will simply result in a higher burst error rate and can be handled by the error handling techniques developed for items 1 & 2. At some point, these error handling techniques will be insufficient and the link will break. It is highly desirable that this point be extended as far as possible by new and novel methods for extending link margin (i.e. range & availability in poor weather). For example, it is acceptable to simply decrease the data rate in these conditions resulting in higher receiver sensitivity and a corresponding increase in link margin. It is also possible to decrease data rate and the

modulation duty cycle while maintaining the same average laser power to increase peak power and increase link margin. These are a couple of examples of methods to improve range and poor weather performance which could be used in the modem and terminal designs for USN/USMC terminals. These are certainly not all possibilities and novel methods to improve performance are encouraged.

At some point for item 3 and always for item 4, insufficient power is present and long duration outages will occur which cannot be made transparent to the user with only minimal impact. These types of outages require re-routing of data over alternative communication paths or simply notification that the network is off-line. To accomplish this, the lasercomm system must be capable of notifying routers of the failure of the lasercomm link as well as notifying routers of the existence of the link once the link is reestablished.

**Automated operation of entire system (for example: acquisition, tracking, laser power, divergence, error handling, data rate, ...)**

Typical operation of USN/USMC terminals (lasercomm or MRR) will be automated with minimal manning requirements. This requires automatic optimization of terminal parameters (laser power, laser divergence, etc.) to ensure the highest possible link quality. Connection between terminals as platforms move within range will also typically be completely automated although some links may require user intervention to initiate the link depending on the concept of operations (CONOPS).

A few examples of automatic optimization of lasercomm terminal parameters are: optimizing laser power and divergence for current range, automatic wavelength adjustment to track MRR temperature dependence, automatic scanning to re-establish lost link, etc. In addition, innovative approaches for allowing the lasercomm system to sense and automatically adjust to link conditions (margin loss, fade depth, etc.) effectively increasing availability, range, etc. are highly desirable.

Automatic connection between nodes will use directional mobile adhoc networking (MANET) systems developed for directional RF links under other programs. These existing discovery systems will be provided by the government and supply the lasercomm terminals with bearing (azimuth & elevation) information for link establishment. Exact bearing error budgets will be provided during the program. For initial proposal and design stages, angular errors due to a standard Global Positioning System (GPS) Circular Error Probability (CEP) of 15 yards should be assumed.

In addition to autonomous node discovery and PAT, a secondary mode of operation for terminals is desirable for CONOPS where Low-Probability-of-Intercept/Low-Probability-of-Detection ( LPI/LPD) considerations are of the utmost importance and no RF emissions or broad divergence beacons are possible. This secondary mode should allow a manual mode of operation where terminals are manually pointed at one another and a narrow beacon or small scan pattern is initiated to allow PAT. This mode should allow both visible pointing of the terminal by eye with optical aids if required (camera, rifle scope, etc.) and pointing via prearranged waypoints where terminals plan on being at

specific coordinates at specific times in order to know rough pointing angles and allow PAT. For rifle scope or other direct viewing alignment techniques, the system must be eye safe to the viewer.

**Single compact optical head design able to operate in a direct or MRR mode and able to be integrated into a single COTS gimbal for all surface operations and possibly another for all airborne operations (speed  $\leq$  200 knots)**

The wide range of operational platforms in the USN & USMC makes specialization and optimization of terminals to each platform impractical due to the high complexity of many designs, multiple training and installation requirements, and cost of manufacture of multiple separate designs. It is highly desirable to minimize the number of lasercomm terminal designs and make a very small number of standard systems (preferably one) that are adaptable to a large variety of platforms. For this program a single optical head design is desired to be integrated into a maximum of two COTS gimbals with one gimbal intended for shipboard (on-the-move) and land (on-the-halt) use and the other for slower flying airborne platforms (speed  $\leq$  200 knots).

Note: Throughout this document, the coarse pointing system is generically referred to as the “COTS gimbal”. A COTS gimbal pointing system is not required and other pointing systems (beam steering mirrors, Risley prisms, custom gimbals, etc.) are usable providing SWAP, cost, risks, performance advantages/disadvantages, etc. are clearly identified.

**Small SWAP single man portable MRR terminal able to be rapidly setup and operated**

MRR terminals are intended for either temporary use or installation on disadvantaged platforms where SWAP restrictions preclude the use of a full lasercomm terminal. For temporary installation operations, it is required that the MRR terminal be easily man portable and able to be easily setup and operated. Also required is battery operation since terminals may be setup in locations where power is unavailable. Installation on SWAP restricted platforms also requires small terminal size but is platform specific and will be handled on a case-by-case basis.

**Low cost**

It is expected that successful completion of this program will result in wide spread operational usage of lasercomm systems in the USN/USMC. Low cost of terminals is required to ensure transition to a program of record and subsequent deployment of USN/USMC lasercomm terminals. The target cost for production of deployable USN/USMC lasercomm terminals, after non-recurring engineering (NRE) costs and including everything except the terminal gimbal, is less than \$100,000. Gimbal costs are platform specific and should be identified but should be reasonable without the requirement for an extremely high precision/expensive gimbal for successful operation of the system.

**High system reliability**

Operational usage of lasercomm system within the USN and USMC requires high reliability with only minimal maintenance required for long term operation in outdoor



(land, air, & sea) environments. Systems developed under this program are not expected to be completely ready for long term deployment but will be temporarily installed on operational platforms for greater than one week for demonstrations. As a result, terminals are expected to be Electro Magnetic Interference (EMI) shielded, resistant to sea spray, dust, mild weather, etc. and reliable enough to operate for extended periods of time without repairs or other user intervention. Design of terminals should take this operational demonstration environment into account and ideally use design practices that will easily transition to development of deployable systems with high reliability and minimal required maintenance.

### **Navy Laser Safety Review Board approval for unattended operation in all applicable operational environments**

Use of lasercomm systems in the USN and USMC for all demonstrations in this program and for operational deployment will require system parameters and operational procedures which are approved by the Navy Laser Safety Review Board (LSRB) to ensure the eye safety of everyone. Ideally, this can be accomplished by using laser powers and laser divergences that are eye safe out of the terminal transmitter aperture for aided viewing with the largest binoculars used by the USN/USMC – 12.5 cm diameter collection optics. Alternatively, standard operating procedures that ensure personnel safety may be possible but are less desirable owing to restrictions on operations incurred by this method for laser safety. Vendors should consult the Navy LSRB early in the development process to ensure the basic system design is reasonable to achieve Navy LSRB approval for operations.

### **Summary of technical goals/challenges:**

Some of the technical challenges that exist for extending current lasercomm system technology to useful USN/USMC lasercomm terminals are:

- Modems which can robustly handle the potentially high error rates over a highly scintillated lasercomm link and deliver standard Ethernet packets with an apparent low error rate
- Compact optical designs which ensure sufficient link margins for communications and minimize effects of atmospheric scintillation
- Reliable systems able to endure military environmental effects: salt water spray, strong EMI, weather, vibrations, etc.
- Automatic sensing of atmospheric distortion of link (low power due to attenuation, lost data due to atmospheric scintillation, etc.) and adaptation of data rate or other system parameters to maintain link and increase range/availability
- Automatic determination of optimal transmit laser power, divergence, etc. to maintain optimal receive power
- Automatic PAT to acquire and maintain links between lasercomm terminals without user intervention
- Designs which deliver desired goals in an integrated, compact, reliable, and low cost system

## Government Approach

ONR will employ a government integrator (not part of this solicitation) to combine vendor products and government-owned technologies into USN/USMC communication systems. As part of this program, products 1 & 2 will be demonstrated in three increasingly complex demonstrations throughout the program. Successful vendors must allow the systems integrator to have full access to their technology in order to have successful technology demonstrations.

The following are the anticipated milestones/demonstrations for a five year program effort – comprised of a base 18 month phase (phase 1), followed by an optional 18 month phase (phase 2), and an optional 24 month phase (phase 3). Testing of point-to-point non-networked links in phase 1 will be primarily conducted by vendors at government test facilities. Bearing information for link establishment will be provided by government systems. Testing over simulated and operational USN/USMC networks in phases 2 & 3 will be primarily conducted by the government. However, vendor support for integration to these networks and testing is required.

- End of Phase 1 demo - 18 months: Point-to-point demonstrations of automated PAT and high quality of service data transfer using compact terminals integrated into standard gimbals.
  - Demonstrate maritime direct link to the horizon and MRR link to maximum range with at least one end of the link on a boat. Operation on the move (OTM) required.

GOAL: Demonstrate automated acquisition, pointing, and tracking of terminals and determine effectiveness of modems and terminals to transmit/receive data with a high quality of service. Significant automation expected with only minimal operator control necessary for system operation. Bearing information for acquisition will be provided by the government. Lessons learned from demo utilized to optimize system for demonstration at end of phase 2.
- End of Phase 2 demo - 36 months (option): Fully automated system demonstration of a minimum of four networked terminals on three platforms (“nodes”) integrated to simulated USN/USMC networks. Utilize automated PAT and implement algorithms to optimize laser power, divergence, adaptation to atmospheric conditions, etc.
  - Demonstrate sea based three node network of maritime direct links to the horizon and MRR link to maximum range with a minimum of two nodes on boats. Three main nodes should communicate through all direct links as base demonstration. Demonstration should also include addition of MRR link to network either as additional link or replacement of direct terminal with MRR terminal. Operation of boat nodes on the move (OTM) required. No manual input required for operation of networked lasercomm system.
  - Demonstrate land based three node network of direct and MRR links with a minimum of two ground nodes and one airborne node (operation above 10,000 feet desired but not required) capable of relaying network between the two ground nodes. Three main nodes should communicate through all direct links as base demonstration. Demonstration should also include addition of

MRR links to network or replacement of direct links with MRR links to demonstrate both air-to-ground and ground-to-air interrogation of MRR. Operation OTM not required for ground mobile node – on the halt (OTH) permissible. Operate at various ranges to investigate limitations of system. No manual input required for operation of networked system.

GOAL: Demonstrate fully automated system with high quality of service operation in simulated USN/USMC environments before demonstration in operational environments.

- End of Phase 3 demo - 52 months (option): Fully automated system installed on operational USN/USMC platforms and integrated to operational USN/USMC networks.
  - USN:
    - Operational underway demonstration of a minimum of three networked US Navy ships to horizon limited range (~20 Nmi) with all terminals integrated to shipboard networks.
    - Demonstrate underway MRR links to a simulated vessel of interest for Maritime interdiction operations and a supply ship for underway replenishment with interrogator fully integrated with shipboard networks.
    - Demonstrate addition of airborne node to network with capability to connect two Navy ships over-the-horizon with a minimum separation between ships of 40 Nmi.
  - USMC:
    - Demonstrate a ground-to-air-to-ground relay with ground terminals separated by >40 Nmi and ground terminals fully integrated to USMC network.
    - Demonstrate addition of MRR terminal to network interrogated from both ground nodes and airborne nodes (not simultaneously).

GOAL: Demonstrate high bandwidth laser communications terminals on operational platforms fully integrated with operational USN/USMC networks in realistic scenarios – USN: Intra-strike group communications; USMC: FOB-to-FOB communications.

### **Additional information:**

#### **Short-medium range modulating retro-reflector lasercomm links**

Conventional lasercomm terminals impose SWAP and platform requirements, which may be unacceptable for smaller platforms and disadvantaged users. Development of MRR links focuses on serving the needs of small SWAP platforms and developing small man portable systems by using a modulating retroreflector (MRR) terminal. An MRR terminal consists of a transceiver that includes an optical retroreflector coupled to an optical modulator, a wide field of view photodetector, and a modem. An MRR terminal has low SWAP. Typical terminals have volumes from 10-100 cm<sup>3</sup> and power draws on the order of a few watts including the modem. Pointing accuracies required for an MRR terminal vary from a few degrees to nearly omnidirectional depending on the optical configuration. An MRR terminal's data rate is determined by the speed of its modulator.

The terminals to be used in this program will use multiple quantum well (MQW) modulators and provide data rates from a few Mbps to tens of Mbps. An MRR link also requires an interrogator at the other end of the link. An interrogator is similar to a conventional lasercomm terminal, but may require some special adaptations. An MRR interrogator can also be used in a conventional lasercomm link and it is desirable for proposed terminals to be able to function in either mode.

The interrogator and modem for the MRR link face somewhat different technical challenges than a conventional lasercomm terminal. These include:

1. High Transmit/Receive (Tx/Rx) isolation without the use of spectral discrimination:
  - a. Because MRR links place the burden of the link on the interrogator they often require high output power and have low receive power. The ratio of transmit to receive power can be in excess of 65 dB
  - b. For retroreflecting links, transmit and receive wavelengths must be the same. Thus spectral filtering cannot be used to provide transmit/receive isolation
2. Low extinction ratio  
MQW MRRs typically have extinction ratios of 3 dB or less. Modems for these links must take these low extinction ratios into account.
3. Desirability for laser interrogator tunable over the telecom c-band  
MQW modulators have a temperature dependant operating wavelength. This can be accommodated either by temperature stabilizing the MRR or by having a tunable laser interrogator. To maintain simplicity at the MRR terminal, a tunable interrogator is desirable, but not required.

MRR terminals are intended to provide low rate Ethernet links for applications such as video teleconferencing and file transfer. Their small size allows a variety of applications including maritime interdiction, Special Operations Forces (SOF) and air to surface links to small platforms. Because MRR links drop off as  $1/R^4$  their range has been limited to a few kilometers for small systems and tens of kilometers for larger systems.

The scope of this solicitation does not cover the development of MRR transceivers. MRR transceivers will be supplied as GFE with a variety of possible designs. It is anticipated that in the later stages of the efforts, MRR manufacture will be transitioned to industry based on the supplied designs.

Proposed efforts should address the design of the MRR interrogator and the design of the modem which drives the MRR transceiver. In particular proposers should demonstrate innovative approaches to the following technical challenges:

1. Pointing, acquisition and tracking of retroreflecting terminals, with particular attention to the ability to operate a PAT system at low retroreflected signal powers ( $\sim$ -50 dBm) typical of retroreflecting links
2. Design of interrogators and modems which extend the range and data throughput of MRR links beyond that which has already been demonstrated

3. Design of interrogators that can also operate as conventional lasercomm terminals
4. Design of MRR modems that maintain low SWAP and simplicity of operation at the disadvantaged end of the link
5. Optimized protocols and encoding for high quality of service

Two kinds of MRR will be supplied as GFE in this program: corner cube MQW MRRs and cats' eye MQW MRR.

Specific characteristics of these transceivers upon which proposed designs may be based are:

1. Corner cube MRRs with apertures of 0.63 cm or 1 cm and bandwidths of 10 MHz and 5 MHz, respectively
2. Cat's eye MRR with apertures up to 3 cm and bandwidths up to 45 MHz

Proposers may choose to use any of these types of MRRs in their design. Corner cube MRRs are simpler and offer much wider fields of view (30° to omnidirectional). Cat's eye MRRs offer larger aperture and bandwidth, but are more complex and may have more restricted fields of view (5°-30°). Detailed descriptions of the operating characteristics of these kinds of MRR terminals, along with examples of link budget calculations, can be found in the following references:

- W. S. Rabinovich, et al, "Free-space optical communications link at 1550 nm using multiple quantum well modulating retro-reflectors in a marine environment," *Optical Engineering*, 44(5), 056001 (2005)
- W.S. Rabinovich et al., "45-Mbit/s cat's-eye modulating retroreflectors", *Optical Engineering*, 46(10), 104001-1 (2007)

### **Transition**

This effort seeks to develop innovative technology solutions while simultaneously delivering robust products to acquisition and experimentation. Transition consists of delivering mature S&T products to acquisition in an agreed upon manner. Offerors selected to perform research will be expected to work with other technology developers and also as members of government-lead teams that will coordinate the delivery of products to acquisition programs in a way that meets the schedule and performance requirements of the acquisition sponsor. Offerors should expect that the prototypes they develop will require modifications in order to properly integrate into the acquisition program or experimentation venue. The government will provide the guidance and coordination for interfacing and integrating products into acquisition programs and experimentation. The government may choose to provide the infrastructure to host selected Performer technology prototypes for transition testing and experimentation. Full government rights to technology products - including intellectual property - is a necessary and important factor in the selection process.

### **Concept of Operations (CONOPS) Development**

Performers selected to participate in the high-bandwidth free-space lasercomm program are expected to contribute to the development of a concept of operations (CONOPS) that will be ultimately delivered to the acquisition transition partner. The government will integrate all performer inputs and produce the final CONOPS document. Performers will

be asked to contribute to the CONOPS in areas corresponding to the technology products that they develop.

Performers will also actively participate in the experimentation process. This may include fleet experiments such as Trident Warrior, Valiant Shield, Annulex, and JEFX. The goals of experimentation in this Program are to: (a) support early evaluation of technology product capabilities in both laboratory and operational settings, and (b) validate and refine CONOPS, Tactics, Techniques and Procedures (TTP) and doctrine.

**Proposal Evaluation:**

To ensure accurate evaluation of proposals, the following information is expected where relevant to the solution proposed:

- Overview of entire system and how components (optical head, PAT systems, modem) are integrated into system;
- General optical design of optical head;
- Techniques to be used for mitigation of optical fades due to both atmospheric scintillation and attenuation due to weather;
- Planned acquisition and tracking methods including general descriptions of both fine and coarse tracking system hardware (if separate systems) and how two systems are integrated together;
- Any other details that are necessary for accurate evaluation of expected system performance and its integration to USN/USMC platforms and corresponding networks;
- Full detailed link budgets of all proposed systems which includes low level detail of link budget analysis: optic transmission, fiber (or detector) coupling losses, propagation losses, pointing error losses, etc.;
- Rough SWaP estimates of full system broken out into optical head, gimbal, and modem for direct links and modem only for MRR links;
- Planned data rates of links and effective estimated throughput rate of system as seen by USN/USMC networks;
- Estimate of number of required optical head designs to cover possible USN/USMC platforms;
- Rough cost estimates of production version of full lasercomm terminals; optical head, modems, and gimbal costs should be identified separately;
- Detailed explanation of any novel techniques proposed.

The government may issue invitations to give oral presentations based on evaluation of the received Proposals.

Vendors must provide proposals that include both Products (Product 1 Lasercomm terminals & Product 2 Modulating Retroreflectors) in their proposals. ONR will employ a government/industry systems integrator (not part of this solicitation) to combine individual vendor products and government-owned technologies into communication systems. Successful vendors must allow the systems integrator to have access to their technologies and products in order to conduct successful technology demonstrations.

Appropriate non-disclosure agreements will be executed in order to protect relevant intellectual property.

Depending on the results of the proposal evaluation, there is no guarantee that any of the proposals submitted will be recommended for funding. Proposers are encouraged to review prior and ongoing work in these areas before proposing completely new solutions.

#### RELEVANT REFERENCES:

- S. Das, et al, "Requirements and Challenges for Tactical Free-Space Lasercomm", MILCOM 2008
- C.I. Moore, et al, "Overview of NRL's maritime laser communication test facility," *Proc. SPIE* 5892, 589206 (2005)
- C.I. Moore, et al, "Lasercomm demonstration during US Navy Trident Warrior 06 FORCENET Exercise", *IEEE Antennas and Propagation Society International Symposium*, 17-20 (2007)
- C.I. Moore, et al, "MIO TAR2HOST Lasercomm experiment during Trident Warrior 08", MILCOM 2008
- L.M. Wasiczko Thomas, et al, "NRL's research at the Lasercomm Test Facility: characterization of the maritime atmosphere and initial results in analog FM lasercomm," *Proc. SPIE* 6951, 69510S (2008)
- B. Epple, H. Henniger, "Discussion on design aspects for free-space optical communication terminals," *IEEE Communications Magazine*, 45(10) , 62 (2007)
- L.B. Stotts, et al; "The Optical RF Communications Adjunct", *Proc. SPIE* 7091, 709102 (2008)
- R.B. Adamson, J.P. Macker, "Quantitative prediction of NACK-oriented reliable multicast (norm) feedback " MILCOM 2002, Vol. 2, 964-9 (2002)
- D.E. Gossink, J.P. Macker, "Reliable multicast and integrated parity retransmission with channel estimation considerations," *IEEE GLOBECOM* 1998, Vol. 6, 3608-3613 (1998)
- H. Henniger, "Link Performance of Mobile Optical Links," *Proc. SPIE* 6709, 670913, (2007)
- H. Henniger: "Packet-Layer Forward Error Correction Coding for Fading Mitigation," *Proc. SPIE* 6304, 630419, (2006)
- Macker, J.P. and M.S. Corson, "Mobile Ad Hoc Networks: Routing Technology for Dynamic, Wireless Networks," S. Basagni et al., eds., *Mobile Ad Hoc Networking*, Chapter 9, IEEE Press, 2003.
- Macker, Corson, "Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations," IETF RFC 2501, January 1999.
- J. Macker, (editor), et al, "Simplified Multicast Forwarding for MANET," <http://cs.itd.nrl.navy.mil/pubs/docs/draft-ietf-manet-smf-08.pdf>, November 2008.
- T. Clausen, C. Dearlove, J. Dean, C. Adjih, "Generalized MANET Packet/Message Format," <http://cs.itd.nrl.navy.mil/pubs/docs/draft-ietf-manet-packetbb-17.pdf>, November 2008.

- Adamson, B., Bormann, C., Handley, M., Maker, J., "NACK-Oriented Reliable Multicast Protocol," <http://cs.itd.nrl.navy.mil/pubs/docs/draft-ietf-rmt-pi-norm-revised-07.pdf>, October 2008.

Proposals that build on current or previous DoD work are encouraged. Offerors enhancing work performed under ONR or DoD projects must clearly identify the point of departure, what existing work will be brought forward, and what new work will be performed under this BAA.

Work funded under a BAA may include basic research, applied research and some advanced technology development (ATD). With regard to any restrictions on the conduct or outcome of work funded under this BAA, ONR will follow the guidance on and definition of "contracted fundamental research" as provided in the Under Secretary of Defense (Acquisition, Technology and Logistics) Memorandum of 26 June 2008. As defined therein the definition of "contracted fundamental research", in a DoD contractual context, includes [research performed under] grants and contracts that are (a) funded by Research, Development, Test, and Evaluation Budget Activity 1 (Basic Research), whether performed by universities or industry or (b) funded by Budget Activity 2 (Applied Research) and performed on campus at a university or by industry. ATD is funded through Budget Activity 3. In conformance with the USD(AT&L) guidance and National Security Decision Directive 189, ONR will place no restriction on the conduct or reporting of unclassified fundamental research, except as otherwise required by statute, regulation or Executive Order. Normally, fundamental research is awarded under grants with universities and under contracts with industry. ATD is normally awarded under contracts and may require restrictions during the conduct of the research and DoD pre-publication review of research results due to subject matter sensitivity. Potential offerors should consult with the appropriate ONR POCs to determine whether the proposed effort would constitute basic research, applied research or ATD. As regards the present BAA, the Research and Development efforts to be funded will consist of basic and applied research. The funds available to support awards are Budget Activity 6.1 and 6.2.

## **7. Point(s) of Contact –**

Questions of a technical nature should be submitted to either:

Dr. Santanu Das  
Program Officer  
Communications and Networks, ONR 312  
Office of Naval Research  
875 North Randolph Street – Suite 1115  
Arlington, VA 22203-1995  
E-mail: [Santanu.Das@navy.mil](mailto:Santanu.Das@navy.mil)

or



Mr. John Moniz  
Program Officer  
USMC C4 Systems, Code 30  
Office of Naval Research  
875 North Randolph Street – Suite 1154  
Arlington, VA 22203-1995  
2/20/08 12  
E-mail: [John.Moniz@navy.mil](mailto:John.Moniz@navy.mil)

Questions of a business nature should be submitted to:

Primary:

Name: Jennifer Williams  
Address: One Liberty Center  
875 North Randolph Street, Suite 1269F  
Arlington, VA 22203-1995  
Code: 0251  
Email: [jennifer.williams4@navy.mil](mailto:jennifer.williams4@navy.mil)

Secondary:

Name: Vera Carroll  
Address: One Liberty Center  
875 North Randolph Street, Suite 1279  
Arlington, VA 22203-1995  
Code: 0251  
Email: [vera.carroll@navy.mil](mailto:vera.carroll@navy.mil)

**8. Instrument Type(s) -**

Awards will take the form of contracts. ONR anticipates that applied research (6.2) and advanced technology development (6.3) funding will be available to make awards. It is anticipated that ONR will award one or more Cost Plus Fixed Fee (CPFF) contracts for this effort. Phase 1 will be the contract base period, with Phases 2 and 3 as options under the contract.

**9. Catalog of Federal Domestic Assistance (CFDA) Numbers -**

12.300

**10. Catalog of Federal Domestic Assistance (CFDA) Titles -**

DoD Basic and Applied Scientific Research

**11. Other Information -**

This announcement is restricted to applied research and that portion of advanced technology development not related to the development of a specific system or hardware procurement. Contracts made under this BAA are for scientific study and experimentation directed towards advancing the state of the art and increasing knowledge or understanding.

**II. AWARD INFORMATION**

The amount and period of performance of each selected proposal will vary depending on the research area and the technical approach to be pursued by the selected offeror.

The estimated total amount of awards is \$16M anticipated to be made available over a five year period. ONR may award less than \$16M under this BAA and apply it elsewhere. One or more work orders in this subject area may be awarded to proposals from Navy laboratories received outside this BAA.

Estimated Total Amount of Funding Available (\$K):

FY10	FY11	FY12	FY13	FY14	Total
1750	3750	5750	3500	1250	16000

Anticipated Number of Awards

It is anticipated that several proposals will be selected for funding initially, followed by a down selection to one after 18 months (phase 1 demo). Vendors should propose a base period up to 18 months, followed by two optional phases beyond that timeframe. Vendors are encouraged to team up in core competency areas to deliver a fully integrated solution as outlined in this BAA.

Anticipated Range of individual Award Amounts: As required to perform tasking.

Anticipated Period of Performance: Up to five (5) years.

**III. ELIGIBILITY INFORMATION**

All responsible sources from academia and industry may submit proposals under this BAA. Historically Black Colleges and Universities (HBCUs) and Minority Institutions (MIs) are encouraged to submit proposals and join others in submitting proposals. However, no portion of this BAA will be set aside for HBCU and MI participation.

Federally Funded Research & Development Centers (FFRDCs), including Department of Energy National Laboratories, are not eligible to receive awards under this BAA.

However, teaming arrangements between FFRDCs and eligible principal bidders are allowed so long as they are permitted under the sponsoring agreement between the Government and the specific FFRDC.

Navy laboratories and warfare centers as well as other Department of Defense and civilian agency laboratories are also not eligible to receive awards under this BAA and should not directly submit either white papers or full proposals in response to this BAA. If any such organization is interested in one or more of the programs described herein, the organization should contact an appropriate ONR POC to discuss its area of interest. The various scientific divisions of ONR are identified at <http://www.onr.navy.mil/>. As with FFRDCs, these types of federal organizations may team with other responsible sources from academia and industry that are submitting proposals under this BAA.

Teams are encouraged to submit proposals in any and all areas. However, Offerors must be willing to cooperate and exchange software, data and other information in an integrated program with other contractors, as well as with system integrators, selected by ONR.

Some topics cover export controlled technologies. Research in these areas is limited to “U.S. persons” as defined in the International Traffic in Arms Regulations (ITAR) - 22 CFR § 1201.1 et seq. For information regarding whether a particular topic may be ITAR restricted, contact one of the Technical Points of Contact (TPOCs) identified in Paragraph 7 above in this BAA.

#### **IV. APPLICATION AND SUBMISSION INFORMATION**

##### **1. Application and Submission Process -**

”White Papers” are not desired for this solicitation.

The due date and time for receipt of Full Proposals is 2:00 p.m. (Eastern Time) on 08 May 2009. Each proposal should state that it is submitted in response to this announcement. Proposals shall be submitted directly to the first Technical Points of Contact (TPOCs), Dr. Santanu Das, stated on page 16 of this announcement. Each proposal will be evaluated by the government to determine whether the technology advancement proposed appears to be of particular value to the Department of the Navy. The submitters of proposals judged to be of “particular value” to the Navy will be so identified in the initial response provided by ONR and encouraged to make oral presentations of their proposals on a specific date. The submitters of any proposals not judged by the ONR reviewers as being of “particular value” to the Navy are ineligible to make an oral presentation or submit a full revised proposal under this solicitation.

Following the oral presentations, the submitters will again receive written notice from ONR as to whether the proposed research is still judged to be of particular value to the Department of the Navy. The submitters of proposals and oral presentations still judged to be of “particular value” to the Navy will be asked to submit a full revised proposal by a specific date and time. Any oral presenter’s proposal subsequently judged to not be of

“particular value” to the Navy is ineligible to submit a full revised proposal under this solicitation. Any full revised proposal submitted can range from either a complete new proposal to simply a timely email notifying the Government that the original proposal as submitted is reaffirmed.

## **2. Content and Format of Proposals –**

Full Proposals submitted under the BAA are expected to be unclassified; however, confidential/classified proposals are permitted. If a classified proposal is submitted, the resultant contract will be unclassified.

### Unclassified Proposal Instructions:

Unclassified proposals shall be submitted directly to the Technical Point of Contract (TPOC).

### Classified Proposal Instructions:

Classified proposals shall be submitted directly to the attention of ONR’s Document Control Unit at the following address and marked in the following manner:

OUTSIDE EVELOPE (no classification marking):

“Office of Naval Research  
Attn: Document Control Unit  
ONR Code 43  
875 North Randolph Street  
Arlington, VA 22203-1995”

The inner wrapper of the classified proposal should be addressed to the attention of Dr. Santanu Das , ONR Code 312 and marked in the following manner:

INNER ENVELOPE (stamped with the overall classification of the material)

“Program: (Program Title)  
Office of Naval Research  
Attn: Dr. Santanu Das  
ONR Code: 312  
875 North Randolph Street  
Arlington, VA 22203-1995”

An ‘unclassified’ Statement of Work (SOW) must accompany any classified proposal.

Proposal submissions will be protected from unauthorized disclosure in accordance with FAR Subpart 15.207, applicable law, and DoD/DoN regulations. Offerors are expected to appropriately mark each page of their submission that contains proprietary information. The proposal shall include a severable, self-standing Statement of Work, which contains only unclassified information and does not include any proprietary restrictions.

IMPORTANT NOTE: Titles given to the Full Proposals should be descriptive of the work they cover and not be merely a copy of the title of this solicitation.

The proposal format and content identified below are applicable to the submission of proposals for contracts.

## **FULL PROPOSALS**

### **Full Proposal Format – Volume 1 - Technical and Volume 2 - Cost Proposal**

- Paper Size – 8.5 x 11 inch paper
- Margins – 1 inch
- Spacing – single or double-spaced
- Font – Times New Roman, 12 point
- Page limits for Volume I are as follows: Technical Approach – 20 pgs, Statement of Work – 3 pgs, Project Schedule and Milestones – 1 pg, Assertion of Data Rights – 1 pg, Deliverables – 1 pg, Management Approach – 10 pgs, Other Agencies – 1 pg. There are no page limitations to the other parts of Volume 1 listed below and to Volume 2.
- Copies – one (1) original, ten (10) hard copies, and one electronic copy on a CD-ROM (in Microsoft® Word or Excel 97 compatible or .PDF format). Please do not use three-ring binders to enclose your proposal.

If a grant is sought, the proposal is to be submitted electronically on Standard Form 424 (R&R) at <http://www.grants.gov/> as delineated below.

### **Full Proposal Content**

Volume 1: Technical Proposal

- **Cover Page**: This should include the words “Technical Proposal” and the following:
  - 1) BAA number;
  - 2) Title of Proposal;
  - 3) Identity of prime Offeror and complete list of subcontractors, if applicable;
  - 4) Technical contact (name, address, phone/fax, electronic mail address)
  - 5) Administrative/business contact (name, address, phone/fax, electronic mail address) and;
  - 6) Duration of effort (differentiate basic effort and any proposed options)
- **Table of Contents**: An alphabetical/numerical listing of the sections within the proposal, including corresponding page numbers.

- **Statement of Work:** A Statement of Work (SOW) clearly detailing the scope and objectives of the effort and the technical approach. It is anticipated that the proposed SOW will be incorporated as an attachment to the resultant award instrument. To this end, the proposals must include a severable, self-standing SOW, without any proprietary restrictions, which can be attached to the contract or agreement award. Include a detailed listing of the technical tasks/subtasks organized by year.
- **Technical Approach:** A description of the technical understanding, technology innovation and technical risks, including but not limited to addressing the areas listed in “Summary of technical goals/challenges” in Section I. General Information.
- **Project Schedule and Milestones:** A summary of the schedule of events and milestones:
- **Assertion of Data Rights and/or Rights in Computer Software:** For a contract award an Offeror may provide with its proposal assertions to restrict use, release or disclosure of data and/or computer software that will be provided in the course of contract performance. The rules governing these assertions are prescribed in Defense Federal Acquisition Regulation Supplement (DFARS) clauses 252.227-7013, -7014 and - 7017. These clauses may be accessed at the following web address:

<http://farsite.hill.af.mil/VDFDARA.HTM>

The Government may challenge assertions that are provided in improper format or that do not properly acknowledge earlier federal funding of related research by the Offeror.

- **Deliverables:** A detailed description of the results and products to be delivered inclusive of the timeframe in which it will be delivered.
- **Management Approach:** A discussion of the overall approach to the management of this effort, including brief discussions of the total organization; use of personnel; project/function/subcontractor/subrecipient relationships; government research interfaces; and planning, scheduling and control practice. Identify which personnel and subcontractors/subrecipients (if any) will be involved. Include a description of the facilities that are required for the proposed effort with a description of any Government Furnished Equipment/Hardware/Software/Information required, by version and/or configuration. Resumes of key personnel should be provided. Resumes will not count toward the page limitation for this section.
- **Other Agencies:** Include the name(s) of any other agencies to which the proposal has also been submitted.

## **VOLUME 2: Cost Proposal**

Although not required and provided for informational purposes only, detailed instructions, entitled “Instructions for Preparing Cost Proposals for Contracts and Agreements”, including a sample template for preparing costs proposals for contracts and

agreements, may be found at ONR's website listed under the 'Acquisition Department – Contracts & Grants Submitting a Proposal' link at:

[http://www.onr.navy.mil/02/how\\_to.asp](http://www.onr.navy.mil/02/how_to.asp)

The Cost Proposal shall consist of a cover page and two parts, Part 1 will provide a detailed cost breakdown of all costs by cost category by calendar or Government fiscal year, and Part 2 will provide a cost breakdown by task/sub-task corresponding to the task numbers in the proposed Statement of Work. Options must be separately priced.

**Cover Page:** The use of the SF 1411 is optional. The words "Cost Proposal" should appear on the cover page in addition to the following information:

- BAA number
- Title of Proposal
- Identity of prime Offeror and complete list of subcontractors, if applicable
- Technical contact (name, address, phone/fax, electronic mail address)
- Administrative/business contact (name, address, phone/fax, electronic mail address) and
- Duration of effort (separately identify basic effort and any proposed options)

**Part 1:** Detailed breakdown of all costs by cost category by calendar or Government fiscal year:

- Direct Labor – Individual labor categories or persons, with associated labor hours and unburdened direct labor rates. Provide escalation rates for out years;
- Indirect Costs – Fringe Benefits, Overhead, G&A, COM, etc. and their applicable allocation bases. If composite rates are used, provide the calculations used in deriving the composite rates.
- Travel – The proposed travel cost should include the following for each trip: the purpose of the trip, origin and destination if known, approximate duration, the number of travelers, and the estimated cost per trip must be justified based on the organizations historical average cost per trip or other reasonable basis for estimation. Such estimates and the resultant costs claimed must conform to the applicable Federal cost principals.
- Subcontracts – A cost proposal as detailed as the Offeror's cost proposal will be required to be submitted by the subcontractor. The subcontractor's cost proposal can be provided in a sealed envelope with the Offeror's cost proposal or may be sent directly to the Government. Subcontractor proposals must be received and reviewed prior to contract award. The prime contractor should perform and provide a cost/price analysis of each subcontractor's cost proposal.\*

\***Note:** DoD Federal Acquisition Regulation provision 252.215-7003 (48 CFR §252.215-7003) is incorporated into this solicitation by reference. The offeror is to exclude excessive pass-through charges from subcontractors. The offeror must identify in its proposal the percentage of effort it intends to perform and the percentage to be performed by each of

its proposed subcontractors. If more than 70 percent of the total effort will be formed through subcontractors, the offeror must include the additional information required by the above-cited clause.

- Consultants – Provide a breakdown of the consultant’s hours, the hourly rate proposed, any other proposed consultant costs, a copy of the signed Consulting Agreement or other documentation supporting the proposed consultant cost, and a copy of the consultant’s proposed statement of work if it is not already separately identified in the prime contractor’s proposal.
- Materials & Supplies – Provide an itemized list of all proposed materials and supplies including quantities, unit prices, proposed vendors (if known), and the basis for the estimate (e.g., quotes, prior purchases, catalog price lists).
- Contractor Acquired Equipment or Facilities – Equipment and/or facilities are normally furnished by the Contractor. If acquisition of equipment and/or facilities is proposed, a justification for the purchase of the items must be provided. Provide an itemized list of all equipment and/or facilities costs and the basis for the estimate (e.g., quotes, prior purchases, catalog price lists).
- Other Direct Costs – Provide an itemized list of all other proposed other direct costs and the basis for the estimate (e.g., quotes, prior purchases, catalog price lists).
- Options – The Base Period of Performance and Option Periods must be priced at the submission of the proposal. Unpriced options will not be included in any resulting contract or agreement.
- Fee/Profit (Contract Proposals Only) – Profit or fee is not allowed on direct costs for facilities or in cost-sharing contracts.

Note: Indicate if you have an approved Purchasing/Estimating System and/or describe the process used to determine the basis of reasonableness (e.g., competition, market research, best value analysis) for subcontractors, consultants, materials, supplies, equipment/facilities, and other direct costs.

**Part 2** : Cost breakdown by task/sub-task corresponding to the same task breakdown in the proposed Statement of Work. When options are contemplated, options must be separately identified and priced by task/subtask.

**3. Significant Dates and Times –**

**Anticipated Schedule of Events**

<u>EVENT</u>	<u>DATE</u>	<u>TIME (EASTERN DAYLIGHT TIME)</u>
<b>Industry Day</b>	<b>April 3 2009</b>	<b>10:00 am</b>
<b>Proposals Due</b>	<b>May 8, 2009</b>	<b>2:00 pm</b>
<b>Notification of oral presentations</b>	<b>May 27 2009*</b>	
<b>Oral Presentation of proposals</b>	<b>June 5, 2009*</b>	



<b>Notification of Navy Evaluations of Oral Presentations</b>	<b>June 10, 2009*</b>	
<b>Full Revised Proposal Due Date</b>	<b>June 17 2009</b>	<b>2:00 pm</b>
<b>Notification of Selection for Award</b>	<b>June 24 2009*</b>	
<b>Issued Awards</b>	<b>October 31, 2009*</b>	

\*These dates are estimates as of the date of this announcement.

**Note: Due to changes in security procedures since Sept. 11, 2001, the time required for hard-copy written materials to be received at the Office of Naval Research has increased. Materials submitted through the U.S. Postal Service, for example, may take seven days or more to be received, even when sent by Express Mail. Thus any hard-copy proposal should be submitted long enough before the deadline established in the solicitation so that it will not be received late and thus be ineligible for award consideration.**

#### **4. Submission of Late Proposals –**

Any proposal, modification, or revision that is received at the designated Government office after the exact time specified for receipt of proposals is “late” and will not be considered unless it is received before award is made, the contracting officer determines that accepting the late proposal would not unduly delay the acquisition and:

- If it was transmitted through an electronic commerce method authorized by the announcement, it was received at the initial point of entry to the Government infrastructure not later than 5:00 P.M. one working day prior to the date specified for receipt of proposals; or
- There is acceptable evidence to establish that it was received at the Government installation designated for receipt of proposals and was under the Government’s control prior to the time set for receipt of proposals; or
- It was the only proposal received.

However, a late modification of an otherwise timely and successful proposal that makes its terms more favorable to the Government will be considered at any time it is received and may be accepted.

Acceptable evidence to establish the time or receipt at the Government installation includes the time/date stamp of that installation on the proposal wrapper, other documentary evidence of receipt maintained by the installation, or oral testimony or statements of Government personnel.

If an emergency or unanticipated event interrupts normal Government processes so that proposals cannot be received at the Government office designated for receipt of proposals by the exact time specified in the announcement, and urgent Government requirements

preclude amendment of the announcement closing date, the time specified for receipt of proposals will be deemed to be extended to the same time of day specified in the announcement on the first work day on which normal Government processes resume. The contracting officer must promptly notify any offeror if its proposal, modifications, or revision was received late and must inform the offeror whether its proposal will be considered.

## **6. Address for the Submission of Full Proposals for Contracts.**

Hard copies of full proposals for Contracts should be sent to the Office of Naval Research at the following address:

Office of Naval Research  
Attn: Santanu Das  
ONR Department Code 31  
875 North Randolph Street  
Arlington, VA 22203-1995

## **V. EVALUATION INFORMATION**

### **1. Evaluation Criteria –**

Award decisions will be based on a competitive selection of proposals resulting from a scientific and cost review. Evaluations will be conducted using the following evaluation criteria:

- 1) Overall scientific and technical merits of the proposal including estimated size, weight, and power (SWAP) and production cost of operational terminals;
- 2) Potential Naval relevance and contributions of the effort to the agency's specific mission;
- 3) The offeror's capabilities, related experience, facilities, techniques or unique combinations of these which are integral factors for achieving the proposal objectives;
- 4) The qualifications, capabilities and experience of the proposed Principal Investigator (PI), team leader and key personnel who are critical in achieving the proposal objectives; and
- 5) The realism of the proposed costs and availability of funds.

Overall, the technical factors (1 – 5 above) are more important than the cost factor, with the technical factors being in descending order of importance. Although cost is not the most important evaluation factor, its degree of importance will increase with the degree of equality of the proposals in relation to the other factors on which selection is to be based, or when the cost is so significantly high as to diminish the value of the proposal's technical superiority to the Government.

For proposed awards to be made as contracts to other than small businesses, the socio-economic merits of each proposal will be evaluated based on the extent of the Offeror's

commitment in providing meaningful subcontracting opportunities for small businesses, small disadvantaged businesses, woman-owned small businesses, HUBZone small businesses, veteran-owned small businesses, service disabled veteran-owned small businesses, historically black colleges and universities, and minority institutions.

The Government will evaluate options for award purposes by adding the total cost for all options to the total cost for the basic requirement. Evaluation of options will not obligate the Government to exercise the options during contract performance.

## **2. Evaluation Panel -**

Technical and cost proposals submitted under this BAA will be protected from unauthorized disclosure in accordance with FAR 3.104-4 and 15.207. The cognizant Program Officer and other Government scientific experts will perform the evaluation of technical proposals. Cost proposals will be evaluated by Government business professionals. Restrictive notices notwithstanding, one or more support contractors may be utilized as subject-matter-expert technical consultants. Similarly, support contractors may be utilized to evaluate cost proposals. However, proposal selection and award decisions are solely the responsibility of Government personnel. Each support contractor's employee having access to technical and cost proposals submitted in response to this BAA will be required to sign a non-disclosure statement prior to receipt of any proposal submissions.

## **VI. AWARD ADMINISTRATION INFORMATION**

### **1. Administrative Requirements –**

- The North American Industry Classification System (NAICS) code – The North American Industry Classification System (NAICS) code for this announcement is “541710” with a small business size standard of “500 employees”.
- Central Contractor Registry (CCR) - Successful Offerors not already registered in the CCR will be required to register in CCR prior to award of any grant, contract, cooperative agreement, or other transaction agreement. Information on CCR registration is available at <http://www.onr.navy.mil/02/ccr.htm>.
- Certifications – Proposals for contracts should be accompanied by a completed certification package which can be accessed on the ONR Home Page at Contracts & Grants located at [http://www.onr.navy.mil/02/rep\\_cert.asp](http://www.onr.navy.mil/02/rep_cert.asp).

#### Contracts:

For contracts, in accordance with FAR 4.1201, prospective contractors shall complete and submit electronic annual representations and certifications at <http://orca.bpn.gov>. In addition to completing the Online Representations and Certifications Application (ORCA), proposals must be accompanied with a completed DFARS and contract specific representations and certifications. These "DFARS and Contract Specific Representations

and Certifications", i.e., Section K, may be accessed under the Contracts and Grants Section of the ONR Home Page at [http://www.onr.navy.mil/02/rep\\_cert.asp](http://www.onr.navy.mil/02/rep_cert.asp).

## **2. Reporting -**

The following are samples of data deliverables that are typically required under a research effort:

- \*Technical and Financial Progress Reports
- \*Presentation Materials
- \*Final Report

Additional data deliverables may be proposed and finalized during negotiations. Research performed under contracts may also include the delivery of software, prototypes, and other hardware deliverables.

## **VII. OTHER INFORMATION**

### **1. Government Property/Government Furnished Equipment (GFE) and Facilities**

Each proposer must provide a very specific description of any equipment/hardware that it needs to acquire to perform the work. This description should indicate whether or not each particular piece of equipment/hardware will be included as part of a deliverable item under the resulting award. Also, this description should identify the component, nomenclature, and configuration of the equipment/hardware that it proposes to purchase for this effort. The purchase on a direct reimbursement basis of special test equipment or other equipment that is not included in a deliverable item will be evaluated for allowability on a case-by-case basis. Maximum use of Government integration, test, and experiment facilities is encouraged in each of the Offeror's proposals.

Government research facilities and operational military units are available and should be considered as potential government-furnished equipment/facilities. These facilities and resources are of high value and some are in constant demand by multiple programs. It is unlikely that all facilities would be used for any one specific program. The use of these facilities and resources will be negotiated as the program unfolds. Offerors should explain as part of their proposals which of these facilities are critical for the project's success.

### **2. Security Classification**

In order to facilitate intra-program collaboration and technology transfer, the Government will attempt to enable technology developers to work at the unclassified level to the maximum extent possible. If access to classified material will be required at any point during performance, the Offeror must clearly identify such need prominently in its proposal.

### **3. Department of Defense High Performance Computing Program**

The DoD High Performance Computing Program (HPCMP) furnishes the DoD S & T and RDT & E communities with use-access to very powerful high performance computing systems. Awardees of ONR contracts, grants, and assistance instruments may be eligible to use HPCMP assets in support of their funded activities if ONR Program Officer approval is obtained and if security/screening requirements are favorably completed. Additional information and an application may be found at <http://www.hpcmo.hpc.mil/>.

### **4. Protection of Proprietary and Sensitive Information**

The parties acknowledge that, during performance of the contract or grant agreement resulting from this BAA, the recipient may require access to certain proprietary and confidential information (whether in its original or derived form) submitted to or produced by the Government. Such information includes, but is not limited to, business practices, proposals, designs, mission or operation concepts, sketches, management policies, cost and operating expense, technical data and trade secrets, proposed Navy budgetary information, and acquisition planning or acquisition actions, obtained either directly or indirectly as a result of the effort performed on behalf of ONR. The recipient shall take appropriate steps not only to safeguard such information, but also to prevent disclosure of such information to any party other than the Government. The recipient agrees to indoctrinate company personnel who will have access to or custody of the information concerning the nature of the confidential terms under which the Government received such information and shall stress that the information shall not be disclosed to any other party or to recipient personnel who do not need to know the contents thereof for the performance of the contract/agreement. Recipient personnel shall also be informed that they shall not engage in any other action, venture, or employment wherein this information will be used for any purpose by any other party.

### **5. Project Meetings and Reviews**

Individual program reviews between the ONR sponsor and the performer may be held as necessary. Program status reviews may also be held to provide a forum for review of the latest results from experiments and any other incremental progress towards the major demonstrations. These meetings will be held at various sites throughout the country. For costing purposes, offerors should assume that 40% of these meetings will be at or near ONR, Arlington VA and 60% at other contractor or government facilities. Interim meetings are likely, but these will be accomplished via video telephone conferences, telephone conferences, or via web-based collaboration tools.

### **6. Submission of Questions**

Any questions regarding this solicitation must be provided to the Science and Technology Point of Contact and/or Business Point of Contact listed on page 16 of this solicitation. All questions shall be submitted in writing by electronic mail.

Questions regarding **proposals** must be submitted by 2:00 P.M. Eastern Time on 15 Apr, 2009. Questions after this date and time may not be answered, and the due date for submission of the proposals will not be extended

## **7. Roles of the Navy Warfare Centers and Laboratories**

The Navy Warfare Centers and Laboratories will have the primary role for the integration and experimentation/demonstration process. They will also participate in the development of technologies where there are unique capabilities and facilities of interest to ONR. They will also assist ONR in the management, engineering, and administrative tasks and will provide government furnished equipment (GFE) and facilities that will be used for system level integration and portions of experiment execution.