BALLISTIC MISSILE DEFENSE ORGANIZATION (BMDO)
SMALL BUSINESS INNOVATION RESEARCH PROGRAM
Submitting Proposals - Instructions

Send an original Phase I proposal packages (an unbound original) by US mail (or any commercial delivery service). Also, it is important that the Company Commercialization Report be included with the proposal. The mailing address follows and the BMDO SBIR/STTR website address is provided.

Ballistic Missile Defense Organization
ATTN: ST/SBIR (BOND)
1725 Jefferson Davis Highway, Suite 809
Arlington, VA 22202

For Administrative HELP ONLY call: **800-WIN-BMDO**
Internet Access: **www.winbmdo.com**

Proposals delivered by other means will not be accepted. Proposals received after the closing date will not be processed. BMDO will acknowledge receipt of proposals, **IF AND ONLY IF**, the proposal includes a self-addressed stamped envelope and a form that needs no more than a signature by BMDO.

Proposers are required to register and submit their entire proposal through the DoD Electronic Submission Website (http://www.dodsbir.net/submission) and, as instructed on the website, to prepare a BMDO Proposal Cover Sheet and Company Commercialization Report to be included in their proposal.

BMDO is working toward developing and deploying a ballistic missile defense system and providing a technology base that will allow the Department of Defense to protect the warfighters against increasingly sophisticated and lethal missiles around the world. BMDO accomplishes these efforts through three broad mission focus areas: Theater Missile Defense (TMD), National Missile Defense (NMD), and Advanced Technology Developments (ATD).

TMD systems respond to and protect U.S. forces, allies, and other countries from existing and emerging short to medium range threat missiles, including cruise missiles. Six Major Defense Acquisition Programs represent the majority of BMDO investments: PATRIOT Advanced Capability-3 (PAC-3), Navy Area Theater Ballistic Missile Defense (TBMD), Theater High-Altitude Area Defense System (THAAD), Navy Theater Wide, Medium Extended Air Defense System (MEADS), and the National Missile Defense (NMD). Also, the Space Based Laser (SBL) has entered into the pre-MDAP stage of the acquisition cycle. NMD is concerned with the possibility of a limited ballistic missile strike against the United States (all 50 states). The key component systems currently under consideration include: ground-based interceptors; ground-based radars; upgraded early-warning radars; forward-based X-Band radars; battle management, command, control, and communications (BMC3); and advanced sensor technology developments. External elements to NMD include the existing early warning satellite system and its planned follow-on: the Space Based Infrared System (SBIRS) system. Finally, BMDO depends on advanced technology developments, of all aspects, to invigorate its ability to implement both TMD and NMD systems in response to increasingly sophisticated ballistic missile threats, to include cruise missiles. Therefore, the continued availability of such advanced technology developments has become an increasingly vital and critical element of the overall BMDO mission.

The intent of BMDO, first and foremost, is to seek out the most innovative technology that might enable a defense against a missile in flight -- lighter, faster, smaller, stronger, more reliable, and less expensive technologies are all of interest. Proposing companies need not know specific details or requirements of possible BMDO systems, research and development goals, or specific technology needs or requirements, but must understand that potential technologies should have application and be relevant to ballistic missile defense at some level. (A better fire extinguisher, although it may be new and innovative and exhibit a potential commercial market, does not support ballistic missile defense requirements at any level.) All topics seek to solicit Research or Research and Development proposals from the small business community. Furthermore, all selections shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not yet been fully established.

Specifically, **BMDO seeks to invest seed-capital, which supplements private sector co-investment support, in a product with a future market potential (preferably private sector, but not at the exclusion of public interest) and a measurable BMDO benefit.** The BMDO SBIR/STTR Program will neither support nor further develop concepts **already mature enough to compete** for private capital or for mainline government research and development funds. BMDO prefers projects that move technology into the private sector market by a market-oriented small company with the best demonstration of volume commercialization with private sector co-investments. Phase I proposals should focus primarily on the innovation of the proposed technology. Proposals should illustrate the concept or feasibility, and the merit of a Phase II for a prototype or at the very least a proof-of-concept demonstration. Phase II competition will also be judged intensely on future market possibilities and commercialization potential demonstrated. The demonstration of commercialization potential is best evidenced by Phase II funding commitments, public or private, submitted as part of the Phase II proposal. BMDO evaluates the presence of other indicators of commercialization potential, but only: 1) support-in-kind from private sector sources, and/or 2) a company's self-investment are considered appropriate other indicators by BMDO in assessing the private sector commercial potential of Phase II proposals.

BMDO does not specifically require co-investment in Phase II, and expects to make some Phase II awards in which the co-investment is not a factor in the selection decision each year. However, co-investment is strongly encouraged, and historically, the best companies with the best proposals demonstrate the commercialization potential of their technology by exhibiting private sector co-investment support, at some level, **and/or** the commitment of a government program willing, as part of the Phase II, to co-invest and leverage the SBIR/STTR investment at the time of Phase II selection. This co-investment standard is now set by the proposing companies, your competition, by attracting an average of a dollar-for-dollar match (1:1) of private sector co-investment support to the SBIR/STTR funding requested. Those companies, that do not demonstrate the commercial potential of their Phase II technology through a co-investment arrangement and/or other means, do not compete well at BMDO.

Phase II proposals may be submitted anytime, for any amount, in any format after the Effective Date of the Phase I effort. Unique efforts showing time sensitivity or submitted for *FasTrack* will be given due consideration for Phase II start-up funding and Phase I proposals may include a post-Phase I optional tasking that will permit rapid start-up if the Phase II or *FasTrack* application is approved. The latest information on how BMDO implements its *FasTrack* Program may be found at the website address under the *FasTrack* or Frequently Asked Questions (FAQs) sections. Additionally, the preferred contract type for BMDO Phase II awards is Firm-Fixed Price, Level of Effort. All Phase II proposals for BMDO SBIR consideration should be submitted on a Firm-Fixed Price, Level of Effort basis. Although proposed contract type will not affect selection for negotiation, Phase II contracting may be delayed if another contracting type is proposed. Also, any Phase II proposal shall contain the most recent and updated Company Commercialization Report.

BMDO implements a Phase II Enhancement policy across all SBIR selections by providing some initial funding and then matching private sector co-investments at some ratio and up to some ceiling. BMDO reserves the right to provide less funding than the company initially proposes. To encourage the transition of SBIR technology into DoD acquisition programs, additional government, non-SBIR, funding may be applied to any existing BMDO SBIR Phase II contract with no ceiling, under BMDO's Phase II Enhancement policy. These arrangements, however, must be coordinated through the managing agency implementing the contract. Also, a company that exhibits a unique and compelling rationale may receive additional Phase II SBIR funding to attract a significant level of private-sector funding, **in cash**, as co-investment. These Phase II extensions or "add-ons" shall only occur to existing BMDO SBIR Phase II efforts and are treated on a case-by-case basis. BMDO, on the average, approves only one Phase II extension per year.

A Principal Investigator, at the small business, who is tenured faculty is **NOT** considered primarily employed by a small firm if they receive any compensation from the university while performing the SBIR or STTR contract; any waiver must be requested explicitly with a justification showing a compelling rational and national need; BMDO expects to grant no such waivers.

BMDO intends for a Phase I to be only an examination of the merit of the concept or technology, that still involves technical risk, with a cost under $65,000. Although proposed cost will not affect selection for negotiation, contracting may be delayed if BMDO reduces the proposed cost. **DO NOT** submit the same proposal, or variations thereof, to more than one BMDO topic area; each idea will be judged once in an open competition among all proposals. Furthermore, BMDO performs numerous cross-reference checks within each solicitation and with other DoD components. It is strongly suggested that you **do not** use the title of the BMDO SBIR Topic as the title of your Phase I or Phase II proposal. Demonstrate more originality than that.

Because BMDO seeks the best nation-wide experts in innovative technology, proposers may suggest technical government reviewers by enclosing a cover letter with the name, organization, address, phone number, and rationale for each suggestion. BMDO promises only to consider the suggestion and reserves the right to solicit other evaluations as needs dictate.

Implementation of DoD's Fast Track Policy at BMDO
Rationale for BMDO's Implementation Plan

The Defense Department's SBIR program has implemented a Fast Track policy for companies which, during their Phase I efforts, attract outside investors (government or private sector) that will match Phase II SBIR funding, in cash, at the matching rates described in the solicitation. Companies that obtain such outside cash investments and qualify for the SBIR Fast Track receive:

* a significantly higher chance of Phase II award, and
* interim funding between Phase I and Phase II, as well as expedited processing, to ensure no significant funding delays between Phases I and II.

The following summarizes how the DoD Fast Track policy is implemented at BMDO. This Implementation Plan is specifically required since the BMDO SBIR Program has evolved to the level that most companies competing for a Phase II award from BMDO obtain private-sector co-investment support – not just companies participating in the Fast Track. In fact, the BMDO SBIR Program, in its decision process for Phase II award selections, uses as a primary selection criterion (but not the only criterion) a company's ability to demonstrate commercial potential by attracting private-sector co-investment support during the performance of the Phase II. The value that BMDO places on this support depends on a number of factors, including the type of co-investment support (e.g. cash, support-in-kind, or self-investment), amount of the matching support, and timing of the matching support.

Thus, implementation of the DoD Fast Track policy at BMDO needs to occur in such a way that Phase II proposals with the greatest commercial potential, as measured by the amount of private-sector co-investment support, receive the highest priority for Phase II award.

BMDO's Fast Track Implementation Plan – "*FasTrack*" – has been in effect since the FY96.1 DoD SBIR solicitation and is approved for implementation by the Under Secretary of Defense for Acquisition and Technology (USD(A&T)).
BMDO's *FasTrack*:

* is consistent with the general principles of the DoD Fast Track policy, described above; and
* has demonstrated a track record of success. Specifically, BMDO implemented its *FasTrack* policy during 1996-1997 using the procedures outlined below, with the approval of the USD (A&T). 31 Phase I projects qualified for BMDO *FasTrack* during this time period -- the highest amount per dollar of SBIR funds of any DoD SBIR component. 30 of these projects were selected for Phase II award and also received interim funding between Phase I and Phase II.

The BMDO *FasTrack* Implementation Plan

A. In General. BMDO implements a *FasTrack* SBIR process for companies which, during their Phase I projects, attract one or more private-sector, outside co-investors that will match Interim SBIR Funding (between Phase I and Phase II) and Phase II SBIR funding, in cash, and at the matching rates described in subsection (c) below. Such companies shall receive (subject to the qualifications described herein):

(1) Interim Funding of $30,000 to $40,000 between Phase I and Phase II;

(2) BMDO's highest priority for Phase II selection and award; and
(3) An expedited Phase II selection decision and an expedited Phase II award.

Questions about the BMDO *FasTrack*, including any of the provisions discussed below, should be directed to the BMDO SBIR/STTR Program Manager, Mr. Jeff Bond, at 703-604-3538 (FAX -3926). The BMDO SBIR Home Page contains a BMDO *FasTrack* Timeline showing the schedule of events for a company participating in BMDO's *FasTrack* program (see http://www.futron.com/bmdo/3FAST/fasttrk.gif).

B. How to Qualify for BMDO *FasTrack*. To qualify for BMDO *FasTrack*, a company that has received a BMDO-sponsored Phase I award must submit the following five items within four (4) months of the effective date of the Phase I award. (Note: The effective date is the date on which the Phase I contract actually takes effect and the company may begin to incur costs under the contract.):

(1) A completed DoD/BMDO *FasTrack* application form (which follows this Plan). A copy of the completed DoD/BMDO *FasTrack* application must also be sent to the DoD SBIR Program Manager at the address listed on the back of the form.

(2) A Commitment Letter from a private sector, outside co-investor(s) – such as another company, a venture capital firm, or an "angel" investor – stating that the investor(s) will match the Interim Funding and the Phase II funding, **in cash**, at the matching rates listed in subsection (c) below. The investment must qualify as a "Fast Track investment," and the co-investor as an "outside investor," as defined in Reference E of the SBIR solicitation (i.e. the investor cannot be an affiliate of the SBIR company). Additionally, under BMDO *FasTrack*, federal, state, and foreign governments do not qualify as valid co-investors.

The Commitment Letter should state that the co-investor's funds will pay for work that is connected to the specific SBIR project, and should also describe the general nature of that work. The work funded by the co-investor may be additional research and development on the project or, alternatively, it may be other activity related to the project (e.g., marketing) that is outside the scope of the SBIR contract. The co-investor may provide its matching funds to the company contingent on the company's being selected for Phase II (procedures for accomplishing this must be discussed with the BMDO SBIR Program Manager, Mr. Jeff Bond, at 703/604-3538).

(3) A concise Statement of Work and Cost Proposal for the Interim Funding effort (typically less than 4 pages in length).

(4) An Executive Summary of the current status of the Phase I effort (typically less than 4 pages in length).

(5) A copy of the first page of the Phase I contract (i.e. the signature page).

Additionally:

(1) The company must submit its Phase II proposal within five (5) months of the effective date of the Phase I award;

(2) The company must submit a Private Sector Investment Certification (PSIC) within seven (7) months of the effective date of the Phase I award, indicating that the co-investor's matching funds have been transferred to the SBIR company. The PSIC consists of: (a) a letter, signed by the co-investor and the company, that states the amount of cash that has been transferred; and (b) documentation to substantiate that the transfer of funds has occurred (e.g. a bank statement, wire transfer, or copies of canceled checks).

If not all the co-investor's funds are transferred to the company by the end of the seventh month, the company will still qualify for the *FasTrack*. However, it will receive a lower preference for Phase II selection than other *FasTrack* participants, as described in subsection (e) below. Additionally, BMDO will match co-investor funds transferred to the company after the seventh month at only a $1 to $1 matching rate, rather than at the more favorable matching rates listed in subsection (c) below. Also, BMDO will only provide installments of Phase II funds to the company after corresponding installments of matching funds have been transferred from the co-investor to the company. (e.g. The company and investor must certify that $60,000 in matching funds has been transferred to the company before BMDO will release a corresponding $60,000 installment of Phase II SBIR funds.)

A company, which fails to meet these conditions in their entirety within the time frames indicated, will generally be disqualified from BMDO *FasTrack* consideration. If disqualified, the company shall still be eligible to compete for a “standard” Phase II award through the regular BMDO Phase II procedures with no penalty.

C. Matching Rates. BMDO *FasTrack* matching rates differ slightly from the matching rates under the DoD Fast Track policy. The BMDO rates are as follows:

(1) For SBIR companies that have 10 or fewer employees **and** have never received a Phase II SBIR or STTR award from any federal agency, the co-investor’s Commitment Letter must state that the co-investor shall provide at least $1 to match every $4 of Interim SBIR Funding and Phase II funding. (e.g. If the company proposes Interim SBIR Funding of $40,000 and Phase II SBIR funding of $600,000, the co-investor must provide a commitment of matching funds of $10,000 and $150,000 respectively for the two efforts.)

(2) For SBIR companies that have received fewer than five (5) Phase II SBIR/STTR awards from the federal government, and do not fall into category (1) above, the co-investor’s Commitment Letter must state that the co-investor shall provide at least $1 to match every $2 of Interim SBIR Funding and Phase II funding. (e.g. If the company proposes Interim SBIR Funding of $40,000 and Phase II SBIR funding of $600,000, the investor must provide a commitment of matching funds of $20,000 and $300,000 respectively for the two efforts.)

(3) For SBIR companies that have received five (5) Phase II SBIR/STTR awards or more from the federal government, the co-investor’s Commitment Letter must state that the co-investor shall provide at least $1 to match every $1 of Interim SBIR Funding and Phase II funding. (e.g. If the company proposes Interim SBIR Funding of $40,000 and Phase II SBIR funding of $600,000, the investor must provide a commitment of matching funds of $40,000 and $600,000 respectively for the two efforts.)

D. Benefits of Qualifying for BMDO *FasTrack*. A company that qualifies for BMDO *FasTrack* will:

(1) Receive Interim Funding of $30,000 to $40,000 between Phase I and Phase II (However, the Interim Funding plus the Phase I award shall not exceed $100,000).

(2) Receive BMDO’s highest priority for selection for Phase II award. Specifically, BMDO shall select the company for Phase II award assuming its project meets or exceeds a “technically sufficient” level, as described in Section 4.3 of the current solicitation. As discussed in subsection (e) below, among *FasTrack* companies, those that receive all of their co-investor matching funds within seven months after the effective start date of Phase I receive higher preference for selection than *FasTrack* companies that receive some or all matching funds after the seventh month.

(3) Receive notification of whether it has been selected for Phase II award within 60 days after the completion of its Phase I project.

(4) If selected, receive its Phase II award within an average of five months after the completion of its Phase I project, to ensure no significant funding delay between Phase I and Phase II. (Note: Although BMDO makes all of its Phase II selection decisions, the Phase II contracts are processed by other DoD organizations, and BMDO therefore does not directly control the timing of the contract awards. However, most BMDO *FasTrack* awards have been made within five months after the completion of the Phase I effort.)

E. BMDO *FasTrack* Preference Levels. As discussed above, companies that qualify for the BMDO *FasTrack* receive BMDO’s highest priority for Phase II selection and award. Among *FasTrack* companies, those that receive all of their co-investor matching funds within seven months after the effective start date of Phase I receive higher preference for selection than *FasTrack* companies that receive some or all matching funds after the seventh month, as follows:

Preference Level 1 applies to *FasTrack* companies that receive **all** of the matching funds for the Interim effort and the Phase II effort within seven months after the effective start date of the Phase I award.

Preference Level 2 applies to *FasTrack* companies that receive all of the matching funds for the Interim effort but only some of the matching funds for the Phase II effort within seven months after the effective start date of the Phase I award.

Preference Level 3 applies to *FasTrack* companies that receive all the matching funds for the Interim effort but none of the matching funds for the Phase II effort within seven months after the effective start date of the Phase I award.

Ballistic Missile Defense Organization Topics

BMDO/01-001 - Directed Energy Concepts and Components

BMDO/01-002 - Kinetic Energy Kill Vehicles and Components

BMDO/01-003 - Sensors

BMDO/01-004 - Manufacturing Sciences and Technology/Unit Cost Reduction

BMDO/01-005 - Non-Nuclear Power Sources and Power Conditioning

BMDO/01-006 - Propulsion and Logistics Systems

BMDO/01-007 - Thermal Management

BMDO/01-008 - Survivability Technology

BMDO/01-009 - Lethality and Vulnerability

BMDO/01-010 - Computer Architecture, Algorithms, and Models/Simulations

BMDO/01-011 - Optical Computing and Optical Signal Processing

BMDO/01-012 - Structural Concepts and Components

BMDO/01-013 - Structural Materials and Composites

BMDO/01-014 - Electronic Materials

BMDO/01-015 - Superconductivity Concepts and Materials

BMDO/01-016 - Surprises and Opportunities

BMDO FY01 SBIR TOPIC DESCRIPTIONS

BMDO 01-001 DIRECTED ENERGY CONCEPTS AND COMPONENTS

DOD KEY TECHNOLOGY AREA: Air Platforms, Materials/Processes, Sensors, Electronics, Battlespace Environments, Space Platforms, Weapons, Nuclear Technology

INTRODUCTION: As part of BMDO's charter to provide for defense against future missile threats, various programs are created to further validate potential technologies to design, develop, and deploy systems in support of various efforts. These new programs provide future decision-makers an option to greatly enhance the capabilities of future TMD and NMD systems. BMDO investigates numerous directed energy technologies for both TMD and NMD applications. As such, a significant investment is made each year in the continued development of increasingly sophisticated systems, which may eventually find their utilization in a ballistic missile technology program or major defense acquisition program. All areas of the electromagnetic spectrum provide potential avenues toward finding and disabling a ballistic missile in flight. Furthermore, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Current examples under consideration include the Space Based Laser, Airborne Laser, the ground based radar systems associated with THAAD and Patriot, and any other comparable sub-system, component, or subcomponent that can potentially support next generation developments. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: BMDO seeks new, innovative and applied research toward advanced technology developments in the generation, propagation, and detection of directed energy in all forms. Dual-use systems under consideration include, but are not limited to, solid-state lasers (i.e. diode lasers), chemical lasers, excimer lasers, IR/Vis/UV lasers, x-ray lasers, gamma-ray lasers, free electron lasers, quantum lasers, particle beams, radio-frequency (RF) and millimeter wave (MMW), and other unique hybrid approaches including explosively or electrically driven devices. Included herein are such topics as beam control, target acquisition, tracking and pointing, mirrors, beam propagation and steering, optics, antennas, conversion methods, countermeasures, coatings, and micro-optical-mechanical devices incorporating these aspects. Furthermore, any component or subcomponent that is utilized by any of these systems is of interest. Examples of such component specific technology include traveling wave tube amplifiers, timing circuits, pulse forming networks, stimulators, laser/radar arrays, transmit/receive modules, and amplifiers. Components, sub-components, or piece part specifics may be ground, air, or space based in their final application.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company A, whose advanced x-ray source is being utilized for waste sterilization, was sponsored from this topic. Company B utilized their tunable filters with the citrus industry and for military hyperspectral image applications.

BMDO 01-002 KINETIC ENERGY KILL VEHICLES AND COMPONENTS

DOD KEY TECHNOLOGY AREA: Air Platforms, Material/Processes, Space Platforms, Weapons

INTRODUCTION: Potential adversaries are expected to improve their ballistic missile systems and develop countermeasures to U.S. ballistic missile defense programs. The future designs of potential threat improvements that BMDO must address cannot be determined explicitly. Broad-based kinetic energy interceptor technologies will potentially contribute to more than one program and possibly to more than one defense area. These kinetic energy weapons benefit from innovations offered in 1) discrimination, 2) agility, 3) accuracy, and 4) affordability. BMDO is constantly investigating potential technologies for both TMD and NMD applications. Additionally, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from the commercial industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: Kinetic energy (KE) weapons candidates presently include a variety of ground and space based interceptor concepts including their propulsion sub-system components. System elements include ground-based launchers, axial and divert motors/nozzles, smart projectile components, and endo/exoatmospheric guidance and control mechanisms. Technology challenges for KE systems include: finding the booster hardbody within the plume, differentiating the missile warhead from the various other incoming objects within a threat complex, high performance axial and divert propulsion sub-systems (especially very low mass divert systems), miniature inertial navigation units, array image processing, C.G. Control algorithms, fast frame multicolor and ultra-violet seekers, missile autopilots, acquisition and track; target discrimination, seeker operational environments, lethality/miss distance; aero-optical effects, guidance and fuzing accuracy, shroud separation, window thermal-structural integrity, non-nuclear kill warhead performance, target acquisition in a hostile environment, performance and survivability of electronics in a hostile environment; firing rate, projectile guidance and control and projectile launch survivability; and, common among all systems reliability, producibility, safety (non-hazardous operation), maintainability, and low cost/low mass; aeroshell ablation control; electromagnetic launches.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company C advanced the metal armature developments for military railgun efforts. Company D began with a bone implantation technology and international investments that resulted from divert motor rocket nozzles. Company E, with a market cap of $157M+, expanded with technology genesis from this topic to a dynamic frame seeker and chip-stacking developments. Company F supported ballistic missile defense efforts with their enhanced lethality kinetic energy projectile and has subsequently graduated out of the small business status, but continues to support the DoD in R&D efforts and was purchased by a Fortune 500 company Nov 1999.

BMDO 01-003 SENSORS & SURVEILLANCE

DOD KEY TECHNOLOGY AREA: Air Platforms, Sensors, Electronics, Battlespace Environments, Space Platforms, Human Systems, Weapons

INTRODUCTION: BMDO investigates various sensor technologies for both TMD and NMD applications. As such, a significant investment is made each year in the continued development of increasingly robust and sophisticated sensor systems, which may eventually find their utilization in a ballistic missile technology program or major defense acquisition program. All areas of the electromagnetic spectrum provide potential avenues toward finding and disabling a ballistic missile in flight. Furthermore, sensor systems, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: Sensors and their associated systems/sub-systems will function as the "eyes and ears" for ballistic missile defense applications, providing early warning of attack, target detection/classification/identification, target tracking, and kill determination. New and innovative approaches to these requirements using unconventional and innovative techniques are encouraged across a broad band of the electromagnetic spectrum, from radar to gamma rays. Passive, active, and interactive techniques for discriminating targets from backgrounds, debris, decoys, chaff, electronic countermeasures, and other penetration aids are specifically sought. Sensor-related device technology is also needed. Examples of some of the technology specific areas are: cryogenic coolers (open and closed systems), cryogenic heat transfer, superconducting focal plane detector arrays (for both the IR and sub-mm spectral regions), next generation InSb focal plane arrays, signal and data processing algorithms (for both conventional focal planes and interferometric imaging systems), low-power optical and sub-mm wave beam steering, range-doppler lidar and radar, passive focal plane imaging (long-wavelength infrared to ultra-violet; novel information processing to maximize resolution while minimizing detector element densities), large format focal plane arrays (cooled and un-cooled), interferometry (both passive and with active illumination), QWIPs, integrated UV/VIS/MIR/IR focal plane arrays, gamma-ray detection, neutron detection, intermediate power frequency agile lasers for diffractive beam steering and remote laser induced emission spectroscopy, lightweight compact efficient fixed frequency radiation sources for space-based ballistic missile defense applications (uv-sub-mm wave), new optics and optical materials. Entirely new and high-risk approaches are also sought. Please indicate the particular identifying letter your specific proposal/technology addresses:

BMDO/00-003**A** - Acoustic and Seismic
BMDO/00-003**B** - Radar and MMW
BMDO/00-003**C** - UV (<0.3 microns)

BMDO/00-003**D** - Visible (0.3 - 0.9 microns)
BMDO/00-003**E** - IR (>0.9 microns)
BMDO/00-003**F** - Gamma/X-Ray
BMDO/00-003**G** - Other

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company G, with annual commercial sales of $15M+, is noted for its laser diode pumped q-switched solid state laser products developed under this topic. Company H, with a market cap of $275M+, transferred its microwave based infrared detector and superconducting millimeter wave mixer technologies funded under this topic for a variety of cryogenic systems and products. Company OO's high power laser array transmitters are utilized on the next generation of military and commercial satellites for communications. Company QQ, with a market cap of $17,931M+, received funding from this topic for their target surveillance, pointing, acquisition, and tracking sensors used by both military and civilian customers.

BMDO 01-004 <u>MANUFACTURING SCIENCES AND TECHNOLOGY/UNIT COST REDUCTION</u>

DOD KEY TECHNOLOGY AREA: Air Platforms, Materials/Processes, Space Platforms, Weapons

INTRODUCTION: BMDO continually investigates various diverse technologies for both TMD and NMD applications. As such, advanced technology demonstrations for affordability and advanced industrial practices to demonstrate the combination of both improved manufacturing process technologies and improved business methods are of interest. BMDO makes significant investments each year in the continued development of increasingly survivable, robust and sophisticated technology based systems. All areas of research, engineering, and manufacturing process technologies provide potential avenues toward finding and disabling a ballistic missile in flight. Furthermore, entire sensor systems, components, sub-components, or piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Proposed efforts funded under this topic may encompass any specific manufacturing process technology at any level resulting in a unit cost reduction. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: BMDO seeks drastically lower unit cost of components through manufacturing revolutions that will lead to high volume production from commercial sales. This will result in an improvement in the affordability of new ballistic missile defense systems and the development of cost effective methods to sustain existing developments while impacting the next generation of acquisition systems. Affordability has become a significant factor in all aspects of the total life-cycle consideration of any military program. Therefore, BMDO will consider proposals that offer such a high unit cost reduction that a heretofore purely anti-missile military technology would become a high volume commercial item. Innovative approaches that will allow BMDO to economically acquire new technologies for the next generation of ballistic missile defense systems and maintain these systems while providing for their upgrades will make total life-cycle costs more affordable. Whereas all other BMDO SBIR topics seek first and foremost a revolution in the military capability of the technology, this topic seeks only a revolution in the reduction of unit cost specifics. BMDO seeks herein only projects that are too risky for ordinary capital investment by the private sector. The proposals must include and will be judged, in part, on an economic analysis of the expected market impact and the viability of the product proposed. Incremental advancements will receive very little consideration. Innovative manufacturing technologies which reduce the cost per unit, repair, or remanufacturing/reengineering of entire sensor systems, components, sub-components, or piece part specifics are under consideration.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company J, with a market cap of $19M+, founded its technology developments under this topic with low-cost radioisotope-powered voltaic cells for military applications and a wide variety of other commercially viable electronic material based applications to include quantum-wire lasers.

BMDO 01-005 NON-NUCLEAR POWER SOURCES AND POWER CONDITIONING

DOD KEY TECHNOLOGY AREA: Air Platforms, Ground and Sea Vehicles, Space Platforms, Weapons

INTRODUCTION: New and unique non-nuclear power sources and new materials and electronics that provide for the efficient use of power are under consideration by BMDO for both TMD and NMD applications. New technology could conceivably provide support to future systems, which may eventually find their utilization in a ballistic missile technology program or major defense acquisition program. All areas of power technology, except nuclear power, provide potential avenues toward finding and disabling a ballistic missile in flight. BMDO SBIR shall not consider any nuclear power source proposal. Furthermore, entire power source systems, components, sub-components, and piece part specifics are constantly under evaluation by the various component TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: New technologies for providing power which provide substantial improvements in lower recurring cost, lower mass, and/or smaller size are sought for all ballistic missile defense applications. New concepts for compact power sources and power conditioning devices for transportable or mobile systems at 200 kW to 1 MW also need to have high efficiency, low signatures, and high reliability. Power generation, power storage, and power conditioning devices that operate at cryogenic temperatures for use in a new concept for all cryogenic systems are sought. Power conditioning devices of interest include, but are not limited to, capacitors, inductors, switches, and transformerless approaches. Space assets' power sources in the 0.5 to 5 kW power range, including solar arrays and their photovoltaic cells, need to tolerate high natural radiation levels. Satellite energy storage systems or novel battery technologies must provide cycle lifetimes of up to 40,000 cycles and may be utilized in low earth orbit sensor satellites, airborne platforms, or ground based assets. Onboard power sources for interceptor missiles need to be periodically testable and have a quick start-up capability. Power conditioning systems and components for space assets should provide very high efficiency.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.
PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company K, with a market cap of $7M+, has provided for commercializing its self-restoring fault current limiter after it was incorporated into military efforts. Company MM, with a market cap of $240M+, has developed new solar cells with increased efficiencies that are utilized by both military and civilian interest.

BMDO 01-006 PROPULSION AND LOGISTICS SYSTEMS

DOD KEY TECHNOLOGY AREA: Air Platforms, Space Platforms, Weapons

INTRODUCTION: BMDO is constantly investigating various propulsion technologies for both TMD and NMD applications. Significant investments are made each year in the continued development of increasingly robust and responsive systems, which may eventually find their utilization in a ballistic missile technology program or major defense acquisition programs. All areas of propulsion technology provide potential avenues toward finding and disabling a ballistic missile in flight. Furthermore, entire propulsion systems, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: In general, missile defense places unprecedented demands on all types of propulsion systems; interceptors, launch to low earth orbit, orbit transfer, orbit maneuvering, and station keeping. Specifically, advancements are needed to achieve major reductions in the costs of placing and maintaining payloads in desired locations. Approaches leading to techniques, methods, processes, and products in support of these propulsion and logistics objectives are sought. Propulsion approaches include liquid, solid, and electric. Advancements are needed in propulsion-related areas, e.g. extending storage time of cryogenic fluids (e.g. H_2 and Xe), reduction of contamination from effluents, and sensors and controls for autonomous operation. Areas of interest include the entire spectrum of space transportation and support: efficient launch systems for small technological payloads as well as full system payloads, assembly, and control systems; expendable and recoverable components; improved structures and materials; and increased propulsion efficiency. In anticipation of solar power demonstration missions incorporating electric thrusters, BMDO seeks high power electric thruster modules (e.g., electrodes, insulators, ignition systems, propellant controls, command and control systems, thermal management systems, and power conditioning units). With the advent of small surveillance satellites, low power (0.5 to 2 kW) electric propulsion is under consideration for station keeping and orbit transfer; for such systems emphasis is being placed on achieving higher power densities for components of the integrated system (thruster, power conditioning unit, fuel control, gimbals, and fuel storage). Low mass or miniature interceptors require advances in divert (small thrusters) propulsion systems (either solid or liquid). High acceleration divert and attitude control systems greater than 10Gs are under consideration.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company L developed a laser radar tracking technology that finds commercial use in laser eye-surgery applications, but was also investigated for tracking ballistic missiles in flight.

BMDO 01-007 THERMAL MANAGEMENT

DOD KEY TECHNOLOGY AREA: Air Platforms, Ground and Sea Vehicles, Space Platforms, Weapons

INTRODUCTION: BMDO constantly investigates various thermal management and cooling technologies for both TMD and NMD applications. Therefore, a significant investment is made each year in the continued development of increasingly robust and sophisticated heating/cooling system technologies, which may eventually find their utilization in a ballistic missile technology program or major defense acquisition program. Furthermore, thermal management (heating and cooling) systems, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: Higher power levels of various ballistic missile defense assets must dissipate heat at state-of-the-art capabilities for waste thermal energy acquisition, transport, and dissipation to space. Technology advancements are required in thermal management for power generation systems, space platform payloads, heat pump radiators, laser diodes, diode fibers, slab lasers and all associated electronics. Some space platforms will require years of storage of large amounts of cryogen with minimum cryogenic loss and high cryogen delivery rates under condition of zero-g. Concepts, devices, and advanced technologies for all types of space-based power cycles are sought, which can satisfy these projected ground/air/space platform requirements.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Currently addressing electric vehicle technology applications for military and commercial interest, Company M got its initial start, and now with a market cap of $310M+, with active magnetic vibration isolation controls funded under this topic. Company SS developed a radiation hardened accelerometer that is used in the Safe-and-Arm device of the PAC-3 missile and by half of the automotive airbags in the U.S.

BMDO 01-008 SURVIVABILITY TECHNOLOGY

DOD KEY TECHNOLOGY AREA: Air Platforms, Materials/Processes, Space Platforms, Weapons, Nuclear Technology

INTRODUCTION: Missile defense elements must operate and survive against determined attacks. Threat actions can generate a reasonable set of hostile man-made environments before and during operations. Collateral environments and natural space environments (atomic oxygen, space radiation and micrometeorites/debris) provide additional technical challenges, which also affect civilian assets. Survivability engineering technology and survivability enhancement options are required to achieve a cost-effective, yet integrated solution to a dynamic and diverse set of hostile environments with a focus toward improving aspects of threat sensing, hardening, passive defense, and camouflage, concealment and deception (CCD). Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: Sensor technologies enable the defense elements to detect nuclear events, laser and radio frequency weapon attacks, and to respond appropriately. Sensor technologies that can characterize the threat according to direction of attack, and spectral characteristics are currently under consideration. Technologies to enhance passive defense missile systems, ground/air/space assets, and support equipment are needed to operate against the threat support sensors, including radar, passive visible/IR sensors and seekers, and laser radar.

Passive hardening against the nuclear, laser, RF, ballistic and debris environments is specifically needed, in addition to novel radiation hardening technologies and approaches against the natural space environments. Sensor technologies and their associated systems, communications antennas (RF and laser), attitude sensors, solar power, propulsion, structure and thermal control are all directly exposed to nuclear, laser, RF and debris in addition to the natural space environments. Materials and component designs, which are intrinsically hard to these environments, and/or protective devices are needed, specifically with dual-use commercialization applications. A key ballistic missile defense area of consideration is seeker/sensor subsystems, the components of which (baffle materials, mirrors, optics, structures, focal plane arrays, read out electronics, and processing) must survive the laser, nuclear, IR, and natural environments. Nuclear and laser hard concepts, materials, and devices for protection against unknown or agile lasers and rejection of RF energy. Structures and coatings providing appropriate thermal characteristics, stability under mechanical impulses and hardness to laser and RF radiation are needed. Processors, high-power ICs, and other electronic devices capable of operating in unique hostile environments presented by the strategic applications while retaining full functionality are desired. Long-term space (commercial and government) applications are direct beneficiaries of these advanced technology developments. Countermeasures and integration of CCD technologies are particular useful to the operational forces and, in general, attempt to incorporate the latest military and commercial technologies to ensure an effective response to any advanced threat. A new class of weapons technologies are evolving incorporating non-lethal methods. These have a broad range of applications as a survivability countermeasure or must themselves be countered to assure full operability. Non-lethal technology efforts in this area have dual-use applications.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company N, with a market cap of $5,300M+, got started with its hardened electronics for military environments and civilian applications. Company O markets holographic products to the commercial market that started with rugate filters for sensor protection of military optics.

BMDO 01-009 <u>LETHALITY AND VULNERABILITY</u>

DOD KEY TECHNOLOGY AREA: Air Platforms, Materials/Processes, Space Platforms, Weapons

INTRODUCTION: In implementing its TMD and NMD program activities, BMDO is continuing its developments of such efforts as the PATRIOT Advanced Capability-3 (PAC-3) missile system which has four major systems components: radar, engagement control station, launching station, and interceptors. The Navy Area Wide system will develop a sea-based capability that builds upon the existing AEGIS/Standard Missile air defense system. This system is based on the AEGIS-class cruisers and destroyers, which provide all elements of missile defense and are particularly suited to protecting forces moving inland from the sea. The Theater High-Altitude Area Defense System (THAAD) system will form the largest umbrella of missile protection in a specific theater, arching over all other missile defense systems. THAAD consists of four major systems components: truck-mounted launchers; interceptors; radar system; and battle management, command, control, communications, and intelligence (BMC3I). These increasingly sophisticated systems will provide the opportunity to destroy short and medium range ballistic missiles and other threats in the atmosphere far enough away that falling debris will not endanger friendly forces. The various BMDO technology and acquisition programs, in support of the TMD and NMD missions, are continually evaluating the latest advanced technology developments from industry as potential replacements for the current state-of-the-art sensor systems, components, sub-components, or piece part specifics. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: A major factor in determining the effectiveness of a ballistic missile defense is the lethality of the directed energy and/or kinetic energy devices used against responsively hardened targets, bulk powder, and submunition targets. Battlefield by-products of post-intercept events are currently under consideration. New concepts and technologies that produce a much higher probability of hit-to-kill intercepts are required to support applications. Ground and Point-of-Intercept technologies, instrumentation, concepts, and innovative methodologies are under consideration for cost effective incorporation into BMDO lethality efforts. Additionally, novel concepts and techniques that reduce the vulnerability of ballistic missile defense systems will increase the operational confidence level of dedicated assets. Commercial applications may benefit from the incorporation of the techniques utilized in cost-reduction, measurement and diagnostics, and meteorology instrumentation packages.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company P was started after receiving initial funding under this topic for its solid-state optical devices, which are now commercially available products.

BMDO 01-010 COMPUTER ARCHITECTURE, ALOGRITHIM, AND MODEL/ SIMULATIONS

DOD KEY TECHNOLOGY AREA: Air Platforms, Information Systems Technology, Space Platforms, Human Systems, Weapons

INTRODUCTION: BMDO investigates various computer technologies in support of both TMD and NMD applications. As such, a significant investment is made each year in the continued development of increasingly robust and sophisticated battle management, command, control, and communications (BMC3I) systems which may eventually find their utilization in, and support of a ballistic missile technology program or major defense acquisition program. All areas of computer software development provide potential avenues toward supporting the ability of future BMDO systems to find and disabling a ballistic missile in flight. Furthermore, complete computer systems, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: Missile defense systems for battle management demand order-of-magnitude advances. A system must acquire and track thousands of objects with hundreds of networked sensors and data processors, direct weaponry to intercept targets, and determine the degree of kill. Areas of specific interest include:
* New computer architectures, which are robust, compact, and fault-tolerant, but allow for the extremely rapid processing of data. Architectures may be implemented by new designs or innovative applications of existing technologies, such as optical signal processing, systolic arrays, neural networks, etc.
* Very high-level language (VHLL) design for both the development and testing of extremely large software systems.
* Novel numerical algorithms for enhancing the speed of data processing for sensing, discrimination, and systems control. These may be specifically tailored to a particular task (for instance, the execution of a phase retrieval algorithm for interferometric imaging) and may include neural networks.
* Language design to develop code optimized for highly parallel processed architectures.
* Software engineering processes, methods, and environments for next generation revolutionary paradigms. Areas of interest include: decision architectures; COTS-based development; risk management; sizing and costing estimation; measurement; supportability; quality; development and acquisition processes; and "Best Practices" for design, development, integration, testing, and support of real-time distributed large-scale software systems.
* Software product line technologies, including domain analysis and engineering, software product line acquisition planning, component evaluation and cataloguing, organizational reuse assessments, and software product line risk management.
* Testing techniques that will provide a high level of confidence in the successful operation of concurrent, real-time, distributed large-scale software systems. Examples include sensitivity analysis, data flow testing, mutation testing, static concurrency analysis, and dependency analysis.

* Computer network and communications security. Areas of interest include: intrusion monitoring, detection, and defense; rapid recovery methodologies; "self-healing" systems capable of isolating corrupted nodes, reallocating resources, and reconstituting lost information; R&D for trusted computer systems in accordance with DoD 5200.28.STD, and integration of COMPUSEC with COMSEC (DoD 5200.5).
* Self-adaptive processing, simulations, and unconventional computing approach. Algorithms and architectures for advanced decision-making. Data compression and adaptive bandwidth management techniques.
* Neurocomputing and Man-Machine Interface - rule-based artificial intelligence and neural networks combined for decision making flexibility and system robustness; development of decision trees and information display for highly, automated, short response time, training adaptive high volume scenarios development of autonomous intelligent agents and self-learning decision aids which operate in distributed heterogeneous environments.
* Software architectures for embedded computer networks that especially facilitate incremental system and software integration, hardware and software maintenance, and system evolution, without significant performance degradation.
* Hardware and software self-diagnostic capabilities for monitoring the operational readiness and performance of space, air, and ground systems incorporating embedded computer networks. Novel testing tools and evaluation methods supporting T&E capabilities.
* Virtual environments to allow diverse groups to interact in real time and in increasingly realistic ways over large distances which may include hostile environments definition and ground effects modeling and simulation efforts.
* Advanced interface effectors, including visualization, multi-sensory, and virtual reality technologies, for total information presentation and improved situational awareness in missile defense application areas.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company Q, with commercial and military sales of its automatic parallelization tool for sequential programs, marketed as *INSURE++* and *CodeWizard for Java*, is in excess of $10M/year.

BMDO 01-011 OPTICAL COMPUTING AND OPTICAL SIGNAL PROCESSING

DOD KEY TECHNOLOGY AREA: Air Platforms, Information Systems Technology, Materials/Processes, Space Platforms, Weapons

INTRODUCTION: In implementing its TMD and NMD program activities, BMDO is continuing its developments of such efforts as the PATRIOT Advanced Capability-3 (PAC-3) missile system which has four major systems components: radar, engagement control station, launching station, and interceptors. The Navy Area Wide system will develop a sea-based capability that builds upon the existing AEGIS/Standard Missile air defense system. This system is based on the AEGIS-class cruisers and destroyers, which provide all elements of missile defense and are particularly suited to protecting forces moving inland from the sea. The Theater High-Altitude Area Defense System (THAAD) system will form the largest umbrella of missile protection in a specific theater, arching over all other missile defense systems. THAAD consists of four major systems components: truck-mounted launchers; interceptors; radar system; and battle management, command, control, communications, and intelligence (BMC3I). These increasingly sophisticated systems will provide the opportunity to destroy short and medium range ballistic missiles and other threats in the atmosphere far enough away that falling debris will not endanger friendly forces. The various BMDO technology and acquisition programs, in support of the TMD and NMD missions, are continually evaluating the latest advanced technology developments from industry as potential replacements for the current state-of-the-art sensor systems, components, sub-components, or piece part specifics. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: Dense computing capability is sought in all architectural variations, from all-optic to hybrid computers. Specific examples of areas to be addressed include, but are not limited to, high speed multiplexing, monolithic optoelectronic transmitters, holographic methods, reconfigurable interconnects, optoelectronic circuits, and any other technology contributing to advances in intra-computer communications, optical logic gates, bistable memories, optical transistors, and power limiters. Non-linear optical materials advancements and new bistable optical device configurations.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company R took a unique technology approach in addressing fiber-optic and other optical communications applications to both the military and commercial industry. Company S is providing a low-loss electro-optical switching array, Company T is providing optical bus extenders and fiber-optic modulators, Company U has funded technology which utilized wavelength division multiplexing techniques; all three support the ever growing optical communication industry.

BMDO 01-012 STRUCTURAL CONCEPTS AND COMPONENTS

DOD KEY TECHNOLOGY AREA: Air Platforms, Materials/Processes, Space Platforms, Weapons

INTRODUCTION: The tremendous explosion in the commercial industry to develop innovative structural components has sustained BMDO investigations into various technologies in support of both TMD and NMD applications. As such, a significant investment is made each year in the continued development of increasingly robust and viable concepts which may produce technologies that eventually find their utilization in, and support of, a ballistic missile technology program or major defense acquisition program. All considered technologies provide potential avenues toward supporting the ability of future BMDO systems to address vibrations and structural integrity more efficiently than current methods will allow. Furthermore, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: Minimum weight structures are needed in ballistic missile defense applications to withstand high-g loading, acoustic and thermal environments of ground-based interceptors, and to provide solid bases for space systems pointing and tracking. Such structures will benefit from: (1) innovative vibration control techniques, (2) innovative fabrication approaches to cut structure cost, (3) innovative use of advanced materials and/or design approaches to minimize structure weight, and (4) innovative rapid prototyping techniques. For instance, techniques and experimental verification are needed for active and/or passive methods to measure and control vibrations caused by thermo-mechanical flutter, thruster firing, or structure borne noise caused by on-board mechanisms. "Active" structural elements containing materials and electronics to provide predictable mechanical displacement in response to applied electrical signals are of interest. Maximization of displacement, mechanical strength, and reliability; parameter stability over extended temperature ranges; and minimization of driving voltage, power, and weight of these elements are desired. Producibility improvements for curved actuator elements, flextensional, and other integrated motion amplifiers are of interest. Fabrication approaches that provide minimum weight with reduced assembly, inspection, and scrap rates for conventional, advanced composite, and "active" structures are needed to reduce costs. Of course, novel designs and material usage to reduce structure weight, while maintaining or increasing capability, are always desirable goals.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company V took its ultrasonic motor technology to the commercial industry and that motor can now be found in assorted novelty and gift items. Company W, with a very accurate and precise gimbal for military laser communications, also has sales to the commercial optical communications industry.

BMDO 01-013 STRUCTURAL MATERIALS AND COMPOSITES

DOD KEY TECHNOLOGY AREA: Air Platforms, Materials/Processes, Space Platforms, Weapons

INTRODUCTION: The commercial industry has made advances in the development of stronger, lighter, and cheaper materials for use in structural applications. BMDO investigates various composites technologies for both TMD and NMD missile applications. Furthermore, a significant investment is made each year in the continued development of increasingly viable technologies which may eventually find their utilization by a ballistic missile technology program or major defense acquisition program. All areas of composites development potentially support BMDO and its next generation of TMD and NMD systems. Furthermore, new structural materials and composites and the associated components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: Many of the anticipated structural advances sought will depend on major improvements in materials properties and cost effectiveness. Space structures supporting seekers and antenna must accommodate retargeting maneuvers without detrimental jitter from vibrations and thermo-mechanical flutter. Surface launched interceptors must withstand high-g loads, aerothermal heating, and structural vibration without compromising tracking accuracy. Lightweight materials are very beneficial for both ground and space based systems. Specific goals require advanced techniques and processes that include imparting oxidation resistance and damage tolerance to composites and creating high elastic modulus composites for use over a broad range of temperatures. The following are specifically sought: (1) innovative manufacturing methods for producing high modulus, fiber-reinforced glass, light metal (i.e. aluminum or magnesium), or resin matrix composites; (2) innovative procedures for the production of instrumentation, sensors, and software for on-line process monitoring and evaluation of high modulus, fiber-reinforced composites during fabrication; (3) novel approaches to tailor fiber/matrix interfaces to maximize capability in advanced composites; (4) novel methods to cut fabrication cost of metallic and/or composite spacecraft and interceptor structures; (5) innovative tooling techniques for near-net shape production of advanced composites; (6) novel low-to-no outgassing joining/bonding techniques for advanced composites; (7) innovative surface modifications to promote wear resistance; (8) new methods for integrating instrumentation (e.g., embedded sensors) into advanced composite materials and structures; and (9) novel instrumentation for determination and telemetry of material properties and data from space. Advances are also sought in materials for optical system components, mechanical moving assemblies, and protective coatings.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company X licensed the technology which produced commercial sales in excess of $100M for its solid lubricants for space structures for both military and civilian applications. Company PP performed so well with their technology that a Fortune 500 business completely bought it and the company now operates as an independent division based on its silicon carbide optical surfacing process sponsored under this topic. Company RR developed a product line of beryllium aluminum metal matrix composites that are utilized in the commercial sector and by the PAC-3 missile system.

BMDO 01-014 ELECTRONIC MATERIALS

DOD KEY TECHNOLOGY AREA: Air Platforms, Materials/Processes, Sensors, Electronics, Battlespace Environment, Space Platforms, Weapons, Nuclear Technology

INTRODUCTION: In implementing its TMD and NMD program activities, BMDO is continuing its developments of such efforts as the PATRIOT Advanced Capability-3 (PAC-3) missile system which has four major systems components: radar, engagement control station, launching station, and interceptors. The Navy Area Wide system will develop a sea-based capability that builds upon the existing AEGIS/Standard Missile air defense system. This system is based on the AEGIS-class cruisers and destroyers, which provide all elements of missile defense and are particularly suited to protecting forces moving inland from the sea. The Theater High-Altitude Area Defense System (THAAD) system will form the largest umbrella of missile protection in a specific theater, arching over all other missile defense systems. THAAD consists of four major systems components: truck-mounted launchers; interceptors; radar system; and battle management, command, control, communications, and intelligence (BMC3I). These increasingly sophisticated systems will provide the opportunity to destroy short and medium range ballistic missiles and other threats in the atmosphere far enough away that falling debris will not endanger friendly forces. The various BMDO technology and acquisition programs, in support of the TMD and NMD missions, are continually evaluating the latest advanced technology developments from industry as potential replacements for the current state-of-the-art sensor systems, components, sub-components, or piece part specifics. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: The necessary advances in electronics for the many ballistic missile defense applications will require advances in electronics materials. Primary emphasis lies in advancing the capability of integrated circuits, detectors, sensors, large-scale integration, radiation hardness, and all electronic components. Novel quantum-well/superlattice structures that allow the realization of unique elective properties through “band gap engineering” are sought, as are new organic and polymer materials with unique electronic characteristics. In addition, exploitation of the unusual electronic properties of gallium nitride is of considerable interest. Specifically, under high speed switching conditions at >10GHz and/or cryogenic temperatures. Among the many BMDO electronic needs and interest are advances in high frequency transistor structures, solid state lasers, optical detectors, low dielectric constant packaging materials, tailored thermal conductivity, microstructural waveguides, multilayer capacitors, single-electron transistors, metallization methods for repair of conducting paths in polyceramic systems, and sol-gel processing for packaging materials.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company Y, with a market cap of $1,038M+, commercialized technology that allowed for the delivery of ultra-pure materials to semiconductor thin film reactors and has graduated from small business status. Company Z, with a market cap of $36M+, manufactures radiation detection devices and was funded for avalanche photodiode arrays under this topic. Company AA, with a market cap of $829M+, has a substantial market share of the atomic layer epitaxy growth method of semiconductor compound materials based on their efforts developed under this topic. Company BB, with a market cap of $2,018M+, which manufactures flat panel display devices, received some initial funding for their silicon-on-insulator films and organometallic chemical vapor deposition technology developments. Company CC commercialized technology based on degradation resistant laser diodes and was bought by a Fortune 100 company in 2000. Company DD, with a market cap of $30M+, is commercializing technology based on its surge suppression devices and marketed as SurgX. Company EE, with a market cap of $18,761M+, had initial funding for its high bandgap compounds and laser diode products to develop a number of commercial and military products, and has graduated from small business status. Company KK established a multilayer coating technology that can be easily transported to any location for application. Company FF developed a magnetoresistive non-volatile random access memory chip, which is also radiation hardened, and is utilized in a number of space applications for the military and commercial sectors. Company LL, with a market cap of $96M+, was started with their first PHASE I from this topic and the products are used in electronics, structural ceramics, composites, cosmetics and skin care, and as industrial catalysts. Company NN, with a market cap of $676M+, is leveraging technology developed under this topic for the efficient production of semiconductors from waste recovery during the manufacturing process.

BMDO 01-015 SUPERCONDUCTIVITY CONCEPTS AND MATERIALS

DOD KEY TECHNOLOGY AREA: Air Platforms, Materials/Processes, Space Platforms, Weapons

INTRODUCTION: New developments in industry support the viability of using superconductivity in novel ways. BMDO investigates various superconducting technologies for both TMD and NMD applications. Furthermore, a significant investment is made each year in the continued development of efforts which may eventually find that their utilization of superconductive technologies support a ballistic missile technology program or major defense acquisition program. All areas of superconductivity research provide potential avenues toward supporting further research with the goal of finding and disabling a ballistic missile in flight. Furthermore, superconductive components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements and program offices for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: BMDO is interested in demonstrating both high temperature superconductor (HTS) and low temperature superconductor (LTS) devices to enable or improve strategic defenses. Emphasis in HTS technology focused toward components integrated with state-of-the-art cryoelectronics for communications systems at K- and S-bands and radar systems in the X-band power and inductive energy storage are of specific ballistic missile defense interest. The demonstration of HTS materials toward limited detection of radiation in the optical, IR, MWIR, and LWIR bands as well as for signal processing applications is also of interest. The emphasis in LTS technology is in the development and demonstration of high sensitivity detectors, digital electronics, and memory enabling on-focal plane array signal processing and operating at temperatures greater than 10K. Efforts should address packaging and interface issues and systems integration with cryocoolers and stored cryogens.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company GG, with a market cap of $123M+, fabricates optical components for industrial and military applications finds traceability back to superconducting detectors funded under this topic. Company HH, with a market cap of $176M+, demonstrated success from its technology based on multi-GHz superconducting shift registers.

BMDO 01-016 SURPRISES AND OPPORTUNITIES

DOD KEY TECHNOLOGY AREA: Any potential new development may address a DoD Critical Technology Area from this topic, provided it supports BMDO mission interest at some level. DoD Key Technology Areas: Air Platforms, Information Systems Technology, Ground and Sea Vehicles, Materials/Processes, Sensors, Electronics, Battlespace Environment, Space Platforms, Human Systems, Weapons, Nuclear Technology

INTRODUCTION: BMDO increasingly depends on advanced technology developments, of all kinds, to invigorate its ability to find and disable missiles in flight and to defend against an increasingly sophisticated threat, to include cruise missiles. Therefore, the continued availability of emerging technology has become a vital part of the BMDO mission. BMDO has interest and investments in specific technology programs that pursue speculative, high-risk technologies that could spur a revolutionary leap or enhancements in either Theater Missile Defense or National Missile Defense capabilities. Specific goals include, but are not limited to, quickening the pace of technology and innovation developments and decreasing the time required to transform scientific breakthroughs into actual applications. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: Since ballistic missile defense is an exploration at technology's leading edge to begin with, it recognizes that surprises and opportunities may arise from creative and innovative minds in a variety of technology sectors. BMDO will consider proposals in other technologies where they present a completely unique and unusual opportunity for ballistic missile defense applications. The proposing company should take special care to describe the specific technology in complete detail and specify why ballistic missile defense applications would benefit from exploring its unique and novel implications. Proposing companies should make particular note that proposals in this topic will receive preliminary screening at BMDO and that they may be rejected as too far afield without the benefit of a full technical review received by proposals in the topics already listed. It is recommended that the proposing company focus their submission toward one of the specific outlined topics above unless the technology proposed is truly an unquestionable innovation. This full and open call is for new/novel/innovative/unique advanced technology developments, and not for the recycling of old ideas, incremental advancements, or questionable improvements.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company JJ, with a market cap of $1,172M+, was funded for technology to further its intelligent client-server software solutions for mission-critical decision applications in real-time military and commercial environments.