DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
FY2010.2 SBIR Proposal Submission

DARPA's mission is to prevent technological surprise for the United States and to create technological surprise for its adversaries. The DARPA SBIR and STTR Programs are designed to provide small, high-tech businesses and academic institutions the opportunity to propose radical, innovative, high-risk approaches to address existing and emerging national security threats; thereby supporting DARPA's overall strategy to bridge the gap between fundamental discoveries and the provision of new military capabilities.

The responsibility for implementing DARPA's Small Business Innovation Research (SBIR) Program rests with the Small Business Programs Office.

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
Attention: DIRO/SBPO
3701 North Fairfax Drive
Arlington, VA 22203-1714
(703) 526-4170
Home Page http://www.darpa.mil/sbpo

Offerors responding to the DARPA topics listed in Section 8.0 of this solicitation must follow all the instructions provided in the DoD Solicitation Instructions preface. Specific DARPA requirements in addition to or that deviate from the DoD Solicitation Instructions are provided below and reference the appropriate section of the DoD Solicitation Instructions. All proposals must be submitted electronically through the DoD SBIR Web site at http://www.dodsbir.net/submission by the submission deadline. Proposals provided in hard copy or via e-mail will not be accepted. In addition, all topics are UNCLASSIFIED and only UNCLASSIFIED proposals will be accepted.

SPECIFIC DARPA REQUIREMENTS:

2.15 Foreign National

DARPA topics are unclassified; however, the subject matter may be considered to be a "critical technology" and may be subject to ITAR restrictions. If you plan to employ NON-U.S. Citizens in the performance of a DARPA SBIR contract, please inform the Contracting Officer who is negotiating your contract. See **Export Control** requirements below in Section 5.

3.5 Phase I Proposal Format

PHASE I OPTION

PHASE I OPTION MUST BE INCLUDED AS PART OF PHASE I PROPOSAL. DARPA has implemented the use of a Phase I Option that may be exercised to fund interim Phase I activities while a Phase II contract is being negotiated. Only Phase I companies selected for Phase II will be eligible to exercise the Phase I Option. The Phase I Option, which must be included as part of the Phase I proposal, covers activities over a period of up to four months and should describe appropriate initial Phase II activities that may lead to the successful demonstration of a product or technology. The Phase I Option must be included within the 25-page limit for the Phase I proposal.

A Phase I Cost Proposal ($149,000 maximum) must be submitted in detail online. Proposers that participate in this Solicitation must complete the Phase I Cost Proposal, not to exceed the maximum dollar amount of $99,000, and a Phase I Option Cost Proposal (if applicable), not to exceed the maximum dollar amount of $50,000. Phase I and Phase I Option costs must be shown separately but may be presented side-by-side on a single Cost Proposal. The Cost Proposal DOES NOT count toward the 25-page Phase I proposal limitation. Phase I awards and options are subject to the availability of funds.

3.7 Phase II Proposal Format

DARPA Program Managers may invite Phase I performers to submit a Phase II proposal based upon the success of the Phase I contract to meet the technical goals of the topic, as well as the overall merit based upon the criteria in section 4.3 of the SBIR 10.2 solicitation. Phase II proposals will be evaluated in accordance with the evaluation criteria provided in Section 4.3. Due to limited funding, DARPA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

PHASE II OPTION

PHASE II OPTION MUST BE INCLUDED AS PART OF PHASE II PROPOSAL. DARPA has implemented the use of a Phase II Option that may be exercised at the DARPA Program Manager's discretion to continue funding Phase II activities that will further mature the technology for insertion into a larger DARPA Program or DoD Acquisition Program. The Phase II Option, which must be included as part of the Phase II proposal, covers activities over a period of up to 24 months and should describe Phase II activities that may lead to the successful demonstration of a product or technology. The Phase II Option must be included within the 40-page limit for the Phase II proposal.

A Phase II Cost Proposal ($750,000 maximum) must be submitted in detail online. Proposers that submit a Phase II proposal must complete the Phase II Cost Proposal, not to exceed the maximum dollar amount of $750,000, and a Phase II Option Cost Proposal (if applicable), not to exceed the maximum dollar amount of $750,000. Phase II and Phase II Option costs must be shown separately but may be presented side-by-side on a single Cost Proposal. The Cost Proposal DOES NOT count toward the 40-page Phase II proposal limitation. Phase II awards and options are subject to the availability of funds.

If selected, the government may elect not to include the option in the negotiated contract.

4.0 Method of Selection and Evaluation Criteria

The offeror's attention is directed to the fact that non-Government advisors to the Government may review and provide support in proposal evaluations during source selection. Non-government advisors may have access to the offeror's proposals, may be utilized to review proposals, and may provide comments and recommendations to the Government's decision makers. These advisors will not establish final assessments of risk and will not rate or rank offeror's proposals. They are also expressly prohibited from competing for DARPA SBIR or STTR awards in the SBIR/STTR topics they review and/or provide comments on to the Government. All advisors are required to comply with procurement integrity laws and are required to sign Non-Disclosure and Rules of Conduct/Conflict of Interest statements. Non-Government technical consultants/experts will not have access to proposals that are labeled by their proposers as "Government Only."

4.2 Evaluation Criteria

DARPA selects proposals for funding based on technical merit and the evaluation criteria contained in this solicitation document. DARPA gives twice the weight to Criterion A. “The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.” Please note proposals that scored low on evaluation Criterion C. “The potential for commercial

(government or private sector) application and the benefits expected to accrue from this commercialization" are considered weaker proposals. As funding is limited, DARPA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and highly relevant to the DARPA mission. As a result, DARPA may fund more than one proposal in a specific topic area if the technical quality of the proposals is deemed superior and are highly relevant to the DARPA mission, or it may not fund any proposals in a topic area. Each proposal submitted to DARPA must have a topic number and must be responsive to only one topic.

4.4 Assessing Commercial Potential of Proposals

DARPA is particularly interested in the potential transition of SBIR project results to the U.S. military, and expects explicit discussion of a transition vision in the commercialization strategy part of the proposal. That vision should include identification of the problem, need, or requirement in the Department of Defense that the SBIR project results would address; a description of how wide-spread and significant the problem, need, or requirement is; identification of the potential end-users (Army, Navy, Air Force, SOCOM, etc.) who would likely use the technology; and the operational environments and potential application area(s).

Technology commercialization and transition from Research and Development activities to fielded systems within the DoD is challenging. Phase I is the time to plan for and begin transition specific activities. The small business must convey an understanding of the transition path or paths to be established during the Phase I and II projects. That plan should include the Technology Readiness Level (TRL) at the start and end of the Phase II. The plan should also include a description of targeted operational environments and priority application areas for initial Phase III transition; potential Phase III transition funding sources; anticipated business model and identified commercial and federal partners the SBIR company has identified to support transition activities. Also include key proposed milestones anticipated during Phase I, II or beyond Phase II that include, but are not limited to: prototype development, laboratory and systems testing, integration, testing in operational environment, and demonstrations.

4.5 SBIR Fast Track

- DARPA encourages Phase I performers to discuss its intention to pursue Fast Track with the DARPA Program Manager prior to submitting a Fast Track application or proposal. Selection of a Fast Track proposal is not mandated and DARPA retains the discretion to not select or fund any Fast Track proposal. Fast Track awards are subject to the availability of funds.
- After coordination with the DARPA Program Manager, the performer and the investor should submit a Fast Track application AND Phase II proposal through the DoD Submission Web site no later than the last day of the 6th month of the Phase I effort.
- The Fast Track Interim amount is not to exceed $40,000.

4.6 Phase II Enhancement Policy

DARPA will provide a Phase II performer up to $200,000 of additional Phase II SBIR funding if the performer can match the additional SBIR funds with non-SBIR funds from DoD core-mission funds or the private sector. Generally, the additional Phase II funds are applied to the Phase II contract. Phase II Enhancements are subject to the availability of funds.

4.7 Commercialization Pilot Program

DARPA does not participate in the Commercialization Pilot Program (CPP); however, DARPA has established a Transition Support Pilot Program focused on transitioning innovative technologies to the most critical U.S. military end-users as well as key collaboration partners. This program will also support transitions within DARPA, civilian agencies, and private-sector, if deemed critical for technology transition success. The program, administered by the DARPA Small Business Programs Office with

support from The Foundation for Enterprise Development (The Foundation), a U.S. owned non-profit organization, consists of the following assistance:

- Transition Assistance. The Foundation will provide DARPA funded SBIR Phase II companies identified to participate in the Pilot with guidance and assistance in identifying and facilitating introductions to potential collaborators, funding sources, and end users, in support of SBIR Company's Phase III technology development activities. Thus, identification of potential funding sources will be primarily focused on enabling the SBIR Company to work towards reaching Technology Readiness Level (TRL) 7 – System prototype demonstration in an operational environment. Specific potential funding sources will be identified throughout a designated period of transition support and may include, but are not limited to:
  - DARPA
  - Other DoD research programs (e.g.: Army, Navy, Air Force, Marine Corps)
  - Prime contractor programs, to include their Independent Research & Development (IR&D) programs
  - Non-DoD Federal research programs in the Intelligence agencies and the Department of Homeland Security
  - Other non-DoD Federal research programs, such as those within National Institutes of Health
  - Other DoD-funded technology transition programs as appropriate (e.g., Technology Transition Initiative, Defense Acquisition Challenge, TechLink and TechMatch)
  - Venture capital funding sources

To be eligible for assistance, the SBIR Company must have an active Phase II, expected technology readiness level of 5 or greater at the completion of Phase II, and understanding of and progress within the expected transition path or paths. DARPA retains the discretion to not select a company. Each identified company will execute a Technology Transition Agreement with the contractor to initiate support. Participation in the DARPA Technology Transition Pilot Program is voluntary.

- All obligations of the SBIR Company shall be carried out <u>at no cost to The Foundation or DARPA and are not billable to any SBIR contract.</u> The SBIR Company shall make relevant experts reasonably available to The Foundation to discuss potential application areas for the technology under development and to support the execution of the technology transition support services described above. The SBIR Company also shall make its relevant experts available for follow-up discussions and briefings with potential collaborators or representatives from federal or other potential funding sources. As appropriate, the SBIR Company will develop appropriate company profiles, briefings and other types of informational materials to support discussions and briefings. SBIR companies involved in the transition pilot will be asked for feedback on the assistance provided upon completion of the Phase II and on transition outcomes within the year following the Phase II.

- Success Reports: The Foundation will document company Phase III transition successes individualized reports as well as or other printed material for distribution at outreach events and for posting on the DARPA SBPO Web site. SBIR companies that have received Phase III funding are eligible to work with The Foundation to develop the success report. Cleared Success Reports will continue to be posted on the DARPA SBPO Web site. The 2007 DARPA SBIR Success Reports can be viewed at this link: http://www.darpa.mil/sbpo/success/index.html

- Outreach/Process Improvement: The Foundation will capture lessons learned, program feedback and best practices from SBIR companies, and will help develop and implement process improvements to increase transition success for DARPA SBIR funded companies. Transition outreach includes panel presentation and one-on-one meetings at relevant SBIR conferences. Additional transition–related documentation and links will be available upon request and via the SBPO web site in the future. All active DARPA SBIR companies are eligible for this outreach support.

- Phase III transition support is subject to the availability of funds.

5.1.b. Type of Funding Agreement (Phase I)

- DARPA Phase I awards will be Firm Fixed Price contracts.
- Companies that choose to collaborate with a University must highlight the research that is being performed by the University and verify that the work is FUNDAMENTAL RESEARCH.
- Companies are strongly encouraged to pursue implementing a government acceptable cost accounting system during the Phase I project to avoid delay in receiving a Phase II award. Visit www.dcaa.mil and download the "Information for Contractors" guide for more information.

5.1.c. Average Dollar Value of Awards (Phase I)

DARPA Phase I proposals **shall not exceed $99,000,** and are generally 6 months in duration. Phase I contracts will not be extended.

5.2.b. Type of Funding Agreement (Phase II)

- DARPA Phase II awards are typically Cost Plus Fixed Fee contracts; however, DARPA may choose to award a Firm Fixed Price Phase II contract or an Other Transaction (OT) on a case-by-case basis. Visit http://www.darpa.mil/sbpo/ot/index.html for more information on Other Transactions.
- Companies are advised to continue pursuit of implementation of a government acceptable cost accounting system in order to facilitate their eligibility for future government contracts.
- Companies that choose to collaborate with a University must highlight the research that is being performed by the University and verify that the work is FUNDAMENTAL RESEARCH.

5.2.c. Average Dollar Value of Awards (Phase II)

DARPA Phase II proposals should be structured as a 24 month effort in two equal increments of approximately $375,000 each. The entire Phase II base effort should generally not exceed $750,000.

5.3 Phase I Report

All DARPA Phase I and Phase II awardees are required to submit a final report, which is due within 60 days following completion of the technical period of performance and must be provided to the individuals identified in Exhibit A of the contract. Please contact your contracting officer immediately if your final report may be delayed.

5.11.r. Export Control

The following will apply to all projects with military or dual-use applications that develop beyond fundamental research (basic and applied research ordinarily published and shared broadly within the scientific community):

(1) The Contractor shall comply with all U. S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, in the performance of this contract. In the absence of available license exemptions/exceptions, the Contractor shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of (including deemed exports) hardware, technical data, and software, or for the provision of technical assistance.

(2) The Contractor shall be responsible for obtaining export licenses, if required, before utilizing foreign persons in the performance of this contract, including instances where the work is to be performed on-site at any Government installation (whether in or outside the United States), where the foreign person will have access to export-controlled technologies, including technical data or software.

(3) The Contractor shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.

(4) The Contractor shall be responsible for ensuring that the provisions of this clause apply to its subcontractors.

Please visit http://www.pmddtc.state.gov/regulations_laws/itar.html for more detailed information regarding ITAR requirements.

5.11.s. Publication Approval

There shall be no dissemination or publication, except within and between the Contractor and any subcontractors, of information developed under this contract or contained in the reports to be furnished pursuant to this contract without prior written approval of the DARPA Public Release Center (DARPA/PRC). All technical reports will be given proper review by appropriate authority to determine which Distribution Statement is to be applied prior to the initial distribution of these reports by the Contractor. Papers resulting from unclassified contracted fundamental research are exempt from prepublication controls and this review requirement, pursuant to DoD Instruction 5230.27 dated October 6, 1987. Any publications shall incorporate an Acknowledgement of Support and Disclaimer in accordance with FAR 252.235-7010.

The following provision will be incorporated into any resultant contract:

When submitting material for written approval for open publication as described above, the Contractor/Awardee must submit a request for public release to the DARPA PRC ***5 weeks prior to the event.*** Requests received with a due date of less than five weeks lead time require a justification. Unusual electronic file formats may require additional processing time. Include the following information:

1) Document Information: document title, document author, short plain-language description of technology discussed in the material (approx. 30 words), number of pages (or minutes of video) and document type (briefing, report, abstract, article, or paper);

2) Event Information: event type (conference, principle investigator meeting, article or paper), event date, desired date for DARPA's approval;

3) DARPA Sponsor: DARPA Program Manager, DARPA office, and contract number; and

4) Contractor/Awardee Information: POC name, e-mail and phone.

Requests can be sent either via e-mail to prc@darpa.mil or via surface mail to 3701 North Fairfax Drive, Arlington VA 22203-1714, telephone (571) 218-4235. Refer to http://www.darpa.mil/prc for information about DARPA's public release process.

5.14.h. Human and/or Animal Use

This solicitation may contain topics that have been identified by the program manager as research involving Human and/or Animal Use. In accordance with DoD Policy, human and/or animal subjects in research conducted or supported by DARPA shall be protected. Although these protocols will most likely not be needed to carry out the Phase I, significant lead time is required to prepare the documentation and obtain approval in order to avoid delay of the Phase II award. Please visit http://www.darpa.mil/sbpo/docs/SBIR_STTRs_Human_Animal.pdf to review the Human and Animal Use PowerPoint presentation(s) to understand what is required to comply with human and/or animal protocols.

- **Human Use:** All research involving human subjects, to include use of human biological specimens and human data, selected for funding must comply with the federal regulations for human subject protection. Further, research involving human subjects that is conducted or supported by the DoD must comply with 32 CFR 219, Protection of Human Subjects (http://www.dtic.mil/biosys/downloads/32cfr219.pdf), and DoD Directive 3216.02, Protection of Human Subjects and Adherence to Ethical Standards in DoD-Supported Research (http://www.dtic.mil/whs/directives/corres/pdf/321602p.pdf).

- **Animal Use:** Any Recipient performing research, experimentation, or testing involving the use of animals shall comply with the rules on animal acquisition, transport, care, handling, and use in: (i) 9 CFR parts 1-4, Department of Agriculture rules that implement the Laboratory Animal Welfare Act of 1966, as amended, (7 U.S.C. 2131-2159); (ii) the guidelines described in National Institutes of Health Publication No. 86-23, "Guide for the Care and Use of Laboratory Animals"; (iii) DoD Directive 3216.01, “Use of Laboratory Animals in DoD Program.”

6.3 Notification of Proposal Receipt

DARPA will send each offeror an e-mail acknowledging receipt of proposal after the solicitation closing date.

6.4 Information on Proposal Status

All letters notifying offerors of selection or non-selection will be sent via e-mail to the person listed as the “Corporate Official” on the proposal.

6.5 Debriefing of Unsuccessful Offerors

DARPA will provide each unsuccessful offeror an automatic debriefing summary as an enclosure to the notification of non-selection. Requests for clarification to information provided in the debriefing summary must be sent via e-mail to sbir@darpa.mil within 15 days of receipt of notification.

DARPA SBIR 10.2 Topic Index

SB102-001	Broadband, low dispersion confocal microscope objective
SB102-002	Handheld Apps for Warfighters
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SB102-005	Revolutionary Advances in Large-Scale Manufacturing in Quantities of One

DARPA SBIR 10.2 Topic Descriptions

SB102-001 TITLE: Broadband, low dispersion confocal microscope objective

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Develop a broadband (visible and ultraviolet), low dispersion objective optical system for use in confocal laser scanning microscopy with sub-micron resolution.

DESCRIPTION: Confocal microscopy [1,2] has become the tool of choice for sub-micron imaging, particularly of biological tissues, and is being used as a diagnostic tool in other disciplines as well. Of growing interest is the non-medical use of one- and two-photon confocal laser scanning microscopy [3,4] to diagnose the excitation and relaxation dynamics of various sub-micron structures such as semiconductor quantum dots and metallic nanoparticles used for surface enhanced Raman spectroscopy. Because structural variations tremendously affect the optical characteristics, the ability to resolve luminescence or scattered light at the sub-micron level is of critical importance to ascertain how the performance varies from structure to structure.

Broadband optics are required to collect emitted or scattered light throughout the visible and ultraviolet (200-800 nm) regions, with particular emphasis on the ultraviolet region because of the relative dearth of low-dispersion focusing and beamsplitting optics here. Minimal spectral and temporal dispersion is required so that ultrafast (< 1 ps) dynamics can be measured without external compensating optics. Presumably this will require all-reflective optics with no oil immersion. [5,6]

PHASE I: Develop a thorough optics-based model for the design and construction of a broadband (200-800 nm) objective optical system with sub-micron resolution for use in confocal laser scanning microscopy. The optical system must be achromatic with low spectral and temporal (< 1 ps) dispersion to allow for both cw and pulsed excitation of the structures to be imaged. The projected optical throughput and amount of magnification must be quantified as a function of wavelength over the spectral region spanned.

PHASE II: Construct and deliver to AMRDEC a broadband (200-800 nm) objective optical system with sub-micron resolution for use in confocal laser scanning microscopy. The optical system must achieve or exceed the performance specified in Phase I while demonstrating low spectral and temporal (< 1 ps) dispersion to allow for both cw and pulsed excitation of the structures to be imaged.

PHASE III: Development and evaluation of organic and inorganic electronic and optoelectronic devices for next generation sensors and information processors will have ubiquitous DoD impact. Of particular interest is the scientific analysis of nanostructured optoelectronic devices for advanced sensing and efficient lighting. More generally, non-destructive test and evaluation of nanostructures and nanofailures is of increasing importance when the integrity of all military platforms must be assessed and maintained. Commercialization of a broadband confocal laser scanning microscope objective with low spectral and temporal dispersion will provide a tremendous asset for the optical characterization and dynamical analysis of a wide variety of nanostructures of interest for nanofabrication, nanoelectronics, nano-optics, optoelectronics, bio-optics, and medical imaging.

REFERENCES:

[1] F. Merchant, K. Bartels, A. Bovik, and K. Diller, “Confocal Microscopy”, chapter 10.9, Handbook of Image and Video Processing (Elsevier Academic Press, 2005).

[2] B. Boruah and M. Neil, “Laser scanning confocal microscope with programmable amplitude, phase, and polarization of the illumination beam,” Rev. Sci. Instruments, Vol. 80, p. 013705 (2009).

[3] For example, see W. Schrof et. al, Progress in Organic Coatings”, Vol. 43, p. 1-9 (Nov., 2001).

[4] Y. Kanai, Y. Kanzaki, M. Wakaki, N. Takeyama, “Design and development of multi-functional confocal laser scanning microscope with UV/VIS laser source,” Proc. SPIE, vol. 5878, pp. 1-8 (2005).

[5] A. Drechsler, M. Lieb, C. Debus, A. Meixner, and G. Tarrach, "Confocal microscopy with a high numerical aperture parabolic mirror," Optics Express, Vol. 9, p. 637 (2001).

[6] J. Stadler, C. Stanciu, C. Stupperich, and A. Meixner "Tighter focusing with a parabolic mirror", Optics Letters, Vol. 33, p. 681 (2008).

KEYWORDS: confocal microscope, scanning microscopy, visible/ultraviolet, nanometrology, nondestructive inspection

SB102-002 TITLE: Handheld Apps for Warfighters

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: The objective of this topic is to rapidly and efficiently develop mobile applications (apps) for handheld devices and to demonstrate their utility in a number of military domains.

DESCRIPTION: Many military handhelds are today characterized by tight integration of the hardware with a single application. This results in stove-piped systems that provide limited functionality and are difficult to update or enhance.

The goal of this topic is to develop and enhance militarily relevant applications (apps) for handheld devices. Innovations are sought in apps for the tactical battlefield as well as for other military missions and tasks. The apps proposed will provide new innovative functionality for various military domains. Examples may include (but are not limited to) apps for language translation, training, command and control, reporting, mission-planning, ISR (Intelligence, Surveillance and Reconnaissance), real-time collaboration, geo-spatial visualization, analysis, and logistics. The apps should target the Android platform for initial design and implementation. Particular attention must be paid to security, ease-of-use, as well as to any server software and infrastructure required. Some of the apps will function largely without network access (except for occasional synchronization or updates), while other apps will require more consistent network connectivity. Strong emphasis is placed on the capability to operate with minimal bandwidth consumption and in environments with frequent network disconnection. A proposed effort may also focus on demonstrating middleware or utilities that enable or can be shared across multiple handheld apps.

The experience garnered from the development of TIGR (Tactical Ground Reporting System) [1,2] has demonstrated that the key to rapid and effective application development is incorporation of direct feedback from users. The intent is to have a pool of military users that will "beta-test" the apps developed under this effort and provide feedback that guide subsequent improvements and enhancements. An 'apps store' like repository will be created that will allow test users to download apps on demand. Appropriate feedback and detailed usage collection mechanism will be put in place.

PHASE I: The effort in Phase I will focus on the initial version of the handheld app and on evaluating possible implementation approaches. The app running on a commercial Android handheld together with the backend software, if appropriate, will be designed as part of the feasibility study. The GUI (Graphical User Interface) must be carefully designed for intuitive user experience.

PHASE II: Enhance initial version of the app demonstrated in Phase I based on feedback from military end-users. Improve the software performance, capability, and usability. Enhance security and robustness. For networked applications, ensure that positive user experience is maintained even when link connectivity is temporarily lost. Similarly, develop mechanisms to minimize bandwidth utilization. Participate in periodic user evaluation events. The minimum targeted Technology Readiness Level for the software is 7.

PHASE III: In Phase III, delivery of mature product to the targeted military customers is expected.
Commercialization efforts are expected for adoption by private and public organizations in the domain areas of, for example, public safety, disaster recovery, humanitarian assistance efforts.

REFERENCES:
1. http://www.darpa.mil/ipto/programs/assist/assist_tigr.asp

2. http://www.technologyreview.com/communications/20202/page1/

KEYWORDS: Software, smartphone, handheld, mobile, android, app, military handheld, mobile computing, tactical network

SB102-003 TITLE: Design Tools For Highly Regular Circuit Geometries

TECHNOLOGY AREAS: Materials/Processes, Sensors

OBJECTIVE: Develop design tools which enable electronic circuit designs leveraging highly regular geometries such as grating-derived line segments. Such Design methodologies have the dual benefit of simplifying the design and fabrication processes as well as lowering the cost of the low volume circuit design and fabrication needs of the DoD.

DESCRIPTION: An ongoing challenge for the DoD in the electronics domain is performance required in a cost effective manner for the low unit volumes typical of Defense systems (relative to the commercial electronics world). Highest performance in terms of both speed and power efficiency is typically achieved using custom application specific circuits (ASICs). These chips are currently quite costly to design and fabricate using today's methods optimized for high volume commercial applications.

The purpose of this SBIR is to help develop novel circuit design methodologies leveraging highly regular geometries such as grating-derived line segments. More specifically, this SBIR calls for the development of software and CAD tools that can enable efficient design using such highly regular circuit geometries. Efficient conversion of legacy designs into such highly regular (1D) geometries is also a goal of this SBIR.

The design tools developed with this SBIR will enable the simplification of the complex IC design process as well as help lower the design and fabrication costs for the low volume, high performance ASICs that the DoD desires. This simplification in design should not sacrifice performance metrics such as speed, power and efficiencies of the ICs. The resulting cost savings will vary depending on the design complexity, technology nodes, process technology, fabrication equipment, and production volume. However, the cost savings will be significant for DoD low volume production of complex ASICs.

PHASE I: Demonstrate the feasibility of the specific highly regular design approach to produce circuits of good performance (speed and density for example). Examples of some common standard digital cells might be an example output of this phase.

PHASE II: Based on the preliminary work in phase I, a more complete set of standard cell library elements will be developed based on highly regular (1D) geometries. These circuit cells will have competitive performance with respect to speed and density to modern state of the art CMOS (Complementary Metal Oxide Semiconductor). For demonstration and validation of the simplified design and the associated circuit performance, test patterns, functional cells or blocks incorporating the novel high regular designs will be fabricated and tested via either MOSIS or TAPO services.

PHASE III: Software tools for highly regular (1D) designs for the sub-20nm CMOS (Complementary Metal Oxide Semiconductor) technology nodes should be broad enough to interest BOTH DoD and commercial low-volume applications. Commercial applications include rapid prototyping or Application Specific Integrated Circuits (ASICs.)

These new design tools should simplify the design costs for complex IC designs thus lowering the cost and improving manufacturability. Particular emphasis will be placed on lowering the high design and fabrication costs of the ASICs that the DoD desires for high performance, power efficient applications. These new design tools

should simplify the design costs for complex IC designs thus lowering the cost and improving manufacturability. Particular emphasis will be placed on lowering the high design and fabrication costs of the ASICs that the DoD desires for high performance, power efficient applications.

REFERENCES:

1. Lin Zhao and M. Qi, “Generating Manhattan Patterns via Cutting and Stitching of Gratings” 52nd EIPBN Meeting, Portland, Oregon, May, 2008

2. Tejas Jhaveri, Andrzej Strojwas, Larry Pileggi & Vyacheslav Rovner "Lithography-Layout-Circuit Design Co-optimization in the Extremely Regular Layout IC's”, Lithography Workshop 2009

3. Tejas Jhaveri, Vyacheslav Rovner, Larry Pileggi, Andrzej J. Strojwas, et al., "Maximization of Layout Printability/Manufacturability by Extreme Layout Regularity", Journal of Micro/Nanolithography, MEMS, and MOEMS, Vol 6 (03), 2007.

4. Michael C. Smayling, Hua-yu Liu, Lynn Cai “Low k1 Logic Design using Gridded Design Rules”, SPIE Advanced Lithography Conference, Feb 2008

KEYWORDS: Circuit design, electronics, low volume fabrication, computer-aided design

SB102-004 TITLE: Large Scale Graphene Synthesis Technology

TECHNOLOGY AREAS: Materials/Processes, Sensors

OBJECTIVE: Develop synthesis technologies to produce high quality large scale graphene thin films in support of emerging military electronics, display, or conformal sensors applications.

DESCRIPTION: The novel material graphene consists of a two-dimensional honeycomb lattice of carbon, or a single atomic plane of graphite. Graphene not only has the highest intrinsic carrier mobility of any known material at room temperature, but also has ultra-high mechanical strength. As a result, graphene is an excellent candidate for the conductive channel material in electronics devices (active transistors or flexible electrodes) as well as mechanical applications in Microelectromechanical Systems (MEMS) devices. In addition, the graphene material system could be used in photonic detectors or emitters by engineering its energy bandgap. The most advanced synthesis technologies for graphene require high temperature processes (usually >1500ºC) only producing high quality films in relatively small areas (currently up to 2-in wafer size).

This SBIR topic will focus on developing innovative synthesis technologies to cost effectively produce high quality graphene in large quantities. The proposed approaches should be manufacturable and will result in large scale graphene production (large area and/or large quantity) while maintaining graphene’s uniformity (electric and mechanical properties). The bidders are strongly encouraged to explicitly propose the target specifications of the graphene thin film (the number of graphene layers, domain size or uniformity, electron mobility, sheet resistance or conductivity, area, and the synthesis conditions) for the graphene films to be developed under this SBIR. A scalable, cost-effective, low-temperature synthesis technique or enabling apparatus is the desirable outcome of this SBIR topic. The synthesis approaches and proposed graphene characteristics will be used to evaluate the technical merits of proposals.

PHASE I: Demonstrate feasibility by designing a synthesis process and required equipment that will result in proposed quality and quantity of the graphene film to be manufactured in later SBIR phases.

PHASE II: Based on successful feasibility study in Phase I, develop, demonstrate and validate the proposed large scale graphene synthesis approaches with a demonstrated prototype tool in a laboratory environment. Additionally, characterize manufactured graphene material to demonstrate specific proposed graphene properties. Required Phase II deliverables will include large-scale graphene material (large area and/or large quantity) to the government for testing.

PHASE III: The proposed large scale graphene synthesis approaches should enable cost-effective manufacture techniques to generate high quality graphene films to benefit both DoD and commercial applications. The DARPA CERA program's goal of high-performance, low-power RF circuits and modules are aligned with this topic and the radar and radio needs of the services. Commercial applications may include large-area flexible digital and RF electronics as well as displays. The graphene films produced will be of interest to and evaluated by the services and the DARPA CERA program. The proposed large scale graphene synthesis approaches should enable cost-effective manufacture techniques to generate high quality graphene films to benefit both DoD and commercial applications. Commercial applications may include large-area flexible digital and RF electronics as well as displays.

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KEYWORDS: graphene, graphite, low noise amplifier, radio frequency

SB102-005 TITLE: Revolutionary Advances in Large-Scale Manufacturing in Quantities of One

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Develop novel approaches to the design and manufacturing of large-scale, one-of-a-kind, complex defense systems to shorten and reduce the variance in development cycles and to enhance the competitiveness of the defense manufacturing industrial base.

DESCRIPTION: DARPA is soliciting proposals that can significantly enhance the ability of the Department of Defense and the defense industrial base to design and manufacture increasingly complex systems in low quantities. To this end, proposals that offer revolutionary advances over the state of the art in the following topic areas are sought:

• Approaches to "erasing the learning curve"—i.e., removing uncertainty, variance, non-conformance, re-work, and the amount of touch labor associated with production of initial units—in manufacturing of large-scale systems in low quantities. Specifically, while production learning effects for typical defense systems today might be in the range of 10-15% labor reduction for a doubling in the number of units, approaches for flattening the learning curve to the 0-5% range are sought.

• Novel tools, methods, and techniques for the rapid design, optimization, and adaptation of manufacturing tooling and processes. Specifically, approaches for effecting significant changes to the manufacturing tooling and process over time horizons ranging from minutes to hours to days—versus months under most status quo approaches—are of interest. Proposals in this area should clearly articulate the advancement over the existing state of the art in their domain of applicability.

• Economical methods for "shimless" manufacturing, i.e., manufacturing at tolerance levels that do not require custom shimming. Proposals in this area should clearly articulate the value proposition (e.g., through a cost-benefit analysis) of their proffered approach.

• Economical methods for manufacturing large-scale structural components with extreme aggregate outer mold-line (OML) tolerances, e.g., 0.001" or less.

• Approaches to the development of “manufacturing cells,” i.e., self-contained systems capable of process engineering, process control, configuration management, and assorted manufacturing tools to enable fully autonomous manufacturing of a wide range of complex systems and rapid product change-over capability.

• Approaches to cyber-physical electromechanical systems, i.e., electromechanical systems, actuators, and structural components with ubiquitous embedded intelligence and control capability.

• Approaches to pushing the limits of modularity in large-scale electromechanical systems to levels comparable to those of very-large-scale integrated (VLSI) systems (i.e., integrated circuits).

• Design and/or manufacturing methods, techniques, and formalisms that enable the decoupling of dependencies between the system design and the manufacturing process.

• Tools, methods, and techniques to enable trade-offs software and electromechanical instantiation of functionality in system designs.

• Approaches to predicting performance and verifying correctness of large-scale complex systems while still in the early phases of design.

PHASE I: Conduct a feasibility study which would investigate and define the proposed idea, approach, method, or tool and its feasibility. Demonstrate key technologies or breakthroughs through limited prototyping or simulation in a laboratory environment.

PHASE II: Develop the research and technology advances and methods identified in Phase I to produce a complete prototype that fully demonstrates the utility of the concept in an operational environment.

PHASE III: The technology developed under this SBIR will be applied in both the military and civilian commercial sectors. Specific domains of applicability in the military realm may include the manufacturing of spacecraft, aircraft, ground vehicles, and naval vessels. Customers would include the respective procurement components of the Air Force, Army, Marines, and Navy. Commercial applications may be found in industries including aviation, shipbuilding, and heavy machinery.

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KEYWORDS: manufacturing, assembly, integration, fabrication, complex systems, design, verification