The National Geospatial-Intelligence Agency

BROAD AGENCY ANNOUNCEMENT for the Geospatial Intelligence Information Visualization Program (GI^2Vis)

BAA #: HM1582-04-BAA0007

6 August 2004

COORDINATING POC: GI2VIS@westfields.net

Part I
Offeror Information

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On behalf of the Intelligence Community's Advanced Research and Development Activity (ARDA) in Information Technology, the National Geospatial-Intelligence Agency (NGA) is selecting this research effort through a Broad Agency Announcement (BAA) process. The following information is for those wishing to respond to the BAA.

1 INTRODUCTION

This Broad Agency Announcement is comprised of two parts:
Part I: Offeror Information; and
Part II: Program Description

Appendices A, B and C are included for informational purposes only. They are provided in order to further enhance the general knowledge of a potential Offeror. These appendices do not form any part of the evaluated base of the Geospatial Intelligence Information Visualization (GI^2Vis) Phase III requirement.

Part I, Offeror Information, provides information on the proposal preparation, submittal, and evaluation process for GI^2Vis Program as well as other general program information.

Part II, Program Description, describes the GI^2Vis Phase III technical requirements.

The following appendices are included:
Appendix A: Intelligence Community's Advanced Research and Development (ARDA)

Appendix B: Analytic Uses for Information Visualization within Phase III of Geospatial Intelligence Information Visualization (GI^2Vis) Research & Development program

Appendix C: Sample Cover Sheet

This BAA is being publicized at www.nga.mil (Click on Business Opportunities). Awards made under this BAA are subject to the Availability of Funds.

2 PROGRAM FUNDING

2.1 GI^2Vis Program Phase III

Phase III performance will be divided into a 12- month base period and a 12-month option period. Option exercise will be dependent upon availability of funding and satisfactory performance. Innovative ideas that address the following research area of interest are encouraged:

1. Integration and Representation of Disparate and Large Information Sources;
2. Maximizing Visualization Effectiveness and Facilitating Visualization Use; and
3. New Visualization Paradigms.

This BAA addresses only the Phase III requirement. Offeror should only provide proposals in response to the Phase III requirement defined herein.

2.2 Program Structure

The Government anticipates allocating approximately $2,500,000 (FY05-06) for the overall GI^{2}Vis program basic 12-month effort. The Government anticipates allocating approximately $2,500,000 (FY06-07) for the 12-month option effort. The option year will be incrementally funded considering performance during program review periods. The Government estimates that individual awards will range from $150,000.00 to $600,000.00 per year (12 month period).

3 SCOPE OF PROPOSALS

Each proposal shall only address one research area of interest (summarized under Section 2.1). A single Offeror can submit multiple proposals. The topic of primary interest should be clearly identified in the proposal. Teaming between industries, independent research centers, and academia is encouraged.

4 PROCUREMENT SCHEDULE

The planned procurement schedule is as follows:

Release of BAA	6 August 04
White Papers due	25 August 04
White Paper Feedback	15 September 04
Proposals due	8 October 04
Award notification	6 December 04
Contract Award	1-15 January 05

5 OVERVIEW OF PROPOSAL PROCESS

This BAA has a two-step procurement process in order to maximize the efficient use of the Offeror's and Government's time and resources.

1. Offerors are encouraged to submit White Papers for review by the Government. Based on the evaluation of these white papers, selected Offerors will be encouraged to submit more detailed proposals. The intent of a request for white papers is to minimize the labor and costs associated with producing a detailed proposal. All interested Offerors, therefore are encouraged to submit white papers. However, all proposals submitted under the terms and conditions cited herein will be reviewed. An Offeror will not be eliminated from consideration or evaluated based on its White Paper or the lack thereof.

2. Submission of proposals for evaluation.

6 WHITE PAPER SUBMITTAL, PREPARATION, AND REVIEW

6.1 White paper Submission Date/Time

Offeror's White Paper shall be submitted electronically to GI2VIS@westfields.net. To ensure review, White Papers must be received according to the schedule in Section 4 and meet the requirements outlined in Section 6.2. Hand delivered, faxed, or mailed White Papers will not be reviewed.

6.2 White Paper Preparation

Offerors are strongly encouraged to submit a White paper that clearly identifies the research area of interest, the technical challenges that are to be addressed, and a general approach to solving the identified problems. Each White Paper should address a single topic.

The following instructions shall be followed in the preparation of White Papers.

White Papers shall be no longer than four pages (a "page" is 8-1/2 by 11 inches with type not smaller than 12 point), plus a cover page for a total of five pages. White papers shall be presented in Microsoft Word 97 or 2000. Files from other software applications are not acceptable.

The White Paper shall have a one-page cover sheet that includes the following information:

1. BAA number;
2. GI^2Vis research area of interest addressed;
3. White Paper title;
4. Principal Investigator including: name, telephone number, electronic mail address, fax (if available) and mailing address;
5. Administrative point of contact including: name, telephone number, electronic mail address, fax (if available), and mailing address; and
6. Summary of the total base and option cost - including cost sharing if relevant.

The White Paper, itself, should include the following information:

1. Title of Proposal, with an enumeration of the research topic of interest;
2. A clear, concise, specific, and organized overview of the Offeror's goals, objectives and technical rational, technical approach to meeting those challenges, and constructive research plan for accomplishment of the technical goals;
3. Innovative ideas for the proposed research, succinctly describing the unique proposed contribution;
4. Expected Outcomes;
5. List of Key Technical Personnel with short description of credentials

6. Summary of Estimated Costs

(NOTE: The information provided for item 5, Technical Personnel and 6 Estimated Costs will be used for informational purposes only and will not be included in the evaluation of the White Paper)

6.3 White Paper Review

White Papers will be reviewed against criteria (1) and (2) under Section 8.1. A notification to encourage or discourage submission of proposals will be sent directly to the Principal Investigator (PI) according to the schedule in Section 4. Government responses will be transmitted via e-mail. Offerors are advised that encouragement to submit a proposal does not imply or guarantee an award.

7 PROPOSAL SUBMISSION AND PREPARATION

7.1 Proposal Submission

Offeror's proposals shall be submitted electronically to GI2VIS2westfields.net. Hand delivered, faxed or mailed proposals will not be reviewed. The e-mail address provided above serves as a collection point for proposals. The Government will provide return e-mail notification to the Offeror that the proposal has been received.

The closing date of this BAA is 08 October 2004. Proposals received after the close of this BAA will not receive consideration.

7.2 Proposal Preparation

The following instructions, as well as other instructions in Section 7 subsections, shall be followed in the preparation of proposals. Failure to comply may result in the proposal being deemed non-responsive and excluded from consideration.

Proposals shall be formatted only as Microsoft Office files and must be less than 1.95MB in file size. The proposals must reference BAA number HM1582-04-BAA-0007. Compressed proposals formatted as .zip files will be rejected due to potential computer virus considerations.

Proposals shall include the following sections:

1. Cover Sheet;
2. Abstract (Project summary);
3. Technical Section;
4. Personnel Section;
5. Past Performance Section; and
6. Cost Section.

No cost information shall be anywhere in or on the technical proposal or cover page.

Technical proposals shall be readable in Microsoft Word 97 or 2000 and cost proposals shall be readable in Microsoft Excel 97 or 2000 with no cell references that are external to the file, in a stand-alone manipulable form. Both technical and cost proposals shall reference BAA Number. Separate attachments, such as institutional brochures or reprints that are not germane to the proposal, are discouraged.

The Offeror must work within all the noted page restrictions and file size restrictions. If page restrictions are violated for a specific section, then any information beyond the stated limitation will not be considered, i.e. the section will be truncated down to the maximum pages allowed. A "page" is 8-1/2 by 11 inches with type not smaller 12 point.

7.2.1 Cover Sheet

Maximum pages: 1 (See Appendix C)

The Cover Sheet must include the following information:

1. BAA number;
2. GI^{2}Vis Technical Topic of interest addressed;
3. Proposal title;
4. Technical point of contact including: name, telephone number, electronic mail address, fax (if available), and mailing address; and
5. Administrative point of contact including: name, telephone number, electronic mail address, fax (if available), and mailing address.

7.2.2 Abstract (Project Summary)

Maximum pages: 1

The Abstract should include the following information:

1. A description of the GI^{2}Vis challenges to be addressed in the research and a high-level overview of the Offeror's goals, objectives and technical approach to meeting those challenges;
2. Innovative claims for the proposed research, succinctly describing the unique proposed contribution; and
3. A narrative scenario that illustrates the expected use or impact of the proposed research in such a way that the Offeror's understanding of GI^{2}Vis technical objectives is apparent.

7.2.3 Technical Section

Maximum pages: 15

The Offeror shall submit a clear, concise, specific, and organized technical description that will serve as the technical baseline for any resultant contract. This Technical Section shall provide the Government with a detailed discussion of the proposed work that is sufficient enough to allow an in-depth review of the specific technical and managerial issues. The Technical Section shall include:

1. Technical rationale, technical approach and constructive research plan for accomplishment of technical goals in support of innovative claims and deliverables.

2. Comparison with other ongoing research, indicating advantages and disadvantages of the proposed effort.

3. Proposed Statement of Work (SOW) written in plain English, outlining the scope of the effort and citing specific tasks to be performed and specific contractor requirements, including a schedule of milestones for the proposed research.

4. Deliverables associated with the proposed research. Include in this section all proprietary claims to results, prototypes, or systems supporting and/or necessary for the use of the research results. If there are no proprietary claims, this should be stated.
   1) The Offeror SHALL submit a separate list of all technical data or computer software that will be furnished to the Government with other than unlimited rights in accordance with DFARS 252.227-7017, Identification and Assertion of Use, Release, or Disclosure Restrictions.
   2) Each contractor shall be required to submit bi-monthly project status reports, cost reports, and an interim and a final technical report. Distribution of the Final Report is public release. Any proprietary information shall be attached to the Final Report.
   3) Each contractor shall be required to provide deliverables (software source code, compiled libraries, binary executables, data sets, and documentation) for use in a government test facility. The Offeror is to address these requirements, along with any and all other proposed data items and / or other types of deliverables, in their proposal. *All* Offerors are also expected to briefly describe their plan for moving these software deliverables into a government test facility. This plan will identify various milestones during the life of the project when components are expected to be delivered to a government test facility. Finally, as part of their proposal, Offerors are required to identify any limitations, restrictions, or caveats to ARDA's use of a separately contracted system integrator and/or its proposed integration and testbed evaluation process. Additional information on the nature and scope of these anticipated activities by a government test facility can be found in Section I Paragraph 13.

5. Description of the facilities available for accomplishment of research objectives. Describe any equipment planned for acquisition under this program and its application to objectives.

6. All Offerors and proposed subcontractors must affirmatively state whether they are supporting any ARDA technical office(s) through an active contract or subcontract. "Support contract" or "support contractor" includes a contract or subcontract for acquisition of System Engineering and Technical Assistance

(SETA) services, and other support service contracts in which any one of the following situations apply: have personnel who regularly maintain offices or frequently occupy space within ARDA; maintain external spaces in which ARDA personnel maintain offices or frequently occupy; or have personnel with any access to the ARDA fiscal database, or contractual or programmatic documentation related to other than their own contract(s). All affirmations must state which office(s) the Offeror supports, and identify the prime contract number. Affirmations should be furnished at the time of proposal, submission. All facts relevant to the existence or potential existence of organizational conflicts of interest, as that term is defined in FAR 9.501, must be disclosed in the proposal, organized by task and year. This disclosure shall include a description of the action the Contractor has taken, or proposes to take, to avoid, neutralize, or mitigate such conflict. Any awards made under this BAA may be subject to the provisions of the Federal Acquisition Regulation (FAR) Subpart 9.5, Organizational Conflict of Interest.

7.2.4 Personnel Section

Resumes should be limited to four (4) pages per person, for a maximum of five people. In the case of a proposal consisting of multiple teams / sites, the maximum of five resumes is applied against each of the proposed teams / sites. This Personnel Section should be separate from the Technical and Cost Sections.

Describe the qualifications of the principal investigator and other key researchers involved in the project. Curriculum vitae must be included for PI and key researchers. For consortia or collaborations, one individual should be the designated PI for purposes of technical responsibility and point of contact.

Indicate the level of effort to be expended by each person during each contract year and other (current and proposed) major sources of support for them and/or commitments of their efforts. ARDA expects all core personnel associated with a proposal to make substantial time commitment to the proposed activity. A chart, such as the following, is suggested.

Participants	Organization	Role	Year 1	Year 2
John Doe	ABC University	Key Personnel / PI	25%	35%
Peter Fillmore	ABC University	Key Personnel		
Mary Smith	ABC University	Significant Contributor	50%	50%
Doctoral Candidate 1	ABC University	Contributor	25%	25%
Doctoral Candidate 2	ABC University	Contributor	40%	40%
Graduate Assistant 1	ABC University	Contributor	50%	50%
Abigail Stone	XYZ Co.	Key Personnel	25%	25%
Ronald Johnson	XYZ Co.	Significant Contributor	40%	50%
Graduate Assistant 1	XYZ Co.	Contributor	25%	50%

7.2.5 Past Performance Section

Maximum pages: 1 (per reference)

The Offeror shall select three contracts in support of private or public customers, which demonstrate its past performance. Preferably, these contracts will have been awarded within the last five years (however, if submitting information on completed contracts, the completion date must be within the last three years) and shall, as nearly as possible, satisfy the following criteria:

The past performance information should be relevant and comparable, in scope and complexity, to the work being performed under the proposed contract. Examples of unique performance should be included. If a specific subcontractor will perform a major portion of the proposed effort, the contractor may submit relevant subcontractor information separately; and

The work was performed within the same plant(s) and / or division(s) as the one in which a contract resulting from this solicitation will perform.

If the Offeror determines that it has not performed any contracts that are relevant to this BAA, then the proposal shall state this fact.

7.2.6 Cost Section

There is no page limit on this section.

The Cost Section shall contain cost estimates sufficiently detailed for meaningful evaluation - including cost details for proposed sub-awards. For budget purposes, use an award start date per schedule Section 4. The Cost Section must include the total cost of the project, as well as a breakdown of the amount(s) by source(s) of funding (e.g., funds requested from ARDA, non-federal funds and/or institutional funds to be provided as cost sharing). The costs should be broken down for the base year and one option year. Costs of entertainment, amusement, diversion and social activities and any costs directly associated with such activities are unallowable. Elements should include:

1. Cover sheet to include: name and address of Offeror; name, title, and telephone number of Offeror's point of contact; award instrument requested: cost-plus-fixed-fee (CPFF), cost-contract-no fee, cost sharing-no fee, or other type of procurement contract (specify), grant or agreement; name, address, and telephone number of the Offeror's cognizant Defense Contract Management Agency (DCMA) administrative Office (if known); name, address, and telephone number of the Offeror's cognizant Defense Contract Audit Agency (DCAA) audit office (if known);

2. Time being charged to the project: for whom (principal investigator, programmer, graduate student, etc.), and the commensurate salaries and benefits. Allowable charges for graduate students include salary, appropriate research costs, and tuition. Allowable charges for undergraduate students include salary and research training costs, but not tuition;

3. Fringe benefits;

4. Costs of equipment: Based on most recent quotations and broken down in sufficient detail for evaluation (equipment costs should be budgeted primarily during the first year). Allowable equipment will ordinarily be limited to research equipment and apparatus not already available for the conduct of the work. General-purpose equipment, such as a personal computer, is not eligible for support unless exclusively used in the actual conduct of scientific research;

5. Travel costs and time, and the relevance to stated objectives;

6. Other direct costs: materials and supplies; publication, documentation and dissemination; consultant services; computer services; communication costs not included in overhead; other (identify);

7. Sub-award costs and type (the portion of work to be sub-awarded and rationale); note that the sub-award of funds among all university and industry performers responding as one consortium must be described carefully in both the text and the cost section. Collaborations between industry and academic institutes are strongly encouraged; and

8. Indirect costs.

8 PROPOSAL EVALUATION

The proposals will be evaluated using the following two-step evaluation process:

1. Technical Evaluation; and
2. Cost Evaluation of Technically Acceptable Proposals.

Offerors are advised that non-Government consultants may assist the Government during the Government's evaluation of proposals. These persons shall be authorized access to only those portions of the proposal data and discussions that are necessary to enable them to provide specific technical advice on specialized matters or on particular problems. They shall be expressly prohibited from scoring, ranking or recommending the selection of a source.

Furthermore, it is anticipated that MITRE personnel will help in the evaluation process and throughout the life of any resultant awards. MITRE is a federally funded research and development center.

All contractor personnel will have signed a non-disclosure statement with the Government.

8.1 Technical Evaluation

The following criteria will be utilized for the Technical evaluation. The criteria are ranked in order of relative importance. Criterion 1 is of equal importance a criterion 2. Criterion 3 is of lesser importance than these, and criterion 4 is of still lesser importance.

1. Scientific and technical merits of the proposed research;
2. Relevance and potential contributions of the research to intelligence missions;
3. The ability of the principal investigator and other key research personnel to perform the proposed research; and
4. Past performance/corporate reputation for product quality, support, and timeliness; and current/planned interactions with other organizations engaged in related research and development, in particular for intelligence applications.

Proposals that demonstrate a significant degree of technical value are deemed technically acceptable.

8.2 Cost Evaluation of Technically Acceptable Proposals

Proposals that are technically acceptable will be analyzed to ensure that proposed costs are reasonable and realistic including proposed cost sharing.

All technically acceptable proposals whose costs are reasonable and realistic are deemed selectable.

9 AWARD SELECTION AND NOTIFICATION

Awards will be made from the pool of proposals that were determined to be selectable via the process defined in Section 8. Selection of proposals for award is based on the following factors:

1. Technical Proposal rating;
2. Cost;
3. Need to balance research activity; and
4. Available Funding.

An example of balancing the research activity would be that the Government may select for award a proposal that was rated lower than other proposals but offers a unique research opportunity. Conversely, the Government may choose to not award to a highly rated proposal because it has a similar research approach compared to a more highly rated proposal that was already chosen for award.

In general, Cost becomes more important as differences among the other factors between selectable proposals grow less.

Not all proposals deemed selectable will be funded. The Government reserves the right to select for award all, some, or none of the proposals received. The actual number of contracts awarded will depend on the number of selected proposals, cost of individual awards, availability of funds, and research opportunities.

The Government reserves the right to accept a portion of a proposal or to request specific modifications to any proposal and enter into negotiations to resolve any issues and related adjustments to a proposal.

You will receive an email notification of whether or not you are selected for award. Awards are expected to be in place soon after the recommendation letters have been distributed.

The Government does not intend to hold discussions, within the FAR meaning, with Offerors prior to selection of proposals for award.

10 CLAUSES

Offerors are hereby advised that any resultant awards will be subject to the following general terms and conditions:

1. NGA Clause 5552.227-9000, Unauthorized Use of NGA Name, Seal and initials
2. DFARS Clause 252.204-7000 Disclosure of Information (Dec 1991)
3. FAR Clause 52.217-9 Option to Extend the Term of the Contract (Mar 1989)

11 OTHER PERTINENT INFORMATION

1. Registration in the DOD's Central Contractor Registry (CCR) database will be a prerequisite for receiving an award resulting from this solicitation. Proposals must reflect compliance or initiation of compliance with this regulation. Information on CCR registration can be found in section 15. Offeror's DUNS number (and CAGE code if one has been assigned) must accompany proposal in order to verify CCR registration. Proposals must identify the Offeror's Taxpayer Identification Number (TIN).
2. Certifications will be executed during negotiation of winning proposals.
3. The information provided in this BAA, as announced in the Federal Business Opportunities (FEDBIZOPPS), constitutes a competitive selection as contemplated in FAR 6.102(d)(2)(1).
4. In the case of the principal Investigator leaving the organization he/she is representing, the Government has the right to terminate the contract.

This BAA represents the totality of available information regarding this acquisition. Requests for hard copies of the FEDBIZOPPS announcement or BAA will not be honored. Interested parties may stay apprised of this solicitation including revision

information and answers to submitted questions by daily checking the NGA/PC public web site at http://164.214.2.59/poc/contracts/contracts.html.

12 PROJECT REVIEWS MEETINGS

The Program Committee will conduct frequent reviews of both the overall program progress and the individual contract performance through informal 1-day project reviews or kickoffs, semi-annual 2-day program-level reviews or kickoffs, and periodic 1-2 day evaluation/integration workshops. The following tentative schedule should be used during preparation of both technical and cost proposals.

Type of Review	Tentative Date	Tentative Location
Program-level Kickoff	45 days after AOC	East Coast
Project Kickoff	Within 90 days after AOC	Contractor's Site
Program Level Review	6 Months after AOC	Washington DC
Project Review	9 Months after AOC	Contractor's Site
Annual Program-level Review	12 Months after AOC	West Coast
Project Review	15 Months after AOC	Contractor's Site
Program Level Review	18 Months after AOC	East Coast
Project Review	21 Months after AOC	Contractor's Site
Final Program-level Review	24 Months after AOC	Washington DC

The Program-level Reviews and kickoff will focus on technical aspects of the program, on program-level evaluation and data issues, and on facilitating open technical exchanges, interaction, and sharing between the various program participants. These reviews will include technical presentations by each contractor during which the contractor will openly describe the technical aspects of their research, results of evaluations conducted, and progress/successes/failures that have occurred as part of their funded research. It is expected that the Principal Investigator of each awarded contract and each significant subcontract (or their designated senior technical representative) will attend each of these Program-level Reviews. The contractors are strongly encouraged to include members of the research staff (graduate students, post-doctoral, and even junior researchers) in their Program-level Review contingents so that they can provide in-depth details of their particular work. The ARDA Program Committee anticipates that a significant number of interested government personnel will also attend and the committee may also elect to invite selected, non-participating technical observers.

The project reviews, held at a site proposed by the contractor and approved by the government, will be attended by the project's COTR and other members of the Program Committee and will focus on project specific technical and administrative issues. The project reviews will provide an opportunity for more in-depth discussions of the technical progress of each individual project.

13 GOVERNMENT TESTBED ENVIRONMENT

13.1 Overview

The principal focus of ARDA's R&D Programs is on advanced research and development. In particular, ARDA's interests centers on identifying and sponsoring innovative research ideas that address some of the most challenging and formidable obstacles to dramatic progress within the field of information technology. On the one hand this implies that these new, advanced research ideas must be high risk, maybe even speculative, and may require long-term support. But this also means that the potential for high risk must be balanced by the promise of high impact and high payoff if the pursued research directions yield tangible results. An important measure of this impact and payoff is the degree to which the results of ARDA sponsored research efforts ultimately are inserted, transferred or otherwise transitioned into operational use.

In the case of the GI2Vis Program, its fundamental goal is to develop advanced data and information visualization techniques for use during both analysis and the presentation of results to colleagues and decision-makers. But at the same time it is important that ARDA and its Information Exploitation (Info-X) R&D Thrust (note that GI2Vis is one of three major R&D programs in this Thrust) directly support and facilitate the subsequent transition of research successes into larger system architectures and analysis tools for use by intelligence analyst against important operational problems and requirements.

In order to actively pursue this latter technology transfer goal while still retaining a clear focus on its advanced research goals, the Info-X R&D Thrust has adopted a Thrust-wide strategy. The central feature of this strategy is a flexible, scalable test facility to directly support all of the Info-X Thrust R&D Programs.

One can think of this government test facility as an intermediary between the researcher/developer's laboratory and operational environments within the IC/ DoD and other government agencies and organizations. The test facility will function as a repository of software systems/components that are developed under the various Info-X Research programs. The principal goal here is to transition the software that ARDA has funded out of the researcher's lab and verify that first, it can be installed successfully and then operated at an independent site. Once the software has been successfully installed ARDA will actively search for further opportunities to hasten the future technology transfer of this software systems/ components into operational use to the maximum extend possible. The functions performed by a government test facility include but are not limited to the following;

1. Reduplicate any tests/experiments that the researcher had conducted -- using the same data sets also provided by the research
2. Conduct additional experiments using other data sets provided by interested government parties; these data sets may range from unclassified, open source data sets to classified data sets.

3. Conduct, where appropriate, more task oriented tests, experiments and evaluations. The goal here is to get a better feel as to whether or not the software has operational utility and to identify potential operational applications as specifically as possible. To the extent possible, these activities will be conducted using either current analysts or other personnel who have significant experience as working analysts.
4. Look for opportunities to loosely couple available systems with other systems and other available GOTS/COTS software in order to study potential utility of more comprehensive systems.
5. Have the ability to conduct demonstrations for interested government personnel. While these demonstrations would be primarily given on-site, off-site demonstrations may be possible in specific cases using high end laptops, via remote login or other client/server arrangements, via internet / web access or other similar means. The primary audience from the government would be researchers (to see status of on-going research), operators/ analysts/ managers (to see what's available and to provide feedback to the original researchers), and technologists, in particular those responsible for technology transfer, (to see what types of capabilities are available and technologically ready for transfer).
6. Perform liaison with technology transfer organizations associated with individual government/military agencies and organizations in order to determine what systems/components might be of interest to these agencies/ organizations and then to facilitate the transfer of selected systems/ components.

The GI^{2}VIS Program as described herein is clearly a basic and applied R&D Program. The importance of the separate, yet tightly coupled, system integration, robust prototype development and test bed evaluation activities described above is based upon the fact that the GI^{2}VIS Program is seeking to produce much more than just significant research results and advancement. The ultimate success of the GI^{2}VIS Program will be the degree to which major research advances can be quickly, widely, and effectively transitioned into practical solutions to multiple, critically important Intelligence Community operational problem. The use of a test facility in particular, provides an intermediate step for determining the effectiveness, robustness, interoperability and extensibility of a research assumption before a system is fully developed for operational use.

In summary, the use of a government test facility provides an opportunity to determine which components, subsystems, and full-systems developed during GI2Vis sponsored/funded projects are, in fact, potential candidates for technology transfer into operational use in their own right as well as to identify ways in which multiple components/systems developed by GI2Vis contractors could be successfully integrated and/or combined with other GOTS/COTS systems/components and existing operational systems to produce even more comprehensive, effective, efficient solutions to challenging operational problems.

13.2 Test Facility Participation

All Offerors are expected to include in their proposal a plan for moving their technology into a government testing facility. This plan will identify various milestones during the life of the project when components, subsystems and full-systems and their upgrades can be delivered to the test facility. ARDA's Info-X Test Facility, in concert with government researchers and technologists from ARDA, the GI^{2}Vis Program Committee, and/or the sponsoring Intelligence Community agencies, will work directly with the GI^{2}VIS contractors to facilitate the movement of these prototype visualization technologies into the test facility. Early movement of prototype elements to the test facility is strongly advised to provide insights into design assumptions and integration challenges that will help guide the on-going research process. Participation with the test facility is also expected to help produce appropriate API's and other integration standards / conditions and resolve problems resulting during the integration process.

14 PATENT AND DATA RIGHTS CLAUSES

Offerors are hereby advised that any resultant contract will be subject to the following clauses:

1. FAR 52-227-11 Patent Rights – Retention by Contractor (Short Form) (for small businesses) or FAR 52.227-12 Patent Rights – Retention by Contractor (Long Form (for big businesses);
2. DFARS 252.227-7013 Patent Rights - Acquisition by the Government;
3. DFARS 252.227-7014 Rights in Data – General;
4. DFARS 252.227-7015 Representation of Limited Rights and Restrictive Computer Software

If the Offeror proposes to bring in data or software that has been developed at its own expense before this contract, then the Offerors are hereby advised that any resultant contract will be subject to the following clauses:

1. DFARS 252.227-7037, Validation of Restrictive markings on Technical Data; DFARS 252.227-7013, Rights in Technical Data; and
2. DFARS 252.227-7017, Identification and Assertion of Use, Release or Disclosure of Restrictions

The Offeror shall include in their proposal any data they propose to deliver under any resultant contract that will be subject to restricted rights.

15 USE OF EXISTING COTS AND/OR GOTS SOFTWARE COMPONENTS

An Offeror may incorporate existing COTS and/or GOTS software components into their approach to provide a framework that allows greater latitude in proposing innovative and revolutionary research in more focused areas. **CAUTION:** Any software developed

under must NOT be so tightly coupled with any existing COTS and/or GOTS software that it becomes difficult or cost prohibitive for the government to integrate it with other similar products. Offerors must clearly state any plans for use of COTS/GOTS products, identify the COTS/GOTS products to be used, specify the cost and any assumptions about existing or emerging capabilities that they plan to use or on which their research depends.

16 CENTRAL CONTRACTOR REGISTRATION (CCR)

CCR is a single repository for contractor data and is updated annually by registrants. The Defense Finance and Accounting, and Director, Defense Procurement required all contractors to be registered in CCR to receive solicitations awards, or payment. To register in CCR, you may use any one of the following methods: (1) Mail a completed application to the Department of Defense (DoD), Central Contractor Registration Assistance Center, Telephone: 1-888-CCR-2423. (2) Input directly to CCR through the WWW application linked from the CCR home page at: http://www.ccr.gov/handbook.cfm.

Should you need additional information please send electronic mail to dodedi@acq.osd.mil or visit their home page at http://www.ccr.gov/handbook.cfm/. The DoD has established a goal of registering an applicant in the CCR database within 48 hours after receipt of a complete and accurate application via the Internet. However, registration of an applicant submitting an application through a method other than the Internet may take up to 30 days. Please note that this policy applies to all DoD procurements, effective 31 May 1998. Please take the time to register now.

17 UNIQUE REQUIREMENTS

The Phase III program is funded by the Intelligence Community's Advanced Research and Development Activity in Information Technology (ARDA) a U.S. Government entity which sponsors and promotes research of import to the Intelligence Community which includes, but is not limited to, the CIA, DIA, NSA, NGIC and NGA. Government representatives from various Intelligence Community Agencies form the Phase III Committee under the leadership of ARDA and NGA. This ARDA-led government committee will assist with the execution, management, and technical direction of the individual contracts awarded. It is anticipated that awards may be made by other Agencies in addition to NGA. These Agencies will each executive individual contracts within the larger program and will use their internal Contracting Officers (COs), Contracting Officer's Technical Representatives (COTRs) and administrative procedures.

18 REMINDER

ONLY E-MAIL PROPOSALS ARE ALLOWED. PAPER PROPOSALS WILL NOT BE ACCEPTED

19 SOURCE SELECTION OFFICIAL

Jon Dale, Contracting Officer Representative, NGA, Innovision
Voice: (703) 735-3055
E-Mail DaleJ@nga.mil

20 CONTRACTING SPECIALIST POINT OF CONTACT

All communication concerning this BAA shall be through Ms. Christy McCabe, NGA, Contracting Specialist:

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Part 2
PROGRAM DESCRIPTION

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1 ANALYTIC USES FOR INFORMATION VISUALIZATION WITHIN PHASE III OF GI^{2}VIS R&D PROGRAM

1.1 Overview

Information Visualization has the potential to be a powerful force multiplier across the entire Intelligence Community for all types of analysis and reporting activities executed by Intelligence Community Analysts. However the tantalizing potential that information visualization offers has yet to be fully realized. ARDA does not believe that there is a single, simple, elegant way to correct this situation. Rather, ARDA believes that significant, marked progress can be achieved towards reaching this potential by focusing advanced R&D activities on several key, underlying roadblocks to this progress. ARDA's GI^{2}Vis R&D Program has been established to focus on these selected areas of Information Visualization on behalf of the Intelligence Community.

Before describing the specific technical problem topics that will be the focus of the advanced R&D program, we wish to briefly describe the three similar, yet distinct "Analytic Uses of Information Visualization" that ARDA and the GI^{2}Vis Program have identified within the Intelligence Community that will focus and drive the research that will conducted throughout the GI^{2}Vis Program. **It is within the scope and context of these three analytic uses that the technical problem descriptions that follow need to be interpreted and understood by potential Offerors of technical proposals developed and submitted in response to this BAA.**

1.2 Selected Analytic Uses for Information Visualization.

The three Analytic Uses of Information Visualization that ARDA and the GI^{2}Vis Program have identified are

1 Exploration. Exploration of Massive, Complex, Heterogeneous Data. The goal of this use of visualization is to more effectively and efficiently assist the Analyst in performing varying degrees of undirected knowledge discovery against potentially unknown data sources that may be massive, diverse, and/or complex. In this environment, the hope is that Analysts will recognize the importance of information and knowledge when they see it. "I'll know it when I see it".

2 Deep Analysis. Deep Analysis of Relevant, Related, Topical Information. The starting assumption in this use of visualization is that the Analyst has already accumulated a manageable collection of information that he or she believes is relevant or otherwise related to the current intelligence requirement that the Analyst is currently addressing. The goal of the Analyst at this stage is to discover and understand how the individual pieces of information that he or she is starting with fit together in a larger mosaic. The hope is that information visualization will make this process far more effective and efficient from the Analyst's perspective.

3 Presentation. Presentation of Intelligence Analysis Results to Senior Decision Makers/Intelligence Community Customers. In this case the Analyst has completed his or her analysis of the data and information associated with a given intelligence requirement to a sufficient level that reportable intelligence results are now available. The hope is that more formal information visualization presentations will help make this reporting function far more effective and efficient. This is particularly

important when complex, detailed intelligence results - potentially involving alternative scenarios/analyses - need to be presented in a succinct, yet comprehensive manner. These information visualizations are necessary but not sufficient for making presentations effective.

Appendix B to this BAA provides a more detailed description of these three analytic uses of visualization, briefly describes the central role of the Intelligence Analyst in these three uses, illustrates the similarities and differences of these three uses in a single diagram, and highlights three important and closely related contextual factors which are:

1. Underlying operational requirement(s);
2. Overarching context; and
3. Tacit knowledge that the IC analyst brings to the table.

Potential Offerors are encouraged to review this Appendix prior to and during their review and study of the technical problem descriptions that follow in the next section. Selected Analytic Uses for Information Visualization.

1.3 Data types for Intelligence Analysis

This section is included to provide a high level overview of the types of data that all-source analysts in the Intelligence Community may encounter. Not all data types will be relevant to all intelligence analysis problems, however this list is provided to give a general understanding of prevalent data types.

Geospatial data
- Maps
- Feature Vector data
- Overhead Imagery
- Elevation data
- Multi-Spectral Imagery / Hyper-Spectral Imagery
- RADAR
- LIDAR
- Motion Imagery (e.g., UAV)

Textual data
- Email and other informally written documents
- Cable Traffic
- Memorandum
- Intelligence Reports (e.g., Imagery analysis reports, President Daily Brief, etc.)
- Newspaper / newswire reports
- Technical / scientific articles
- Open Source (e.g., web pages, list & discussion (chat) groups, ‘deep web’)

Tabular data (raw and extracted)

Signals data
- Telemetry

SIGINT – signals intelligence
Electronic (e.g., radar emitters) collections
Telecommunication collections

Other

Broadcast video (e.g., Streaming news feeds)
Broadcast audio (e.g., radio news)

Note: All human readable materials may be in a variety of languages

2 INTRODUCTION

The activities of intelligence analysts include, in broad terms, analysis and presentation. In the analysis process, the analysts collect data, read or view them, and develop an understanding of what is happening, its importance, and its value. The second set of activities is presentation. If the results of analysis at all levels are not made available to others in a clear, timely, and effective manner, then the analysis that has been accomplished has gone for naught. In this second case, the analyst needs to present the results of the analysis to his/her peers, supervisors and to policy makers. In the course of the analyst's work, he or she might need to trace the current results or situations and present the results to himself/herself. Thus, these two sets of activities, namely analysis and presentation, are not mutually exclusive but rather are highly intertwined.

ARDA through Phase III of its GI^{2}Vis R&D Program is soliciting advanced research proposals in one or more of the research topic areas described below. Each proposal should focus on exactly one of the three major categories labeled 1, 2, and 3 mentioned below. Offerors wishing to address multiple categories may do so by submitting separate proposals.

ARDA sponsors high risk, high payoff research designed to produce new technology to address some of the most important and challenging IT problems faced by the IC. The GI^{2}Vis program is seeking research proposals that fall within the areas of basic and applied research as described here:

- Basic research includes all effort of scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs. It provides farsighted, high payoff research that provides the basis for technological progress.
- Applied research translates promising basic research into solutions for broadly defined intelligence and military needs, short of development projects. This type of effort may vary from sophisticated bread-board hardware, study, programming and planning effort that establish the initial feasibility and practicality of proposed solutions to technological challenges.

3 SCOPE OF GI^{2}VIS PHASE III PROPOSALS

The three research areas of interest are:

1. Integration and Representation of Disparate and Large Information Sources;
2. Maximizing Visualization Effectiveness and Facilitating Visualization Use; and
3. New Visualization Paradigms.

The first two areas are further subdivided into subcategories. A proposal developed for one of these three top-level areas of interest may choose to focus on one or more of these subcategories described in section 5. While ARDA does not exclude proposals that address a single subcategory, Phase III of the GI^{2}Vis Program is particularly interested in proposals that cut across multiple subcategories with a consistent, unified approach. In all cases, proposals in responses to this BAA must propose to research, investigate and implement new, innovative ideas and methods that will use visualization to facilitate, improve and make the analysis activities (both the analysis and presentation phases) more effective and objective. Offeror's proposals should address one or more of the research questions that have been identified under each subcategory. These proposals must also specifically address how the proposed research approach will materially and positively impact one or more of the Uses of Visualization (Exploration, Deep Analysis and Presentation) discussed in Section 1 and in further detail in Appendix B.

Additionally, proposals must address the effectiveness and utility of their proposed research.

1. Methods, processes, or guidelines to measure or evaluate the effectiveness or increased value of utilizing visualization in various analytic processes must be addressed in each proposal.
2. Issues such as ease of use and understanding, learning curve, and level of complexity of new processes, methods, and systems should be considered.

4 RESEARCH AREAS OF INTERESTS AND THEIR SUBCATEGORIES

4.1 Research Area of Interest 1: Integration and Representation of Disparate and Large Information Sources

4.1.1 Background:

The challenge in today's intelligence community is how to quickly view, fuse and integrate data extracted from disparate sources. The analyst must quickly view different types of data coming in various modalities and genres, make sense of the information, summarize, extract, and provide analytical judgments to peers and the policy makers. Dealing with this integrated data and communicating its relevant content and significance can be done more effectively in many cases using visual means. In particular there is a strong need to develop methods and tools for visual analysis and presentation of geospatial data with other forms and modalities of data.

This research topic is particularly interested in visualization algorithms, techniques, methodologies and approach that focus on one or more of the following subcategories of this research topic.

4.1.1.1 Subcategory 1A: Visual Data Integration

Methods and tools are needed for visual analysis and presentation of geospatial and other integrated data. The main thrust and impact of this research topic to the all-source analyst is on the visual component of exploration, search, and data integration leading to the generation of an effective final product.

Research Questions:

1. How can various types of intelligence be integrated together to represent and visualize relevant information in the analysis environment.
   Different types of data integration should include:
   1) Geospatial, spatial and non-spatial data, temporal information, abstract information, imagery, sound, weather, text, visual (static, animated and video)
   2) Data of different size, from different databases, different format (e.g., formatted or unformatted, structured, unstructured and semi-structured), data with and without meta tags, streaming data, live or static.

2. How can the time dependencies of integrated data be best visualized?
   Much data has a time element or dependence, and can be placed into a time line or within a sequence of events. For the analyst, having data or data objects integrated and placed in time sequence can provide context, temporal information, and enable a deeper understanding of the intelligence problem. The intelligence problem is reflected in these areas:
   1) Tools/techniques are necessary to visualize events that have a continuous representation over time along with events that are intermittent and those with temporal patterns.
   2) Tools/techniques are necessary to enable linking and representing intelligence data with geospatial and temporal components together.

3. How can various data types and forms be integrated and presented visually to better convey information to the policy maker?
   1) Visualization methodology should support static, live and streaming data, databases, data links, and alternative scenarios.
   2) Methods for analytical visualization should/could include, presentations driven by humans, presentations driven by software, and web-like tools or methodologies. These may include interaction with the audience.

   Example: An analyst presents information to policy makers, utilizing many forms of data on a new weapon system or new terrorist group, describing the organization, methods, types, and sources of an event.

4.1.1.2 Subcategory 1B: Dealing Visually with Massive, Heterogeneous, and Complex Data or Information Sources

Data and information facing analysts can quite often possess one, or more of the following aspects:

1. Very large sections of reasonably homogeneous data – Difficult because of its size.

2. Highly heterogeneous data of moderate sections – Difficult because of its diversity or differences
3. Highly complex data of even modest sections – Difficult because of the very high dimensionality and high degree of linkages that exist in the data.

A number of analytic algorithms and techniques have been developed in recent years to assist the analyst in performing a variety of analytic tasks against massive, complex, heterogeneous, geospatial, abstract and temporal data or information. These algorithms may measure similarities or differences, the depth of different types of correlations, the strength of linkages or relationships between individual data items, or identify, select or extract other identifying values, properties or characteristics in individual data or information objects. Through the selection and use of an appropriate metaphor, information visualization attempts to present to the analyst a visual representation of some combination of these similarities, correlations, linkages, relationships and values. This allows the analyst to gain valuable insights, make important and timely discoveries, efficiently and effectively select data for further analysis, evaluate hypotheses or competing alternatives, reach conclusions, detect trends, uncover relationships, see patterns, and otherwise visually understand and interpret data and information that would be far more difficult to do using non-visual means. The objective or goal of these visual representations is to use the analyst's visual capacity and ability to interpret and understand the data or information in question when non-visual means become overwhelmed due to the sheer massiveness of the data or information, or its complexity and heterogeneity.

Research Questions:

1. How can visual representations combine massive, heterogeneous and complex data and information to facilitate the understanding of inherent complexities and relationships? Visualization systems should:
   1) Combine heterogeneous data and information to facilitate the understanding of inherent complexities and relationships.
   2) Increase the capacity for representing massive, complex, and heterogeneous data and information visually.
   3) Visually reduce information overload and clutter.
   4) Use visual representations to summarize data and information of multiple source types to show the analysts enough information to carry out their work while providing links to related information.
   5) Take into consideration that there is a human limit to the volume and complexity that can be understood and retained from a visual presentation of information.

2. How can new visualization methods be effectively integrated into existing analytic tools and operations? It is often difficult to integrate new visualization methods with existing tools. For example, how can we interact with and make sense of visual representations of clusters, and integrate analysis tools with visual cluster representations?

3. How can the analyst visually and interactively drill down through textual and visual data and associated information while maintaining context. Visualizations can compactly represent massive, complex, and heterogeneous data and information, analysts and their customers need to drill down and see the details.

4. How can we link disparate visuals, and detect and represent relationships that may exist across them? Relationships in data and information can exist within a single visualization or across multiple visuals. Linking different visual displays to communicate context and correlated information will become increasingly important as multiple visualization methodologies are introduced into the analysts operational environment.

4.1.1.3 Subcategory 1C: Visual Expression of Integrity & Context

Visual representation of intelligence information needs to appropriately and correctly reflect the degree of uncertainty associated with the underlying data and its sources. The origins of this uncertainty are many and range from quantifiable degrees of uncertainty resulting from measurement and data processing errors to highly subjective degrees of uncertainty associated with data sources and with possible deception by those sources. In addition visualization needs to appropriately and completely account for the tacit knowledge that the analyst uses to effectively and efficiently analyze the available data against a given operational requirement within a current overarching analytic context. (See Appendix B for a further discussion.)

Research Questions:

1. How can context be communicated in visualization of information? Intelligence analysis is heavily dependent upon the context of an event or situation. As events unfold over time and space or the results of individual analytic efforts are integrated, it is important to preserve the context of the original observations. Techniques are needed to represent context to include geospatial, non-spatial (e.g. temporal, ethnicity), and abstract representations.

2. How can the uncertainty inherent in intelligence questions, data, and information be represented in visualizations? Uncertainty may involve a wide variety of issues including:
   1) Visualizations of ranges of probability do not lend themselves well to representation by simple lines. Gradation of shade does not preserve the precision of the calculated uncertainty for a given point. Effective visualization strategies and techniques are necessary to better represent this information to intelligence analysts and policy makers.
   2) As alternative scenarios are developed and we attempt to visualize them, there is a need to represent the evolving likelihood of particular outcomes among the range of possibilities.

3. How can visualization techniques be used to represent measures of consistency and missing information in the results of intelligence analysis? Research needs in this area include:

1) Tools/techniques to differentiate between holes and/or omissions within information sets and occurrences of null data.
2) Tools/techniques that allow the representation and detection of inconsistencies in data sets and the evaluation of conflicting data.

4. How can visualization methods be used to convey metadata to the analyst and in the intelligence products? Management and representation of ancillary data (such as attribute and metadata for maps and images, as well as annotations) is a difficult problem. In today's environment, the analyst often finds himself or herself downloading disparate data sets via networks and integrating this data into a common view. Tools or techniques are necessary to incorporate metadata with the data which provide the analyst or decision maker with rapid access to and clear understanding of this information.

4.2 Research Area of Interest 2: Maximizing Visualization Effectiveness and Facilitating Visualization Use

4.2.1 Background:

Intelligence community analysts are faced with sections of complex data from multiple sources and of multiple types that they must evaluate, correlate and use to support time critical decisions. Data sources for analysis may include text, message traffic, signal intelligence, geospatial data of various types including: maps, imagery, photographs, and video; other sensor data; as well as databases and open source information to include newspapers, internet, and broadcast. The analyst prepares and presents reportable findings along with supporting information to peers, superiors and decision-makers. These tasks are often performed utilizing rapidly emerging data and in a rapid response time environment.

Advancements in the effectiveness of visualization can provide improvements throughout the analytic process. These advancements should augment the analyst's insight and understanding of complex issues and improve how information and findings are integrated, composed, and presented.

To facilitate the use of visualization within the intelligence community, tools and methods must not only provide robust capabilities, but must be highly functional and efficient. Intelligence analysts may not be visualization experts and they have limited time to learn complex new methodologies. This creates resistance to the introduction of new tools and is one reason for the limited use of visualization technologies within the intelligence community today.
This topic is focused on the development of highly effective visualization tools and methods to support and improve analysis and presentation of intelligence data and to facilitate the adoption of visualization within the intelligence community. Evaluation of the effectiveness of these visualization tools and methods to is an integral part of the topic and must be considered in all proposals.

4.2.1.1 Subcategory 2A: Evaluation of Visualizations and Visualization Use by Non-experts

The applicability and effectiveness of incorporating visualization technology into the intelligence analysis process is not well understood. Methods are needed to measure the effectiveness or added value of utilizing visualization in various analytic processes. The style and scope of the evaluation may depend on the users, task, agency, domain, work environment, customer, and how users go about doing their work. Another consideration is usability; for successful adoption of new tools and methods, in addition to providing significant benefits to the analyst, they must also be relatively straightforward to introduce into the analytic processes. The visualization process is not a point solution and thus its overall effectiveness cannot be evaluated in isolation except in some cases where effectiveness depends solely on perceptual and cognitive abilities of the user.

Research Questions:

1. How can the effectiveness of visualizations be evaluated?

2. Could a general metric or a general set of metrics be developed?

3. Can meaningful guidelines be built that will enable visualization developers to make appropriate design choices based on the type of audience, task, agency, domain, and customer?

4.2.1.2 Subcategory 2B: Effective Visualization for Enhanced Analysis

Visualizations have been used successfully to find and identify patterns and relationships in disparate and large data sets. The challenge for Intelligence Community application is the complexity and variety of the geospatial, abstract, and temporal data and information that must be addressed by an all-source analyst. Visualizations that provide different ways of looking at data and information can be useful, but do not go far enough in helping the user with complex analysis. The intelligence community has been tasked to place more emphasis on exploring alternative courses of action. This may be accomplished by such techniques as comparison of alternative hypothesis and structured argumentation. Each scenario tested may be enhanced through the addition of temporal, geospatial, structural, or some other visualized component.

Research Questions:

1. How can the analyst see changing patterns in data as they develop?

2. How can the visualization be tightly coupled with the data to allow the analyst to delve into the underlying data?

3. How can visualization provide additional functionality or capability to existing analytic tools?

4. Can new analysis tools and methods be developed that are based on visualization technology?

5. Can visualization advances be made more tangible and relevant to support intelligence analysts?

4.2.1.3 Subcategory 2C: Effective Visualization for Presentation

Intelligence analysts present their research and findings to other analysts, superiors and decision-makers. Most analysts are inexperienced in visualization and do not have time to learn the complexities of layout and construction of polished visualizations. The visualizations that typically appear in Intelligence reports and presentations are in the form of pictures, graphs, or videos that are included to reinforce the information in the text. Novel visualization methods have the potential to dramatically increase the amount of information included in these reports.

Research Questions:

1. What methods can be found to incorporate information visualization into reports, documents and presentations?

2. How can visualizations be made an integrated part of the report or presentation, as opposed to representative images included for illustration?

3. What tools or methods can be developed to assist in the generation of professional looking visualizations that represent the information accurately, effectively, and concisely?

4.3

4.4 Research Area of Interest 3: New Visualization Paradigms

4.4.1 Background

The use of new visualization paradigms may provide greater understanding, insight and retention of the information being presented. The following are a few examples out of a large number of possibilities:

New paradigms are not limited to the present hardware environment. For example, high-resolution large screen displays with varying size (from desk size to large wall displays) will be a reality in the analysts' environments. These new environments will allow analysts to review and manipulate a large number of documents and look at both content and context simultaneously. New paradigms for visualization and presentation on large high-resolution displays are needed to make an effective use of these displays. Similarly, new capabilities to consider that for development of new visualization paradigms could include auto-stereoscopic 3D and 4D displays, multi-media, augmented reality systems, or other emerging technologies. Novel application of these technologies have the potential to provide analysts with better ways to view, exploit, and interact with complex mult-int intelligence information. Other possible areas of interest could include visual storytelling to provide alternative effective ways to present complex information.

Research Questions:
Offeror's proposals within Research Area #3 may choose to address one or more of the following research questions or choose to address a research question of their own choosing with the broad category of "New Visualization Paradigms". In this latter case the Offeror must clearly describe the new paradigms and most importantly, must justify why their new visualization paradigm would significantly enhance the effectiveness and/or efficiencies of Intelligence Community analysts.

1. How should the analyst's environment be modified to take advantage of the visualization and presentation opportunities provided by large, high-resolution screen displays or other new visualization technologies? Visualization of geospatial, abstract, and temporal data and information in high-resolution large screen displays with varying size (from desk size to large wall displays) provides the opportunity to organize and simultaneously present increasing amounts of information. These increases may provide the potential to better understand information context and interrelationships.

2. Can the use of storytelling or other unconventional methods be effectively applied to intelligence information visualization and presentation? Lessons from other areas, such as entertainment may provide insight into this area.

3. How can we use visualization and multimedia to effectively integrate sight, motion, and sound in representing data and information?

4. Can we devise other new visualization and presentation paradigms, not included in Research Questions (1)-(3) to take advantage of emerging display technologies? What is the applicability and effectiveness for the Intelligence Community?

APPENDIX A INTELLIGENCE COMMUNITY'S ADVANCED RESEARCH AND DEVELOPMENT ACTIVITY FOR INFORMATION TECHNOLOGY (ARDA)

ARDA is a joint Department of Defense and Intelligence Community organization that was established in December 1998. While the ARDA office is organizationally part of the National Security Agency, ARDA's mission is to incubate revolutionary Research and Development (R&D) activities within the broad field of Information Technology for the shared benefit of the Intelligence Community. In order to satisfy this mission, ARDA, in close cooperation with its Intelligence Community partners, originates and manages advanced R&D programs that:

1. Will have fundamental impact on future Intelligence Community operational needs and strategies;
2. Demand substantial, long-term venture investment to spur risk-taking;
3. Progress measurably toward mid-term and final goals; and
4. Take many forms and employ many delivery vehicles.

GI^{2}Vis has been developed under ARDA's guidance and direction by representatives from a number of Intelligence Community Agencies that include National Geospatial-Intelligence Agency, (NGA), the Central Intelligence Agency (CIA), the Defense Intelligence Agency (DIA), the National Reconnaissance Office (NRO), the National Security Agency (NSA), and the National Ground Intelligence Center (NGIC). NGA has agreed to issue the solicitation for GI^{2}Vis. The evaluation of white papers and proposals, the selection of awardees, the execution of the resulting contracts, and the overall management of GI^{2}Vis will be accomplished jointly by NGA and other Intelligence Community Agencies under the guidance and direction of ARDA.

APPENDIX B ANALYTIC USES FOR INFORMATION VISUALIZATION WITHIN PHASE III OF GI^{2}VIS R&D PROGRAM

INTRODUCTION

Information Visualization has the potential to be a powerful force multiplier across the entire Intelligence Community for all types of analysis and reporting activities executed by Intelligence Community Analysts. However the tantalizing potential that information visualization offers has yet to be fully realized. ARDA does not believe that there is a single, simple, elegant way to correct this situation. Rather, ARDA believes that significant, marked progress can be achieved towards achieving this potential by focusing advanced R&D activities on several key, underlying roadblocks to this progress. ARDA's GI^{2}Vis R&D Program has been established to focus on these selected areas of Information Visualization on behalf of the Intelligence Community.

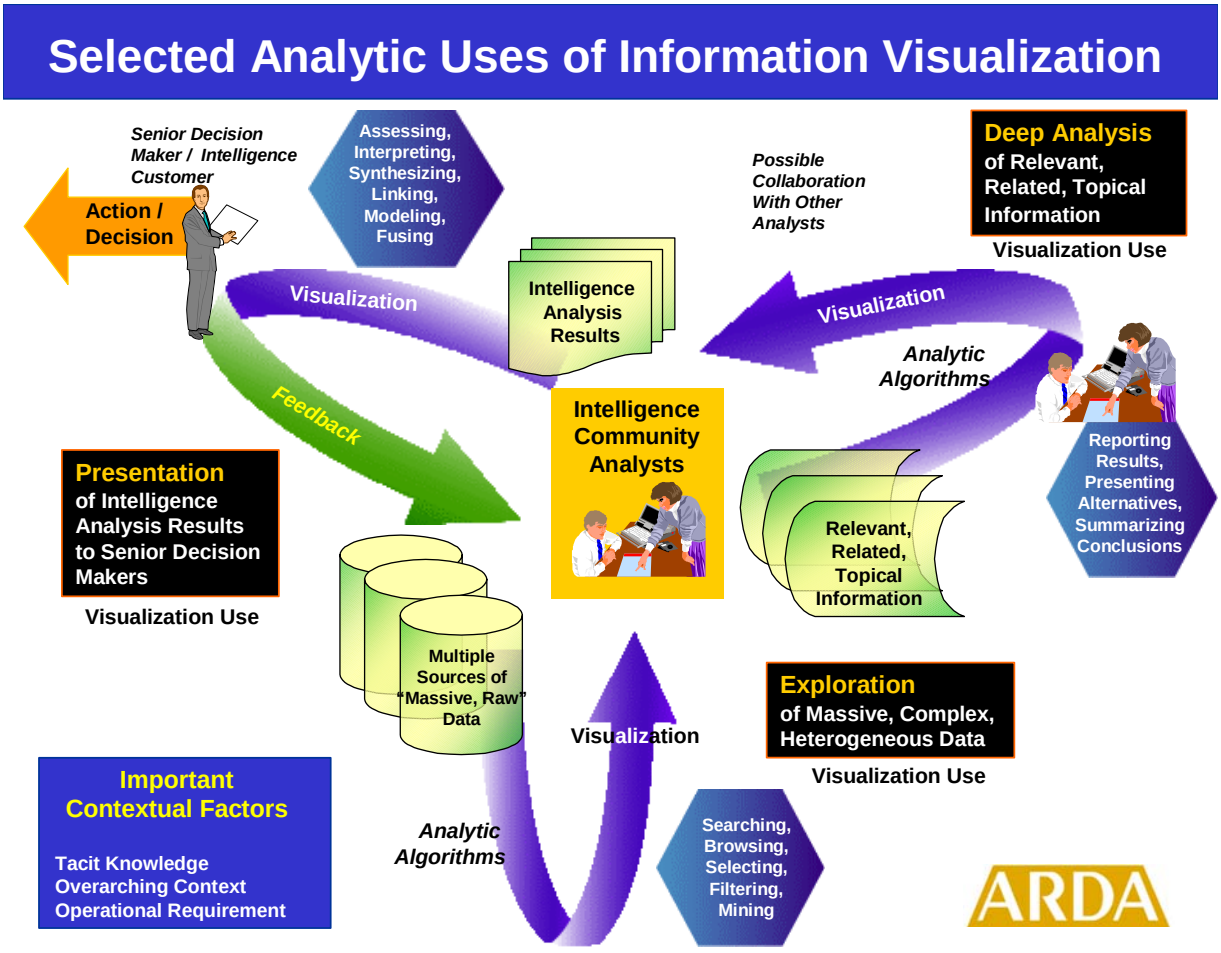

Figure 1: Some Analytic Uses for Information Visualization within the Intelligence Community

Before describing the specific technical problem topics that will be the focus of the advanced R&D program, we wish to briefly describe the three similar, yet distinct "Analytic Uses of Information Visualization" that ARDA and the GI^{2}Vis Program have

identified within the Intelligence Community that will focus and drive the research that will conducted throughout the GI2Vis Program. It is within the scope and context of these three analytic uses that the technical problem descriptions that follow need to be interpreted and understood by potential Offerors of technical proposals developed and submitted in response to this BAA.

IDENTIFICATION OF SELECTED ANALYTIC USES FOR INFORMATION VISUALIZATION

Figure 1 above pictorially illustrates three selected analytic Uses of Visualization:

1. Exploration of Massive, Complex, Heterogeneous Data;
2. Deep Analysis of Relevant, Related, Topical Information; and
3. Presentation of Intelligence Analysis Results to Senior Decision Makers/Intelligence Community Customers.

This figure emphasizes our position that Information Visualization enables analysts to look into the structure and content of data, information, knowledge and intelligence results with their eyes and intellect, to:

1. Help guide and direct their exploration of these different sources;

2. Provide valuable insights into and to facilitate an increased understanding of the results produced during their deep analysis of information; and

3. Succinctly produce timely, accurate, complete, usable and relevant presentations of intelligence results for senior decision makers and other intelligence community customers.

Our view is that Information Visualization is an enabler, a facilitator, an enhancer rather than a computational engine. Information Visualization does not perform the analytic and reporting functions, but it makes them more efficient, effective, insightful, and timely. This is particularly true when they are used and applied in conjunction with an appropriate computational algorithm or function and then interpreted by an experienced intelligence community analyst.

In a nutshell, we see the three critical uses of Information Visualization as enablers, facilitators, and enhancers of Analyst driven and guided:

1. Exploration
2. Deep Analysis
3. Presentation

CENTRAL ROLE OF THE INTELLIGENCE COMMUNITY ANALYST

In Figure 1, the Intelligence Community Analysts are shown in the center of this pictorial diagram. Arrayed around these analysts are a subset of fourteen distinct analytic functions that analysts of all types use to interact with the data, information and knowledge that they are charged with reviewing, understanding and interpreting and then finally reporting on as appropriate.

Clearly there are other important analytic functions not depicted in Figure 1 (e.g. data and information filtering, selecting, markup, transformation, transcription, translation, extraction, summarization, etc.). For the purposes of this solicitation the fourteen selected analytic functions have been grouped into three categories and each category has been represented in Figure 1 by hexagon-shaped objects (colored in blue).

1. Exploration
   - Searching
   - Browsing
   - Selecting
   - Filtering
   - Mining

2. Deep Analysis
   - Assessing
   - Interpreting
   - Synthesizing
   - Linking
   - Modeling
   - Fusing

3. Presentation
   - Reporting Results
   - Presenting Alternatives
   - Summarizing Conclusions

These three analytic function categories have been chosen for the following reasons:

1. At slightly higher level of abstraction, there is a natural similarity across the grouped analytic functions;

2. The nature and characteristics of the data, information, and/or knowledge against which any of the grouped analytic functions could be applied also share a similar natural similarity at this level of abstraction; and

3. More importantly for this BAA, each of these three analytic function categories has distinctly different Information Visualization features, characteristics, properties and technical problems associated with it.

IMPORTANT CONTEXTUAL FACTORS

Before discussing the analytic uses of information visualization in each of the three depicted categories, we need to quickly highlight three other important factors that uniformly impact the entire analytic environment of the Intelligence Community analysts:

1. Underlying operational requirement(s);
2. Overarching context; and
3. Tacit knowledge that the IC analyst brings to the table.

These have been illustrated in Figure 1 by placing the entire analytic work environment within a single background rectangle that has been labeled with these three factors.

UNDERLYING OPERATIONAL REQUIREMENT(S)

The underlying operational requirement refers to the intelligence and mission needs that the analyst is attempting to satisfy. These requirements may be at the strategic, operational or tactical level and they may have been assigned to the analyst through a formal requirements development process or in a far more informal manner. They may be very detailed and specific or they may be broadly defined and generic. But however they are articulated, the underlying operation requirement defines the scope, duration, and the focus of the intelligence analysis task that constitutes the analyst's current activities. This specific instantiation helps to define what, where, how deep, how broad, and for how long the analyst will look for a solution or other resolution to this task.

OVERARCHING CONTEXT

The overarching context is always present but may be only incompletely articulated. Typically, the current operational requirement fits within a larger context or goal. Typically, a larger intelligence need has been subdivided into a number of smaller, more focused requirements. The more specific the underlying operational requirement, the more important it is to understand the nature and content of the larger requirement and context. Also the analyst may be attempting to satisfy a given operational requirement from a given perspective or viewpoint. That is, a military analyst, the political analyst, the economic analyst, the country/region analyst may all see different things in the same or similar data and/or may focus their attention on different elements or components. In the same way, the context within which an all source analyst works may be decidedly different from that of a source specific analyst (e.g. photo imagery interpreter, a SIGINT analyst analyzing signals, a linguist comprehending foreign language material, etc.). In particular, the methods and strategies that they use as well as the senses and skills that they most heavily rely on may differ. It is important to understand that analysts of all types, background, and experience will track and follow a given event, scenario, problem, or situation within their assigned intelligence area for an extended period of time. In this regards they frequently develop extensive "notes" and "working papers" that help them keep track of their evolving investigation. So when they pursue the solution to their current operational requirement, they are doing so within an extensive context, that is known to the analyst but which may not be specifically expressed.

TACIT KNOWLEDGE

Tacit knowledge is knowledge that is difficult to express in words, often personal or context-specific, hard to communicate, and even harder to represent in a formal way, in spite of the fact that it is crucial to analytic processes used daily. Tacit knowledge is akin to common-sense knowledge, in that it is often applied unconsciously but differs in the sense that a single, experienced analyst may uniquely hold it. It includes cultural knowledge and assumptions, as well as mental models of problems, and biases. Tacit knowledge includes both the factual and procedural knowledge an analyst brings to the

table when beginning an analytic challenge and the accumulated prior knowledge developed during previous analytic efforts. It is important for information visualization systems to recognize the existence of tacit knowledge. While it is a central task of this information visualization in general and the GI^{2}Vis Research Program in particular to capture it, it is clearly central to both for Tacit Knowledge to be appropriately accounted for in information visualization results. In particular "appropriately accounted for" includes:

1. Avoiding offering the analyst a "discovery" that is already known or that is irrelevant to the task at hand;

2. Capitalizing on the analyst's knowledge to guide the subsequent analysis of data and information and to help formulate any visual presentations of intelligence results to a senior decision maker; and

3. Allowing other analysts to benefit from what each individual knows via shared access to the knowledge. (Implicit here is the need to recognize and represent uncertainty associated with knowledge, as well as the temporal aspect of knowledge that changes over time).

DESCRIPTION OF SELECTED ANALYTIC USES FOR INFORMATION VISUALIZATION

As indicated above ARDA views Information Visualization as an enabler, a facilitator, an enhancer that makes use of appropriate computational engines. In this interpretation, Information Visualization becomes closely tied to various analytic algorithms. ARDA's GI^{2}Vis is interested in having the results of its GI^{2}Vis advanced R&D Program becoming used and integrated into the analytic environment of its supported Intelligence Community analysts in three similar, yet distinctly different ways:

1. **Exploration:** i.e. Exploration of Massive, Complex, Heterogeneous Data;
2. **Deep Analysis:** Deep Analysis of Relevant, Related, Topical Information; and
3. **Presentation:** Presentation of Intelligence Analysis Results to Senior Decision Makers/Intelligence Community Customers.

In Figure 1 these three distinct visualization uses are depicted as one side of an arrow that emerges from the Intelligence Analyst(s), proceeds through one of the three analytic categories, loops through one of the three data/ information/ intelligence results categories, and returns back to the analyst(s). In the first two visualization uses, analytic algorithms that support one or more of the specific functions included in the analytic category are applied to the appropriate data or information. The output of these algorithms provides input to the visualization tools, techniques, and methods that comprise the given Visualization Use. The Visualization results are then returned and presented to the analyst(s) for their interpretation and use in any subsequent analytic efforts. The situation is different in the third visualization use. In this case the Intelligence Community analysts have completed their analytic efforts and have produced what they believe to be reportable intelligence results. The analyst to create an intelligence visualization product that is forwarded or presented to the Intelligence

Customer in this case uses the Visualization Use. Of particular interest to the GI^{2}Vis R&D Program is the situation where this intelligence visualization product is presented to a Senior Decision Maker or Policy Maker for action or for a decision. In this case the analyst is not the recipient of the visualization product but rather the developer of it. Clearly if this visualization product is to have its intended purpose, it must accurately and fairly represent the intelligence results on which it is based and its intended message must be clearly and fully interpreted and understood by its intended audience. What returns back to the intelligence analyst is not a visualization result but rather feedback from the Senior Decision Maker or Policy Maker.

1. **EXPLORATION**. The focus of the first Use of Visualization is on Massive, Complex, Heterogeneous "Raw" Data. More specifically:

a. Very large sections of reasonably homogeneous data – "Massive" because of its size.

b. Highly heterogeneous data of moderate sections – "Heterogeneous" because of its diversity or differences

c. Highly complex data of even modest sections or even highly similar data – "Complex" because of the very high dimensionality and highly degree of linkages and relationships that exist in the data.

The term "Raw" Data is used to indicate that for this particular analyst because it represents the initial data source for this analyst. "Raw" should not be interpreted as implying that this input data has undergone little, or no previous processing or analysis. In fact, this "Raw" Data may have already undergone extensive processing and been analyzed by other analysts. But for the analyst in question, this data represents his or her starting point in the analysis process. When dealing with massive "Raw" Data, analysts may have varying degrees of understanding, experience, and knowledge of exactly what they are searching for and they may have varying degrees of knowledge about the types and nature of the information, the underlying structure, the inter-relationships and relationships that exist in the data sources that they are searching. So in some sense, the worst-case scenario for an analyst is when they are performing undirected knowledge discovery against unfamiliar data sources that are massive across all three factors of size, diversity, and complexity. In this environment, the hope is that analysts will recognize the importance of information and knowledge when they see it. It's the "I'll know it when I see it" situation. A number of analytic algorithms and techniques have been developed to assist the analyst in performing a variety of information discovery analytic tasks (Searching, Browsing, Exploring, Mining). These algorithms have been used to produce clusters, classifications, categorizations, indexes, sorts, and/or groupings and then to adopt various metaphors to visually present these results to the analyst in hopes of facilitating the analyst in his or her searching, browsing, exploring, or mining of this input data. These algorithms may measure or otherwise highlight similarities or differences, and linkages or relationships between individual data items. The hope is that through the appropriate selection of a metaphor, these same data characteristics and properties may be visually presented to

the analyst in such a way, that the analyst will be able to gain valuable insights, make important and timely discoveries, and efficiently and effectively select or otherwise identify a significantly smaller subset of data from this input source that will be the focus of subsequent analysis and interpretation. While these visualizations are closely tied to underlying analytic algorithms and techniques, each algorithm and technique can support a number of significantly different and unique data visualizations. The emphasis of the GI2Vis R&D Program is on the latter data visualizations and to a far lesser degree on the former algorithms and techniques.

2. DEEP ANALYSIS. The focus of the second Use of Visualization is on "Relevant, Related, Topical" Information. In this case, the analyst is involved in one or more intermediate analytic tasks (Assessing, Interpreting, Synthesizing, Linking, Modeling, Fusing). The starting assumption is that the analyst, by one means or another, has accumulated a manageable collection of information that he or she believes is relevant or otherwise related to the intelligence requirement that the analyst is currently working on. This information often exhibits a significant amount of homogeneity with respect to its structure and format or to its topical content. At some cognitive level, the analyst has important insights into this information and has some level of familiarity with it. But at a different cognitive level, the analyst believes that this data source contains significantly more information than has been currently discovered or currently understood. The goal of the analyst at this stage is to discover and understand how the individual pieces of information that he or she is starting with fit together in a larger mosaic. How are these individual pieces of information linked or related? How can they be fused or synthesized? Can a model be developed that explains the assembled information and relationships? What is a more comprehensive assessment of the value, importance, and interpretation of this information? What is it really telling the analyst? At this stage of analysis, there may be significant collaboration among analysts working the same or related intelligence requirements. The emphasis of the GI^{2}Vis R&D Program is on investigating new methods and approaches for information visualization that will support these assessing, interpreting, synthesizing, linking, modeling and fusing analytic tasks.

3. PRESENTATION. The focus of the third Use of Visualization is on the Presentation of Intelligence Analysis Results to Senior Decision Makers. In this case the Intelligence Community Analysts have completed their analysis of data and information associated with a given intelligence requirement to a sufficient level that reportable intelligence results are now available. In many cases the presentation of these results to Senior Decision Makers may take the form of a written report or an oral presentation both of which might be supported by graphics and other visuals. The emphasis of the GI^{2}Vis R&D Program is on preparation and presentation of these supporting graphics and visuals. This Use of Visualization was the primary focus of Phase I of the GI^{2}Vis Program.

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APPENDIX C SAMPLE COVER SHEET

Submitted by:

Proposal Title:

Research Area of Interest:

Submitted in Response to:

ARDA/NGA BAA Number
for the
Geo-Spatial Intelligence Information Visualization Program (GI^{2}VIS)

Points of Contact:

	Technical	Administrative
Point of Contact:		
Voice:		
Fax:		
Email:		
Mailing Address:		
Location Address: (if it is different)		

Summary of Cost Section:

	Total Cost
Base (12 months)	
Option (12 months)	
Total	

Date of Submission:
DUNS Number:
Corporate and Government Entity (CAGE) Code:
Taxpayer Identification Number (TIN):