Foundations of Computing Processes and Artifacts   (CPA)

National Science Foundation

Directorate for Computer & Information Science & Engineering
   Division of Computer and Communication Foundations

Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):

   October 10, 2006

REVISION NOTES

In furtherance of the President's Management Agenda, NSF has identified programs that will offer proposers the option to utilize Grants.gov to prepare and submit proposals, or will require that proposers utilize Grants.gov to prepare and submit proposals. Grants.gov provides a single Government-wide portal for finding and applying for Federal grants online.

In response to this program solicitation, proposers may opt to submit proposals via Grants.gov or via the NSF FastLane system. In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. Chapter II, Section D.3 of the Grant Proposal Guide provides additional information on collaborative proposals.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

   Foundations of Computing Processes and Artifacts (CPA)

Synopsis of Program:

   The Foundations of Computing Processes and Artifacts (CPA) cluster supports basic research and education projects to advance discovery and application of scientific and engineering knowledge pertaining to the artifacts and processes for building computing and communication systems. Computational artifacts range from formalisms, models, algorithms, theories and languages to hardware/software architectures, technology components and a variety of physical manifestations of implementations. Proposals submitted in

response to this solicitation will address the nature of such artifacts and the computational processes they perform, as well as the artifacts and processes involved in specifying, designing, building and using them.

Research areas of interest for the CPA cluster include the following: topics concerning the foundations of software and software engineering, including analysis and testing of software, components and composition, verification and synthesis, and programming language semantics, design, and implementation; software/ hardware systems and techniques for reliable and high performance computing including parallel compilers, programming models, and run-time support for resource allocation and scheduling; computer system architecture spanning memory and I/O subsystems, interconnection networks, on-chip networks, processor microarchitecture, reconfigurable and application-specific architectures; multicore, multithreaded, and system-on-a-chip; hardware and software tools for design, simulation, benchmarking, performance measurement and tuning, including performance metrics and evaluation tools; VLSI electronic design and pertinent analysis, synthesis and simulation algorithms; architecture and design for mixed media or future media (e.g., MEMs and nanotechnology); computer graphics and visualization topics such as photorealistic and non-photorealistic rendering of geometry, lighting and materials, mathematical modeling, physically-based graphics, scientific and information visualization, graphics and display hardware, computational photography, and mixed reality.

Cognizant Program Officer(s):

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Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.070 --- Computer and Information Science and Engineering

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 80 to 120 awards with an average funding amount of $125,000/year for up to three years are anticipated. Up to 2 collaborative multi-institutional awards of $250,000/year for four years on topics dealing with architecture and design for nanosystems with relevance to computing (based on silicon or beyond) are also anticipated. Up to 5 awards of $500,000/year for three years for well-integrated projects of larger scope are also likely.

Anticipated Funding Amount: $44,000,000 dependent on the availability of funds

Eligibility Information

Organization Limit:

Proposals may only be submitted by the following:

- Academic Institutions located in the U.S.: U.S. universities and colleges located in the U.S.

PI Limit:

An investigator may participate as PI, co-PI or Senior Personnel in at most one proposal in response to this solicitation.

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI: 1

An investigator may participate as PI, co-PI or Senior Personnel in at most one proposal in response to this solicitation.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not Applicable

- **Full Proposals:**

  - Full Proposals submitted via FastLane: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.

  - Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: http://www.nsf.gov/bfa/dias/policy/docs/grantsgovguide.pdf/)

B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required by NSF.

- **Indirect Cost (F&A) Limitations:** Not Applicable

- **Other Budgetary Limitations:** Not Applicable

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. proposer's local time):

  October 10, 2006

Proposal Review Information Criteria

Merit Review Criteria: National Science Board approved criteria apply.

Award Administration Information

Award Conditions: Standard NSF award conditions apply

Reporting Requirements: Standard NSF reporting requirements apply

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I. INTRODUCTION

The CPA cluster supports basic research and education projects to advance discovery and application of scientific and engineering knowledge pertaining to the artifacts and processes for building computing and communication systems. Computational artifacts range from formalisms, models, algorithms, theories and languages to hardware/software architectures, technology components and a variety of physical manifestations of implementations. Proposals submitted in response to this solicitation will address the nature of such artifacts and the computational processes they perform, as well as the artifacts and processes involved in specifying, designing, building and using them. Submitted proposals will also address the development of innovative curricula or educational materials to help advance the training of new experts in the areas covered by this solicitation.

The CPA cluster promotes integrated research in Advanced Computation, Compilers, Computer System Architecture, Design Automation for Micro and Nano Systems, Graphics and Visualization, and Software Engineering and Languages. Research topics of particular interest to the CPA cluster include the following: topics concerning the foundations of software and software engineering, including analysis and testing of software, components and composition, verification and synthesis, and programming language semantics, design, and implementation; software/hardware systems and techniques for reliable and high performance computing, including parallel compilers, programming models, and run-time support for resource allocation and scheduling; computer system architecture spanning memory and I/O subsystems, interconnection networks, on-chip networks, processor microarchitecture, reconfigurable and application-specific architectures; multicore, multithreaded, and system-on-chip; hardware and software tools for design, simulation, benchmarking, performance

measurement and tuning, including performance metrics and evaluation tools; VLSI electronic design and pertinent analysis, synthesis and simulation algorithms; architecture and design for mixed media or future media (e.g., MEMs and nanotechnology); computer graphics and visualization topics such as photorealistic and non-photorealistic rendering of geometry, lighting and materials, mathematical modeling, physically-based graphics, scientific and information visualization, graphics and display hardware, computational photography, and mixed reality. The CPA cluster promotes and strongly encourages cross-disciplinary research that transcends the artificial confines of imposed topical or area boundaries.

II. PROGRAM DESCRIPTION

The CPA cluster solicits proposals that advance at a fundamental level the understanding, design, operation, utilization, and evaluation of computer software and hardware systems. These typically involve novel software and/or hardware, algorithms to create new or enhanced functionality, or methods and tools for the design and implementation of computer systems. Novel component and system architectures, their design principles, and analytical or simulation-based evaluation are also addressed. The CPA cluster emphasizes integration of research and education in all areas of interest. Principal investigators can range from faculty members beginning their careers to teams of senior investigators working on novel directions within a multi-disciplinary mode. Collaborations between computer scientists, computer engineers, and other disciplinary investigators are encouraged as cross-disciplinary research projects have the potential to strengthen the foundations of computing processes and artifacts. Proposals for larger projects should provide demonstrable evidence of the existence, quality, and growth potential of precursor research.

This cluster also supports projects that develop innovative curricular materials and that have the potential to greatly improve higher education in the topics covered in this solicitation. Such projects are typically proposed as one component of broader research and educational impact in the proposal. Curriculum development activities must include strong justification of the need for the new materials and must include plans for disseminating them to the community and for evaluating their effectiveness.

While each area described below deals with a set of topics of specific interest to the area, research issues inevitably cross over artificially imposed topical and area boundaries. The CPA cluster strongly encourages proposals that transcend the confines of each of the areas and sub-areas elaborated. We anticipate two larger awards for collaborative, multi-institutional proposals and up to five larger awards for well-integrated projects of larger scope.

Advanced Computation, Compilers, Computer Architecture and Design Automation

This area sponsors integrated research and education projects to advance scientific foundations, engineering practice, and education in topics related to advanced computation, compilers, computer system architecture, and design automation for micro and nano systems. Virtually all fields of science and engineering (and society at large) depend on fundamental advances in computing. Progress toward achieving robust high-performance computing in traditional and non-traditional system environments is enabled by breakthroughs in electronics design and design tools, architectures for a broad spectrum of computer systems, and software tools for using them effectively. Hardware architectures and software that exploit parallelism in a scalable manner, hybrid architectures and software tools for mapping and integration of abstractions onto reconfigurable hardware, and systems-on-a-chip architectures encompassing multiple/many cores and technologies are all challenges in this area. There is a compelling need to stimulate research in promising new design automation methods and tools, parallel architectures, parallel programming models, parallelizing compilers, and associated algorithms and system software to substantially improve computation platforms along several critical axes, including performance, energy/power efficiency, reliability, security, programmability, and reduced design complexity.

Advanced Computation: This sub-area encompasses high-performance hardware and software research and enabling technologies for advancing the state-of-the-art in computational science and engineering. In addition to shear compute power, observation- and simulation-driven applications fundamentally require high throughput input/output (I/O) capabilities, large data storage capacities, and tools for efficiently organizing, locating, and moving data. Data management challenges include the need to access large volumes of data, possibly produced by different applications in numerous locations and in various formats. This sub-area supports research and education projects in I/O, file, and storage system design for efficient, high-throughput data storage, retrieval, and management in high-performance computing environments.

Specific research topics of interest include, but are not limited to, the following: design of multi-level (hierarchical, layered) parallel algorithms and libraries; scalable and latency tolerant computational/numeric algorithms; performance modeling of scalable algorithms; management of large-scale distributed file systems and data; novel storage devices, architectures, and middleware for high-throughput I/O; software and hardware processes and artifacts for design, simulation, benchmarking, tracing, performance measurement and tuning of I/O, file, and storage systems in high-performance computing environments.

Compilers: This sub-area covers foundations in compilers for enabling robust high-performance computer systems.

Processes for specifying properties of high-level abstractions to the compiler and for automating the mapping of code to the architectural features of a target platform remain elusive. As such, automatic algorithm mapping, code and data transformation, translation to hardware description language (for reconfigurable architectures) and optimization (both static and dynamic) remain as open areas of research. Research on compilers capable of advanced analysis to verify program correctness and improve programmer productivity is also needed, as is research on compiler support for automating the exploitation of parallelism (i.e., parallelizing compilers). As the emergence of multicore architectures will mainstream parallel computing, effective compiler support for automatically parallelizing single-threaded programs to fully utilize the potential of multicore processors and multiprocessor systems built from multicores is an important challenge.

Specific research topics of interest include, but are not limited to, the following: parallelizing compilers and infrastructure for optimizing compilers for multiple platforms; parallelization techniques for exploiting parallelism at multiple levels applicable to multiple programming models; software and compiler support for mapping and scheduling multiple threads on (possibly heterogeneous) multicore and multiprocessor systems; compiler techniques for managing on-chip communication, power consumption, temperature and fault tolerance in multicore architectures; compiler techniques to guarantee safety from potential deadlocks, memory leaks, race conditions and other forms of correctness in parallel programs.

Computer System Architecture: This sub-area covers foundations in computer system architecture research and education for enabling robust high-performance computer systems. Computer architectures that provide enhanced functionality and scalable performance to meet the growing demands of diverse applications while meeting stringent constraints on energy and power consumption, reliability, design complexity, and so on are needed. Such functionality includes architectural support for facilitating programmability, real-time computation, security, power and thermal management, soft and hard error detection and recovery, dynamic adaptation, and self repair of systems implemented in nano-scale technologies that provide giga-scale integration.

Specific research topics of interest include, but are not limited to, the following: computer system architecture, including processor microarchitecture, memory, interconnection network, I/O and storage subsystems; high-level design and analysis of computer systems, including methods, tools, processes, and artifacts for automated design space exploration, modeling, benchmarking, simulation, synthesis, and performance evaluation; design and performance modeling of multithreaded, multicore, many-core, and multiprocessor architectures, including chip multiprocessors, tiled architectures, and heterogeneous systems-on-a-chip; on-chip networks and distributed register and cache structures; parallel programming and memory models; multi-objective optimizations, including performance, power, temperature, reliability, security, area and complexity; application-specific processors and reconfigurable computing, including tools and techniques to facilitate application-to-hardware mapping and fault-induced reconfiguration; novel architectures and hardware primitives that facilitate concurrency and exploit parallelism at multiple levels (e.g., fine-grained, instruction, data, thread, stream, task and coarse-grained).

Design Automation for Micro and Nano Systems: Design methodologies for VLSI continue to be challenged by rapid miniaturization consisting of millions to a billion transistors on a chip. This, together with advances in novel MEMs, optical and nano-scale devices, presents new opportunities for design in both conventional CMOS technologies as well as other novel technologies. This sub-area supports basic research underlying the science and methodologies for designing integrated systems comprised of micro systems in traditional silicon VLSI technology, in MEMS technologies, 3-D technologies, and in other emerging computing media of the future. While device related research is not a focus, molecular and nano-computing as it relates to the circuits/architecture-level interface will be given due consideration. More specifically, this sub-area will explore fundamental questions of how to design in future computing media, stimulate crossover activities between electronic design automation research and micro/nano/molecular technology research in order to meet challenges of VLSI design as geometries shrink, and provide the basic science for design of next generation VLSI chips using deep submicron technologies. This is meant to include digital as well as analog VLSI design.

Specific research topics of interest include, but are not limited to, the following: physical design (routing & layout, power optimization, logic synthesis, on-chip communication, modeling & device simulation); system-level design (systems-on-a-chip, multicore systems, embedded systems, application-specific processor design, hardware/software co-design); test and verification (testing of analog, digital mixed-signal systems, built-in self-test, design for testability, formal proof of correctness); investigation of design methods for technologies such as optical, MEMS, 3-D integration, and mixed signal systems.

Graphics and Visualization

This CPA cluster area sponsors integrated research and education projects to advance the scientific foundations and engineering practices that underlie the ability to perform visual information transfer, address models of physical events, develop mechanisms for image production, and utilize visualization to represent and explore information such as computer system performance and security, large, disparate data sets, and data from specific application domains. This requires the ability to model, render, and display data and to understand the forms of visualization that can best transfer particular types of information. The CPA cluster seeks fundamental advances that will enhance the numerous activities that utilize computer graphics and visualization, including science, engineering, medicine, entertainment, education, business, and homeland security. Proposals that utilize techniques from digital imaging and machine vision must clearly seek solutions to

fundamental problems in computer graphics and visualization to merit consideration.

Specific research topics of interest include, but are not limited to, the following: mathematical models for representing geometric and non-geometric data, algorithms for the photorealistic and non-photorealistic rendering of geometry, lighting, and materials, physical-based modeling and graphical simulation, animation techniques, multi-resolution algorithms for graphics modeling and applications, visibility algorithms, scientific visualization algorithms and systems, visualization aspects of visual analytics, visualization aspects of location-aware computing, virtual and augmented reality, novel hardware for graphics processing, and graphics issues in computational photography and video. Innovative multidisciplinary proposals that join visualization with other computer-science domains, and, in particular, other cluster area topics such as software design, architecture, or topics covered within the advanced computational research sub-area are also welcome.

Software Engineering and Languages

This area sponsors integrated research and education projects to advance scientific foundations, engineering practice and education in topics related to software engineering and languages. Relevant projects may concern any of the artifacts and processes involved in software engineering, including languages, theories, models, techniques, methods, tools and environments relating to requirements, specification, design, programming, verification, testing, maintenance, transformation, evolution and other activities of software development. Research in this area should contribute to new understanding of software and software development issues, with an objective of significantly increasing productivity of software development as well as attaining the highest quality of software-based products and services. Proposals should emphasize lasting principles, robust theories, high-leverage tools and novel approaches. Proposals should include plans for validation through proofs of concept, empirical evaluation and/or other scientific methods.

Specific research topics of interest include, but are not limited to, the following: constructive methods for software design and evolution; issues of software analysis, composition and architectures; enhancement of confidence and quality; tools and environments supporting automation of activities of software development, including model-driven development, software understanding, maintenance and evolution; notations, theories, models and techniques for constructing and reasoning about descriptions for all activities of software engineering; requirements engineering; the application of representation, reasoning and problem-solving approaches from other disciplines, such as artificial intelligence to software development activities and artifacts; contributions from human-computer interaction, cognitive science and social science to software development, evolution, management and use; advances in programming language design and implementation; general-purpose, domain-specific and special-purpose languages; integration of programming languages with other software engineering artifacts, processes and capabilities, such as specifications, formal methods, analysis tools, proofs, and architectures.

Proposals are encouraged on the topic of software engineering support for scientists/engineers. Cyber infrastructure and computational science creates software engineering challenges for the "e-science" community engaged in software-intensive application development. Research and education proposals should address the unique requirements of this community, including application composition, synthesis and validation, incorporation of physical models and application domain knowledge into software systems, formalization of software development and science workflow processes, and other software engineering topics as applied to the science/engineering domains.

Proposals are also encouraged in the area of end-user software engineering. As software pervades the processes and artifacts of our everyday lives, technology users are increasingly having the same concerns as software engineers, e.g., formulating logical procedures, using data structures, understanding and stating requirements, efficiently generating working code, making programs understandable and adaptable, and validating software systems. Research and education proposals are sought to fill this need, including building a better understanding of the needs of end-user software development, adapting current approaches and tools, and developing new theories, languages, tools environments and methods. Projects should address issues such as usability, scale, and validation through experimentation.

Relation to Other Programs

Computational artifacts range from formalisms, models, algorithms, theories and languages to hardware/software architectures, technology components and a variety of physical manifestations of implementations. Consequently, many projects will address topics described above as well as topics covered in related programs. If the major emphasis of a proposal is one of the types of systems or topics described in this solicitation, then it should be submitted to the CPA program. The following NSF programs most closely overlap with the CPA program:

Theoretical Foundations of Computing (TF in CCF Division);

Computer Systems Research (CSR in CNS Division);

Research in Networking and Technology (NeTS in CNS Division);

Dynamic Data Driven Applications Systems (DDDAS Emphasis Area in CISE Directorate);

Cyber Trust (CT Emphasis Area in CISE Directorate); and

 NSF Middleware Program (NMI in Office of Cyberinfrastructure).

Attention should be paid to where proposals are submitted. For example, a proposal that develops new compiler technology to support dynamic and adaptive runtime tuning support of applications executing on complex, heterogeneous, and distributed platforms should be submitted to the Computer Systems Research (CSR) program or the Dynamic Data Driven Applications Systems (DDDAS) program, but a proposal that addresses parallelizing compiler technology should be submitted to the Computing Processes and Artifacts (CPA) program. Similarly, a project that develops programming languages, models, or software tools to facilitate programming parallel applications should be submitted to CPA, whereas a project that develops systems software for parallel computing should be submitted to CSR or some other related program. If the major emphasis of the proposal is computer networks, then it should be submitted to the Research in Networking Technology and Systems (NeTS) program. If the major emphasis is making systems more secure, then the proposal should be submitted to the Cyber Trust (CT) program. Likewise, a project that hardens computational science systems software should be submitted to the NSF Middleware Initiative (NMI), whereas projects that propose basic research on middleware would be more appropriate for CSR. As other programs become active, PIs are encouraged to contact the cognizant program officers for discussion.

III. AWARD INFORMATION

Estimated Number of Awards: 80 to 120 awards with an average funding amount of $125,000/year for up to three years are anticipated. Up to 2 collaborative multi-institutional awards of $250,000/year for four years on topics dealing with architecture and design for nanosystems with relevance to computing (based on silicon or beyond) are also anticipated. Up to 5 awards of $500,000/year for three years for well-integrated projects of larger scope.

IV. ELIGIBILITY INFORMATION

Organization Limit:

Proposals may only be submitted by the following:

- Academic Institutions located in the U.S.: U.S. universities and colleges located in the U.S.

PI Limit:

 An investigator may participate as PI, co-PI or Senior Personnel in at most one proposal in response to this solicitation.

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI: 1

An investigator may participate as PI, co-PI or Senior Personnel in at most one proposal in response to this solicitation.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from pubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: (http://www.nsf.gov/bfa/dias/policy/docs/grantsgovguide.pdf). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from pubs@nsf.gov.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. Chapter II, Section D.3 of the Grant Proposal Guide provides additional information on collaborative proposals.

Full proposals submitted via FastLane

- Grant Proposal Guide (GPG) Guidelines apply

Full proposals submitted via Grants.gov

- NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply. (NOTE: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at http://www.nsf.gov/bfa/dias/policy/docs/grantsgovguide.pdf) To obtain copies of the Application Guide and Application Form Package, click on the Apply tab on the Grants.gov website, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link, enter the funding opportunity number (i.e., the program solicitation number without the NSF prefix), and press the Download Package button.

B. Budgetary Information

Cost Sharing: Cost sharing is not required by NSF in proposals submitted to the National Science Foundation.

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. proposer's local time):

    October 10, 2006

D. FastLane/Grants.gov Requirements

- **For Proposals Submitted Via FastLane:**

Detailed technical instructions regarding the technical aspects of preparation and submission via FastLane are available at: https://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

Submission of Electronically Signed Cover Sheets. The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see Chapter II, Section C of the Grant Proposal Guide for a listing of the certifications). The AOR must provide the required electronic certifications within five working days following the electronic submission of the proposal. Further instructions regarding this process are available on the FastLane Website at: https://www.fastlane.nsf.gov/fastlane.jsp.

- **For Proposals Submitted Via Grants.gov:**

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. The Grants.gov's Grant Community User Guide is a comprehensive reference document that provides technical information about Grants.gov. Proposers can download the User Guide as a Microsoft Word document or as a PDF document. The Grants.gov User Guide is available at: http://www.grants.gov/CustomerSupport. In addition, the NSF Grants.gov Application Guide provides additional technical guidance regarding preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program and, if they meet NSF proposal preparation requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with the oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts with the proposer.

A. NSF Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board (NSB)-approved merit review criteria: intellectual merit and the broader impacts of the proposed effort. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two NSB-approved merit review criteria are listed below. The criteria include considerations that help define them. These considerations are suggestions and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which the reviewer is qualified to make judgements.

What is the intellectual merit of the proposed activity?
How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?
How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

NSF staff will give careful consideration to the following in making funding decisions:

Integration of Research and Education
One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

Integrating Diversity into NSF Programs, Projects, and Activities
Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review.

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. The time interval begins on the date of receipt. The interval ends when the Division Director accepts the Program Officer's recommendation.

A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award letter, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award letter; (4) the applicable award conditions, such as Grant General Conditions (GC-1); * or Federal Demonstration Partnership (FDP) Terms and Conditions * and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/awards/managing/general_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from pubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpm.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period. (Some programs or awards require more frequent project reports). Within 90 days after expiration of a grant, the PI also is required to submit a final project report.

Failure to provide the required annual or final project reports will delay NSF review and processing of any future funding increments as well as any pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through FastLane, for preparation and submission of annual and final project reports. Such reports provide information on activities and findings, project participants (individual and organizational) publications; and, other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system. Submission of the report via FastLane constitutes certification by the PI that the contents of the report are accurate and complete.

VIII. AGENCY CONTACTS

General inquiries regarding this program should be made to:

- Sankar Basu, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computing and Communication Foundations, 1106 N, telephone: (703) 292-8910, email: sabasu@nsf.gov

- Almadena Chtchelkanova, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computing and Communication Foundations, 1115 N, telephone: (703) 292-8910, fax: (703) 292-9059, email: achtchel@nsf.gov

- Sol Greenspan, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computing and Communication Foundations, 1108N, telephone: (703) 292-8910, fax: (703) 292-9059, email: sgreensp@nsf.gov

- Timothy Pinkston, telephone: (703) 292-8910, email: tpinksto@nsf.gov

- Lawrence Rosenblum, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computing and Communication Foundations, 1115 N, telephone: (703) 292-8910, fax: (703) 292-9059, email: lrosenbl@nsf.gov

- Joseph Urban, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computing and Communication Foundations, 1115 N, telephone: (703) 292-8910, fax: (703) 292-9059, email: jurban@nsf.gov

- Alan Hevner, telephone: (703) 292-8649, email: ahevner@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

The primary contacts for the various components are:

- Advanced Computation: Almadena Chtchelkanova
- Compilers: Almadena Chtchelkanova
- Computer System Architecture: Timothy M. Pinkston
- Design Automation for Micro and Nano Systems: Sankar Basu
- Graphics and Visualization: Lawrence Rosenblum
- Software Engineering and Languages: Sol Greenspan and Joseph Urban

Administrative support contact persons:

- Ms. Neila Odom, Project Specialist, nodom@nsf.gov, (703) 292-8910
- Ms. Charmain Woods, Project Specialist, cwoods@nsf.gov, (703) 292-8910

IX. OTHER INFORMATION

The NSF Website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this Website by potential proposers is strongly encouraged. In addition, MyNSF (formerly the Custom News Service)is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Regional Grants Conferences. Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. MyNSF also is available on NSF's Website at http://www.nsf.gov/mynsf/.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this new mechanism. Further information on Grants.gov may be obtained at http://www.grants.gov.

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to

academic institutions for basic research.

NSF receives approximately 40,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at http://www.nsf.gov

- **Location:**   4201 Wilson Blvd. Arlington, VA 22230

- **For General Information**   (703) 292-5111
  (NSF Information Center)**:**

- **TDD (for the hearing-impaired):**   (703) 292-5090

- **To Order Publications or Forms:**

  Send an e-mail to: pubs@nsf.gov

  or telephone: (703) 292-7827

- **To Locate NSF Employees:**   (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records, " 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Division of Administrative Services
National Science Foundation
Arlington, VA 22230

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