Computing and Communication Foundations (CCF): Core Programs

PROGRAM SOLICITATION
NSF 09-555

REPLACES DOCUMENT(S):
NSF 08-577

National Science Foundation

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

Submission Window Date(s) (due by 5 p.m. proposer's local time)**:**

Medium Projects: August 1, 2009 - August 30, 2009, August 1 - August 30, Annually Thereafter

Large Projects: November 1, 2009 - November 28, 2009, November 1 - November 28, Annually Thereafter

Small Projects: December 1, 2009 - December 17, 2009, December 1 - December 17, Annually Thereafter

REVISION NOTES

The descriptions for the CCF core programs have been updated.

Please be advised that the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) includes revised guidelines to implement the mentoring provisions of the America COMPETES Act (ACA) (Pub. L. No. 110-69, Aug. 9, 2007.) As specified in the ACA, each proposal that requests funding to support postdoctoral researchers must include a description of the mentoring activities that will be provided for such individuals. Proposals that do not comply with this requirement will be returned without review (see the PAPP Guide Part I: *Grant Proposal Guide* Chapter II for further information about the implementation of this new requirement).

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Computing and Communication Foundations (CCF): Core Programs

Synopsis of Program:

CISE's Division of Computing and Communication Foundations (CCF) supports research and education projects that develop new knowledge in three core programs:

- The Algorithmic Foundations program;
- The Communications and Information Foundations program; and
- The Software and Hardware Foundations program.

Proposers are invited to submit proposals in three project classes, which are defined as follows:

- Small Projects - up to $500,000 total budget with durations up to three years;
- Medium Projects - $500,001 to $1,200,000 total budget with durations up to four years; and
- Large Projects - $1,200,001 to $3,000,000 total budget with durations up to five years.

A more complete description of the three project classes can be found in section *II. Program Description* of this document.

CISE investments in Small, Medium and Large projects complement the directorate's investments in the Expeditions in Computing program, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503169&org=CISE&from=home, where projects are funded at levels of up to $10,000,000 total for durations up to 5 years.

Cognizant Program Officer(s):

- Dmitry Maslov, Point of Contact, Algorithmic Foundations, 1115, telephone: (703) 292-8910, email: dmaslov@nsf.gov
- John H Cozzens, Point of Contact, Communications and Information Foundations, 1115, telephone: (703) 292-8910, email: jcozzens@nsf.gov
- Sol Greenspan, Point of Contact, Software and Hardware Foundations, 1115, telephone: (703) 292-8910, email: sgreensp@nsf.gov

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: 120 to 160 - It is anticipated that up to 160 awards will be made each year.

Anticipated Funding Amount: $90,000,000 Approximately $90 million each year, dependent upon the availability of funds.

Eligibility Information

Organization Limit:

None Specified

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI: 2

In any contiguous August through December period, an individual may participate as PI, Co-PI or Senior Personnel in no more than **two** proposals submitted in response to the *coordinated solicitation* (where *coordinated solicitation* is defined to include the *Information and Intelligent Systems (IIS): Core Programs*, the *Computer and Network Systems (CNS): Core Programs* and the *Computing and Communication Foundations (CCF): Core Programs* solicitations). For example, between August 2009 and December 2009, an individual may participate as PI, co-PI or Senior Personnel in one proposal submitted to a core program in CCF and in a second proposal submitted to a core program in CNS, or an individual may participate as PI, co-PI or Senior Personnel in two proposals submitted to an IIS core program, etc.

These eligibility constraints will be strictly enforced in order to treat everyone fairly and consistently. In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on earliest date and time of proposal submission (i.e. the first two proposals received will be accepted and the remainder will be returned without review). **No exceptions will be made.**

The limit on the number of proposals per PI, co-PI or Senior Personnel applies only to the *coordinated solicitation.*

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not Applicable
- **Preliminary Proposal Submission:** Not Applicable
- **Full Proposal Preparation Instructions:** This solicitation contains information that supplements the standard NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) proposal preparation guidelines. Please see the full text of this solicitation for further information

B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required under this solicitation.
- **Indirect Cost (F&A) Limitations:** Not Applicable
- **Other Budgetary Limitations:** Not Applicable

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. proposer's local time)**:**

  Medium Projects: August 1, 2009 - August 30, 2009, August 1 - August 30, Annually Thereafter

  Large Projects: November 1, 2009 - November 28, 2009, November 1 - November 28, Annually Thereafter

  Small Projects: December 1, 2009 - December 17, 2009, December 1 - December 17, Annually

Thereafter

Proposal Review Information Criteria

Merit Review Criteria: National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions: Standard NSF award conditions apply.

Reporting Requirements: Standard NSF reporting requirements apply.

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I. INTRODUCTION

The Division of Computing and Communication Foundations (CCF) supports research and education projects that explore the foundations of computing and communication devices and their usage. The Division seeks advances in computing and communication theory, algorithms for computer and computational sciences, and architecture and design of computers and software. CCF-supported projects also investigate revolutionary computing models and technologies based on emerging scientific ideas and integrate research and education activities to prepare future generations of computer science and engineering workers.

II. PROGRAM DESCRIPTION

CCF CORE PROGRAMS

CCF supports three core programs as described below.

- ***Algorithmic Foundations***

  The Algorithmic Foundations program supports research characterized by algorithmic thinking accompanied by rigorous analysis. Research on algorithms for problems that are central to computer science, as well as new techniques for the rigorous mathematical analysis of such algorithms, are solicited. Moreover, there is an interest in theoretical work to bound the intrinsic difficulty of problems to determine the measures of complexity in formal models of computation, classical or new. The goal is to understand the fundamental limits of resource-bounded computation and to obtain optimal solutions within those limits. Specifically, the time and space complexity of finding exact and approximate solutions in deterministic and randomized models of computation are the central concern of the program. Resources other than time and space, such as communication, heat, power, etc., are also of interest. In addition to the traditional, sequential computing paradigm, research on models of computing such

as, parallel and distributed models are welcomed. Such research includes optimizations across complex processor/memory hierarchies. Quantum computing, error correction, and techniques for dealing with decoherence are of interest.. The program also supports rigorous work in experimental algorithmics in all of these models that relies on hypothesis formulation, experiment design, observation, modeling, and prediction in arriving at an understanding of algorithm behavior.

The program supports research in algorithms needed in other areas both within and outside computer science. Algorithmic research in databases, networks, communications, operating systems, languages and compilers and machine abstractions. New techniques for the design and analysis of algorithms in areas such as cryptography, computational geometry, computational biology, numerical, symbolic, algebraic, and scientific computing are appropriate for the program. In computational geometry, research can range from theoretical problems to algorithms for applications that arise in computational biology and computer graphics. Numerical methods include recent algorithmic innovations such as smoothed analysis and symbolic methods include symbolic constraint satisfaction problems. Hybrid numeric-symbolic-algebraic methods in support of multi-scale, multi-grid methods and computation on peta-scale machines are also welcome. An emerging area of interest lies at the interface of computer science and economics. This program supports research on computing economic equilibria, mechanism design, graphical economic models and other topics in computational game theory and economics. Relevance to the application areas is important and collaborations with researchers in these areas are encouraged. However, research funded by this program must advance the study of algorithms.

More information on topics of interest within the program is available at: http://www.nsf.gov/cise/ccf/af_pgm09.jsp .

- ***Communications and Information Foundations (CIF)***

  The Communications and Information Foundations (CIF) program supports transformative research that addresses the theoretical underpinnings and current and future enabling technologies for information acquisition, transmission, and processing in communication and information networks. As a result, CIF research and education projects strengthen the intellectual foundations of communications and information theory and signal processing in a variety of types of networks such as sensor networks, wireless and multimedia networks, biological networks, and networks of quantum devices. Research outcomes can lead to more secure and reliable communications and advanced mathematical capabilities that are applicable throughout science and engineering.

  The program supports basic research in wireless communications, information theory and coding, and networking. Included in the CIF research program is the reliable transmission of information, in both analog and digital form, in the presence of a variety of channel impairments (noise, multipath, interference, etc.). A number of channel architectures are of interest, including multiple-input multiple-output (MIMO) channels, feedback channels, optical channels, quantum channels, and biological channels. CIF has a strong interest in the theoretical performance limits for various communication systems architectures and in the presence of various channel impairments. Also of interest are performance metrics and tradeoffs, such as error probability and latency tradeoffs, resulting with coding/decoding algorithms, diversity techniques, and other types of signal processing.

  The CIF program also supports fundamental research in networking including network information theory, network coding, cross-layer research at the lower layers, as well as foundational research at higher layers. Also of interest are research issues that lie at the intersections of communications and information theory, signal processing, and networking. Examples include the impact of physical-layer performance on the higher network layers; sensor networks including applications to environmental monitoring, civil infrastructure monitoring, data communications system monitoring, and power grid monitoring; and network tomography, which involves detecting and classifying spatially distributed anomalies within complex large-scale systems from multiple monitoring (sensor) sites.

  In addition to the contemporary signal processing topics that have enabled the IT revolution, there is growing interest within the program in new paradigms that enlarge the scope of signal and information processing from the domain of the linear to the realm of the nonlinear - from linear algebra to algebra, from Euclidean to curved spaces, from uniform to highly non-uniform time and space sampling, to signal processing on graphs. Research that will develop efficient power aware and hardware-friendly algorithms and research on signal/information processing algorithms for the new network science of distributed, decentralized, and cooperative algorithms that avoid global communications is encouraged. The exploration of new approaches to manage massive datasets, such as compressive sampling/sensing, also promises advances in the field.

  This program is particularly interested in the application of signal/information processing in complex systems. Some examples of exciting applications are monitoring the Nation's critical infrastructures, signal processing in biological systems, and biomedical signal and image processing. These and other emerging application domains pose new constraints and challenges, leading to the reexamination of old questions and assumptions.

  More information on topics of interest within this program is available at: http://www.nsf.gov/cise/ccf/cif_pgm09.jsp.

- ***Software and Hardware Foundations (SHF)***

  Virtually all fields of science and engineering - and society at large - depend on fundamental advances in scientific foundations and engineering methods for the hardware and software that comprise computing systems. Progress toward achieving robust, reliable computing in traditional and non-traditional system environments is enabled by breakthroughs in electronic design and design tools, hardware and hardware architectures for a broad spectrum of computer systems, algorithms and software for utilizing them effectively, and methods and tools for designing and programming applications that are efficiently producible, verifiably correct and adaptable to changing requirements and environments.

  The SHF program solicits proposals that advance the design, verification, operation, utilization, understanding and evaluation of the hardware and software that make up computers and computer-based systems. Such advances may proffer principles, formalisms, models, methods, languages, logics, novel software and/or hardware artifacts, algorithms to create new or enhanced functionality, and formal methods and tools for the design and implementation of computer systems and their applications. 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. They may also address issues of usability and scale.

  The SHF program supports all aspects of the science and engineering of software. We welcome research projects in software enginerring emphasizing verifiability, certifiability, usability, safety, privacy, interoperability, etc. with an emphasis on formal methods and usable tools. SHF supports the entire range of programming language and compiler research from principles and semantics to compiling for multi-threaded and multi-core architectures. High-performance computing research may produce new programming languages, models, better I/O, storage,

organization, and indexing capabilities for data, SHF also supports research on models of computation and architectures that exploit biological processes and biological and nano materials.

The SHF program welcomes hardware-focused projects on design automation for micro and nano systems address design methodologies for VLSI to respond to rapid miniaturization resulting in millions to a few billion transistors on a chip. Projects on computer systems architecture research may address aspects of uniprocessor, multiprocessor/multi-core/CMP and system-on-chip (SoC) architectures with emphasis on topics such as characterization of workloads, processor microarchitectures, memory systems, I/O systems, interconnects, and hardware-software co-design to facilitate programmability, real-time computation, power and thermal management, fault-tolerance, and dynamic adaptation for quality-of-service (QoS) provisioning.

SHF especially welcomes research that cuts across these areas. For example, numerous challenges must be addressed to harness the full computing power of multi-core architectures. The SHF program supports projects whose research outcomes promise advances in parallel programming models, abstractions, languages and algorithms; software development, compilation, debugging, visualization tools, and platforms and testbeds for parallel architectures and scientific computing, frameworks for automatic parallelization, optimized code generation and dynamic run-time execution, scalable mechanisms for concurrency control and synchronization in heterogeneous environments, virtualization for optimized performance, and power-aware scheduling and load balancing algorithms.

Another crosscutting theme is the development and use of new formalisms and logics for reasoning about properties of software and hardware systems. Included here is research on techniques such as model checking and theorem proving to enhance the applicability, usability, and efficiency of such techniques.

Proposals in the topical areas described above are in scope for the SHF program, but in addition, the SHF cluster encourages proposals that transcend traditional areas, import ideas from other fields, or capture the dynamic interactions between the architecture, language, compiler, systems software, and applications layers.

More information on topics of interest within this program is available at: http://www.nsf.gov/cise/ccf/shf_pgm09.jsp.

Proposals submitted to this solicitation must be consistent with one of three project classes defined below. Proposals will be considered for funding within their project classes.

- **Small Projects, with total budgets up to $500,000 for durations of up to three years,** are well suited to one or two investigators (PI and one co-PI or other Senior Personnel) and at least one student and/or postdoc.
- **Medium Projects, with total budgets ranging from $500,001 to $1,200,000 for durations up to four years,** are well-suited to one or more investigators (PI, co-PI and/or other Senior Personnel) and several students and/or postdocs. Medium project descriptions must be comprehensive and well-integrated, and should make a convincing case that the collaborative contributions of the project team will be greater than the sum of each of their individual contributions. Rationale must be provided to explain why a budget of this size is required to carry out the proposed work. Since the success of collaborative research efforts are known to depend on thoughtful coordination mechanisms that regularly bring together the various participants of the project, a Collaboration Plan is **required** for all Medium proposals with more than one investigator. The length of and level of detail provided in the Collaboration Plan should be commensurate with the complexity of the proposed project. Please see *Proposal Preparation Instructions* Section V.A for additional submission guidelines.
- **Large Projects, with total budgets ranging from $1,200,001 to $3,000,000 for durations of up to five years**, are well-suited to two or more investigators (PI, co-PI(s), or other Senior Personnel), and a team of students and/or postdocs. Large project descriptions must be comprehensive and well-integrated, and should make a convincing case that the collaborative contributions of the project team will be greater than the sum of each of their individual contributions. Rationale must be provided to explain why a budget of this size is required to carry out the proposed work. Since the success of collaborative research efforts are known to depend on thoughtful coordination mechanisms that regularly bring together the various participants of the project, a Collaboration Plan is **required** for all Large proposals. The length of and degree of detail provided in the Collaboration Plan should be commensurate with the complexity of the proposed project. Please see *Proposal Preparation Instructions* Section V.A for additional submission guidelines.

CISE investments in Small, Medium and Large projects complement the directorate's investments in the Expeditions in Computing program, where projects are funded at levels of up to $10,000,000 total for durations of up to 5 years. The Expeditions solicitation can be accessed at
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503169&org=CISE&from=home .

IMPORTANT PROJECT CHARACTERISTICS

The submission of far-reaching, creative research and education projects is encouraged. Funds will be used to support potentially transformative research with high-impact potential. In this way, CISE will catalyze exciting new research activities with the potential to make significant advances in the state-of-the-art.

Interdisciplinary, international and/or academic-industry collaborations that promise to result in major science or engineering advances are welcome. The directorate hopes to attract proposals from faculty at a broad range of academic institutions, including faculty at minority-serving and predominantly undergraduate institutions.

Proposals submitted should demonstrate that enriching learning experiences will be provided for a diverse population of students, and may describe the development of innovative curricula or educational materials that advance literacy about and expertise in areas supported by CISE.

Proposals that extend beyond the scope of one CISE core program are welcome. In such cases, PIs should identify the most relevant program(s) in the proposal submission process (see *Proposal Preparation Instructions* later in this document). CISE Program Officers will work with their NSF colleagues to ensure that these proposals are appropriately co-reviewed and considered for funding.

III. AWARD INFORMATION

Approximately $90 million will be available each year to support up to 160 awards, pending the availability of funds.

IV. ELIGIBILITY INFORMATION

Organization Limit:

None Specified

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI: 2

In any contiguous August through December period, an individual may participate as PI, Co-PI or Senior Personnel in no more than **two** proposals submitted in response to the *coordinated solicitation* (where *coordinated solicitation* is defined to include the *Information and Intelligent Systems (IIS): Core Programs*, the *Computer and Network Systems (CNS): Core Programs* and the *Computing and Communication Foundations (CCF): Core Programs* solicitations). For example, between August 2009 and December 2009, an individual may participate as PI, co-PI or Senior Personnel in one proposal submitted to a core program in CCF and in a second proposal submitted to a core program in CNS, or an individual may participate as PI, co-PI or Senior Personnel in two proposals submitted to an IIS core program, etc.

These eligibility constraints will be strictly enforced in order to treat everyone fairly and consistently. In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on earliest date and time of proposal submission (i.e. the first two proposals received will be accepted and the remainder will be returned without review). **No exceptions will be made.**

The limit on the number of proposals per PI, co-PI or Senior Personnel applies only to the *coordinated solicitation.*

Additional Eligibility Info:

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Instructions: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the guidelines specified 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-PUBS (7827) or by e-mail from pubs@nsf.gov.

The following information SUPPLEMENTS (not replaces) the guidelines provided in the NSF Grant Proposal Guide (GPG).

Proposal Titles: Proposal titles must begin with an acronym that indicates the most relevant core program. Select an acronym from the following list:

- Algorithmic Foundations - AF
- Communications and Information Foundations - CIF
- Software and Hardware Foundations - SHF

The acronym should be followed with a colon, then the project class followed by a colon, then the title of your project. For example, if you are submitting a medium proposal to the Communications and Information Foundations core program, then your title would be **CIF:Medium:Title**. If you submit a proposal as part of a set of collaborative proposals, the title of the proposal should begin with the acronym that indicates the most relevant core program followed by a colon, then the project class followed by a colon, then "Collaborative Research" followed by a colon, and the title. For example, if you are submitting a collaborative set of proposals to the Software and Hardware Foundations core program for a Large project, the title of each would be **SHF:Large:Collaborative Research: Title.** Proposals from PIs in institutions that have RUI (Research in Undergraduate Institutions) eligibility should begin their proposal title with the acronym that indicates the most relevant core program, followed by a colon then the project class, followed by a colon then "RUI", followed by a colon and then the title, for example, **AF:Small:RUI:Title.**

Proposals that extend beyond the scope of one CISE core program are welcome. In such cases, PIs should identify the acronym for the **most relevant** core program, followed by any other relevant program acronym(s) separated by colons (for example, **SHF:CSR:Medium:Title**). CISE Program Officers will work with their NSF colleagues to ensure that these proposals are appropriately co-reviewed and considered for funding.

Project Summary: All proposals must provide up to 6 sets of key words at the end of the Project Summary. These key words should describe the main scientific/engineering areas explored in the proposal. Key words should be prefaced with "Key Words" followed by a colon and each key word separated by semi-colons. Key words should be of the type used to describe research in a journal submission. They should be put at the end of the project summary and might appear, for example, as Key Words: formal logic; multi-modal interfaces; computer graphics; sensor networks; information visualization; privacy.

Project Description: Since the success of collaborative research efforts are known to depend on thoughtful coordination mechanisms that regularly bring together the various participants of the project, all Medium proposals with more than one investigator and all Large proposals must include Collaboration Plans. ***Relevant Medium proposals and all Large proposals that fail to include a Collaboration Plan will be returned without review.*** While the length of the Project Description for Small proposals is limited to 15 pages, for Medium and Large proposals up to 3 additional pages are allowed for Collaboration Plans. The

length of and degree of detail provided in the Collaboration Plan should be commensurate with the complexity of the proposed project. Where appropriate, the Collaboration Plan might include: 1) the specific roles of the project participants in all organizations involved; 2) information on how the project will be managed across all the investigators, institutions, and/or disciplines; 3) identification of the specific coordination mechanisms that will enable multi-investigator, cross-institution, and/or cross-discipline scientific integration (e.g., yearly workshops, graduate student exchange, project meetings at conferences, use of the grid for videoconferences, software repositories, etc.), and 4) specific references to the budget line items that support collaboration and coordination mechanisms.

Proposals that incorporate curriculum development activities should describe the curriculum development activities in a separate section of the Project Description entitled "Curriculum Development Activities."

Supplementary Documents: In the Supplementary Documents Section, include a list of all PIs, Co-PIs, Senior Personnel, paid Consultants, Collaborators and Postdocs to be involved in the project. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon. Each person listed should start a new numbered line. For example:

1. Mary Smith; XYZ University; PI
2. John Jones; University of PQR; Senior Personnel
3. Jane Brown; XYZ University; Postdoc
4. Bob Adams; ABC Inc.; Paid Consultant

PIs from predominantly undergraduate institutions should also include a Research in Undergraduate Institutions (RUI) Impact Statement and Certification of RUI Eligibility in this Section.

Proposers are reminded to identify the program solicitation number (NSF 09-555) 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.

B. Budgetary Information

Cost Sharing: Cost sharing is not required under this solicitation.

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. proposer's local time)**:**

  Medium Projects: August 1, 2009 - August 30, 2009, August 1 - August 30, Annually Thereafter

  Large Projects: November 1, 2009 - November 28, 2009, November 1 - November 28, Annually Thereafter

  Small Projects: December 1, 2009 - December 17, 2009, December 1 - December 17, Annually Thereafter

D. FastLane Requirements

Proposers are required to prepare and submit all proposals for this program solicitation through use of the NSF FastLane system. Detailed instructions regarding the technical aspects of proposal preparation and submission via FastLane are available at: http://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.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program where they will be reviewed if they meet NSF proposal preparation requirements. 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 of interest with the proposal.

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, original, or potentially transformative 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?

Examples illustrating activities likely to demonstrate broader impacts are available electronically on the NSF website at: http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf.

NSF staff also 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.

Additional Review Criteria:

For Medium and Large proposals only, reviewers will be asked to:

- Comment on the extent to which the project scope justifies the level of investment requested, and the degree to which the participating investigators will work synergistically to accomplish the project objectives.
- Comment on the Collaboration Plan.

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 deadline or target date, or receipt date, whichever is later. 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 Research 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/award_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 *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

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:

- Dmitry Maslov, Point of Contact, Algorithmic Foundations, 1115, telephone: (703) 292-8910, email: dmaslov@nsf.gov
- John H Cozzens, Point of Contact, Communications and Information Foundations, 1115, telephone: (703) 292-8910, email: jcozzens@nsf.gov
- Sol Greenspan, Point of Contact, Software and Hardware Foundations, 1115, telephone: (703) 292-8910, email: sgreensp@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.
- Velma Lawson, Integrative Activities Specialist, 1115, telephone: (703) 292-8910, email: vlawson@nsf.gov

In addition to the Program Officers identified as program points of contact above, the following CCF Program Officers also support CCF core programs as indicated below:

Algorithmic Foundations (AF)

- Mitra Basu, (703) 292-8910, mbasu@nsf.gov, Room 1115
- Richard Beigel, (703) 292-8910, rbeigel@nsf.gov, Room 1115
- Tracy Kimbrel, (703) 292-8910, tkimbrel@nsf.gov, Room 1115
- Lenore Mullin, (703) 292-8910, lmullin@nsf.gov, Room 1115

Communications and Information Foundations (CIF)

- Eun Park, (703) 292-8910, epark@nsf.gov, Room 1115
- William Tranter, (703) 292-8910, wtranter@nsf.gov, Room 1115

Software and Hardware Foundations (SHF)

- Sankar Basu, (703) 292-8910, sabasu@nsf.gov, Room 1115
- Almadena Chtchelkanova, (703) 292-8910, achtchel@nsf.gov, Room 1115
- Chitaranjan Das, (703) 292-8910, cdas@nsf.gov, Room 1115

Tatsuya Suda, (703) 292-8910, suda@nsf.gov, Room 1115
- Lenore Zuck, (703) 292-8910, lzuck@nsf.gov, Room 1115

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, National Science Foundation Update is a free e-mail subscription service 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 when new publications are issued that match their identified interests. Users can subscribe to this service by clicking the "Get NSF Updates by Email" link on the NSF web site.

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.

In addition to the *coordinated solicitation* discussed in this document, NSF provides funding opportunities for the computing community via the following programs and their solicitations:

Discovery Research Programs

Advanced Learning Technologies (ALT), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12834&org=NSF&sel_org=NSF&from=fund

CAREER: Faculty Early Career Development, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5262

CISE Cross-Cutting Programs: FY 2009 and FY 2010, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13451

Collaborative Research in Computational Neuroscience (CRCNS), http://nsf.gov/funding/pgm_summ.jsp?pims_id=5147

Community-Based Data Interoperability Networks (Interop) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=502112&org=CISE&sel_org=CISE&from=fund*

CreativeIT, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501096

Cyber-enabled Discovery and Innovation (CDI), http://www.nsf.gov/crssprgm/cdi/

Cyber-Physical Systems (CPS), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503286&org=NSF&sel_org=NSF&from=fund

Engineering Research Centers (ERCs), *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5502&org=NSF&sel_org=NSF&from=fund*

Expeditions in Computing, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503169&org=NSF&sel_org=NSF&from=fund

Foundations of Data and Visual Analytics (FoDaVA), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501081&org=NSF&sel_org=NSF&from=fund

Grant Opportunities for Academic Liaison with Industry (GOALI), *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13706&org=CISE&sel_org=CISE&from=fund*

High-End Computing University Research Activity (HECURA), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13645&org=NSF&sel_org=NSF&from=fund

Industry/University Cooperative Research Centers Program (I/UCRC), *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5501&org=CISE&sel_org=CISE&from=fund*

Partnerships for International Research and Education (PIRE) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12819&org=CISE&sel_org=CISE&from=fund*

Research in Undergraduate Institutions (RUI) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5518&org=CISE&sel_org=CISE&from=fund*

Science of Learning Centers (SLCs) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5567&org=CISE&sel_org=CISE&from=fund*

Science and Technology Centers (STCs) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5541&org=CISE&sel_org=CISE&from=fund*

Sustainable Digital Data Preservation and Access Network Partners (DataNet) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503141&org=CISE&sel_org=CISE&from=fund*

Education and Workforce Development Programs

ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383&from=fund

Advanced Technological Education (ATE) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5464*

Broadening Participation in Computing (BPC), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13510&org=NSF&sel_org=NSF&from=fund

CISE Pathways to Revitalized Education in Computing (CPATH), http://www.nsf.gov/funding/pgm_summ.jsp?

pims_id=500025&org=NSF&sel_org=NSF&from=fund

Computational Science Training for Undergraduates in the Mathematical Sciences (CSUMS) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13655&org=EHR&sel_org=EHR&from=fund*

Course, Curriculum, and Laboratory Improvement (CCLI) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5741&org=EHR&sel_org=EHR&from=fund*

Developing Global Scientists and Engineers [International Research Experiences for Students (IRES) and Doctoral Dissertation Enhancement Projects (DDEP)] *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12831&org=CISE&sel_org=CISE&from=fund*

Discovery Research K-12 (DR-K12) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=500047&org=EHR&sel_org=EHR&from=fund*

Federal Cyber Service: Scholarship for Service (SFS) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5228*

Graduate Research Fellowships (GRF), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=6201&org=DGE&from=home

Integrative Graduate Education and Research Training (IGERT), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12759

International Research Fellowship Program (IRFP) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5179&org=CISE&sel_org=CISE&from=fund*

Information Technology Experiences for Students and Teachers (ITEST) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5467&org=EHR&sel_org=EHR&from=fund*

NSF Graduate Teaching Fellows in K-12 Education (GK-12), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5472&from=fund

NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) *http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5257&org=EHR&sel_org=EHR&from=fund*

Research Experiences for Undergraduates (REU) Sites and Supplements, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5517&from=fund

Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP) http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5488&org=EHR&sel_org=EHR&from=fund

Research Infrastructure Programs

Computing Research Infrastructure (CRI), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12810&org=NSF&sel_org=NSF&from=fund

EPSCoR Research Infrastructure Improvement Grant Program http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5672&org=CISE&sel_org=CISE&from=fund

Major Research Infrastructure (MRI), http://www.nsf.gov/od/oia/programs/mri/

For more information on these programs, please consult the NSF web site.

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

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