

Computer Systems Research (CSR)

Program Solicitation

NSF 04-609



National Science Foundation

Directorate for Computer and Information Science and Engineering
Division of Computer & Network Systems

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

November 23, 2004

November 11, 2005

Second Friday in November

annually thereafter

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Computer Systems Research (CSR)

Synopsis of Program:

Computer systems are ubiquitous, and society is increasingly dependent on them. They range from microprocessors embedded in automobiles and appliances to worldwide grids of advanced processors, storage, graphics devices, and instruments interconnected by high-speed networks. They are controlled by *systems software*, which has two main roles: manage the underlying hardware resources, and provide abstractions and services that facilitate the implementation and execution of application programs. However, too often computer systems fail, become compromised, or perform poorly. Moreover, they have become increasingly large and complex, thereby compounding problems. Addressing these challenges requires major advances in systems software.

The Computer Systems Research (CSR) program supports innovative research and education projects that have the potential to: lead to significant improvements in existing computer systems by increasing our fundamental understanding of such systems; produce systems software that is qualitatively and

quantitatively more reliable and more efficient; and/or, to produce innovative curricula or educational materials that better prepare the next generation of computing professionals. The CSR program is also interested in projects that expand the capabilities of existing systems by exploiting the potential of new technologies or by developing innovative new ways to use existing technologies. Projects supported will strive to make significant progress on challenging, high-impact problems—as opposed to incremental progress on familiar problems—and will have a credible plan for demonstrating the utility and potential impact of the proposed work.

The CSR program contains four topical areas: embedded and hybrid systems, parallel and distributed operating systems, advanced execution systems, and systems modeling and analysis. Projects may range in size from single investigators to teams of several investigators.

The CSR program also accepts proposals for workshops and Small Grants for Exploratory Research (SGERs).

Cognizant Program Officer(s):

- Frederica Darema, Senior Science and Technology Advisor, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 1122 N, telephone: (703) 292-8950, fax: (703) 292-9010, email: fdarema@nsf.gov
- D. Helen Gill, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 1145 N, telephone: (703) 292-8950, fax: (703) 292-9010, email: hgill@nsf.gov
- Brett Fleisch, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 1175 N, telephone: (703) 292-8950, fax: (703) 292-9010, email: bfleisch@nsf.gov

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

- 47.070 --- Computer and Information Science and Engineering

Eligibility Information

- **Organization Limit:** None Specified.
- **PI Eligibility Limit:**

An individual may appear as PI, Co-PI, or Senior Personnel on no more than two proposals per annual CSR competition.

- **Limit on Number of Proposals:** None Specified.

Award Information

- **Anticipated Type of Award:** Standard or Continuing Grant
- **Estimated Number of Awards:** 41 to 57 - 35-45 small awards with durations of two or three years; 6-12 team awards with durations of three or four years
- **Anticipated Funding Amount:** \$27,000,000 subject to the availability of funds

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Full Proposal Preparation Instructions:** This solicitation contains information that deviates from the standard 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.
- **Indirect Cost (F&A) Limitations:** Not Applicable.
- **Other Budgetary Limitations:** Not Applicable.

C. Due Dates

- **Full Proposal Deadline Date(s)** (due by 5 p.m. proposer's local time):
 - November 23, 2004
 - November 11, 2005
 - Second Friday in November
annually thereafter

Proposal Review Information

- **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**

Computing platforms and applications are increasingly complex and dynamic. They also cover a wide range of technologies and capabilities, such as globally distributed, heterogeneous platforms; high-end computing systems, including grids; local-area networks of enterprise systems; clusters of workstations; shared-memory multiprocessors; mobile and special-purpose embedded processors; real-time process controllers; and assemblies of embedded sensor systems and physical control actuation devices.

The Computer Systems Research (CSR) program supports innovative research and education projects that will lead to better computer systems by increasing our fundamental understanding of such systems and by producing better systems software. The program aims to support projects that have the potential to lead to systems that are more reliable and robust, contain fewer bugs, have better and more predictable performance, provide useful new services, and exploit the potential of emerging technologies.

CSR also supports the development of innovative curricular materials that have the potential to greatly improve higher education on computer systems topics. Such activities may be submitted as stand-alone projects or may be included as part of broader research and education projects. Stand-alone curriculum development projects are expected to include strong justification of the need for the new materials and must include both plans for disseminating them to the community and for evaluating their effectiveness.

Systems software contains services and runtime support for applications as well as operating systems services for resource management and process control. It interacts with applications from above and hardware and communication services from below. In order to be effective, systems software must be developed with a *systems view*, where both its design and operation incorporate the effects of the entire computing system. Projects that propose to create systems software thus have to consider the environment in which it will execute. Projects that propose to model or analyze computer systems have to treat components not as isolated entities but with respect to their functionality and performance in relation to other components and layers of an entire system. Creating new systems software will often require teams of researchers with expertise from several computing sub-disciplines.

II. **PROGRAM DESCRIPTION**

The CSR program is organized into four interacting topical areas:

- Embedded and hybrid systems (EHS)
- Parallel and distributed operating systems (PDOS)
- Advanced execution systems (AES)
- Systems modeling and analysis (SMA)

The first three areas are organized around technologies, from embedded and real-time control systems, through multiprocessors and distributed systems, to high-end grids. The systems modeling and analysis area addresses topics that cut across the other three areas. In addition, several themes are common to the first three areas, such as resource and process management; interactions between systems software, applications, compilers, and runtime systems; and system services to support the composition and execution of applications.

The CSR program will fund proposals that address the topics in the four topical areas described below as well as projects that span areas. The program is especially interested in projects that have the potential to lead to significant advances in systems software and that integrate research and education in creative ways. Proposals are expected to describe how the project will demonstrate potential impact—e.g., by validating theories on real systems, by demonstrating the utility of new systems software and making it available to the community, and/or by disseminating and evaluating new educational materials or curricula.

Embedded Systems (EHS)

Information technology for embedded systems is a key accelerator of progress and innovation in modern engineered systems. Embedded systems control devices that range from hearing aids and automobiles to the electrical power grid and global aviation infrastructure. The nation's critical infrastructures depend on embedded sensing and control systems. However, current systems are built on top of decades-old technology, often as closed, single systems. Future supervisory and real-time process control systems must be open and interoperable with other systems in a widely distributed environment.

The EHS area supports research and education in scientific foundations and systems technology that will revolutionize the design and development of embedded and real-time systems. EHS emphasizes temporal and hybrid (discrete and continuous) aspects of computational control for this class of systems. The goals are to create and unify the foundations for interacting physical and computational systems and to supply technologies needed for building reliable embedded systems. This requires a rethinking of the underpinnings, architectures, and system implementation philosophies for these kinds of systems. A pervasive theme for the EHS area is the creation of high-confidence systems that integrate functionality with mechanisms that provide real-time, survivability, reliability, and security guarantees. Key drivers for this theme are the coordination demands that are required by future generations of complex, networked embedded systems. The area draws upon control theory, modeling, software generation, real-time and resource-aware scheduling, and formal methods.

Specific topics of interest to the EHS area include the following:

- Embedded systems software composition: algorithms, middleware, virtual machines, and system services; new concepts for distributed real-time and light-weight operating systems; component technology for functional and non-functional aspects of systems; and, programming methods for integration of embedded system services.
- Foundations and technology for distributed software control: hybrid discrete and continuous models for predicting behavior of systems; new concepts to support and secure future generation supervisory control and data acquisition (SCADA) systems and process control systems (PCS); and, scalable support for embedded sensors and sensor nets.
- Methods for modeling and design of embedded software and systems: foundations, design, implementation, synthesis, analysis, and certification methods; and, innovative approaches for failure modes, self-test, and recovery and reconstitution.
- Resource management and optimization: methods and tools for allocating, scheduling, and managing real-time, power-aware, distributed embedded systems; and, static and real-time dynamic scheduling technology that addresses and integrates multiple concerns such as real-time guarantees, power, clock frequency, thermal gain, RF emission and interference, network bandwidth, and criticality level.

Parallel and Distributed Operating Systems (PDOS)

Most computer systems are general-purpose meaning that they use commodity hardware and the systems software supports a variety of applications. This contrasts with embedded and real-time systems, which are closely tied to a single application and often use customized hardware. General-purpose computer systems include uniprocessors, shared-memory multiprocessors, mobile devices and applications, local area distributed systems, clusters, wide area distributed systems, and computational grids.

The PDOS topical area supports research and education projects that advance the state of the art in operating systems software for the range of computer systems described above. The goals are to improve the capabilities, reliability, and efficiency of existing systems, to create new ways to utilize current technologies, and to harness the potential of emerging technologies. Projects are expected to increase our fundamental understanding of how to design and build better operating

systems and/or to create new types of systems and systems services and to demonstrate their utility through empirical prototypes that are evaluated and disseminated to the community.

Specific topics of interest to the PDOS area include the following:

- Resource management: Scheduling, virtual memory management and protection; management of multiple levels of memory hierarchy and file systems; process and data migration; scalable and robust methods for communication and synchronization; virtualization of resources and efficient resource utilization; and, resource management across heterogeneous platforms with distinct administrative boundaries.
- System services: Mechanisms that enable dynamic coalitions, such as peer-to-peer or ad-hoc groups; membership, naming, and authorization services; local and remote resource discovery and resource requests services; system monitoring for performance tuning or to provide resilience to faults; support for debugging large, widely dispersed distributed systems; checkpoint and recovery services; configuration management; and, customizable and adaptable systems services.
- System architecture: New ways to organize systems, such as peer-to-peer; software architectures that scale to handle thousands of components; software architectures addressing changing trends, such as in sizes or speeds of processors, memory, address spaces, and backing store; multi-threaded kernel design and kernel-level management functions for end-to-end provisioning of services; and, dynamic, customizable kernels.
- System properties: Fault-tolerance and reliability; efficiency; security; scalability; and, ability to cope with unexpected events.

Advanced Execution Systems (AES)

Advanced applications execute on large, heterogeneous high-end computing and grid platforms; require multiple resources, from fast processors to large data stores; and consume large amounts of communication network bandwidth. These applications have dynamically changing resource requirements, and the underlying resources available to an application also change dynamically due to competing demands from other applications. Consequently, an advanced execution environment has to support adaptive mapping of applications to underlying resources during execution.

The AES topical area supports research and education projects that create systems software to facilitate the development and runtime support of complex applications. One way to meet the above kinds of execution requirements is by means of runtime compiling systems and application composition systems. These systems interface with the operating systems services developed in the parallel and distributed systems (PDOS) topical area, and they incorporate methods and tools developed in the systems modeling and analysis (SMA) topical area.

A runtime compiling system (RCS) extends the standard static notion of a compiler by embedding a portion of the compiler in the runtime system and endowing the RCS system with resource awareness and adaptive mapping capabilities. In addition to analyzing an application's characteristics, an RCS interfaces with the underlying operating systems services and resource managers in order to discover and request system resources and system services during the execution of the application. An RCS also measures and queries features of components of the execution environment in order dynamically to optimize the mapping of the application to the underlying resources as resource availability changes or as the application's needs change. Developing RCS technology requires advances in areas such as programming models and tools for partitioning an application across distributed, heterogeneous computing platforms; new compiler techniques for determining functional and data dependencies across platforms and across multiple levels of memory hierarchy; application-level checkpointing and recovery; and mechanisms for matching an application's resource needs to underlying resources when both are changing as the application executes.

An application composition system (ACS) allows an application to be constructed to fit the available resources and to adapt to changes in the underlying execution environment. It also supports application-level monitoring, debugging, and recovery. An ACS interacts with and supports an RCS to compose applications dynamically. Creating an ACS requires designing methods for automatically selecting application components; creating knowledge bases for application components; interfacing with the underlying computing platform models to determine suitable application components; and developing appropriate application component libraries and interfaces so the run-time portion of the RCS can link to such libraries.

System Modeling and Analysis (SMA)

The SMA topical area supports the development of methods and tools for modeling, measuring, analyzing, evaluating, and predicting the performance and correctness of complex computing and communications systems. Ideally these methods and tools will be general and powerful enough to be applicable to the range of platforms addressed in this solicitation, from embedded systems to high-end computational grids.

Proposed methods and tools should support analysis of all levels of a system—hardware, systems software, and application—and of entire systems. One way to do this is to create performance frameworks that employ models and measurements (in a plug-and-play fashion) of different levels of detail of each component and layer as needed for the specific analysis at hand. Of specific interest are methods that provide hierarchical or multilevel analysis of such systems, enable assessment of the effects of individual hardware and software layers and components of these systems, and are pluggable into the performance frameworks to assess their impact on the performance of the entire system. It is also important to be able to model how the behavior of the system scales as aspects of the application, systems software, or hardware change—e.g., when one shifts from a small prototype to a production environment or from one machine or to another with different architectural features.

Relation to Other Programs

Systems software exists in the context of applications, and it interacts with other software systems. 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 CSR 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 program. A proposal that develops or uses compiler technology to address a system software problem should be submitted to CSR, but a proposal that addresses traditional compiler technology should be submitted to the Computing Processes and Artifacts (CPA) program. Similarly, a project that develops programming languages or software tools to facilitate programming parallel applications should be submitted to CPA, whereas a project that develops systems software to support parallel computing should be submitted to CSR. Finally, a project that develops middleware to support a specific computational science application or that hardens prototype systems software should be submitted to the NSF Middleware Initiative (NMI), whereas a project that proposes basic research on middleware services would be more appropriate for CSR.

III. ELIGIBILITY INFORMATION

The categories of proposers identified in the [Grant Proposal Guide](#) are eligible to submit proposals under this program announcement/solicitation.

An individual may appear as a PI, co-PI or Senior Personnel on no more than two proposals per annual CSR competition.

Limit on number of proposals: None specified.

IV. AWARD INFORMATION

The CSR program will make two types of awards:

- **Small.** These awards include one or two PIs, have budgets of up to \$800,000, and durations of two or three years. Approximately 35-45 small awards will be given in each annual CSR competition, with an estimated average award size of approximately \$450,000.
- **Team.** These awards include three or more PIs, have budgets of up to \$2,000,000, and durations of three or four years. Approximately 6-12 team awards will be given in each annual CSR competition, with an estimated average award size of \$1,000,000.

If a project requires computing equipment or other infrastructure in order to be successful, and the required infrastructure is not available to the PIs, then it should be requested. List the items on the budget pages and give a thorough justification in the budget explanation section of the proposal. If the infrastructure request is for more than \$100,000, the PI should discuss the need with one of the program officers identified in this solicitation.

The CSR program will also accept proposals for workshops and Small Grants for Exploratory Research (SGER). These may be submitted at any time, but a prospective PI is required to discuss their idea with one of the program officers mentioned in this solicitation before submitting such a proposal.

In unusual circumstances, the Division of Computer and Network Systems will entertain proposals that are beyond the scope and funding levels noted elsewhere in this solicitation. Such proposals would be expected to explore groundbreaking or paradigm-changing ideas or to pursue a grand challenge requiring the work of a substantial number of researchers. Projects of this type might well include multidisciplinary investigators and cover topics in more than one CNS or CISE program. PIs who have in mind such a project must first brief the appropriate program officers and the CNS Division Director. PIs may submit a full proposal *only* after being given permission to do so. The briefing must take place before the program solicitation deadline so the Division can plan for the receipt and review of this type of proposal.

Estimated program budget, number of awards, and average award size/duration are subject to the availability of funds.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Instructions:

Proposals submitted in response to this program announcement/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/cgi-bin/getpub?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.

The following information deviates from the GPG guidelines:

To assist NSF staff in sorting proposals for review, proposal titles should begin with “CSR---key” where key is an acronym for one of the topical areas. If a proposal addresses topics in more than one area, it should be directed at whichever one of the areas is most appropriate. Use the following acronyms to identify the topical area:

- EHS --- embedded and hybrid systems
- PDOS --- parallel and distributed systems
- AES --- advanced execution systems
- SMA --- system modeling and analysis

For example, a proposal might have a title such as “CSR---PDOS: Resource Management in Peer to Peer Systems.”

A workshop proposal should have the key “WORKSHOP” and a SGER proposal should have the key “SGER.”

Every proposal must include a discussion of broader impacts. Appropriate goals for the broader impacts component include the integration of education and research, promoting diversity in the computer systems workforce, developing substantial experimental research educational experiences, and developing curriculum and supporting materials in emerging computer systems areas. The following URL contains several examples of broader impacts activities: <http://www.nsf.gov/pubs/2002/nsf022/bicexamples.pdf>.

Proposers are reminded to identify the program announcement/solicitation number (04-609) in the program announcement/solicitation block on the proposal Cover Sheet. 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 in proposals submitted under this Program Solicitation.

C. Due Dates

Proposals must be submitted by the following date(s):

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

November 23, 2004

November 11, 2005

Second Friday in November
annually thereafter

D. FastLane Requirements

Proposers are required to prepare and submit all proposals for this announcement/solicitation through the FastLane system. Detailed instructions for proposal 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 announcement/solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this announcement/solicitation.

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. Proposers are no longer required to provide a paper copy of the signed Proposal Cover Sheet to NSF. Further instructions regarding this process are available on the FastLane Website at: <http://www.fastlane.nsf.gov>

VI. PROPOSAL REVIEW INFORMATION

A. NSF Proposal Review Process

Reviews of proposals submitted to NSF are solicited from peers with expertise in the substantive area of the proposed research or education project. These reviewers are selected by Program Officers charged with the oversight of the review process. NSF invites the proposer to suggest, at the time of submission, the names of appropriate or inappropriate reviewers. Care is taken to ensure that reviewers have no conflicts with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority-serving institutions, or adjacent disciplines to that principally addressed in the proposal.

The National Science Board approved revised criteria for evaluating proposals at its meeting on March 28, 1997 (NSB 97-72). All NSF proposals are evaluated through use of the two merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

On July 8, 2002, the NSF Director issued [Important Notice 127](#), Implementation of new Grant Proposal Guide Requirements Related to the Broader Impacts Criterion. This Important Notice reinforces the importance of addressing both criteria in the preparation and review of all proposals submitted to NSF. NSF continues to strengthen its internal processes to ensure that both of the merit review criteria are addressed when making funding decisions.

In an effort to increase compliance with these requirements, the January 2002 issuance of the GPG incorporated revised proposal preparation guidelines relating to the development of the Project Summary and Project Description. Chapter II of the GPG specifies that Principal Investigators (PIs) must address both merit review criteria in separate statements within the one-page Project Summary. This chapter also reiterates that broader impacts resulting from the proposed project must be addressed in the Project Description and described as an integral part of the narrative.

Effective October 1, 2002, NSF will return without review proposals that do not separately address both merit review criteria within the Project Summary. It is believed that these changes to NSF proposal preparation and processing guidelines will more clearly articulate the importance of broader impacts to NSF-funded projects.

The two National Science Board approved merit review criteria are listed below (see the [Grant Proposal Guide](#) Chapter III.A for further information). 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 he/she is qualified to make judgments.

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.

All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. Proposals submitted in response to this announcement/solicitation will be reviewed by Ad Hoc 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.

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 Director. In addition, the proposer will receive an explanation of the decision to award or decline funding.

NSF is striving to be able to tell proposers whether their proposals have been declined or recommended for funding within six months. The time interval begins on the closing date of an announcement/solicitation, or the date of proposal receipt, whichever is later. The interval ends when the Division Director accepts the Program Officer's recommendation.

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 Division 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.A. 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 (NSF-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 agreement awards also are administered in accordance with NSF Cooperative Agreement Terms and Conditions (CA-1). Electronic mail notification is the preferred way to transmit NSF awards to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/home/grants/grants_gac.htm. 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 is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, available electronically on the NSF Website at <http://www.nsf.gov/cgi-bin/getpub?gpm>. The GPM is also for sale through the

Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402. The telephone number at GPO for subscription information is (202) 512-1800. The GPM may be ordered through the GPO Website at <http://www.gpo.gov>.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the PI must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period.

Within 90 days after the expiration of an award, the PI also is required to submit a final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for the PI and all Co-PIs. 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. This system permits electronic submission and updating of project reports, including information on project participants (individual and organizational), activities and findings, 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.

VIII. CONTACTS FOR ADDITIONAL INFORMATION

General inquiries regarding this program should be made to:

- Frederica Darema, Senior Science and Technology Advisor, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 1122 N, telephone: (703) 292-8950, fax: (703) 292-9010, email: fdarema@nsf.gov
- D. Helen Gill, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 1145 N, telephone: (703) 292-8950, fax: (703) 292-9010, email: hgill@nsf.gov
- Brett Fleisch, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 1175 N, telephone: (703) 292-8950, fax: (703) 292-9010, email: bfleisch@nsf.gov

The primary contacts for the four topical areas are:

- Embedded and hybrid systems: D. Helen Gill
- Parallel and distributed operating systems: Brett Fleisch
- Advanced execution environments: Frederica Darema
- System modeling and simulation: Frederica Darema

For questions related to the use of FastLane, contact:

- Joan Goetzinger, Staff Assistant for Integrative Activities, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 1160 N, telephone: (703) 292-8188, fax: (703) 292-9030, email: jgoetzin@nsf.gov

IX. OTHER PROGRAMS OF INTEREST

The NSF *Guide to Programs* is a compilation of funding for research and education in science, mathematics, and engineering. The NSF *Guide to Programs* is available electronically at <http://www.nsf.gov/cgi-bin/getpub?gp>. General descriptions of NSF programs, research areas, and eligibility information for proposal submission are provided in each chapter.

Many NSF programs offer announcements or solicitations concerning specific proposal requirements. To obtain additional information about these requirements, contact the appropriate NSF program offices. Any changes in NSF's fiscal year programs occurring after press time for the *Guide to Programs* will be announced in the NSF [E-Bulletin](#), which is updated daily on the NSF Website at <http://www.nsf.gov/home/ebulletin>, and in individual program announcements/solicitations. Subscribers can also sign up for NSF's [Custom News Service](#) (<http://www.nsf.gov/home/cns/start.htm>) to be notified of new funding opportunities that become available.

Related Programs:

Systems software exists in the context of applications, and it interacts with other software systems. 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 CSR 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 program. A proposal that develops or uses compiler technology to address a system software problem should be submitted to CSR, but a proposal that addresses traditional compiler technology should be submitted to the Computing Processes and Artifacts (CPA) program. Similarly, a project that develops programming languages or software tools to facilitate programming parallel applications should be submitted to CPA, whereas a project that develops systems software to support parallel computing should be submitted to CSR. Finally, a project that develops middleware to support a specific computational science application or that hardens prototype systems software should be submitted to the NSF Middleware Initiative (NMI), whereas a project that proposes basic research on middleware services would be more appropriate for CSR.

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