Software Infrastructure for Sustained Innovation (SI^2)

PROGRAM SOLICITATION
10-551

National Science Foundation

Office of Cyberinfrastructure

Directorate for Biological Sciences

Directorate for Computer & Information Science & Engineering

Directorate for Engineering

Directorate for Geosciences

Office of International Science and Engineering

Directorate for Mathematical & Physical Sciences

Directorate for Social, Behavioral & Economic Sciences

Letter of Intent Due Date(s) *(required)* (due by 5 p.m. proposer's local time)*:*

May 10, 2010

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

June 14, 2010

IMPORTANT INFORMATION AND REVISION NOTES

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:

Software Infrastructure for Sustained Innovation

Synopsis of Program:

Computation is accepted as the third pillar supporting innovation and discovery in science and engineering and is central to NSF's future vision of *Cyberinfrastructure Framework for 21st Century Science and Engineering (CF21)*[1]. Software is an integral part of the computation paradigm and a primary modality for realizing the CF21 vision. Scientific discovery and innovation are advancing fundamentally new pathways opened by development of increasingly sophisticated software. Software is also directly responsible for increased scientific productivity and significant enhancement of researchers' capabilities. In order to nurture, accelerate and sustain this critical mode of scientific progress, NSF is establishing a new program, *Software Infrastructure for Sustained Innovation (SI^2)*, with the overarching goal of transforming innovations in research and education into sustained software resources that are an integral part of the cyberinfrastructure.

SI^2 is a long-term investment focused on catalyzing new thinking, paradigms, and practices in using software to understand natural, human, and engineered systems. SI^2's intent is to foster a pervasive cyberinfrastructure to help researchers address problems of unprecedented scale, complexity, resolution, and accuracy by integrating computation, data, networking and experiments in novel ways. It is NSF's expectation that SI^2 investment will result in robust, reliable, usable and sustainable software infrastructure that is critical to the CF21 vision and will transform science and engineering.

It is expected that SI^2 will generate and nurture the multidisciplinary processes required to support the entire software lifecycle and will result in the development of sustainable software communities. SI^2 envisions vibrant

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partnerships among academia, government laboratories and industry for the development and stewardship of a sustainable software infrastructure that can enhance productivity and accelerate innovation in science and engineering. The goal of the SI^2 program is to create a software ecosystem that includes all levels of the software stack and scales from individual or small groups of software innovators to large hubs of software excellence. The program addresses all aspects of CI, from embedded sensor systems and instruments, to desktops and high-end data and computing systems, to major instruments and facilities.

The SI^2 program envisions three classes of awards:

1. **Scientific Software Elements (SSE):** SSE awards target small groups that will create and deploy robust software elements for which there is a demonstrated need, encapsulating innovation in science and engineering. The effort targeted by a SSE award is up to a level roughly comparable to: summer support for two investigators with complementary expertise; two graduate students; and their collective research needs (e.g. materials, supplies, travel) for three years.

2. **Scientific Software Integration (SSI):** SSI awards target larger groups of PIs organized around common research problems as well as common software infrastructure, and will result in a sustainable community software framework. The effort targeted by a SSI award is up to a level roughly comparable to: summer support for three to four investigators with complementary expertise; three to four graduate students; one or two senior personnel (including post-doctoral researchers, software developers, and staff); and their collective research needs (e.g., materials, supplies, travel) for three to five years. The integrative contributions of the SSI team should clearly be greater than the sum of the contributions of each individual member of the team.

3. **Scientific Software Innovation Institutes (S2I2):** S2I2 awards will focus on the establishment of long-term community-wide hubs of software excellence. These hubs will provide expertise, processes, resources and implementation mechanism to transform computational science and engineering innovations and community software into robust and sustained tools for enabling science and engineering. S2I2 proposals will bring together multidisciplinary teams of domains scientists and engineers, computer scientists and software engineers, technologists and educators.

The FY 2010 SI^2 competition will be limited to SSE and SSI awards. The solicitation in FY 2011, and in subsequent years, will outline funding opportunities for all three classes of awards (SSE, SSI and S2I2), subject to availability of funds.

Cognizant Program Officer(s):

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

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.050 --- Geosciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences
- 47.079 --- Office of International Science and Engineering
- 47.080 --- Office of Cyberinfrastructure

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 22   In FY 2010, the number of SSE and SSI awards will be determined based on the results of separate review processes. There will be no S2I2 awards in FY 2010. In FY 2011 and beyond, subject to availability of funds, SSE, SSI and S2I2 awards will be made based on the results of separate review processes.

Anticipated Funding Amount: $11,400,000 Estimated program budget, number of awards and average award size/duration are subject to the availability of funds. Pending availability of funds, approximately $11,400,000 will be available in FY 2010 for proposals submitted in response to this solicitation. SSE awards are expected to total $300K - $500K for 3 years, and SSI

approximately $1M / year for 3-5 years. It is estimated that each year approximately 18 SSE and 4 SSI awards will be made subject to the availability of funds. In 2011 and 2012 it is expected that 2 S2I2 awards will be made, subject to the availability of funds.

Eligibility Information

Organization Limit:

Proposals may only be submitted by the following:

- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI: 2

An individual may participate as Principal Investigator, co-Principal Investigator or other Senior Personnel in at most two full proposals in each annual competition. Any individual whose biographical sketch is provided as part of the proposal will be considered Senior Personnel in the proposed activity. After the proposal submission deadline, if a person appears on more than two full proposals, submitters may withdraw proposals to reduce that person's participation to two proposals; otherwise, after the first two submitted proposals in which that individual is participating, the remainder will be returned without review. In this context, a multi-institution collaborative project is treated as one proposal that is considered submitted when the last component proposal is submitted.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Submission of Letters of Intent is required. Please see the full text of this solicitation for further information.

- **Preliminary Proposal Submission:** Not Applicable

- **Full Proposals:**
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.
  - Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)

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

- **Letter of Intent Due Date(s)** *(required)* (due by 5 p.m. proposer's local time)*:*

  May 10, 2010

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

  June 14, 2010

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: Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements: Standard NSF reporting requirements apply.

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I. INTRODUCTION

Software Infrastructure for Sustained Innovation (SI^2) is a bold and long-term investment focused on realizing the *Cyberinfrastructure Framework for 21st Century Science and Engineering (CF21)*[1] vision and catalyzing new thinking, paradigms and practices in science and engineering. CF21 fosters a pervasive cyberinfrastructure that enables research at unprecedented scales, complexity, resolution, and accuracy by integrating computation, data and experiments in novel ways. CF21 has the potential for revolutionizing virtually every discipline by providing unique insights into complex problems, and thus creates unprecedented opportunities for understanding natural, human and engineered systems.

Software is a primary modality through which CF21 innovation and discovery will be realized. It permeates all aspects and layers of cyberinfrastructure (from application codes and frameworks, programming systems, libraries and system software, to middleware, operating systems, networking and the low-level drivers). CF21 envisions a linked cyberinfrastructure architecture that integrates large-scale computing, high-speed networks, massive data archives, instruments and major facilities, observatories, experiments, and embedded sensors and actuators, across the nation and the world.

The CF21 software infrastructure must address the complexity of this cyberinfrastructure, accommodating disruptive hardware trends, ever-increasing data volumes, complex application structures and behaviors, and emerging concerns such as fault-tolerance and energy efficiency. The software must be continually refined, at one end, to support these new trends and requirements. At the other end, the software must support new advances in the disciplines and their computational methodologies. There is also a new sense of urgency and opportunity for such an investment driven in part by the confluence of various stresses, including disruptive hardware trends, new technologies, new application formulations, emerging new and diverse collections of data, and community readiness.

It is clear that the community must redefine research, development, and maintenance of software in the context of CF21 and make significant long-term investments commensurate with hardware investments. The programs must focus on building robust, reliable and sustainable software that will support and advance sustained scientific innovation and discovery.

The Office of CyberInfrastucture (OCI) is partnering with Directorates and Offices across the foundation to establish SI^2, a long-term comprehensive program focused on realizing a sustained software infrastructure that is an integral part of CF21. The goal of this program is to catalyze and nurture the multidisciplinary processes required to support the entire software lifecycle, and result in the development of sustainable community software elements at all levels of the software stack. The program addresses all aspects of CI, from embedded sensor systems and instruments, to desktops and high-end data and computing systems, to major instruments and facilities.

It is envisioned that the SI^2 program will collectively support vibrant partnerships between academia, government laboratories and industry for the development and stewardship of a sustainable software infrastructure that can enhance productivity and accelerate innovation in science and engineering.

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[1] http://www.nsf.gov/pubs/2010/nsf10015/nsf10015.jsp

II. PROGRAM DESCRIPTION

The goal of the SI^2 program is to create a software ecosystem that scales from individual or small groups of software innovators to large hubs of software excellence. The program envisions three classes of awards:

1. Scientific Software Elements (SSE)
2. Scientific Software Integration (SSI)
3. Scientific Software Innovation Institutes (S2I2)

Note that the FY 2010 SI^2 competition will be limited to SSE and SSI awards. The solicitation in FY 2011, and in subsequent years, will outline funding opportunities for all three classes of awards (SSE, SSI and S2I2), subject to availability of funds.

Scientific Software Elements (SSE): SSE awards target small groups that will create and deploy robust software elements for which there is a demonstrated need, encapsulating innovation in science in engineering. It is expected that the created software elements will be designed so as to demonstrate potential for addressing issues of sustainability, manageability, usability and interoperability, and will be disseminated into the community as reusable software resources.

Scientific Software Integration (SSI): SSI awards target larger multidisciplinary groups of PIs organized around a common research problem as well as common software infrastructure, and will result in sustainable community software. These awards will focus on software architectures, processes that explicitly address issues of sustainability, manageability, usability, composability and interoperability, as well as environments (e.g., code repository, build and test framework, reporting mechanisms, etc.) that are meaningful for the targeted science community. Well thought-out dissemination and outreach mechanisms, pathways for integration of community software elements (such as those developed by SSE teams) into the developed framework, as well as support structures, will be an integral part of these awards. When appropriate, involvement with industry and government laboratories, and partnering with international efforts are encouraged.

Scientific Software Innovation Institutes (S2I2): The S2I2 awards will focus on the establishment of long-term community-wide hubs of software excellence. They will provide expertise, processes, resources and implementation mechanism to transform computational science and engineering innovations and community software into a robust and sustained software infrastructure for enabling science and engineering. S2I2 proposals will bring together multidisciplinary teams of domains scientists and engineers, computer scientists and software engineers, technologists and educators. Furthermore, in addition to innovating in the domain (or domains) and the computational and computer science aspects of the software, the proposals will also focus on the required processes and services necessary to support the community. The institutes will provide necessary structures and mechanisms for support and outreach, and will stimulate interaction between all stakeholders through various means including the definition of joint research directions, community standards and models, and collaborative development activities. The institutes will also provide pathways for community involvement, enabling software elements developed within the community, for example, as part for SSE and SSI awards, to be transitioned to conform to community software frameworks standards and processes, and to be made accessible, usable and extendible by the community. Institutes may leverage existing infrastructure investments, and where appropriate, involvement with industry and government laboratories, and partnering with international efforts are encouraged. Finally, a S2I2 proposal should also include a model for longer-term sustainability of the institute itself.

Recognizing the challenges of understanding requirements, structures and processes that are appropriate for Scientific Software Innovation Institutes, both within and across disciplines, NSF will be engaging in exploratory efforts with the community in the near future.

The SI^2 program envisions an integrated software infrastructure composed of interlocking projects of the three classes described above. Specifically, SSE awardees are expected to affiliate with one or more SSI groups, and with S2I2 institutes as they come online in future years. Similarly, it is expected that each SSI group will affiliate with one or more S2I2 institutes as they come online. S2I2 institutes are expected to link with each other as well as with other major CF21 elements (e.g., computing and data hubs, networking, instruments, major resources, etc.).

A **competitive** SI^2 proposal will:

- Identify application areas in science or engineering where the proposed software element is needed and describe how the use of the proposed software will have a significant impact on science and engineering research;
- Identify one or more specific domain communities that are targeted users of the proposed software;
- Include an explicit description of the engineering process used for the design, development, deployment, testing and sustainability of the software;
- Define a list of tangible metrics, with end user involvement, to be used to measure the success of the software element developed; and
- Provide a compelling discussion of the software's potential use by broader communities.

III. AWARD INFORMATION

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds. Pending availability of funds, approximately $11,400,000 will be available in FY 2010 for proposals submitted in response to this solicitation. SSE awards are expected to total $300K - $500K for 3 years, and SSI approximately $1M / year for 3-5 years. It is estimated that each year approximately 18 SSE and 4 SSI awards will be made subject to the availability of funds. In 2011 and 2012 it is expected that 2 S2I2 awards will be made, subject to the availability of funds.

IV. ELIGIBILITY INFORMATION

Organization Limit:

Proposals may only be submitted by the following:

- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI: 2

An individual may participate as Principal Investigator, co-Principal Investigator or other Senior Personnel in at most two full proposals in each annual competition. Any individual whose biographical sketch is provided as part of the proposal will be considered Senior Personnel in the proposed activity. After the proposal submission deadline, if a person appears on more than two full proposals, submitters may withdraw proposals to reduce that person's participation to two proposals; otherwise, after the first two submitted proposals in which that individual is participating, the remainder will be returned without review. In this context, a multi-institution collaborative project is treated as one proposal that is considered submitted when the last component proposal is submitted.

Additional Eligibility Info:

Proposals that capitalize upon productive intellectual partnerships involving investigators from academe, industry and/or other types of organizations, including international entities, are encouraged. Partnerships between academe and other types of organizations, both foreign and domestic, promise the identification of compelling research challenges, and the more effective transformation of discoveries into innovations that create wealth and other societal impacts. While NSF will consider supporting SI^2 activities undertaken by SBIR-eligible organizations through subawards, other for-profit entities and international partners must support their participation in SI^2 projects from other funding sources.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent *(required):*

A one-page Letter of Intent must be submitted via FastLane by the deadline date. Letters of Intent received after this date will not be considered compliant and any associated full proposal will be returned without review. Each Letter of Intent must include the following:

1. TITLE - The title of a SI^2 proposal must be preceded by the words "SI2-SSE:" or "SI2-SSI:" as described in the full proposal instructions below.

2. TEAM - Names, departmental and university affiliation, and expertise of the Principal Investigator and all co-Principal Investigators.

3. SYNOPSIS (GOALS) - Brief description of the specific goals of the proposal (maximum of 250 words). This should clearly outline (1) the science/engineering drivers and specific need(s) that will be addressed by the proposal, (2) the specific target user community, (3) the software elements and/or framework that will be developed and deployed.

These Letters of Intent help NSF anticipate review requirements for full proposals. They will not be used as pre-approval mechanisms for the submission of full proposals and no feedback is provided to the submitters of a Letter of Intent.

Letter of Intent Preparation Instructions:

When submitting a Letter of Intent through FastLane in response to this Program Solicitation please note the conditions outlined below:

- Sponsored Projects Office (SPO) Submission is not required when submitting Letters of Intent
- Submission of multiple Letters of Intent is allowed

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

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and

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

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

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

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. Chapter II, Section D.4 of the Grant Proposal Guide provides additional information on collaborative proposals.

Cover Sheet: Provide a short informative title for the proposed SI^2 project. To assist NSF staff in sorting full proposals for review, for the FY 2010 competition, full proposal titles should begin with "SI2-SSE:" or "SI2-SSI:". The system allows one PI and at most four Co-PIs to be designated for each proposal. If your project involves international partners, check the international activities box and list the countries involved. If needed, additional lead personnel should be designated as non co-PI, Senior Personnel on the Budget form.

Project Summary (1-page limit): At the top of this page enter the title of the SI^2 project, beginning with "SI2-SSE:" or "SI2-SSI:", the name of the PI and the lead institution. Provide a summary description of the SI^2 project, including its transformative research and education goals, the innovative software infrastructure being proposed, and the community (communities) that will be impacted. In separate statements, provide a succinct summary of the intellectual merit and broader impacts of the proposed project.

Full proposals that do not address the intellectual merit and broader impacts of the proposed project in separate statements will be returned without review.

Project Description (15-page limit): The project description should explicitly address the following additional criteria:

- Define a multidisciplinary research agenda that, through the development and deployment of robust and sustainable software, promises significant impact in science and engineering.
- Identify application areas in science or engineering where the proposed software element is needed, a description of the value of the proposed work in the context of the missing capability required by the domain, and specific examples of how the use of the proposed software element will have an impact on science and engineering research, for example, in terms of increased capabilities, increased productivity, etc.
- Provide a clear description of how the proposed software element compares to alternative or existing elements (including other commercial and research solutions) and what are the limitations of these existing elements. Proposals that could be supported by other programs at NSF or at other agencies should be submitted to those programs, and possibly related programs should be explicitly identified and reasoned as to why the proposal is not appropriate for those opportunities. Investigators are encouraged to contact the program with questions about appropriateness for this program prior to sending in a proposal.
- Provide an explicit description of the engineering process used for the design, development, and release of the software, its deployments and associated outreach to the end user community, its interoperability with widely used tools by the community, and an evaluation plan that involves end users. Describe use of facilities, such as the NMI Build and Test services, to support their software development and testing. Details of the NMI Build and Test facility can be found at http://nmi.cs.wisc.edu/.
- Include a project plan, including user interactions and a community-driven approach, and provide a timeline including a proof-of-concept demonstration of the key software components. The proposal must include a list of tangible metrics, with end user involvement, to be used to measure the success of the software element developed, especially the quantitative and qualitative definition of a "working prototype" against which that milestone will be judged, and the steps necessary to take the software element from prototype to dissemination into the community as reusable software resources.
- Provide a compelling discussion of the software's potential use by broader communities, preferably via use cases developed in concert with relevant domain scientists.
- Describe the extent to which issues of sustainability, manageability, usability and composability/interoperability will be addressed and integrated into the proposed software system.
- Provide an explicit outreach and education plan to allow additional end user groups to take advantage of the proposed work.
- Describe a sustainability plan for the developed software beyond the lifetime of the award. Identify the open source license to be used.

Budget:

Awardees are expected to participate in an Annual PI meeting with travel costs supported by the award. These travel costs should be included in the FastLane budget.

Proposers should include costs for affiliation in the FastLane budget. SSE awardees are expected to affiliate with one or more SSI groups and with S2I2 institutes as they come online in future years. SSI group are expected affiliate with one or more S2I2 institutes as they come online. Affiliation costs should be supported by the award.

Supplementary Documents:

Management and Coordination Plan (SSI proposals only, 3-page limit): Each SSI proposal must contain a clearly labeled management and coordination plan, which includes: 1) the specific roles of the PI, co-PIs, other senior personnel and paid consultants at all institutions involved, 2) how the project will be managed across institutions and disciplines, 3) identification of the specific coordination mechanisms that will enable cross-institution and/or cross-discipline scientific integration (e.g., yearly workshops, graduate student exchange, project meetings at conferences, use of videoconferences, use of common software repositories, build process and/or test suites, etc.), and 4) pointers to the budget line items that support these management and coordination mechanisms.

Full proposals that request funding for postdoctoral support and that fail to provide the following information will be returned without review.

Postdoctoral Researcher Mentoring Plan. As stated in the GPG (http://www.nsf.gov/pubs/policydocs/pappguide/nsf10_1/gpg_2.jsp#IIC2j), each proposal that requests funding to support postdoctoral researchers must include, as a supplementary document, a description of the mentoring activities that will be provided for such individuals. In no more than one page, the mentoring plan must describe the mentoring that will be provided to all postdoctoral researchers supported by the project, irrespective of whether they reside at the submitting organization, any sub-awardee organization, or at any organization participating in a simultaneously submitted collaborative project. Proposers are advised that the mentoring plan may not be used to circumvent the 15-page project description limitation.

Single copy documents: *Full proposals that do not provide the following information will be returned without review.*

Project Personnel (a text-searchable single PDF document, in FastLane, under Additional Single Copy Documents). List all Senior Personnel in the project. For each person, provide the last name, first name, and institution/organization. In the main body of the proposal, a corresponding biographical sketch should be provided for all individuals included on this list, as instructed in Section II.C.2.f of the Grant Proposal Guide.

Collaborators/Individuals with Conflicts of Interest (a text-searchable single PDF document, in FastLane, under Additional Single Copy Documents). Provide a single list, alphabetically ordered by last name and including institutional affiliation, of potential conflicts of interest, as specified in NSF's Grant Proposal Guide, for each PI, Co-PI and other Senior Personnel. Include all co-authors/editors and collaborators (within the past 48 months), all graduate advisors and advisees, and any other individuals or institutions with which the investigator has financial ties (please specify type). In addition, list all sub-awardees who would receive funds through the SI^2 award.

NOTE: Full proposals that fail to provide these electronic documents with proper information and according to the required format will be returned without review.

No other items or appendices are to be included. *Full proposals containing items other than those required above or by the Grant Proposal Guide (GPG) will not be reviewed or considered for NSF funding.*

Proposers are reminded to identify the program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

B. Budgetary Information

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

Budget Preparation Instructions:

Awardees are expected to participate in an Annual PI meeting with travel costs supported by the award. These travel costs should be included in the FastLane budget.

Proposers should include costs for affiliation in the FastLane budget. SSE awardees are expected to affiliate with one or more SSI groups and with S2I2 institutes as they come online in future years. SSI group are expected affiliate with one or more S2I2 institutes as they come online. Affiliation costs should be supported by the award.

C. Due Dates

- **Letter of Intent Due Date(s)** *(required)* (due by 5 p.m. proposer's local time)**:**

    May 10, 2010

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

    June 14, 2010

D. FastLane/Grants.gov Requirements

- **For Proposals Submitted Via FastLane:**

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

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

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

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

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

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program 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.

Mentoring activities provided to postdoctoral researchers supported on the project, as described in a one-page supplementary document, will be evaluated under the Broader Impacts criterion.

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:

- Does the proposal define a multidisciplinary research agenda that, through the development and deployment of robust and sustainable software, promises significant impact in more than one field of science and engineering?
- Does the proposal identify multiple application areas in science and/or engineering where the software is needed, provide a description of the value of the work in the context of a missing capability required by the domain fields, and present specific examples of how the use of the developed software will have an impact on science and engineering research?
- Does the proposal provide a project plan and timeline including a proof-of-concept demonstration of the key software elements? Are tangible metrics described to measure the success of the software developed, and the steps necessary presented to take the software from prototype to dissemination into the community as reusable software resources?
- To what extent are issues of sustainability, manageability, usability and composability/interoperability addressed

and integrated into the proposed software?

- Does the project plan include user interaction, a community-driven approach, and a timeline of new feature releases? Does it plan to extend the work to additional user communities?

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 nsfpubs@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.

Special Award Conditions:

- Awardees are expected to participate in an Annual PI meeting with travel costs supported by the award.
- SSE awardees are expected to affiliate with one or more SSI groups and with S2I2 institutes as they come online in future years. SSI group are expected affiliate with one or more S2I2 institutes as they come online. Affiliation costs should be supported by the award.

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, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report 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. The project outcomes report must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

VIII. AGENCY CONTACTS

General inquiries regarding this program should be made to:

- Manish Parashar, Program Director, OD/OCI, telephone: (703) 292-4766, email: SI2Queries@nsf.gov

- Reed S. Beaman, Program Director, BIO/DBI, telephone: (703) 292-8470, email: SI2Queries@nsf.gov

- William Y. B. Chang, Program Director, OD/OISE, telephone: (703) 292-7239, email: SI2Queries@nsf.gov

- Almadena Y. Chtchelkanova, Program Director, CISE/CCF, telephone: (703) 292-8910, email: SI2Queries@nsf.gov

- Clark Cooper, Program Director, ENG/CMMI, telephone: (703) 292-7899, email: SI2Queries@nsf.gov

- Cheryl L. Eavey, Program Director, SBE/SES, telephone: (703) 292-7269, email: SI2Queries@nsf.gov

- John H. Hall, Program Director, OIA/EPSCoR, telephone: (703) 292-4361, email: SI2Queries@nsf.gov

- Clifford A. Jacobs, Program Director, GEO/AGS, telephone: (703) 292-8521, email: SI2Queries@nsf.gov

- Leland M. Jameson, Program Director, MPS/DMS, telephone: (703) 292-4883, email: SI2Queries@nsf.gov

- Peter H. McCartney, Program Director, BIO/DBI, telephone: (703) 292-8470, email: SI2Queries@nsf.gov

- Eduardo A. Misawa, Program Director, ENG/EEC, telephone: (703) 292-5353, email: SI2Queries@nsf.gov

- Rob Pennington, Program Director, OD/OCI, telephone: (703) 292-7025, email: SI2Queries@nsf.gov

- Thomas F. Russell, Program Director, OD/OIA, telephone: (703) 292-4863, email: SI2Queries@nsf.gov

- Barry I. Schneider, Program Director, OD/OCI, telephone: (703) 292-7383, email: SI2Queries@nsf.gov

For questions related to the use of FastLane, contact:

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

For questions relating to Grants.gov contact:

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

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.

ABOUT THE NATIONAL SCIENCE FOUNDATION

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

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

NSF receives approximately 40,000 proposals each year for research, education and training projects, of which approximately

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

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

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

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

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

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

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

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

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

- **To Order Publications or Forms:**

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

        or telephone: (703) 292-7827

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

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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

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

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

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