

Software Infrastructure for Sustained Innovation (SI2: SSE & SSI)

Software Elements and Frameworks

PROGRAM SOLICITATION

NSF 16-532

REPLACES DOCUMENT(S):

NSF 14-520



National Science Foundation

Directorate for Computer & Information Science & Engineering
Division of Advanced Cyberinfrastructure
Division of Computing and Communication Foundations
Division of Information & Intelligent Systems
Division of Computer and Network Systems

Directorate for Biological Sciences

Directorate for Education & Human Resources

Directorate for Engineering
Division of Chemical, Bioengineering, Environmental, and Transport Systems
Division of Civil, Mechanical and Manufacturing Innovation
Division of Electrical, Communications and Cyber Systems

Directorate for Geosciences

Directorate for Mathematical & Physical Sciences
Division of Astronomical Sciences
Division of Chemistry
Division of Materials Research
Division of Mathematical Sciences
Division of Physics

Directorate for Social, Behavioral & Economic Sciences

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

April 26, 2016

SSE Proposals

September 20, 2016

SSI Proposals

February 21, 2017

SSE Proposals

September 19, 2017

SSI Proposals

IMPORTANT INFORMATION AND REVISION NOTES

Due to repairs to the Foundation's electrical systems, there will be no access to FastLane, Research.gov or the NSF website on September 17-18, 2016. The deadline date for SSI proposals for this solicitation has therefore been changed to September 20, 2016 at 5:00 PM submitter's local time.

Revisions are as follows:

- The Introduction section has been revised to better position the SI² program within the CIF21 initiative.
- The paragraph on additional NSF unit-specific participation information within the section titled Synopsis of the Program has been extensively revised and moved to the Program Description.
- The section on Solicitation Specific Review Criteria has been revised, and additional review criteria have been added.
- This solicitation does NOT include the option to submit S²I² proposals. Please refer to solicitation [NSF 15-553](#) for S²I² proposals in FY2016. At present there is no solicitation that addresses S²I² proposals for 2017.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) ([NSF 16-1](#)), which is effective for proposals submitted, or due, on or after January 25, 2016. Please be advised that proposers who opt to submit prior to January 25, 2016, must also follow the guidelines contained in [NSF 16-1](#).

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Software Infrastructure for Sustained Innovation - SSE & SSI (SI²-SSE&SSI)

Synopsis of Program:

Software is an integral enabler of computation, experiment and theory and a primary modality for realizing the Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21) vision, as described in [NSF 10-015](#). Scientific discovery and innovation are advancing along 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 has established the Software Infrastructure for Sustained Innovation (SI²) program, with the overarching goal of transforming innovations in research and education into sustained software resources that are an integral part of the cyberinfrastructure.

I² has been a long-term investment focused on catalyzing new thinking, paradigms, and practices in developing and using software to understand natural, human, and engineered systems. The intent of SI² has been to foster a pervasive cyberinfrastructure to help researchers address problems of unprecedented scale, complexity, resolution, and accuracy by integrating computation, data, networking, observations and experiments in novel ways. NSF expects that its SI² investment will result in trustworthy, robust, reliable, usable and sustainable software infrastructure that is critical to achieving the CIF21 vision and will transform science and engineering while contributing to the education of next-generation researchers and creators of future cyberinfrastructure. Indeed, education at all levels will play an important role in integrating such a dynamic cyberinfrastructure into the fabric of how science and engineering is performed.

The goal of the SI² 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 cyberinfrastructure, from embedded sensor systems and instruments, to desktops and high-end data and computing systems, to major instruments and facilities. Thus, SI² will continue to nurture the interdisciplinary processes required to support the entire software lifecycle, and will successfully integrate software development and support with innovation and research. Furthermore, it will result in the development of sustainable software communities that transcend scientific and geographical boundaries. SI² envisions vibrant partnerships among academia, government laboratories and industry, including international entities, for the development and stewardship of a sustainable software infrastructure that can enhance productivity and accelerate innovation in science and engineering. Furthermore, SI² recognizes that integrated education activities will play a key role in sustaining the cyberinfrastructure over time and in developing a workforce capable of fully realizing its potential to transform science and engineering.

The SI² program includes 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; these software elements will in turn advance one or more significant areas of science and engineering.
2. **Scientific Software Integration (SSI):** SSI awards target larger, interdisciplinary teams organized around the development and application of common software infrastructure aimed at solving common research problems faced by NSF researchers in one or more areas of science and engineering. SSI awards will result in a sustainable community software framework serving a diverse community or communities.
3. **Scientific Software Innovation Institutes (S²I²):** S²I² awards will focus on the establishment of long-term hubs of excellence in software infrastructure and technologies, which will serve a research community of substantial size and disciplinary breadth.

Note: This solicitation includes only SSE and SSI classes of awards. For S²I² proposals in FY2016 please refer to solicitation [NSF 15-553](#). At present, there is no solicitation that addresses S²I² proposals for 2017 and beyond.

Please refer to (i) A Vision and Strategy for Software for Science, Engineering, and Education ([NSF 12-113](#)) and (ii) Implementation of NSF Software Vision (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504817) for further information about NSF's vision for software as part of cyberinfrastructure and the programs that support this vision. Proposers are also encouraged to consider positioning their work in the wider context of NSF priority areas and national and international initiatives where advanced cyberinfrastructure is relevant, such as, but not limited to, Understanding the Brain (<https://www.nsf.gov/brain>) and the National Strategic Computing Initiative (NSCI) (<https://www.whitehouse.gov/the-press-office/2015/07/29/executive-order-creating-national-strategic-computing-initiative>).

Prospective Principal Investigators (PIs) should be aware that SI² is a multi-directorate activity and that they are encouraged to submit proposals for software with broad, interdisciplinary interest. PIs are encouraged to refer to core program descriptions, Dear Colleague Letters, and recently posted initiatives on directorate and divisional home pages to gain insight about the priorities for the relevant areas of science to which their proposals may be responsive.

As not all divisions are participating at the same level and divisional priorities differ, it is strongly recommended that prospective PIs contact Cognizant Program Officers in the division(s) that typically support the scientists and

engineers who would make use of the proposed work, to ascertain whether the scientific focus and budget of the proposed work are appropriate for this solicitation.

Please note that some NSF units have additional specific information about their participation in this program:

- Within the Directorate for **Computer and Information Science and Engineering (CISE)**
 - The Division of Advanced Cyberinfrastructure (ACI) manages the SI² program, and is especially interested in proposals as follows:
 - Proposals that develop multidisciplinary and omni-disciplinary software cyberinfrastructure, and proposals that meaningfully integrate, leverage or build on other ongoing ACI-supported programs such as the eXtreme Digital (XD) program, Campus Cyberinfrastructure - Data, Networking, and Innovation (CC*DNI), Cyber-security Innovation for Cyberinfrastructure (CICI), and Data Infrastructure Building Blocks (DIBBs) programs.
 - Proposals that, in addition to the software cyberinfrastructure development and ecosystem building activities that should make up the core of the work, *integrate* innovation and research on the effectiveness, usability, and adoption of the software, and its adaptability to new technologies, and to changing requirements.
 - Proposals that consider security, trustworthiness and reproducibility as important requirements to be met by their software. With respect to security, software developers are encouraged to demonstrate utilization of vulnerability analysis scanning tools throughout the development process (such as [Coverity](#) and [SWAMP](#)).
 - Proposals with objectives (including education and workforce-development objectives) that align with and contribute to the NSCI.
 - CISE's other divisions (Computing and Communication Foundations, Computer and Network Systems, and Information and Intelligent Systems) are interested in supporting SSE and SSI proposals that advance software infrastructure to sustain progress in CISE research areas, and that advance and adapt software engineering research to impact the software sustainability needs of other scientific disciplines.
- The Directorate for **Biological Sciences (BIO)** is primarily interested in SSI proposals that impact both BIO-supported researchers and those supported by other directorates. PIs wishing to submit SSE projects that focus on biological sciences should consider submitting to Advances in Biological Informatics (ABI: [NSF 15-582](#)).
- The Directorate for **Engineering (ENG)** is primarily interested in proposals that focus on innovative computational tools that enable advances and scientific discovery in the research areas of its Divisions of Chemical, Bioengineering, Environmental, and Transport Systems (CBET); Civil, Mechanical and Manufacturing Innovation (CMMI); and Electrical, Communications and Cyber Systems (ECCS). SSE proposals that are planned to become part of larger SSI-type integrated software systems, leading to increased community involvement, will be given priority in SSE funding decisions.
- The Directorate for **Geosciences (GEO)** is interested in software development projects that serve the academic geosciences (atmosphere and geospace, ocean, earth and polar sciences) community. Projects must demonstrate strong connections with geosciences end users and their research needs. Understanding of, and integration with, GEO and/or NSF investments in cyberinfrastructure, participation in EarthCube and interaction between geoscientists and cyber/computer scientists will be considered in prioritizing funding of SSI and SSE projects. PIs should contact and consult with both the SI² GEO Program Officer as well as Program Officers in the relevant geosciences domains.
- Within the Directorate for **Mathematics and Physical Sciences (MPS)**:
 - The Division of Materials Research (DMR) encourages proposals that focus on innovative software tools that enable advances in the division's research areas and at the interfaces of materials research and other research domains. The division is particularly interested in projects that develop software tools to enable and support research under the Materials Genome Initiative (MGI), such as through Designing Materials to Revolutionize and Engineer our Future (DMREF: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505073), and under Sustainable Chemistry, Engineering, and Materials (SusChEM: [NSF 15-085](#)).
 - The Chemistry Division (CHE) encourages proposals that focus on innovative software tools that enable advances in the division's research areas and at the interface of chemistry and other research domains. The division welcomes proposals that enable scientific advances in NSF priority areas.
 - The Physics Division (PHY) will consider proposals that focus on innovative computational tools that enable advances in the division's research areas.
 - The Division of Astronomical Sciences (AST) will consider proposals to support the development of sustainable software that will enable broad community progress on key questions in astronomy and astrophysics.
 - The Division of Mathematical Sciences (DMS) welcomes proposals building computational tools that have broad application in mathematical sciences and related areas.
 - MPS also supports education and community development in cyberinfrastructure, for example, through proposals that include visitor support (particularly for graduate students and postdoctoral researchers), postdoctoral opportunities, or short training courses that increase interactions of domain scientists and software and/or cyberinfrastructure specialists.
- The Directorate for **Social, Behavioral & Economic Sciences (SBE)** is interested in proposals that focus on innovative software infrastructure that supports the directorate's research priorities, such as those outlined in SBE 2020 (https://www.nsf.gov/sbe/sbe_2020/). In particular, SBE is interested in proposals that will further the goals of SBE and at least one of the other directorates participating in this solicitation.
- The Directorate for **Education and Human Resources (EHR)** is interested in proposals that focus on innovative software infrastructure that supports the directorate's research areas, namely STEM learning and learning environments, STEM workforce development, and broadening participation in STEM. For example, EHR is interested in research studies on how software tools foster science and engineering learning.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Rajiv Ramnath, Program Director, CISE/ACI, telephone: (703) 292-4776, email: SI2Queries@nsf.gov
- Daniel S. Katz, Program Director, CISE/ACI, telephone: (703) 292-2254, email: SI2Queries@nsf.gov
- Peter H. McCartney, Program Director, BIO/DBI, telephone: (703) 292-8470, email: SI2Queries@nsf.gov

- Almadena Y. Chtchelkanova, Program Director, CISE/CCF, telephone: (703) 292-8910, email: SI2Queries@nsf.gov
- Sol Greenspan, Program Director, CISE/CCF, telephone: (703) 292-8910, email: SI2Queries@nsf.gov
- John C. Cherniavsky, Senior Advisor, EHR, telephone: (703) 292-5136, email: SI2Queries@nsf.gov
- Joanne D. Culbertson, Program Director, ENG/CMMI, telephone: (703) 292-4602, email: SI2Queries@nsf.gov
- Hao Ling, Program Director, ENG/ECCS, telephone: (703) 292-2210, email: SI2Queries@nsf.gov
- Dimitrios V. Papavassiliou, Program Director, ENG/CBET, telephone: (703) 292-4480, email: SI2Queries@nsf.gov
- Eva Zanzierka, Program Director, GEO/EAR, telephone: (703) 292-4734, email: SI2Queries@nsf.gov
- Evelyn Goldfield, MPS/CHE, telephone: (703) 292-2173, email: SI2Queries@nsf.gov
- Daryl W. Hess, Program Director, MPS/DMR, telephone: (703) 292-4942, email: SI2Queries@nsf.gov
- Bogdan Mihaila, Program Director, MPS/PHY, telephone: (703) 292-8235, email: SI2Queries@nsf.gov
- Andrew D. Pollington, Program Director, MPS/DMS, telephone: (703) 292-4878, email: SI2Queries@nsf.gov
- Nigel A. Sharp, Program Director, MPS/AST, telephone: (703) 292-4905, email: SI2Queries@nsf.gov
- Cheryl L. Eavey, SBE/SES, telephone: (703) 292-7269, email: SI2Queries@nsf.gov

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
- 47.076 --- Education and Human Resources

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 22

The number of SSE and SSI awards will be determined by separate review processes and will be based on quality of proposals, availability of funds, and responsiveness to priorities of the participating directorates/divisions. Up to 10 SSE awards and 12 SSI awards are estimated, subject to the availability of funds.

Anticipated Funding Amount: \$17,500,000

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds. Up to \$5,000,000 is expected to be available for SSE awards, and up to \$12,500,000 is expected to be available for awards to SSI proposals, subject to availability of funds.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- 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.
- 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.
- FFRDCs may not receive funds directly from NSF under this solicitation.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI:

An individual may participate as PI, co-PI or other Senior Personnel in at most one full proposal in the pair of SSE and SSI competitions that occurs in a given calendar year. Any individual whose biographical sketch is provided as part of the proposal will be considered as Senior Personnel in the proposed activity, with or without financial support from the project. In the event that an individual exceeds this limit, any proposal submitted to this solicitation with this individual listed as PI, co-PI, or Senior Personnel after the first proposal is received at NSF will be returned without review. No exceptions will be made. For this purpose, 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:** Not required
- **Preliminary Proposal Submission:** Not required
- **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: https://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: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)

B. Budgetary Information

- **Cost Sharing Requirements:**

Inclusion of voluntary committed cost sharing is prohibited.

- **Indirect Cost (F&A) Limitations:**

Not Applicable

- **Other Budgetary Limitations:**

Not Applicable

C. Due Dates

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

April 26, 2016

SSE Proposals

September 20, 2016

SSI Proposals

February 21, 2017

SSE Proposals

September 19, 2017

SSI Proposals

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 (SI²) is a bold and long-term investment that has maintained a sustained focus on realizing the Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21) vision and catalyzing new thinking, paradigms and practices in science and engineering. Since its inception, CIF21 has helped foster a pervasive cyberinfrastructure that has enabled research at unprecedented scales, complexity, resolution, and accuracy by integrating computation, data and experiments in novel ways. CIF21 envisioned 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; and has helped make great strides towards revolutionizing virtually every discipline by providing unique insights into complex problems, and creating unique opportunities for understanding natural, human and engineered systems.

Software is a primary modality through which CIF21 innovation and discovery has been realized. Software 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). Software, in fact, is a cyberinfrastructure in itself.

This software cyberinfrastructure needs to be continually refined to address complexity, accommodate disruptive hardware trends, ever-increasing data volumes, complex application structures and behaviors, and emerging concerns such as fault-tolerance and energy efficiency. Additionally, software should support new advances in the disciplines and their computational methodologies. Across the spectrum, attention should be paid to reducing complexity so that software can be easily used. There is continued urgency and opportunity for such software 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. Education is an important element needed to sustain this vision and to propagate through time a vital and responsive cyberinfrastructure -- one that builds upon the most crucial existing cyberinfrastructure elements and one that innovatively creates needed new elements. SI² will contribute to an able workforce capable of exploiting the full capability of the cyberinfrastructure and the promise for innovation in science and engineering.

It is clear that the community must redefine research, development, and maintenance of software in the context of CIF21 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 Division of Advanced Cyberinfrastructure (CISE/ACI) is partnering with Directorates and Offices across the Foundation to support SI², a long-term comprehensive program focused on realizing a sustained software infrastructure that is an integral part of CIF21. The goal of this program is to catalyze and nurture the interdisciplinary processes required to support the entire software lifecycle, and result in the development of sustainable community software elements and reusable components at all levels of the software stack. The program addresses all aspects of cyberinfrastructure, 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 SI² program will collectively support vibrant partnerships among academia, government laboratories and industry, including international entities, for the development and stewardship of a sustainable software infrastructure that can enhance productivity and accelerate innovation in science and engineering.

II. PROGRAM DESCRIPTION

The goal of the SI² 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 includes three classes of awards:

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

This solicitation includes only SSE and SSI classes of awards. For S²I² proposals in FY2016 please refer to solicitation NSF 15-553. At present, there is no solicitation that addresses S²I² proposals for 2017 and beyond.

The SI² program envisions an integrated software infrastructure composed of interlocking projects of the above three classes. Specifically, SSE awardees are expected to develop meaningful affiliations 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 elements of the national cyberinfrastructure (e.g., computing and data hubs, networking, instruments, major resources, etc.).

A competitive SI² proposal will:

- Describe application areas in science or engineering where the identified software is needed, and how the use of the identified software will have a significant impact on science and engineering research;
- Describe the targeted user communities of the proposed software and how they will be engaged; and
- Provide a compelling discussion of the software's potential use by a wider audience and its contribution to a national cyberinfrastructure.

Scientific Software Elements (SSE): SSE awards target small groups that will create and deploy robust software elements for which there is a demonstrated need; these elements will in turn advance one or more significant areas of science and 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. The development approach may support the hardening of early prototypes and/or expanding functionality to increase end user relevance.

Scientific Software Integration (SSI): SSI awards target larger, interdisciplinary teams organized around the development and application of common software infrastructure aimed at solving common research problems faced by NSF researchers in one or more areas of science and engineering. SSI awards will result in a sustainable community software framework serving a diverse community or communities. 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-reasoned dissemination and outreach mechanisms, pathways for integration of community software elements (such as those developed by SSE teams) into the developed framework, and associated support structures will be an integral part of these awards. When appropriate, involvement with industry and government laboratories, as well as partnering with international efforts is encouraged. Some SSI awards are anticipated to be continuing grants, and funds will be released annually subject to agreed-upon milestones, and based on approval by NSF and the availability of funds.

Industry and International Participation in SI²: NSF encourages participation by industry and international collaborators in all classes of SI² awards where it clearly strengthens the proposed activity (e.g., involvement of specific and unique expertise or resources, or addressing sustainability).

International participants are encouraged to seek support from their funding organizations. NSF funds may not be used to support the expenses of international researchers at their home institutions. However, NSF funds may be used for travel expenses for US scientists and students integral to the NSF-funded project, or for international collaborators to participate in activities in the US. For those who plan to submit a proposal with international counterparts, please contact the Office of International Science and Engineering (OISE) program officer who covers that country: <https://www.nsf.gov/od/oise/country-list.jsp>.

The SI² program recognizes that software is a fundamental infrastructure that spans academic, government, civic, and commercial organizations. The program encourages proposals to explore novel partnerships beyond academe wherever beneficial and permissible within the guidelines of the NSF Grant Proposal Guide (GPG).

III. AWARD INFORMATION

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

Each SSE award shall not exceed a total of \$500,000 and 3 years duration. Each SSI award shall range from \$200,000 to \$1,000,000 per year, and shall be 3 to 5 years in duration. Projects in the upper portion of this range must be exceptional in terms of scientific impact, and as with all proposals, should be discussed with program officers from the divisions that fund the researchers that would be impacted. Proposed funding amounts should be commensurate with the work being proposed, the size of the community that will be affected, and the level of impact anticipated. Note that SSE and SSI are not categories of funding, but rather, are types of projects, as described elsewhere in this solicitation.

It is strongly recommended that prospective PIs contact Cognizant Program Officers in the division(s) closest to the major disciplinary impact of the proposed work to ascertain whether the scientific focus and budget of the proposed work are appropriate for this solicitation.

The number of SSE and SSI awards will be determined by separate review processes and will be based on the proposals submitted and the available budget.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- 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.
- 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.
- FFRDCs may not receive funds directly from NSF under this solicitation.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI:

An individual may participate as PI, co-PI or other Senior Personnel in at most one full proposal in the pair of SSE and SSI competitions that occurs in a given calendar year. Any individual whose biographical sketch is provided as part of the proposal will be considered as Senior Personnel in the proposed activity, with or without financial support from the project. In the event that an individual exceeds this limit, any proposal submitted to this solicitation with this individual listed as PI, co-PI, or Senior Personnel after the first proposal is received at NSF will be returned without review. No exceptions will be made. For this purpose, a multi-institution collaborative project is

treated as one proposal that is considered submitted when the last component proposal is submitted.

Additional Eligibility Info:

None.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

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

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: https://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: (https://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.5 of the Grant Proposal Guide provides additional information on collaborative proposals.

See Chapter II.C.2 of the [GPG](#) for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the GPG instructions.

The following supplements guidance contained in the GPG or NSF Grants.gov Application Guide.

Cover Sheet: Provide a short informative title for the proposed SI² project. To assist NSF staff in sorting proposals for review, 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):

The Project Summary consists of an overview, a statement on the intellectual merit of the proposed activity, and a statement on the broader impacts of the proposed activity.

The overview includes a summary description of the SI² project, including its transformative research and education goals, the innovative software infrastructure being proposed, and the community (communities) that will be impacted. The statement on intellectual merit should describe the potential of the proposed activity to advance knowledge. The statement on broader impacts should describe the potential of the proposed activity to benefit society and contribute to the achievement of specific, desired societal outcomes. The Project Summary should be written in the third person, informative to other persons working in the same or related fields, and, insofar as possible, understandable to a scientifically- or technically-literate lay reader. It should not be an abstract of the proposal.

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

- Define a research and development agenda that will lead to robust and sustainable software.
- Discuss how the proposed software will fill a recognized need and advance research capability within a significant area or areas of science and engineering.
- Provide a clear description of how the proposed software compares to alternative or existing elements (including other commercial and research solutions) including 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. 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 one of the listed Cognizant Program Officers with questions about appropriateness for this program prior to preparing a proposal. PIs who have been previously funded under an SSE or SSI award should show quantifiable evidence of the use and impact of the previously funded software, and should also include citations to the published software in their biosketches as one of their relevant products.
- Provide an explicit description of the engineering process to be used for the design, development, documentation, and release of the software, its deployments and associated outreach to the end user community, and an acceptance and evaluation plan that involves end users.
- State which software license will be used for the released software, and why this license has been chosen. (NSF expects that a standard open source license will be used, but a different option can be proposed if well justified in terms of meeting the SI² program goals.)
- 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 definitions of a "working prototype" against which that milestone will be judged, and the steps necessary to take the software element from prototype to dissemination throughout the community as a reusable software resource.

- Provide a compelling discussion of the potential of the software by broader communities, preferably via use cases developed in concert with relevant domain scientists.
- Describe the extent to which issues of security, trustworthiness, reproducibility, and usability will be addressed by the project and integrated into the proposed software system.
- Describe the extent to which adaptability to new technologies and changing requirements will be addressed by the project and built into the proposed software system.
- Provide an explicit outreach and education plan for additional end user groups to take advantage of the proposed work, with the potential to have impact beyond the institution, including the possible adoption of approaches, curricula, and instructional material broadly within the relevant disciplines.
- Describe a sustainability plan for the developed software beyond the lifetime of the award.
- Describe how the proposed software will leverage and be interoperable with widely used tools by the community, and with NSF and national cyberinfrastructure investments as appropriate.

Please note that per guidance in the GPG, the Project Description must contain, as a separate section labeled "Broader Impacts." This section should provide a discussion of the broader impacts of the proposed activities. You can decide where to include this section within the Project Description.

Budget: Awardees are expected to participate in annual PI meetings near NSF with travel costs supported by the award. These travel costs should be included in the proposed budget.

Supplementary Documents: In addition to the Data Management Plan (please follow the CISE Data Management Guidance available at https://www.nsf.gov/cise/cise_dmp.jsp) and the Postdoctoral Research Mentoring Plan (if required), the following items are the only items permitted as supplementary documents.

1. **Management and Coordination Plan (SSI proposals only, 3-page limit, to be submitted as a Supplementary Document):** Each SSI proposal must contain a clearly labeled Management and Coordination Plan that 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 exchanges; project meetings at conferences; use of video conferences; use of common software repositories, build processes and/or test suites; etc.); and 4) pointers to the budget line items that support these management and coordination mechanisms.
2. **Letters of Collaboration (optional, submitted as a Supplementary Document):** Include documentation of funded or unfunded collaborative arrangements of significance to the proposal through letters of collaboration (see GPG Chapter II.C.2.d(iv) for details). Letters of collaboration should be limited to stating the intent to collaborate and should not contain endorsements or evaluation of the proposed project. The recommended format for letters of collaboration is as follows:

"If the proposal submitted by Dr. [insert the full name of the Principal Investigator] entitled [insert the proposal title] is selected for funding by NSF, it is my intent to collaborate and/or commit resources as detailed in the Project Description or the Facilities, Equipment or Other Resources section of the proposal."

Scan your signed letters of collaboration, containing only text similar to that above, and upload them into the Supplementary Documents section of FastLane or [Grants.gov](https://www.nsf.gov/grants), but do not send originals.

Do not submit letters of support. For example, letters of endorsement and letters of a laudatory nature for the proposed project are not acceptable.

Single Copy Documents: The following information is required in addition to that included within the provisions of the GPG or NSF *Grants.gov Application Guide*:

- **Information on Project Personnel and their Affiliations** (a text-searchable single PDF document, to be submitted as an Additional Single Copy Document): List all the personnel in the project. For each person, provide the last name, first name, and institution/organization, and a list, alphabetically ordered by last name and including institutional affiliation, of conflicts of interest, as specified in NSF's Grant Proposal Guide. Note that the personnel listed should include the PI, each Co-PI, other Senior Personnel, and all named sub-awardees who would receive funds through the SI² award.
- In the main body of the proposal, a corresponding biographical sketch should be provided for all individuals listed above, as instructed in Section II.C.2.f of the Grant Proposal Guide.

Separate Electronic Document Submission: In addition to the PDF documents included as Single Copy Documents, proposers must send the following document immediately after submission of the proposal:

- **"List of Personnel, Collaborators and Affiliates":** After receipt of the proposal number from FastLane, send an e-mail to si2@nsf.gov. The subject heading of the e-mail should note the proposal number and the lead institution. Attach a file in CSV "flat text" format (e.g., by saving an Excel spreadsheet as a CSV file), which lists the full names and institutional affiliations of all people having conflicts of interest (COI) with any PIs, Co-PIs, and other Senior Personnel (SP). The columns of the spreadsheet should be "proposal number", "PI/SP Last Name", "PI/SP First Name", "PI/SP Institution", "COI Last Name", "COI First Name", and "COI Institution". The PI should ensure that all authors of Letters of Collaboration with the current proposal are also listed as COIs. This list will be used by NSF to check for conflicts of interest when assembling reviewers. The filename should be the proposal number [which begins with the last two digits of the current fiscal year (e.g., "16"), not the temporary proposal number used during proposal preparation] followed by the three characters "coi" (for example, for a proposal number 1623456, this file name will be "1623456coi.csv"). The 7-digit proposal number should appear in every row of the file. Each project participant should be listed (repeatedly) in all rows that name his/her conflicted individuals.

(There is redundancy between the COI information provided in the Additional Single Copy Documents, which become part of the FastLane proposal file, and this Electronic Document, which is used for automated data handling. At present, it is not technically possible for one document to perform both functions.)

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 be returned without review.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

Awardees are expected to participate in annual PI meetings with travel costs supported by the award. These travel costs should be included in the proposed budget.

C. Due Dates

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

April 26, 2016

SSE Proposals

September 20, 2016

SSI Proposals

February 21, 2017

SSE Proposals

September 19, 2017

SSI Proposals

D. FastLane/Grants.gov Requirements

For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions 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.

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. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: <http://www.grants.gov/web/grants/applicants.html>. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical 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.

Proposers that submitted via FastLane are strongly encouraged to use FastLane to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with 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. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in the GPG as [Exhibit III-1](#).

A comprehensive description of the Foundation's merit review process is available on the NSF website at: https://www.nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in [Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014-2018](#). These strategies are integrated in

the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which 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.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. ([GPG Chapter II.C.2.d.i.](#) contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including [GPG Chapter II.C.2.d.i.](#), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
 - a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
 - b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and

mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

All proposals must clearly address the following solicitation-specific review criteria through well-identified proposal elements:

- To what extent does the proposed software fill a recognized need and advance research capability within a significant area (or areas) of science and engineering?
- To what extent does the project integrate innovation and research into the project activities?
- How well does the proposal present and discuss the project plan and timeline, including proof-of-concept demonstrations of key software elements and the steps necessary to take the software from prototype to dissemination into the community as reusable software resources?
- Does the proposal state the software license to be used and is the choice both suitably justified and appropriate, given the goals of the project?
- If the proposers claim to have previously developed widely-used software, particularly if funded under an SSE or SSI award, how significant was the use and impact of the previously funded software, as shown by the quantifiable evidence in the proposal, and is the software properly listed in the appropriate proposers' biosketches?
- Are tangible metrics described to measure the success of any software that may be developed? How appropriate are these metrics?
- How well does the software engineering and development plan include and/or enable the integration of relevant activities to ensure the software is responsive to new computing developments?
- To what extent are issues of security, trustworthiness, reproducibility, and usability addressed and integrated into the proposed software?
- To what extent is adaptability to new technologies and changing requirements addressed by the project and built into the proposed software system?
- How well does the project plan include user interaction, a community-driven approach, and a timeline of new feature releases? Is there a strong plan to extend the work to additional user communities?
- How well does the project address the sustainability of the developed software beyond the lifetime of the award?
- To what extent does the proposed software leverage, and to what extent is it interoperable with, widely used tools by the community, and NSF and national cyberinfrastructure investments, as appropriate?

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 evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will be completed and submitted by each reviewer. 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 strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

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. After an administrative review has occurred, Grants and Agreements Officers perform 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.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, 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.

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 notice, 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 notice; (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 notice. 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 https://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 https://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

Special Award Conditions:

- Awardees are expected to participate in annual PI meetings with travel costs supported by the award.
- Some SSI awards are anticipated to be continuing grants, and funds will be released annually subject to agreed-upon milestones, and based on approval by NSF and the availability of funds.

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 no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following 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 all identified PIs and co-PIs on a given award. 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 Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also 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.

More comprehensive information on NSF Reporting Requirements 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 https://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Rajiv Ramnath, Program Director, CISE/ACI, telephone: (703) 292-4776, email: SI2Queries@nsf.gov
- Daniel S. Katz, Program Director, CISE/ACI, telephone: (703) 292-2254, email: SI2Queries@nsf.gov
- Peter H. McCartney, Program Director, BIO/DBI, telephone: (703) 292-8470, email: SI2Queries@nsf.gov
- Almadena Y. Chtchelkanova, Program Director, CISE/CCF, telephone: (703) 292-8910, email: SI2Queries@nsf.gov
- Sol Greenspan, Program Director, CISE/CCF, telephone: (703) 292-8910, email: SI2Queries@nsf.gov
- John C. Cherniavsky, Senior Advisor, EHR, telephone: (703) 292-5136, email: SI2Queries@nsf.gov
- Joanne D. Culbertson, Program Director, ENG/CMMI, telephone: (703) 292-4602, email: SI2Queries@nsf.gov
- Hao Ling, Program Director, ENG/ECCS, telephone: (703) 292-2210, email: SI2Queries@nsf.gov
- Dimitrios V. Papavassiliou, Program Director, ENG/CBET, telephone: (703) 292-4480, email: SI2Queries@nsf.gov
- Eva Zanterkia, Program Director, GEO/EAR, telephone: (703) 292-4734, email: SI2Queries@nsf.gov
- Evelyn Goldfield, MPS/CHE, telephone: (703) 292-2173, email: SI2Queries@nsf.gov
- Daryl W. Hess, Program Director, MPS/DMR, telephone: (703) 292-4942, email: SI2Queries@nsf.gov
- Bogdan Mihaila, Program Director, MPS/PHY, telephone: (703) 292-8235, email: SI2Queries@nsf.gov
- Andrew D. Pollington, Program Director, MPS/DMS, telephone: (703) 292-4878, email: SI2Queries@nsf.gov
- Nigel A. Sharp, Program Director, MPS/AST, telephone: (703) 292-4905, email: SI2Queries@nsf.gov
- Cheryl L. Eavey, SBE/SES, telephone: (703) 292-7269, 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, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF [Grants Conferences](#). Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on [NSF's website](#).

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

See also:

- A Vision and Strategy for Software for Science, Engineering, and Education -- [NSF 12-113](#)
- Implementation of NSF Software Vision -- https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504817

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 55,000 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 Arctic 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 <https://www.nsf.gov>

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **For General Information** (NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**
 - Send an e-mail to: nsfpubs@nsf.gov
 - or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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