

CISE Research Infrastructure: Mid-Scale Infrastructure - NSFCloud (CRI: NSFCloud)

PROGRAM SOLICITATION

NSF 13-602



National Science Foundation

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

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

December 17, 2013

IMPORTANT INFORMATION AND REVISION NOTES

A revised version of the **NSF Proposal & Award Policies & Procedures Guide** (PAPPG), [NSF 13-1](#), was issued on October 4, 2012 and is effective for proposals submitted, or due, on or after January 14, 2013. Please be advised that the guidelines contained in [NSF 13-1](#) apply to proposals submitted in response to this funding opportunity.

Please be aware that significant changes have been made to the PAPPG to implement revised merit review criteria based on the National Science Board (NSB) report, [National Science Foundation's Merit Review Criteria: Review and Revisions](#). While the two merit review criteria remain unchanged (Intellectual Merit and Broader Impacts), guidance has been provided to clarify and improve the function of the criteria. Changes will affect the project summary and project description sections of proposals. Annual and final reports also will be affected.

A by-chapter summary of this and other significant changes is provided at the beginning of both the [Grant Proposal Guide](#) and the [Award & Administration Guide](#).

Please note that this program solicitation may contain supplemental proposal preparation guidance and/or guidance that deviates from the guidelines established in the [Grant Proposal Guide](#).

Important Information about revisions to the original solicitation: The eligibility information has been updated. The deadline was extended to December 17, 2013.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

CISE Research Infrastructure: Mid-Scale Infrastructure - NSFCloud (CRI: NSFCloud)

Synopsis of Program:

The CISE Research Infrastructure (CRI) program drives discovery and learning in the computing disciplines by supporting the creation and enhancement of world-class computing research infrastructure. This infrastructure will enable CISE researchers to advance the frontiers of CISE research. Further, through the CRI program, CISE seeks to ensure that individuals from a diverse range of academic institutions, including minority-serving and predominately undergraduate institutions, have access to such infrastructure.

This Mid-scale Infrastructure - NSFCloud solicitation constitutes a track within the CRI program specifically supporting research infrastructure that enables the academic research community to develop and experiment with novel cloud architectures addressing emerging challenges, including real-time and high-confidence systems.

CISE anticipates two phases of activity for NSFCloud. This solicitation enables Phase I, which will support required infrastructure design and ramp-up activities, as well as demonstration of readiness for full-fledged execution. An anticipated future solicitation will enable Phase II, during which funded infrastructure is expected to become fully staffed and operational, fulfilling the proposed mission of serving as a testbed that is used extensively by the research community.

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.

- Joseph B. Lyles, Program Director, telephone: (703) 292-8950, email: jlyles@nsf.gov
- Geoffrey Brown, Program Director, telephone: (703) 292-8950, email: gebrown@nsf.gov

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

- 47.070 --- Computer and Information Science and Engineering

Award Information

Anticipated Type of Award: Cooperative Agreement

Estimated Number of Awards: 2

Anticipated Funding Amount: \$20,000,000 subject to the availability of funds

Eligibility Information

Organization Limit:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

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

None Specified

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- Letters of Intent: Not Applicable
- 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: 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):
December 17, 2013

Proposal Review Information Criteria

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

Award Administration Information

Award Conditions: Standard NSF award conditions apply.

Reporting Requirements: Standard NSF reporting requirements apply.

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I. INTRODUCTION

Since its inception, the National Science Foundation (NSF) has supported the development of research infrastructure in order to advance the frontiers of science and engineering, and to enable an academic science and engineering research enterprise that continues to be among the world's best. As part of this commitment, the NSF's Directorate for Computer and Information Science and Engineering (CISE) has a tradition of supporting research infrastructure to enable transformative research at the frontiers of computing, and to provide unique opportunities for current and future generations of computing researchers and educators.

In recent years, cloud computing in various forms has rapidly become the dominant method of providing computing infrastructure for Internet services. Through the use of virtualization, multi-tenancy, and various service models, even small companies are able to quickly create and scale web and mobile applications. Many businesses today could not exist without the availability of cloud computing. The success of the cloud computation model is also changing network architectures. Access network providers are moving toward providing edge infrastructure that exploits virtualization, allowing for innovative ways of offering data, communication, and computation with an approach highly tuned to support new distributed and mobile applications. While most of the original innovations supporting cloud computing came from the academic community, much of the recent innovation in cloud architectures has been driven by industry because of the infrastructure requirements. Academic researchers are now considering a new generation of innovative applications of cloud computing and cloud computing architectures, including time- and safety-critical cyber-physical applications for medical devices, power grid, and transportation, which require advances beyond the directions industry is pursuing.

This solicitation comprises a long-term and comprehensive program seeking infrastructure that will specifically enable the academic research community to (a) develop and experiment with novel cloud architectures and (b) pursue architecturally-enabled novel applications of cloud computing.

II. PROGRAM DESCRIPTION

With its CISE Research Infrastructure (CRI) program, CISE drives discovery and learning in the computing disciplines through support for the creation and enhancement of world-class computing research infrastructure. Further, through the CRI program, CISE seeks to ensure that individuals from a diverse range of academic institutions, including minority-serving and predominantly undergraduate institutions, have access to such infrastructure. Over the years, CRI has supported system testbeds, software libraries and tools, networks of wireless and mobile devices, programmable network components, data clusters, data repositories and visualization capabilities, and other related infrastructure, with the aim of providing unique and compelling research opportunities otherwise inaccessible to the CISE research and education community.

In the last decade, CISE's investments in infrastructure, particularly networking research infrastructure, have demonstrated the value of developing and using shared infrastructure for accelerating research and education in this space. For example, since 2007, CISE has supported the [Global Environment for Network Innovations \(GENI\)](#), laying the foundation for a unique national virtual laboratory for at-scale networking experimentation. Over 300 networking researchers spanning more than 60 universities throughout the US have contributed to developing and prototyping GENI. Key features of GENI are resource slicing and deep programmability. In parallel, NSF has also made substantial investments in software and hardware infrastructure for high-performance computing. The NSF-funded [FutureGrid](#) is an architecture built around software-defined systems at all levels – network, infrastructure, platform and software as a service. Today FutureGrid is being used by systems researchers as well as by computational scientists.

Recently, driven by the needs of high-performance computing and the potential and opportunity to move advances enabled by GENI and related efforts onto campus environments, NSF established the [Campus Cyberinfrastructure – Network Infrastructure and Engineering \(CC-NIE\) program](#). CC-NIE seeks improvements and re-engineering at the campus level to leverage dynamic network services and support both a range of scientific data transfers and GENI-like experimental infrastructure. Other infrastructure programs (see, for example, [NSF 13-528](#), "High Performance Computing System Acquisition: Building a More Inclusive Computing Environment for Science and Engineering") are funding advanced computing infrastructure with an emphasis on "building, testing, and deploying" computing resources within a collaborative ecosystem.

In this solicitation, we seek proposals for research infrastructure that build upon existing investments as well as the recent rapid growth in cloud computing, and enable the academic research community to develop and experiment with novel cloud and cloud-like architectures that can support a diversity of innovative applications. We also seek to facilitate interactions between the broader academic community as well as industry, including cloud computing researchers, the high-performance computing community, and cyber-physical systems researchers. In the long run, the goal is that such community infrastructure will enable exploration of resource sharing in clustered computing, virtualization with software-defined networking technologies, quality of service guarantees, and the interplay among applications, cloud computing architectures, and the physical environment. It will be available across a spectrum of configurations. The infrastructure will further support research both into the design, provisioning, and management of a reliable, persistent, real-time cloud architecture, as well as into the design and deployment of large-scale distributed services and applications that use such an environment. Ultimately, the research infrastructure will enable researchers to go beyond the use of existing commercial cloud offerings, allowing them to influence such offerings in the future.

CISE anticipates two phases of activity. Phase I, to be enabled by this solicitation, will support required infrastructure design and ramp-up activities, as well as demonstration of readiness for full-fledged execution. This phase is expected to last up to four years and will focus on concrete design and implementation activities necessary for eventual scaling to a larger, community infrastructure should additional funds become available. Approximately one year prior to the end of each Phase I award, each funded infrastructure activity will be evaluated by an external committee based on the goals of the NSFCloud program as well as specific metrics outlined in the original proposal. Depending upon the outcome of this review, NSF may choose to ramp down a funded project over the remaining duration of the award. A successful project will continue to receive the planned support through the remainder of the Phase I grant period. Subject to the availability of funds, CISE expects to issue a solicitation for Phase II of NSFCloud approximately two to three years following funding of the Phase I awards, seeking competitive proposals from among the Phase I awardees describing how the infrastructure activity would transition to full operations. In Phase II, the infrastructure is expected to become fully staffed and operational, fulfilling the proposed mission of serving as a testbed that is used extensively by the research community. Subject to the availability of funds, Phase II will have a similar duration and funding level.

While this solicitation is focused on infrastructure building and operating activities, NSF anticipates future support for research projects using these facilities. Consequently, proposals responsive to this solicitation should address how different NSF research communities will interface with, and leverage, the proposed facilities.

NSFCloud projects must accomplish the following:

- Present an architecture and deployment plan that will support multiple experiments, each of sufficient size so as to enable meaningful evaluation of different cloud computing configurations. The number of concurrent experiments should be a function of the computing resources, not of the architecture or the NSFCloud organizational structure. The architecture should be able to support short- as well as long-term experiments, along with capabilities for experiment instrumentation.
- Support the construction of experiments consisting of communications, computation and data resources that may span real-time and safety-critical systems. The NSFCloud must support both experiments involving novel cloud computing architectures and experiments involving novel applications of cloud computing. Examples of such experiments might include new and novel virtualization mechanisms beyond existing industry standards such as OpenStack or experiments coupling cloud computing to high-performance computing applications and cyber-physical systems.
- Engage the relevant research and education communities as developers and users. Projects must also present plans addressing broader participation and development of persistent infrastructures.

NSFCloud proposals are encouraged to consider leveraging existing NSF investments such as GENI and CC-NIE as well as commercial or open source software as a means of responsibly reducing cost, risk and time to deploy. Risk reduction includes strategies for facilitating use of new facilities by existing user communities. Leveraging of commercial relationships may be part of a strategy for reducing cost, risk and time to deploy as well as increasing project impact in the broader society.

III. AWARD INFORMATION

NSF expects to award 2 Cooperative Agreements under this solicitation, subject to the availability of funds. Per the terms of these Cooperative Agreements, there will be regular meetings between NSF staff and the infrastructure management to monitor progress with respect to the technical plans.

The two Cooperative Agreements will total up to \$20 million for up to 4 years, subject to the availability of funds.

Approximately one year prior to the end of each Phase I award, the infrastructure activity will be evaluated by an external committee based on the goals of the NSFCloud program as well as specific metrics outlined in the original proposal. Depending upon the outcome of this review, NSF may choose to ramp down the activity over the remaining duration of the award. A successful project will continue to receive the planned support through the remainder of the grant period.

IV. ELIGIBILITY INFORMATION

Organization Limit:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

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

None Specified

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

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

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from 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.

Important Proposal Preparation Information: FastLane will check for required sections of the full proposal, in accordance with *Grant Proposal Guide* (GPG) instructions described in Chapter II.C.2. The GPG requires submission of: Project Summary; Project Description; References Cited; Biographical Sketch(es); Budget; Budget Justification; Current and Pending Support; Facilities, Equipment & Other Resources; Data Management Plan; and Postdoctoral Mentoring Plan, if applicable. If a required section is missing, FastLane will not accept the proposal.

Please note that the proposal preparation instructions provided in this program solicitation may deviate from the GPG instructions. If the solicitation instructions do not require a GPG-required section to be included in the proposal, insert text or upload a document in that section of the proposal that states, "Not Applicable for this Program Solicitation." Doing so will enable FastLane to accept your proposal.

The following information supplements (note that it does not replace) the guidelines provided in the NSF Grant Proposal Guide (GPG) and NSF Grants.gov Application Guide.

Project Description: Within the 20 pages allocated for the Project Description, describe the:

Overall project vision: The project vision should include initial computing resource deployments, a vision of growth opportunities (both those funded by NSF and those funded by other parties), a discussion of mechanisms for engaging and broadening a user community, and a vision for long-term project governance.

Proposed computing research infrastructure: Proposals should describe the components of the NSFCloud and how this infrastructure will leverage existing NSF investments or commercial software. In cases where new development is needed, the proposal must describe why the new development is required, the research and development challenges of the new development, and a risk assessment and risk mitigation strategy. Proposals must include estimates of development complexity and cost. Estimates that are based on actual experience with comparable software modules are encouraged.

Enabling of new research and education opportunities: Proposals must describe or show how the architecture will support compelling new research and education opportunities. In particular, proposals must discuss how the infrastructure, when fully operational, will support multiple experiments, each of sufficient size so as to enable meaningful evaluation of different cloud computing configurations – at scale, long-running, instrumented. Proposals may choose to describe the capabilities of the proposed infrastructure to isolate experiments from each other, as well as the limits of the isolation and how the isolation properties are expected to affect the classes of experiments that can be run on the infrastructure.

Community engagement: Proposals must address the mechanisms for outreach to ensure that a broad community will be engaged both in the design and use of the shared research infrastructure. What social or organizational mechanisms are needed for community outreach? How will industrial involvement through subcontracts, for example in provisioning or in partnering on research and development, aid in this process? What are the tools and facilities that the broader community will need in order to make use of the infrastructure? What are the key organizational and community issues, as well as the key technical enablers of long-term sharing and growth/extension? As noted previously, NSF anticipates future support for research projects using facilities funded under this solicitation. Consequently, the outreach discussion must address how different NSF research communities will interface with, and leverage, the proposed facility.

Team Qualifications: Proposals must present the qualifications of the PIs and the project team, including project management and systems engineering, responsible for managing the creation, enhancement and operations of the research infrastructure. This description is distinct from the biographical material, which is a mandatory part of the proposal, and should focus on the skills needed to run a successful project of this type. This section should include discussion of any prior experience with shared infrastructures at the scale of GENI.

Project Management: The proposal must contain a project management plan, including a timeline, that outlines all steps to be undertaken to acquire, develop, and/or operate the research infrastructure, and identify the parties responsible for each major task. The management plan should map directly to the technical plan and describe how the project team will ensure progress. If the

proposed infrastructure is related to previously NSF-funded infrastructure, describe the impact on, and steps for, integrating the previously funded infrastructure with the new infrastructure. Describe how funds remaining from earlier NSF grants for related infrastructure will be integrated with the requested award.

The project management section must include a risk management plan, providing an initial assessment of major technical or organizational risks and approaches to mitigating them. Proposals must also describe an ongoing plan for periodic risk assessment and mitigation.

Success Metrics: The proposal must identify an initial set of metrics for both short- and long-term progress toward a shared infrastructure, as well as a plan for periodically updating and tracking progress metrics.

Long-term Vision: The proposal must describe a longer-term vision for transition to community governance and sustainability, and the associated management aspects. Proposers must also describe the management aspects associated with scaling to a larger infrastructure should the infrastructure advance to Phase II with additional funding.

Proposers may wish to review the material available at: <http://www.nsf.gov/cise/cns/MIC%20report%20May-2013.pdf>

Supplementary Documents: Beyond required Supplementary Documents such as a Data Management Plan and Postdoctoral Mentoring Plan (if applicable), please provide the following in the Supplementary Documents section:

(1) *List of Project Personnel and Partner Institutions (Note: In the case of separately submitted collaborative proposals, only the lead institution should provide this information):*

Provide current, accurate information for all personnel and institutions involved in the project. NSF staff will use this information in the merit review process to manage conflicts of interest. The list should include all PIs, Co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, Postdocs, and project-level advisory committee members. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon. Each person listed should start a new numbered line. For example:

1. Mary Smith; XYZ University; PI
2. John Jones; University of PQR; Senior Personnel
3. Jane Brown; XYZ University; Postdoc
4. Bob Adams; ABC Inc.; Paid Consultant
5. Mary White; Welldone Institution; Unpaid Collaborator
6. Tim Green; ZZZ University; Subawardee

(2) *A list of Collaborators (Note: In the case of separately submitted collaborative proposals, only the lead institution should provide this information):*

Provide current, accurate information for all active or recent collaborators of personnel and institutions involved in the project. NSF staff will use this information in the merit review process to manage conflicts of interest. This list -- distinct from (1) above -- must include all active or recent Collaborators of all personnel involved with the proposed project. Collaborators include any individual with whom any member of the project team -- including PIs, Co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, Postdocs, and project-level advisory committee members -- has collaborated on a project, book, article, report, or paper within the preceding 48 months; or co-edited a journal, compendium, or conference proceedings within the preceding 24 months. This list should be numbered and include (in this order) Full name and Organization(s), with each item separated by a semi-colon. Each person listed should start a new numbered line.

1. Mary Smith; XYZ University
2. John Jones; University of PQR
3. Jane Brown; XYZ University
4. Bob Adams; ABC Inc.
5. Mary White; Welldone Institution
6. Tim Green; ZZZ University

PIs from predominantly undergraduate institutions should also include a Research in Undergraduate Institutions (RUI) Impact Statement and Certification of RUI Eligibility in this Section. See the [RUI website](#) for further information.

B. Budgetary Information

Cost Sharing: Inclusion of voluntary committed cost sharing is prohibited

Budget Preparation Instructions:

The NSFCloud program will support:

- acquisition and/or development of new software tools, equipment, testbeds, resources, platforms, etc.;
- enhancement (through acquisition and/or development) of existing software tools, equipment, testbeds, resources, platforms, etc.;
- technical personnel essential to the successful design, acquisition, development, and deployment of the proposed research infrastructure;
- postdocs as well as graduate and/or undergraduate students to participate in the design, acquisition and/or development of the proposed research infrastructure;
- travel expenses necessary for coordination of multi-institutional projects;
- support for professional staff critical to the operation of the infrastructure, including providing effective user support;
- postdocs, or graduate or undergraduate students to participate in the operation (including providing user support) and assessment of the infrastructure;
- outreach and participation activities such as workshops or training activities that broaden participation and prepare researchers, educators and students to use the proposed infrastructure effectively; and
- assessment activities that evaluate project outcomes.

Proposal budgets should include funds for domestic travel for two two-day meetings each year. These meetings will facilitate discussion and coordination of engineering or programmatic issues that cross project boundaries and support engagement with the user community. For budgetary purposes, PIs should assume these meetings will be held in varying locations throughout the U.S.

The NSFCloud program will **not** provide support for the following items:

- general-purpose personal computing equipment, office equipment, software, or databases; or
- individual research enabled by the infrastructure.

C. Due Dates

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

December 17, 2013

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. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage:

http://www07.grants.gov/applicants/app_help_reso.jsp. 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 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: http://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 [Empowering the Nation Through Discovery and Innovation: NSF Strategic Plan for Fiscal Years \(FY\) 2011-2016](#). 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 core strategies 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 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 variety of learning perspectives.

Another core strategy in support of NSF's mission is broadening 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

In addition to the merit review principles and criteria described above, NSFCloud proposals will also be evaluated by assessment of:

- The qualifications of the team and its ability to deliver the infrastructure;
- The completeness of the management plan, including how well the proposed project structure and management plan provides adequate community participation in the development, governance and use of the facility;
- How well the proposal addresses currently understood cloud research problems, and the likelihood that the proposal will support new research challenges;
- How well the proposed project leverages existing NSF investments and other opportunities;
- The success metrics and plan for periodic evaluation of the project against those metrics; and
- How well the proposal describes project risk factors and strategies for overcoming these aspects.

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.

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 prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). Within 90 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 http://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:

- Joseph B. Lyles, Program Director, telephone: (703) 292-8950, email: jlyles@nsf.gov
- Geoffrey Brown, Program Director, telephone: (703) 292-8950, email: gebrown@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, "My NSF" 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. "My NSF" also is available on NSF's website at <http://www.nsf.gov/mynsf/>.

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

Related Programs:

NSF provides additional funding opportunities for the computing community via the following programs and their solicitations:

Discovery Research Programs

CISE Cross-Cutting Programs, http://nsf.gov/funding/pgm_summ.jsp?pims_id=13451&org=IIS&sel_org=IIS&from=fund

Computer and Network Systems: Core Programs, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12765&org=CNS&from=home

Information and Intelligent Systems: Core Programs, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13707&org=IIS&from=home

Computing and Communication Foundations: Core Programs, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503220&org=CCF&from=home

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

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

Expeditions in Computing, http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf07592

Faculty Early Career Development (CAREER), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503214&org=CISE

Education and Workforce Development Programs

Transforming Undergraduate Education in Science, Technology, Engineering, and Mathematics (TUES), http://nsf.gov/funding/pgm_summ.jsp?pims_id=12759&org=DGE&from=home

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

Computing Education for the 21st Century (CE21), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503582&org=CNS&from=home

Research Experiences for Teachers (RET) in Engineering and Computer Science, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5736&org=CISE&from=home

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

Integrative Graduate Education and Research Training (IGERT), http://nsf.gov/funding/pgm_summ.jsp?pims_id=12759&org=DGE&from=home

Research Experiences for Undergraduates (REU) Sites and Supplements, http://nsf.gov/funding/pgm_summ.jsp

[pims_id=5517&org=NSF&sel_org=XCUT&from=fund](http://www.nsf.gov/pims_id=5517&org=NSF&sel_org=XCUT&from=fund)

Research Infrastructure Programs

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

Major Research Instrumentation Program (MRI), http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5260&org=NSF&sel_org=XCUT&from=fund

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 <http://www.nsf.gov>

- Location: 4201 Wilson Blvd. Arlington, VA 22230
- For General Information (NSF Information Center): (703) 292-5111
- TDD (for the hearing-impaired): (703) 292-5090
- To Order Publications or Forms:
 - Send an e-mail to: 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
Office of the General Counsel
National Science Foundation
Arlington, VA 22230

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