Campus Cyberinfrastructure (CC*)

PROGRAM SOLICITATION
NSF 16-567

REPLACES DOCUMENT(S):
NSF 15-534

National Science Foundation

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

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

August 23, 2016

IMPORTANT INFORMATION AND REVISION NOTES

CC* was formerly known as CC*DNI as described in solicitation 15-534. The program name, now "Campus Cyberinfrastructure (CC*)", reflects the comprehensive nature of the program in terms of investments across the cyberinfrastructure (CI) spectrum. The Campus CI Engineer area from last year was modified and renamed Cyber Team, and proposals into this area can also be submitted by non-profit, non-academic institutions. Two new areas were added: Campus Computing, and Innovative Integrated Storage Resources. Instrument Networking was discontinued. Universities and Colleges may submit proposals to any of the seven requested areas, but non-profit, non-academic organizations may only submit to area (2) Cyber Team.

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.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Campus Cyberinfrastructure (CC*)

Synopsis of Program:

The Campus Cyberinfrastructure (CC*) program invests in coordinated campus-level cyberinfrastructure (CI) components of data, networking, and computing infrastructure, capabilities, and integrated services leading to higher levels of performance, reliability and predictability for science applications and distributed research projects. Learning and workforce development (LWD) in CI is explicitly addressed in the program. Science-driven requirements are the primary motivation for any proposed activity.

CC* awards will be supported in seven areas:

1. Data Driven Multi-Campus/Multi-Institution Model Implementations awards will be supported at up to $3,000,000 total for up to 4 years.
2. Cyber Team awards will be supported at up to $1,500,000 total for up to 3 years.
3. Data Driven Networking Infrastructure for the Campus and Researcher awards will be supported at up to $500,000 total for up to 2 years.
4. Network Design and Implementation for Small Institutions awards will be supported at up to $400,000 total for up to 2 years.
5. Network Integration and Applied Innovation awards will be supported at up to $1,000,000 total for up to 2 years.
6. Campus Computing awards will be supported at up to $500,000 for up to 3 years.
7. Innovative Integrated Storage Resources awards will be supported at up to $200,000 for up to 2 years.

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.

- Kevin Thompson, ACI Program Director, telephone: (703) 292-4220, email: CCDNIQueries@nsf.gov
- Amy Walton, ACI Program Director, telephone: (703) 292-4538, email: CCDNIQueries@nsf.gov
- Jack Brassil, CNS Program Director, telephone: (703) 292-8950, email: CCDNIQueries@nsf.gov

Edward Walker, ACI Program Director, telephone: (703) 292-4863, email: CCDNIQueries@nsf.gov

- Sushil K. Prasad, ACI Program Director, telephone: (703) 292-5059, email: CCDNIQueries@nsf.gov
- Anita Nikolich, ACI Program Director, telephone: (703) 292-4551, email: CCDNIQueries@nsf.gov
- Robert Chadduck, ACI Program Director, telephone: (703) 292-2247, email: CCDNIQueries@nsf.gov

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

- 47.070 --- Computer and Information Science and Engineering

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 21 to 33

The estimated number of awards per research area is as follows: Data Driven Multi-Campus/Multi-Institution Model Implementations is estimated to have 1-2 awards; Cyber Team is estimated to have 2-4 awards; Data Driven Networking Infrastructure for the Campus and Researcher is estimated to have 5-10 awards; Network Design and Implementation for Small Institutions is estimated to have 5-8 awards; Network Integration and Applied Innovation awards is estimated to have 2-5 awards; Campus Computing is estimated to have 2-4 awards; and Innovative Integrated Storage Resources is estimated to have 4-8 awards.

Anticipated Funding Amount: $16,000,000 to $18,000,000

Funding will span the following seven areas:

1. Data Driven Multi-Campus/Multi-Institution Model Implementations awards will be supported at up to $3,000,000 total for up to 4 years.
2. Cyber Team awards will be supported up to $1,500,000 total for up to 3 years.
3. Data Driven Networking Infrastructure for the Campus and Researcher awards will be supported up to $500,000 total for up to 2 years.
4. Network Design and Implementation for Small Institutions awards will be supported at up to $400,000 total for up to 2 years.
5. Network Integration and Applied Innovation awards will be supported up to $1,000,000 total for up to 2 years.
6. Campus Computing awards will be supported at up to $500,000 for up to 3 years.
7. Innovative Integrated Storage Resources awards will be supported at up to $200,000 for up to 2 years.

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.

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:

There are no restrictions or limits.

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: 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. submitter's local time):

  August 23, 2016

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.

TABLE OF CONTENTS

Summary of Program Requirements

I. Introduction

II. Program Description

III. Award Information

IV. Eligibility Information

V. Proposal Preparation and Submission Instructions
- A. Proposal Preparation Instructions
- B. Budgetary Information
- C. Due Dates
- D. FastLane/Grants.gov Requirements

VI. NSF Proposal Processing and Review Procedures
- A. Merit Review Principles and Criteria
- B. Review and Selection Process

VII. Award Administration Information
- A. Notification of the Award
- B. Award Conditions
- C. Reporting Requirements

VIII. Agency Contacts

IX. Other Information

I. INTRODUCTION

Campuses today face challenges across multiple levels of Cyberinfrastructure (CI), where meeting the needs of scientific research and education goes far beyond the networking layer in capacity and services, and extends to computing, data services, secure and trustworthy systems, and especially human expertise, collaboration and knowledge sharing. Recognition of the "data driven" nature of scientific advancement and discovery has led to an increased focus in addressing the data challenges posed by the NSF research and education community.

In recent years, NSF has addressed the growing requirements of the NSF community, and opportunities to innovate, in networking

infrastructure through the Campus Cyberinfrastructure program. The Campus Cyberinfrastructure - Network Infrastructure and Engineering (CC-NIE) program in 2012 and 2013 focused on campus networking upgrades and re-architecting, and innovative development and integration of new networking capabilities in support of driving scientific application requirements. The Campus Cyberinfrastructure - Infrastructure, Innovation and Engineering (CC*IIE) program in 2014 expanded these themes to include campus network-related activities including regional coordination, identity management integration and professional engineering support. The program also presented the network research community opportunities to apply successful research outcomes to campus network environments. In 2015, the program was called Campus Cyberinfrastructure - Data, Networking, and Innovation (CC*DNI), reflecting the new element of Data Infrastructure Building Blocks (DIBBs) and NSF's response to data challenges by encouraging development of robust and shared data-centric cyberinfrastructure capabilities to accelerate interdisciplinary and collaborative research in areas of inquiry stimulated by data.

While challenges remain in campus networking infrastructure, especially for under-resourced institutions, opportunities have emerged to leverage high-performance network paths among campuses to more effectively share and integrate campus-level CI resources into their scientific environments. This program evolves to address those opportunities, challenges, and needs: activities that explore model implementations for sharing and analyzing data across campuses; activities to build and apply shared pools of CI expertise across groups of campuses; continued investment in campus networking infrastructure and innovation; and the coordinated deployment into the campus fabric of innovative computing and storage resources shared outside of the campus and interoperable with multi-institutional and national resources.

The Campus Cyberinfrastructure (CC*) program invests in innovative, coordinated, and secure campus, multi-campus and multi-institution cyberinfrastructure (CI) components of data, networking, and computing infrastructure, capabilities, and services. These investments are intended to exhibit demonstrable higher levels of performance, reliability and predictability for science applications and distributed research projects. Learning and workforce development (LWD) in CI is explicitly addressed in the program. Science-driven requirements are the primary motivation for any proposed activity.

CC* awards will be supported in seven areas:

1. Data Driven Multi-Campus/Multi-Institution Model Implementation awards will be supported at up to $3,000,000 total for up to 4 years.
2. Cyber Team awards will be supported at up to $1,500,000 total for up to 3 years.
3. Data Driven Networking Infrastructure for the Campus and Researcher awards will be supported at up to $500,000 total for up to 2 years.
4. Network Design and Implementation for Small Institutions awards will be supported at up to $400,000 total for up to 2 years.
5. Network Integration and Applied Innovation awards will be supported at up to $1,000,000 total for up to 2 years.
6. Campus Computing awards will be supported at up to $500,000 for up to 3 years.
7. Innovative Integrated Storage Resources awards will be supported at up to $200,000 for up to 2 years.

II. PROGRAM DESCRIPTION

Program-wide Criteria

Science-driven requirements are the primary motivation for any proposed activity. Proposals will be evaluated on the strength of the science enabled (including research and education) as drivers for investment and innovation in data, networking, and computing cyberinfrastructure.

A common theme across all aspects of the CC* program is the critical importance of the partnership among campus-level CI experts, including the campus Information Technology (IT)/networking/data organization, contributing domain scientists, research groups and educators necessary to engage in, and drive, new network and data-centric capabilities in support of scientific discovery. Proposals across the program should reflect and demonstrate this partnership on campus. Proposals will be evaluated on the strength of institutional partnerships, as they are expected to play a central role in developing and implementing the eventual network and data infrastructure upgrades.

All proposals into the CC* program must include a Campus Cyberinfrastructure (CI) plan within which the proposed CI improvements are conceived, designed, and implemented in the context of a coherent campus-wide strategy and approach to CI that is integrated horizontally intra-campus and vertically with regional and national CI investments and best practices. This Campus CI plan must be included as a supplementary document and is limited to no more than 5 pages. Further, proposals are expected to address within the Campus CI plan the sustainability of the proposed work in terms of ongoing operational and engineering costs. The plan should also describe campus IPv6 deployment and use of the In Common Federation global federated system, and if applicable, campus federation approaches to supporting scientific Virtual Organizations. Also, for proposals into the Data Driven Networking Infrastructure for the Campus and Researcher area, the Campus CI plan should address efforts to prevent IP spoofing by potential adoption of "BCP 38". If it is determined that "BCP 38" cannot be deployed due to cost or technical reasons, discussing those reasons is an acceptable form of addressing the issue. More information on this technique can be found at http://spoofer.cmand.org/index.php. Proposers are encouraged to test their campuses with the "spoofer" tool, available through the same website, in ascertaining the current status of IP spoofing prevention in their networks. A website, at http://fasterdata.es.net/campusCIplanning/, contains a number of Campus CI plans provided by existing CC* program awardees as examples. Proposals addressing a multi-institution or regional activity and approach to coordinated and integrated CI, such as area 2 on Cyber Team, may submit a Campus CI plan representing the multi-institution group or region. Since security and resilience are fundamental issues in Campus CI, the campus CI plan should address the campus-wide approach to cybersecurity in the scientific research and education infrastructure, including the campus approach to data and privacy.

As noted in CISE/ACI's companion solicitation, Cybersecurity Innovation for Cyberinfrastructure (NSF 16-533), security is a shared requirement across collaborative scientific environments and the institutions supporting these activities. All proposals submitted to CC* are expected to address the relevant cybersecurity issues and challenges related to their proposed activities. Depending on the type of proposal, these issues may include, but are not limited to: data integrity, privacy, network security measures, federated access and identity management, and infrastructure monitoring.

As a campus CI program, funded activities should represent ongoing opportunities for student engagement, education, and training. Proposals that demonstrate opportunities to engage students directly in the deployment, operation, and advancement of the CI funded activities, consistent with the required Campus CI plan, are welcome.

As a reminder, NSF's *Grant Proposal Guide* states that for any proposal, the Project Description must contain, as a separate section within the narrative, a section labeled "Broader Impacts". Refer to *GPG* section II.C.2 for more information.

Program Areas

The Campus Cyberinfrastructure (CC*) program welcomes proposals in seven areas: (1) Data Driven Multi-Campus/Multi-Institution Model Implementations; (2) Cyber Team; (3) Data Driven Networking Infrastructure for the Campus and Researcher; (4) Network Design and Implementation for Small Institutions; (5) Network Integration and Applied Innovation; (6) Campus Computing; and (7) Innovative Integrated Storage Resources. These are described in detail below.

(1) Data Driven Multi-Campus/Multi-Institution Model Implementations

The goal of these investments is to enable 21st-century science, engineering, and education to move toward effective use of digital data to advance discovery. They are expected to provide innovative, reusable data and knowledge infrastructure to support data-intensive science, and to enable and encourage the science community to address data governance and lifecycle issues.

These awards will serve as innovative model implementations for potential future national-scale, network-aware, data-focused cyberinfrastructure attributes, approaches, and capabilities enabling 21st-century data driven scientific, engineering, and educational discoveries and advances. These campus-based investments are expected both to serve as evaluative resources, leveraging and integrating with existing campus cyberinfrastructure; and to enable and inform data driven innovations leading to discoveries and advances while developments in data governance, data lifecycle models, sustainability, policy, national-scale access, and relevance to "data driven" scientific advancements and discoveries continue to evolve.

These awards emphasize the value of sharing data beyond a specific institution to wider scientific, engineering, and educational communities to enable scientific discoveries, advances and actions. This area invests in multi-campus and/or multi-institutional regional cyberinfrastructure to leverage high-performance network paths among campuses enabling integration of new data-focused services, capabilities, and resources supporting data driven scientific discoveries, collaborations, innovations and advances.

NSF strongly urges the community to think broadly and not simply rely on traditional models when considering multi-campus and/or multi-institutional cyberinfrastructure, for example with respect to general research infrastructure, including distributed network accessible services, data and/or computational resources.

Proposals are expected to be science-driven and demonstrate a strong and credible connection to the multi-campus, multi-institutional, and/or regional scientific, engineering, and educational communities they serve. Proposals must provide a compelling case for significant impact on the multi-campus, multi-institutional and/or regional scientific environment through direct engagements. Proposals must also specify how adoption and usage will be measured and monitored, and how effectiveness of the resulting cyberinfrastructure model implementation will be assessed.

As model implementations potentially driving future national scale cyberinfrastructure, proposals are expected to address:

- Integrated, end-to-end approaches and methods for assured federated access;
- The integration of innovative, high-performance, end-to-end networking services to provide effective, optimized processing and sustainable throughput of ultra-large, heterogeneous data collections across the demonstrated network and associated full system(s) processing data path; and
- Multi-institution/regional caliber data preservation and access lifecycles, including: acquisition; documentation; security and integrity; storage, including robust persistent data identification; access, analysis and dissemination; migration; and deaccession.

Proposed activities will require collaborations across a range of disciplines, including participating institutions' information technology (IT), networking, available general research infrastructure, data, CI organizations, contributing domain scientists, engineers, researchers and educators. Proposals must document explicit partnerships and collaborations.

Proposals in this area are required to include:

- A Project Plan, as part of the Project Description, identifying in its goals and milestones the anticipated results of the model implementation in the targeted multi-institution/regional context. The Project Plan should address requirements for optimized processing and sustainable throughput of ultra-large, heterogeneous data collections across the demonstrated network and associated full system(s) processing data path as criteria contributing to define project success.
- A management plan, as part of the Project Description, addressing roles, responsibilities, and support. The plan should explain how science data flows will be supported;
- A campus cyberinfrastructure plan, as a supplementary document, representing the lead PI's institution and addressing a multi-institution scope of planning.
- Tangible metrics, as part of the Project Description, to evaluate the success of the integrated system, and the value of the resulting capability beyond the target environment.

Proposals in this program area are encouraged to address in their Data Management Plan how the project will manage its data and software and share its research results (including software), including the types of data and other materials to be produced in the course of the project; standards to be used for data and metadata format and content (as deemed appropriate); policies for access and sharing, including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, or other rights or requirements; policies and provisions for re-use, re-distribution, and the production of derivatives; and plans for archiving data, samples, and other research products, and for preservation of access to them including software sharing.

All proposals in this area must document explicit partnerships or collaborations with the campus IT/networking organization, as well as one or more domain scientists, research groups, and educators in need of the new data-centric, network-aware capabilities. Partnership documentation from personnel not included in the proposal as PI, Co-PI, or Senior Personnel should be in the form of a letter of collaboration located in the Supplementary Documents section of the proposal.

Note: This area is not the appropriate mechanism for obtaining support for individual faculty research projects. Requests for support of such projects should be directed to NSF's research grant programs.

As a campus CI program, funded activities represent ongoing opportunities for student engagements, education, and training, including the preparation of computer scientists for data science challenges.

Additional proposal preparation guidance for this area can be found in Section V.A. Proposal Preparation Instructions.

Universities and colleges are eligible to submit proposals in this program area. Proposals in this area require titles that begin with "CC* Data:" followed by the title of the project.

(2) Cyber Team

This program area recognizes the organizational dimension of CI and the ability of multi-institutional teams and regional

organizations to knit together the potentially limited cyberinfrastructure resources available at individual sites, campuses, and institutions. As a result this program area seeks to build centers of expertise and knowledge in cyberinfrastructure whose impact is multi-institutional and transcends specific projects. Over the last two years of CC* (CC-IIE and CC*DNI), NSF supported 21 Campus CI Engineer awards to institutions and seeded the CI Engineer function as an emerging professional role responding to current needs and opportunities in advancing scientific discovery. In parallel, NSF supported the "Advanced Cyberinfrastructure - Research and Education Facilitator (ACI-REF)" experimental initiative demonstrating the value of cross-institutional sharing and leveraging of advanced cyberinfrastructure facilitators. The CI Engineer function is not merely a research support role, but rather an integrative one that centers on partnering with research projects within the campus and across campuses on shared goals. The program evolves the CI Engineer role to address the challenges of scaling, sharing and sustaining CI expertise across institutions where pooled groups of CI Engineers and Facilitators - a Cyber Team of expert technical and facilitating personnel spanning integrated data, networking, and computing - can be leveraged and applied across sets of institutions.

NSF sponsored a 2015 workshop whose report, "The Role of Regional Organizations in Improving Access to the National Computational Infrastructure," is available online at https://drive.google.com/file/d/0B9RBtxud9RbBemdYcGpnOExPUmM/view?usp=sharing. This report describes the role of regional organizations in providing broader support to computational researchers, expanding research engagement to underrepresented communities, addressing aspects of education, training and outreach efforts, and exploring regional approaches to coordination and sharing of computational knowledge and resources. NSF considers this report among the relevant sources of community input motivating the establishment of the Cyber Team program area.

Proposals in this area should describe the multi-institutional science-driven needs and enabling impact of long-term access to and engagement with a shared Cyber Team. Proposals should describe planned engagement activities in multiple science and engineering projects across campuses, including plans to leverage existing campus cyberinfrastructure and how these bridging services can be managed. Proposals should describe and justify the structure and make-up of the proposed Cyber Team, including the approach to its engagement, interactions, and partnerships with science and engineering research as well as education and training activities. Proposals should describe one or more areas of expertise, such as networking, distributed data management, and scientific computing. Proposals should address details of the initial planned engagements.

Proposals may request up to four full-time equivalents (FTE) for up to three years. Proposals must address institutionalization of positions and activities represented in this Cyber Team in the longer term through discussion of a viable sustainability plan. Proposals are encouraged to consider how the proposed Cyber Team interacts with national CI entities, collaborations, participating campuses, and scientific virtual organizations where relevant. Proposals are encouraged to include letters of commitment from campuses and projects impacted by the proposed activities. Proposals may choose to focus group formation around one or more CI component areas of scientific data, networking, computing and software, and to justify such choices on focus and diversity based on documented campus and scientific project needs.

Proposals should describe their organizational and management structure and discuss their approach to accepting input and requests from campuses in the region and prioritizing and responding to their needs for CI expertise. Proposals are encouraged to consider how researchers and users play a role, as well as local IT staff, for example through an advisory or user committee providing feedback on direction. The treatment of these issues is one factor in determining long-term sustainability of the effort.

Proposals should describe plans for broadening participation, including how under-resourced institutions can be meaningfully engaged.

Tangible goals and milestones for the Cyber Team should be addressed in an explicit section of the Project Description. This section should address campus-level and/or science project-level engagements. Proposals are encouraged to discuss how the Cyber Team will be evaluated in the context of quality and quantity of services provided, and impact on science and engineering research and education projects.

Proposals are encouraged from multi-institution teams or regional network organizations and consortia representing and serving the cyberinfrastructure needs of academic institutions within a designated region of the U.S. Proposals are also allowed from an individual leadership institution representing a state or region, or group of institutions.

Proposals that include network engineering or network performance functions in their proposed Cyber Team are encouraged to address specific plans on engaging their campuses on a set of current and future networking challenges: native IPv6 application support; IP spoofing and BPC 38; Resource Public Key Infrastructure (RPKI) experimental deployment and adoption; and PerfSonar-based end-to-end network performance visibility.

Proposals in this area are allowed to have their Campus CI plan represent a multi-institutional or regional CI plan, as opposed to a single campus. These plans have an opportunity to convey a future vision of inter-campus cyberinfrastructure in support of distributed scientific research and education.

Additional proposal preparation guidance for this area can be found in Section V.A. Proposal Preparation Instructions.

Non-profit organizations are eligible to submit proposals in this area. Universities and colleges are eligible to submit proposals in this area. Proposals in this area require titles that begin with "CC* Cyber Team:" followed by the title of the project.

(3) Data Driven Networking Infrastructure for the Campus and Researcher

Proposals submitted to this area should address network infrastructure improvements at the campus level to enable national and global high-performance end-to-end access to dynamic network services that in turn enable rapid, unimpeded movement of diverse and distributed scientific data sets and advanced computing. These networking improvements include, but are not limited to, the following types of activities:

- Network upgrades within a campus network to support a wide range of science data flows (including large files, distributed data, sensor networks, real-time data sources, and virtualized instruments for computer systems research);
- Re-architecting a campus network to support large science data flows, for example, by designing and building a Science DMZ (see http://fasterdata.es.net/fasterdata/science-dmz/ for more information on the Science DMZ approach); and/or
- A network connection upgrade for the campus connection to a regional optical exchange or point-of-presence that connects to Internet2.

Proposals must address scientific and engineering project and application drivers that require network engineering or upgrades of their existing infrastructure. Proposals must also present project-specific end-to-end scenarios for data movement, distributed computing, and other end-to-end services driving the networking upgrade. Proposals are strongly encouraged to include in their description of data movement scenarios and use cases a quantitative element, for example providing current or historical data flow rates. Proposals should consider expected outcomes; they should explain the compelling need for proposed network improvements in light of current conditions and expected enabling benefits to identified science drivers and applications. All of the above elements should be included in the Project Description. Inclusion of itemized vendor quotes is required for all proposals in this program area, to be included as a supplementary document.

Proposals must include, in the Project Description, a summary table of the science drivers and their network requirements – these requirements may be specified in terms of throughput ranges or as part of a composition or workflow profile for repeating cycles of scientific data movement.

Proposals must include, in the Project Description, a Project Plan addressing in its goals and milestones the end result of a working system in the target environment. Proposals are encouraged to address end-to-end networking performance in considering metrics of success.

All proposals in this area must document explicit partnerships or collaborations with the campus Information Technology (IT)/networking organization, as well as one or more domain scientists, research groups, and educators in need of the new network capabilities. Partnership documentation from personnel not included in the proposal as PI, Co-PI, or Senior Personnel should be in the form of a letter of collaboration located in the Supplementary Documents section of the proposal.

Any budget request for professional services, such as IT staff support, must be documented in coordination with the institution's campus IT or CIO organization. Note that requests for significant human resources should be considered in the Cyber Team area of this solicitation.

Proposals are required to include, in the Project Description, a network management plan addressing responsibilities, support, and roles. The plan should spell out how science data flows will be supported.

A letter of support from a campus leader is encouraged and should address sustainability and commitment from the institution.

Target environments must be campus infrastructure residing within the U.S.

Proposals are encouraged, but not required, to include a network diagram of the proposed network upgrades. Proposals are encouraged to document current utilization in the context of the proposed upgrades.

Preference will be given to proposals describing an operational role for IPv6, for example, describing native IPv6 support for one or more specific science applications.

Proposals are expected to describe an approach to end-to-end network performance measurement based on the perfSonar framework with associated tool installation and use; proposals may describe an alternative approach to perfSonar with sufficient justification. Proposers are encouraged to reference the following community web site for more information on perfSonar: http://fasterdata.es.net/performance-testing/perfsonar/.

Proposals asking for significant funding of storage assets are encouraged to consider proposing instead to the Innovative Integrated Storage Resources area. Proposals asking for significant computing resources are encouraged to consider proposing to the Campus Computing area.

An award in this program area is not the appropriate mechanism to provide support for individual faculty research projects. Requests for support of such projects should be directed to NSF's research grant programs.

Additional proposal preparation guidance for this area can be found in Section V.A. Proposal Preparation Instructions.

Current and previous awardees in this area are not encouraged to apply.

Universities and colleges are eligible to submit proposals in this program area. Proposals in this area are required to have titles that begin with "CC* Networking Infrastructure:" followed by the title of the project.

(4) Network Design and Implementation for Small Institutions

This area supports smaller institutions with fundamental challenges to address in networking infrastructure and resources. Guidance for proposals is similar to the Data Driven Networking Infrastructure for the Campus and Researcher area but with fewer required components as described below.

Proposals submitted to this area should address scientific research and education needs for improved research and education (R&E) networking connectivity on campus and/or externally. Networking improvements described in the proposal can focus on equipment and wireless or fiber/wired connectivity needed within a campus and between research and education buildings. Plans can also focus on upgrading an institution's connectivity to Internet2. Proposals may also point to a need to redesign their campus network to better support academic data flows, such as the scienceDMZ approach (see http://fasterdata.es.net/fasterdata/science-dmz/ for more information).

Proposals in this area should focus on establishing their institutions' science research and education needs and aspirations, and discuss how that translates to the need for greater connectedness and investment in network capacity. Institutions whose missions are primarily education-focused may choose to present their scientific needs in the context of network-enabled education activities and distance education. Proposals are encouraged to discuss research and education drivers with specific descriptions.

Proposals in this area are not required to present a complete technical design and may choose to defer technical solutions and equipment purchases to the second year of activities. Therefore, vendor quotes are not required for this program area. Under this scenario, the year 1 annual report is required to provide these details with NSF approval, prior to expenditures in year 2. The NSF approval of the annual report is also subject to a successful review before the end of the first year of the technical design developed. Equipment is not expected to be fully specified in the budget; however equipment choices will be specified in the annual report and review.

Proposals in this area are required to partner with a leadership institution in their jurisdiction or region, and at a minimum are expected to actively participate in CC*-related community events and engineering exchanges, especially in the first year while developing the technical solution. The leadership entity is expected to be experienced in high-performance R&E networking and well-resourced to be capable of actively working with the proposing institution on designing and making operational the proposed networking improvements. The partnering institution's engagement activities may be supported in the proposal and included as a sub-award or non-lead proposal.

Proposals will be evaluated mainly on the strength of the science use cases presented - including research and education - and their quantification. Proposals will also be evaluated on the strength of institutional partnerships as they are expected to play a central role in developing and implementing the eventual network upgrades.

Proposals are encouraged to provide, in the project description, a summary table of the science drivers and their network requirements - these requirements may be specified in terms of throughput ranges or as part of a composition or workflow profile for repeating cycles of scientific data movement.

Proposals are required to include, in the Project Description, a conceptual or functional network diagram of the proposed network upgrades and are encouraged to include the context of end system and user connectivity. Proposals are encouraged to document current utilization in the context of the proposed upgrades.

Proposals must include, in the Project Description, a Project Plan addressing in its goals and milestones the end result of a working system in the target environment. Proposals are encouraged to address end-to-end networking performance in considering metrics of success.

All proposals in this area must document explicit partnerships or collaborations with the campus Information Technology (IT)/networking organization, as well as one or more domain scientists, research groups, and educators in need of the new network capabilities. Partnership documentation from personnel not included in the proposal as PI, Co-PI, or Senior Personnel should be in the form of a letter of collaboration located in the supplementary documents section of the proposal.

Proposals are encouraged to describe an approach to end-to-end network performance measurement based on the perfSonar framework with associated tool installation and use; proposals may describe an alternative approach to perfSonar with sufficient justification. Proposers are encouraged to reference the following community website for more information on perfSonar: http://fasterdata.es.net/performance-testing/perfsonar/.

Any budget request for professional services, such as IT staff support, must be documented in coordination with the institution's campus IT or CIO organization.

Proposals are required to include, in the Project Description, a network management plan addressing responsibilities, support, and roles. The plan should spell out how science data flows will be supported.

A letter of support from a campus leader is encouraged and should address sustainability and commitment from the institution.

An award in this program area is not the appropriate mechanism to provide support for individual faculty research projects. Requests for support of such projects should be directed to NSF's research grant programs.

Target environments must be campus infrastructure residing within the U.S.

Additional proposal preparation guidance for this area can be found in Section V.A. Proposal Preparation Instructions.

Universities and colleges are eligible to submit proposals in this area. Proposals in this area are required to have titles that begin with "CC* Network Design:" followed by the title of the project.

(5) Network Integration and Applied Innovation

This program area supports end-to-end network CI through integration of existing and new technologies and applied innovation. The goal is to take advantage of research results, prototypes, and emerging innovations to use them to enable specified researchers in a networking context. Proposals in this area may leverage new and existing investments in network infrastructure, services, and tools by combining or extending capabilities to work as part of the CI environment used by scientific applications and users.

Unlike proposals directed to the "Data Driven Networking Infrastructure for the Campus and Researcher" program area that focus primarily on equipment-based data networking improvements, proposals in this area support the development and integration of innovative networking capabilities; network-related software development and deployment activities resulting in an operational environment prototype are expected to be part of the proposed activities.

A broad range of activities is covered by this area, including but not limited to:

- Integration of networking protocols and technologies with application layer code and processes;
- Transition of successful research prototypes in Software Defined Networking (SDN), activities supported by NSF's Global Environment for Network Innovations (GENI) project and Future Internet Architectures-Next Phase (FIA-NP) program, and others, to distributed scientific environments and campus infrastructure;
- Networking solutions to problems driven by distributed computing and Software Defined Infrastructure (SDI), including cloud services;
- Innovative research prototypes integrating programmable packet processing components into campus infrastructure; and
- Network engineering support through the creation and application of new and novel procedures and tools for solving end-to-end network performance issues, especially for dynamically constructed network services.

Proposals in this area must identify, in the Project Description, one or more supported science or engineering research projects or applications and describe how the proposed network integration activities will support those projects, particularly in the context of addressing data movement, throughput, and predictable performance end-to-end.

Where appropriate, proposals are encouraged to document explicit partnerships or collaborations with the campus IT/networking organization.

Proposals in this area must include, in the Project Description, a Project Plan with clear project goals and milestones resulting in a working system in a target environment. Proposals must define base metrics relevant to the proposal goals and address measurement and evaluation of the resulting system. Any software development under proposed activities must be made available under an open source license.

Additional proposal preparation guidance for this area can be found in Section V.A. Proposal Preparation Instructions.

Universities and colleges are eligible to submit proposals in this area. Proposals in this area require titles that begin with "CC* Integration:" followed by the title of the project.

(6) Campus Computing

The use of computation is ubiquitous in many scientific and engineering domains, and the range of technologies to enable these computational activities is ever-growing in diversity. The evolving landscape of enabling technologies ranges from new processor architectures to adaptable run-time modes, and includes new elastic access models as exemplified in the proliferation of public cloud computing providers. This program area seeks to deploy shared computer resources that will serve the scientific computation needs at the campus level, incentivizing integration into national or regional activities with the goal of building our next-generation high-performance computing (HPC) workforce.

In particular, proposals are encouraged that introduce innovative capabilities or system architectures to the campus and wider scientific community, driven by concrete scientific needs and applications. Also, proposals are required to present plans for integration into a regional or national cyberinfrastructure ecosystem. The plan must include HPC outreach, training and education of

future HPC scientists and cyberinfrastructure professionals, as well as participation in regional or national activities. Examples of such plans could include, but are not limited to: designing HPC curriculum and/or hosting HPC training courses for regional or national adoption; actively participating in national coordination groups such as the eXtreme Digital (XD) Service Provider (SP) Forum; and installing the Open Science Grid (OSG) or Extreme Science and Engineering Discovery Environment (XSEDE) software stack. Each proposal will be evalutated on how well the proposed resource will be used by its campus scientific community, and its potential to enable transformational advances in both cyberinfrastructure and scientific discoveries. Furthermore, proposals will be reviewed on their potential impact for building our next-generation HPC workforce.

Proposals must address, in the Project Description, science and engineering project and application drivers that require new or additional computing resources, describing project-specific scenarios for scientific computing tied to the proposed computing cluster. Proposals should describe the features, capabilities, network interfaces, and software platform representing the computing cluster configuration. Scientific computing codes expected to run on the resource should be included in the description.

Each proposal should consider expected outcomes; it should explain the compelling need for the proposed computing resource in light of current conditions and expected enabling benefits to identified science drivers and applications, as well as its impact on the national or regional workforce development and research activities. Proposals should concretely demonstrate their identified scientific drivers and applications by, for example, including a summary table of their identified computing requirements - these requirements may be specified in terms of compute job profile parameter ranges, core count ranges per job, times to completion or as part of a composition or scientific workflow profiles.

Each proposal should describe and show the network connectivity of the proposed computing resource, both intra-campus [for example, the campus network path(s) connecting the resource with the researchers and driving science applications on campus] and inter-campus [for example, the network path connecting with the regional exchange point or Internet2]. Proposals should include in their plans putting in place PerfSonar-based network performance measurement capability to initially measure achievable end-to-end network performance for scientific data flows between the resource and relevant end points of researchers.

Each proposal should describe its approach to sharing the proposed computing resource (1) across the science drivers and researchers at its institution; (2) how the resource will be accessed by external research groups; and (3) how the resource will be integrated with national or regional activities, broadly defined.

Inclusion of itemized vendor quotes is required as a supplementary document for all proposals in this program area.

Additional proposal preparation guidance for this area can be found in Section V.A. Proposal Preparation Instructions.

Universities and colleges are eligible to submit proposals in this area. Proposals in this area require titles that begin with "CC* Compute:" followed by the title of the project.

(7) Innovative Integrated Storage Resources

These awards will serve to deploy and/or augment network-accessible, sharable, campus-level, multi-campus/multi-institutional and/or regional network-accessible storage resources, services and/or capabilities leveraging and integrating with existing campus, multi-campus/multi-institutional and/or regional networking cyberinfrastructure to enable 21st century data driven scientific, engineering, and educational discoveries and advances.

In particular, these awards will serve to deploy innovative, integrated storage resources, services and/or capabilities responsive to scientific, engineering, and educational priorities and interests enabling data driven discoveries and advances. Proposals should:

- Be responsive to campus-level, multi-institutional and/or regional data preservation and access lifecycles, including: data sharing; acquisition: documentation; security and integrity; data retention; robust persistent data identification; access; analysis and dissemination; migration; and de-accession; and
- Seek to achieve reliable and repeatable high-performance throughput transfers of large, heterogeneous data collections across the demonstrated network and associated full system(s) processing data path(s).

Proposals will be evaluated according to:

- How well the proposed innovative integrated storage resources, services and/or capabilities will result in community adoption at the local campus, and across multi-campus and/or multi-institutional cyberinfrastructure to enable transformational scientific discoveries, collaborations, innovations and advances. Proposals must describe scientific, engineering and/or educational drivers requiring the proposed new or augmented storage resources, services and/or capabilities, and how the proposed resources are responsive to data driven scientific, engineering, and/or educational priorities and interests. Proposals must include a summary table presenting the scientific, engineering and/or educational drivers and their storage requirements; and
- How the proposed network-accessible storage resource, services and/or capabilities will be shared with and accessed by external research groups, including how the resource, services and/or capabilities will be coordinated with external resources, services and/or capabilities. Proposals should describe and document network connectivity of the proposed storage resource, services and/or capabilities. Proposals should include in their plans putting in place PerfSonar-based network performance measurement capability to initially measure achievable end-to-end network performance for scientific data flows between the resource and relevant end points of researchers.

Inclusion of itemized vendor quotes is required for all proposals as a supplementary document in this program area.

Additional proposal preparation guidance for this area can be found in Section V.A.

Universities and colleges are eligible to submit proposals in this area. Proposals in this area require titles that begin with "CC* Storage:" followed by the title of the project.

III. AWARD INFORMATION

Approximately $16 million-$18 million will be made available in FY 2017 to support 21-33 awards, subject to the availability of funds.

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.

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:

There are no restrictions or limits.

Additional Eligibility Info:

Universities and Colleges may submit proposals to any of the seven requested areas.

Non-profit, non-academic organizations may submit to area (2) Cyber Team only.

Proposals must identify a lead institution. Collaborative proposals submitted as simultaneous submission of proposals from different organizations, with each organization requesting a separate award are not allowed. Collaborative proposals submitted as a single proposal, in which a single award is being requested (with subawards administered by the lead organization) are allowed.

Current and past awardees in area (3) "Data Driven Networking Infrastructure for the Campus and Researcher" are encouraged not to apply this year to that same area.

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.

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.

For Data Driven Multi-Campus/Multi-Institution Model Implementations Proposals:

Proposals in this area require titles that begin with "CC* Data:" followed by the title of project.

Refer to Section II, Program Description, for additional information about requirements for CC* proposals. In particular, a Campus CI Plan must be included, with a limit of up to 5 pages, as a supplemental document.

For Cyber Team Proposals:

Proposals in this area require titles that begin with "CC* Cyber Team:" followed by the title of project.

Refer to Section II, Program Description, for additional information about requirements for CC* proposals. In particular, a Campus CI

Plan must be included, with a limit of up to 5 pages, as a supplemental document.

Proposals in this area are allowed to have their Campus CI plan represent a multi-institutional or regional CI plan, as opposed to a single campus. These plans have an opportunity to convey a future vision of inter-campus cyberinfrastructure in support of distributed scientific research and education.

For Data Driven Networking Infrastructure for the Campus and Researcher Proposals:

Proposals in this area require titles that begin with "CC* Networking Infrastructure:" followed by the title of project.

Refer to Section II, Program Description, for additional information about requirements for CC* proposals. In particular, a Campus CI Plan must be included, with a limit of up to 5 pages, as a supplemental document.

For Network Design and Implementation for Small Institutions Proposals:

Proposals in this area require titles that begin with "CC* Network Design:" followed by the title of project.

Refer to Section II, Program Description, for additional information about requirements for CC* proposals. In particular, a Campus CI Plan must be included, with a limit of up to 5 pages, as a supplemental document.

For Network Integration and Applied Innovation Proposals:

Proposals in this area require titles that begin with "CC* Integration:" followed by the title of project.

Refer to Section II, Program Description, for additional information about requirements for CC* proposals. In particular, a Campus CI Plan must be included, with a limit of up to 5 pages, as a supplemental document.

For Campus Computing Proposals:

Proposals in this area require titles that begin with "CC* Compute:" followed by the title of project.

Refer to Section II, Program Description, for additional information about requirements for CC* proposals. In particular, a Campus CI Plan must be included, with a limit of up to 5 pages, as a supplemental document.

For Innovative Integrated Storage Resources Proposals:

Proposals in this area require titles that begin with "CC* Storage:" followed by the title of project.

Refer to Section II, Program Description, for additional information about requirements for CC* proposals. In particular, a Campus CI Plan must be included, with a limit of up to 5 pages, as a supplemental document.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

Budgets should include travel funds for the project principal investigators and other team members as appropriate from all collaborating institutions to attend one annual Principal Investigators' meeting.

C. Due Dates

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

  August 23, 2016

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: http://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 CC* projects will be reviewed with careful attention to the following**:*

- *The extent to which the work provides a needed capability required by science, engineering and education.*
- *The expected impact on the deployed environment described in the proposal, and potential impact across a broader segment of the NSF community.*
- *Where applicable, how resource access control, federated identity management, and other cybersecurity related issues and community best practices are addressed.*
- ***A Cyberinfrastructure (CI) Plan** - To what extent is the planned cyberinfrastructure likely to enhance capacity for discovery, innovation, and education in science and engineering? How well does the plan as presented position the proposing institution(s) for future cyberinfrastructure development? How well does the cyberinfrastructure plan support and integrate with the institutions' science and technology plan? Are IPv6 deployment and InCommon Federation addressed? Are the activities described in the proposal consistent with the institution's cyberinfrastructure plan?*

Additionally, for proposals in area (1) Data Driven Multi-Campus/Multi-Institution Model Implementations:

- ***A Project Plan** addressing in its goals and milestones the end result of a working system in the target environment, and describing outcomes/deliverables that will result each year of the award period. Are innovative solutions to community-wide, data-related issues and policies discussed, and plans for sustainability beyond the scope of the award described?*
- ***A Management Plan** describing plans and procedures for the development and assessment of the proposed activity. Are there clearly defined responsibilities for leadership and the role of the PI institution and other organizations? Are plans described for maintaining an appropriate degree of openness and for encouraging the involvement of additional interested parties? Are means described for self-evaluation of progress toward the network goals and are they presented as an important part of the management plan? Are formal mechanisms included to ensure fair and equitable allocation of group resources?*
- ***A detailed Data Management Plan** describing plans for retaining and sharing data. See http://www.nsf.gov/cise/cise_dmp.jsp for guidance.*
- ***Tangible metrics** to evaluate the success of the integrated system, and the value of the resulting capability beyond the target environment.*

Additionally, for proposals in area (3) Data Driven Networking Infrastructure for the Campus and Researcher:

- ***A Project Plan** addressing in its goals and milestones the end result of a working system in the target environment.*

Additionally, for proposals in area (5) Network Integration and Applied Innovation:

- ***A Project Plan** addressing in its goals and milestones the end result of a working system in the target environment.*
- ***Tangible metrics** to measure the success of the integrated systems and any associated software developed, and the steps necessary to take the systems from prototype status to production use.*

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 generally be completed and submitted by each reviewer and/or panel. 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 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 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 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:

- Kevin Thompson, ACI Program Director, telephone: (703) 292-4220, email: CCDNIQueries@nsf.gov
- Amy Walton, ACI Program Director, telephone: (703) 292-4538, email: CCDNIQueries@nsf.gov
- Jack Brassil, CNS Program Director, telephone: (703) 292-8950, email: CCDNIQueries@nsf.gov
- Edward Walker, ACI Program Director, telephone: (703) 292-4863, email: CCDNIQueries@nsf.gov
- Sushil K. Prasad, ACI Program Director, telephone: (703) 292-5059, email: CCDNIQueries@nsf.gov
- Anita Nikolich, ACI Program Director, telephone: (703) 292-4551, email: CCDNIQueries@nsf.gov
- Robert Chadduck, ACI Program Director, telephone: (703) 292-2247, email: CCDNIQueries@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.

Related Programs:

NSF Advisory Committee for Cyberinfrastructure Task Force on Campus Bridging, *Final Report,* March 2011. Available from: http://www.nsf.gov/od/oci/taskforces/TaskForceReport_CampusBridging.pdf

Reference material on the "Science DMZ" concept is available at: http://fasterdata.es.net/fasterdata/science-dmz/

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