CISE Cross-Cutting Programs: FY 2010

PROGRAM SOLICITATION
NSF 09-558

REPLACES DOCUMENT(S):
NSF 08-578, NSF 08-560

National Science Foundation

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

Submission Window Date(s) (due by 5 p.m. proposer's local time)**:**

August 01, 2009 - August 30, 2009

Medium Projects

November 01, 2009 - November 28, 2009

Large Projects

December 01, 2009 - December 17, 2009

Small Projects

REVISION NOTES

The cross-cutting program descriptions have been updated, and the Data Intensive Computing program has subsumed the CISE Cluster Exploratory (CluE) program.

Please be advised that the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) includes revised guidelines to implement the mentoring provisions of the America COMPETES Act (ACA) (Pub. L. No. 110-69, Aug. 9, 2007.) As specified in the ACA, each proposal that requests funding to support postdoctoral researchers must include a description of the mentoring activities that will be provided for such individuals. Proposals that do not comply with this requirement will be returned without review (see the PAPP Guide Part I: *Grant Proposal Guide* Chapter II for further information about the implementation of this new requirement).

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

CISE Cross-Cutting Programs: FY 2010

Synopsis of Program:

This solicitation seeks proposals in cross-cutting areas that are scientifically timely, and that benefit from the intellectual contributions of researchers with expertise in a number of computing fields and/or sub-fields. The cross-cutting programs for FY 2010 are:

- Data-intensive Computing;
- Network Science and Engineering; and
- Trustworthy Computing.

The full descriptions of these programs can be found in the *II. Program Description* section of this solicitation.

CISE expects that over time, these cross-cutting programs will evolve or be absorbed into the core programs, and that new cross-cutting programs will be introduced.

Proposers are invited to submit proposals in three project classes, which are defined as follows:

- Small Projects - up to $500,000 total budget with durations up to three years;

- Medium Projects - $500,001 to $1,200,000 total budget with durations up to four years; and
- Large Projects - $1,200,001 to $3,000,000 total budget with durations up to five years.

A more complete description of the project classes can be found in section *II. Program Description*, of this document.

CISE investments in Small, Medium and Large projects complement the directorate's investments in the Expeditions in Computing program, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503169&org=CISE&from=home , where projects are funded at levels of up to $10,000,000 total for durations up to 5 years.

Cognizant Program Officer(s):

- Chitaranjan Das, Point of Contact, 1115, telephone: (703) 292-8910, email: cdas@nsf.gov
- Darleen L. Fisher, Point of Contact, Network Science and Engineering Program, 1175N, telephone: (703) 292-8950, fax: (703) 292-9010, email: dlfisher@nsf.gov
- Carl Landwehr, Program Director, 1175, telephone: (703) 292-8338, email: clandweh@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: 95 to 120 - It is anticipated that up to 120 awards will be made each year - up to 30 awards in Data-intensive Computing, 30 awards in Network Science and Engineering; and 60 awards in Trustworthy Computing

Anticipated Funding Amount: $85,000,000 $85 million in FY 2010, dependent upon the availability of funds: - up to $10 million in Data-intensive Computing, $20 million in Network Science and Engineering; and $55 million in Trustworthy Computing

Eligibility Information

Organization Limit:

None Specified

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI: 2

An individual may participate as PI, Co-PI or Senior Personnel in no more than **two** proposals submitted in response to this solicitation. For example, an individual may participate as PI, co-PI or Senior Personnel in one Trustworthy Computing proposal and in a second proposal submitted to the Data intensive Computing program, or an individual may participate as PI, co-PI or Senior Personnel in two proposals submitted to Network Science and Engineering, etc.

These eligibility constraints will be strictly enforced in order to treat everyone fairly and consistently. In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on earliest date and time of proposal submission (i.e. the first two proposals received will be accepted, and the remainder will be returned without review). **No exceptions will be made.**

The limit on the number of proposals per PI, Co-PI or Senior Personnel applies only to this solicitation.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not Applicable
- **Preliminary Proposal Submission:** Not Applicable
- **Full Proposal Preparation Instructions:** This solicitation contains information that deviates from the standard NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) proposal preparation guidelines. Please see the full text of this solicitation for further information.

B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required under this solicitation.
- **Indirect Cost (F&A) Limitations:** Not Applicable
- **Other Budgetary Limitations:** Not Applicable

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. proposer's local time)**:**

August 01, 2009 - August 30, 2009

Medium Projects

November 01, 2009 - November 28, 2009

Large Projects

December 01, 2009 - December 17, 2009

Small Projects

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: Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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I. INTRODUCTION

This solicitation seeks proposals in three programs of interest to all three CISE divisions, and which pose important and timely research and education challenges optimally addressed by researchers from a range of computing fields or sub-fields and beyond. Proposals submitted to each of the cross-cutting programs will be reviewed collaboratively by the three CISE divisions, with the goal of creating a comprehensive portfolio of awards with high-impact potential. CISE expects that, over time, these cross-cutting programs will evolve or be absorbed in our core programs, and that new cross-cutting programs will be introduced.

II. PROGRAM DESCRIPTION

CROSS-CUTTING PROGRAMS

The three cross-cutting programs are defined below.

1. Data-Intensive Computing

Enormous digital datasets abound in all facets of our lives - in e-commerce, in World Wide Web information resources, and in many realms of science and engineering. Looking ahead, the pace of data production will only accelerate with increasing digitization of communication and entertainment and the continuing assimilation of computing into everyday life. Data will arise from many sources, will require complex processing, may be highly dynamic, be subject to high demand, and be of importance in a range of end-use tasks. The broad availability of data coupled with increased capabilities and decreased costs of both storage and computing technologies has led to a rethinking of how we solve problems that were previously impractical or, in some cases, even impossible to solve. Further, despite the continuing advances and decreasing costs of computing and storage technologies, data production and collection are outstripping our ability to process and store data. This compels us to rethink how we will manage – store, retrieve, explore, analyze, and communicate – this abundance of data.

These technical and social drivers have increased the urgent need to support computation on data of far larger scales than ever previously contemplated. Data-intensive computing is at the forefront of ultra-large-scale commercial data processing, and industry has taken the lead in creating data-centers comprised of myriad servers storing petabytes of data to support their business objectives and to provide services at Internet-scale. Such data centers are instances of data-intensive computing environments, the target of this solicitation. For data-intensive computing, massive data is the dominant issue with emphasis placed on the data-intensive nature of the computation.

Data intensive computing demands a fundamentally different set of principles than mainstream computing. Many data-intensive applications admit to large-scale parallelism over the data and are well-suited to specifications via high-level programming primitives in which the run-time system manages parallelism and data access. The increasingly capacious and economical storage technologies greatly change the role that storage plays in such large-scale computing. Many data-intensive applications also require extremely high degrees of fault-tolerance, reliability, and availability. Applications also often face real-time responsiveness requirements and must confront heterogeneous data types and noise and uncertainty in the data. Scale will impact a system's ability to retrieve new and updated data and to provide, whenever appropriate, guarantees of integrity and availability as part of the system's basic functionality in the face of varying levels of uncertainty.

The Data-intensive Computing program seeks to increase our understanding of the capabilities and limitations of data-intensive computing. How can we best program data-intensive computing platforms to exploit massive parallelism and to serve best the varied tasks that may be executed on them? How can we express high-level parallelism at this scale in a natural way for users? What new programming abstractions (including models, languages and algorithms) can accentuate these fundamental capabilities? How can data-intensive computing platforms be designed to support extremely high levels of reliability, efficiency, and availability? How can they be designed in ways that reflect desirable resource sensibilities, such as in power consumption, human maintainability, environmental footprint, and economic feasibility? What (new) applications can best exploit this computing paradigm, and how must this computing paradigm evolve to best support the data-intensive applications we may seek? These are examples of questions that at their core ask how we can support data-intensive computing when the volume of data surpasses the capabilities of the computing and storage technologies that underlie them.

The program will fund projects in all areas of computer and information science and engineering that increase our ability to build and use data-intensive computing systems and applications, help us understand their limitations, and create a knowledgeable workforce capable of operating and using these systems as they increasingly become a major force in our economy and society.

This program also supports research previously supported separately by the Cluster Exploratory (CluE) program, which made available for data-intensive computing projects a massively scaled highly distributed computing resource supported by Google and IBM and a similar resource at the University of Illinois in partnership with Hewlett-Packard, Intel, and Yahoo!. The Data-Intensive Computing program welcomes proposals that may request and use any such resources available to or accessible by the proposer(s), in order to pursue innovative research ideas in data-intensive computing and explore the potential benefits this technology may have for science and engineering research as well as to applications that may benefit society more broadly.

Proposals requesting or intending to use such resources are required to include in a separate section of their Project Description a description of the computing resources needed to test and evaluate their research ideas. This description should include what facility/facilities they plan to access and how, including as much detail as possible (e.g., schedule of use, time, space, data upload) to show the viability of their project.

2. Network Science and Engineering (NetSE)

In the past few decades, our network infrastructure has undergone radical changes. It has evolved from a small number of interconnected computer networks to a global socio-technical infrastructure upon which society now depends. Using this network of heterogeneous networks, people communicate and interact spontaneously in cyber space and with the cyber physical world, conducting business and providing services, managing their day-to-day lives, expanding and enriching their social circles, learning and playing. In the future, global society will increasingly rely on socio-technical networks designed in harmony with societal values and economic viability, with enhanced security, privacy, resilience, availability and manageability, and the ability to incorporate as yet unforeseen technologies, applications and services.

The Network Science and Engineering (NetSE) program has been created to develop the science and engineering of these networks, yielding new scientific understanding about their complexity and informing their future design. The program subsumes and expands upon the former CISE programmatic areas of Future INternet Design (FIND), Science for the Internet Next Generation (SING) and Next-Generation Information Systems (NGNI). NetSE specifically challenges individuals and teams with different perspectives, e.g. theoreticians and experimentalists, as well as different domain expertise, e.g. mathematicians, information, computer, social and economic scientists, and engineers, to come together to address this important challenge.

NetSE seeks proposals focused on developing the scientific foundations necessary to understand and reason about socio-technical networks. Of particular interest are frameworks that explicitly incorporate human values at multiple levels and scale, inform the development of applications, services and network technologies, and give coherence to the highly diverse ways users might create and access information in the future. NetSE also encourages research proposals focused on exploring network architecture innovations. Encouraged to take "clean slate" approaches unconstrained by the current Internet, researchers are empowered to rethink network functions, layers and abstractions in the context of a range of scientific, technical and social challenges and opportunities. NetSE emphasizes integrative activities focused on creating and synthesizing network components into theoretically grounded architectures that address fundamental policy and design trade-offs, support sound economic models, and promote social benefits. Future networks must also be designed to provide users with timely and coherent access to massive quantities of highly distributed information. Consequently, the NetSE program encourages research on Internet-scale, topologically-aware models for accessing, processing and aggregating multiple high-volume information flows; and on cognitive capabilities, context-awareness, and architectures that enable the discovery, invocation and composition of globally distributed, highly evolving services and information systems. These new kinds of models, capabilities, and architectures in turn enable the exploration of new applications that provide information based on both content and context, and the improvement of existing classes of applications, such as gaming, virtual worlds, augmented reality and tele-presence.

NetSE proposals should include a description of how research ideas will be validated, for example through formal verification, simulation, modeling, proof-of-concept development, prototype testing on a testbed, or when applicable, usability evaluation involving human subjects.

3. Trustworthy Computing

The Trustworthy Computing program envisions a future in which our increasingly ubiquitous and distributed computing and communication systems deliver the quality of service they are designed to achieve, without disruption, while enabling and preserving privacy, security and trust. The program supports research and education activities that explore novel frameworks, theories, and approaches towards secure and privacy-preserving systems, recognizing that a number of intertwined scientific, technological, economic and sociological challenges must be overcome, if we are to realize a trustworthy computing future.

The program will support projects that strengthen the scientific foundations of trustworthiness, in order to inform the creation of new trustworthy technologies. We especially seek new models, logics, algorithms, and theories for analyzing and reasoning about all aspects of trustworthiness -- security, privacy, and usability-- about all systems and data components and their composition. Building on its predecessor program Cyber Trust, the Trustworthy Computing program will also continue to support projects that explore the fundamentals of cryptography, that examine and strengthen security weaknesses in current algorithms and protocols, and that explore new computing models that have potential to improve trustworthiness and our ability to reason with respect to different aspects of trustworthiness.

A trustworthy system depends on its building blocks and their interoperability. These building blocks range from hardware processes, possibly with new features to support trustworthiness, to network protocols and system software, to applications software and data. While today many researchers focus on one of the many building blocks that comprise our systems, the Trustworthy Computing program encourages investigators to explore research opportunities directed towards integrating these building blocks through new security architectures, with emphasis on those that are generic but also including those that are application-specific.

As computing systems continue to pervade every aspect of daily life, people need to be able to trust them-so much of their lives depend on them. The Trustworthy Computing program seeks proposals to provide scientific and technological perspectives on privacy. Threats to citizens' privacy arise in many sectors of daily life, e.g., health, financial, and e-commerce, and assuring privacy is essential to the foundations of democracy, e.g., voting and the freedom of speech. The program will support the exploration of new scientific methodologies and technologies to formulate, reason about, and resolve conflicts among privacy policies, and to explore the interplay among privacy, security and legal policies. Further, we need new models, methods, algorithms, and tools, including logics and privacy metrics, to safeguard the information of individuals wherever it may digitally reside. Future systems also raise complex security concerns regarding integration of identity and privacy protection. Needed are attack-resistant methods and protocols for identity management commensurate with application requirements, that preserve privacy and enforce accountability.

The Trustworthy Computing program also seeks proposals focused on usability. Incorporating trustworthiness into a system should not place undue demands on human users or impact human or system performance. People are often the weakest link in security. How can we make it easy for people to use computing systems yet still protect them from unforeseeable attacks on their security and privacy? The needs of users are many, and include being informed of threats and breaches, to managing the appropriate dissemination of personal information on social networks, to controlling access to information that may be harmful to minors. System design for usability in different contexts demands new approaches to integrating and balancing among different functionalities, understanding human perception of trust including privacy, informing users of potential pitfalls, and predicting the potential consequences of user decisions. Needed are new methods, supported by automation, to promote usability and provide users with security controls they can understand.

Understanding the interplay between people and technology is also essential, for trustworthiness cannot be assured through technological innovation alone. Consequently, the Trustworthy Computing program will support multidisciplinary research proposals that consider both the social and technical dimensions of creating a trustworthy computing future, recognizing that such research must be undertaken in a context that considers regulatory and legal implications.

If we are to make progress toward realizing a trustworthy computing future, we must characterize trustworthiness and the many different classes of threats. While current solutions largely focus on known security threats, the Trustworthy Computing program seeks proposals aimed at characterizing future threats too, where such threats may be driven by adversarial motives that are yet to be identified or understood. Methods must be developed to evaluate systems for trustworthiness, so that they can be confidently used. Evaluation may include a combination of methods that involve analytical reasoning, simulation, experimental deployment and, where possible, deployment on live systems. New technology is required, such as testbeds and methodologies that enable system experimentation at scale without exposing operational systems to threats, such as those that may be unintentionally introduced by trustworthiness enhancements. Metrics must be developed that can confidently predict system trustworthiness based on realistic assumptions of the capabilities of adversaries, and they must be measurable or amenable to reasoning. Requirements for trustworthiness must be defined, so that they inform the effective design of trustworthy computing and communications systems.

Information on projects supported by the Cyber Trust program is available at:
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13451&org=CNS&from=home .

PROJECTS CLASSES

Proposals submitted to this solicitation are divided into three project classes.

- **Small Projects, with total budgets up to $500,000 for durations of up to three years,** are well suited to one or two investigators (PI and one co-PI or other Senior Personnel) and at least one student and/or postdoc.
- **Medium Projects, with total budgets ranging from $500,001 to $1,200,000 for durations up to four years,** are well suited to one or more investigators (PI, co-PI and/or other Senior Personnel) and several students and/or postdocs. Medium project descriptions must be comprehensive and well-integrated, and should make a convincing case that the collaborative contributions of the project team will be greater than the sum of each of their individual contributions. Rationale must be provided to explain why a budget of this size is required to carry out the proposed work. Since the success of collaborative research efforts are known to depend on thoughtful coordination mechanisms that regularly bring together the various participants of the project, a Collaboration Plan is **required** for all Medium proposals with more than one investigator. The length of and level of detail provided in the Collaboration Plan should be commensurate with the complexity of the proposed project. Please see *Proposal Preparation Instructions* Section V.A for additional submission guidelines.
- **Large Projects, with total budgets ranging from $1,200,001 to $3,000,000 for durations of up to five years**, are well suited to two or more investigators (PI, co-PI(s), or other Senior Personnel), and a team of students and/or postdocs. Large project descriptions must be comprehensive and well-integrated, and should make a convincing case that the collaborative contributions of the project team will be greater than the sum of each of their individual contributions. Rationale must be provided to explain why a budget of this size is required to carry out the proposed work. Since the success of collaborative research efforts are known to depend on thoughtful coordination mechanisms that regularly bring together the various participants of the project, a Collaboration Plan is **required** for all Large proposals. The length of and degree of detail provided in the Collaboration Plan should be commensurate with the complexity of the proposed project. Please see *Proposal Preparation Instructions* Section V.A for additional submission guidelines.

CISE investments in Small, Medium and Large projects complement the directorate's investments in the Expeditions in Computing program, where projects are funded at levels of up to $10,000,000 total for durations of up to 5 years. The Expeditions solicitation can be accessed at http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503169&org=CISE&from=home .

IMPORTANT PROJECT CHARACTERISTICS

In all cross-cutting programs, the submission of far-reaching, creative research and education projects is encouraged. Funds will be used to support potentially transformative research with high-impact potential. In this way, CISE will catalyze exciting new research activities with the potential to make significant advances in the state-of-the-art.

Interdisciplinary, international and/or academic-industry collaborations that promise to result in major science or engineering advances are welcome. The directorate hopes to attract proposals from faculty at a broad range of academic institutions, including faculty at minority-serving and predominantly undergraduate institutions.

Proposals submitted should demonstrate that enriching learning experiences will be provided for a diverse population of students, and may describe the development of innovative curricula or educational materials that advance literacy about and expertise in areas supported by CISE.

III. AWARD INFORMATION

It is estimated that approximately $85 million will be available in FY 2010, dependent upon the availability of funds: - up to $10 million in Data-intensive Computing, $20 million in Network Science and Engineering; and $55 million in Trustworthy Computing. Up to 120 awards will be supported each year.

IV. ELIGIBILITY INFORMATION

Organization Limit:

None Specified

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI: 2

An individual may participate as PI, Co-PI or Senior Personnel in no more than **two** proposals submitted in response to this solicitation. For example, an individual may participate as PI, co-PI or Senior Personnel in one Trustworthy Computing proposal and in a second proposal submitted to the Data intensive Computing program, or an individual may participate as PI, co-PI or Senior Personnel in two proposals submitted to Network Science and Engineering, etc.

These eligibility constraints will be strictly enforced in order to treat everyone fairly and consistently. In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on earliest date and time of proposal submission (i.e. the first two proposals received will be accepted, and the remainder will be returned without review). **No exceptions will be made.**

The limit on the number of proposals per PI, Co-PI or Senior Personnel applies only to this solicitation.

Additional Eligibility Info:

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Instructions: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the guidelines specified 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-PUBS (7827) or by e-mail from nsfpubs@nsf.gov.

The following information SUPPLEMENTS (not replaces) the guidelines provided in the NSF Grant Proposal Guide (GPG).

Proposal Titles: Proposal titles must begin with an acronym that indicates the most relevant cross-cutting program as described below. Select an acronym for the most relevant cross-cutting program from the following list:

- Data-intensive Computing (DC)
- Network Science and Engineering (NetSE); and
- Trustworthy Computing (TC).

The acronym should be followed with a colon, then the project class, followed by a colon and the title of your project. For example, if you are submitting a Medium proposal to Data-intensive Computing, then your title would be **DC:Medium:Title**. If you submit a proposal as part of a set of collaborative proposals, the title of the proposal should begin with the acronym that indicates the most relevant cross-cutting program followed by a colon, then the project class followed by a colon, then "Collaborative Research" followed by a colon, and the title. For example, if you are submitting a collaborative set of proposals describing a Large project to the Network Science and Engineering program, the title of each would be **NetSE:Large:Collaborative Research:Title.** Proposals from PIs in institutions that have RUI (Research in Undergraduate Institutions) eligibility should have a proposal title that begins with the acronym that indicates the most relevant crosscutting program, followed by a colon then the project class, followed by a colon then “RUI”, followed by a colon and then the title, for example, **DC:Small:RUI:Title.**

Project Summary: All proposals must provide up to 6 sets of key words at the end of the Project Summary. These key words should describe

the main scientific/engineering areas explored in the proposal. Key words should be prefaced with "Key Words" followed by a colon and each key word separated by semi-colons. Key words should be of the type used to describe research in a journal submission. They should be put at the end of the project summary and might appear, for example, as **Key Words: formal logic; multi-modal interfaces; sensor networks; information visualization; privacy.**

Project Description: Since the success of collaborative research efforts are known to depend on thoughtful coordination mechanisms that regularly bring together the various participants of the project, Medium proposals with more than one investigator and all Large proposals must include a Collaboration Plan. ***Relevant Medium and all Large proposals that fail to include a Collaboration Plan will be returned without review.*** While the length of the Project Description for Small proposals is limited to 15 pages, for Medium and Large proposals up to 3 additional pages are allowed for Collaboration Plans. The length of and degree of detail provided in the Collaboration Plan should be commensurate with the complexity of the proposed project. Where appropriate, the Collaboration Plan might include: 1) the specific roles of the project participants in all organizations involved; 2) information on how the project will be managed across all the investigators, institutions, and/or disciplines; 3) identification of the specific coordination mechanisms that will enable cross-investigator, cross-institution, and/or cross-discipline scientific integration (e.g., yearly workshops, graduate student exchange, project meetings at conferences, use of the grid for videoconferences, software repositories, etc.), and 4) specific references to the budget line items that support collaboration and coordination mechanisms.

Proposals that incorporate curriculum development activities should describe the curriculum development activities in a separate section of the Project Description entitled "Curriculum Development Activities."

When appropriate to the research activities proposed, Data-intensive Computing proposals should include a separate section that describes the computing resources needed to test and evaluate the proposed research ideas. This section should include a description of the facility/facilities to be accessed, how it/they would be accessed, and should include as much detail as possible (e.g., schedule of use, time, space, data upload) to show the viability of the project.

Supplementary Documents: In the Supplementary Documents Section, include a list of all PIs, Co-PIs, Senior Personnel, paid Consultants, Collaborators and Postdocs to be involved in the project. 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

PIs from predominantly undergraduate institutions should also include a Research in Undergraduate Institutions (RUI) Impact Statement and Certification of RUI Eligibility in this Section.

Proposers are reminded to identify the program solicitation number (NSF 09-558) in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

B. Budgetary Information

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

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. proposer's local time)**:**

  August 01, 2009 - August 30, 2009

  Medium Projects

  November 01, 2009 - November 28, 2009

  Large Projects

  December 01, 2009 - December 17, 2009

  Small Projects

D. FastLane Requirements

Proposers are required to prepare and submit all proposals for this program solicitation through use of the NSF FastLane system. Detailed instructions regarding the technical aspects of proposal preparation and submission via FastLane are available at: http://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.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program where they will be reviewed if they meet NSF proposal preparation requirements. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with the oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal.

A. NSF Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board (NSB)-approved merit review criteria: intellectual merit and the broader impacts of the proposed effort. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two NSB-approved merit review criteria are listed below. The criteria include considerations that help define them. These considerations are suggestions and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which the reviewer is qualified to make judgements.

What is the intellectual merit of the proposed activity?
How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?
How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

Examples illustrating activities likely to demonstrate broader impacts are available electronically on the NSF website at: http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf.

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

NSF staff also will give careful consideration to the following in making funding decisions:

Integration of Research and Education
One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

Integrating Diversity into NSF Programs, Projects, and Activities
Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

Additional Review Criteria:

For Medium and Large proposals only, reviewers will be asked to:

- Comment on the extent to which the project scope justifies the level of investment requested, and the degree to which the participating investigators will work synergistically to accomplish the project objectives.
- Comment on the Collaboration Plan.

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 before the end of the current budget period. (Some programs or awards require more frequent project reports). Within 90 days after expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report will delay NSF review and processing of any future funding increments as well as any pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through FastLane, for preparation and submission of annual and final project reports. Such reports provide information on activities and findings, project participants (individual and organizational) publications; and, other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system. Submission of the report via FastLane constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

Site visits for Cyber Trust Medium and Large awards may be conducted at NSF's discretion.

VIII. AGENCY CONTACTS

General inquiries regarding this program should be made to:

- Chitaranjan Das, Point of Contact, 1115, telephone: (703) 292-8910, email: cdas@nsf.gov
- Darleen L. Fisher, Point of Contact, Network Science and Engineering Program, 1175N, telephone: (703) 292-8950, fax: (703) 292-9010, email: dlfisher@nsf.gov
- Carl Landwehr, Program Director, 1175, telephone: (703) 292-8338, email: clandweh@nsf.gov

For questions related to the use of FastLane, contact:

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

In addition to the Program Officers identified as program points of contact above, the following CISE Program Officers also support the cross-cutting programs as indicated below:

Data-Intensive Computing (DC)

- Krishna Kant, (703) 292-8950, kkant@nsf.gov, Room 1175
- Frank Olken, (703) 292-8930, folken@nsf.gov , Room 1125

Network Science and Engineering (NetSE)

- David McDonald, (703) 292-8074, dmcdonal@nsf.gov, Room 1125
- William Tranter, (703) 292-8910, wtranter@nsf.gov, Room 1115

Trustworthy Computing (TC)

- Samuel Weber, (703) 292-8950, sweber@nsf.gov, Room 1175
- Xiaoyang (Sean) Whang, (703) 292-8930, xwang@nsf.gov, Room 1125
- Lenore Zuck, (703) 292-8910, lzuck@nsf.gov, Room 1115

IX. OTHER INFORMATION

The NSF Website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this Website by potential proposers is strongly encouraged. In addition, National Science Foundation Update is a free e-mail subscription service designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Regional Grants Conferences. Subscribers are informed through e-mail when new publications are issued that match their identified interests. Users can subscribe to this service by clicking the "Get NSF Updates by Email" link on the NSF web site.

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

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

Discovery Research Programs

Advanced Learning Technologies (ALT),
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12834org=NSFsel_org=NSFfrom=fund

CAREER: Faculty Early Career Development,
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5262

Collaborative Research in Computational Neuroscience (CRCNS),
http://nsf.gov/funding/pgm_summ.jsp?pims_id=5147

Community-Based Data Interoperability Networks (Interop)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=502112&org=CISE&sel_org=CISE&from=fund

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

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

CreativeIT, http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501096

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=NSF&sel_org=NSF&from=fund

Engineering Research Centers (ERCs),
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5502&org=NSF&sel_org=NSF&from=fund

Expeditions in Computing,
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503169&org=NSF&sel_org=NSF&from=fund

Foundations of Data and Visual Analytics (FoDaVA),
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501081&org=NSF&sel_org=NSF&from=fund

Grant Opportunities for Academic Liaison with Industry (GOALI),
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13706&org=CISE&sel_org=CISE&from=fund

High-End Computing University Research Activity (HECURA),
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13645&org=NSF&sel_org=NSF&from=fund

Industry/University Cooperative Research Centers Program (I/UCRC)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5501&org=CISE&sel_org=CISE&from=fund

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

Partnerships for International Research and Education (PIRE)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12819&org=CISE&sel_org=CISE&from=fund

Research in Undergraduate Institutions (RUI)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5518&org=CISE&sel_org=CISE&from=fund

Science of Learning Centers (SLCs)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5567&org=CISE&sel_org=CISE&from=fund

Science and Technology Centers (STCs)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5541&org=CISE&sel_org=CISE&from=fund

Sustainable Digital Data Preservation and Access Network Partners (DataNet)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503141&org=CISE&sel_org=CISE&from=fund

Education and Workforce Development Programs

ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers,
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383&from=fund

Advanced Technological Education (ATE)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5464

Broadening Participation in Computing (BPC),
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13510&org=NSF&sel_org=NSF&from=fund

CISE Pathways to Revitalized Education in Computing (CPATH),
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=500025&org=NSF&sel_org=NSF&from=fund

Computational Science Training for Undergraduates in the Mathematical Sciences (CSUMS)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13655&org=EHR&sel_org=EHR&from=fund

Course, Curriculum, and Laboratory Improvement (CCLI)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5741&org=EHR&sel_org=EHR&from=fund

Developing Global Scientists and Engineers [International Research Experiences for Students (IRES) and Doctoral Dissertation Enhancement Projects (DDEP)]
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12831&org=CISE&sel_org=CISE&from=fund

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

Federal Cyber Service: Scholarship for Service (SFS)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5228

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://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12759

International Research Fellowship Program (IRFP)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5179&org=CISE&sel_org=CISE&from=fund

Information Technology Experiences for Students and Teachers (ITEST)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5467&org=EHR&sel_org=EHR&from=fund

NSF Graduate Teaching Fellows in K-12 Education (GK-12),
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5472&from=fund

NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5257&org=EHR&sel_org=EHR&from=fund

Research Experiences for Undergraduates (REU) Sites and Supplements,
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5517&from=fund

Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP)
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5488&org=EHR&sel_org=EHR&from=fund

Research Infrastructure Programs

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

EPSCoR Research Infrastructure Improvement Grant Program
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5672&org=CISE&sel_org=CISE&from=fund

Major Research Infrastructure (MRI), http://www.nsf.gov/od/oia/programs/mri/

For more information on these programs, please consult the NSF web site.

ABOUT THE NATIONAL SCIENCE FOUNDATION

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

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

NSF receives approximately 40,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

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

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that

enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

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

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

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

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **For General Information** (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:

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