

Research in Networking Technology and Systems (NeTS)

Program Solicitation

NSF 04-540



National Science Foundation

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

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

April 14, 2004

REVISIONS AND UPDATES

Change in instructions for submitting proposals to Program Solicitation 04-540 Research in Networking Technology and Systems (NeTS) closing on April 14, 2004. Once the program solicitation number is selected on the FastLane Cover Sheet, the NSF unit of consideration is automatically filled in. A drop down menu or radio button requesting selection of the research area will not be available or required. The title of the project remains unchanged and should begin with "NeTS" followed by an acronym for the research area.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Research in Networking Technology and Systems (NeTS)

Synopsis of Program:

Computer and communications networks are among society's most important infrastructures. They are vital to the operation of many systems---from financial and manufacturing to education and health care---and they are engines of economic growth, especially in the high-tech industry. However, the existing network architecture is stressed and reaching the limits of its capabilities, so substantial changes and innovations will be required in order to meet future demands. Moreover, we envision a future in which communication networks are available anywhere and anytime, are accessible from a variety of devices, require minimal management overhead, can survive faults and attacks, and can be trusted with all types of communication. The network architecture must also continue to scale and support the evolution of the network's capabilities.

The goals of the Networking Technology and Systems (NeTS) program are to sustain the science and technology needed to fulfill our vision for next-generation networks as well as to address the limitations of existing networks. Projects are encouraged to make bold assumptions about the future and to develop network architectures, protocols, and technologies to realize these goals.

NeTS will fund a balance of fundamental and experimental research projects to create next-generation networks, increase our understanding of large and complex heterogeneous networks, continue the evolution of the existing network, and integrate research and education in creative ways. NeTS will also fund projects in targeted focus areas of networking research in order to initiate and sustain research activities in areas where concentrated efforts hold promises for breakthroughs, and where collaboration has the potential to lead to new discoveries and significant advances.

This program solicitation seeks innovative, forward-looking research projects in networking research broadly defined and in the following two focus areas:

- **Programmable Wireless Networks:** Exploit the capabilities of programmable radios to make more effective use of the frequency spectrum and to improve wireless network connectivity.
- **Networking of Sensor Systems:** Create architectures, tools, algorithms, and systems that will make it easy to assemble and configure a network of sensor systems.

Funded proposals will range from single-investigator projects to multiple-investigator, multi-disciplinary projects that address a related set of topics.

Cognizant Program Officer(s):

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

- 47.070 --- Computer and Information Science and Engineering

Eligibility Information

- **Organization Limit:** None Specified.
- **PI Eligibility Limit:**

An individual may appear as PI, Co-PI, Senior Personnel, or Consultant on no more than two NeTS proposals.

- **Limit on Number of Proposals:** None Specified.

Award Information

- **Anticipated Type of Award:** Standard or Continuing Grant or Cooperative Agreement
- **Estimated Number of Awards:** 50 to 60
- **Anticipated Funding Amount:** \$40,000,000

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Full Proposal Preparation Instructions:** This solicitation contains information that deviates from the standard 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.
- **Indirect Cost (F&A) Limitations:** Not Applicable.
- **Other Budgetary Limitations:** Not Applicable.

C. Due Dates

- **Full Proposal Deadline Date(s)** (due by 5 p.m. proposer's local time):
April 14, 2004

Proposal Review Information

- **Merit Review Criteria:** National Science Board approved criteria apply.

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

Today's communication networks comprise one of society's most important infrastructures. Consequently, it is critical that they operate dependably and continue to evolve. However, much work needs to be done to meet future demands and to create robust, fault-tolerant networks. Networks have been growing at a remarkable pace in many dimensions. The amount and volume of network traffic has increased tremendously, as have the number and heterogeneity of users, applications, devices, and links. To remain vital five to ten years from now, networks will have to scale by orders of magnitude in all these dimensions. Networks will also have to cope with increasing numbers of hostile attacks.

The next-generation networking infrastructure must overcome the limitations of existing networks and add new capabilities and services. Future networks should be available anytime and anywhere, be accessible from any communication device, require little or no management overhead, be resilient to failures and malicious attacks, and be trustworthy for all types of communication.

The goal of the Networking Technology and Systems (NeTS) program is to develop and sustain the science and technology needed to (1) create next generation networks, (2) increase fundamental understanding of large and complex heterogeneous networks, (3) continue the evolution of existing networks, and (4) integrate research and education in creative ways for the benefit of both technical specialists and the general populace.

NeTS will fund single investigator, multi-investigator, and multi-disciplinary projects that address a wide range of networking problems. For example, NeTS will entertain proposals that lead to new paradigms or that develop network architectures, protocols, and technologies for next-generation networks.

NeTS will also fund research projects in targeted focus areas, which are chosen to initiate and sustain research activities in promising new areas; foster the development of a research area where concentrated efforts facilitate significant advancements; encourage multi-disciplinary collaborations, particularly among research teams who typically have not worked together; or enable the development, implementation, and testing of innovative networking systems and technologies in an area that is ripe for a move from conceptual design to prototyping and experimental research. This program solicitation describes two focus areas:

- Programmable Wireless Networks, and
- Networking of Sensor Systems.

II. PROGRAM DESCRIPTION

The NeTS program has three components: general networking research broadly defined, the programmable wireless networks focus area, and the networking of sensor systems focus area. A proposal should be directed toward the appropriate component as described in Section V. Proposal Preparation and Submission Instructions.

Networking Research

The general networking-research component supports research aimed at creating next-generation networks, as well as research to evolve the existing network into a highly reliable, secure, and scalable infrastructure. Proposals are expected to address the following kinds of network capabilities:

- **Ubiquity:** The ability of the network to support seamless access to information and services by anyone, anywhere, anytime, using any communication device.
- **Autonomicity:** The ability of the network autonomously to maintain, configure, protect, and heal itself with minimal human intervention.
- **Trustworthiness:** The ability of the network securely and reliably to process, protect, and transmit sensitive information.
- **Evolvability:** The ability of the network to evolve over time to incorporate new technologies, support new classes of applications, and meet new requirements and challenges, all without significant redesign or redeployment.
- **Scalability:** The ability of the network to accommodate growth and unforeseen changes across many dimensions---including traffic load, network size and topology, link speed, number and type of applications, and node heterogeneity---without significant performance degradation.

Building a network with capabilities such as these is a significant challenge that requires a top-to-bottom re-examination of the way we architect and build network infrastructures.

The NeTS program will fund proposals in a wide range of areas including but not limited to the following.

- **Network and Protocol Architectures.** Research in this area will enable innovative and possibly radical network architectures, protocols, and technologies---for wired and/or wireless environments---that are responsive to the evolving requirements of large-scale, heterogeneous networks. The network systems underlying this research include mobile wireless networks and systems; integrated, dynamically configurable optical networks; innovative satellite networking technologies; and broadband access architectures for home networking. Example topics include innovative architectures and algorithms for resource discovery, naming, addressing, routing and congestion control; mechanisms to support mobility of a massive number of network elements; architectures that support multiple protocol stacks; and new paradigms and abstractions to facilitate seamless optimization between layers of the network.
- **Fundamental Understanding and Design.** One topic in this area is to develop mathematically rigorous models to study and analyze the dynamics and properties of large-scale networks. The goal is to understand the fundamental performance limits of networks and to design algorithms that allow us to approach these limits. Another topic is to address the fundamental methodological barriers that make it hard to reproduce experiments or to validate simulations in real world systems. The goal here is to understand network behaviors for varying time-scales, a range of spatial topologies, and a range of protocol interactions. Toward this aim, NeTS will support the development of scalable, non-intrusive mechanisms, tools, and methodologies for measurements, traffic characterization, and simulations. NeTS will also support the development of specific reference models for networked systems as well as the development and distribution of benchmarks targeted at specific classes of networking research, e.g., ad-hoc routing or congestion control.
- **Network Control and Management.** Research in network control and management includes methods and protocols to enable networks to monitor, diagnose, and repair themselves. Proposed solutions are expected to bring the network closer to autonomy, where human intervention is minimal. NeTS will entertain research in real-time, scalable, protocol-independent control and management techniques or tools. These techniques or tools are expected to be applicable to networks ranging from home networks with numerous "smart" appliances to enterprise networks, core networks, and application-level networks. Other areas of interest include network operation and management tools that support the large-scale deployment of current and emerging classes of network services. NeTS will also consider research in automated network management techniques for high-stress, rapid-deployment systems (e.g., disaster recovery networks) and for commodity systems designed to serve the technically non-savvy user.
- **Innovative Networking Technologies.** Research in this area will enable technological advances for the

development of a new generation of high performance networking technologies and systems. Example topics include integrated, dynamically configurable switching and routing systems with security and measurement capabilities; broadband wireless and mobile technologies and systems; and protocols and broadband-access technologies and systems for home networking.

- **Network Extensibility.** Topics include the development of network designs that lead to modular, efficient, and upgradeable protocol implementations in large-scale, heterogeneous networks; hardware and software technologies to support dynamic network extensibility; and innovative mechanisms to enable application configuration to accommodate quality-of-service requirements and user preferences. The resulting software and hardware technologies should be scalable, ensure robust network operation even in the most demanding high performance environments, and be able to support automatic instantiation of protocols and to facilitate the evolution of protocols.
- **Strategic Research for the Internet.** NeTS will also consider compelling, far-reaching projects that are aimed at addressing the strategic evolution of today's Internet and its capabilities in terms of scalability, robustness, security, and ability to support new as well existing applications. Proposals are expected to address major limitations to the evolution of the Internet and to describe how the proposed solutions could be integrated into the Internet---i.e., into the existing TCP/IP protocol stack---and into existing network components such as routers, switches, and firewalls.

Projects that primarily address network security or trustworthiness should be submitted to the Cyber Trust program rather than to the NeTS program.

Focus Area 1: Programmable Wireless Networking

Wireless systems today are characterized by wasteful static spectrum allocations, fixed radio functions, and limited network and systems coordination. This has led to a proliferation of standards---such as Wi-Fi/802.11, Bluetooth, 3G, 4G, CDMA, and GSM---which in turn has encouraged stovepipe architectures and services and has discouraged innovation and growth. Two urgent issues are the increasing interference in unlicensed frequency bands and low overall spectrum utilization.

The Programmable Wireless Networking focus area will address these issues by supporting the creation of innovative wireless networking systems based on programmable radios: wireless, frequency-agile data communication devices with rich control and monitoring interfaces. The objectives are to

- Capitalize on advances in processing capabilities and radio technology and on new developments in spectrum policy;
- Improve connectivity and make more effective use of shared spectrum resources; and
- Enhance the wireless networks community by intermixing the networking, radio, and policy communities, integrating education with research through focused activities, and diversifying participation.

Programmable radio systems offer the opportunity to use dynamic spectrum management techniques to help prevent interference, adapt to local and current situations, provide greater quality of service, deploy networks and create services rapidly, enhance interoperability, and in general enable innovative and open network architectures through flexible and dynamic connectivity. However, experimental research in innovative wireless networking systems has been hindered by a lack of programmable radio platforms. Such research is typically confined to commercially available platforms that offer only limited flexibility and that are insufficient to allow exploration of new approaches. This focus area will facilitate experimental research by making programmable, frequency-agile radios available to the research community and by encouraging research into ways to use them effectively.

Programmable wireless networks will need to route messages through the network and interoperate with the larger Internet, manage spectrum resources dynamically, self-organize with a rapid initial configuration, accommodate mobility, support a variety of network services, use adaptation to ensure quality of service, and support multiple users and domains. It is anticipated that this focus area will, within a few years, result in multiple programmable wireless radio platforms, prototypes of dynamic spectrum management systems, and prototypes of wireless networks that exploit the capabilities of dynamic radios.

In order to realize this vision, the Programmable Wireless Networking focus area seeks research proposals on the following topics:

- **Dynamic Spectrum Management Architectures and Techniques.** Research in this area will develop spectrum management architectures and techniques that exploit the capabilities of programmable wireless systems. These architectures must be secure and robust, offer quality of service capabilities, and provide for policy enforcement. They might be broker-based, sensing-based, or follow other approaches. Evaluation of architectures and techniques is a necessary part of these efforts, and it should include consideration for the relationship between the architectures and possible spectrum policies.
- **Topology Discovery and Optimization and Network Self-Configuration.** Projects will develop algorithms for topology discovery and optimization in programmable wireless networks and protocols for subsequent network configuration. By simultaneously using multiple spectrum regions, frequency-agile radios offer the capability to construct more complex topologies than have heretofore been possible with traditional radio or wired networks. Proposed algorithms must determine what topologies are possible and how to choose among them, and protocols must automatically configure the network based upon the topology chosen. Research efforts must include evaluation methods for the network architectures and protocols.
- **Routing and Topology Policies and Interactions.** Routing and topology policies designed for programmable wireless networks will be critical to automating network use and configuration across multiple domains. Interdomain routing is currently limited to static policies tuned to particular sets of peers, and many mobile routing approaches make implicit assumptions regarding administrative and security domains and policies. Flexible wireless topologies imply more opportunities for connectivity with a larger set of other nodes from different administrative domains. Proposed research efforts will create policy frameworks and flexible, automatic routing and topology algorithms and protocols that provide for diverse policies. Proposed efforts will also create Application Programming Interfaces (APIs) for inter-layer and inter-plane awareness that can be used to implement interactions between policy, network, and internetwork routing and topology.
- **Programmable Radios for the Community.** Projects will develop and possibly disseminate the programmable, flexible radios needed for experimentation and evaluation of algorithms and systems. These radios must be agile in RF carrier frequency (e.g., from base band to 6 GHz) flexible in bandwidth (e.g., several tens of MHz), and flexible in waveform (e.g., A/D and D/A driven and generated/processed by programmable DSP and/or FPGAs). The DoD's Joint Tactical Radio System (JTRS) is an example of this type of radio. Projects may construct and evaluate programmable radios, or they may create partnerships that provide usable radios already developed through other government or commercial activities. Individual projects funded in this area must make available a non-trivial number of radio units (e.g., ten or more) as well as APIs and documentation. The expectation is that these radios will be used for experimentation by other researchers in the community. These projects must provide milestones for delivery of versions of the radio systems.

For further information, visit the focus area web site at <http://www.cise.nsf.gov/prowin/>. Proposals on other wireless networking topics should be submitted to the general NeTS program rather than to this focus area.

Focus Area 2: Networking of Sensor Systems

An individual sensor system can sense its immediate environment, process what it senses, communicate its results to others over a wireless link, and possibly take an action in response. Sensor systems are enabled by developments in digital sensors, digital actuators, and low power RF radios and by integrating these in a single chip with a processor-memory system. While a single sensor system has very limited use, a network of sensors be used to instrument and manage large environments and systems.

Significant scientific and technical progress is required to realize the potential of networks of sensor systems. This focus area

examines networking aspects of small sensor systems that are used as building blocks in large-scale, in-situ sensing applications. Sensor systems contain new types of computing machines, run different kinds of network applications, execute in different physical environments, and have large numbers of nodes. Moreover, a sensor system needs to operate with severe power and other resource constraints, and it needs to communicate and cooperate with a large number of other sensor systems over wireless links that have severe bandwidth and range constraints. In short, building networks of sensor systems requires overcoming many challenges.

The Networking of Sensor Systems focus area is concerned with the design and development of protocols, operating systems, and network architectures and with building systems that facilitate constructing networks of sensor systems. The overall goal is to make it as easy to assemble a network of sensor systems in the next few years as it became in the 1980s to assemble a LAN of workstations using the BSD Unix protocol stack and socket interface and Ethernet line cards. The focus area will achieve its goals by

- Creating strong foundation and system knowledge for the design and development of networks of sensor systems that are easy to manage, evolve, and secure, and that can provide quality of service guarantees;
- Developing a range of efficient and usable network sensor system platforms and tools; and
- Creating network testbeds for sensor systems with diverse applications and platforms in order to gain significant experimental knowledge and experience.

The emphasis of this focus area is on networking, and hence the focus area will fund both systems and foundations research that is closely tied to building networks of sensor systems. Networking research projects that do not focus on networking of sensor systems should be submitted to the general NeTS program. Research or development projects on physical sensing devices, distributed real-time embedded sensor systems, or sensor applications that do not include a significant networking component should consider other NSF programs such as Sensors and Sensor Networks; Embedded and Hybrid Systems; or Data, Inference and Understanding.

Successful proposals in this focus area will address at least one of the following topics:

- **Foundations and Architectures.** Efforts in this area will develop algorithms and techniques for key network functions that are power, resource, scale, and applications aware and that can be implemented efficiently in a real network of sensor systems. Proposals are encouraged to focus on multi-tier network and protocol architectures. Example topics include addressing, naming, routing, topology discovery and localization, network-centric clock distribution and synchronization, spatial and temporal message tagging, and security and privacy. Protocol and system architectures must include appropriate security and privacy mechanisms as fundamental capabilities. The focus area will also fund research in network management for sensor systems, including dynamic network topologies and mobile sensors.
- **Systems Research.** Successful efforts in this area will lead to new insights and tools for the design, measurement, and analysis of networks of sensor systems. System designs are encouraged to consider trading off computing and communications to suit a given application environment. Protocol stack implementations must allow multi-layer abstractions with well-specified interfaces as well as applications-aware optimizations and integrated layer processing. Another topic is design and development of network programming interfaces (NPIs) that will allow development of networked applications over an array of sensor systems. Resulting NPIs should allow a user to provide a high level description of an application's communication requirements using appropriate abstractions and then automatically map it to an array of sensor systems. The focus area will not fund efforts focused solely on building systems or solely on application development.
- **Hardware and Software Platforms.** The program will fund the development of sensor system platforms that can be networked and used to prototype other system components and testbeds. The platforms have to possess capabilities that are required for research on networking of sensor systems and that are not available in commercial systems. Proposals may also request support for distributing sensor system platforms. A proposer who wants to distribute a

platform to others must have significant interest from the community and should talk to a cognizant Program Director before writing a proposal.

- **Testbeds and Applications.** Projects in this area will build testbeds and deploy real applications in collaboration with applications researchers. Proposals must show how the testbeds would be used to demonstrate key networking capabilities and gain experimental experience and insights.

For further information, visit the focus area web site at <http://www.cise.nsf.gov/noss/>.

III. ELIGIBILITY INFORMATION

- **Organization Limit:** None Specified.
- **PI Eligibility Limit:**

An individual may appear as PI, Co-PI, Senior Personnel, or Consultant on no more than two NeTS proposals.

- **Limit on Number of Proposals:** None Specified.

IV. AWARD INFORMATION

The NeTS program emphasizes high-impact fundamental or systems-oriented research with significant experimental and testbed components. Projects should clearly articulate ways in which the architectures, algorithms, protocols, and systems can be evaluated through experimental, emulation, simulation, or analytical means. NeTS will also support theoretical research projects that are closely tied to systems development and that advance understanding of complex networking systems.

The scope of the proposed project should determine the requirements for a particular number of investigators and students, as well as the type and cost of equipment. These requirements in turn will determine the proposal budget.

The NeTS program expects to make the following types of awards:

- Individual investigator and small group awards that last up to three years and average about \$150,000 per investigator per year.
- Large group awards that last up to four years and request up to \$1,000,000 per year. Multi-investigator projects must convincingly argue why the collaboration is needed, discuss the management and collaborative aspects of the project, and have a compelling strategy for achieving demonstrable impact.
- Facilities awards that provide programmable radios to the community, develop and possibly distribute platforms for networked sensor systems, or build proof-of-concept testbeds. Awards last up to three years and average about \$500,000 per year.
- Small planning grants to support community building and to develop large-scale collaborations around one or more research topics. The need for such a planning grant must be clearly justified in the proposal. Proposing principal investigators (PIs) are expected to be established researchers; NeTS planning grants are not intended for new investigators seeking to strengthen their ability to write competitive proposals.

- Workshops in new or emerging areas in networking to bring researchers together, including those from multiple disciplines.

Principal investigators considering planning grants or workshops must discuss their idea with a cognizant Program Director prior to submitting a proposal.

The estimated program budget (\$40M), estimated number of awards (50-60), and average award size/duration are subject to the availability of funds.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Instructions:

Proposals submitted in response to this program announcement/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/cgi-bin/getpub?gpg>. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from pubs@nsf.gov.

The following instructions deviate from the GPG guidelines:

In FastLane, proposers must select the solicitation number at the beginning of this solicitation.

To assist NSF staff in sorting proposals for review, proposal titles should begin "NeTS-" and be followed by an acronym for the research area. Use the following acronyms to identify the area:

- Networking Research = **NR**
- Programmable Wireless Networking = **ProWiN**
- Networking of Sensor Systems = **NOSS**

For example, a NeTS proposal submitted this year might have a title such as "NeTS - ProWiN: Cross-layer Architectures for Coordinated Spectrum Management." Proposals not specifically intended for one of the focus areas should be submitted to the general Networking Research area.

The proposal must include a discussion of broader impact and ideally will include a substantial educational component, particularly in the larger proposals. Appropriate goals for the education component include the integration of education and research, promoting diversity in the networking research workforce, developing substantial experimental research educational experiences, and developing curriculum in emerging network areas. The following URL contains examples illustrating activities that are likely to demonstrate the broader impacts: <http://www.nsf.gov/pubs/2002/nsf022/bicexamples.pdf>.

Proposers are reminded to identify the program announcement/solicitation number (04-540) in the program announcement/solicitation block on the proposal Cover Sheet. 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 in proposals submitted under this Program Solicitation.

C. Due Dates

Proposals must be submitted by the following date(s):

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

April 14, 2004

D. FastLane Requirements

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

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. Proposers are no longer required to provide a paper copy of the signed Proposal Cover Sheet to NSF. Further instructions regarding this process are available on the FastLane Website at: <http://www.fastlane.nsf.gov>

VI. PROPOSAL REVIEW INFORMATION

A. NSF Proposal Review Process

Reviews of proposals submitted to NSF are solicited from peers with expertise in the substantive area of the proposed research or education project. These reviewers are selected by Program Officers charged with the oversight of the review process. NSF invites the proposer to suggest, at the time of submission, the names of appropriate or inappropriate reviewers. Care is taken to ensure that reviewers have no conflicts with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority-serving institutions, or adjacent disciplines to that principally addressed in the proposal.

The National Science Board approved revised criteria for evaluating proposals at its meeting on March 28, 1997 ([NSB 97-72](#)). All NSF proposals are evaluated through use of the two merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

On July 8, 2002, the NSF Director issued [Important Notice 127](#), Implementation of new Grant Proposal Guide Requirements Related to the Broader Impacts Criterion. This Important Notice reinforces the importance of addressing both criteria in the preparation and review of all proposals submitted to NSF. NSF continues to strengthen its internal processes to ensure that both of the merit review criteria are addressed when making funding decisions.

In an effort to increase compliance with these requirements, the January 2002 issuance of the GPG incorporated revised proposal preparation guidelines relating to the development of the Project Summary and Project Description. Chapter II of the GPG specifies that Principal Investigators (PIs) must address both merit review criteria in separate statements within the one-page Project Summary. This chapter also reiterates that broader impacts resulting from the proposed project must be addressed in the Project Description and described as an integral part of the narrative.

Effective October 1, 2002, NSF will return without review proposals that do not separately address both merit review criteria within the Project Summary. It is believed that these changes to NSF proposal preparation and processing guidelines will more clearly articulate the importance of broader impacts to NSF-funded projects.

The two National Science Board approved merit review criteria are listed below (see the [Grant Proposal Guide](#) Chapter III.A for further information). 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 he/she is qualified to make judgments.

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 and original 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?

NSF staff 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.

B. Review Protocol and Associated Customer Service Standard

All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. Proposals submitted in response to this announcement/solicitation will be reviewed by Ad Hoc 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.

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 Director. In addition, the proposer will receive an explanation of the decision to award or decline funding.

In most cases, proposers will be contacted by the Program Officer after his or her recommendation to award or decline funding has been approved by the Division Director. This informal notification is not a guarantee of an eventual award.

NSF is striving to be able to tell proposers whether their proposals have been declined or recommended for funding within six months. The time interval begins on the closing date of an announcement/solicitation, or the date of proposal receipt, whichever is later. The interval ends when the Division Director accepts the Program Officer's recommendation.

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 Division 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.A. 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 (NSF-GC-1); * or Federal Demonstration Partnership (FDP) Terms and Conditions * and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreement awards also are administered in accordance with NSF Cooperative Agreement Terms and Conditions (CA-1). Electronic mail notification is the preferred way to transmit NSF awards to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/home/grants/grants_gac.htm. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from pubs@nsf.gov.

More comprehensive information on NSF Award Conditions is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, available electronically on the NSF Website at <http://www.nsf.gov/cgi-bin/getpub?gpm>. The GPM is also for sale through the Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402. The telephone number at GPO for subscription information is (202) 512-1800. The GPM may be ordered through the GPO Website at <http://www.gpo.gov>.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the PI must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period.

Large group projects may be site visited one or more times at NSF's discretion.

Within 90 days after the expiration of an award, the PI also is required to submit a final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for the PI and all Co-PIs. 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. This system permits electronic submission and updating of project reports, including information on project participants (individual and organizational), activities and findings, 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.

VIII. CONTACTS FOR ADDITIONAL INFORMATION

General inquiries regarding this program should be made to:

- Joseph B. Evans, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 1175 N, telephone: (703) 292-8950, fax: (703) 292-9010, email: jbevans@nsf.gov
- Admela Jukan, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 1175 N, telephone: (703) 292-8950, fax: (703) 292-9010, email: ajukan@nsf.gov
- Guru Parulkar, Program Director, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 1160 N, telephone: (703) 292-8950, fax: (703) 292-9010, email: gparulka@nsf.gov

For questions related to the use of FastLane, contact:

- Helen A. Walston, Senior Program Assistant, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 255 N, telephone: (703) 292-8950, fax: (703) 292-9010, email: hwalston@nsf.gov

IX. OTHER PROGRAMS OF INTEREST

The NSF *Guide to Programs* is a compilation of funding for research and education in science, mathematics, and engineering. The NSF *Guide to Programs* is available electronically at <http://www.nsf.gov/cgi-bin/getpub?gp>. General descriptions of NSF programs, research areas, and eligibility information for proposal submission are provided in each chapter.

Many NSF programs offer announcements or solicitations concerning specific proposal requirements. To obtain additional information about these requirements, contact the appropriate NSF program offices. Any changes in NSF's fiscal year programs occurring after press time for the *Guide to Programs* will be announced in the NSF *E-Bulletin*, which is updated daily on the NSF Website at <http://www.nsf.gov/home/ebulletin>, and in individual program announcements/solicitations. Subscribers can also sign up for NSF's *Custom News Service* (<http://www.nsf.gov/home/cns/start.htm>) to be notified of new funding opportunities that become available.

Related Programs:

- Cyber Trust
- Distributed Systems
- Embedded and Hybrid Systems
- Sensors and Sensor Networks

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The National Science Foundation (NSF) funds research and education in most fields of science and engineering. Awardees are wholly responsible for conducting their project activities and preparing the results for publication. Thus, the Foundation does not assume responsibility for such findings or their interpretation.

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Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF-supported projects. See the GPG Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

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: pubs@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; 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 applicant 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 needing information as part of the review process or in order to coordinate programs; 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," 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records," 63 Federal Register 268 (January 5, 1998). 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 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 this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to: Suzanne Plimpton, Reports Clearance Officer, Division of Administrative Services, National Science Foundation, Arlington, VA 22230.

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