Networking Research Program (NR)

Program Solicitation

NSF-02-123

DIRECTORATE FOR COMPUTER AND INFORMATION SCIENCE AND ENGINEERING
ADVANCED NETWORKING INFRASTRUCTURE AND RESEARCH

FULL PROPOSAL DEADLINE(S): August 1, 2002, February 1, 2003

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SUMMARY OF PROGRAM REQUIREMENTS

GENERAL INFORMATION

Program Title: Networking Research Program (NR)

Synopsis of Program: This Networking Research program seeks to establish a sound scientific foundation and technological basis needed to facilitate the efficient transfer of information through large-scale, high-speed networks and enable new kinds of communications-oriented service protocols and architectures in highly heterogeneous and ubiquitous networking and distributed environments. The focus will be on the capability to securely and robustly accommodate extreme ranges of user demands and quality of service requirements. This research is needed to build the next generation communications and networking infrastructure required for a current and future, highly connected, IT-enabled society. The program seeks to fund innovative research that spans the entire spectrum, from network design and performance evaluation to middleware and software frameworks capable of providing the security assurances and adaptability necessary to support various types of distributed applications and application oriented network services, as well as tools and analytical models for managing and analyzing large-scale, highly complex networks.

Cognizant Program Officer(s):

- Dr. Admela Jukan, Networking Research, Program Director, CISE, ANIR, 1175, telephone: 703 292 8949, e-mail: ajukan@nsf.gov.
- Dr. Taieb Znati, Networking Research, Senior Program Director, CISE, ANIR, 1175, telephone: 703 292 8949, e-mail: tznati@nsf.gov.

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

- 47.070 --- Computer and Information Science and Engineering

ELIGIBILITY INFORMATION

- **Organization Limit:** None
- **PI Eligibility Limit:** None
- **Limit on Number of Proposals:** None

AWARD INFORMATION

- **Anticipated Type of Award:** Standard or Continuing Grant
- **Estimated Number of Awards:** 10 awards per deadline
- **Anticipated Funding Amount:** $3,000,000 per deadline pending availability of funds

PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

- **Full Proposals:** Standard Preparation Guidelines
    - Standard GPG Guidelines apply.

B. Budgetary Information

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

C. Deadline/Target Dates

- **Letters of Intent (*optional*):** None
- **Preliminary Proposals (*optional*):** None
- **Full Proposal Deadline Date(s):** August 1, 2002, February 1, 2003

D. FastLane Requirements

- **FastLane Submission:** Required
- **FastLane Contact(s):**
    - Priscilla Bezdek, Program & Technology Specialist, CISE, ANIR, 1175, telephone: 703 292 8950, e-mail: pbezdek@nsf.gov.

PROPOSAL REVIEW INFORMATION

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

AWARD ADMINISTRATION INFORMATION

- **Award Conditions:** Standard NSF award conditions apply.
- **Reporting Requirements:** Standard NSF reporting requirements apply.

I. INTRODUCTION

The information technology revolution is radically altering our whole world at an ever-accelerating pace. The explosive emergence of the Internet as a global information infrastructure is at the very heart of this revolution. With its ability to support virtually all modes of information generation, transport and use, the Internet has proven to be highly successful in meeting its original vision.

With the continued evolution of applications and services, the Internet is growing well beyond the intent of its designers. Revolutionary new applications, barely foreseen today, will continue to further expand the growth of the Internet at even faster rates. One important future driver for further growth of the Internet is the emergence of small, inexpensive and low-powered devices with the capability to support different types of functionalities and perform regular tasks. These devices can be deployed in large numbers and can be embedded, pervasively and unobtrusively, in the environment. Their rapid proliferation creates opportunities for the development of smart spaces that allow users to communicate effectively and interact seamlessly with the surrounding environment.

These advances in computing and communications technology will bring fundamental changes to the next generation networks, including the degree of mobility and dynamism of the hosts and services, the degree of integration with the physical environment, and the heterogeneity of the data to be transmitted. The ability of these networks to sustain vigorous growth, in the number of users to be connected, the number of ways users interact with the network, and the amount of data that each user or device typically transmits, brings about scaling challenges at all levels. Challenges include addressing the functional requirements of new and emerging applications and coping with the highly varying underlying infrastructure, all of which have the effect of compounding the vulnerability of these networks to various security threats and unpredictable emergent behaviors.

As the size, capability and complexity of future networks grow, it is imperative that we learn how to build and use large, complex, highly reliable, and secure networking systems. This program seeks revolutionary science and technology research needed to address a range of issues, including scalability and complexity, interoperability among heterogeneous network components and devices, flexibility, trustworthiness and emergent behaviors in large scale systems.

The goal of the Networking Research program is to create and sustain the science and technology needed to enable the next generation networks and information infrastructure. Innovative technical approaches representing a distinct break with current practice and techniques requiring revolutionary paradigm shift are highly encouraged.

II. PROGRAM DESCRIPTION

The Networking Research program seeks to develop the science and technologies necessary to enable flexible, robust and trustworthy, large-scale networks capable of supporting a wide variety of current and emerging applications. The performance of large-scale networks is difficult to predict, because of both the large number of interacting components and connected devices, and the uncertain patterns of usage exhibited by users, applications and traffic. This raises a host of research challenges and technical issues which either existed in the early days of networking and have now become critical, or arose recently as a result of the increase in scale and the degree of interconnection complexity between different components and communications devices.

Revolutionary research in a number of areas is required to address these issues and challenges for the realization of large scale network systems that are reliable, robust and able to tolerate security breaches and hostile attacks without failing. Research in this area confronts a range of difficult questions and require a fresh insight into the fundamental design principles undertaken by the research community in developing network infrastructures.

Some specific research topics include:

- **Advanced network architectures and services**, including peer-to-peer networking architectures, overlay-based network services, novel distributed applications, content distribution networks, directory and naming service for large scale networks, performance enhancement services and proxies, scalable and practical methods for data and media services, flexible and expandable middleware to support multimedia applications in a networked environment, and QoS mechanisms frameworks to provide finer granularity and stronger guarantees than class-based mechanisms, while avoiding the scaling and administrative overhead of flow-based mechanisms,

- **Adaptive protocols in large scale**, **wired and wireless networks**, including the exploration of the use of control theory to derive stability measures and conditions for adaptive protocols in large-scale networks, development of principles to allow on-the-fly protocol selection in wireless mobile networks, characterization of the types and extent of protocol interactions that occur when one or more protocols attempt to adapt to new conditions,

- **Network security and trustworthiness**, including security and survivability of network systems, scalable and efficient techniques for secure name service, intrusion detection mechanisms with greater adaptability to mobility and power-awarness, efficient schemes for traffic filtering and firewalls, security provision for mobile code and intelligent agents, verifiable and affordable network security across network domains, and security assurance methods and tools,

- **Ubiquitous and pervasive networking in wireless ad-hoc networks**, including novel applications of sensor networks, energy efficient media access, error control and traffic management schemes, scalable and energy efficient data dissemination schemes, novel routing, addressing and location management schemes, QoS provisioning and secure communication in ad hoc wireless networks, efficient use of satellite networks to extend network coverage to wider geographic areas,

- **Heterogeneity and scalability**, including research leading to a deeper understanding of heterogeneous networking environments and research addressing solutions to support increasing heterogeneity in next generation networks, and research addressing such issues as traffic measurements of heterogeneous large-scale networks, seamless internetworking between wired and wireless networks, and middleware frameworks to conceal heterogeneity of underlying networking environments,

- **Network modeling and traffic measurement**, including the development of new scalable and efficient modeling methodologies to take the understanding of network dynamics and scaling to beyond what that afforded by current models, and new schemes and methodologies for emulation, simulation and modeling of large scale networks,

- **Scalable algorithms, protocols and systems for routing, switching and signaling**, including QoS-based routing and multicast technologies, resource management and congestion control, traffic engineering and control, novel circuit switching, packet and burst switching techniques to achieve orders of magnitude higher transmission rates in ultra-high-speed networks.

These topics are representative, not exhaustive. Furthermore, the order in which they are listed is completely arbitrary and is not intend to imply any priority ranking.

III. ELIGIBILITY INFORMATION

The categories of proposers identified in the Grant Proposal Guide are eligible to submit proposals under this program announcement/solicitation.

IV. AWARD INFORMATION

The estimated program budget is $3,000,000 per deadline for a total of $6,000,000. Approximately 10 awards per deadline are expected, with a duration of 2 to 3 years. Expected award amounts range from $80,000 to $150,000 per year for single- and two-investigator proposals, and for a range of $100,000 to $250,000 per year for collaborative and multi-investigator awards. The number of awards and average award size/duration are subject to the availability of funds.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal:

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 Web Site 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.

Proposers are reminded to identify the program solicitation number (NSF-02-123) in the program announcement/solicitation block on the *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 is not required in proposals submitted under this Program Solicitation.

C. Deadline/Target Dates

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

Full Proposals *by 5:00 PM local time*: August 1, 2002, February 1, 2003

D. FastLane Requirements

Proposers are required to prepare and submit all proposals for this Program Solicitation through the FastLane system. Detailed instructions for 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 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 two 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 he/she 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 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.

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 identities of 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.

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 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.

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 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 one's 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 Web site 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 Web site 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 Web site 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.

Within 90 days after the expiration of an award, the PI also is required to submit a final project report. Approximately 30 days before expiration, NSF will send a notice to remind the PI of the requirement to file the final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

NSF has implemented an electronic project reporting system, available through FastLane. 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 Networking Research Program should be made to:

- Dr. Admela Jukan, Networking Research, Program Director, CISE, ANIR, 1175, telephone: 703 292 8949, e-mail: ajukan@nsf.gov.

- Dr. Taieb Znati, Networking Research, Senior Program Director, CISE, ANIR, 1175, telephone: 703 292 8949, e-mail: tznati@nsf.gov.

For questions related to the use of FastLane, contact:

- Priscilla Bezdek, Program & Technology Specialist, CISE, ANIR, 1175, telephone: 703 292 8950, e-mail: pbezdek@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 web site 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.

ABOUT THE NATIONAL SCIENCE FOUNDATION

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.

NSF welcomes proposals from all qualified scientists, engineers and educators. The Foundation strongly encourages women, minorities and persons with disabilities to compete fully in its programs. In accordance with Federal statutes, regulations and NSF policies, no person on grounds of race, color, age, sex, national origin or disability shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NSF (unless otherwise specified in the eligibility requirements for a particular program).

Facilitation Awards for Scientists and Engineers with Disabilities (FASED) 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 program announcement/solicitation for further information.

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 or (800) 281-8749, FIRS at 1-800-877-8339.

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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.

Pursuant to 5 CFR 1320.5(b), 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, or to Office of Information and Regulatory Affairs of OMB, Attention: Desk Officer for National Science Foundation (3145-0058), 725 17th Street, N.W. Room 10235, Washington, D.C. 20503.

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