Wireless Innovation between Finland and US (WiFiUS)

PROGRAM SOLICITATION
NSF 16-587

REPLACES DOCUMENT(S):
NSF 14-563

National Science Foundation

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

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

October 17, 2016

IMPORTANT INFORMATION AND REVISION NOTES

The limit on the number of proposals per PI or co-PI has been changed to 1.

The main theme of this solicitation has been revised to emphasize wireless innovation in the context of the emerging Internet of Things (IoTs).

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 16-1), which is effective for proposals submitted, or due, on or after January 25, 2016.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Wireless Innovation between Finland and the US (WiFiUS)

Synopsis of Program:

The US National Science Foundation (NSF) and the Academy of Finland have signed a Memorandum of Understanding (MOU) on research cooperation in the area of wireless networking. This MOU provides an overarching framework to encourage collaboration between the US and Finland research communities, and sets out the principles by which jointly supported activities may be developed.

With this solicitation, NSF's Directorate for Computer and Information Science and Engineering (CISE) and the Academy of Finland continue a joint program in the area of wireless networking, known as Wireless Innovation between Finland and US (WiFiUS) that provides for an international collaboration arrangement whereby US researchers may receive funding from NSF and Finnish collaborators may receive funding from the Academy of Finland to pursue joint projects.

Specifically, this solicitation continues the previous WiFiUS effort (see NSF 14-563), encouraging new and closer research collaborations, and addressing compelling research challenges on novel frameworks, architectures, protocols, theories, methodologies, and tools for the design and analysis of robust and highly dependable wireless communication systems and networks, particularly in light of the emerging Internet of Things (IoT).

This NSF solicitation parallels an equivalent Academy of Finland solicitation. Proposals submitted pursuant to this solicitation must describe joint research with Finnish counterparts who are requesting funding separately under the Academy of Finland solicitation.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Wenjing Lou, Program Director, CNS, 1175, telephone: (703) 292-8950, email: wlou@nsf.gov
- D. Richard Brown, Program Director, CCF, 1115, telephone: (703) 292-8910, email: ribrown@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

Estimated Number of Awards: 7 to 9

Anticipated Funding Amount: $2,500,000

Subject to the availability of funds. Each award may be up to $300,000 over two years, and will be made to US institutions.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in, the US acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI: 1

In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on the earliest date and time of proposal submission (i.e., the first proposal received will be accepted and the remainder will be returned without review). **No exceptions will be made.**

All projects are expected to start in April 2017.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.
  - Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)

B. Budgetary Information

- **Cost Sharing Requirements:**

  Inclusion of voluntary committed cost sharing is prohibited.

- **Indirect Cost (F&A) Limitations:**

  Not Applicable

- **Other Budgetary Limitations:**

  Not Applicable

C. Due Dates

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

  October 17, 2016

Proposal Review Information Criteria

Merit Review Criteria:

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

Award Administration Information

Award Conditions:

Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements:

Standard NSF reporting requirements apply.

TABLE OF CONTENTS

I. INTRODUCTION

The US National Science Foundation (NSF), through its Directorate for Computer and Information Science and Engineering (CISE), and the Academy of Finland have a history of collaboration that extends back several years. In 2011 and 2012, NSF and the Academy of Finland (along with Tekes - the Finnish Funding Agency for Innovation) supported a set of projects in the area of wireless networking, establishing new collaborations among researchers from the US and Finland. In 2014, NSF and the Academy of Finland, along with Tekes, embarked on a joint research program, i.e., Wireless Innovation between Finland and US (WiFiUS), that aimed to enlarge the scope of the US-Finland collaboration by including additional topics related to wireless networking.

Based on the success of past and ongoing collaborative projects, NSF and the Academy of Finland are continuing this joint program. WiFiUS seeks to fund innovative collaborative research that has the potential to make significant contributions in the area of wireless communications and networking, especially in light of the emerging Internet of Things (IoT). NSF strongly encourages new collaborations pursuant to this solicitation.

II. PROGRAM DESCRIPTION

Proposals are solicited for joint US-Finland foundational and transformative research in the area of wireless networking. Reflecting the funding priorities of each participating NSF division as well as those of the Academy of Finland, this program seeks research projects on novel frameworks, architectures, protocols, methodologies, and tools for the design and analysis of robust and highly dependable wireless communication systems and networks, especially as they support and enable the emerging Internet of Things (IoT).

Driven by global digitalization and emerging IoT paradigms, the number of connected devices is increasing at an exponential rate. Hundreds of billions and even trillions of IoT-connected devices are expected in the next five years. This growing abundance of wireless sensors, gadgets, multimedia services, autonomous robots, cognitive Internet, augmented reality, and other similar devices and applications will require unparalleled access rates with high reliability and low latency. To achieve the anticipated capacity, reliability, latency, security, sustainable power efficiency, and cost-efficient realization of networks for wide-scale deployment, a complete paradigm shift in wireless communication technologies as well as their operation in wireless networks is required. The richness and variety of devices and connections in heterogeneous IoT systems is expected to generate a broad class of new and innovative communication technologies, protocols, network architectures, and applications.

This program seeks joint US-Finland research projects that leverage each nation’s expertise and address these challenges via work in three areas:

1. IoT architectures and protocols: The IoT enables exchange of information in a variety of application scenarios requiring unique performance guarantees including throughput, latency, and energy efficiency. This area addresses the design, modeling, performance analysis, and optimization challenges associated with increasingly diverse and heterogeneous IoT systems and applications at scale.

2. Cognitive IoT systems: In many emerging IoT systems, wireless networks are playing a central role. These networks are not just a bit-pipe to transport information. Rather, they are an intelligent fabric that combines network functions with communication, computation, and storage within the wireless network. A large volume of information available in an IoT system can be used to improve the overall communication and network performance. This area addresses collecting, processing, analyzing, and storing spatial-temporal information available through a variety of devices and protocols in an IoT context, and the use of these data in improving network performance and addressing quality of experience (QoE).

3. Security and privacy in IoT: Emerging IoT systems involve a large number of devices and highly diverse device/application types. Traditional security solutions that rely on cryptography become inadequate due to the difficulty in providing physical protection of devices and initializing and securing key materials in the lifetime of an IoT system. This area seeks novel techniques leveraging fundamental physical properties in the context of their use to increase security, protect privacy, ensure resiliency, improve usability, and support scalability with extreme heterogeneity and mobility.

III. AWARD INFORMATION

For each project, the US team will be funded by NSF, and the Finnish team will be funded by the Academy of Finland, through separate NSF and Academy of Finland funding instruments.

For each project, NSF support will be provided via a NSF grant. It is anticipated that approximately 7 to 9 projects, each up to $300,000 over two years, will be made to US institutions, subject to the availability of funds.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in, the US acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI: 1

In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on the earliest date and time of proposal submission (i.e., the first proposal received will be accepted and the remainder will be returned without review). **No exceptions will be made.**

All projects are expected to start in April 2017.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

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

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on

the Grants.gov website and on the NSF website at: (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. Chapter II, Section D.5 of the Grant Proposal Guide provides additional information on collaborative proposals.

See Chapter II.C.2 of the GPG for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the GPG instructions.

In addition to the guidelines in the GPG or NSF Grants.gov Application Guide, proposal preparation instructions specific to the preparation of proposals submitted in response to this solicitation are provided below:

It is expected that Finnish researchers taking part in the joint research project will submit proposals separately to the Academy of Finland. US researchers will submit to NSF in accordance with NSF's guidelines and procedures. **Proposals must be coordinated: the Project Summary, Project Description, References Cited, Biographical Sketches, Collaboration Plan and Data Management Plan, and List of Personnel *must be identical* in the submissions to NSF as well as the Academy of Finland. Bibliographies must include not only the references relevant to the work to be undertaken by PIs at US institutions but also those relevant to the work to be undertaken by their Finnish counterparts. Furthermore, Biographical Sketches for the researchers to be funded by NSF and the researchers to be funded by the Academy of Finland must be included in the proposals submitted separately to NSF as well as the Academy of Finland.** PIs at US institutions taking part in a joint research project are expected to coordinate their NSF submissions with their Finnish counterparts' submissions to the Academy of Finland.

The following information supplements the guidelines provided in the NSF Grant Proposal Guide (GPG):

Proposal Titles: Proposals for this solicitation require titles that begin with "WiFiUS:" followed by project-specific text, i.e., **WiFiUS: Title**. If you submit a proposal as part of a set of collaborative proposals, the title of the proposal should begin with "WiFiUS:" followed by "Collaborative Research:", followed by the title. For example, **WiFIUS: Collaborative Research: Title.**

Project Description: The Project Description is limited to 15 pages. ***Please note that, per guidance in the GPG, the Project Description must contain, as a separate section titled "Broader Impacts of the Proposed Work" within the narrative, a discussion of the broader impacts of the proposed activities. Proposers may decide where to include this section within the Project Description.***

Single Copy Document: In the Single Copy Documents section, upload the following:

(1) A list of past and present Collaborators not related to this proposal: In lieu of the instructions specified in the GPG, Collaborators and Other Affiliations Information should be submitted as follows. (Note: In collaborative proposals, the lead institution should assemble and provide this information for all participants in the collaborative group):

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

1. Collaborators for Mary Smith; XYZ University; PI
    - Helen Gupta; ABC University
    - John Jones; University of PQR
    - Fred Gonzales; DEF Corporation
    - Susan White; DEF Corporation
2. Collaborators for John Jones; University of PQR; Senior Personnel
    - Tim Green; ZZZ University
    - Ping Chang; ZZZ University
    - Mary Smith; XYZ University
3. Collaborators for Jane Brown; XYZ University; Postdoc
    - Fred Gonzales; DEF Corporation
4. Collaborators for Bob Adams; ABC Community College; Paid Consultant
    - None
5. Collaborators for Susan White; DEF Corporation; Unpaid Collaborator
    - Mary Smith; XYZ University
    - Harry Nguyen; Welldone Institution
6. Collaborators for Tim Green; ZZZ University; Subawardee
    - John Jones; University of PQR

NOTE: The list of collaborators includes all current and past (see above timelines) projects for all participants in the proposal. It is not a list of the collaborators for the given proposal; this should be provided pursuant to item (1) of Supplementary Documents below.

Required Supplementary Documents: In the Supplementary Documents Section, upload the following information where relevant:

(1) *A list of Project Personnel and Partner Institutions (Note: In collaborative proposals, the lead institution should provide this information for all participants):*

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

separated by a semi-colon. Each person listed should start a new numbered line. For example:

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

(2) Biographical Sketches for the researchers to be funded by the Academy of Finland:

Biographical Sketches of the researchers to be funded by the Academy of Finland should be uploaded as a supplementary document.

See Chapter II.C.2.f of the GPG for the format and requirement of NSF biographical sketches.

(3) Collaboration Plan (required):

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, **all proposals must include a Collaboration Plan of up to 2 pages**. 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, cross-country, 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. **If a proposal does not include a Collaboration Plan of up to 2 pages, that proposal will be returned without review.**

(4) Data Management Plan (required):

Proposals must include a supplementary document of no more than two pages labeled "Data Management Plan." This supplementary document should describe how the proposal will conform to NSF policy on the dissemination and sharing of research results.

See Chapter II.C.2.j of the GPG for full policy implementation.

For additional information, see: http://www.nsf.gov/bfa/dias/policy/dmp.jsp.

For specific guidance for proposals submitted to the Directorate for Computer and Information Science and Engineering (CISE) see: http://www.nsf.gov/cise/cise_dmp.jsp.

(5) Documentation of collaborative arrangements of significance to the proposal through Letters of Collaboration:

There are two types of collaboration, one involving individuals/organizations that are included in the budget, and the other involving individuals/organizations that are not included in the budget. Collaborations that are included in the budget should be described in the Project Description. Any substantial collaboration with individuals/organizations not included in the budget should be described in the Facilities, Equipment and Other Resources section of the proposal (see GPG Chapter II.C.2.i). In either case, whether or not the collaborator is included in the budget, **a letter of collaboration from each named participating organization *other than the submitting lead, non-lead, and/or subawardee institutions* must be provided at the time of submission of the proposal. Such letters must explicitly state the nature of the collaboration, appear on the organization's letterhead and be signed by the appropriate organizational representative. These letters must not otherwise deviate from the restrictions and requirements set forth in the GPG Chapter II.C.2.j.**

Please note that letters of support may not be submitted. Such letters do not document collaborative arrangements of significance to the project, but primarily convey a sense of enthusiasm for the project and/or highlight the qualifications of the PI or co-PI. **Reviewers will be instructed not to consider these letters of support in reviewing the merits of the proposal.**

No other Supplementary Documents, except as permitted by the NSF Grant Proposal Guide, are allowed.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

The budget must request funding for travel to two grantee review meetings. For budgetary purposes, proposers should assume that one of these meetings will be held in Finland and one will be held in the US.

C. Due Dates

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

  October 17, 2016

D. FastLane / Grants.gov Requirements

For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: https://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: http://www.grants.gov/web/grants/applicants.html. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via FastLane are strongly encouraged to use FastLane to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in the GPG as Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: http://www.nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014-2018*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be

accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (GPG Chapter II.C.2.d.i. contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including GPG Chapter II.C.2.d.i., prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
    a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
    b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

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

- The extent to which the proposed work supports the solicitation theme of WiFiUS, including the unique aspects of the proposed US-Finnish international collaboration; and
- The extent to which the work and collaboration plans describe a unified project between the US and Finnish participants.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by

Ad hoc Review and/or Panel Review.

NSF will manage and conduct the review process of proposals submitted in accordance with NSF standards and procedures. Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will be completed and submitted by each reviewer. Reviewers will be asked to formulate a recommendation to either support or decline each proposal. Following, and based upon the results of, independent and parallel review processes by NSF and the Academy of Finland, officials at the agencies will discuss recommendations. During this discussion, NSF and the Academy of Finland officials may share unattributed reviews (i.e., the reviews will not include reviewer identities) with one another. The NSF program officer assigned to manage the proposal's review will consider the advice of both the US and Finnish review processes and the results of the discussions with Academy of Finland officials, and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell

applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process).

B. Award Conditions

An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)*; or Research Terms and Conditions* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

Special Award Conditions:

NSF intends to make awards to the US collaborators named in the recommended proposals. The Academy of Finland intends to make awards to the Finnish collaborators named in the recommended proposals. NSF and Academy of Finland awardees will acknowledge the collaboration in their award notices. NSF awards will be made as standard grants.

Grantees of this program will be expected to attend, and should budget for, annual grantee review meetings for the purpose of sharing research progress with representatives of other projects funded under this solicitation as well as NSF and Academy of Finland representatives (and any other persons designated by these agencies). The first such meeting will be held approximately 9 months after the awards are made, and the second meeting will be held 12 months thereafter.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF

awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Wenjing Lou, Program Director, CNS, 1175, telephone: (703) 292-8950, email: wlou@nsf.gov
- D. Richard Brown, Program Director, CCF, 1115, telephone: (703) 292-8910, email: ribrown@nsf.gov

For questions related to the use of FastLane, contact:

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

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

IX. OTHER INFORMATION

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Grants Conferences. Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on NSF's website.

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

ABOUT THE NATIONAL SCIENCE FOUNDATION

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

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

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

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

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

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

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

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

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **For General Information** (NSF Information Center)**:** (703) 292-5111

- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**

  Send an e-mail to: nsfpubs@nsf.gov

  or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Office of the General Counsel
National Science Foundation
Arlington, VA 22230