US Ignite: Networking Research and Application Prototypes Leading to Smart & Connected Communities

PROGRAM SOLICITATION
NSF 16-553

REPLACES DOCUMENT(S):
NSF 15-508

National Science Foundation

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

Directorate for Engineering
    Division of Civil, Mechanical and Manufacturing Innovation

U.S. Department of Justice – Office for Access to Justice

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

    June 14, 2016

IMPORTANT INFORMATION AND REVISION NOTES

The US Ignite program solicitation has been revised for the FY 2016 competition. Prospective Principal Investigators are encouraged to read the solicitation carefully. Among the changes are the following:

- The two "Tracks" from the FY 2015 solicitation have been revised and relabeled "Focus Areas;"

- Similar to Track 1 in the previous solicitation, Focus Area 1 seeks proposals for innovative application ideas and prototypes that leverage or enhance advanced networking technologies and support progress toward Smart & Connected Communities;

- Focus Area 2 has a different emphasis than the previous Track 2, and seeks proposals for fundamental research that will advance both the capabilities and our understanding of gigabit networking infrastructure to meet future application demands; and

- The U.S. Department of Justice (DOJ) Office for Access to Justice (ATJ) is participating in the program.

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:

    US Ignite:
    Networking Research and Application Prototypes Leading to Smart & Connected Communities

Synopsis of Program:

US Ignite is an initiative that seeks to promote US leadership in the development and deployment of next-generation gigabit applications with the potential for significant societal impact. The primary goal of US Ignite is to break a fundamental deadlock: there is insufficient investment in gigabit applications that can take advantage of advanced network infrastructure because such end-to-end infrastructure is rare and geographically dispersed. And conversely, there is a lack of broad availability of advanced broadband infrastructure for open experimentation and innovation because there are few advanced applications and services to justify it. US Ignite aims to break this deadlock by providing incentives for imagining, prototyping, and developing gigabit applications that address national priorities, and by leveraging and extending this network testbed across US college/university campuses and cities.

This solicitation builds on the experience and community infrastructure gained from initial US Ignite activities to further engage the US academic research and non-profit communities along with local cities, municipalities, and regions in exploring the challenges of developing and applying next-generation networking to problems of

significant public interest and benefit. In particular, this solicitation has two focus areas: the first encourages the development of application ideas and prototypes addressing national priority areas that explore new uses for high-speed networks and give rise to the Smart & Connected Communities of the future, as well as novel networking and application paradigms; and the second pursues fundamental research advances in networking technology and protocols that will further both the capabilities and our understanding of gigabit networking infrastructure to meet current and future application demands. In 2016, NSF is also working with the U.S. Department of Justice (DOJ) Office for Access to Justice (ATJ) to identify additional application ideas and prototypes and basic research directions that may serve national priority areas of mutual interest.

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.

- Jack Brassil, Program Director, CISE/CNS, telephone: (703) 292-8041, email: jbrassil@nsf.gov

- Bruce Kramer, Program Director, ENG/CMMI, telephone: (703) 292-5348, email: bkramer@nsf.gov

- Wendy Nilsen, Program Director, CISE/IIS, telephone: (703) 292-2568, email: wnilsen@nsf.gov

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

- 47.041 --- Engineering
- 47.070 --- Computer and Information Science and Engineering

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 12 to 14

NSF expects to award up to 10 Focus Area 1 projects and up to 4 Focus Area 2 projects.

Focus Area 1 proposals may request up to $600,000 for up to three years. Focus Area 2 proposals may request up to $1,000,000 for up to three years.

Anticipated Funding Amount: $10,000,000

Up to $10 million to support projects.

Eligibility Information

Who May Submit Proposals:

> The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

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: 2

> An individual may participate as PI, Co-PI, or Senior Personnel in **no more than two proposals** submitted in response to this solicitation. **These eligibility constraints will be strictly enforced in order to treat everyone fairly and consistently**. In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on earliest date and time of proposal submission (i.e., the first two proposals received will be accepted and the remainder will be returned without review). **No exceptions will be made.**

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):

  June 14, 2016

Proposal Review Information Criteria

Merit Review Criteria:

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

Award Administration Information

Award Conditions:

Standard NSF award conditions apply.

Reporting Requirements:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

In June 2012, NSF, in partnership with the White House Office of Science and Technology Policy (OSTP) and other Federal agencies, announced US Ignite, an initiative seeking to promote US leadership in the development and deployment of next-generation gigabit applications with the potential for significant societal impact. The primary goal of US Ignite is to break a fundamental deadlock: there is insufficient investment in gigabit applications that can take advantage of advanced network infrastructure because such end-to-end infrastructure is rare and geographically dispersed. And conversely, there is a lack of broad availability of advanced broadband infrastructure for open experimentation and innovation because there are few advanced applications and services to justify it. US Ignite aims to break this deadlock by providing incentives for imagining, prototyping, and developing gigabit applications that address national priority areas, and by leveraging and extending this network testbed across US

college/university campuses and cities.

Over the last three years, projects funded by NSF through the US Ignite initiative have yielded novel ideas and prototypes of applications in a variety of public sectors, including advanced manufacturing, clean energy, transportation, cyberlearning, health, and public safety/emergency preparedness. These projects have in turn demonstrated the potential societal impact of broad use of ultra-fast, software-defined networks.

Additionally, NSF has supported efforts to grow community ecosystems supporting continuous application innovation and sharing. For example, US Ignite, Inc., is a public-private partnership working with cities and companies to encourage and foster development and deployment of ecosystems of next-generation networking. At the same time, the Mozilla Foundation is also working to catalyze development of gigabit applications. Both teams serve as anchors in the US Ignite initiative, using community events and workshops to catalyze diverse groups of municipal, educational, and non-profit entities to capture the social, educational, and economic benefits of gigabit networking in over a dozen targeted testbed cities throughout the country.

This solicitation builds on the experience and community infrastructure established through previous US Ignite investments, encouraging the US academic research community, non-profits, and local governments to explore the fundamental challenges of piloting and eventually transitioning into practice next-generation networking.

II. PROGRAM DESCRIPTION

In the last decade, NSF's significant investments in networking research infrastructure, through its Directorate for Computer and Information Science and Engineering (CISE), have demonstrated the value of shared resources for accelerating advances in research and education. Since 2012, the US Ignite initiative has particularly sought to leverage investments made through the Global Environment for Network Innovations (GENI) and Campus Cyberinfrastructure programs by integrating academic campuses that have GENI research backbone networks and numerous broadband cities across the nation. Furthermore, in 2014, the NSFFutureCloud program funded two advanced cloud computing testbeds (Chameleon and CloudLab) to provide unprecedented computing and storage resources that can support future research and deployment projects (**see** NSF 15-081 for **more information).** Through US Ignite, NSF and other Federal agencies are exploring next-generation networking at scale, and creating a national innovation ecosystem that will have profound, long-term social and economic impacts. In 2016, NSF is also working with the U.S. Department of Justice (DOJ) Office for Access to Justice (ATJ) to identify additional application ideas and prototypes and basic research directions that may serve national priority areas of mutual interest.

This solicitation has two focus areas: the first (Focus Area 1) builds on activities explored by previous US Ignite investments, enabling application ideas and prototypes addressing national priority areas that give rise to Smart & Connected Communities of the future as well as novel networking and application paradigms; and the second (Focus Area 2) seeks to support fundamental research that will advance both the capabilities and our understanding of gigabit networking infrastructure to meet future application demands. While Focus Area 1 projects will largely assume that the networks in place are adequate to support the proposed gigabit application ideas or prototypes, Focus Area 2 projects should seek to challenge this assumption, proposing fundamental advances in networking infrastructure that if successful, would better enable current or future gigabit to multi-gigabit applications.

Focus Area 1: US Ignite Applications: Toward Smart & Connected Communities

In Focus Area 1 of this solicitation, NSF seeks proposals for **innovative application ideas and prototypes** that leverage or enhance advanced networking technologies (i.e., gigabit or greater throughput, software-defined networking, advanced wireless), and that address national priority areas. This Focus Area seeks to leverage the presence of broadband networking infrastructure, including residential access networks, where available. For example, Google Fiber in Provo, Utah, and EPB Fi-Speed Internet service in Chattanooga, Tennessee, enable high-speed Internet access capable of supporting conventional gigabit and multi-gigabit applications. Importantly, applications enabled by this Focus Area will lead toward Smart & Connected Communities (S&CC), a vision in which innovative networking research and effective, scalable pilot deployments will play a role in helping municipalities surmount deeply interlocking physical, social, behavioral, economic, and infrastructural challenges and improve quality of life for people across the nation. US Ignite is one component of NSF's substantial commitments toward enabling S&CC, which also include a cross-directorate Dear Colleague Letter (NSF 15-120) seeking innovative research proposals in support of the S&CC vision.

Each US Ignite application should address one or more national priority areas, including but not limited to advanced manufacturing, education and workforce, energy, transportation, health, and public safety/emergency preparedness. Among these priority areas are those identified by the White House Legal Aid Interagency Roundtable (WH-LAIR), to which both NSF and the Department of Justice (DOJ) are members. [The mission of the WH-LAIR is to increase the availability of meaningful access to justice for individuals and families, regardless of wealth or status, and to advance relevant evidence-based research, data collection, and analysis of civil legal aid and indigent defense. As discussed in the jointly issued DOJ-NSF WH-LAIR: Civil Legal Aid Research Workshop Report (Feb. 2016), research supports the connection between legal aid and successful efforts to reduce domestic violence or elder abuse, remove obstacles to employment and education, and improve health outcomes. Therefore, potential US Ignite applications that could demonstrate a networking technology advancement that improves access to justice, and informs a research agenda and/or identifies technology priorities for civil legal aid, would be of interest.]

Thus, a proposal responsive to this Focus Area must accomplish each of the following:

a. Pursue an application in one or more areas of national priority including but not limited to: advanced manufacturing, education and workforce, energy, transportation, health, and public safety/emergency preparedness. Consider, in particular, how the application may make one or more communities more livable, workable, and sustainable.

b. Leverage or enhance one or more advanced networking technologies such as gigabit throughput, software-defined networks, or advanced wireless.

c. Identify one or more anchor institution(s) (e.g., a school, college/university campus, health care facility, public safety entity, library, museum, or city government) to perform early demonstrations and evaluations of the application's ability to transition to widespread adoption. When developing plans for community engagement, proposers are encouraged to interface with the expanding number of cities and communities within the US Ignite, Inc., and Mozilla Foundation networks, recognizing that the list of partner communities continues to evolve over time.

d. Develop a prototype of the US Ignite application to be demonstrated in a US Ignite broadband networking setting. Again, proposers are encouraged to interface with the cities and communities within the US Ignite, Inc., and Mozilla Foundation networks.

In addition, NSF anticipates that the combination of novel applications and advanced networking will inform one or more research questions in the domains of networking, networked systems, or networked applications, which will in turn inform and improve understanding of how to design, deploy, manage, support, or use advanced networking capabilities. **While the emphasis of Focus Area 1 is on innovative application ideas and prototypes leveraging current advanced networks, proposals must seek to link the implementation of the application idea or prototype to ongoing and/or future exploration and assessment of potential networking research question(s).** For example, applications implemented through Focus Area 1 have the potential to expose needed changes to underlying networks that could dramatically expand or improve application performance, in turn informing fundamental research needs that could be addressed through future Focus Area 2 proposals.

Focus Area 2: Innovating Advanced Networks for Future US Ignite Applications

In Focus Area 2 of this solicitation, NSF seeks proposals for **fundamental research** that advances networking and computing infrastructure to support emerging applications that address one or more national priority areas.

NSF anticipates the emergence of new applications that exceed the networking capabilities of current broadband networks. Such an emerging application might demand multi-gigabit bandwidth and/or ultra-low latency transport to support a high degree of user interactivity or real-time communications. For example, a training application enhanced by augmented reality and with simultaneous classroom-wide participation might demand lower latency or delay jitter than is within the capabilities of currently deployed networks. In such a case, fundamental advances in network technologies and/or protocols must be achieved to realize such an envisioned application at scale.

Alternately, an emerging application might require computational resources to be located in close proximity to users to support real-time or interactive use. Demanding applications can leverage the presence of `edge' computation on shared research infrastructure – including GENI racks and NSFFutureCloud testbeds – to enhance the capabilities of current networks. Fundamental advances in the use of computation near the network edge must be achieved to realize such an envisioned application.

Furthermore, fundamental advances in network technologies, protocols, and architectures will demand associated advances in broadband network measurement infrastructure. Advances in network instrumentation can have broad societal impact by 1) serving to improve public understanding of network performance and Quality of Experience (QoE), and 2) assisting network operators with improved information in support of network management.

Thus, a proposal responsive to this Focus Area must accomplish each of the following:

a. Identify an emerging application idea or prototype (i.e., a motivating application) that is not well served by existing broadband networking infrastructure. Motivating applications should address one or more areas of national priority, including but not limited to advanced manufacturing, education and workforce, energy, transportation, health, and public safety/emergency preparedness. Ideally, the proposed research will support platform technologies with the potential to benefit a broad range of national priority areas.

b. Seek to investigate a fundamental advance in networking technologies, protocols, and/or architectures, and/or computation at the network edge, that promises to enhance existing network capabilities to better support the target application. Alternately, the proposal may seek to investigate a fundamental advance in network measurement or monitoring infrastructure to improve our understanding of networks operating with increasingly demanding gigabit applications.

c. Link the motivating application to the exploration and assessment of the identified fundamental research question(s). Demonstrate how the fundamental networking advance serves to better support the target application than is possible on current operating networks, and attempt to quantify the magnitude of potential societal impacts resulting from the improvement.

III. AWARD INFORMATION

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 12-14

NSF expects to award up to 10 Focus Area 1 projects and up to 4 Focus Area 2 projects.

Focus Area 1 proposals may request up to $600,000 for up to three years. Focus Area 2 proposals may request up to $1,000,000 for up to three years.

Anticipated Funding Amount: $10,000,000

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

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: 2

An individual may participate as PI, Co-PI, or Senior Personnel in **no more than two proposals** submitted in response to this solicitation. **These eligibility constraints will be strictly enforced in order to treat everyone fairly and consistently**. In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on earliest date and time of proposal submission (i.e., the first two proposals received will be accepted and the remainder will be returned without review). **No exceptions will be made.**

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.

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

Proposal Titles: Each proposal title must begin with "US Ignite:" followed by "Focus Area 1:" or "Focus Area 2:" indicating to which focus area of this solicitation the proposal is responsive. In other words, appropriate titles for proposals include **US Ignite: Focus Area 1: Title** and **US Ignite: Focus Area 2: Title**. For a collaborative proposal, all participating institutions should use the same title, which should also include the keyword "Collaborative Research:"; for example, a collaborative proposal responsive to Focus Area 1 should use a title of the form **US Ignite: Collaborative Research: Focus Area 1: Title**.

Project Summary: The Project Summary consists of an overview of the proposed activity, followed by separate statements on the intellectual merit and broader impacts of the proposed activity.

Project Description: Describe the research and education activities to be undertaken **in up to 15 pages**.

Proposers are reminded that, as specified in GPG Chapter II.C.2.d:

- **The Project Description must contain, as a separate section within the narrative, a section labeled "Broader Impacts of the Proposed Work."** This section should provide a discussion of the broader impacts of the proposed activities.
- **Results from Prior NSF Support: If any PI or co-PI identified on the proposal has received NSF funding with a start date in the past five years (including any current funding and no cost extensions), information on the award is required for each PI and co-PI, regardless of whether the support was directly related to the proposal or not.** In cases where the PI or co-PI has received more than one award (excluding amendments to existing awards), they need only report on the one award most closely related to the proposal. Funding includes not just salary support, but any funding awarded by NSF. Please refer to the GPG for details about the information that must be provided. **Note that these results from prior NSF support must be separately described under two distinct headings, "Intellectual Merit" and "Broader Impacts."**

Proposals without these two distinct sections (including the headings "Results from Prior NSF Support" and "Broader Impacts of the Proposed Work") within the Project Description may be returned without review.

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

A list of past and present Collaborators not related to this proposal (Note: In collaborative proposals, the lead institution should provide this information for all participants):

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

Supplementary Documents: In the Supplementary Documents Section, upload the following information:

(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) *Collaboration Plans (if applicable):*

Since the success of collaborative efforts are known to depend on thoughtful coordination mechanisms that regularly bring together the various participants of the project, all proposals that include more than one investigator must include a Collaboration Plan of up to two pages. The length and degree of detail provided in the Collaboration Plan should be commensurate with the complexity of the proposed project. Where appropriate, the Collaboration Plan might include: 1) the specific roles of the project participants in all organizations involved; 2) information on how the project will be managed across all the investigators, institutions, and/or disciplines; 3) identification of the specific coordination mechanisms that will enable cross-investigator, cross-institution, and/or cross-discipline scientific integration (e.g., yearly workshops, graduate student exchange, project meetings at conferences, use of the grid for videoconferences, software repositories, etc.), and 4) specific references to the budget line items that support collaboration and coordination mechanisms. If a proposal with more than one investigator does not include a Collaboration Plan of up to two pages, that proposal will be returned without review.

(3) *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.

Proposals that include Data Management Plans exceeding two pages in length will be returned without review.

(4) *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.**

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.

C. Due Dates

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

  June 14, 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 standard NSF merit review criteria, proposals responsive to this US Ignite solicitation will be evaluated based on

the following criteria:

For Focus Area 1 proposals:

1. Does the application idea/prototype address one or more national priorities (including but not limited to advanced manufacturing, education and workforce development, energy, transportation, health, and/or public safety/emergency preparedness)?
2. Does the team contain the range of subject matter expertise needed to address the application domain(s) and understand potential underlying networking research?
3. Is there clear evidence of collaboration between the proposers and the anchor institution (for example, as evidenced by one or more letters of collaboration)?
4. Does the application have the potential to inform research questions that further our understanding of next-generation networking architectures or applications?
5. If successful, will the project demonstrate the value of advanced networking technologies?

For Focus Area 2 proposals:

1. Does the team contain the range of subject matter expertise needed to address the fundamental networking research questions proposed?
2. Is the research motivated by an emerging application idea/prototype that addresses one or more national priorities (including but not limited to advanced manufacturing, education and workforce development, energy, transportation, health, and/or public safety/emergency preparedness)?
3. Does this research support the creation of platform technologies, particularly technologies that could benefit a broad range of national priority areas?
4. Does the proposal demonstrate how the research advances, if successful, would support the motivating application beyond what is possible on current operating networks, and attempt to quantify the magnitude of potential societal impacts resulting from the improvement?

B. Review and Selection Process

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

Ad hoc Review and/or Panel Review.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

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

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

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

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

B. Award Conditions

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

Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

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

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

C. Reporting Requirements

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

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

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

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

VIII. AGENCY CONTACTS

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

General inquiries regarding this program should be made to:

- Jack Brassil, Program Director, CISE/CNS, telephone: (703) 292-8041, email: jbrassil@nsf.gov

- Bruce Kramer, Program Director, ENG/CMMI, telephone: (703) 292-5348, email: bkramer@nsf.gov

- Wendy Nilsen, Program Director, CISE/IIS, telephone: (703) 292-2568, email: wnilsen@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**   (703) 292-5111
>   (NSF Information Center)**:**
>
> - **TDD (for the hearing-impaired):**   (703) 292-5090
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> - **To Order Publications or Forms:**
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>   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

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