

**Program Announcement  
To DOE National Laboratories  
LAB 08-27**

***High-Performance Networks  
for Distributed Petascale Science***

**SUMMARY:** The Office of Advanced Scientific Computing Research (ASCR) of the Office of Science (SC), U.S. Department of Energy (DOE), hereby announces its interest in receiving proposals for research and development projects in high-capacity and high-performance networks to support distributed petascale science. Awards for this solicitation will be made in FY2009, subject to the availability of funds.

**LETTER OF INTENT DUE DATE: October 31, 2008, 5:00 p.m., Eastern Time**

A one-page Letter of Intent (LOI) is **REQUIRED** and must be received by **October 31, 2008, 5:00 p.m., Eastern Time**. The Letter of Intent should be submitted by e-mail as a PDF file attachment to: [network\\_research@ascr.doe.gov](mailto:network_research@ascr.doe.gov). Please use "Letter of Intent for Announcement **LAB Announcement 08-27**" in the subject line of the email.

The purpose of the Letter of Intent (LOI) is to facilitate the planning of the peer review process and the selection of reviewers, including identifying any potential conflicts of interest. The one-page LOI must include the following information: the announcement number LAB Announcement 08-27; name, institutional affiliation, and contact information of the Principal Investigator (PI); names and institutional affiliations of other PIs and senior personnel; projected funding request (if possible); title of the proposed effort; and an abstract of the proposed research. For collaborations involving multiple institutions, a single Letter of Intent should be submitted by the PI of the lead institution. An example of the format for the one-page Letter of Intent can be viewed at: <http://www.science.doe.gov/ascr/Research/NextGen/Solicitation.html>.

A response to the Letters of Intent encouraging or discouraging formal proposals will be communicated to the applicants by **November 14, 2008**. **Formal proposals will be accepted only from those encouraged to submit. No other formal proposals will be considered.**

**DUE DATE: December 17, 2008 p.m., Eastern Time** to be accepted for merit review and to permit timely consideration for award in Fiscal Year 2009.

Researchers must complete a formal FWP consistent with policies of the investigator's laboratory and the local DOE Operations Office. (Field Work Proposal Format (Reference DOE O 412.1A). Additional information is requested to allow for scientific/technical merit review. The FWP should be submitted via email as a single PDF file of the entire LAB proposal and FWP.

The email should be addressed to Dr. Thomas Ndousse-Fetter at: [network\\_research@ascr.doe.gov](mailto:network_research@ascr.doe.gov). Please use "LAB Announcement 08-27" as the subject of the

email. Other communications related to the formal proposal should use "LAB Announcement 08-27" in the subject line

Dr. Thomas Ndousse-Fetter Next-Generation Networks for Science Programs, SC-21.1 Office of Advanced Scientific Computing Research Office of Science 19901 Germantown Road Germantown, MD 20874-1290 ATTN: LAB Announcement 08-27

### **SUPPLEMENTARY INFORMATION:**

The emergence of distributed petascale science in DOE, characterized by supercomputers that perform quadrillions of mathematical operations per second; large science experiments that generate petabyte-scale data; and large-scale scientific collaborations that are of National and International scale, have generated the need for a new generation of networks with unprecedented capabilities. The core capabilities of these networks include: 1) the ability to deliver multi-gigabits/sec - terabits/sec throughputs to high-end science applications; 2) the capability to dynamically provision on-demand bandwidth and circuit services to a variety of science applications across federated networks; and 3) the ability to diagnose faults, and to measure, monitor, and predict end-to-end performance of federated networks.

This announcement solicits innovative basic and applied research to develop and deploy terabits network technologies in existing and new DOE network infrastructures to meet the short- and long-term needs of the emerging distributed petascale science. Prospective researchers should observe that:

- Proposed research activities should be relevant to DOE networking infrastructures by focusing on technologies that are directly applicable to the following networking infrastructures: 1) Energy Science Network (ESnet - <http://www.es.net>) core IP backbone network and the Science Data Network (SDN); 2) DOE laboratories LANs; and 3) end systems hosting DOE high-end applications. Applicants are strongly encouraged to contact the engineering teams of these facilities for information on using them to enhance, validate, or test concepts and technologies proposed in their applications.
- Collaborative proposals involving multiple institutions, which may include: universities, laboratories, and/or private institutions, are encouraged but not required. Collaborative proposals should be developed as a single unified and complete proposal. However, each participating institution is required to submit a formal copy of the same Proposal. Additional information on preparing and submitting multi-institution proposals can be obtained at: <http://www.sc.doe.gov/ascr/Research/NextGen.html>
- Researchers may request a period of performance of up to a maximum of three (3) years, subject to the availability of funds.

### **Technical Areas**

The emerging distributed petascale science environment in DOE will require a new generation of networks with unprecedented capabilities. Achieving such capabilities will require scaling existing network technologies and developing revolutionary new protocols, tools, and services that will make end-to-end terabit networks possible. In contrast to today's networks that use best-

effort IP network concepts to provide conventional networking services, it is anticipated that the next-generation of terabit networks for science will use federated hybrid (packet and circuit-switched) networking concepts to support the diverse needs of DOE science proposals. In addition, it is expected that alternatives or enhanced versions of protocols, such as TCP, UDP, and IP will be needed to achieve terabits/sec throughputs. Also, new provisioning techniques that offer on-demand switched circuit services will be needed to overcome the limitations of best-effort IP networks where guaranteed bandwidths and quality of services are critical. The ability to diagnose faults and monitor and predict network performance across federated networks will also be critical. This announcement focuses on innovative and revolutionary technologies that address these challenges, especially at the terabits/sec end-to-end performance level. Particular technical areas of interest include, but are not limited to, the following:

**1. Terabit data transfer protocols, tools, and services.** Advanced technologies capable of providing secure and rapid data transfers will be needed to support the distribution of petabyte-scale data generated by scientific experiments and petascale simulation. Such technologies must be easily deployable and deal effectively with the end-to-end issues of data transfers over very long distances, and securely provide terabit throughputs in a variety of scientific data transfer settings, including peer-to-peer and real-time data transfers. Other highly desirable features include: 1) dynamic reconfiguration capabilities to support different data transfer objectives such as batch, scheduled, streaming, and reservation data delivery; 2) automatic detection and use of appropriate and available transport protocols, such as (TCP-variants, UDP-variants, Fiber Channel, Infiniband, SCSI, etc.) in different data transfer scenarios; 4) data transfer utilities such as fault recovery, optional authentication services, real-time throughput monitoring, etc.; and 5) APIs to integrate data transfer protocols with host applications and workflows, including network control and management applications.

**2. Composable transport protocols.** The vast majority of today's network services revolve around TCP and UDP stacks. These two widely deployed stacks converge on the use of a single IP stack. While a single IP stack simplifies network usage, it makes it difficult to develop and deploy advanced capabilities needed to support distributed petascale science applications in terabits/sec networks. Transport protocols envisioned for next-generation networks should preferably be component-based to enable different types of networking scenarios achieved by dynamically assembling protocol components that are optimized for different types of applications and layer 1-3 transport network technologies. The goal is to have composable transport protocols that can effectively deliver terabit throughput and can be dynamically reconfigured to take full advantage of today's rich variety of transport media (circuit-based DWDM, VLANs, SONET, guaranteed bandwidth, etc.). Other desired features for composable transport protocol frameworks include the following: 1) user-space and kernel-level instrumentation to collect real-time performance data; 2) modular design to facilitate composability; 3) selectable congestion control to be used only when needed; 4) variable packet lengths with corresponding error correction capabilities; and 5) the ability to handle real-time applications.

**3. Advanced network provisioning technologies.** Innovative techniques will be needed to enable secure dynamic multi-layer end-to-end circuit-based services across federated networks. Particular network provisioning technologies of current interest are those that will use out-of-band signaling and control plane technologies to implement on-demand, reservation, and scheduled services to offer coarse- and fine-grain federated switched services. Applicants interested in this topic are encouraged to focus on technologies that are directly applicable to DOE's ESnet and Science Data Networks (<http://www.es.net>). The current technical areas of interest include the following: 1) extensions of existing control plane technologies such as GMPLS, MPLS, etc., to accommodate advanced scheduling, reservation, and authentication; 2) techniques to secure federated control plane networks; 3) mathematical modeling of unified control plane technologies, path computations, and traffic engineering for multi-layer and multi-domain networks offering hybrid best-effort IP and switched circuit services; and 4) secure APIs to integrated control plane and signaling systems with user applications and network monitoring systems.

**4. High-performance network interfaces.** Providing secure access and coupling distributed high-end applications to next-generation networking for science will require robust distributed systems software. Specific areas of interest include, but are not limited to, the following: 1) network-storage system interfaces to enable petascale storage systems to take full advantage of terabit network capabilities; 2) network-application interfaces to facilitate the deployment and usage of network-enabled applications; 3) network-file system services for mapping data from networks onto storage systems; 4) host systems stack enhancements that hide network complexities from users.

**5. Federated network management and monitoring.** Advanced network instrumentation services and tools will be needed to efficiently and effectively measure and predict the performance of terabit networks. These include multi-layer, end-to-end network management tools and services such as end-to-end performance prediction, fault location and diagnosis, and dynamic circuit monitoring of heterogeneous multi-domain networks. Particular technical issues of critical importance in the area include, but are not limited to, the following: 1) robust techniques based on sound principles to collect, store, analyze, and correlate network monitoring data in multi-domain networks; 2) scalable frameworks for coordinating different network monitoring policies and network measurement standards across multiple networks; 3) advanced tools and services for diagnosing faults and monitoring the performance of dynamic circuits across multiple domains; and 4) discovery services network measurement in peer networks.

More information on DOE's Next-Generation Networking for Science can found at this Website: <http://www.sc.doe.gov/ascr/Research/NextGen.html>.

### **Additional Information**

As a mission-oriented agency, DOE conducts network research to support its mission objectives. As part of the proposal development, applicants are required to justify that their proposed research is relevant to DOE's science mission by including in the technical narrative of their

proposal plan to transfer the research results to DOE's network and computing infrastructure should they be successful. A network testbed facility operated by DOE's Energy Science Network (<http://www.es.net>) will be made available to assist researchers to develop and test prototypes resulting from successful network research projects funded under this announcement. Other arrangements to validate research prototypes not directly applicable to DOE's ESnet will be possible in National Laboratories and collaborating science facilities. Additional information on DOE networking requirement can be obtained in the following DOE networking workshop reports:

a) Workshop on Advanced Networking for Distributed Petascale Science: R&D Challenges and Opportunities. April 8-9, 2008. [Report in PDF](#)

b) Workshop on Science-Driven R&D Requirements for ESnet, April 23-24, 2007. [Report in PDF](#)

### **Program Funding**

It is anticipated that up to \$500,000 per year for multi-institution proposals and \$150,000 per year for single investigator proposals. The funding period for all projects will be three years, subject to availability of funds. It is anticipated that up to six multi-institution and ten single awards will be made for this announcement contingent on availability of appropriated funds in Fiscal Year 2009.

DOE is under no obligation to pay for any costs associated with the preparation or submission of any proposals. DOE reserves the right to fund, in whole or part, any, all, or none of the proposals submitted in response to this Notice.

DOE is under no obligation to pay for any costs associated with the preparation or submission of an application. DOE reserves the right to fund, in whole or part, any, all, or none of the applications submitted in response to this Notice.

The instructions and format described below should be followed. You must reference Program Announcement LAB 08-27 on all submissions and inquiries about this program.

## **OFFICE OF SCIENCE GUIDE FOR PREPARATION OF SCIENTIFIC/TECHNICAL PROPOSALS TO BE SUBMITTED BY NATIONAL LABORATORIES**

Proposals from National Laboratories submitted to the Office of Science (SC) as a result of this program announcement will follow the Department of Energy Field Work Proposal process with additional information requested to allow for scientific/technical merit review. The following guidelines for content and format are intended to facilitate an understanding of the requirements necessary for SC to conduct a merit review of a proposal. Please follow the guidelines carefully, as deviations could be cause for declination of a proposal without merit review.

### **1. Evaluation Criteria**

Proposals will be subjected to formal merit review (peer review) and will be evaluated against the following criteria which are listed in descending order of importance:

1. Scientific and/or technical merit of the project;
2. Appropriateness of the proposed method or approach;
3. Competency of applicant's personnel and adequacy of proposed resources; and
4. Reasonableness and appropriateness of the proposed budget.

The evaluation process will include program policy factors such as the relevance of the proposed research to the terms of the announcement and the agencies' programmatic needs.

## **2. Summary of Proposal Contents**

- Field Work Proposal (FWP) Format (Reference DOE Order 412.1A) (DOE ONLY)
- Proposal Cover Page
- Table of Contents
- Budget (DOE Form 4620.1) and Budget Explanation
- Abstract (one page)
- Narrative (main technical portion of the proposal, including background/introduction, proposed research and methods, timetable of activities, and responsibilities of key project personnel)
- Literature Cited
- Biographical Sketch(es)
- Description of Facilities and Resources
- Other Support of Investigator(s)
- Appendix (optional)

### **2.1 Number of Copies to Submit**

Researchers must complete a formal FWP consistent with policies of the investigator's laboratory and the local DOE Operations Office. (Field Work Proposal Format (Reference DOE O 412.1A). Additional information is requested to allow for scientific/technical merit review. The FWP should be submitted via email as a single PDF file of the entire LAB proposal and FWP.

The email should be addressed to Dr. Thomas Ndousse-Fetter at: [network\\_research@ascr.doe.gov](mailto:network_research@ascr.doe.gov). Please use "LAB Announcement 08-27" as the subject of the email. Other communications related to the formal proposal should use "LAB Announcement 08-27" in the subject line

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## **3. Detailed Contents of the Proposal**

Adherence to type size and line spacing requirements is necessary for several reasons. No researcher should have the advantage, or by using small type, of providing more text in their

proposals. Small type may also make it difficult for reviewers to read the proposal. Proposals must have 1-inch margins at the top, bottom, and on each side. Type sizes must be 11 point. Line spacing is at the discretion of the researcher but there must be no more than 6 lines per vertical inch of text. Pages should be standard 8 1/2" x 11" (or metric A4, i.e., 210 mm x 297 mm).

### **3.1 Field Work Proposal Format (Reference DOE Order 412.1A)**

The Field Work Proposal (FWP) is to be prepared and submitted consistent with policies of the investigator's laboratory and the local DOE Operations Office. Additional information is also requested to allow for scientific/technical merit review. Laboratories may submit proposals directly to the SC Program office listed above. A copy should also be provided to the appropriate DOE operations office.

### **3.2 Proposal Cover Page**

The following proposal cover page information may be placed on plain paper. No form is required.

Title of proposed project  
SC Program announcement title  
Name of laboratory  
Name of principal investigator (PI)  
Position title of PI  
Mailing address of PI  
Telephone of PI  
Fax number of PI  
Electronic mail address of PI  
Name of official signing for laboratory\*  
Title of official  
Fax number of official  
Telephone of official  
Electronic mail address of official  
Requested funding for each year; total request  
Use of human subjects in proposed project:  
    If activities involving human subjects are not planned at any time during the proposed project period, state "No"; otherwise state "Yes", provide the IRB Approval date and Assurance of Compliance Number and include all necessary information with the proposal should human subjects be involved.  
Use of vertebrate animals in proposed project:  
    If activities involving vertebrate animals are not planned at any time during this project, state "No"; otherwise state "Yes" and provide the IACUC Approval date and Animal Welfare Assurance number from NIH and include all necessary information with the proposal.  
Signature of PI, date of signature  
Signature of official, date of signature\*

\*The signature certifies that personnel and facilities are available as stated in the proposal, if the project is funded.

### **3.3 Table of Contents**

Provide the initial page number for each of the sections of the proposal. Number pages consecutively at the bottom of each page throughout the proposal. Start each major section at the top of a new page. Do not use unnumbered pages and do not use suffices, such as 5a, 5b.

### **3.4 Budget and Budget Explanation**

A detailed budget is required for each fiscal year. It is preferred that DOE's budget page, Form 4620.1 be used for providing budget information\*. Modifications of categories are permissible to comply with institutional practices, for example with regard to overhead costs.

A written justification of each budget item is to follow the budget pages. For personnel this should take the form of a one-sentence statement of the role of the person in the project. Provide a detailed justification of the need for each item of permanent equipment. Explain each of the other direct costs in sufficient detail for reviewers to be able to judge the appropriateness of the amount requested.

Further instructions regarding the budget are given in section 4 of this guide.

\* Form 4620.1 is available at web site: <http://www.science.doe.gov/grants/budgetform.pdf>

### **3.5 Abstract**

Provide an abstract of less than 400 words. Give the project objectives (in broad scientific terms), the approach to be used, and what the research is intended to accomplish. State the hypotheses to be tested (if any). At the top of the abstract give the project title, names of all the investigators and their institutions, and contact information for the principal investigator, including e-mail address.

**3.6 Narrative** (main technical portion of the proposal, including background/introduction, proposed research and methods, timetable of activities, and responsibilities of key project personnel).

The narrative comprises the research plan for the project and is limited to 13 pages (maximum). It should contain enough background material in the Introduction, including review of the relevant literature, to demonstrate sufficient knowledge of the state of the science. The major part of the narrative should be devoted to a description and justification of the proposed project, including details of the methods to be used. It should also include a timeline for the major activities of the proposed project, and should indicate which project personnel will be responsible for which activities.

If any portion of the project is to be done in collaboration with another institution (or institutions), provide information on the institution(s) and what part of the project it will carry out. Further information on any such arrangements is to be given in the sections "Budget and Budget Explanation," "Biographical Sketches," and "Description of Facilities and Resources."

### **3.7 Biographical Sketches**

This information is required for senior personnel at the institution submitting the proposal and at all subcontracting institutions (if any). The biographical sketch is limited to a maximum of two pages for each investigator.

To assist in the identification of potential conflicts of interest or bias in the selection of reviewers, the following information **must be provided in each biographical sketch**.

**Collaborators and Co-editors:** A list of all persons in alphabetical order (including their current organizational affiliations) who are currently, or who have been, collaborators or co-authors with the investigator on a research project, book or book article, report, abstract, or paper during the 48 months preceding the submission of the proposal. Also include those individuals who are currently or have been co-editors of a special issue of a journal, compendium, or conference proceedings during the 24 months preceding the submission of the proposal. If there are no collaborators or co-editors to report, this should be so indicated.

**Graduate and Postdoctoral Advisors and Advisees:** A list of the names of the individual's own graduate advisor(s) and principal postdoctoral sponsor(s), and their current organizational affiliations. A list of the names of the individual's graduate students and postdoctoral associates during the past five years, and their current organizational affiliations.

### **3.8 Description of Facilities and Resources**

Facilities to be used for the conduct of the proposed research should be briefly described. Indicate the pertinent capabilities of the institution, including support facilities (such as machine shops), that will be used during the project. List the most important equipment items already available for the project and their pertinent capabilities. Include this information for each subcontracting institution (if any).

### **3.9 Statement of all Current and Pending Support**

Other support is defined as all financial resources, whether Federal, non-Federal, commercial, or institutional, available in direct support of an individual's research endeavors. Information on active and pending other support is required for all senior personnel, including investigators at collaborating institutions to be funded by a subcontract. For each item of other support, give the organization or agency, inclusive dates of the project or proposed project, annual funding, and level of effort (months per year or percentage of the year) devoted to the project.

### **3.10 Appendix (optional)**

Information not easily accessible to a reviewer may be included in an appendix. Reviewers are not required to consider information in an appendix, and reviewers may not have time to read extensive appendix materials with the same care they would use with the proposal proper. The appendix may contain the following items: up to five publications, manuscripts accepted for publication, abstracts, patents, or other printed materials directly relevant to this project, but not generally available to the scientific community; and letters from investigators at other institutions stating their agreement to participate in the project (do not include letters of endorsement of the project).

## **4. Detailed Instructions for the Budget**

(DOE Form 4620.1 "Budget Page" may be used).

### **4.1 Salaries and Wages**

List the names of the principal investigator and other key personnel and the estimated number of person-months for which DOE funding is requested. Proposers should list the number of postdoctoral associates and other professional positions included in the proposal and indicate the number of full-time-equivalent (FTE) person-months and rate of pay (hourly, monthly or annually). For graduate and undergraduate students and all other personnel categories such as secretarial, clerical, technical, etc., show the total number of people needed in each job title and total salaries needed. Salaries requested must be consistent with the institution's regular practices. The budget explanation should define concisely the role of each position in the overall project.

### **4.2 Equipment**

DOE defines equipment as "an item of tangible personal property that has a useful life of more than two years and an acquisition cost of \$25,000 or more." Special purpose equipment means equipment which is used only for research, scientific or other technical activities. Items of needed equipment should be individually listed by description and estimated cost, including tax, and adequately justified. Allowable items ordinarily will be limited to scientific equipment that is not already available for the conduct of the work. General purpose office equipment normally will not be considered eligible for support.

### **4.3 Domestic Travel**

The type and extent of travel and its relation to the research should be specified. Funds may be requested for attendance at meetings and conferences, other travel associated with the work and subsistence. In order to qualify for support, attendance at meetings or conferences must enhance the investigator's capability to perform the research, plan extensions of it, or disseminate its results. Consultant's travel costs also may be requested.

### **4.4 Foreign Travel**

Foreign travel is any travel outside Canada and the United States and its territories and possessions. Foreign travel may be approved only if it is directly related to project objectives.

#### **4.5 Other Direct Costs**

The budget should itemize other anticipated direct costs not included under the headings above, including materials and supplies, publication costs, computer services, and consultant services (which are discussed below). Other examples are: aircraft rental, space rental at research establishments away from the institution, minor building alterations, service charges, and fabrication of equipment or systems not available off-the-shelf. Reference books and periodicals may be charged to the project only if they are specifically related to the research.

##### **a. Materials and Supplies**

The budget should indicate in general terms the type of required expendable materials and supplies with their estimated costs. The breakdown should be more detailed when the cost is substantial.

##### **b. Publication Costs/Page Charges**

The budget may request funds for the costs of preparing and publishing the results of research, including costs of reports, reprints page charges, or other journal costs (except costs for prior or early publication), and necessary illustrations.

##### **c. Consultant Services**

Anticipated consultant services should be justified and information furnished on each individual's expertise, primary organizational affiliation, daily compensation rate and number of days expected service. Consultant's travel costs should be listed separately under travel in the budget.

##### **d. Computer Services**

The cost of computer services, including computer-based retrieval of scientific and technical information, may be requested. A justification based on the established computer service rates should be included.

##### **e. Subcontracts**

Subcontracts should be listed so that they can be properly evaluated. There should be an anticipated cost and an explanation of that cost for each subcontract. The total amount of each subcontract should also appear as a budget item.

#### **4.6 Indirect Costs**

Explain the basis for each overhead and indirect cost. Include the current rates.