

Program Announcement To DOE National Laboratories

LAB 11-523

Terabit Networking for Extreme-Scale Science

Office of Science
Office of Advanced Scientific Computing Research Office of Science

GENERAL INQUIRES ABOUT THIS LAB ANNOUNCEMENT SHOULD BE DIRECTED TO:

Technical/Scientific Program Contacts:

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SUMMARY:

The Office of Advanced Scientific Computing Research (ASCR) in the Office of Science (SC) at the U.S. Department of Energy (DOE) hereby invites proposals to address key challenges in developing, exploiting, or operating federated end-to-end terabit networks that support distributed extreme-scale science. ASCR contributes to the DOE's science mission by supporting leading-edge high-performance networking facilities, which provides DOE scientists and their national and international collaborators with unfettered access to scientific instruments and supercomputing facilities, and by supporting research into tools and services that enhance the use of these facilities.

A new generation of science facilities (e.g., National Synchrotron Light Source II - [NSLS-II](#), International Thermonuclear Experimental Reactor - [ITER](#), Large Hadron Collider - [LHC](#), Linac Coherent Light Source - [LCLS](#)) scientific research communities using globally distributed tera/petascale class computing environments, and leading edge researchers exploiting exascale class supercomputers to simulate physical processes, will all produce and/or consume large amounts of data. The common element that enables these activities is a federated collection of high-performance networks with unprecedented end-to-end capabilities. Projections show that

DOE's Energy Science Network ([ESnet](#)) will need to support Tb/sec transmission rates by 2015-2016. While industry will supply the underlying optical technologies to build the network, DOE will need to develop and deploy the tools and services that will allow scientists to exploit this advanced infrastructure.

This Announcement calls for innovative approaches to develop federated terabit network tools and services that address DOE's emerging network challenges. The major priorities in addressing these challenges include mechanisms that: allow hosts to create/terminate a dynamic circuit; isolate high-impact science flows from normal traffic flows; allow flows to seamlessly move between shared Internet Protocol (IP) and dynamic circuit infrastructures; allow network operators to effectively manage their part of the end-to-end path; perform fault diagnosis and performance prediction; allow flows to operate across domain boundaries; co-schedule components/resources needed by an application; and predict application behavior notifying users/administrators when it falls below a threshold. Projects supported by this Announcement may be a combination of algorithms, hardware, software, and/or radical concepts that scale beyond what can be achieved over today's infrastructure. Proposals should also address how their solutions could be deployed, tested, and integrated into DOE network infrastructure.

Please see the SUBMISSION section below for further instructions on the method of submission for the proposal.

SUBMISSION INSTRUCTIONS

Have your LAB administrator submit the entire LAB proposal and Field Work Proposal (FWP) via Searchable FWP (<https://www.osti.gov/fwp>). If you have questions about who your LAB administrator is or how to use Searchable FWP, please contact the Searchable FWP Support Center.

All submissions and inquiries about this Program Announcement must reference Program Announcement LAB 11-523.

FOR FURTHER INFORMATION CONTACT:

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DATES:

Full proposals submitted in response to this Announcement must be received by May 23, 2011, 11:59 p.m. Eastern Time, to be accepted for merit review and to permit timely consideration for award in Fiscal Year 2011. Please see the SUBMISSION INSTRUCTIONS below.

SUPPLEMENTARY INFORMATION:

The focus of this Announcement is to build upon the optical network industry standards and deployed optical network infrastructure in DOE to address emerging terabit network challenges summarized above and detailed in workshop reports [1], [2], and [3]. The ultimate goal of the research activities generated by this Announcement are to: 1) develop mechanisms and frameworks to develop, deploy, and operate federated multi-domain Tbps networks; 2) remove performance bottlenecks in hosts and other network attached devices; and 3) enable distributed high-end science application to fully exploit terabit networks. Although a wide range of technical issues exist in end-to-end terabit networks, current program priorities are in the following critical technical areas: a) federated terabit network services and tools, b) terabit end system technologies, and c) scalable tools and services for terabit network-aware applications.

A) Federated terabit network services and tools – This technical topic deals with research and development of system-level tools and services that can be deployed over multi-domain terabit networks built with industry standard optical components. Research activities which make significant changes to industry standards and vendors equipments are beyond the scope of this ANNOUNCEMENT. The current priorities for this topic include but are not limited to:

- Novel traffic engineering concepts and security frameworks that will enhance and secure DOE's [On-demand Secure Circuits and Advance Reservation System](#) (OSCARS) to support on-demand and guaranteed end-to-end circuits across federated research and education network domains.
- Advanced multi-layer and multi-domain services and tools to enable dynamic hybrid networking capabilities based on the emerging 100 Gbps link technologies.
- Advanced services and tools for measuring, monitoring, modeling, and validating end-to-end performance and fault diagnosis capabilities that scale effectively to Tbps rates.

B) Terabit end system technologies – Hosts and end systems have historically introduced their own set of performance bottlenecks into end-to-end paths. Today's end systems built with multi-core technologies and parallel Input/Output (I/O) sub-systems offer a high-degree of parallelism that can be explored in solving these problems. This topic addresses the technical challenges of Local Area Networks (LANs) and end systems hosting extreme-scale science applications.

Specific issues of interest include, but are not limited to:

- Composable high-speed (Terabit/sec) transport protocols that can be dynamically re-configured for Storage Area Network (SANS): Remote Direct Memory Access (RDMA), Fiber Channel (FC), Internet Small Computer System Interface (iSCSI), on-demand circuits, best-effort IP, or a hybrid combination in federated networking environments,
- Scalable and secure APIs (Application Programming Interfaces) and services to extend dynamic network provisioning capabilities, (e.g., OSCARS, Multi-protocol Label Switching (MPLS)/ Generalized Multi-Protocol Lambda Switching (GMPLS), OpenFlow) to end host systems or storage systems and high-end science applications),
- Innovative protocols or services that hide network complexity from applications while exposing enough information to support end-to-end performance monitoring and faults diagnosis

C) Scalable tools and services for terabit network-aware applications – this technical topic addresses the fundamental challenges in tools and services that enable high-end science applications to take full advantage of terabit network capabilities. Potential technical topics of interest include, but are not limited to:

- Advanced tools or services that enable distributed high-end science applications to effectively exploit terabits network capabilities, perform monitoring, fault diagnosis, or measure end-to-end performance,
- Network-aware resource brokers that can discover and co-schedule network, storage, and related resources to enable the transfer of massive data sets,
- Innovative performance models that can accurately describe or predict how high-end science applications perform over advanced network infrastructures.

For more information, please see the following workshop and conference reports:

- [1] Terabit networks for extreme scale science, February 16-17, 2011, Rockville, Maryland, [Report](#) (PDF)
- [2] Workshop Report on Advanced Networking for Distributed Petascale Sciences: R&D Challenges and Opportunities, April 8-9, 2008, [Report](#) (pdf)
- [3] Science Driven R&D Requirements for ESnet Workshop, April 23-24, 2007 - [Report](#) (pdf)
- [4] Networking Requirements Workshop- Office of Biological and Environmental Research, April 29-30, 2010- [Report](#) (pdf)
- [5] Networking Requirements Workshop- Office of Basic Energy Sciences - [Report](#) (pdf)
- [6] Networking Requirements Workshop- Report: Office of Fusion Energy, Conducted March 13 and 14, 2008 -[Report](#) (pdf)
- [7] ESnet Future Technology Assessment and Requirements Dynamic Bandwidth and Circuit Provisioning - [Report](#) (pdf)
- [8] ESnet On-Demand Secure Circuits and Advanced Reservation Systems Federation Networking, [Report](#) (ppt)
- [9] Multi-Layer Networking -- An Architecture Framework, [Report](#) to download (pdf)

DOE Networking Facilities Awareness

The ultimate goal of this ANNOUNCEMENT is to develop advanced networking technologies that can be integrated into DOE's network infrastructures that include ESnet (<http://www.es.net/>) and related supporting systems in DOE national laboratory systems. Grant applications should therefore address how they plan to collaborate with related research efforts or DOE production facilities to facilitate the adoption of their proposed technology. To facilitate this process, the DOE Advanced Network Initiative (ANI) network research testbed (<https://sites.google.com/a/lbl.gov/ani-testbed/>) is available to assist researchers to develop and test advanced disruptive technologies that cannot be directly deployed in production network facilities.

Collaboration

Applicants are encouraged to collaborate with researchers in other institutions, such as universities, industry, non-profit organizations, federal laboratories and Federally Funded Research and Development Centers (FFRDCs), including the DOE National Laboratories, where appropriate. Additional information on developing and submitting collaborative submissions can be found in the [FAQ](#).

Funding

It is anticipated that up to a total of \$3.7 million annually will be available for multiple awards for this program. Awards are planned to be made in Fiscal Year 2011, and may occur in FY12. The funding level for single investigator/institution is \$250K and \$1M for multi-institutional projects. All awards are contingent on the availability of funds and programmatic needs. DOE is under no obligation to pay for any costs associated with the preparation or submission of an proposal. DOE reserves the right to fund, in whole or part, any, all, or none of the proposals submitted in response to this Notice.

It is anticipated that selections will be completed by July 29, 2011. Laboratory awards will be made in Fiscal Year 2011.

The instructions and format described should be followed. You must reference Program Announcement LAB 11-523 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

After an initial screening for eligibility and responsiveness to this Announcement, proposals will be subjected to a formal scientific merit review (peer review). The proposals 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) Scope of the Proposed Collaborative Effort, is the scope of the proposal sufficient to address the range of challenges presented in developing a generic future detector technology
- 4) Competency of Researcher's Personnel and Adequacy of Proposed Resources; and

5) Reasonableness and Appropriateness of the Proposed Budget.

In considering item 1 particular attention will be paid to:

- the importance of the physics that motivates developing the proposed detector,
- whether the proposed research is generic detector research that will benefit more than one experiment or research area,
- the magnitude of the potential beneficial impact versus the risk of failure.

In considering item 3 particular attention will be paid to:

- the breadth and depth of the collaborative proposal.

The evaluation process will include program policy factors such as the relevance of the proposed research to the terms of the Announcement and the agency's programmatic needs. Note that external peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Both Federal and non-Federal reviewers may be used, and submission of a proposal constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

2. Summary of Proposal Contents

- Field Work Proposal (FWP) Format (Reference DOE Order 412.1A) (DOE ONLY)
- Proposal Cover Page - **Terabit Networking for Extreme-Scale Science (LAB 11-523)**
- 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 - 25-page limit)
- Literature Cited
- Biographical Sketch(es)
- Description of Facilities and Resources
- Other Support of Investigator(s)
- Appendix (optional)

DATES

Full proposals submitted in response to this Announcement must be received by May 23, 2011, 11:59 p.m. Eastern Time, to be accepted for merit review and to permit timely consideration for award in Fiscal Year 2011. Please see the SUBMISSION INSTRUCTIONS below.

2.1 Submission Instructions

Have your LAB administrator submit the entire LAB proposal and FWP via Searchable FWP (<https://www.osti.gov/fwp>). All submissions and inquiries about this Program Announcement must reference Program Announcement LAB 11-532. If you have questions about who your LAB administrator is or how to use Searchable FWP, please contact the Searchable FWP Support Center.

For further information contact:

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E-mail: Richard.carlson@science.doe.gov

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 his or her proposal. 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 at least 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) (DOE ONLY)

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.

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 and number: **Terabit Networking for Extreme-Scale Science (LAB 11-523)**
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 the entire project period and 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

Summarize the proposal in one page. 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 lead DOE national Laboratory, 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 a **maximum of 25 pages**. 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. It is important that the 25-page technical information section provide a complete description of the proposed work, because reviewers are not obliged to read the Appendices. Proposals exceeding these page limits may be rejected without review or the first 25 pages may be reviewed without regard to the remainder.

All proposals submitted in response to this LAB Announcement must explicitly state how the proposed project will support the accomplishment of the program goals and the HEP mission, including the project's impact on applications of interest to the Office of Science.

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 Literature Cited

Give full bibliographic entries for each publication cited in the narrative. Each reference must include the names of all authors (in the same sequence in which they appear in the publication),

the article and journal title, book title, volume number, page numbers, and year of publication. Include only bibliographic citations. Principal investigators should be especially careful to follow scholarly practices in providing citations for source materials relied upon when preparing any section of the proposal.

3.8 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 and must include:

Education and Training. Undergraduate, graduate and postdoctoral training, provide institution, major/area, degree and year.

Research and Professional Experience. Beginning with the current position list, in chronological order, professional/academic positions with a brief description.

Publications. Provide a list of up to 10 publications most closely related to the proposed project. For each publication, identify the names of all authors (in the same sequence in which they appear in the publication), the article title, book or journal title, volume number, page numbers, year of publication, and website address if available electronically. Patents, copyrights and software systems developed may be provided in addition to or substituted for publications.

Synergistic Activities. List no more than five professional and scholarly activities related to the effort proposed.

To assist in the identification of potential conflicts of interest or bias in the selection of reviewers, the following information must also 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. Finally, list any individuals who are not listed in the previous categories with whom you are discussing future collaborations. 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.

3.9 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).

3.10 Other Support of Investigators

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.

3.11 Appendix

Information not easily accessible to a reviewer may be included in an appendix, but **do not use the appendix to circumvent the page limitations of the proposal**. 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 \$50,000 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.