

**Program Announcement
To DOE National Laboratories**



**U.S. Department of Energy
Office of Science
Advanced Scientific Computing Research (ASCR)**

**Big Data-Aware Terabits Networking
LAB 13-883**

Amendments made 3/25/2013: The following items have been changed.

Deadlines on pages 3 and 15

End dates on page 16

**GENERAL INQUIRIES ABOUT THIS PROGRAM ANNOUNCEMENT TO DOE
NATIONAL LABORATORIES SHOULD BE DIRECTED TO:**

Technical/Scientific Program Contact:
Dr. Thomas Ndousse-Fetter
Office of Advanced Scientific Computing Research
Phone: 301-335-4876
Email: Thomas.ndousse-Fetter@science.doe.gov

SUMMARY

The Office of Advanced Scientific Computing Research (ASCR) in the Office of Science (SC) at the U.S. Department of Energy (DOE) hereby announces its interest in receiving grant proposals to address the networking challenges of scientific Big Data across the Office of Science. DOE's scientific instruments, observatories, and supercomputers are increasingly generating complex heterogeneous massive data sets that are revolutionizing the conduct of science and overwhelming scientific computing and network infrastructures. In particular, these massive data sets are introducing distributed data management challenges that cannot be adequately addressed with current state-of-the-art Internet-based networking and commercial storage system management technologies. This PROGRAM ANNOUNCEMENT has two main objectives: 1) to conduct research on terabit data-aware network technologies and storage system management to address scientific Big Data infrastructure challenges, and 2) to explore innovative theoretical frameworks, network-aware data management concepts, and storage system performance optimization models that will improve our understanding of how complex heterogeneous massive data sets should be organized, stored, and shared.

As major computational science efforts increasingly depend on the manipulation of complex data sets, scientists face considerable hardship and waste of productive time in locating, accessing, and moving complex data sets in batch-oriented or streaming modes over current networks.

Incremental improvements of the current Internet's best-effort Transmission Control Protocol/Internet protocol (TCP/IP) networking technologies have so far met the needs of some distributed High-Performance Computing (HPC) ps. However, this incremental approach may not produce networks with adequate capabilities to support emerging network-intensive science proposals that involve the movement of massive data sets. Moving large data sets over Wide Area Networks (WANs) will introduce complex network traffic patterns and distributed data management that will require advanced network capabilities that far outstrip what is available in most commercial networks today. Proposals must therefore focus on those data-aware network technologies that can deliver 100x end-to-end throughputs to distributed data-intensive science proposals.

Proposals must be submitted through a DOE national laboratory. A companion funding opportunity announcement (DE-FOA-0000883) available on Grants.gov describes the Big Data-Aware Terabits Networking funding opportunity for institutions that are not DOE national laboratories. Consult DE-FOA-0000883 for information on eligibility for that announcement.

More specific information is included under SUPPLEMENTARY INFORMATION below.

PROPOSAL DUE DATE: April 19, 2013 at 5:00 PM Eastern time

Formal proposals submitted in response to this Program Announcement must be received by **April 19, 2013 at 5:00 PM Eastern time**, to permit timely consideration of awards in Fiscal Year 2013. **You are encouraged to transmit your proposal well before the deadline. PROPOSALS RECEIVED AFTER THE DEADLINE WILL NOT BE REVIEWED OR CONSIDERED FOR AWARD.**

IMPORTANT SUBMISSION INFORMATION:

Full proposals must be submitted into the DOE Office of Science Portfolio Analysis and Management System (PAMS). For help with PAMS, click the “External User Guide” link on the PAMS website, <https://pamspublic.science.energy.gov/>. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9:00 AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free number) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this Program Announcement should reference **LAB 13-883**. Full proposals submitted in response to this Program Announcement must be submitted into PAMS no later than **April 19, 2013 at 5:00 PM Eastern time**.

All PIs and those submitting on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to ensure timely submissions. To register, click “Create New PAMS Account” on the website <https://pamspublic.science.energy.gov/> and follow the instructions for creating an account.

The following information is provided to help with proposal submission. Detailed instructions and screen shots can be found in the user guide. To find the user guide, click the “External User Guide” link on the PAMS home page. Onscreen instructions are available within PAMS.

- Log into PAMS. From the proposals tab, click the “View DOE National Laboratory Announcements” link and find the current announcement in the list. Click the “Actions/Views” link in the Options column next to this announcement to obtain a dropdown menu. Select “Submit Proposal” from the dropdown.
- Note that you must select one and only one Principal Investigator (PI) per proposal; to do so, click the “Select PI” button on the far right side of the screen. Find the appropriate PI from the list of all registered users from your institution returned by PAMS. (Hint: You may have to sort, filter, or search through the list if it has multiple pages.) Click the “Actions” link in the Options column next to the appropriate PI to obtain a dropdown menu. From the dropdown, choose “Select PI.”
- If the PI for whom you are submitting does not appear on the list, it means he or she has not yet registered in PAMS. For your convenience, you may have PAMS send an email invitation to the PI to register in PAMS. To do so, click the “Invite PI” link at the top left of the “Select PI” screen. You can enter an optional personal message to the PI in the “Comments” box, and it will be included in the email sent by PAMS to the PI. You must wait until the PI registers before you can submit the proposal. Save the proposal for later work by selecting “Save” from the dropdown at the bottom of the screen and then clicking the “Go” button. It will be stored in “My Proposals” for later editing. As a minimum, you must complete all the required fields on the PAMS cover page before you can save the proposal for the first time.
- The cover page, budget, and attachments sections of the lab proposal are required by PAMS before it can be submitted to DOE.
- Complete the sections in PAMS one at a time, starting with the cover page and following the instructions for each section.

- Click the “+View More” link at the top of each section to expand the onscreen instructions. On the budget section, click the “Budget Tab Instructions” link to obtain detailed guidance on completing the budget form.
- Save each section by selecting either “Save” (to stay in the same section) or “Save... and Continue to the Next Section” (to move to the next section) from the dropdown menu at the bottom of the screen, followed by clicking the “Go” button.
- If you save the proposal and navigate away from it, you may return later to edit the proposal by clicking the “View My Existing Proposals” or “My Proposals” links within PAMS.
- You must enter a budget for each annual budget period.
- You must also enter a budget for each proposed sub-award. The sub-award section can be completed using the same steps used for the budget section.
- In the attachments section of the lab proposal, the abstract, the budget justification, and the proposal narrative are required and must be submitted as separate files.
- You must bundle everything other than the budget, abstract, and budget justification into one single PDF file to be attached under “Proposal Attachment.”
- Do not attach anything under “Other Attachments.”
- To upload a file into PAMS, click the “Attach File” button at the far right side of the screen. Click the “Browse” (or “Choose File” depending on your browser) button to search for your file. You may enter an optional description of the file you are attaching. Click the “Attach” button to upload the file.
- Once you have saved all of the sections, the “Submit to DOE” option will appear in the dropdown menu at the bottom of the screen.
- To submit the proposal, select “Submit to DOE” from the dropdown menu and then click the “Go” button.
- Upon submission, the PI will receive an email from the PAMS system acknowledging receipt of the proposal.
- The proposal will also appear under My Proposals with a Proposal Status of “Submitted to DOE.”

Please only submit a PAMS lab technical proposal in response to this announcement; do not submit a DOE Field Work Proposal (FWP) at this time. The Office of Advanced Scientific Computing Research will request FWPs later from those who are selected for funding under this announcement.

For help with PAMS, click the “External User Guide” link on the PAMS website, <https://pamspublic.science.energy.gov/>. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9:00 AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free number) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this Program Announcement should reference **LAB 13-883**.

SUPPLEMENTARY INFORMATION

Scientists today encounter many challenges in conducting research that involves large shared data sets. Many of the challenges have to do with how massive data sets generated by complex instruments and supercomputers are captured, archived, searched, and shared among

geographically distributed research teams. Other challenges are due to the performance limitations of conventional distributed data management systems and associated network infrastructure bottlenecks that hinder the timely and reliable distribution of large data sets. End systems such as storage systems, file systems, metadata, and Data Transfer Nodes (DTN) continue to be challenging performance bottlenecks in high-speed data movement. The performance of storage systems has not kept up with that of other computing hardware and advanced optical network components. This introduces a major throughput mismatch between end-system and backbone networks that impact end-to-end throughputs. Additionally, current distributed data movement systems, optimized for batch-oriented data transfers, lack the capability to meet the diverse needs of emerging data-centric applications with real-time constraints. For example, support for online data exploration, remote I/O operation, remote visualization, and on-demand data movement at execution time is lacking in current systems. In particular, given that online data explorations are emerging as a new modality of scientific inquiry around scientific instruments such as light sources, the need for such capability will be critical in the next few years.

Grant applicants interested in addressing the above challenges should focus on scaling existing network technologies or developing radically new ones. The common thread that should run across all proposed solutions is data awareness and 100x network throughputs for data movement applications. The outcomes of successful research awards funded under this PROGRAM ANNOUNCEMENT are anticipated to be technologies that could be seamlessly integrated into DOE's production network and storage system infrastructures or theoretical concepts, methodologies, and optimization models that improve our understanding of organizing and sharing complex scientific massive data sets. The above challenges are summarized into two main categories corresponding to the following two major technical areas of research:

- a) **Terabit data-aware network technologies** –The focus of this topic is on innovative network technologies optimized for automated sharing of complex data over ultra-high-speed optical networks. The proposed technologies should be able to deliver end-to-end throughputs several orders of magnitude greater than what is possible today promptly and reliably. Despite the abundant bandwidth in the backbone networks made possible by Dense Wave Division (DWDM) Multiplexing) optical communication technology, scientists continue to face insurmountable challenges in transferring massive data promptly. The low throughput of end-to-end distributed data-intensive applications can be attributed to the pervasive use of best-effort TCP/IP network technologies, legacy ftp-based file transfer software, and low-speed network security systems that do not fully exploit parallelism in emerging hardware and software subsystems. Beyond the throughput issues, scientists need intelligent data-aware network middleware services embedded in applications that facilitate the automated discovery, query, and transfer of complex data sets at execution time or offline. The objective of grant awards in this topic is to develop scalable and automated network solutions to address the above issues. Applicants interested in this topic are encouraged to address these challenges with innovative and scalable network protocols, intelligent network traffic management schemes, and associated network-aware data management services, while exploiting multicore parallelism to scale the resulting software implementations whenever possible. These include but are not limited to (a) scalable and composable transport network protocols that can be dynamically configured to handle different modes of data transfer

modes, including real-time, batch, and streaming traffic over different types of transport networks (dynamic circuits, shared networks) at speeds several orders of magnitude (100x) greater than what is possible with existing ones; (b) automated high-speed data movement software that dynamically adapts to a wide variety of transport protocols (TCP, UDP-based Data Transfer), RoCE (RDMA over Converge Ethernet), IB (InfiniBand), etc.); (c) intelligent traffic management schemes that leverage the emerging Software-Defined Networking (SDN) concepts to simplify the management of complex end-to-end network flows resulting from large data movements; d) intelligent high-speed network security technologies for Science De-Militarized Zone (DNZ) such as smart high-speed firewalls, dynamic circuit authentication mechanisms; and e) data movement workflows that simplify or automate the sharing of complex data sets for scientists.

- b) **Network-Aware Storage and File System Middleware** – The focus of this topic is on improving the performance and reliability of end systems (storage systems, file systems, metadata, disk-to-network I/O, and data transfer nodes) involving high-speed data transfers. The volume of data anticipated in the next decade will drastically increase the complexity of these end systems, making them a source of potential data movement bottlenecks. In particular, given that the performance of disk systems has not kept up with advances in many areas of computing, improving the performance of end systems will require innovative network-aware storage management middleware to bridge the performance gap between low-speed disk-to-network I/O subsystems and ultra-high-speed optical network links. It has been shown that data movement applications cannot be achieved at line rates over 100 Gbps optical links because end systems cannot source and ingest data at these rates. In many data movement scenarios, the data transfer nodes are not provisioned to provide QoS services that take full advantage of dynamic circuit reservation and on-demand bandwidth services available in backbone networks such as the ESnet's OSCARS bandwidth reservation system. These and other related end-system issues highlight the challenges that must be addressed to improve the throughput of end-to-end data transfers. Grant applicants interested in this topic are encouraged to propose innovative frameworks, methodologies, protocols, and optimization models that significantly improve the throughput of end systems in distributed data-centric environments. Potential areas of interest include but are not limited to (a) storage resource brokers and co-schedulers to coordinate end-to-end data movement resources, (b) end-system QOS mechanisms that are linked to WAN provisioning schemes such as ESnet's OSCARS, (c) scalable parallel file systems and metadata extensions to improve disk-to-network I/O performance, and d) network-aware storage system virtualization capabilities.

Proposals may focus on other related high-performance networks and storage systems; however, they must address the two main elements of this Program Announcement, namely 100x network capability and scientific Big Data awareness. Research themes specific to a single proposal or limited to a single laboratory are strongly discouraged. All proposed solutions must be generic enough to support a wide range of applications in different laboratories or science environments.

References

- [01] DOE ASCR 2011 Scientific Collaborations for Extreme-Scale Science (SCCESS) Workshop, December 6-7, 2011, Gaithersburg Marriott Washington Center, Gaithersburg,

- MD - SCESS Workshop ([Report in PDF](#))
- [02] Terabits Networks for Extreme-Scale Science, February 16-17, 20011, Rockville Hotel & Executive Meeting Center, MD – ([Report in PDF](#))
 - [03] Data and Communications in Basic Energy Sciences: Creating a Pathway for Scientific Discovery Workshop, October 24-25, 2011, Bethesda Marriott Hotel and Conference Center, Bethesda, MD – [PDF Report](#)
 - [04] DOE Exascale Workshop on Data Analysis, Management, and Visualization Workshop, February 22-23, 2011, Hilton Hotel, Houston, TX – [PDF Report](#)
 - [05] Fusion Energy Network Requirements Workshop, December 2011 - Final Report, ESnet Network Requirements Workshop, December 8, 2011, ([Report.pdf](#))
 - [06] Nuclear Physics Network Requirements Workshop, August 2011 - [Report.pdf](#)
 - [07] Cross-cutting Technologies for computing at the Exascale Workshop, February 2-4, 2010, Washington DC – [PDF Report](#)
 - [08] Science Driven R&D Requirements for ESnet Workshop, April 23-24, 2007 - [Report](#) (pdf)
 - [09] Networking Requirements Workshop- Office of Biological and Environmental Research, April 29-30, 2010- [Report](#) (pdf)
 - [10] Networking Requirements Workshop- Office of Basic Energy Sciences - [Report](#) (pdf)
 - [11] ESnet On-Demand Secure Circuits and Advanced Reservation Systems Federation Networking, [Report](#) (ppt)
 - [13] A. Shoshani et al, Scientific Data management, CRC Press, pp. 773-180, 2009

ADDITIONAL REQUIREMENTS:

Annual Meeting

If a project is funded, beginning in the first year of funding, one or more project participants will be required to attend an annual investigator meeting, generally held in the Washington, DC, area.

Reasonable travel expenses may be included as part of the project budget.

Collaboration

Collaborative research projects with other institutions such as universities, industry, non- profit organizations, and Federally Funded Research and Development Centers (FFRDCs), including the DOE National Laboratories are strongly encouraged but not required. Collaborative proposals submitted from different institutions should clearly indicate they are part of a proposed collaboration. All collaborative proposals must use the same title, abstract and technical narrative. In addition, such proposals must describe the work and the associated budget for the research effort to be performed under the leadership of the principal investigator in each participating institution. The first page of collaborative proposals should contain the project title followed by a tabular list of the researcher names, institutions, annual budget, and role as lead PI or co-PI of each participant. These collaborative proposals should all have the same title as the lead institution. Each collaborating institution submitting a proposal must use the same title.

Our intent is to create from the various proposals associated with a collaborative group one document for merit review that consists of the common, identical proposal materials combined with a set of detailed budgets from the partner institutions. Thus, it is very important that every proposal in the collaborative group be exactly identical (including the title) with the exception of the budget and budget justification pages.

Collaborative proposals from institutions other than DOE National Laboratories should be submitted following the above rules in response to the companion announcement, DE-FOA-0000883.

Award Information

TYPE OF AWARD INSTRUMENT

DOE anticipates awarding laboratory work authorization awards under this DOE National Laboratory Announcement.

ESTIMATED FUNDING

It is anticipated that up to \$3,000,000 per year will be available under this DOE National Laboratory Announcement and Funding Opportunity Announcement DE-FOA-0000883, contingent on satisfactory peer review and the availability of appropriated funds. Applicants should request project support for up to 3 years, with out-year support contingent on the availability of appropriated funds, progress of the research, and programmatic needs. Awards are expected to begin in FY 2013.

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

MAXIMUM AND MINIMUM AWARD SIZE

Ceiling

The maximum award for single-investigator/single-institution proposals is \$400,000 per year. The maximum award for multi-investigator/multi-institution proposals is \$800,000 per year. Multiple investigator awards must involve multiple institutions. Proposals that exceed these funding limits will not be reviewed.

Floor

None

EXPECTED NUMBER OF AWARDS

DOE anticipates making approximately 8 single-investigator awards and 1-2 multi-institution/multi-investigator awards under this DOE National Laboratory Announcement and Funding Opportunity Announcement DE-FOA-0000883. The number of awards will depend on

the number of meritorious applications and the availability of appropriated funds.

ANTICIPATED AWARD SIZE

The anticipated maximum award size over 3 years is \$1,200,000 for single investigator projects and \$2,400,000 for multi-investigators/institutions over 3 years. Typical budgets per year will be \$400,000 per year for three years for single investigators and \$800,000 for multi-investigator/multi-institution projects for three years. Proposals that exceed these funding limits will not be reviewed.

PERIOD OF PERFORMANCE

DOE anticipates making awards with a project period of three years. Out-year funding will depend upon suitable progress and the availability of appropriated funds.

TYPE OF PROPOSAL

DOE will accept new laboratory technical proposals through the Portfolio Analysis and Management System (PAMS, located at <https://pamspublic.science.energy.gov>) under this Announcement. DOE is only accepting laboratory technical proposals submitted into PAMS for this announcement. Do not submit or attach a DOE Field Work Proposal (FWP) at this time. Do not use Searchable FWP to respond to this announcement.

The program office will request submission of Field Work Proposals later from only those who are selected for funding.

All PIs and those submitting on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to avoid submission delays. You may establish a PAMS account at <https://pamspublic.science.energy.gov/>.

For help with PAMS, click the “External User Guide” link on the PAMS website, <https://pamspublic.science.energy.gov/>. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9:00 AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free number) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this Program Announcement should reference **LAB 13-883**.

Everything other than the budget, the abstract, and the budget justification should be combined into a single Portable Document Format (PDF) file. Submit the budget, abstract, budget justification, and proposal pdf into PAMS. Each DOE national laboratory has already appointed and registered at least one administrative business officer into PAMS. If you need contact information for your Administrative business officer, please contact the PAMS Support Center.

ELIGIBILITY

This is a DOE Lab-only Announcement. FFRDCs from other Federal agencies are not eligible to submit in response to this Program Announcement.

For official postings see the Office of Science Grants and Contracts web site, <http://www.science.doe.gov/grants>.

COST SHARING

Cost sharing is not required.

ELIGIBLE INDIVIDUALS

Individuals with the skills, knowledge, and resources necessary to carry out the proposed research as a Program Director/Principal Investigator are invited to work with their organizations to develop a proposal. Individuals from underrepresented groups as well as individuals with disabilities are always encouraged to apply for funding.

MERIT REVIEW

Proposals will be subjected to a formal merit review and will be evaluated based on criteria based on those codified at 10 CFR 605.10(d) in accordance with the guidance provided in the “Office of Science Merit Review System for Financial Assistance,” which is available at: <http://www.sc.doe.gov/grants/merit.asp>.

SELECTION

The Selection Officials will consider merit review recommendations as well as program policy factors, such as ensuring a programmatically appropriate balance within the program areas, and quality of previous performance. Selection of proposals for award will be based upon the findings of the technical evaluations, the importance and relevance of the proposed research to the SC mission, and funding availability.

AWARD NOTICES

It is anticipated that the award selection will be completed by June 15, 2013. DOE will notify proposers selected for award. This notice of selection is not an authorization to begin performance. Organizations whose proposals have not been selected will be advised as promptly as possible. This notice will explain why the proposal was not selected.

LATE SUBMISSIONS

Late submissions will not be accepted in this DOE National Laboratory Announcement. However, delays in submitting letters of intent, preproposals, and proposals may be unavoidable.

DOE has accepted late submissions when applicants have been unable to make timely submissions because of technological disruptions or significant natural disasters. Other circumstances do not justify late submissions. Unacceptable justifications include the following:

- Failure to begin submission process early enough.
- Failure to provide sufficient time to complete the process.
- Failure to understand the submission process.
- Failure to understand the deadlines for submissions.
- Failure to satisfy prerequisite registrations.
- Unavailability of administrative personnel.

AVAILABILITY OF FUNDS

Funds are not presently available for this award. The Government's obligation under this award is contingent upon the availability of appropriated funds from which payment for award purposes can be made. No legal liability on the part of the Government for any payment may arise until funds are made available to the Contracting Officer for this award and until the awardee receives notice of such availability, to be confirmed in writing by the Contracting Officer.

The instructions and format described below should be followed. You must reference Program Announcement LAB 13-883 on all submissions and inquiries about this program.

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

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.

Prior to a comprehensive merit evaluation, SC will perform an initial review to determine that (1) the applicant is eligible for the award; (2) the information required by this announcement has been submitted; (3) all mandatory requirements are satisfied; (4) the proposed project is responsive to the objectives of the announcement, and (5) the proposed project is not duplicative of programmatic work. proposals that fail to pass the initial review will not be forwarded for merit review and will be eliminated from further consideration.

Applications requesting more funding than permitted will fail the initial review:

Type of Application	Maximum Total Budget	Maximum Annual Budget
Single investigator	\$1,200,000	\$400,000
Multi-investigator / multi-institution	\$2,400,000	\$800,000

Applications requesting funding for international travel will fail the initial review.

Evaluation Criteria

- Scientific and/or Technical Merit of the Project;
- Appropriateness of the Proposed Method or Approach;
- Competency of Applicant's Personnel and Adequacy of Proposed Resources; and
- 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 National Laboratory 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 an application constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

The questions below will be provided to the merit reviewers to elaborate the criteria established by regulation:

SCIENTIFIC AND/OR TECHNICAL MERIT OF THE PROPOSED RESEARCH

- Comment on the scientific objectives of the proposed research in terms of an achievable plan.

- Comment on the competence of the investigators, the institutionally available infrastructure, and proposed resources for achieving this plan.
- Comment on the likelihood that the specific project will lead to fundamental advances or discovery in its field within the proposed project period.
- Comment on whether or not the proposed research will significantly advance the state-of-the-art in operating systems and runtime software for Exascale computing.
- Comment on how comprehensive the proposed solution is and how well it addresses all identified challenges in this area.
- Comment on how well the proposed research deals with a dynamic environment resulting from adaptive hardware and software mechanisms as well as from transient faults.
- What is the likelihood that the applicant can overcome the key challenges and, as warranted, shift research directions in response to promising advances in basic research?
- Assess strengths and weaknesses of each high-impact, high-risk research component proposed.
- Comment on the required plans listed in the Summary of Proposal Requirements section.

APPROPRIATENESS OF THE PROPOSED METHOD OR APPROACH

- How logical and feasible are the proposed research approaches?
- Does the proposed research employ innovative concepts or methods?
- Are the conceptual framework, methods, and analyses well justified, adequately developed, and likely to lead to scientifically valid conclusions?
- To what extent does the applicant recognize significant potential problems and consider alternative strategies?
- Does the proposed research leverage the nominal architecture? If no, comment on the presented justifications for creating a new one.
- Comment on the effectiveness of the proposed research effort in addressing the scientific issues and/or objectives of the proposed research.
- Provide separate assessment on the method and approach for each high impact, high risk research component proposed.
- Are details of the proposed OS/R prototype clearly presented?
- Comment on the proposed coordinating activities with X-Stack projects, Co-Design Centers, and other ASCR-funded projects.
- Does the research plan contain appropriate performance metrics that will allow progress and contributions to be measured?
- If this is a collaborative proposal, does it include a management plan that addresses the organization, communications, and coordination of the collaborating teams? Does it include mitigation strategies for foreseeable risks and explain how the project will have sufficient flexibility to adapt to changing priorities, challenges, and resources

COMPETENCY OF APPLICANT'S PERSONNEL AND ADEQUACY OF PROPOSED RESOURCES

- How well qualified are the applicant's personnel to carry out the proposed research?
- Comment on the applicants proven record of success in research and development in the disciplines needed for the proposed work.

- Comment on the applicants' proven record of delivering OS/R results for advanced computational science research.
- Are the roles and intellectual contributions of the Principal Investigator(s), and each senior/key personnel adequately described? Do you consider the contributions of each senior/key personnel of significant value for the project?
- Comment on the applicant's research environment and resources.
- Does the proposed work take advantage of unique facilities and capabilities and/or make good use of collaborative arrangements?
- How well versed are applicants on legacy scientific codes and OS/R issues?
- How well connected are applicants to the exascale ecosystem?
- Do applicants have sufficient connections with the vendor community in order to influence their support for research artifacts generated by the proposed work?

REASONABLENESS AND APPROPRIATENESS OF THE PROPOSED BUDGET

- Are the proposed budget and staffing levels adequate to carry out the proposed research?
- Is the budget as lean as it can be to deliver the promised results? Are budget overheads minimized?
- Does the requested budget support the applicant's specified management structure in a meaningful way?
- Is travel budget appropriate? Are video conferencing technologies proposed to reduce the travel budget?
- Is the requested budget appropriate to support the evaluation plan?

OTHER FACTORS

Merit reviewers will also be asked these questions:

- If applicable, please comment on the educational benefits of the proposed activity.
- What are the overall strengths and weaknesses of the proposal?

Summary of Proposal Contents and Information about PAMS

LETTERS

Do not submit general letters of support as these are not used in making funding decisions and can interfere with the selection of peer reviewers.

Optional letters of collaboration for unfunded or funded collaborations may be placed in Appendix 6 (Other Attachments). Letters of collaboration should state the intention to participate, but they should not be written as recommendation or endorsement letters, which are not allowed.

Each optional letter of collaboration may contain two and only two sentences and must use the following format:

Dear <Principal Investigator Name>:

If your proposal entitled, “<Proposal Name>,” is selected for funding under the DOE Office of Advanced Scientific Computing Big Data-Aware Terabits Networking announcement, it is my intent to collaborate in this research by <Complete Sentence With a Very Short Description of What the Collaborator Offers to Do or Provide>. Thank you for the opportunity to participate.

Sincerely,

<Collaborator’s Name and Signature Block>

Each proposal will contain the following sections:

- Budget, entered into PAMS as structured data using the PAMS budget form
- Abstract (one page), entered into PAMS as a separate pdf
- Budget justification, entered into PAMS as a separate pdf
- Proposal, combined into a single pdf containing the following information:
 - o Proposal Cover Page
 - o Table of Contents
 - o Project Narrative (main technical portion of the proposal, including background/introduction, proposed research and methods, timetable of activities, management plan and responsibilities of key project personnel – 25 page limit)
 - o Appendix 1: Biographical Sketch(es)
 - o Appendix 2: Current and Pending Support
 - o Appendix 3: Bibliography and References Cited
 - o Appendix 4: Facilities and Other Resources
 - o Appendix 5: Equipment
 - o Appendix 6: Other Attachments (optional)

SUBMISSION INSTRUCTIONS\

Full proposals must be submitted into the DOE Office of Science Portfolio Analysis and Management System (PAMS). For help with PAMS, click the “External User Guide” link on the PAMS website, <https://pamspublic.science.energy.gov/>. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9:00 AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free number) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this Program Announcement should reference **LAB 13-883**. Full proposals submitted in response to this Program Announcement must be submitted PAMS no later than **April 19, 2013, 5:00 PM Eastern Time**.

Detailed Contents of the Proposal

BUDGET AND BUDGET EXPLANATION

The budget must be submitted into PAMS using the PAMS budget form. Research proposed under this announcement should have five annual budget periods. Please enter the following budget period start and end dates into PAMS for proposals submitted to this announcement:

- Budget Period 1: 8/1/2013 – 7/31/2014
- Budget Period 2: 8/1/2014 – 7/31/2015
- Budget Period 3: 8/1/2015 – 7/31/2016

PAMS will calculate the cumulative budget totals for you.

A written justification of each budget item is to follow the budget pages. The budget justification should be placed in a separate, single pdf document and attached on the appropriate screen in PAMS.

Further instructions regarding the budget and justification are given below and in the PAMS software.

Project Summary/Abstract (no more than one page)

The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s) (PD/PI), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (i.e., benefits, outcomes), and major participants (for collaborative projects). This document must not include any proprietary or sensitive business information as the Department may make it available to the public. The project summary must not exceed 1 page when printed using standard 8.5" by 11" paper with 1" margins (top, bottom, left and right) with font not smaller than 11 point.

The abstract may be used to prepare publicly accessible reports about DOE-supported research. The one-page project summary/abstract should be placed in a separate, single pdf document and attached on the appropriate screen in PAMS.

PROPOSAL COVER PAGE

The proposal narrative should begin with a cover page that will not count toward the project narrative page limitation. The cover page must include the following items:

- The project title
- Applicant/Institution:
- Street Address/City/State/Zip:
- Postal Address:

- Lead PI name, telephone number, email:
- Administrative Point of Contact name, telephone number, email:
- Funding Opportunity FOA Number: LAB 13-883
- DOE/Office of Science Program Office:
- DOE/Office of Science Program Office Technical Contact:
- DOE Award Number (if Renewal Proposal):
- Research area or areas (as identified in Supplementary Information)

COVER PAGE SUPPLEMENT FOR COLLABORATIONS

If the project is a collaboration, provide the following information on a separate page as a supplement to the cover page.

- List all collaborating institutions by name with each institution's principal investigator on the same line.
- Indicate the lead PI who will be the point of contact and coordinator for the combined research activity.
- Include a table modeled on the following chart providing summary budget information from all collaborating institutions. Provide the total costs of the budget request in each year for each institution and totals for all rows and columns.

Collaborative Proposal Information

Collaborative Proposal Information						
	Names	Institution	Year 1 Budget	Year 2 Budget	Year 3 Budget	Total Budget
Lead PI						
Co-PI						
Co-PI						
Co-PI						

Example budget table (\$ in thousands)

* Note that collaborating proposals must be submitted separately.

PROJECT NARRATIVE (NO MORE THAN 25 PAGES LONG)

The project narrative must not exceed 25 pages of technical information, including charts, graphs, maps, photographs, and other pictorial presentations, when printed using standard 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right). The font must not be smaller than 11 point. Merit reviewers will only consider the number of pages specified in the first sentence of this paragraph. Proposals exceeding the page limit will be rejected without review.

Do not include any Internet addresses (URLs) that provide supplementary or additional information that constitutes a part of the proposal. Using Internet sites in an attempt to avoid page limits will fail: the content of those sites will not be reviewed. References

posted to an Internet-based archive or publications are permitted in a list of references. To attach a Project Narrative, click “Add Attachment.”

Background/Introduction: Explanation of the importance and relevance of the proposed work as well as a review of the relevant literature.

Proposed Research and Methods: Identify the hypotheses to be tested (if any) and details of the methods to be used including the integration of experiments with theoretical and computational research efforts.

Timetable of Activities: Timeline for all major activities including milestones and deliverables.

Project Objectives: This section should provide a clear, concise statement of the specific objectives/aims of the proposed project.

The Project Narrative comprises the research plan for the project. 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 method 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 project narrative 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. The page count of 25 does not include the Cover Page and Budget Pages, the Title Page, the biographical material and publication information, or any Appendices.

APPENDIX 1: BIOGRAPHICAL SKETCH(ES)

Provide a biographical sketch for the project director/principal investigator (PD/PI) and each senior/key person listed in the PAMS Budget form.

- Provide the biographical sketch information as an appendix to your project narrative.
- Do not attach a separate file.
- The biographical sketch appendix will not count in the project narrative page limitation.

The biographical information (curriculum vitae) for each person must not exceed 2 pages when printed on 8.5” by 11” paper with 1 inch margins (top, bottom, left, and right) with font not smaller than 11 point 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 5 professional and scholarly activities related to the effort proposed.

Identification of Potential Conflicts of Interest or Bias in Selection of Reviewers: Provide the following information in this section:

Collaborators and Co-editors: List in alphabetical order all persons, including their current organizational affiliation, who are, or who have been, collaborators or co-authors with you on a research project, book or book article, report, abstract, or paper during the 48 months preceding the submission of this proposal. For publications or collaborations with more than 10 authors or participants, only list those individuals in the core group with whom the Principal Investigator interacted on a regular basis while the research was being done. Also, list any individuals who are currently, or have been, co-editors with you on a special issue of a journal, compendium, or conference proceedings during the 24 months preceding the submission of this proposal. If there are no collaborators or co-editors to report, state “None.”

Graduate and Postdoctoral Advisors and Advisees: List the names and current organizational affiliations of your graduate advisor(s) and principal postdoctoral sponsor(s) during the last 5 years. Also, list the names and current organizational affiliations of your graduate students and postdoctoral associates during the past 5 years.

APPENDIX 2: CURRENT AND PENDING SUPPORT

Provide a list of all current and pending support (both Federal and non-Federal) for the Project Director/Principal Investigator(s) (PD/PI) and senior/key persons, including subawardees, for ongoing projects and pending proposals. For each organization providing support, show the total award amount for the entire award period (including indirect costs) and the number of person-months per year to be devoted to the project by the senior/key person. Provide the Current and Pending Support as an appendix to your project narrative. Concurrent submission of an proposal to other organizations for simultaneous consideration will not prejudice its review.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 3: BIBLIOGRAPHY AND REFERENCES CITED

Provide a bibliography of any references cited in the Project 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. For research areas where there are routinely more than ten coauthors of archival publications,

you may use an abbreviated style such as the Physical Review Letters (PRL) convention for citations (listing only the first author). For example, your paper may be listed as, "A Really Important New Result," A. Aardvark et. al. (MONGO Collaboration), PRL 999. You may also use this convention in the proposal bibliography. Include only bibliographic citations. Applicants should be especially careful to follow scholarly practices in providing citations for source materials relied upon when preparing any section of the proposal. Provide the Bibliography and References Cited information as an appendix to your project narrative.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 4: FACILITIES AND OTHER RESOURCES

This information is used to assess the capability of the organizational resources, including subawardee resources, available to perform the effort proposed. Identify the facilities to be used (Laboratory, Animal, Computer, Office, Clinical and Other). If appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Describe only those resources that are directly applicable to the proposed work. Describe other resources available to the project (e.g., machine shop, electronic shop) and the extent to which they would be available to the project. For proposed investigations requiring access to experimental user facilities maintained by institutions other than the applicant, please provide a document from the facility manager confirming that the researchers will have access to the facility. Please provide the Facility and Other Resource information as an appendix to your project narrative.

APPENDIX 5: EQUIPMENT

List major items of equipment already available for this project and, if appropriate identify location and pertinent capabilities. Provide the Equipment information as an appendix to your project narrative.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 6: OTHER ATTACHMENTS

Information not easily accessible to a reviewer may be included in this appendix, but do not use this 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).

Detailed Instructions for the Budget

Budgets are required for the entire project period. A budget form should be completed for each budget period of the award, and a cumulative budget form for the entire project period will be populated by PAMS. A detailed budget justification narrative should be included after the budget pages. The justification should cover labor, domestic travel, equipment, materials and supplies, and anything else that will be covered with project funds.

To edit a section on the budget, click the edit icon () for each section on the page. Remember to save all budget periods before moving on to the next section.

A. Senior/Key Person (Required)

For each Senior/Key Person, enter the appropriate information. List personnel, salary funds, and the number of months that person will be allocated to the project. Also include a written narrative in the budget justification that fully justifies the need for requested personnel.

B. Other Personnel

List personnel, salary funds, and the number of months that person will be allocated to the project. Also include a written narrative in the budget justification that fully justifies the need for requested personnel.

C. Equipment Description

For the purpose of this budget, equipment is designated as an item of property that has an acquisition cost of \$5,000 or more and an expected service life of more than one year. (Note that this designation applies for proposal budgeting only and differs from the DOE definition of capital equipment.) List each item of equipment separately and justify each in the budget justification section. Allowable items ordinarily will be limited to research equipment and apparatus not already available for the conduct of the work. General-purpose office equipment, such as a personal computer, is not eligible for support unless primarily or exclusively used in the actual conduct of scientific research.

D. Travel

In the budget justification, list each trip's destination, dates, estimated costs including transportation and subsistence, number of staff traveling, the purpose of the travel, and how it relates to the project. Indicate whether travel cost estimates are based upon quotes from travel agencies; upon past experience of similar number of trips to similar travel destinations; or something else (describe). 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.

Funds will not be awarded for international travel: do not request these costs in the budget.

Budgets should include a request for reasonable travel costs to a **mandatory** annual investigator meeting. The meetings will typically be held in the Washington, DC, area.

E. Participant/Trainee Support Costs:

If applicable, submit training support costs. Educational projects that intend to support trainees (precollege, college, graduate and post graduate) must list each trainee cost that includes stipend levels and amounts, cost of tuition for each trainee, cost of any travel (provide the same information as needed under the regular travel category), and costs for any related training expenses. Participant costs are those costs associated with conferences, workshops, symposia or institutes and breakout items should indicate the number of participants, cost for each participant, purpose of the conference, dates and places of meetings and any related administrative expenses. In the budget justification, indicate whether trainee cost estimates are based upon past experience of support of similar number of trainees on similar projects; past experience of support of similar number of participants attending similar conferences/workshops/symposia; or something else (describe).

F. Other Direct Costs:

Enter Other Direct Costs information for each item listed.

- **Materials and Supplies:** Enter total funds requested for materials and supplies in the appropriate fields. In the budget justification, indicate general categories such as glassware, and chemicals, including an amount for each category (items not identified under "Equipment"). Categories less than \$1,000 are not required to be itemized. In the budget justification, indicate whether cost estimates are based upon past experience of purchase of similar or like items; quotes/catalog prices of similar or like items; or something else (describe).
- **Publication Costs:** Enter the total publication funds requested. The proposal budget may request funds for the costs of documenting, preparing, publishing or otherwise making available to others the findings and products of the work conducted under the award. In the budget justification, include supporting information. In the budget justification, indicate whether cost estimates are based upon past experience of purchase of similar or like items; vendor quotes of similar publication services; or something else (describe).
- **Consultant Services:** Enter total funds requested for all consultant services. In the budget justification, identify each consultant, the services he/she will perform, total number of days, travel costs, and total estimated costs. In the budget justification, indicate whether consultant cost estimate is based upon previous experience/quotes for similar or like services; or something else (describe).
- **ADP/Computer Services:** Enter total funds requested for ADP/Computer Services. The cost of computer services, including computer-based retrieval of scientific, technical and education information may be requested. In the budget justification, include the established computer service rates at the proposing organization if applicable. In the budget justification, indicate whether cost estimates are based upon quotes/past experience of purchase of similar computer services; established computer service rates at the proposing institution; or something else (describe).
- **Subawards/Consortium/Contractual Costs:** Enter total costs for all subawards/consortium organizations and other contractual costs proposed for the project. In the budget justification, justify the details.
- **Equipment or Facility Rental/User Fees:** Enter total funds requested for Equipment or Facility Rental/User Fees. In the budget justification, identify each rental/user fee and justify. In the budget justification, indicate whether cost estimates are based upon past

experience with similar or like items; vendor quotes of similar items; or something else (describe).

- **Alterations and Renovations:** Enter total funds requested for Alterations and Renovations.
- In the budget justification, itemize by category and justify the costs of alterations and renovations, including repairs, painting, removal or installation of partitions, shielding, or air conditioning. Where applicable, provide the square footage and costs.
- **Other:** Add text to describe any other Direct Costs not requested above. Enter costs associated with “Other” item(s). Use the budget justification to further itemize and justify.

G. Direct Costs

This represents Total Direct Costs (Sections A thru F) and will be calculated by PAMS.

H. Other Indirect Costs

Enter the Indirect Cost information for each field. Only four general categories of indirect costs are allowed/requested on this form, so please consolidate if needed.

I. Total Direct and Indirect Costs

This amount will be calculated by PAMS (Sections G + H)