PathForward Project

Procurement & Materiel
University of California /DOE
Contract W-7405-ENG-48

May 2, 2001

Subject: **Request For Proposal (RFP) Number B514193**
Proposal Due Date: June 4, 2001

Dear RFP Recipient:

Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL) and Sandia National Laboratories (SNL) (hereinafter called the Tri-Labs and including the Department of Defense Maryland Office), in support of the U.S. Department of Energy, jointly request a proposal for ***The Development of New High Performance Computer File System Technology*** that can be integrated with current and upcoming file system technologies and lead to potential commercial products for future use within the high performance computing marketplace. This RFP is a result of collaboration among the Tri-Labs, the Department of Energy and the DOD Maryland Office. Proposals shall be in accordance with this RFP and the enclosed sample Subcontract.

The Board of Regents of the University of California (University) manages the Lawrence Livermore National Laboratory and conducts business under Laboratory Procurement Policies and Procedures consistent with the Prime Contract between the University and the United States Government represented by the Department of Energy (DOE). The University's Procurement office at LLNL will conduct this solicitation and award any resulting subcontracts. The University reserves the right to reject any and all proposals, to waive any minor irregularities in any proposal, and to cancel this RFP at any time prior to award without cost to the University. This RFP does not include provisions for the direct reimbursement of costs for proposal preparation.

The University Procurement Representative is Ann Huber and may be reached by telephone at (925) 422-6564, by fax at (925) 423-8019 or by e-mail at huber2@llnl.gov. Members of the Technical Review Committee are listed in the table below. After this RFP is issued and until subcontracts have been awarded by the University, discussions related to the RFP between an Offeror and a Technical Review Committee member may only be conducted in the presence of the University Procurement Representative.

Technical Review Committee
Jim Finlayson, Dept. Of Defense
Gary Grider, LANL
Terry Jones, Principal Investigator, LLNL
Rich Mark, LLNL
Lee Ward, SNL

High Performance Computing Procurement Group, Mail Station L-550
7000 East Avenue, Livermore, CA 94550
P.O. Box 808, Livermore, CA 94551

FUNDING

Funding to perform the work described in the sample Subcontract is not currently available. The Tri-Labs anticipate that funding for all of the work will become available in a manner that will allow the successful Offeror(s) to perform continuously until completion of the work.

Based on the proposals received, the Tri-Labs may award more than one subcontract, some of which may be incrementally funded. The Tri-Labs anticipate that funding for the technology categories shown in the table below may range in value from approximately $300,000.00 to $6,900,000.00, depending upon the scopes of work proposed. The anticipated term for any resulting subcontracts will be one to three years.

Technology Category (Refer to Desired Performance Features listed below and the Statement of Work)	**Funding Guidance (over three years)**
Global Access	$1.00M to $2.00M
Scalable Infrastructure for Clusters and Enterprise	$1.25M to $2.50M
Integrated Infrastructure for Wan Access	$0.30M to $0.60M
Scalable Management & Operational Facilities	$0.30M to $0.60M
Security	$0.60M to $1.20M
A proposal addressing all five technology categories listed above	$3.45M to $6.90M

PROPOSAL CONTENTS

DUNS Number
The Offeror shall provide its DUNS number as part of the proposal.

Minimum Requirements
An Offeror shall address all minimum requirements and its proposal shall demonstrate why it meets or exceeds each one. The attached Statement of Work contains detailed discussions of the minimum requirements.

1. POSIX-LIKE INTERFACE
The file system must provide Posix style language bindings.

2. INTEGRATION COMPATIBILITY
Partial solutions must not prohibit integration with other technologies for unaddressed areas.

3. NO SINGLE POINT OF FAILURE
The software architecture must preclude a single point of failure in the event of adequate hardware.

Features and Attributes
Performance features are the elements the Tri-Labs believe will contribute to attainment of the Tri-Labs' objectives. Supplier attributes are the elements the Tri-Labs believe will contribute to an Offeror's successful performance of the proposed Subcontract. An Offeror is not solely limited to discussion of these features and attributes. An Offeror may propose other features or attributes if the Offeror believes they may be of value to the Tri-Labs. If the Tri-Labs agree, consideration may be given to them in the evaluation process. In all cases, the Tri-Labs will assess the value of each proposal as submitted.

Desired Performance Features
The attached Statement of Work contains detailed discussions of the Desired Performance Features.

1. GLOBAL ACCESS

1.1 Global Scalable Name Space
Clients should have the ability to see the same name space regardless of their physical location.

1.2 Client software
Client software should be made available for many different vendors and architectures.

1.3 Exportable interfaces and protocols
Support for legacy protocols such as NFS v2, NFS v3, and CIFS.

1.4 Coexistence with other file systems
The provided client should not preclude a vendor's native file system running concurrently.

1.5 Transparent global capabilities
Access to remote files should not require a special API.

1.6 Integration in a SAN environment
For sites that have SAN storage, the architecture should not preclude utilizing that hardware.

2. SCALABLE INFRASTRUCTURE FOR CLUSTERS AND THE ENTERPRISE

2.1 Parallel I/O Bandwidth
Multiple clients should be able to efficiently access the same file at hundreds of GB/sec.

2.2 Support for very large file systems
Single files of multi-terabyte size should be permitted.

2.3 Scalable file creation & Metadata Operations
Metadata services should be scalable to permit millions of files in the same directory, and thousands of file creates per second within the same directory.

2.4 Archive Driven Performance
The file system should support high bandwidth data movement to tertiary storage.

2.5 Adaptive Prefetching (a discussion)
Sophisticated prefetch and write-behind schemes are encouraged, but a method to disable them should accompany them.

3. INTEGRATED INFRASTRUCTURE FOR WAN

3.1 WAN Access to files
Transparent global name space, plus performance benefits from multiple WAN links where provided.

3.2 Global Identities
A mechanism for managing global (WAN) principals (e.g., userids) is desired.

3.4 Security Integration
The file system should support multiple administrative domains.

4. SCALABLE MANAGEMENT & OPERATIONAL FACILITIES

4.1 Need to minimize human management effort
The amount of work to manage the file system should not scale with the size of the file system.

4.2 Integration with other Management Tools
Intelligent storage devices should be easily managed.

4.3 Dynamic tuning & reconfiguration
One should not need to take the file system offline to adjust important parameters.

4.4 Diagnostic reporting
The file system should be able to provide per-client and per-device statistics.

4.5 Support for configuration management
The file system should track applied patches and versions.

4.6 Problem determination GUI
The file system should provide problem resolution interfaces.

4.7 User statistics reporting
The file system should include tools to provide statistics on selectable scopes (e.g., per file, per user).

4.8 Security management
The file system should provide efficient mechanisms for tracking and changing security controls.

4.9 Improved Characterization and Retrieval of Files
Improvements over the traditional hierarchical storage namespace are sought.

4.10 Full documentation
The use and management of the file system should be well documented.

4.11 Fault Tolerance, Reliability, Availability, Serviceability (RAS)
Novel approaches to improving file system up-time are desired.

4.12 Integration with Tertiary Storage
The file system should provide a transparent interface to tertiary storage (e.g., a standards based method of integration with a hierarchical storage manager that makes manual ftp-like access unnecessary).

4.13 Standard POSIX and MPI-IO
Completely compliant POSIX and MPI-IO are desired.

4.14 Special API semantics for increased performance
Alternative locking semantics which permit increased performance are desired.

4.15 Time to build a file system
File system build times of tera-bytes per hour or better are desired.

4.16 Backup / Recovery
Supporting infrastructure for backup / recovery tools.
4.17 Snapshot Capability
Snapshot and restore capabilities.
4.18 Flow Control & Quality of I/O Service
Since data may be remote, flow control and quality of service capabilities are desired.
4.19 Benchmarks
Metrics which quantify performance are desired.

5. SECURITY

5.1 Authentication
A strong authentication scheme and compatibility with our existing Kerberos/PKI infrastructure are desired.
5.2 Authorization
A strong authorization scheme and compatibility with our existing Kerberos/PKI infrastructure are desired.
5.3 Content Based Authorization
Authorization with extensible site-defined policy engines.
5.4 Logging and auditing
The ability to log events as defined by a system administrator is desired.
5.5 Encryption
FIPS approved encryption desired.
5.6 Deciding what can be trusted
A predefined understanding of vulnerabilities to rogue nodes and privileged accounts are desired.

Supplier Attributes

The Offeror shall provide a written summary of its qualifications and capabilities for performing the work, including how it would develop the key commercial technologies proposed. The summary shall include descriptions of the Offeror's facilities where the work will be done and identify the key personnel, including name, address, email address and telephone number, who will conduct and oversee the research.

The Offeror may describe projects of similar scope and complexity as this project that the Offeror has completed recently. These may include public and private contracts. Include technical and business references by name, title, address, telephone number and, if available, e-mail address. Offerors are encouraged to include a self-assessment of their performance on these projects including what went well and what did not. Offerors may discuss the latter in the context of a lessons learned scenario.

Scope Of Work

This request is for proposals pertaining to the research, development and engineering of technologies that have the promise to address the Tri-Labs' needs for fully integrated file system technologies. By fully integrated, the Tri-Labs mean any separable components should fully function together with the other file system components. The Tri-Labs are interested in any and all technologies, regardless of

architecture, that contribute to scalable file system technologies and which are both secure and globally accessible.

Any one of the technology categories by itself is of little use to the Tri-Labs. Similarly, any combination of technology categories up to four is also less useful to the Tri-Labs. The most valuable proposals will reflect a file system that **fully integrates the functionality of each of these five categories**. An Offeror proposing less than all five categories should be willing to partner with another Offeror or Offerors. The Tri-Labs encourage Offerors unable or unwilling to address all of the technology categories to find a suitable partner to complement their proposal. If an Offeror is unable to find a suitable partner, the Tri-Labs may suggest a partner subsequent to reviewing all proposals.

All of the desired performance features in any technology category could be addressed by different teams in a large organization while some small organizations may be unable to address them all. Therefore, the Tri-Labs will consider proposals that address any (as opposed to all) of the desired performance features for any particular technology category. Requested functionality is divided into minimum requirements and desired performance features. Although the Tri-Labs desire Offerors to address all five major technology categories, it is not necessary to address each sub-category. For example, a Security proposal may address Authentication, Authorization and Access Control (5.1, 5.2, and 5.3 in the list above) while not addressing Encryption (5.5). A single end-to-end solution for all of the desired performance features (5.1, 5.2, 5.3, 5.4, 5.5, and 5.6) would be preferred. However, the Tri-Labs are prepared to act as system integrators in the scenario where an Offeror is unable to address all of the desired performance features in the given time frame.

Pricing for each category should reflect how completely the category is addressed (Are all sub-categories addressed?), and how well the category is addressed (Do the proposed solutions for each sub-category fully and efficiently address the topic?).

Proposals shall address the proposed technology development path. Proposals which indicate development time frames of one to three years will be considered; however, proposals capable of delivering a series of increasingly capable systems every 12 to 18 months are preferred. Development should follow a recognized software development methodology including steps such as requirements review, architecture review, design review, coding review, testing of components, integration, etc., to maximize robustness. Descriptions of software methodology practices will be used to determine the likelihood of extensible/reusable code; the Tri-Labs do not require any specific software methodology.

Offerors are advised that if software products not normally distributed in source form are offered as any part of the proposed file systems solution, the Tri-Labs may require delivery of the source code for these products under appropriate non-disclosure agreements with the Tri-Labs.

The Offeror’s proposal shall discuss how the research relates to the Statement of Work. The proposal shall include a detailed technical description of the technology R&D or other engineering efforts that will lead to file systems technologies that are both secure and globally accessible. Some discussion of how the Offeror’s efforts will realize, or aid in the realization of, such a file system architecture

should be included. Additionally, ideas for follow-on work beyond the one to three year time frame should be presented.

The Offeror's proposal shall describe a proposed scalable file system and how the architecture satisfies the minimum requirements and proposed performance features described in the Statement of Work. Include any plans for scalability testing of proposed technologies to verify that it meets the Tri-Labs' scalability requirements. This may include a specific request for the Tri-Labs to support such testing by providing access to DOE equipment and facilities. It is desired that any effort be structured such that as many mid-project deliverables of function or partial function be available as soon as possible, without being disruptive to the overall project, in order to allow early evaluation and exploitation, if possible, by the participating government supercomputing sites. It is expected that the first deliverables of any resulting award will be detailed specifications for the overall file system architecture, as well as documentation for management tools.

The Statement of Work portion of the proposal shall include at least the two following sections.

1. The first section should contain information that demonstrates the Offeror's ability to comply with the minimum requirements of this RFP.

2. The second section should include an itemized list of proposals addressing each of the desired performance features. The Offeror should either provide a summary of the Offeror's implementation plan for the desired feature or state that the feature has not been addressed.

Business Plan
The Offeror shall provide a business plan that includes information to help illustrate the likelihood that this effort will result in a marketable product.

Business Model
The Offeror shall describe the business model it wishes to use during the performance of its proposed work. Sample models are described below.

1. Sole Provider for All Five Desired Performance Features Categories
A proposal that uses this model will address all technical categories and desired performance features of the Statement of Work. A "Sole Provider" proposal should specify how and why the file system will always be available on the machines and operating systems of interest, and how other vendors will support the file system on their hardware.

2. Open Source Consortia with the Tri-Labs
A proposal that uses this model will include a consortia of technology providers. The consortia may address any one or more technology categories and desired performance features listed in the Statement of Work. Proposals that do not address all of the desired performance features should indicate a willingness to consider partnering with other providers at the request of the Tri-Labs. Include the identification of any proposed use of open standards. An "Open Source Consortia" proposal should specify how the slow development

cycles typical of that approach will be avoided, and how company longevity through financial performance will be achieved.

3. Partnering with Other Providers for an Integrated Solution

A proposal that uses this model will consider partnering with other providers at the request of the Tri-Labs. A "Partner / Integrated Solution" proposal should specify how and why the file system will always be available on the machines and operating systems of interest, and how other vendors will support the file system on their hardware.

R&D Execution

The Offeror may choose to perform its R&D without interaction with the Tri-Labs, or it may choose to partner with the Tri-Labs during the term of the subcontract. In the latter case, the Offeror shall describe the proposed partnering relationship with the Tri-Labs. This shall include how the Offeror will interact with the Tri-Labs. Tri-Lab participation is encouraged; the Tri-Labs have a significant history and understanding of high performance computing. Furthermore, the Tri-Labs may be able to offer access to unique high performance machines/environments.

Resources Available From The Tri-Labs ***All resources available on a per case, mutually agreed upon basis.***
Large Platform Access This may include time/access requests for large testbed machines and, to a lesser extent, requests for production ASCI platforms (e.g., blue, red, white).
ASCI Application Access Requests for access to unclassified applications will be given preferential consideration. Access to classified codes will not be granted, but Tri-Lab personnel may be able to perform tests with classified applications on behalf of the Offeror.
Personnel Access The Tri-Labs anticipate close interaction with a limited number of computer scientists from each site. In addition, some access to those developing simulations and/or analysis tools (computational physicists, mathematicians, physicists, etc.) may be approved.
Other The Tri-Labs may be able to accommodate other requests on a per-request basis.

Proposals submitted as a result of joint participation with industry, government laboratories and other organizations are encouraged.

Price and Schedule

The proposal shall include a total firm fixed price for the work and a delivery completion schedule. An Offeror shall propose a schedule that clearly shows each milestone, its price and the deliverable. The Tri-Labs anticipate completion by September 30, 2004. Alternate dates may be proposed which may be subject to negotiation prior to award.

An Offeror may assume that any proposed file system will require new hardware including servers, SAN/NAS devices (spindles), interconnect fabrics, etc. The Tri-Labs prefer solutions which can utilize existing technology.

The Offeror shall indicate milestones and deliverables for the entire project (preferably in a table format). Each deliverable shall include the quarter and year of completion, the milestone payment amount, the milestone payment category (see table below), the milestone title, and a brief description of the deliverable.

Milestone Payment Category
Demonstration Results of research & development
Materials for Demonstration Typically hardware, software, other equipment Note: Usually not a major part of the payment. Also, access to special equipment at the Tri-Labs may be granted to selected subcontractors.
Report Legal work, partnership contracts, feasibility studies, etc.
Other Miscellaneous expenses. These other direct costs should be adequately detailed, commensurate with their price.

TRI-LAB EVALUATION OF PROPOSALS

Evaluation Factors

The Tri-Labs shall consider the quality of the Offeror's response in addressing the minimum requirements, the desired performance features, Offeror attributes, and price in evaluating proposals. The Tri-Labs will evaluate the balance between a proposal's relative value and the expected results embodied in the proposal. The Tri-Labs' assessment of each proposal will form the basis for selection using the following general criteria.

Feasibility

Likelihood of a Fully Integrated Solution

Whether the responsibility for each component piece is clearly identified among the Offerors.

Whether the partnership arrangement is complete and realistic.

The likelihood that the approach will work as claimed.

The extent to which an Offeror's design and implementation approaches represent feasible solutions to the requirements of the Statement of Work.

The ready availability of the component(s) proposed by an Offeror.

The completeness, realism and likelihood of the primary obstacles to proposed approach (most significant technical risks, likely failures) as noted by the Offeror.

Applicability
The impact the proposed research will have in the utilization of, and performance on, systems with thousands of processors and how that impact will be demonstrated.
The degree to which the proposed research has value to more than one of the three national laboratories and the DOD Maryland Office.
How the approach contributes to the goals and technologies of importance to the Tri-Labs and the ASCI Program.
The extent to which the system or technology is modular, extensible and scalable.
Short- and long-term upgrade paths and support (e.g., the degree to which commercial off-the-shelf components are utilized in the proposed technology).
The stability and dependability of the system configuration, including an assessment of the redundancy of architectural components as they contribute to fault-tolerant operation.
Any proposed use of open standards.
Any proposed technology's ability to be seamlessly integrated into the upcoming computational environments.

Capability
The relevance and adequacy of the Offeror's past experience on similar projects.
The current roadmap status, maturity and scope of the Offeror's existing and proposed products.
The current level of existing technology development insofar as it will be used as part of the final system configuration.

Affordability
The proposed price in relation to the approach the Offeror intends to employ.
The reasonableness of the total price, including the Offeror's contribution, in terms of the Tri-Labs' budget and relative to other proposals.

Marketability
The target pricing of the technologies being developed under this PathForward effort so that the feasibility of future purchases of the developed technology might be taken into consideration.
The likelihood of future commercialization opportunities, including potential expansion into new markets and/or deeper penetration into existing markets.
Given the discussions on the foregoing topics, the likelihood of maintenance availability and long-term support for the technology or system.
An assessment of a major goal of this effort: If a subcontract award will accelerate or initiate the development of technology. (The Offerors should demonstrate that the funding will be used to augment their research and development activities and not simply fund their normal R&D plans.)

BASIS FOR SELECTION

The Tri-Labs may select one or more Offerors for award. The Tri-Labs will select those Offerors whose proposals contain the combination of price, desired performance features, and Offeror

attributes offering the best overall values to the Tri-Labs. The Tri-Labs will determine the best overall values by comparing differences in performance features and Offeror attributes offered with differences in price, striking the most advantageous balance between expected performance and the overall price to the Tri-Labs. Offerors must, therefore, be persuasive in describing the value of their proposed performance features and Offeror attributes in enhancing the likelihood of successful performance or otherwise best achieving the Tri-Labs' objectives. The Tri-Labs may select Offerors whose proposals are considered to offer the best overall value compared to proposals with either higher or lower prices. The Tri-Labs' selection may be made on the basis of the initial proposals or the Tri-Labs may elect to negotiate with any or all Offerors.

PROPOSAL INSTRUCTIONS

The Tri-Labs will respond to questions submitted in writing to the Tri-Lab's Procurement Representative on or before **May 25, 2001**. Questions may be submitted by letter, facsimile or e-mail. Answers to questions that are germane to the interpretation of the Tri-Labs' requirements will be issued to all Offerors in writing.

Deadline for Submitting Proposals
Proposals are due to the University Procurement Representative on **June 4, 2001**, not later than 4:00 PM, Pacific Time. Acceptance of late proposals will be at the sole discretion of the Tri-Labs. Facsimile proposals are not acceptable. Proposals shall be submitted in Microsoft Word (Windows or Macintosh compatible) or in PDF format. Proposals may be submitted by email. Submit email responses to Ann Huber at huber2@llnl.gov. Proposals not provided by email must be submitted on 3.5-in. floppy disk or CD-ROM to the address listed below.

Submittal of a proposal indicates the Offeror's willingness to accept the terms and conditions of the sample Subcontract and its attachments unless specific exceptions are taken. These terms and conditions have been approved by the Department of Energy. Changing them may be time consuming. Failure to accept the terms and conditions may result in significant, unacceptable delays in award of a subcontract that could cause the Tri-Labs to reject a proposal.

The Offeror shall deliver the proposal to one of the following addresses.

Address for Commercial Courier
(Not For Hand Delivery):
University of California
Lawrence Livermore National Laboratory
Attention: Ann Huber
Mail Station L-550
RFP: B514193
7000 East Avenue
Livermore, CA 94550

Address for Mailing:
University of California
Lawrence Livermore National Laboratory
Attention: Ann Huber
Mail Station L-550
RFP: B514193
P.O. Box 808
Livermore, CA 94551

Proprietary Data
The Tri-Labs expect to receive proprietary data. If proprietary data is included in a proposal, it must be marked "Proprietary." The Tri-Labs will maintain the proprietary data in confidence, giving it the same degree of care, but no less than a reasonable degree of care, as the Tri-Labs exercise with their own proprietary data to prevent its unauthorized disclosure.

NAICS Codes and Size Standards
Due to the broad range of possible solutions that may be proposed in response to this RFP, there are several possible North American Industry Classification System (NAICS) Codes under which an Offeror could classify itself for purposes of determining its business size. The table below lists those which the Tri-Labs feel may be the most likely candidates for selection by an Offeror. Offerors are not limited to selecting from this list but each Offeror must identify, as part of its proposal, the NAICS Code used.

NAICS Code	Description	Size Standard
334111	Electronic Computer Manufacturing	1,000 Employees
334119	Other Computer Peripheral Equipment Manufacturing	1,000 Employees
511210	Software (Publisher)	$18.0 M
541511	Custom Computer Programming Services	$18.0 M
541512	Computer System Design Services	$18.0 M
541330	Engineering Services	$4.0 M
541710	Research and Development in the Physical, Engineering and Life Sciences (See note below)	500 Employees

Note: For research and development subcontracts requiring the delivery of a manufactured product, the appropriate size standard is that of the manufacturing industry for the product.

The small business size standard for a concern that submits an offer in its own name and proposes to furnish an item that it did not itself manufacture is a number-of-employees size standard of 500 employees. Annual receipts are based on the average annual gross revenue for the past three fiscal years. Refer to Subpart 19.1 - Size Standards of the Federal Acquisition Regulation for information on calculating your annual average gross revenue.

OTHER PROPOSAL REQUIREMENTS

Intellectual Property
It is anticipated that intellectual property rights to new intellectual property developed under PathForward funding may be retained by a company performing the development, rather than by the Government, provided that the appropriate cost-sharing conditions exist and documentation is filed supporting approval of a waiver by DOE. See the following notice.

NOTICE TO OFFERORS

DEAR 952.227-84 - RIGHT TO REQUEST PATENT WAIVER (JUNE 1998). Offerors have the right to request a waiver of all or any part of the rights of the United

States in inventions conceived or first actually reduced to practice in performance of the [sub]contract that may be awarded as a result of this solicitation, in advance of or within 30 days after the effective date of [sub]contracting. Even where such advance waiver is not requested or the request is denied, the [sub]contractor will have a continuing right under the [sub]contract to request a waiver of the rights of the United States in identified inventions, i.e., individual inventions conceived or first actually reduced to practice in performance of the [sub]contract. Domestic small businesses and domestic nonprofit organizations normally will receive the patent rights clause at 952.227-11 which permits the [sub]contractor to retain title to such inventions, except under contracts for management or operation of a Government-owned research and development facility or under [sub]contracts involving exceptional circumstances or intelligence activities. Therefore, small businesses and nonprofit organizations normally need not request a waiver. See the patent rights clause in the draft [sub]contract in this solicitation. See also DOE's patent waiver regulations at 10 CFR part 784.

ENCLOSURES

The following enclosures are provided and need not be returned with the proposal.

Sample Subcontract with its Incorporated Documents
Model Small Business Subcontracting Plan

The Offeror shall complete the following enclosures and submit them with the proposal.

Representations and Certifications

Sincerely,

Ann Huber
Sr. Contract Administrator