

**SCHEDULE OF ARTICLES  
FOR  
CONTRACT NO. SFS-DEV-004**

**ARTICLE 1 – SCHEDULE OF WORK**

- A. The Contractor shall perform the OpenSFS Lustre Development work (the “Services”) further described in the Statement of Work (“SOW”) incorporated in this Contract.
  
- B. The Contractor shall carry out the project described herein as well as the milestone-tasks, which are the units of work, and the milestones and deliverables described in the *Project Milestones Detailed Overview* section of the SOW.
  
- C. The Contractor shall furnish all personnel, supervision, materials, supplies, equipment, tools, facilities, transportation, testing, and other incidental items and services necessary for performance of the work. The Contractor shall deliver the materials, products, supplies, reports and residuals, as specified.
  
- D. Acceptance of the Services and deliverables under this Contract shall be based on the Contractor's performance and completion of the Services and deliverables in consonance with high professional standards and in compliance with the delivery and reporting requirements specified herein.

**STATEMENT OF WORK**  
**FOR**  
**CONTRACT NO. SFS-DEV-004**

**Project 1. CLIO Simplification Implementation**

*Technical Description and Approach*

The Lustre client implementation for the IO path (called “CLIO”) is responsible for issuing RPC commands for reading and writing data to the OSTs. CLIO was reconstructed in Lustre 2.0 for cross-platform portability. The CLIO implementation is too complex for the current usage, thus making the code hard to understand and maintain. As part of OpenSFS Lustre<sup>1</sup> software development, Contract SFS-DEV-003, the following items were developed:

- CLIO Simplification Scope Statement
- CLIO Simplification Solution Architecture
- CLIO Simplification High Level Design

This project (the “Project”) will implement into Lustre the CLIO Simplification High Level Design specified by SFS\_DEV-003 Project 2-CLIO Simplification Design into CLIO, which consists of:

- cl\_lock re-factoring (simplified and cache-less)
- ioctl calls implementation
- Remove obsolete OBD API call-backs
- Remove non-linux interfaces
- Remove stripe md direct access beyond LOV layer.

The CLIO Simplification High Level Design is attached hereto as Appendix 1 as reference of the Services to be performed.

---

<sup>1</sup> \* Other names and brands may be claimed as the property of others.

## Project Approach

### *Management Approach*

This section includes the standard processes used by Contractor when developing features or making revisions to Open SFS Lustre. For the implementation project identified in the Statement of Work, the following milestones will be completed by Contractor:

### *Project Milestone Detailed Overview*

- 1) **Implementation Phase:** Contractor shall complete implementation and unit testing for the approved solution from the SFS\_DEV-003 Project 2-CLIO Simplification Design. Contractor shall regularly report development progress to Open SFS, including progress metrics at project meetings and engineers shall share interim unit testing results as they become available. OpenSFS shall conduct a review of the code to verify the completion of the work described in the *Technical Description and Approach* section of this SOW. OpenSFS may choose to request a formal code review, the format of which will be determined by both parties should the need arise.
  
- 2) **Test and Fix Phase:** Upon functional completion of the Implementation Phase, Contractor shall commence a Test and Fix Phase characterized by execution of the functional test plan, new unit test cases developed during the Implementation Phase as well as the standard set of Lustre test suites available through Contractor's Autotest environment. The Test and Fix Phase will close when:
  - a) Contractor demonstrates the code passing the complement of tests in Contractor's Autotest environment with the code applied to the Lustre Master tree.
  - b) Contractor demonstrates the code runs successfully at scale (typically completing a 48 hour SWL run on the Hyperion platform at the Lawrence Livermore National Laboratory).
  - c) Contractor executes performance regression testing identifying and addressing performance regressions related to the development of the revised code. This performance testing will be run on a system with at least 100 clients and will compare results of IOR, mdsrate, and Inet-selftest on builds before and after the implementation of the CLIO Simplification High Level Design. Degradation of more than 5% will be taken as a failure, but small drops will be accepted as within normal variation.

- 3) **Demonstration Phase:** Upon completion of the Implementation Phase and Test and Fix Phase, Contractor shall demonstrate the appropriate functionality of the Project. Demonstration specifics will be defined and mutually agreed to for the Project in the Implementation Phase.
  - a) **Functional Test Plan:** Contractor shall develop and recommend a functional test plan, as defined by OpenSFS, designed to demonstrate the functional completeness of the revised code. The results of the functional testing, with supporting documentation, will be presented to OpenSFS for review.
  - b) **Performance Test Execution:** Contractor shall define and recommend a set of performance tests, to be approved by OpenSFS, that shall document the performance characteristics for performance related features. Contractor shall execute these tests and present results of these tests to OpenSFS for review. OpenSFS shall provide adequate test platforms to Contractor when scale is necessary for performance testing as recommended by Contractor and defined by OpenSFS.
  
- 4) **Landing and Delivery Phase:** Once the feature has been successfully demonstrated as functional, effort is required to integrate the development work from the Project branch back to the Lustre Master tree. The completion of this phase is measured by:
  - a) **Landing:** finalizing the code, testing and landing the patches to the Lustre Master Tree until all Project code is landed.
  - b) **Delivery:** the Project is considered complete and acceptance by OpenSFS will be requested once all code is checked into the Lustre Master branch. Feature code residing on the Lustre Master branch will be available in the next major Lustre release.

Acceptance by OpenSFS of Contractor's completion of the Project shall be based on Contractor's integration of the Project development branch into the Contractor Lustre tree. This revised code will then be tested within 20 business days by OpenSFS (performance, stability, and feature set compliance) for final acceptance or rejection which will be provided to Contractor in writing. No response from OpenSFS shall constitute implicit acceptance and approval. Contractor will land the Project branch to the Lustre Master tree following internal landing practices and policies.

### ***Project Approval Committee***

OpenSFS shall designate a Project Approval Committee (“PAC”), comprised of community members who will have final and documented authority for project-level decision-making. The purpose of the PAC is to both facilitate clear decision-making throughout the Project and provide an avenue for community collaboration during the Project. Timely decision-making will support the advancement of the Project and ensure that OpenSFS is well informed about Project milestone progress. The OpenSFS board-appointed Technical Representative shall serve as committee chair of the PAC and shall have final authority on all decisions of the PAC subject to the discretion of the OpenSFS board.

OpenSFS shall openly declare the membership of this committee and shall only change this membership during the course of the Project with advance notification to Contractor.

### ***Milestone-Task Approvals***

A milestone-task is defined as the work or effort necessary to complete a specific Project milestone, as described in *Project Milestone Detailed Overview* sub-section within this SOW, and is a sub-component or step along the way to completing a sub-project or the Project within the overall Contract.

Approval will be required from the Contract Administrator at the end of each milestone-task, for Contractor to invoice for the milestone.

For all requested approvals, the Contract Administrator will have 10 business days from work submission or decision request to provide feedback and render a decision. No response from OpenSFS shall constitute implicit acceptance and approval. If at a later time there is a dispute by OpenSFS, a separate resolution meeting will be held between OpenSFS PAC and Contractor’s High Performance Division Senior Leadership which will include the GM and Chief Architect.

### ***Project Termination***

Either party may terminate the Project at any time by thirty (30) days’ prior written notice to the other party pursuant to the Project Termination provision in the OpenSFS Terms and Conditions. In the event of termination of a Project the Contractor shall terminate work upon the termination date and payment shall be made, if applicable, in accordance with the OpenSFS Terms and Conditions. Milestones will be considered complete once completion is confirmed in writing (email is acceptable) by the PAC and approved by the Contract Administrator.

### ***Project Planning***

The Project contained within this SOW is comprised of Research and Development engineering efforts and as such the solutions are not necessarily straightforward or easy to determine. Contractor shall make best efforts to define appropriate target delivery dates based on information available.

With the completion of each milestone, Contractor shall deliver updated estimates for both interim milestone delivery and effort estimates using data and information acquired during the process of the Project to refine estimates.

If, during the course of the Project, information is discovered that was previously unknown and significantly complicates the solution, Contractor shall present this new evidence to OpenSFS with a list of proposed alternate solutions. Some solutions may become so large as to not be able to be completed under the fixed price of the SOW. In this event, Contractor shall offer alternate options from which OpenSFS may select those that can be completed within the bounds of the SOW.

#### *Project Meetings*

Project calls shall be held monthly, and additionally as needed, with participation from both Contractor and OpenSFS project team members. The purpose of this meeting is for the Project team members to gather to discuss progress against plan. OpenSFS attendance shall include at least one PAC member. Contractor attendance will include the Senior Engineer assigned to project, the Project Manager assigned to project, and any relevant development engineers depending on topic(s) of discussion. Contractor shall provide a standard project review template as recommended by Contractor and defined by OpenSFS to include progress since the last meeting, current activities, risks and issues. Meeting minutes shall be recorded at all Project meetings and stored as project artifacts.

#### *Vendor Neutrality*

All software shall be designed and developed to be broadly applicable to the entire Lustre user base. Contractor shall not design or implement to benefit or exploit a particular hardware configuration. The Lustre software has always been designed to work on a wide variety of vendor server and storage platforms; Contractor shall not change this fundamental Lustre design principle.