

Exhibit A WORK STATEMENT

TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2		Technical Tasks
2.1		Convert Prototype Integrated Circuits to Production Ready Integrated Circuits
2.2		Transform Prototype Hardware to Customer Ready Hardware
2.3		Complete Basic Release Software Features
2.4		Load Balancing for Power Optimization
2.5		Complete System Quality Assurance
2.6		Design 10-Gigabit Ethernet Integrated Circuit
2.7		Project Management and Reporting (1)
2.8		Develop PCB for the 10-Gigabit Capable Integrated Circuit
2.9		Develop Additional PCBs that Allow SeaMicro to Address New Markets by Changes to the Non-CPU PCBs
2.10		Develop Additional PCBs that Allow SeaMicro to Address New Markets by Changing the Compute Card
2.11		Modify Existing Form Factor for Smaller Deployments
2.12		Reduce the Costs of the PCBs
2.13		Modify the SeaMicro Integrated Circuits
2.14		Develop PCB for the Modified Integrated Circuits
2.15		Complete Advanced Software Features
2.16		System Quality Assurance
2.17		Project Management and Reporting (2)
3		Technology Transfer Activities
4		Production Readiness Plan

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor (s)	Key Partner (s)
1	Anil Rao--SeaMicro Andrew Fetter--SeaMicro		
2.1	Gary Lauterbach--SeaMicro Dhiraj Mallick--SeaMicro		
2.2	Gary Lauterbach--SeaMicro Dhiraj Mallick--SeaMicro Michael Yukelson—SeaMicro		
2.3	Gary Lauterbach--SeaMicro Anil Rao--SeaMicro		

Exhibit A WORK STATEMENT

	Girish Sarveiya--SeaMicro		
2.4	Gary Lauterbach--SeaMicro Anil Rao--SeaMicro		
2.5	Gary Lauterbach--SeaMicro Girish Sarveiya--SeaMicro		
2.6	Gary Luaterbach--SeaMicro Jim Bauman--SeaMicro		
2.7	Anil Rao --SeaMicro Andrew Fetter--SeaMicro		
2.8	Gary Lauterbach--SeaMicro Michael Yukelson—SeaMicro		
2.9	Gary Lauterbach--SeaMicro Michael Yukelson—SeaMicro		
2.10	Gary Lauterbach--SeaMicro Michael Yukelson—SeaMicro		
2.11	Gary Lauterbach--SeaMicro Micheal Yukelson--SeaMicro Tim Botsford--SeaMicro Girish Sarveiya—SeaMicro		
2.12	Gary Lauterbach--SeaMicro Micheal Yukelson--SeaMicro John Walker--contractor		
2.13	Gary Lauterbach--SeaMicro Dhiraj Mallick--SeaMicro Jim Bauman--SeaMicro		
2.14	Gary Lauterbach--SeaMicro Michael Yukelson—SeaMicro		
2.15	Shivi Fotedor		
2.16	Girish Sarveiya		
2.17	Anil Rao --SeaMicro Andrew Fetter--SeaMicro		
3.0	Anil Rao --SeaMicro Andrew Fetter--SeaMicro		
4.0	Anil Rao --SeaMicro Andrew Fetter--SeaMicro		

GLOSSARY

Specific terms and acronyms used throughout this scope of work are defined as follows:

Term/ Acronym	Definition
ARRA	American Recovery and Reinvestment Act
ASIC	Application Specific Integrated Circuit
CO ₂	Carbon Dioxide

Exhibit A WORK STATEMENT

Term/ Acronym	Definition
CPR	Critical Project Review
CPU	Central Processing Unit
DOE	U.S. Department of Energy
EFPGA	Ethernet Field Programmable Gate Array
Energy Commission	California Energy Commission
FPGA	Field Programmable Gate Array
IT	Information Technology
PAC	Project Advisory Committee
PCB	Printed Circuit Board
PIER	Public Interest Energy Research
RD&D	Research, Development and Demonstration
RTL	Resistor-Transistor Logic
SQA	System Quality Assurance

Problem Statement:

In 2006, data centers consumed 1.5% of the total electricity in the United States. In the data centers, 68% of the power consumed by information technology (IT) infrastructure is consumed by volume servers. SeaMicro, Inc. was formed to address this crisis in power consumption in data centers and is dedicated to reducing the power consumed by volume servers by 75%.¹ SeaMicro has identified the primary drivers underlying volume servers' inefficiency, which result from the confluence of three factors:

- (a) The rise of a new and different workload;
- (b) The inability of Central Processing Units (CPU), historically the data-center workhorses, to fully meet the needs of the predominant and fastest-growing workload; and
- (c) The inherent inefficiency in server packaging that left enormous duplication in components.

The SeaMicro compute appliance systematically addresses each of these factors to better ensure that the computation delivered is in complete alignment with the most prevalent workload. It reduces by 75% the power used by a volume server on the most common workload in data centers. It is also ¼ the size of volume servers and significantly less expensive to manufacture than traditional volume servers, even at low volume.

SeaMicro's economic advantages over traditional volume servers are compelling. A single large data center can save more than \$116 million in power, space, and acquisition cost over the three-year depreciable life of the system. The SeaMicro solution saves more than the total acquisition cost of the servers. The potential benefit

¹ 2007, "EPA Report to Congress on Server and Data Center Efficiency, Public Law 109-43."

Exhibit A WORK STATEMENT

to the environment is similarly enormous. An analysis of the project determined it could reduce domestic power demand by 29.3 billion kilowatt-hours per year and eliminate 17.4 million metric tons of CO₂ emissions per year.

Goals of the Agreement:

The goals of this Agreement are to accelerate development and extend the market of the SeaMicro compute appliance. The appliance has the potential to save billions of kilowatt hours per year and to reduce data center carbon emissions by millions of metric tons per year.

Objectives of the Agreement:

The objectives of this Agreement are to:

- Accelerate product availability by 12 months by:
 - (1) Accelerating development engineering
 - (2) Accelerating quality-assurance testing
- Enhance dynamic power-management software to further drive down power draw
- Accelerate market adoption by:
 - (1) Reducing cost
 - (2) Modifying the system so that it addresses markets beyond volume servers working on the most common workloads, including volume servers working on less-common workloads, mid-range servers, and high-end servers.

TASK 1 ADMINISTRATION

Task 1.1 Attend Kick-off Meeting

The goal of this task is to establish the lines of communication and procedures for implementing this Agreement.

The Recipient shall:

- Attend a “Kick-Off” meeting with the Commission Project Manager, the Grants Officer, and a representative of the Accounting Office. The Recipient shall bring its Project Manager, Agreement Administrator, Accounting Officer, and others designated by the Commission Project Manager to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the Commission Project Manager will provide an agenda to all potential meeting participants.

The administrative portion of the meeting shall include, but not be limited to, the following:

- Discussion of the terms and conditions of the Agreement
- Discussion of Critical Project Review (Task 1.2)

Exhibit A WORK STATEMENT

- Match fund documentation (Task 1.6)
- Permit documentation (Task 1.7)

The technical portion of the meeting shall include, but not be limited to, the following:

- The Commission Project Manager's expectations for accomplishing tasks described in the Scope of Work
- An updated Schedule of Products
- Discussion of Progress Reports (Task 1.4)
- Discussion of Technical Products (Product Guidelines located in Section 5 of the Terms and Conditions)
- Discussion of the Final Report (Task 1.5)

The Commission Project Manager shall designate the date and location of this meeting.

Recipient Products:

- Updated Schedule of Products (no draft)
- Updated List of Match Funds (no draft)
- Updated List of Permits (no draft)

Commission Project Manager Product:

- Kick-Off Meeting Agenda (no draft)

Task 1.2 Critical Project Review (CPR) Meetings

The goal of this task is to determine if the project should continue to receive Energy Commission funding to complete this Agreement and to identify any needed modifications to the tasks, products, schedule or budget.

CPRs provide the opportunity for frank discussions between the Energy Commission and the Recipient. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Commission Project Manager and as shown in the Technical Task List above. However, the Commission Project Manager may schedule additional CPRs as necessary, and any additional costs will be borne by the Recipient.

Participants include the Commission Project Manager and the Recipient and may include the Commission Grants Officer, the Public Interest Energy Research (PIER) Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Project Manager to provide support to the Energy Commission.

If DOE is conducting similar meetings, the Recipient shall notify and invite the Commission project manager to participate, either by teleconference or by actual meeting attendance. The DOE required meetings can be used in place of the Commission's CPR meetings, at the discretion of the Commission project manager.

Exhibit A WORK STATEMENT

The Commission Project Manager shall:

- Determine the location, date, and time of each CPR meeting with the Recipient. These meetings generally take place at the Energy Commission, but they may take place at another location.
- Send the Recipient the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on both match funding and permits.
- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.
- Determine whether to continue the project, and if continuing, whether or not modifications are needed to the tasks, schedule, products, and/or budget for the remainder of the Agreement. Modifications to the Agreement may require a formal amendment (please see the Terms and Conditions). If the Commission Project Manager concludes that satisfactory progress is not being made, this conclusion will be referred to the Energy Commission's Research, Development and Demonstration (RD&D) Policy Committee for its concurrence.
- Provide the Recipient with a written determination in accordance with the schedule. The written response may include a requirement for the Recipient to revise one or more product(s) that were included in the CPR.

The Recipient shall:

- Prepare a CPR Report for each CPR that discusses the progress of the Agreement toward achieving its goals and objectives. This report shall include recommendations and conclusions regarding continued work of the projects. This report shall be submitted along with any other products identified in this scope of work. The Recipient shall submit these documents to the Commission Project Manager and any other designated reviewers at least 15 working days in advance of each CPR meeting.
- Present the required information at each CPR meeting and participate in a discussion about the Agreement.
- Recipient will provide copies of any DOE correspondence (emails, reports, letters, etc.) that relate to the project status. This includes copies of project performance reviews on Recipient work and summaries and results of project review meetings with DOE.

Commission Project Manager Products:

- Agenda and a list of expected participants (no draft)
- Schedule for written determination (no draft)
- Written determination(no draft)

Recipient Product:

- CPR Report(s) (no draft)
- DOE correspondence and reporting (no draft)

Exhibit A WORK STATEMENT

Task 1.3 Final Meeting

The goal of this task is to closeout this Agreement. If DOE is conducting a similar final meeting, the Recipient shall notify and invite the Commission project manager to participate, either by teleconference or by actual meeting attendance. The DOE required meeting can be used in place of the Commission's final meeting, at the discretion of the Commission project manager. However, all items listed in this task will need to be covered in the meeting.

The Recipient shall:

- Meet with Energy Commission staff to present the findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement.

This meeting will be attended by, at a minimum, the Recipient, the Commission Grants Office Officer, and the Commission Project Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Commission Project Manager.

The technical portion of the meeting shall present an assessment of the degree to which project and task goals and objectives were achieved, findings, conclusions, recommended next steps (if any) for the Agreement, and recommendations for improvements. The Commission Project Manager will determine the appropriate meeting participants.

The administrative portion of the meeting shall be a discussion with the Commission Project Manager and the Grants Officer about the following Agreement closeout items:

- What to do with any equipment purchased with Energy Commission funds (Options)
- Energy Commission's request for specific "generated" data (not already provided in Agreement products)
- Need to document Recipient's disclosure of "subject inventions" developed under the Agreement
- "Surviving" Agreement provisions, such as repayment provisions and confidential Products
- Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement.
- Copies of all correspondence and reports discussing DOE's findings on the project, and future disposition of the project, if applicable. When directed by the Commission project manager, recipient will provide copies of any DOE correspondence (emails, reports, letters, etc.) that relate to project performance.

Exhibit A

WORK STATEMENT

Products:

- Written documentation of meeting agreements (no draft)
- Schedule for completing closeout activities (no draft)
- DOE correspondence on project findings and results (no draft)

Task 1.4 Quarterly Progress Reports

The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement on time and within budget.

The objectives of this task are to summarize activities performed during the reporting period, to identify activities planned for the next reporting period, to identify issues that may affect performance and expenditures, and to form the basis for determining whether invoices are consistent with work performed.

With Commission Project Manager approval, the Recipient can submit a DOE Progress Report in lieu of the required Commission report if it contains the information listed in Attachment 1 of the Terms and Conditions.

The Recipient shall:

- Prepare Quarterly Progress Reports which summarize all Agreement activities conducted by the Recipient for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the Commission Project Manager within 10 days of the end of the reporting period. The recommended specifications for each progress report are contained in Exhibit A, Attachment A-2.
- Unless otherwise directed by the Commission project manager, each Progress Report must contain any reports made to DOE, including summaries of meetings with DOE, as it that relates to the project outcome and performance. Include names and contacts of DOE representatives.

Product:

- Quarterly Progress Reports (no draft)
- Copies of DOE reporting and meeting summaries (no draft)

Task 1.5 Final Report

The goal of the Final Report is to assess the project's success in achieving its goals and objectives, advancing science and technology, and providing energy-related and other benefits to California.

Exhibit A WORK STATEMENT

The final report shall describe the following at a minimum: a) original purpose, approach, activities performed, results and conclusions of the work done under this Agreement; b) how the project advanced science and technology to the benefit of California's ratepayers and the barriers overcome; c) assessment of the success of the project as measured by the degree to which goals and objectives were achieved; d) how the project supported California's economic recovery in the near term and number of jobs created or sustained; e) how the project results will be used by California industry, markets and others; f) projected cost reduction impact and other benefits resulting from the project; g) discuss the project budget, including the total project cost and all the funding partners and their cost share; h) discuss how the Energy Commission funding was spent on the project, including any unique products and benefits; i) observations, conclusions and recommendations for further RD&D projects and improvements to the PIER project management process.

If a final report is required by DOE, the Recipient will include a copy of it along with the Energy Commission's final report requirements. In addition, the Recipient shall submit the draft final DOE report to the Energy Commission for review at the same time it submits it to DOE.

The Final Report shall be a public document. If the Recipient has obtained confidential status from the Energy Commission and will be preparing a confidential version of the Final Report as well, the Recipient shall perform the following activities for both the public and confidential versions of the Final Report.

The Recipient shall:

- Provide a draft copy of the Final Report including a copy of the draft submitted to the U.S. DOE in response to the American Recovery and Reinvestment Act Funding Opportunity Notice for which an award was received. The Final Report must be completed on or before the end of the Agreement Term.
- Submit written correspondence from DOE regarding acceptance of the final report.

Products:

- Draft Final Report, including a copy of the draft report submitted to DOE
- Final Report, including a copy of the final report submitted to DOE
- Written correspondence from DOE regarding acceptance of final report (no draft)

Task 1.6 Identify and Obtain Matching Funds

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for and applied to this Agreement during the term of this Agreement.

Exhibit A WORK STATEMENT

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. Although the PIER budget for this task will be zero dollars, the Recipient may utilize match funds for this task. Match funds shall be spent concurrently or in advance of PIER funds for each task during the term of this Agreement. Match funds must be identified in writing and the associated commitments obtained before the Recipient can incur any costs for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Project Manager at least 2 working days prior to the kick-off meeting. The letter needs to identify the following at a minimum:
 - Amount of each cash match fund, its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied.
 - Amount of each in-kind contribution, a description, documented market or book value, and its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.
- Provide a copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured.
- Discuss match funds and the implications to the Agreement if they are reduced or not obtained as committed, at the kick-off meeting. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide the appropriate information to the Commission Project Manager if during the course of the Agreement additional match funds are received.
- Notify the Commission Project Manager within 10 days if during the course of the Agreement existing match funds are reduced. Reduction in match funds must be approved through a formal amendment to the Agreement and may trigger an additional CPR.

Products:

- A letter regarding match funds (no draft)
- Copy(ies) of each match fund commitment letter(s) (no draft)
- Letter(s) for new match funds (if applicable) (no draft)
- Letter that match funds were reduced (if applicable) (no draft)

Exhibit A

WORK STATEMENT

Task 1.7 Identify and Obtain Required Permits

The goal of this task is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track.

Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement. Although the PIER budget for this task will be zero dollars, the Recipient shall budget match funds for any expected expenditures associated with obtaining permits. Permits must be identified in writing and obtained before the Recipient can make any expenditures for which a permit is required.

The Recipient shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Project Manager at least 2 working days prior to the kick-off meeting. If there are no permits required at the start of this Agreement, then state such in the letter. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:
 - A list of the permits that identifies the:
 - Type of permit
 - Name, address and telephone number of the permitting jurisdictions
 - or lead agencies
 - The schedule the Recipient will follow in applying for and obtaining these permits.
- Discuss the list of permits and the schedule for obtaining them at the kick-off meeting and develop a timetable for submitting the updated list, schedule and the copies of the permits. The implications to the Agreement if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in the Progress Reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, provide the appropriate information on each permit and an updated schedule to the Commission Project Manager.
- As permits are obtained, send a copy of each approved permit to the Commission Project Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Project Manager within 10 days. Either of these events may trigger an additional CPR.

Products:

- Letter documenting the permits or stating that no permits are required (no draft)
- A copy of each approved permit (if applicable) (no draft)

Exhibit A WORK STATEMENT

- Updated list of permits as they change during the term of the Agreement (if applicable) (no draft)
- Updated schedule for acquiring permits as changes occur during the term of the Agreement (if applicable) (no draft)

TASK 2 TECHNICAL TASKS

The Recipient has completed tasks 2.1 through 2.9, which were funded by the American Recovery and Reinvestment Act of 2009 (ARRA). The Recipient must complete tasks 2.10 through 4. This Agreement will fund task 2.10.

Task 2.1 CONVERT PROTOTYPE INTEGRATED CIRCUITS TO PRODUCTION READY INTEGRATED CIRCUITS

Task 2.1 has been completed. The goal of this task was the conversion of the field programmable gate array (FPGA) into an application specific integrated circuit (ASIC) and the tasks are the major steps in the process. A completed and tested ASIC is ready to be deployed in the SeaMicro system.

The Recipient Has:

- Completed the design and testing of the resistor-transistor logic (RTL), the logic embedded in an integrated circuit. This activity completed the design and testing of the logic that will be inside of the SeaMicro ASIC.
- Completed the physical design and taped out the chip. This involved working with a partner to complete the physical design and deliver to the foundry (the company that actually manufactures the ASIC) the final instructions for fabrication of the SeaMicro ASIC.
- Tested the ASIC after the foundry manufactured the ASIC and sent the first parts back to the Recipient. Extensive testing then began to ensure that the logic database produced the desired features and that the integrated circuits were manufactured correctly.

Product:

- Progress Reports submitted to the Energy Commission per Task 1.4. The reports must be submitted upon execution of the Agreement.

Task 2.2 TRANSFORM PROTOTYPE HARDWARE TO CUSTOMER READY HARDWARE

Task 2.2 has been completed. The goal of this task was to develop, modify and finalize the printed circuit boards (PCB) and the metal chassis that encloses the complete system. The PCB used in the prototype system required modification for live customer deployment. Activities included the addition of new features, the removal (board clean up) of mistakes in the logic, and the addition of test points. The result was completed and tested PCBs in the chassis married together with the software in the system quality assurance (SQA) group and under test.

Exhibit A

WORK STATEMENT

The Recipient Has:

- Completed modifications to prototype PCBs including but not limited to the boards that hold the disk, the boards that hold the Ethernet Field Programmable Gate Array (EFPGA), the boards that control power distribution throughout the system, and the boards that create the pathways that make up the physical manifestation of the fabric.
- Completed the concept design, schematics and layout of the ASIC-based Compute Card. This involved the creation of the logic, placement of components, and the layout of the PCB.
- Completed lifecycle engineering, design for manufacturing, industrial design, and modifications for assembly and serviceability of the chassis.
- Tested circuit boards and chassis upon the return of the first PCBs and the first few chassis. This involved testing the PCB in standalone form as well as in the chassis prior to releasing more of the units for manufacturing and assembly.
- Completed the build PCBs and chassis so that the SQA group can reliably test the functionality of the software running on the PCBs, with the newly developed ASIC in the chassis as customers will see it.

Product:

- Progress Reports submitted to the Energy Commission per Task 1.4. The reports must be submitted upon execution of the Agreement.

Task 2.3 COMPLETE BASIC RELEASE SOFTWARE FEATURES

Task 2.3 has been completed. The goal of this task was to divide the many disparate software features into several collections of features called “releases”. In stepwise fashion a group of features were added, tested, and the software sent with the new baseline feature set to SQA for system testing and validation. Each release will establish a new stable baseline to which additional features can be added. Software releases 1.6-2.0 were released to SQA.

The Recipient Has:

- Released internal software 1.6 and 1.7 and functionality necessary to undertake the next series of Beta tests. These features improved the manageability of the system, making it easier for customers to use.
- Released internal software 1.8, 1.9 and 2.0. The features in these releases included support for the ASIC based compute card as well as performance and scale improvements and brought the SeaMicro software to the minimum saleable feature set.
- Delivered releases 1.6 and 1.7 to SQA with the outcome of delivering a tested system to the Beta customers. Received feedback on the implementation of said features.
- Delivered features to SQA so that it can be tested on the integrated circuits that reside on the PCBs in the chassis.

Exhibit A WORK STATEMENT

Product:

- Progress Reports submitted to the Energy Commission per Task 1.4. The reports must be submitted upon execution of the Agreement.

Task 2.4 LOAD BALANCING FOR POWER OPTIMIZATION

Task 2.4 has been completed. The goal of this task was to further reduce power draw by keeping the CPUs operating in their most efficient ranges. Load balancing CPU architecture with performance in excess of 35,000 connections per second was submitted to SQA for system testing.

The Recipient Has:

- Developed and implemented basic load balancing architecture and algorithms. This will allow the user to create pools of compute. It will also allow traffic to be directed based on preset rules.
- Modified the EFPGA to accelerate the load balancing algorithms. The EFPGA is the integrated circuit that sits on the Ethernet card and is in the form of a FPGA so that it can continue to be modified and tuned for increased performance.
- Developed and implemented advanced load balancing algorithms that improve performance. This will allow the user to enjoy high speed balancing of load across servers and the creation at high speed of pools of compute and through a feedback loop. It will also allow traffic to be directed to servers so that they operate in their maximally efficient range.

Product:

- Progress Reports submitted to the Energy Commission per Task 1.4. The reports must be submitted upon execution of the Agreement.

Task 2.5 COMPLETE SYSTEM QUALITY ASSURANCE

Task 2.5 has been completed. The goal of this task was the development of a stable, reliable system that meets or exceeds customer quality expectations. The system with new features was delivered in releases 1.8, 1.9 and 2.0 to Beta customers and then to paying customers.

The Recipient Has:

- Test released internal software 1.6, 1.7, 1.8, 1.9 and 2.0 at feature, combination of features, and system performance levels. Testing involved directed tests (tests designed to break each new feature), regression tests (tests that run as if a customer was using the system), and performance/stress tests (tests designed to be intentionally unrealistic but help establish the bounds of the system's capabilities).
- Developed and maintained automated test libraries. This enabled the automation of tests, so that they can be run without manual intervention.

Exhibit A WORK STATEMENT

Product:

- Progress Reports submitted to the Energy Commission per Task 1.4. The reports must be submitted upon execution of the Agreement.

Task 2.6 DESIGN 10-GIGABIT ETHERNET INTEGRATED CIRCUIT

Task 2.6 has been completed. The goal of this milestone task was to develop the necessary 10-Gigabit integrated circuit as well as a PCB to house it. An integrated circuit was synthesized. The logical rules were synthesized or compiled into an integrated circuit, creating a piece of hardware with the desired functional characteristic.

The Recipient Has:

- Completed modifications to prototype PCBs including but not limited to the boards that hold the disk, the boards that hold the EFPGA, the boards that control power distribution throughout the system, and the boards that create the pathways that make up the physical manifestation of the fabric.
- Completed the architecture and micro architecture of the 10 Gigabit integrated circuit. These are engineering specifications at various levels of detail that describe the workings of the integrated circuit.
- Written the logic embedded in the integrated circuit that enables it to behave in the desired manner.
- Developed a test bench and verification environment so that the logic in the integrated circuit can be thoroughly tested in multiple scenarios.
- Tested the integrated circuit. The logical rules are now encapsulated in hardware and are tested as a “chip” rather than in simulation or test benches.

Product:

- Progress Reports submitted to the Energy Commission per Task 1.4. The reports must be submitted upon execution of the Agreement.

Task 2.7 PROJECT MANAGEMENT AND REPORTING (1)

Task 2.7 has been completed. The goal of this task was to effectively manage tasks 2.1-2.6 while fulfilling all DOE and American Recovery and Reinvestment Act (ARRA) reporting requirements.

The Recipient Has:

- Managed Tasks 2.1-2.6.
- Met all reporting requirements at the state and federal levels.
- Performed the activities from Tasks 2.1-2.6 through effective program management.
- Participated in monthly update phone calls with the DOE program office.

Exhibit A WORK STATEMENT

Product:

- Progress Reports to the Energy Commission per Task 1.4. The reports must be submitted upon execution of the Agreement.

Task 2.8 DEVELOP PCB FOR THE 10-GIGABIT CAPABLE INTEGRATED CIRCUIT

Task 2.8 has been completed. The goal of this task was constructing a PCB housing and integrated circuit that supports 10 Gigabit Ethernet functionality.

The Recipient Has:

- Completed the concept design, schematics and layout of the 10 Gigabit Ethernet based PCB. This task described the creation of the logic, placement of components, and the layout of the PCB.
- Created the logic, placement of the components, and the layout of the PCBs, and released for manufacturing and assembly.
- Tested the PCBs in both standalone form and in the chassis.

Product:

- Progress Reports submitted to the Energy Commission per Task 1.4. The reports must be submitted upon execution of the Agreement.

Task 2.9 DEVELOP ADDITIONAL PCBS THAT ALLOW SEAMICRO TO ADDRESS NEW MARKETS BY CHANGES TO THE NON-CPU PCBS

Task 2.9 has been completed. The goal of this task was to modify existing hardware (in particular the PCBs) to add new functionality that will accelerate market adoption and extend the reach of the SeaMicro compute appliance to new applications.

The Recipient Has:

- Completed the concept design, schematics and layout of the non compute card PCBs. This task involved the creation of the logic, placement of components, and the layout of the PCB.
- Tested the PCBs in both standalone form and in the chassis.
- Completed and tested PCBs in the mechanical system (the chassis) ready to be married together with the software for system test.

Product:

- Progress Reports submitted to the Energy Commission per Task 1.4. The reports must be submitted upon execution of the Agreement.

Task 2.10 DEVELOP ADDITIONAL PCBS THAT ALLOW SEAMICRO TO ADDRESS NEW MARKETS BY CHANGING THE COMPUTE CARD

The goal of this task is to modify existing hardware (in particular the PCBs) to add new functionality that will accelerate market adoption and extend the reach of the SeaMicro compute appliance to new applications.

Exhibit A

WORK STATEMENT

The Recipient Shall:

- Complete the concept design, schematics and layout of the compute card PCBs. This involves creation of the logic, placement of components, and the layout of the PCB.
- Bring up and test new compute card PCBs. This involves testing the PCB in standalone form as well as in the chassis.
- Prepare a report on the development of the PCB for new markets along with the quarterly report submitted to DOE. The report will include but not be limited to a list of targeted markets.

Products:

- Completed and tested PCBs in the mechanical system (the chassis) ready to be integrated with the software for system test
- PCB Development Report (no draft)

Task 2.11 MODIFY EXISTING FORM FACTOR FOR SMALLER DEPLOYMENTS

The goal of this task is to modify the hardware by reconfiguring the chassis into a smaller form factor. The initial form factor supporting 512 CPUs is designed for large customers in large data centers. The smaller form factor supporting between 50 and 200 CPUs addresses medium size and small data centers. It has a smaller footprint, a lower entry cost, and proportionally the same advantages in power and space as the large system.

The Recipient Shall:

- Complete the system architecture of small form factor systems. This step provides a high level blueprint for the development of the smaller form factor system.
- Complete the mechanical redesign in support of the smaller form factor. This step takes the blueprint for the system and creates detailed engineering drawings of the smaller chassis. This step also includes three dimensional modeling, simulation, and thermal and airflow testing.
- Modify PCBs as necessary. Complete schematics and layouts of the PCBs that must be changed for the smaller form factor. This task involves creation of the logic, placement of components, and the layout of the PCB.
- Bring up and test the PCBs. This is performed on the PCBs and the small form factor chassis. It involves testing the PCB in standalone form as well as in the smaller chassis. This includes testing and comparing actual data to the data produced by simulation for thermal load.

Product:

- Completed and tested PCBs in the small form factor chassis ready to be included in a System Test Matrix

Task 2.12 REDUCE THE COSTS OF THE PCBs

Exhibit A

WORK STATEMENT

The goal of this task is to develop a series of cost-reduced PCBs and lower prices for customers.

The Recipient Shall:

- Complete the concept design, schematics and layout of the PCBs. This task involves creation of the logic, placement of components, and the layout of the PCB.
- Bring up and test. This involves testing the PCB in standalone form as well as in the chassis.

Product:

- Completed and tested PCBs in the mechanical system (the chassis) ready to be integrated with the software for system test

Task 2.13 MODIFY THE SEAMICRO INTEGRATED CIRCUITS

The goal of this task is to modify each of the integrated circuits with improved features. The FPGA “programmability” will be used to add features, shrink their footprint, and convert them to the lower cost ASICs if feasible. Integrated circuits that are already ASIC will have added features to reduce its size and thereby reduce its costs and power draw. The goals are to reduce cost, add features and reduce power. Each of these modifications necessitates the development of a new PCB to house the new and improved integrated circuits.

The Recipient Shall:

- Map desired features to existing and proposed architectures as well as to new integrated circuit technologies and different integrated circuit vendors.
- Develop an architectural level engineering plan for modifications to integrated circuits.
- Develop the logic necessary for new features in each of the integrated circuits.
- Extend test benches and verification infrastructure to test newly added logic on each of the integrated circuits.
- Synthesize the completed logic, and if moving from an FPGA to an ASIC, release netlist (connectivity of an electronic design). If not, synthesize the new logic inside of the FPGA for new functionality.
- Complete the physical design and tape out the chip. This task involves working with a physical design partner to complete the physical design and deliver to the foundry (the company that actually manufactures the ASIC) the final instructions for the fabrication of the SeaMicro application specific integrated circuit.
- Fabricate the ASIC.
- Test the ASICs and the new FPGAs in stand-alone form, and then on new PCBs.

Exhibit A WORK STATEMENT

Product:

- Modified integrated circuits with improved features

Task 2.14 DEVELOP PCB FOR THE MODIFIED INTEGRATED CIRCUITS

The goal of this task is to reduce the cost, power draw, and reduce the latency to access disk, and increase the storage performance in the mechanical system.

The Recipient Shall:

- Complete the concept design, schematics and layout of the PCBs. This task involves creation of the logic, placement of components, and the layout of the PCB.
- Bring up and test. This involves testing the PCBs in standalone form as well as in the chassis.

Product:

- Completed and tested PCBs that show a reduction in the cost, power draw and latency to the access disk, and increase the storage performance in the mechanical system (the chassis) ready to be integrated with the software for system test

Task 2.15 COMPLETE ADVANCED SOFTWARE FEATURES

The goal of this task is the full development of advanced software features. These features will keep customers rapidly deploying SeaMicro compute appliances.

The Recipient Shall:

- Release external software releases 2.1 and 2.2, which add functionality that provides additional manageability, reliability and control for the system.
- Release external software releases 2.3 and 2.4. The features in these releases include performance improvements as well as improvements necessary for the support of the modified integrated circuits.

Product:

- Software releases 2.1 through 2.4 delivered to SQA

Task 2.16 SYSTEM QUALITY ASSURANCE

The goal of this task is to deliver a stable, reliable system that meets or exceeds customers' quality expectations.

The Recipient Shall:

- Test releases 2.1, 2.2, 2.3, and 2.4 at feature, combination of features, and system performance levels. Testing involves directed, regression, and performance/stress tests.
- Roll out software releases 2.3 and 2.4 to all existing and new customers.

Exhibit A WORK STATEMENT

- Develop and maintain automated test libraries. This will enable the automation of tests, so that they can be run without manual intervention.

Product:

- Software releases 2.3 and 2.4 delivered to all customers

Task 2.17 PROJECT MANAGEMENT AND REPORTING (2)

The goal of this task is to effectively manage Tasks 2.8-2.16 while fulfilling all DOE, ARRA, and PIER reporting requirements.

The Recipient Shall:

- Manage Tasks 2.8-2.16.
- Participate in update phone calls with the DOE program office.
- Meet all reporting requirements at the state and federal levels.

Products:

- Deliverables from Tasks 2.8-2.16
- Quarterly progress reports per Task 1.4, to include summaries of update phone calls with the DOE program office

TASK 3.0 TECHNOLOGY TRANSFER ACTIVITIES

The goal of this task is to develop a plan to make the knowledge gained, experimental results and lessons learned available to key decision-makers.

The Recipient Shall:

- Prepare a Technology Transfer Plan. The plan shall explain how the knowledge gained in this project will be made available to the public, such as, participation in briefings and/or presenting the project results at appropriate technical conferences or meetings as specified by the DOE and Energy Commission Project Officer. The level of detail expected is least for research-related projects and highest for demonstration projects. Key elements from this report shall be included in the Final Report for this project.
- Conduct technology transfer activities in accordance with the Technology Transfer Plan. These activities shall be reported in the Progress Reports.

Products:

- Draft Technology Transfer Plan
- Final Technology Transfer Plan

TASK 4.0 PRODUCTION READINESS PLAN

The goal of this task is to determine the steps that will lead to the manufacturing of the technologies developed in this project or to the commercialization of the project's results.

Exhibit A

WORK STATEMENT

The Recipient Shall:

- Prepare a Production Readiness Plan. The degree of detail in the Production Readiness Plan discussion should be proportional to the complexity of producing or commercializing the proposed product and its state of development. The plan shall include, as appropriate, but not be limited to:
 - Identification of critical production processes, equipment, facilities, personnel resources, and support systems that will be needed to produce a commercially viable product.
 - Internal manufacturing facilities, as well as supplier technologies, capacity constraints imposed by the design under consideration, identification of design critical elements and the use of hazardous or non-recyclable materials. The product manufacturing effort may include “proof of production processes.”
 - A projected “should cost” for the product when in production.
 - The expected investment threshold to launch the commercial product.
 - An implementation plan to ramp up to full production.

Products:

- Draft Production Readiness Plan
- Final Production Readiness Plan