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Sandia National Laboratories

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date: August 24, 2018

to: Robert Clay, 8753

from: Michael Heroux, 1400

subject: Certification of successful completion of ASC CSSE Level 2 Milestone #6362: Local Failure Local Recovery (LFLR) Resiliency for Asynchronous Many Task (AMT) Programming and Execution Models

The ASC Computational Systems and Software Environment (CSSE) program issued a joint Level 2 Milestone in FY18 entitled, "Local Failure Local Recovery (LFLR) Resiliency for Asynchronous Many Task (AMT) Programming and Execution Models", with the following specific deliverables:

1. Prototype implementation of resilience schemes for the asynchronous many-task model, including task replication and replay.
2. An analysis of the accuracy-cost tradeoffs, scalability, performance and costs for multiple AMT resilience options.
3. A report to inform the code development roadmap guiding the Sandia/ASC strategy for AMT resilience for NGP (Next Generation Platform).

The exit criteria for this milestone states: This milestone will be completed when the above-mentioned analyses are complete and a report is provided summarizing the key results and recommendations concerning AMT programming framework development for NGP.

At a milestone review presentation on August 6, Keita Teranishi presented the results for the first three criteria, including a thorough set of experimental results and analysis. On August 17, Keita delivered a complete draft of the milestone report, satisfying the final deliverable.

For the first deliverable, the team built on Habanero C++, an asynchronous many tasking (AMT) framework developed by team member Vivek Sarkar and his research group. The milestone team extended the task launch functions to support replication, replay and algorithm-based fault tolerance. These new interfaces enable the experiments conducted for the second and third deliverables.

The second and third deliverables were completed with the presentation and the contents of the delivered technical report. In this content, a thorough analysis of the scalability, performance and computational costs, and the accuracy-cost tradeoffs of application-specific schemes was delivered using the Habanero C++ extensions, a simulator environment and other computations. The presentation and report provided insight into future design and implementation strategies as the high-performance computing community addresses requirements for extreme levels of concurrent execution via AMT and the risk of increasing application-level faults that must be addressed within the programming and execution environment.

The milestone team is to be commended for their work to complete this milestone, in particular the use and extension of a modern parallel computing framework (Habanero C++), development of a

simulator to conduct experiments, and extensive computational experiments, analysis and conclusions, especially the conclusions that show the interplay between AMT capabilities and their potential impact on improving resilience in unreliable computing environments.

The proofs of concepts presented here provide a good foundation for further research and development in this important branch of programming and execution models that are necessary for Sandia's mission success via high performance computational science and engineering.

As the review committee chair, with concurrence from the other committee members:

- Franck Cappello, Argonne National Laboratory,
- Christian Engelmann, Oak Ridge National Laboratory,
- Mattan Erez, University of Texas at Austin, and
- Michael Glass, Sandia National Laboratories.

I certify that Keita Teranishi and the milestone team have fully met the completion criteria for this L2 Milestone.

Sincerely,

Michael A. Heroux, Chair, on behalf of the ASC L2 Milestone Committee

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