Validation and Improvement of the SMPI simulation framework for MPI applications

Project Summary

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Cross-platform testing and validation framework SMPI aims at predicting the performance of (potentially computation-heavy) MPI applications. It is important to note that MPI has multiple notable implementations, which can have differences in performance. Validation of predictions for the different implementations is a tedious task, as a lot of the code has to be changed to do it. One of the research directions is to create a testing and validation framework which we could use to create tests with the ability of seamlessly - with as little intervention from the user as possible - switching between the MPI implementations. The first aim is to do so with the MPI implementations OpenMPI and MPICH.

STAR-MPI Self-Tuned Adaptive Routines for MPI Collective Operations (STAR-MPI) is a sadly discontinued project, but one which's ideas could be utilized in SMPI. It is a set of MPI collective communication routines that are capable of dynamically adapting to system architecture and application workload. The main idea lays in a technique called "delayed finalization of MPI collective communication routines" (DF). For each operation, STAR-MPI maintains a set of communication algorithms. The aim is to postpone the decision of which algorithm to use until after the platform and/or the application is known. This technique bears the potential of platform-specific or application-specific optimalization of an MPI application.
A development idea for SMPI is to apply the same technique there: a set of potentially choosable algorithms could be implemented alongside a set of selector mechanisms. By using the STAR-MPI approach, extensive testing could be conducted on SMPI with different tuning parameters. The results of these tests could be used to suggest better parameters for the actual MPI implementations, in order to help improve their performance.