

Characterization of Benchmarks: Network and MPI Performance

Bachelor's/Master's Thesis – Open Assignment

Assigning professor:

Prof. Dr. Martin Schulz

Supervisors:

Karlo Kraljic,

Dr. Matthias Maiterth

Contact: karlo.kraljic@tum.de

November 17, 2022

Description:

Benchmarks are an essential tool for performance assessment of HPC systems. During the procurement process of HPC systems both benchmarks and proxy applications are used to assess the system which is to be procured. With new generations of HPC systems, the selected proxy application and benchmarks are often exchanged and benchmarks for specific needs of the system are selected. Only a few of these have stayed persistent over longer time periods. At the same time the quality of benchmarks is typically not questioned as they are seen to only be representatives of specific performance indicators.

This work targets to provide a more systematic approach with the goal of evaluating benchmarks targeting Network performance, namely regarding MPI (Message Passing Interface) [1] in both functional test as well as for benchmark applications.

Problem statement:

How can benchmarks used to assess Network performance, using MPI routines, be systematically compared amongst each others?

Anticipated Outcome

The objective of this work is to assess a selection of benchmarks used in HPC as indicators of Network performance using MPI. With this assessment, a metric is constructed which indicates the quality of the benchmarks. The quality should indicate how well the benchmarks represent pure MPI functionality, as well as usage of MPI in proxy applications. The anticipated outcome is a metric to compare the quality of benchmarks stressing the network using MPI:

- Initial starting point is the evaluation of the OSU Micro-benchmarks [2].
- The second part is an analysis of HPC system procurements and how network performance is assessed and reported in these documents.
- Assessment of a selection of network benchmark applications from the procurements
- Construction and comparison using the newly created quality metric for network benchmarks.

- For evaluation, a selection of the LRZ systems are used [3].
- An question to be answered is, if such metric is independenten of the underlying network architecture, or if dependence and influence cannot be ignored and even has to be made explicit.

The possibility of ranking the benchmarks for specific procurement requirements may be an additional outcome.

References

- [1] the MPI Forum. *MPI Documents*. URL: <https://www.mpi-forum.org/docs> (visited on 2022-05-23).
- [2] Dhabaleswar K. Panda. *OSU Micro-Benchmarks*. URL: <http://mvapich.cse.ohio-state.edu/benchmarks/> (visited on 2022-05-23).
- [3] Leibniz-Rechenzentrum (LRZ) der Bayerischen Akademie der Wissenschaften. *LRZ Doku – Access and Overview of HPC Systems*. URL: <https://doku.lrz.de/display/PUBLIC/Access+and+Overview+of+HPC+Systems> (visited on 2022-05-23).