

HPC CHALLENGE

PROJECT GOALS

- Provide performance bounds in locality space using real world computational kernels
- Allow scaling of input data size and time to run according to the system capability
- Verify the results using standard error analysis
- Allow vendors and users to provide optimized code for superior performance
- Make the benchmark information continuously available to the public in order to disseminate performance tuning knowledge and record technological progress over time
- Ensure reproducibility of the results by detailed reporting of all aspects of benchmark runs

SUMMARY OF HPCC AWARDS

Class 1: Best Performance

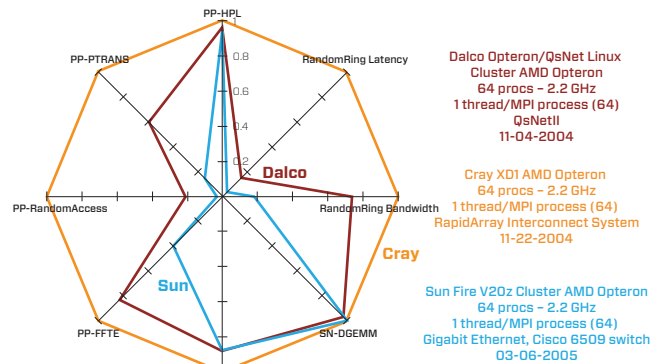
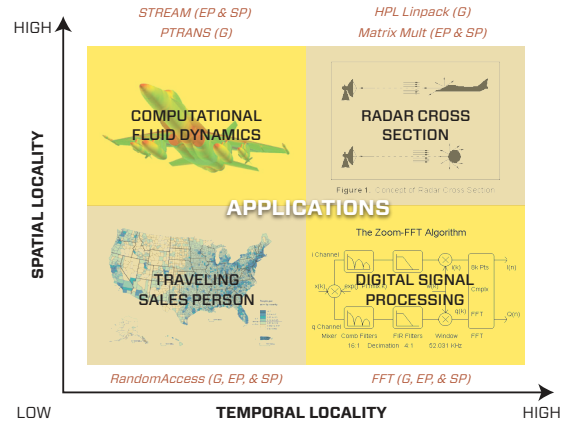
- Best in G-HPL, EP-STREAM-Triad per system, G-RandomAccess, G-FFT
- There will be 4 winners

Class 2: Most Productivity

- One or more winners
- Judged by a panel at SC10 BOF
- Stresses elegance and performance
- Implementations in various (existing and new) languages is encouraged
- Submissions may include up to two kernels not present in HPCC
- Submission consists of: code, its description, performance numbers, and a presentation at the BOF

FEATURE HIGHLIGHTS OF THE LATEST HPCC RELEASE (1.4.1)

- New variants of RandomAccess that use Linear Congruential Random Number Generator
- New order of tests makes HPL run last so users may abort execution early if necessary
- Initialization of the main array of RandomAccess is no longer timed
- Global reduction is used for error calculation in MPI FFT to achieve more accurate error estimate
- Updated documentation
- New initialization and finalization routines allow proper setup of external software/hardware components without changing the rest of the HPCC testing harness.
- Fixed memory leaks in G-RandomAccess and FFT driver routines.
- Better interface to 64-bit versions of FFTW such as Intel's MKL.



System	Processors	Frequency	Memory	Cache	OS	Compiler	Language	Kernel	Value	Unit	Time	Score	Rank
AMD Optron/OsNet Linux Cluster	64	2.2 GHz	16 GB	4 MB	Linux	gcc	C	HPL	1.000000	1.000000	1.000000	1.000000	1
Cray XD1	64	2.2 GHz	16 GB	4 MB	Linux	gcc	C	HPL	0.999999	0.999999	0.999999	0.999999	2
Sun Fire V20z	64	2.2 GHz	16 GB	4 MB	Linux	gcc	C	HPL	0.999998	0.999998	0.999998	0.999998	3

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Jack Dongarra and Piotr Luszczek of the Innovative Computing Lab (ICL) at the University of Tennessee Knoxville announced the new release of a benchmark suite - the HPC Challenge Benchmarks - at SC2004 in Pittsburgh, November 12, 2004 at a panel session. But work on the benchmark started more than a year earlier with the first result submissions dated November 5, 2003. March 2004 marked two important milestones for the benchmark: 1 Tflop/s was exceeded on the HPL test and the first submission with over 1000 processors was recorded. The FFT test was introduced in version 0.6 in May 2004 and the first submission with the new test was recorded in July the same year. As of early October 2005, the fastest system in the database obtained nearly 1 Tflop/s in the Global FFT test (three orders of magnitude increase over time). At the same time, the fastest (in terms of HPL) system was listed at position 11 on June's edition of TOP500 list, but the result recorded in the HPCC database was four percentage points higher in terms of efficiency. Today all of these achievements have been superseded by submissions from TOP500's highest ranking machines including the number one entry.

Jack Dongarra described the goals of the HPC Challenge Benchmarks: "The HPC Challenge Benchmarks will examine the performance of HPC architectures using kernels with more challenging memory access patterns than just the High Performance Linpack (HPL) benchmark used in the TOP500 list. The HPC Challenge Benchmarks are being designed to augment the TOP500 list, provide benchmarks that bound the performance of many real applications as a function of memory access characteristics - e.g., spatial and temporal locality, and provide a framework for including additional benchmarks." HPCC is already up to par with the TOP500 in terms of HPL performance and it also offers a far richer view of today's High End Computing (HEC) landscape as well as giving an unprecedented array of performance metrics for various analyses and comparison studies.

HPCC has received exposure in numerous news outlets including Business Wire, Cnet, eWeek, HPCwire, and Yahoo!. The website receives over 100,000 hits per month and the source code download rates exceed 1,000 downloads per year. A different kind of publicity comes from the acquisition procedures as supercomputer centers around the world choose HPCC for their required performance testing from bidding vendors.

June 2010 marked the release of version 1.4.1 of the benchmark code and announcement of the 2010 HPCC Awards competition. In summary, the competition has two classes of submissions; Class 1: Best Performance and Class 2: Most Productivity. The former invites submissions from large HPC installations around the globe and awards four winners in four categories (HPL, STREAM, FFT, RandomAccess). The latter invites mostly source code submissions in various languages and stresses the productivity aspect of programming languages and HEC architectures. One or more winners are awarded. The competition results will be announced during a BOF session at SC10 in New Orleans, Louisiana on November 16, 2010 at 12:15pm in room 389. Additional information about the awards competition can be found on the HPCC Awards website - <http://www.hpcchallenge.org/>.

Development of the HPC Challenge Benchmarks is being funded by the Defense Advanced Research Projects Agency (DARPA) High Productivity Computing Systems (HPCS) Program. William Harrod, the HPCS program manager, states, "We are interested in not only improved performance, but also ease of programming. These two combined are what will give us the productivity that the national security community needs. The HPCS program is developing activity and purpose benchmarks to allow developers and users to accurately evaluate emerging HPC systems. The HPC Challenge Benchmarks are the first major release of the activity and performance oriented benchmarks."

HPCC BENCHMARKS

HPL

This is the widely used implementation of the Linpack TPP benchmark. It measures the sustained floating point rate of execution for solving a linear system of equations.

STREAM

A simple benchmark test that measures sustainable memory bandwidth (in GB/s) and the corresponding computation rate for four vector kernel codes.

RandomAccess

Measures the rate of integer updates to random locations in large global memory array.

PTRANS

Implements parallel matrix transpose that exercises a large volume communication pattern whereby pairs of processes communicate with each other simultaneously.

FFT

Calculates a Discrete Fourier Transform (DFT) of very large one-dimensional complex data vector.

b_eff

Effective bandwidth benchmark is a set of MPI tests that measure the latency and bandwidth of a number of simultaneous communication patterns.

DGEMM

Measures the floating point rate of execution of double precision real matrix-matrix multiplication.

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