

## About Setonix

The Setonix supercomputer is a heterogeneous system consisting of CPUs and GPUs, with AMD providing both types of hardware, and it is based on the HPE Cray EX architecture. After its complete delivery, Setonix will have more than 200,000 CPU cores and 750 GPUs, with a peak computational power of 50 petaflops, 40 of which come from GPU accelerators. Nodes are interconnected using the Slingshot interconnect, providing a 200Gb/s bandwidth. The AMD Infinity Fabric interconnect provides a direct channel of communication among GPUs, as well as among CPUs and GPUs. At the Phase 1, Setonix count with 500 nodes equipped with 2 AMD EPYC "Milan" CPU with 64 cores, 2.45GHz and 256GB of memory.

<https://pawsey.org.au/systems/setonix/>

## About Codee

Codee is a software development platform that provides automated code inspection specifically designed to improve the performance of C/C++/Fortran applications. It provides a systematic predictable approach to optimize C/C++/Fortran source code for the target environment.

Codee discovers performance optimization opportunities in C/C++/Fortran source code, enabling to benefit from the memory efficiency, vectorization, multithreading and offloading capabilities available in modern computers.

Reproduce the impact on the performance of selected codes representative of embedded and high-performance computing benchmarks. Follow the instructions in the following GitHub repository:

<https://github.com/codee-com/performance-demos>

## Benchmarking on Setonix using GCC 12.1 (\*)

```
$ CC=cc RUNS_WARMUP=5 RUNS=10 ./benchmark-mbedTLS-vector.sh
...
Algorithm      Original      Optimized     Speedup
-----
AES-XTS-128    495324 KiB/s 390665 KiB/s -21.13%
AES-XTS-256    429247 KiB/s 331814 KiB/s -22.70%
AES-CBC-128    416991 KiB/s 522387 KiB/s 25.28%
AES-CBC-192    359556 KiB/s 463985 KiB/s 29.04%
AES-CBC-256    328219 KiB/s 420590 KiB/s 28.14%
AES-CMAC-128   257531 KiB/s 404973 KiB/s 57.25%
AES-CMAC-192   242801 KiB/s 371811 KiB/s 53.13%
AES-CMAC-256   235201 KiB/s 341850 KiB/s 45.34%
AES-CMAC-PRF-128 251147 KiB/s 403010 KiB/s 60.47%
ARIA-CBC-128   65861 KiB/s  66618 KiB/s  1.15%
ARIA-CBC-192   58018 KiB/s  58313 KiB/s  0.51%
ARIA-CBC-256   51828 KiB/s  52100 KiB/s  0.53%
```

```
$ CC=cc RUNS_WARMUP=5 RUNS=10 ./benchmark-omp-multi.sh
...
Code           Original     Optimized    Speedup
-----
ATMUX          0.29        0.08         72.49% (3.64x)
CANNY          6.23        4.55         26.97% (1.37x)
COULOMB        10.59       0.36         96.61% (29.51x)
HACCmk         34.97       1.60         95.43% (21.89x)
MATMUL         3.19        0.12         96.20% (26.29x)
NPB_CG         26.50       5.37         79.75% (4.94x)
PI             4.15        0.13         96.85% (31.76x)
```

(\*) Benchmarking conducted on Setonix using Codee 1.6.0-212 (Jan 19, 2023) on a remote machine equipped with AMD EPYC 7763 64-Core CPU and SUSE Linux Enterprise Server 15 SP3 Operating System and GCC 12.1 compiler. Performance measured by running 5 warm-up runs and calculating the average of 10 runs. The compiler optimization levels are as follows: MbedTLS release with -O2 and MULTI benchmarks with -O3.

## About Pawsey

The Pawsey Supercomputing Research Centre is a world-class high-performance computing facility accelerating scientific discoveries for Australia's researchers. Pawsey is currently serving over 4000 researchers achieving unprecedented results, in domains such as radio astronomy, energy and resources, engineering, bioinformatics and health sciences. Pawsey is also playing a key role in the Australian Space Data Analysis Facility, providing access to businesses to space data and tools, training and capacity building, and analytical expertise to stimulate innovation. The Pawsey Centre is an unincorporated joint venture of CSIRO – Australia's national science agency, Curtin University, Edith Cowan University, Murdoch University and The University of Western Australia.

