CASE STUDY

Intel® Xeon® processor E7 family

Enterprise Server
Performance for Data-Intensive Computing

Defining the future of computing

CERN openlab tests the Intel® Xeon® processor E7 family

CERN openlab is a framework for evaluating and integrating cutting-edge IT technologies and services in collaboration with industry, focusing on future versions of the World-Wide Large Hadron Collider Computing Grid* (WLCG*). Working closely with leading industrial players, CERN acquires early access to technology before it is available for the general computing market segment. As such CERN openlab tested an Intel® Xeon® processor E7-4870-based server for use with its Large Hadron Collider* (LHC*) and infrastructure services.

CERN openlab

"We count heavily on continued improvements in throughput per watt to satisfy the ever-growing demands of the physicists associated with the Large Hadron Collider and its four experiments."

Sverre Jarp, CTO, CERN openlab

CHALLENGES

- **Test new technologies:** CERN openlab develops and evaluates leading-edge IT solutions for CERN in collaboration with industry
- **Processor power:** It needs to evaluate the performance, energy-efficiency and scalability of new processors to ensure that CERN has the best technologies available for its LHC activities and its infrastructure services

SOLUTIONS

- **Benchmarking the next-generation Intel Xeon processor:** CERN openlab carried out extensive benchmarking on the Intel Xeon processor E7-4870
- **Performance assessments:** Compared new processors to previous-generation Intel Xeon processor X7560, comparing like-for-like performance and scalability for running high-energy physics applications

IMPACT

- **Significant performance leap:** Intel Xeon processor E7-4870 delivered significant throughput gains of up to 39 percent when using HEPSPEC06 benchmark
- **Stunning performance-per-watt:** Energy efficiency increased, in line with performance, by up to 39 percent

Investigating mysteries

CERN is a world-renowned organization that carries out research in elementary particle physics. Its current focus is on the LHC, the world's largest and highest-energy particle accelerator, designed and built by CERN to address some of the most fundamental questions of physics. Answers to these questions will advance humanity's understanding of the deepest laws of nature.

The LHC supports four main experiments: ALICE*, ATLAS*, CMS* and LHCb*. ALICE studies a fluid form of matter called quark-gluon plasma that would have existed in the first instants of the universe's life. ATLAS and CMS look for new physics including the origins of mass, clues to the nature of dark matter and hints of extra dimensions. LHCb investigates what happened to missing anti-matter created during the Big Bang.

CERN has multiple departments, among which is the IT Department hosting CERN openlab. The IT Department provides centralized information technology support. It is split into different groups and one of these, Computing Facilities (CF), operates the CERN Computer Centre. CF is responsible for selecting, acquiring and installing servers.

The CERN Computer Centre hosts the Tier-0 centre inside CERN's World-Wide LHC Computing Grid* (WLCG*). The WLCG is a scientific data grid based on computer centres around the world. It has a four-tier computing model in which data from LHC experiments is collected, stored and distributed to scientists around the world. The CERN Tier-0 centre is the primary back-up for data. After initial processing, the data is distributed to Tier-1 centres that have sufficient storage capacity and can support the Grid around-the-clock. The data is then made available to Tier-2 centres, which can store sufficient data and provide adequate computing power for specific analysis tasks. Individual scientists can access these facilities through Tier-3 computing resources which can be local clusters in a university department or even individual computers.

Intel® Xeon® processor E7 family delivers compelling performance punch and energy-saving benefits

CERN openlab

CERN openlab is a framework for evaluating and integrating cutting-edge IT technologies or services through collaboration with industry, focusing on future versions of the WLCG. Through close collaboration with leading industrial organizations, CERN acquires early access to technology that is often years from the general computing marketplace. In return, CERN offers expertise and a highly demanding computing environment for pushing new technologies to their limits, which provides a neutral ground for carrying out advanced R&D.

Testing new processors

CERN openlab has four competence centres. One of these centres, the Platform Competence Centre (PCC) is, among other things, dedicated to carrying out tests on relevant Intel processors.

CERN openlab wanted to evaluate the performance, scalability and power consumption of servers based on the Intel Xeon processor E7 family to assess whether these processors might have benefits for the CERN Computer Centre, and CERN openlab PCC, the IT department and groups within the IT department such as Platform and Engineering Services (PES), whose main mission is the provisioning of services on a large scale to grid and local CERN users.

CERN openlab tested an Intel Xeon processor E7-4870-powered server. It used the HEP-SPEC06 benchmark and other benchmarks derived from physics computing. HEPSPEC06 is a selection of applications from the SPEC* CPU 2006 test suite run under well-defined conditions typical of Worldwide LHC Computing Grid applications.

Benchmarking

In the benchmark the Intel Xeon processor E7-4870, running at 2.40 GHz with a thermal design power (TDP) of 130W, was compared to the Intel Xeon processor X7560, running at 2.26 GHz.

The Intel Xeon processor E7-4870 has up to 25 percent more shared L3 cache (reaching 30MB) compared to the Intel Xeon processor 7500 series. CERN openlab noted that the additional two cores and the 6MB bigger L3 cache were added with no penalty in terms of frequency, while keeping power consumption within the thermal envelope. The benchmark test used a 64-bit Scientific Linux* Cern 5.6 (SLC5) based on Red Hat Enterprise Linux* 5 (server).

Performance increases

The Intel Xeon processor E7 family has up to a 25 percent core increase compared to the Intel Xeon processor 7500 series. This is reflected in the performance of the monitored applications. The additional two cores, compared to the eight cores of the Intel Xeon processor 7500 series, yielded an extra 20 to 47 percent in performance, depending on the benchmark. Its variant of the SPEC benchmark, HEPSPEC06, provided 39 percent more throughput. The HEPSPEC performance per watt improved by up to 39 percent due to Intel's 32nm process shrink and additional C-states for better power management.

With regards to energy consumption, Sverre Jarp, CTO, CERN openlab, said: "We count heavily on continued improvements in throughput per watt to satisfy the ever-growing demands of the physicists associated with the LHC and its experiments. CERN considers the platform power consumption an important factor given the power constraints in its computer centre building."

Spotlight on CERN openlab

CERN openlab evaluates and integrates cutting-edge IT technologies and services in collaboration with industry, focusing on future versions of the World-Wide LHC Computing Grid (WLCG).Through close collaboration with leading industrial players, CERN acquires early access to technology that is still years from general computing market. In return, CERN offers expertise and a highly demanding computing environment for pushing new technologies to their limits while providing a neutral ground for carrying out advanced research and development with various organizations.

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