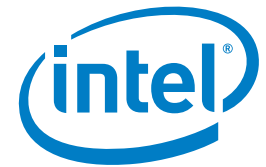


Case Study

Intel® Xeon® Processor 5600 Series

High-Performance Computing



Infrastructure for Mathematical Modeling and Simulation

India's high-tech scientific research center takes on Intel® Xeon® processor 5600 series to handle its latest HPC requirements



C-MMACS

C-MMACS conducts research using mathematical modeling and computer simulation and provides courses, technical advice, consultancy services, and access to its computing resources

“SGI Altix ICE 8400 EX* systems with Intel Xeon processor 5600 series gave us the best solution in terms of price/performance.”

R.P. Thangavelu
Scientist, C-MMACS

CHALLENGES

- **Expand computing capability.** System needed to meet stringent computing requirements for multi-discipline scientific research.
- **Deliver high performance.** Demanding, data-intensive computing research environment needed high-performance data processing with intensive input/output (I/O) file storage and transfer requirements.
- **Maximize the use of multi-core architecture.** C-MMAVS needed to use multi-core Intel® Xeon® processors¹ for computational modeling and simulation.

SOLUTIONS

- **Deploy multi-core-processor-based servers.** C-MMAS deployed an HPC server cluster based on the Intel Xeon processor 5600 series with a total of 1,152 cores.

The Council of Scientific Research (CSIR) Center for Mathematical Modeling and Computer Simulation (C-MMACS, pronounced as *Seemax*), located in Bangalore, India, is one of the country's foremost research centers in the physical, mathematical, and engineering sciences. Recognizing the growing significance of mathematical modeling and computer simulation in its research activities, C-MMACS has implemented a 192-processor high-performance computing (HPC) cluster using the Intel Xeon processor 5600 series.

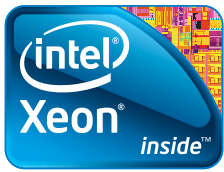
Computational Needs in Research

C-MMACS is one of the largest weather and oceanographic HPC users in India and has a core scientific and technical staff with a dozen PhDs in various areas, notably physical, mathematical, and engineering sciences. The Center does research on both in-house and collaborative projects with other agencies. It conducts specially-designed courses as well as providing technical advice, consultancy services, and access to its computing resources. Important areas of research and development include modeling of hazardous environments, pollution, and climate change and modeling for new drugs.

Since its establishment in 1988, C-MMACS has understood that modeling approaches are critical in illuminating the structure and evolution of complex systems in areas of scientific analysis and technological design. Fields like geology and biology, long considered largely observational and qualitative, had already begun to exploit the new possibilities offered by mathematical modeling and computer simulation to grow new areas of computational geology and computational biology. With this background, C-MMACS has been an early adopter of computational technology to aid in its research activities. The Center has implemented third-party processor technologies for its computational needs and, since 2002, it has also included the Intel® Itanium® processor in its server infrastructure with 400 cores.

The Center has initiated a number of programs that demand even more intensive computing power. These include, among others, modeling geographical constructs such as the crustal strain in the Indian crust, developing mathematical models for the early warning of cyclones, and molecular structure simulations to aid in developing new drugs.

C-MMACS was seeking to expand its compute infrastructure with an HPC cluster supporting parallel file system-based storage on InfiniBand Interconnect* and delivering high-performance I/O for a very demanding, data-intensive environment.



C-MMACS chose the Intel® Xeon® processor 5600 series platform to meet the stringent requirements of its world-class computing environment

Platform Price vs. Performance is a Key Issue for C-MMACS

C-MMACS was not looking to replace its existing platform, but was essentially building up its infrastructure for a “world-class computing” environment for scientific research. This placed high demands on performance, since the HPC cluster solution was intended to meet requirements from multi-discipline scientific research in the various fields of research at C-MMACS. To decide on the platform to adopt, C-MMACS developed a series of extensive benchmarking simulations that it carried out with the Intel Xeon processor 5600 series and other third-party platforms. These were accomplished by running simulations for two days with WRF 3 for climate modeling and MOM4 for weather simulation, as well as running various other simulations such as computational fluid dynamics (CFD) with Fluent* and other related applications. Intel provided technology advisory, software optimization, and benchmarking support to C-MMACS.

C-MMACS decided to run its new HPC cluster on the Intel Xeon processor 5600 series after running the extensive simulations the Center had devised. Based on this decision, the Center implemented an SGI Altix ICE 8400 EX* cluster running 192 Intel Xeon processors with a total of 1,152 cores.

“SGI Altix ICE 8400 EX systems with Intel Xeon processor 5600 series gave us the best solution in terms of price/performance,” says R.P. Thangavelu, a scientist at C-MMACS. “The unique combination of processor performance, memory bandwidth, and low-latency, high-bandwidth interprocessor communication outperformed, by a large margin, other competitive systems including the latest massively parallel processing (MPP) class systems in the price/performance evaluations done.”

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Benefits

Initially, mathematical modeling and simulation can be very I/O intensive when reading source files and images. This is followed by a compute-intensive phase where the processor is heavily taxed across all cores. With the Intel Xeon processor 5600 series-based HPC cluster, C-MMACS is able to maximize its investment to effectively carry out its research activities within budget. The Intel Xeon processor 5600 series provides clear advantages, particularly in performance efficiency per watt, achieving better efficiency with less power consumption. Some of the benefits the new HPC cluster brings to C-MMACS include:

- **Faster analytics**, enabling complex mathematical modeling and simulations to be run quickly and cost-effectively.
- **More accurate simulations** through high performance and optimal use of all compute cores of the HPC.
- **Greater productivity** by enabling scientists to speed the execution of simulation models with the added computing power.
- **Faster ROI** through faster completion of projects, thus reducing the costs of investments in projects and leading to a quick and compelling return on investment.
- **World-class computing environment** for scientific research that can attract top scientists and investments.

SOLUTION PROVIDED BY:



¹64-bit Intel® Xeon® processors with Intel® EM64T requires a computer system with a processor, chipset, BIOS, OS, device drivers and applications enabled for Intel EM64T. Processor will not operate (including 32-bit operation) without an Intel EM64T-enabled BIOS. Performance will vary depending on your hardware and software configurations. Intel EM64T-enabled OS, BIOS, device drivers and applications may not be available. Check with your vendor for more information. Performance will vary depending on the specific hardware and software you use. See most up to date benchmarks at <http://www.intel.com/products/benchmarks/server/index.htm> for detailed information.

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