**CASE STUDY**
**Low-Voltage Intel® Xeon® Processors 5000 Series**
High-Performance Computing
Energy: Efficiency, Environment, and Performance

# Unlocking Life's Secrets at Columbia University

Intel® Xeon® processor–based cluster provides 44 teraflops of peak performance and saves USD 95,000 on the annual power bill

Can Intel® processors enable progress on the most demanding life sciences applications—and do it within the strict floor space and power constraints of a Manhattan data center? One of the largest academic computing centers devoted to molecular and systems biology says yes. Columbia University's Center for Computational Biology and Bioinformatics (C2B2) has installed an HP ProLiant* Server Blade with 928 low-voltage Intel® Xeon® processors 5400 series. C2B2 says the machine is helping scientists advance their research while saving USD 95,000 annually in energy and cooling costs.

$C_2B^2$ Center for Computational Biology & Bioinformatics

"The power difference is dramatic. We're saving roughly USD 95,000 in energy and cooling costs in a year."

*– John Wofford*
*HPC Manager*
*Center for Computational Biology and Bioinformatics, Columbia University*

## CHALLENGES

- **Performance, price, and flexibility.** C2B2 needs cost-effective computational resources to support cancer research and a broad range of life sciences applications.
- **Energy and floor space.** Located in uptown Manhattan, C2B2's data center operates under stringent space and energy requirements.

## SOLUTION

- **A Titan of a system.** After comparing multiple systems and processors, C2B2 installed a system it calls Titan*—an HP ProLiant BL2x220c G5 Server Blade powered by 928 low-voltage Intel Xeon processors 5450.

## IMPACT

- **Ten times more performance than the next-fastest system.** Researchers are advancing their work by running more sophisticated simulations, digging deeper into their data, and getting results in days or weeks instead of months or years.
- **High-density design, USD 95,000 annual power savings.** The cluster fits into five racks, and its power consumption and cooling are almost 40 percent less than alternative solutions.

## Demanding Workloads

Columbia University's Center for Computational Biology and Bioinformatics (C2B2) is at the forefront of efforts to advance the understanding of biological systems and structures and find better ways to prevent, diagnose, and treat diseases ranging from AIDS to cancer. "A lot of biology is still a big unknown," says John Wofford, director of high-performance computing (HPC) at C2B2. "Running massive computational models and doing sophisticated biostatistical analyses are critical to expanding our knowledge."

C2B2 and the Herbert Irving Cancer Research Center at Columbia University Medical Center are using an HP ProLiant BL2x220c G5 Server Blade powered by 928 low-voltage Intel Xeon processors 5450 to drive progress in these areas. The machine has 8 TB of RAM, runs Fedora Core Linux*, and uses 10 gigabit Ethernet core switches with 1 gigabit Ethernet to the nodes.

Dubbed Titan, the system runs applications in many fields of biology and informatics, including data analysis for large, multi-site clinical trials. It was funded by


# Performance was important, but energy efficiency sealed the deal.

a grant from Empire State Development, New York State's economic development agency. In addition to researchers from C2B2 and the cancer center, the machine supports the area's growing health and biotechnology sector through technology-transfer activities.

## Performance Leadership

Before selecting a solution, Wofford's team conducted a comprehensive evaluation of systems that would deliver the best combination of performance and energy efficiency for their budget and be suitable for a wide array of life sciences applications. They rejected RISC architectures as too complex and costly. "The development push has been stronger in the non-RISC world," says Wofford. "You'd be hard-pressed to find a cost-per-slot comparison on a RISC platform that's anywhere close to what you can get with the Intel® architecture."

Three major vendors provided blade chassis and blades with various processors, and C2B2 subjected them to head-to-head comparisons. "We ran a sample set of our applications on Intel and non-Intel processors, and the Intel Xeon processor came out ahead on every application except one," Wofford recalls.

The cluster's 44.54 teraflops of peak performance ranked it at 124 on the November 2008 Top500 list and 238 on the June 2009 list.[1] It remains one of the most powerful computers dedicated to biological computing, and its performance not only fosters research breakthroughs but also enhances C2B2's status as an innovation leader.

## Energy Savings

Given C2B2's New York City location, power constraints were top-of-mind in selecting technologies. "ConEd could give us 800 kW for the entire data center," explains Wofford. "Anything more than that, we would have had to do another power feed. Titan has theoretical peak power consumption of 95 kW, which is pretty impressive."

The energy efficiency of the Intel and HP technologies leaves C2B2 with plenty of its power budget available to support other data center requirements. It also contributes significantly to savings on total cost of ownership (TCO). "Titan's 95 kW peak is about 55 kW less than the next-most-efficient system we looked at—roughly 40 percent less," Wofford adds. "The power difference is dramatic. We're saving roughly USD 95,000 in energy and cooling costs in a year. The power numbers really sealed the deal."

### SPOTLIGHT ON C2B2

The Center for Computational Biology and Bioinformatics at Columbia University supports research programs in areas such as computational biophysics, structural biology, pattern recognition, machine learning, functional genomics, and the modeling of regulatory, signaling, and metabolic networks. The Center also supports numerous graduate education programs.

The system's high-density design was also a plus. The BL2x220c packs two servers into each slot, enabling C2B2 to fit 464 nodes, each with a dual-socket, low-voltage Intel Xeon processor 5450, into five racks. "That's pretty small for that much performance," Wofford says. "It saved us about USD 110,000 in rack and chiller costs up front compared to the 10 racks that other manufacturers required."

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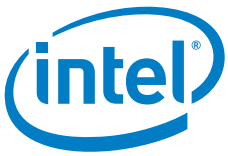



[1] www.top500.org/lists