World's fastest supercomputer paves path to efficient, affordable exascale computing

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Titan is a supercomputer capable of churning through more than 20,000 trillion calculations each second -- or 20 petaflops -- by employing a family of processors called graphic processing units first created for computer gaming.

Titan, the world's fastest open-science supercomputer, was completed this month at Oak Ridge National Laboratory in Tennessee, opening new windows of opportunity into the exploration of some of the world's toughest scientific challenges.

Titan's peak performance is more than 20 petaflops—or 20 million billion floating-point operations per second—about 90 percent of which comes from 18,688 NVIDIA Tesla K20 GPU accelerators. These are based on the NVIDIA Kepler architecture, the fastest, most efficient, highest-performance computing architecture ever built.

Researchers use ever faster supercomputers to accelerate the pace of discovery and innovation across a range of scientific fields of inquiry—from developing more efficient engines and higher capacity, lighter weight batteries, to studying climate change and finding cures for disease. Titan is a milestone on the path to exascale computing, which targets building a 1,000 petaflops supercomputer.

Titan is operated by Oak Ridge National Laboratory, part of the U.S. Department of Energy's network of research labs, as an open-science system. This means it is available to researchers from academia, government laboratories, and a broad range of industries who will use Titan to model physical and biological phenomena and seek breakthroughs faster than possible by experimentation alone.

Supported by the energy efficiency and cost-effectiveness of the Tesla K20 GPU, Titan is more than 10 times faster and five times more energy efficient than its predecessor, the 2.3-petaflops Jaguar system, while occupying the same floor space. Had Oak Ridge upgraded Jaguar by simply expanding its CPU-based architecture, the system would be more than four times its current size and consume more than 30 megawatts of power.

"Basing Titan on Tesla GPUs allows Oak Ridge to run phenomenally complex applications at scale, and validates the use of accelerated computing to address our most pressing scientific problems," said Steve Scott, chief technology officer of the GPU Accelerated Computing business at NVIDIA. "You simply can't get these levels of performance,

power- and cost-efficiency with conventional CPU-based architectures. Accelerated computing is the best and most realistic approach to enable exascale performance levels within the next decade."

Titan development began three years ago with Oak Ridge's decision to upgrade Jaguar, the previous open science system leader and a former world No. 1 most powerful supercomputer. The upgrade includes the Tesla K20 GPU accelerators, a replacement of the compute modules to convert the system's 200 cabinets to a Cray XK7 supercomputer, and 710 terabytes of memory.

"Science and technology have always been our primary goal, and Titan is a groundbreaking tool that will allow researchers worldwide to leverage GPU-accelerated computing to make unparalleled breakthroughs," said Jeff Nichols, associate laboratory director for computing and computational sciences at Oak Ridge National Laboratory. "The new Tesla GPU accelerators offer the performance and energy efficiency that enable Titan to scale to unprecedented performance levels without consuming the energy equivalent of a small city."

Provided by NVIDIA

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