Why the world's fastest computer is a scientific 'time machine'

November 21 2012, by Brian Caulfield

This week it became official: the Titan supercomputer at Oak Ridge National Laboratory in Tennessee was crowned the fastest computer on Earth, according to the Top500 list released this week that tracks these systems.

Titan is so quick that Buddy Bland, the project director for the Oak Ridge Leadership Computing Facility, calls it a "time machine."

Titan has a peak performance of more than 27 petaflops – or 27 thousand trillion calculations per second (see video, below). It can do more work in an hour than your personal computer can do in 20 years. "The simulations on the machine today are trying to predict what's going to happen in the future," Bland says. "So with a more powerful computer we can look farther into the future to predict what's going to happen."

But what truly sets this machine apart isn't just the machine's time-blurring speed that put Titan at the top of Top500 list of the world's fastest supercomputers this week. Or even that it's five-times more energy efficient than its predecessor, when running compute-intensive, large-scale scientific research. It's the machine's potentially world-changing applications. "We're simulating things like what goes on in the climate, what goes on in building engines, what goes on in nuclear reactors," Bland says.

Titan is an open-science system, which means it can be used by researchers from academia, government labs, and private companies

from around the world to advance their work. If you've got a project that can benefit from what Titan can do, the team at Oak Ridge may be able to help, says Bronson Messer, acting group leader for scientific computing at ORNL's National Center for Computational Sciences.

Among the projects Titan is tackling now:

- Tom Evans, at Oak Ridge, is using the machine to simulate nuclear reactor cores, improving the efficiency of the plants that now supply 20 percent of the electricity generated in the United States;
- Jackie Chen at Sandia National Laboratories is using Titan to simulate the way hydrocarbons are burned: potentially improving fuel efficiency by 25 to 50 percent;
- Warren Washington at the National Center for Atmospheric Research is using Titan to better understand and predict climate change, by generating high-resolution simulations of the atmosphere for the next one to five years, in the same time it took Jaguar to simulate three months out.

The applications running on supercomputers such as Titan can change lives. Maybe even save them. "They can be used for better predictive capabilities for hurricanes – people want to know when and where a hurricane is going to hit, and civil authorities want to be able to pull those people out quickly and get them evacuated," says Messer.

Science-fictioney, stuff. But crack Titan open, and the technology inside is much less so. Most of Titan's computing muscle comes from its new Tesla K20X GPU accelerators (PDF 473 KB). Based on the same Kepler architecture used in NVIDIA's workstation and PC gaming chips, Titan's K20X accelerators – which are the flagship of the new Tesla K20 accelerator family—crank through computations far more power

efficiently than any machine equipped with CPUs alone.

The result: more than 200 software applications have been developed to take advantage of GPU acceleration – spanning all areas of science and engineering. When paired with a CPU the K20 can make software used to tackle engineering, physics, earth science, and molecular dynamics software an order of magnitude faster.

Looking to change the world? Grab a Tesla K20 or K20X accelerator – available for order now from leading server manufacturers and NVIDIA reseller partners. Or, take a free test drive on a remote cluster to see what it can do for you.

Chances are there's an app for that.

Provided by NVIDIA

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