U.S. to build two new world-class supercomputers

The U.S. Department of Energy (DOE) announced today two major efforts to push supercomputing power well beyond where it is today. DOE will spend $325 million on two extreme-scale computers to be built at national labs in Oak Ridge, Tennessee, and Livermore, California. The agency will spend another $100 million on FastForward 2, a program designed to improve software and applications that will run on the new machines. Though the specifications for the new machines are still in flux, they're expected to run at top speeds of between 100 and 300 petaflops. (Each petaflop is equal to 10^{15} floating-point operations per second.) That's considered a key milestone toward the goal of creating the first exascale (10^{18} flops) supercomputer, the next major landmark in high-performance computing.

"It's great," says Jack Dongarra, a supercomputing expert at the University of Tennessee, Knoxville. "[These machines] are one step away from exascale. This is the jumping point to get there," Dongarra says. It also suggests that if the current pace of improvement in high-performance computing continues, the first exascale machine could come online somewhere around 2022 to 2023, Dongarra says.

The Oak Ridge supercomputer, called Summit, will be open to the scientific community and is expected to run at up to 300 petaflops. Sierra, the Livermore machine, is expected to top out somewhere around 200 petaflops and will be used by the National Nuclear Security Administration to test the safety and security of U.S. nuclear weapons. Both the Summit and Sierra machines are expected to be delivered in 2017 and become operational in 2018.

The speed of the both machines is expected to easily outpace the United States' current speed champ, Titan at Oak Ridge, which tops out at 27 petaflops. They will also be faster than the current world record–holder, Tianhe-2, which reaches top speeds of almost 35 petaflops at China's National Supercomputer Center in Guangzhou. Although, Dongarra says that engineers are already working to boost the speed of Tianhe-2 to about 100 petaflops, and may do even more later.

The design of the new machines is expected to continue a recent trend in revamping the way top supercomputers are built. Engineers previously boosted supercomputing power by adding additional central processing units (CPUs) that serve as the brains of the machine. But these chips are power-hungry. So simply adding more and more isn't a viable way to get to exascale. Instead, these new machines will increase the use of graphics processing units (GPUs) that accelerate certain calculations, as well as add new high-speed interconnections between GPUs and CPUs. As a result, even though Summit is expected to have five to 10 times higher performance than Titan, it will use only 10% more power. The components for the new machine will be built by IBM, NVIDIA, and Mellanox.

The new computers are expected to enable discoveries in fields ranging from materials science and biofuels development to combustion research and nuclear weapons engineering. "High-performance computing is an essential component of the science and technology portfolio required to maintain U.S. competitiveness and ensure our economic and national security," said DOE Secretary Ernest Moniz in a statement.