ASCR@40

BUILDING BETTER COMPUTERS

Computer Architecture Research Supports Science

Summit simulation models Mars vehicle's descent. *Credit: Oak Ridge National Laboratory.*

The Department of Energy (DOE) has fostered a decades-long collaboration between its Advanced Scientific Computing Research (ASCR) program and the U.S. computer industry. As Moore's Law reaches its limits, that approach continues to shape high-performance computing (HPC) today. Researchers can no longer rely on packing more processors onto ever smaller silicon chips. Instead, they must make dramatic changes to computer architectures to continue to boost computational performance. ASCR researchers are working closely with industry partners to ensure that future machines will meet DOE's needs.

Credit: Oak Ridge National Laboratory.

INNOVATIONS

PARTNERSHIPS WITH INDUSTRY SHAPE ADVANCED COMPUTING

Partnerships between ASCR-funded researchers and industry have long been central to HPC. For example, in the 1980s and early 1990s ASCR-funded researchers pioneered and drove the transition to massively parallel computers through close collaborations with industry.

- DOE purchased cutting-edge machines to support innovative scientific research.

- ASCR has helped shape the direction of high-performance computing through investments in architecture research, systems software and applications.

- The collaboration in parallel computing also benefitted the U.S. computer industry, which used those valuable lessons to produce leading hardware and software for the commercial marketplace.

IMPACT

DESIGNING HARDWARE, ALGORITHMS AND SOFTWARE SIMULTANEOUSLY

ASCR researchers have pioneered co-design, an approach that weighs tradeoffs among hardware, software and algorithms to find the best computing solutions.

- This co-design approach led to today's fastest supercomputers, such as Summit at the Oak Ridge Leadership Computing Facility. Summit has reached a peak performance of 200 petaflops (quadrillion scientific calculations per second) through the combination of CPUs with graphics processing units.

- ASCR's collaboration with the DOE National Nuclear Security Administration's Advanced Scientific Computing program on the Exascale Computing Initiative is ensuring that DOE supercomputers continue to lead the world as tools for scientific discovery while positioning U.S. computer vendors to succeed commercially.

TAKEAWAY

NAVIGATING A HETEROGENEOUS FUTURE

ASCR's collaborations with industry have guided the design of novel computer architectures and are supporting the development of tomorrow's exascale supercomputers, capable of a billion-billion calculations per second.