ARGONNE LEADERSHIP COMPUTING FACILITY

LEADERSHIP-CLASS COMPUTING

for breakthrough science and engineering

The Argonne Leadership Computing Facility (ALCF) enables breakthrough science—science that will change our world through major advances in biology, chemistry, energy, engineering, climate studies, astrophysics and more.

Operated for the U.S. Department of Energy's (DOE) Office of Science, the ALCF gives scientists access to world-class computation resources and a team of expert computational scientists and engineers. The majority of ALCF resources are allocated through the DOE's "Innovative and Novel Computational Impact on Theory and Experiment" program (INCITE). http://science.energy.gov/ascr/facilities/incite/

Work under way at the ALCF spans all scientific disciplines to help researchers:

- Guide treatment discoveries for Parkinson's disease
- Assess the impacts of climate change
- Design technologies to improve fuel efficiency and reduce aerodynamic noise
- Make safe, clean nuclear energy available globally
- Explore Type Ia supernovae

Advancing Science with World Class, Efficient Resources

Intrepid, the ALCF's IBM Blue Gene/P

IBM Blue Gene Supercomputer recipient of the 2008 National Medal of Technology and Innovation

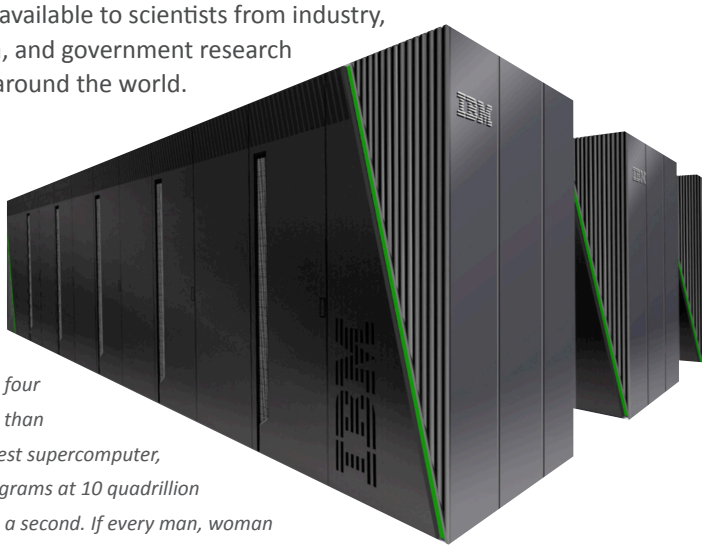
The ALCF is home to the IBM Blue Gene/P, Intrepid, one of world's fastest supercomputers for open science. Intrepid features 40,960 quad-core compute nodes (163,840 processors), 80 terabytes of memory and a peak performance of 557 teraflops. Despite its power, the energy-efficient system uses one-third the electricity of comparably sized machines built with more conventional parts. President Obama awarded IBM with a National Medal of Technology and Innovation for its Blue Gene family of supercomputers.

The ALCF also operates Surveyor, a Blue Gene/P system with 1,024 quad-core nodes (4,096 processors) and two terabytes of memory, used for testing and development.

Coming in 2012: Mira, the next-generation IBM Blue Gene/Q

IBM's next-generation Blue Gene supercomputer, the Blue Gene/Q, will be delivered to the Argonne Leadership Computing Facility in 2012. Four times faster than today's fastest supercomputer, experts look to the unprecedented power of this leadership-class system to propel national innovation in science and technology.

The 10-petaflops supercomputer (named Mira) will feature 48K 16-way compute nodes (768K processors), and 768 terabytes of memory. Like the ALCF's Intrepid, Mira will be made available to scientists from industry, academia, and government research facilities around the world.



Mira will be four times faster than today's fastest supercomputer, running programs at 10 quadrillion calculations a second. If every man, woman and child in the U.S. performed one calculation each second, it would take them almost a year combined to do as many calculations as Mira will do in one second.

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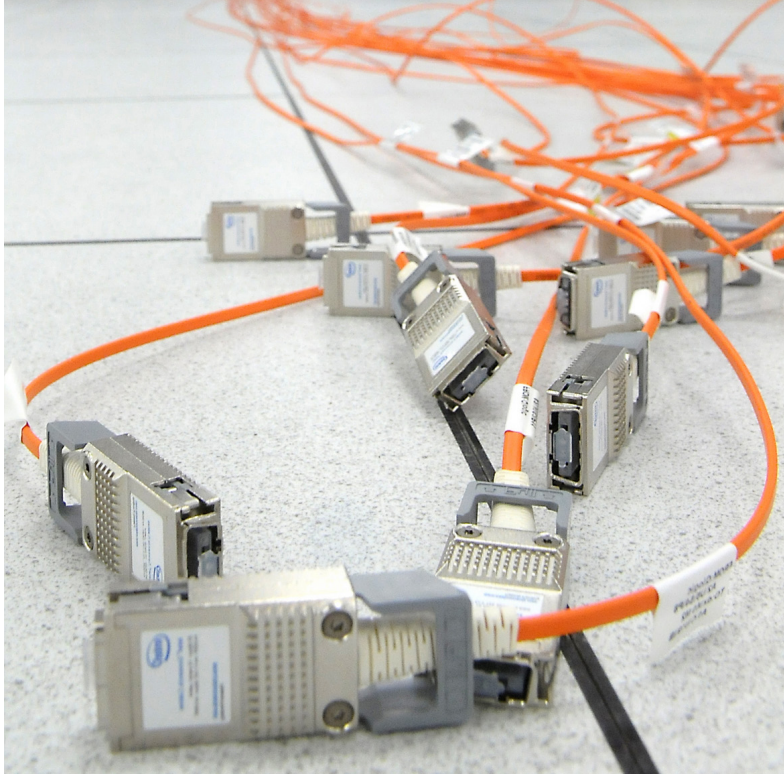
Other ALCF resources include:

Networking

The Blue Gene/P uses five different networks for different communication operations. The 3D torus network is used for general-purpose, point-to-point message passing as well as for collective operations using irregular communication or large message sizes. Each node has six nearest neighbors. Each link provides a bandwidth of 425 MBs per direction, for a total bidirectional bandwidth of 5.1 GBs. Though each node has six bidirectional links on each node, there is only one shared DMA engine. The 3D torus network is also usable as a 3D mesh.

The supercomputer connects to other research institutions using a total of 20 GBs of public network connectivity. This allows scientists to transfer datasets to and from other institutions over fast research networks such as the Energy Science Network (ESNet) and the Metropolitan Research and Education Network (MREN).



Visualization and Data Analytics

Researchers often analyze the huge data output generated on Intrepid by converting it into visual representations on the ALCF's Eureka, a system featuring one of the world's largest installations of NVIDIA Quadro Plex S4 external graphics processing unit (GPUs).

Eureka

- 100 compute nodes: Each with (2) 2.0 GHz quad-core Xeon servers with 32 GB RAM
  - 200 NVIDIA Quadro FX5600 GPUs in 50 S4s
    - Memory: More than 3.2 terabytes of RAM
      - Peak Performance: More than 111 mostly single precision teraflops of computation use a fraction of electricity compared to alternative architectures.

The ALCF also operates Gadzooks, a visualization test and development system with four compute nodes (each with two 2.0 GHz quad-core Xeon servers with 32 GB RAM) and a total of 8 NVIDIA Quadro FX5600 GPUs in two S4s.

Data Storage

The supercomputer's data systems consist of 640 I/O nodes that connect to a storage system with 7,680 disk drives with a total capacity of 7.6 petabytes of raw storage and a maximum aggregate transfer speed of 88 gigabytes per second. The ALCF uses parallel file systems to access the storage. The tape drives have built-in hardware compression allowing compression ratios of between 1.25:1 and 2:1, depending on the data, giving an effective capacity of 16-24 petabytes. An HPSS automated tape storage system provides archival storage with 16,000 tapes in two 10,000-slot libraries.

For more information about the ALCF, visit
www.alcf.anl.gov

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