

# The Columbus Dispatch

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## SCIENCE

Super fast ... Super big ... Supercomputer

Researchers line up to use Ohio's setup, which can perform 21.9 trillion computations per second

Tuesday, April 29, 2008 3:02 AM

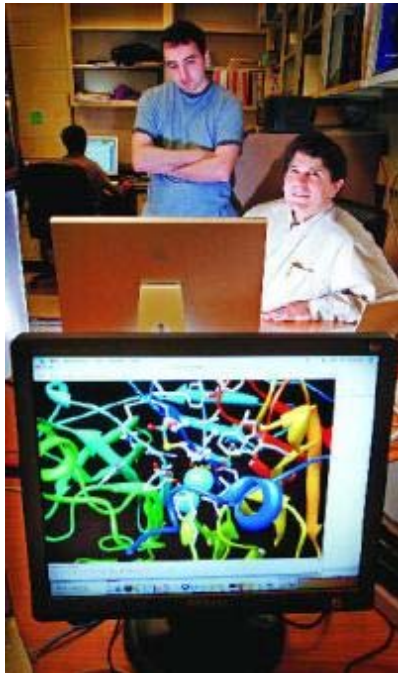
By [Kevin Mayhoo](#)

THE COLUMBUS DISPATCH



FRED SQUILLANTE | Dispatch

The Ohio Supercomputer Center has about 2,000 users that include universities, hospitals, businesses and the military. Jim Giuliani, left, is client and technology support manager; Kevin Wohlever is director of supercomputing operations.



TOM DODGE | Dispatch

Toby Sanan, left, an Ohio State University graduate student, and OSU chemistry professor Christopher Hadad display a complex enzyme they modeled using the supercomputer.

## Supercomputer by the numbers:

**6**

The number of supercomputers at the center

**5,100**

Processors in those  
supercomputers

**2,000**

Registered users  
(100 to 300 at a time)

**13,811,270.3**

Hours that processors  
ran in 2007

**400**

Memory in terabytes,  
enough to store 90,000 full-length movies

**3,864**

Processors in the largest  
of the supercomputers,  
the IBM 1350 Cluster

**21.9 trillion**

Calculations the IBM  
can make per second

**20,000**

The processing equivalent in standard desktop computers

## 90

Tons of cooling power needed

Source: Ohio Supercomputer Center

Sitting at old wood desks topped with computer keyboards and flat screens, Christopher Hadad's team of computational chemists bang out program codes in their lab at Ohio State University.

They are trying to design a customized enzyme that, if injected into the body, would protect the military, first responders and others from fatal nerve agents.

At the University of Toledo, physics professor Jacques Amar's team of researchers simulates how films that could be used in semiconductors, computer chips and solar panels can be grown in layers as thin as a molecule.

And at the University of Cincinnati, physics professor Mark Jarrell leads a team trying to understand and predict how complex materials, made up of three or more elements, behave.

They are all plugged into the Ohio Supercomputer Center, where the latest incarnation of a computer can do in one day what a top-model desktop computer would take several years to accomplish.

"I need the firepower," said Hadad, who is working on six federally funded projects that depend on the center housed at Ohio State and others like it across the country.

In the most recent ranking in November, the Ohio Supercomputer Center was named the 76th-fastest computer worldwide and the ninth-fastest among academic centers.

Since then, Ohio has increased the center's speed by about 5 percent, said Kevin Wohlever, director of supercomputing operations.

This supercomputer center, which turns 21 this year, is starting to hum.

The Ohio Supercomputer Center has about 2,000 users that include universities, state agencies, hospitals, private businesses, the military and the National Institutes of Health.

Researchers have access to six computer systems, and 100 to 300 users can run programs at a time.

They are connected, along with K-12 schools, public broadcasters and federal labs, by more than 1,800 miles of high-speed fiber-optic cable.

"I'm typically using several hundred processors," Amar said. "For the biggest projects, the calculations take months."

By subject, top users are studying physics, chemistry, materials research, molecular bioscience and a variety of engineering disciplines.

Most are using computational science, which simulates all kinds of phenomena, as different as the interaction between two molecules and the influence of greenhouse gases on the global climate.

"There are so many high-quality people here doing really nice work," said Jarrell, who chose to work in Ohio because of access to the center and the support provided by its more than 100

employees.

Ohio created the center in 1987 after the National Science Foundation rejected Ohio State's bid to become home to a federal supercomputing center. Universities in Illinois, San Diego and Pittsburgh won the grants.

Ohio rented computers at first, and in 1989 plunked down \$20 million (Ohio State asked for \$40 million) to buy the Cray Y-MP 8D, the largest and fastest supercomputer in the world.

The system was capable of performing 2.6 billion calculations per second and had about 40 gigabytes of memory, or about half of what a \$250 iPod can store.

Today, the center's largest computer, an IBM 1350 Cluster, cost \$4.5 million and is more than 10,000 times faster than the original Cray. The Cluster also has 210 times more memory.

The 1350 is made up of nearly 4,000 processors that use chips that are three times faster than those in an average desktop PC. The processors are linked so closely that they can act as a, well, supercomputer.

To create a top-10 supercomputer, the center estimates it would need \$200 million or more, said Executive Director Stanley Ahalt. Power and cooling costs alone would run as high as \$5 million annually.

Ohio invests millions of dollars every two years to buy newer, faster equipment, Ahalt said. The most current funding includes \$6.8 million for supercomputing and \$8.5 million for maintaining the network. Researchers say they are happy with the IBM cluster and its capabilities, including performing 21.9 trillion calculations per second.

"It's a machine with a Midwest attitude," Wohlever said.

The BlueGene/L, developed by IBM and Lawrence Livermore National Laboratory, is the world's fastest supercomputer. It has held the crown since November 2004.

Last year, the computer system, operated by the University of California, was beefed up to perform 578.2 trillion calculations per second (in computerese, it's called 578.2 teraflops).

The largest cluster computers can handle highly complex calculations that would leave smaller computers breathless. For example, the U.S. Department of Energy uses supercomputers at Livermore to simulate the effects of aging and storage on the country's nuclear-weapons stockpile.

The four next-fastest computers are housed at the Forschungszentrum Juelich research center in Germany, the New Mexico Computer Applications Center, Computational Research Laboratories in Pune, India, and a Swedish government agency.

The speeds at those centers range from 102.8 teraflops to 167.3 teraflops.

The National Center for Supercomputing Applications, at the University of Illinois at Urbana-Champaign, is set to become the biggest of the big in 2011 when it installs a \$218 million IBM setup. The system, called Blue Water, will reportedly perform 1 quadrillion calculations per second. The National Science Foundation is footing the bill.

The federal government began to boost its supercomputer spending when Japan's Earth Simulator became the world's fastest system in the world in 2002. At the time, the Japanese computer was

five times faster than the best the United States had to offer.

Gregory Wiet, a pediatric ear, nose and throat surgeon at Nationwide Children's Hospital, developed a surgical simulator that relies on the Ohio Supercomputer.

The simulator, created with the center's Don Stredney, lets medical students feel as if they are drilling into the temporal bone in the side of a skull while "seeing" the results.

Stredney also helped develop simulators for veterinary students learning simple procedures including skin-punch biopsies, said OSU professor Mary McLoughlin.

These kinds of simulated surgeries reduce the number of live animals the veterinary school has to use.

In Chillicothe, doctors at Adena Health Care Systems use the network to consult "face to face" with specialists at Children's Hospital who examine newborns via digital cameras and look at X-rays and MRIs to help them decide whether more-intensive care is needed in Columbus.

"The visual clarity is wonderful; they can see a rash and determine what to do," said Susan Rowe, service-line director of Women and Children Services at Adena.

Online consultations helped reduce transfers from Chillicothe to Columbus from 70 to 35 last year, Adena said.

Other examples of supercomputing capabilities include Procter & Gamble analyzing the aerodynamics of potato chips because its Pringles chips flew all over the place when packaged at high speed. All it took was a slight shape change.

The Ohio center estimates it draws in \$8.75 in research money for each \$1 it spends. Much of the return is in the form of grant money that researchers receive to do their work; not all of it comes to the center.

"A modest investment in high-performance computing does not produce a top-10-in-the-world machine," Ahalt said. "But a modest investment does yield incredible results in terms of the research done."

For more information about the center, go to <http://www.osc.edu/>. [kmayhood@dispatch.com](mailto:kmayhood@dispatch.com)