

# Sandia counterintuitive simulation: After a certain point, more chip cores mean *slower* supercomputing



MULTICORE DILEMMA — More cores on a single chip doesn't mean faster clock speeds, a Sandia simulation has demonstrated. (Photo by Randy Montoya)

By Neal Singer

Simulations by Sandia researchers show that the worldwide attempt to increase computer speed on the most complex problems merely by increasing the number of processor cores on individual chips unexpectedly reaches a quick dead end for many applications important to Sandia's missions.

A Sandia simulation graph that modeled algorithms important for network discovery — the ability of a processor to find and be seen by other devices on the network — shows a significant increase in speed going from two to four multicores, but an insignificant increase from four to eight multicores. Exceeding eight multicores causes a decline. Sixteen multicores perform barely as well as two. Steeper dropoffs are registered as more cores are added.

The problem is the lack of memory bandwidth, as well as contention between processors over the memory bus available to each processor. (The memory bus is the set of wires used to carry memory addresses and data to and from the system RAM.)

To use a supermarket analogy, if two clerks at the same checkout counter are processing your food instead of one, the checkout process should go faster.

Or, you could be served by four clerks. Or eight clerks. Or sixteen. And so on.

The problem is, if each clerk doesn't have access to the groceries, he or she doesn't necessarily help the process. Worse, the clerks may get in each other's way.

Similarly, it seems a no-brainer that if one core is fast, two would be faster, four still faster, and so on.

But the lack of immediate access to individualized memory caches —

*(Continued on page 4)*

## Nobel Laureate Steven Chu tapped by President-elect Obama to head Department of Energy

By Neal Singer

The announcement that Nobel Laureate physicist and Lawrence Berkeley National Laboratory Director Steven Chu has been nominated for the post of DOE Secretary has generated a wave of enthusiasm similar to that caused in wider circles by Obama himself.

The overt public response was positive to the unexpected possibility that a first-rate scientific mind with a strong leaning toward alternative energies would take the job of Energy Secretary.

The normally dyspeptic, widely read science-policy newsletter "What's New," from physicist and former Sandian Bob Park, headlined Chu's nomination: "ENERGY TRANSITION: OBAMA MAKES A PERFECT CALL."

An Associated Press report from China began: "BEIJING — China's media are cheering President-elect Barack Obama's pick of Chinese-American Steven Chu for the post of U.S. energy secretary, saying it bodes well for future cooperation between the two countries."

The unexpected pick — bypassing California Gov. Arnold Schwarzenegger and other more political candidates — has caused elation even in the often-critical blogosphere.

"What a novel concept!" one blogger wrote, "A physicist in charge of the Department of Energy." And another, wrote, "Nuurrrds!!! We're BACK!"

Chu, who shared the 1997 Nobel Prize for using lasers to trap atoms by slowing them in a procedure he referred to as "optical molasses," has turned LBL into a center of research into biofuels and solar energy. He has been eloquent in his belief that

*(Continued on page 5)*



SECRETARY of Energy-designate Steven Chu in his office at Lawrence Berkeley National Laboratory.

## Sandia LabNews

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## Labs scores 'outstanding' on annual report card

By Chris Miller

Sandia has received an "outstanding" rating on the annual NNSA Performance Evaluation Report for fiscal year 2008, issued Dec. 2. The report details NNSA's evaluation of Sandia's mission-related performance, operations performance, and overall performance.

"Sandia continues to demonstrate exceptional leadership across the Nuclear Weapons Complex and to provide high-quality scientific and engineering support of the United States' national security interests," the report said.

The report cites numerous achievements in mission performance over the past year, including performing in an outstanding manner as the lead laboratory for the Yucca Mountain Project; completing within costs all scheduled deliveries of all first production unit components in the W76-1 life extension



*"This result was only possible through the commitment and hard work of all members of the Sandia workforce and I want to thank all of you for your contribution. This is the third consecutive year that we have reached this level of achievement and that is a testament to your dedication and hard work."*

—Labs Director Tom Hunter

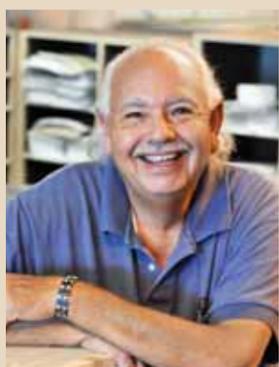
program and B61 Alt programs for the canned subassembly and spin rocket motor; and receiving numerous prestigious awards and honors for scientific, technology, and engineering advances, including three R&D 100 Awards.

In operations performance, the report cites as evidence Sandia's total recordable case rate of 1.72 injuries per 200,000 workhours, an improvement of 55 percent over the 2003 rate and a 9 percent reduction from 2007. In addition, the days-away case rate of 0.68 per 200,000 workhours is a reduction of 51 percent from 2003 to 2008.

The outstanding rating is the highest possible evaluation in both the mission and operations categories and allows the contract for Sandia Corporation to be extended one additional year, until October 2012. The report this year does not assign numerical scores as it has done in past years, but provides strictly the word ratings in order to mirror how the other NNSA labs are rated. The possible ratings are outstanding, good, satisfactory, and unsatisfactory.

"This result was only possible through the commitment and hard work of

*(Continued on page 3)*



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# That's that

As the shape of the next administration begins to become clear, New Mexicans have some occasion to take real pride in the cabinet selections announced so far by President-elect Barack Obama. With our excellent track record – a bipartisan record, by the way – of influential and effective congressional leadership in Washington, our small state has always had a disproportionately respected and listened-to voice in national affairs. In recent presidential elections, as a so-called battleground state, we've also attracted attention from presidential candidates all out of proportion with our paltry five electoral votes.

It should come as no surprise, then, that when the president-elect started making cabinet appointments, two individuals with strong New Mexico connections rose to the fore. Gov. Bill Richardson, of course, has long been a highly visible figure on the national stage and had already served as captain of our mother ship – the Department of Energy – in the Clinton administration. Although he's not a native New Mexican, he's made the state his home; he's been a political force of nature ever since winning election to Congress in 1982. Obama wants him as Secretary of Commerce.

And Obama has asked Arizona Gov. Janet Napolitano to take on the sprawling Department of Homeland Security. Though Napolitano built her political career in our neighboring state, she was raised in Albuquerque and graduated in 1975 from Sandia High School. There are probably a number of her classmates employed here today.

And, oh, there is at least one Sandian who knows Gov. Napolitano extremely well: her brother Len, who's director of Computer Sciences and Information Systems Center 8900.

\* \* \*

Speaking of Cabinet nominees, how about Stephen Chu at DOE? Seems to me that having a Nobel laureate at the top of your org chart is something pretty special.

\* \* \*

A few days back, I posted a poll question on Sandia's internal-only *Lab News Interactive* website. With the highly publicized surge of piracy activity on the high seas, I thought it would be interesting to ask Sandians if they think the Labs has a role to play in developing antipiracy technologies. The topic must have struck a chord, because that question has generated more responses than anything we've ever posted. And the various comments confirm what I've known all along: Sandians have an opinion – usually a well-informed and thoughtful one – about everything.

The poll results suggest that a substantial majority of us do in fact think Sandia can help in global antipiracy efforts. Among the comments, a number of folks suggested that Sandia's work in sensors, remote monitoring, access denial, and data analysis would seem to have applications in combating pirates. Other folks were more blunt, arguing that this essentially low tech problem calls for a low-tech solution: fire a warning shot across the bow and then sink 'em.

And this comment from a Sandian serving an active-duty military stint particularly caught my attention:

*I happened to be checking the Sandia website and caught this post. I am a reservist currently deployed to the Horn of Africa in the US Navy and am involved in solutions for this issue. The region needs a reliable inexpensive solution that local governments could maintain. It is an area that Sandia can definitely assist with and could present a great opportunity for partnering between Sandia and the military. If there is interest, I can help facilitate coordination with the Combined Joint Task Force in the region.*

(To protect his privacy, I'm not mentioning this individual's name, but if you're interested, I can provide you his email address.)

Of all the comments, though, there's one that really stands out, one that's smack-yourself-on-the-forehead-obvious: Hire swashbucklers! Of course. See you next time.

– Bill Murphy (505-845-0845, MS0165, wtmurph@sandia.gov)

## Employee death

### Mike Prairie remembered for his passion for science, sincerity in relationships

Mike Prairie (1500) died at home with family in attendance Nov. 28, following a 13-month struggle with cancer. Mike was 48 years old and was the senior manager for the Thermal, Fluid, and Aero Sciences Group.



MIKE PRAIRIE IN 2002

Mike's energy, his passion for science and technology, and his commitment to excellence will be deeply missed, says Art Ratzel, director of Engineering Sciences Center 1500.

"Mike's operational and strategic leadership of the Engineering Sciences research programs and the Enable Predictive Simulation LDRD (Laboratory Directed Research and Development) program, including work he tirelessly performed while recovering from medical treatments this past year, was phenomenal," Art says. "What separated Mike from others was his ability to assemble high-performing teams — this was no doubt due to the fact that Mike was unassuming, willing to share credit for success, and accept responsibility for failure — on those rare occasions — so effectively. His ability to reduce tension in meetings and to deal with difficult personnel and business issues in the workplace, without losing his patience and infectious smile, made him a true delight to work with."

Jim Miller (1815), Mike's good friend and hunting buddy, says Mike was very good at what he did, and he expected the same of others.

"He did what he could to make sure Sandia lived up to its aspiration to be exceptional," Jim says. "He was the most energetic person I ever knew and he squeezed every ounce of living out of his years."

Jim has countless memories of their hunting trips, which, as he recalls, were great, miserable times that he wouldn't trade for anything.

"Mike was first on the river, and last off," Jim says. "He went up the mountain hours before daylight and came back down hours afterwards. He liked the fresh powder, but he also caught the last ride on the chair lift at the end of the day. He would fill his turkey tags in New Mexico and head to Kansas or Mississippi for more."

Tom Blejwas (9700), another friend of Mike's, remembers when he had the opportunity to interview Mike for an opening for a senior/group manager for Power Sources (known informally as the battery group).

"I was blown away by his interpersonal skills," says Tom. "He was just so friendly, so interested in other perspectives, so willing to learn — yet technically strong, strong in character, with no real weaknesses."

Tom says he saw a great manager in Mike. Selecting and working with Mike as manager confirmed his impressions.

"I learned quickly that he was strong in adversity," Tom says. "Mike didn't whine when we felt victimized, but quickly focused on how to deal with the problems and improve the situation. He also passed on bad news in a straightforward but compassionate way. I believed that Mike was a future leader for the Labs."

After a couple of years, Mike transferred back to 1500, but Tom was able to continue his friendship with Mike in an informal golfing foursome including Steve Harris (2123) and Bob Brandhuber (4130).

"Seeing Mike was like a ray of sunshine in my day — his upbeat way, his friendly manner, his sincerity in relationships," Tom says. — Michael Padilla

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## Executive Diversity Council members announced

The newly reformed Executive Diversity Council (*Lab News*, Aug 15, 2008) is designed to advise and engage Sandia executive management. It will serve as a forum to develop and communicate diversity strategies to achieve maximum impact for the Laboratories. The members of the newly formed Executive Diversity Council are:

Cochairs: Les Shephard (6000), Becky Krauss (11000); Standing members: John Slipke (3000), BJ Jones (3030), Mike DeWitte (3600 acting), and Rochelle Lari (3552).

Rotating team members serving three year terms are: Gil Herrera (1700), Gary Sanders (2100), Linda Duffy (3300), Brian Bielecki (4200), James Chavez (5900), Ron Moya (6400), Jill Hruby (8100), W. David Williams (9500), Bonnie Apodaca (10600), and David Palmer (12800).

Rotating team members are selected at the director level to ensure broad representation of the Laboratories.

The team has held two forming meetings and will undertake these responsibilities:

- Embrace diversity as a business imperative
- Develop key corporate strategies to achieve and advance Sandia's diversity goals
- Communicate and model the value of diversity to all employees
- Develop partnerships for the deployment of the diversity and inclusion strategies with the Corporate Diversity Team and Sandia Business Resource Groups (such as Division Diversity councils, Outreach Groups and Networking Groups)

# National Security Agency honors Navid Jam for videoconferencing security work

By Patti Koning

This fall, Navid Jam (8965) was chosen as one of three finalists for the National Security Agency's (NSA) 2008 Frank B. Rowlett Award, which recognizes outstanding organizational and individual excellence in the field of information systems security.

"Navid represented a team that found critical vulnerabilities in common off-the-shelf videoconference systems that are widely used by government agencies," says Len Napolitano, director of Computer Sciences and Information Systems Center 8900. "They identified the problem and then Navid carried the message outside the Labs. Now the government is using their work as a standard, to the point that they are holding up procurements."

Navid was awarded an honorable mention for his contributions, but this is a case in which being a finalist is truly a remarkable achievement. The Rowlett Award typically stays within the armed services. Navid was the only nonuniformed individual nominee this year; never has there been an individual winner from outside the Department of Defense (DoD).

Navid says that at the ceremony he was surprised and pleased by the positive feedback he received from people in high-level positions with a variety of government agencies.

"Seeing the breadth and depth of customers and the impact we have had was rewarding," he says. "I think this shows the recognition of the important role national laboratories play in information assurance and cyber security for the nation and also recognition of this new, important area in which a national lab has had an impact across many areas including the government, vendors, and the standards community."

Navid and Len attended the awards ceremony in Washington, D.C., on Oct. 30. Before the ceremony began, all six nominees sat down privately with NSA Director Lt. Gen. Keith Alexander to discuss their work. The ceremony itself featured a four-minute video on the work of each nominee.

Sandia's videoconferencing work began four years ago as an internal, operational project. Corbin Stewart, a technologist in Videoconference and Collaborative

Technologies Dept. 8947, discovered a security issue with videoconferencing software.

"I was trying to update a feature and discovered that it did not require authentication," he says. "That was a red flag."

Jim Berry (8944), manager of Dept. 8947 at the time, decided the potential security issues surrounding videoconferencing were worth investigating. Using funding from Jim's department, Corbin, Steve Hurd (8965), a Sandia computer scientist and program manager for the Labs' Center for Cyber Defenders (CCD), and a group of college interns in the CCD initiated a risk analysis nearly four years ago that focused on commercial codecs. Navid was one of those interns.

"He really stood out and took the lead to advertise these types of vulnerabilities in embedded communication applications," says Corbin. "It's gratifying to see that the work we have done is benefitting so many others."

He adds that while one reason for turning to the CCD was because as interns, they were inexpensive, it wound up bringing new, fresh insights to the problem.

Another former CCD student, Elliot Proebstel (8965), has also contributed to the work.

"We are really impressed with Elliot," says Corbin. "During his second summer with the CCD, he was able to circumvent access controls on the evaluation device and recover the administrative password in only a few hours."

Sandia's primary concern was analyzing and mitigating security risks on its own network, risks addressed and rectified immediately after security holes were found. The research team evaluated hardware from several industry sources. After analyzing the devices and related hardware and software, the team developed "attack trees" (step-by-step tactics) and performed a variety of attacks to demonstrate vulner-

abilities. The objective was to attempt system compromises, independently assess vulnerabilities that were found to exist, and develop "best practices" and tools to aid users.

the Labs already has begun to develop and carry out plans to address them. Among the opportunities for improvement cited in the report are the need for focused management attention on the weapons quality assurance program; full implementation of work planning and control system; improving electrical safety programs and fire protection programs; and continued focus on nuclear operations in Tech Area 5.

The report highlighted a number of achievements in performance, including:

- Achieving a Defense Programs "Getting the Job Done" goal for 2008 for completing the MESA project ahead of schedule and under budget.
- Delivering on all commitments, completing all Level II milestones, and improving processes for the neutron generator enterprise.
- Removing all remaining security category I and II special nuclear materials in February 2008, completing the job six months ahead of schedule.
- Diversifying its research foundations and core technical competencies in preparation for emerging threats and technology surprise.
- Excelling in the management of the Technology Partnerships Program, including administering cooperative research and development agreements, funds-in-agreements, and management of intellectual property and licensing.
- Exceeding performance expectations in many areas in the Defense Nuclear Nonproliferation Programs such as the Global Threat Reduction Initiative, Full Toss exercise, Highly Enriched Uranium Transparency Program, and the Bratislava sites.



Photo by Randy Wong

NAVID JAM

## Sandia California News

This internal project developed into a full-fledged program with work for others funding from vendors of videoconferencing and embedded communications systems and government agencies using such systems.

"For external customers, we approach the problem from two perspectives," says Navid. "Sandia acts as a consultant for various government agencies, advising them on architecture, setups, and potential vulnerabilities. We also work with vendors to help them analyze some of the risks and vulnerabilities apparent with their systems."

Getting to this point was not easy. Navid recalls several years when no one would take him seriously.

"When we raised these concerns, they fell on deaf ears initially," he says. "We didn't give up and began sharing what we had learned with our government contacts and partners. We felt strongly that this was an important issue that needed to be addressed, not swept under the rug. No one was concerned about it and the vendors weren't listening to Sandia. That was something that was putting the nation at risk."

### Not rocket science

Mitigating the risks is actually fairly simple. A problem, explains Corbin, is that people often don't think of these videoconferencing devices as computers, and having the same kind of web services and FTP services as your computer, and as a result, the same need for security.

"Some vendors continue to tout the latest features, benefits, and productivity gains that videoconferencing technology offers, but not enough thought or effort has been placed in securing these devices," says Navid. "The irony is that it isn't rocket science. It's really akin to home PCs. By now, most people connected to the Internet understand the need to have antivirus software. Similarly, people responsible for videoconferencing events should understand that a videoconferencing device operates much like a PC and as such requires protection such as a firewall program. But there are a lot of companies out there who overlook that need."

Navid began giving talks at DOE, DoD, and public Internet security conferences. He says he talked to anyone and everyone willing to learn about the risks of embedded collaboration systems. A breakthrough came in 2006 at a Sandia Red Team conference, where he met with the NSA Red Team and shared the issues Sandia had identified and the tools and techniques to mitigate those issues.

"The NSA Red Team has been a terrific partner. They really championed our cause and helped us gain fairly high visibility throughout the government," says Navid. Recently the Defense Information Systems Agency (DISA) released a Security Technical Implementation Guide (STIG) for videoconferencing based on Sandia's work.

Sandia set up the Center for Collaborative Security (CCS) to educate companies and organizations about videoconferencing vulnerabilities and the need for industry-wide fixes. This virtual team comprises a wide swath of computer and security experts, including network operators, vulnerability researchers, IT architects, and systems analysts and spans many directorates across Sandia, including 8900, 8100, and 5600.

The CCS conducts research and development on security issues related to collaboration systems such as distributed information-sharing applications and instant messaging solutions. It provides basic tools and information on security vulnerabilities found in all types of collaboration devices, as well as best practices to enhance the security of collaborative systems. The CCS also provides a method for external partners to establish work-for-others business agreements with Sandia, which can perform company-specific evaluations and assessments.

Navid continues to drive broad acceptance of Sandia's work, working with standards bodies and meeting with more potential customers.

He's enjoying his role, which could be described as a spokesman, salesman, interface, or as he jokes, "just the pretty face." Navid says his key strength is being able to bridge both the technical and business aspects and understanding all the issues that come to play — understanding how the business works.

## Outstanding

(Continued from page 1)

all members of the Sandia workforce and I want to thank all of you for your contribution," said President and Labs Director Tom Hunter in a letter to employees. "This is the third consecutive year that we have reached this level of achievement and that is a testament to your dedication and hard work."

Said Kimberly Davis, acting manager of the DOE/NNSA Sandia Site Office, "The NNSA is pleased overall with Sandia's performance over the past year and appreciates Sandia's contributions to the NNSA missions and the nation. The Sandia Site Office is looking forward to working with Sandia to accomplish our fiscal year 2009 objectives."

The NNSA assessment, while generally lauding the Labs' performance, also identified some areas where Sandia needs to improve, most notably in safety performance. In his message to employees, Tom acknowledged the need for improvement in these areas and said

**"The Sandia Site Office is looking forward to working with Sandia to accomplish our fiscal year 2009 objectives."**

—Kimberly Davis

# Sometimes walls aren't the answer

## Sandia group provides access delay options for high-value facilities



TRUCK STOP — A flatbed truck, accelerated by tow cable into a modified box beam barrier, is stopped dead in its tracks. Sandia is conducting crash tests for the US Department of State.

By Stephanie Holinka

When most people think about physical security, they think about building walls to keep outsiders out of an area. Turns out walls aren't always the answer.

"Solid walls aren't always a good solution," says Dave Swahlan, manager of Active Response and Denial Dept. 6475. "Any kind of solid barrier can provide cover for bad guys," he says, which can make it harder to distinguish the early stages of an attack in time to mount a response.

In the past four and a half years, Sandia has conducted some 28 vehicle barrier-type tests at the Texas Transportation Institute in College Station, Texas. Sandia conducts tests for the Department of State on systems intended for perimeter security, checkpoints, and other security concerns.

Sandia has tested many different items and configurations such as barriers using large concrete blocks, ballards, sections of walls, Jersey barriers in multiple variations, and trucks configured and parked to serve as temporary barriers.

The Department of State has many facilities that require physical security specialized for their location and for the unique concerns of the facility and area. "Some facilities may only have a sidewalk-sized area for a barrier," Dave says. "In others, utilities and footings in already-existing locations can impact how large a barrier can be." He says that even facilities with limited space must still try to prevent facility breaches from big vehicles such as dump trucks.

The barrier system most recently tested used a modified box beam with additional items inside the beam to provide additional delay should an adversary try to

breach the barrier by cutting it open.

During the test, a large truck was pulled forward and up to speed using a tow truck and pull system that disengaged at the last second after the vehicle had reached its target speed. Instruments and video footage are later used to analyze how the barrier behaves during an attempted breach.

Sometimes a barrier's movement is an important part of the design. "Most people don't realize that movement is important in barriers," Dave says. "High deceleration loads with a rigid barrier can still sometimes bring the load into the area you're trying to protect." Stopping a truck too quickly, he says, can lead to bed-shearing, where the load continues forward from the truck.

Test engineer Mark McAllaster (6475) has been integrally involved in all the tests at College Station, from the design process to the logistics of arranging, funding, and purchasing testing equipment. He's also responsible for assuring the test components were correctly manufactured, installed, and tested according to the proper protocol to make the design eligible for certification according to an ASTM F2656-07 standard.

"Each test allows engineers to modify designs to potentially improve a barrier's performance," Mark says.

Mark says the most recent barrier tested met its design goal, adding that "engineers always hope that a design can be improved upon." Mark says the test's biggest surprise happened after the crash test, when the barrier

proved more resistant to common cutting techniques than originally estimated.

Sandia is contracted by the Department of State through FY09 for both new design and testing. The State Department is interested in creating a portfolio of generic designs that it can contract out and have built for deployment. Sandia expects to design six generic barriers and test each one. Those designs may be gateway designs or perimeter designs depending on what the State Department decides it needs for the near future.

Another purpose of the tests is to create a collection of barrier designs that are precisely understood, so that the Department of State can have them built any time it requires new barriers, rather than relying on off-the-shelf systems.

In the past, the Department of State ranked barriers using "K-ratings," which set up criteria for a barrier's breachability. But the Department is replacing the "K-ratings" with the ASTM standard so many organizations can compare barriers using the same standards and the results of tests will be interpreted the same way.

Right now, that testing information is not all kept in the same place. Sandia hopes the standardization of information will create a single standard and a single repository for all the information.

The testing group had company for its most recent test. More than 40 home-schooled students observed the testing. Mark says the kids wanted to know the purpose for the testing. "They asked many very good questions," Mark says, "and we talked about the purpose and the logistics of setting up the tests."

The test was explained to them in advance so students would know what to look for. Mark also wanted the students to know how the truck

was being propelled, so they would be assured there was not a driver who could be injured. Mark says the most enjoyable part was telling them "do *not* do this at home with your Dad's truck."

Mark says the kids were amazed by the crash of the truck into the barrier, adding that there was a lot of yelling and clapping as the truck plowed into the barrier. After the test, the students yelled, "Cool, we want to see you do it again!"



DAMAGED GOODS — Researchers examine and assess damage to a truck after it was crashed into a test barrier.

## Multicore

(Continued from page 1)

the "food" of each processor — slows the process down instead of speeding it up once the number of cores exceeds eight, according to a simulation of high-performance computers by Richard Murphy, Arun Rodrigues (both 14222), and former student Megan Vance. A graph of the simulation was published in the Nov. 8 online issue of *IEEE Spectrum*.

"To some extent, it is pointing out the obvious — many of our applications have been memory-bandwidth-limited even on a single core," says Arun. "However, it is not an issue to which industry has a known solution, and the problem is often ignored."

"The difficulty is contention among modules," says James Peery, director of Sandia's Computations, Computers, Information and Mathematics Center (1400). "The cores are all asking for memory through the same pipe. It's like having one, two, four, or eight people all talking to you at the same time, saying, 'I want this information.' Then they have to wait until the answer to their request comes back. This causes delays."

"The original AMD processors in Red Storm were chosen because they had better memory performance than other processors, including other Opteron processors," says Ron Brightwell (1422). "One of the main reasons that AMD processors are popular in high-performance computing is that they have an integrated memory controller that, until very recently, Intel processors didn't have."

Multicore technologies are considered a possible savior of Moore's Law, the prediction that the number of transistors that can be placed inexpensively on an integrated circuit will double approximately every two years.

"Multicore gives chip manufacturers something to do with the extra transistors successfully predicted by

Moore's Law," Arun says. "The bottleneck now is getting the data off the chip to or from memory or the network."

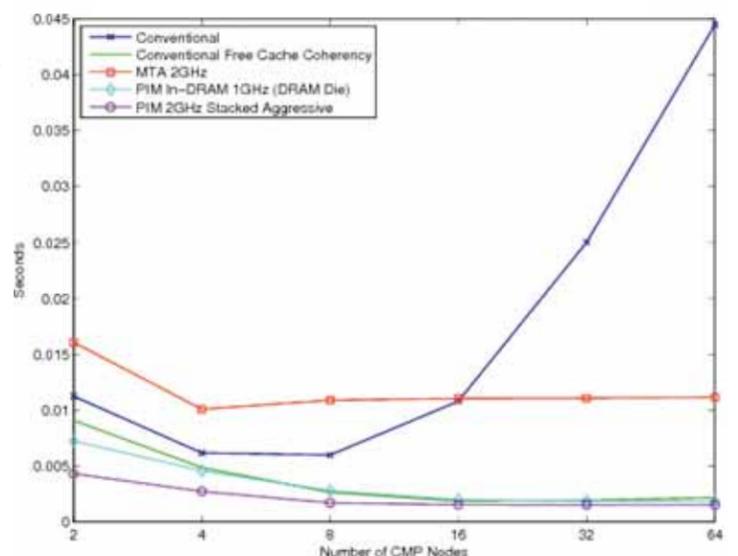
A more natural goal of researchers would be to increase the clock speed of single cores, since the vast majority of applications are designed for single-core performance on word processors, music, and video applications. But power consumption, increased heat, and basic laws of physics involving parasitic currents meant that designers were reaching their limit in improving chip speed for common silicon processors.

"The [chip design] community didn't go with multicore because they were without flaw," says Mike Heroux (1416). "The community couldn't see a better approach. It was desperate. Currently we are seeing memory system designs that provide a dramatic improvement over what was available 12 months ago, but the fundamental problem still exists."

In the early days of supercomputing, Seymour Cray produced a superchip that processed information faster than any other chip. Then a movement — led in part by Sandia — proved that ordinary chips, programmed to work different parts of a problem at the same time, could solve complex problems faster than the most powerful superchip. Sandia's Paragon supercomputer, in fact, was the world's first parallel processing supercomputer.

Today, Sandia has a large investment in message-passing programs. Its Institute for Advanced Architectures, operated jointly with Oak Ridge National Laboratory (ORNL) and intended to prepare the way for exaflop computing, may help solve the multichip dilemma.

## Performance vs. number of nodes (10 GB/sec bandwidth)



THIS GRAPH DEPICTS a simulation of four potential multicore computers: the "conventional," which basically consists of adding more standard cores to a single processor socket; an MTA, which looks like the processor used in an exotic supercomputer built by Cray called the XMT; and a PIM, which is based on Sandia's X-caliber processor design and includes memory tightly integrated with the processor. The fourth line, labeled "Conventional Free Cache Coherency," is a theoretical conventional processor that could never actually be built in practice but is meant to represent a theoretical ideal.

ORNL's Jaguar supercomputer, currently the world's fastest for scientific computing, is a Cray XT model based on technology developed by Sandia and Cray for Sandia's Red Storm supercomputer, whose original and unique design is the most copied of all supercomputer architectures.

# Solar Energy is H.O.T.

Story by Stephanie Holinka

Clifford Ho (6311/6337) thinks solar energy is hot, and he wants you to think about it too. Cliff's two-minute video "Solar Energy is H.O.T." is a finalist in *Discover* magazine's "The Future of Energy in 2 Minutes or Less" contest.

Cliff works in the Solar Technologies department doing analyses and computer modeling of concentrating solar processes and systems. But the *Discover* magazine video arose out of a home improvement project.

"I was in the process of investigating solar heating and solar photovoltaic (PV) systems for our house," Cliff says. "When I saw the ad for the video contest, I thought it would be a good way to promote solar energy."

Cliff thought it would be fun and challenging to gather what he had learned during the process and present it in a two-minute video.

"I considered different topics (wind, hydro, geothermal, conservation, etc.)," says Cliff. "But I thought solar energy was the best because it can address multiple energy needs. That's how I came up with the acronym H.O.T. (Heating, On-site electricity production, and Transportation)."

In his video, Cliff explains that the world's three primary energy needs can be split nearly equally among three areas: heating (for thermal comfort and industrial processes), electricity, and transportation. In the video he makes the case that solar energy can address all three.

Cliff says the majority of the video was made in PowerPoint, where he used some basic clip art, animation, and narration. He then used software to convert the Power-



BREAKING NEWS from Cliff Ho on the promise of solar energy.

Point presentation to a video file and used Windows Movie Maker to add some music, the introduction, and credits.

Cliff estimates that it probably took at least 40 hours to produce the whole thing, and he credits his wife (and fellow Sandian) Sylvia Saltzstein (2733) "for being so patient and watching our three young girls while I worked on the video at home."

Cliff says solar energy is unique because it can be implemented widely on an individual residential scale (for both heating and electricity production).

"I think the implementation of residential solar PV systems is analogous to the PC revolution," he says. "We used to rely on large centralized mainframe computers, but now we all have our own PCs to satisfy our personal computing needs." He says he hopes residential solar PV systems will become just as pervasive as PCs, and a significant amount of household electricity needs will be satisfied from on-site solar PV systems. Also, as with projects such as SETI@home (<http://setiathome.berkeley.edu>), where individual PCs connected to the Internet serve a larger computing need, Cliff says individual solar PV systems can be tied to the electrical grid to provide excess electricity to the "mainframe" for electricity use by others.

Cliff notes that the technology exists today for people to implement residential systems to cleanly and efficiently provide hot water, space heating, and electricity for their homes. As more and more people adopt residential solar-energy systems and electric-based vehicles (which can use electricity produced by the sun), Cliff says we can significantly reduce our dependence on nonrenewable fossil fuels (e.g., oil, coal, natural gas) that produce tons of greenhouse gases and pollute the environment.

*Discover* magazine was to announce the winner of the contest on Wednesday, Dec. 17. If Cliff wins, he plans to donate the prizes to the new Georgia O'Keeffe elementary school, which is currently under construction and should be completed by 2010, on behalf of his two oldest daughters who attend school there (and a third who will be attending as a kindergartner in 2010).

For more information about how solar energy can make a difference in your own household, check out the extended version of this story in *Lab News Interactive* at <https://www-irn.sandia.gov/newscenter/interactive> (internal web only).

## Steven Chu

(Continued from page 1)

the greatest danger faced by humanity is global warming. His wide scientific interests have earned him the title of professor of physics and molecular and cellular biology at the University of California, Berkeley. He was selected to speak at Sandia as a Truman Distinguished Lecturer.

His efforts toward improving renewable energy technologies dovetail in part with Sandia's efforts. But, obviously, not with all of it, particularly in the areas of nuclear weapons and electronic security measures.

### Sandians respond to selection

Sandia upper management responded positively.

Says Sandia President and Labs Director Tom Hunter, "I am delighted with President-elect Obama's nomination of Steven Chu for DOE. I have had the pleasure of working with him on several occasions as a fellow lab director. He will bring a strong focus on the role of energy in our country's future and will be especially effective in bringing the nation's attention to the vital role of science. He will also add keen insight into the science and engineering foundation that is so important in national security. I am looking forward to

working with him as Secretary."

Said Sandia Executive VP Joan Woodard, "With his experience as a DOE lab director, Dr. Chu will bring an extremely important perspective to the DOE position. National priorities will change, and the labs will be challenged to contribute. But the health of the labs is a core issue regardless of the national focuses. And Dr. Chu will be extremely well-informed and positioned to provide leadership to sustain the health of the laboratories."

Says Deputy Labs Director Al Romig, "I applaud President-elect Obama's choice of Dr. Steven Chu as his Secretary of Energy-designate. We have known Dr. Chu for many years, beginning with his early tenure in Bell Laboratories and continuing to the present day with our recent successful partnering with him and Lawrence Berkeley Lab on our Joint BioEnergy Institute endeavor with the DOE's Office of Science. Dr. Chu is an extraordinary scientist and an outstanding scientific administrator. His passion for advancing energy science is particularly notable because of the significant and complex energy challenges that we face as a nation."

### A few concerns

Other Sandians were generally positive to the appointment, but expressed reservations about a possible negative effect on Sandia.

Julia Phillips, director of Physical, Chemical, and

Nanosciences Center 1100, who worked at Bell Labs at the same time Chu did, described him as "very intense, extremely focused, and an eloquent spokesperson for energy, probably the heir to (Nobel laureate and nanotechnologist) Richard Smalley, who tried to get energy on the map.

"I think someone like that is absolutely the right person for the DOE right now; he has the technical background and the Nobel Prize, so he'll be listened to. He is clearly passionate about energy and climate change. We will need to make sure that he also develops appreciation for DOE's other mission areas."

Says Dan Barton (1123), "I'm concerned if it derails our DoD-related business relation. Our growth areas are defense system and applications. But if we have it so we can support both areas, then it's all for the better."

Says senior scientist John Emerson (2453), who worked at Bell Labs at the same time as Chu, "We all worry about people who weren't formerly nuclear-weapons oriented and how much they could hurt nuclear defense work. But the general feeling was, he was a great technical person. When he went to LBL he did a fantastic job of reorienting an already-great lab. He's been in three environments: the industrial, academic, and government. People talk very favorably about him. I see Obama putting the right people in place for increased energy funding. It's good to have a person who'll have a voice in Washington."

### 'An incredibly strong science person'

Terry Michalske, director of Energy Innovations Initiatives (6100) and currently in Washington to provide technical expertise when requested by the new administration as it forms policies, took a longer view on Chu's experience.

"It's certainly an indication of the importance of science, technology, and energy to the incoming administration that it appointed someone of Chu's stature — an incredibly strong science person — to lead DOE," says Terry. "It suggests they are looking to DOE to lead. He'll be the highest science-credentialed person in the Cabinet."

An energetic, highly respected DOE leader may be especially helpful if the White House chooses to spur energy innovation by coordinating across additional departments like Commerce and Defense, as seems likely, says Terry.

Probably Steven Chu's strongest support came from a man who has known him the longest: Chuck Shank, former director of LBL, now retired and leading a research group at Genelia Farms (part of Howard Hughes Medical Institute), who knew Chu when he was a graduate student.

"I was thrilled when he took over my job at LBL when I retired," Shank said. "He understands more about energy than anyone on the planet and I think he'll do a great job. He's a quick learner with an extraordinary intellect. He's well aware of the science going on at all the [DOE] labs. I have no doubt he'll embrace the full measure of responsibility."

## Labs breaks ground on new Ion Beam Laboratory

The day was gray, but participants breaking ground for Sandia's new Ion Beam Laboratory were all smiles at the thought of retiring the 53-year-old "temporary" structure it will replace. The building's variety of electronic beams — the enabler of many technical papers and awards over the decades — will continue to serve Sandia's main missions. Project money was sparked by savings resulting from Sandia's efficient construction of the MESA complex. Said Deputy Administrator for NNSA's Office of Defense Programs Robert Smolen, "This building will be an invitation to the next generation of scientists."

In the photo here, officials from Sandia, NNSA, and the New Mexico congressional delegation celebrate the groundbreaking for the facility. They are, from left, Sandia Science and Technology and Research Foundations VP Rick Stulen, US Rep.



Photo by Randy Montoya

Heather Wilson, R-N.M., Sandia Site Office acting Manager Kim Davis, Deputy Administrator Smolen, Sandia Executive VP Joan Woodard, Radiation-Solid Interactions Dept. 1111 Manager Barney Doyle, and representing US Sen. Jeff Bingaman, D-N.M., Jill Halverson.

# Mileposts

New Mexico photos by Michelle Fleming  
California photo by Randy Wong



Jimmie McDonald  
40 1658



Michael Pendley  
35 5632



David Waymire  
35 5935



Gwen Pullen  
30 9548



Theresa Sanchez  
30 4225



Timothy Stephens  
30 2739



Bess Campbell-Domme  
25 1000



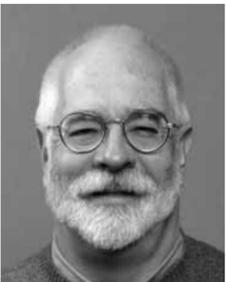
Douglas Dederman  
25 5431



Mike Dvorack  
25 4225



Rebecca Darnell Horton  
25 5640



Melvin Krein  
25 5418



Mark Pilcher  
25 5424



Steve Wagner  
25 5536



Ephraim Arquileta  
20 5747

## Sandia improves work planning & control process

Over the next year Sandians will see changes in the area of work planning & control (WP&C).

WP&C is a uniform method to keep employees safe while accomplishing the Labs' mission. Personnel use work controls to understand and control hazards associated with their jobs, and managers use them to provide a safe work environment.

Bob Brandhuber, ES&H Emergency Management Center 4100 senior manager, says WP&C is Sandia's way of implementing the five core functions of the Integrated Safety Management System (ISMS) at the activity level — plan work, evaluate risk, implement controls, perform work, and improve process.

"Our goal is full and effective WP&C implementation by the end of 2009 for all members of the workforce performing activity-level work," Bob says.

As part of an ongoing effort to enhance WP&C at Sandia, a WP&C team was formed during the summer to lead improvement activities. The team, together with members of line organizations, revised the WP&C process that provides requirements, guidance, tools, and templates essential for the safe and effective performance of mission work.

Realizing that effective communication is essential to the success of WP&C, the team is engaged in ongoing dialogue with the line

organizations to let them know about the new process, help them implement it, and solicit feedback to improve, simplify, and streamline it.

The WP&C team is deploying Implementation Assistance Teams (IAT) to assist organizations by reviewing their current WP&C process and documentation, performing a gap analysis against the revised WP&C process, and helping develop the tailored organization-specific procedure. The IATs will also collect feedback and suggest improvements during their visits. The WP&C team will be in contact with centers and departments to assist in the implementation of the revised WP&C process. This approach ensures that

WP&C implementation is effective, efficient, and as simple as possible, while assuring individual safety while working.

"We urge everyone to work with the IATs over the next six months to improve our activity-level WP&C execution," Bob says. "The ultimate goal is to increase worker safety and efficient product delivery at Sandia."

Anyone with questions or comments can contact Bob at 505-845-1237 or rbrandh@sandia.gov or Brad Elkin, ISM manager, at 505-844-0418 or bselkin@sandia.gov. More information will be provided over the next few months, including a new WP&C site in ILMS, informational posters, and additional articles.



# Recent Retirees



Francisco Gonzalez  
42 1381



Hovey Corbin  
40 5419



Ronald Glaser  
40 6455



John Lavasek  
38 5434



David Haaland  
36 8632



Ron Hadley  
36 1742



Don Hardesty  
35 4739



Dave Carlson  
32 0600



Steve Lambert  
32 2957



A. Conrad Lucero  
32 2956



Louise Weston  
30 12335



Linda McNiel  
27 1031



Tina Martin  
25 1658



Ruby Mee Cheng Hsia  
20 2542



Barb Meloche  
16 10667



Vicky Claunch  
15 8632

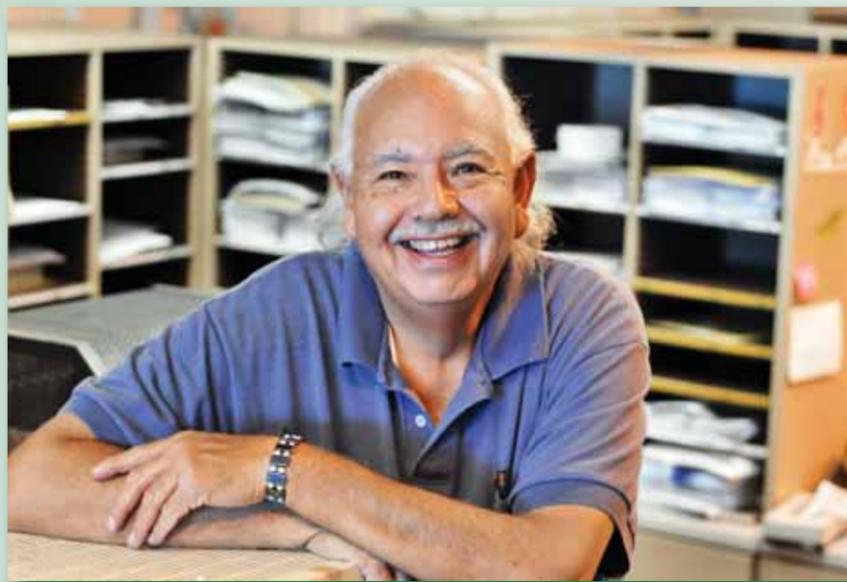


Jose Archuleta  
25 12870

Olga Archuleta  
31 9600

# ONE HOUR FOR FISHING, ONE FOR HUNTING

With a little help from his friends in Preventive Health, Art Lucero makes lifestyle change



ART LUCERO pauses from his busy schedule in the mailroom for a photo. (Photo by Randy Montoya)

By Iris Aboytas

Meet Art Lucero (10263), a Sandia mail carrier. Those who know him might have noticed his transition from a burly, slightly bent-over mailman into a taller, statuesque, silver-haired Energizer Bunny®.

His transition just sort of evolved. It wasn't exactly planned. Because of his ankylosing spondylitis arthritis (inflammation of the spine and large joints resulting in stiffness and pain), he had one hip replaced, then the other. "It had become painful to do even the slightest walking," says Art. "Sleeping was hard. Everything we take for granted caused me pain." The hip replacements took care of his walking and stature, but he was still not feeling exactly top-notch, so he went to Sandia Medical.

His blood test indicated the possibility of diabetes, which, he says, stunned him. His doctor suggested he meet with a dietitian and lose weight. He followed the doctor's suggestion. With the help of Ana Barreras (3334) Art has lost 105 pounds over the past year and a half. He might be not only Sandia's biggest weight loser, but biggest health winner.

Life for Art began in Cuba, N.M. His dad Joaquin worked in the timber industry, and his mother Elizaida worked in a restaurant. "Life seemed slower then," says Art. "We could ride our horses in town. We didn't worry about getting hit by cars."

Art was raised as much by his grandfather Tranquilino, grandmother Gregorita, and an uncle as he was by his parents. Both parents worked long hours, but his grandparents lived next door, so he hung out with his extended

family. "Hung out' is not exactly right," says Art. "Hung out was hard work. I helped my grandfather and uncle with the ranch. They had cows, horses, sheep, goats, chickens, and turkeys. The winters were harder. It didn't matter how cold it was or how much snow had fallen, the animals still needed to be fed."

During the school year, Art had a routine. He would change his clothes and bring in fresh water from the well and chop wood for cooking and heating. "We did not have indoor plumbing or gas heating," he says. "After I finished those chores, I would go help my grandfather and uncle milk the cows and goats. My grandmother and mother would make

butter and cheese almost every day."

His grandmother was a very short woman with long hair. She was a *curandera* (healer) who was born in Cochiti pueblo. "Her hair went past her waist and her eyes were dark and penetrating," says Art. "She loved to laugh and enjoyed going to pick her *remedios* (herbs) to make her medicine. People would come from Las Vegas, Santa Fe, Bernalillo, and Belen to seek her healing. They came from as far away as Los Angeles. She learned how to be a healer from her mother, who learned it from her mother, and so on."

Art's grandfather was about 6 feet 4 inches tall and weighed about 200 pounds. "As he got older he shrank a little," says Art. "He was a hard-working rancher who enjoyed playing gags on his grandchildren. He especially liked to play gags on my grandmother. He lived to be 96. My grandfather enjoyed fishing and hunting. 'For every hour you spend fishing and hunting, you add an hour to your life,' he would say."

The first month-and-a-half after working with dietitian Ana Barreras' suggestions, Art did not lose any weight. "It took me that long to get the concept," he says. "I had been doing it wrong for so many years. I began riding my bike and was amazed. I lost five pounds in one week. Ana advised me to slow down. I just tried to lose a pound and a half a week. Now it is easy. I eat whatever I want — in moderation. I think about what I am eating and how I am going to burn the energy. I don't deprive myself of anything."

Art says he realized some time back that there is no secret pill that will take away his weight. "The only diet that works for me is eating the right portions and

preparing my food properly," says Art. "I start with a large breakfast; I realize it is the most important meal of the day. I have a light lunch and an even lighter dinner. You must not deny yourself anything because if you do, your mind will always want to eat that. I can still eat ice cream, but not before I go to bed. I need to eat it after lunch when I can burn the calories. At first it was hard, especially at night, but I was determined to lead a new lifestyle. When I saw that it started working, I became more determined. I will not go back to that old lifestyle."

Art took his 12-year-old grandson Adam bow hunting for elk this fall. "We didn't get one," says Art, "but Adam will never forget our hunting trip. We had a great time in the mountains. We had our scent killer on our camouflage. Squirrels and chipmunks were crawling all over us. We sat down next to a coyote den without knowing it. When the mama coyote came back, the smell told her something was not right. She was about 15 feet from us and smelled the air until she spotted her little babies."

"I think that is what my grandfather had in mind when he said that each hour fishing or hunting added an hour to your life," says Art. "I understand the television ads that describe families and the cost it takes for certain things. Then there are some things they label as priceless: time with my grandchildren — priceless."

"I have six grandchildren. I want to be a part of their lives. The only way that is going to happen is if I am healthy. My dream is to someday live next to my grandchildren, just like my grandfather did. It was such a joy for me. I think maybe with a lot of praying my hopes and dreams could come true."

## Nutritional assessment

"In 2006, Art Lucero came in to Preventive Health for a nutrition assessment to learn about eating healthful," says Ana Barreras. "The focus was to give him the knowledge and skills to make dietary changes that were sustainable long term and realistic based on his lifestyle. After two or three one-on-one appointments Art had made significant changes to his eating habits and was beginning to see results. Ultimately, it was Art's hard work and motivation to make changes to both his diet and exercise regimen that led to his successful weight loss."

If you are interested in meeting with a registered dietitian or an exercise physiologist to learn about how you can make lifestyle changes to meet your health goals, contact HBE at 844-HBES (4237) to get scheduled for a nutrition assessment and fitness consultation.



ON TOP OF THE WORLD — Art Lucero and his grandson Adam take a break during their elk hunting trip this fall. (Photos above and at right courtesy of Art Lucero)



CAN YOU SEE ME NOW? — Art and Adam test out their camouflage during their recent hunting trip.