Failure the only option at the Mechanics Lab

BREAK TIME — Helena Jin and Kevin Nelson (both 8526) inspect the test setup for upcoming experiments to determine the breaking strength of weapon case lugs. (Photo by Dino Vournas)

By Patti Koning

For most people, breaking something is unplanned and unwelcome. But for Bonnie Antoun (8256) and the rest of the Micromechanics & Materials Mechanics Experimental Facilities staff, also known as the Mechanics Lab, it's all in a day's work.

Bonnie and the rest of the staff — Wei-Yang Lu, Bo Song, Helena Jin, Kevin Connelly, Andy Kung, and Kevin Nelson (8256) — will stretch, squeeze, torque, heat, cool, and pound any material to failure. Material systems of interest include metals, ceramics, structural foams, polymers, and composites.

They do this using equipment that can apply from 2 million pounds of load to less than 1 micronewton (μN) of load or 1 micrometer (μm) displacement; apply load at a rate of 220 inches per second; enforce strain rates of 1,000-5,000 per second; and capture it all with high speed and ultra-high speed optical cameras, and high-speed, high-resolution thermal imaging cameras.

To study the effects of complex stress history, Bonnie might subject a specific material to stress and twisting on the MTS 100 Kip axial and torsional test frame. "To see the effects of deformation history, we would apply tension and torsion to failure, then reverse the order on another sample, and continue repeating the experiment with different configurations," she says.

Other equipment includes Hopkinson Bar test systems for testing materials at very high strain rates, flexible Endura Tech axial/torsional systems, atomic force microscope (AFM), scanning

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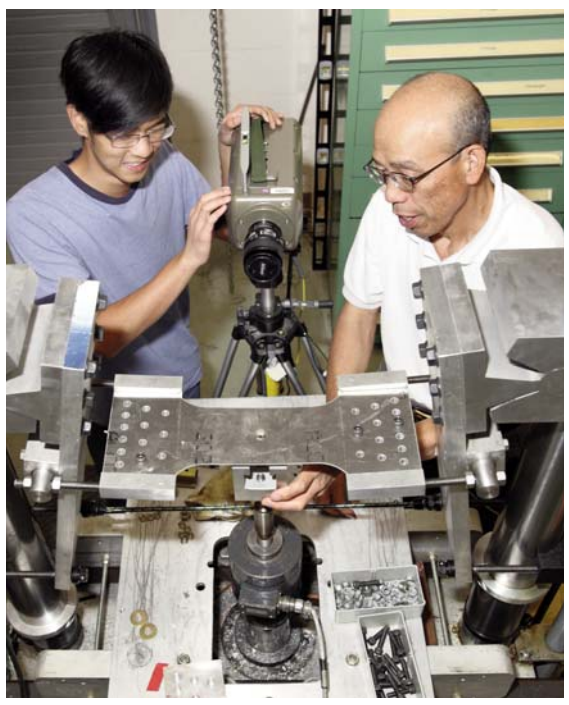

A RIVETING EXPERIENCE — Andy Kung and Wei-Yang Lu (both 8526) install a specimen made from aircraft fuselage material, which will be used to evaluate rivet strength. (Photo by Dino Vournas)

Island hopping, bacterial style

BIOINFORMATICIST Kelly Williams (8623) is shedding light on mobile DNA elements called genomic islands. See the story on **page 4.**

LIVERMORE

Sandia LabNews

CALIFORNIA

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Sandia National Laboratories

Livermore Valley Open Campus

LVOC, 20 months after: New buildings, programs highlight continued open campus growth

By Mike Janes

Though the Livermore Valley Open Campus (LVOC) is officially less than two years old, robust activity and a tangible shift in culture almost make it seem like it's been around Sandia/California forever.

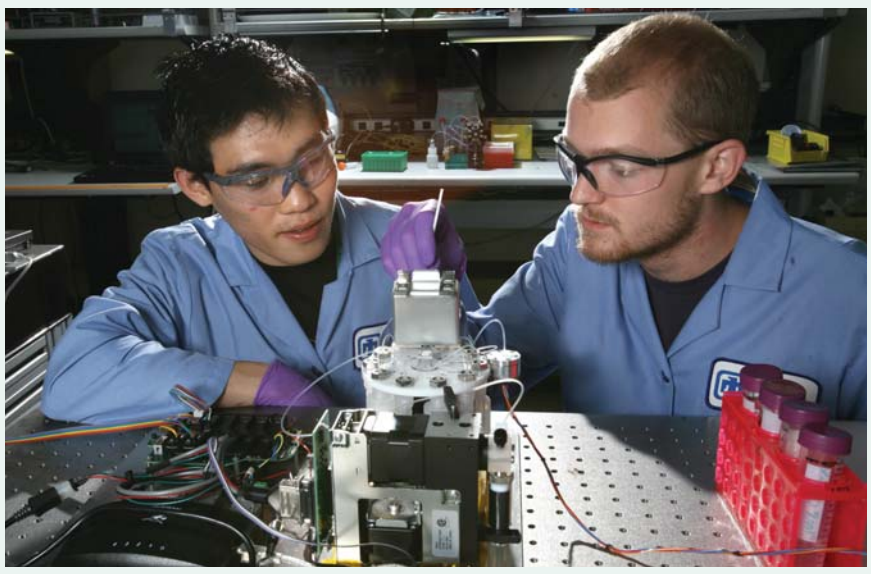
Indeed, a peek under the LVOC hood suggests that the open campus already has a foothold at the lab and has started to impact the California site's culture in positive ways.

The first major LVOC development on Sandia's side of East Avenue (LVOC is a joint initiative with Lawrence Livermore National Laboratory) was the design and construction of the Combustion Research Computation and Visualization (CRCV) facility, which opened in January 2011. Though the facility itself has enhanced combustion research as expected, the dynamic atmosphere in the CRCV has been even more transformative in the way that staff and visitors do business.

"This building just has a different feel," says Andy McIlroy (8310), previously a senior manager at the Combustion Research Facility (CRF) and currently the lead for LVOC Development. Conversation pits, comfortable couches and chairs, collaborative spaces, and an open design, he says, put visitors and researchers at ease and fos-

(Continued on page 12)

DNA fingerprinting to go



SUMMER INTERNS Harrison Edwards and Daniel Lee (both 8125) work with the Battlefield DNA Analysis amplification module. (Photo by Dino Vournas)

By Patti Koning

On popular television shows like *CSI*, it often seems that detectives send DNA crime scene evidence to the forensic lab and have their results in hand after a single commercial break.

"In real life, an entire laboratory filled with technicians and PhD-level scientists using equipment worth thousands and even millions of dollars is at work analyzing those samples, a process that can take hours if not days," says Michael Bartsch (8125). "That fade-to-commercial glosses over a lot of time, effort, and expertise."

Mike is leading a project for the US Army Criminal Investigation Laboratory (USACIL) that aims to make the practical process of forensic DNA analysis more closely match the duration of that commercial break, at least in part. Over the last year, Mike and the science and engineering team in Advanced Systems Engi-

(Continued on page 4)

Inside . . .

Day in the Life

On July 26, photographers Dino Vournas and Randy Wong spent the day capturing the spirit and energy of the Sandia/California campus. Visit the site with them on **pages 6-7.**

That's that

Note: This guest column was written especially for the special California edition of the Sandia Lab News *by postdoc Oliver Welz.*

* * *

OLIVER WELZ

Postdoc or, more precisely, postdoctoral appointee, as my official job title says, is usually the next step after finishing a Ph.D. and an important one toward establishing an independent scientific career. Coming from Germany, this experience helps build an international network with other scientists, enables one to learn new techniques, and is a great opportunity to experience life and culture in foreign country.

In my case, the postdoc is actually my second "real" job. Before joining Sandia, I led a junior research group at the Karlsruhe Institute of Technology in Germany, where I applied fundamental gas phase chemical kinetics to problems in combustion and atmospheric chemistry.

Moving from Germany to California was more than just a location change. It was a move from metric units to inches, feet, and miles, from two-lane highways and no speed limit to five-lane highways and speed capped at 65 mph, to a place where everything is bigger – cars, parking spots, water bottles, fridges, and even squirrels.

Sandia was my top choice for a postdoc position. The Combustion Research Facility (CRF) at Sandia is among the leading institutions in combustion research and enjoys an excellent international reputation. So I was thrilled when I finally got the job offer from Sandia. However, there's a small caveat: I'm a foreign national, which means I couldn't just accept the offer and start the job right away. Background checks, and especially the visa petition process, delayed my start date by seven months.

But it was worth the wait. Very soon after starting at Sandia in February 2010, I realized that when following certain "do's and don'ts", being a foreign national postdoc at Sandia is not much different from being a postdoc at Sandia. A big part is that people at Sandia are nice and friendly, which makes it easy for everyone to feel welcome and included. And most importantly, when working with my colleagues I don't feel like a foreign national, but a member of the team. This aspect is what I have found most gratifying about being a foreign national postdoc at Sandia. If questions arise related to being a foreign national (for example, can I go to the Lawrence Livermore National Laboratory cafeteria across the street? No, I can't!), the competent international HR department and the Foreign National Networking Group with its regular on- and offsite meetings are excellent resources.

I enjoy working at Sandia in a motivating, inclusive environment and on an excellent team with world class scientists in the combustion chemistry department (8353) at the CRF. My task is to investigate the fundamental combustion chemistry of novel biofuels, such as alcohols, and conventional fuels using state-of-the-art experimental and theoretical techniques. This research helps us understand and predict combustion and aids in designing tailored biofuels and making future combustion technologies more efficient.

An aspect of my job I especially appreciate is being involved in several projects. This includes working with a unique Sandia-developed experiment at the Advanced Light Source Synchrotron at Lawrence Berkeley National Laboratory where we use a chemical reactor coupled to a synchrotron photoionization mass spectrometer to study isolated chemical reactions in unique detail. Among other interesting results, this experiment enabled us for the first time ever to measure directly reactions of so-called Criegee intermediates, which are critical intermediates in hydrocarbon oxidation systems.

This work recently led to a publication in *Science* magazine, which for me certainly is a highlight of my time at Sandia. Rudolf Criegee, who proposed the existence of these intermediates 70 years ago, was a professor at the University of Karlsruhe, the same university where I studied chemistry. The world can be pretty small sometimes.

My experience as a foreign national postdoc at Sandia has been very positive, and I'm sure it will be very valuable for my further scientific career. If anyone asks me whether I would recommend Sandia as a place for a postdoc, my answer would be a clear "yes."

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Sandia/California receives joint awards with LLNL for environmental stewardship

This summer, NNSA announced the Pollution Prevention (P2) awards, given to national laboratories and sites for innovative efforts in environmental stewardship. Sandia/California received recognition for two efforts conducted jointly with Lawrence Livermore National Laboratory (LLNL).

The first award went to the Fresh @ the Labs project, a farmers market collaboration that brings locally sourced fruits, vegetables, nuts, grains and more to the two labs. The pilot effort saw more than 2,000 attendees with 20 local vendors. The market was a monthly event that ran from July through October 2011, and is running again this year.

BOB CARLING (8300) describes Sandia's hydrogen research to members of the community at an event to showcase hydrogen shuttle buses now in service at LLNL and Sandia. The shuttle bus initiative has been awarded a prestigious Pollution Prevention Award from NNSA. (Photo by Randy Wong)

The second award recognized work with the hydrogen shuttle bus, administered by the Office of Energy Efficiency and Renewable Energy's Fuel Cell Technologies Program. Two hydrogen buses, one with 12-passenger and the other with eight-passenger and wheelchair capacity, were integrated into the LLNL taxi fleet. The buses were used to transport employees on-site and to promote education about the benefit and safety of hydrogen vehicle technologies. The hydrogen buses reduced the use of traditional diesel-powered buses onsite, logging a total of 7,561 miles. These vehicles operated at near-zero regulated emissions (below Super Ultra Low Emission Vehicle regulations for oxides of nitrogen) and had no carbon dioxide emissions.

Recent Patents

Note: Patents listed here include the names of active and retired Sandians only; former Sandians and non-Sandia inventors are not included. Following the listing for each patent is a patent number, which is searchable at the US Patent and Trademark Office website (www.uspto.gov).

* * *

Cy H. Fujimoto, Michael Hibbs, and Andrea Ambrosini (all 6124): Multi-Block Sulfonated Poly(Phenylene) Copolymer Proton Exchange Membranes. Patent No. 8,110,636.

Jonathan R. Salton (6533) and Barry Spletzer (6530): Apparatus for Inspecting a Group of Containers and Method of Using Same. Patent No. 8,126,596.

Sandia CaliforniaNews

IN WHAT HAS BECOME a summer tradition, Mike Janes and Patti Koning (both 8521) once again took over the helm of *Sandia Lab News* as guest editors for the annual California issue focused on the site's research, people, and happenings. (Photo by Randy Wong)

Mech lab

(Continued from page 1)

electronic microscope (SEM) loading stage for in-situ experiments under microscopes, and an extensive variety of loading frames and diagnostic equipment.

"All of our work is toward development of constitutive models that describe materials as a function of loading, rates, temperatures, environments, and other conditions," Bonnie says.

The Mechanics Lab works closely with modeling and simulation in designing experiments. The physical experiment must exactly match the modeling boundary conditions so that the data can be used to then validate the model.

"Our end-users are the material modelers, finite element analysts, and, finally, the weapons component and systems engineers," she says. "Ultimately, we're always trying to improve our understanding and modeling of complex events. As modeling and simulation capabilities have grown, they can handle more information. We are moving toward more volume measurements to study what goes on beneath the surface."

Assessing the accuracy of models

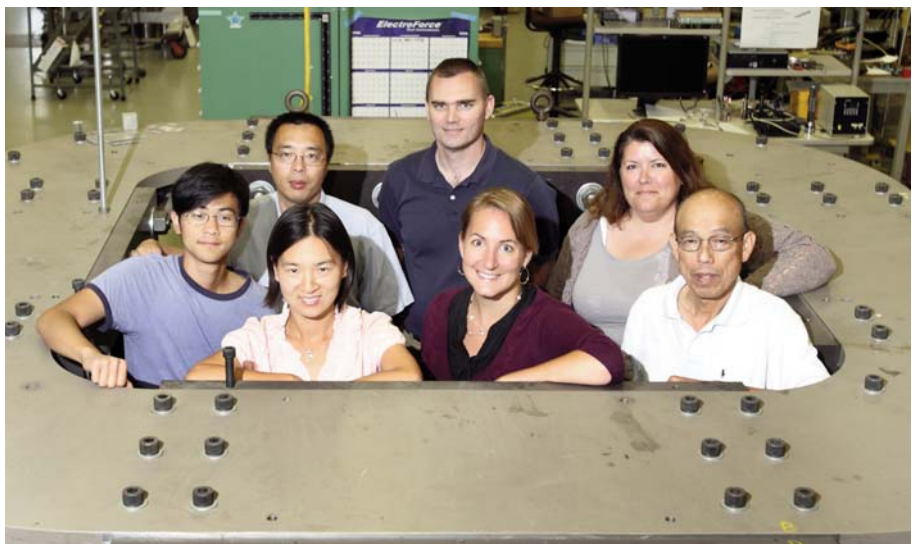
Lu and Helena are developing X-ray computed tomography (XCT) techniques to understand what happens inside a material as it is loaded to failure. This new experimental capability is necessary to keep pace with advances in modeling and simulation. The Mechanics Lab hopes to acquire a high-resolution XCT device to gain more data for the modelers from these experiments.

Arthur Brown (8259) often turns to the Mechanics Lab for projects with experimental needs for material characterization, validation, or both. "They have helped me populate constitutive models for metals and composites over various loading rates and temperatures. They have also performed complex experiments that I have used to assess the accuracy of model predictions," he explains.

The Mechanics Lab may be physically located at the California site, but the group works equally with New Mexico organizations. The lab has teamed with the solid mechanics staff of the Engineering Sciences Center (1500) for many years.

"We have formed a uniquely integrated team of analysts and experimentalists, all working toward a common goal to better understand, design, assess, and predict physical response characteristics of our components and systems for many environmental threats," says Frank Dempsey (1526).

"With computers getting larger and faster, enhancements to our predictive physics code capabilities require experimental validation. The Mechanics Lab staff is now an essential part of the analyst community with increasingly more challenges to predict, assess, design, and capture the physics correctly."



IF AIN'T BROKE, BREAK IT — Sandia's Mechanics Lab team pushes materials to their limits and beyond. Pictured here, clockwise from top center: Kevin Nelson, Bonnie Antoun, Wei-Yang Lu, Stephanie Sibert, Helena Jin, Andy Kung, and Bo Song (all 8256) inside the in-plane biaxial system. Kevin Connelly is not pictured. (Photo by Dino Vournas)

About 75 percent of the group's work is nuclear weapons-related. This has led to development of specific diagnostics and capabilities.

"There are few industries where you need to test to completely quantify materials to failure," says Bonnie. "We need to understand not just when and how materials fail, but every step along the way."

Much of the rest of the group's work is Work for Others. In 2003, the Mechanics Lab played a key role in the space shuttle *Columbia* accident investigation (See the Sept. 5, 2003, issue of *Sandia Lab News*.)

Lu, Bonnie, and John Korellis (8254-1) led studies on the reinforced carbon-carbon (RCC) panels, thermal protection system (TPS) tiles, and foam impacting materials that provided data for the material response models critical to the computational studies. This led to a follow-on project with NASA for return-to-flight testing.

The Mechanics Lab has also worked on projects for the US Army, the US Navy, and DOE (non-nuclear weapons), and has been involved in several CRADAs, including Goodyear. In 2009, the group was involved in a DOE project to study liquid natural gas (LNG) cascading damage. "One concern is what would happen to the integrity of the tankers if there was a fire followed by rupturing of the tanks. The LNG is extremely cold, so it would quench the hot tanker steel immediately," Bonnie says.

Currently, the group is studying potential materials for tubes on solar receivers for DOE. This project is unusual because of the duration of each experiment.

"Many of our experiments are finished in less than a minute," says Bonnie. "The material in the solar receivers would be used for 30 years, so this is a test that will be going on for weeks." To speed the aging process, researchers are imposing day and night cycles on materials of about a minute each.

The experiments may be fast, but the design and set-up are not. A new experiment can easily be more than a year in the making. Setting up experiments is a painstaking process as special fixtures often have to be designed to handle unusually shaped components.

Still, Bonnie says there is never a dull day in the Mechanics Lab.

"There is a balance between developing our own capabilities for the future and working on experiments happening right away," she says. "Our work is all about helping others do their jobs better."

Early career LDRD projects highlighted

Sandia NewMexicoNews

By Neal Singer

Anyone taking the trouble on Aug. 14 to wander through the 25 posters in Bldg. 897 representing Sandia's current early career LDRD-sponsored projects would have found a startling variety of approaches to solve problems of national importance.

There is, for example, the issue of detecting counterfeit or defective integrated circuit (IC) components before they do harm. These might be fabricated by a hostile entity, already outlived their life cycle, or merely been made from inferior materials for economic reasons.

One way to avoid the problem is to have components fabricated in a certified facility, as Sandia does on-site for reasons of national security. But how can a less well-connected manufacturer determine whether an integrated circuit will malfunction before its time through malice or from early failure of a re-used or second-rate part?

Currently available solutions include investigating the manufacturing supply chain, screening each part, or comparing outputs when the part is integrated into a larger system.

Ryan Helinski (5624), proposes a quicker, possibly better way. In work mentored by Ed Cole (1726) and Lyndon Pierson (ret.), Ryan proposes collecting, into one device, electronic circuits already used to characterize the parameters of ICs. The new device could detect an inserted IC manufactured part from its mates by comparing the output distribution along specific parameters with those from a gold-standard IC or from a sample of trusted ICs. Multiple parameter comparisons would minimize the number of false positives or negatives expected from single-parameter comparison. Ryan's next step: to compare outputs from a batch of ICs built in Taiwan that he will compare with a group with the same overt characteristics fabricated in Austria. Can Ryan's method tell the difference?

Crystal Reed (1532) wants to characterize the particles that form airborne hazes over our metropolises by using multi-spectrum remote sensing measurement techniques. "Current atmospheric lidar techniques can distinguish particle concentration and approximate size distributions but cannot determine particle composition," she said. "Using this laboratory technology to determine what these particles are made of, it should be possible to better model climate forcing due to atmospheric aerosol concentration and at the same time better calibrate our lidar's capabilities to discriminate."

Or perhaps it might be valuable to detect low levels of pathogens such as viruses without resorting to enzymatic amplification of the few viruses that may be present in the sample. Enzymes require cold storage, which might not be practical in the field. Instead, Robert Meagher (8621) proposes using electrophoresis to "stack" up the viruses that might be present into a nanoliter volume adjacent to a microfabricated membrane, and then inserting a DNA probe chosen to bond to a particular virus. Electrophoresis is then used for an analytical separation to determine whether the probes are bound to a target, allowing for detection without amplification. Clever, no?

Perhaps you are aware of Rayleigh Taylor instabilities — omnipresent destroyers of rapidly generated electromagnetic fields— but were you aware of Richtymer-Meshkov instabilities? Eric Harding (1648) has a way of using these instabilities to get more information about materials subjected to extreme pressures.

EARLY CAREER RESEARCHER William Johnson (8131) discusses his LDRD project with Deputy Chief Technology Officer and Center 1900 Director Julia Phillips.

Nedra Bonal (6913) has a method to improve our capabilities to detect shallow tunnels by use of surface seismic methods.

David Zage (4516) believes he can improve the confidentiality, privacy, and verification of services provided in cloud computing through the use of algebraic-based encoding solutions. These, he says, would securely distribute data to multiple service providers while minimally impacting end users.

Jeremy Wendt believes he can identify dynamic patterns in network electronic traffic that would predict and mitigate cyberattacks.

And so it went, the inventions of many minds, the furthest thing from boring.

"Twenty years ago," said Dan Sanchez, assistant manager at the Sandia Site Office, to the assembled early careerists at the close of the poster session, "congressional authorization for LDRD was passed. The remarks I hear now are always very positive about the contribution you are making to advance science and push missions forward."

In a lively final question-and-answer session, Div. 1000 VP and Chief Technology Officer Steve Rottler provided a seasoned perspective on the possibilities inherent in continuing the various lines of research or in moving on to new fields.

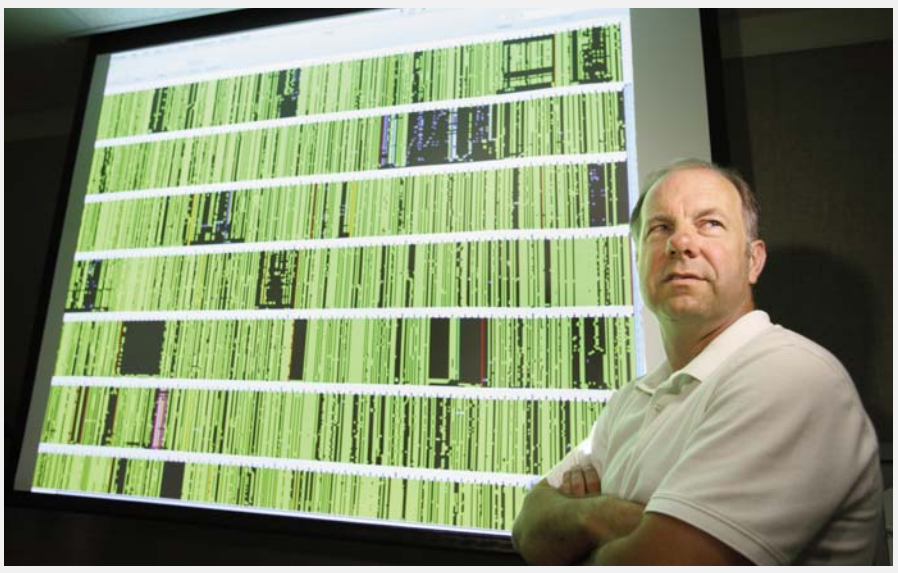
Island hopping, bacterial style

By Patti Koning

We often think of evolution as a slow, orderly process. Over generations, incremental genomic changes are passed from parent to child through the tree of life. Not so with bacteria — their form of evolution is more akin to paper trading on the floor of the New York Stock Exchange, with genes being swapped horizontally in a tree of life that would be better described as a tumbleweed.

We know about the "Wild West" environment of bacterial evolution thanks to genomic sequencing. "More than 6,000 bacterial genomes have been sequenced to date, so we're beginning to get a really good picture of what they look like," says staff bioinformaticist Kelly Williams (8623).

Bacteria have a slow mutation rate, about one in a billion changes per base pair per generation, but genetic change can, in fact, occur rapidly in these organisms because of their ability to swap genes horizontally via mobile DNA elements called genomic islands. Genomic islands are a focus of Sandia bioinformatics research because they are the main source of bacterial genes of interest to biodefense and bioenergy applications, such as pathogenicity genes underlying microbial virulence and biodegrading enzyme genes that could be tailored for use in the biofuels industry.



THE DARK AREAS ON THIS VISUALIZATION of 40 genomes of the bacteria *Brucella* represent genomic islands — gene clusters that bacteria swap horizontally. Kelly Williams (8623, above) is studying genomic islands to better understand how pathogenicity naturally evolves in bacteria, which will aid in recognizing the unnatural pathogenicity of a synthesized bioweapon. (Photo by Dino Vournas)

Shedding light on how islands move

In an LDRD project, Kelly is using comparative genomics to better understand the structure and content of genomic islands. His first step was to write a computer algorithm that aligns multiple bacterial genomes in chromosomal order for easy visualization of their mobile elements. He has used this algorithm to order and visualize 40 genomes of the bacteria *Brucella*, and is now moving onto *Rickettsia* and other bacteria of interest.

"It's a quick, visual way to focus on the islands and begin in-depth analysis of island genomic sites and arrangements, as well as their phylogenetic distributions," says Kelly. "This analysis will shed light on how islands move, evolve, and cooperate combinatorially to promote pathogenicity."

Together with developing visualization tools, Kelly also is building a database of known pathogenicity islands and more basic reference databases for Sandia's growing program in biology and bioinformatics. "The ultimate goal is to use this information to machine learn the ability to predict pathogenicity genes," he says.

This is where Kelly's research interest in bacterial evolution via genomic islands fits into Sandia's broader national security mission. The understanding of how pathogenicity naturally evolves in bacteria can be used to identify unnatural evolution of pathogenicity, in other words, a synthesized bioweapon.

Bioengineering used to leave behind "toolmarks" that enabled researchers to identify engineered biological agents (EBA) as such. Today's biosecurity challenge is that EBAs are more sophisticated and can escape such detection, but even in the "Wild West" there are still rules governing the horizontal gene transfer that occurs in genomic islands.

Kelly, together with collaborators Owen Solberg and Joe Schoeniger (both 8623), is working toward a computational tool to measure the "naturalness" of a suspect organism in terms of novel gene combinations.

"This is just one critical area where bioinformatics can aid in biodefense," says Cathy Branda, manager of Systems Biology Department 8623. "We are harnessing the incredible amount of data made available by advanced genetic sequencing technology to further our understanding of basic biology, which in turn allows us to pinpoint certain processes like horizontal gene transfer."

Makes sense to focus on genomic solutions

Sandia, like other research institutions, is developing a bioinformatics capability hand-in-hand with the technological revolution in genomic sequencing. "Sequencing has become so fast and sophisticated that it makes sense to focus on genomic solutions to problems in biodefense, energy, and the clinical world," she says.

Kelly brings to Sandia deep expertise in phylogenetic characterization of sequence datasets. He earned his bachelor's degree from the University of California, Santa Barbara in physiology and cell biology and his doctorate from University of California, San Diego in biology. Before joining Sandia, Kelly spent seven years as an assistant professor of biology at Indiana University and five years as a research investigator at the Virginia Bioinformatics Institute at Virginia Tech.

Kelly initially joined Sandia to work on the RapTOR Grand Challenge, which helped lay important groundwork in bioinformatics. "This is an area in which we'd all like to see Sandia grow," says Cathy.

DNA

(Continued from page 1)

neering & Deployment Dept. 8125 have been developing a prototype Battlefield Automated DNA Analysis Sampling System, an instrument designed to enable rapid DNA fingerprinting (genotyping) in a field-portable package.

Currently, DNA samples collected in Afghanistan, for example, may be sent to a containerized laboratory at a US or Coalition base in-theater, or to the USACIL headquarters outside Atlanta for forensic analysis. The Battlefield DNA Analysis System will ultimately help bring that laboratory capability to investigation sites near the front lines and provide results in about an hour.

MICHAEL BARTSCH (8125) introduces a buccal swab sample into the Battlefield DNA Analysis extraction module. (Photo by Dino Vournas)

"It takes time to transport a sample back to the lab," says Ken Patel (8125). "The forward-deployed forensics labs reduce the travel time, but still require highly trained scientists and specialized equipment. The Army has a real interest in rapidly processing DNA samples to aid decision-making for emerging military and intelligence needs" And, as in the case of confirming the identity of Osama Bin Laden, the turnaround time required for DNA analysis can be critical.

In particular, the Army wants to use rapid DNA analysis in investigations of improvised explosive devices (IEDs) to identify bomb-makers and their associates. Even after an explosion, investigators can often collect usable DNA from IED remnants. Other potential applications include screening at checkpoints and detention centers or determining which individuals may have been present at places of interest, such as terrorist training camps.

The Battlefield DNA System brings together four traditional benchtop DNA sample preparation steps: extraction, quantification, amplification, and separation. Amplification, or polymerase chain reaction (PCR), is critical for touch and trace DNA samples like those collected from IED components.

"You can start with a very small amount of DNA, even just one copy, and amplify it until you have thousands of copies that you can readily measure," says Mike. "It's a very powerful technique that makes it possible to obtain DNA analysis from an actual fingerprint. It's also very challenging to implement outside a laboratory environment."

Digital Microfluidic Hub

Key to bringing together these four steps in an automated, portable platform is the Sandia Digital Microfluidic Hub, a tool for manipulating and transporting microliter-scale sample droplets using electrostatic forces. Initially developed for the RapTOR (Rapid Threat Organism Recognition) Grand Challenge, this technology won an R&D 100 Award this year (*Lab News*, June 29, 2012) and last year garnered the Society for Laboratory Automation and Screening's innovation award (*Lab News*, April 22, 2011).

The Hub acts like a network router, directing, assembling, translating, and scheduling the movement of discrete packets — in this case DNA and reagent droplets — to and from the four sample processing modules.

"The Microfluidic Hub allows us to optimize each of those modules independently. They don't need to be compatible with each other, only with the Hub," says Ken. "It really streamlines what would otherwise be an almost intractable engineering problem."

This difficult, multidisciplinary problem requires a diverse and well-integrated project team.

"Engineering team lead Ron Renzi [8125] contributes a strong mechanical design and systems engineering ethic. Electrical engineer Jim Van DeVreudge [8125] has the expertise to seamlessly interface hardware controls with the software developed by our programmer, Dan Knight [independent contractor]. And Mark Claudnic's [8233-1] CAD designs and assemblies are brought to life by Jerry Inman [8125], an expert technologist in electronic and microfluidic systems," Ken says.

With a couple months remaining on the project, the team has built and tested prototype hardware for most elements of the DNA analysis platform. Summer interns are currently testing an automated DNA extraction module that uses a commercially available protocol for isolating DNA from cheek swab samples, but adapts it to work without a benchtop centrifuge or other bulky laboratory equipment — all in a footprint smaller than a shoebox.

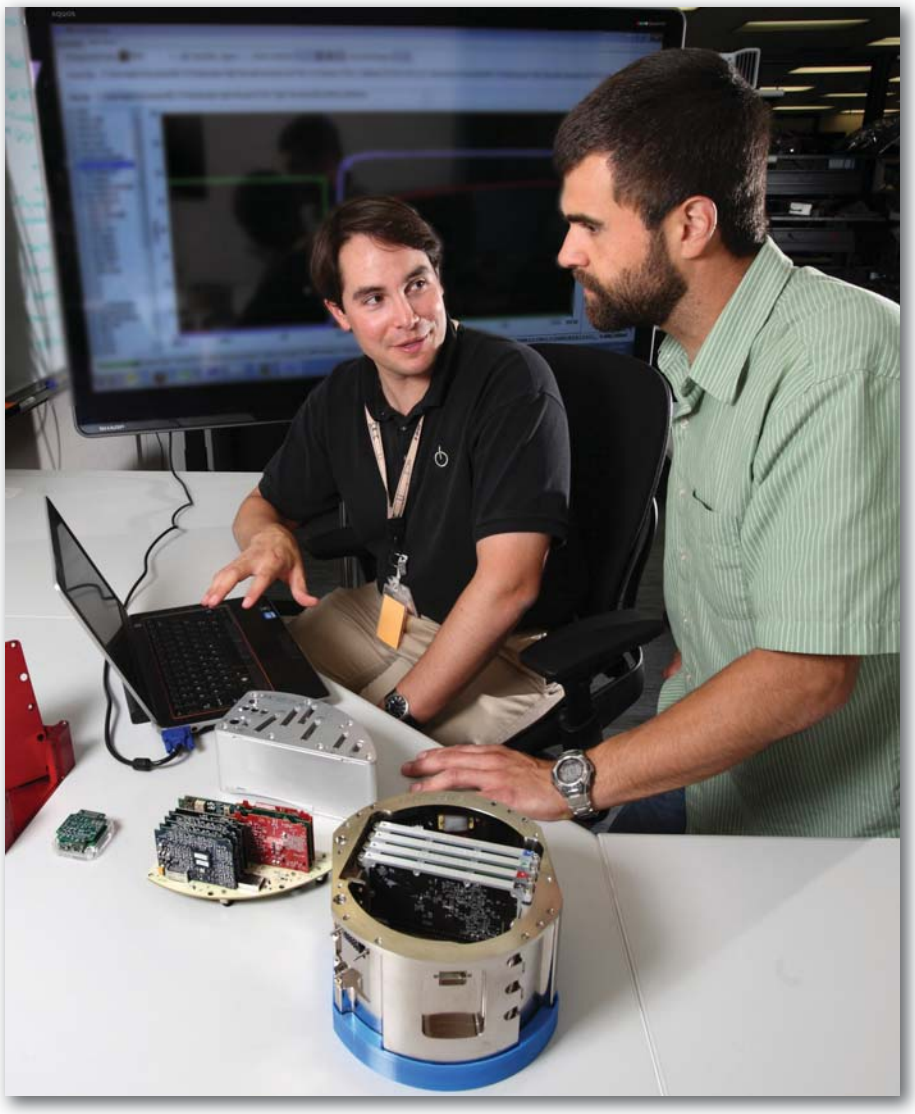
The PCR amplification component also is nearing completion. This module uses a novel rapid thermal cycling approach for which the team has filed a technical advance and hopes to submit a patent application. "We've got the testbed PCR prototype integrated to a level where you introduce the sample, push a button, and walk away. Ninety minutes later, you have a result," says Mike.

Even the separation module, a fairly typical capillary electrophoresis design, uses unconventional components to enhance capability. In this case, a low-cost spectrometer the size of two decks of playing cards allows the system to work with virtually any commercially available DNA fingerprinting kit without the need to reconfigure system optics or include multiple kit-specific filter sets.

In the next few months, the modules will be connected through the Microfluidic Hub and the proof of concept prototype will be delivered to USACIL. "It will be a benchtop-integrated prototype that they can test and give us feedback," says Mike. "Moving forward, we will optimize for size, speed, and performance."

Forensics is not a traditional area of research for Sandia, but Ken expects that to change. "It plays well to our strengths in microfluidics, bioassays, and system integration," he says. "This opportunity could open new areas of business for Sandia in developing sample preparation platforms for field and laboratory use. The FBI, for example, may not need portable analysis, but they have huge casework backlogs that could make the speed of our system very attractive."

Telemetry innovates to keep pace with new challenges



THE TELEMETRY LAB was designed to collocate multidisciplinary staff, facilitating dialogue and collaboration. Here, mechanical engineer Ryan Layton, left, and electrical engineer Doug Stark (both 8133) discuss data from the first B61 JTA Modernization Flight Test. (Photo by Dino Vournas)

By Patti Koning

Can you do more with less? This seems to be the question heard round the world these days.

In Sandia's Telemetry Systems groups (departments 8133, 8135, and 8136), the answer to this question is a resounding yes, driven by a transformed process for developing Joint Test Assembly (JTA) telemetry (TM) systems that has enabled several game-changing innovations.

The roots of this change can be traced back to the 2010 Engine Room experiment, in which Ryan Layton (8133) led a group of interns and new hires to deliver a new instrumentation system in 10 weeks (see the Aug. 13, 2010, issue of *Sandia Lab News*). This project evolved into a next-generation light electronics and prototyping laboratory that supports fast design, fabrication, and testing in a setting that enhances teamwork through staff colocation.

As a result, California's TM groups have gained visibility and opportunity, evidenced by an increase in new projects including aircraft compatibility tests, vibration fly-around units, and a B61 Davis Gun test series. They have also kept pace with customer demands for high reliability-instrumentation that is smaller in size, produces more data, and costs less.

"Increasing the fidelity of JTA flights in an environment that asks more for less without sacrificing reliability requires innovation," says Michael Forman (8136). "These constraints have manifested themselves in a firmware development and verification process and a new TM architecture called the Micro-Modular Telemetry (MMT) architecture."

Firmware Verification

Led by Yalin Hu (8136), the firmware verification team successfully executed a functional verification of the B61 JTA Modernization firmware, earning the team 2011 NNSA Defense Programs Award of Excellence. This was the first verification of a JTA telemetry system's digital hardware using state-of-the-art techniques employed in industry and academia.

"The team acts as independent reviewers to validate that the firmware design functions as intended in both normal and abnormal scenarios. With the addition of the firmware verification process, we increase the reliability of the firmware design," says Kiet Tieu (8133), project lead of the B61 Modernization.

The team verified subsystem components, improved the firmware development process, and eliminated low-probability critical errors through hardware fuzzing, a technique that uses high-performance computing (HPC) resources to input random data to hundreds of simulated firmware instances to identify hard-to-find system faults. This effort improved the quality and reliability of the B61 TM system and could potentially change the qualification process of future digital, high-consequence NW systems.

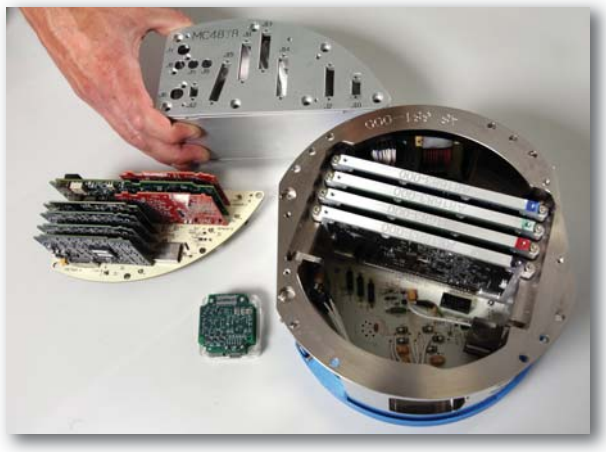
"With each correction to an edge-case anomaly or low-probability error, the verification effort improves the quality of the flight recorder, and lowers risk to the program," says Ryan.

Micro-Modular Telemetry

The Micro-Modular Telemetry architecture is an instrumentation package implemented as a set of cards that can be rapidly modified, combined, and assembled into a multitude of configurations. The MMT has been a catalyst for making telemetry in California more nimble, efficient, and collaborative.

"MMT is both a design philosophy and architecture to implement data collection and transmission for flight and ground tests," says Matt Johnson (8136). "It grows and changes each time we use it."

MMT was the result of an NNSA Stockpile Stewardship Readiness project, led initially by Mike Bell (8135) and completed by Brett Chavez (8135) and Matt. "The initial goal was to create a fundamentally robust, modular, and small instrumentation package to cover typical telemetry applications," Matt says. "For the Level 2 Milestone, we completed a study of all stockpile instrumentation and environmental requirements. The goals of MMT were to monitor 80 percent of the typical channels while surviving an envelope of mechanical environments."



THE DIFFERENT CONFIGURATIONS of the Micro-Modular Telemetry architecture. On the left (the crescent shaped pieces) is the card-based system used in the B61 and in the center and right is the distributed modules architecture used in the W88.

MMT has reduced costs and turnaround time and increased reusability. It's also allowed different weapons groups to team in ways never before possible. "With design continuity, it's much easier for the engineers to talk across the bench," says Rex Eastin (8135). "We can build on the lessons learned from the last implementation."

This also simplifies design reviews and adds value to that process. "When I go into design reviews, I have a better understanding because MMT is the basis," he adds. "I can learn from that team's work and issues to plan forward."

B61 JTA Modernization

The B61 First Insertion Unit was developed as a pilot for the B61 JTA Modernization. MMT was initially designed as a series of distributed modules, but it quickly became apparent that the cables and connectors were a hindrance in the highly collocated design of the B61 Data Recorder.

"The design evolved to place the circuit designs from each MMT module onto a single printed circuit board. Instead of a cabled bus, the cards are connected with a backplane system, using the same communication architecture," says Matt. "So now MMT can be a collection of distributed modules or a single enclosure of multiple instrumentation cards."

Like the firmware-verification team, these innovations earned the B61 JTA Modernization TM team a 2011 NNSA Defense Programs Award of Excellence.

The MMT enables design reuse between different weapon systems. "Every implementation will have distinct design specifications based on the mechanical envelope, environmental design specifications, margins, and other factors," says Matt. "With design reuse of our mechanical architecture, we have a suite of environmental qualification data to draw upon."

W88 Alt

The W88 Alt team, led by Rex, is adapting the MMT to fit inside a tight volume. "Because of space constraints, we're adapting it to small circular boards using the same design philosophy and MMT interface," he explains.

The telemetry system for the W88 is being designed to capture "first motion," a first for any JTA telemetry system that is flown in a reentry body configuration. Previously, batteries for the telemetry system could not be turned off and turned back on again. This meant not turning on the telemetry system until the missile launch was already under way.

"There is a lot of shock, acceleration, and pressure when the missile first begins to move," Rex says. "Capturing of this data will give our customers the ability to confirm their models."

The engineers plan to use lithium batteries to power the W88 Alt JTA telemetry system, something that has never been done before for Navy systems. This is possible because of advances in lithium battery technology — one of the options being considered are 2/3 A-cells that have been previously certified for use on NASA manned space flights.

Another change for the W88, enabled by MMT, is a multiple-configuration JTA. Multiple configurations allow for more specialized data collection than within a single configuration.

"This will be a big deal within the W88 community," says Rex. "Because of the MMT and the use of lithium batteries, we can configure our telemetry system smaller and place it in areas within the warhead or reentry body that was unachievable just a few years ago. The recent march on technology allows us to offer these options to the Navy and NNSA."

The Future

Today, 30 engineers and technologists support the telemetry mission, up from approximately 20 a few years ago. "As we continue to respond to different needs with this architecture, people come back to us and begin considering our telemetry products for needs beyond JTAs." Michael adds, "It's not just Handling Gear, Telemetry Systems, or Cyber-Physical Systems. Our product is also the culture and innovation necessary to thrive in a changing laboratory environment."

Sandia/California . . .

A day in the life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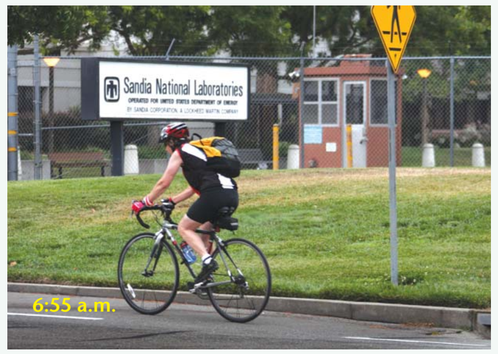

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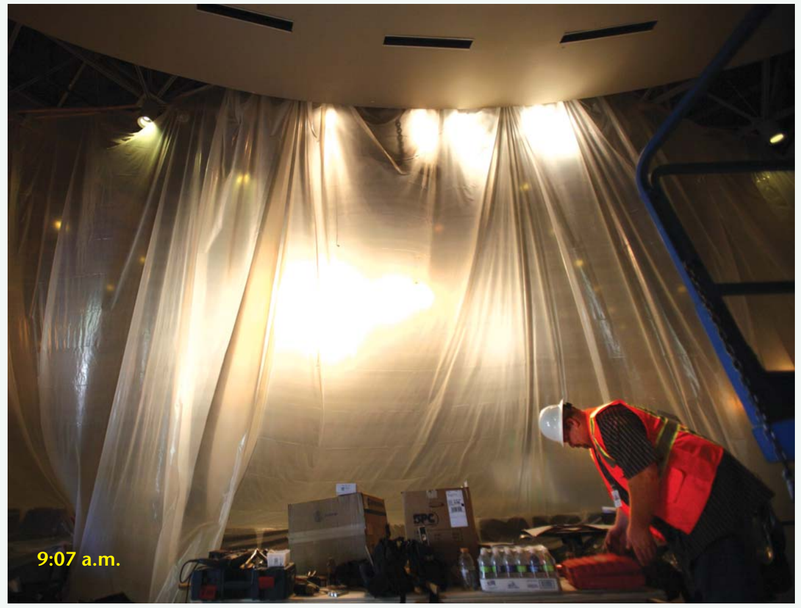
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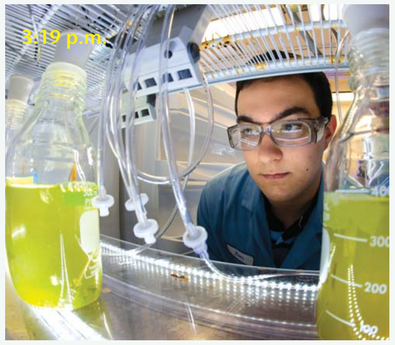
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In homage to Lab News *photographer Randy Montoya's "Day in the Life of Sandia National Labs" photo feature commemorating Sandia's 60th anniversary, we asked our two Sandia/California photographers, Dino Vournas and Randy Wong, to spend a day capturing the spirit, sights, and work that goes on during a typical workday at the Livermore site. They ventured out Thursday, July 26, to see what they could find to visually depict a day in the life of a Sandian in California.*

Starting with sunrise and ending with the lowering of the flag, Dino and Randy snapped away as members of the workforce entered the site, worked in labs, tended the grounds, tested equipment, and met with colleagues. Thanks to Jennifer Benoit (8521) for her work in coordinating this busy day. We hope you enjoy their work as much as we do!

— Mike Janes and Patti Koning

Photo captions beginning from top left corner. In the captions, (DV) stands for Dino Vournas, (RW) for Randy Wong.

6:21 a.m. — Sunrise at the Greenville Road entrance to Livermore Valley Open Campus. (DV)

6:55 a.m. — A cyclist on East Avenue. (DV)

8:58 a.m. — Div. 8000 VP Rick Stulen greets site visitor Ann Mitchell, director of Installations, Logistics, and Mission Support at Headquarters, US Air Force Global Strike Command. (RW)

9:07a.m. — James Prior (8515-5) installs a new media screen in the Combustion Research Facility auditorium. (DV)

10:34 a.m. — Paul Boggs (8954) puts pen to white-board to ponder big ideas. (RW)

10:51 a.m. — Katherine Dunphy Guzman (8114) shares some ideas at the SUMMIT team meeting. (DV)

11:27 a.m. — Adrian Marquez (8515) cares for the lawn outside of Micro and Nano Technologies Laboratory. (DV)

11:49 a.m. — Lindsey Schuster (8532) holds the Warrior 2 in a yoga class at the Life Design Center. (RW)

12:34 p.m. — The Games People Play club enjoys card and board games every Thursday at noon outside the 915 deli. (DV)

1:41 p.m. — Intern Chris Daskalos from USC works on a unit for the Center for Cyber Defenders. (DV)

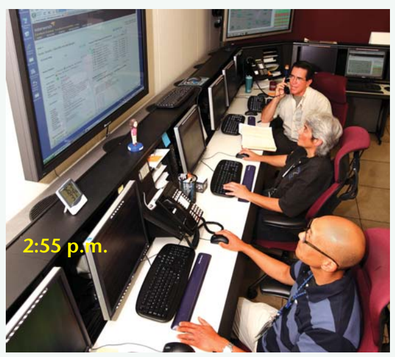
2:42 p.m. — Al Latora and Ken Boehmer (8949) create a new fiber optics network for Sandia's intranet. (DV)

2:45 p.m. — Mary Bao Tran-Gyamfi (8634), Haifeng Geng (8623), and Benjamin James Carvalho (8634) check on the algal pond experiment. (RW)

2:55 p.m. — Channing Young, Michele Kahn, and Frank Bielecki (all 8949) keep an eye on Sandia's networks.

3:19 p.m. — Summer intern Benjamin James (8634) checks on cultures of micro algae cultures for biofuel research. (RW)

4:45 p.m. — Shaun Stewart (8511) lowers the American flag at the end of the workday. (RW)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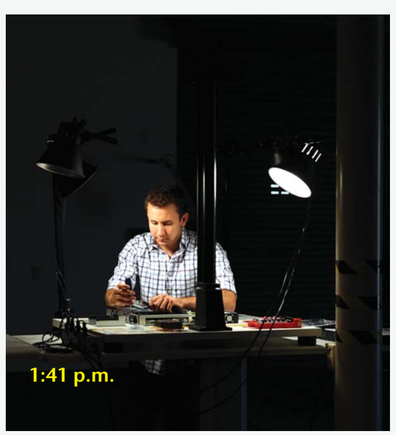
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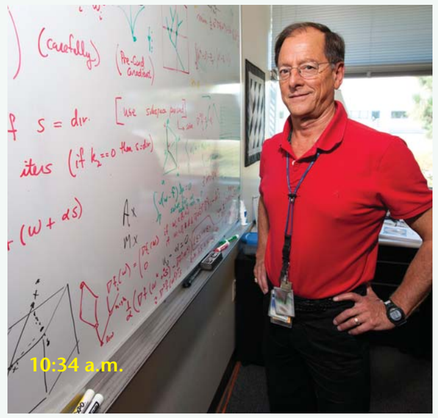

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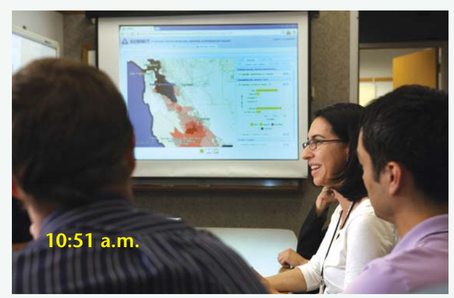
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MegaDroid

Self-contained, Android-based network created by Sandia researchers for study and analysis

By Mike Janes

As part of the ongoing effort to help cyberspecialists combat the devastating problem of malicious computer networks on the Internet, researchers at Sandia's California site have now turned their attention to the handheld computing environment.

Building on the success of earlier work that focused on virtual Linux and Windows desktop systems, Sandia cyberresearchers have now linked together 150,000 virtual handheld computing devices using the Android operating system. Android dominates the smartphone industry and runs on various computing gadgets.

"Smartphones are now ubiquitous and used as general-purpose computing devices as much as desktop or laptop computers," says electrical engineer David Fritz (8966). "But even though they are easy targets for malware and botnets, no one is really studying them at the scale we're attempting."

A VIRTUAL ANDROID WORLD — David Fritz (8966) holds two Android smartphones, representing the virtual network of 150,000 such devices that he and other researchers are using to advance understanding of malicious computer networks on the Internet. (Photo by Dino Vournas)

The Android project, dubbed MegaDroid, is expected to help Sandia and others who struggle with understanding the complexity and size of infected computer networks, particularly as the problem relates to smartphones.

Soon, Sandia expects to complete a sophisticated demonstration of the MegaDroid project that could be presented to potential industry or government collaborators, says John Floren (8961).

The virtual Android network at Sandia, says John, is carefully insulated from the rest of the Labs and the outside world, but can be built up into a realistic computing environment. That environment might include a full domain name service (DNS), an Internet relay chat (IRC) server, a Web server, and multiple subnets.

A key element of the Android project, John says, is a "spoof" Global Positioning System (GPS). He and his colleagues created simulated GPS data of a smartphone user in an urban environment, an important experiment since smartphones (and their various features, such as Bluetooth and Wi-Fi capabilities) are very location-dependent and thus could easily be controlled and manipulated by rogue actors. The researchers then fed that data into the GPS input of an Android virtual machine; to software on the virtual machine, the location data is indistinguishable from real GPS data. This, John says, offers researchers a much richer and more accurate emulation environment from which to analyze and study the effects hackers could have on smartphone networks.

This latest development by Sandia cyberresearchers, John says, represents a significant stepping stone for those hoping to understand and limit the damage from attacks that can occur against individual consumers, companies, and governments. "You can't defend against something you don't understand," he says.

The larger the scale the better, John says, since more computer nodes offer more data for researchers to observe and study. Some malware, John and David say, doesn't even activate until a certain scale of infected machines is reached.

Builds off MegaTux project

The research, conducted through internal Sandia investments, builds on a project that started in 2009 (MegaTux) that saw Sandia scientists run a million virtual Linux machines, and a later project focused on the Windows operating system (MegaWin). Sandia researchers created those virtual networks at high scale using Windows Emulation (WINE) technology available on Linux, and by running real Windows instances in virtual machines.

The main challenge in studying Android-based machines, the researchers say, is the sheer complexity of the software. Google — the developer of the Android operating system — wrote some 14 million lines of code into the software, and the system runs on top of a Linux kernel, which adds at least 15 million more lines.

"It's harder to be the defender in this kind of complex environment rather than to be the malicious attacker," says David. "They [the attackers] just need to find one place to hide their attack, so it's a needle in a haystack since you can't possibly read through 15 million lines of code."

Much of Sandia's work on virtual computing environments will soon be available for other cyberresearchers via open source, and David and John both believe Sandia should continue to work on tools that industry leaders and developers can use to combat cyberterrorism.

"Tools are only useful if they're used," says David.

MegaDroid will be primarily useful, says Keith Vanderveen (8961), as a tool to ferret out either security holes or other problems that would manifest themselves when there are large numbers of smartphones interacting.

"You could also extend the technology to other platforms besides Android," Keith says. "Apple's iOS, for instance, could take advantage of our body of knowledge and the toolkit we're developing." He says Sandia also plans on using MegaDroid to explore issues related to data protection and data leakage, "something of concern to government sponsors including DoD and Department of Homeland Security."

Exploring cyber issues from many angles: A multidisciplinary look

From Aug. 5-10, top graduate students pursuing careers in cybersecurity participated in a weeklong summer institute, Cyber Security Technology, Policy, Law, and Planning for an Uncertain Future, at Sandia/California. The busy week included mentor-led discussions and workshops and talks by Sandia's cyber- and national security experts as well as prominent external speakers including University of California, Berkeley professor of public policy Michael Nacht (bottom left). (Photos by Randy Wong)

Sandia researchers recommend hydrogen-specific equipment use at AC Transit bus station

Sandia experts asked to lead technical investigation of hydrogen release incident

By Mike Janes

Hydrogen experts at Sandia/California were tapped for their technical expertise through a first-ever contract with the state of California to investigate a May 4 hydrogen release at the Bay Area's Alameda-Contra Costa Transit District (AC Transit) hydrogen fueling station in Emeryville, Calif.

Based on the outcome of that investigation, on July 25, AC Transit's board of directors unanimously agreed to adopt the Sandia researchers' recommendations and take steps to re-open the station, which had been closed since the incident.

Sandia was asked by California's Air Resources Board (ARB) and by DOE's Office of Energy Efficiency and Renewable Energy (EERE) Fuel Cell Technologies program to lead the investigation into the hydrogen release incident. Although incident investigations are routine, with more than 5,000 gasoline-related incidents at gas stations per year, each of the handful of hydrogen-related incidents is taken extremely seriously to better understand the causes, implement lessons learned, and communicate best practices.

In their 33-page report, *Investigation of the Hydrogen Release Incident at the AC Transit Emeryville Facility*, Sandia researchers Aaron Harris (8367) and Chris San Marchi (8252) concluded that an internal component of a pressure relief valve used in the facility's fueling station failed, and that the material of construction of the valve component, type 440-C martensitic stainless steel, was a poor choice for hydrogen service.

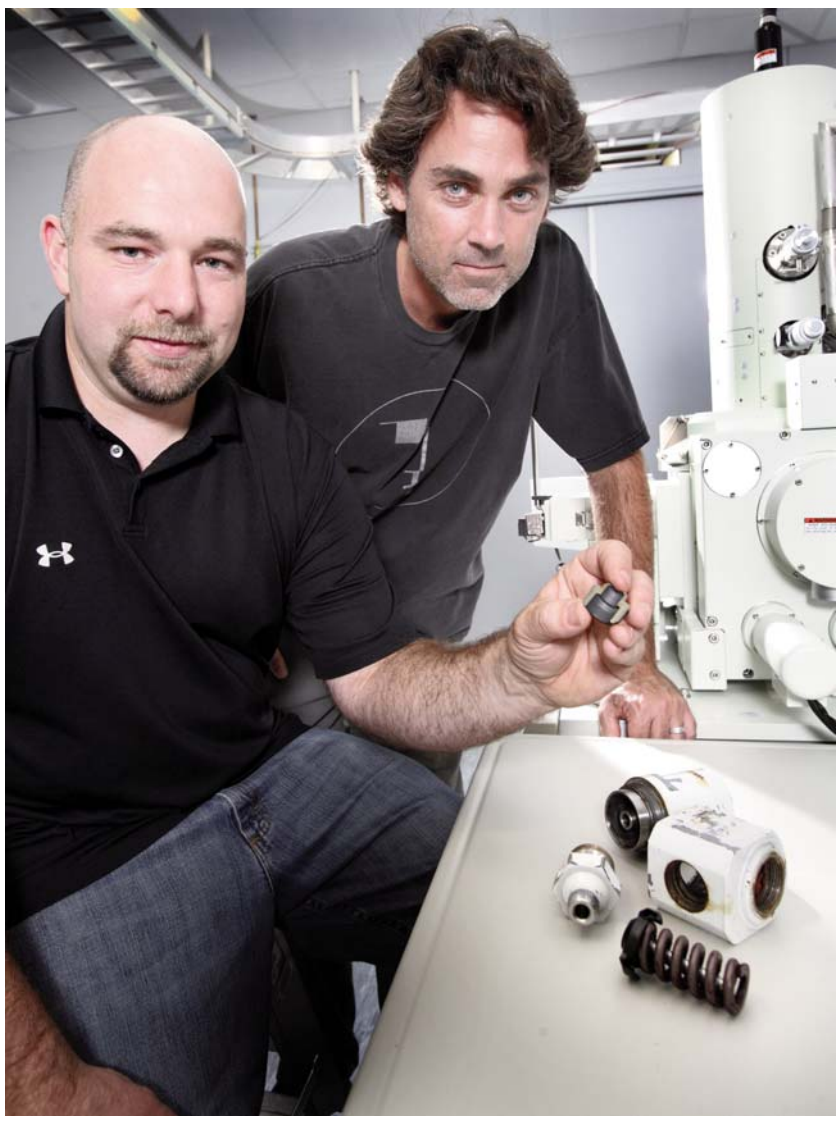
Aaron and Chris say that they likely could not have successfully completed the investigation without the support of the lab's machine shop (8247) and energy nanomaterials group (8651). Together, those departments provided turn machining, microscopy, and metallurgic analysis that were vital to the project's success.

"The fact that we were able to transition capabilities commonly used for scientific research to perform a high-visibility investigation in such a short time speaks to the cooperative culture and technical strength of Sandia," says Aaron.

With its hydrogen program, Sandia leverages long-established capabilities in understanding unintended hydrogen releases, storage systems, and materials compatibility in hydrogen and the application of these capabilities to support the development of safety, codes, and standards associated with the commercial use of hydrogen as a transportation fuel.

Sandia's materials scientists, publishers of the *Technical Reference for Hydrogen Compatibility of Materials*, recommended that AC Transit replace pressure relief valves with devices specifically designed for hydrogen service. They also recommended a system-wide analysis of the materials for devices used at the station to ensure that designs account for material compatibility.

Sandia's researchers note that manufacturers often offer similar components in hydrogen-compatible materials, such as type 316 austenitic stainless steel. Materials compatibility, Sandia researchers wrote, is only one of many parameters that design engineers must consider for hydrogen applications.



SANDIA RESEARCHERS Aaron Harris (8367) and Chris San Marchi (8252) display components of a pressure relief valve used in an Alameda-Contra Costa Transit District hydrogen fueling station. An unintended hydrogen release occurred at the station when one of the internal components of the valve failed. (Photos by Dino Vournas)

A COMPONENT of this pressure release valve failed, leading to an unintended hydrogen release at an AC Transit fueling station.

The Emeryville site is considered to be an essential component of California's hydrogen fueling infrastructure and is part of ARB's Zero Emission Bus ("ZBus") program. The station is significant in that it offers both public automotive and AC Transit bus fueling capabilities.

While the failed component within the valve was found by Sandia to be the root cause of the accident, the safety features of the hydrogen station functioned properly, venting hydrogen overhead without causing harm. Multiple factors contributed to an unnecessary escalation of the event, Sandia analysts concluded, including the lack of timely communication regarding the status of the fueling system as well as the design approach for safety systems.

A fire at the site, Sandia researchers say, resulted in relatively minor damage to the station canopy. There were no injuries.

Daniel Dedrick (8367), the manager of Sandia's hydrogen energy program, says the lab was able to quickly and effectively provide leadership and expertise in response to this event due to the established programs, capabilities, and partnerships that have been assembled with the investment of the Safety, Codes, and Standards program in the DOE EERE's Office of Fuel Cell Technologies.

Looking toward the future, Daniel says Sandia is now working closely with ARB and with the California Fuel Cell Partnership to develop assessment tools to prevent future accidents and implement lessons learned from the Emeryville incident. Learning from these initial hydrogen refueling stations, he says, is critical for the continued successful deployment of hydrogen infrastructure in the US and around the world.

"Many tools are available that can help stakeholders plan for and prevent these kinds of events from happening," says Daniel. "We will continue to work with the state and the various stakeholders and jurisdictions to learn from the AC Transit incident and develop and implement tools to reduce the possibility of such accidents from happening in the future."

The state, through energy initiatives such as the AB118 - Alternative and Renewable Fuel and Vehicle Technology Program, has supported the construction of hydrogen stations in northern and southern California, with more planned in the future.

White House science adviser visits California site

JOHN HOLDREN, President Barack Obama's top science adviser, visited Sandia/California on Aug. 7 and toured the Lab's Combustion Research Facility (CRF) and Cybersecurity Technologies Research Laboratory (CTRL). Holdren is the assistant to the president on science and technology, director of the White House Office of Science and Technology Policy (OSTP), and co-chairman of the President's Council of Advisers on Science and Technology (PCAST). Here, Holdren poses at the Combustion Research Computation and Visualization (CRCV) facility with, left to right, Dawn Manley (8350), Jackie Chen (8351), Pat Falcone (8100), and Div. 8000 VP Rick Stulen. (Photo by Michele Clark)

Sandia Classified Ads

MISCELLANEOUS

DINING TABLE, small (3-1/2' x 3-1/2'), oak colored, w/leaf, 4 caster, cloth, armed chairs, $150; 24-in. bolt cutter, $25. Smith, 268-5392.

CHANDELIER & WALL-MOUNT LIGHTING, antique/vintage, 2 lantern, 2 candle-like, both brass/gold in color, photos available. Walraven, 291-8242, ask for Jerry.

OXYGEN/ACETYLENE TORCH, for cutting/brazing, call for more info, $450. Herrera, 833-5035.

FLARED WHEEL WELL GUARDS, bolt or no bolt attachment, contoured mud flaps, fit '02-'05 Dodge Ram 1500, new $290, asking $190. Lyons, 250-2481.

TV STAND, oak, 27" x 16" x 25", very good condition, $25; Magic Bullet blender, w/all accessories, very lightly used, $25. Hussong, 505-332-3523.

HOVEROUND MPU4 POWER-CHAIR, used 1 yr., great shape, w/control panel lock, $1,500; chair carrier, $75. Vrooman, 505-321-9102.

WOOD JOINTER/PLANER, almost an antique, 6-in. w/custom wood stand, carving tools, $65. McAllister, 281-5188 or 980-2851.

MOUNTED TIRES, on aluminum wheels, off '12 Kia, only 700 miles on tires, wheels 17" x 17", tires P215x45/R17, $900. Hill, 205-1496.

KITCHEN TABLE, glass top, round, 42-in. diameter, w/4 chairs, very good condition, $200. Walsh, 554-2707.

WASHER & DRYER, apt. size ASKO, $300; Frigidaire washer, Kenmore dryer, $200 ea.; queen headboard, gold metal, $30. Willis, 304-5034.

TODDLER BED, Disney Princess, w/mattress, sheets & bed pad, Princess Belle chair, princess tent & couch, $130 OBO/all. Velasquez, 610-3672.

TONNEAU COVER, fits '05-'11 Toyota Tacoma, regular bed, new condition, easily bolts on, no drilling, $100 delivery included. Mihalik, 816-8469.

LOVESEAT, tan, textured fabric, accented w/small brass studs, 2 throw pillows, paid $450, asking $200. Garner, 328-1272, ask for Jane.

DESK, metal, almond colored, $60; 10-in. table saw, Craftsman, great condition, $100. Jenkins, 505-908-1553.

PLASTIC CHAIR MATS, 2, for carpet protection, only used 3 mos., $25. Mills, 847-6286.

CAR FLOOR MATS, gray, from '08 Tacoma OEM, front & back, $40. Hennessey, 505-506-7936.

BUNK BEDS, red, twin over full, $75; 4 Firestone Wilderness tires, 265/70R16 LE, $200. Wimpy, 822-0223, ask for Steve.

VACATION, 2 nights, 1-bdr., Pagosa Springs, w/hot springs admission, expires 10-10-12, upgrade available, $255. Yawakie, 228-0350.

CHINA, Nancy Prentiss-Foxhall, aqua/white, missing 4 bowls, otherwise all serving dishes etc. $300 OBO. Williams, 299-3108.

TRUNDLE BED, wrought iron frame, pillow-top mattresses, mint condition, paid $595, asking $325. Record, 243-5103.

TRUMPETS, w/cases, both need repair, call for details, $20 ea. Saiz, 505-459-0783.

PHONE/ANSWERING SYSTEM, GE Dect 6.0, cordless, 2 handsets, ultra slim design, red, box/manual, works fine, $20. Hall, 280-4344.

HOT TUB, '94 CalSPA, excellent tub, needs pump, TLC on redwood surround, has cover, you haul, free. Brown, 293-5768.

AIR COMPRESSOR, Sears, 33-gal., like brand new, regularly $400, asking $200 or $250 w/reel & extra hose. Saladin, 881-2219.

DORM REFRIGERATOR, Sanyo, 3.3-cu. ft., $40; 4'x 8', 3v3 goal, needs net, $20. Dye, 897-0304.

SEWING MACHINE, black, Singer Featherweight, model 221-1, very nice condition w/case accessories & extras, $300. Vigil, 505-553-9596.

SWAMP COOLER, Master Cool, down draft, 6500cfm, 1-hp motor, 3 yrs. old, $250; Graco baby crib, oak, $60. Finley, 293-1961.

ROLL-TOP OFFICE DESK, 3 book shelves, $350/all. Salas, 505-507-0340.

MICROWAVE, Sharpe 1100W, $25; Proform Space Saver elliptical, $125. Dinge, 505-818-8933.

LAPLINK PC FILE MOVER, new, $20; white Kenmore washer, GE electric dryer, $150 ea. or $250/both OBO. Garcia, 280-5815.

AUDIO/VIDEO MULTI-CHANNEL RECEIVER; HP PhotoSmart color printer; new Compac IPAQ Pocket H3950, all accessories; Toshiba DVD/VHS; $25 ea. Hagerman, 401-1402.

DINING TABLE, w/6 chairs & 1 leaf, $460; china cabinet, $250; dresser w/mirror $100; 6-drawer dresser, gold color, antique, good condition, $100. Aragon, 265-9109.

BUILT-IN OVEN, GE, white, $300; GE over-the-range microwave, white, $75; excellent condition. Haid, 292-0159.

CLARINET, $200; Karate sparring gear & boxing gloves, paid $240, asking $140. Huppertz, 286-3287.

How to submit classified ads

DEADLINE: Friday noon before week of publication unless changed by holiday. Submit by one of these methods:

- **EMAIL: Michelle Fleming (classads@sandia.gov)**
- **FAX: 844-0645**
- **MAIL: MS 0165 (Dept. 3651)**
- **DELIVER: Bldg. 811 Lobby**
- **INTERNAL WEB: On internal web homepage, click on News Center, then on *Lab News* link, and then on the very top of *Lab News* homepage "Submit a Classified Ad." If you have questions, call Michelle at 844-4902. Because of space constraints, ads will be printed on a first-come basis.**

Ad rules

1. Limit 18 words, including last name and home phone (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)
2. Include organization and full name with the ad submission.
3. Submit ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. One ad per issue.
6. We will not run the same ad more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active Sandia members of the workforce, retired Sandians, and DOE employees.
10. Housing listed for sale is available without regard to race, creed, color, or national origin.
11. Work Wanted ads limited to student-aged children of employees.
12. We reserve the right not to publish any ad that may be considered offensive or in bad taste.

SOFA & LOVESEAT, matching recliners, like new, Southwest-style cloth upholstery, $1,250. Cowen, 292-0948.

FOOTBALL TICKETS, Cardinal's home games: Broncos, Aug. 30, 8 p.m., $10; Seahawks, Sept, 9, $35; Rams, Nov. 25, $35. Lifke, 822-8741.

CELLPHONE, T-Mobile Samsung Galaxy S3, excellent condition, no scratches, 1 mo. old, $400 OBO. Bitsie, 350-7712.

HORSE TACK, clothing, art, misc., pet items, antique chairs, Native American items, telescope, 5 double pane windows. Siegrist, 293-4148.

TWIN CAPTAIN BED, solid oak, w/4 drawers & middle door, w/mattress, bedding & comforter, $175. Henfling, 933-9937.

TRANSPORTATION

'11 FORD RANGER SPORT, 6-cyl., bed liner, tinted windows, 4,500 miles, $20,500. Sanchez, 505-503-0112.

'99 SAAB SE TURBO sunroof, heated seats, kept in garage, 73.9K miles, $4,300 OBO. Hwang, 505-797-4588.

'00 CHEVY CAMERO, AT, newer tires, new rims, ~58K miles, looks & runs great, $6,500. Jones, 259-8031.

'11 INFINITI G37 IPL, fully loaded, graphite shadow, 11.7K miles, KBB $46,600, asking $45,500 OBO. Noriega, 505-850-2371.

'06 DODGE RAM 1500, HEMI engine, tow pkg., w/trailer brake, many extras, excellent condition, $12,000 OBO. Fauteck, 286-2787.

'01 SATURN L-200, AT, 58K miles, great condition, $3,100. Thomas 822-1923.

RECREATIONAL

'78 GMC ELEGANZA MOTOR HOME, 26-ft., great condition, photos available, $9,500 OBO. Leighley, 281-1865.

'11 HONDA SHADOW PHANTOM, windshield, backrest, & more, 1,415 miles, mint condition, $6,500 OBO. Chavez, 505-720-1537.

'06 KAWASAKI CLASSIC 1600, blue & silver, highway bars, rear foot rests, lights, windshield, sissy bar, 6.3K miles, $5,000. Ortiz, 505-610-3278.

'02 HARLEY DAVIDSON FLST, 8,800 miles, nice bike, don't use anymore, $8,300 OBO. Garcia, 948-0466.

'10 YAMAHA AR240 JET BOAT, like new, twin jets, cover, wake tower, 10-passenger, safe, fun, garaged, $32,500. Horton, 286-2182.

REAL ESTATE

4-BDR. HOME, 2 baths, 3,500-sq. ft., 1,400-sq. ft. patio, MLS#739120, search 7 Calle Amable Peralta, NM at www.gaar.com/finda home. Morrison, 869-3017.

3-BDR. HOME, 1,530-sq. ft. Willow Wood, near KAFB, patio w/park-like backyard, excellent condition, $199,000. Clayton, 249-4008.

5 ACRES, in Edgewood, well drilled & power parallel to property, $60,000. Beenau, 505-264-1390.

TRIPLEX, ea. unit 1-bdr/1 bath, 530-sq. ft., near KAFB, good income property, newer AC, wood/tile floors, MLS# 729035, $129,000. Lioce, 697-9521.

3-BDR. HOME, 2 baths, 2,400-sq. ft., 40 acres, built in '04, Mountainair area, hot tub, 3 barns, fabulous views, $239,000 negotiable. Bott, 505-847-2409.

3-BDR. HOME, 2 baths, 2-car garage, 2,600-sq. ft., 20+ acres, beautifully remodeled, 30 mins. east of Albuquerque, $275,000. Mayer, 615-2924.

WANTED

VOLUNTEERS, for Albuquerque Animal Shelters, administrative, walking dogs, etc. Lotosky, 767-5632 or blotosky@cabq.gov.

NEW MEMBERS, Albuquerque Breakfast Civitan Club, helps handicapped in Albuquerque, including many retired Sandians. Lappin, 296-3457.

GEN 2/3 NAVIGATION DVD, for Lexus/Toyota, need something newer than '02. Deuel, 379-4799.

CARPORT PARTS, 10' x 10' or larger, prefer steel posts & metal panels. Salazar, 797-8064, ask for David.

ROOMMATES, 2, to share large 3-bdr. home, 3 miles to UNM, safe neighborhood, $400/mo., + 1/3 utilities. Black, 505-331-9147.

DVD PLAYER, cheap. Lensi, 505-217-4874.

FEMALE ROOMMATE, responsible young professional/grad student, few blocks from UNM main, $500/mo., all utilities included. Walker, 263-3194.

In New Mexico

Labs' annual retiree social scheduled for Sept. 5

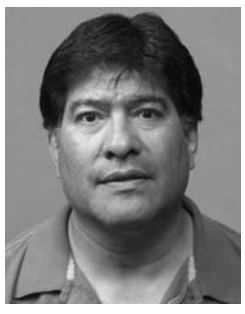
Due to our increasing retiree population and the increased attendance at the Retiree Social, Sandia pursued several options for securing a venue for this year's event. The Albuquerque Convention Center was selected as the 2012 venue, as this location has adequate indoor space to allow for gathering of friends, good food, reminiscing, and catching up, all within the same banquet room. This year's event will include a presentation from senior leadership and presentations from Sandia's Corporate Archives and History Program.

When: Sept. 5
Time: 11:30 a.m.-2:30 p.m.
Where: Albuquerque Convention Center
Note: *Sandia will also provide a park-and-ride service from Hoffmantown Church*

An invitation with event details will be sent to retirees via mail in early August. Information on the California Retiree Social will be announced in a future edition of *Lab News*.

Mileposts

New Mexico *photos by Michelle Fleming*



Christopher Flores
35 2541

John Baney
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C. David Turner
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Tim Draelos
25 5563

Division 8000

Cultivating a diverse and inclusive environment

By Mike Janes

When people think of "diversity" at work, they might tend to think of race, gender, and ethnicity. While those factors are certainly important in developing a diverse workforce, creating a diverse and inclusive environment in the workplace is about so much more.

Div. 8000, with California site VP Rick Stulen leading the way, has made a new commitment to diversity and inclusion at the site. Rick gives credit to director Bob Carling (8300) and now-retired director Glenn Kubiak (8600) for pioneering the diversity and inclusion efforts at Sandia/California.

The intention, Rick says, is two-fold: to improve the site's culture and to develop an environment that more effectively fosters innovation. Meeting both these objectives, he believes, will lead to both a happier workforce and more robust mission success.

Surveys and other employee feedback looking at the health of Div. 8000 convinced Rick that Sandia/California's leadership needed to look more closely at diversity and inclusion issues. Specific findings, such as a perceived glass ceiling, low numbers of women in technical leadership positions, dissatisfaction among the foreign national population, and the general demographics of the site, strengthened his resolve to initiate some changes.

In 2010, Rick attended a Lockheed Martin executive session on diversity and inclusion that opened his eyes, and he soon forged stronger ties with Sandia's Esther Hernandez (Org. 40, Corporate Diversity and Inclusion), as well as Nanci Luna-Jiménez, an internationally known consultant whose company conducts intensive diversity and inclusion seminars. Luna-Jiménez's seminars are known for offering a very deep and proactive approach to diversity and inclusion, including transformational programs that inspire and empower individuals and organizations to heal from effects of oppression and increase their commitment to transformative social change through personal transformation, organizational change, and social justice.

Kristine Freitas (8522) serves as diversity and inclusion point-of-contact for Div. 8000. As Kristine explains, there are three primary groups through which Rick's diversity and inclusion goals are fostered: the Division Diversity Council (DDC), the ELK group (which came out of the FY11 Emerging Leaders Program), and the Inclusion Diversity Action Planning Team (iDAPT).

The DDC, she says, is the "more traditional" diversity body and has been at Sandia for many years. The DDC sponsors diversity events, celebrates diverse groups, and helps with recruiting. The DDC, Kristine says, hopes to become even more engaged and have even more of an impact on Div. 8000 diversity and inclusion goals, and Rick has met with the group in hopes of further developing its role.

IN JUNE THE INCLUSION Diversity Action Planning Team (iDAPT) met to develop specific diversity initiatives for the year. This group, along with the Diversity Division Council and ELK group, are fostering Rick Stulen's diversity and inclusion goals for the California site.

The Emerging Leaders Program (ELP), which aims to develop new and future leaders at the California site, included diversity and inclusion as one of its focus topics this past year. Having been immersed in diversity and inclusion topics as part of ELP, the group continued its discussions in the format of weekly lunch meetings under the name of ELK (which is not an acronym). Reinforced through Luna-Jiménez's off-site workshops and consulting, ELK continues working toward Rick's site diversity objectives.

Engaging the entire site population

Finally, iDAPT is a new group that is currently developing its specific initiatives for this year. Its membership includes members of the workforce who have participated in one of Luna-Jiménez's seminars.

Each of the diversity and inclusion groups has a similar objective, says Kristine: to more effectively engage the entire site population, which ultimately needs to happen to impact the culture.

"To continue hiring the best people and to retain them, we must create a work environment that people love and find exciting," says Rick. "We need our managers to listen to members of their staff, spend time with them, and respond to their needs."

Rick says differences in life and work experiences are key to a diverse and inclusive workplace. For example, he said, some of the Laboratory's best cyber-researchers don't necessarily possess a traditional university background.

"Some of them might not have gone to college right away, or maybe they went to schools that we typically don't recruit from," Rick says. "In any event, they might just think in a different way and offer approaches and styles that aren't just the traditional, standard approaches. And that can be a very good thing."

As another example, he noted that Sandia's Ed Noma (8521), a member of the business development team, came from an industry background, has had significant exposure to Asia, and understands how companies think and operate.

"Now, he's bringing that experience and knowledge to Sandia," Rick says. "We need to be able to identify these kinds of individuals, bring more of them into the lab, and retain them once they're here."

With inclusion, Rick says laboratory management needs to avoid the trap of going to the same people all the time with the same assignments. He references a recent study within the nuclear weapons group in Div. 8000, and a resulting objective to give significant assignments to early career staff in hopes of engaging them on important issues early in their Sandia careers.

Rick points out that he doesn't believe the Labs — or Div. 8000 — is "broken" and needs to be fixed.

"But we can do better," he says. "And diversity in thought and experiences, then tying it to inclusive practices and leading to more innovation, is the direction we want to head."

Exercise is the top of Rick Stulen's agenda

DIV. 8000 VP Rick Stulen and Norm Bartelt (8656) cross the finish line at the November 2011 Turkey Run. (Photo by Emily Thompson)

By Patti Koning

Rick Stulen may be one of the busiest people at Sandia, but he'll always choose walking over driving.

"When I'm in Albuquerque, I park on the opposite side of the campus from where I need to be so I can enjoy a 15-minute walk," he says. "People driving by in cars or carts will offer me a ride, but I'd rather they get out and walk with me."

Exercise is a priority for Rick, so when he is traveling for work, he fits in as much walking as possible. Most other times, you can find him running or cycling.

About 30 years ago when he was fairly new at Sandia, Rick ran his first marathon. "Art Pontau [8360] and I were part of a lunchtime running group. We decided to challenge ourselves," he recalls.

Two years ago he ran a half-marathon in Santa Cruz, Calif., and he's currently training for the Portland Half Marathon in October. In April, he and his wife rode the Chico Wildflower Century Ride, their first century-length (100-mile) ride. They are gearing up for the 70-mile route in the Wheels for Meals Ride in Livermore this fall.

"Exercise was a really important part of my upbringing," he says. "Growing up near the upper peninsula of Michigan, I was always out skiing, sailing, hiking, biking, or just being outdoors. I have always made an effort to run and bike regularly, even if it was just a three-mile ride into work."

'Rick walks his talk'

Health educator Morgan Edwinson (8527) describes Rick as an inspiration. "He is generous with his time to champion onsite fitness activities and he makes it clear that fitness and health are priorities for himself and the site. There can be no one here who is busier or has a more demanding job, yet he takes the time to keep himself fit and engaged in life outside Sandia," she says. "It reaffirms for me that working hard and being successful do not need to be at the expense of your health and wellbeing. Rick walks his talk, and that goes a long way with me."

After that first marathon, Rick scaled back his fitness goals as a growing family and promotions at work made it more difficult to train. Exercise still remained a priority with his children. The family did plenty of hiking and backpacking over the years. He ran 5ks with his kids when they were young and increased that to 10ks as they grew up. He's run the last two Bay to Breakers (7.46 miles) with each of his daughters.

"Now, with the kids out of the nest, my wife and I have more time to be active and we are taking on bigger challenges," says Rick. He runs about three times a week after work and goes on long bike rides with his wife and other friends most weekends.

Travel, he admits, is the biggest challenge. "If I'm training for an event, I bring my running shoes and use the workout room," says Rick. "Otherwise, I walk as much as I can."

Back home at the California site, he walks the hill at lunchtime as often as possible. When Pat Smith (700) visits the site, she and Rick make it a point to walk together.

"It's amazing how much walking around the site helps," he says. "Exercise provides balance. If I can get out at noontime, my afternoons are much more productive."

LVOC makes its mark

Photos by Dino Vournas

(Continued from page 1)

ter a more informal, conversational environment. "This has really impacted meetings and briefings," Andy says. He cites a recent visit from Livermore's mayor and city manager and says the group was engaged from start to finish. "The openness of the CRCV helps us avoid 'death by viewgraph' syndrome," Andy jokes.

Another important moment in the early growth of the LVOC was the opening of the Cybersecurity Technologies Research Laboratory (CTRL).

THE EAST ENTRANCE to the California site brings members of the workforce and visitors directly to the LVOC.

"Up until CTRL, the open campus had largely been associated with our transportation and energy missions, probably due to the fact that the CRF was already here and has always been more 'open' than the rest of the site," Andy says. "So our transportation mission was always a natural fit for the open campus, but by itself doesn't speak to the breadth and depth of what we do at Sandia."

CTRL's location enhances the lab's cyber work in tangible ways, says Jim Costa (8950), senior manager of computational sciences and analysis at Sandia/California.

"We wanted to put CTRL in the LVOC for very specific reasons," Jim says. "Because we're at the open campus, we can run experiments and talk more freely about a wide range of cyber research activities. Better yet, we can do so with a variety of US and international collaborators but without some of the restrictions often associated with a national security laboratory."

Cool Earth CRADA

Following on the heels of CRCV and CTRL successes, the LVOC is poised to make a splash with other near-term technical and programmatic developments, the most visible being a new cooperative research and development agreement (CRADA) with a Livermore-based solar company called Cool Earth Solar. As part of the agreement, roughly five acres on the grounds of the LVOC will be set aside to pilot and test the inflated solar concentrators that are key to Cool Earth's innovative design.

Most of today's solar energy systems take the form of heavy metal boxes-with-lenses. Cool Earth's concentrators, on the other hand, are lightweight films inflated into tube shapes, a design approach aimed at reducing material requirements as well as deployment costs and time.

"The challenge with solar concentrator technology has been that optics crafted from glass and metal are heavy and expensive," says Andy. "Cool Earth has a pretty out-of-the-box idea and hopes to develop a system that can produce solar power cheaply." The company, he says, has already produced prototypes of the technology, but now it is ready to demonstrate that it's commercially viable. The CRADA with Sandia, which will take advantage of Sandia's New Mexico-based solar program, will include monitoring and benchmarking the technology for reliability and durability.

Coming developments

Other Sandia technical programs poised to make their mark on LVOC grounds are the Center for Infrastructure Research and Innovation (CIRI) and the Institute for Translational Biomedicine (ITB).

CIRI will be a part of the Research, Engineering, and Applications Center for Hydrogen (REACH), the umbrella for the lab's hydrogen program. In addition to CIRI, REACH is focused on international university and industrial partnerships to remove barriers facing the development and adoption of hydrogen technologies for energy applications.

A CIRI facility, though still in the conceptual stage, will one day feature a "bread-board" hydrogen refueling and research facility that allows for the development of new enabling, high-pressure technologies, such as compressors or storage tanks, and the investigation of advanced infrastructure architectures. The objective, says Sandia hydrogen program manager Daniel Dedrick (8367), is to perform critical R&D that will lead to improved performance and, ultimately, consumer acceptance of hydrogen as a fuel.

"Today's automakers all have hydrogen vehicles ready to go, but full-scale commercialization is stalled since little infrastructure is in place to fuel and maintain them," Daniel says. "A CIRI facility, we believe, would help smooth the road for vehicle manufacturers, industrial gas companies, and others with a stake in the success of hydrogen vehicles. It would help them to work out all of the relevant technical issues early and do so in a systems-oriented environment where things like reliability, safety, fueling performance, and other challenges could be addressed effectively."

Along with the solar concentrators that will soon be present as part of the Cool Earth Solar CRADA, the hydrogen refueling facility represents the early makings of a clean energy demonstration site on LVOC grounds, says Andy.

The Institute for Translational Biomedicine aims to expedite the process of translating the biomedical research at Sandia and Lawrence Livermore national labs into real-world pharmaceuticals and medical devices.

"Bringing new healthcare technologies to market is risky, time-consuming, and expensive," says Malin Young (8600), Sandia's acting director for biological and materials sciences. "The goal of ITB is to apply Sandia and Lawrence Livermore technologies, resources, facilities, and skills to accelerate the development, maturation, and transition of lead compounds and biomedical devices to the marketplace."

She and her LLNL counterparts plan on doing this, Malin says, through public-private partnerships that leverage resources from government, academic, and private entities. Medical technologies such as Sandia's SpinDx are prime examples of lab-developed devices that could have success in the commercial marketplace if and when ITB is up and running on LVOC grounds.

THE CYBERSECURITY TECHNOLOGIES Research Laboratory brought Sandia's cybersecurity mission into LVOC.

THE FIRST MAJOR DEVELOPMENT of the Sandia side of LVOC, the Combustion Research Computation and Visualization facility, has enhanced combustion research and fostered an informal, conversational environment.

'KICC' starting the future of LVOC

Perhaps the most ambitious plan for LVOC is the construction of a new building to be known as the Knowledge, Innovation, and Collaboration Center (KICC).

KICC would house various cyber and engineering research activities, a higher-education component, and significant administration functions. Most "open" activities at Sandia's California site — including human resources, public and community relations, badging, and other common functions — would take place within KICC. In addition, Andy says, automotive technology and welding programs spearheaded by local partner Las Positas College would be located in the 100,000-square-foot building.

The building is in the midst of conceptual planning and will need to go through a DOE approval process before construction can begin. Third-party financing options are being explored, says Andy, to pay for the facility.

"Just 20 months ago, we didn't even have an open campus," Andy points out. "So its very existence is still pretty new, and we are still learning what we can do with it and how to leverage it. Overall, the LVOC is coming along very nicely and adds a completely different element to Sandia/California and the broader laboratory."