California Scientists Demonstrate How to Use Advanced Fiber-Optic Backbone for Research

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UC San Diego music professor Peter Otto demonstrates a new technique for post-production editing of a film soundtrack by synchronizing audio parameters at remote locations.

(PhysOrg.com) -- How can super-fast networking among research institutions in California help scientists make new discoveries? Researchers, campus administrators and networking infrastructure officials converged on the University of California, San Diego in September to find out.

Taking advantage of the statewide, fiber-based California Research & Education Network (CalREN) and campus fiber-optic connections in and out of the California Institute for Telecommunications and Information Technology (Calit2) building on the UC San Diego campus,

the Corporation for Education Network Initiatives in California (CENIC) held a two-day workshop showcasing end-to-end advanced scientific applications enabled by CalREN's high-performance "experimental-developmental" (CalREN-XD) and "high performance & research" (CalREN-HPR) infrastructure.

"We brought together the community in order to educate researchers in a variety of disciplines about new cyberinfrastructure technologies to enable new ways of doing science," said Jim Dolgonas, president of the Corporation for Education Network Initiatives in California (CENIC). "We expect to continue doing these types of workshops, because they give domain scientists very concrete examples of how their colleagues are benefiting from access to California's considerable investment in a world-class networking infrastructure."

CalREN is owned, designed, and operated by CENIC, which was formed in 1997 by the state's educational community in order to ensure that their institutions would benefit from the explosion in networking technology. The CalREN fiber-optic backbone stretches 2,700 miles throughout the state, supported by dark-fiber and lines leased from telecommunications carriers which penetrate into every county in California. CalREN connects all of the state's public K-20 research and education institutions as well as a significant number of private and independent institutions to one another and to the world - at astonishing speeds.

Nearly 100 people attended the invitation-only workshop Sept. 15-16 at Calit2 in San Diego, and institutions from throughout the state staged 13 demonstrations, eight of which required multi-Gigabit bandwidth. Attendees were wowed by demonstrations in research areas as diverse as space science, high-quality cinema, cloud and grid computing, geospatial data, telepresence, and data visualization.

Attendees include California researchers who are not yet using CalREN-

XD, as well as chief information officers (CIOs) on California campuses. "We made special efforts to invite scientists who can immediately benefit from learning about and applying advanced infrastructure to their science, as well as CIOs to hear from others involved in modifications or overlays to existing campus infrastructure, on what they need to put in place to connect research labs to CalREN-XD at the campus edge," said Caltech's John Dundas, Chair of the CENIC XD/HPR Committee. "In addition to providing cyberinfrastructure in support of distributed research, there was substantial discussion about the need for CENIC to undertake ongoing programs that support research communities."

Case in point: Andrea Silvestri, a postdoctoral researcher at UC Irvine.

"I work in particle physics and I deal with hundreds of terabytes of data, and for now I have been physically transferring data from one lab to another," said Silvestri. "My ideal goal would be to transfer a comparable amount of data via the network instead, specifically by improving the transfer rate performance of the network between UC Irvine and the San Diego Supercomputer Center. I got to see how some other researchers are making use of CalREN between Irvine and San Diego, so I think the workshop was very useful and productive."

Silvestri added that his immediate challenge is to improve the actual speed of transferring data. "We tested the network between Irvine and San Diego and confirmed 1Gbps capacity over the entire distance, but in practice, I am still getting a transfer rate of roughly 40Mbps using various different protocols," noted the physicist. "Now we are looking at a dedicated network between my lab and the SDSC cluster, which could improve performance by a factor of ten."

HIPerVerse

One of the demonstrations involved real-time applications running on dual 1Gbps lightpaths between Calit2's divisions at UC San Diego and UC Irvine. Falko Kuester, a former professor at Irvine who is now Calit2's Professor of Visualization and Virtual Reality at UC San Diego, demonstrated the prototype for a system he calls the "HIPerVerse". The technology allows two of the world's highest-resolution, distributed visualization systems - the HIPerSpace display in San Diego and the HIPerWall in Irvine - to be interconnected into ultra-resolution environments at the pixel level.

"The common practice is to 'join' walls via a couple of video streams, sharing pre-rendered scientific data, animation or live video feeds in support of telepresence, but none of these approaches has ever surpassed the equivalent of 16 million pixels worth of shared data," said Kuester, who is also a professor of structural engineering in UCSD's Jacobs School of Engineering. "Those in the audience familiar with scalable, high-resolution display environments were blown away by our HIPerVerse approach, which can scale to global proportions. Assuming the right network topology in place, we now can reach out and connect to all OptIPortals and derivatives running our CGLX software system within the OptIPlanet Collaboratory."

"This opens up fascinating possibilities," Kuester added.

Calit2 Director Larry Smarr called the HIPerVerse demonstration a "breakthrough which momentarily created the world's largest virtual OptIPortal." Observed Smarr, principal investigator on the OptIPuter project: "The mega-displays in both Calit2 buildings were temporarily united into a 124-tile HIPerVerse, exceeding half a billion pixels. This extension of CGLX, developed by Kai-Uwe Doerr and Falko Kuester, sets the stage for linking together a number of the 33 sites around the world that are currently using CGLX."

Alternate Endings

A high-definition, interactive mystery film, "Alternate Endings," caught the imagination of workshop attendees. The film -- by University of Southern California graduate student Greg Townsend - was presented by Richard Weinberg, professor at the USC School of Cinematic Arts. Encompassing 16 storylines and 5 different endings, the film presented several opportunities for workshop attendees to choose the action at critical junctures in the plot. The presentation marked the first time that an interactive film had been streamed to a remote location from the Robert Zemeckis Center for Digital Arts in Los Angeles (in this case, to Calit2 over CalREN).

CineGrid Testbed for Advanced Networked Digital Audio Post Production

Calit2's Director of Sonic Arts R&D, Peter Otto, staged a demonstration of multichannel streaming for cinematic sound post-production, and he used a technique that had never been used before. "Previous experiments involved transport control of a distant audio workstation, which means we were able to start, stop, rewind and locate arbitrary points of a sound track and play them back at will," said Otto, who is also a professor of music at UC San Diego. "But that approach is bandwidth intensive. So our next step was to use the network to send device-control streams to the distant workstation and receive status updates at the lowest latency possible to achieve seemingly instantaneous control of any audio parameter at the source. Synchronization information passed between sites allowed us to synch video in our audition space."

"The net result," he added, pun intended, "was a much higher degree of immediacy and control of a distant audio workstation, with integrated and recallable mixing data." According to Otto, sound-editing experts in

attendance felt that the system was "fast, accurate and detailed enough to be used for high-level, final editing decisions in professional film production."

Researchers involved in the real-time demos appreciated the opportunity to push the envelope. "The workshop provided the inspiration to experiment with radically different approaches," concluded Calit2's Falko Kuester. "The bar was set very high with all of the exciting research projects that leveraged CalREN capabilities."

Links: vis.ucsd.edu/projects/hiperspace
www.cenic.org/workshop/demos/demo8.html
vis.ucsd.edu/~cglx/
www.cenic.org/workshop/demos/demo9.html
www.cenic.org/workshop/demos/demo7.html

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