For Immediate Release

Calient Networks Chosen as a Core Platform for OptIPuter
Global Research Network to Deploy DiamondWave (TM) All-Optical Switches

San Jose and San Diego, Calif. and Chicago, Ill., February 10, 2003 — Calient Networks, a leading global provider of intelligent all-optical switching systems and software, will team with the California Institute for Telecommunications and Information Technology [Cal-(IT)2] and the University of Illinois at Chicago (UIC) on development of the "OptIPuter," a powerful distributed cyber-infrastructure project designed to support data-intensive scientific research and collaboration. UIC has awarded a major purchase of all-optical switches to Calient Networks, which will install them at facilities in the United States and the Netherlands.

The OptIPuter program is funded by the National Science Foundation. OptIPuter is so named for its use of **opt**ical networking, **I**nternet **P**rotocol, as well as comp**uter** storage, processing and visualization technologies. It is a "virtual machine" that sits atop a LambdaGrid, an experimental network of optical fiber, where each fiber carries data on multiple wavelengths of light (lambdas) to connect distributed computing resources at speeds equivalent to internal PC bus speeds. Each lambda can transmit data at 1 to 10 Gigabits per second (Gbps), and soon will achieve 40 Gbps and greater speeds.

"We will be intensely exploring applications of lambda-switching, given the growth and functionality we anticipate over the next few years as part of the OptIPuter initiative," said Cal-(IT)2 Director Larry Smarr, principal investigator on the OptIPuter project and the Harry E. Gruber Professor in Computer Science and Engineering at the University of California, San Diego (UCSD) Jacobs School of Engineering. "Calient's DiamondWave platform will enable our OptIPuter vision of a highly flexible, cost-effective and future-proof all-optical core network."

Calient switches installed at the StarLight site in Chicago and the NetherLight site in Amsterdam will make those facilities the most advanced 1 Gbps and 10 Gbps switch/router exchanges in the world. "Research and government networks are always the first to deploy the next generation of communications products and lead the way to wide scale commercial deployment," said Charles Corbalis, president and CEO of Calient. "OptIPuter's terabit switching demands make it an ideal application to leverage the reliability, transparency and scalability of our all-optical DiamondWave product. We look forward to supporting the continued growth and success of the Optical Networking Grid program."

DiamondWave is an advanced, field proven all-optical switch for telecom, research and government networks. It is the only photonic switch that scales to 256x256 ports in non-blocking fashion and supports advanced lambda control strategies. It will be used to prototype multi-Gigabit LambdaGrids with a 128x128 platform at StarLight, and a 64x64 platform at NetherLight. Both sites interconnect numerous 1Gbps and 10Gbps national and international backbone trunks, and the number of available computational and connection resources is growing.

The benefit and simplicity of an all-optical switch in this high growth, dynamic environment lies in its ability to rapidly reconfigure 1 Gbps and 10 Gbps experiments. The StarLight and NetherLight sites are working with multiple 1 Gbps dedicated Layer 2 circuits that act like lambdas. Said Cees de Laat, associate professor in the Faculty of Science at the University of Amsterdam: "An all-optical switch is one-tenth the cost of an electronic switch, which is one-tenth the cost of a router. We noticed that the most data intensive applications usually only involve a very limited number of end points and, therefore, can bypass expensive router infrastructure. So, not only is speed an issue, but cost as well."

Calient will also enable UIC's evaluation of the newly standardized signaling protocol suite, Generalized Multiprotocol Lambda Switching (GMPLS), and its applicability to OptIPuter's network provisioning, reservation and control systems.

“Throughout our prospective vendor evaluations, we were highly impressed by DiamondWave’s innovative MEMS-based switching design, very high interconnection speed and optical transparency,” said Tom DeFanti, Distinguished Professor of Computer Science and Director of the Electronic Visualization Laboratory at UIC. “These capabilities allow the system to rapidly switch any bit rate or protocol that exists today, or is anticipated. This is of particular importance as we prototype the OptIPuter over the 10 Gbps link to Amsterdam, with new networking protocols. We intend to build a global scale experimental network that provides the equivalent of ‘heavy freight hauling’, in parallel to the Internet’s zillions of ‘taxicabs’ of data. Optical switching is the core technology of this experiment.”

According to John Bowers, chief technology officer at Calient, “The maturity and superior design of DiamondWave’s 3D MEMS switching system provide significant advantages for programs like OptIPuter. First, it’s truly transparent to bit rates and protocols. Together with the industry’s shortest path length through the switch, this means there’s minimal signal power loss and virtually no signal quality degradation or latency. Second, DiamondWave’s unique switching density and ability to scale to 256x256 in non-blocking fashion enable over 65,000 connection possibilities, effectively delivering wavelengths on demand. Third, we achieve very high yields in our manufacturing processes, making the system very reliable and affordable to customers.”

Calient Networks’ DiamondWave provides connections where the data path is purely photonic, with no electrical components or conversions. It is based on a highly reliable single-crystal silicon 3D MEMS (Micro-ElectroMechanical Switch) design. The system’s protocol independence means that the switch does not need to be replaced as protocols change. DiamondWave works at existing (2.5 Gbps to 10 Gbps) as well as at future bit rates (10 Gbps to 40+ Gbps), making it ideal for OptIPuter’s phased network capacity upgrades. The system is equipped with Calient’s industry leading GMPLS networking software and is thus able to dynamically and rapidly provision, switch and protect trunk interconnections. It has successfully completed interoperability with a wide variety of peer networking elements.

About Calient Networks

Calient Networks is a leading provider of intelligent all-optical switching systems and GMPLS networking software that help service providers reduce the cost of scaling their optical network infrastructure. Calient’s DiamondWave(TM) switching system and GMPLS-powered networking innovations provide a seamless migration path that is non-disruptive to legacy operations, highly cost-effective, and an enabler to revenue-generating optical services. Calient is shipping its DiamondWave systems in configurations ranging from 32x32 to 256x256 to carrier networks worldwide. The company is headquartered in San Jose, California. Additional engineering and manufacturing operations are located in Santa Barbara, California, while MEMS design and fabrication operations are located in Ithaca, New York. For additional information about Calient, see: <http://www.calient.net>. Calient Networks, the Calient Networks logo, and DiamondWave are trademarks of Calient Networks, Inc.

About Cal-(IT)2

The California Institute for Telecommunications and Information Technology is one of four institutes funded through the California Institutes for Science and Innovation initiative. Created in late 2000 by the State of California, the institutes aim to ensure that the state maintain its leadership in cutting-edge technologies. Cal-(IT)2 is a collaboration between the UCSD and UC Irvine. Its mission: to extend the reach of the current information infrastructure throughout the physical world, enabling anywhere/anytime access to the Internet. More than 220 faculty members from the two campuses are collaborating on interdisciplinary projects, with the participation of more than 55 industry partners. For more information about Cal-(IT)2, see: <http://www.calit2.net> or send e-mail to info@calit2.net.

About the OptIPuter

The OptIPuter is a five-year, $13.5 million project funded by the National Science Foundation. It will enable scientists who are generating massive amounts of data to interactively visualize, analyze, and correlate their data from multiple storage sites connected to optical networks. UCSD and UIC lead the research team, in partnership with researchers at Northwestern University, San Diego State University, the Information Sciences Institute at the University of Southern California, and UC Irvine, with industrial partners IBM, Telcordia Technologies, Inc. and Chiaro Networks. Co-PIs on the project are UIC's Thomas A. DeFanti, Jason Leigh, and Project Manager Maxine Brown, and UCSD's Mark Ellisman and Phil Papadopoulos.
For more information, see: <http://www.calit2.net/news/2002/9-25-optiputer.html>.

About StarLight

StarLight(SM), the optical STAR TAP(SM) initiative, is an advanced optical infrastructure and proving ground for network services optimized for high-performance applications. Operational since summer 2001, StarLight is a 1-GigE and 10-GigE switch/router facility for high-performance access to participating networks that will ultimately become a true optical switching facility for wavelengths. StarLight is being developed by the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago (UIC), the International Center for Advanced Internet Research (iCAIR) at Northwestern University, and the Mathematics and Computer Science Division at Argonne National Laboratory, in partnership with Canada's CANARIE and Holland's SURFnet. STAR TAP and StarLight are made possible by major funding from the U.S. National Science Foundation to the University of Illinois at Chicago. STAR TAP and StarLight are service marks of the Board of Trustees of the University of Illinois. For more information, see: <http://www.startap.net/starlight>.

About NetherLight

NetherLight, located at SARA on the campus of the Amsterdam Science & Technology Centre, is an advanced optical infrastructure and proving ground for network services optimized for high-performance applications. Operational since summer 2001, NetherLight is a multiple Gigabit Ethernet (GigE) switching facility for high-performance access to participating networks and will ultimately become a pure lambda switching facility for wavelength circuits, as optical technologies and their control planes mature. NetherLight's international connectivity includes dedicated lambdas to the StarLight facility in Chicago and to CERN in Switzerland. Researchers use the NetherLight facility to investigate novel concepts of optical bandwidth provisioning and to gain experience with these techniques. In particular, researchers are investigating different scenarios on how lambdas can be used to provide tailored network performance for demanding grid applications. Important issues are: how to get traffic onto and out of lambdas; how to map load on the network to a map of lambdas; how to deal with lambdas at peering points; how to deal with provisioning when more administrative domains are involved; and, how to do fine-grain, near-real-time grid application-level lambda provisioning. NetherLight has been realized by SURFnet, the Dutch Research Network organization, within the context of GigaPort, the Dutch Next Generation Internet project. For more information, see: <http://www.surfnet.nl/en/> (SURFnet) and <http://www.gigaport.nl/> (GigaPort); for optical research information, see: <http://www.science.uva.nl/~delaat/optical>.

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Optical Networking, LambdaGrids and the OptIPuter

In the earth and biomedical sciences, individual data objects such as a 3D terrain dataset or brain image are very large, compared to what can be interactively manipulated or visualized over today's networks. Yet scientists want to interactively explore massive amounts of previously uncorrelated data for instance, to make earthquake predictions, or to understand the structure of the human brain to advance scientific understanding and ultimately enable practitioners to make timely and important crisis-management or health-care decisions.

Some of today's academic research and education production networks achieve rates of 10 Gigabits per second, but applications using that much bandwidth over the Internet would be shut down as Denial-of-Service (DoS) attacks. The speed of the network alone doesn't determine how fast data moves. Getting data in and out of computers, and electronically managing data flow along different fiber paths from source to destination, all affect speed. Today's personal computers have 1 Gigabit per second (Gbps) Network Interface Cards (NICs), which current high-end electronic switches and routers can handle. However, PC vendors now have prototype 10Gbps NICs and the promise of much faster CPU processors. Together with new network protocols PCs and collaborative computing applications can blast out more data than before.

To handle high-performance scientific applications, experimental networks are being built that are different from production data networks, taking advantage of two major technology trends:

- Advancements in Grid middleware (a grid is a set of networked computing resources); and
- Availability of tens-of-gigabits of networking bandwidth, enabled by the ability to encode data on individual wavelengths of light (or "lambdas") on single optical fibers.

Each lambda is currently capable of transmitting 1-10 Gigabits per second (Gbps), and soon will achieve speeds of 40Gbps and greater. The resulting networks, dubbed "LambdaGrids," eliminate bandwidth as a barrier to computing, analyzing and exploring very large datasets (hundreds of Gigabytes today, Terabytes soon, and approaching Petabytes by the end of this decade).

A 10Gbps transoceanic experimental network is currently operational between the StarLight facility in Chicago, and the NetherLight facility in Amsterdam. A major obstacle to scaling up to handle scores of 10Gbps flows has been the cost of upgrading routers and electronic switches. Line cards to handle 10Gbps are currently very expensive. Scientists at UIC and UvA believe that all-optical switches can be a relatively cost-effective solution for moving massive amounts of data to keep pace with order-of-magnitude increase in bandwidth requirements. The advantage of all-optical switches lies in their ability to handle this increased data throughput without an increase in cost or complexity. Calient's DiamondWave switch can handle 10 Gbit/s per wavelength today, and does not need an upgrade to switch the 40 Gbits signals of the future.

By deploying Calient Networks' DiamondWave switches at the Starlight and Netherlight facilities, researchers at both locations will actively engage in experiments as part of the OptIPuter project. The OptIPuter itself is a "virtual machine" that sits on top of the LambdaGrid. Depending on an application's requirements, the OptIPuter schedules and configures the computational resources needed for the period of time needed. The resources (whether a cluster, data store, large-scale instrument or visualization display) and the lambdas that connect them are focused on expedient solutions to hard problems. OptIPuter scientists at UIC and the University of California, San Diego (UCSD) have also launched a major effort to develop new network protocols required to support this new vision of optical networking.

Links

- California Institute for Telecommunications and Information Technology, http://www.calit2.net

- University of California, San Diego (UCSD), http://ucsd.edu
  National Center for Microscopy and Imaging Research, http://ncmir.ucsd.edu
  San Diego Supercomputer Center (SDSC), http://www.sdsc.edu
  Scripps Institution of Oceanography (SIO), http://scripps.ucsd.edu
  Jacobs School of Engineering, http://www.jacobsschool.ucsd.edu/
  UCSD Sixth College, http://sixth.ucsd.edu
  Preuss School, http://preuss.ucsd.edu

- University of Illinois at Chicago, http://www.uic.edu
  Electronic Visualization Laboratory, http://www.evl.uic.edu
  Laboratory for Advanced Computing, http://www.lac.uic.edu
  I-WIRE, http://www.iwire.org

- Northwestern University, http://www.northwestern.edu
  International Center for Advanced Internet Research, http://www.icair.org
  Department of Electrical and Computer Engineering, http://www.ece.northwestern.edu

- San Diego State University (SDSU), http://www.sdsu.edu

- University of Southern California, http://www.usc.edu
  Information Sciences Institute, http://www.isi.edu

- University of California-Irvine, http://www.uci.edu
  School of Information and Computer Science, http://www.ics.uci.edu
  Department of Electrical Engineering and Computer Science, http://www.ece.uci.edu

- IBM Corp., http://www.ibm.com

- Telcordia Technologies, Inc., http://www.telcordia.com

- Chiaro Networks, http://www.chiaro.com/

- University of Amsterdam, Faculty of Science, http://www.science.uva.nl/research/air/