

# **New Global Grid Computing and Communications Technology Demonstrated by Researchers in U.S. and Japan**

## *Demonstration Foreshadows Integration of Computing and Networking in the Next-Generation Internet*

**RESEARCHTRIANGLE PARK, N.C. (Sept. 11, 2006)** -- Researchers in the United States and Japan today demonstrated “automated” interoperability between network and computing resources in two national grid computing research testbeds – the first such demonstration of this scale between two countries of new, integrated computing and communication technology that can be used to exponentially enhance next-generation Internet performance.

The researchers believe that the future of information technology will include these types of capabilities - the direct integration of computing and the Internet across the globe.

The interoperability between the G-lambda project in Japan and the Enlightened Computing project in the United States was demonstrated at the Global Lambda Integrated Facility (GLIF) annual Global Lambda Grid Workshop in Tokyo, Japan.

For the first time, a software application in a research testbed in one country was able to reserve, manage and monitor computing and network resources across both countries— a key milestone toward the development of a Global Grid of networked, interoperable resources, which some believe will lead to the next generation of computing and the Internet.

Typically, the use of the high-performance computing resources and optical network resources have to be arranged and manually configured well in advance – a process that often requires weeks or more, and connections established for months or years.

Researchers working with the G-lambda group in Japan and the Enlightened Computing group in the United States demonstrated how software applications can establish network connections “on demand” to computing resources, databases of information and scientific instruments. The duration of these connections is based on the particular application’s requirement – for precisely the amount of time that is needed, and no more. Whether seconds or days, the network and resources are connected and managed to perform a task. Then, the connection is released in order to share resources for other purposes.

The Enlightened team’s middleware relies on a novel algorithms based on HARC, the Highly-Available Robust Co-allocator designed and implemented by Louisiana State University. HARC provides a means for reliably coordinating both compute and network resources.

A key goal for the Japanese consortium was to demonstrate and familiarize the community with the GNS-WSI(Grid Network Services-Web Services Interface), a Web services interface between a grid resource management system and network resource management system for the purpose of standardization.

“This has been a wonderful collaboration to demonstrate the interoperability of resource management middleware,” said Tomohiro Kudoh of Japan’s National Institute of Advanced Industrial Science and Technology. “In addition, we together obtained a lot of

knowledge about the middleware integration in terms of the architecture as well as the implementation. This collaboration will become a model of future service infrastructure provided by multiple organizations in multiple network domains.”

The goal in developing next-generation optical networks is to extend the control of the network and resources to software applications – through what is called the “optical control plane.” The optical control plane controls the establishment, maintenance and release of connections in an optical network as well as algorithms for engineering an optimal path between resources.

The demonstration also featured a Generalized Multiprotocol Label Switching (GMPLS) control plane including an External Network-to-Network Interface (E-NNI) available on Calient switches as a result of the collaboration between Calient Networks and KDDIR&D. This is the first time the GMPLS E-NNI was demonstrated across two countries to provide on-demand end-to-end lightpaths. The researchers plan on integrating the E-NNI capability into the middleware as well, in the near future. Today’s demonstration of the E-NNI capability used the Calient Graphical User Interface (GUI) to create the end-to-end E-NNI path.

“Enhanced E-NNI capability addresses optical network scalability and interoperability the same way SS7 did for the telephone network” explains Olivier Jerphagnon from Calient Networks. “We are glad to have supplied optical equipment to demonstrate this capability on a global scale with our customers.”

The G-lambda and Enlightened Computing demonstration showed how grid technology dovetails with high-capacity optical networks. “The ability for end-users or applications to reserve and manage the network and compute resources in a coordinated manner is required to fully realize the potential of global grids” said Gigi Karmous-Edwards, principal scientist at MCNC, principal investigator for the Enlightened Computing project and chair of the GLIF Control Plane Working Group. “This demonstration shows evidence of new opportunities unfolding through the interoperability of global Grid resources.”

### **Computing Resources**

The demonstration included computing resources in the United States at the N.C. State University Virtual Computing Lab and MCNC in North Carolina, the Center for Computation & Technology at Louisiana State University, the California Institute of Technology (Caltech), and Starlight facility in Chicago.

The computing resources involved in the demonstration from N.C.State University are part of the Virtual Computing Lab, developed by the College of Engineering and the Information Technology Division.

“Grid technology enables resources to be shared throughout the university environment through the Virtual Computing Lab, and we are working to extend the sharing of resources across North Carolina,” said Mladen Vouk, department head and professor of Computer Science, and associate vice-provost for Information Technology at N.C. State University. “We are proud to participate in the G-lambda and Enlightened Computing demonstration that showcased how advanced networking technology can enable sharing resources no matter where they are located.”

### **Network Infrastructure Support**

In the United States, the demonstration was supported by the National LambdaRail (NLR), a national research network infrastructure, and an international hub of research network in Chicago called StarLight. The StarLight global optical network hub at Northwestern University in Chicago is an international optical network connection point, developed and operated in partnership by Northwestern, the University of Illinois at Chicago, and Argonne National Laboratory.

The networking resources have been made available by Cisco Systems through allocation grants to the Enlightened Computing Project, to the Louisiana Optical Networking Initiative(LONI) and to CalTech, on Cisco's share of the National Lambda Rail infrastructure.

The grant to the Enlightened Computing research project is for use of a 10 gigabit-per-second network connection from Raleigh connecting through to Washington, Pittsburgh and terminating in Chicago. The grant to LONI is for use of a 10 gigabit-per-second network connection from Baton Rouge connecting through to Houston, Dallas, Kansas City, and terminating in Chicago. The grant to CalTech is part of the shared Layer 2 services utilizing NLR's layer 2 (FrameNet) services from Los Angeles to Chicago, with 10G ports on the 6500 routers located in Los Angeles and Chicago.

### **Next-Generation Internet**

While NLR and other research networks are not a part of the commercial Internet, the technology being developed by researchers today may evolve into the commercial services available to businesses and the general public in the future.

"NLR was developed to support research innovation and provide network gateways for researchers to use to collaborate with each other across the globe," said Tom West, CEO of NLR.

"The Internet that people are familiar with today is being transformed by these new advanced technologies. The G-Lambda and Enlightened demonstration is a major advance toward creating a new global information technology environment that closely integrates computing and light-speed communications. These new capabilities are already allowing researchers to create a completely new generation of services and applications," said Joe Mambretti, director of Northwestern University's International Center for Advanced Internet research and Co-Director of StarLight.

IBM helping initiate the Virtual Computing Lab at N.C. State through a 2004 research grant is a prime example of industry and university collaboration leading to new services. IBM Blade Center servers are part of the Virtual Computing Lab.

"IBM's involvement in the Enlightened Computing project and the Virtual Computing Lab helps us understand the interaction among computing resources and the network in a Global Grid environment for the enablement of advanced services," said Steve Hunter, IBM Distinguished Engineer, CTO, IBM Blade Center.

With capabilities demonstrated today, we are enhancing opportunities for collaboration and sharing resources on global scale," said John Crites, CEO of MCNC. "The accomplishment is an important step in unleashing the collective power of grid computing and fostering collaboration on a global basis. MCNC shares this success with

N.C. State University and all our partners in the N.C. Research and Education Network. It has been a collective effort from the beginning.”

A similar grid testbed interoperability demonstration is planned in November at Supercomputing 2006, an international conference on high performance computing and networking in Tampa, Fla. In addition, future collaborative demonstrations are planned that will add European Grid testbeds.

#### **About Enlightened Computing**

Enlightened Computing project is a collaboration that includes National Lambda Rail, N.C. State University, the Renaissance Computing Institute at UNC Chapel Hill, MCNC, Louisiana State University, the Southeastern Universities Research Association, and the Naval Research Lab. Private company research organizations include Cisco, IBM, AT&T Research and Calient Networks.

#### **About G-lambda**

The G-lambda project in Japan is a collaboration that includes National Institute of Advanced Industrial Science and Technology (AIST), KDDI R&D Laboratories, NTT Network Innovation Laboratories, and the National Institute of Information and Communications Technologies (NICT).

#### **About GLIF**

Global Lambda Integrated Facility (GLIF) is an international organization dedicated to developing next generation optical networks. GLIF integrates optical networks to support data-intensive scientific research, bringing together some of the world’s premier researchers.

#### **About the Center for Computation & Technology (CCT)**

The CCT Editors Note: Additional Grid Computing Background

Multiple computing platforms and data sources on the grid operate, and appear to a user, as a single computing system. Resources on the grid include the network, computers, storage systems, scientific instruments and software applications. Grid technology provides users with unprecedented computing power, services and information no matter where the resources are located.