

## ESnet and Internet2 Complete Next-Generation Network

ESnet and Internet2 — two of the nation's leading research networks — announced in November that they have completed five interconnected rings, each consisting of one or more 10-gigabit-per-second (Gbps) paths, that form a coast-to-coast network that is the backbone of DOE's next-generation scientific network.

Called ESnet4, the new network built by this partnership is a highly reliable, high capacity nationwide network that will greatly enhance the capabilities of scientists at national laboratories and universities across the country. The long-term ESnet-Internet2 partnership, initially announced in August 2006, brings together

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## New Circuits Provisioning Service Featured at Conference

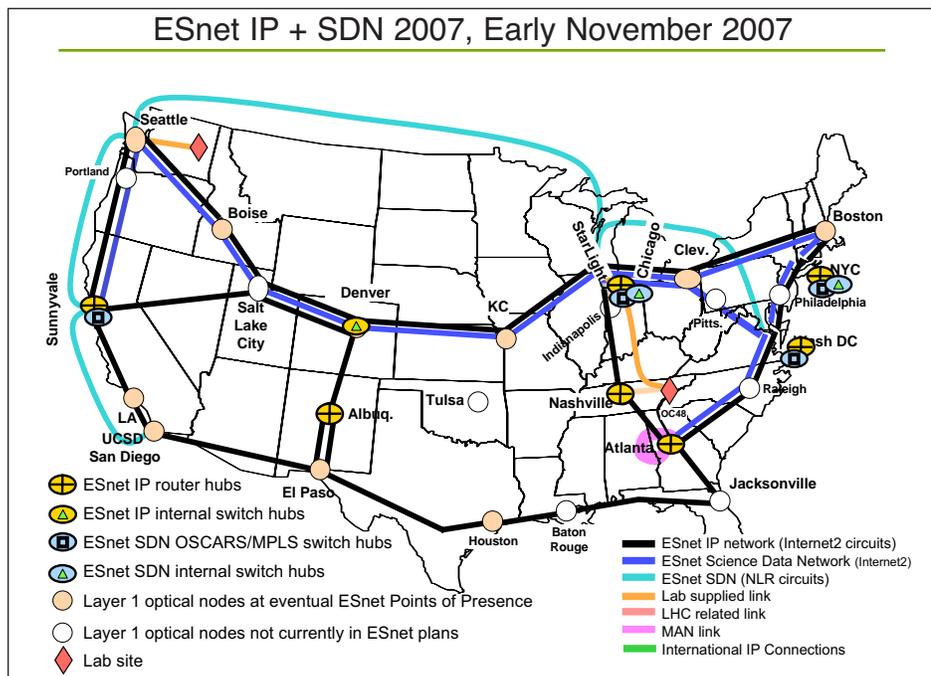
ESnet and its network partners from the United States and Europe treated SC07 attendees with demonstrations of the next-generation science network and services that provide a more responsive and faster transfer of scientific data across many domains.

The supercomputing conference demonstrations, splashed across large screens at the Internet2 booth, showed gigabytes of data moving among various national labs and universities in real time. The real time — and historical — network traffic data on screen offered a good look at a new service that enables scientists to request uncontested bandwidth for sending large amount of data across networks and countries.

The demonstration showcased ESnet's On-Demand Secure Circuits and Advance Reservation System (OSCARs) along with corresponding collaborative projects, which allow scientists to request bandwidth dedicated to moving a large amount of data — up to terabytes at a time — across several domains. Implemented on ESnet's Science Data Network and Internet2's Dynamic Circuit Network, the service will be key for carrying out experiments and enabling computational science that transfer a tremendous amount of data. For example, the Large Hadron Collider (LHC) at CERN near Geneva will begin producing petabytes of high-energy physics data and send them to national labs and other U.S. research centers starting in mid-2008.

"What makes this so interesting is it's done over production networks. It's not a canned set up," said Chin Guok, an ESnet engineer who is in charge of developing OSCARs. "We developed the software interface for anyone who wants to use it,

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## Web Site Offers Tips for Making Data Transfer Easy

ESnet has launched a new web site aimed at providing users tips and tools on ensuring a trouble-free transfer of large amounts of data over scientific networks.

The site, at [Fasterdata.es.net](http://Fasterdata.es.net), is a handy, step-by-step guide on how to configure computers to optimize file transfer speed, select the proper software and monitor the data movement. Brian Tierney of ESnet developed the site in response to feedback from researchers

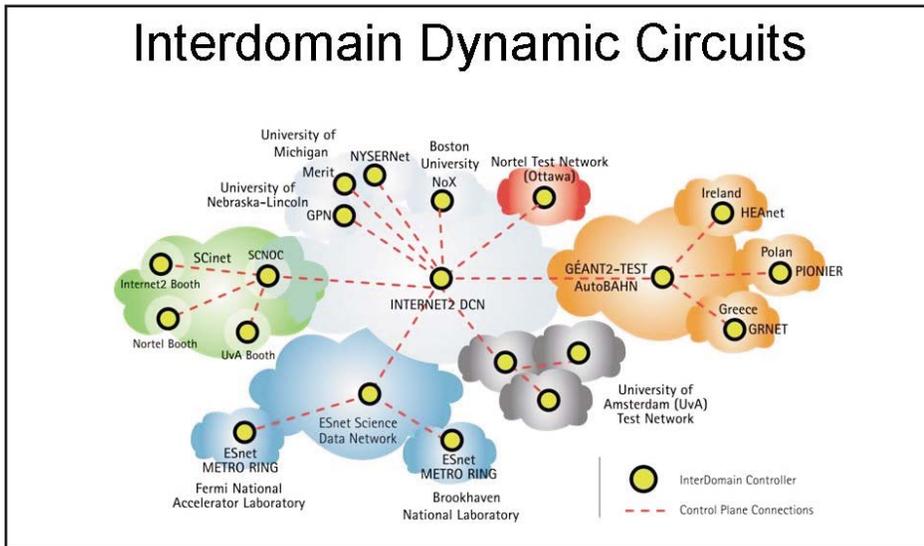
looking for instructions on setting up their systems before sending the data that often travel across domains and networks managed by different operators before reaching their destinations.

"After talking to several researchers, we learned that most scientists have no idea how fast data transfers across ESnet can be," Tierney said. "But it's important to use the right tools and to do some tun-

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## Circuits Provisioning Service continued from page 1

## ESnet4 continued from page 1



Source: Internet2

ESnet and its science network partners demonstrated the dynamic circuits provisioning service for transferring large amounts of data between different locations in North America and Europe.

so that they can communicate with ESnet.”

The software protocol has been adopted by many regional and national networks to ensure that they can communicate with each other in making bandwidth requests and setting aside circuits. These partner networks and research centers worked intensely to implement the protocol and test how well their software interacts in order to demonstrate the service at SC07 in Reno.

The research institutions that adopted the protocol in their software include DOE’s Fermi National Accelerator Laboratory and Brookhaven National Laboratory, both of which will receive LHC data from CERN and distribute them to other research institutions in the country. The demonstrations at SC involved transferring data between multiple starting points and destinations. They included data movement between Fermi Laboratory and the University of Nebraska at Lincoln; Brookhaven Laboratory and Boston University; Brookhaven Laboratory and the University of Michigan; and HEAnet in Ireland and the Internet2 booth at the conference.

The partner networks that jointly developed and incorporated the proto-

col include the pan-European research and education network, GEANT2; HEAnet in Ireland; GRNET in Greece; the PIONIER network in Poland; a European Union project on testing optical networking called Phosphorous at the University of Amsterdam; and Internet2. Internet2, a consortium of U.S. education and research institutions, is a key partner for ESnet in building ESnet4, a long-term project currently underway to set up a national network capable of transferring hundreds of gigabits per second in the next five years.

Currently, ESnet has just placed into production a national IP ring of 10-Gbps circuits and is working on completing the Science Data Network, another coast-to-coast network that will scale to multiple 10-Gbps rings in the next few years.

The circuit setup software interoperability extends beyond networks serving universities and government-funded research centers. Telecom giant Nortel, which participated in the dynamic circuits demonstration, is the first vendor to implement the protocol in its software.

ESnet began developing OSCARS in 2005, after DOE’s Office of Science held a workshop that identified a critical need for a more efficient service to ensure the

er two advanced networks which have a combined 30 years of experience in providing service to thousands of researchers around the world. The network is managed by ESnet and operated across Internet2’s backbone infrastructure.

The next steps will be to add a sixth ring connecting the northern and southern sections of the national network, and to increase the capacity of all of the rings by adding 10 Gbps to the existing rings. Once complete, these connections will increase both bandwidth and network reliability for the tens of thousands of DOE-supported researchers at national laboratories and universities around the country.

“The deployment of ESnet4 is remarkable both for its technical achievement and for the fact that it is proceeding ahead of schedule, bringing more robust and innovative services to the U.S. research community and their collaborators around the globe,” said Michael Strayer, director of DOE’s Office of Advanced Scientific Computing Research, which funds ESnet, managed by Lawrence Berkeley National Laboratory. “Our partnership with Internet2 underscores the value of the collaborative spirit we have fostered in the high performance computing community for years — you bring experts together, let them do their jobs and the nation’s researchers reap the rewards.”

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timely delivery of large and time-sensitive data. A couple dozen scientists from research centers and industry have been participating in the test deployment of the service to provide feedback. A full deployment is scheduled for later next year, Guok said.

Guok gave a talk about OSCARS at the Berkeley Lab booth during the conference. He also served at the Internet2 booth to explain the various technical demonstrations.

## Fasterdata Web Site

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ing of the end hosts. This new web site is part of an education campaign to make users aware of these tools and techniques."

Thanks to more powerful computers and sophisticated software, scientists are generating a growing amount of data to accelerate their research. ESnet, in collaboration with operators of other science networks around the world, has continuously upgraded its network with more bandwidth and new services.

In fact, ESnet has just deployed a national ring of 10 Gbps circuits for their IP and Science Data networks, part of a long-term project called ESnet4 that will boost ESnet's backbone capability to more than 200 Gbps in five years.

ESnet also hosts workshops for researchers from science programs within the DOE Office of Science in order to get feedback about the scientists' networking needs. It held two such workshops for researchers in the Basic Energy Sciences and Biological and Environmental Research program offices this summer.

In the workshops, participants talked about how they use the science network, problems they encounter and the resources they need. Results from the dis-

## ESnet4 *continued from page 2*

ESnet4 network utilizes dedicated 10-Gbps wavelengths on the new Internet2 nationwide optical infrastructure and will seamlessly scale by adding additional 10-Gbps circuits each year for the next four to five years in order to meet the needs of the DOE Office of Science. The Office of Science oversees more than 30 DOE laboratories, 100,000 DOE laboratory scientists, 18,000 researchers from universities, other government agencies and private industry who contribute to many large scale DOE research activities like the experiments at the Large Hadron Collider project at CERN, the Relativistic Heavy Ion Collider at Brookhaven National Lab, among many others.

In addition to providing production IP services, ESnet4 will enable new opti-

## ESnet Receives Kudos for Services, Collaboration

A DOE operational review gave ESnet kudos for developing and delivering new services and network infrastructures that meet the current and future needs of the scientific community.

The review, carried out by representatives from DOE, DOE labs and industry, assessed ESnet's efforts to resolve problems and anticipate the growing demand for more bandwidth.

The review committee's report commended ESnet for working closely with the program offices within the Office of Science to understand their networking requirements and addressing those needs. It noted the ongoing build-out of ESnet4, a joint project with Internet2 to create the next-generation national science network, as well as a new service that will provide guaranteed bandwidth for sending and receiving large amounts of data. The committee also lauded ESnet for sound fiscal management.

"ESnet and ASCR management should be commended for brokering a successful partnership with Internet2 that has provided significant benefits for the U.S. science community," the report said.

cussions will be part of the final reports submitted to DOE program managers and form the basis for planning network upgrades in the future.

The idea to develop a user-friendly web site came from the workshops. The web site outlines the common problems that can cripple efforts to move a large amount of data across the network. The site illustrates what steps scientists can

take to properly set up their computers, use the right software and accurately gauge the network's performance.

The web site also offers additional information on trouble-shooting tools and getting help from ESnet staff.

Tierney intends to add more materials to the site and welcomes feedback. Check out the new site at [Fasterdata.es.net](http://Fasterdata.es.net).

cal services like point-to-point dynamic circuit networking, which will serve as an advanced and dependable platform for scientists and researchers supported by ESnet. ESnet is working with Internet2 and other partners to develop and deploy interoperable dynamic circuit networking which extends the reach and value of this revolutionary technology.

"Internet2 and ESnet share a commitment to support next-generation network capabilities that will allow our scientific community to focus its resources on its core research and educational objectives," said Doug Van Houweling, Internet2 president and CEO. "With the first national phase of the ESnet4 deployment complete, the ESnet and Internet2 communities now have capabilities that

just a few years ago could only be imagined, enabling scientists and researchers across the country who utilize this robust network to achieve new breakthroughs in physics research.

The new ESnet4 network is provided by Internet2 using advanced optical equipment from Infinera, Inc., and through its agreement with Level 3 Communications. Internet2 and Level 3 have deployed a dedicated, high capacity backbone with dynamic optical circuit provisioning for the Internet2 community. Internet2 and ESnet will operate the underlying optical infrastructure to provide flexibility and control in the dynamic provisioning of optical circuits needed to support today's large-scale and highly complex scientific research.

## High-Speed Data Demo Showed Off New Network

ESnet and its research and industry technology partners demonstrated the next generation of high-speed networking by deploying a 40-Gbps network during SC07.

The demonstration enabled the transmission of data at speeds faster than the current industry standard for wide area network circuits of 10-Gbps from the Fermi National Accelerator Laboratory (Fermilab) near Chicago to the booth of the California Institute of Technology

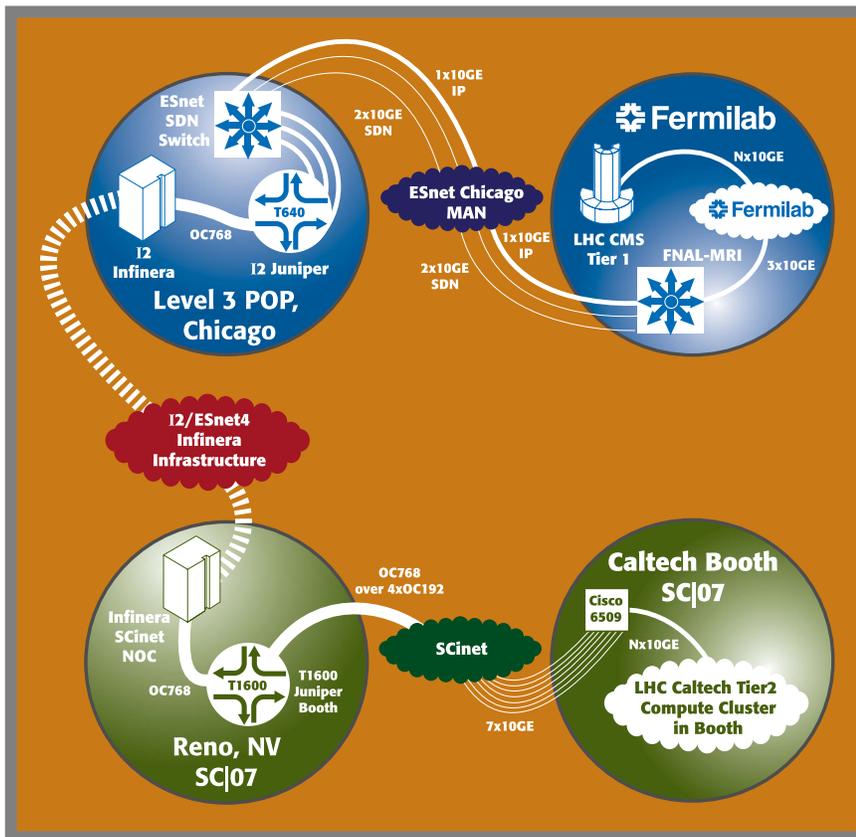
(Caltech) on the show floor of the SC07 conference in Reno, Nevada. Fermilab is a designated Tier 1 center for storing and distributing data from the Large Hadron Collider (LHC), the world's largest high-energy particle accelerator, to Tier 2 centers such as Caltech. LHC, located at CERN near Geneva, is scheduled to begin production next year.

ESnet and its partners, Internet2 and Level 3 Communications, built the 40-Gbps network using Internet2's national

fiber optic infrastructure. Juniper Networks and Infinera provided the hardware. ESnet is building a new network, called ESnet4, using the same optical infrastructure to provide reliable, scalable high-bandwidth national connectivity in support of the mission of the DOE Office of Science.

During the demonstration, the data traversed ESnet's Chicago Area Metropolitan Area Network (CHIMAN), built in partnership with IWIRE (Illinois Wired Infrastructure for Research and Education) to provide robust high capacity connectivity between ESnet4, DOE research institutions in the Chicago area such as Argonne National Laboratory and Fermilab, and Chicago area peering points such as Starlight.

## LHC CMS Infrastructure Demo



### About ESnet News

ESnet News is a quarterly that highlights the services and accomplishments by the staff of the Energy Sciences Network (ESnet), a high-speed communications network that serves more than 50,000 scientists and their collaborators at dozens of national labs and research centers funded by the U.S. Department of Energy. ESnet is headquartered at the Lawrence Berkeley National Laboratory. Learn about ESnet's services at <http://www.es.net>.

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