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Internet2 Visualization Lab

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NSCEE will open its Internet2 Visualization lab this summer. The lab will be a campus-wide resource in support of advanced high-performance networking activities and application development in all disciplines from the sciences and engineering through arts and humanities.

The Internet2 connection offers new and unexpected perspectives and opportunities for UNLV's academic and research community. Through Internet2, UNLV researchers will collaborate and conduct experiments not only with colleagues within the UCCSN, but also with other research centers throughout the world.

Think of Internet2 as a giant test bed, where more than 200 universities (of which UNLV is a proud member), government researchers and



NSCEE Internet2 Visualization Lab

high-tech companies participate in research, with their efforts coordinated by the University Corporation for

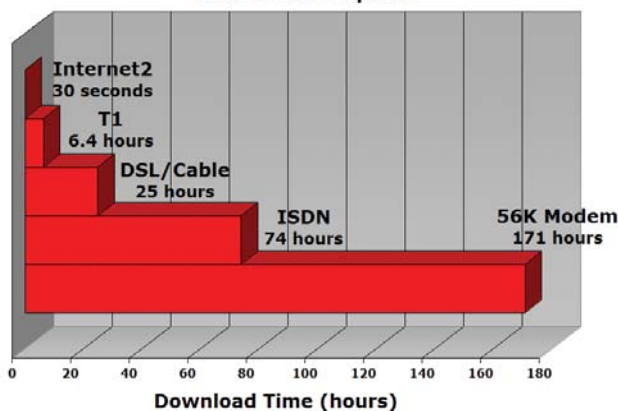
Advanced Internet Development (UCAID, www.ucaid.org) in Washington, D.C.

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How Fast is Internet2?

"9000 times faster than a typical home broadband connection!"

Figure 1: Comparison of Internet Data Transfer Speeds



The Race for "The Matrix"

Figure 1 is a comparison of four common Internet connection speeds and the advanced Internet2, each downloading the DVD version of the motion picture "The Matrix." Times are approximate.

The Internet2 Land Speed Record

The current "Internet2 Land Speed Record" (IPv4) was established in February, 2003 by an international team transferring 1.1 terabytes of data across 10,037 kilometers (more than 6,236 miles) of network (from Sunnyvale, CA to Geneva, Switzerland, by way of Chicago)

in just over one hour. The mark of 23,888.06 terabit-meters/second represents an average rate of more than 2.3 gigabits per second and is equivalent to transferring a DVD movie every 23 seconds at speeds more than 9000 times faster than a typical home broadband connection.

The Internet2 Landspeed Record (I2-LSR) competition for the highest bandwidth, end-to-end networks is an open and ongoing contest. Only entries that exceed the current mark by at least 10% are recognized as new record-setters.

For additional information on the Internet2 Land Speed Record, visit <http://lsr.internet2.edu>.

Internet2 Links and Glossary

To clarify the often-cryptic acronyms and specialized terms associated with high performance **networks and organizations**, here's a brief glossary with some links to their web resources.

- **Internet2 (I2)** - <http://www.internet2.edu>: A high-speed academic and research consortium connecting over 200 leading higher education institutions, 70 private sector companies and US government research laboratories directly or via a Gigapop. Gigapops and directly connected I2 schools interconnect with each other via Abilene or vBNS.
- **Abilene** - <http://abilene.internet2.edu>: The most advanced native IP backbone network available to universities participating in Internet2, operated by Qwest in conjunction with Cisco, Juniper and Nortel for UCAID. The network is undergoing an upgrade from 2.5 Gigabits/sec to 10 Gigabits/sec expected to be completed by the end of 2003.
- **NSF/ANIR** - <http://www.cise.nsf.gov/div>: The National Science Foundation's Division of Advanced Networking Infrastructure and Research approves institutions for connections to the vBNS and related federally authorized high-performance academic and research networks like Abilene.
- **UCAID** - <http://www.ucaid.edu>: University Corporation for Advanced Internet Development, formed by Internet2, largely to facilitate deployment of Abilene.
- **NGI** - <http://www.darpa.mil/ipto/research/ngi>: Next Generation Internet is developing technologies that enable networks to scale dramatically in size, speed and reach, focusing

particularly on the capability to robustly accommodate extreme ranges of user demand.

- **NLANR** - <http://www.nlanr.net>: The National Laboratory for Applied Network Research (NLANR) provides technical, engineering, and traffic analysis support of NSF High Performance Connections sites and HPNSP (high-performance network service providers) such as the NSF/MCI very high performance Backbone Network Service (vBNS).
 - **StarTap** - <http://www.startap.net>: The Science, Technology and Research Transit Access Point, located in Chicago, where approved foreign high-performance research networks connect to their American counterparts, such as vBNS+ and Abilene. Participating foreign networks include: **AMPATH** (South America), **APAN** (Asia-Pacific), **ASNet** (Taiwan), **CA*net4** (Canada), **GEMnet** (Japan), **RBNet** (Russia), **SURFnet** (Netherlands), **CERNET** (China), **Renater2** (France), **EUDataTag** (European Union) **HEAnet** (Ireland) and **KREONet2** (Korea).
- Federal Mission Networks:** Specialized, limited-access, high-speed networks deployed by individual Federal agencies in support of specific research programs or as a testbed for advanced technologies. Examples include:
- **DREN** - <http://www.hpcml.hpc.mil/Htdocs/DREN>: Defense Research and Education Network
 - **ESnet** - <http://www.es.net>: DOE's Energy Sciences Network
 - **NREN** - <http://www.nren.nasa.gov>: NASA Research and Education Network

Internet2 Grant/Funding Opportunities

- At the NSF, the Directorate for Computer and Information Sciences and Engineering (CISE) promotes basic research and education in the computer and information sciences and engineering, and helps maintain the nation's preeminence in these fields. Visit them at:
<http://www.nsf.gov/home/cise>
- The NSF's Information Technology Research (ITR) program wishes to fund innovative, high payoff research, which explores new scientific, engineering, and educational areas in IT. Visit them at:
<http://www.itr.nsf.gov>
- A complete listing of the United States National Library of Medicine (NLM) Funding Resources can be found at:
<http://www.nlm.nih.gov/research/funding.html>

- A summary of National Library of Medicine's NGI & Telemedicine Projects can be found at:
<http://www.nlm.nih.gov/research/telfront.html>
- Current solicitations for the Information Processing Technology Office (IPTO) of DARPA can be found at:
<http://www.darpa.mil/ipto/Solicitations>
- U.S. Department of Health & Human Services Grants & Funding is located at:
<http://www.hhs.gov/grants>
- The National Institutes of Health (NIH) Grants & Funding Opportunities web page is located at:
<http://grants1.nih.gov/grants>

The Access Grid™

The Access Grid is an ensemble of resources including multimedia large-format displays, presentation and interactive environments, and interfaces to Grid middleware and to visualization environments.

These resources are used to support group-to-group interactions across the Grid. For example, the Access Grid is used for large-scale distributed meetings, collaborative work sessions, seminars, lectures, tutorials, and training. The Access Grid thus differs from desktop-to-desktop tools that focus on individual communication.



spaces," that contain the high-end audio and visual technology needed to provide a high-quality compelling user experience. The nodes are also used as a research environment for the development of distributed data and visualization corridors and for the study of issues relating to collaborative work in distributed environments.

NSCEE's Access Grid conference room solution will be installed by fall 2003 and will include all the connections necessary to activate four cameras, three projectors, two speakers, and eight microphones.

The Access Grid technology was developed at Argonne National

Laboratory and is deployed by the NCSA PACI Alliance.

The Access Grid is now used at over 150 institutions worldwide. Each institution has one or more AG nodes, or "designed

Help Desk

IPv6 (Internet Protocol version 6)

IPv6 is the next generation Internet Protocol, the data packaging and routing standard on which the Internet is based. The current version is IPv4; IPv5 was experimental and was never widely deployed.

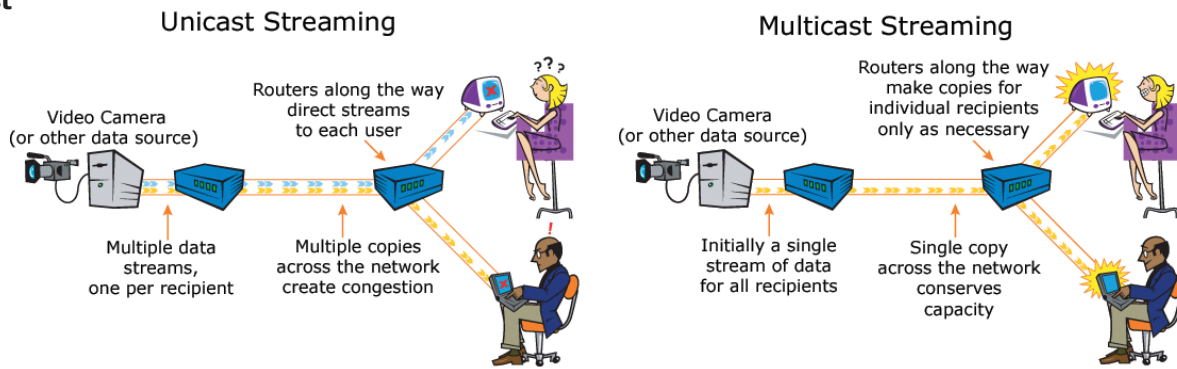
IPv6 offers several improvements over IPv4. IPv6 vastly increases the number of addresses available from about 4 billion to about 340 trillion trillion trillion.

Given the continued rapid growth of the Internet, ensuring an abundance of addresses is crucial. The proliferation of wired and (especially) wireless devices means that in the near future not one or two, but many addresses will be required for each person who uses the Internet. The techniques currently employed to cope with the shortage of IPv4 addresses are reaching their limits, and many of these techniques—such as temporary address assignment and network address translation—compromise engineering principles fundamental to the Internet’s success, thus jeopardizing its future growth.

Note: Information presented on *IPv6* courtesy of Internet2.

Number of Addresses in IPv4:	4,294,967,296 (2^{32})	Surface of the Earth:	509,600,000 km ²
Population of Earth (2002):	6,214,891,000	IPv4 Addresses/km²:	8.43
Number of Addresses in IPv6:	340,282,366,920,938,463,463,374,607,431,768,211,456 (2^{128})	IPv6 Addresses/km²:	6.68×10^{29}

Multicast



Unicast Streaming	Multicast Streaming
Multiple data streams, one per recipient	Initially a single stream of data for all recipients
Multiple copies across the network create congestion	Single copy across the network conserves capacity
Routers along the way direct streams to each user	Routers along the way make copies for individual recipients only as necessary

Multicast is a set of technologies that enables efficient delivery of data to many locations on a network.

In today’s Internet, the dominant model of communication is “unicast”—the data source must create a separate copy of the data for each recipient. When there are many recipients, and when large amounts of data (e.g., streaming video) are being sent, unicast becomes prohibitively wasteful of bandwidth. The key behind multicast is to create each recipient’s copy of each message at a point as close to that recipient as possible, thus minimizing bandwidth consumed.

Network multicast capability is crucial for distance learning, digital video libraries, online collaboration tools, and other types of advanced applications important to research and education.

Multicast is routinely used to distribute better-than-TV-quality video to thousands of viewers at Internet2 universities. Multicasting enables the creation of a potentially globe-spanning virtual conference hall.

Note: Information and graphics presented on *Multicast* courtesy of Internet2.

NSCEE Internet2 Projects

Current on-going projects that use NSCEE Internet2 resources include:

•UNLV E-Health Initiative

The primary goals of this initiative are intended to solve the technical challenges in deploying and developing networking technologies to empower health and medical care delivery.

•National Institute for Advanced Technology (NIAT)

NIAT, a center for information technology research and development and enterprise data management, is the base for a program to advance government electronic record keeping, including the need to enhance access and ensure preservation

of critical environmental, scientific, medical and legal records.

•NOAA Weather Simulation and Forecasting

A high-resolution weather simulation model (RAMS) runs on NSCEE’s SGI supercomputer twice each day to assist forecasters in predicting weather for the Southwestern United States at resolutions of 32, 8 and 2 kilometers.

•DOE/NNSA Modeling of Radiation Detection Systems

The Monte Carlo N-Particle Transport (MCNP) program runs daily (run times vary from 4-24 hours) on NSCEE’s SGI supercomputer to predict gamma, neutron and electron transport through user-defined media with a random number

generator and probability distributions based on cross-section data.

•Compressible Fluid Flow

The finite element method is being employed to develop a compressible flow model that solves both the Euler Equations and viscous equations in two- and three-dimensions.

•Groundwater Contaminant Transport

Uses GWADAPT, a finite-element model which incorporates mesh (h-) adaptation to calculate ground-water flow and pollutant transport.

•Indoor Air Quality

A web-based model has been developed for simulating the transport of toxic materials within rooms and building interiors. Graphical results are displayed as

Internet2 Visualization Lab

continued from page 1

High quality interactive video, remote control of scientific instruments, collaborative creation of music, dance or other performance art, shared distributed file storage, shared access to high-performance computational systems and resources, data mining, and access to digital library resources including high quality graphics, audio and video are all applications that will be enhanced or made possible using Internet2.

Internet2 and its members are developing and testing new technologies, such as IPv6, multicasting (see page 3) and quality of service (QoS) that will enable revolutionary Internet applications.

Current NSCEE Internet2 projects include: E-Health, Weather Simulation and Forecasting, Modeling of Radiation Detection

Systems, Compressible Fluid Flow, Groundwater Contaminant Transport, Outdoor/Indoor Air Quality, Network Security, and Medical Informatics (see page 3).

The lab includes 20 visualization workstations that accommodate both the Microsoft Windows XP Professional and Unix (Red Hat Linux) operating systems.

Additionally, an Access Grid Node will be installed by fall 2003 providing a state-of-the-art conferencing and collaboration platform with complete IP-based, full-duplex audio, 30 frame-per-second video, and total data interaction/sharing capabilities among anywhere from two to 30 locations (see page 2).

For Internet2 Visualization Lab scheduling, call (702) 895-4153.

NSCEE Internet2 Projects

continued from page 3

velocity vectors and contour plots of concentration.

•Niobium Cavity Design

Studies and optimizes the process and effect of chemical etching on surface roughness. The finite element computational fluid dynamics model developed is two-dimensional, axisymmetric, steady state fluid flow.

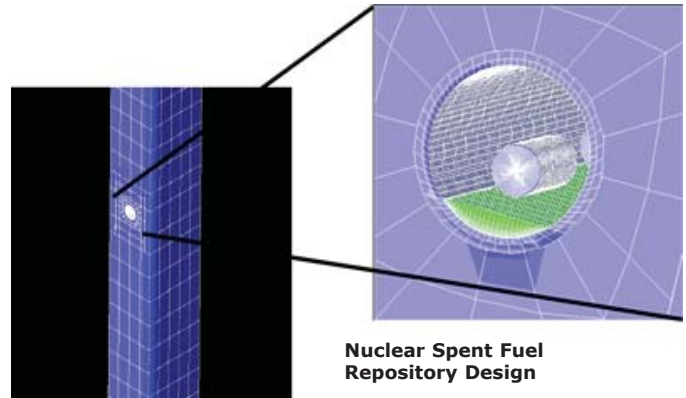
•Nuclear Spent Fuel Repository Design

Development of a thermal model for heat transfer in the

potential repository at Yucca Mountain, NV. The finite-volume method is used to accomplish the numerical simulation; k-e closure is used to model turbulence.

•High-Performance Computing Alliance

This collaboration between UNLV and University of New Mexico's High Performance Computing, Education and Research Center (HPCERC) provides an opportunity for sharing and leveraging activities to support DOE national laboratories.



Nuclear Spent Fuel Repository Design

Articles Invited

The National Supercomputing Center for Energy and the Environment invites you to contribute articles on your work on high-performance computers and especially our resources. Please submit your articles to:

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