TransLight / StarLight

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Table of Contents

1. Participants

1.A. Primary Personnel

Participant's Name(s)	Project Role(s)	>160 Hours/Yr
Thomas A. DeFanti (1)	Principal Investigator	Yes
Maxine Brown (2)	Co-Principal Investigator	Yes

(1) Tom DeFanti, PI, focuses on managing the link procurement process, network engineering, budgets and accounts payable, interfacing with personnel from Internet2, ESnet, NLR and DANTE/GÉANT2, coordinating project management and oversight activities with the NSF, and performing day-to-day project management. He participates in regularly scheduled IRNC phone calls and attends meetings as requested.

(2) Maxine Brown, co-PI, focuses on managing documentation and education and outreach activities, and is responsible for TransLight/StarLight quarterly and annual reports, web pages and events planning. She also participates in regularly scheduled IRNC phone calls and attends meetings as requested.

1.B. Other Senior Personnel (Excluding PI and Co-PI)

Additional people who contribute greatly to the project are listed below. While some receive a salary from this grant, others provide in-kind services:

Participant's Name(s)	Project Role(s)	>160 Hours/Yr
Alan Verlo (3)	Professional staff	Yes
Laura Wolf (4)	Professional staff	Yes
Steve Sander (5)	Professional staff	Yes
Pat Hallihan (6)	Professional staff	Yes
Lance Long (7)	Professional staff	Yes
Linda Winkler (8)	Professional staff	Yes
Rick Summerhill (9)	Professional staff	Yes
Roberto Sabatino (10)	Professional staff	Yes
Erik-Jan Bos (11)	Professional staff	Yes
Kees Neggers (12)	Other Senior Personnel	Yes
Joe Mambretti (13)	Other Senior Personnel	Yes

(3) Alan Verlo is the TransLight/StarLight network engineer, and is a member of the StarLight engineering team. For many years Verlo has also been a member of the SC conferences' SCinet committee, focusing on enabling international SC research demos that have network connections at StarLight in Chicago. He was also co-chair of the iGrid 2005 international cyberinfrastructure team, responsible for clusters and international networking. Verlo regularly participates in JET and GLIF GOLE meetings.

(4) Laura Wolf was responsible for TransLight/StarLight technical writing and web documentation; she left UIC in August 2009 for a position at Argonne National Laboratory.

(5) Steve Sander is the TransLight/StarLight budget, accounts payable and equipment procurement person.

(6) Pat Hallihan reports to Alan Verlo and is technical support staff.

(7) Lance Long reports to Alan Verlo and is technical support staff.

(8) Linda Winkler of Argonne National Laboratory, while not compensated by UIC, serves as part-time StarLight engineer with Alan Verlo and assists with TransLight/StarLight. For many years, Winkler has been a member of the SCinet committee, helping enable international SC research demos with network connections at StarLight in Chicago. She was also co-chair of the iGrid 2005 international cyberinfrastructure team, responsible for clusters and international networking.

(9) Rick Summerhill, until recently, was the Internet2 Chief Technology Officer and, while not compensated by UIC, was one of the stewards of the TransLight/StarLight link that connects the Internet2 network at MAN LAN to the GÉANT2 POP at the Amsterdam Internet Exchange. Summerhill retired June 2009 and was replaced by Randall Frank.

(10) Roberto Sabatino is the DANTE Chief Technology Officer and, while not compensated by UIC, is one of the stewards of the TransLight/StarLight link that connects the Internet2 network at MAN LAN to the GÉANT2

POP at the Amsterdam Internet Exchange.

(11) Erik-Jan Bos is a SURFnet Managing Director and, while not compensated by UIC, is one of the stewards of the TransLight/StarLight link connecting StarLight in Chicago to NetherLight in Amsterdam.

(12) Kees Neggers is a SURFnet Managing Director and a founder and current chair of GLIF. While not compensated by UIC, he does the tenders and procures both TransLight/StarLight links on UIC's behalf, and is one of the stewards of the TransLight/StarLight link connecting StarLight in Chicago to NetherLight in Amsterdam.

(13) Joe Mambretti is the StarLight managing director and head of the International Center for Advanced Internet Research (iCAIR) at Northwestern University. While not compensated by UIC, he has been a strong supporter and advisor regarding our IRNC efforts. Mambretti has assisted with connectivity issues, not only at StarLight, but also at MAN LAN.

1.C. Other Organizations That Have Been Involved as Partners

Argonne National Laboratory
Argonne National Laboratory's Mathematics and Computer Science Division (MCS) <www.mcs.anl.gov> has been, and continues to be, a strong supporter of US international networking activities. Linda Winkler has facilitated STAR TAP/StarLight network engineering since its inception, and continues to serve as a senior engineer today; her salary comes from Argonne.

Northwestern University
Joe Mambretti, director of Northwestern's International Center for Advanced Internet Research (iCAIR) <www.icair.org>, manages the StarLight facility <www.startap.net/starlight> and assists with connectivity issues.

SURFnet
SURFnet, the national network for research and education in the Netherlands <www.surfnet.nl>, is a TransLight/StarLight "key institutional partner," responsible for negotiating, procuring and implementing the TransLight OC-192 circuit(s) between Open Exchanges in the US and in Europe, which UIC pays for upon receipt of an invoice from SURFnet, as has been our practice since our previous NSF HPIIS Euro-Link award.

1.D. Other Collaborators or Contacts

CANARIE
The Canadian Network for the Advancement of Research, Industry and Education (CANARIE) <www.canarie.ca> is Canada's advanced Internet development organization. It operates the CANARIE Network, a series of point-to-point optical wavelengths, most of which are provisioned at 10Gbps speeds, interconnecting Canada's provincial research networks with each other and international peer networks, and forming an innovative framework to support grids and e-Science.

DANTE
Owned by European NRENs, the DANTE <www.dante.net> organization plans, builds and operates pan-European networks for research and education. The GÉANT2 project is a collaboration among 30 National Research & Education Networks representing 34 countries across Europe, the European Commission, and DANTE. Its principal purpose is to develop the GÉANT2 network -- a multi-gigabit pan-European data communications network for research and education <www.geant2.net>. TransLight/StarLight funding provides a 10Gbps routed infrastructure to connect the Internet2 network, NLR PacketNet and DOE/ESnet with DANTE/GÉANT2. TransLight/StarLight also makes a 10Gbps switched infrastructure available for use.

ESnet
The Energy Sciences Network, (ESnet) <www.es.net> is funded by the DOE Office of Science to provide network and collaboration services in support of the agency's research missions, serving thousands of DOE scientists and collaborators worldwide. ESnet provides direct connections to all major DOE sites with high-performance speeds, as well as fast interconnections to more than 100 other networks. TransLight/StarLight funding provides a 10Gbps routed infrastructure to connect the Internet2 network, NLR PacketNet and DOE/ESnet with DANTE/GÉANT2. TransLight/StarLight also makes a 10Gbps switched infrastructure available for use.

Global Lambda Integrated Facility (GLIF)
GLIF <www.glif.is> is an international virtual organization of NRENs, consortia and institutions that promotes lambda networking. GLIF provides lambdas internationally as an integrated facility to support data-intensive scientific research, and supports middleware development for lambda networking. It brings together premier networking engineers to develop an international infrastructure by identifying equipment, connection requirements, and necessary engineering functions and services.

GLORIAD
GLORIAD, the Global Ring Network for Advanced Applications Development, <www.gloriad.org> is constructing a dedicated lightwave round-the-world connecting scientific organizations in the United States, Russia, China, Korea, Canada, the Netherlands and the Nordic countries. GLORIAD currently has 3x1Gbps VLANs on the TransLight/StarLight CHI/AMS link to NetherLight. Russia, a GLORIAD partner, connects to NetherLight in Amsterdam from Moscow via Stockholm.

Internet2
Internet2 <www.internet2.edu> is a consortium of leading US research universities working in partnership with industry and government to develop and deploy advanced network applications and technologies. In Spring 2007, the new Internet2 network <www.internet2.edu/network/>, a hybrid optical and packet network designed in collaboration with Level 3 Communications, came online. TransLight/StarLight funding provides a 10Gbps routed infrastructure to connect the Internet2 network, NLR PacketNet and DOE/ESnet with DANTE/GÉANT2. TransLight/StarLight also makes a 10Gbps switched infrastructure available for use by the Internet2-DCN (Dynamic Circuit Network).

National LambdaRail (NLR)
NLR <www.nlr.net> is a major initiative of US research universities and private sector technology companies to provide a national-scale infrastructure for research and experimentation in networking technologies and applications. TransLight/StarLight considers itself, in part, to be the international extension of NLR, and encourages data-intensive e-science drivers needing gigabits of bandwidth to use NLR FrameNet and international links for schedulable production services not available with "best effort" networks. TransLight/StarLight funding provides a 10Gbps routed infrastructure to connect the Internet2 network, NLR PacketNet and DOE/ESnet with DANTE/GÉANT2. TransLight/StarLight also makes a 10Gbps switched infrastructure available for use by NLR FrameNet.

TransLight/PacificWave
TransLight/PacificWave <www.pacificwave.net/participants/irnc> is a distributed exchange facility on the West Coast (in Seattle, Sunnyvale, and Los Angeles) to allow interconnection of international research and education networks with US research networks. TransLight/PacificWave is the sister project to TransLight/StarLight.

2. Activities and Findings

2.A. Research Activities

2.A.1. Accomplishments and Milestones

In Year 5, TransLight/StarLight continues to fund two international links, which were both delivered July 2005: an OC-192 routed connection between MAN LAN in New York City and NetherLight at the Amsterdam Internet Exchange (AMS-IE) connecting GÉANT2 to the US Internet2, NLR and ESnet networks, and an OC-192 switched connection between StarLight in Chicago and NetherLight (co-located at the AMS-IE facility) that is part of the GLIF fabric.

We have been working on the following activities during the third quarter of Year 5 of the grant:

- Preparing the TransLight/StarLight quarterly report
- Provisioning VLANs on TransLight/StarLight CHI/AMS for e-science applications (ongoing)
- Representing TransLight/StarLight at major conferences and workshops (as members of the program committee and/or as participants); continuing to participate in network engineering JET and GLIF GOLE meetings; continuing to participate in the IRNC Measurement Group; and, continuing to learn/design cybersecurity best practices for IRNC (ongoing)
- Identifying and assisting applications on both IRNC circuits (ongoing)
- Continuing to update the TransLight/StarLight website <www.startap.net/translight> (ongoing)
- Continuing to contribute to the GLIF applications website <www.glif.is/apps>.
- Participated in and helped prepare demonstrations for the GLIF 9th Annual LambdaGrid Workshop, October 2009
- Continuing preparations for SC'09 international application demonstrations

2.A.2. Infrastructure Topology

No updates to report.

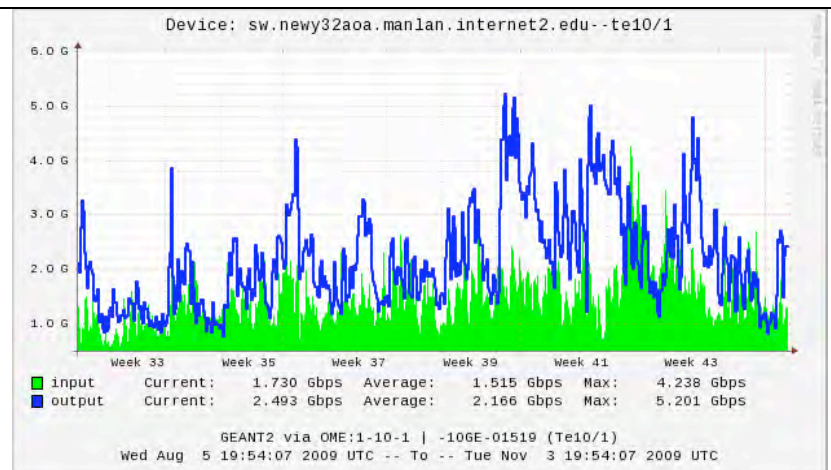## 2.A.3. NYC/AMS Network Operations and Engineering

PoP Connectivity and Peering

No updates to report.

Usage

Aggregate traffic utilization information for Internet2, NLR and ESnet on TransLight/StarLight can be accessed from the TransLight/StarLight website <www.startap.net/translight/pages/measurement.html>. This website also lists utilization for Internet2 and NLR. ESnet is transitioning from MRTG to an improved service, so specific graphs are not available.

Internet2/ESnet/NLR aggregate traffic (~5Gbps) on IRNC NYC/AMS for the period August 1 – October 31, 2009.	

Internet2 traffic (~2Gbps) on IRNC NYC/AMS for the period August 1 – October 31, 2009.	
NLR traffic (>3Gbps) on IRNC NYC/AMS for the period August 1 – October 31, 2009.	
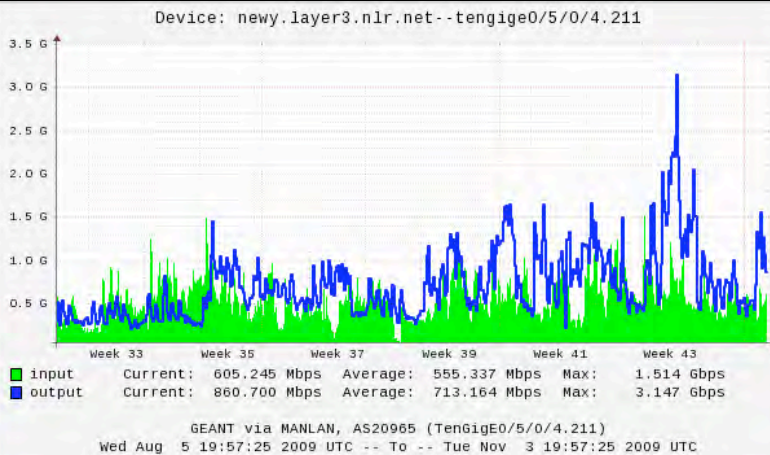
Routing Policies

No updates to report.

Peering Policies

No updates to report.

Security

No updates to report.

Engineering

No updates to report.

NOC Operations

No updates to report.

RENOG: Global NOC-NOC Communications

No updates to report.

2.A.4. CHI/AMS Network Operations and Engineering
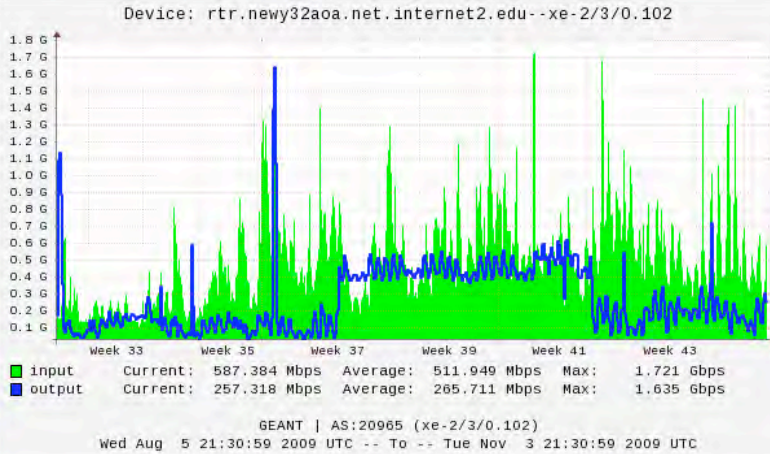
PoP Connectivity and Peering

No updates to report.

Usage

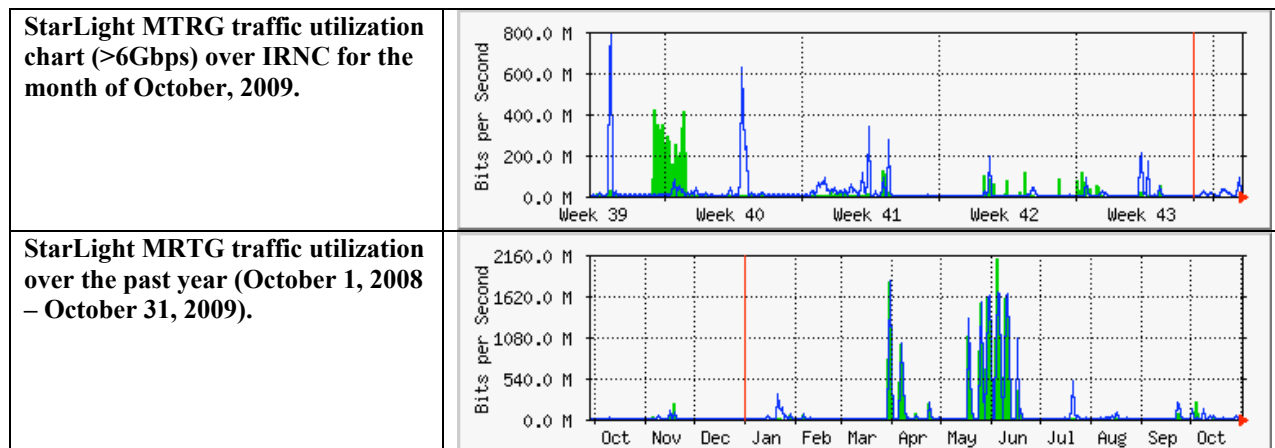MRTG traffic utilization information for the CHI/AMS TransLight/StarLight link can be accessed from the TransLight/StarLight website <www.startap.net/translight/pages/measurement.html>. *Note: Daily and weekly StarLight MRTG usage charts appear in this report to substantiate bandwidth for some of the heroic applications and experiments that took place over the past quarter (Section 2.B.3).*

StarLight MTRG traffic utilization chart (>6Gbps) over IRNC for the month of October, 2009.	
StarLight MRTG traffic utilization over the past year (October 1, 2008 – October 31, 2009).	

Routing Policies

No updates to report.

Peering Policies

No updates to report.

Security

No updates to report.

Engineering

No updates to report.

Engineering: LightPath Services

The following VLANs have been in place (see prior TransLight/StarLight reports):

- GLORIAD…3x1Gbps
- NOAA…1Gbps
- Teraflow Testbed…1Gbps
- OptIPuter…1Gbps
- Korea-NORDUnet Medical Imaging… 1Gbps on the SURFnet AMS-CHI link *(leveraging investments from SURFnet for international transatlantic network connectivity)*
- Arecibo Radio Telescope in Puerto Rico…1Gbps
- HEPGrid (RNP/CLARA) and SPRace (Sao Paulo/ANSP)…2x1Gbps
- i2CAT (Barcelona)…1Gbps
- ON*VECTOR…no bandwidth limits
- CosmoGrid…no bandwidth limits

- LHC/Tier2…3Gbps
- KAUST…1Gbps

KAUST…The new $20,000,000,000 King Abdullah University of Science and Technology (KAUST) in Saudi Arabia, modeled after the best university research and education facilities worldwide and engaging faculty from those facilities, opened in September 2009. To fill its international research mission, KAUST leased a 10Gbps circuit from its campus to the NetherLight exchange, based on requirement specifications and architectural and engineering advice from TransLight/StarLight[1] and SURFnet. *This link became operational October 20, 2009 (see Section 2.B.3: KAUST Teleconferencing).*

The CHI/AMS TransLight/StarLight circuit now carries R&E traffic from Amsterdam to KAUST partner universities in the US where KAUST funds collaborative research and joint courses. These universities, who have been awarded an aggregate of more than $50M/yr for the next 5 years, are: UC Berkeley, Stanford, Texas A&M, Cornell, MIT, Georgia Tech, Penn State, Caltech, UCSD and UIC, plus Woods Hole. To reach specific labs at these institutions, KAUST is also paying for last mile and regional connections as needed to guarantee US/KAUST projects have first-class high-definition videoconferencing as well as data sharing and access to its computing facilities; KAUST has installed an IBM Blue Gene/P supercomputer, which is the largest in the world outside of the DOE labs.

TransLight/StarLight inspired this connectivity, helped engineer it, and is making it possible for US researchers to fulfill the requirements of over a quarter of a billion dollars of sponsored research and education funding from KAUST, while minimizing travel requirements. TransLight/StarLight's partnership with KAUST includes ongoing close cooperation with designing and implementing advanced communication services in support of its scientific research. Other countries in the Middle East are certain to engage with KAUST as well, and replicate the networking infrastructure pioneered by TransLight/StarLight and its global partners. In fact, discussions have started about establishing a major open exchange, the Saudi Arabia Light (SALight) at KAUST.

NOC Operations

No updates to report.

2.A.5. Meeting and Conference Participation

TransLight/StarLight principals have participated in the following meetings and conferences to promote IRNC:

November 2-6, 2009. Alan Verlo attended the SCInet staging meeting in Portland, OR.

October 30-November 5, 2009. Tom DeFanti and representatives of EVL went to Japan for meetings with research collaborators at NTT Network Innovations Laboratory. NTT sponsors ON*VECTOR wide-area research experiments that rely on GLIF networks, as well as an annual Photonics Workshop.

October 30, 2009. Prof. Andy Johnson of EVL hosted Celina Pereira of the University of São Paulo's Faculty of Medicine, Department of Telemedicine, Brazil. Her visit, organized by the Illinois-São Paulo Chapter of Partners of the Americas, enabled EVL to showcase its international networking and research collaborations and explain IRNC partner activities with WHREN-LILA .

October 27-29, 2009. Tom DeFanti and Joe Mambretti attended the 9th Annual LambdaGrid Workshop sponsored by GLIF in Daejeon, Korea. The GLIF meeting was held October 27-28, followed by a meeting of the GLIF North American (GLIF-NA) Working Group on October 29. Maxine Brown served as a member of the LambdaGrid Workshop Program Committee.

October 20, 2009. Alan Verlo participated in a JET meeting.

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[1] Tom DeFanti, PI of TransLight/StarLight, is also PI of a KAUST award to UCSD for "Calit2 OptIPresence," October 1, 2008 – September 30, 2012. UIC/EVL receives a subaward.

October 13, 2009. Maxine Brown was the keynote speaker at the Chicago Community Trust's 8th Annual Newman Lecture and Dinner. Her talk featured StarLight, and was entitled, "Prototyping Tomorrow's Computer and Networking Technologies Today." She was selected because of being honored as a "Global Visionary" by the *2009 Chicago Matters: Beyond Burnham* TV/radio series, organized by Chicago Public Radio and Public Television.

September 16-25, 2009. Tom DeFanti traveled to Saudi Arabia for the opening of KAUST. (Funded by KAUST.)

September 15, 2009. Joe Mambretti participated in a JET meeting.

September 14-15, 2009. Alan Verlo attended the CyberSecurity Summit 2009 for Large Research Facilities, sponsored by EDUCAUSE in Arlington, VA <http://www.educause.edu/cyb09>

August 18, 2009. Alan Verlo participated in a JET meeting.

August 11-September 15, 2009. Calit2 and EVL staff traveled to Saudi Arabia to help set up the KAUST Visualization Showcase area. (Funding provided by KAUST.)

2.B. Research Findings

2.B.1. IRNC Projects Interactions

Internet2/ESnet/NLR/GÉANT2 and StarLight/NetherLight Compatibilities

The TransLight/StarLight NYC-AMS routed network seamlessly connects Internet2, ESnet, NLR and GÉANT2, and the switched CHI-AMS switched circuit seamlessly connects StarLight and NetherLight, thereby assuring that international network services conform to those currently offered or planned by domestic research networks.

As an interesting statistic, the research group TeleGeography recently published an article titled "Internet traffic growth not slowed by recession." This September 14, 2009 article states "international traffic growth accelerated to 79% in 2009, up from 61% in 2008. Growth was fastest in emerging markets, such as Eastern Europe, South Asia, and the Middle East. Traffic from each of these regions grew well over 100% in 2009. However, even more mature markets experienced rapid growth: peak traffic volumes on international links connected to the US and Canada increased 59% in 2009…The need to upgrade Internet backbones in light of traffic growth is not a new development. Since 2007, the annual growth rate of international Internet capacity has exceeded 60%. In 2009, international internet bandwidth increased 64%. In 2009, network operators added 9.4Tbps of new capacity—exceeding the 8.7Tbps in existence just two years earlier." The article is at <www.telegeography.com/cu/article.php?article_id=30081>.
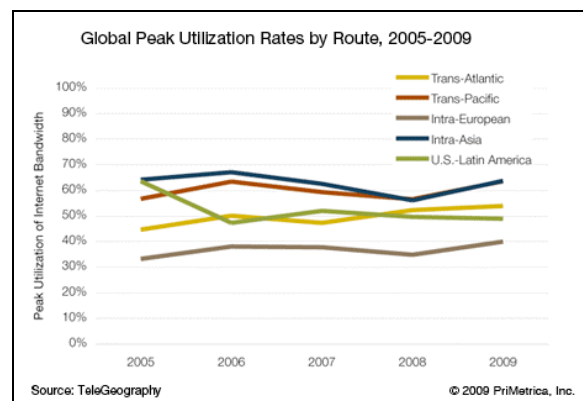
9th Annual GLIF Global LambdaGrid Workshop

The annual GLIF meeting was held October 27-28, 2009 in Daejeon, South Korea, and hosted by KISTI. Several international demonstrations took place, some of which utilized the TransLight/StarLight switched circuit <www.glif.is/meetings/2009/demos/>.

- HPMDnet - *iCAIR, KISTI & HPDMNet Consortium*
- perfSONAR - *CANARIE*
- IDC: MAN LAN - NetherLight - *MAN LAN & NetherLight*
- Fast Data Transfer for LHC - *CERN*
- GNI API Fenius interoperability framework - *KISTI, G-lambda, ESnet, & HPDMnet*
- Medical Video Streaming – *NTNU*

SC 2009

In progress. Alan Verlo is a member of the SC'09 SCInet team.

2.B.2. E-Science Application Identification and Support

Maxine Brown has been involved with the following organizations and conferences throughout the past year, whose goals are to find and encourage application and middleware development.

- **TransLight/PacificWave's Applications group (ongoing)**, organized by John Silvester, stimulates application development. This group meets occasionally via telephone and at conferences. Maxine Brown is a member of this group, representing TransLight/StarLight. This group has provided advice and support to several projects. In particular, Brown was involved in early discussions for the upcoming eResearch Australasia Workshop, November 9-13, 2009 <www.eresearch.edu.au/programme-details-2009>.

- **Cyberinfrastructure (CI) Days** <www.cidays.org> is an ongoing effort to educate campuses about what national-scale CI resources are available; it is organized by a consortium of CI providers, including TeraGrid, Educause, Internet2, Open Science Grid, National LambdaRail, SURA and IRNC. Maxine Brown represents IRNC. During the past quarter, no CI Days events were held.

- **9th Annual LambdaGrid Workshop, sponsored by GLIF** <www.glif.is/meetings/2009>. Maxine Brown served as a member of the Program Committee.

2.B.3. E-Science Support (Quantified Science Drivers)

For many years, we documented international applications on the StarLight website <www.startap.net/starlight/APPLICATIONS> and, more specifically, US/European applications on the Euro-Link website <www.startap.net/euro-link/APPLICATIONS>. However, as international collaborations become more prevalent, as collaborations expand from two to three to four continents, and as more transoceanic links become operational, it is difficult to identify and document these applications − they are ubiquitous. Of more interest to us, is to identify and serve high-end applications − that is, data-intensive e-science applications requiring advanced networking capabilities − for they are the drivers for new networking tools and services to advance the state-of-the-art of production science.

Below is a list of recent applications (both routed and switched) that we are tracking; more are documented on the TransLight/StarLight website <www.startap.net/translight/pages/applications.html>. Applications utilizing GLIF links are publicized at <www.glif.is/apps>.

US/European Applications 2009

CosmoGrid: The Gravitational Billion Body Problem 2009

http://wiki.2048x2048x2048.org/

Collaborators:
- Drexel University; Vanderbilt University; StarLight; US
- CANARIE; Canada
- Department of General Sciences and Department of Astronomy, University of Tokyo; National Astronomical Observatory of Japan (NAOJ)/Center for Computational Astrophysics; JGN2plus; SINET3; T-LEX; Japan
- Astronomical Institute ("Anton Pannekoek"), Computational Science and System and Network Engineering Science, University of Amsterdam (UvA); University of Leiden/Leiden Observatory (Sterrewacht Leiden); SARA; SURFnet; The Netherlands
- University of Edinburgh/School of Mathematics; UK
- Ludwig-Maximilians Universität at München; Germany

Researchers in Tokyo and Amsterdam are building an intercontinental supercomputer grid to run cosmological N-body simulations of 10 billion particles. This collaboration began last year, and early progress was reported in previous TransLight/StarLight reports. This is an update of activities in the last quarter.

The week of September 16, 2009, the group met in Tokyo to discuss CosmoGrid current progress and future directions. Outcomes:

- After having run the production simulation (N2048^3 in a 30Mpc box) for several months in Tokyo, they reached z=1.5 They will now re-initiate the Amsterdam-Tokyo connection, but with 256 processors in Tokyo and 512 in Amsterdam. *They are requesting network availability during October-December*

2009 timeframe, not including SC09.

- The group is beginning to think about data analysis and data reduction strategies. They plan to store 110TBytes data (400 shapshots of 300GBytes each) on tape. Snapshots of z=1.5 (and higher) are available.
- A CosmoGrid-II run is planned to study the first dark matter clumps at high redshift. These simulations would be numerically as well as astrophysically challenging. From experience with CosmoGrid, it would be better to use a few processors on many supercomputers rather than many processors on a few supercomputers. They are currently investigating which supercomputers are willing/eligible to contribute to this second endeavor; the goal is 12-24 computers in Europe, the US and Asia.
- A second workshop is being planned in January/March 2010, once simulation data is in hand, to discuss data analysis strategies and the CosmoGrid-II run.

The group submitted the paper "Simulating the universe on an intercontinental grid of supercomputers" to IEEE Computer for review.

Image from film "Enquanto a Noite nao Chega"

FILE Media Arts Festival 2009

www.file.org.br
www.calit2.net/newsroom/release.php?id=1579
www.cinegrid.org

Collaborators:
- Calit2 and Center for Research in Computing and the Arts (CRCA), UCSD; StarLight; CineGrid; US
- Electronic Language International Festival (FILE); RNP; Brazil

The Electronic Language International Festival (FILE 10), one of the world's leading venues for new media arts, was held in Sao Paulo, Brazil, July 28-August 30, 2009. This year, July 30-31, featured the first 4K digital cinema to premiere simultaneously on three continents: at the festival in Brazil, and streamed in real time over optical networks to both Calit2 at UCSD and to Keio University's Design Media lab in Tokyo, Japan. The film was by Brazilian director Beto Souza, "Enquanto a Noite nao Chega" (While the Night Doesn't Come).

Michael Stanton of the RNP Brazilian network emailed the above photo showing pre-exhibition presentations using the 4K 4-panel screen. Speakers are director Beto Souza (top left), an auditorium view (top right), Keio University (bottom left), and Ramesh Rao at Calit2 (bottom right). The bottom two windows were live videoconference windows, streaming uncompressed HD (about 1.5Gbps).

Below is the network configuration used for this 4K digital cinema demonstration. *Note: While the TransLight/StarLight link was not used, there was much engineering done at StarLight to enable this demonstration. In the future, it will be easy to enable European sites to participate in FILE festivals.*

Plan B: unicast VLAN assignments
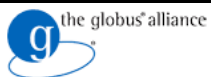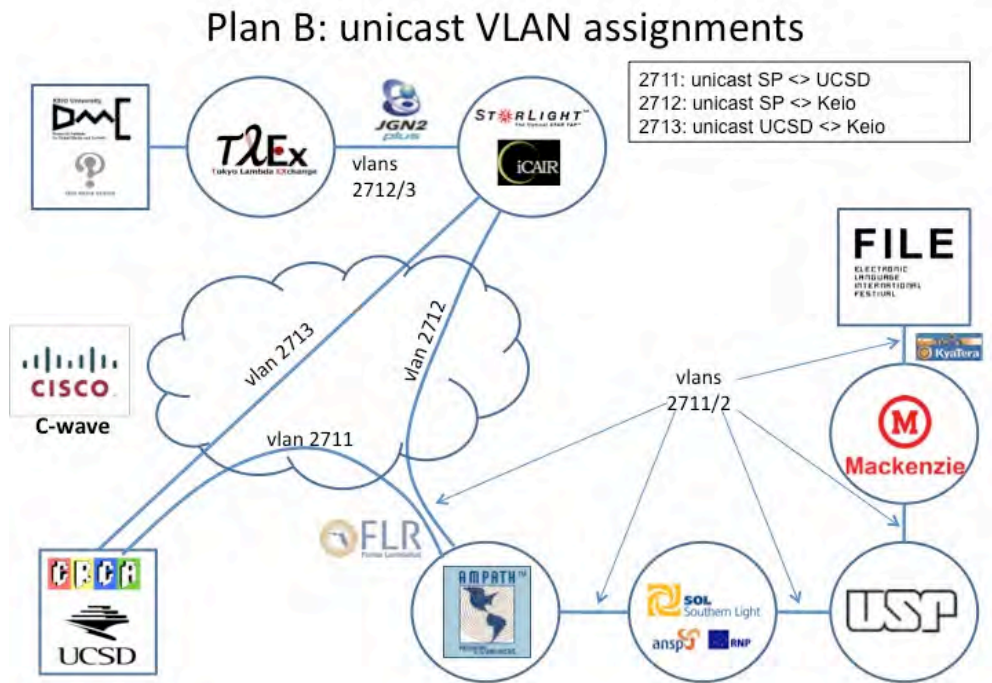
GLOBUS: WS-VLAM

www.isgtw.org/?pid=1001961
http://staff.science.uva.nl/~gvlam/wsvlam/
www.globus.org
www.vl-e.nl

Collaborators:
- The Globus Team; US
- Virtual Laboratory for e-Science (University of Amsterdam, Vrije University, Delft University, AMOLF, NIKHEF, NWO, CWI, TNO); The Netherlands

A new, grid-enabled scientific workflow management system, WS-VLAM (Workflow management System – Virtual Laboratory Abstract Machine), developed by the Virtual Laboratory for e-Science, provides a basic set of tools for building workflows by connecting components to each other based on data dependencies.

The traditional batch processing of grid jobs and workflow execution based on file exchange between the components is not suitable in some scenarios. In contrast,

WS-VLAM supports the simultaneous execution of co-allocated processes on the grid, which enables direct data streaming between distributed components, making it highly useful for near real-time distributed applications, such as bio-medical research and online video processing and analysis.

Performance tests indicate that the overhead of WS-VLAM is negligible compared to the standard Globus tool 'globus-url-copy,' which uses the GridFTP protocol. It is currently deployed on the Dutch Distributed Supercomputer 3, but WS-VLAM could also be used for any grid (Globus) enabled system.
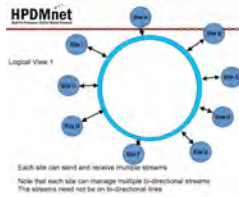
HPDMnet @ GLIF 2009

www.hpdmnet.org

Collaborators:
- CANARIE; Communications Research Centre (CRC); Inocybe; Nortel; Synchromedia: Laboratory for Multimedia Communication in Telepresence of The Ecole de Technologie Superieure (ETS); Canada
- i2CAT; Barcelona
- Northwestern University/International Center for Advanced Internet Research (iCAIR); National Center for Supercomputing Applications (NCSA) at University of Illinois at Urbana-Champaign; NLR; StarLight; US
- NetherLight; SARA; SURFnet; University of Amsterdam; The Netherlands
- KISTI; KREONet2; Korea
- NCHC; Taiwan
- Networked Media Laboratory, University of Essex; UK
- Technische Universität Braunschweig; Germany

Northwestern University's iCAIR demonstrated its High-Performance Digital Media Network (HPDMnet) by streaming high-resolution digital content from servers in North America (including NCSA) to the GLIF 2009 Workshop, held October 27-28 at KISTI in Daejeon, Korea. The HPDMnet research consortium collaborates on the design, development, and implementation of advanced communication services to support extremely high-resolution digital content.

Note: While transmissions for this demonstration were not sent to Europe, past demos have included Europe, and rely on TransLight/StarLight to get there. Network engineering at StarLight facilitates transmission to Asia as well as Europe.
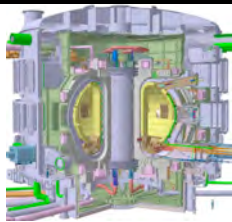
ITER Long-Distance Data-Transfer Experiments 2009

www.iter.org

Collaborators:
- University of Tokyo/Data Reservoir project; National Institute of Fusion Science (NIFS); Japan
- StarLight; US
- ITER Institute; Cadarache, France
- *Note: The 7 members of the international ITER project are the People's Republic of China, the European Atomic Energy Community (via EURATOM), the Republic of India, Japan, the Republic of Korea, the Russian Federation and US.*

In June 2009, University of Tokyo's Data Reservoir project and Japan's National Institute of Fusion Science (NIFS) started performing long-distance data transfer experiments between Japan and the ITER Institute in Cadarache, France. This

was the first of the series of experiments to establish dedicated network connections for the ITER fusion system. Initial efforts, reported previously, used a 1Gbps path. This past quarter, experiments used a full 10Gbps path.

During September 21-25, 2009, the ITER Data Transfer team conducted data-transfer experiments using 10Gbps from Japan to ITER (Cadarache, France). The objectives of the experiments were to test dynamic control of pacing over the 10Gbps network to reduce packet loss, and to test the feasibility of using small 10Gbps-connected file servers, preferred by scientific users. Results indicate there was considerable packet loss, which the researchers are now investigating.

The network path used was SINET (Gifu, where NIFS is located, to Tokyo), JGN2plus (Tokyo to Chicago/StarLight), TransLight/StarLight (Chicago to Amsterdam/NetherLight), GÉANT2 (Amsterdam to Paris), and RENATER (Paris to Cadarache). A network diagram appears below.
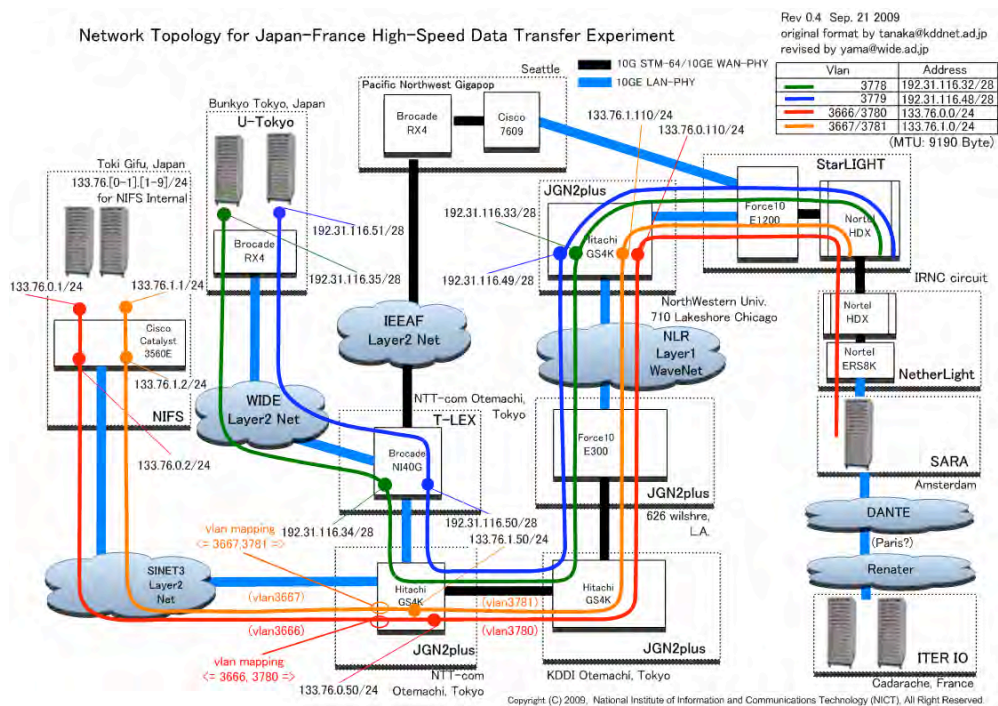
KAUST High-Definition Video Teleconferencing 2009

www.kaust.edu.sa/
www.calit2.net/newsroom/release.php?id=1599

Collaborators:
- KAUST Visualization Team
- UCSD Calit2 Visualization Team
- UIC EVL Visualization Team

On October 20, 2009, the new KAUST 10Gbps circuit from Saudi Arabia to NetherLight (Amsterdam) was used for a 3-way high-definition video-teleconference (VTC) among collaborators at KAUST, UCSD and UIC. KAUST data went over a 1Gbps VLAN from KAUST to NetherLight to Chicago via TransLight/StarLight, and then on to UCSD/Calit2 over CAVEwave. The photo below shows the Calit2 meeting room, with EVL participants displayed on the left

VTC unit and images of KAUST participants displayed on the right.
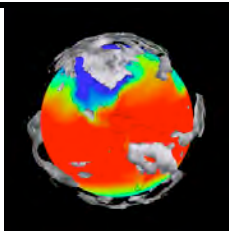
PINNACLE: Weather Prediction

www.isgtw.org/?pid=1001960
www.deisa.eu/science/deci/projects2007-2008/PINNACLE

Collaborators:
- Delft University of Technology; Netherlands
- Imperial College London; UK
- National Center for Atmospheric Research (NCAR); US
- DEISA; Europe

Scientists seeking to develop models for predicting weather, climate and air quality have long been confronted with the fundamental problem of how to accurately forecast the height of the atmospheric boundary layer (ABL) as it develops during daytime heating. In an attempt to solve this controversy, a team of scientists from Delft University of Technology, Imperial College London and NCAR initiated the PINNACLE project, using the resources of the DEISA grid of supercomputers.

The ABL is the lower layer of the atmosphere, the part that we live in. Its height grows throughout the day, from a few hundred meters in the morning to one kilometer or more in the afternoon. The ABL has a large Reynolds number (a measure of the turbulence of the system), which means that the motion of the rising hot air within is highly turbulent.

For weather, climate, and air quality models, it is of vital importance to correctly forecast the height of the boundary layer as it develops under daytime heating. Ascertaining how to predict the evolution of the daytime ABL, and determine a "growth-rate law," is problematic. The PINNACLE project sought to solve the problem by using computer simulations to recreate the different classical laboratory experiments which existing ABL growth-rate laws are based on. By varying the Reynolds number up or down by as much as thousand, and analyzing the impact it made, researchers were able to resolve some of the controversies surrounding the competing theories.

Findings suggest that fluid properties play a much greater part in determining boundary growth than commonly assumed and, more importantly, reveal which of

the growth-rate laws is correct. PINNACLE also sheds light on why different laboratory experiments, conducted in the past by various groups using different methods, gave different growth-rate laws.

Because the total computational cost of the simulations exceeded anything that can normally be requested at the national level, the team relied on the DEISA framework. The resource allocation was the equivalent of 1.9 million CPU-hours, divided equally among the different supercomputing centers that constitute the DEISA consortium. Some of the simulations were so demanding that the resource allocation on each individual platform was insufficient, and a "super-run" on the BlueGene supercomputer at the Jülich Research Centre (Germany) was required, which made use of 32,768 processors – half of the machine's full capacity.

2.B.4. Plans for the Coming Quarter (Quarterly Reports Only)

TransLight/StarLight plans for the fourth quarter of Year 5 (November 1, 2009 – January 31, 2010) include:

- Continue provisioning VLANs on TransLight/StarLight CHI/AMS for e-science applications (ongoing)
- Continue representing TransLight/StarLight at major conferences and workshops (as members of the program committee and/or as participants); continue to participate in network engineering JET and GOLE meetings; continue to participate in the IRNC Measurement Group; and, continue to learn/design cybersecurity best practices for IRNC
- Continue identifying and developing production applications on both IRNC circuits.
- Continue updating the TransLight/StarLight website.
- Continue to contribute to the GLIF applications website.
- Provide appropriate support for successful networked demonstrations at SC09
- Prepare two-month "bridge" supplement request for TransLight/StarLight funding.

2.C. Research Training

National Research & Education Network (NREN) management and engineers from Internet2, ESnet, NLR and DANTE work closely with IRNC management and engineers at UIC and SURFnet, as well as at MAN LAN, StarLight, and NetherLight, to facilitate connectivity and greater advances in global networking than a single-investigator effort can afford. In addition, numerous researchers, middleware developers, network engineers and international NRENs are involved as users of TransLight/StarLight. This global, dedicated community has elected to work together, on a persistent basis, to further the goals of international e-science collaboration.

2.D. Education/Outreach

TransLight/StarLight's primary education and outreach activities include web documentation, articles, and conference presentations and demonstrations. We also provide PowerPoint presentations and other teaching materials to collaborators to give presentations at conferences, government briefings, etc.

EVL has partnered with NCSA and ANL since 1986, with NU/iCAIR since 1994, and with Calit2/UCSD since 2000, in ongoing efforts to develop national/international collaborations at major professional conferences, notably ACM/IEEE Supercomputing (SC), IEEE High Performance Distributed Computing (HPDC), and Internet2 and GLIF meetings. We have participated in European conferences, NORDUnet annual meetings and a UKERNA seminar on optical networking. Our success has been in the development of teams, tools, hardware, system software, and human interface models on an accelerated schedule to enable multi-site collaborations for complex problem solving.

We participate in the annual GLIF and SC conferences, and have participated in AAAS 2008 and 2009, to promote the goals of IRNC and TransLight/StarLight. We also organized the iGrid 2005 in San Diego in September 2005 to showcase international advanced applications and middleware developments.

3. Publications and Products

3.A. Journals/Papers

None.

3.B. Books/Publications

None.

3.C. Internet Dissemination

www.startap.net/translight

3.D. Other Specific Products

Other than the information reported here, we have not developed any other specific product of significance.

4. Contributions

4.A. Contributions within Discipline

TransLight/StarLight, by its very nature, is interdisciplinary. There is clearly a fine team of computer scientists, computational scientists and networking engineers involved with TransLight/StarLight, facilitating greater advances in global networking than single-investigator efforts can afford. TransLight/StarLight developed its management team in the Chicago area (UIC/EVL), and leverages the efforts of its IRNC partners (particularly TransLight/PacificWave, GLORIAD and WHREN-LILA), and technical and administrative contacts at national NRENs (Internet2, ESnet and NLR) and foreign NRENs (DANTE and SURFnet).

4.B. Contributions to Other Disciplines

Within the Computational Science and the Computer Science communities, TransLight/StarLight efforts help lead 21st century discipline science and computer science innovation. TransLight/StarLight's 10Gbps routed circuit connecting Internet2, NLR, ESnet and GÉANT2 provides greater transatlantic connectivity, and the 10Gbps switched circuit between StarLight and NetherLight provides long-distance, high-bandwidth capability for demanding data-intensive e-science applications.

4.C. Contributions to Human Resource Development

We promote TransLight/StarLight through web documentation, articles, demonstrations and presentations at major networking conferences (e.g., SC, HPDC, Internet2), workshops (GLIF, PFLDNeT), scientific conferences (AAAS), as well as PowerPoint presentations and other instructional material. We teach the infrastructure, the grid advancements, the technological innovations and the application advancements that global connectivity enables. In fact, thanks to previous NSF funding of STAR TAP, StarLight and Euro-Link, we have a current mailing list of ~400 <stars@startap.net> individuals, from academia, government and industry, interested in information about international networking developments.

4.D. Contributions to Resources for Research and Education

TransLight/StarLight is a necessary and integral part of application advances and technological innovations for the US Computational Science and Computer Science research and education communities, as well as of major interest to network engineers. In particular, the TransLight/StarLight

switched circuit between StarLight and NetherLight is part of the GLIF LambdaGrid fabric and represents a major resource for science and technology.

4.E. Contributions Beyond Science and Engineering

Because of TransLight/StarLight's interest in advanced applications and lightpath provisioning, we often get inquiries from network equipment manufacturers and telecommunication providers about partnering with us to create and showcase a marketplace for wavelength-based network services and products. We look forward to working with these companies and introducing them to the Nation's foremost university and Federal laboratory networking engineers, computer programmers and applications scientists, who are developing and using today's evolving grid technologies. Our users expect us to grow in capacity and sophistication, and we look forward to the engineering challenges ahead.

5. Conference Proceedings

None.

6. Special Requirements

6.A. Objectives and Scope

A brief summary of the work to be performed during the next year of support if changed from the original proposal.
Our scope of work has not changed.

6.B. Special Reporting Requirements

Do special terms and conditions of your award require you to report any specific information that you have not yet reported?
No.

6.C. Animals, Biohazards, Human Subjects

Has there been any significant change in animal care and use, biohazards, or use of human subjects from what was originally approved (or approved later)?
No.