TransLight / StarLight

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www.startap.net/translight

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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, receives one-month funding and primarily focuses on managing the link procurement process, network engineering, budgets and accounts payable, and interfaces with personnel from Internet2/Abilene and DANTE/GÉANT2. DeFanti also participates in monthly IRNC phone calls and attends meetings as time permits.
(2) Maxine Brown, co-PI, primarily focuses on managing documentation and education and outreach activities, and is responsible for TransLight/StarLight quarterly and annual reports, web pages and events planning. The co-PI also participates in monthly IRNC phone calls and attends meetings as requested.

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

Additional people who contributed greatly to the project, and received a salary, wage, stipend or other support from this grant:

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 several years, Verlo has also been a member of the SCinet committee, focusing on enabling international SC research demos that have connections in Chicago. He is also co-chair of the iGrid 2005 international cyberinfrastructure team, responsible for clusters and international networking.
(4) Laura Wolf is the TransLight/StarLight technical writer and web developer.
(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 the University of Illinois at Chicago (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, focusing on enabling international SC research demos that have connections in Chicago. She is also co-chair of the iGrid 2005 international cyberinfrastructure team, responsible for clusters and international networking.
(9) Rick Summerhill is the Internet2 Director Network Research, Architecture, and Technologies and, while not compensated by UIC, is one of the stewards of the TransLight/StarLight link that connects Abilene at MAN LAN to GÉANT2 at their POP at the Amsterdam Internet Exchange.
(10) Roberto Sabatino is the DANTE/GÉANT2 chief network engineer and, while not compensated by UIC, is one of the stewards of the TransLight/StarLight link that connects Abilene at MAN LAN to GÉANT2 at their POP at the Amsterdam Internet Exchange.
(11) Erik-Jan Bos is the SURFnet chief network engineer and, while not compensated by UIC, is one of the stewards of the TransLight/StarLight link connecting StarLight in Chicago to NetherLight at the Amsterdam Internet Exchange in Amsterdam.
(12) Kees Neggers is 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, Joe 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

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 USA and in Europe, which UIC pays for upon receipt of an invoice from SURFnet, as has been our practice with our previous NSF HPIIS Euro-Link award.

Mathematics and Computer Science Division, Argonne National Laboratory
Argonne National Laboratory <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 engineering since its inception, and is the lead engineer today; her salary comes from ANL.

International Center for Advanced Internet Research (iCAIR), Northwestern University
Joe Mambretti, director of iCAIR <www.icair.org>, also runs the StarLight facility <www.startap.net/starlight>, and is assisting with connectivity issues, not only at StarLight, but also at MAN LAN.

1.D. Other Collaborators or Contacts

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 Department of Energy 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 makes a 10Gbps link available to Internet2, DOE and DANTE, to connect Abilene and ESnet with the pan-European backbone, GÉANT2.

DANTE
Owned by European NRENs, DANTE <www.dante.net> is an organization that plans, builds and operates pan-European networks for research and education. The GÉANT2 project is a collaboration between 26 National Research & Education Networks representing 30 countries across Europe, the European Commission, and DANTE. Its principal purpose has been to develop the GÉANT2 network -- a multi-gigabit pan-European data communications network for research and education; see <www.geant2.net>. TransLight/StarLight funding makes a 10Gbps link available to Internet2, DOE and DANTE, to connect Abilene and ESnet with the pan-European backbone, GÉANT2.

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. Abilene <http://abilene.internet2.edu> is an Internet2 high-performance backbone network that enables the development of advanced Internet applications and the deployment of leading-edge network services to Internet2 universities and research labs across the country. TransLight/StarLight funding makes a 10Gbps link available to Internet2, DOE and DANTE, to connect Abilene and ESnet with the pan-European backbone, GÉANT2.

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 wants to encourage data-intensive e-science drivers needing gigabits of bandwidth to use NLR and international links for schedulable production services not available with "best effort" networks.

2. Activities and Findings

2.A. Research Activities

2.A.1. Accomplishments and Milestones

We have been working on the following activities during the third quarter of year 1 of the grant:

- Installed a CANARIE-owned Nortel HDXc at StarLight and connected the CHI/AMS TransLight/StarLight link to it in time for iGrid 2005
- GÉANT2 received delivery of its 10GigE interface for its Juniper M160 router at MAN LAN and connected the NYC/AMS TransLight/StarLight link to it in time for iGrid 2005
- Worked on iGrid 2005, an advanced application demonstration that utilized all IRNC links
- Internet2/GÉANT2 are discussing how to re-engineer the NYC/AMS TransLight/StarLight link so it plugs into switches instead of routers.
- Preparing for SC|05 demonstrations, which will also heavily use these links

2.A.2. Topology

NYC/AMS…VSNL International (the new owner of Tyco Global Network and our OC-192 provider) delivered the 10Gbps NYC/AMS link on June 30; however, GÉANT2 was not ready in New York, so testing was postponed until after the July 4th weekend. Subsequently, a problem with cabling at New York's 32 Avenue of the Americas facility was diagnosed and fixed on July 14 by VSNL and SARA engineers. GÉANT2 waited until after the weekend to make it operational, so the link became operational July 20th.

Unfortunately, GÉANT2 did not get delivery of a 10GigE interface for its Juniper M160 router at MAN LAN, so could not connect to the TransLight/StarLight link via the MAN LAN 6513 until mid-August. Instead, GÉANT2 established temporary peering using one of its two GigE connections to New York, maintaining the configuration that had been in place for over a year between Abilene and GÉANT2. In early September, the new interface card arrived and a new BGP session was established.

When the HPIIS Euro-Link connection was in place, most outbound traffic from the US to Europe went over GÉANT's 2x1GigE connections in New York and Washington DC. Inbound traffic from Europe to the US went primarily to Chicago (Euro-Link) and Washington DC (GÉANT) and then to Abilene. When Chicago (Euro-Link) went away, all points on the Abilene network that were close to New York (as measured in fiber route miles on the backbone circuits) started talking to GÉANT via the New York peering.

Once the TransLight/StarLight link was in place, Abilene engineers reported that it appeared as though GÉANT2 modified its routing policy to move traffic from Europe to peer with Abilene at MAN LAN instead of Washington DC. (Traffic charts showed a sharp drop in Washington DC traffic, from 100Mbps to 25Mbps.) As of September 14, 2005, GÉANT2 moved all its MAN LAN traffic to the new 10 GigE peering and requested that one of its 1GigE connections to the MAN LAN switch be dephased.

Rick Summerhill will meet with Roberto Sabatino, DANTE chief network engineer, in early December on several issues, and will talk to him about re-engineering the IRNC link to plug into switches instead of routers.

CHI/AMS…Global Crossing provides the CHI/AMS link, which is a continuation of the NSF HPIIS Euro-Link setup. Its configuration of one OC-48 (for Abilene peering) and 6x1GE was kept in place until the NYC/AMS link became operational on July 20th. The 10GigE link is connected to Force10s that connect, in turn, to a CANARIE-owned HDXc box at StarLight and a SURFnet-owned HDXc box at NetherLight. It is matched by a SURFnet-paid OC-192, which also connects into HDXc equipment. Global Crossing is the carrier for both, although separate fiber routes have been procured for the two circuits. The HDXc installation at StarLight was completed just a few weeks prior to the iGrid 2005 event at the end of September, and the links are being heavily used for iGrid and SC events as well as for production traffic.

2.A.3. Usage Summary and Performance

2.A.4. NYC/AMS Network Operations and Engineering

Usage

Internet2 makes MRTG traffic statistics of Abilene/GÉANT2 peering at MAN LAN available at:
http://stryper.uits.iu.edu/abilene/summary.cgi?network=nycm-geant-newyork&data=bits

GÉANT2 statistics are password protected, but we will try to arrange open access for publication on the TransLight/StarLight website. GÉANT2 statistics are located at:
http://stats.geant.net/cgi-bin/cricket-1.0.2/grapher.cgi?target=%2Fbandwidth%2Fny1.ny.geant.net%2Fso-7_0_0;list-single-target=so-7_0_0;ranges=d%3Aw;view=Aggregate

Routing Policies

The NYC/AMS link is a routed, L3 connection providing connectivity between GÉANT2 in Europe and Internet2's Abilene network and DoE's ESnet at the MAN LAN exchange point. While other links between Abilene and GÉANT2 exist, this link is being preferred for traffic between Abilene and GÉANT2.

Peering Policies

Internet2's Abilene network and the GÉANT2 network follow their established peering policies with respect to accessing and transiting traffic that might flow over this link. Abilene peers with networks listed at <http://abilene.internet2.edu/peernetworks/>. Abilene, by default, transits traffic between all non-US peers. GÉANT2 interconnects participant networks, listed at <http://www.geant.net/server/show/nav.121>, and connects with other research and education networks outside the European region, such as EUMEDCONNECT, TEIN2, CLARA, TENET, and others. GÉANT2 provides Abilene not only with access to all of its participant networks, but also with transit to these other GÉANT2 peer networks. Internet2 and GÉANT2 continue to work together to address routing issues brought about by the increasing interconnectivity between all regional/continental-scale networks and the transit being provided across them.

Measurement and Performance Tools

For almost two years, Internet2 and GÉANT2 have been jointly developing a network performance, measurement and monitoring infrastructure for deployment across both the Abilene and GÉANT2 (as well as on their connector) networks, in order to provide both network engineer and end user access to information about the performance of the networks. The perfSONAR project is the result of this collaboration (and the successor name to the Internet2-initiated pIPEs project). Currently, Abilene has deployed this measurement infrastructure as part of its Abilene Observatory project and deployments are beginning across the GÉANT2 and connector National Research & Education Network infrastructures in Europe.

Security

Internet2 and GÉANT2 work in close coordination on issues related to network operations security. The NYC/AMS link is just one of many monitored by the NOCs of the two networks. The Abilene NOC and GÉANT2 NOC have methods for contacting one another in response to observed incidents. The Abilene NOC and REN-ISAC monitor the Abilene network in the US, including connector and peering connections. As part of semi-annual operational and technical direction coordination meetings, Internet2 and GÉANT2 (along with ESnet and CANARIE) are planning an operational security exercise designed to further highlight areas where communications methods, security incident tools and procedures could be improved.

GÉANT2 security information is at <http://www.geant.net/server/show/nav.599>.
Abilene security information is at <http://abilene.internet2.edu/security/>.

NOC Operations

NOC operations for Abilene are handled by the Abilene NOC based at Indiana University: <http://abilene.internet2.edu/NOC/>.

NOC operations for the MAN LAN facility (through which Abilene and GEANT peer in New York) are also

handled by the Global NOC at Indiana University: <http://globalnoc.iu.edu/>

NOC operations for GEANT are handled by the GEANT NOC. Information about GEANT2 operations can be found at <http://www.geant2.net/server/show/nav.759>.

2.A.5. CHI/AMS Network Operations and Engineering

Usage

Multiple lightpaths, varying over time, run over this lambda. Several semi-permanent lightpaths supporting research projects − with bandwidths ranging from 150Mbps to 1Gbps − are using this link throughout 2005.

While L1 links cannot be monitored for usage, the CHI/AMS link goes from the NetherLight HDXc into the University of Amsterdam's (UvA's) Force10, for which Cricket usage diagrams are available. [Note: The Force10 was subsequently replaced in early 2006, so these statistics are no longer available.]

Similarly, the CHI/AMS link goes from the StarLight HDXc into the StarLight Force10, for which MRTG usage diagrams are available: <http://starlsd.sl.startap.net/mrtg/206.220.241.244_tengigabitethernet_1_1.html>.

Routing Policies

The CHI/AMS link is a 10Gbps lambda implemented between StarLight and NetherLight. Since no IP routers are on the lambda, there are no routing policies to report.

Peering Policies

Lightpaths are L1 point-to-point connections, so traditional peering policies don't apply. Instead, *peering* is based on the GLIF principle that resources are shared among collaborating participants; the owner of any resource decides on its use.

Measurement and Performance Tools

Lightpaths are L1 transmission pipes that cannot be measured optically; monitoring and measuring can only be done at L2 and above. The CHI/AMS link endpoints are currently monitored on the L2/L3 Force10 switches at StarLight and University of Amsterdam.

NetherLight is currently developing reporting tools for lightpaths cross-connected at NetherLight, but these tools are currently not available.

Security Event Reporting

Currently there is nothing to report.

2.A.6. Project Governance/Management and Oversight – Meeting and Conference Participation

TransLight/StarLight principals ensure that an efficient and effective project governing structure is in place throughout the award period to support all critical or significant project activities. To date, TransLight/StarLight principals have participated in several meetings and conferences to promote IRNC activities. Major activities are listed here.

October 18, 2005. Alan Verlo and Linda Winkler participated in the monthly JET (Joint Engineering Team) meeting.

October 16-November 7, 2005. Brown gave presentations on TransLight/StarLight and participated in several international Asia-Pacific, meetings, notably:

- PRAGMA-9 meeting, Hyderabad, India (October 16-24). Note: During PRAGMA, Brown met S. Ramakrishnan, Director General of the Center for Development of Advanced Computing (DCAC) of Pune University, who is also with India's Ministry of Communications and Information Technology, spearheading the GARUDA project on grid computing; he and his staff were very interested in iGrid 2005.
- Sathya Sai Institute of Higher Learning (SSSIHL) in Puttaparthi (near Bangalore), hosted by Radha Nandkumar of UIUC/NCSA (October 25-28)
- GLORIAD/Hong Kong Light (HKLight) meetings in Hong Kong (October 29-31)

- Chinese American Networking Symposium (CANS 2005), Shenzhen, China (November 1-2)
- CANS 2005 Extension program sponsored by Wuhan University, Wuhan and Yichang, China (Nov 3-7)

October 11, 2005. Julio Ibarra visited UIC while in Chicago to attend LHC meetings at FermiLab. He visited UIC to learn more about all our projects, and to discuss our complementary IRNC activities.

October 5, 2005. Tom DeFanti and Maxine Brown participated in an IRNC phone call to discuss status updates.

September 30, 2005. Maxine Brown met with Larry Smarr and members of the Chinese Academy of Sciences, particularly the Computer Network Information Facility (including BaoPing Yan, who is part of GLORIAD), at the Calit2 building on the UCSD campus, San Diego, California, at lunch during the GLIF meeting. This visit was organized by Peter Arzberger, head of PRAGMA.

September 26-30, 2005. Tom DeFanti, Maxine Brown, Alan Verlo, Joe Mambretti, Linda Winkler, Kees Neggers, Erik-Jan Bos attended and participated in the iGrid 2005 Workshop (Sept 26-29) and the annual GLIF meeting (Sept 29-30) at UCSD, San Diego, California. It should be noted that all IRNC-funded links were in use for real-time application demonstrations done during iGrid 2005. <www.igrid2005.org>

September 19-22, 2005. On behalf of TransLight/StarLight, Julio Ibarra presented an update of our activities at the International Task Force (ITF) meeting at the Fall 2005 Internet2 Member Meeting in Philadelphia.

September 14, 2005. Alan Verlo and Linda Winkler participated in the monthly JET (Joint Engineering Team) meeting.

September 12-14, 2005. Tom DeFanti, Joe Mambretti, Kees Neggers and Linda Winkler attended the NCO/LSN's Optical Network Testbeds Workshop 2 (ONT2) at NASA Ames,California, as well as Maartin Büchli of DANTE. Mambretti, ONT2 co-chair, gave a presentation on "OMNInet Roadmap" and DeFanti gave a presentation on "OptIPuter Roadmap," both of which involve international Dutch collaborations over the CHI/AMS TransLight/StarLight and SURFnet links. <http://www.nren.nasa.gov/workshop8/agenda.html>

August 31, 2005. Tom DeFanti and Maxine Brown participated in an IRNC phone call to discuss status updates.

August 19-23, 2005. Tom DeFanti attended the GigaPort Next Generation project's Scientific Advisory Committee (SAC) annual meeting in Amsterdam, of which he is a member. (SURFnet receives its funding from the GigaPort project, so the SAC is an oversight committee.)

August 16, 2005. Alan Verlo and Linda Winkler participated in the monthly JET (Joint Engineering Team) meeting.

August 10, 2005. John O'Callaghan (head of the APAC Australian supercomputer centers program), Rhys Francis (Manager of the APAC Grid Program) and Robin Stanton (Australian National University) visited UIC to learn more about our various projects, including TransLight/StarLight.

August 8, 2005. Takahiro Ueno, Yukihisa Osaka and Koichi Hiragami from the Network Testbed Advancement Division of NiCT, the Japanese agency that funds the JGN-II 10Gbps link from Tokyo to Chicago, visited UIC and StarLight to meet with Tom DeFanti and Joe Mambretti to discuss collaboration opportunities.

2.B. Research Findings

2.B.1. Research Findings for Current Quarter

iGrid 2005 and SC|05

Together with our IRNC siblings, we are supporting science and engineering research and education applications at major events and activities, notably the iGrid 2005 Workshop in San Diego, September 26-30, 2005, with follow-up plans for helping the research demonstrations at SC|05 in Seattle, November 12-18, 2005. For information on iGrid, see <www.igrid2005.org>.

iGrid Documentation

All iGrid 2005 participants have been asked to contribute a paper to the Elesvier journal *Future Generation Computer Systems,* to describe their experiences and lessons learned. That issue will be published mid-2006.

Global Lambda Integrated Facility (GLIF)

IRNC principal investigators and/or individuals from all participating IRNC institutions attended the 2005 GLIF meeting at iGrid 2005. Specifically, Tom DeFanti, Maxine Brown, Alan Verlo, Laura Wolf, Linda Winkler, Rick Summerhill, Erik-Jan Bos, Kees Neggers and Joe Mambretti attended from TransLight/StarLight; John Silvester and Ron Johnson attended from TransLight/Pacific Wave; Julio Ibarra and Heidi Alvarez attended from WHREN; and, Greg Cole, Natasha Bulashova and their Russian, Chinese and Korean collaborators attended from GLORIAD. Steve Wallace from Indiana University also attended, though not an official representative of TransPAC2.

One of GLIF's major engineering activities is to define GLIF Open Lambda Exchanges (GOLEs) that enable interoperability and interconnectivity of L1, L2 and L3 links. TransLight/StarLight's hubs in MAN LAN/New York, StarLight/Chicago and NetherLight/Amsterdam are GOLEs, connecting our 2 x 10Gbps lambdas as either permanent or configurable links.

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

TransLight/StarLight plans for November 1, 2005 – January 31, 2006, include:

1. Assist GÉANT and Abilene in any way possible to get 10GigE over the New York/Amsterdam circuit.
2. Work on iGrid 2005 journal articles.
3. Assist with SC|05 research demonstrations.

2.C. Research Training

National Research Network (NRN) management and engineers from Internet2, ESnet, DANTE and NLR 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 would afford. In addition, numerous researchers, middleware developers, network engineers and international NRNs are involved as users of TransLight. 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, journal articles, and conference presentations and demonstrations. We also provide PowerPoint presentations, and other teaching materials to collaborators to give presentations at many conferences, government briefings, etc.

Since 1986, EVL has partnered with NCSA, ANL, and more recently NU/iCAIR, 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 meetings. We have participated in European conferences (e.g., GLIF/LambdaGrid Workshops), 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 are the primary organizers of the iGrid 2005 in San Diego in September 2005, and plan to participate in the SC 2005 conference in Seattle in November 2005, to promote the goals of IRNC and TransLight/StarLight.

3. Publications and Products

3.A. Journals/Papers

None at this time.

3.B. Books/Publications

None at this time.

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, facilitating greater advances in global networking than single-investigator efforts could produce. TransLight developed its management team in the Chicago area (UIC/EVL), and leveraged the efforts of national networking groups (Internet2, ESnet and NLR) and international NRNs (DANTE and SURFnet) technical and administrative contacts.

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's OC-192 Layer-3 circuit among Abilene, ESnet and GÉANT provides greater connectivity, and the OC-192 Layer-2 circuit between StarLight and NetherLight provides a unique infrastructure to study the effects of long-distance, high-bandwidth networks on advanced applications.

4.C. Contributions to Human Resource Development

We promote TransLight through web documentation, journal articles, demonstrations and presentations at major networking conferences (e.g., Supercomputing, HPDC and Internet2), 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, STAR TAP has a mailing list of ~1,000 <stars@startap.net> individuals, from academia, government and industry, interested in information about international advanced networking developments.

4.D. Contributions to Resources for Research and Education

TransLight is a necessary and integral part of application advances and technological innovations for the Computational Science and Computer Science communities, as well as of major interest to network engineers. In particular, the Layer-2 TransLight circuit between StarLight and NetherLight represents a major resource for science and technology.

4.E. Contributions Beyond Science and Engineering

Because of TransLight's interest in advanced applications and light-path 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. Special Requirements

5.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.

5.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.

5.C. Unobligated Funds

Do you anticipate that more than twenty percent of the funds under your NSF award will remain unobligated at the end of the period for which NSF currently is providing support?
No.

5.D. 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.