**GLIF North American (GLIF-NA) Community Meeting**
**Thursday, October 2, 2008**
**GLIF 2008 Workshop, Bell Harbor Conference Center, Seattle, WA**
**Final Meeting Notes**

*Global Lambda Integrated Facility (GLIF): For almost a decade, the GLIF community has been at the forefront of developing and implementing advanced communication services, networks and facilities. GLIF's leadership activities have inspired National Research and Education Networks (NRENs) worldwide to enhance services to their constituencies based on GLIF models, technologies and best practices. GLIF has also had considerable influence on many equipment design considerations by major networking product manufacturers, in part through GLIF participation in its meetings and in standards' organizations. The North American members of GLIF (GLIF-NA) have been key participants in the design, development and operation of advanced services and facilities that have become the models for many national and local research and education network organizations. The GLIF community anticipates continuing its leadership role for the foreseeable future.*

*This was the second meeting of the GLIF-NA community. The first was held at the GLIF 2007 Workshop in Prague, Czech Republic, September 16, 2007.*

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## A. Meeting Objectives and Overview

This meeting of the Global Lambda Integrated Facility – North American participants (GLIF-NA) took place at the annual GLIF 2008 Workshop in Seattle. One goal of the meeting was to look ahead a few years (2010-2015) and project future GLIF/GOLE needs and capabilities

required to meet those needs. Another goal was to discuss ways to expand existing capabilities to more research and education sites and communities worldwide that do not yet have access to advanced services and facilities.

## B. Major Trends In North American International Connection Requirements and Communities Served, Projections for 2010-2015

From its inception, GLIF has taken a leadership position in creating new, "disruptive" communication services for its user communities, driven by community demand; particularly data-intensive e-science applications with persistent large data flows, real-time visualization and collaboration, and/or remote instrumentation scheduling. For example, the GLIF community advocated L1/L2 international networking very early, at a time when the concept was highly controversial and resisted by some traditional R&E networking organizations. Nonetheless, these services subsequently became very successful, are now widely accepted and used to provide services to many scientific communities, and are being adopted by some commercial providers in limited deployment. GLIF supported these disruptive innovations through demonstrations; e.g., GLIF annual meetings; specialized workshops, such as iGrid; and, at major national and international conferences, such as SC06, SC07, and SC08.

To determine new areas of opportunity, GLIF-NA meeting participants asked "What are the emerging trends?" Some emerging trends are demonstrated at annual GLIF Workshops – such as inter-domain control plane management, real-time eVLBI correlations, high-definition teleconferencing, and digital media distribution. There was consensus that the entire research and education community benefits from having the GLIF international community work in partnership to develop these capabilities. Given the time constraints of the meeting, participants were asked to identify and describe major issues/themes only and not discuss them; notably:

1. Continued development of dynamic provisioning, including inter-domain provisioning, a key focal point of the GLIF Technical working group, including its activities with standards organizations.
2. Requirements for current and future large-scale, data-intensive, international e-science projects, such as the need for large amounts of bandwidth capacity and the need for compatible, interoperable methods for dynamic provisioning/allocation
3. The requirement for large amounts of bandwidth capacity pertains to both enhancing capacity to existing sites as well as expanding capacity to new sites
4. The need for new architectures, technologies, and methods for inter-domain provisioning and related capabilities, such as resource discovery, resource identifiers, and resource monitoring
5. Other demand-side requirements are emerging, from the need to combine multiple large-scale distributed databases within shared environments, to providing new types of high-resolution digital media distribution techniques.
6. Many communities require sensor networks and new types of wireless services; wireless/ optical components are important, especially across domains, optical at the core with wireless at the edge
7. Networking security at all levels is a major concern
8. New monitoring and operations/performance (measurement) capabilities, especially at

L1/L2, are required
9. Need for networking services for cloud computing
10. Need for carbon-neutral computing and networking; GLIF may be able to provide useful solutions to these types of problems, such as providing networks to international computing sites that are environmentally advantageous
11. A historical focus has been EAST and WEST, and GLIF-NA should give more consideration to NORTH and SOUTH and NORTHEAST/NORTHWEST and SOUTHEAST/SOUTHWEST. (A question raised was: Is this concern actually part of GLIF's charter, as GLIF has primarily focused on high-end networking, not expansion of existing services to new areas.)
12. A major disruptive trend over the past 10 years was community owned and operated fiber. As L1/L2 services continue to be developed and deployed, what will be the trend for the next 15 years?

## C. Options for Addressing Requirements and Areas of Potential New Opportunity

Over the past 10 years, North American higher education and networking organizations have purchased thousands of miles of dark fiber. Internationally, there have been discussions of the potential for such organizations to buy/construct dark fiber as a consortium. The GLIF community may wish to pursue this. Although some underseas fiber companies do not want to sell fiber, others may be willing to do so. One option is for GLIF participants to join fiber-build consortia. For a large initial capitalization cost, major capacity could be purchased for a modest amount over the long term. It is important to join such consortia early in the process. Because of today's financial environment, there may not be much construction in the future, so it may be difficult to continue to buy fiber.

However, from a long-term perspective, such as 10 years, the US higher-education organizations could investigate purchasing transoceanic fiber. *Waiting for telcos to sell fiber to this community will result in cost-prohibitive pricing.* In the Pacific, the price to join a consortium may be $5M-10M. For some, the price may be as high as ~$250M. Some opportunities may have already been lost because consortia have formed; however, new consortia are always forming. If this strategy is pursued, it might be possible to approach administrators who manage endowments at institutions; the activity could be explained as an investment in the future of the institution to collaborate globally.

Today, IRNC members buy circuits individually, and it may be possible to achieve economies of scale by purchasing fiber or long-term leased waves (although the landings are typically at very different places so there isn't global competition). The community should not worry about economies; it should look for opportunities.

Utilization of capacity was discussed. On some circuits, traffic utilizes on average 10-15% of capacity, although it was pointed out that this is a typical utilization rate for data traffic, which requires large headroom for bursts. Utilization is also influenced by campus policies, which often have a single low-level rate limit for the whole campus network – whether students, administrators, or research faculty. Such policies should be more application oriented, taking into consideration major projects like LHC and eVLBI, which should have the potential to bypass

campus production networks. Note that GLIF bandwidth is, by definition, excess capacity, as applications and bandwidth funding are asynchronous, making capacity above that which is absolutely required available to the GLIF community.

A question was asked about creating a higher education multi-purpose "Tier 1" North American fabric – however, some meeting participants thought that higher education could not become a Tier 1 with only a national footprint. TransitRail and CPS are Tier 2s. If the community invests internationally to get robust capacity, GLIF-NA could become a Tier 1 provider. Is this an opportunity or a major problem? It is a concept worth investigating even if it is ultimately rejected. The more routes possible (e.g., TransitRail and CPS), the better – look at the trend line in this area. Goals are different for different types of services – e.g., interconnections and peering points for higher-education projects versus commodity Internet.

## D. Potential New Cooperative Processes to Allow the Community to Benefit from These Opportunities

It might be possible to form a consortium to buy international fiber. Buying existing undersea fiber would not be a good idea – it is unlike buying terrestrial fiber, as it would be necessary to buy the undersea cables and the landing points to make changes, which is impossible to do compared to terrestrial changes. It would be better to join a major consortium as it is forming. The overall cost model would have to be carefully considered; consortiums undertake **new** builds, which require major financial investments. Some undersea fiber providers might be willing to consider having this community as consortium members. If universities give funds for this type of investment, researchers would have to help make the argument. In any case, more must be done to educate/train researchers in networking in general. Many researchers are asked to deal with major network issues with no local support.

## E. Recommendations for the Role of the NSF Related to International Networking

Many of National Science Foundation's (NSF) large funded projects require international networking, which are already supported by GLIF-NA participants. A subset of these activities is supported by the NSF's IRNC program. NSF requested community input on its forthcoming IRNC2 solicitation, expected in April 2009, at a workshop chaired by Alan Blatecky and held in Washington DC in 2007. There was a meeting of GLIF-NA at the GLIF 2007 workshop in Prague, where IRNC2 was briefly discussed.

I2 sponsored a meeting in Denver in 2008, but attendance was small as not all those invited were able to attend, Several issues were discussed. One was that the last IRNC proposal development process could have been more productive, so it would be good to avoid the same issues in the next round; more specifically, that I2 not compete with its members by developing or coordinating proposals. Also discussed was the role of I2 in international networking. I2 has done a good job introducing the concept of R&E networking to countries that have not had an NREN, and should continue to do so. However, I2 should not manage international exchange facilities, and it was recommended that I2 phase out its management of MAN LAN (which receives a subsidy from I2). This recommendation subsequently led to a discussion among NYSERNET Board members, who expressed interest in taking over complete management of

the facility. NYSERNET has invested $20M, including fiber in Manhattan. The minutes of the Denver meeting have been distributed.

A question was raised about how GLIF-NA can make sure that existing Exchange facilities continue to be responsive to needs of their customers and ensure their future success. One answer is continued, ongoing communication with customers.

## F. Review of Fall 2007 IRNC Program Workshop and Report, and Additional Recommendations, Suggestions, Comments

The Fall 2007 IRNC Program Workshop organized by Alan Blatecky on behalf of the NSF produced a report, which has been distributed. The report is not comprehensive, and more suggestions are welcomed. The new NSF OCI director Ed Seidel has solicited additional comments and recommendations. There have been discussions on the small amount of NSF investment in this area and the potential for doubling the current $5M per year (which was recommended in the report). However, this amount still seems small compared to opportunities and requirements; perhaps it should be quadrupled? *How can this community ensure that the report be related to the next solicitation?* GLIF-NA meeting participants recommended that NSF pay attention to the advice given in the Workshop report.

A key question is whether NSF can/should increase its investment. The GLIF-NA community has significantly augmented NSF funding – through other NSF program grants but also through major additional local investments. GLIF-NA should develop a long-range strategy that includes NSF's IRNC investment and puts it in perspective. NSF's level of funding is generally considered only within the context of its programs and not within an overall strategy. A more complete picture would show how the GLIF-NA community enhances NSF's investments. "It is not possible to build this research house on the 3rd floor" – NSF needs to build the foundation, and the foundation should be larger than it currently is. Researchers report that, while important, the IRNC infrastructure is at times difficult to use – they need additional technical support, which could be provided by graduate students. Unfortunately, while the previous NSF HPIIS international program paid for graduate students, the current IRNC program does not. IRNC only supports professional technical staff.

NSF should provide funding for advanced high-risk services and technology, not just traditional services and resources. NSF should fund the measurement of more routes, not only the measurement of unused bits. The current measurement model does not capture the total level of activities, especially high-volume L1/L2 traffic for specialized applications.

## G. Recommendations for I2's Role Related to the IRNC

At the Denver meeting, it was noted that I2 introduced the concept of an NREN to a number of countries, particularly developing countries that had been supporting R&E through ISPs. I2 also explained the importance of international R&E networking – NREN to NREN. I2 should continue to help create NRENs in countries that do not have them.

Some countries have multiple NRENs, which leads to difficult issues. For example, I2 could sign

an MOU with a single NREN or with all of them. With countries with multiple NRENs, I2 requests that they work together. For example, in China, the NRENs agreed to mutually work together – which is a different issue than connecting them technically. Also, I2 connects with ANSP, the Sao Paulo network, as well as the Brazilian network RNP. For some countries, a signed MOU precludes individual connections outside that agreement. Perhaps having bilateral peering, like in Seattle and LA, should not only be made possible but encouraged.

It was noted that some major international R&E networks are not NRENs, but networks formed by individual institutions/consortiums. For example, CERN has connections to the US and it is not an NREN. Given technology trends, more such networks are anticipated. Another example of this model is an organization or consortium that wants to bypass its NREN. What is the response? And, what if that NREN requests that the international community not accept the link (perhaps wanting an exclusive direct connection to a specific institution to share costs)? These are policy considerations for the international networking community to discuss.

Other questions are: What is the current level of transit traffic across existing international networks? Are there any major change trends that have been seen or that are anticipated? Certainly, large-scale growth in traffic is continuing.

## H. Recommendations for the NLR's Role Related to the IRNC

NLR provides large-scale capacity to the major US GLIF GOLE exchange points. NLR demonstrated leadership in providing high-capacity infrastructure, has shown the advantages of consortium-owned infrastructure, and in advancing L1/L2-based service capabilities. NLR provides multiple 10Gb lightpaths on which vLANs can be implemented. vLANs are increasingly popular with scientific communities and are important for large-scale demonstrations. A potential role for GLIF is to assist with coordinating vLAN numbers. It has been suggested that a process for vLAN mappings be implemented at GigaPoPs. The GLIF Tech Working Group is defining a process to reserve vLAN designation blocks.

NLR may have a role in purchasing international networking capacity and selling it to others, and helping to connect global communities in a much richer way. NLR currently supports multiple major research network testbeds.

The NLR has a major initiative with Darkstrand, a corporate networking entity, to provide interconnections between R&E communities and corporations working on cooperative projects. This initiative could benefit international connections, as well.

I2 and the NLR established a healthcare initiative with FCC, which provided funds to connect many types of heath-care organizations (e.g., hospitals), via existing or newly established advanced health-care networks. In part, FCC funding enables local and state-wide networks to connect these institutions to the national R&E networks. The establishment of a national health-care network is also being considered. Similarly, an international health-care network could be considered. The majority of regional networks have endorsed these plans.

This leads to discussions about economic development, and raises policy issues from the

perspective of the Regionals – some of which may not want to be involved in economic development. Discussions on this topic are continuing.

## I. Recommendations for the US GLIF GOLEs

The GLIF GOLEs provide reliable production-level services and operations. However, if IRNC2 requires fail-safe guarantees for service, NSF should consider providing the US GLIF GOLEs with additional funding for increased technical support and network redundancy. The GLIF GOLEs, in cooperation with international GOLEs and the GLIF Technical Working Group, have been designing and implementing innovative processes for dynamic provisioning, including inter-domain, which are being migrated to standards' bodies. They have also been demonstrated at multiple national and international conferences. A major opportunity exists to fully automate these processes and implement them at other locations. As part of this process, techniques could be implemented to enable GOLEs to back each other up as standard operating procedure.

## J. Potential for A New Services Model Across International Facilities, Especially for Large-Scale Research Projects, and the Potential for a Distributed GLIF GOLE NOC and Related Processes

It is important for the wider networking community to realize that "big science" communities can and should have their own networks. Technology is becoming more complex as it is becoming more powerful. A macro trend is virtualized networks where the networks are provided to communities and individuals – not merely the connections but also the control and management planes for all network resources. These types of networks can be made simpler to deploy to scientific research communities.

Distributed NOC processes (handled both via better inter-communication and via automation) can help realize this objective. Inter-communication among GOLEs can be enhanced – not merely better personal communications. Currently, much GOLE inter-communication is conducted via emails, phone calls, and two GLIF Tech working group meetings yearly. These types of communications can be replaced with more formalized and automated methods. Escalation procedures are also required; i.e., calls to reach appropriate responders for specific issues. A draft framework could be created for these processes that would provide more than standard network tools and services; e.g., an engineer in Korea could fix a problem at StarLight because it's night in Chicago and the appropriate local responder would have to travel to the facility if not for the intervention from Korea. For over a year, GLIF GOLEs had monthly phone calls, but those calls were terminated because immediate core issues were resolved. The GLIF GOLE community is very project focused (as they are not funded to work on overall GLIF activities, but do the best they can in addition to their regular jobs). They tend not to have meetings and conference calls for their own sake, but to discuss issues related to specific incidents, projects, events, demonstrations, and/or trials. Currently, every connection is a "one off" implementation. However, a major level of standardization of processes exists, and there is no reason to standardize all procedures, as such monolithic approaches are suboptimal. ESnet has processes in place to simplify its tasks. Individual GOLEs have also implemented methods that work for them locally.

Further discussions would be useful to address common GLIF operating issues. In the past, there was a proposal that the GigaPoPs all do things the same way – but it was determined that this approach would be suboptimal. A better approach would be to have each GigaPoP provide the best services and processes for its customers; e.g., StarLight and PNWGP allow their customers to connect their networks to their facilities the way they want/require, with no artificial constraints. It is inevitable that complexity will get greater, yet this will lead to richer, more powerful communication services.

## K. Review of Recommendations, Final Items, and Summary Schedule for Next Meeting

A commitment was made to develop, review and distribute a draft of the meeting notes and then distribute before finalizing.

Perhaps a future GLIF-NA meeting might be held if/when IRNC2 is announced in the Spring (potential dates could be distributed as part of the review of the meeting minutes). Another meeting will be scheduled to coincide with the GLIF 2009 Workshop in Korea in October 2009.

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