America Connects to Europe (ACE)
(ACI - 0962973)
Annual Report 2013
March 1, 2013 through 28-February-2014
(Including Fourth Quarterly Report Data)

Jennifer M. Schopf – Principal Investigator

(Prepared by Jennifer M. Schopf and Alice Jackson)

Summary

During the fourth year of the project, March 1, 2013 – Feb 28, 2014, the America Connects to Europe (ACE) project continued its collaborative and engineering activities to support international research. This report outlines collaborations, software and systems work, operational activities, and usage statistics for the project. Highlights include hiring a new director, some additional staff changes to accommodate work funded by a supplemental award, significant outreach to application end-users, a strengthened approach to both active and passive monitoring, significant SDN experiments, and extended collaborations.

1. ACE Overview

The America Connects to Europe (ACE) project supports a series of circuits and services between the US East coast and Europe. In the current set up, these circuits are:

- Three 10G circuits between WIX (McLean, VA) and Frankfurt. These circuits are lagged together and load balanced for performance, and sometimes they are reported on as a single unit. Two of these links are funded by NSF, the third is an in-kind contribution by GEANT.
- Three 10G circuits between MAN LAN (New York City) and Amsterdam. These circuits are lagged together and load balanced for performance, and sometimes they are reported on as a single unit. One of these links is funded by NSF, the other two are in-kind contributions by GEANT.One 10G circuit between Paris and New York to connect Internet2's ION service to GEANT's AutoBAHN service and provide bandwidth on demand services for researchers. This circuit is fully funded by GEANT.
- One 10G circuit between StarLight in Chicago and Amsterdam for use in SDN experiments. This circuit is fully funded by NSF.
- The 10G NSF funded circuit between New York City and the London Open Exchange was discontinued, as detailed in Section 5.

These circuits are used in production to support a wide variety of science applications, including but not limited to physics (LHC), astronomy (e-VLBI), and biomedical research (GENIUS). Overall, this award supports tool development, software defined networking (SDN) experimental work, and measurement and security activities.

On August 1, 2013, ACE received a $600,000 supplement from NSF to provide engineering, application support, and service development for the use of the Advanced North Atlantic 100G (ANA-100G) link between MAN LAN in New York City and NetherLight in Amsterdam. This funding will enable network engineers and end-user

scientists with large data flows to better understand how 100G circuits between continents can be used effectively.

Please note that some of the activities (outreach to Africa, PerfSONAR training, etc.) are also included in the TransPAC Annual Report, as appropriate, as joint funding supports these efforts.

2. Staffing

At the beginning of the year, project staff consisted of:

- Jim Williams, Director
- Andrew Lee, primary ACE senior network engineer
- John Hicks, primary network research engineer
- Chris Small, part time network researcher
- Scott Chevalier, primary contact for GlobalNOC support desk
- Alice Warner, administration
- Eric-Jan Bose, European network consultant
- Gabriel Iovino, REN-ISAC staff member
- Wesley Young, REN-ISAC staff member
- Doug Pearson, REN-ISAC staff member

Several significant staffing changes took place this year.

Jim Williams retired as the director for this project on August 30, 2013. He was replaced by Dr. Jennifer Schopf, who was hired on August 1, 2013. She has held positions at IEEE Computer Society, the US National Science Foundation (NSF), the Woods Hole Oceanographic Institution, the UK National eScience Center, Argonne National Laboratory, and Northwestern University. She began a project overview upon arrival, which is ongoing.

Starting June 1, 2013, Dale Smith was hired on as a consultant to assist with recruitment and interviewing for the new director, to assist in the transition from the old director to the new director, and to offer advice on work in Asia-Pacific and Africa. This is ongoing. His expertise in part makes up for the lose of Eric-Jan Bose, who stepped down as a consultant in September 2013 for family reasons.

John Hicks began a new position with Internet2 on February 1, 2014. Andrew Lee is transitioning to full time on the ACE project to pick up the work that John Hicks previously covered.

After consultations with GlobalNOC staff, Von Welch (Center for Applied CyberSecurity Research), and members of the ESnet team involved in security work, a re-evaluation of security staffing was performed, and the value contributed by the REN-ISAC staff was found lacking. They had had no direct activities related to ACE to report many months running, and upon consultation with them could not enumerate a work plan with Schopf. As such, Schopf terminated the contract paying REN-SAC staff members as of November 30, 2014. ACE will continue to receive basic REN-ISAC updates via the contract with the GlobalNOC, and if needed Welch offered staffing support for any security planning in the future.

As part of the supplemental funding, several staff members joined the team including Robert Henschel, Manager for High Performance Applications in the IU Research Technologies Division, was brought on part time to coordinate work between the ACE

group and collaborators in this space. Two of his staff members were also brought on to the ACE team. Abhinav Thota will be working half time with Lustre application users in larger than 10G flows and Arvind Gopu, who is working half-time directly with end users to support them in adjusting to larger networks. Discussions are still underway with the systems engineering group to contract for support for 100G PerfSONAR updates.

Dan Doyle and Michael Johnson started working on ACE-related PerfSONAR work in January, 2014. This work is funded by the ACE supplemental award and is focusing on cross US-EU deployment of PerfSONAR, including the combination of the US PerfSONAR PS and EU PerfSONAR MDM versions, which are not compatible. They will also be working on extensions to PerfSONAR to enable greater than 10G measurements.

Chris Small shifted from working with ACE to being a full time employee of the IU InCENTRE project in July 2013, with a focus on SDN research.

So with these changes, the current staff chart is:

- Jennifer Schopf, Director
- Andrew Lee, primary ACE senior network engineer
- Scott Chevalier, primary contact for GlobalNOC support desk
- Alice Warner, administration
- Dale Smith, network consultant
- Robert Henschel, coordination of 100G work
- Abhinav Thota, Lustre over 100G
- Arvind Gopu, application support over 100G
- Dan Doyle, PerfSonar support
- Michael Johnson, PerfSonar support

3. Collaborations, Travel, and Training

Over the year, the group participated in many international conferences and training sessions. Quarterly reports include the details for meetings before Dec 1, 2013. These included:

Large international meetings:

- Hicks and Williams attended the Internet2 members meeting, Washington DC, April 2013
- 6th GENI Engineering Conference (GEC) held March 19-21 in Salt Lake City
- Williams and Hicks attended the TERENA conference in Maastricht, Netherlands
- Schopf, Hicks, Henschel, Gopu, and Thota attended SuperComputing and its associated workshops in November 2013 in Denver, CO

Smaller collaboration meetings

- Collaborative meetings at IU with members of the UbuntoNet Alliance, KENET, and MARWAN, April 2013
- Williams attended the Orient+ launch event in London, May 2013
- Dale Finkelson, Internet2, on behalf of the ACE project traveled to the LHCOne and associated LHC activities meetings in Geneva in late May and to Paris in June

- Hicks attended the Chinese American Network Symposium (CANS) meeting in Hangzhou, China, August 2013
- 15-year Global NOC celebration was held at IUPUI in September
- Schopf attended a 2-day meeting with ESnet staff at Lawrence Berkeley Lab in September.
- Schopf attended the Earth Systems Informatics Partnership (ESIP) winter members meeting in January, Washington DC. This is a pre-cursor to the IU International group becoming a member of ESIP.
- Schopf visited Cambridge, UK for a series of collaborative meetings DANTE/GEANT in February 2014. This meeting laid the ground work for extended collaborative work in PerfSONAR joint deployments, applications using the 100G trans-Atlantic testbed, and future trans-Atlantic circuit capacity planning.
- Schopf, Doyle, and Johnson attended an NSF-supported PerfSONAR meeting during which plans were made for a US-EU combined PerfSONAR version demo for the May Terena meeting.
- Schopf attended a collaboration meeting with other senior members of the IU Networks group and Internet2 in Washington DC, February 2014. This meeting established roles and relationships for additional collaboration in international circuits and outreach.

Training:

- Hicks, PerfSONAR for South African NSRC meeting, April 15-19
- Sweeny, Open Flow for OIN training, Washington DC May 2013
- Hicks taught a one-day performance workshop for the InCENTRE Summer of Networking (SoN)
- Hicks assisted with PerfSONAR training for the Open Science Grid (OSG) in October 2013
- Hicks helped the NSRC with PerfSONAR training at their December 2013 meeting in Tunisia
- Sweeny assisted with the Operating Innovative Networks (OIN) training workshops in Los Angeles, sponsored by UCLA and USC on January 29-30, 2014 and at LBNL, co-sponsored by CENIC and Lawrence Berkeley National Laboratory, on February 27-28, 2014

In addition to these formal meetings, as part of the supplemental work Gopu, Henschel, and Schopf continue to identify and collaborate with scientific application groups interested in larger than 10G international data transfers. This work began at a kick-off meeting for the grant as part of SC'13, but have continued with a variety of application projects, including:

- Ongoing video conferences with representatives of USATLAS and USCMS (LHC) supporting LHCONE in part;
- Assistance with the PanSTARRs project to evaluate their cross-Atlantic data transfer approach;

- Fortnightly meetings with representatives of DANTE to cross-connect with their application groups;
- Phone calls with Belle II project, whom we expect to collect data transfer statistics later this spring;
- Initial contacts with representatives from the European Bioinformatics Institute (EBI), with formal project planning to begin in April; and

One of the challenges we are facing with these projects is the difficulty in acquiring and retaining expensive networking gear (typically on loan) and associated cyberinfrastructure which are necessary to connect to, and take advantage of, 100Gbps links such as the ANA-100.

4. Software and Systems Work

A. Tool Development and Acquisition

The development of new and expanded GlobalNOC tools, funded in small part by ACE, continued throughout the year. The most notable release was the next generation of the GlobalNOC's database, DB2, which was officially launched in Spring, 2013. A new schema allows technicians to more easily view information tied into the DB and will simplify many of the steps for searching that were previously part of the Service Desk workflow.

Through the supplemental funding, an IXIA 100G tester was purchased. IU staff were trained in the use of this tester in January, at which time the project sought to deploy it at MAN LAN, as was originally suggested in the supplemental proposal. Negotiations are continuing with Internet2 as to the costs and conditions of this placement, which we hope to have resolved shortly.

In December, development work for PerfSONAR began, in part funded by the ACE supplemental award, specifically looking at modifications for the merged versions of PerfSONAR, updates needed for a trans-continent deployment, and adaptations for better understanding of performance over 100G networks. As part of the larger PerfSONAR development team, Doyle and Johnson worked on testing new releases of the toolkit related to patch the NTP mirror vulnerability along with testing of several releases of newer upstream kernels for security patches that required the pS team to patch for a perfSONAR environment (integration of web100 and AuFS). The IU team was also responsible for creating and patching one of these kernels and did so successfully. The developers were tasked with analyzing the web100 kernel's use by perfSONAR tools and whether there were other mechanisms with which to get the same information but without the overhead of web100. This resulted in an internal document describing web100 perfSONAR functionality and alternative data sources. The IU developers also performed integration testing of a version of the NDT client a third party organization had written that used a flash based client instead of the Java one in hopes of replacing the Java one. Ultimately this was unsuccessful on because the flash version had insufficient performance and functionality. Finally, the IU team began taking shifts of the "Person of the Week", whose function is to be responsible for monitoring the various user support lists and ensuring that a response is given in a timely manner, whether escalating to others developers or handling the question personally.

B. Software Defined Networking (SDN) Activities

Over the course of the year, SDN activities expanded primarily using the circuit between StarLight (Chicago) and Amsterdam. Early in the year, this circuit transitioned from the legacy WAN-PHY to a LAN-PHY circuit, which simplified the path and circuit management. We installed an NEC switch that enabled OpenFlow capabilities previously not available from Chicago to Amsterdam. Figure 1 shows the current SDN architecture for the ACE links.

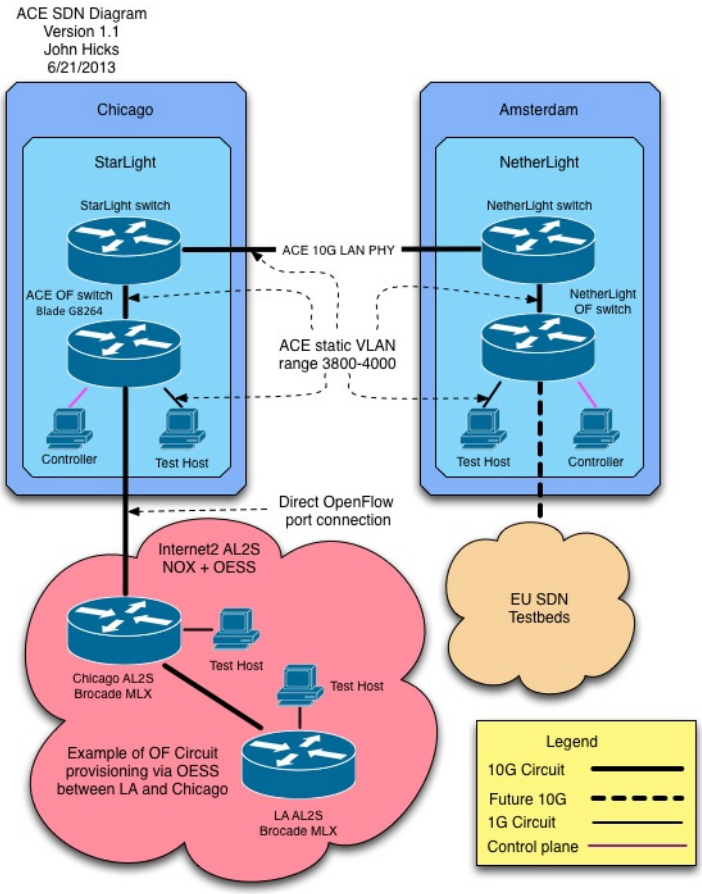

Figure 1. Chicago to Amsterdam circuit used for SDN experiments.

Demonstrations of OpenFlow capabilities, primarily connecting Internet2's AL2S to the OpenFlow testbed at SARA in Amsterdam, took place throughout the year. This also extended OpenFlow connectivity into Europe to other OpenFlow testbeds, including using GÉANT. Our primary partners were Internet2 and SURFnet. Hicks presented this work at the GLIF session of the 2013 Terena meeting, SC13, and CANS. The SC demo that had originally been planned included transferring data between Tokyo, the US, and Amsterdam using OpenFlow and dynamic circuit technologies, however a cut circuit between the US and Europe meant that demonstration only took place on TransPAC links. These demos are laying the groundwork to provide a transparent data movement over long distances using advanced network technologies for end users with large data flows.

We installed an Inter Domain Controller (IDC) at MAN LAN, which makes it possible to create dynamic circuits through MAN LAN using OSCARS. This will enable us to provide Layer 2 Virtual Circuits dynamically instead of relying on static services. US researchers

using the Internet2 ION facility will now be able to create dynamic circuit to Europe using the ACE networks.

The LHC community started a Working Group, at the early summer meetings, to help understand how an OpenFlow environment could be of use to the LHC Open Network Environment (LHCONE) project. This involves both understanding how to provision and use Inter-Domain circuits, such as the ACE circuits, and how to make the applications take advantage of SDN capability. ACE staff continues to participate in these ongoing discussions.

C. Measurement Activities

Despite ongoing discussions over the prior year, when Schopf joined the project there was little monitoring information available on the primary ACE links, out of WIX and MAN LAN. Through ongoing discussions with both Internet2 and Dante, there are now installed perfSONAR deployments, with the expectation that they will be fully interacting for the Terena Conference in May 2014. A piece of this work has been the political discussions surrounding the combining of the US and EU perfSONAR versions, which are not compatible. We anticipate a fully functioning test mesh in May or June, 2014.

We have also been advancing the discussions of capturing FLOW data on the primary ACE links. Schopf began these discussions with Internet2 to capture this data from the US side in November 2014, and talks are currently stalled awaiting the new Internet2 Data Privacy policy to be published. There is concern that even data anonymized to the level of the university could be seen as a privacy violation by Internet2 members. Members of the Dante team have offered to collect this data for us instead, and are putting in place the infrastructure needed to collect this automatically at intervals as their privacy policy only lets them store a limited window of data at a time.

Basic monitoring on the MAN LAN to Paris link was initiated August, as shown in Figures 7 and 8. In addition, basic monitoring of the third 10G circuit between WIX and MAN LAN was added at that time as well.

D. Data Transfer Protocols over 100G

As part of the supplemental work focused on use of 100G circuits, the group started up work looking Lustre tests to support the Basic Local Alignment Search Tool (BLASTn). A wide area Lustre file system was mounted from IU onto Blacklight at the Pittsburgh Supercomputing Center and on a server in TU Dresden, Germany, and RWTH Aachen, Germany. The experiments were run on the regular 10Gbps research network as well as the ANA-100 link, and found our experiment ran 35.6% faster over two runs (actual runtimes are shown in Figure 2). We were able to run the experiment only twice because our partners in Aachen had to return their borrowed networking hardware connected to the link. We are currently working on repeating this experiment with our endpoint in Dresden, Germany.

We performed bandwidth throughput testing between IU and TU Dresden to estimate the maximum bandwidth to be expected for the transfers and to identify possible bottlenecks, using a combination of the dedicated 100Gbps link between TU Dresden and MAN LAN, and the production Internet2 link between MAN LAN and IU Bloomington. We achieved a throughput of 70Gbps using iperf.

Additional work investigated the I/O characteristics of BLASTn on a Lustre filesystem.

The Lustre filesystem attempts to read ahead of the application's read requests, and we are trying to verify if this behavior is beneficial to the BLASTn application's performance, and if applications with similar characteristics can generally benefit as well.

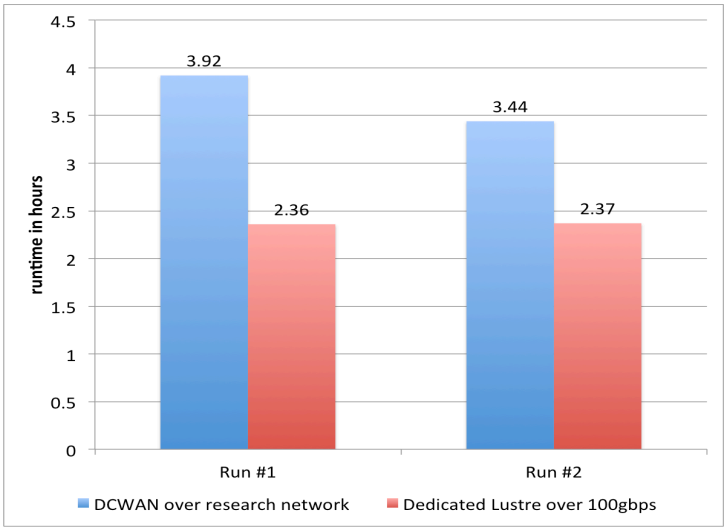

Figure 2: Lustre experiments between the US and Germany. The blue bar shows the regular research network using the DCWAN production file system and the red bar shows the runtimes using the ANA-100 link and a dedicated Luster file system, with a 25% improvement.

Discussions with the Globus Online team and the system administrators at IU who maintain a commodity Globus Online service (currently over 1Gbps) to chalk out a path for testing the protocol/service over the ANA-100 link. We are registered to participate in the Globus World workshop to be held in mid-April at Argonne National Laboratory, with an objective of advancing our collaboration with the Globus team.

5. Operational Activities

Overall, the production ACE circuits performed well during year. There were some outages, detailed in Section 5.D, however the redundancy built into the ACE project prevented those outages from causing any user level degradation in service. During this period there were no operational difficulties with any of the exchange points where the primary ACE circuits land, although the Chicago-Amsterdam circuit had some significant problems, as detailed below.

A. Circuit Procurement

Three new circuits were provisioned this year.

First, an additional 10G service from Washington to Frankfort was installed. This has resulted in 60G (3x10 + 3x10) of bandwidth as part of the core ACE service, between the US (from MAN LAN and WIX) and the EU (via Amsterdam and Frankfurt).

Second, a new circuit from Chicago to Amsterdam was installed for use as a testbed for SDN experiments. This upgraded the prior circuit that had been inherited from the previous IRNC award in this area.

The third circuit that was procured was a new 10G circuit to connect MAN LAN in New York to the London Open Lightpath Exchange (OLE). This circuit was intended to provide better connectivity between the US and the Africa UbuntuNet. However, UbuntuNet decided not land their circuit on the London OLE, and at the time of this writing appears to have no intention to do so in the near future. In addition, there was almost no traffic on this link (see Figures 7 and 8). Based on this information, Williams made the decision to terminate the circuit, which took place in November.

ACE circuits continue to provide valuable backup paths for other projects. Sweeny worked with GÉANT, CERNET (the owners of the TransPAC Los Angeles –Beijing circuit), and Internet2 engineers to design, validate, and engineer a backup path for Internet2 to GÉANT through the 5Gbs Orient+ path through CERNET. Although not part of the original design for Orient+, this is a useful outcome to increase the available backup paths for the associated links. This project was a great example of China-EU-US collaboration, and laid the groundwork for future projects.

B. Significant Downtime Issues

The majority of the ACE circuits provide exceptional uptime statistics, and have redundancies built in so small disruptions have little impact on the performance of the links. The exception to this is the Chicago to Amsterdam circuit.

Zayo, the contract provider for this circuit, continues to have difficulties keeping the Chicago-Amsterdam link fully operational. Between February 28, 2013 and April 17, 2013, the link was unavailable a number of times, often for days. In addition, there was a 5 week outage in September to October 2013 for service to a set of repeaters. This link was also impacted by a fiber cut for 3+ weeks in November, leading up to SuperComputing ’13 Over the course of the year, we have had many meetings with Zayo representatives, have re-worked their downtime contact lists and procedures, and even argued successfully for a small reimbursement for the extended October downtime. However, as the circuit was contracted for with out an SLA (in part due to its primary use as a circuit for experiments), there has been little recourse open to us. In general, we have been very disappointed with the stability of this link and will be avoiding this vendor in future contracts.

B. Traffic Graphs

Figures 3 and 4 show the aggregated traffic for the three 10G circuits from WIX to Frankfurt. The circuits are lagged together to create a total capacity of 30Gbps. 5es 4 and 6 show the aggregated traffic for the three 10G circuits from MAN LAN to Amsterdam. The circuits are also lagged together to create a total capacity of 30Gbps.

In addition to these 6 circuits, ACE supports three other circuits. The first circuit is the New York to London link, which was terminated on November 7. Traffic is shown in Figures 7 and 8. The New York to Paris link is funded by the GEANT project to support Internet2’s ION service to GEANT’s AutoBAHN service, and Figures 9 and 10 show that traffic. The third is a link from Chicago to Amsterdam, which is used as a test-bed for SDN. The usage of the Chicago to Amsterdam link consisted of lightpaths for many diverse projects involving US-funded and Europe-funded projects. The VLAN assignments on this link are presented in Appendix A. Traffic information for this link is not available.

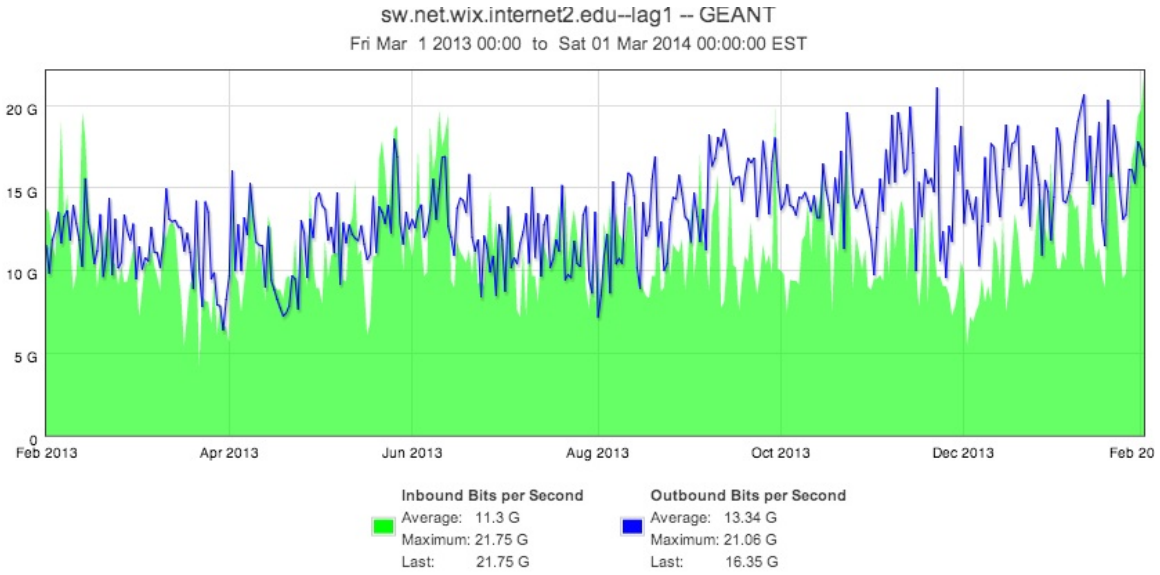

Figure 3. Aggregated traffic using maximum daily values on the 30G Lag between WIX and Frankfurt for February 1, 2013 through February 28, 2014.

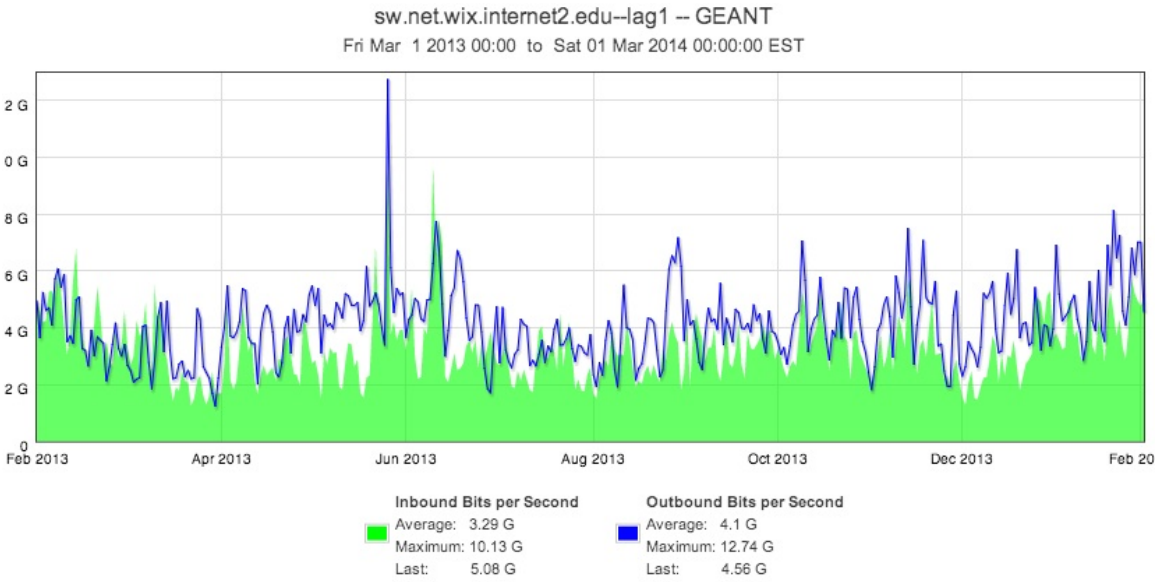

Figure 4. Aggregated traffic using smoothed daily average values on the 30G Lag between WIX and Frankfurt for February 1, 2013 through February 28, 2014.

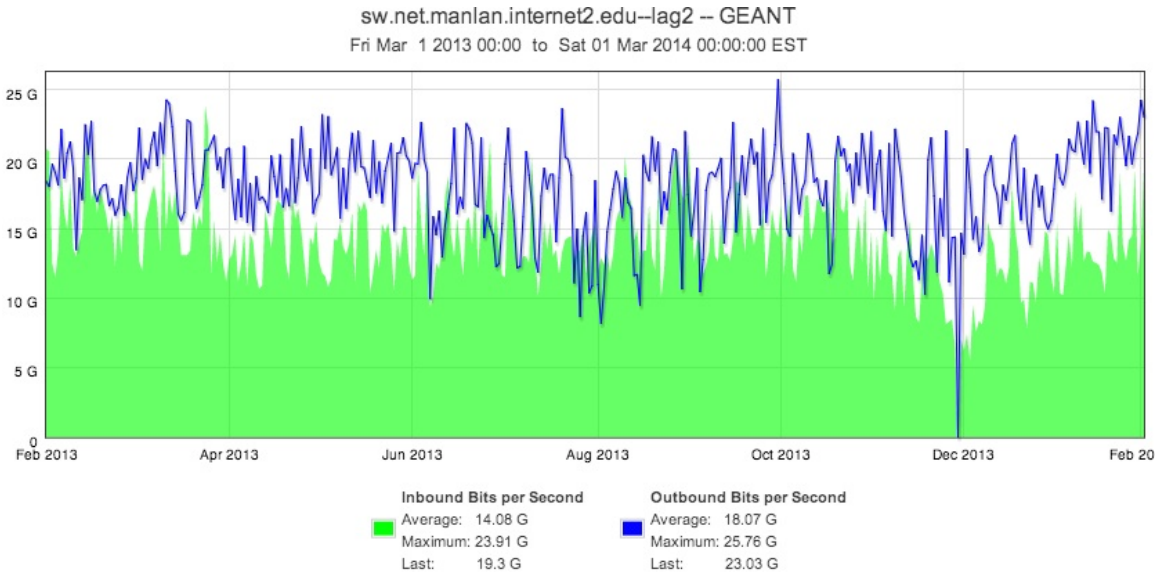

Figure 5. Aggregated traffic using maximum daily values on the 30G Lag between MANLAN and Amsterdam for February 1, 2013 through February 28, 2014.

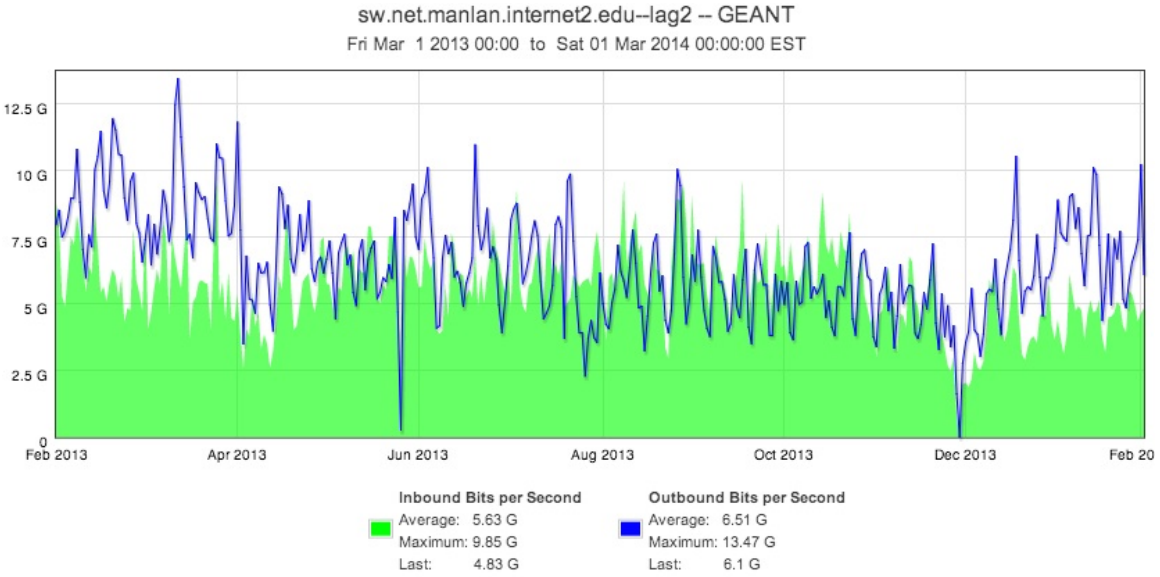

Figure 6. Aggregated traffic using smoothed daily averages on the 30G Lag between MANLAN and Amsterdam for February 1, 2013 through February 28, 2014.

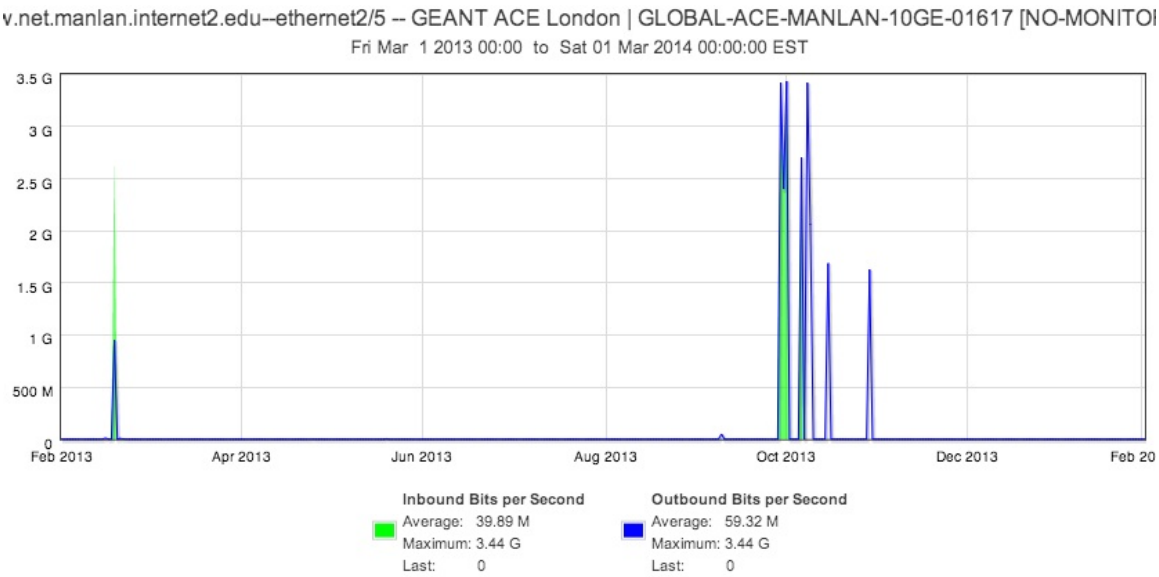

Figure 7. Aggregated traffic using maximum daily values on the 10G circuit between New York and London for February 1, 2013 through February 28, 2014. The link was terminated in November 2014. Please note scale of Axis.

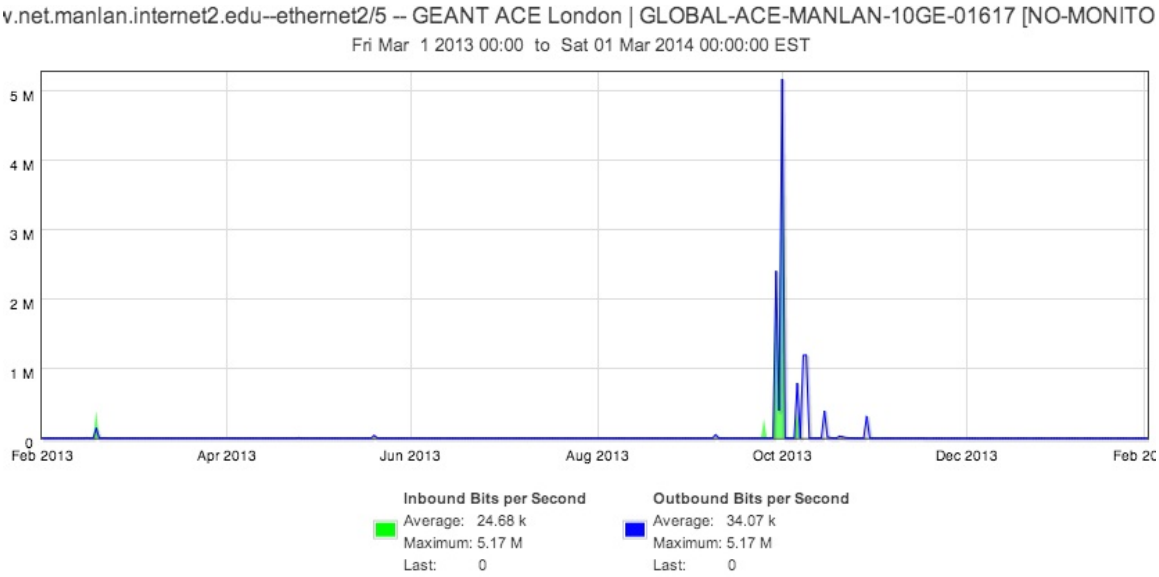

Figure 8. Aggregated traffic using smoothed daily averages on the 10G circuit between New York and London for February 1, 2013 through February 28, 2014. The link was terminated in November 2014. Please note scale of Axis.

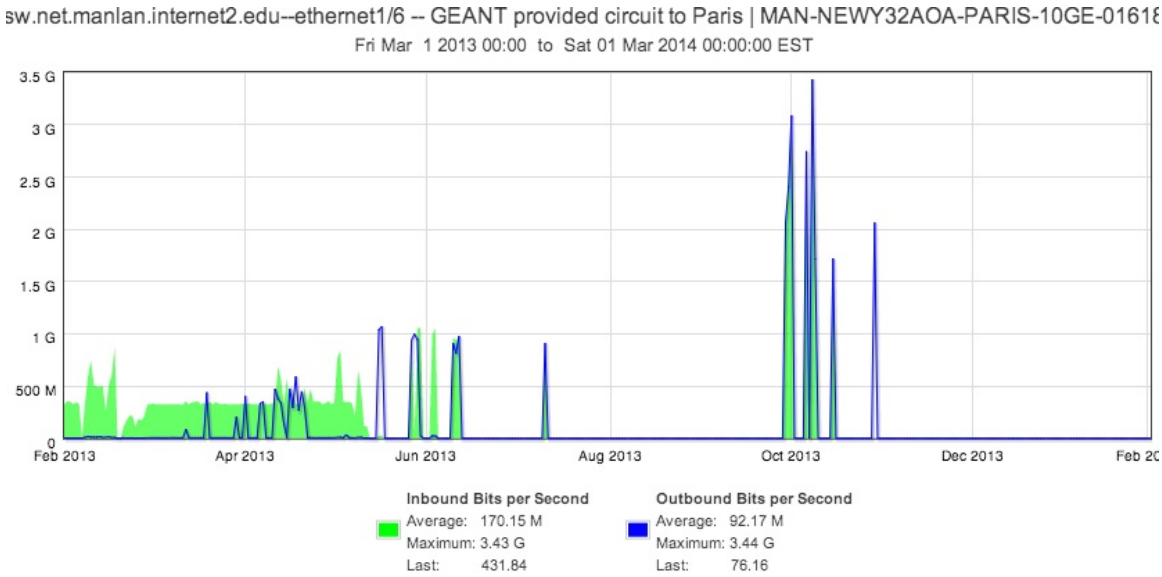

Figure 9. Aggregated traffic using maximum daily values on the 10G circuit between New York and Paris for February 1, 2013 through February 28, 2014. Please note scale of Axis.

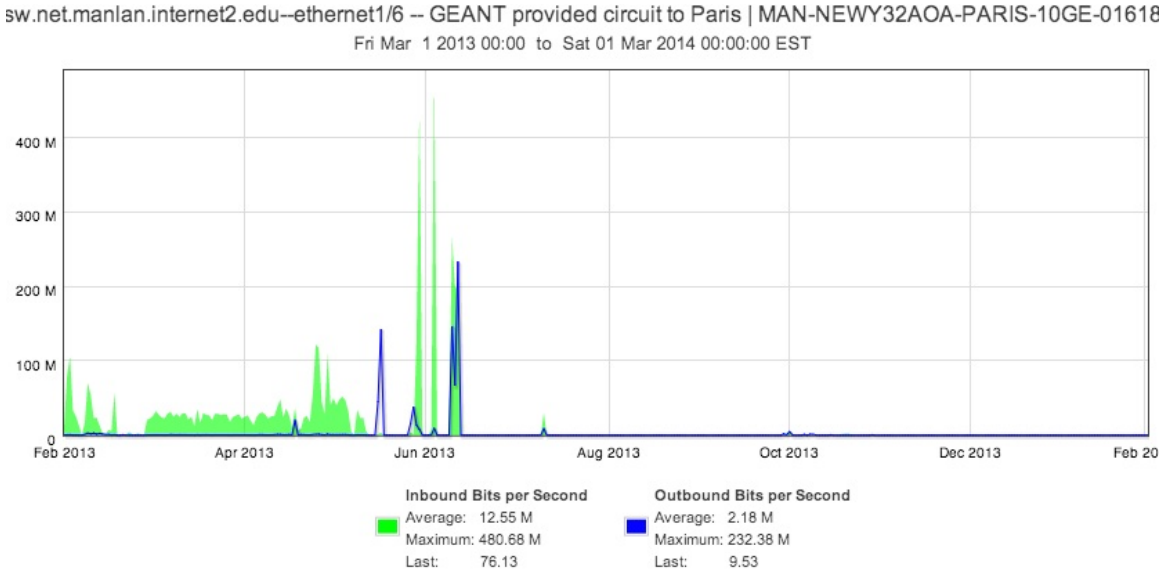

Figure 10. Aggregated traffic using smoothed daily averages on the 10G circuit between New York and Paris for February 1, 2013 through February 28, 2014. Please note scale of Axis.

C. Trouble Tickets

Over Project Year 4, there were 23 tickets for unscheduled maintenance, detailed in Table 1, and 21 tickets for scheduled maintenance, detailed in Table 2. Table 3 shows a summary of the number and type of tickets by quarter. Additional trouble ticket information is available at https://tick.globalnoc.iu.edu/fp_tools/public_ticket_viewer/index.cgi .

Ticket Number	Customer Impact	Network Impact	Title	Outage Type	Source Of Impact	Start Time (UTC)	End Time (UTC)
168	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 Outage Resolved	Unannounced Maintenance	Vendor	03/13/2013 11:01 PM	03/14/2013 12:50 AM

171	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-MANLAN-O192-01500 Instability Resolved	Undetermined	Vendor	03/14/2013 10:55 AM	08/09/2013 1:00 AM
181	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 Outage Resolved	Circuit - Damaged Fiber	Vendor	04/02/2013 7:12 PM	04/03/2013 1:52 AM
188	3-Elevated	2-High	ACE Various Backbone Circuits Outage Resolved	Circuit - Damaged Fiber	Vendor	04/25/2013 6:49 PM	04/26/2013 2:23 AM
202	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 Outage Resolved	Circuit - Damaged Fiber	Vendor	05/14/2013 5:20 AM	05/21/2013 6:34 PM
203	4-Normal	3-Elevated	ACE Backbone Circuit ACE-AMS-STAR-10GE-01622 Outage Resolved	Circuit - Damaged Fiber	Vendor	05/14/2013 5:20 AM	05/21/2013 6:34 PM
212	4-Normal	3-Elevated	ACE Backbone Circuit GLOBAL-ACE-MANLAN-O192-01505 Availability	Undetermined	Undetermined	06/05/2013 5:21 AM	06/05/2013 5:44 AM
216	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 Outage Resolved	Undetermined	Vendor	06/20/2013 3:34 AM	06/20/2013 4:38 AM
218	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 Brief Outage	Undetermined	Vendor	06/26/2013 6:19 PM	06/26/2013 6:21 PM
231	3-Elevated	3-Elevated	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 & GLOBAL-ACE-MANLAN-10GE-01617 Brief Outage Resolved	Circuit - Damaged Fiber	Vendor	07/17/2013 7:48 AM	07/17/2013 8:03 AM
238	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 Outage Resolved	Circuit - Bumped Fiber	Vendor	07/22/2013 3:06 PM	07/22/2013 3:51 PM
259	2-High	2-High	Outage Resolved - ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 and GLOBAL-ACE-WIX-O192-01504	Circuit - Damaged Fiber	Vendor	09/23/2013 12:57 PM	10/07/2013 9:52 AM
260	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-MANLAN-O192-01500 Availability	Undetermined	Vendor	09/24/2013 8:57 AM	09/24/2013 9:18 AM
266	3-Elevated	2-High	Availability - ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 and GLOBAL-ACE-MANLAN-O192-01500	Undetermined	Vendor	10/09/2013 10:53 AM	10/09/2013 11:38 AM
271	3-Elevated	2-High	Outage Resolved - ACE Backbone GLOBAL-ACE-WIX-O192-01502	Circuit - Damaged Fiber	Vendor	10/30/2013 8:49 PM	11/18/2013 5:03 PM
272	1-Critical	1-Critical	Outage Resolved - ACE Backbone ACE-AMS-STAR-10GE-01622	Circuit - Damaged Fiber	Vendor	10/30/2013 8:49 PM	11/18/2013 5:03 PM
279	1-Critical	1-Critical	Outage Resolved - ACE Backbone ACE-AMS-STAR-10GE-01622	Undetermined	Vendor	11/20/2013 5:10 AM	11/21/2013 1:28 PM
288	2-High	2-High	Outage Resolved - ACE Backbone GLOBAL-ACE-MANLAN-O192-01500	Hardware	Vendor	12/10/2013 2:26 PM	12/10/2013 7:55 PM
293	2-High	2-High	Availability - ACE Backbone GLOBAL-FRK-WASH2-10GE-01507	Undetermined	Vendor	01/07/2014 4:28 AM	01/07/2014 4:55 AM
297	2-High	2-High	Outage Resolved - ACE Backbone Circuits (Frankfurt)	Undetermined	Vendor	01/16/2014 4:40 PM	01/17/2014 3:07 AM
304	1-Critical	1-Critical	Availability - ACE Backbone ACE-AMS-STAR-10GE-01622	Undetermined	Vendor	02/11/2014 4:57 AM	02/11/2014 10:10 AM
303	3-Elevated	2-High	Outage Resolved - ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502	Circuit - Damaged Fiber	Vendor	02/11/2014 9:59 AM	02/11/2014 3:13 PM
305	3-Elevated	3-Elevated	Availability - ACE Backbone Circuit GLOBAL-FRK-WASH2-10GE-01507	Circuit - Damaged Fiber	Internal	02/11/2014 6:25 PM	02/12/2014 12:41 AM

Table 1. Unscheduled maintenance tickets for the ACE circuits for March 1, 2013 through February 28, 2014.

Ticket Number	Customer Impact	Network Impact	*Title*	Maintenance Type	Source Of Impact	*Start Time (UTC)*	*End Time (UTC)*
157	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 Maintenance Completed	Circuit	Vendor	03/05/2013 6:13 AM	03/05/2013 6:33 AM
172	3-Elevated	2-High	ACE Backbone Circuits GLOBAL-ACE-WIX-O192-01502 and GLOBAL-ACE-MANLAN-10GE-01617 Emergency Maintenance Completed	Circuit	Vendor	03/16/2013 6:45 AM	03/16/2013 7:08 AM
176	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-MANLAN-O192-01500 Maintenance Completed	Circuit	Vendor	04/04/2013 4:55 AM	04/04/2013 4:59 AM
186	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 Maintenance Completed	Circuit	Vendor	05/02/2013 6:17 AM	05/02/2013 7:48 AM
191	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 Maintenance Completed Alternate Window	Circuit	Vendor	05/10/2013 5:53 AM	05/10/2013 8:04 AM
204	3-Elevated	3-Elevated	ACE Backbone Circuits GLOBAL-ACE-MANLAN-O192-01500 and ACE-FRK-WASH2-10GE-01507 Maintenance Completed	Circuit	Vendor	05/27/2013 10:55 PM	05/28/2013 1:35 AM
210	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 Maintenance Completed	Circuit	Vendor	06/13/2013 10:05 PM	06/14/2013 1:51 AM
215	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-WIX-O192-01502 Maintenance Completed	Circuit	Vendor	07/01/2013 10:48 PM	07/02/2013 3:49 AM
225	3-Elevated	2-High	ACE Backbone Circuit GLOBAL-ACE-MANLAN-O192-01500 Maintenance Completed	Circuit	Vendor	07/18/2013 1:19 AM	07/18/2013 2:00 AM
239	3-Elevated	3-Elevated	ACE Backbone Circuits GLOBAL-ACE-WIX-O192-01502 and GLOBAL-ACE-MANLAN-10GE-01617 Maintenance	Hardware	Vendor	08/06/2013 10:07 PM	08/07/2013 12:34 AM
242	3-Elevated	3-Elevated	ACE Backbone Circuit ACE-AMS-STAR-10GE-01622 Maintenance Completed	Circuit	Vendor	08/06/2013 10:07 PM	08/07/2013 12:34 AM
246	3-Elevated	3-Elevated	ACE Backbone Circuits GLOBAL-ACE-WIX-O192-01502 and GLOBAL-ACE-MANLAN-10GE-01617 Maintenance Completed	Circuit	Vendor	08/18/2013 5:08 AM	08/18/2013 5:24 AM
249	3-Elevated	2-High	ACE Backbone Circuits GLOBAL-ACE-WIX-O192-01502 and GLOBAL-ACE-MANLAN-10GE-01617 Maintenance Completed	Circuit	Vendor	08/29/2013 6:55 AM	08/29/2013 7:12 AM
251	3-Elevated	3-Elevated	ACE Backbone Circuit ACE-AMS-STAR-10GE-01622 Maintenance Completed	Circuit	Vendor	09/08/2013 2:23 PM	10/07/2013 2:19 PM
270	3-Elevated	1-Critical	Emergency Maintenance Completed - ACE Various Backbone Circuits	Hardware	Vendor	10/29/2013 4:05 AM	10/29/2013 4:07 AM
282	3-Elevated	3-Elevated	Maintenance Completed - ACE Backbone Circuit GLOBAL-FRK-WASH2-10GE-01507	Power	Vendor	12/04/2013 6:19 AM	12/04/2013 10:19 AM
278	3-Elevated	2-High	Maintenance Completed - ACE Backbones GLOBAL-ACE-MANLAN-O192-01500 and GLOBAL-FRK-WASH2-10GE-	Circuit	Vendor	12/05/2013 4:11 AM	(No Data Available)

			01507				
294	3-Elevated	2-High	Maintenance Completed - ACE Backbone Circuit GLOBAL-ACE-MANLAN-O192-01500	Circuit	Vendor	02/09/2014 12:09 AM	02/09/2014 3:32 AM
306	3-Elevated	3-Elevated	ACE Backbone Circuit GLOBAL-FRK-WASH2-10GE-01507 Maintenance Completed	Circuit	Vendor	02/13/2014 5:18 AM	02/13/2014 5:26 AM
310	3-Elevated	3-Elevated	Maintenance Compelted - ACE Backbone GLOBAL-ACE-WIX-O192-01502	Circuit	Vendor	02/20/2014 2:02 PM	02/26/2014 8:02 PM
311	3-Elevated	3-Elevated	Emergency Maintenance Completed - ACE Backbone ACE-AMS-STAR-10GE-01622	Circuit	Vendor	02/20/2014 9:02 AM	02/26/2014 8:02 AM

Table 2. Tickets for scheduled maintenance on ACE circuits for March 1, 2013 through February 28, 2014

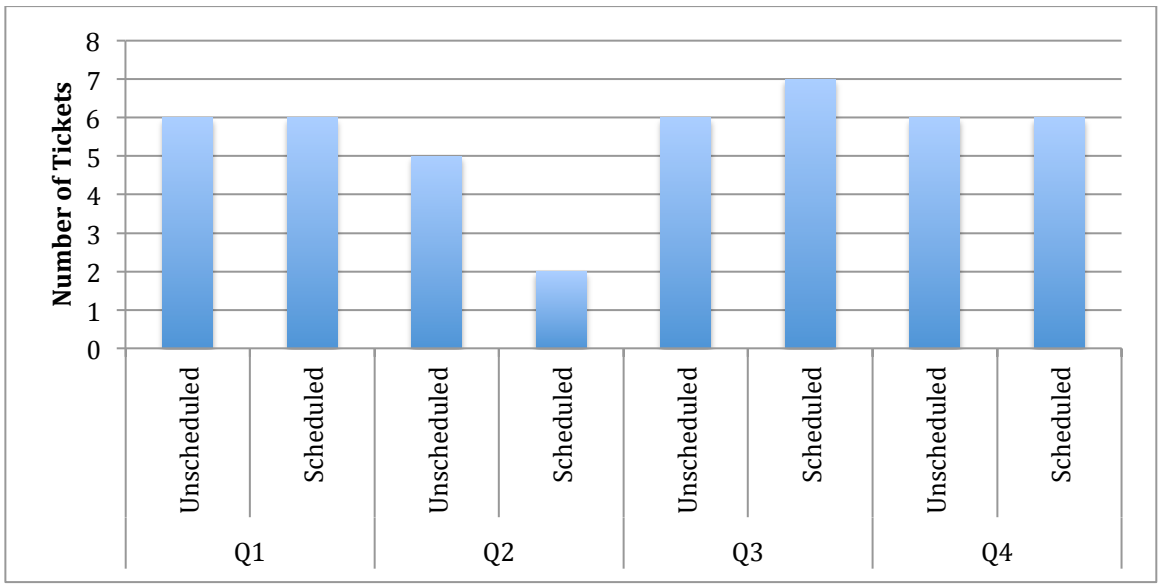

Table 3: Total Tickets by type for March 1, 2013 through February 28th, 2014.

D. Downtime and Availability

ACE Core Nodes	Down Time	Reporting Period Availability	52 Week Availability
	0 hr 0 min	100.00%	100.00%
Aggregate ACE Core Nodes	0 hr 0 min	100.00%	100.00%

ACE Backbone Circuits	Down Time	Reporting Period Availability	52 Week Availability
GLOBAL-ACE-MANLAN-O192-01500	1199 hr 16 min	86.31%	86.35%

GLOBAL-ACE-MANLAN-O192-01501	0 hr 2 min	99.99%	99.99%
GLOBAL-ACE-WIX-O192-01502	1167 hr 10 min	86.68%	86.71%
GLOBAL-ACE-WIX-O192-01504	18 hr 1 min	99.79%	99.79%
GLOBAL-ACE-MANLAN-O192-01505	0 hr 25 min	99.99%	99.99526%
GLOBAL-ACE-WIX-10GE-01507	593 hr 6 min	93.22945%	93.25%
ACE-AMS-STAR-10GE-01622	1512 hr 22 min	82.74%	82.78%
MAN-NEWY32AOA-PARIS-10GE-01618	0 hr 0 min	100.00%	100.00%
Aggregate All ACE Backbone Circuits	4490 hr 22 min	93.59%	93.61%

Table 4. Downtime and availability for ACE core nodes and circuits (March 1, 2013 – February 28th, 2014).

6. Security Events and Activities

Basic security measures were maintained over the course of the year, and there were no security incidences to report. ACE software and equipment was updated as needed to patch the NTP mirror vulnerability in Q4 without incident.

REN-ISAC had no ACE activities to report over multiple quarters, and were removed form the project in December 2013. Basic security work continues to be a part of the ongoing funded support ACE receives from the GlobalNOC. If additional assistance is needed, Von Welch at the IU Center for Applied Cybersecurity Research has volunteered staff members who can consult with ACE.

7. Beyond Year 5 Sustainability Plan

Discussions have begun to address sustain the ACE effort past the end of Year 5 (May 2015). We consider only the situation where funding is ceased, or it is cut to a level where this is the approximate outcome. We split this plan into several components, and address them separately.

Production Traffic: The current 60G LAG carries significant production traffic in its current configuration which must be taken into account as we approach a time of transitions to not impact science and research collaborations between the US and Europe. We have had significant conversations with both our EU collaborators, Dante/GEANT, as well as the Office of Science funded ESnet project, about possible future trans-Atlantic network planning. Should ACE funding cease, all of the US end points for the 6 circuits will also cease, so the first step would be to transition those contracts to the EU for the remaining 3 EU circuits to carry what traffic they can. Two obvious candidates are planned to pick up the remaining traffic. The ANA consortium currently supports a 100G trans-Atlantic experimental circuit that is planned to transition to production support in Fall 2014. It is likely that this circuit would have some capacity available for the current ACE traffic. In addition, ESnet is in the planning stage for significant capacity funded by the US Office of Science. Some, but not all, of the current ACE traffic would be eligible to use that capacity with their (planned) updated usage policy. These conversations will continue in Year 5 to adequately adjust flows as needed so to not affect researchers.

Experimental Traffic: If funding for the ACE project were discontinued, the ACE experimental link between Chicago and Amsterdam would be shut down. The obvious circuit to pick up this work would be the Dante funded New York to Paris link, which is currently very undersubscribed. However, Dante is currently making plans to rehome (or re-bid) this circuit to land at the London Open Exchange. We do not believe this change would significantly effect transitioning experimental traffic to this link.

SDN Experimental Work: Most of the SDN experimental work to date for the ACE project has been achieved by collaborating with SURFnet engineers, who prefer to work with end points based in Amsterdam. It is possible that some of this work could continue on the updated production ANA link. This matter needs more investigation.

Monitoring Work: The ACE monitoring work is not reliant on any given circuit, but the collaboration between US and EU networking partners has enabled stronger collaborations than prior times in this space. We are in active discussions with our European colleagues to make sure effort to achieve a single, unified PerfSONAR version and additional trans-Atlantic passive monitoring data will continue.

End-user Outreach Work (supplemental): Because of our supplemental funding to help users work with larger than 10G flows, the Dante/GEANT user support group has been able to expand its focus and reach several additional end user groups that they would not have been able to without our collaboration. There is no obvious US funding source to continue to support international application outreach, but Dante/GEANT sources will continue at their prior reduced rate.

8. Reporting against Objectives February 2013-February 2014

1. Overall
    a. New director to review activities and adjust as needed (ongoing)
    b. REN-ISAC staffing adjusted
    c. Address need for PerfSONAR data on lagged circuits (ongoing)
2. Staffing
    a. Contracted with Dale Smith, NSRC
    b. Hired new director
    c. Lee shifting to full time engineer for the project (ongoing)
3. Collaboration and Demonstrations
    a. Attend variety of large scale international meetings
    b. Work with InCNTRE to assist with Summer of Networking instruction
    c. Hold ANA-100G science support kick-off meeting
    d. Seek out additional end users to support in use of 100G testbeds (ongoing)
4. Systems and Software Work
    a. Completed OpenFlow implementation of Chicago-Amsterdam link
    b. Connected OpenFlow switch in Chicago to AL2S Fabric
    c. Connect NetherLight OpenFlow switch to the GEANT OpenFlow Pop in Amsterdam
    d. Disconnect the MAN LAN to London Open exchange circuit
    e. Add basic monitoring to the MAN LAN to Paris circuit
    f. Add basic monitoring to the additional third circuit between WIX and Frankfurt

    g. Continue investigation active and passive measurements at WIX and MAN LAN (ongoing)
    h. Work towards combined PerfSONAR PS-MDM versioning (ongoing)
    i. Additional Lustre work in support of supplement (ongoing)
5. Operational Activities
    a. Implemented new Chicago-Amsterdam circuit
    b. Implemented new WIX-Frankfurt circuit
    c. Follow up with Zayo over extended outage of Chicago-Amsterdam link
    d. Continue full support of 8 circuits

9. Plans for March-2014 through May-2014

1. Overall
    a. New director to review activities and adjust as needed
    b. Address need for PerfSONAR data on lagged circuits (ongoing)
2. Staffing
    a. Lee shifting to full time engineer for the project (ongoing)
3. Collaboration and Demonstrations
    a. Attend variety of large scale international meetings
    b. Plan and implement SDN experiments, and work in multi-domain
    c. Seek out additional end users to support in use of 100G testbeds
    d. Use additional monitoring information to increase outreach and support of circuit end users, verifying performance
4. Systems and Software Work
    a. Continue support for OpenFlow implementation of Chicago-Amsterdam link
    b. Add active monitoring to 60G LAG circuits
    c. Add passive monitoring to 60G LAG circuits
    d. Work towards combined PerfSONAR PS-MDM versioning
    e. Additional Lustre work in support of supplement
    f. Placement and experiments using IXIA tester
5. Operational Activities
    a. Continue full support of 8 circuits
    b. Transition as needed for project completion

APPENDIX A. VLAN assignment on Chicago-Amsterdam Link

The table below shows the VLAN assignment on the Chicago to Amsterdam circuit on the last date of this reporting period.

NetherLight service ID	VLANs	Description	Global ID
5029VL_CZPRG-USCHI(NBD-CESNET-CineGrid-1)	440	VLAN between Prague and Chicago for CineGrid	urn:ogf:network:netherlight.net:5029VL
5030VL_CZPRG-USCHI(NBD-CESNET-CineGrid-2)	441	VLAN between CESNET (Prague) and Chicago for CineGrid	urn:ogf:network:netherlight.net:5030VL
5039VL_CZPRG-USCHI(NBD-CESNET-Masaryk_University_projects-1	438	VLAN between CESNET (Prague) and Chicago used by Masaryk University projects	urn:ogf:network:netherlight.net:5039VL
5041VL_CZPRG-USCHI(NBD-CESNET-Masaryk_University_projects-3	3440	Vlan between Prague-Chicago used by Masaryk University projects (EAGER project)	urn:ogf:network:netherlight.net:5041VL
5042VL_NBD-PSNC-LSU	3442	Vlan between PSNC and LONI/LSU	urn:ogf:network:netherlight.net:5042VL(PSNC-LSU)
5048VL_NBD-EVL/CineGrid	21	UvA SNE to Starlight used for CineGrid	-
5051VL_NBD-CESNET-NCSA	3441	VLAN from Supercomputing Center Brno to NCSA (EAGER project), CESNET, Starlight, Supercomputing Center Brno involved	urn:ogf:network:netherlight.net:5051VL
5053VL_NBD-Optiplanet	376	Optilan - UvA SNE, Starlight and SARA	-
5054VL_NBD-4K	439	Madrid (i2CAT, via GÉANT2) to Chicago for 4K video	-
5056VL_NBD-USLHCnet	451	RNP/HEPGrid to USLHCNet/Caltech connection	-
5057VL_NBD-USLHCnet	452	SPRace to USLHCNet/Caltech connection	-
5058VL_NBD-JIVE	454	JIVE testing between Dwingeloo en Arecibo (Puerto Rico), NAIC	urn:ogf:network:netherlight.net:5058VL

5073VL_NBD-USLHCnet	457	VLAN for US Tier2s - Caltech USLHCNet	-
5074VL_NBD-USLHCnet	458	VLAN for US Tier2s - Caltech USLHCNet	-
5085VL_NBD-KAUST	459	VLAN 459 between KAUST (Saudi Arabia) and StarLight	urn:ogf:network:netherlight.net:5085VL
5123VL_NBD-KAUST	3717	VLAN 3717 between KAUST and Calit2	urn:ogf:network:netherlight.net:5123VL
5779VL_EXP-AutomatedGOLE	1779 – 1799	Connection between JGN2 and Asd001A_F25S1T - Automated GOLE pilot	urn:ogf:network:netherlight.net:5779VL_AutomatedGOLE(Starlight-Netherlight)
5086VL-RP1-loop-IRNC	515	VLAN loop for 802.1aq research by SARA	-
5087VL-RP1-loop-IRNC	514	VLAN loop for SARA	-
5099VL_SARA-Caltech_OpenF-CT	2750	VLAN for MPTCP and OpenFlow tests between CalTech and SARA	-

Table 5. VLAN assignment on Chicago-Amsterdam Link