

**Annual Report  
America Connects to Europe (ACE)  
(SCI - 0962973)  
1-March-2012 thru 28-February-2013**

**James G. Williams – Principal Investigator**

***Yearly Summary***

The ACE project is operating within budget. See the Budget Summary section.

During this Project Year IU hosted four interns. Their intern reports are attached at the end of this AR.

A third 10G connection was added from AMS to NYC, giving a total of 30Gs between Amsterdam and NYC. Significant engineering work was done at MANLAN and WIX. The AMS-CHI circuit was re-tendered to reduce costs. A third 10G connection was tendered and added (almost) to FFT-WIX, giving a total of 30Gs on this second set of ACE aggregated circuits. The Internet2-ACE NYC-London circuit was connected at the GEANT Open Exchange in London. See the Network Engineering section for further details.

ACE engineer John Graham returned to the UK. His role has been filled by Dale Finkelson of Internet2.

Project team members attended and participated in the Fall Internet2 Member Meeting and SC2012. Project team members attended and participated in Techs in Paradise (TIP2013) meeting at the University of Hawaii. Project team members also participated in a number of other meetings highlighted in the Quarterly Milestones section.

Steven Wallace and InCNTRE presented OpenFlow Workshops in the UK (DANTE) and APAN (Hawaii Joint Techs). See the report attached at the end of this AR.

Hicks is working with NSRC to develop curriculum for an IU-NSRC trip to South Africa to take place in April 2013.

## ***Quarterly Milestones and Accomplishments***

### **Quarter 1**

In response to a projected increase in demand, a third transatlantic circuit was installed between Amsterdam and New York during this reporting period. The circuit is supplied by DANTE and the provider is Level3 Communications. The total capacity for GEANT IP peerings in New York is now 3 x 10G.

The IP peerings with ESnet at Washington, DC were moved away from their single 10G connection to the NGIX-E switch and onto a new 2 x 10G link-aggregated bundle that connects the ESnet router directly to the WIX switch. This means that ESNet now enjoys 20 Gb/s of capacity for their peerings with Internet2 and GEANT at Washington.

A 100G line has been installed between the Internet2 router in Washington, DC and the WIX switch. This is in preparation for moving the Internet2 peerings with ESnet and GEANT away from a single 10G connection to the WIX and onto the high-capacity 100G.

### **Quarter 2**

Hicks attended summer Joint Techs conference at Stanford University and helped teach an OpenFlow Work Shop.

Work has begun on an RFP for a new circuit from AMS-CHI. We expect the RFP will be issued in September and a new circuit in place by 1-January-2013.

Planning is underway for the Internet2 Fall Member meeting. Williams will host a session on OpenFlow and will be involved in discussions with Internet2 and our European partners about 100G services between the US and the EU.

Planning has begun to add an additional 10G service from Frankfort to Washington. We hope to have this done by 1/1/2013.

John Graham, the ACE engineer since the ACE project began has returned to the UK. Dale Finkelson, who is an engineer with Internet2 will fill John's role. Dale has been the Internet2 international engineer (among other roles) and is well suited to this role.

### **Quarter 3**

Work has begun on an RFP for a new circuit from AMS-CHI. The RFP was issued in September, an award was made and a new circuit will be in place by 1-February-2013.

Williams hosted a session on OpenFlow and held discussions with Internet2 and our European partners about 100G service between the US and the EU and the Fall Internet2 Member meeting.

An RFP was issued to add an additional 10G service from Frankfort to Washington and an award has been made. We hope to have this circuit operational by 3/1/2013. This will result in 60G (3x10 + 3x10) of bandwidth between the US (NYC and WIX) and the EU (AMS and FFT).

Discussions continued about connecting the NYC-London 10G circuit to the London Open Lightpath Exchange. We hope to have the contract issues clarified (the only outstanding problem now) before 1/1/2013 and a direct connection made in February/March 2013. This London OLE connection will provide direct US connectivity for Africa and the ORIENTPlus Beijing connection.

Williams attended SC2012 and had a number of meetings including a meeting about ACE involvement with the XCEDE-PRACE collaboration, which produced no results.

#### **Quarter 4**

Hicks and Sweeny participated as instructors in OpenFlow workshops at the TIP meeting. Hicks made presentations at the Future Internet Testbed and Engineering sessions at the TIP meeting.

Hicks started working with NSRC to help develop curriculum for a trip to South Africa, planned in April 2013.

Steven Wallace and InCNTRE presented OpenFlow Workshops in the UK (DANTE) and APAN (Hawaii Joint Techs). See the report attached at the end of this AR.

## Operations Events and Activities

For the year in review we report the following updates and additions to the services and support of ACE network services:

The GlobalNOC Service Desk began the annual review of its Business Continuity Plan in March of 2012. As part of the IU Ready system, the Service Desk maintains a structured Continuity plan and performs periodic testing to insure ACE NOC viability in situations where physical or network accessibility is not available in the primary location. The service desk regularly exercises this plan throughout the year. This plan has expanded further to include off-site techs. These off-site techs provide another point of contact should both GRNOC locations suffer catastrophic loss of connectivity or are forced to vacate those facilities for any reason.

A Specialized Support Technician (SST), Scott Chevalier, was assigned to cover International Networks, including ACE. SST's focus on high level user support and troubleshooting, training of frontline Network Technicians, and documentation of process and procedures for the networks under their supervision beginning in April of 2012. ACE SST, Scott Chevalier, participates in the off-site technician program.

Work Flow tool development for the Service Desk was completed for several networks after launching for production testing during the last quarter of 2011. A controlled rollout for other networks, including ACE, was made throughout the year in 2012.

Updates continue to be made to existing notifications adding trouble-ticket impact status and further definition within the ticketing system for clarity.

System Engineering continued development of the Service Desk "targeted notification tool" to enable us to further define a "target" recipient group and provide notification on services to only those affected. As part of ACE NOC processes and procedures, network documentation was reviewed and updated to reflect recent circuit and network redundancy updates.

John Hicks and Brent Sweeny participated as instructors in an OpenFlow workshop for Brocade in Indianapolis, August, 2012.

During the Fall of 2012, the ACE network welcomed Andrew Lee, replacing John Graham, as our new point-person for engineering and network planning.

The GlobalNOC has completed hiring and begun training six new technicians. In tandem with this expansion of personnel, the GlobalNOC has also focused its members into specialized teams (focus teams) able to provide assistance more efficiently and with greater knowledge of ongoing and network-specific issues. These teams bridge across the Service Desk and Engineering groups allowing for greater information-sharing and wider training on diagnosis, triage, and planning of network events.

The development of new tools and expansion of existing GlobalNOC tools has continued. DB2, the next generation of the GlobalNOC's database, has been in full testing and is expected to launch officially soon. The new schema will allow techs to more easily view information tied into the DB and will simplify many of the steps of searching that done as part of the Service Desk workflow today.



# Network Engineering

Here we review troubleshooting and provisioning activities that occurred over the reported period of time.

## 1. Increased Capacity in New York.

At the start of this reporting period, the GEANT IP peerings with other MANLAN connectors was supported by a 2 × 10G link-aggregated bundle. One circuit was supplied by the IRNC ACE project and the other by DANTE.

A third transatlantic circuit was installed between Amsterdam and New York. The circuit is supplied by DANTE and the provider is Level3 Communications. The total capacity for GEANT IP peerings in New York is now 3 × 10G.

## 2. Hands-On Work at MANLAN

A visit was made by John Graham to New York during this reporting period. Several items of work were completed at the MANLAN facility.

The IP address range that is used to support GlobalNOC management of the equipment at MANLAN was changed from a small block of addresses that had been assigned to Internet2 by the EP.NET, to a /27 subnet drawn from the ARIN range that is formally assigned to Internet2. This was necessitated by a policy change at EP.NET.

Testing continued to unambiguously determine whether there is any packet loss across the transatlantic lines.

## 3. Brocade Hardware Investigation

We continue to work with Brocade to investigate the inability to retrieve SONET Alarms and Performance Management (PM) statistics from 10G interfaces that are configured for WAN-PHY operation.

Previously, the transatlantic circuits were terminated on a Ciena CoreDirector, which also supported local 10G lines to the Layer-II switching equipment. As a result of a hardware refresh at DANTE the transatlantic circuits now terminate directly on 10G interfaces on the Brocade MLXe-16. These ports are configured for WAN-PHY operation rather than as SONET OC-192's.

## ESNet Connection to WIX

The IP peerings with ESNet at Washington, DC were moved away from their single 10G connection to the NGIX-E switch and onto a new 2 × 10G link-aggregated bundle that connects the ESNet router directly to the WIX switch. This means that ESNet now enjoys 20 Gb/s of capacity for their peerings with Internet2 and GEANT at Washington.

## 4. Internet2 100G Connection to WIX

A 100G line has been installed between the Internet2 router in Washington, DC and the WIX switch. This is in preparation for moving the Internet2 peerings with ESNet and GEANT away from a single 10G connection to the WIX and onto the high-capacity 100G.

Other significant activities during the year include:

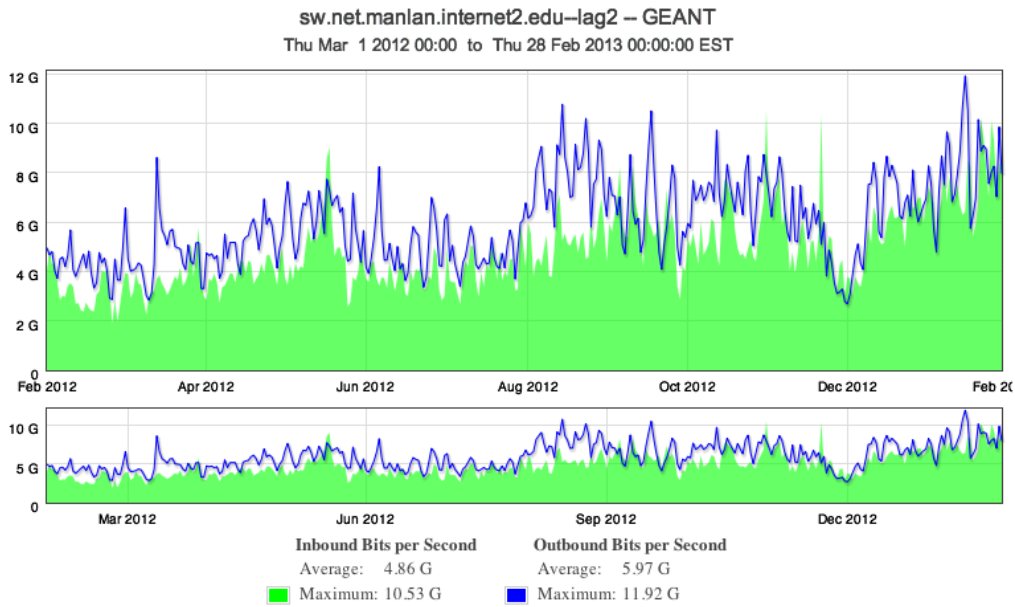
Developing and issuing an RFP for a new circuit AMS-CHI. The RFP was issued early in the year. The award was made to Zayo. A few delays occurred but the circuit was installed early in 2013.

Work also began on an RFP for a 3<sup>rd</sup> FFT-WIX (Frankfort to Washington) 10G circuit. The RFP was issued and an award was made. The circuit became operational in late April of 2013.

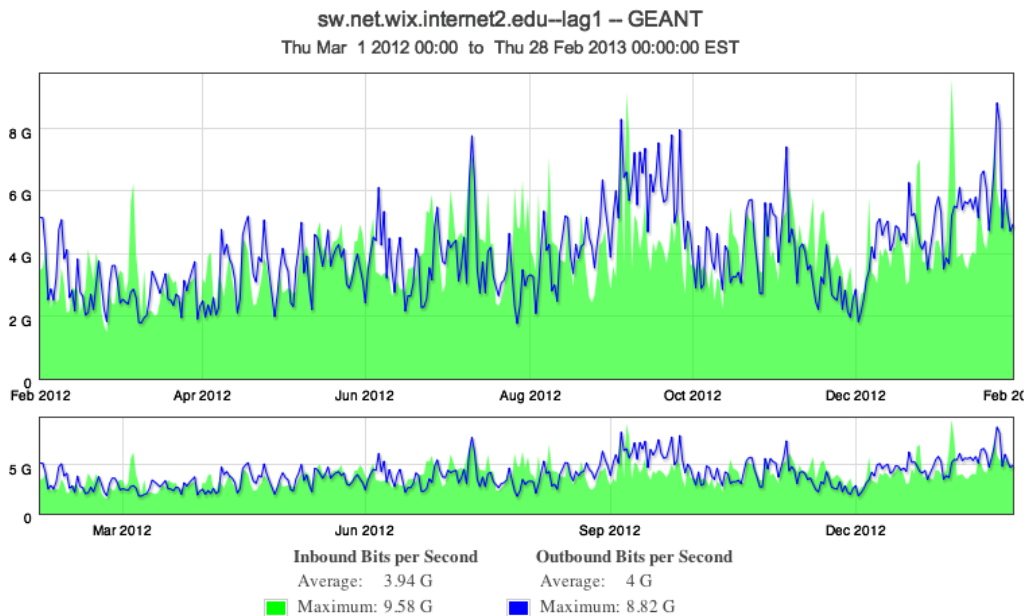
The result is 60G (3x10 + 3x10) of bandwidth between the US (MAN LAN and WIX) and the EU (AMS and FFT).

Following are the traffic usage graphs for the 3x10G connection in New York and for the 2x10G connection in Washington. Note that maxima will be substantially attenuated as the graphs represent the entire year representing this reporting period.

(using 1 day averages) ?



(using 1 day averages) ?



Williams hosted a session on OpenFlow and held discussions with Internet2 and our European partners about 100G service between the US and the EU.

Williams attended SC2012 and had a number of meetings including a meeting about ACE involvement with the XSECE-PRACE collaboration.

The NYC-London 10G circuit was moved to the London Open Lightpath Exchange. This London OLE connection will provide direct US connectivity for Africa and the ORIENTPlus Beijing connection.

Internet2 staff, ACE staff and GEANT staff made significant progress on establishing a framework for testing the performance and capacity of the trans-Atlantic circuits. Additional test nodes were set up and configured in this time period. This provides additional tools for debugging any issues that occur on the circuits.

## Intern Activity

In this annual report year the ACE+TP3 project supported four undergraduate interns. Their projects varied from basic international networking written communications work to security tools development.

The reports of these interns are attached at the end of this AR.

## Transition Plan

Within the ACE project there is equal US and EU funding for the network connections. Any transition plan must be developed in conjunction with our European partners. The



US project team (both IU and Internet2) commits to the development of an ACE transition plan in the next project year.

## **Software Defined Networking (SDN) Activities**

SDN and specifically OpenFlow has become an area of great interest in the networking community in the last couple of years. SDN provides a new networking paradigm that separates the control plane with the data plane. A data plane connection simply provides an exchange of user data in an OpenFlow environment. A control plane connection provides control of OpenFlow resources and the ability to manipulate OpenFlow rules. We refer to a set of OpenFlow resources with a common control structure as an OpenFlow domain or testbed. OpenFlow controller technology and path provisioning within an OpenFlow domain has matured over the last year.

Inter-domain path provisioning and resource sharing is less mature. There are efforts that use external layer 2 dynamic provisioning mechanisms like OSCARS and NSI to provide path provisioning between OpenFlow domains. These methods only provide connections on the data plane level. Full peering will require some form of sharing resources and control but it is currently unclear what this will be. We hope to help define what peering means and how to implement this between own international partners.

ACE has deployed an OpenFlow capable switch on the U.S. side of the connection that will aid in interconnecting Europe and U.S. OpenFlow environments. This switch is now directly connected with the StarLight facility in Chicago and will use OSCARS to connect to the U.S. Internet2 OpenFlow testbed, the Advanced Layer 2 Services (AL2S). This approach provides an excellent OpenFlow peering/exchange platform to experiment with different inter-domain connection techniques. We are working with Asian, U.S. (ACE, Internet2, ESNet), and European (SURFNet, DANTE') colleagues to provide a mechanism to transfer data, over the three continents use OpenFlow technology.

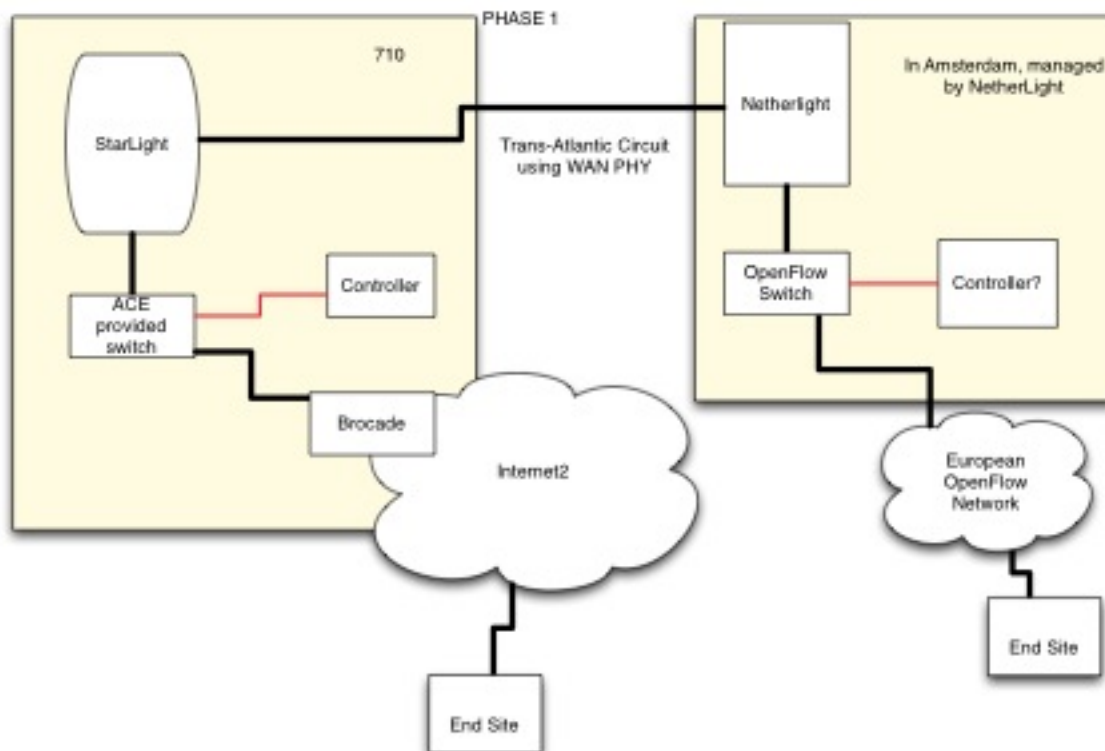
Another aspect of ACE's SDN involvement is teaching and outreach. Hicks helped develop course material for Brocade SDN workshop and participated as an instructor at Brocade SDN workshop. This workshop provides a general overview of OpenFlow capabilities and hands on experience with real OpenFlow capable equipment. A lot of the workshop material was developed using HP switches. We discovered, first hand, that OpenFlow implementations differ greatly even though they adhere to the OpenFlow 1.0 specification. Here are a few key differences between the current implementations on the HP and Brocade switches:

- Brocade switches do not automatically send packets that do not match an OpenFlow rule to the controller. This process is called a 'packet in' procedure. HP switches perform a 'packets in' procedure by default.
- Brocade switches only provide one Data Path Identification (DPID) number. The DPID numbers identify an OpenFlow instance. HP switches can have a DPID per vlan.
- Brocade will not match on layer 3 fields only limited layer 2 fields. HP currently provides a full set of match fields based on the OpenFlow 1.0 specification.

Hicks helped teach the OpenFlow Workshop at IU for the Summer of Networking SDN OpenFlow week. One interesting outcome was that we discovered a bug in FlowVisor. The bug was identified and later fixed by the FlowVisor development team.

Hicks and Sweeny attended summer Joint Techs conference at Stanford University and helped teach OpenFlow Work Shop. GRNOC is establishing itself as a major SDN resource, through the InCENTRE lab and the hands-on OpenFlow workshops led by Steven Wallace, and Hicks and Sweeny are among those at GRNOC who are active in this effort, including providing input to the development of the instructional materials, systems support, user support, and actual instruction.

ACE staff met with Internet2 to discuss OpenFlow connectivity between the US and Europe. Phase 1 is complete and includes re-rendering the existing WAN PHY Chicago to Amsterdam circuit as a LAN PHY circuit and purchasing an OpenFlow switch for the US side. A NEC switched is installed in Chicago.



## Measurement Activities

The ACE measurement infrastructure using the perfSONAR software suite is a little hard to define due to the fact that the circuits terminate in Internet2 managed facilities and equipment. The goal of the measurement effort is to provide debugging and circuit performance verification to engineers, researchers, and staff. To date we have deployed SNMP perfSONAR on ACE circuits

Williams met with DANTE to discuss operational issues including perfSONAR and dashboard issues with [Domenico Vicinanza](#) and policy issues with [Wayne Routly](#). These discussions will continue and future meetings are planned.

Another aspect of the TransPAC3 measurement effort is education and outreach.

- Hicks gave perfSONAR talk to ERnet (India) visitors.
- Attended CANS meeting and gave talk concerning measuring and monitoring 'elephant flows'. Also participated in the CANS measurement working group meeting.
- Attended TIP meeting and gave talk concerning TP3 measuring and monitoring.
- Hicks participated in CENIC perfSONAR calls.

Met with Jon Dugan of ESnet at the Joint Techs conference to discuss possible collaboration to develop a portal and application database for TP3 and ACE traffic. Talks stalled with ESnet so this same idea was introduced to the GRNOC. Preliminary portal efforts are underway.

Worked with DANTE on developing perfSONAR UI ACE interface.

Attended TIP meeting and gave talk concerning ACE measuring and monitoring.

Continue to work on sFlow passive monitoring. Installed NFsen and other flow analysis tools. Internet2 may stop supplying sFlow feed from WIX and MANLAN so alternatives are being explored.

## ***Security Events and Activities***

Note: This information is duplicated in the TransPAC3 report, as activities are tightly linked.

Pearson and Iovino developed an activity for an intern to:

- (1) Develop a testbed of two CIF<sup>1</sup> instances, representing different trusted communities (e.g. the REN-ISAC community and APAN);
- (2) To establish a security sensor collection point feeding one of the CIF instances;
- (3) To inter-federate share security indicator data from one CIF to another; and to thoroughly and publicly document (published open source along with the CIF code) all steps in standing up the CIF instance, adding local sensor inputs, and inter-federating with another CIF instance.

This work will serve as a guide for establishing inter-federated threat indicator information sharing.

The inter-federation use case documentation<sup>2</sup> is published at the open source CIF project wiki. Kyushu University successfully setup a CIF instance following the documentation. The Kyushu CIF instance is collecting indicators generated from failed login attempts to their servers. A test CIF instance at REN-ISAC is configured to aggregate several public feeds of indicators. The two community instances are successfully sharing data with one another.

Upon successful outcome of the work - testbed inter-federation of security event information sharing using the CIF tool between US REN-ISAC and APANTransPAC3 partners - the partners gave a joint talk concerning the activity and results at the APAN/ESnet/Internet2 TIP2013 Conference. The talk "*International Collaboration for Security Event Information Sharing*"<sup>3</sup> was given January 16, 10:00 AM HAST by Asst. Prof. Yoshiaki Kasahara (Research Institute for Information Technology, Kyushu University), Yasuichi Kitamura (National Institute of Information and Communications Technology, Japan), Kevin Benton (PhD Student, Security Informatics, Indiana University), and Gabriel Iovino (Principal Security Engineer, REN-ISAC).

The work revolved around the REN-ISAC Collective Intelligence Framework (CIF). CIF provides a near real-time path from community and global observations of security-related events, to the derivation of threat indicators, and application to local defenses; and provides analyst interface for threat research and incident response. CIF is the open source component of the REN-ISAC Security Event System (SES)<sup>4</sup>. SES version 3 is the subject of a current NSF award, SDCI Sec: SESv3 (Security Event System - Version 3), award OCI-1127425. A typical CIF/SES installation serves a circumscribed trust community, such as REN-ISAC. Among the deliverables of the SESv3 project is to develop the capability to "inter-federate" indicator sharing among trust communities, guided by policy and sharing markers (e.g. Traffic Light Protocol<sup>5</sup>)

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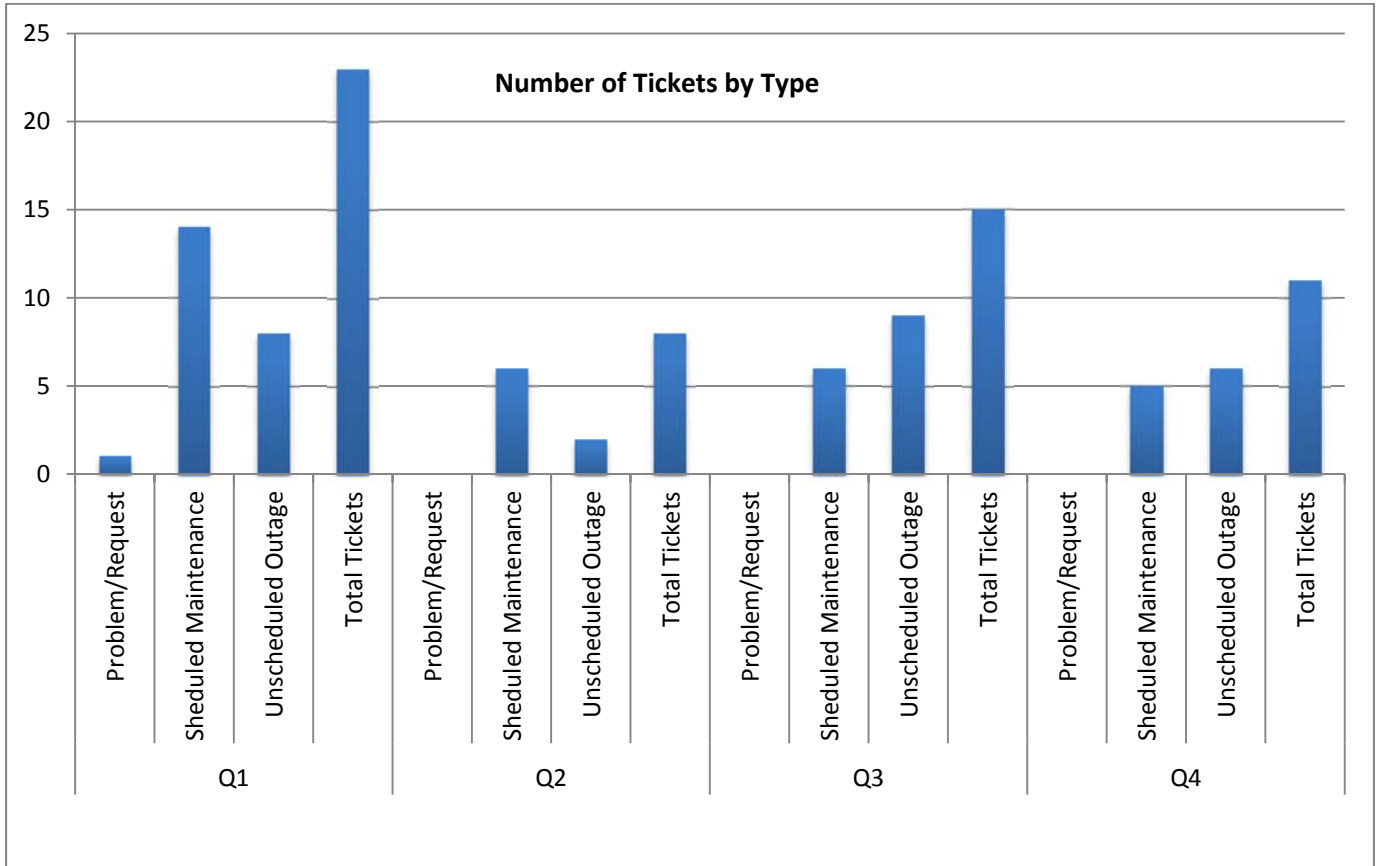
<sup>1</sup> <http://code.google.com/p/collective-intelligence-framework/>

<sup>2</sup> [http://code.google.com/p/collective-intelligence-framework/wiki/Recipe\\_FederatedSharing\\_v1](http://code.google.com/p/collective-intelligence-framework/wiki/Recipe_FederatedSharing_v1)

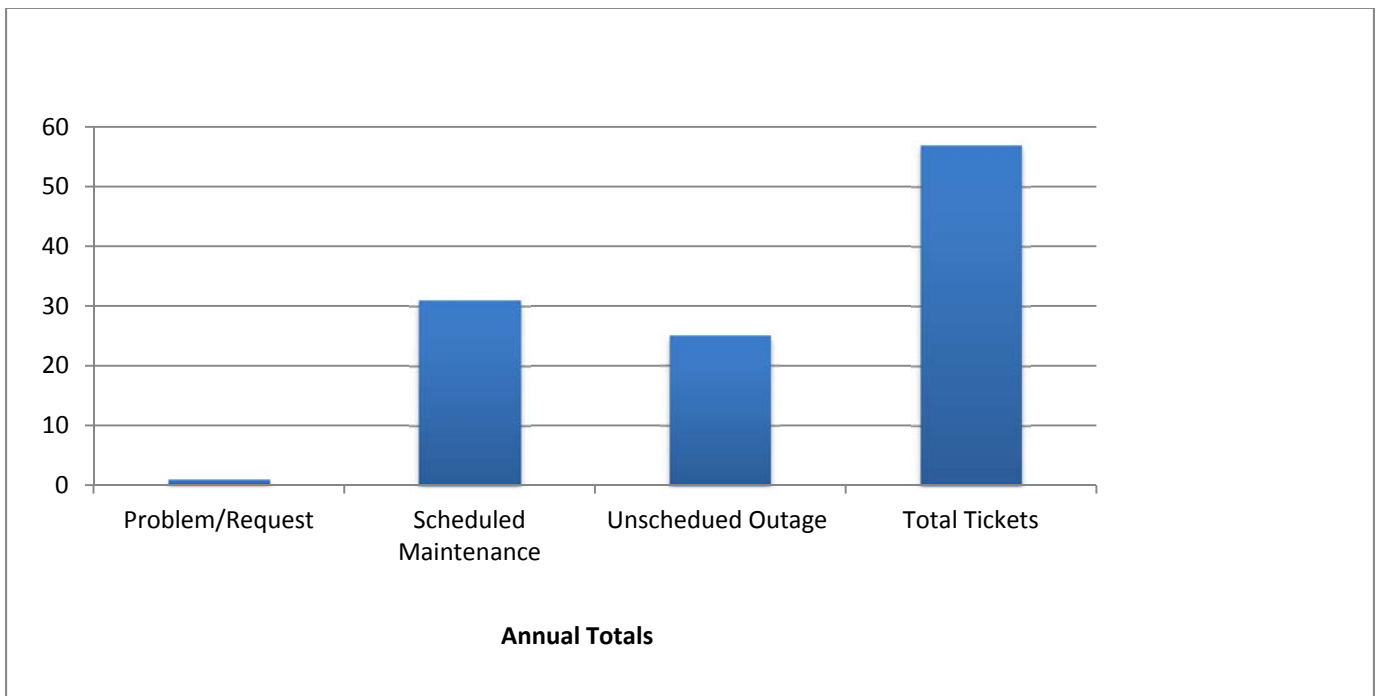
<sup>3</sup> <http://events.internet2.edu/2013/tip/agenda.cfm?go=session&id=10002762&event=1261>



## ACE, 2012-2013, Ticket Types by Quarter



## ACE, 2012-2013, Annual Tickets by Type



## **Tasks completed 1-March-2012 thru 28-February-2013**

### **Measurement**

Measurement machines ordered and installed in NYC.

Continued to work on sflow traffic analysis portal and implementing perfSONAR resources (passive & active) on ACE.

Moved ACE perfSONAR SNMP MA under GRNOC support

### **Engineering**

Begin engineering planning for installation of US funded circuit to balance the 3<sup>rd</sup> 10G between AMS-NYC. And, later in the year, NYC-AMS connection upgraded to 30G.

Begin careful analysis of AMS-CHI circuit with possible transition to OF test circuit. Later in the year, publish AMS-CHI RFP and make vendor selection. Also, later in the year, awarded RFP for AMS-CHI circuit and began installation.

Begin planning to upgrade FFT-WIX connection to 30G. Later in the year, publish FFT-WIX RFP and make vendor selection and award RFP. Installation work begun.

### **Security**

Draft information sharing agreement: Completed [1]. Shared with AP and EU partners for their review.[1] <https://github.com/collectiveintel/cif-legal>

Developed testbed for inter-federation sharing of security threat indicators; implemented testbed sharing between REN-ISAC and APAN researchers; and developed cookbook documentation for establishing similar inter-federation sharing based on the CIF tool.

### **Dynamic circuits**

Work on OSCARS 0.6 implementation with Brocade

### **OpenFlow**

Continue developing OpenFlow training workshop. Helped teach OpenFlow tutorial workshop at Stanford and Merit. Helped teach OpenFlow training workshop at the TIP2013/APAN meeting. Supported OpenFlow tutorial workshop at DANTE (Cambridge, UK)

Implement phase 1 plan on AMS-CHI circuit for OpenFlow testing.

- a. Determine type of US switch to purchase. (NEC switch selected and installed)
- b. Collaborate with SURFnet on international peering mechanism

Continue to work on phase 1 plans for AMS-CHI circuit for OpenFlow testing.

- a. Install test equipment and prepare for GridFTP demonstration.
- b. Install OpenFlow hardware in Europe.

## **Meetings**

ACE personal attended various meetings and presented talks. These are detailed in the Quarterly events portion of this report.



## **Plans for 1-March-2013 thru 28-February-2014**

1. Investigate active measurements at WIX and MANLAN.
2. Continue to work on ACE portal
3. Work on OpenFlow implementation of AMS-CHI link
4. Implement new AMS-CHI circuit.
5. Implement new FFT-WIX circuit.
6. Examine potential for conducting security event and threat indicator information sharing with the European partner (exploring such issues as privacy), and establish a testbed implementation.
7. Investigate active perfSONAR measurements at WIX and MANLAN.
8. Working with NSRC, Help develop NREN activities in Africa
9. Implement OSCARS on ACE circuits
10. Work on load balancing techniques for the multiple 10G Trans-Atlantic Circuits.
11. Develop ACE transition plan.
12. Work closely with all partners on 100G trans-Atlantic activities.

## ACE Financial Details 3/1/2012 thru 2/28/2013

ACE NSF, OCI-0962973					
	1st Quarter total(s)	2nd Quarter total(s)	3rd Quarter total(s)	4th Quarter total(s)	Annual total(s)
<b>Compensation</b>					
Williams, James	3,249.09	2,217.35	4,537.73	3,402.96	13,407.13
Pearson, Douglas	887.22	17,450.57	12,017.60	61.56	30,416.95
Iovino, Gabriel	-	1,526.08	1,845.51	(895.90)	2,475.69
Young, Wesley	-	12,793.62	5,375.25	(5,578.14)	12,590.73
Chris Small (Openflow as of 10/1)	-	8,760.83	5,355.03	4,064.30	18,180.16
NOC Service Desk Support	-	11,372.20	3,048.22	6,681.50	21,101.92
Graham, John	17,090.07	-	-	-	17,090.07
Wittke, Eric	-	-	-	-	-
Wagner, Kimberly	-	-	-	-	-
Meylor, John	-	-	-	-	-
Wiersema, Alisa	285.00	-	-	-	285.00
F&A on Compensation	6,883.64	17,318.61	10,297.39	2,475.61	36,975.25
<b>Total Qtr Compensation</b>	<b>28,395.02</b>	<b>71,439.26</b>	<b>42,476.73</b>	<b>10,211.89</b>	<b>152,522.90</b>
<b>Other Expense</b>					
JIB Consulting	-	2,368.71	3,141.93	5,916.75	11,427.39
Jacqueline Brown/Consultant	3,676.40	2,436.00	-	-	6,112.40
PO1252449 Matrix/KINGSTON - 4GB 1333MHZ ECC FOR DE	-	-	-	160.00	160.00
Travel - J. Williams/12th Annual Global LambdaGrid Work	-	716.60	913.48	24.90	1,654.98
Travel - J. Williams/SuperComputing Conf	-	877.44	823.61	12.00	1,713.05
Travel - J. Williams/NSF Meeting 12/18/12	-	-	-	656.06	656.06
Travel - Steve Wallace/2 day Openflow workshop for Dar	-	-	2,194.10	-	2,194.10
Remove GLIF/TERENA Expense Chgd in Error Previously	-	(1,587.60)	-	-	(1,587.60)
UCAID Internet 2 Manlan	-	23,036.56	-	-	23,036.56
UCAID Internet 2 WIX Participation	-	84,291.62	-	-	84,291.62
Skype Communication for Intl Calls	-	53.94	-	-	53.94
Dell - SFP+ Optics SR- Intel Ace	-	536.38	-	-	536.38
Terena Conference/Workshop Fee & Travel J. Williams	2,264.11	2,701.78	-	-	4,965.89
Travel - J. Hicks/Summer Joint Techs 2012	-	2,314.85	-	-	2,314.85
Travel Credit C. Small APAN Travel	-	(2,985.01)	-	-	(2,985.01)
Travel - J. Williams/Meet with Toby Rodwell	-	57.72	-	-	57.72
Travel - J. Williams/Presenter @ European Networking C	-	4,265.28	-	-	4,265.28
Travel - J. Williams/Security @ The Cyberborder Worksh	56.61	-	-	-	56.61
Travel - J. Williams/I2 Mtg & IT Conference/Boston April	1,424.69	-	-	-	1,424.69
Travel - J. Williams/Mtg w/Hibernia & Kokusai Denshin D	1,108.95	-	-	-	1,108.95
Dell PowerEdge R610 Server (2)	10,531.52	-	-	-	10,531.52
Spectrum Printing (ACE Brochure)	328.00	-	-	-	328.00
ACE/GEANT Printing	-	-	196.00	-	196.00
Dale Smith Contractual Service Agreement	-	2,000.00	1,500.00	-	3,500.00
Wire Transfer Fees	80.00	60.00	20.00	20.00	180.00
F&A on Other Expense 32%	6,230.49	38,766.17	2,812.52	2,172.71	49,981.88
<b>Total Qtr Other Expense</b>	<b>25,700.77</b>	<b>159,910.44</b>	<b>11,601.64</b>	<b>8,962.42</b>	<b>206,175.26</b>
<b>Circuit Expense</b>					
Surfnet	45,336.00	27,936.20	52,051.20	50,481.10	175,804.50
George McLaughlin/Consultant Services	-	-	-	-	-
Hibernia Atlantic (OC-192 Connections)	54,082.13	87,568.46	99,819.22	53,111.52	294,581.33
Wire Transfer fee	40.00	40.00	100.00	60.00	240.00
<b>Total Qtr Circuit Expense</b>	<b>99,458.13</b>	<b>115,544.66</b>	<b>151,970.42</b>	<b>103,652.62</b>	<b>470,625.83</b>
<b>Grand Total ACE Annual</b>	<b>153,553.92</b>	<b>346,894.35</b>	<b>206,048.79</b>	<b>122,826.93</b>	<b>829,323.99</b>

**Summer Internship Report**  
**IRNC:ProNet: TransPAC3 - Asia-US High Performance International**  
**Networking NSF OCI Award #0962968**  
Kevin Benton

## **Background**

I am a PhD student about to start my second year in Security Informatics at Indiana University this fall (2012). I received a M.S. in Informatics with a focus on security from the University of Nevada, Las Vegas (UNLV) and a B.S. in Network Technology from Montana Tech.

I have experience developing web applications from my employment at UNLV. However, my primary background is in network engineering and systems administration from my work in the IT department at Montana Tech during my undergraduate career.

## **Internship Activities**

The work centered on “community security” deliverables identified in the TransPAC3 project<sup>1</sup> description, specifically: “[the] community security plan emphasizes linkage of US and Asian trusted information sharing communities and engagement with those communities to effectively address security threats and incidents. In the US, we will engage with the Research and Education Networking Information Sharing and Analysis Center (REN-ISAC) to accomplish these objectives.”

The work was conducted in engagement with REN-ISAC staff, and revolved around the Collective Intelligence Framework (CIF) they have developed for sharing network security intelligence data on a large scale.<sup>2</sup> CIF is the open source component of the REN-ISAC Security Event System (SES), which is utilized by hundreds of institutions to get nearly real-time threat indicators.<sup>3</sup> SES version 3 is the subject of a current NSF award, SDCI Sec: SESv3 (Security Event System - Version 3), award OCI-1127425.

The goals of the internship were to: (1) establish a test bed of multiple CIF installations sharing data through "inter-federation", (2) create documentation, as a case study, on configuring and establishing inter-federation, and (3) work with our TransPAC3 partners to establish an active inter-federation pilot.

## **Accomplishments: Federated Sharing Use Case**

The primary goal of the internship was to create documentation that describes how to utilize the Collective Intelligence Framework developed by REN-ISAC in a federated data sharing use case scenario. In this context, "federated data sharing" involves the capability for sharing threat

<sup>1</sup> <http://internationalnetworking.iu.edu/TransPAC3> <sup>2</sup> <http://code.google.com/p/collective-intelligence-framework/> <sup>3</sup> <http://www.ren-isac.net/ses/>

indicators among disparate trust communities, such as REN-ISAC sharing with other ISACs, the DHS, national CERTs, etc. This goal was accomplished and the finished document is available to the public on the project's website.<sup>4</sup>

The document also includes a small Perl script I wrote that extracts failure events from SSH authentication logs and puts them into a format that can be consumed by a CIF instance. While not directly related to federated sharing, it illustrates how an organization can easily format and collect private internal data using CIF.

This documentation can be used by anyone to setup a CIF instance and begin sharing network threat intelligence with other organizations. We are working with the chair and co-chair of the APAN Security Working Group to establish a data sharing relationship between Kyushu University and REN-ISAC.

Kyushu University has successfully setup a CIF instance following the documentation developed from the test bed at REN-ISAC. The only issues they ran into were related to an older version of Perl that they were using, but they worked around them with a few minor changes.

A test CIF instance at REN-ISAC is configured to aggregate several public feeds of indicators and provide access to Kyushu University. Additionally, their CIF instance is collecting indicators generated from failed login attempts to their servers. Each CIF instance is also configured to share the collected data with the remote CIF instance, which completed the goal of setting up a functional test bed of federated data sharing.

The co-chair has proposed a joint presentation of the results of the collaboration in a session at the Winter 2013 APAN / ESnet / Internet2 international technical conference.<sup>5</sup>

### **Amazon EC2 Image**

Setting up a CIF instance has a large number of software prerequisites and steps, which led us to the idea of creating a pre-configured Amazon Machine Image (AMI) to lower the technical barrier to try out the framework. An AMI is a snapshot of a virtual machine that can be turned into a virtual machine on Amazon's Elastic Compute Cloud.<sup>6</sup>

The complete guide is available to the public along with the AMI image on the collective intelligence framework website.<sup>7</sup> This AMI drastically reduced the setup time because it eliminated the need to provision hardware, configure prerequisites, compile code, etc.

### **Browser Clients**

One of the barriers to overcome when working with CIF is learning to use the Perl client on a command-line interface to run queries against CIF to view data. A command-line environment with the Perl CIF client installed may not be available or easily accessible for many CIF users. To lower the barrier for the inter-federation pilot sites to interact with CIF, I wrote browser plugins for Mozilla Firefox and Google Chrome, both of which are open source and available to

<sup>4</sup><http://code.google.com/p/collective-intelligence-framework/wiki/FederatedSharingExample> <sup>5</sup><http://events.internet2.edu/2013/tip/> <sup>6</sup><https://aws.amazon.com/amis/> <sup>7</sup><http://code.google.com/p/collective-intelligence-framework/wiki/CIFDemoOnEC2>

the public on Github.<sup>8</sup>

The plugins offer a convenient interface integrated directly into the browser, allowing security researchers to query CIF instances for data points in a few clicks and get formatted, sortable results with links to related events without leaving their browser. The plugins also offer functionality beyond the command-line client by allowing users to submit threat indicators directly to a CIF instance rather than adding them to a separate data-source that the CIF instance would eventually read.

### **Web Interface (work in progress)**

One of the current limitations of CIF is its lack of support for a commenting system. REN-ISAC handles this with additional custom components in their SES system that handle conversations. However, the custom components are very specific to REN-ISAC and are not available to the public.

To make similar functionality available to inter-federation partners, I began work on an open-source web interface that allows users to submit threat indicators and have conversations centered around each indicator. These indicators are then aggregated into feeds that can be consumed by CIF instances. This partially completed project will be available on Github in the Collective Intelligence repository collection.<sup>9</sup>

### **Experience Gained**

All of the experience I received while working for REN-ISAC over the summer involved working with the Collective Intelligence Framework, ranging from creating test beds and documentation to writing clients and contributing code. The browser clients are used on a daily basis by many CIF users and REN-ISAC has received positive feedback about them several times.

I gained a better understanding of the challenges when working with big data with limited hardware resources and the impact of software architecture decisions at large scales. The current version had started to hit performance bottlenecks due to the way data was represented during transportation and storage. I saw how the new version being developed performed an order of magnitude better by switching to Protocol Buffers for storage and transport along with a new component-based architecture that scales better by spreading the workload across many processors/servers .

This was the first time I authored code that was part of a larger project (outside of class projects) with multiple active developers. I gained experience using source code version control systems in a collaborative environment to allow concurrent development on software while ensuring quality control and change history for accountability. It was also the first large project I've worked on using the Perl language, which gave me experience with object-oriented programming in Perl and common Perl practices to make code easy to maintain and reuse.

Finally, I gained insight into how information sharing communities work and the advantages they provide to network operators trying to mitigate threats. From a research perspective, the information aggregated by communities in systems like CIF could provide insight into the behavior of attackers or networks over time. I plan to continue working with REN-ISAC throughout this school-year and utilize the Collective Intelligence Framework for a research project as part of my academic work.

<sup>8</sup><https://github.com/collectiveintel/cif-client-chrome> <sup>9</sup><https://github.com/collectiveintel>

Darah Patton  
International Networking @ Indiana University: Reflection  
April 13, 2012

After growing up in a Boilermaker family, to say my family was surprised I chose to attend Indiana University is an understatement. But IU's prestigious Journalism School was just too difficult to turn down. I am now about to finish my junior year at IU with a double major in Journalism and Political Science. At IU, I stay busy through my involvement in the Public Relations Student Society of America, Indiana Daily Student reporting, and Greek life. After studying abroad in London last summer, I became consumed with plans of future travel. I would love to work for an international public relations firm and live abroad for a few years after graduation.

This interest in travel and global affairs led to my internship with International Networking @ Indiana University. To be honest when I first started this position, I was not even sure what international networking was. I read through the IN@IU website feeling as though I was trying to comprehend a foreign language. But after a lot of research and a lot of questions I began to understand the basics of computer networking. One of our first assignments as an intern was to write a science highlight about the ACE project. This piece of writing summarizes the background, impact, and outcomes of a National Science Foundation project in order to help the NSF receive future funding from congress. This assignment was extremely helpful because it forced me to translate all of the scientific terminology into simple and direct language. After pushing past the learning curve, I was able to put my background in communications and public relations to work. A majority of the work I completed during this internship involved design. I used the Adobe products to create multiple maps to illustrate the different international network connections for ACE and TransPAC3. These visuals make it much easier to the impact and outreach of IN@IU's projects. I also created a display poster for the TransPAC3

project. This poster illustrates and briefly explains the significance of the TP3 project. This poster will hang in the Cyber Infrastructure Building along with the other GlobalNOC project posters. It will also be used at conferences and events as a visual promotional tool. Along with the poster, James Williams needed digital visuals to assist him in his presentations at these same events. Therefore, I created a Prezi presentation, the next generation of PowerPoint, for Williams to use during his presentations. While most of the tasks I completed over my internship were requested, the press release I and the other intern collaborated on initially started as a mere suggestion to Williams. Before this internship, I had no idea IU was the leading institution in international networking. Therefore, we decided something needed to be done to improve awareness on the IU Bloomington campus about its International Networking program. After completing research and interviews, we wrote a press release to be submitted to the Indiana Daily Student. We also hope to send this news release to other Indiana newspapers.

This internship was a great experience because it allowed me to advance my communication and design skills while gaining knowledge on an extremely complicated topic. Because I want to work in public relations after graduation, any writing practice is valuable. The experience I gained writing company highlights, press releases and presentations will be crucial skills I can translate into any type of communications job. My experience with the Adobe products also greatly improved because of the many illustrations and poster I created. Before this internship, the design segment of PR is where I most lacked experience. Now, my experience with the Adobe products will help me to be a more competitive and well-rounded applicant for future jobs. While I did gain very valuable practice with communications work, the most important lesson this internship taught me was to step out of my comfort zone and learn new things. It is so easy to be intimidated by fields you do not understand or language you are unfamiliar

with. However, this internship forced me to be uncomfortable and learn new information, showing me that being unsure is too often an excuse not to challenge yourself.



Alisa Wiersema  
IN@IU – Intern Reflection  
April 13, 2012

When I entered college I thought Journalism was limited to writing, broadcasting and essentially telling people what was going on in the world around them. However, within my first few weeks as a college student, I was quickly taught that there is more to Journalism than simple information dissemination, but rather that there was in fact, quite a bit of strategy involved in the very essence of communication. I found this intricacy fascinating but did not feel as connected to the practice of journalism as I expected. I enjoyed my classes thoroughly but wished there was a way for me to practice communication in action rather than simply writing about it. Luckily, when I began having these issues I enrolled in an introductory course in Public Relations. After creating my first communications plan I knew I found passion in my education; not only was I able to write, but I also had the ability to see my efforts materialize into results, while learning from a variety of people and situations.

Since then, Public Relations has taught me much about the professional world, the non-profit sector, agency relations, and now, international networking. My internship at Hirons & Company during the summer of 2011 showed me that a diverse clientele builds up professional experience, while simultaneously refining a person's education. I can definitely say that working with International Networking at Indiana University for the past few months allowed me to accomplish both of those aspects.

Initially, I did not expect to have the amount of creative freedom in a technologically-based field, but this internship actually provided me with the most creative liberty I have had to date in any work experience. Not only were there actual creative assignments, but also, I was able to execute these creative strategies on my own with few limitations. Alongside with another intern, I was able to create revised business

cards, a professional IN@IU poster, write an upcoming article about the program, and design a professional presentation, all the while learning about the topic of International Networking. The variety of assignments truly helped me understand the impact of what International Networking at Indiana University contributes to not only our university and nation, but to the world. It is incredible to know that a university in the middle of Indiana can aid people across the world in their communication and research endeavors, and it makes me proud to have attended such an institution. I would have never guessed that as a senior in college I would be exposed to a topic that seems so unrelated to my field of study, but I am so grateful to have had this opportunity because it embodied what Public Relations is all about—consistently learning from your clients and audiences.

Upon conclusion of this internship, I was offered (and accepted) admission to Georgetown University's Communication, Culture and Technology (CCT) Graduate Program, and I have a feeling that my involvement with International Networking at Indiana University greatly helped my placement in the program. When I applied to Georgetown, I was unsure if I had any kind of technological experience to associate with CCT. Now, I feel confident about pursuing this area of study because I feel that I am better informed about the process of creating and maintaining international networks and partner relationships than the average, college educated person. I can tell that this area of research will be (and already is!) incredibly important in the near future as it parallels the process of globalization.

As a graduating senior and upcoming graduate student, I hope to apply this newfound understanding of International Networking in the area of Public Affairs. I am certain that the types of relationships created through international networking will help politicians and other public figures have a common ground in creating projects together, rather than antagonizing one another on a global level. I believe that having the understanding about how countries all around the world are able to unite over research

and academia is comforting and valuable. It is good to know that countries can work together on projects that do not center on conflict and communicate with one another productively.

## OpenFlow Instruction for DANTE and APAN

Steven Wallace, Director – InCNTRE

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As a result of the TransPAC3 supplemental funding, InCNTRE was able to improve its “OpenFlow in A Day” workshop and deliver the workshop, as-well-as consulting on how to conduct the workshop, to representatives of DANTE and APAN. Exact delivery dates are listed below.

In addition to actual delivery of the workshop, the funding allowed the method of delivering the workshop to be changed from using limited capacity server equipment located on the IU campus to using Amazon Web Services virtual machines. This greatly reduced the risk of “network problems” interfering with the workshop.

The fees for using the AWS VMs only apply to the time they're actually spun up to support the workshop, and, in theory, any number of VMs can be created allowing the workshop to meet a varying number of participants. This is quite cost effective and allows for significant variation in the number of participants (limited only by the number of instructors).

The workshop materials, both the slides and the Amazon Machine Images, were made available to DANTE and APAN for their use in conducting their own workshops and are available to others. The dates and pointers to the slide decks used for these workshops are found here:

31-Oct-2012 Dante (slides <http://tinyurl.com/Dante-OF-training>)

16-Jan-2013 APAN (slides <http://tinyurl.com/TIP2013>)

As an unexpected benefit, we were also able to leverage workshop improvements to offer a cost effective, cost reimbursed workshop to SURFnet on 7-Mar-2013.

The agenda for the workshops included the following:

- OpenFlow use cases
- OpenFlow's origin
- ONF overview
- SDN overview
- OpenFlow overview
- OpenFlow (more detail)
- OpenFlow 1.0 vs. 1.1+
- OpenFlow QoS
- Hands on exercises
  - + learn switch
  - + manual rule insertion
  - + FlowVisor virtualization

The workshops and content development were both prepared/conducted by Steven Wallace ([ssw@indiana.edu](mailto:ssw@indiana.edu)).