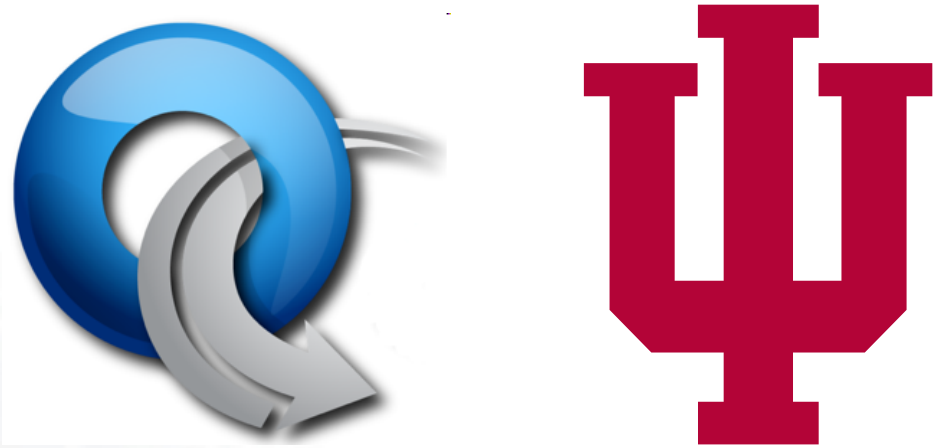
Indiana University OpenFlow CampusTrial
Spiral 2 Year-end Project Review



Indiana University

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Project Summary

The Indiana University OpenFlow Trials focus on:

- Operational Management
- Inter-campus connectivity
- Distributed Measurement

A major goal of the IU campus trials is to provide the necessary tools and procedures to allow network operators to deploy and maintain OpenFlow networks. This includes integration of OpenFlow into widely used tools used to manage networks, development of new tools to troubleshoot OpenFlow networks.

The IU OpenFlow campus trials are not only focused on a single campus but exploring methods for inter-campus connectivity. Measurement and other applications are researched both for there use in Operations but also in terms of instrumentation and measurement applications for researchers and experiments.

Milestone & QSR Status

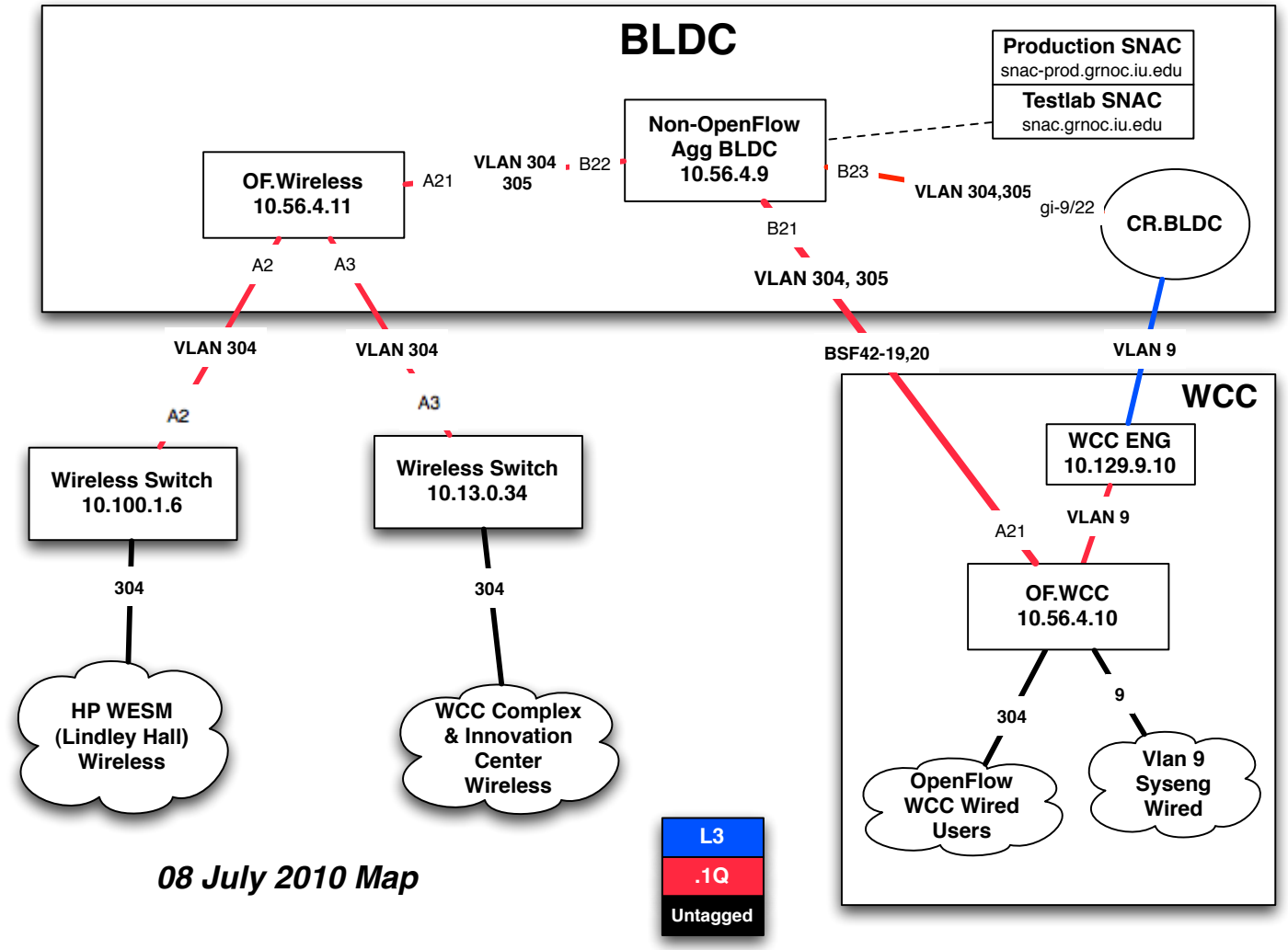
ID	Milestone	Status	On Time?	On Wiki?	GPO signoff?
S2.a1	Select Vendors	HP 6600 switches selected	Early	Complete	yes
S2.a2	Purchase Equipment	HP 6600 switches purchased and deployed	On Time	Complete	yes
S2.b	Small Campus Deployment	OpenFlow .89 deployment with 4 test and 2 production switches	On Time	Complete	yes
S2.c	Install GENI software with AM API	Deployed latest FlowVisor; waiting on Expedient availability	>2 M incomplete	In Progress	
S2.d	Begin integration testing with Stanford and BBN	NLR Connectivity tested and demoed at GEC8; Re deploying vlans for new tests	On time	Complete	no
S2.e	Plan and Engineer GEC9 Demo	Demo will be an extension of GEC8 demo with more management data collected	On Time	Documentation - In Progress	no
S2.f	Upgrade Small deployments to use OF 1.0	Deployed to all switches by 7/1	On Time	Complete	no
	QSR: 4Q2009	Initial testlab deployed	On Time	Yes	Yes
	QSR: 1Q2010	Purchase of switches; Deployment of .89 Firmware and controllers; Production	On Time	Yes	Yes
	QSR: 2Q2010	OF 1.0 code deployed; 20 wired uses/3 buildings/ 2campuses; Wireless SSID	On Time	Yes	Yes

Accomplishments 1: Advancing GENI Spiral 2 Goals

- Campus Deployment
  - 2 campuses, Buildings (4 wired/6 wireless), 7 switches
  - ~30-40 users, 75 devices
  - Deployment of OF 1.0 w/ latest SNAC, FlowVisor, NOX
  - Testlab for code testing, experiment
  - Scalable

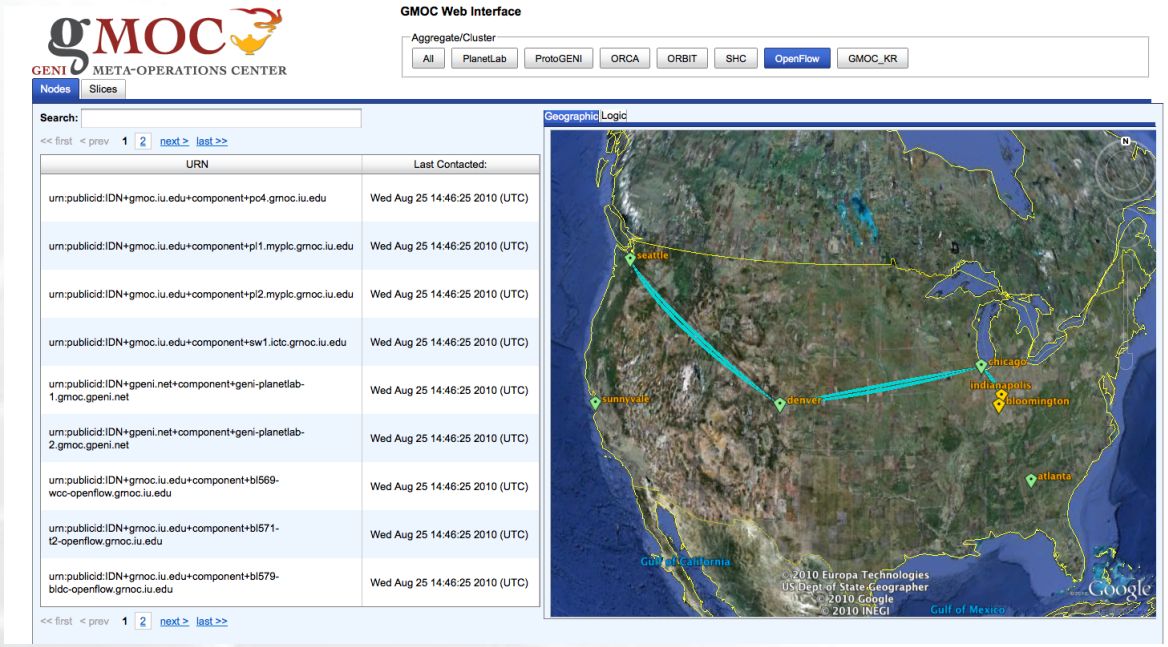
- Measurement Tools
  - Created and demonstrated at GEC8 tools for monitoring OpenFlow activities
  - Measure state of OpenFlow enabled hardware and specialized queries to switches and controllers
  - Visualized multiple administrative domains with integration into the GMOC visualization tools

Accomplishments 1: Advancing GENI Spiral 2 Goals (con't)



Accomplishments 1: Advancing GENI Spiral 2 Goals (con't)

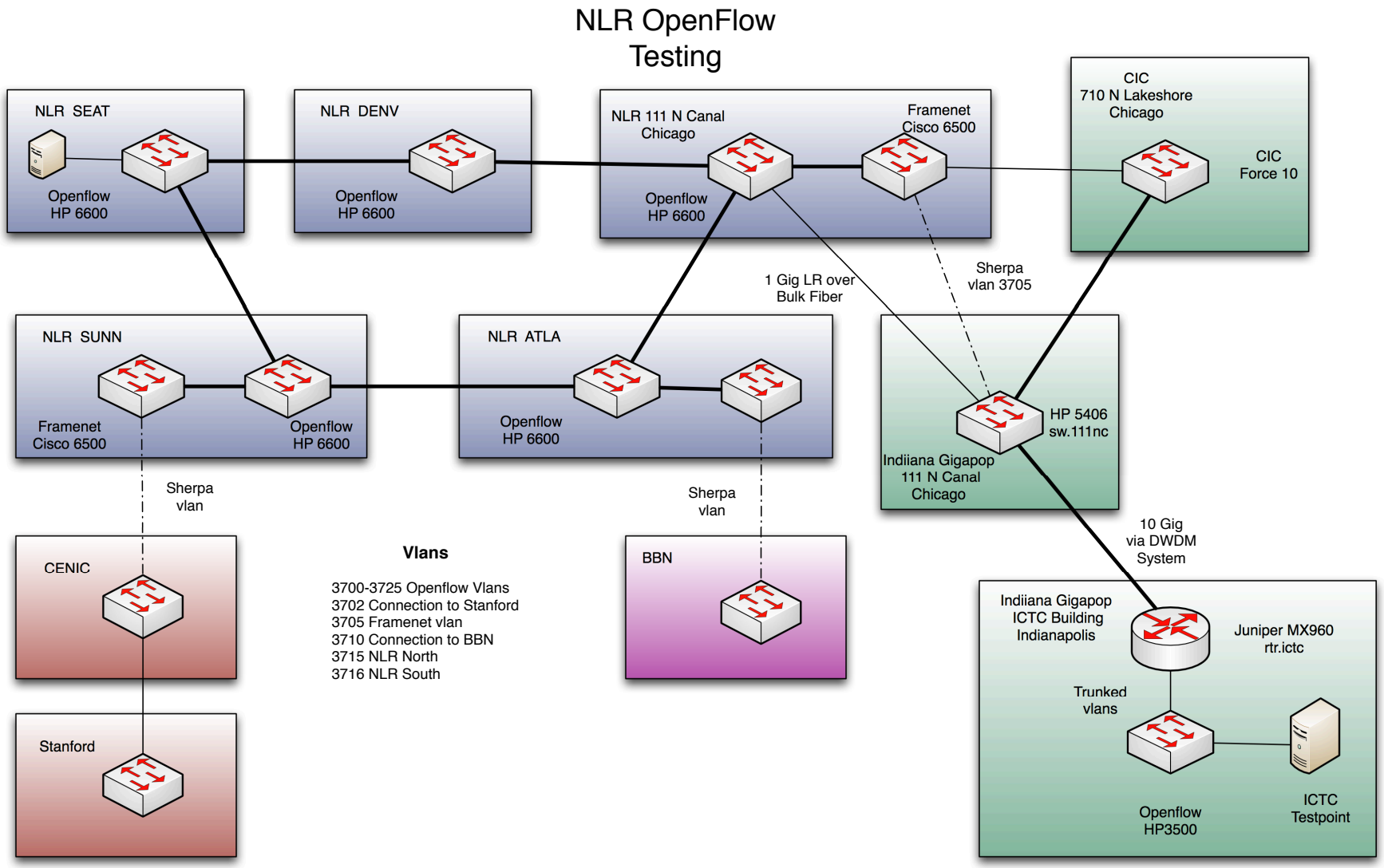
- GENI Integration
  - GpENI, Planetlab(s), GMOC, LAMP
  - VMs, Dedicated hardware, Network Hardware,Test Sets
  - Allowing early experimentation on resources
  - Allowing for I&M resources to be integrated into OpenFlow networks
    - LAMP/PerfSONAR
    - Packet Capture



Accomplishments 1: Advancing GENI Spiral 2 Goals (con't)

- Interoperability
  - Connectivity between multiple campuses
  - Connectivity and testing to backbone networks other campuses
  - Work on the best procedures to connect OpenFlow "islands" together
  - Astri*x demo
  - Interoperability with campus tools
    - Campus AAA systems
    - Wireless statistics
    - Network troubleshooting

Accomplishments 1: Advancing GENI Spiral 2 Goals (con't)



Accomplishments 2: Other Project Accomplishments

- Outreach
  - Talks at Internet2 Joint Techs, APAN, IU, CIO Summit
  - Discussions about International connectivity (IRNC TransPac3 and OFELIA)
  - Promote OpenFlow both to researchers and network operators
- Security
  - Best Practices for securing control plane
- Testing
  - High bandwidth
  - Multicast
  - Control Plane connectivity outages
  - Preventing loops
  - Debugging

Issues

- Hardware
  - Availability of hardware capable of large flow tables
  - Networks with varying capabilities
- Inter-connectivity issues for Layer 2 networks
  - VLAN negotiation
  - Wide Area Ethernet debugging
  - Design
- Security
  - Control Plane
  - Data Plane
- Reliability
  - Firmware changes
  - Failover
  - Statistics through OpenFlow
- Event Correlation

Plans

- Spiral 2 plans
  - Expand tools used in GEC8 demo to GEC9 Demo;
  - Capture Measurement data from more networks
  - Expand production users
  - Documentation
  - Continue backbone multi campus testing; I2 connectivity
- Spiral 3 plans
  - Wider campus deployment
    - Expansion of SSID/Wired deployments
    - More vendors - Interoperation
  - Monitoring Plane software
    - Config Protocol
    - Measurement and Alarm Monitoring Improvements
  - Network Operator Outreach
    - Training (Internal and External)
  - Experiment deployment
    - Multicast TV
    - Routing Experiments
    - Non IU users supported; Training Use
  - Integration
    - BGPMux, NetKarma, Packaging