GENI Racks and Campuses: Infrastructure Overview

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www.geni.net

Session Organization:

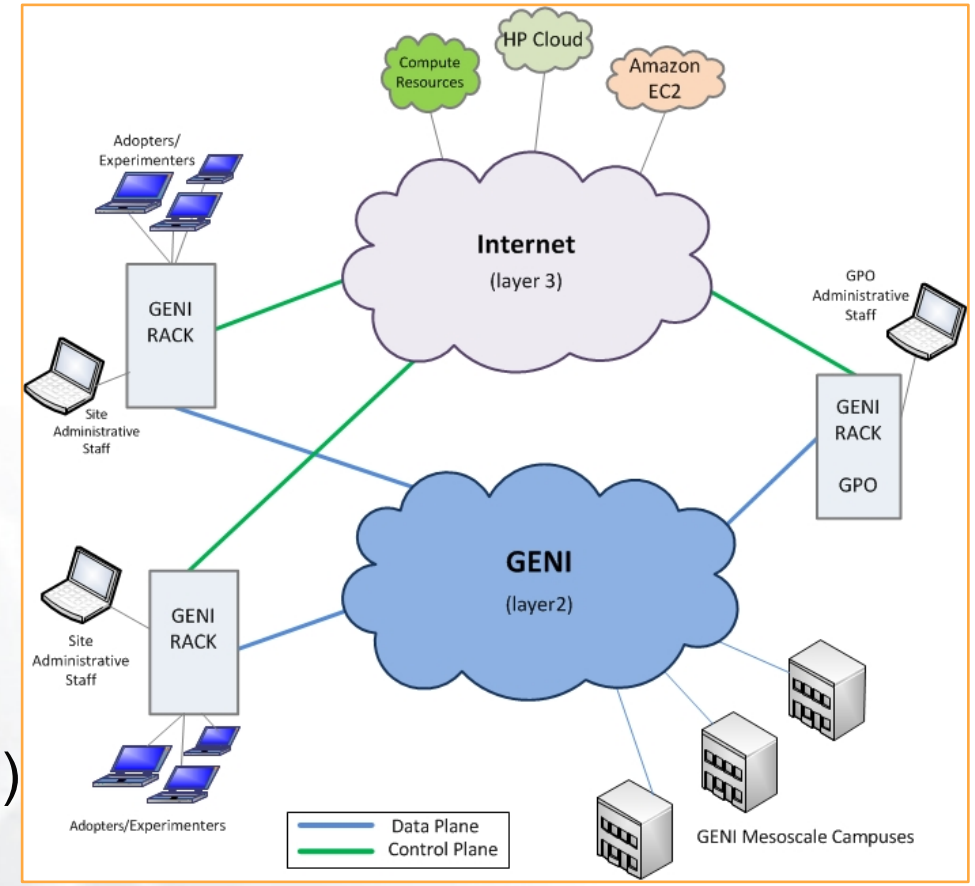
- **ExoGENI racks update** Chris Heermann
- **InstaGENI racks update** Rick McGeer
- **GMOC update** Jon-Paul Herron
- **Meso-scale update** Heidi Picher Dempsey

Agenda:

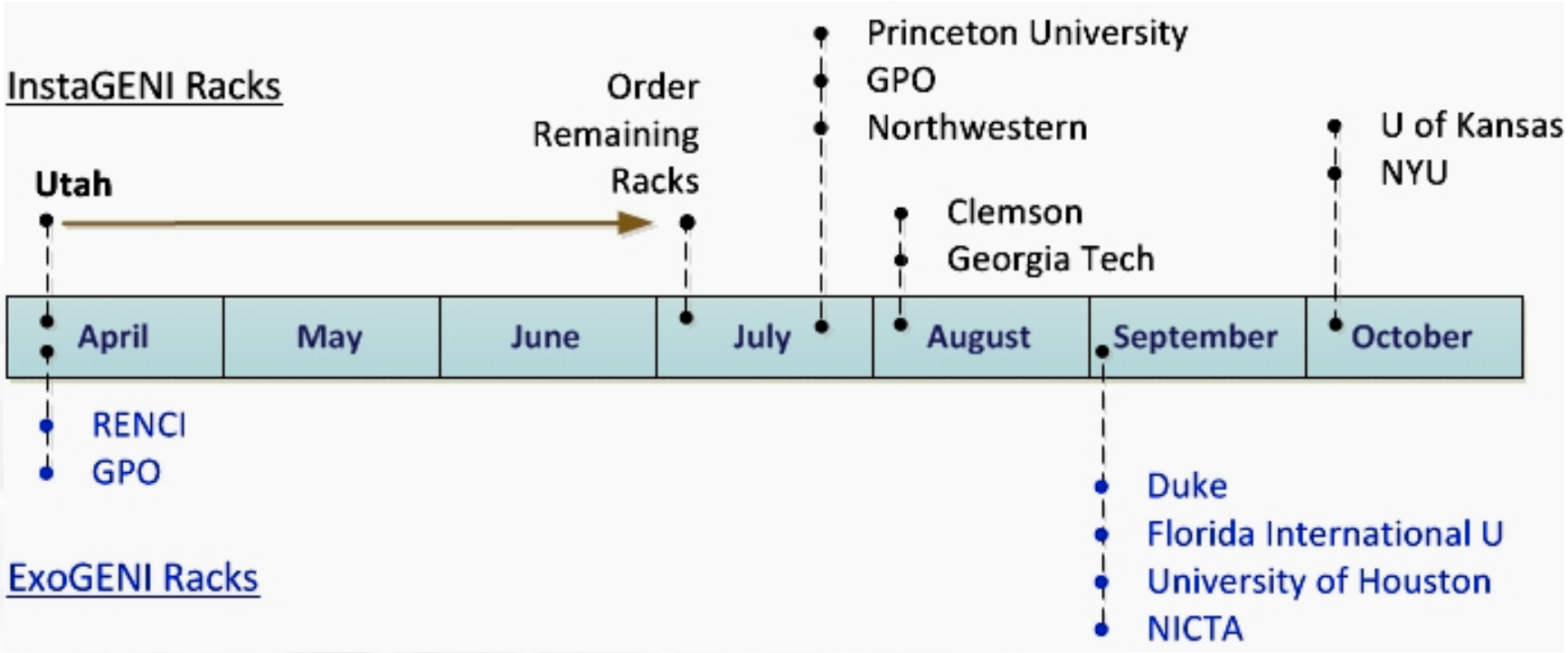
- GENI Racks
  - GENI Racks Status
  - Acceptance Tests
  - Open Source and International OpenFlow and Racks
- MesoScale
- Regionals and GENI core evolution
- WiMAX Integration
- Support

GENI Racks

- GENI Racks projects are expanding available GENI infrastructure in the US.
- Racks provide reservable, sliceable compute and network resources using Aggregate Managers.
- GENI AM API compliance
- GENI RSpec v3 support
- Federation with Slice Authorities (GPO, PG, PLC)



GENI Racks Status



- Deployment plans for 2012 and current status at http://groups.geni.net/geni/wiki/Regionals
- Spiral 5 deployments will ramp up quickly

GENI Rack Software Acceptance Tests

- GPO revised GENI AM API Acceptance Tests, available in GCF 1.6.2:
  - http://trac.gpolab.bbn.com/gcf/wiki/GettingGcf
  - http://trac.gpolab.bbn.com/gcf/wiki/AmApiAcceptanceTests
- Acceptance Tests are used by rack teams to verify GENI AM API compliance.
- Aggregates that passed GENI AM API acceptance tests:
  - PG Utah (RSpecs pass rspeclint)
  - PLC (RSpecs pass rspeclint)
  - FOAM
  - InstaGENI

GENI Rack System Acceptance Tests

- GPO is performing System Acceptance Tests for each of the GENI rack implementations: ExoGENI and InstaGENI.
  http://groups.geni.net/geni/wiki/GENIRacksHome/AcceptanceTests
- Test goals are to validate rack integration, monitoring, experimenter, and aggregate functions by evaluating:
  - Services and resources available to experimenters
  - Administrative functions for campus/IT personnel
  - Potential experiment topologies
  - Experimenters' access to resources
  - Interoperability with existing Meso-scale aggregates
  - Monitoring features and GMOC data collection
  - GMOC rack operations and procedures

GENI Rack System Acceptance Tests

Administrative Acceptance Tests

Validate campus IT owner tasks and supporting documentation for the following:

- Rack site delivery process (receipt, installation, wiring, power, component inventory)
- Rack administrative accounts (creation and usage)
- Rack component access (console, ssh)
- Rack shutdown, reboot, hard power off.
- Emergency Stop
- Software update of system RPM packages, AM software, and FOAM components.
- Administrative support documentation

GENI Rack System Acceptance Tests

Monitoring Acceptance Tests

Validate availability and access to rack components monitoring data required to support racks. Areas validated:

- Rack component health monitoring
- Experiment state monitoring
- Rack handling of outage conditions
- OpenFlow control monitoring
- GMOC monitoring and data collection
- Monitoring support documentation

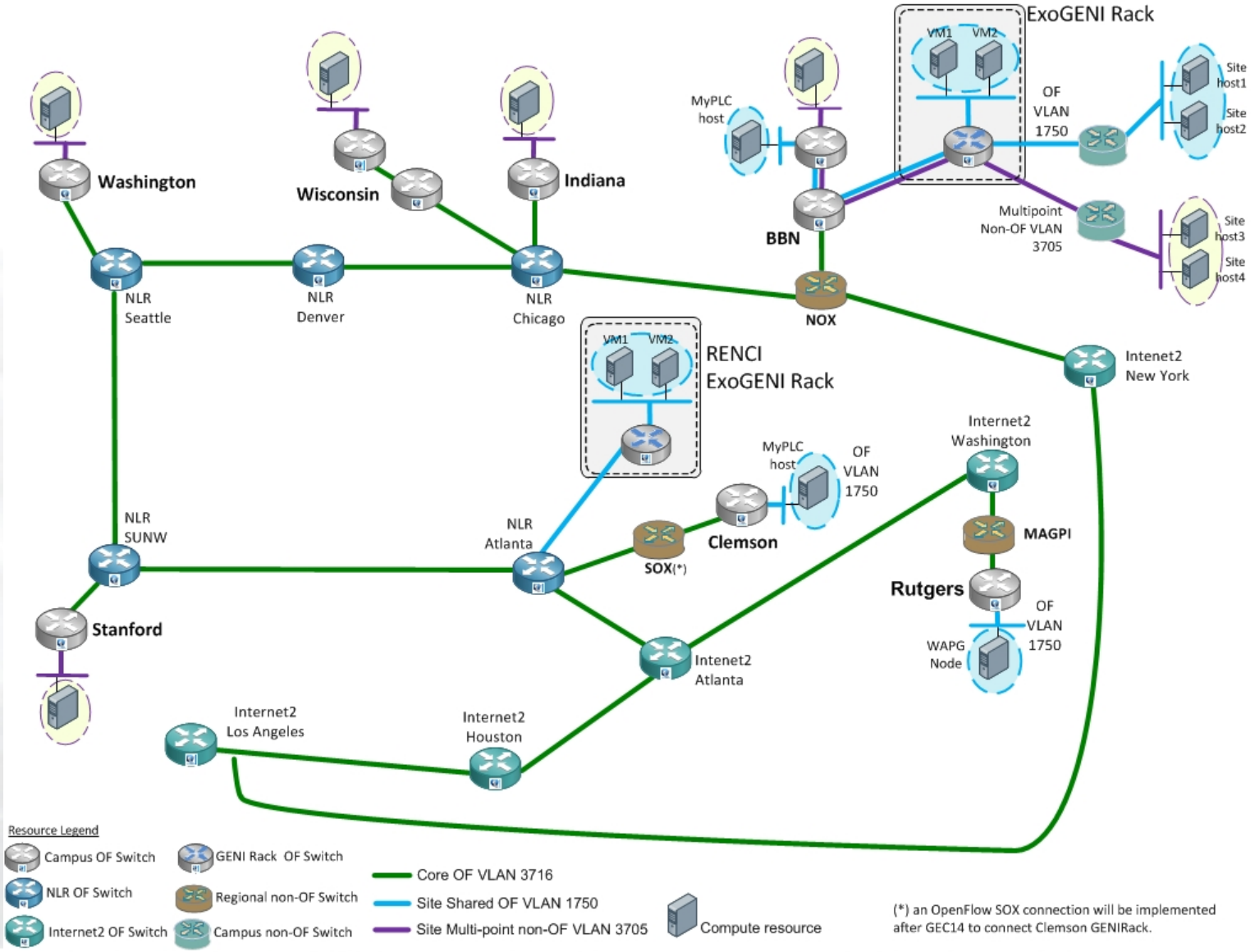
GENI Rack Acceptance Tests

Experimenter Acceptance Tests

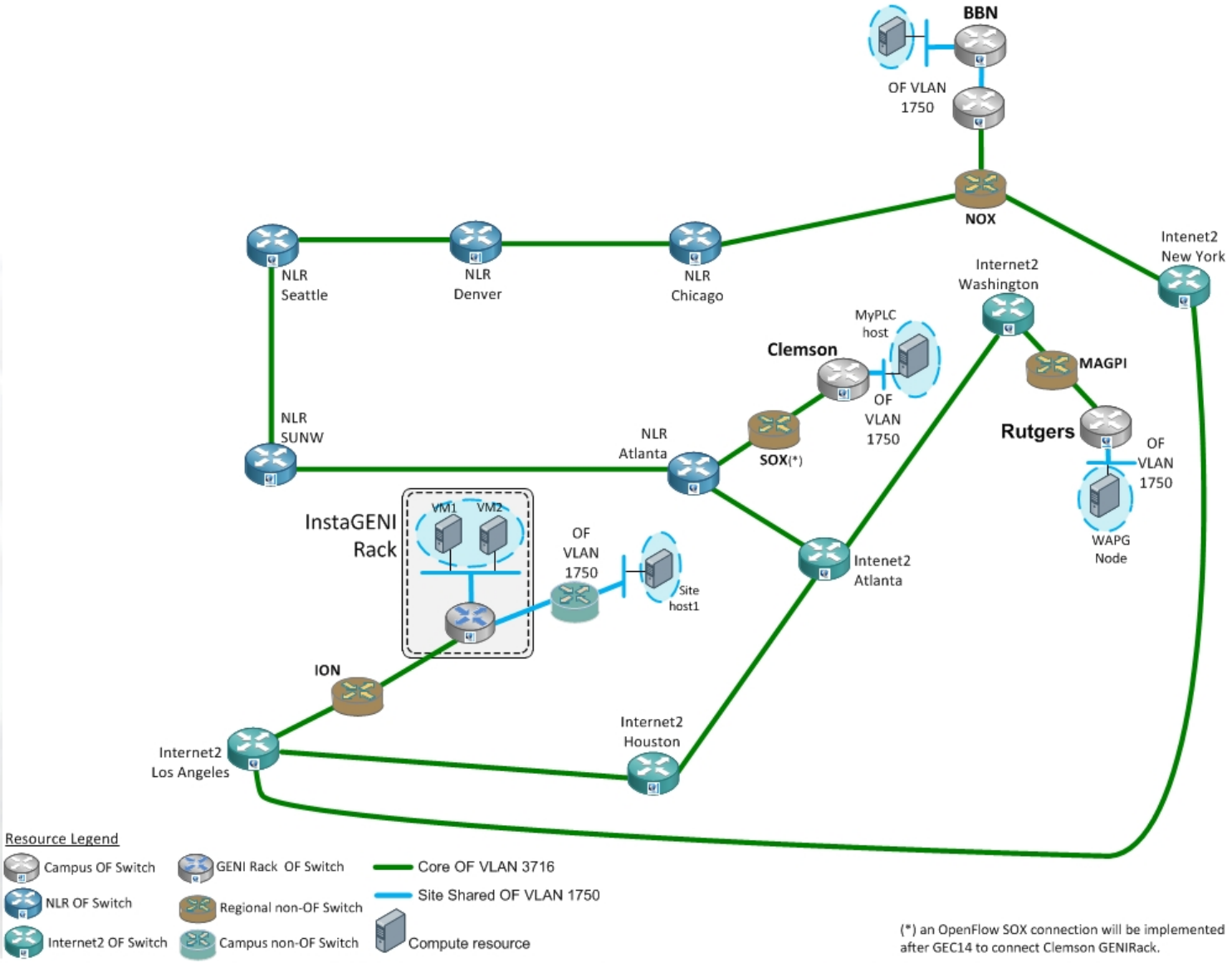
Validate Experimenter scenarios which use:

- Single site and multisite topologies
- OpenFlow topologies
- Interoperability with Meso-scale sites
- Network and compute resources handling (request, use, monitor, release)
- Compute resource support:
  - Virtual Machines
  - Bare metal/Physical node
  - OS images available for rack
  - User-defined custom image support.
- User documentation

GENI Rack Acceptance Tests: ExoGENI



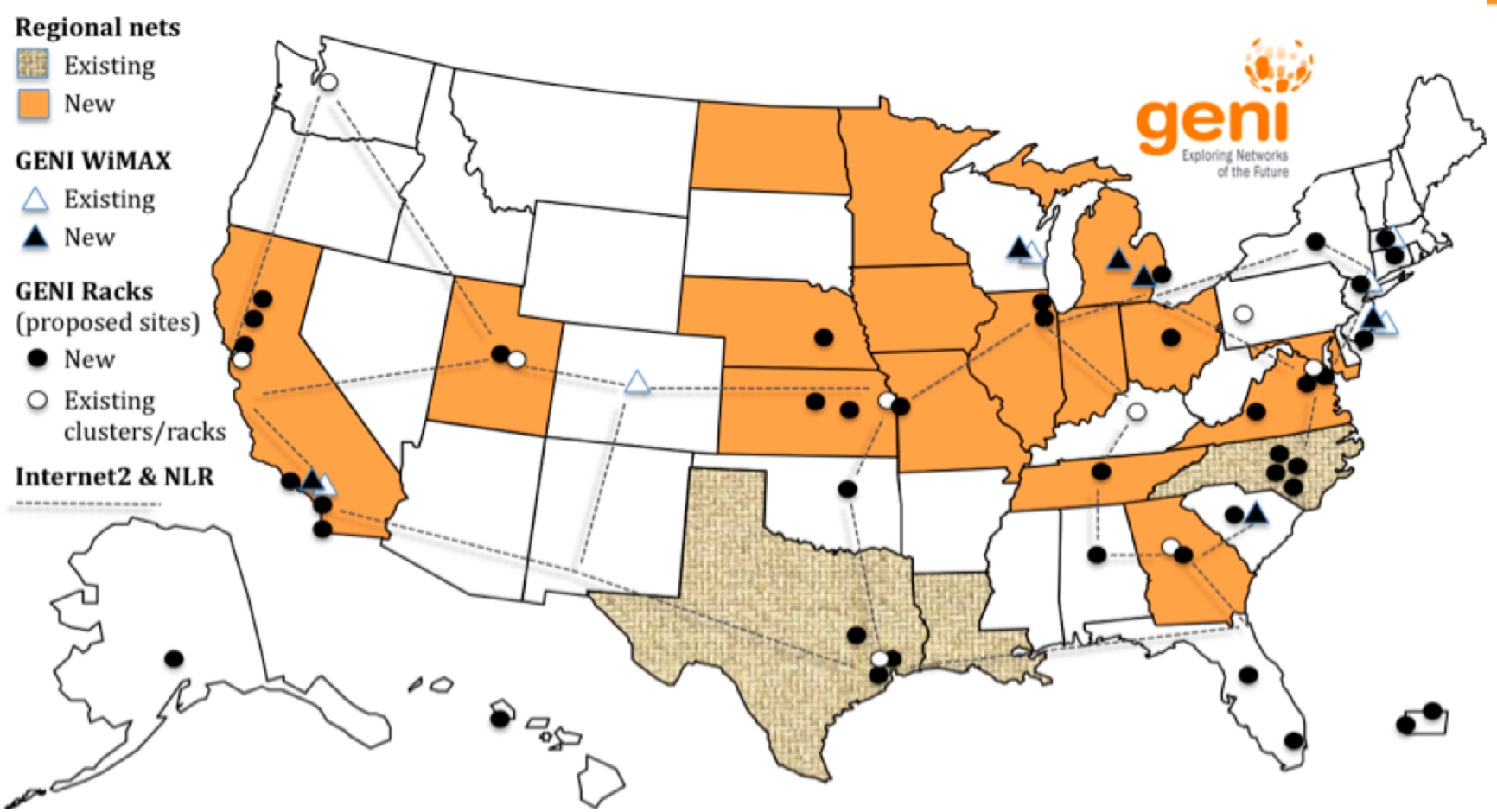
GENI Rack Acceptance Tests: InstaGENI

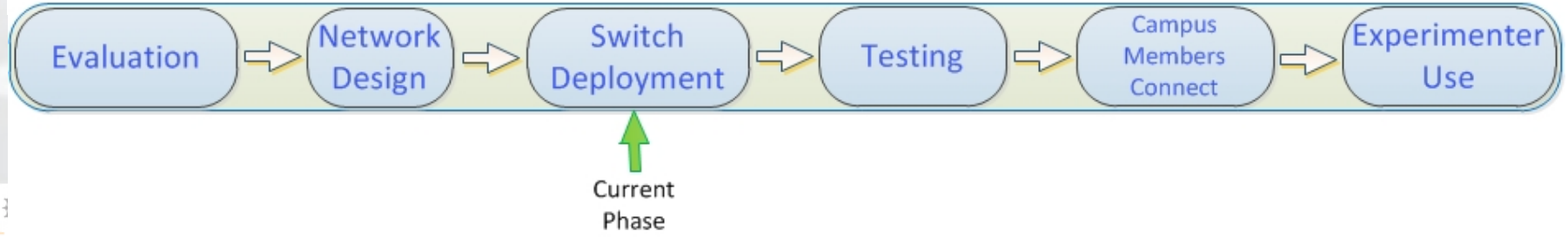


GENI International OpenFlow and Racks

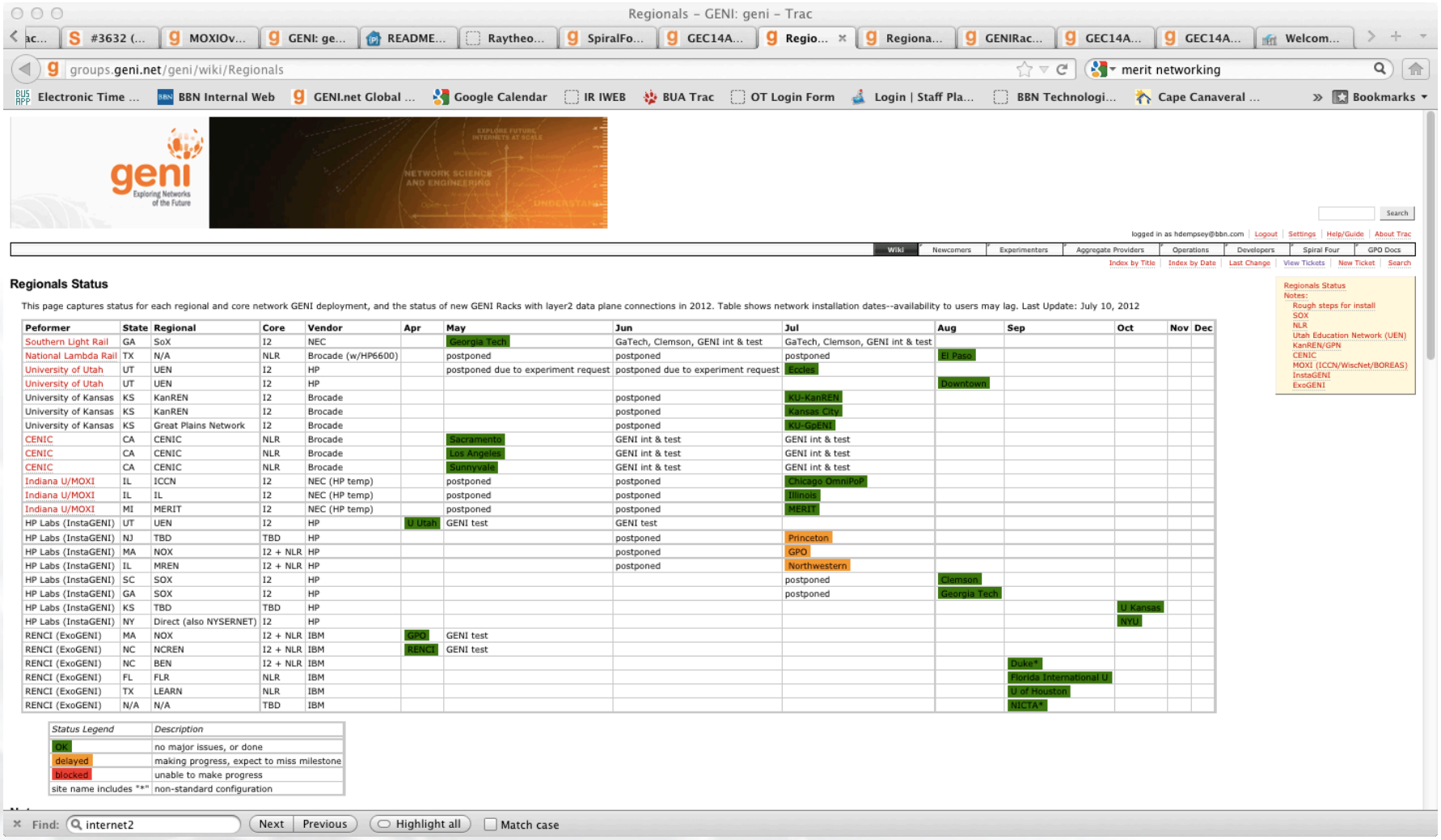
- Slice Around the World demo at GEC14 and GEC15 connects meso-scale and international sites
- Terena networking 2012, TridentCom 2012, SIGMETRICS/Performance 2012 international papers, GENI tutorial
- NEC racks (Japan)
  - Using NEC switches, TREMA and OpenStack
  - Implemented with open source community
- OFELIA deployments (EU)
  - Includes 5 EU OpenFlow campuses
  - Aggregate manager similar to GENI AM

Mesocale Overview





Meso-Scale Spiral 4 Deployments



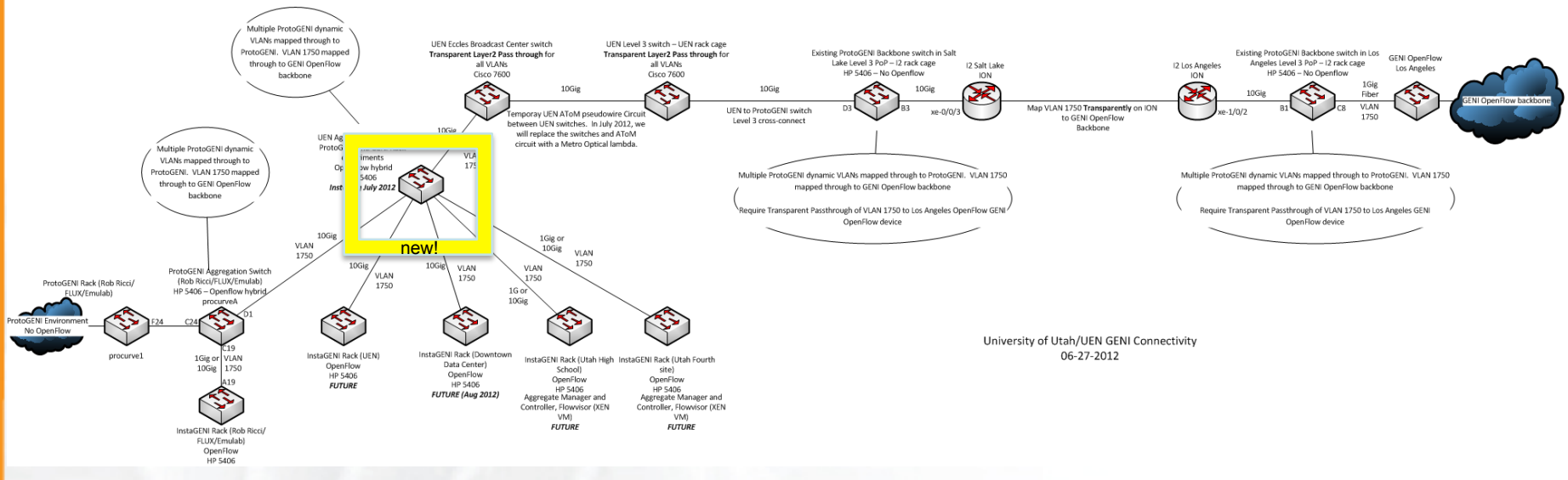
Peformer	State	Regional	Core	Vendor	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Southern Light Rail	GA	SoX	I2	NEC		Georgia Tech	GaTech, Clemson, GENI int & test	GaTech, Clemson, GENI int & test					
National Lambda Rail	TX	N/A	NLR	Brocade (w/HP6600)		postponed	postponed	postponed	El Paso				
University of Utah	UT	UEN	I2	HP		postponed due to experiment request	postponed due to experiment request	Eccles					
University of Utah	UT	UEN	I2	HP					Downtown				
University of Kansas	KS	KanREN	I2	Brocade			postponed	KU-KanREN					
University of Kansas	KS	KanREN	I2	Brocade			postponed	Kansas City					
University of Kansas	KS	Great Plains Network	I2	Brocade			postponed	KU-GpENI					
CENIC	CA	CENIC	NLR	Brocade		Sacramento	GENI int & test	GENI int & test					
CENIC	CA	CENIC	NLR	Brocade		Los Angeles	GENI int & test	GENI int & test					
CENIC	CA	CENIC	NLR	Brocade		Sunnyvale	GENI int & test	GENI int & test					
Indiana U/MOXI	IL	ICCN	I2	NEC (HP temp)		postponed	postponed	Chicago OmniPoP					
Indiana U/MOXI	IL	IL	I2	NEC (HP temp)		postponed	postponed	Illinois					
Indiana U/MOXI	MI	MERIT	I2	NEC (HP temp)		postponed	postponed	MERIT					
HP Labs (InstaGENI)	UT	UEN	I2	HP	U Utah	GENI test	GENI test						
HP Labs (InstaGENI)	NJ	TBD	TBD	HP			postponed	Princeton					
HP Labs (InstaGENI)	MA	NOX	I2 + NLR	HP			postponed	GPO					
HP Labs (InstaGENI)	IL	MREN	I2 + NLR	HP			postponed	Northwestern					
HP Labs (InstaGENI)	SC	SOX	I2	HP				postponed	Clemson				
HP Labs (InstaGENI)	GA	SOX	I2	HP				postponed	Georgia Tech				
HP Labs (InstaGENI)	KS	TBD	TBD	HP							U Kansas		
HP Labs (InstaGENI)	NY	Direct (also NYSERNET)	I2	HP							NYU		
RENCI (ExoGENI)	MA	NOX	I2 + NLR	IBM	GPO	GENI test							
RENCI (ExoGENI)	NC	NCREN	I2 + NLR	IBM	RENCI	GENI test							
RENCI (ExoGENI)	NC	BEN	I2 + NLR	IBM						Duke*			
RENCI (ExoGENI)	FL	FLR	NLR	IBM						Florida International U			
RENCI (ExoGENI)	TX	LEARN	NLR	IBM						U of Houston			
RENCI (ExoGENI)	N/A	N/A	TBD	IBM						NICTA*			

Status Legend	*Description*
OK	no major issues, or done
delayed	making progress, expect to miss milestone
blocked	unable to make progress
site name includes "*"	non-standard configuration

Regional interconnections and campus/regional GENI rack current status at http://groups.geni.net/geni/wiki/Regionals

Meso-Scale: Utah Education Network

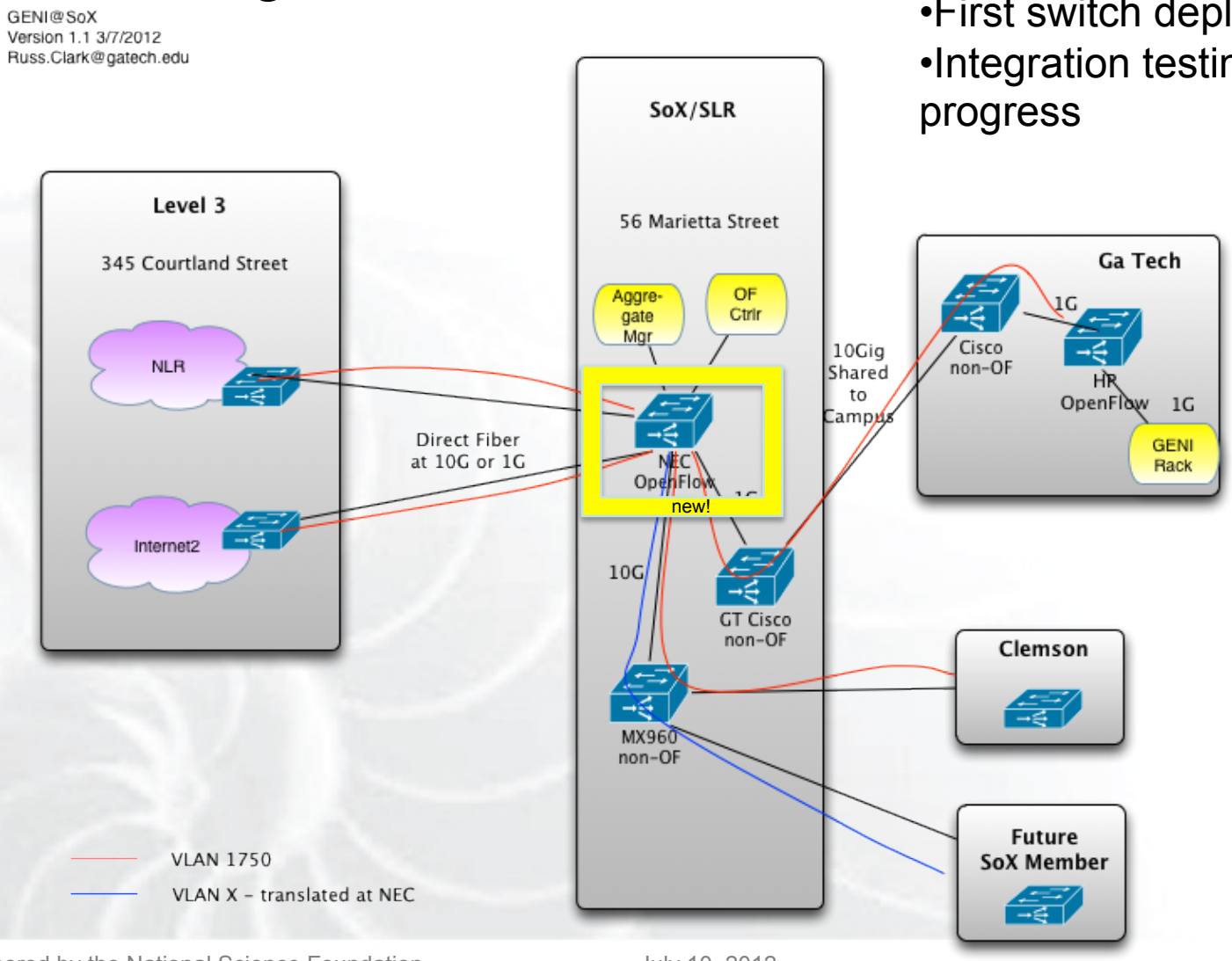
UEN, ProtoGENI and InstaGENI:



- Switch deployed
- Will connect Emulab Utah, I2 and schools
- Integration postponed for Slice Around the World demo

Meso-scale: Southern Crossroads

SOX OF Regional

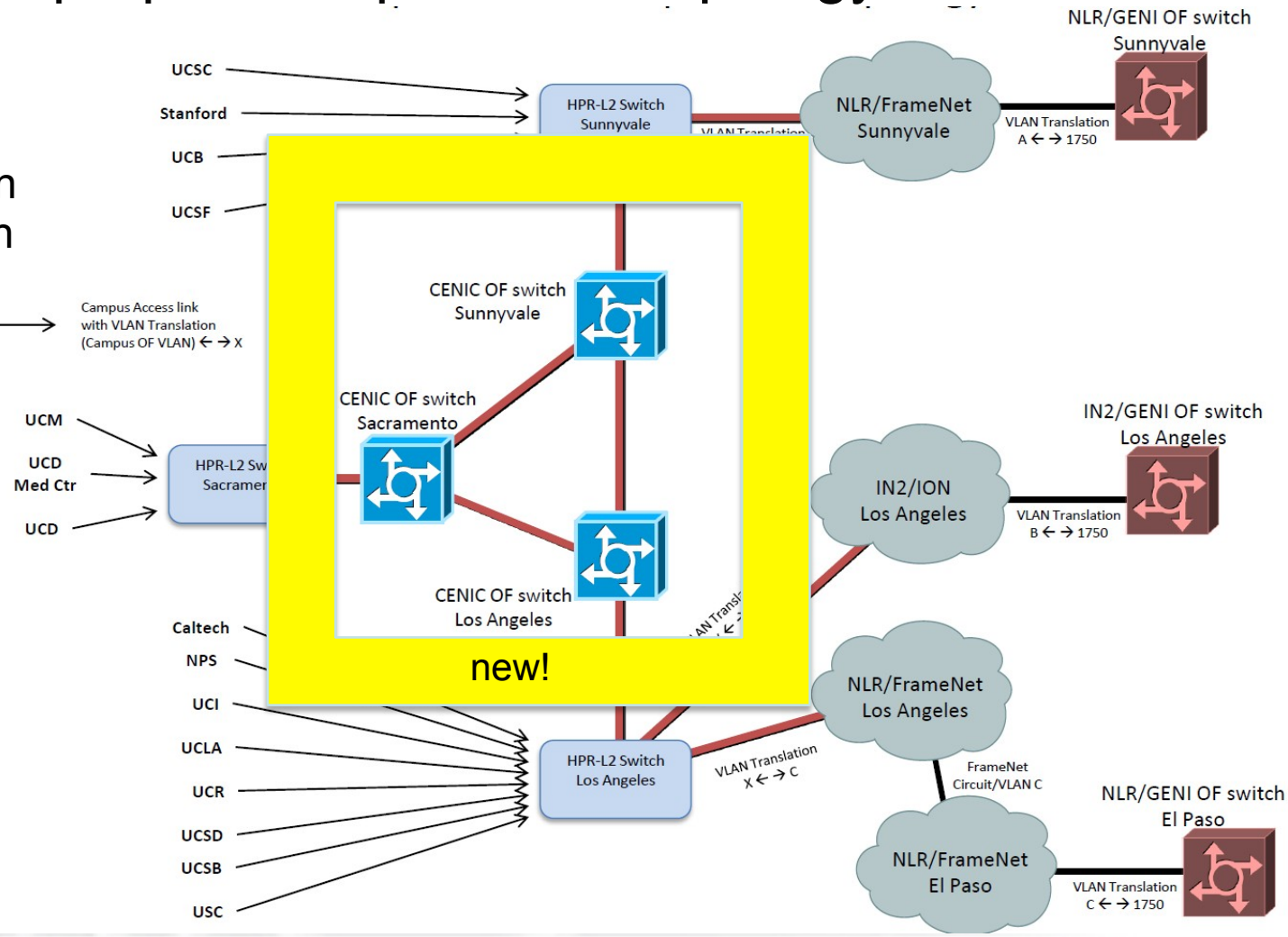


- First switch deployed
- Integration testing in progress

Regionals: CENIC (California)

CENIC proposed OpenFlow Topology

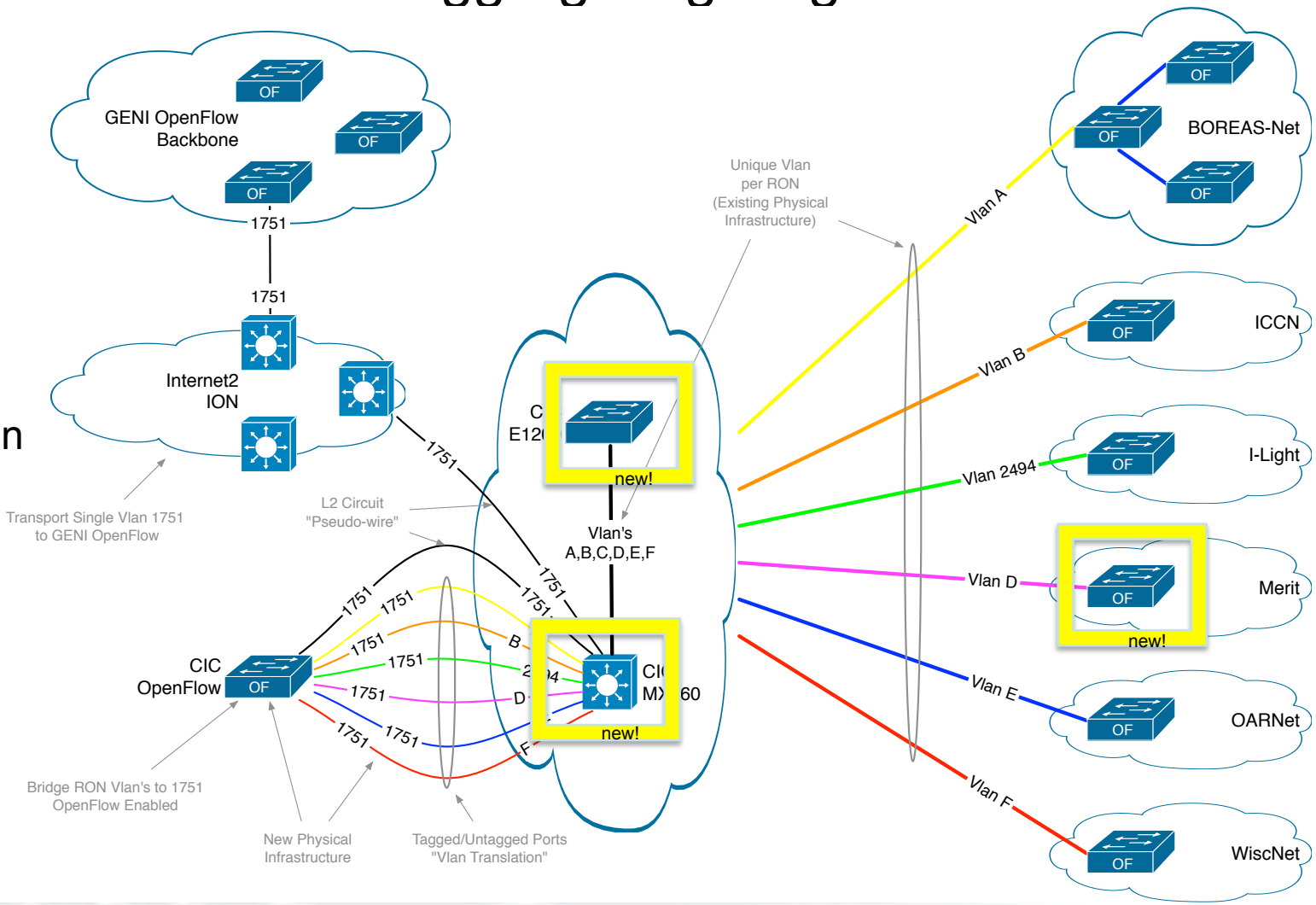
- Three switches deployed
- Integration testing with pre-alpha Brocade software



Regionals: Midwest OpenFlow Crossroads

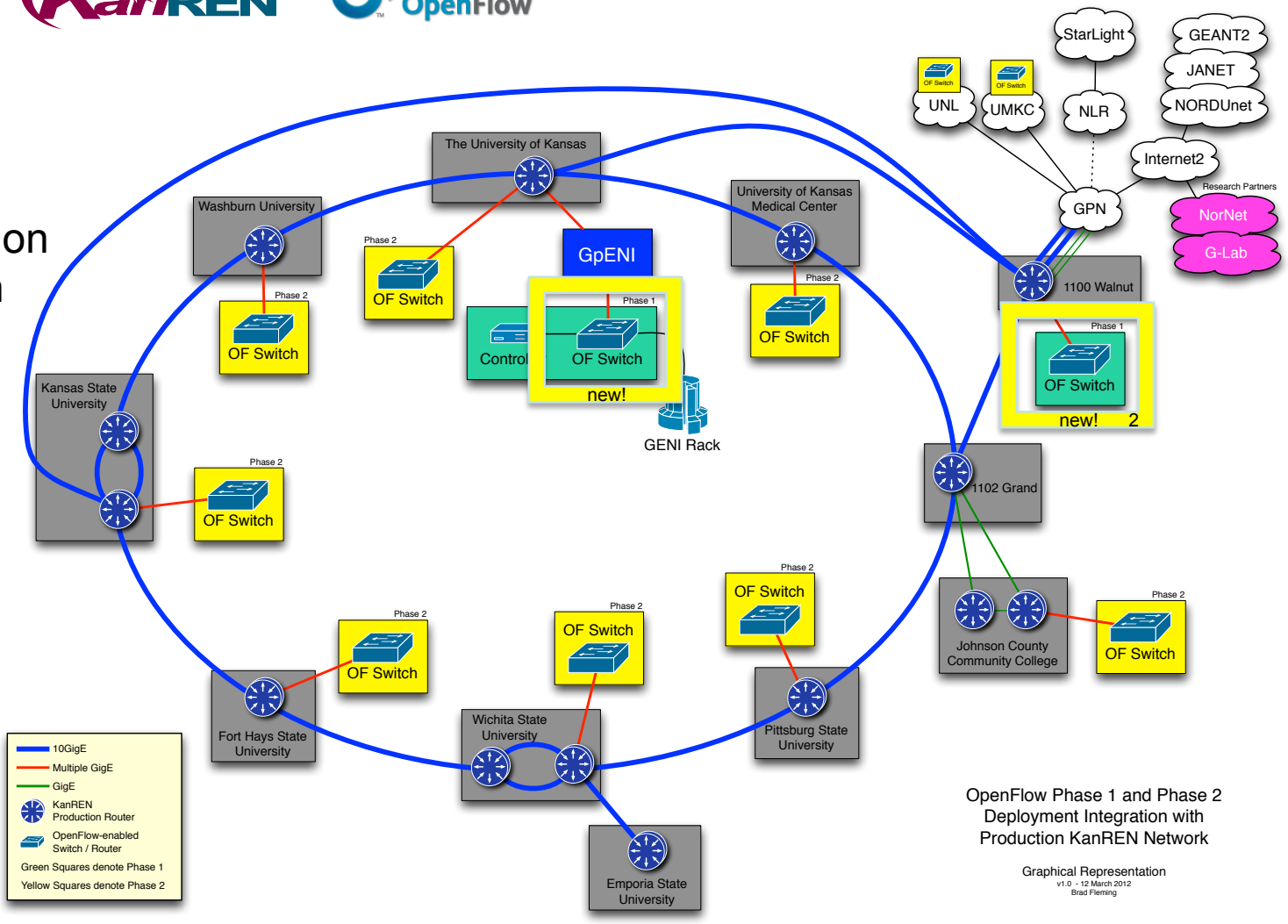
MOXI Architecture – Aggregating Regionals

- Three switches deployed
- Integration testing in progress

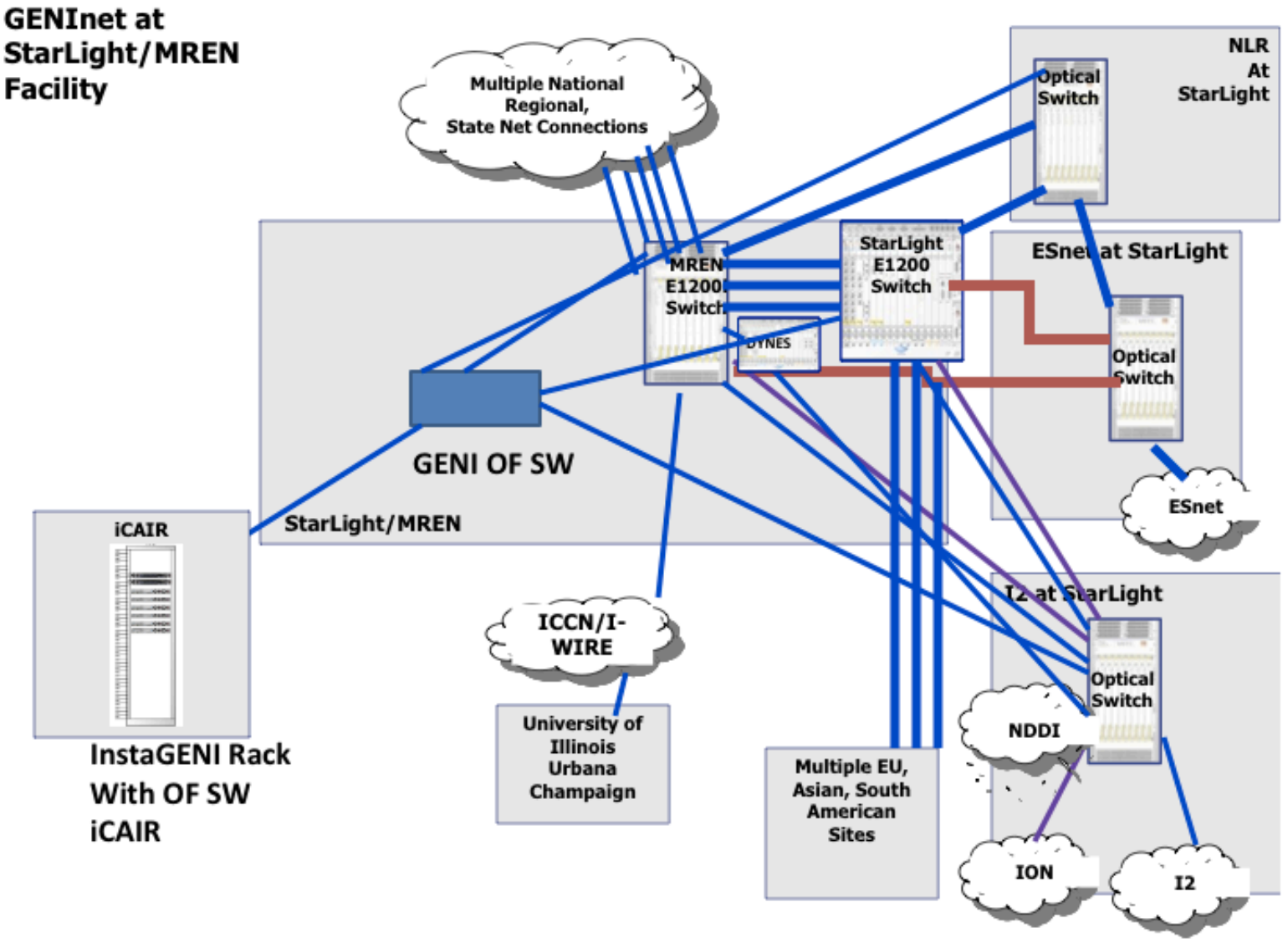


Expanding regional testbeds: GpENI + KanREN

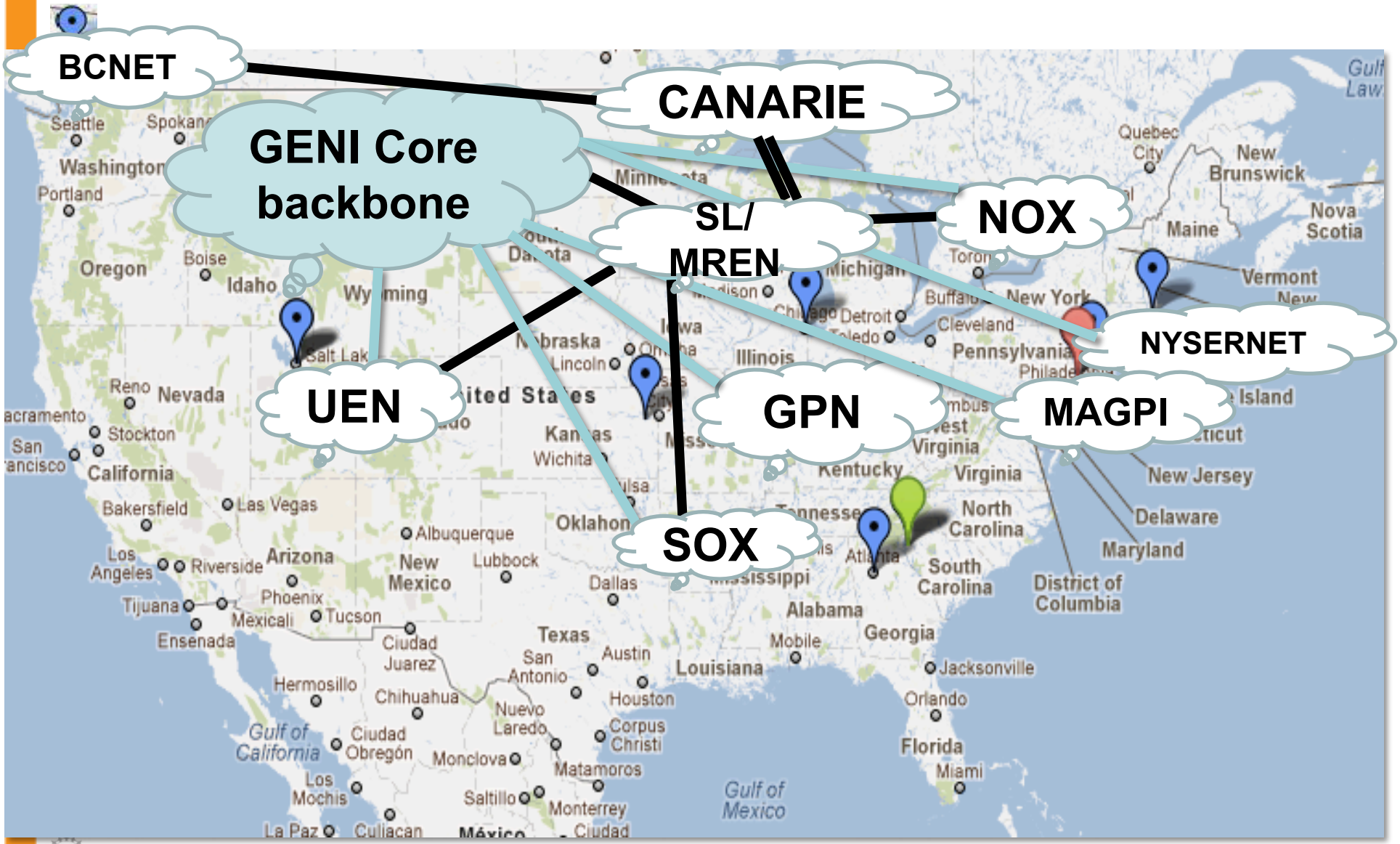
- Three switches installed.
- Integration testing in progress



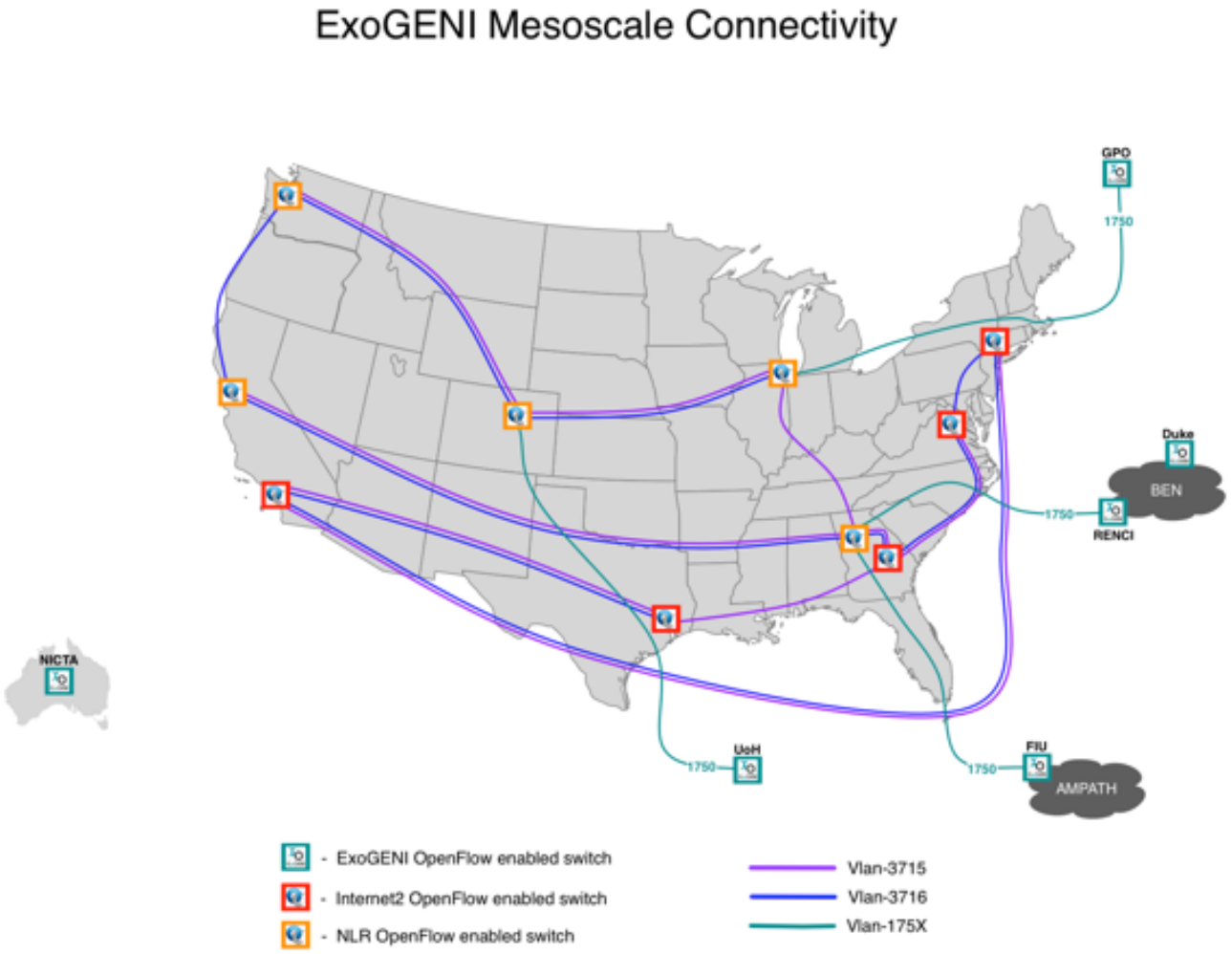
Starlight/MREN: InstaGENI and international access



InstaGENI Spiral 4: University of Utah, Princeton University, GPO, Northwestern University, Clemson University, Georgia Tech , University of Kansas , New York University, University of Victoria

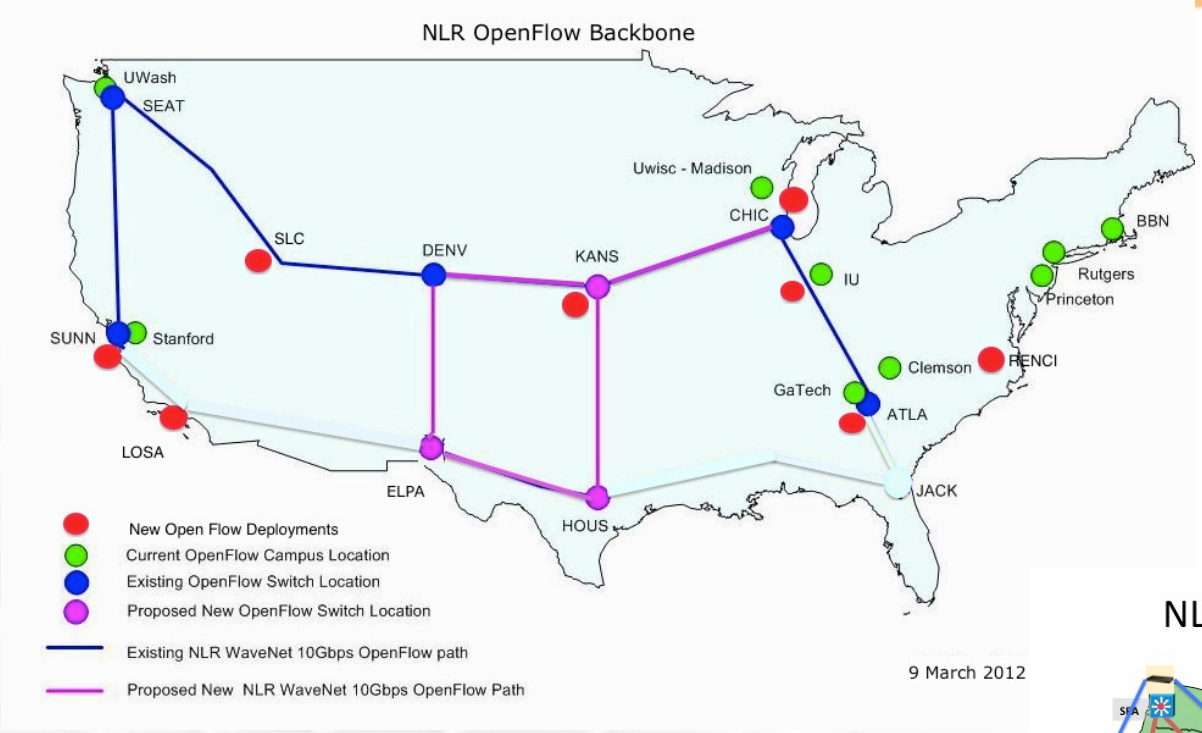


ExoGENI Spiral 4



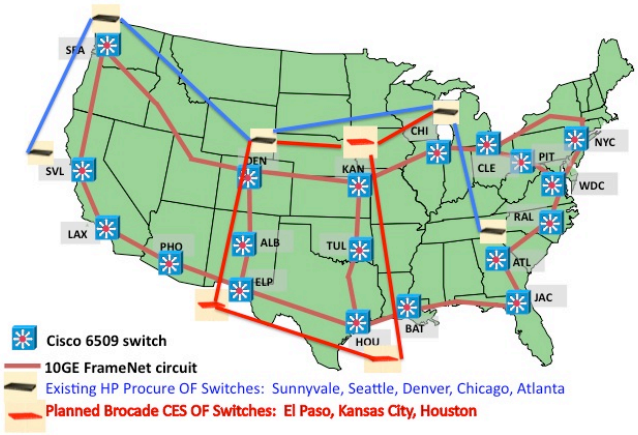
June 26, 2012

NLR OpenFlow Expansion

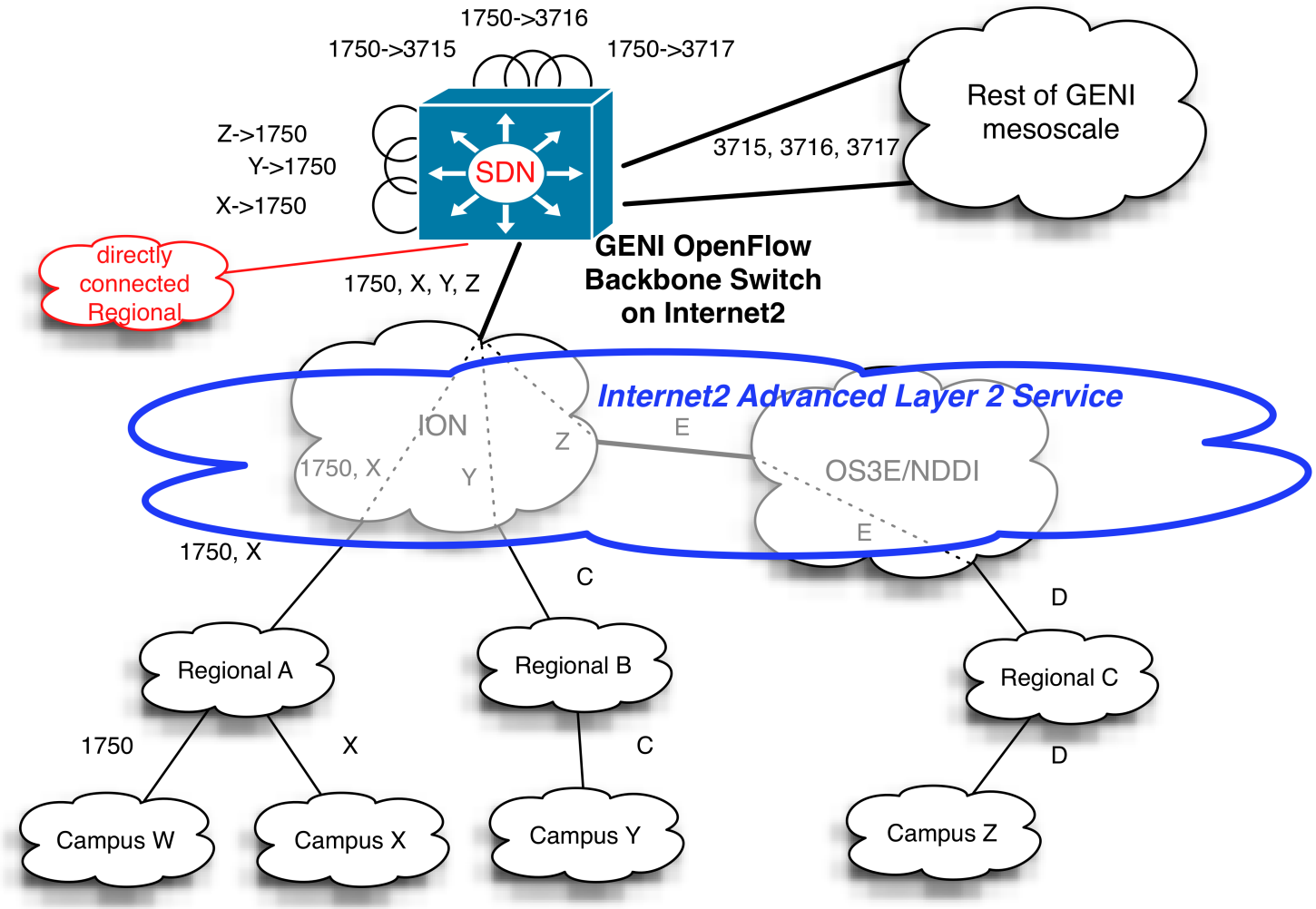


Switch installation planned for August

NLR OpenFlow Backbone



Internet2 Meso-scale Support and Layer 2 Services



NOTE: Both ION and OS3E can translate VLANs. Here, C->Y by ION; D->E by OS3E and E->Z by ION. There will be three 10G connections between OS3E and ION: New York Chicago, Los Angeles

GENI Deployed OpenFlow Software

*** OpenFlow switch firmware**

* NEC:
  * !NEW! Product version 11.1.C.Af, fixes a bug in handling tagged ports
  * Prototype version rev278
* HP:
  * K14.83o from HP Labs
  * !NEW! K.15.05.006, now a fully-supported GA release
* !NEW! IBM: 7.2, in ExoGENI racks
* !NEW! Brocade: Pre-release versions in some regionals

*** FlowVisor**

* Recommended version: 0.8.1.2
* !NEW! Current version: 0.8.4
  * Flowspace is now in a database (significant performance improvements)
  * Config file is now JSON
  * Various other bug fixes and improvements
* More info: https://openflow.stanford.edu/display/DOCS/Flowvisor
* !NEW! Roadmap: https://openflow.stanford.edu/display/ONL/Software+Roadmap

*** FOAM (FlowVisor OpenFlow Aggregate Manager)**

* Recommended version: 0.6.3 (Ubuntu) or 0.6.4 (Debian)
* !NEW! Current version: 0.8.1
  * Auto-approval of non-overlapping IP subnet, MAC address, Ethertype
  * Auto-approval allows "only one of the ports from this list" for cross-connects
  * RSpec improvements (get e-mail address from slice credential, etc)
  * GENI AMI API compliance
* More info: http://groups.geni.net/geni/wiki/OpenFlow/FOAM
* !NEW! Roadmap: https://openflow.stanford.edu/display/ONL/Software+Roadmap

*** GENI Aggregate Managers with some OpenFlow support**

* !NEW! ProtoGENI in InstaGENI racks:
  * Can create VMs on OF-controlled VLANs and connect to meso-scale
  * Can exchange switchport-based auto-approval info with FOAM
* !NEW! ORCA in ExoGENI racks:
  * Can create VMs on OF-controlled VLANs and connect to meso-scale
  * Can create OF-controlled VLANs within and between ExoGENI racks

*** !NEW! OpenFlow monitoring (tango-monitor-foam):**

* Reports data about FOAM to GMOC
* Recommended version: 0.3

Instructions: http://groups.geni.net/geni/wiki/PlasticSlices/MonitoringRecommendations/FoamConfiguration

*** OpenFlow controllers**

* http://groups.geni.net/geni/wiki/OpenFlow/Controllers
* Various as selected by experimenters.

*** OpenFlow debugging**

* Wireshark Dissector: http://www.openflow.org/wk/index.php/OpenFlow_Wireshark_Dissector
* Do "Analyze -> Decode As" if using ports other than 6633

GENI Upcoming Software Integration

*** ON.LAB**
 * FlowVisor:
   * 0.8.5 bug fix releases in July
   * 0.10 release in August
   * Roadmap: https://openflow.stanford.edu/display/ONL/Software+Roadmap

*** Nick Bastin (in collaboration with ON.LAB and BigSwitch)**
 * FOAM:
   * Further 0.8.x bug fix releases in Spiral 4
   * Expected 0.10 release in October

*** DYNES**
 * Rutgers connection changing from ION to DYNES to reach the GENI core
 * MAX using DYNES to connect to GENI and for stitching

LEARN will use DYNES likewise in the future

*** Stitching and Clearinghouse prototypes**
 * Stitching extensions are converging
 * Likely to include DYNES racks
 * Clearinghouse prototype demonstrated at GEC 14

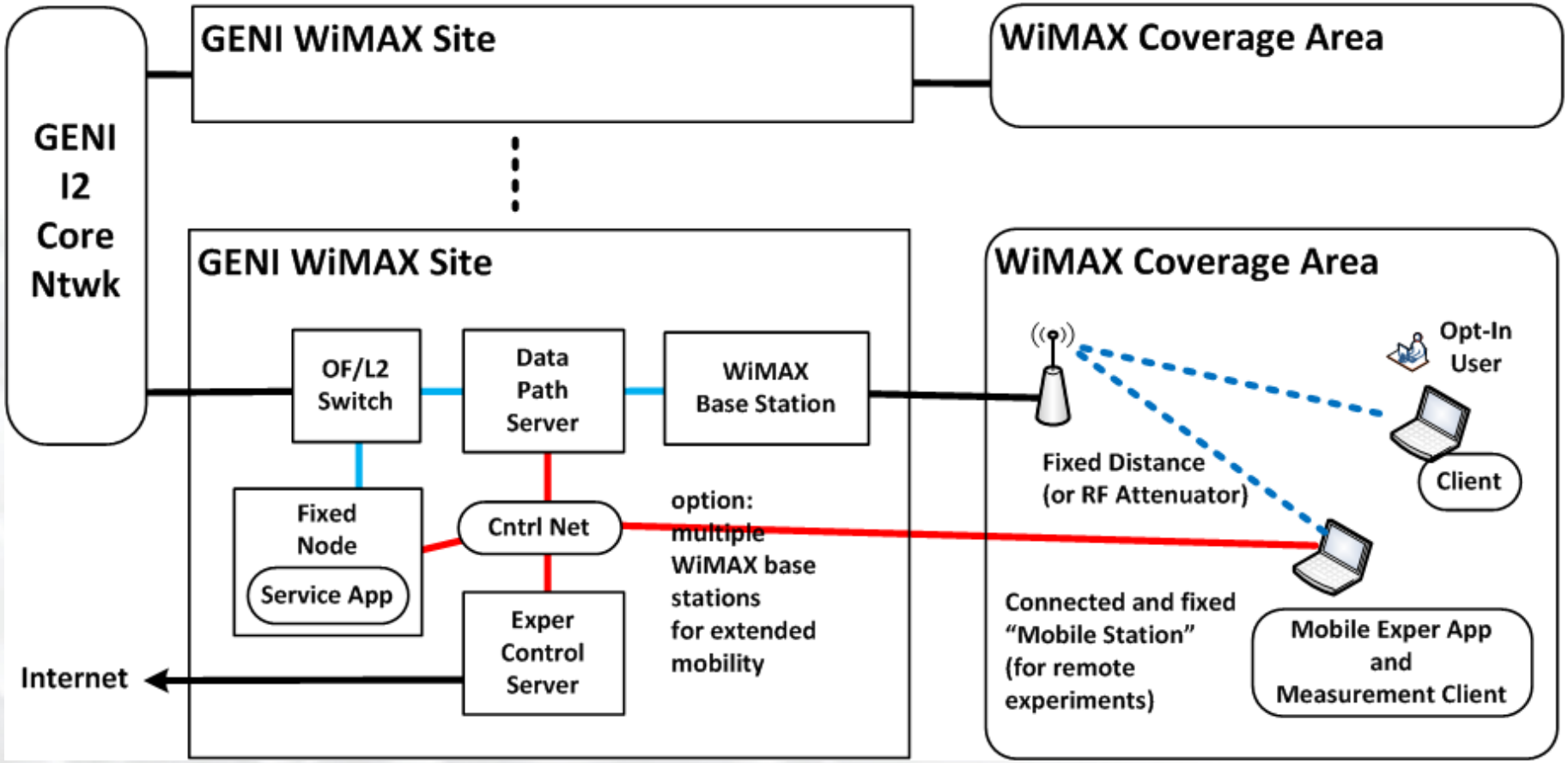
*** Plastic Slices**
 * Continuing to generate traffic to exercise resources/monitoring/etc
 * Expanding to include racks as they come online
 * More info: http://groups.geni.net/geni/wiki/PlasticSlices/Continuation

WiMAX Integration

	Total WiMAX sites	with multiple base stations
now:	8	1
YE2012:	10	3
YE2013:	13	4

- Provide WiMAX wireless coverage for research and service experiments
- Additions and extensions funded by GENI Solicitation 3
- Multiple base stations support enhanced mobility experiments
- Connections via I2 core network support multi-site experiments

Networked GENI WiMAX sites



GENI WiMAX Initiatives

- **Adding 12 Airspan base stations at 3 existing and 5 new sites**
  - **Currently 3 installed and on the air**
  - **Plan to complete 9 other installations by YE2012**
  - **Plan 4 sites with multiple base stations, to provide enhanced mobility**
- **Providing support for remote experiments**
  - **Currently 2 (soon to be 3) sites use OMF with login service**
  - **These sites connected by I2 core network to support multi-site experiments**
  - **Used for WiMAX tutorials**
- **Providing support for enhanced experiments**
  - **e.g., for MobilityFirst future Internet architecture project experiments**
- **Discussions with Clearwire**
  - **Working towards agreement on enhanced cooperation on spectrum use**
- **Discussions with Sprint**
  - **Working towards agreement to purchase unlocked WiMAX handsets**

Evolving Production Support

- Help:
  - help@geni.net mailing list
  - GMOC helpdesk http://gmoc.grnoc.iu.edu/gmoc/index/support.html
  - Credential setup, ops assistance at GEC coding sprints
    http://groups.geni.net/geni/wiki/GEC14Agenda/CodingSprintAndExperimenterTutoring
  - IRC/chat (informal)
    http://groups.geni.net/geni/wiki/HowTo/ConnectToGENIChatRoom
- Prototype monitoring and status for Meso-scale sites:
  - http://monitor.gpolab.bbn.com (at GPO)
  - http://gmoc-db.grnoc.iu.edu (at GMOC)
  - GMOC GENI rack prototype monitoring (not public yet): request GMOC accounts for testing
- Emergency Stop Procedure tests completed
- *GMOC Concept of Operations* revision pending GENI rack projects acceptance test completion