GENI Racks at Campuses and Regionals: Infrastructure Overview

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- GENI Rack 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)

- Early integration with GENI Clearinghouse and InCommon identity providers

GENI Rack Campuses

Funds in hand

Needs funding

Oct. 24, 2012
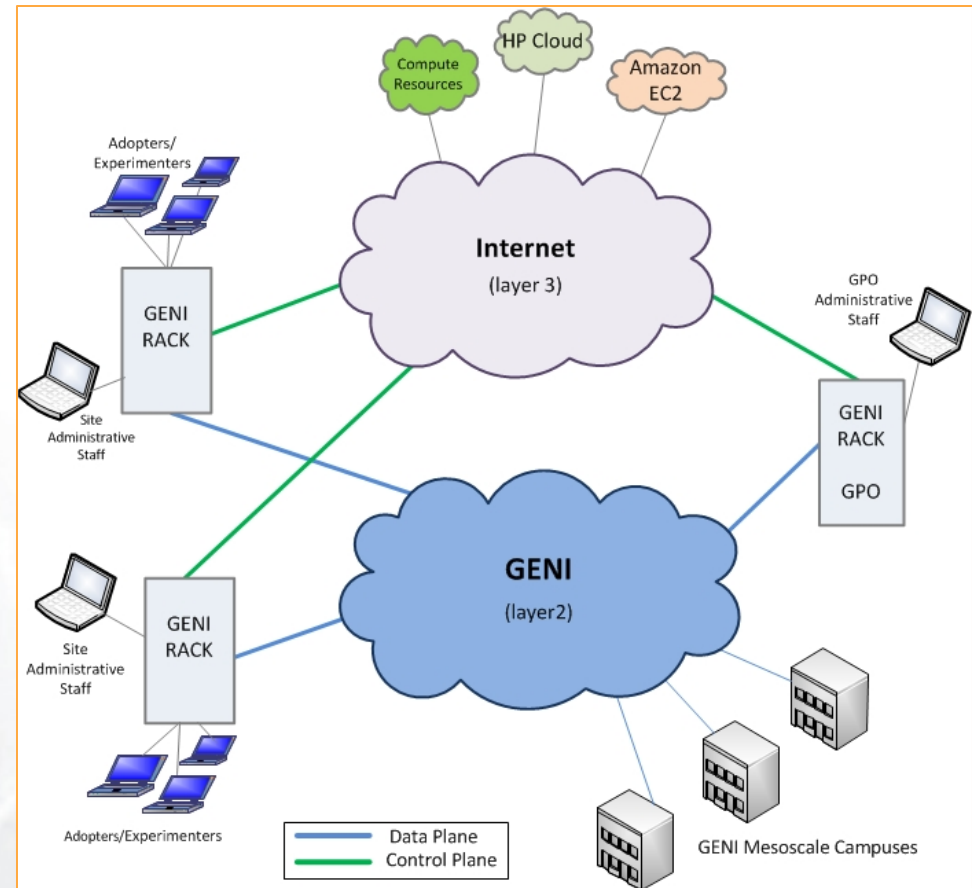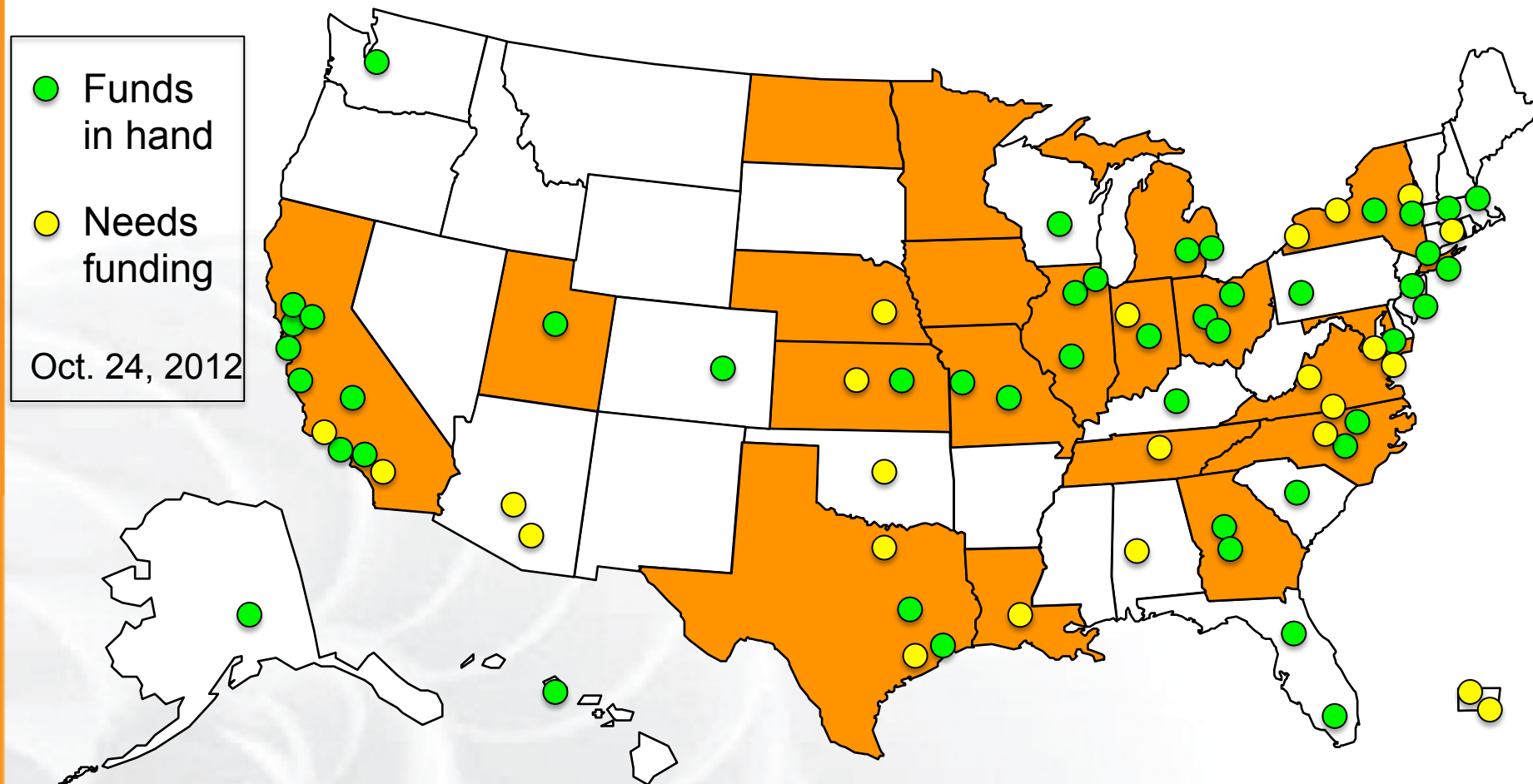
- 43 racks planned
- Negotiations still in progress, track on GENI wiki

GENI Rack Recipient Expectations

- Provide space, power, security (as with other campus IT resources)

- Provide at least 1Gbps OpenFlow/SDN path from rack to campus boundary (within 3-6 months of receipt)

- Provide connection from rack to on-campus resources (varies by campus, usually SDN)

- Operate with up-to-date GENI-specified software (e.g. AM API, OpenStack)

- Provide no-cost access to rack resources for GENI authorized users at other campuses

- Provide points of contact for GENI response team (see http://groups.geni.net/geni/attachment/wiki/ComprehensiveSecurityPgm/Aggregate Provider Agreement v3.pdf)

GENI Racks Deployment

GENI Rack Deployment Phases

GENI Rack Type	Rack Delivered to Site	Rack Connected to Network	Rack Integrated with GENI	New Site Confirmation Tests	Rack integrated with Site Resources	Ready for Experimenters
InstaGENI	-University of Kansas -Princeton University -New York University -Kettering University	Clemson	-Georgia Tech		-Northwestern University -University of Kentucky	-University of Utah -GPO
ExoGENI		-University of Houston	-Florida International University			-GPO -RENCI

- New racks from Cisco and Dell under development in joint efforts with GENI sites.
- Same deployment phases planned for new racks.
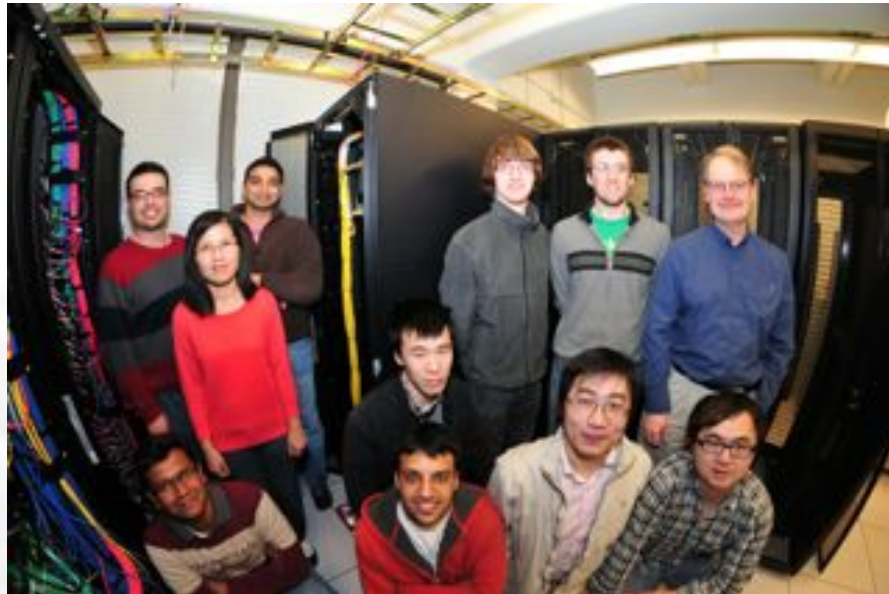
- Acceptance Tests for experimenter, administrator, and monitoring functions re-executed for new hardware and software versions.

- ExoGENI passed most tests. Still working on documentation, control network admin, OpenFlow hybrid mode on IBM switches, and monitoring.

- InstaGENI passed most tests. Still working on documentation, click router tests, and monitoring.

- Latest Status

http://groups.geni.net/geni/wiki/GENIRacksHome/ExogeniRacks/AcceptanceTestStatus

http://groups.geni.net/geni/wiki/GENIRacksHome/InstageniRacks/AcceptanceTestStatus

GENI Rack Deployment Schedule

Rack Type	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct -13	Nov-13	Feb-14
InstaGENI	2 racks	3 racks	3 racks	3 racks	3 racks	3 racks	3 racks	3 racks	5 racks	
ExoGENI			2 racks			2 racks			2 racks	2 racks

- 43 racks with integrated OpenFlow, compute nodes, and some support for dynamic VLANS deploying Jan 2013-February 2014
- Software updates and continued GENI testing expected for both rack types
- Schedule subject to change. Latest status on GENI wiki:

http://groups.geni.net/geni/wiki/GENIRacksHome/ExogeniRacks/ConfirmationTestStatus

http://groups.geni.net/geni/wiki/GENIRacksHome/InstageniRacks/ConfirmationTestStatus

- Local sites provide details on their site resources and access on Aggregate Info wiki pages

Example Meso-scale Integration: InstaGENI

Example Meso-scale Integration : ExoGENI
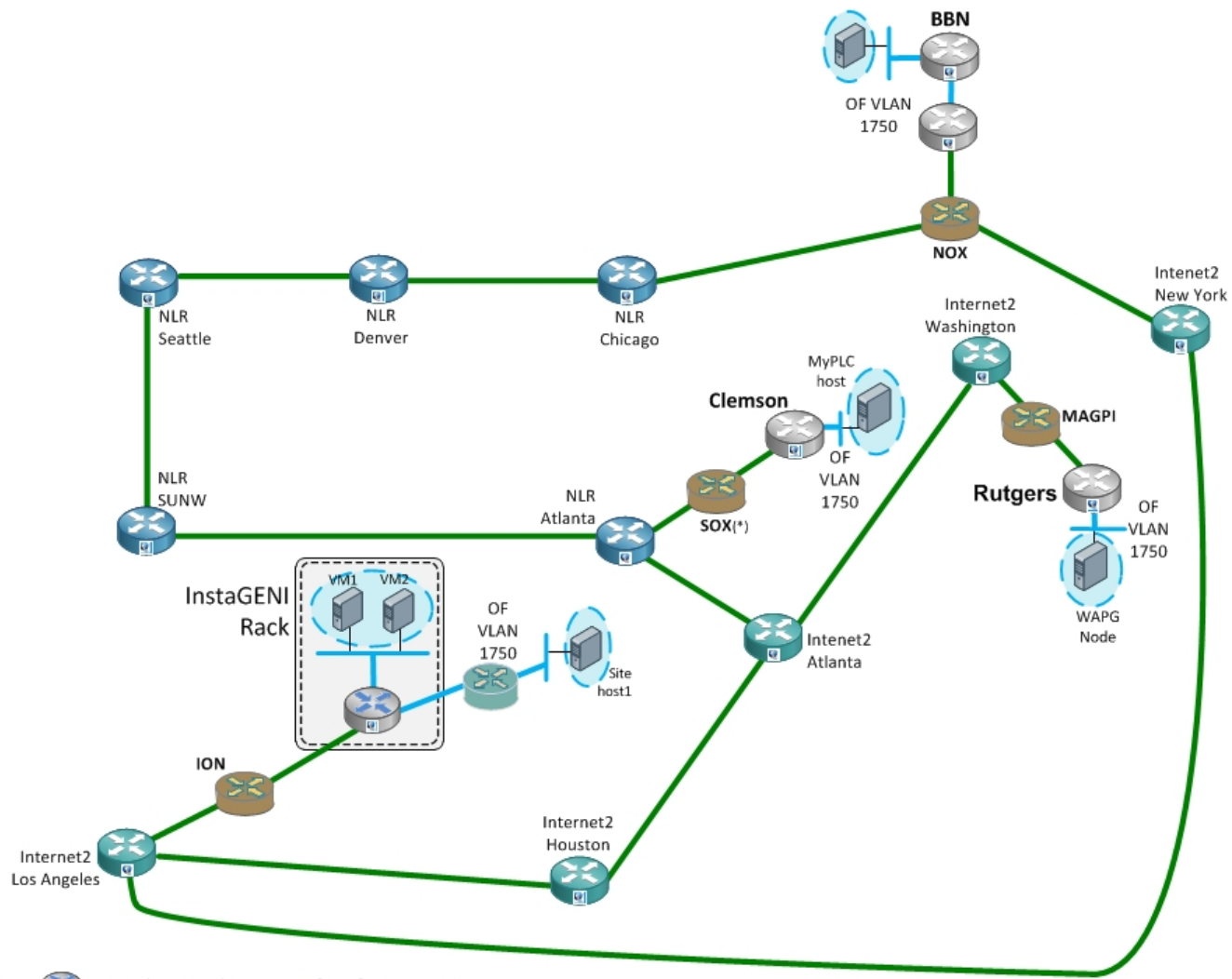
Resource Legend

Campus OF Switch	GENI Rack OF Switch
NLR OF Switch	Regional non-OF Switch
Internet2 OF Switch	Campus non-OF Switch

— Core OF VLAN 3716
— Site Shared OF VLAN 1750
— Site Multi-point non-OF VLAN 3705

Compute resource

(*) an OpenFlow SOX connection will be implemented after GEC14 to connect Clemson GENIRack.
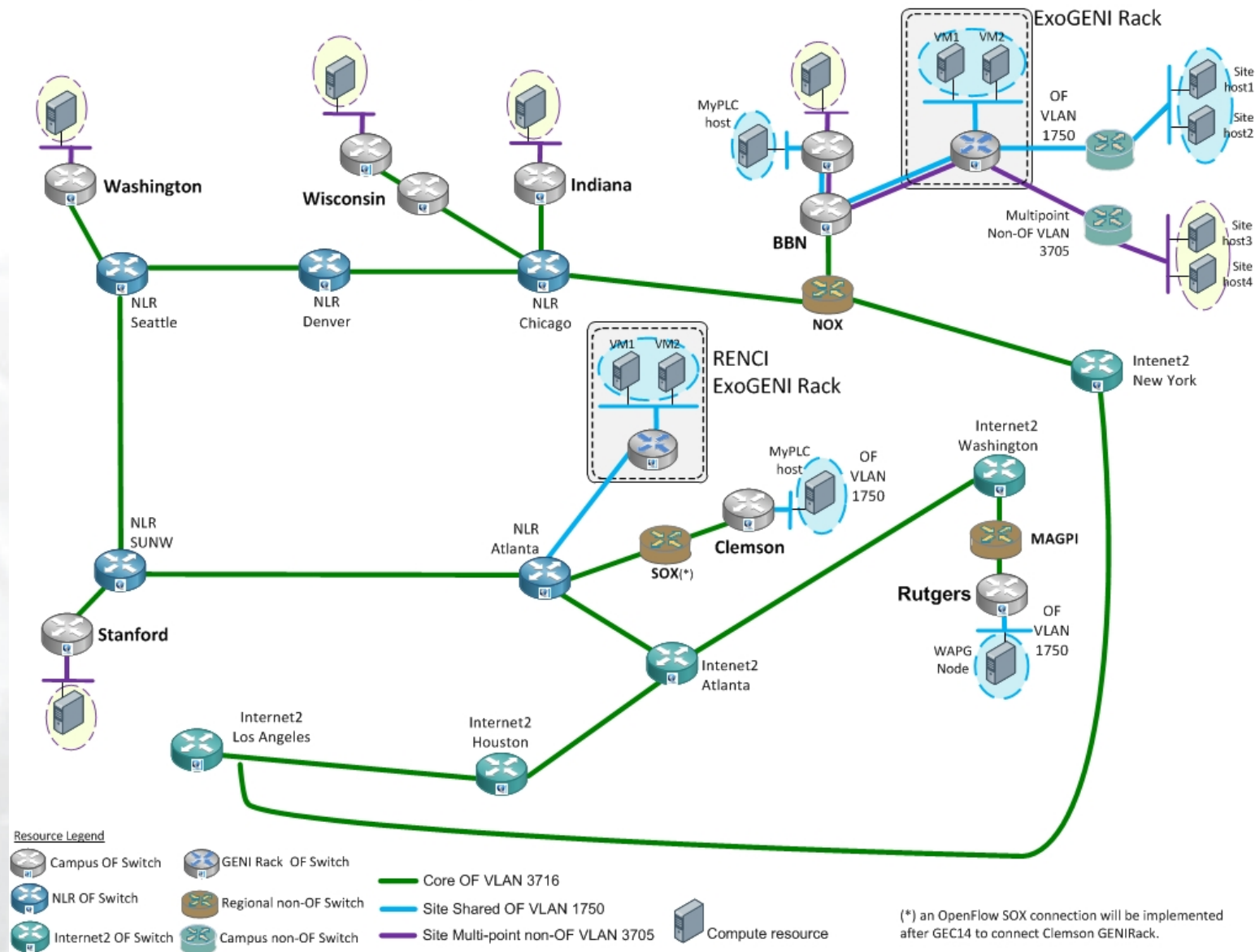
GENI Regionals

Regional	Sites	Regional OpenFlow	Location	Connection Method(s)	GENI Core Connection(s)
CENIC	Stanford OpenFlow	No	Sunnyvale, Sacramento, Los Angeles CA	ION FrameNet	Internet2,NLR
FLR	FIU ExoGENI	No	Miami, FL	FrameNet	NLR
KanREN/GPN	KSU OpenFlow, integration test sites	Yes	Lawrence, KS	ION	ION
LEARN	Houston ExoGENI	No	Houston, TX	FrameNet	NLR
MAX	Integration test sites	**Yes**	College Park, Maryland	ION	Internet2
MOXI	Indiana University	**Yes**	Indianapolis, IN	ION	Internet2
NCREN	RENCI ExoGENI	No	Chapel Hill, NC	FrameNet	NLR
NoX	GPO InstaGENI GPO ExoGENI GPO OpenFlow	No	Cambridge, MA	ION FrameNet	Internet2, NLR
NYSERNet	Integration test sites	Yes	Syracuse, NY	ION	Internet2
SoX/SLR	Georgia Tech multiple Clemson multiple	**Yes**	Atlanta, GA	Fiber	Internet2
SoX	U of Kentucky InstaGENI	No	Lexington, KY	ION	Internet2
StarLight	Northwestern U InstaGENI	No	Chicago, IL	Fiber	Internet2, NLR, ESNet
UEN	U of Utah ProtoGENI and InstaGENI	**Yes**	Salt Lake, UT	ION Fiber	Internet2

NLR OpenFlow Backbone

Internet2 SDN networks

9 March 2012
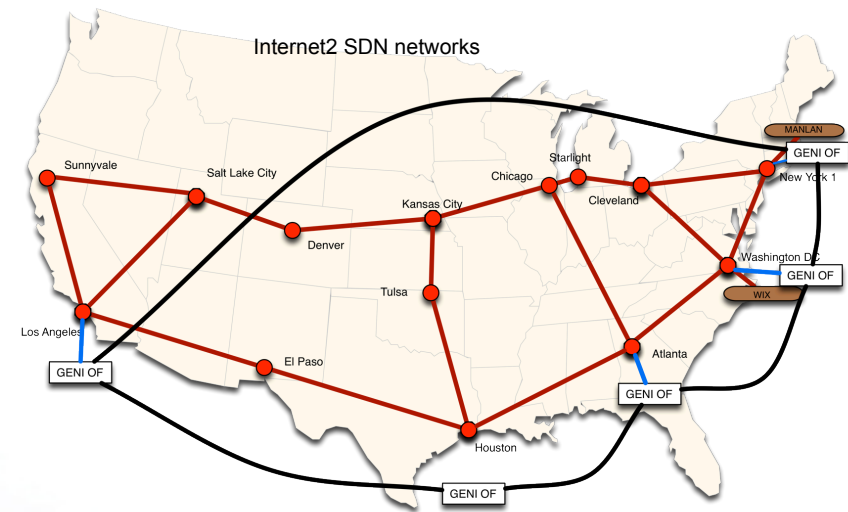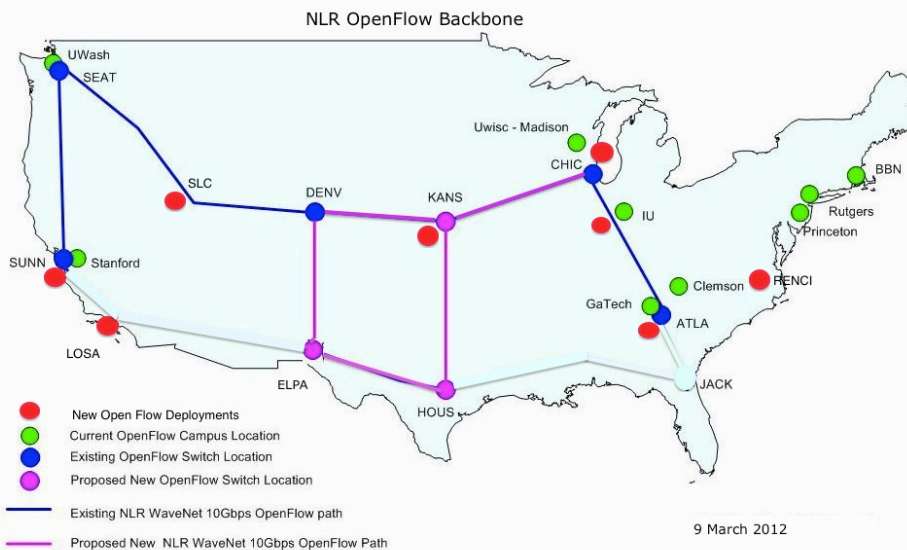
- NLR 2013 meso-scale OpenFlow expansion in progress
- Internet2 10GbE paths to Advanced Layer 2 Services (AL2S) available at four of the five OpenFlow meso-scale/ProtoGENI PoPs
- Internet2 GENI Aggregate Manager in AL2S expected Q2
- GENI stitching aggregate prototype integrating with Internet2 ION now, NLR later

OpenFlow integration and test

- OpenFlow switch firmware:
  - NEC:
    - Version 1.0.2.0 on newer models (e.g. PF5820s in SoX)
    - "Product" version 11.1.C.Af on older OpenFlow campus switches (IP8800) and Internet2 meso-scale switches
  - HP:
    - K.15.06.5008 in InstaGENI racks
    - K.14.83o at OpenFlow campus sites and including NLR meso-scale switches
  - IBM:
    - 7.4.0.41 is a pre-release testing version on G8624s in ExoGENI racks
    - The hardware is substantially the same as the NEC PF5820
  - Brocade:
    - 5.4.00b is the current GA release on MLXe and CES switches in regionals
    - A major limitation: Can't match both layer 2 and layer 3 fields at the same time
    - Fix expected in a future version

OpenFlow integration and test (cont.)

- FlowVisor
  - Recommended version: 0.8.1.7
  - Current version: 1.0.0
    - Packaging and admin improvements, per-slice rate limits
    https://github.com/OPENNETWORKINGLAB/flowvisor/issues?milestone=2
    - GPO testing now
    - More info: https://github.com/OPENNETWORKINGLAB/flowvisor/wiki
  - Roadmap
    - https://github.com/OPENNETWORKINGLAB/flowvisor/wiki/RoadMap
- FOAM (FlowVisor OpenFlow Aggregate Manager)
  - Recommended version: 0.10.13
  - Most sites upgraded, racks upgrades planned after GEC16
  - More info: http://groups.geni.net/geni/wiki/OpenFlow/FOAM
  - Roadmap: https://openflow.stanford.edu/display/ONL/Software+Roadmap
- OpenFlow monitoring (tango-monitor-foam)
  - Reports data about FOAM to GMOC
  - Recommended version: 0.5
  - Instructions: http://groups.geni.net/geni/wiki/TangoGeniMonitoring/FoamConfiguration

Monitoring Improvements

- Updated monitoring client available in Python
- Updated monitoring software running on aggregates in both types of GENI racks, backbones, regionals and campuses. (26 FOAM servers and 6 GENI racks so far)
- GMOC shared database streamlined
- Relational data download from GMOC now available

Aggregate Name		Type	Version	Operator	AM API Status	Last Updated
rci-hn.exogeni.net:11443	[Details]	orca	4.0	urn:publicid:IDN+gmoc.geni.net+organization+RENCI	Unknown	2013-03-19 01:51:02
bbn-hn.exogeni.net:11443	[Details]	orca	4.0	urn:publicid:IDN+gmoc.geni.net+organization+ExoGENI	Unknown	2013-03-19 01:51:02
utah.geniracks.net:12369	[Details]	protogeni	7e584af01b968c18b7d87fe7e78a5dde3549c47f	urn:publicid:IDN+gmoc.geni.net+organization+InstaGENI	Unknown	2013-03-19 01:50:45
lan.sdn.uky.edu:12369	[Details]	protogeni	7e584af01b968c18b7d87fe7e78a5dde3549c47f	urn:publicid:IDN+gmoc.geni.net+organization+InstaGENI	Unknown	2013-03-19 01:50:44
instageni.gpolab.bbn.com:12369	[Details]	protogeni	7e584af01b968c18b7d87fe7e78a5dde3549c47f	urn:publicid:IDN+gmoc.geni.net+organization+InstaGENI	Unknown	2013-03-19 01:50:43
instageni.northwestern.edu:12369	[Details]	protogeni	7e584af01b968c18b7d87fe7e78a5dde3549c47f	urn:publicid:IDN+gmoc.geni.net+organization+InstaGENI	Unknown	2013-03-19 01:50:42
foam.utah.geniracks.net:3626	[Details]	foam	8ea56b139ec9-0.8.2-FIX	urn:publicid:IDN+gmoc.geni.net+organization+InstaGENI	Unknown	2013-03-19 01:50:30
of.cs.washington.edu:3626	[Details]	foam	0.8.2	urn:publicid:IDN+gmoc.geni.net+organization+UW	Unknown	2013-03-19 01:50:29
foam.wail.wisc.edu:3626	[Details]	foam	foam-0.10.3,flowvisor-0.8.17	urn:publicid:IDN+gmoc.geni.net+organization+Wisconsin	Unknown	2013-03-19 01:50:28
foam.noc.iu.edu:3626	[Details]	foam	foam-0.10.3,flowvisor-0.8.17	urn:publicid:IDN+gmoc.geni.net+organization+Indiana	Unknown	2013-03-19 01:50:27
foam-cotn-1.lam-hyper-1.cenic.org:3626	[Details]	foam	foam-0.10.3,flowvisor-0.8.17	urn:publicid:IDN+gmoc.geni.net+organization+CENIC	Unknown	2013-03-19 01:50:26
foam.sox.net:3626	[Details]	foam	foam-0.10.3,flowvisor-0.8.17	urn:publicid:IDN+gmoc.geni.net+organization+SOX	Unknown	2013-03-19 01:50:26
						2013-03-19

Evolving Production Support

- Help for campuses and experimenters
  - 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
  - Improved documentation e.g. GENI Use Cases
  - GMOC Support for racks and OpenFlow campus infrastructure
  - Monitoring and status for Meso-scale sites and racks

  http://gmoc-db.grnoc.iu.edu under revision

  https://gmoc-db.grnoc.iu.edu/protected/ requires admin password

  - Scheduled/unscheduled outage notification and calendars
  - Emergency Stop
  - Escalation, tracking, some troubleshooting for reported problems
  - GENI rack and OpenFlow campus GMOC workflows in place