GENI Racks and Campuses: Infrastructure Overview

Heidi Picher Dempsey
October 24, 2012
www.geni.net

Session Organization:

• **ExoGENI racks**	Ilia Baldine
• **InstaGENI racks**	Rick McGeer
• **GENI Meta-Operations**	Jon-Paul Herron
	Kevin Bohan
	Eldar Urumbaev
• **Internet2 update**	Eric Boyd
• **National LambdaRail**	Bonnie Hurst
• **Meso-scale update**	Heidi Picher Dempsey

For WiMAX meso-scale info, see the concurrent WiMAX Campus session.

Agenda:

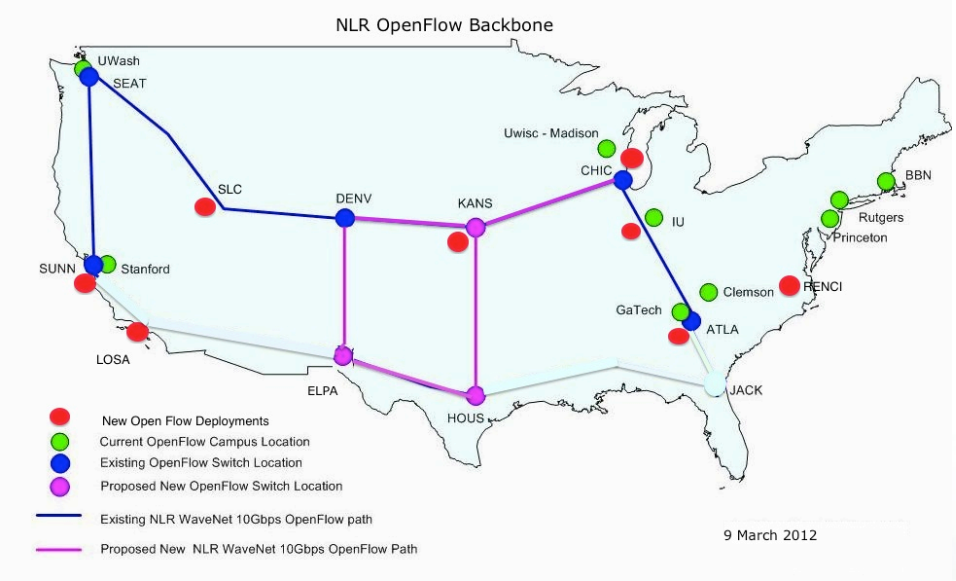
- Regional Networks
- Core Networks
- GENI Racks and Campuses
- OpenFlow
- Monitoring
- Operations

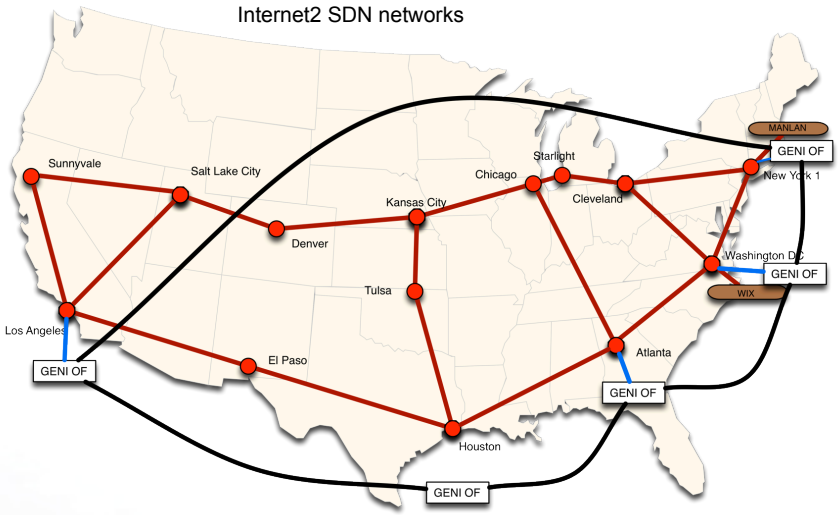
Regional Networks

- Spiral 4 integration and test uncovered issues, but all networks are running
- Spiral 5 adds more switches, campuses and racks
- Bad News:
  - UEN data center facilities issues delayed latest switch, but integration with ProtoGENI and InstaGENI on track
  - Brocade GA software delay, missing features slowed integration at CENIC and KanREN
- Good News:
  - Some regionals are currently supporting experimenters.
  - NYSERNet and MAX integrating with meso-scale in Spiral 5
  - FOAM and shared monitoring upgrades successful. Thanks!
- Latest updates

  http://groups.geni.net/geni/wiki/Regionals

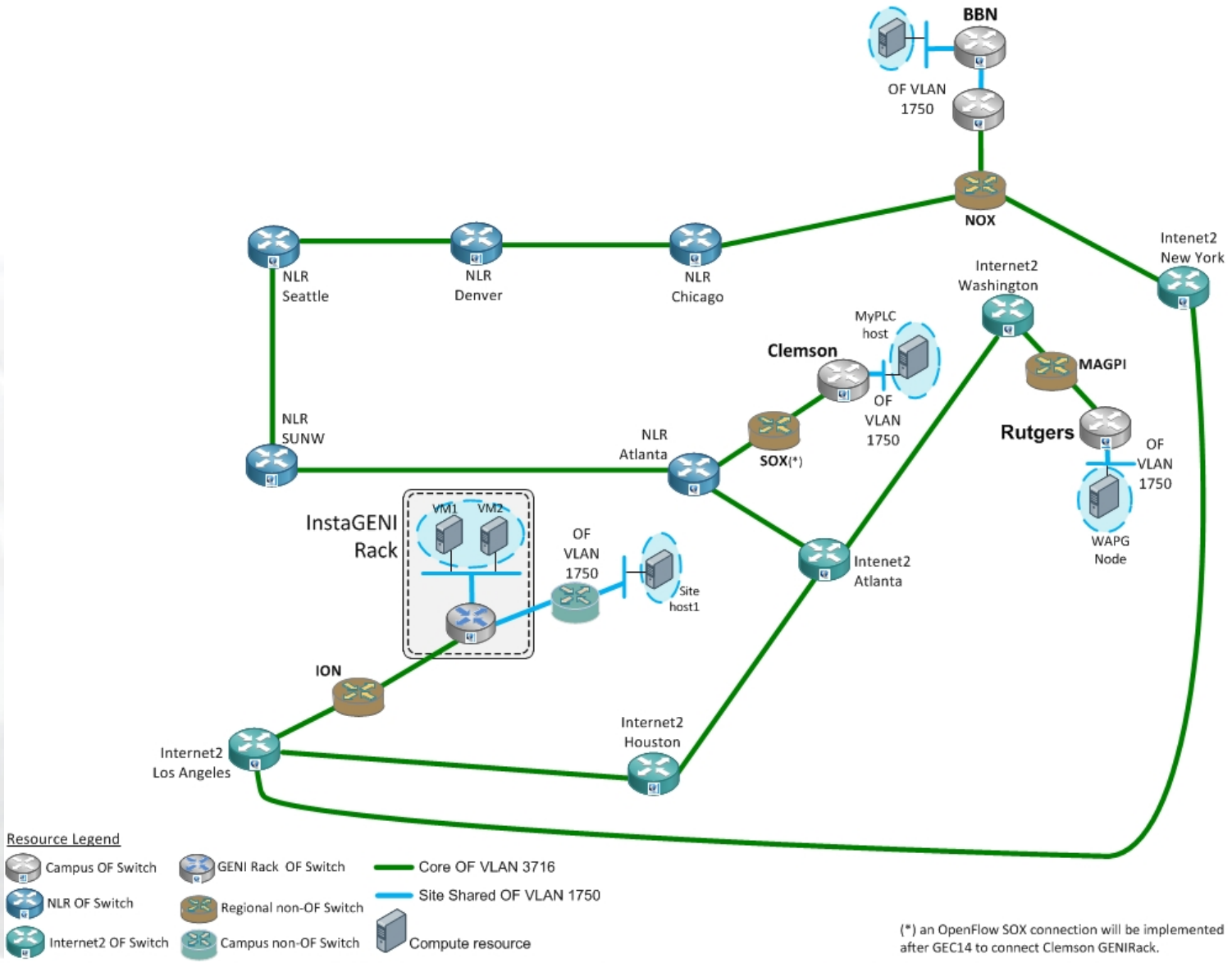
Core Networks



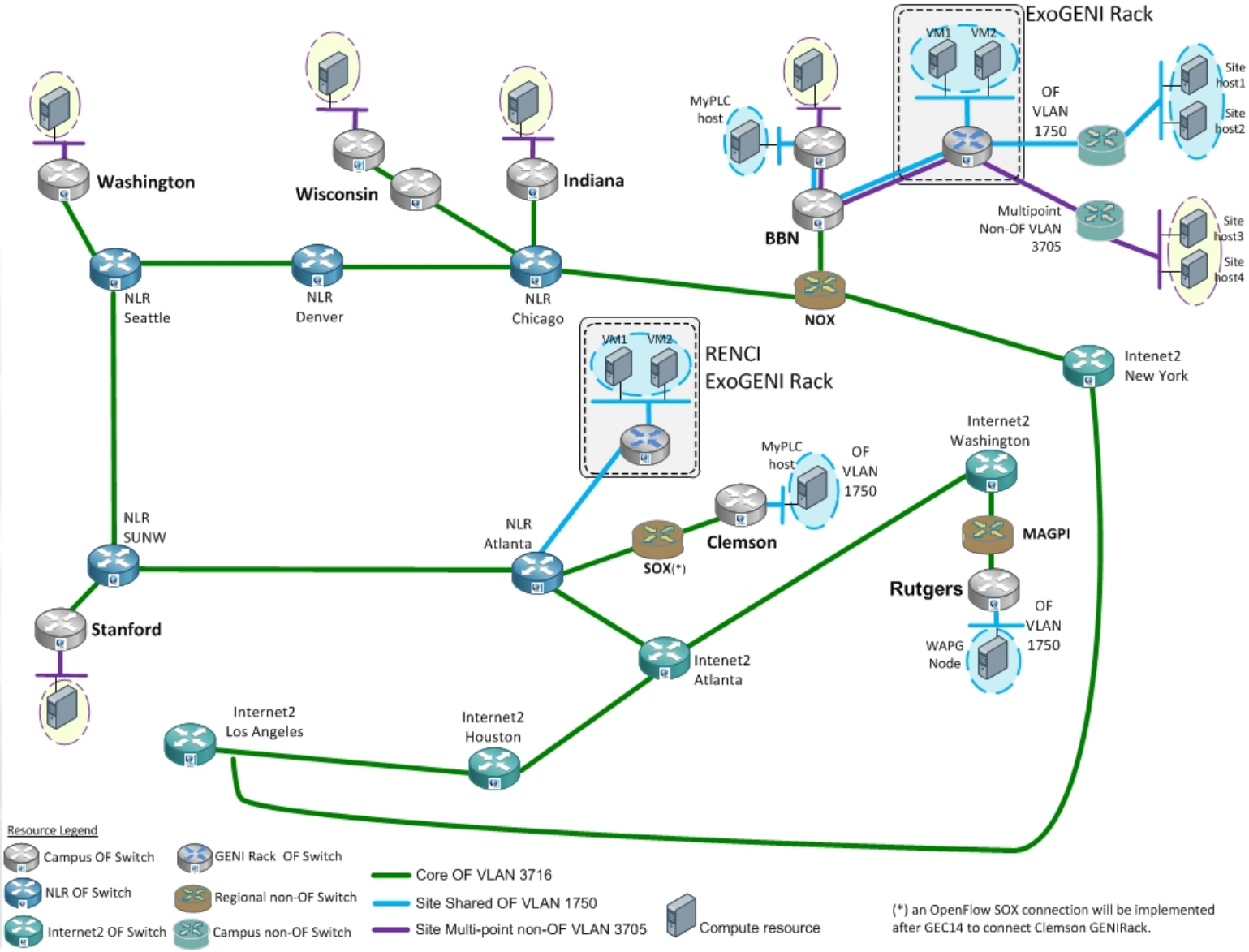


- NLR committed to 2013 meso-scale expansion following reorganization
- Internet2 adding 10GbE paths to Advanced Layer 2 Services (AL2S) at 4 of 5 OpenFlow meso-scale/ProtoGENI Pops
- GENI Aggregate Manager in Internet2 AL2S and dynamic stitching with GENI coming in Spiral 5

Network Integration with InstaGENI Racks

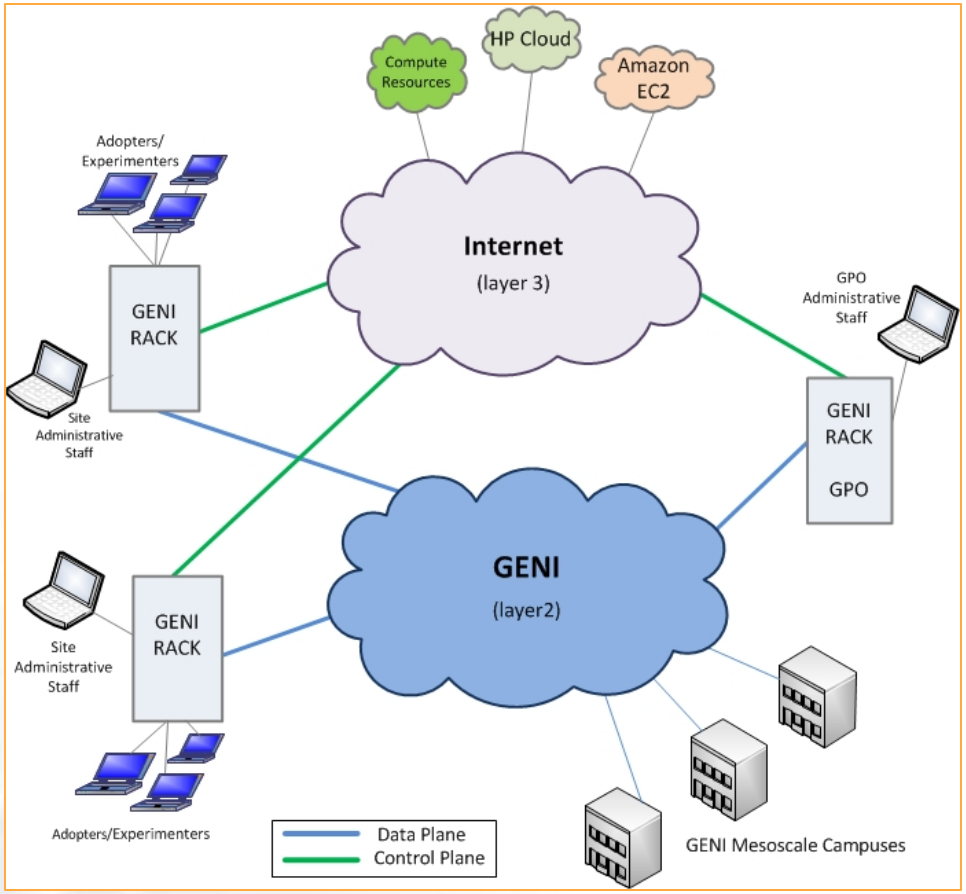


Network Integration with ExoGENI Racks



Racks and Campuses

- 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)



Deployed racks in testing




- Acceptance Tests for experimenter, administrator, and monitoring functions still underway
- ExoGENI experimenter functions good, shared monitoring just added, administration in progress
- InstaGENI network and administration tests delayed by delivery logistics, monitoring just added, administration
- Latest Status

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

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

GENI Rack Deployment Plans

Rack Teams → GPO & Rack Teams → Campus Engineering GPO & Rack Teams → Campus Engineering & GENI Operations

GENI Racks Acceptance Testing

Experimenter Tests:
- Access to compute resources, bare metal & VM.
- Access to network resources.
- Multi-site experiments.
- Multi-site OpenFlow Experiments.
- VLAN support for rack and campus connections.
- Experimenter custom image support.
- Meso-scale OpenFlow interoperability.

Administrator Tests:
- Administrative access to all rack components.
- Management of all infrastructure rack components.

Monitoring Tests:
- Rack components monitoring.
- Resource and FOAM aggregate resources monitoring.

Site Deployments

Site Install Checklist:
- Set up control plane
- Set up FOAM/FV
- Verify connectivity
- Set monitoring
- Connect to campus

Site Confirmation Tests:
- Experiment support
- Admin and monitoring

Site support:
- Meso-scale eng.
- GMOC support.

Ready for GENI Network environment?

Site Preparation and Validation.

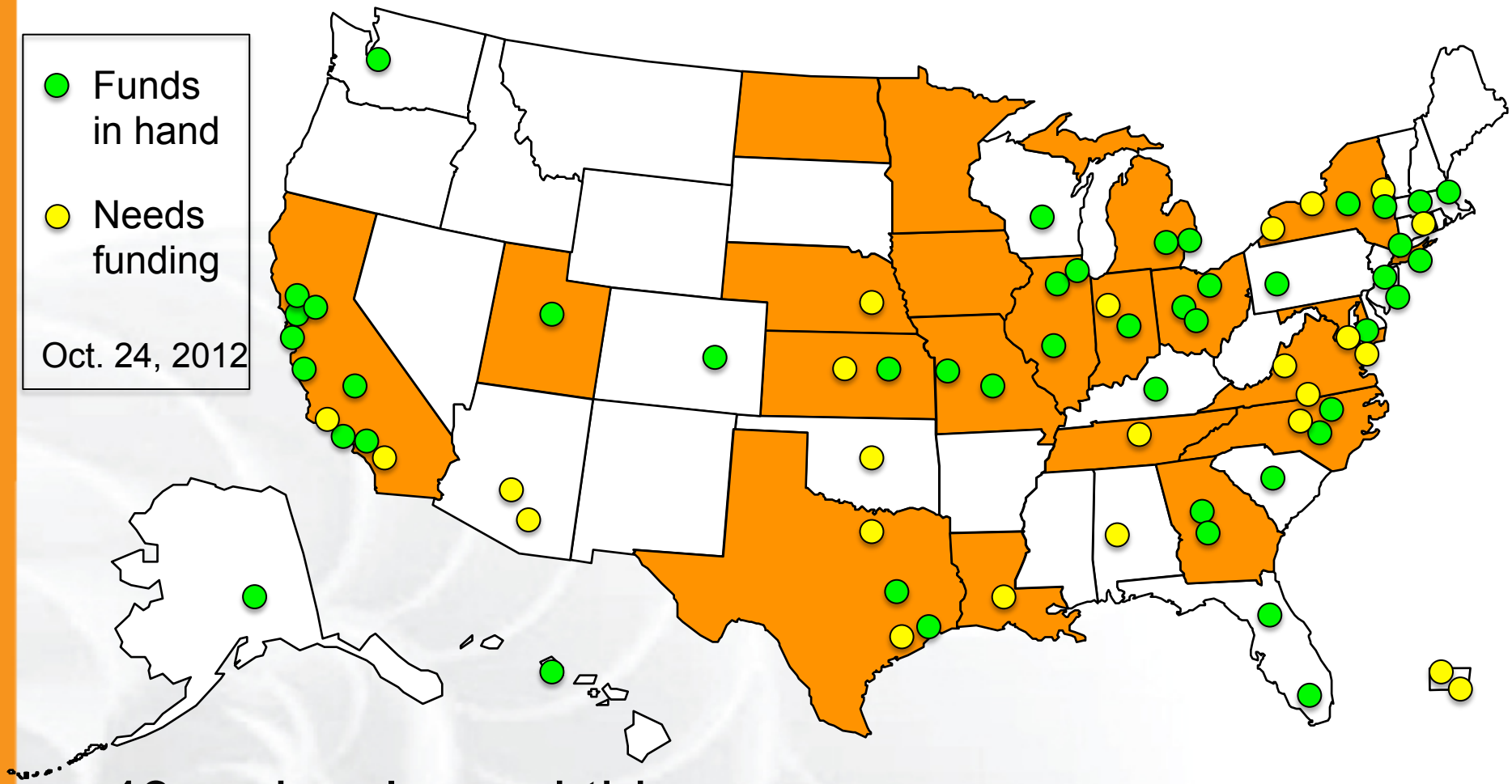
Ready for Experimenters

GENI Rack Deployment Schedule

Activity	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13
InstaGENI		4 racks	racks should pass Acceptance Tests	3 racks	3 racks	3 racks	3 racks	3 racks	3 racks	3 racks	3 racks	3 racks
ExoGENI	2 racks		2 racks	IBM firmware upgrade (hybrid mode)	2 racks, rack should pass Acceptance Tests		2 racks		2 racks		2 racks	

- 43 racks with integrated OpenFlow, compute nodes, and some support for dynamic VLANS deploying this year
- Software updates expected for each rack, will retest to verify
- Schedule subject to change

GENI Rack Campuses



- 43 racks planned this year
- 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)
- 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)

More GENI Integration Efforts

- **Slice Around the World** demo at GEC15 connects meso-scale and international sites. Joe Mambretti
- **Peering agreements** forming e.g. production integration with Europe and Asia. Jim Williams.
- **Dell GENI** racks evolving, working with Clemson
- **Cisco SDN** announcements and GENI rack possibilities
- **The Quilt RFP** defined a preferred set of features and configurations for the R&E community, as well as purchasing program/discounts for Brocade, HP, IBM, NEC, Pica8. Jen Leasure. (more details in slides posted for this session)

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 most older models (IP8800)
    - "Prototype" version rev278 on some older models (IP8800)
  - HP:
    - K.14.83o from HP Labs, most places
    - K.15.08.0013 is the latest GA release
  - 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:
    - 5.4.0a is the current GA line 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: 0.8.1.2
  - Current version: 0.8.6
    - Packaging and environment improvements
    - GPO testing now
    - More info: https://github.com/OPENNETWORKINGLAB/flowvisor/wiki
  - Roadmaps
    - https://openflow.stanford.edu/display/ONL/Software+Roadmap
    - https://github.com/OPENNETWORKINGLAB/flowvisor/wiki/RoadMap
- FOAM (*F*lowVisor *O*penFlow *A*ggregate *M*anager)
  - Recommended version: 0.8.2
  - 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: 0.4
  - Instructions http://groups.geni.net/geni/wiki/PlasticSlices/MonitoringRecommendations/FoamConfiguration

Monitoring Improvements

aggregates
resources
circuits

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Virtual Machines on Racks

Resource Name	Type	Operator	POP Name	Last Updated
urn:publicid:IDN+exogeni.net:bbnvmsite+vmserver+bbn-w1[Details]	vmserver	urn:publicid:IDN+gmoc.geni.net+organization+ExoGENI	urn:publicid:IDN+gmoc.geni.net+pop+gpolab	2012-10-18 15:05:48
urn:publicid:IDN+exogeni.net:bbnvmsite+vmserver+bbn-w2[Details]	vmserver	urn:publicid:IDN+gmoc.geni.net+organization+ExoGENI	urn:publicid:IDN+gmoc.geni.net+pop+gpolab	2012-10-18 15:05:48
urn:publicid:IDN+exogeni.net:bbnvmsite+vmserver+bbn-w3[Details]	vmserver	urn:publicid:IDN+gmoc.geni.net+organization+ExoGENI	urn:publicid:IDN+gmoc.geni.net+pop+gpolab	2012-10-18 15:05:48
urn:publicid:IDN+exogeni.net:bbnvmsite+vmserver+bt				
urn:publicid:IDN+exogeni.net:bbnvmsite+vmserver+bt				
urn:publicid:IDN+exogeni.net:bbnvmsite+vmserver+bt				
urn:publicid:IDN+exogeni.net:bbnvmsite+vmserver+bt				

Database Measurements

gMOC GENI META-OPERATIONS CENTER

chaos@bbn.com | Account |

Details for urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+tuptymon

main
organizations
contacts
pops
sas
slices
aggregates
resources
circuits

FOAM aggregates

Database Measurements

gMOC GENI META-OPERATIONS CENTER 3626 Search

main
organizations
contacts
pops
sas
slices
aggregates
resources
circuits

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Aggregate Name		Type					
foam1.gpolab.bbn.com:3626	[Details]	foam					
foam.clemson.edu:3626	[Details]	foam					
internal2.orbit-lab.org:3626	[Details]	foam					
foam-tutorial.gpolab.bbn.com:3626	[Details]	foam					
foam.gpolab.bbn.com:3626	[Details]	foam					
foam.oflow.cip.gatech.edu:3626	[Details]	foam					
foam.ece.ksu.edu:3626	[Details]	foam					
foam.wail.wisc.edu:3626	[Details]	foam					
foam.utah.geniracks.net:3626	[Details]	foam					
of.cs.washington.edu:3626	[Details]	foam	0.8.2	urn:publicid:IDN+gmoc.geni.net+organization+UW	Unknown	2012-10-21 20:04:54	
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foam.net.internet2.edu:3626	[Details]	foam	0.6.3	urn:publicid:IDN+gmoc.geni.net+organization+Internet2	Unknown	2012-10-21 20:00:28	
foam.nlr.net:3626	[Details]	foam	0.6.3	urn:publicid:IDN+gmoc.geni.net+organization+NLR	Unknown	2012-10-21 20:00:39	
bbn-hn.exogeni.gpolab.bbn.com:3626	[Details]	foam	0.8.2	urn:publicid:IDN+gmoc.geni.net+organization+ExoGENI	Unknown	2012-10-21 20:05:22	
foam.sox.net:3626	[Details]	foam	0.8.2	urn:publicid:IDN+gmoc.geni.net+organization+SOX	Unknown	2012-10-21 20:05:26	
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moxifoam.ictc.indiana.gigapop.net:3626	[Details]	foam	0.6.3	urn:publicid:IDN+gmoc.geni.net+organization+MOXI-Indiana	Unknown	2012-10-21 20:00:17	
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foam-cotn-1.lam-hyper-1.cenic.org:3626	[Details]	foam	0.6.3	urn:publicid:IDN+gmoc.geni.net+organization+CENIC	Unknown	2012-10-21 20:05:18	
of-foam-1.ku.gpeni.net:3626	[Details]	foam	0.8.2	urn:publicid:IDN+gmoc.geni.net+organization+GpENI	Unknown	2012-10-21 20:05:25	

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Slivers on Racks

Details | Slivers | Resources

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Aggregate	Sliver URN	Expires	Status	Last Updated
foam.gpolab.bbn.com:3626	urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+tuptymon:2e4830a6-948e-4dc4-92d6-56151a1da94e[Details]	2012-10-30 00:00:00	Up	2012-10-21 20:00:44
foam.utah.geniracks.net:3626	urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+tuptymon:b75b02da-a161-49df-a02e-38ecaa3e609f [Details]	2012-10-30 02:00:00	Up	2012-10-21 20:00:48
bbn-hn.exogeni.gpolab.bbn.com:3626	urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+tuptymon:e10d67f9-4680-4774-9968-aae42c8fdccb [Details]	2012-10-29 20:00:00	Up	2012-10-21 20:01:01
rci-hn.exogeni.net:3626	urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+tuptymon:fd437437-7f96-4b79-b5ac-e8fc8bd32846 [Details]	2012-10-29 20:00:00	Up	2012-10-21 20:00:59
foam.net.internet2.edu:3626	urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+tuptymon:5c9a6f0d-0328-415f-a694-bd95d78920c3 [Details]	2012-10-29 20:00:00	Up	2012-10-21 20:00:27
foam.nlr.net:3626	urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+tuptymon:ad23ad56-e8fb-407e-8698-85caa47edca9 [Details]	2012-10-30 03:00:00	Up	2012-10-21 20:00:38

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* Open Source monitoring client available in Python
* Updated monitoring software running on all racks, backbones, and most OpenFlow aggregates
* Monitoring uses URNs for resource names for better interoperabilty
* Format for InstaGENI and ExoGENI reported data is similar

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
- GMOC Support for racks and OpenFlow campus infrastructure
  - Monitoring and status for Meso-scale sites and racks

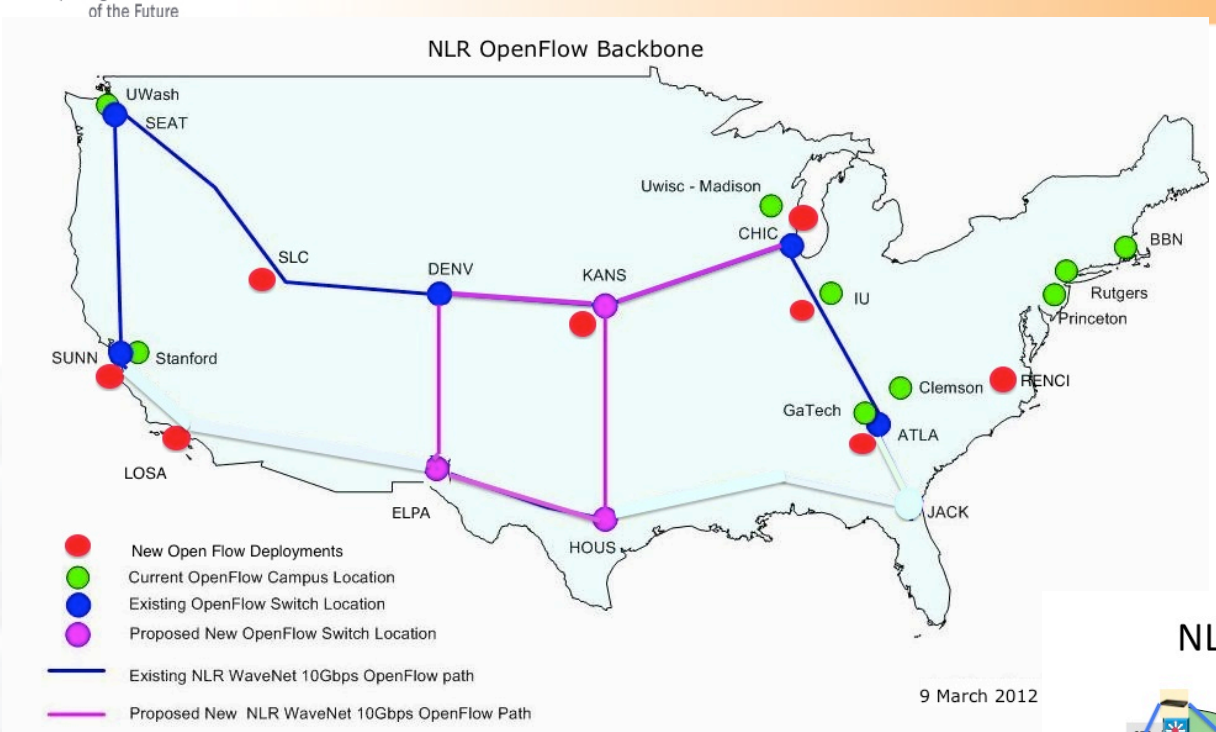
  http://gmoc-db.grnoc.iu.edu under revision

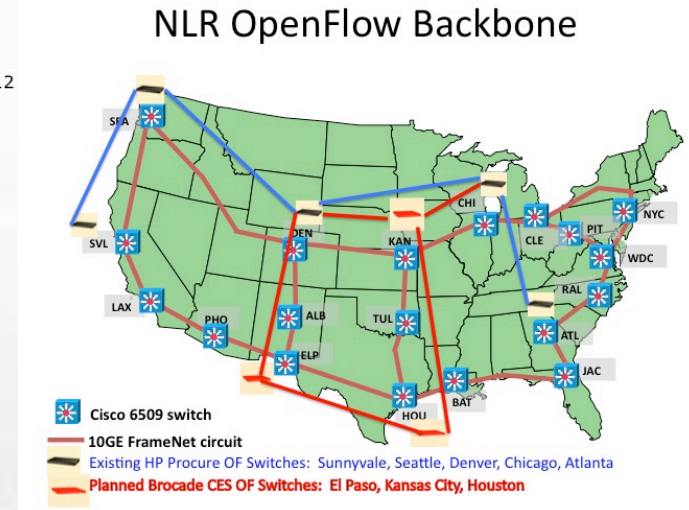
  https://gmoc-db.grnoc.iu.edu/protected/ requires admin password
  - Scheduled/unscheduled outage scheduling and calendars
  - Emergency Stop
  - Escalation, tracking, some troubleshooting for reported problems
  - Draft workflows

More Information

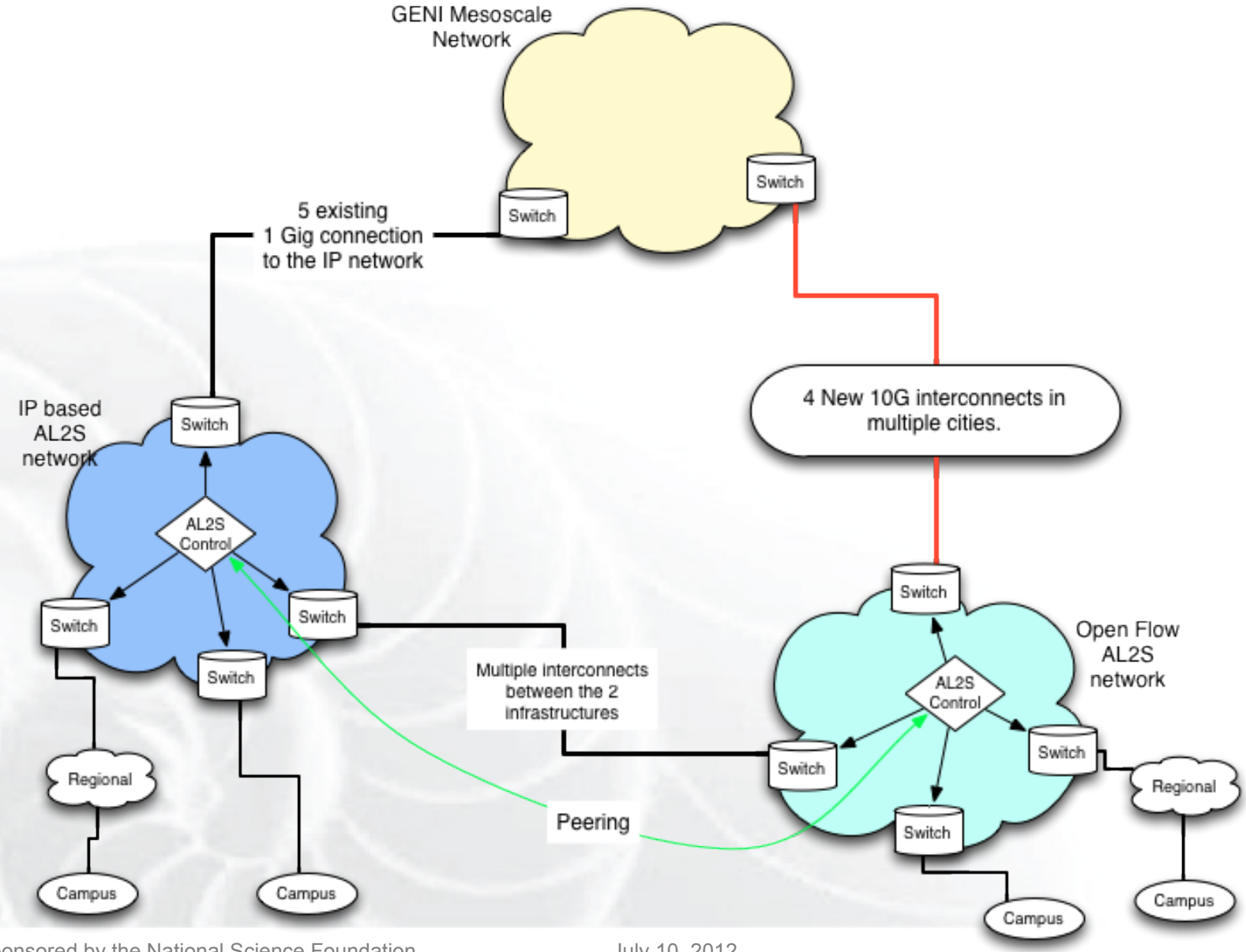
Thank you!

NLR OpenFlow Expansion





Internet2 Advanced Layer 2 Services (AL2S) and meso-scale



Internet2 Advanced Layer 2 Services (AL2S) and meso-scale (cont.)

GENI interconnectivity in a representative city, e.g. DC