



GENI



Exploring Networks of the Future

www.geni.net

- What is GENI?
- How is GENI being used?
- Key GENI Concepts
- Demo: A simple experiment using GENI

GENI: Infrastructure for Experimentation



Regional nets

-  Existing
-  New

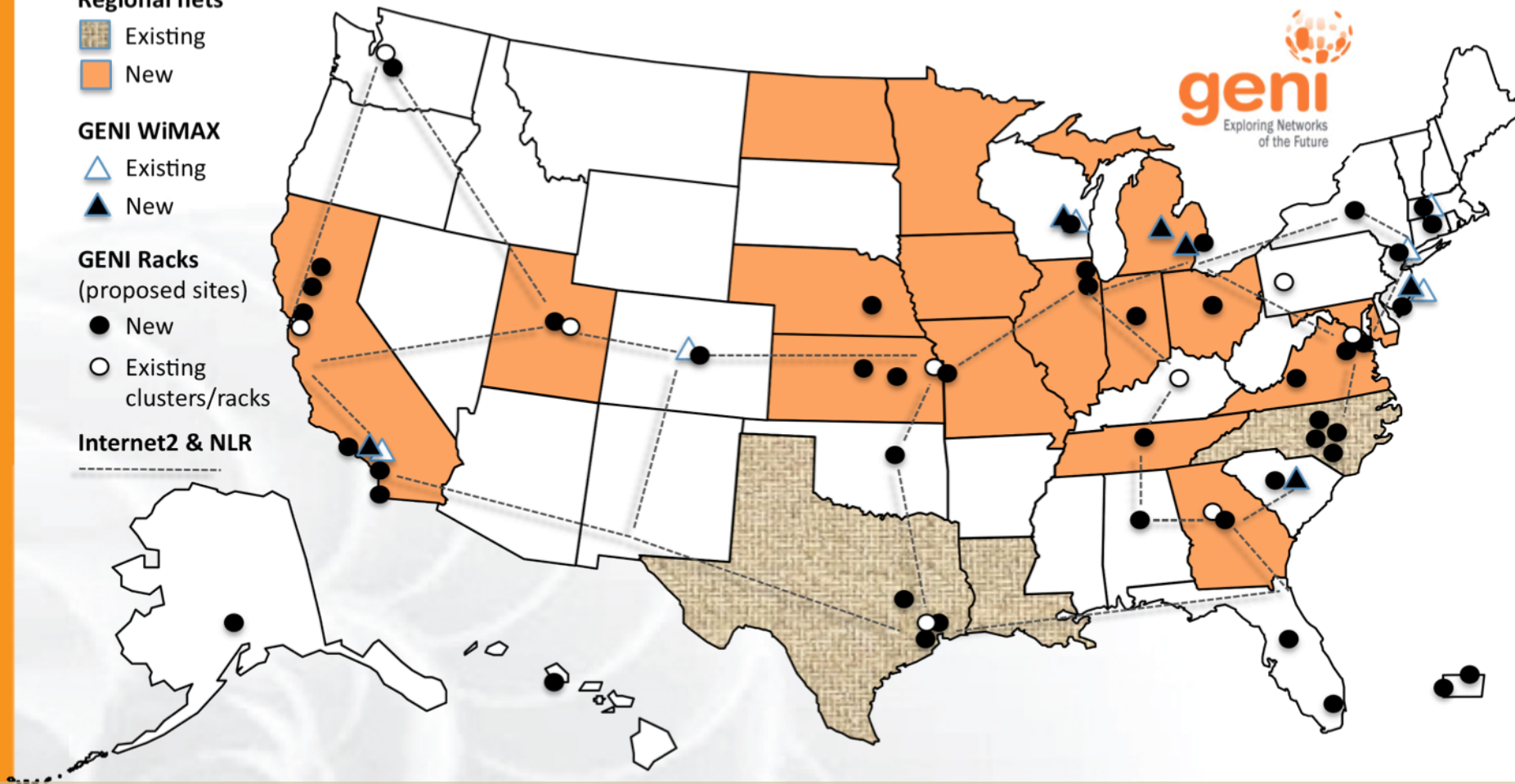
GENI WiMAX

-  Existing
-  New

GENI Racks

- (proposed sites)
-  New
 -  Existing clusters/racks

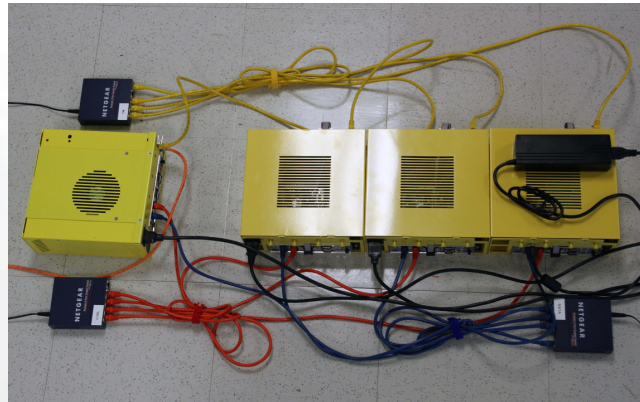
Internet2 & NLR



GENI provides compute resources that can be connected in experimenter specified Layer 2 topologies.



GENI Racks

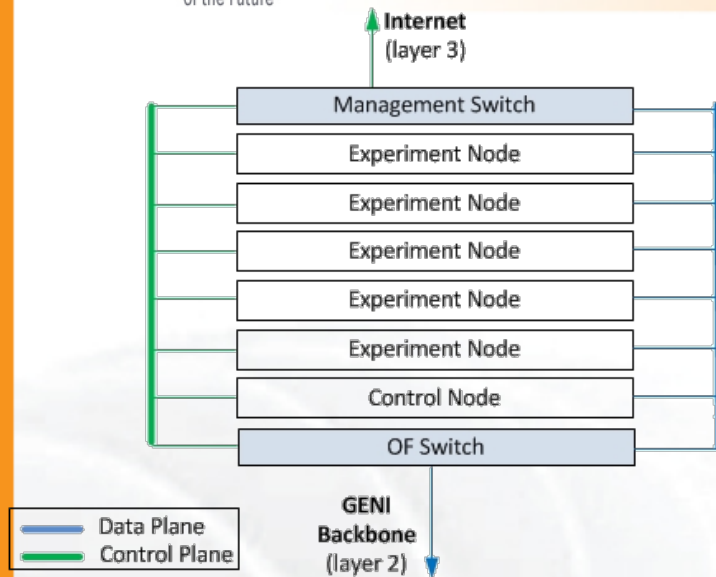


GENI Wireless
compute nodes



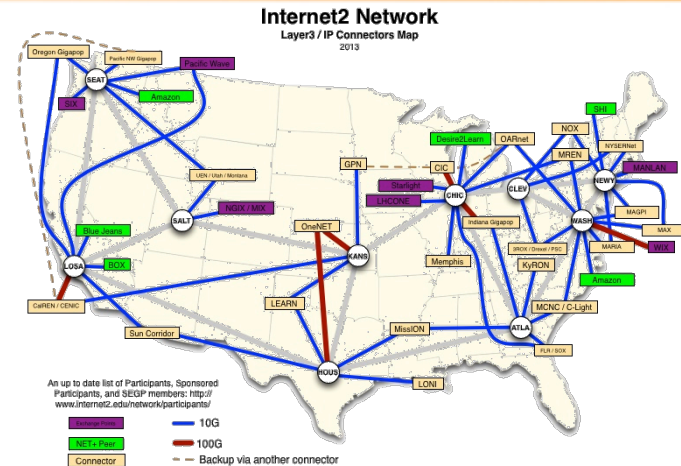
Existing Testbeds
(e.g. Emulab)

Examples of GENI Networking Resources



Networking within a Rack

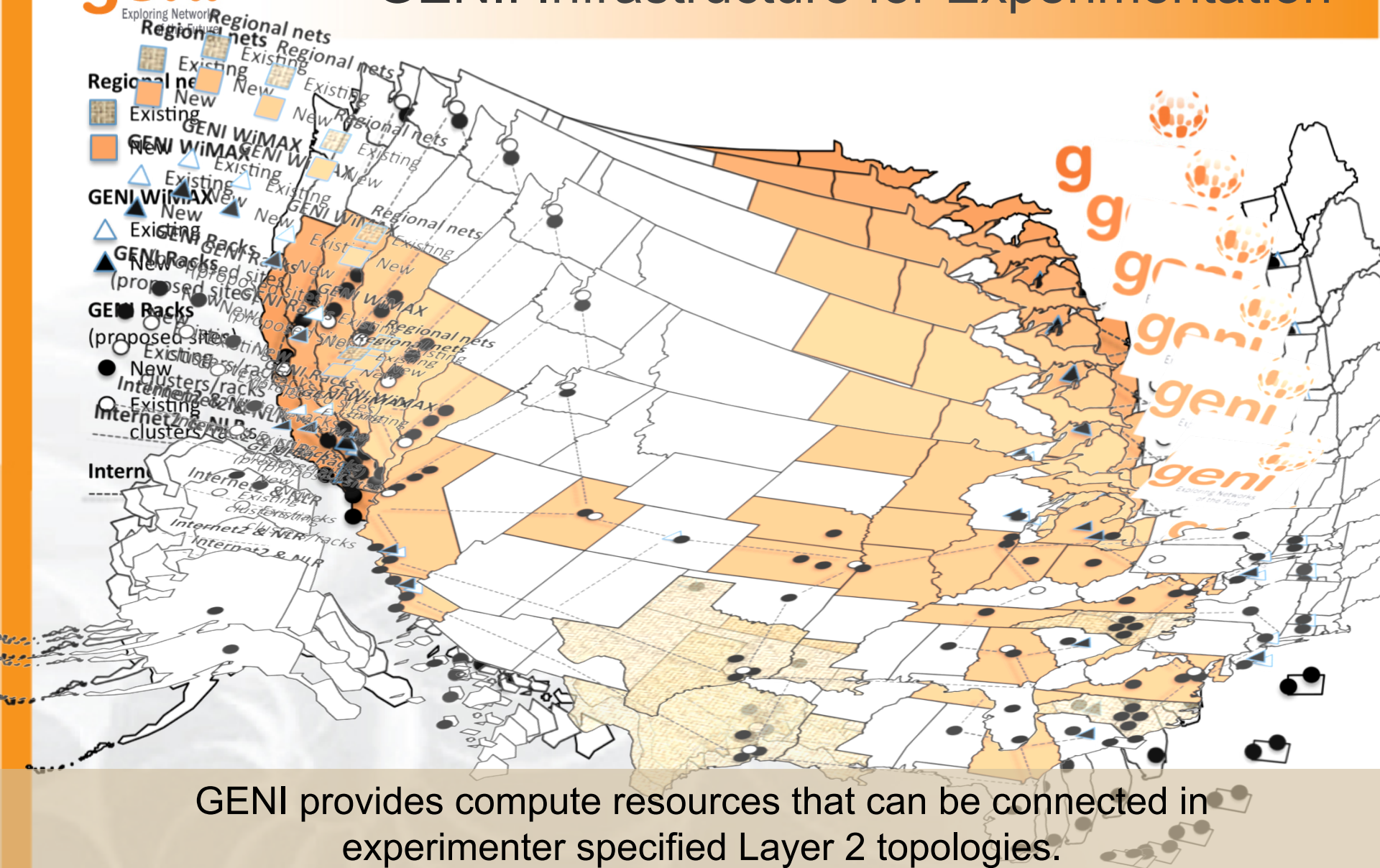
WiMAX Base Stations



National Research Backbones
(e.g. Internet2)



Regional Networks
(e.g. CENIC)



GENI provides compute resources that can be connected in experimenter specified Layer 2 topologies.

Multiple GENI Experiments run Concurrently

Experiments
live in **isolated**
“slices”

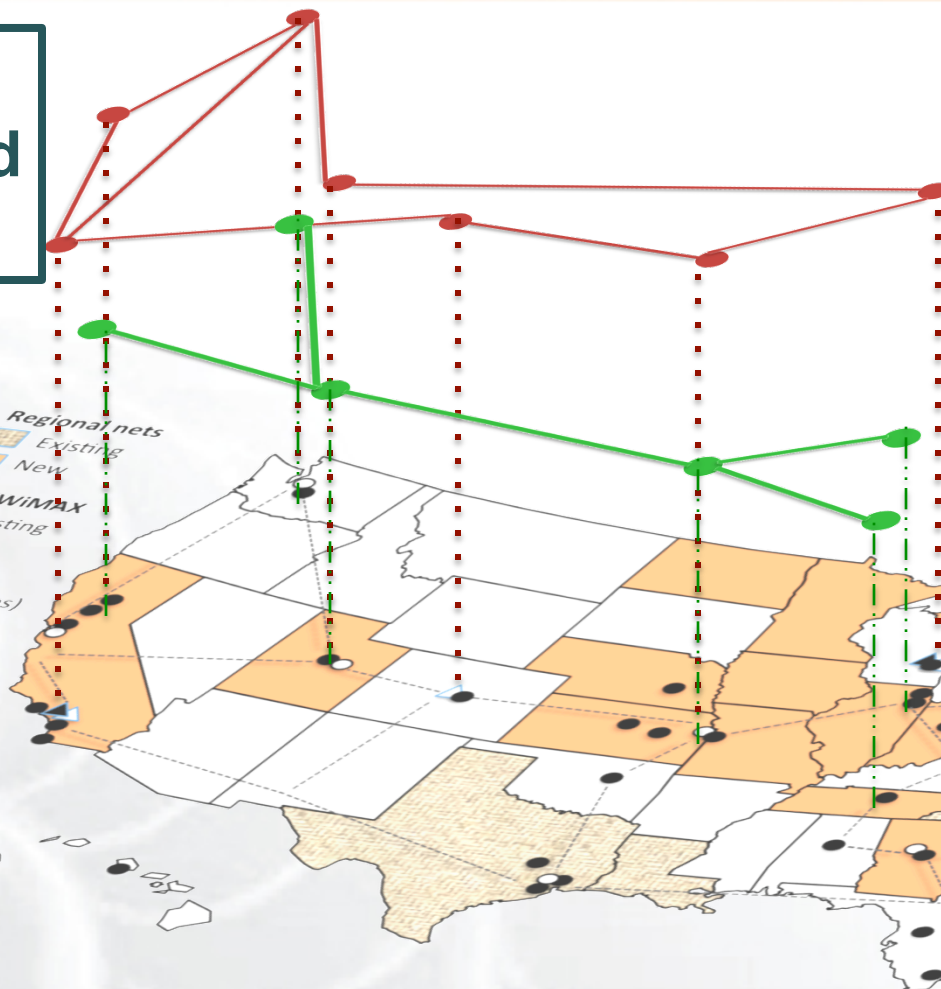


Regional nets
Existing
New

GENI WiMAX
Existing
New

GENI Racks (proposed sites)
New
Existing clusters/racks

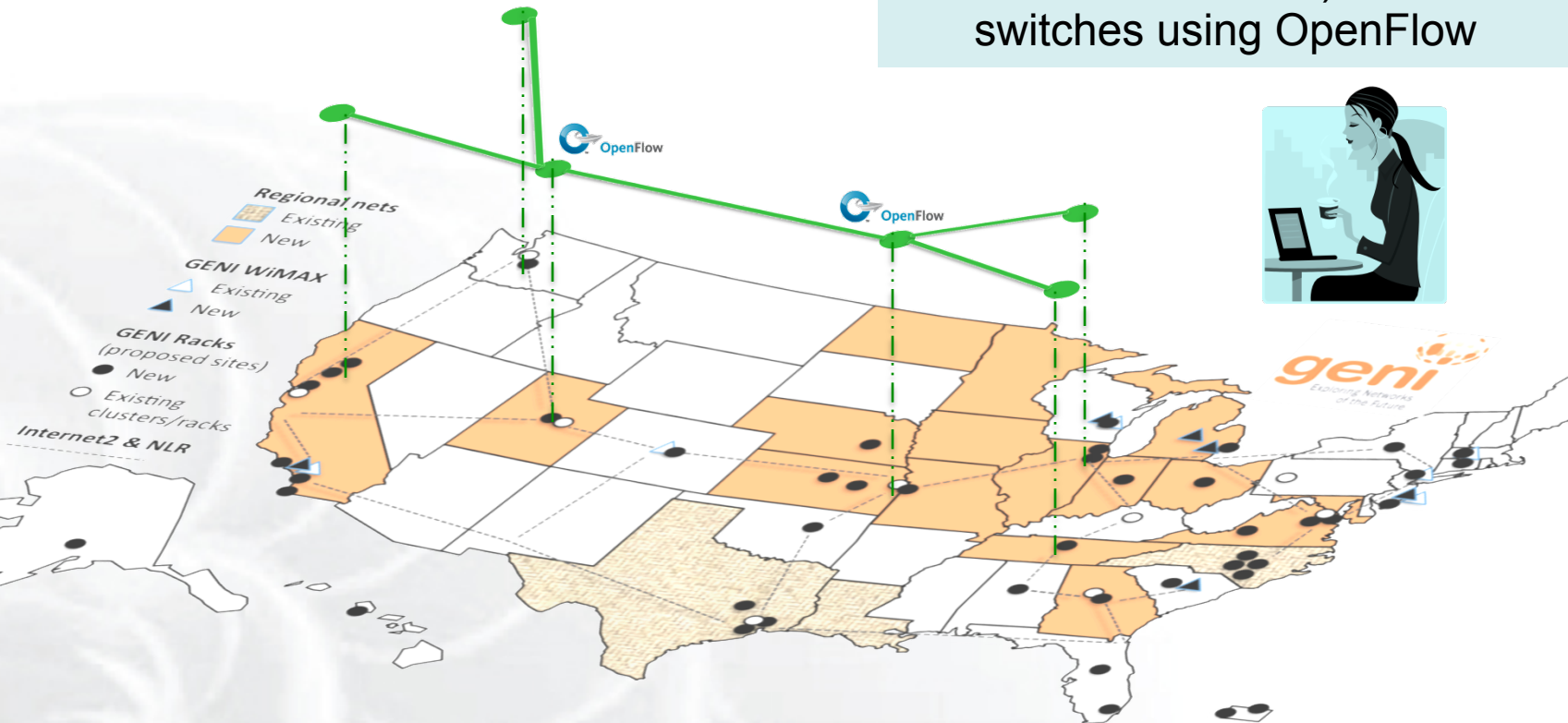
Internet2 & NLR



Resources can be **shared** between slices

GENI is “Deeply Programmable”

I install software I want throughout my network slice (into routers, switches, ...) or control switches using OpenFlow



OpenFlow part of the experiment not only the infrastructure

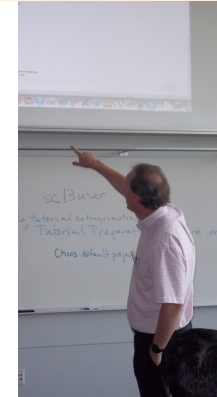
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How is GENI being Used?



Research

- Future Internet architectures
- Software defined networking
- Large scale evaluation of smart grid protocols

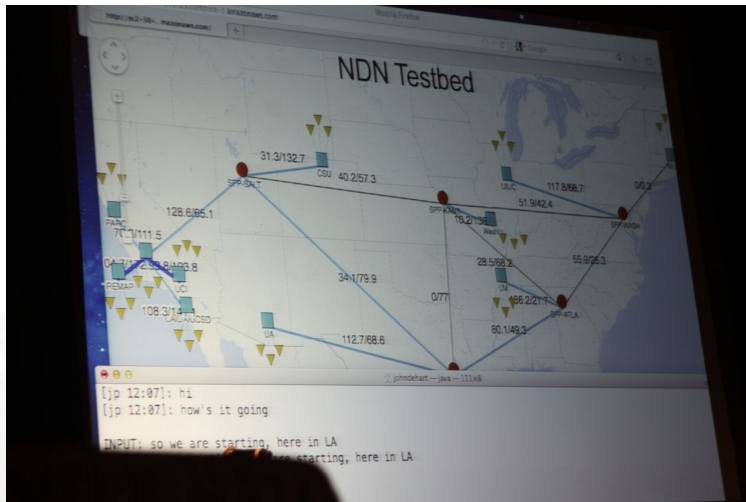


Education

- Networking and Distributed systems classes
- Cloud computing classes
- WiMAX classes

As of October 2013, GENI had over a 1200 users!

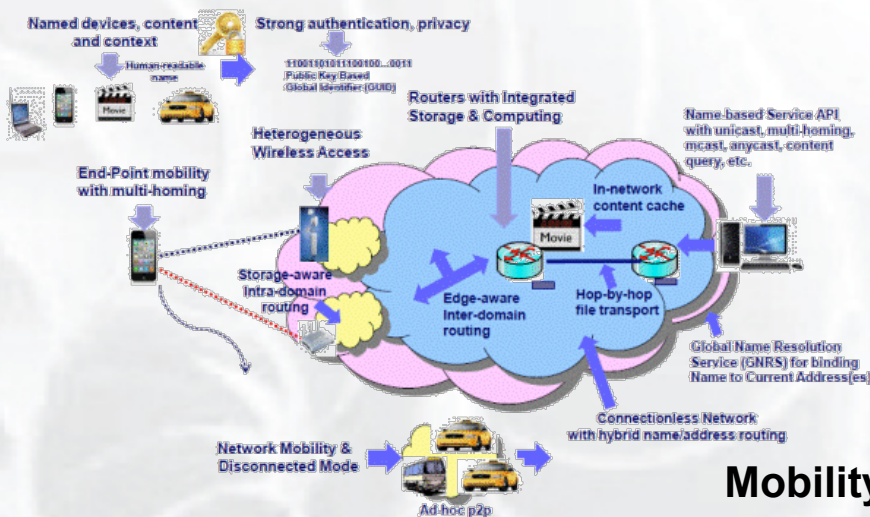
Three FIA Teams have Slices on GENI



NDN (demo at GEC 13)



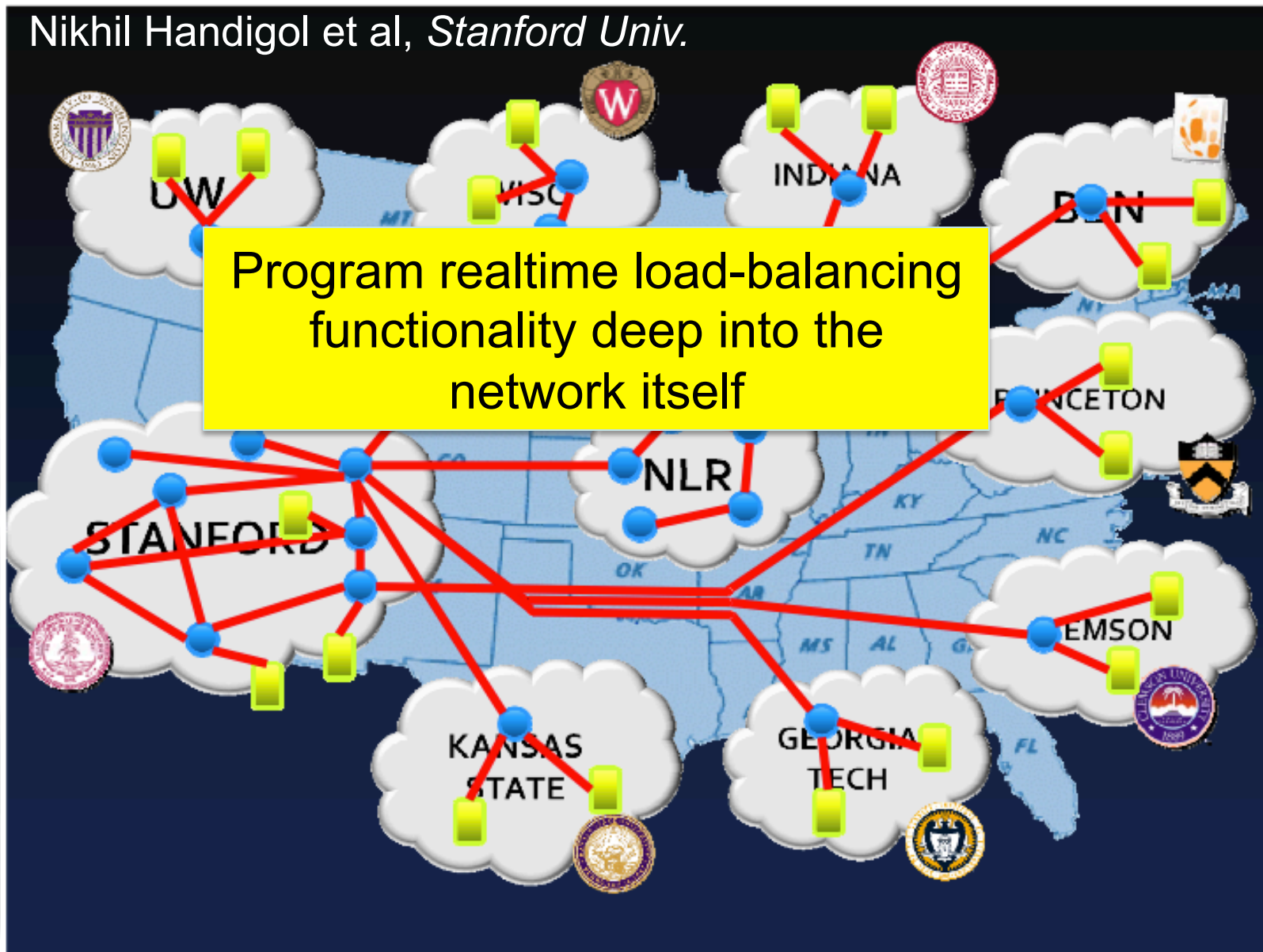
XIA (demo at GEC15)



MobilityFirst (demo at GEC 12 & GEC18)

GENI is the only testbed that can support these teams.

Nikhil Handigol et al, *Stanford Univ.*



GENI in the Classroom – A great success!



Jeannie Albrecht (Williams College) with students from her Spring 2012 Distributed Systems class

Fall 2012:

Rudra Dutta (NCSU)
Zongming Fei (U. of KY)
Fraida Fund (NY Poly)
Kaiqi Xiong (RIT)

Spring 2013:

Jay Aikat (U. of NC)
Rudra Dutta (NCSU)
Khaled Harfoush (NCSU)
Jelena Marasevic (Columbia U)
Parmesh Ramanathan (U. Wisc)
Violet Syrotiuk (Arizona State U.)
KC Wang (Clemson)
Michael Zink (U. of MA)

Fall 2013:

Prasad Calyam (U. of Missouri)
Zongming Fei (U. of KY)
John Geske (Kettering U.)
Deniz Gurkan (U. of Houston)
Christos Papadopoulos (Col. State)
Violet Syrotiuk (Arizona State U.)
Zhi-Li Zhang (U. of MN)

SIGCSE ATLANTA 2014

IC2E 2014: IEEE International Conference on Cloud Engineering

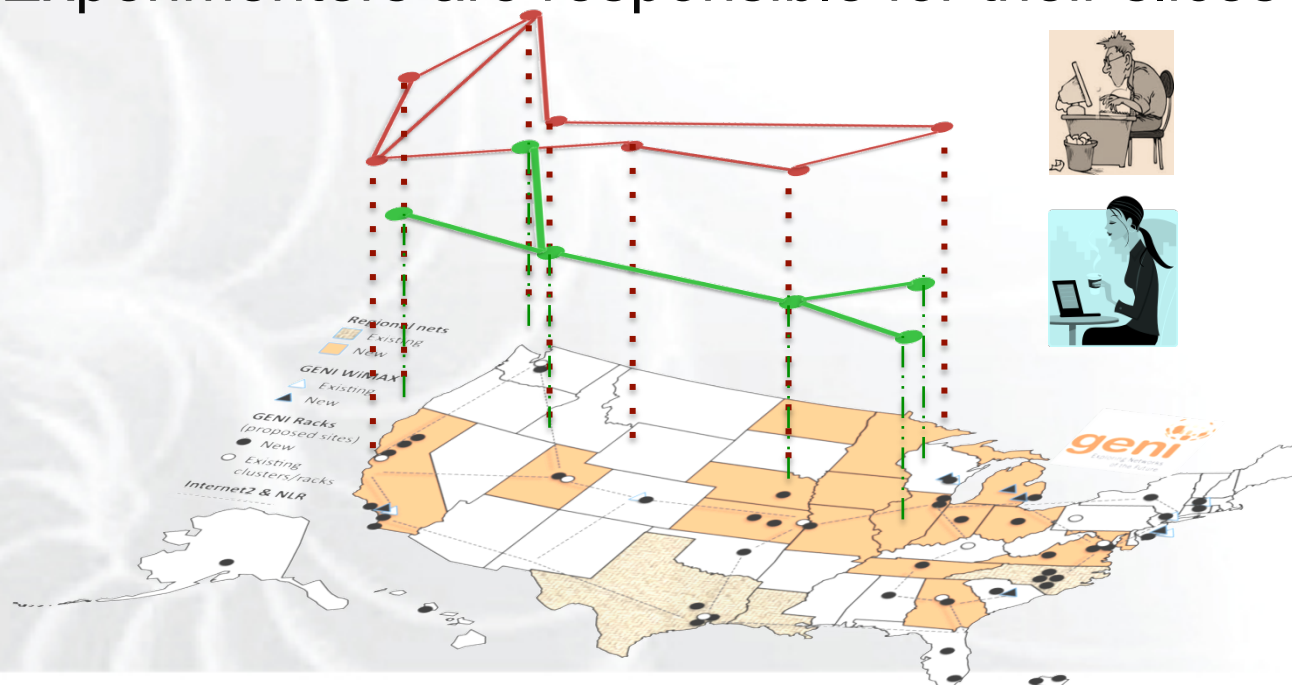


Boston, Massachusetts, USA

March 11-14, 2014

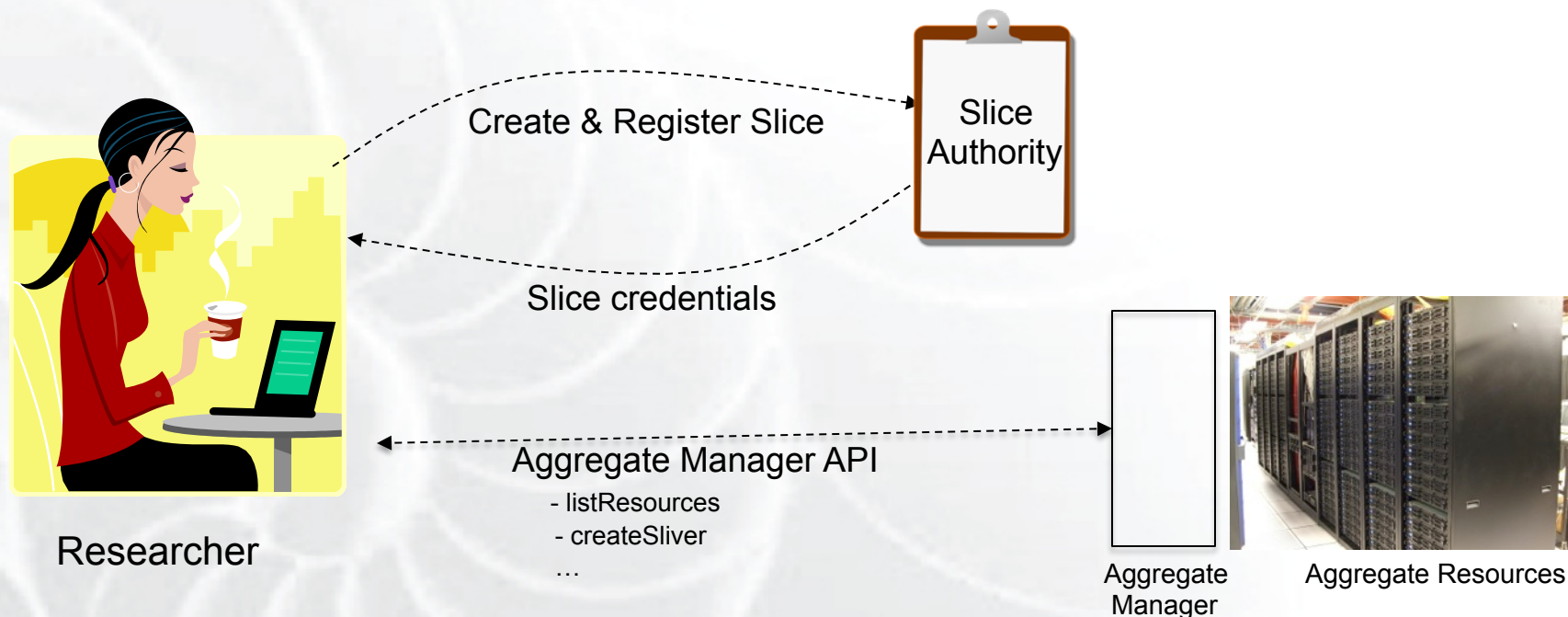
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- Slice: Abstraction for a collection of resources capable of running experiments
 - An experiment uses resources in a slice
 - Slices isolate experiments
 - Experimenters are responsible for their slices



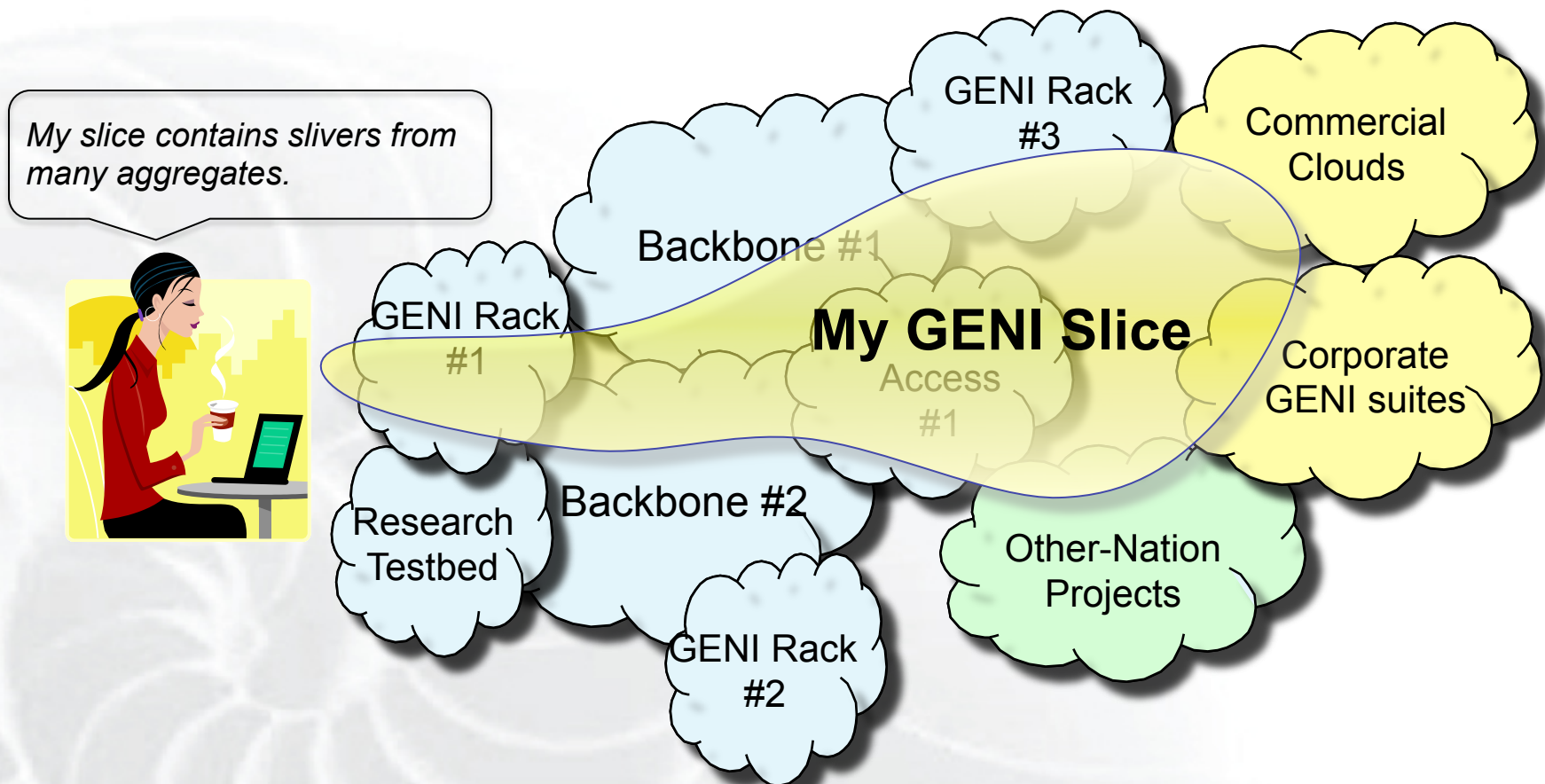
GENI: Terms and Definitions

- Slice authority: Creates and registers slices
 - GENI slice authorities: GENI Portal, PlanetLab, ProtoGENI
- Aggregate: Provides resources to GENI experimenters
 - Typically owned and managed by an organization
 - Examples: GENI Racks, Internet2, Emulab, PlanetLab
 - Aggregates implement the GENI AM API



GENI: Terms and Definitions

- A slice : One or more resources provided by an aggregate
 - E.g. Bare machines, virtual machines, VLANs

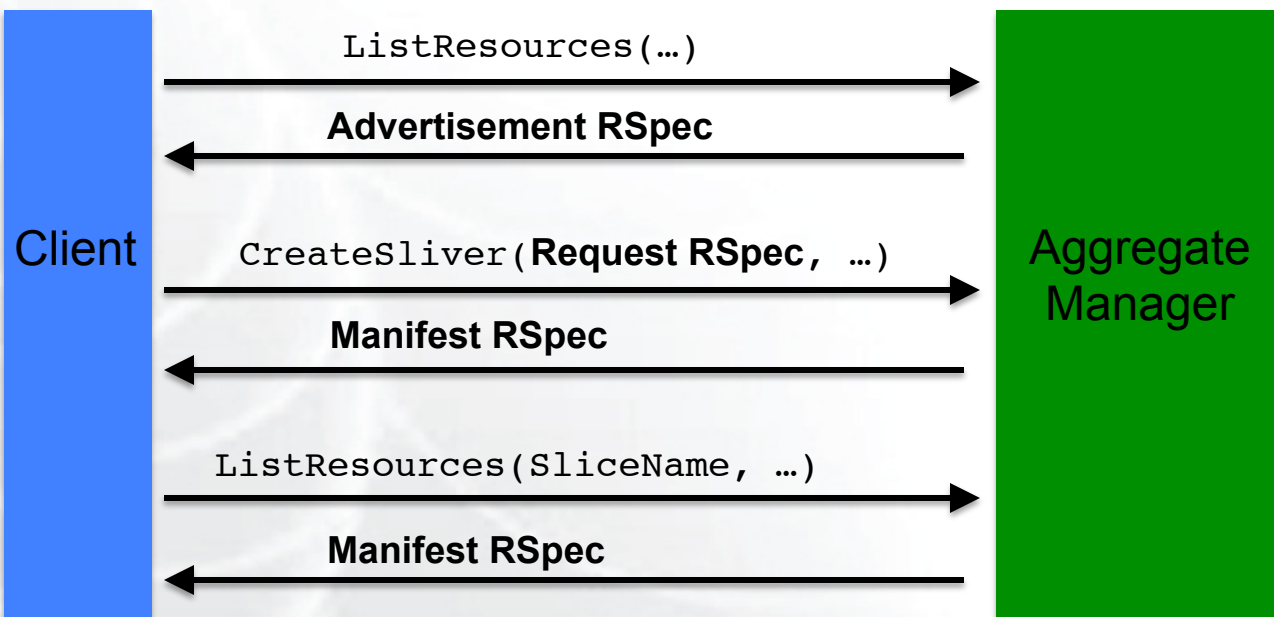
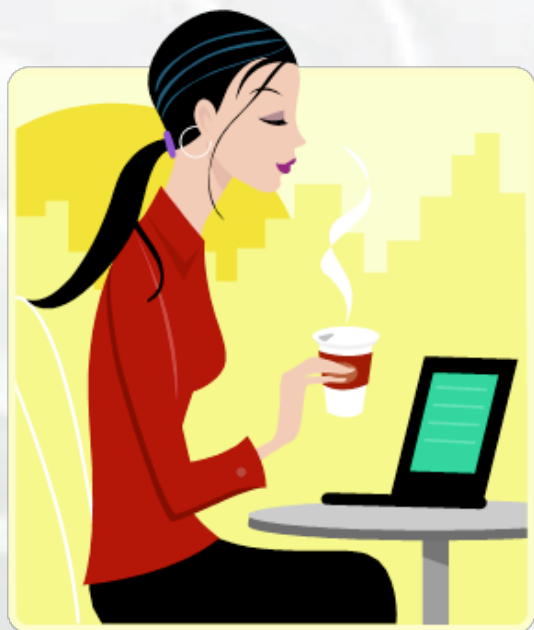


- RSpecs: Lingua franca for describing and requesting resources
 - “Machine language” for negotiating resources between experiment and aggregate
 - Experimenter tools eliminate the need for most experimenters to write or read RSpec

```
<?xml version="1.0" encoding="UTF-8"?>
<rspec xmlns="http://www.protogeni.net/resources/rspec/2"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.protogeni.net/resources/rspec/2
    http://www.protogeni.net/resources/rspec/2/request.xsd"
  type="request" >
  <node client_id="my-node"
    exclusive="true">
    <sliver_type name="raw-pc" />
  </node>
</rspec>
```

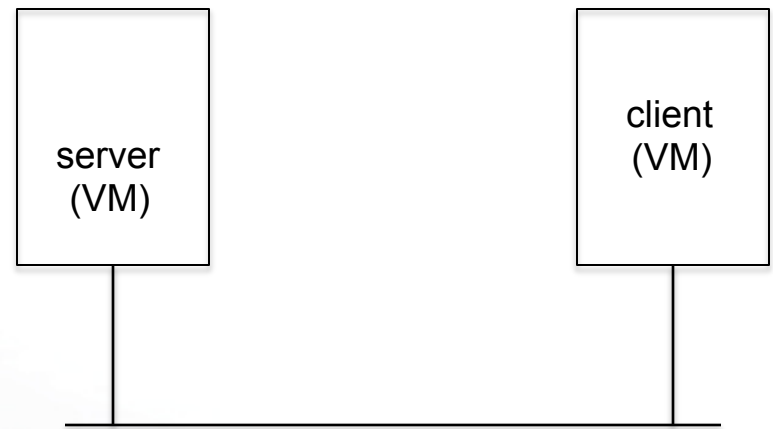
RSpec for requesting a single node

- Advertisement RSpec: What does an aggregate have?
- Request RSpec: What does the experimenter want?
- Manifest RSpec: What does the experimenter have?

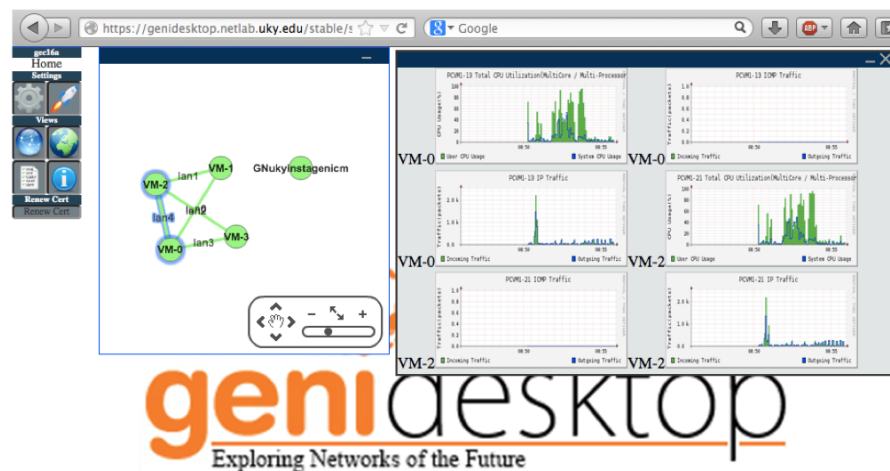


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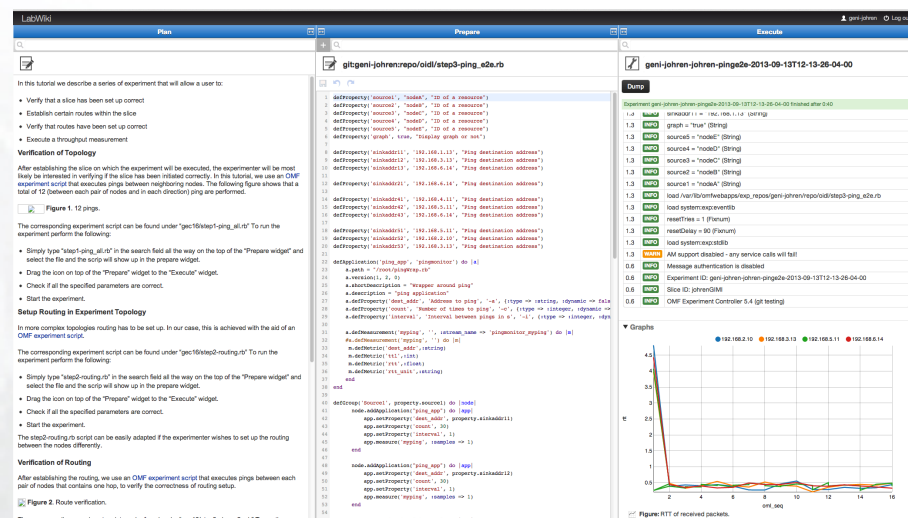
- Demo
 - Create a slice
 - Create a sliver at one aggregate
 - Two computers (raw PCs), connected by a LAN
 - Install and run software on the machines
 - View output of software
 - Delete sliver
- Experimenter tool: Flack



- Two major I&M systems being implemented
 - GEMINI (Indiana U. & U. of Kentucky)
 - GIMI (U. of Massachusetts, RENCI, NICTA)
- Support for active and passive measurements
- Repositories for archiving (and searching) for measurement data & meta-data



The GENI Desktop and GEMINI



LabWiki and GIMI

Omni: Resource Reservation tool

- A command line experimenter tool
- Useful for making AM API calls on aggregates
- Written in and scriptable from Python
- **Works with aggregates that implement the GENI AM API**
 - ProtoGENI, PlanetLab, OpenFlow, InstaGENI, ExoGENI

```
$ omni.py createsliver aliceslice myRSpec.xml
INFO:omni:Loading config file omni_config
INFO:omni:Using control framework pgeni
INFO:omni:Slice urn:publicid:IDN+pgeni.gpolab.
        expires within 1 day on 2011-07-07
INFO:omni:Creating sliver(s) from rspec file
INFO:omni:Writing result of createsliver for
INFO:omni:Writing to 'aliceslice-manifest-rspe
INFO:omni: -----
INFO:omni: Completed createsliver:
```

Options as run:

```
aggregate: https://www.emulab.
framework: pgeni
native: True
```

Args: createsliver aliceslice myRSpec.xml

```
Result Summary: Slice urn:publicid:IDN+pgeni
Reserved resources on https://www.emulab.net/p
Saved createsliver results to aliceslice-man
INFO:omni: =====
```

<http://trac.gpolab.bbn.com/gcf/wiki/Omni>

QUESTIONS?