



GENI

Exploring Networks of the Future

www.geni.net

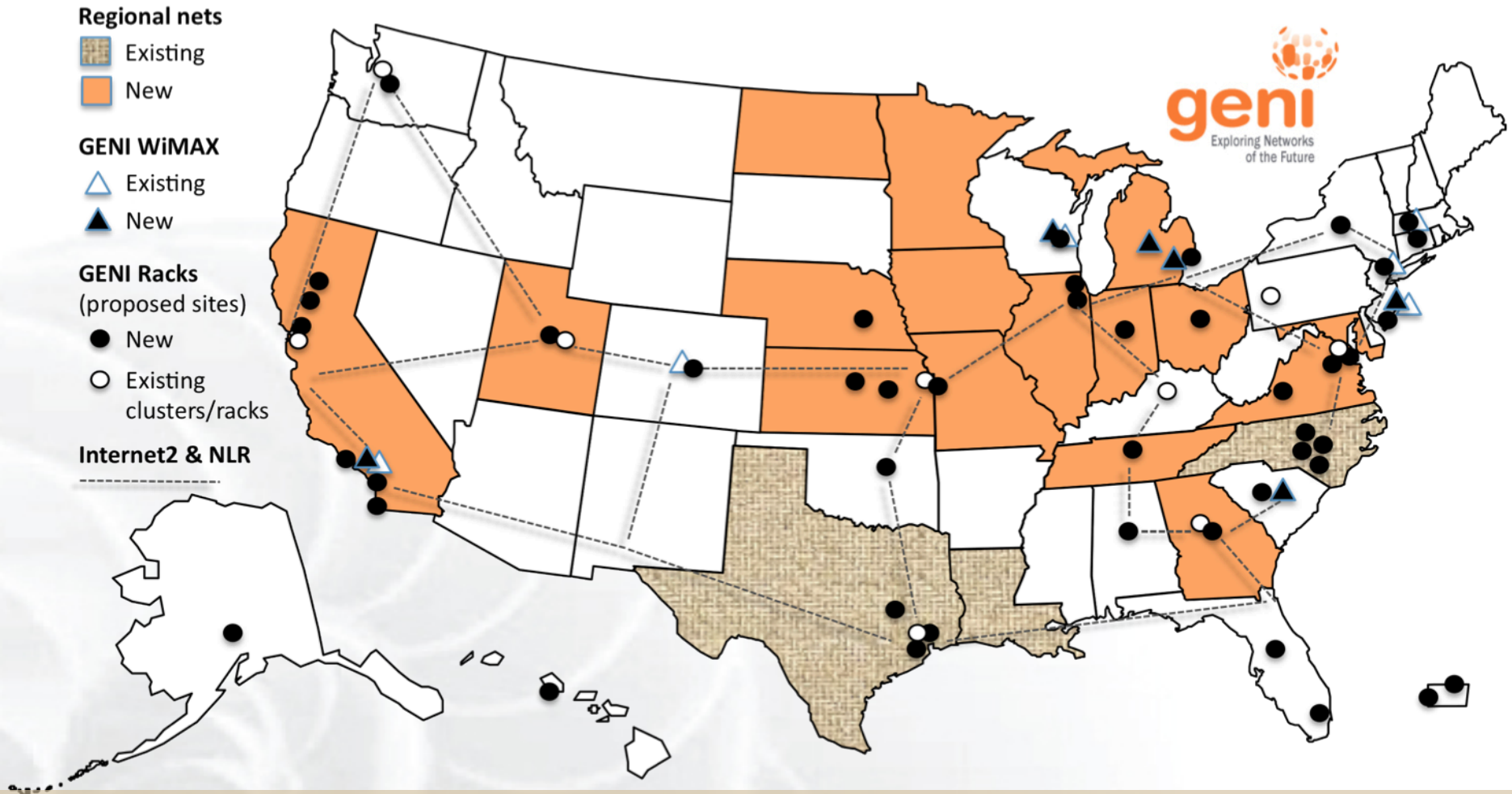
What is GENI?

How is GENI being used?

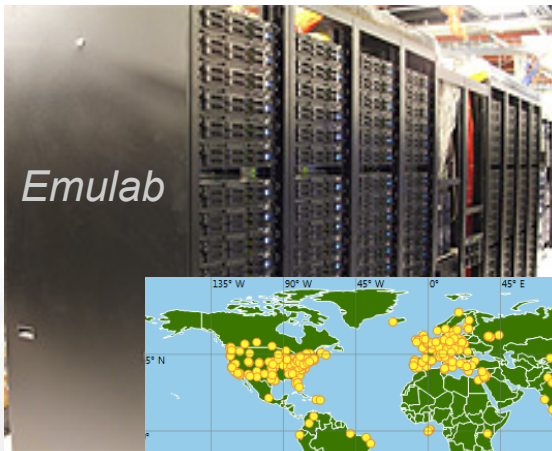
Key GENI Concepts

Demo: A simple experiment using GENI

GENI: Infrastructure for Experimentation

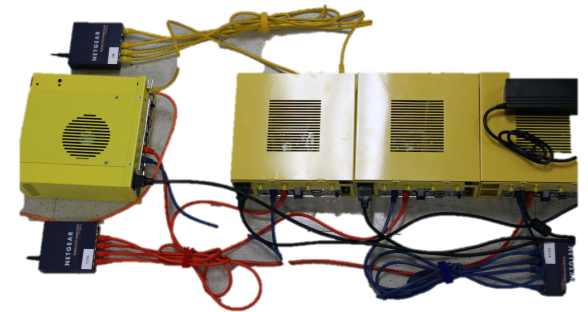


GENI provides compute resources that can be connected in experimenter specified Layer 2 topologies.

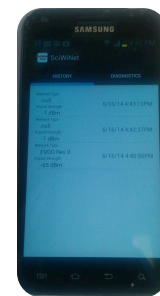


Existing Testbeds

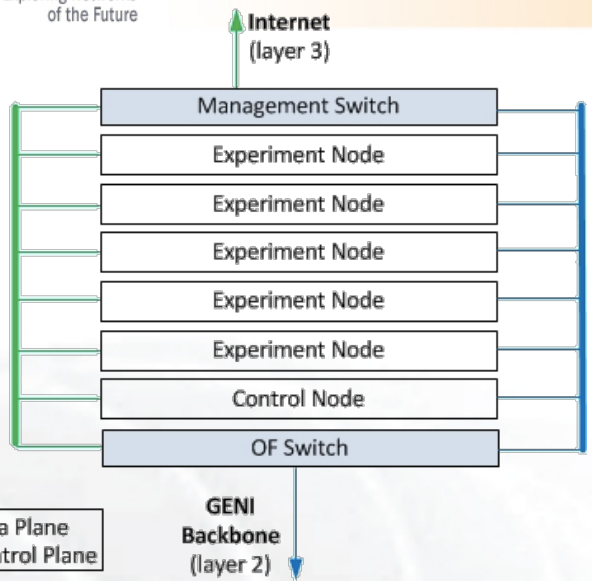
GENI Racks



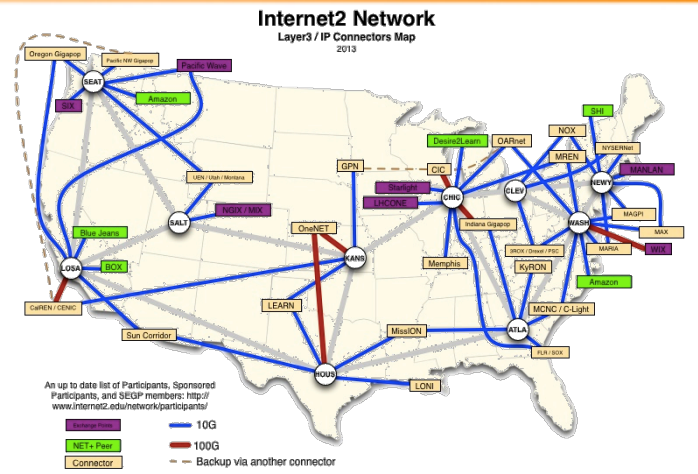
GENI Wireless
compute nodes



GENI Networking Resources



Networking within a Rack

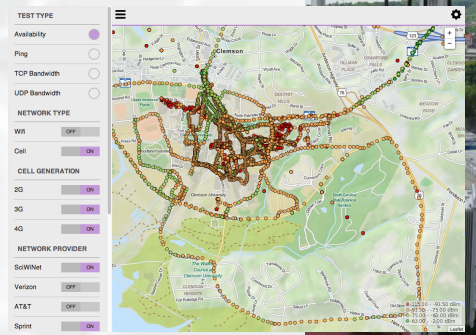


National Research Backbones (e.g. Internet2)

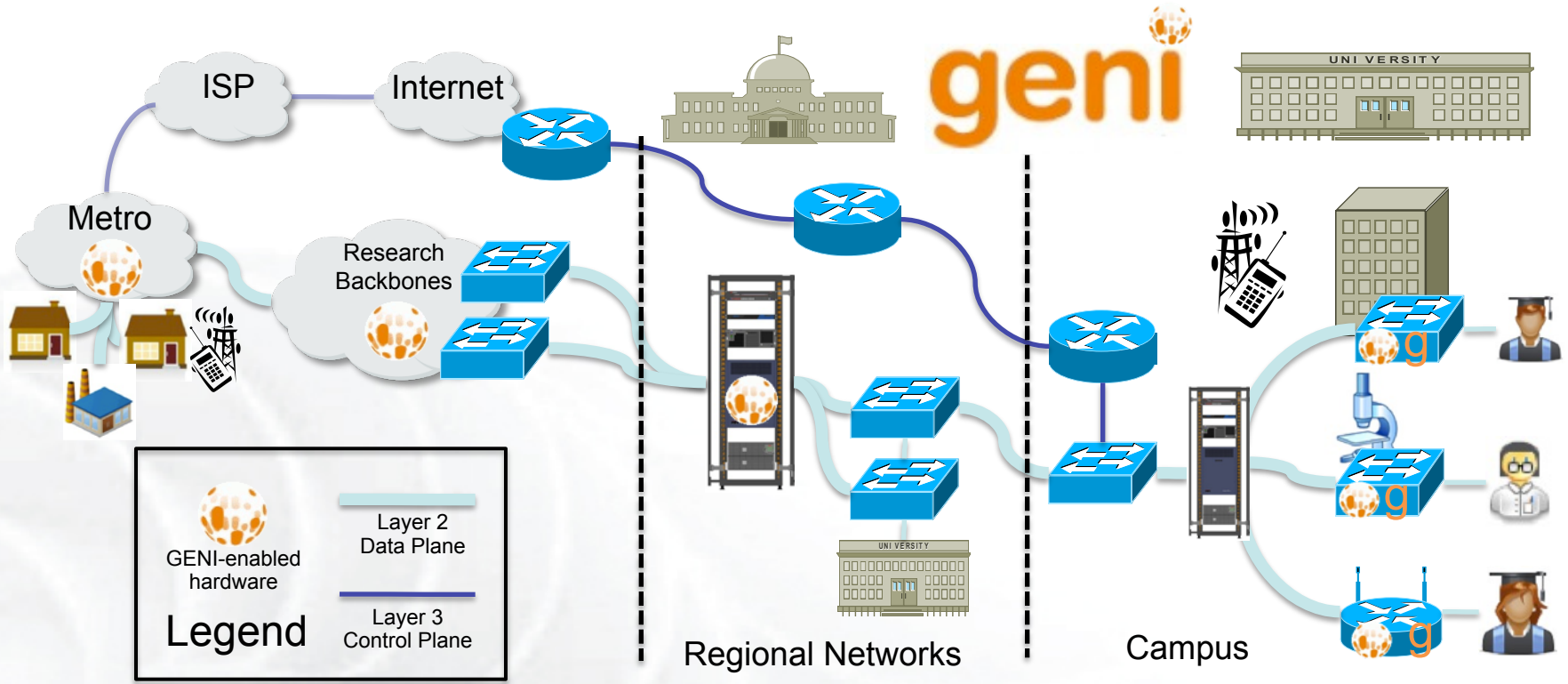


WiMAX Base Stations

4G/3G
GENI network



Regional Networks (e.g. CENIC)



- Flexible network / cloud research infrastructure
- Also suitable for physics, genomics, other domain science
- Distributed cloud (racks) for content caching, acceleration, etc.

- More **WiMAX base stations** with Android handsets
- GENI-enable 5-6 **regional networks**
- Inject more **OpenFlow switches** into Internet2
- Add **GENI Racks** to 50-80 locations within campuses, regionals, and backbone networks



GENI Racks serve as programmable routers, distributed clouds, content distribution nodes, caching or transcoding nodes, etc

Creating and deploying GENI racks



Ilia Baldine
RENCI
More resources / rack,
fewer racks



Rajesh Narayanan
DELL

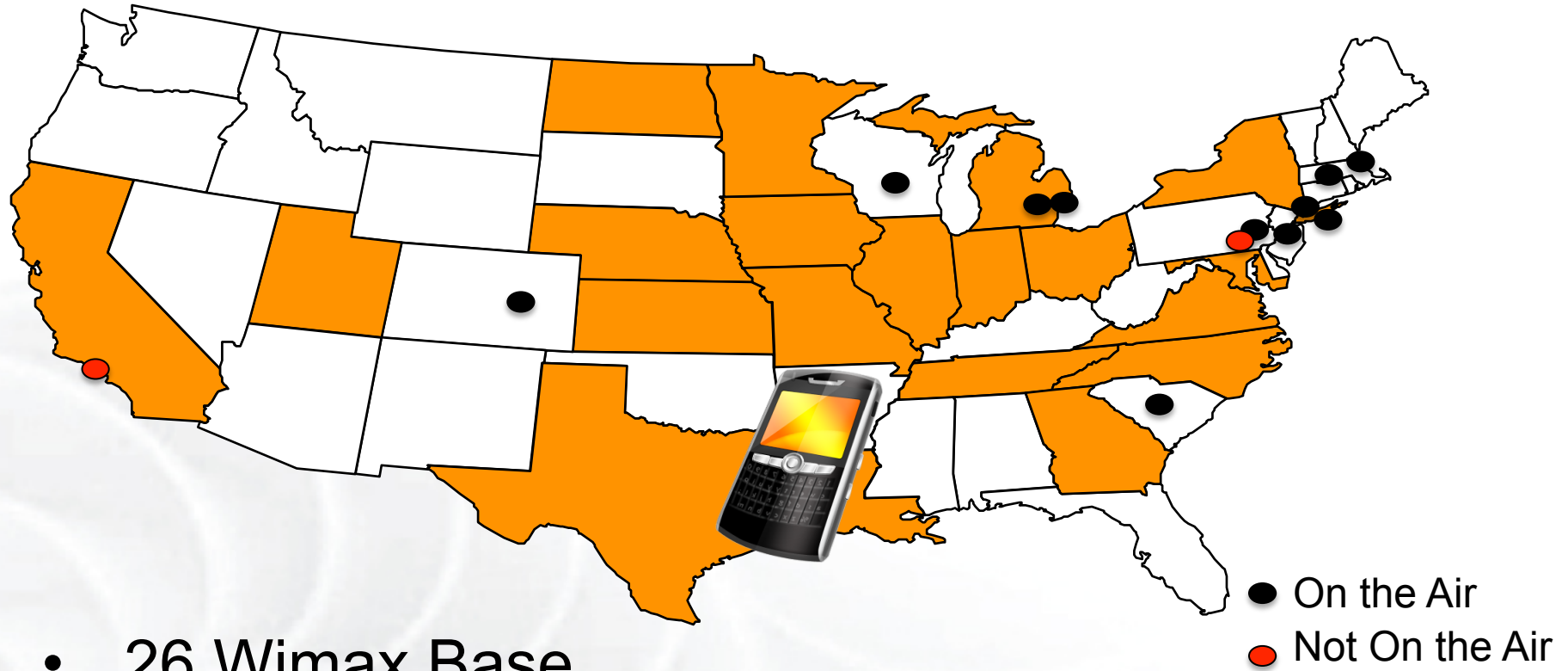


KC Wang Clemson



Rick McGeer
HP Labs
Fewer resources / rack,
more racks

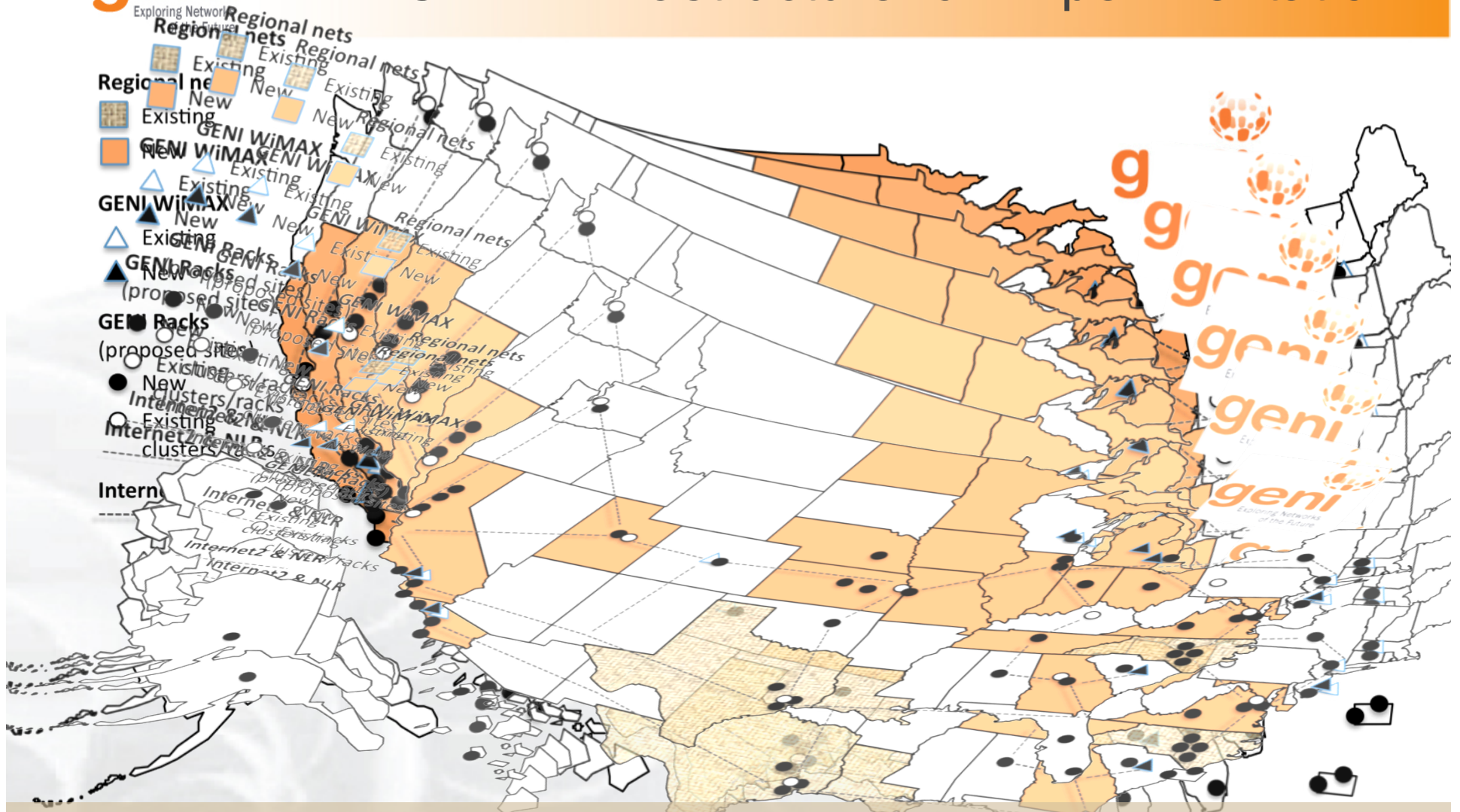




- 26 Wimax Base Stations in 13 Sites
- Sliced, virtualized and interconnected
- Researcher-owned,
- researcher-operated
- 4G cellular systems



GENI: Infrastructure for Experimentation

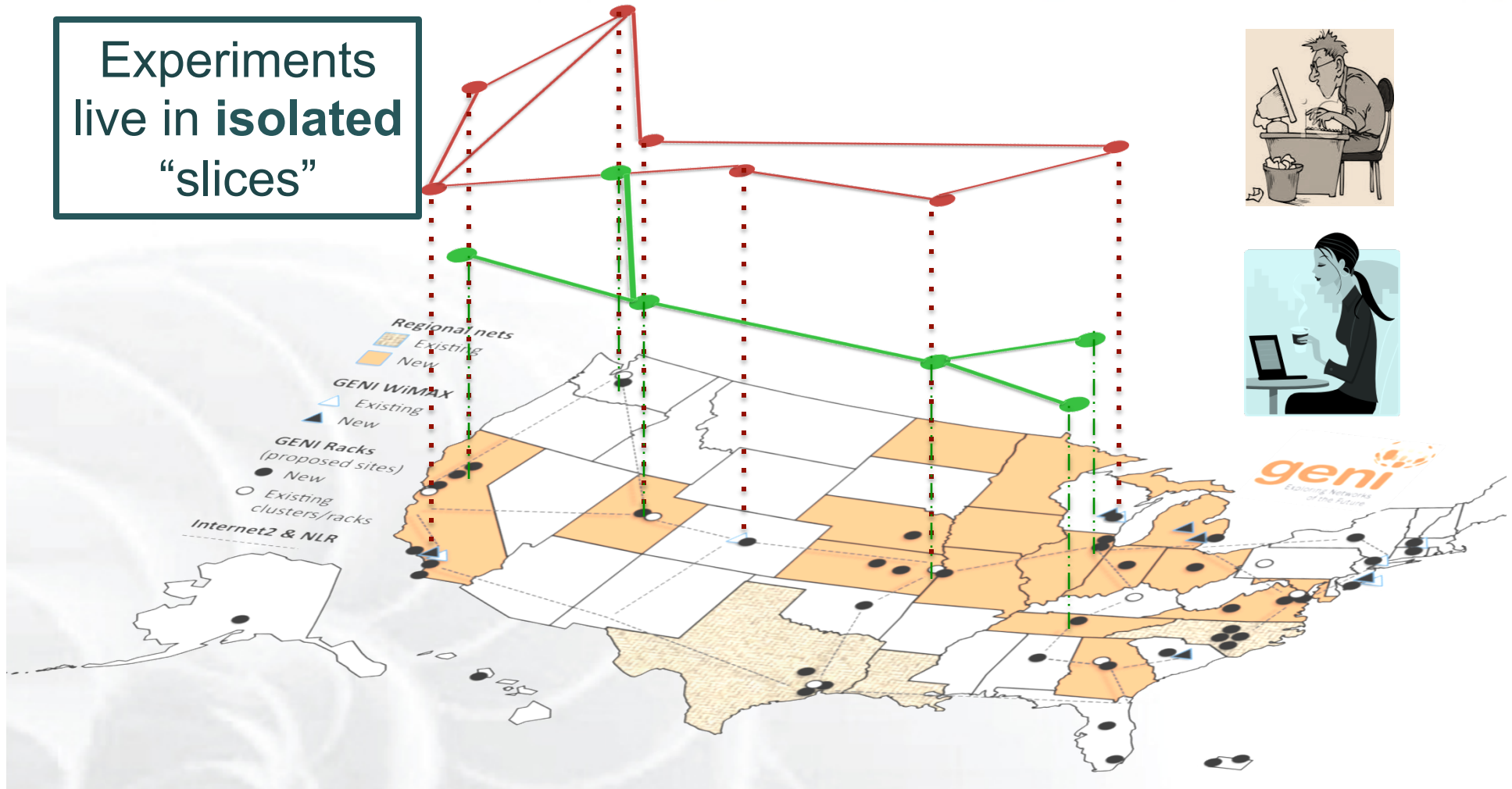


GENI provides compute resources that can be connected in experimenter specified Layer 2 topologies.



Multiple GENI Experiments run Concurrently

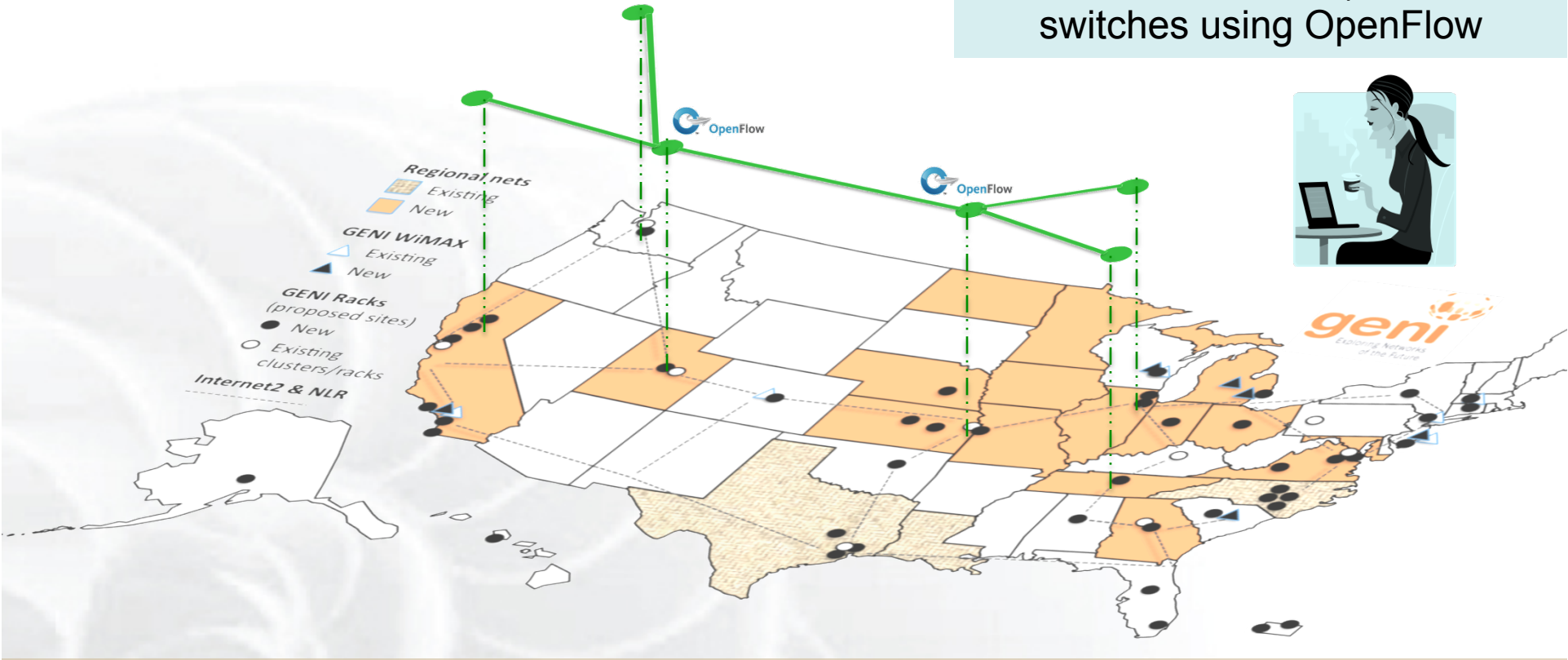
Experiments live in isolated "slices"



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

What is GENI?

How is GENI being used?

Key GENI Concepts

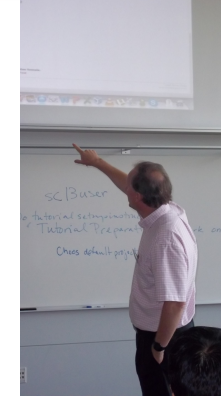
Demo: A simple experiment using GENI

How is GENI being Used?



Research

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

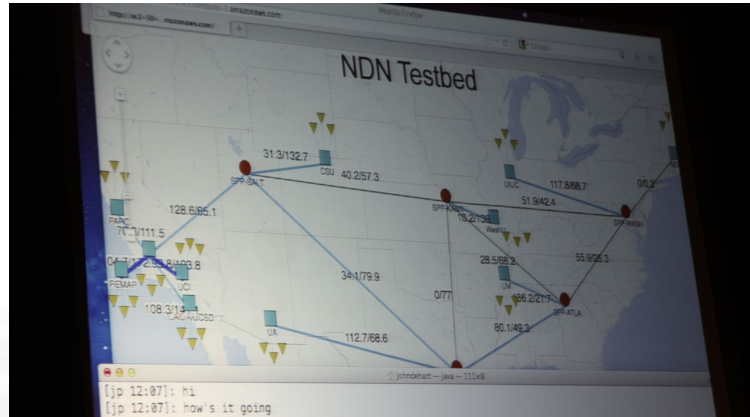


Education

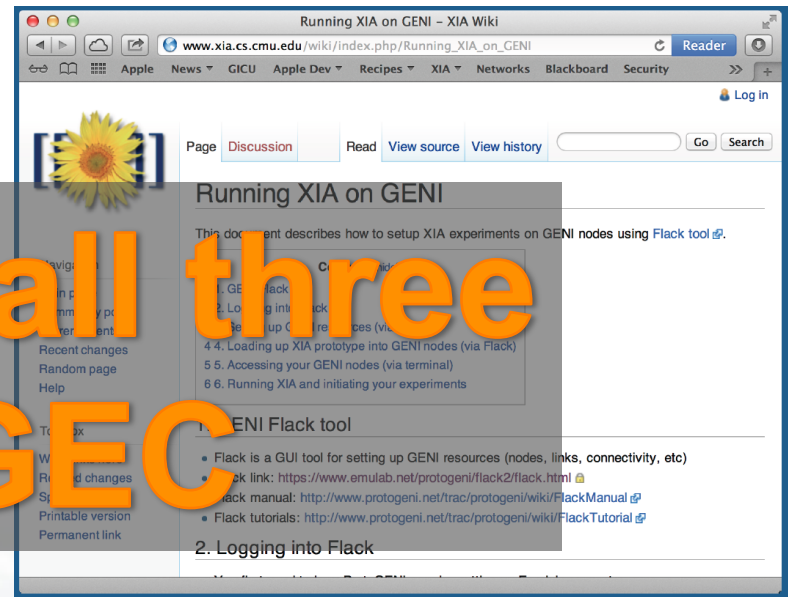
- Networking and Distributed systems classes
- Cloud computing classes
- WiMAX classes

As of October 2014, GENI has over 2700 users!

Three FIA Teams have Slices on GENI



NDN (demo at GEC 13)



XIA (demo at GEC15)



MobilityFirst (demo at GEC 12, GEC18, GEC20)

GENI is a unique testbed that can support all of these teams

Over 50 classes using GENI

- Undergrad level
- Graduate level
- Used Internationally

Ready-to-use tutorials assignments

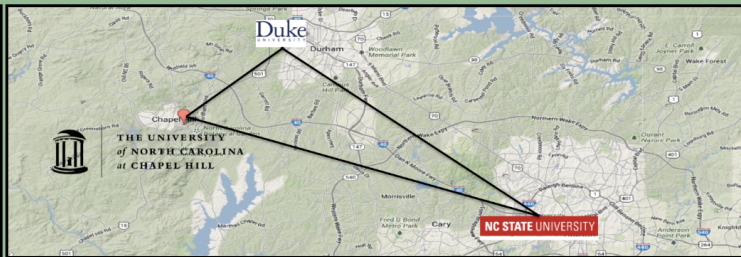
- Teach how to use GENI
- Teach networking concepts
- Teach distributed computing concepts
- Teach programmable networks



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

GENI at Conferences and Workshops

The 22nd IEEE International Conference on Network Protocols



October 21-24, 2014

The Research Triangle, North Carolina



October 24th 2014

- 6 long papers, 4 short
- Live demos for most papers

KEEP CONNECTED



SIGCESE 2015
KANSAS CITY

KEEP COMMITTED



KEEP COMPUTING

SIGCESE 2015
March 4 – 7

GENI Pre-symposium
event on Education

November 6-7 2014

In depth overview of GENI Functionality for

- researchers
- educators

INTRODUCTION TO GENI WORKSHOP

MORGAN STATE UNIVERSITY
BALTIMORE, MD
NOVEMBER 6-7, 2014

What is GENI?

How is GENI being used?

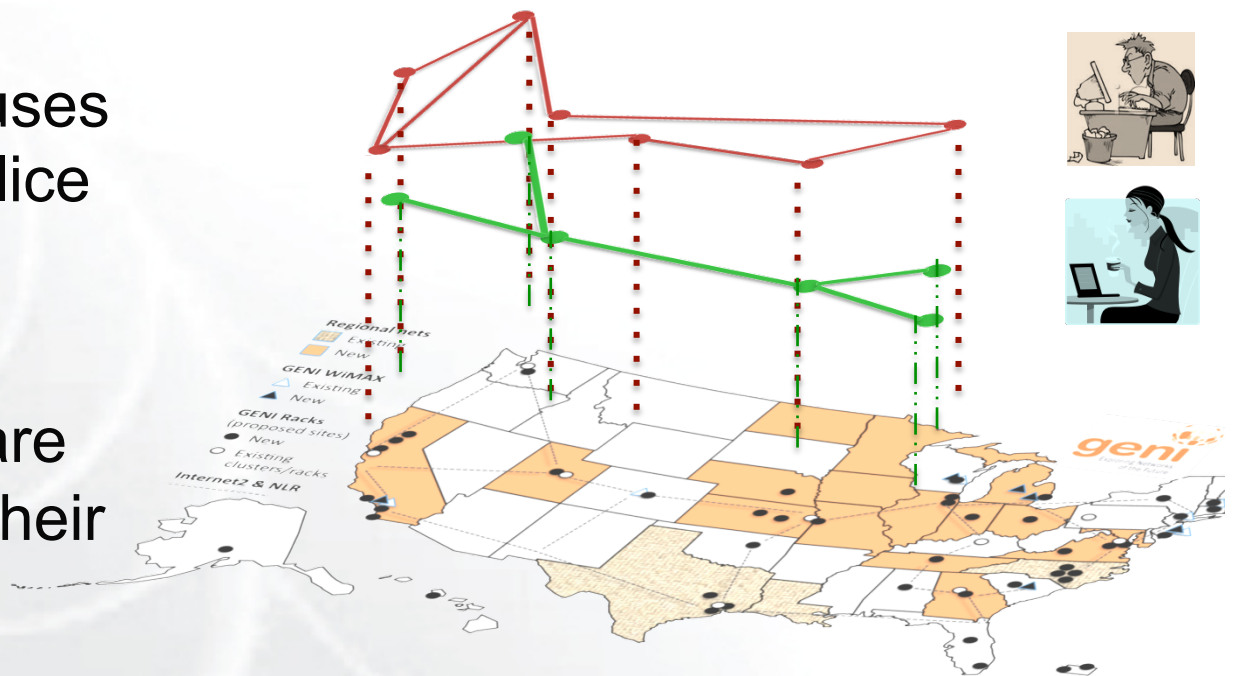
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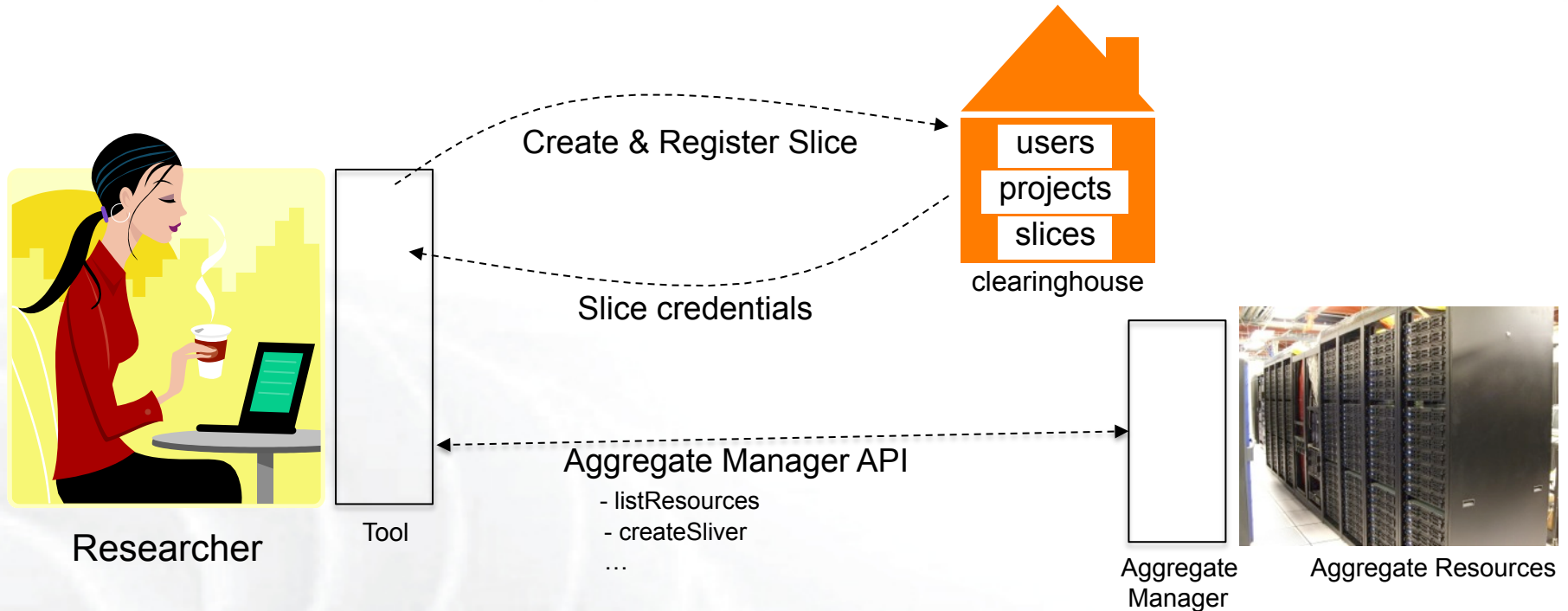
Demo: A simple experiment using GENI

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

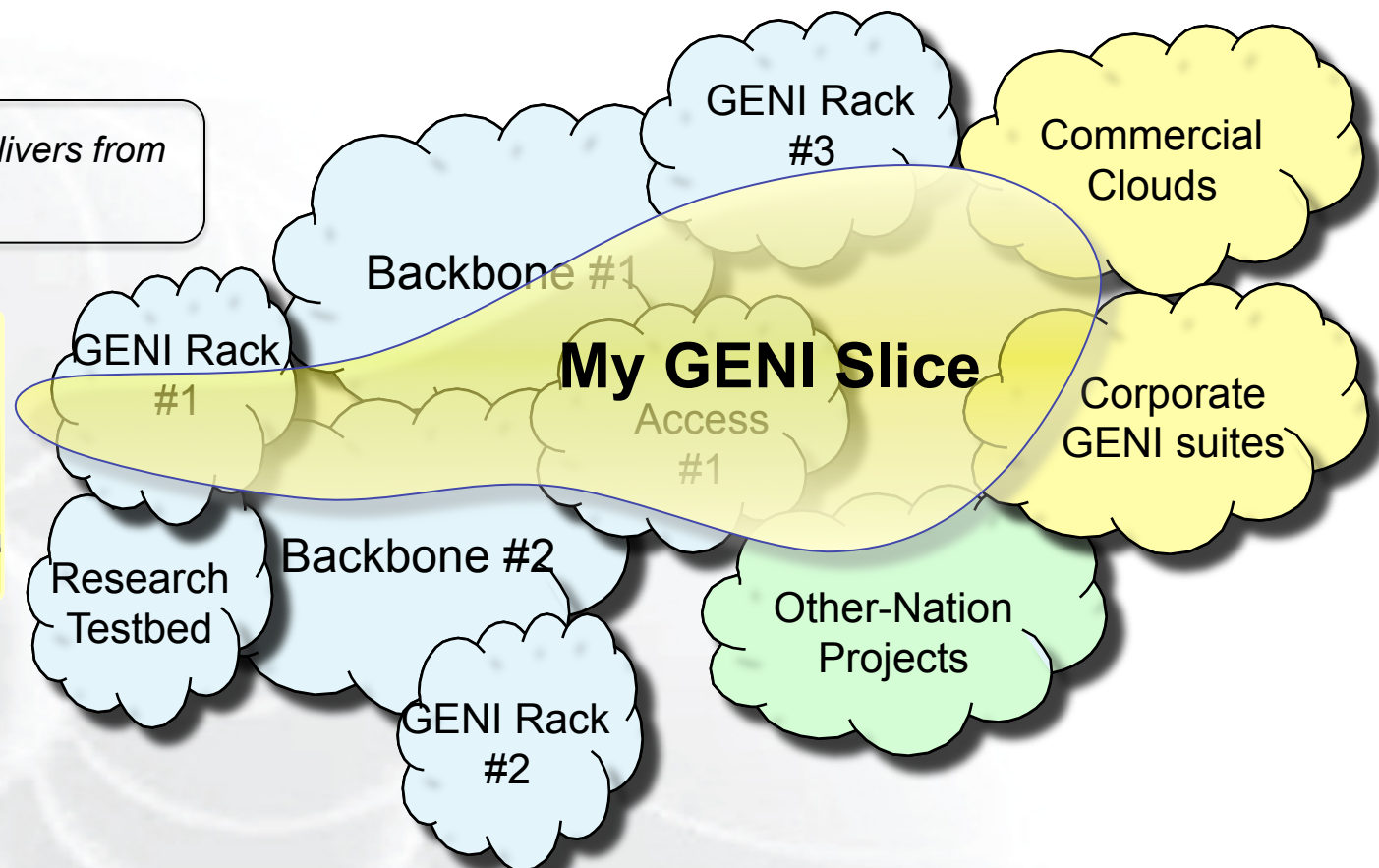
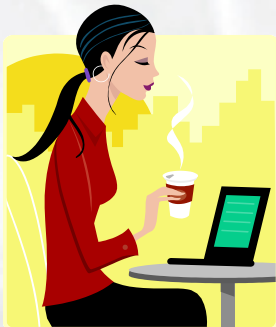




- **Clearinghouse: Manages users, projects and slices**
 - Standard credentials shared via custom API or new Common CH API
 - GENI supported accounts: GENI Portal/CH, PlanetLab CH, ProtoGENI CH
- **Aggregate: Provides resources to GENI experimenters**
 - Typically owned and managed by an organization
 - Speaks the GENI AM API
 - Examples: PlanetLab, Emulab, GENI Racks on various campuses

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

My slice contains slivers from many aggregates.

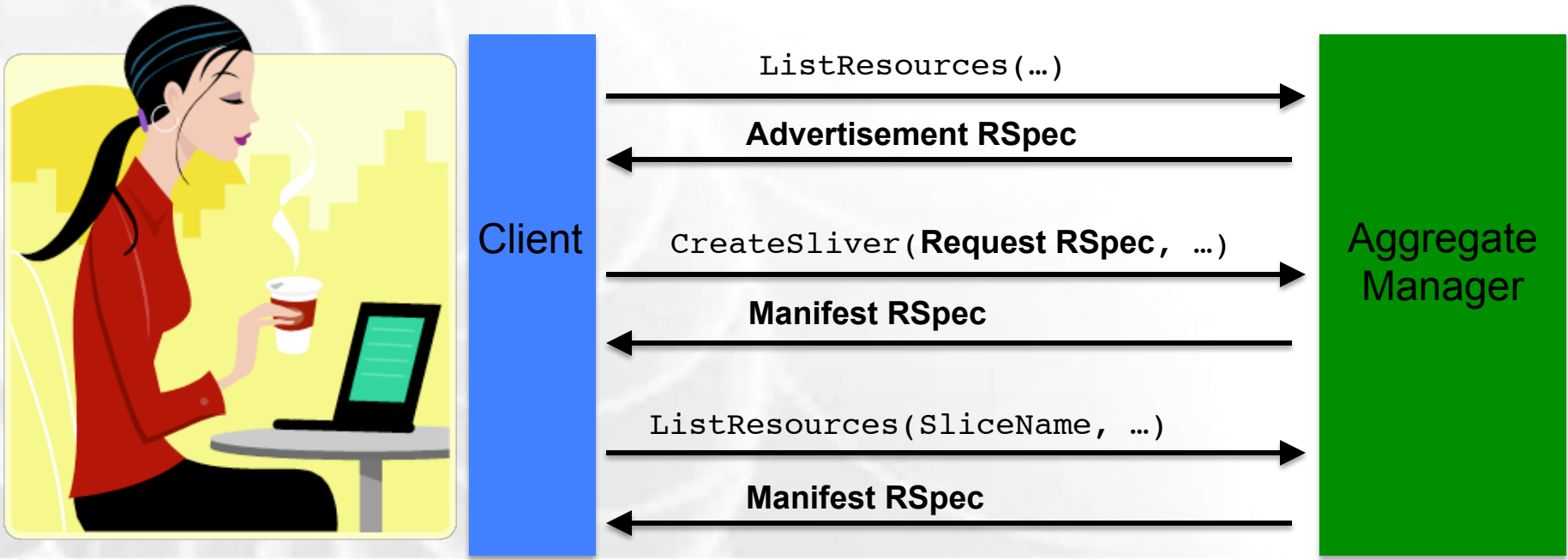


- RSpecs: Lingua franca for describing and requesting resources
 - “Machine language” for negotiating resources between experiment and aggregate
 - Experimenter tools eliminate the need for most experimenters to write or read RSpec

```
<?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?



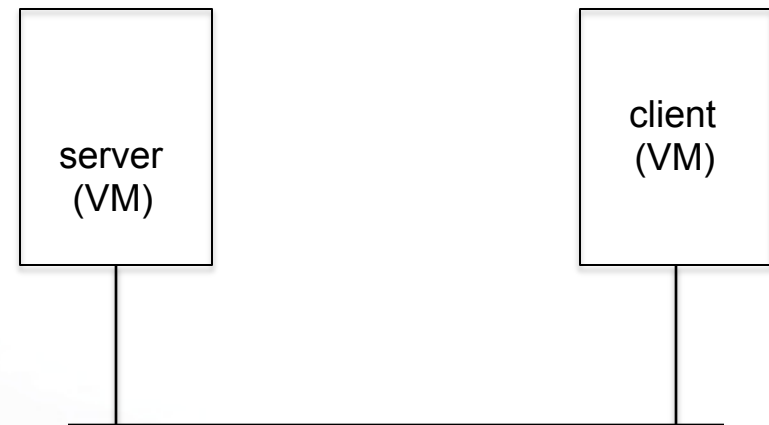
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How is GENI being used?

Key GENI Concepts

Demo: A simple experiment using GENI

- 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: Jacks





- Sign Up for :
geni-users@googlegroups.com
- Use #geni IRC chatroom
- HowTo pages on the GENI Wiki

<http://groups.geni.net/geni/wiki/GENIExperimenter/GetHelp>

- **geni-announce**
 - GENI news and events
- **Experimenters**
 - Announcements of interest to GENI experimenters
- **Experimenter-ops**
 - Announcements about infrastructure maintenance

Full list at:

<http://groups.geni.net/geni/wiki/GENICommunicationChannels>

Have a question?

Answer is

help@geni.net

which is an email list which only goes to members of the GPO including...



Sarah Edwards



Niky Riga

(However, the archive of the list is public)



Vic Thomas

GEC21 Recommendations for Newcomers

Newcomers Day - Mon Oct 20		General Sessions 1 - Tue Oct 21				General Sessions 2 - Wed Oct 22				Developer Day - Thu Oct 23									
Frangipani	Oak	Frangipani	Dogwood	Oak	Walnut	Frangipani	Dogwood	Oak	Walnut	Oak	Walnut	Walnut							
Registration + Breakfast		An Overview of GENI (8am - 9.15am) Frangipani		Breakfast (7.30am - 9.30am) Solarium		Architects Meeting - By invitation (8am - 9.15am) Walnut		Breakfast (7.30am - 8.30am) / Newcomers B'fast Solarium				Breakfast (7.30am - 9am) Solarium							
An Introduction to GENI and Experimentation using GENI (9am - 10am) Frangipani		Lightning Talks (9.30am) Solarium		Break (10am - 10.30am)		Plenary (8.30am - 11am) Alumni Hall				Developer Roundtable (9am - 10.30am) Oak	Expt Support Office Hours Walnut	Operations & Monitoring Office Hours Walnut							
Break (10am - 10.15am)		Tutorial: Getting Started with GENI - Part 1 (10.15-11.30am) Frangipani		Tutorial: Getting Started with GENI - Part 1 (10.15-11.30am) Oak		Tutorial: Intro to the XIA Future Internet Architecture protocol suite* (10.30am - 12.30pm) Frangipani		Tutorial: Orchestration, Instrumentation and Execution using LabWiki# (10.30am - 12.30pm) Dogwood		GENI in Education (10.30am - noon) Oak		Tutorial: Wireless Experiments using the iMinds w-Lab.t testbed (10.30am - 12.30pm) Walnut		Break (10.30am - 11am)					
Intro to the GENI Network Architecture (11.30am - 12.30pm) Frangipani		Break (11am - 11.30am)		Intro to GENI Network Architecture (11.30am - 12.30pm) Frangipani		Introduction to OpenFlow Architecture (repeat of Tue 3.30pm) Dogwood		GENI Meta Operations Center Live! (11.30am) Oak		WiMAX Developers Meeting (11.30am) Walnut		Developer Roundtable (11am - 12.30pm) Oak							
Lunch (12.30pm - 1.30pm) Solarium		Lunch (12.30pm - 1.30pm) Solarium		Lunch (12.30pm - 1.30pm) Solarium		Lunch (12.30pm - 1.30pm) Solarium		Boxed Lunch (12.30pm - 1pm)											
Tutorial: Getting Started with GENI - Part 2 (1.30pm - 3pm) Frangipani		Tutorial: Getting Started with GENI - Part 2 (1.30pm - 3pm) Oak		Tutorial: Intro to the ChoiceNet Future Internet Architecture * (1.30pm) Frangipani		Tutorial: Further experiment development using OEDL# (1.30pm) Dogwood		Experimenter-Developer Roundtable (1.30pm - 3pm) Oak		Tutorial: Introduction to GENI WiMAX (1.30pm - 3pm) Walnut		Tutorial: Intro to the NDN Future Internet Network Architecture * (1.30pm - 3.30pm) Frangipani		Tutorial: Programming GENI OF Resources and Stitching (1.30pm - 3.30pm) Dogwood		Tutorial: GENI Desktop (1.30pm - 3.30pm) Oak		GENI Operations (1.30pm - 3.30pm) Walnut	
Break 3pm - 3.30pm		Break (3pm - 3.30pm)		Tutorial: Advanced ChoiceNet* (3.30pm - 5pm) Frangipani		Tutorial: Intro to the MobilityFirst FIA protocol suite* (3.30pm - 5pm) Dogwood		Intro to OpenFlow (repeated Wed @ 11.30am) Oak		Tutorial: Learn to Deploy 3rd Party Svcs on Home WiFi routers (3.30pm) Walnut		Break (3.30pm - 4pm)		Tutorial: Scripting experiments with genilib# (4pm - 5.30pm) Frangipani		Tutorial: Scaling up experiment s# (4pm - 5.30pm) Dogwood		Developer Drop-in (4pm - 5.30pm) Walnut	
Tutorial: Getting Started with GENI - Part 3: Work on your own on assigned exercises (3.30pm - 5.30pm) Frangipani		Adjourn 5pm		Adjourn 5pm		Adjourn 5pm		Adjourn 5pm		BoF Dinners									
Newcomers BoF Dinners		Poster/Demo Session (5.30pm - 7.30pm) Cyberinfrastructure Building		BoF Dinners		BoF Dinners		BoF Dinners											

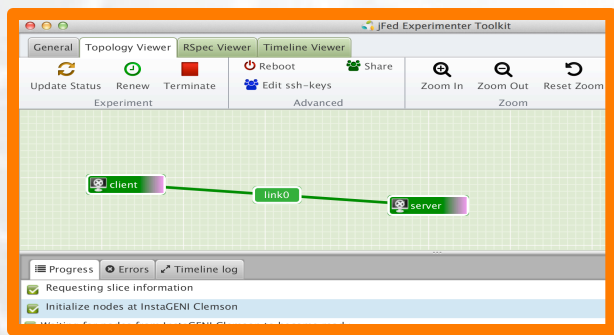
Legend	
	General interest
	Experimenter targeted
	Developer targeted
	Experimenter and developer targeted
	Campus IT/Rack administrator targeted
	Recommended for newcomers
	Hands-on Tutorial; Bring a laptop if you want to do the hands-on exercises
*	Session topics relate to theme Future Internet Architectures (FIA)
#	Session topics relate to theme Scripting Experiments



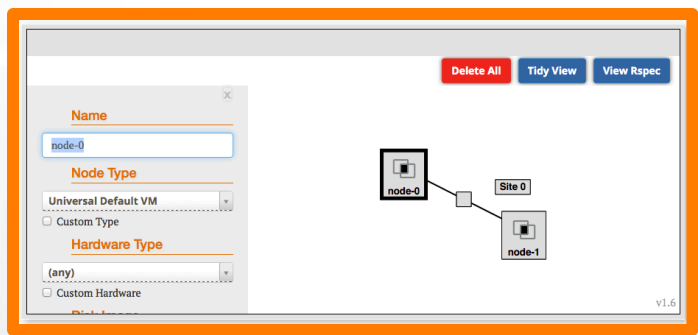
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Two tracks

- different graphical tools
- online instructions
- use for reservation throughout the conference
- Common session in Frangipani
- BOF Dinner, who's coming?



jFed



Jacks

QUESTIONS?