Outline

What is GENI?
How is GENI being used?
Key GENI Concepts
Demo: A simple experiment using GENI
GENI provides compute resources that can be connected in experimenter specified Layer 2 topologies.
GENI Compute Resources

GENI Racks

GENI Wireless compute nodes

Existing Testbeds

- Emulab
- Planetlab
- ORBIT
GENI Networking Resources

Networking within a Rack

National Research Backbones (e.g. Internet2)

Regional Networks (e.g. CENIC)

4G/3G GENI network

WiMAX Base Stations

GENI Networking Resources

GENI Introduction – 05 November 2014

Sponsored by the National Science Foundation
• 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
Creating and deploying GENI racks

Ilia Baldine
RENCI
More resources / rack, fewer racks

Rick McGeer
HP Labs
Fewer resources / rack, more racks

Rajesh Narayanan
DELL

KC Wang
Clemson
Latest addition
• 26 WiMAX Base Stations in 13 Sites
• 90 android handsets available to experimenters

• Sliced, virtualized and interconnected through Internet2
GENI: Infrastructure for Experimentation

GENI provides compute resources that can be connected in experimenter specified Layer 2 topologies.
Multiple GENI Experiments run Concurrently

Resources in a slice may be virtualized

Experiments live in isolated 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 2014, GENI has over 2700 users!
Four FIA Teams have Slices on GENI

GENI is the only testbed that can support these teams.
Growing use of GENI in the Classroom!

Over 50 classes have used 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

Train-the-TA tutorials
- Start of each semester
- Taught over WebEx

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

- **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

- **Create & Register Slice**
  - Tool
  - Aggregate Manager API
    - listResources
    - createSliver
  - Slice credentials
  - Clearinghouse: Manages users, projects and slices
  - Aggregate: Provides resources to GENI experimenters
• A slice: One or more resources provided by an aggregate
  – E.g. Bare machines, virtual machines, VLANs

My slice contains slivers from many aggregates.
Resource Specifications (RSpecs)

• **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
<?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
Resource Reservation using RSpecs and the AM API

- 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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Putting it all Together: Demo

• 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: jFed
Upcoming Events

GENI Winter Camp
University of Connecticut
13 – 17 January 2015
http://groups.geni.net/geni/wiki/APRAGENI/GREE–WC2015

Travel grants available!
Apply by: 21 November 2014

GENI in Education
Pre-symposium event at SIGCSE 2015
Kansas City, Missouri
4-7 March 2015
GENI Engineering Conferences
We welcome your participation in GENI

• 22\textsuperscript{nd} meeting, open to all:
  March 23-26, 2015, \textbf{Washington, DC}
  – Planning & discussion for experimenters, software, infrastructure
  – Tutorials and workshops
  – \textbf{Travel grants} to US academics for participant diversity
Ways to Get Help

• 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
Other Important Lists

• 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  
Vic Thomas

(However, the archive of the list is public)
QUESTIONS?