

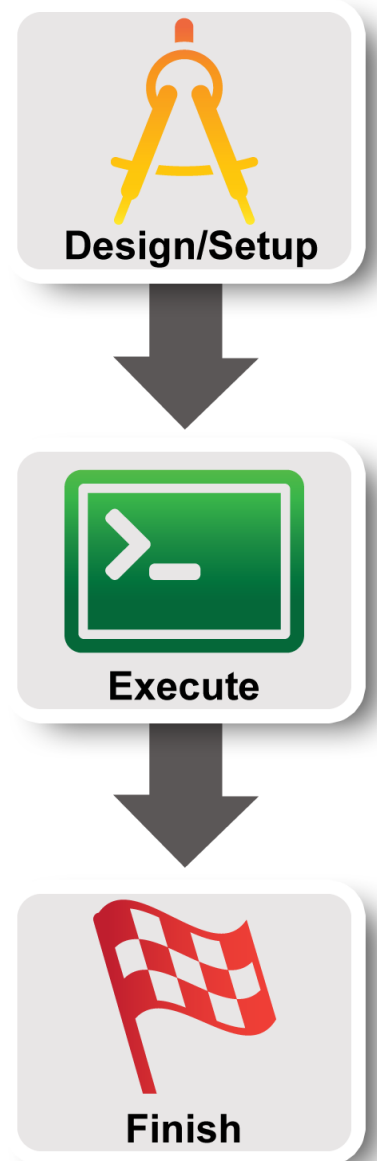
# Are you ready for the tutorial?

1. Sign In
2. Grab a Worksheet
3. Did you do the pre-work?
  - A. Are you able to login to the GENI Portal?
    - Using your home institution username and password, or
    - Using a GPO issued username and password, or
    - A temporary account
  - B. Have the VM including both:
    - Installing VirtualBox
    - Importing VM image

GENI Portal is at:

<http://panther.gpolab.bbn.com>

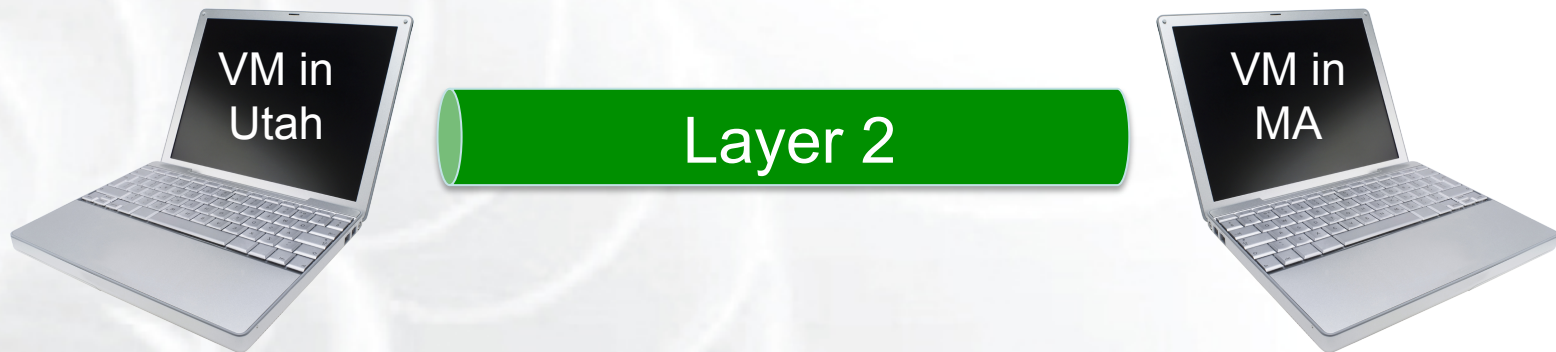
# Tutorial: Getting Started with GENI Using the GENI Portal



# Hands On Exercise

## Do a Simple Layer 2 Experiment in GENI

Reserve two VMs across the US from each other connected by a Layer 2 circuit



# Understand GENI Terminology

**slice**

**project**

**experimenter**

**resource**

**aggregate**

# Use the GENI Portal



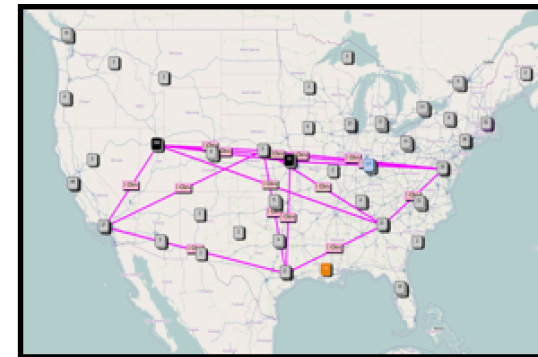
## Welcome to GENI

GENI is a new, nationwide suite of infrastructure supporting "at scale" research in networking, distributed systems, security, and novel applications. It is supported by the National Science Foundation, and available without charge for research and classroom use.

Use GENI

### Find out more about using GENI

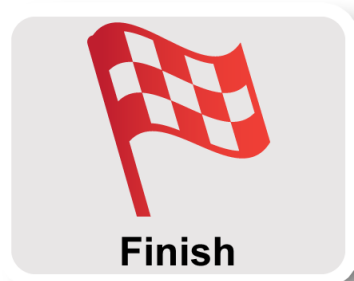
- Information for GENI experimenters
- Published research that used GENI resources
- Get help using GENI



These are some of the many resources being used in GENI experiments across the country.

*GENI is sponsored by the*  *National Science Foundation*

# Experiment Workflow



- Part I: Design/Setup
  - Step 1: Establish Management Environment
  - Step 2: Obtain Resources
- Part II: Execute
  - Execute Experiment
- Part III: Finish
  - Teardown Experiment

# The GENI Portal is...

Use GENI

A web-based tool for experimenters to manage **experimenters, projects, and slices.**

Includes simple tools to reserve **resources.**

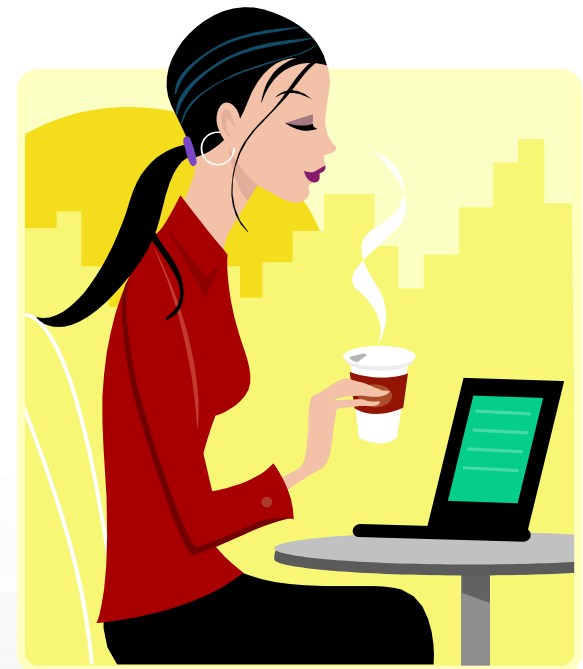
More to come in the future.

# Experimenter

An **experimenter** is a researcher who uses GENI resources

Different types of experimenters have different roles and permissions:

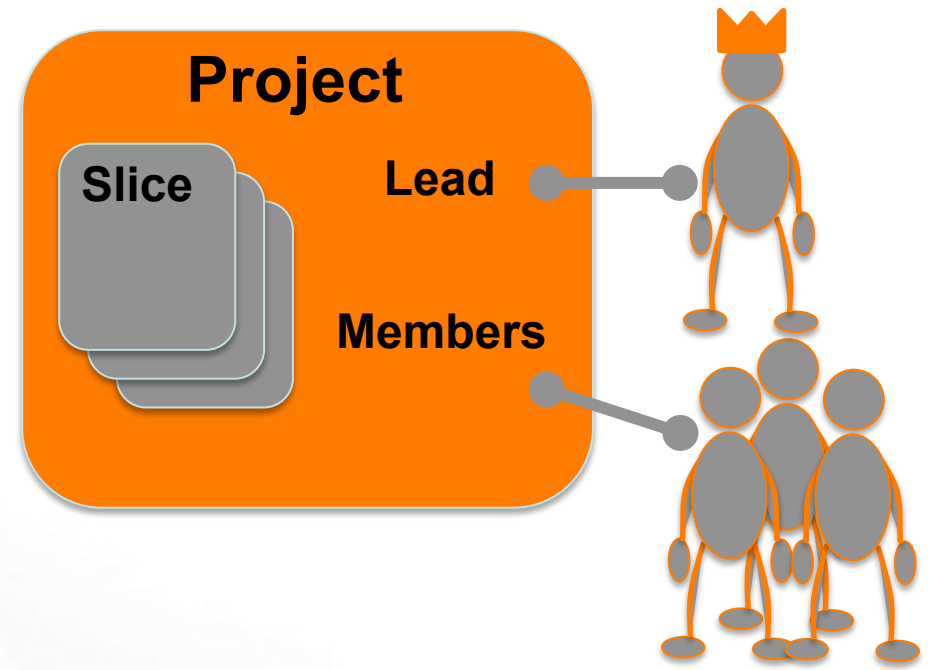
- Advisor vs Grad Student
- Teacher vs TA vs Student



# Experimenter



## Projects organize research in GENI



Projects contain both **people** and their **experiments**

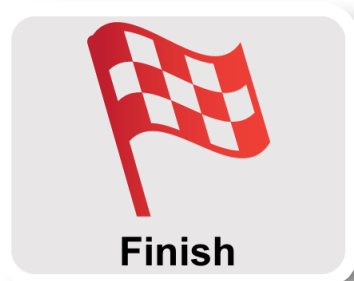
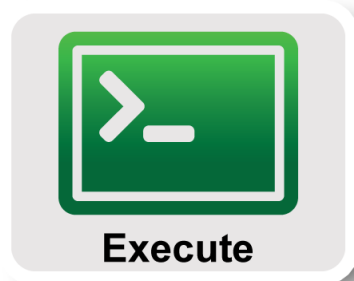
A project is led by a single responsible individual:  
the **project lead**

# Creating Projects

- Only project **leads** can create projects.
- Project **names** are ***public, unique*** and ***permanent***
- A project may contain many experimenters; an experimenter may be a member of many projects
- Projects have an optional **expiration** (e.g. for classes, tutorials)

**For today's tutorial we will all join a project which expires on Friday**

# Experiment Workflow



- **Part I: Design/Setup**
  - Step 1: Establish Management Environment
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  - Teardown Experiment

# Part I: Step 1: Establish Management Environment

Use GENI

1. Pre-work: Login to the Portal
2. Generate and Download SSH Keypair
3. Join a Project

**Project Name:** *See your worksheet*

Tutorial instructions:

<http://groups.geni.net/geni/wiki/GENIExperimenter/Tutorials/PortalSimpleLayer2Example>

# Creating a GENI account

- GENI Portal is at:

**<https://panther.gpolab.bbn.com>**

- Anyone with an account at a supported identity provider (usually your school or employer) can log in, but they will have no privileges
- If you don't have such an account, we will make you an account at the GPO Identity Provider
- You must be a member of a project to do anything interesting

Leverage InCommon for  
single sign-on authentication



Experimenters from 288  
educational and research  
institutions have  
InCommon accounts

For many experimenters:

- no new passwords
- familiar login screens





## Projects

### My Projects

**Congratulations! Your GENI Portal account is now active.**

**You can now participate in GENI research, by joining a 'Project'. Note that your account is not a 'Project Lead' account, meaning you must join a project created by someone else, before you can create slices or use GENI resources.**

**A project is a group of people and their research, led by a single responsible individual - the project lead. See the [Glossary](#).**

**You are not a member of any projects. Please join an existing Project, ask someone to create a Project for you, or ask to be a Project Lead.**

[Join a Project](#)

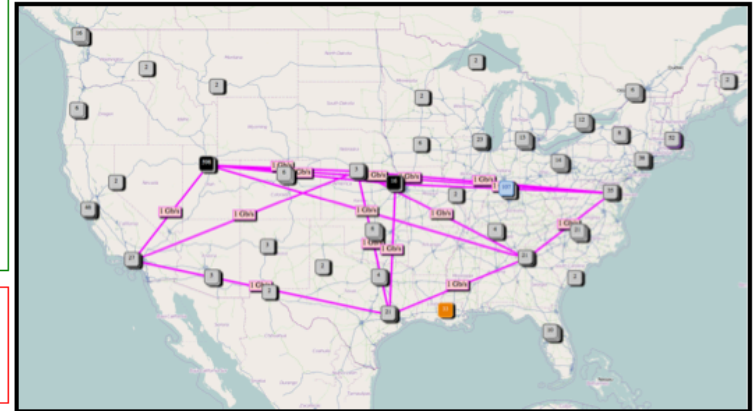
[Ask Someone to Create a Project](#)

[Ask to be a Project Lead](#)

*No projects.*

*No outstanding project join requests by you.*

### GENI Resources



## Slices

### My Slices

*You do not have access to any slices.*

## Log Messages

### GENI Messages

2013-03-11 21:09:58 UTC	sergyar.mbrinn Registering SSH key "Generated SSH keypair"
2013-03-11 21:03:28 UTC	Canceled join request: Marshall Brinn in project P1
2013-02-26 16:02:23 UTC	Marshall Brinn requested to join project P1
2013-02-26 16:02:07 UTC	sergyar.km authorizing client sergyar.portal
2013-02-26 16:02:05 UTC	Activated GENI account for mbrinn@geni.net

[Invite Someone to GENI](#)



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[Join a Project](#)

[Ask Someone to Create a Project](#)

[Ask to be a Project Lead](#)

No projects.

No outstanding project join requests by you.

## My Slices

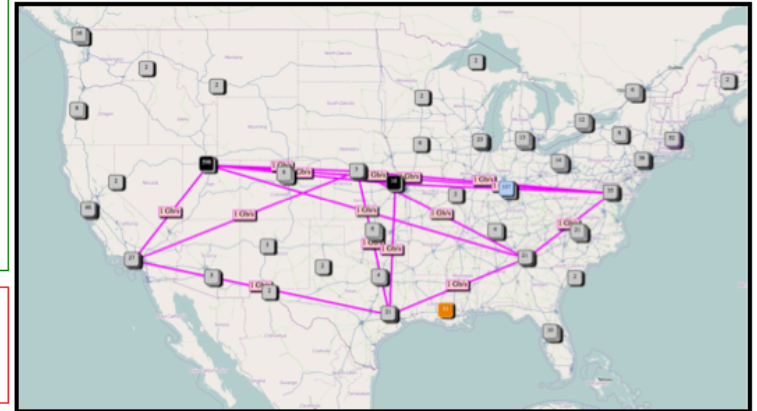
You do not have access to any slices.

## GENI Messages

2013-03-11 21:09:58 UTC	sergyar.mbrinn Registering SSH key "Generated SSH keypair"
2013-03-11 21:03:28 UTC	Canceled join request: Marshall Brinn in project P1
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2013-02-26 16:02:05 UTC	Activated GENI account for mbrinn@geni.net

[Invite Someone to GENI](#)

## GENI Resources





In your local VM ...

```
> mv ~/Downloads/id_geni_ssh_rsa ~/.ssh/.  
> chmod 600 ~/.ssh/id_geni_ssh_rsa  
> ssh-add ~/.ssh/id_geni_ssh_rsa
```

## My Projects

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[Join a Project](#)

[Ask Someone to Create a Project](#)

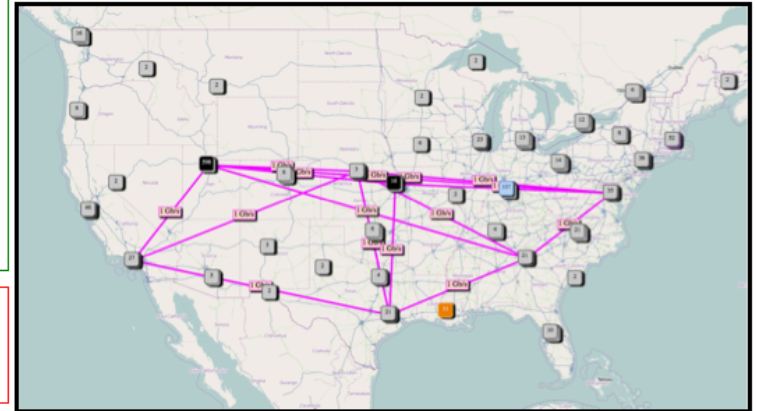
[Ask to be a Project Lead](#)

No projects.

No outstanding project join requests by you.

**Join a Project  
Name on worksheet**

## GENI Resources



## My Slices

You do not have access to any slices.

## GENI Messages

2013-03-11 21:09:58 UTC	sergyar.mbrinn Registering SSH key "Generated SSH keypair"
2013-03-11 21:03:28 UTC	Canceled join request: Marshall Brinn in project P1
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[Invite Someone to GENI](#)

A **resource** is a piece of infrastructure

A resource can be real or virtual.

**Resource specifications** are used to describe and request resources.

Examples:

- Compute: computer vs virtual machine (VM)
- Wireline Network: VLAN or OpenFlow
- Wireless: WiMAX



# Aggregate

An **aggregate** manages a set of reservable **resources**

Aggregates include:

GENI racks

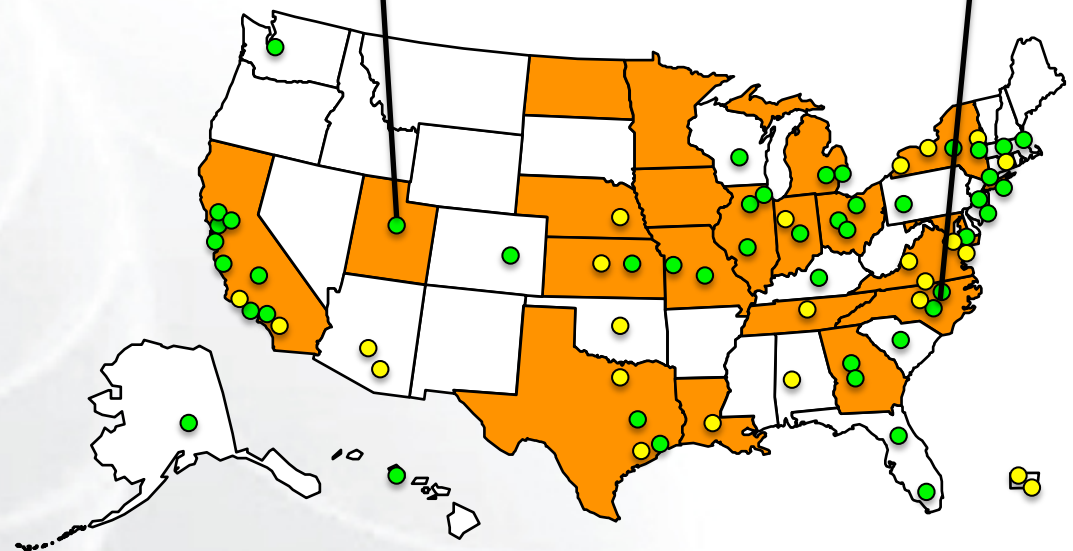
OpenFlow

WiMAX

InstaGENI Rack



ExoGENI Rack



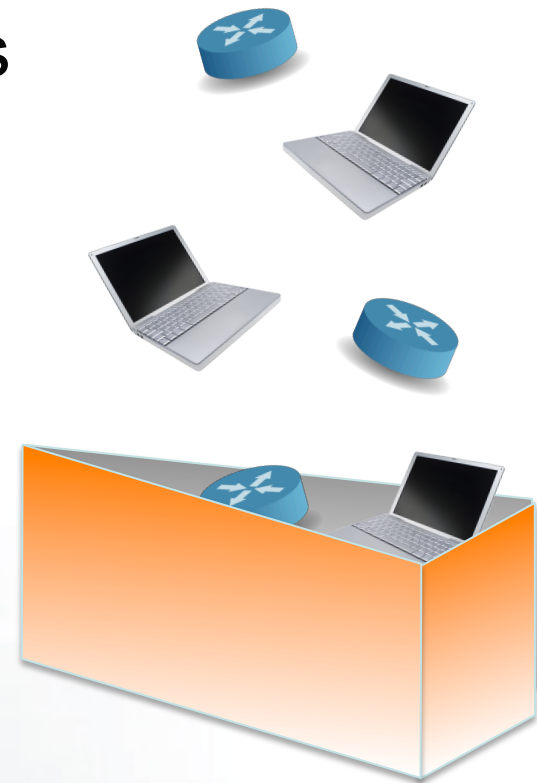
A **slice** is a *container* of resources used in an *experiment*.

A slice can contain resources from one or more aggregates

A slice is in a single project

A slice has an ***expiration***

Slice names are ***public, reusable*** and ***unique***



# Putting it all together

**project**

**Lead:**



**Experimenter**

**Member:**



**Experimenter**

**slice**

**aggregate**



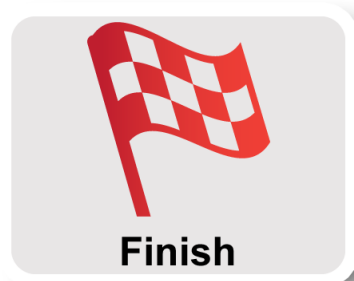
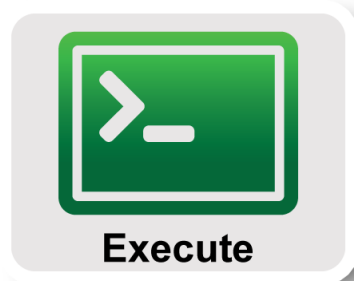
**Layer 2 VLAN**

**aggregate**





# Experiment Workflow



- **Part I: Design/Setup**
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## Part I: Step 2: Obtain Resources

**slice**



Layer 2 VLAN



1. Create a slice
2. Reserve VM at Two Aggregates
  - Utah InstaGENI
  - GPO InstaGENI
3. Check Whether VMs are Ready to be Used

*Wait for  
your turn*



# GENI Project: tutorial

## Project Actions

Create Slice Edit

Create Slice

## Project Identifiers (public)

Name	tutorial
Purpose	GEC16 tutorial prep
Expiration	None
Creation	2013-02-08 19:18:26 UTC

## Contact Information

Project e-mail	<a href="mailto:project-tutorial@example.com">project-tutorial@example.com</a>
Project Lead	<a href="#">Sarah Edwards e-mail</a>

## Project slices:

*You do not have access to any slices in this project.*

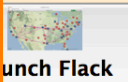
## Project members

Project Member	Roles
<a href="#">Sarah Edwards</a>	Lead

Invite new project members

# GENI Slice: portal01

Extend slice expiration  
Extend resource expiration

Slice Actions		Renew	
<b>Add Resources</b>	Resource Status	Details	Add Note
Delete Resources		2013-03-05 21:58:41 UTC <input type="button" value="Renew Slice"/>	
		2013-03-05 21:58:41 UTC <input type="button" value="Renew Resource Reservations"/>	
Tools		Ops Mgmt	
 Launch Flack	<input type="button" value="Use omni"/>	<input type="button" value="Disable Slice"/> <input type="button" value="Shutdown Slice"/>	

Add Resources

Confused? Look at the [Portal Help](#) or [GENI Glossary](#).

## Slice Status

Status	Aggregate	Renew	Actions
<input type="button" value="Get All"/>			
<b>READY</b>			
<input type="button" value="Get Status"/>	GPO InstaGENI	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
no resources	Kentucky ProtoGENI	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
<input type="button" value="Get Status"/>			
no resources	ExoGENI ExoSM	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
<input type="button" value="Get Status"/>			
<b>READY</b>			
<input type="button" value="Get Status"/>	Utah InstaGENI	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
no resources	Utah ProtoGENI	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
<input type="button" value="Get Status"/>			
no resources	GPO ExoGENI	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
<input type="button" value="Get Status"/>			
no resources			

## Add resources to GENI Slice: portal01

Choose Resources:  or [upload your own Resource Specification \(RSpec\)](#).

Choose Aggregate:

**Add  
Resources at  
*Utah InstaGENI***

**Wait for  
your turn**

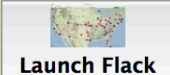
## Add resources to GENI Slice: portal01

Choose Resources:  or [upload your own Resource Specification \(RSpec\)](#).

Choose Aggregate:

**Add  
Resources at  
*GPO InstaGENI***

# GENI Slice: portal01

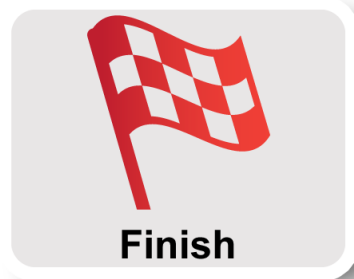
Slice Actions	Renew
<a href="#">Add Resources</a> <a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Add Note</a> <a href="#">Delete Resources</a>	2013-03-05 21:58:41 UTC <a href="#">Renew Slice</a>
	2013-03-05 21:58:41 UTC <a href="#">Renew Resource Reservations</a>
Tools	Ops Mgmt
 <a href="#">Use omni</a>	<a href="#">Disable Slice</a> <a href="#">Shutdown Slice</a>

Confused? Look at the [Portal Help](#) or [GENI Glossary](#).

## Slice Status

Status		Renew	Actions
<a href="#">Get All</a>			
READY	GPO InstaGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
<a href="#">Get Status</a>			
no resources	Kentucky ProtoGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
<a href="#">Get Status</a>			
no resources	ExoGENI ExoSM	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
<a href="#">Get Status</a>			
READY	Utah InstaGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
<a href="#">Get Status</a>			
no resources	Utah ProtoGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
<a href="#">Get Status</a>			
no resources	GPO ExoGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
<a href="#">Get Status</a>			
no resources	RENCI ExoGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
<a href="#">Get Status</a>			

# Experiment Workflow

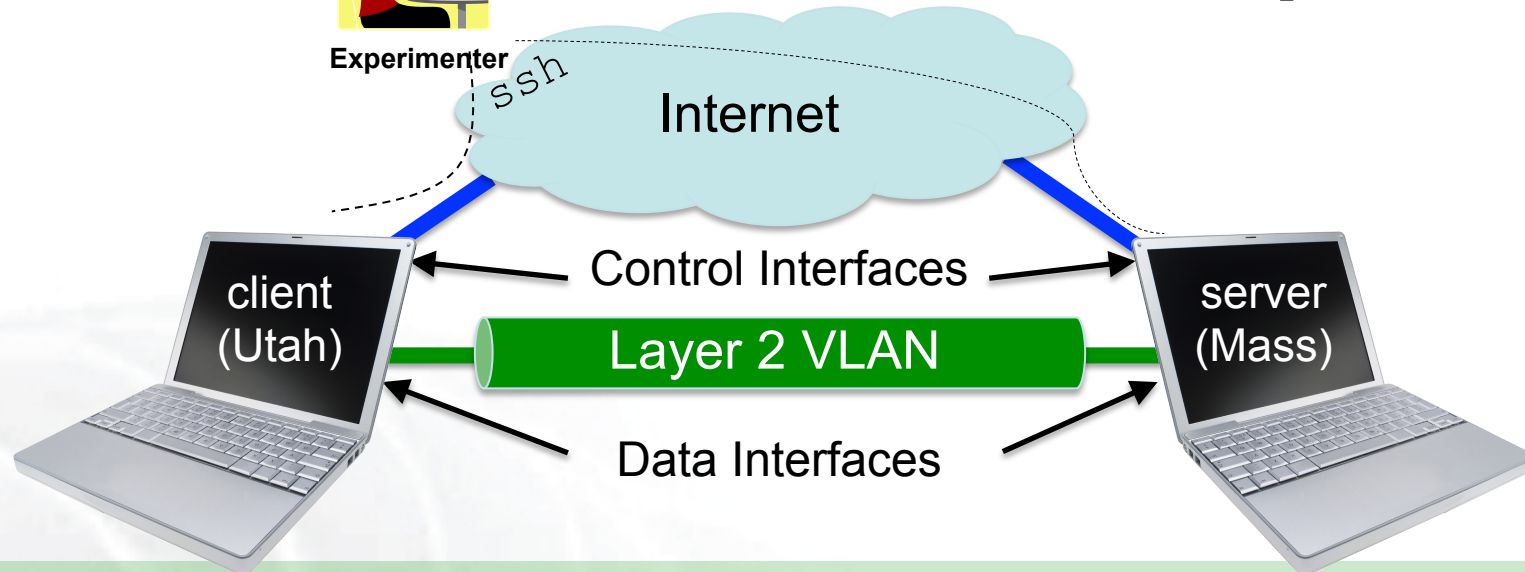


- **Part I: Design/Setup**
  - Step 1: Establish Management Environment
  - Step 2: Obtain Resources
- **Part II: Execute**
  - **Execute Experiment**
- **Part III: Finish**
  - Teardown Experiment




Experimenter

## Part II: Execute Experiment



1. Login to nodes (two nodes: client & server)
2. Run your experiment
  1. Send IP Traffic
  2. Disable IP
  3. Send Layer 2 (non-IP) Traffic
3. Logout of nodes

# GENI Slice: portal01

Slice Actions	Renew
<input type="button" value="Add Resources"/> <input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Add Note"/> <input type="button" value="Delete Resources"/>	2013-03-05 21:58:41 UTC <input type="button" value="Renew Slice"/>
	2013-03-05 21:58:41 UTC <input type="button" value="Renew Resource Reservations"/>
Tools	Ops Mgmt
 <input type="button" value="Launch Flack"/> <input type="button" value="Use omni"/>	<input type="button" value="Disable Slice"/> <input type="button" value="Shutdown Slice"/>

Confused? Look at the [Portal Help](#) or [GENI Glossary](#).

## Slice Status

Status	Aggregate	Renew	Actions
<input type="button" value="Get All"/>			
READY	GPO InstaGENI	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
<input type="button" value="Get Status"/>			
no resources	Kentucky ProtoGENI	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
<input type="button" value="Get Status"/>			
no resources	ExoGENI ExoSM	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
<input type="button" value="Get Status"/>			
READY	Utah InstaGENI	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
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<input type="button" value="Get Status"/>			
no resources	GPO ExoGENI	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
<input type="button" value="Get Status"/>			
no resources	RENCI ExoGENI	2013-03-05 21:58:41 UTC <input type="button" value="Renew"/>	<input type="button" value="Resource Status"/> <input type="button" value="Details"/> <input type="button" value="Delete Resources"/>
<input type="button" value="Get Status"/>			

Login

```
# login to "client" VM
```

```
> ssh username@hostname1 -p port1
```

```
$ /sbin/ifconfig
```



```
# login to "server" VM
```

```
> ssh username@hostname2 -p port2
```

```
$ /sbin/ifconfig
```





## Resources on slice: portal01

Aggregate **Utah InstaGENI's** Resources:

There are 1 node and 1 link at this aggregate.

Node #1

Client ID	Component ID	Exclusive	Type	Hostname
client	pc3	not exclusive	emulab-openvz	client.portal01.pantherlab.utah.geniracks.net
Login		<a href="#">ssh sedwards@pc3.utah.geniracks.net -p 31546</a>		
Interfaces		MAC	Layer 3	
client:if0	pc3:eth1	0237463003a4	ipv4: 10.10.10.1	

Link #1

Client ID	Endpoint #0
L2-ping-tutorial-0	client:if0

## Resources on slice: portal01

Aggregate **GPO InstaGENI's** Resources:

There are 1 node and 1 link at this aggregate.

Node #1

Client ID	Component ID	Exclusive	Type	Hostname
server	pc2	not exclusive	emulab-openvz	server.portal01.pantherlab.geni.gpolab.bbn.com
Login		<a href="#">ssh sedwards@pc2.instageni.gpolab.bbn.com -p 30778</a>		
Interfaces		MAC	Layer 3	
server:if0	pc2:eth1	029ee9eb3614	ipv4: 10.10.1.1	

Link #1

Client ID	Endpoint #0
L2-ping-tutorial-0	server:if0

```
$ /sbin/ifconfig
```



```
$ /sbin/ifconfig
```



# Worksheet

**Project Name:** <project name>

**Slice Name:** portal**01**

## Client

### Control Interface

Name eth \_\_\_\_  
IP Address \_\_\_\_ . \_\_\_\_ . \_\_\_\_ . \_\_\_\_

### Data Interface

Name mv \_\_\_\_ . \_\_\_\_  
Initial IP Addr 10 . \_\_\_\_ . \_\_\_\_ . \_\_\_\_  
Des IP Addr 10 . 11 . **1** . 1 /24

## Server

### Control Interface

Name eth \_\_\_\_  
IP Address \_\_\_\_ . \_\_\_\_ . \_\_\_\_ . \_\_\_\_

### Data Interface

Name mv \_\_\_\_ . \_\_\_\_  
Initial IP Addr 10 . \_\_\_\_ . \_\_\_\_ . \_\_\_\_  
Des IP Addr 10 . 11 . **1** . 2 /24  
MAC Address \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_

**EtherType:** 111**01**

```
# configure your IP
$ sudo /sbin/ifconfig
mv10.1 10.11.1.1/24
```

```
# should SUCCEED
$ ping 10.11.1.2 -c 5
```

```
# disable IP on your nodes
$ sudo /sbin/ifconfig
mv10.1 0.0.0.0
```

```
# should FAIL
$ ping 10.11.1.2 -c 5
```

```
# start L2 client
$ sudo /usr/local/bin/
pingPlus 01:02:03:04:05:06
mv10.1 11101
```

```
$ exit
```



```
# configure your IP
$ sudo /sbin/ifconfig
mv2.3 10.11.1.2/24
```

```
# disable IP on your nodes
$ sudo /sbin/ifconfig
mv2.3 0.0.0.0
```

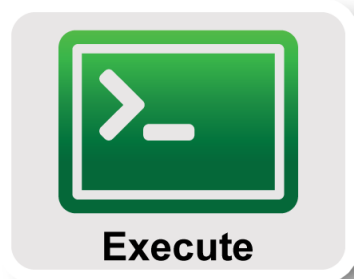
```
# start L2 server
$ sudo /usr/local/bin/
pingPlusListener 11101
```

```
$ exit
```



**Be  
careful!**

# Experiment Workflow



- **Part I: Design/Setup**
  - Step 1: Establish Management Environment
  - Step 2: Obtain Resources
- **Part II: Execute**
  - Execute Experiment
- **Part III: Finish**
  - Teardown Experiment

## Part III: Finish Experiment

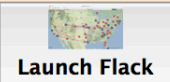
project resource  
experimenter  
aggregate



When your experiment is done, you should always release your resources.

- Normally this is when you would archive your data
- Delete your resources at **each** aggregate

# GENI Slice: portal01

Slice Actions	Renew
<a href="#">Add Resources</a> <a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Add Note</a> <a href="#">Delete Resources</a>	2013-03-05 21:58:41 UTC <a href="#">Renew Slice</a> 2013-03-05 21:58:41 UTC <a href="#">Renew Resource Reservations</a>
Tools	Ops Mgmt
 <a href="#">Use omni</a>	<a href="#">Disable Slice</a> <a href="#">Shutdown Slice</a>

Confused? Look at the [Portal Help](#) or [GENI Glossary](#).

## Slice Status

**Delete Resources** at both *GPO InstaGENI* and *Utah InstaGENI*

Status	Aggregate	Renew	Actions
<a href="#">Get All</a>			
<b>READY</b> <a href="#">Get Status</a>	GPO InstaGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
no resources <a href="#">Get Status</a>	Kentucky ProtoGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
no resources <a href="#">Get Status</a>	ExoGENI ExoSM	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
<b>READY</b> <a href="#">Get Status</a>	Utah InstaGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
no resources <a href="#">Get Status</a>	Utah ProtoGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
no resources <a href="#">Get Status</a>	GPO ExoGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>
no resources <a href="#">Get Status</a>	RENCI ExoGENI	2013-03-05 21:58:41 UTC <a href="#">Renew</a>	<a href="#">Resource Status</a> <a href="#">Details</a> <a href="#">Delete Resources</a>

# Congratulations!

You have...

- Run your first GENI Experiment!
- Exercised your knowledge of GENI terminology
- Used the GENI Portal



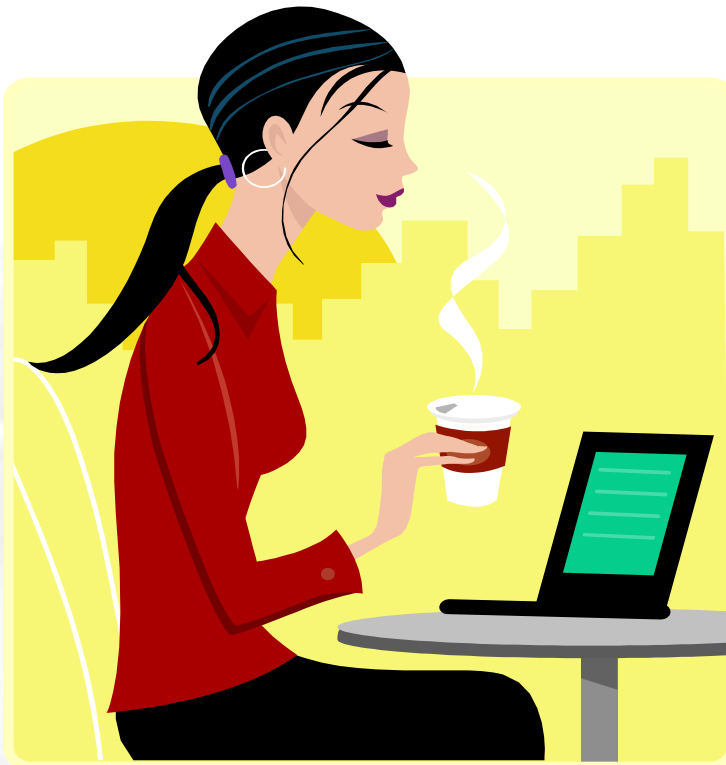
# What's Next?

- (If needed) Request a permanent account
- Are you a Professor or PI?
  - Ask to be a Project Lead so you can create projects
  - Invite students to join your project
- Are you a Student?
  - Ask your professor to create a project
  - Request to join that project

**Keep experimenting!**

# Learn about other tools

- Tools that are integrated with the Portal
  - Flack GUI is linked on each slice page
  - Omni command line tool (config linked on bottom of portal page)
- Get help
  - [help@geni.net](mailto:help@geni.net) (Niky Riga and Vic Thomas)



# Welcome to GENI!

## Don't forget to fill out the tutorial survey!