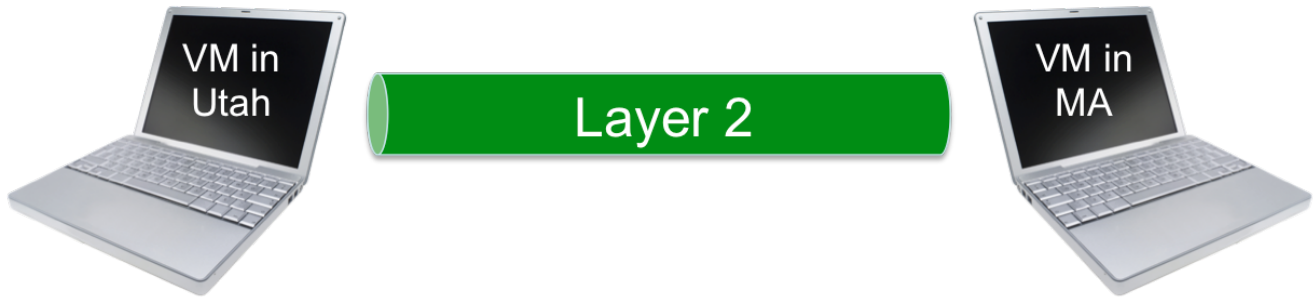


# Simple Layer 2 Experiment Using the GENI Portal

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## Experiment Description



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

Then send layer 2 traffic between these two nodes (without IP).

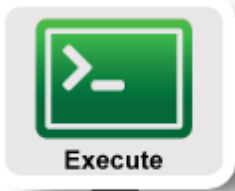
## Prerequisites

In order to participate in this tutorial you need to have an account at an [InCommon](#) institution or from the GPO. If you haven't done so before, please [sign in to the GENI Portal](#).

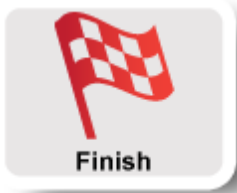
Make sure you know which institution will provide you access to GENI and the username and password you need to authenticate. If you don't know, please let us know.

It will be helpful for you to have access to your email.

## Tutorial Instructions



- Part I: Design/Setup
  - [Step 1: Establish Management Environment: Setup your GENI account and join a GENI Project](#)
  - [Step 2: Obtain Resources: Create a slice and reserve resources](#)
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- Part III: Finish
    - [Teardown Experiment: Delete Resources](#)
-

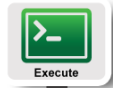
# Part I/Step 1: Establish Management Environment

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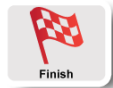
Introduction: [Getting Started with GENI using the GENI Portal](#)



- **Part I: Design/Setup**
  - **Step 1: Establish Management Environment: Setup your GENI account and join a GENI Project**
  - **Step 2: Obtain Resources: Create a slice and reserve resources**



- Part II: Execute
  - **Execute Experiment: Login to nodes and execute a simple layer 2 experiment**



- Part III: Finish
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## Instructions

### 1. Pre-work: Create a GENI account

1. Go to <https://panther.gpolab.bbn.com> and press the **Use GENI** button
2. From the Drop Down menu select your institution. If you got an account through the GENI Identity Provider, please select **GENI Project Office**. **Tip:** Start typing the name of your institution and see the list become smaller.
3. You will be transferred to the Login Page of your institution. Fill in your username and password.
4. Complete the form that appears after you have successfully logged in and press **Continue**.
5. You will be transferred to an **Activation Page**. Make sure both checkboxes are checked and then press **Activate**.

## GENI

Please sign in using your account at one of our partners:

Enter your college, university, or organization's name

GENI	Continue
<a href="#">GENI Project Office in a list</a>	<a href="#">Get Help</a>

No account? [Contact GENI Help](#)



Congratulations, you have successfully created a GENI account.

### 2. Generate and Download SSH Keypair

Access to compute resources in GENI is provide through ssh key pairs and thus the portal needs a public key to upload to compute resources. For the purposes of the tutorial we will have the portal create an SSH key pair for you. (However, if you prefer to use your personal public key you can choose to upload it.)

## About Me

### SSH Keys

No SSH keys have been uploaded. SSH keys are required to log in to reserved compute resources.

You can [generate and download an SSH keypair](#) or [upload an SSH public key](#), if you have one you want to use. If you're not sure what to do, choose 'Generate'.

3. Enter a passphrase twice, then press **Generate SSH private key**.

1. Once you are logged in, click on the *Profile* page.
2. On the *Profile* page in the *SSH Keys* section, select **generate and download an SSH keypair** button.

### Generate an SSH private key

SSH keys are required to log in to reserved compute resources.

On this page, you can generate a new SSH key pair. Please supply a new passphrase to protect your SSH private key (minimum 5 characters).

Passphrase:

Confirm Passphrase:

If you already have an SSH key pair that you want to use, you can instead [upload an SSH public key](#).

If you're not sure what to do, use this page to generate a new key pair.

## About Me

### SSH Keys

Name	Description	Private Key	Edit
id_geni_ssh_rsa	Generated SSH keypair	<input type="button" value="Download Private Key"/>	<input type="button" value="Edit"/>

*Note:* You will need your SSH private key on your local machine. If you generated your SSH keypair on this portal and have not already done so, be sure to Download your SSH key. After you download your key, be sure to set local permissions on that file appropriately. On Linux and Mac, do "chmod 0600 [path-to-SSH-private-key]". When you invoke SSH to log in to reserved resources, you will need to remember the path to that file. Your SSH command will be something like: "ssh -i path-to-SSH-key-you-downloaded [username]@[hostname]".

4. Now, press the **Download Private Key** button
5. Open a terminal and execute `chmod 600 ~/Downloads/id_geni_ssh_rsa` and then `ssh-add ~/Downloads/id_geni_ssh_rsa`. Later in the tutorial, this will allow you to log into your nodes securely without a password.

### 3. Join a Project

In order to use the portal to reserve resources, you must join a project. We have created a project for this tutorial.

1. Check your email, you should have an invitation to join a project for this tutorial.\*
2. Follow the instructions about joining the project.

Congratulations, you have joined a project!

\* If you are not doing this exercise as part of an in-person tutorial please sign up for a [GENI account](#) and join a project.

### Next: Obtain Resources

## Obtain Resources: create a slice and reserve resources

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- **Part I: Design/Setup**

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- **Part II: Execute**

- [Execute Experiment: Login to nodes and execute a simple layer 2 experiment](#)



- **Part III: Finish**

- [Teardown Experiment: Delete Resources](#)

## Instructions

Now that you are a member of a project, you can create a slice and reserve resources.

### 1. Create a slice

#### Create New Slice

Create a new Slice. A GENI slice is a container for reserving and managing a set of GENI resources.

Project name	tutorial
Slice name	portal01 -- Required
Slice description	

**Note: Slice name is public**

1. Go to the *Home* tab.
2. Press the **Create Slice** button for this project.
3. As a slice name use the slice name on your worksheet (the slice name should be of the form `portal##`), you can leave the description empty and press **Create Slice**

### 2. Reserve Virtual Machines at Two Aggregates

For this tutorial, we have manually reserved a VLAN (a layer 2 circuit) from a GENI rack in Utah to a GENI rack in Massachusetts.

Now reserve a virtual machine (VM) connected to each end of the manually configured VLAN.

**WARNING: In order to pace the creation of the VMs, please only reserve your two VMs when you are given a "blinking ball" by the tutorial instructor.**

First, reserve a VM on the Utah end of the VLAN. This node will be referred to as the "client".

#### Add resources to GENI Slice: portal01

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

Choose Aggregate:

1. Go to the *Slice* page and press the **Add Resources** button. Complete the form as shown in the picture on the left and press the **Reserve Resources** button. Reserving the node at the aggregate may take awhile (in excess of 30 seconds). Do not reload the page or press the back button while waiting.

Second, reserve a virtual machine connected to the Massachusetts end of the manually configured VLAN. This node will be referred to as the "server".

#### Add resources to GENI Slice: portal01

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

Choose Aggregate:

2. Go back to the *Slice* page and again press the **Add Resources** button. Complete the form as shown in the picture on the left and press the **Reserve Resources** button. Again, this may take awhile. Do not reload the page or press the back button while waiting.

### 3. Check Whether Virtual Machines are Ready to be Used

It takes some time for the VMs to boot. Check to see if they are up.

1. Return to the *Slice* page. Press the **Get All** button in the aggregate table.

### GENI Slice: portal01

Slice Actions					Renew		
Add Resources	Resource Status	Details	Add Note	Delete Resources	2013-03-05 21:58:41 UTC	Renew Slice	
					2013-03-05 21:58:41 UTC	Renew Resource Reservations	
Tools			Ops Mgmt				
Launch Flask	Use omni						Disable Slice   Shutdown Slice

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

#### Slice Status

Status Get All	Aggregate	Renew	Actions			
READY	GPO InstaGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
no resources	Kentucky ProtoGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
no resources	ExoGENI ExoSM	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
READY	Utah InstaGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
no resources	Utah ProtoGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
no resources	GPO ExoGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
no resources	RENCI ExoGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources

### Next: Execute a Simple Layer 2 Experiment

### GENI Slice: portal01

Slice Actions					Renew		
Add Resources	Resource Status	Details	Add Note	Delete Resources	2013-03-05 21:58:41 UTC	Renew Slice	
					2013-03-05 21:58:41 UTC	Renew Resource Reservations	
Tools			Ops Mgmt				
Launch Flask	Use omni						Disable Slice   Shutdown Slice

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

#### Slice Status

Status Get All	Aggregate	Renew	Actions			
not retrieved	GPO InstaGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
not retrieved	Kentucky ProtoGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
not retrieved	ExoGENI ExoSM	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
not retrieved	Utah InstaGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
not retrieved	Utah ProtoGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
not retrieved	GPO ExoGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources
not retrieved	RENCI ExoGENI	2013-03-05 21:58:41 UTC	Renew	Resource Status	Details	Delete Resources

2. The rows for *InstaGENI GPO* and *InstaGENI Utah* should say *READY* against a green background and look as shown on the left.
3. If one of the rows do not say *READY*, press the **Get Status** button on that row periodically until it does.

# Execute Experiment: Login to the nodes and execute a simple layer 2 experiment

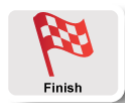
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- **Part II: Execute**
  - **[Execute Experiment: Login to nodes and execute a simple layer 2 experiment](#)**



- Part III: Finish
  - [Teardown Experiment: Delete Resources](#)

## Instructions

Now that you have reserved your resources, you are ready to run your first GENI experiment. For the purpose of this tutorial we are going to do a simple layer 2 experiment.

### 1. Login to nodes

#### 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.panther.utah.geniracks.net |
| <b>Login</b> | <code>ssh sedwards@pc3.utah.geniracks.net -p 31546</code> |               |                  |                                            |
| 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  |


```

1. Return to the Slice page. Press the **Details** button in the row of the slice table for *Utah InstaGENI*.
2. Click on the ssh link. If you have installed FireSSH a new tab will open up.
3. In the window that will pop up :
  - in the password field type in your passphrase
  - in the private key, browse to the file that has your private key
  - **Press OK**
4. If you don't have FireSSH installed, open a new terminal window. Copy the command to the right of **Login** into that terminal window. You have now logged into your VM.
5. Return to the Slice page and repeat the previous two steps for *GPO InstaGENI* in a second terminal window.

### 2. Run your experiment

1. **Send IP traffic** The first simple experiment that we will run is to verify the IP connectivity between our hosts.

i. Check the interfaces of your nodes. In the terminal type:

```
/sbin/ifconfig
```

You should see at least two interfaces:

- The **control interface**. This is the interface you use to access the node, e.g. ssh into your host. The control interface is mainly used for control traffic, i.e. traffic for controlling the node and the experiment. The control interface usually has a publicly routable IP.
  - The **data interface**. This is the interface that is used for sending experimental traffic. This is the interface that connects to the other hosts of your experiment through GENI. The links between these interfaces are the ones that allow you to run non-IP experiments.
- ii. Fill in the worksheet, noting the name and IP address of the control and of the data interfaces for each node. The data interface is the one that has an IP that starts with 10. **Note:** The "client" is the node in Utah and the "server" is the node at the GPO (in Massachusetts). The command prompt on each node says "client" or "server" respectively.
- iii. When we reserved the resources, we did not specify the IP address for the data interfaces. Instead, do this now. Configure the IP address on the data interface of each node using the desired data IP address from the worksheet :

```
sudo /sbin/ifconfig <data i/f name> <desired data IP addr>/24
```

For example:

```
sudo /sbin/ifconfig mv7.90 10.10.1.1/24
```

- iv. Use /sbin/ifconfig to confirm the new IP address and mask for each node.
- v. From the client, ping the server. From the xterm that is logged in to the client type :

```
ping <server data IP addr> -c 5
```

For example:

```
ping 10.10.1.2 -c 5
```

An example output should look like :

```
[sedwards@client ~]$ ping 10.10.1.2 -c 5
PING 10.10.1.2 (10.10.1.2) 56(84) bytes of data.
64 bytes from 10.10.1.2: icmp_req=1 ttl=64 time=183 ms
64 bytes from 10.10.1.2: icmp_req=2 ttl=64 time=91.2 ms
64 bytes from 10.10.1.2: icmp_req=3 ttl=64 time=91.1 ms
64 bytes from 10.10.1.2: icmp_req=4 ttl=64 time=91.1 ms
64 bytes from 10.10.1.2: icmp_req=5 ttl=64 time=91.2 ms

--- 10.10.1.2 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4004ms
rtt min/avg/max/mdev = 91.156/109.579/183.129/36.775 ms
```

2. **Send non-IP traffic**. GENI provides the capability of running non-IP experiments, since you can connect your hosts at Layer 2. For the purpose of this tutorial we have installed in all the



hosts a very simple Layer 2 ping program that sends packets using a custom ethernet type.

- i. Disable the IP in your nodes. First of all we are going to completely disable IP on our nodes. In each of the terminals type:

```
sudo /sbin/ifconfig <data i/f name> 0.0.0.0
```

**Note:** Be extra careful to bring down the IP on the data interface, bringing down the IP on the control interface means that you will lose connectivity to your host.

- ii. Try again to ping from the client to the server. In the xterm of the client type:

```
ping <server data IP addr> -c 5
```

For example:

```
ping 10.10.1.2 -c 5
```

This time the ping should timeout.

- iii. Start the Layer 2 ping server: In the server xterm, type:

```
sudo /usr/local/bin/pingPlusListener <EtherType from worksheet>
```

- iv. From the client try to ping the server at layer 2. You will need the mac address of the data interface of the server, the name of the data interface of the client, and the EtherType from your worksheet. In the xterm of the client, type:

```
sudo /usr/local/bin/pingPlus <server data mac addr> <client data
```

The result should look like :

```
[uncusr20@client ~]$ sudo /usr/local/bin/pingPlus 02:00:9B:48:3E:20  
RQ:'5582+2067' to 2:0:9b:48:3e:20.  
RQ:5582+2067 from 2:0:3e:15:6c:ab.
```

### 3. Logout of your nodes

- When you are done, CTRL-C in the server window to stop PingPlusListener.
- Then type `exit` in each of your open terminals.

Congratulations you have run a Layer 2 experiment in GENI!

### Next: Teardown Experiment

# Teardown Experiment: Delete Resources

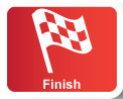
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- Part III: Finish
  - [Teardown Experiment: Delete Resources](#)

## Instructions

When we are done with our experiments it is always good to clean up and release our resources so other people can use them.

### 1. Delete your resources

#### 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="#">Launch Flack</a>	<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	Aggregate	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>

1. Return to the *Slice* page. On the *GPO InstaGENI* row in the aggregate table, press the **Release Resources** button.
2. When prompted, confirm that you want to delete this sliver. Then, make sure you see a message that you have successfully deleted resources at this aggregate.
3. Return to the slice page and repeat the previous two steps for *Utah InstaGENI*.

Congratulations you have successfully completed your first GENI experiment!