

Lab Zero: A First Experiment Using GENI and Jacks Tool

Overview

This is a first, simple experiment on GENI useful for familiarizing new experimenters with GENI and the tools for using GENI.

What you will learn

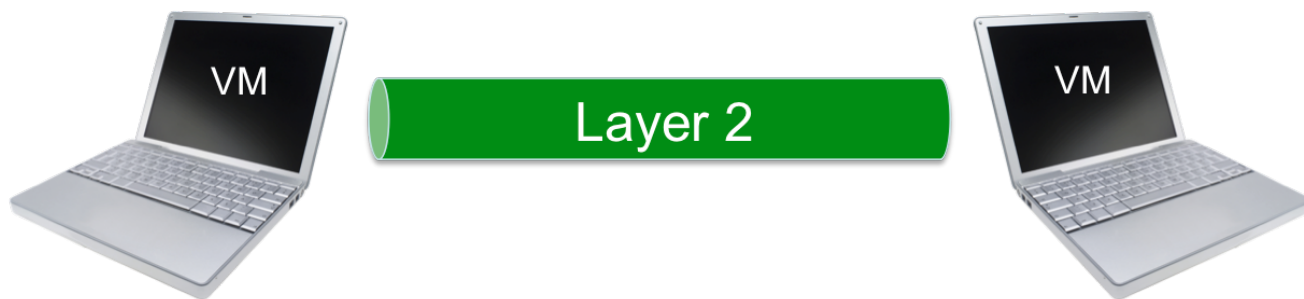
The high levels goals for this exercise are to:

1. Do a simple but complete GENI experiment
2. Learn and use 5 GENI terms: experimenter, project, slice, resource, and aggregate
3. Use the [GENI Experimenter Portal](#) and Jacks

Specifically, during this exercise you will:

- Use your GENI account for the first time and do some one time setup
 - Login to the GENI Experimenter Portal for the first time
 - Join a Project
 - Specify `ssh` keys for use logging into resources
- Learn how to reserve, login to, and release resources in GENI
 - Create and renew a slice
 - Generate and reserve your own topology of GENI resources using Flack
 - Learn how to login to compute resources using `ssh`
 - Learn how to delete resources in GENI
- Understand the difference between the control and data plane interfaces on each node
- Use these resources to do a very simple first experiment
 - Use `ping` to test connectivity between the reserved resources
 - Use `ifconfig` to identify your data and control plane interfaces

Experiment Topology and Setup

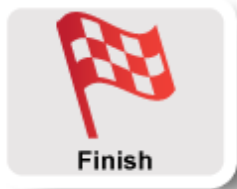
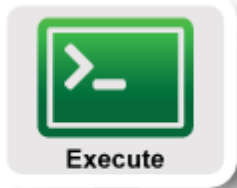


Reserve two VMs at the same location connected by a Layer 2 circuit.

Background

[Background information](#) about pre-requisites, tools, resources, and where to get help.

Procedure



- **Part I: Design/Setup**

- Step 1: Design Experiment
- Step 2: Establish Management Environment
- Step 3: Obtain Resources

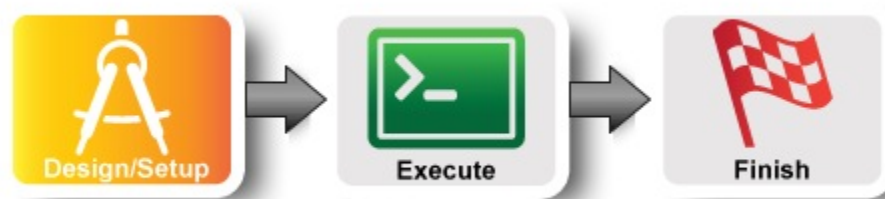
- **Part II: Execute**

- Step 4: Configure and Initialize Services
- Step 5: Execute Experiment
- Step 6: Analyze and Visualize Experiment

- **Part III: Finish**

- Step 7: Teardown Experiment
- Step 8: Archive Experiment

Lab Zero: A First Experiment Using GENI



1. Design the Experiment

- a. In today's experiment you will use resources at the aggregate listed on the worksheet. If you don't have a worksheet use *Clemson InstaGENI* (aka *instageni.clemson.edu*)

2. Establish the Environment

2.1 Pre-work: Create a GENI account

- a. Go to <https://portal.geni.net> and press the **Use GENI** button
- b. From the Drop Down menu select your institution. If you got an account through the GENI Identity Provider, please select **GENI Project Office**.



Start typing the name of your institution and see the list become smaller.

- c. You will be transferred to the Login Page of your institution. Fill in your username and password.
- d. Complete the form that appears after you have successfully logged in and press **Continue**.
- e. 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
GENI Project Office in a list	Get Help

No account? [Contact GENI Help](#)



Figure 2-1 Logging into the GENI Experimenter Portal.

Congratulations, you have successfully created a GENI account.

2.2 Pre-work: Project lead adds you to a project

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

- a. The tutorial organizers should have added you to the project for this tutorial. On the home page, you should see that you are a member of at least one 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.

2.3 Generate and Download SSH Keypair

Access to compute resources in GENI is provided 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.)

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

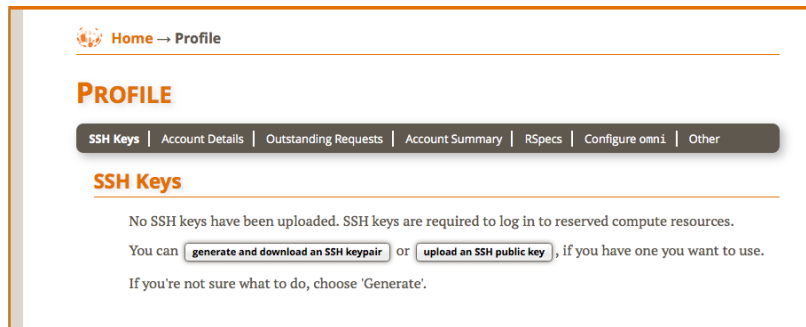


Figure 2-2 On the Profile page, select the "generate and download an SSH keypair" button.

- c. Enter the same passphrase twice, then press **Generate SSH private key**.

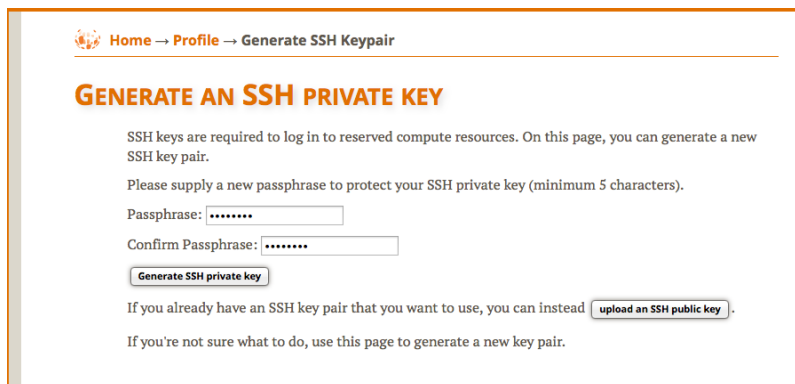


Figure 2-3 Enter passphrase twice, then generate SSH private key.

- d. Now, press the **Download Private Key** button
- e. **If you are using a command line based ssh client**, open a terminal and execute:

```
$ mv ~/Downloads/id_geni_ssh_rsa ~/.ssh/.  
$ chmod 0600 ~/.ssh/id_geni_ssh_rsa  
$ ssh-add ~/.ssh/id_geni_ssh_rsa
```

Later in the tutorial, this will allow you to log into your nodes securely without a password.

Home → Profile

Notice
Generated SSH keypair - now download the private key

PROFILE

SSH Keys | Account Details | Outstanding Requests | Account Summary | RSpecs | Configure omni | Other

SSH Keys

Name	Description	Public Key	Private Key	Edit	Delete
id_geni_ssh_rsa	Generated SSH keypair	Download Public Key	Download Private Key	Edit	Delete

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:

1. Download your SSH key.
2. 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]
```
3. When you invoke SSH to log in to reserved resources, you will need to remember the path to that file.
4. Your SSH command will be something like:


```
ssh -i path-to-SSH-key-you-downloaded [username]@[hostname]
```

[Upload another SSH public key](#)

Figure 2-4 Download an SSH Key Pair.

3. Obtain Resources

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

3.1 Create a slice

- Go to the *Home* tab.
- Press the **Create Slice** button for this project.
- As a slice name use the slice name on your worksheet. If you don't have a worksheet, use *lab0<your initials>*. You can leave the description empty and press **Create Slice**

Home → Project tutorial → Create Slice in project tutorial

CREATE NEW SLICE

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

Project name	tutorial
Slice name	geni01 -- Required
Slice description	

Note: Slice name is public

[Create slice](#) [Cancel](#)

Figure 3-1 Create a new slice.

3.2 (optional) Renew your slice

Slices and the resources within them are reserved until their individual *expiration times*. Renewing allows you to extend the expiration time of your slice and the resources in them.



Slices and the resources within them have *distinct* expiration times. You must renew **both** the slice and the resources separately.

- On the *Slice* page, select the **Renew slice only** radio button.
- Click on the date below. In the calendar that pops up, select a date in the near future.
- Press **Renew** to renew the slice. Renewing the slice now allows the resources to have longer initial expiration times.

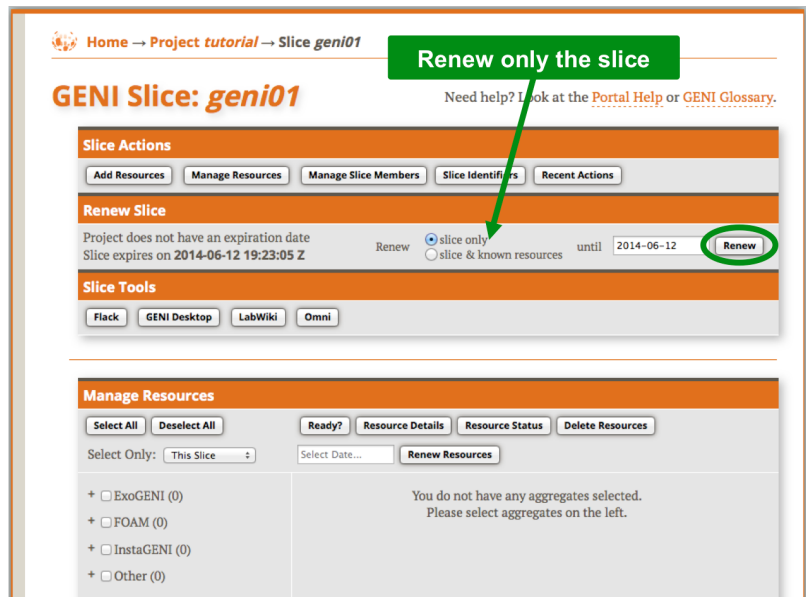


Figure 3-2 *Renew the slice.*

3.3 Reserve Two Virtual Machines at One Aggregate

The Portal is integrated with a tool, Jacks, which allows you to draw topologies of GENI resources and then reserve them.

- On the *Slice* tab, press the **Slice Jacks (beta)** button.
- In the window that opens, click the *Add Resources* button.

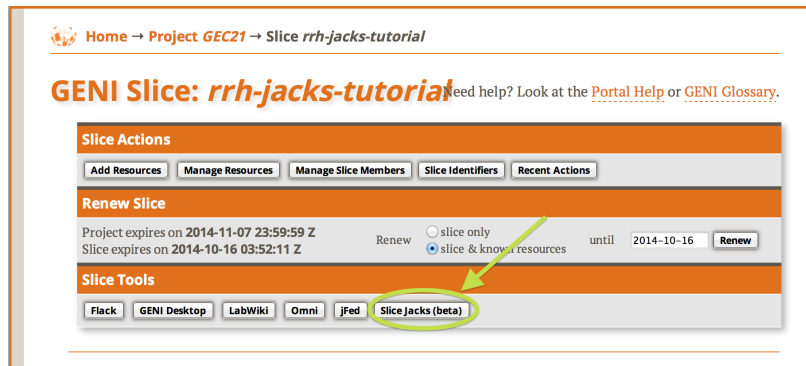


Figure 3-3 *Launch Jacks*

- c. Wait for Jacks to open in editing mode. Jacks should look like the picture to the right.

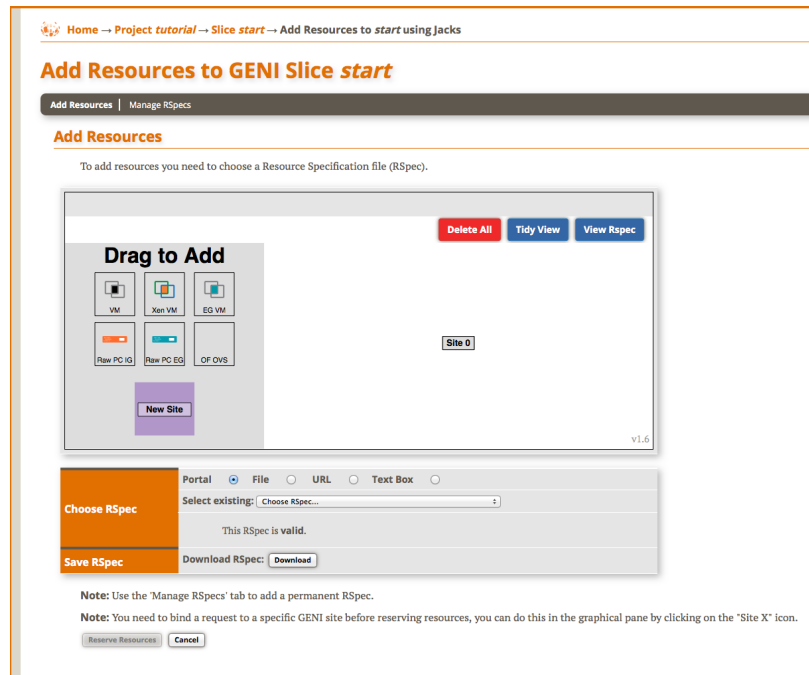


Figure 3-4 Jacks after it has loaded.

- d. Click the black **VM** box and drag it onto the canvas. This icon represents a generic default-vm which the aggregate has a well known default for (for InstaGENI it is a Xen VM and for ExoGENI it is an ExoSmall).
- e. Repeat the above step. You should now see two **VM** boxes on the canvas.
- f. Now click near one of the VM boxes on the canvas, then click and drag towards the other VM. Release when you reach the other VM. You should now see a line and a box representing a link connecting the two VMs.
- g. The canvas should now look like the picture on the right.

Add Resources

To add resources you need to choose a Resource Specification file (RSpec).

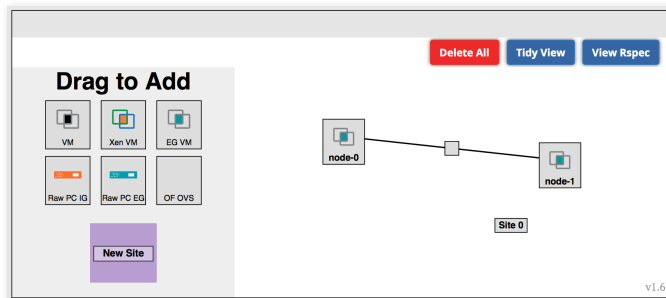


Figure 3-5 Two VMs connected by a link.

- h. To edit the name of the VM, click the VM box.
- i. In the "Name" field at the top, replace "node-0" with "client".
- j. Repeat for the VM labeled node-1. In the "Name" field at the top, replace "node-1" with "server".

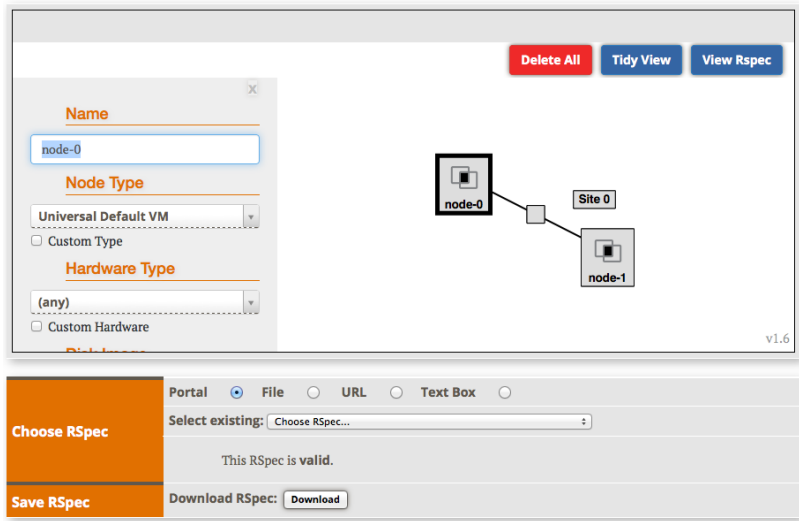


Figure 3-6 Edit the name of the VM.

- k. Now click on the unlabeled box in the middle of the link.
- l. Enter an IP Address for the "node-0/client" interface of 10.1.1.1.
- m. Enter a Mask of 255.255.255.0.
- n. Scroll down further and set IP Address of the "node-1/server" interface to 10.1.1.2 and a Mask of 255.255.255.0.

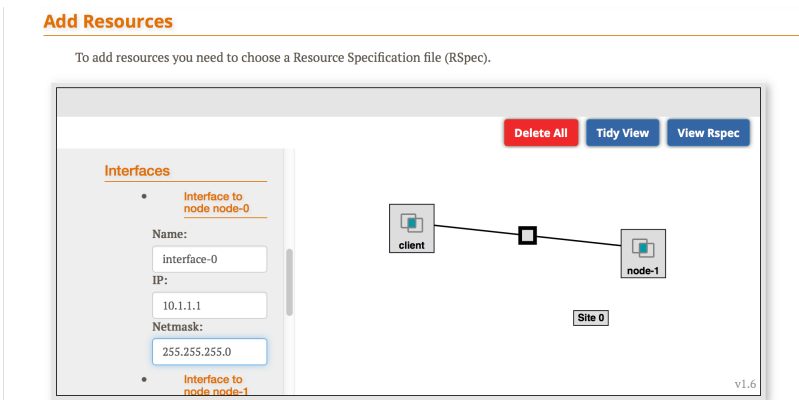


Figure 3-7 Edit the IP Address and Mask of the VM.

- o. Click the "Site 0" box and select the aggregate you've been assigned from the pulldown menu. The "Reserved Resources" button at the bottom of the pane should now be clickable.
- p. Click the "Reserve Resources" button near the bottom of the page.

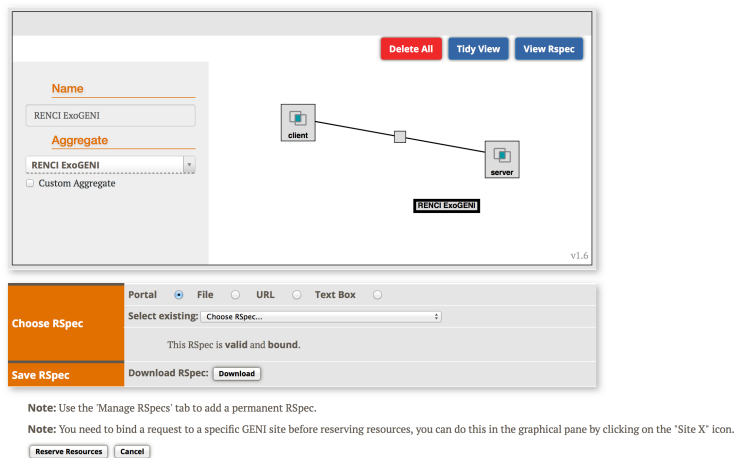


Figure 3-8 Binding the topology to an aggregate.

3.4 Check Whether Virtual Machines are Ready to be Used

Add Resources to GENI Slice *gec21-tools* (Results)

Total run time: **1 minute, 10 seconds**
Status: **Finished**

Started at: Fri, 17 Oct 2014 09:47:58 -0400
Finished at: Fri, 17 Oct 2014 09:49:08 -0400

Results | Detailed Progress | Request RSpec | Manifest RSpec | Send Problem Report | Advanced

Results

Resources requested from RSpec:

Note that the results are current as of the finish time. Your resource allocation may have changed after this time if resources expired or were deleted. Check the [slice page](#) for the most up-to-date results about your slice's current allocated resources.

Node #1 (at RENCI ExoGENI):

Client ID	Component ID	Exclusive	Type	Hostname
client	rcivmsite:orca-vm-cloud	not exclusive	xo.small	(not specified)
Interfaces		MAC	Layer 3	
interface-0			ipv4: 10.1.1.1	

- After clicking the "Reserve Resources" button, a new page will open giving "Status".
- Once the "Status" states "Finished", resources have been reserved. However, the nodes still need to come up which may take some time.

Figure 3-9 Reservation complete.

Manage Resources

Resources on RENCI ExoGENI are ready.

server client

RENCI ExoGENI

Renew Renew Date Delete SSH Restart Details Status Add Resources

- Return to the **Slice** page, and then the **Slice Jack (beta)** page.
- Wait until all of the nodes turn green. The page should now look like the picture on the right.

Figure 3-10 Nodes are ready to login.

Introduction

Next: Execute

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4. Configure and Initialize

Now that you have reserved your resources, you are ready to run your first GENI experiment.

4.1 Login to nodes

- To get login information for a VM from the **Slice Jacks** page, click on the node and scroll through the information on the left. In addition, depending on the configuration of your system, you may be able to click on the *SSH* button.
- However, to get login information for a VM from the **Slice** page, again click on the "slice page" link at the top of the page.
- This will bring you to the slice page and you can click on the "Details" button in your aggregate rectangle.

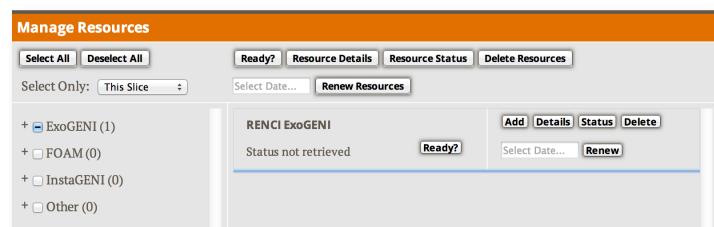


Figure 4-1 Get Login VM Details.

Aggregate **RENCI ExoGENI's** Resources:

Node #1:

Client ID	Component ID	Exclusive	Type	Hostname
client	rcivmsite:orca-vm-cloud	not exclusive	xo.small	(not specified)
Login		ssh ahelsing@152.54.14.49		
		ssh agosain@152.54.14.49		
		ssh nriga@152.54.14.49		
		ssh vthomas@152.54.14.49		
		ssh tupty@152.54.14.49		
		ssh asydne01@152.54.14.49		
		ssh sedwards@152.54.14.49		
		ssh tmitchel@152.54.14.49		
		ssh lnevers@152.54.14.49		
		ssh rrhain@152.54.14.49		
ssh root@152.54.14.49				
Interfaces		MAC	Layer 3	
interface-0			ipv4: 10.1.1.1	

Figure 4-2 Login to a VM.



To ssh from the command line on unix-based machines, do the following (substituting the values shown on the screen):

```
ssh USERNAME@HOSTNAME -p PORT
```



To ssh from Windows machines, launch your favorite ssh client and substituting the values shown on the screen.

5. Execute Experiment

5.1 Send IP traffic

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

- a. Check the interfaces of your nodes. In the terminal type:

```
sudo ifconfig
```

You should see at least two interfaces:

- o 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.
 - o 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. **The data interface is the one that has an IP address and mask that match what you configured before you reserved your resources.**
- b. Fill in the worksheet, noting the name and IP address of the control and of the data interfaces for each node.



The command prompt on each node may say "client" or "server" respectively.

- c. From the client, ping the server **data plane interface**. From the terminal window that is logged in to the client type :

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

For example:

```
ping 10.1.1.2 -c 5
```

- d. Now, ping the server **control plane interface**. From the terminal window that is logged in to the client type :

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

For example:

```
ping 172.17.1.9 -c 5
```

5.2 Install and use iperf

- a. Install the iperf software on both nodes: appropriate command below.



To install on ExoGENI nodes, you need to login as root. You cannot sudo from your user account. Login information was provided for root along with your user login information.

```
sudo apt-get install iperf  
hash
```

- a. Start an iperf server on the server node:

```
iperf -s
```

- b. Run an iperf client via the data plane:

```
iperf -c <server data IP addr>
```

For example:

```
iperf -c 10.1.1.2
```

What is the bandwidth of this link?

Why?

- a. Run an iperf client via the control plane:

```
iperf -c <server control IP addr>
```

For example:

```
iperf -c 172.17.2.2
```

What is the bandwidth of this link?

Why?

- a. Type CTRL-C on the server node to stop the iperf server.

5.3 Bring down the server's data interface

- a. ExoGENI nodes run a service called "neuca" that managed network interfaces on the node. To manually adjust the IP address, we must first disable neuca on both nodes.

```
sudo service neuca stop
```



The ExoGENI "neuca" service controls a variety of network configuration details.

- b. From the client node, start pinging the server **data plane interface**:

```
ping <server data IP addr>
```

- c. On the server node, bring down the **data plane interface** (being careful to disable the data interface NOT the control interface):

```
sudo ifconfig <server data interface name> down
```

After you bring down the data interface, the pings should indicate that the destination is unreachable.

Why?



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

5.4 Bring down the server's control interface

- a. From the client node, start pinging the server **control plane interface**:

```
ping <server control IP addr>
```

- b. From the server node, bring down the **control plane interface** and try to ping it from the client node:

```
sudo ifconfig <server control interface name> down
```

Your ssh session should immediately hang.

Why?

After you bring down the control interface, the pings should indicate that the destination is unreachable. Why?



Unfortunately, in order to recover from a situation like this where you've lost the ability to login to your nodes, the only way to recover is to delete your resources and start again.

6. Analyze Experiment

Now is when you would ordinarily analyze the results of your experiment.

6.1 Logout of your nodes

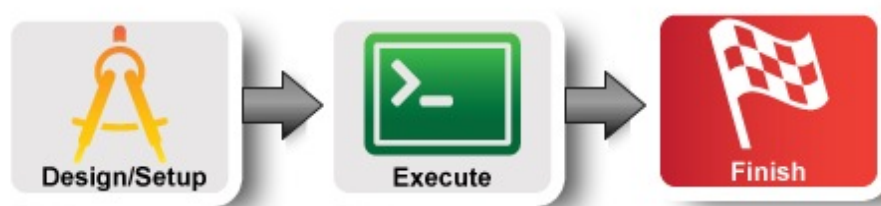
- Then type `exit` in your open terminal.

Congratulations you have run an experiment in GENI!

Setup

Next: Finish

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7. Teardown Experiment



When you are done with your experiment it is always good to clean up and release your resources so other people can use them.

7.1 Delete your resources

- Press the "Delete" button on the bottom.

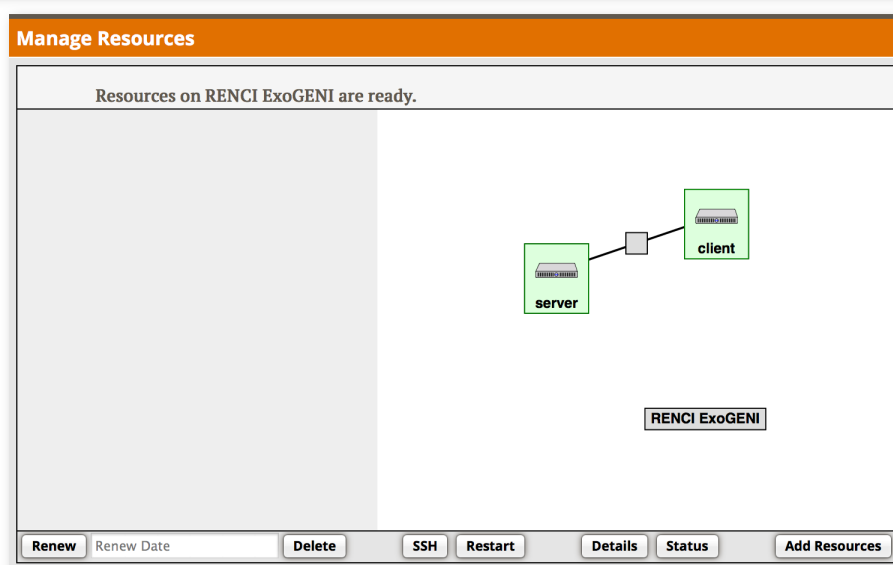


Figure 12-1 Delete resources at aggregate.

- b. Press the "OK" button on the pop up window confirming that you want to delete resources at the aggregates you used.

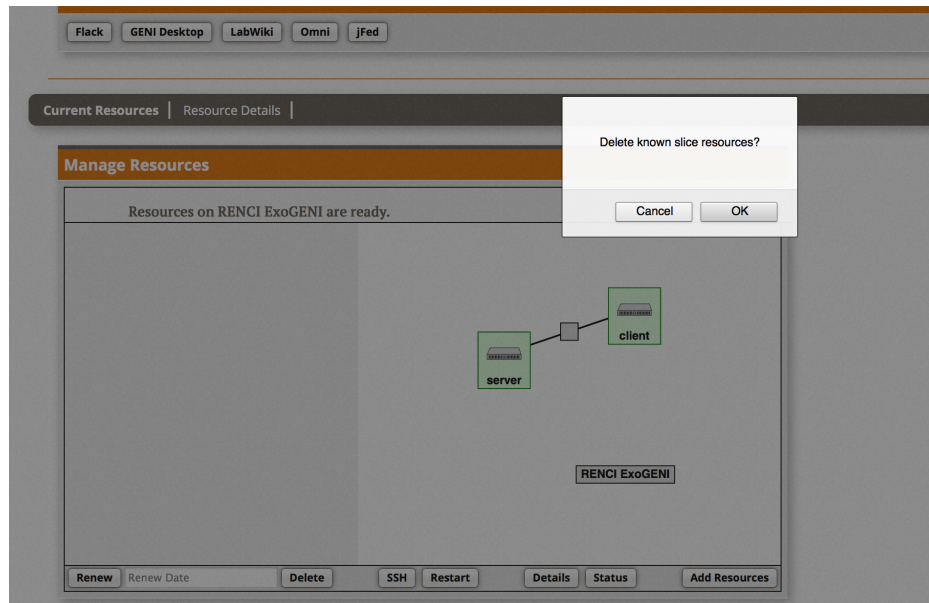


Figure 12-2 Delete resources at aggregate.

8. Archive Experiment

Congratulations you have successfully completed your first GENI experiment!

Introduction