Lab Zero: A First Experiment Using GENI and Jacks Tool

These instructions are at: http://tinyurl.com/geni-labzero

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

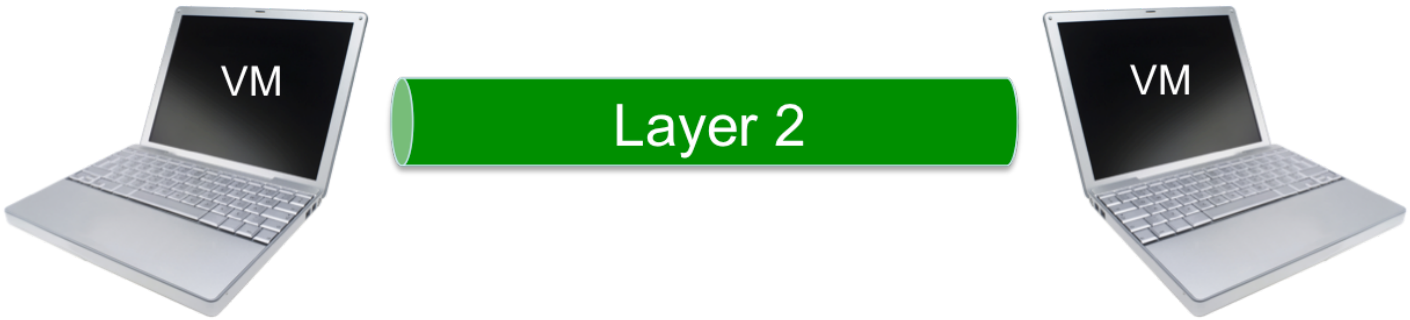
The high levels goals for this exercise are to:

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 (a.k.a. site) listed on the worksheet. If you don't have a worksheet, use any aggregate with *InstaGENI* or *ExoGENI* in it's name.

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. Where prompted, begin typing your organization's name, and select it from the list. If you got an account through the GENI Identity Provider, type **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**.

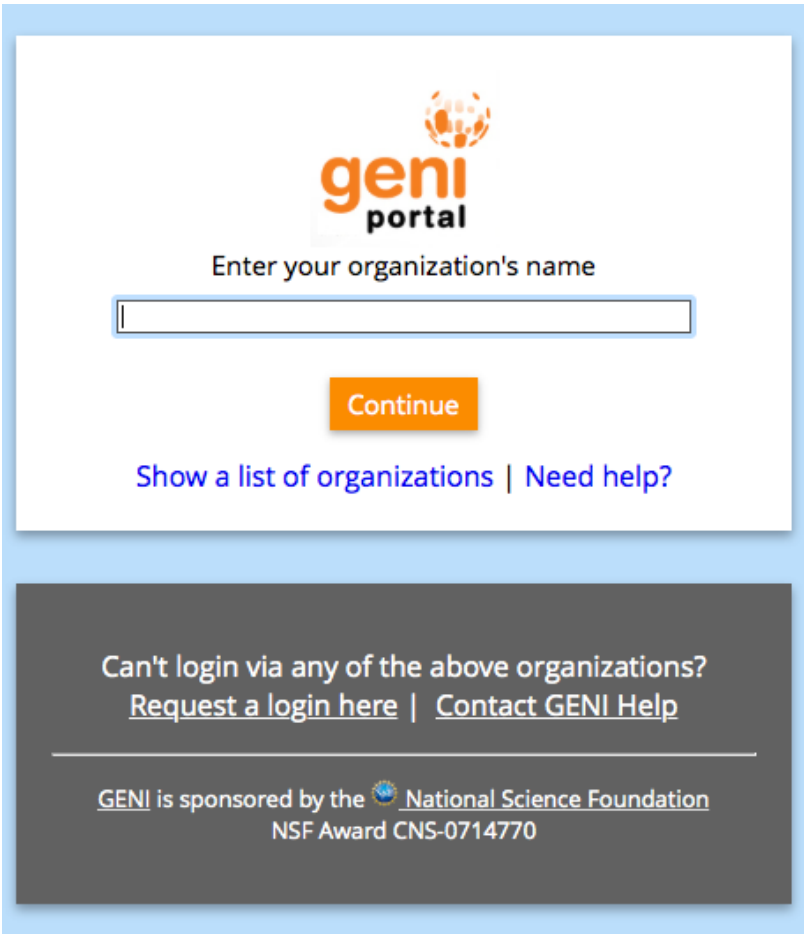


Figure 2-1 *Logging into the GENI Experimenter Portal.*

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 your name in the upper right hand corner and select *SSH Keys* from the pulldown menu.
b. On the new page, select the **generate and download an SSH keypair** button.
c. Enter the same passphrase twice, then press **Generate SSH private key**. Note: You will need to remember the passphrase later in the tutorial.

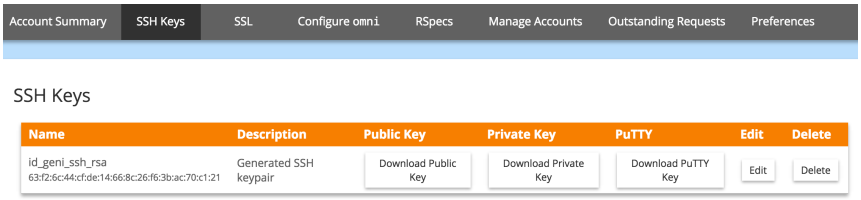


Figure 2-4 *Download an SSH Key Pair.*

Mac OS X/Linux

a. Now, click the **Download Private Key** button.
b. In a command line terminal, move your key to the appropriate location and ensure that it has the right permissions by typing (replacing ~/Downloads/ with actual location if necessary):

```
mv ~/Downloads/id_geni_ssh_rsa ~/.ssh/.
chmod 0600 ~/.ssh/id_geni_ssh_rsa
```

c. Finally, add this key to the authentication agent by typing:

```
ssh-add ~/.ssh/id_geni_ssh_rsa
```

Windows PuTTY

a. Now, click the **Download PuTTY Key** button, and save the key to your computer.
b. Later you will need to remember the location of the key.

Windows FireSSH

a. Now, click the **Download Private Key** button, and save the key to your computer.
b. Later you will need to remember the location of the key.

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

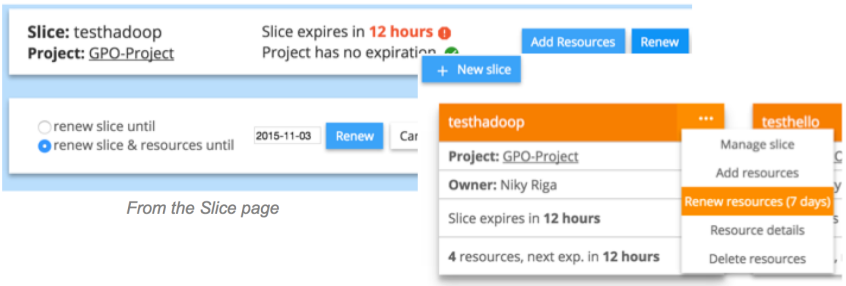
a. Go to the *Home* tab.
b. Press the **+ New slice** button.
c. Ensure the correct project name is selected in the Project name field.
d. As a slice name use the slice name on your worksheet. If you don't have a worksheet, use *lab0<your initials>*. You can leave the description empty and press **Create Slice**

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.

a. You can renew your slice and resources both from the Home page and from the Slice page. From the Home page you can only renew slices once they have resources and only for a predetermined amount of time, i.e. 7 days. For this tutorial we are going to Slice page.
b. On the *Slice* page, select Renew and then **Renew slice only** radio button.
c. Click on the date to the right. In the calendar that pops up, select a date in the near future.
d. Press **Renew** to renew the slice. Renewing the slice now allows the resources to have longer initial expiration times.



From the Slice page

From the Home page

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.

a. In the upper left hand corner of the Slice page, click the *Add Resources* button.
b. Wait for Jacks to open in editing mode. Jacks should look like the picture to the right.

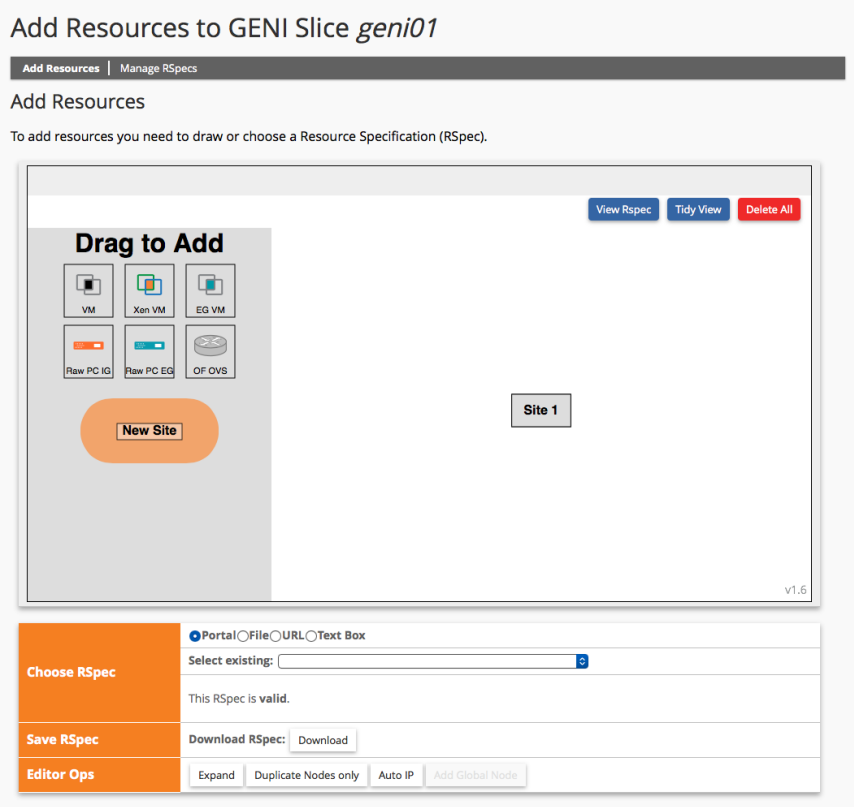


Figure 3-3 *Jacks after it has loaded.*

c. 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).
d. Repeat the above step. You should now see two **VM** boxes on the canvas.
e. 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.
f. The canvas should now look like the picture on the right.

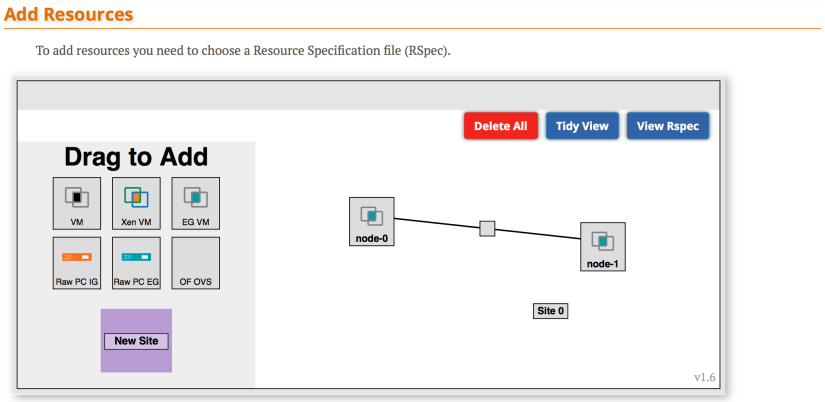


Figure 3-4 *Two VMs connected by a link.*

g. To edit the name of the VM, click the VM box.
h. In the "Name" field at the top, replace "node-0" with "client".

i. Repeat for the VM labeled node-1. In the "Name" field at the top, replace "node-1" with "server".

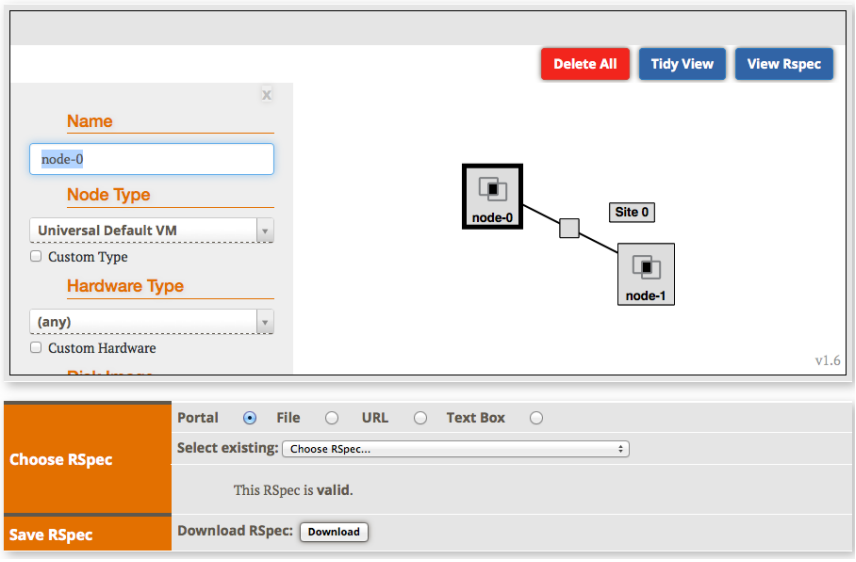


Figure 3-5 *Edit the name of the VM.*

j. Assign IP addresses to the interfaces. The easiest way to do this is to have the tool auto-assign IP addresses by clicking on the Auto IP button.

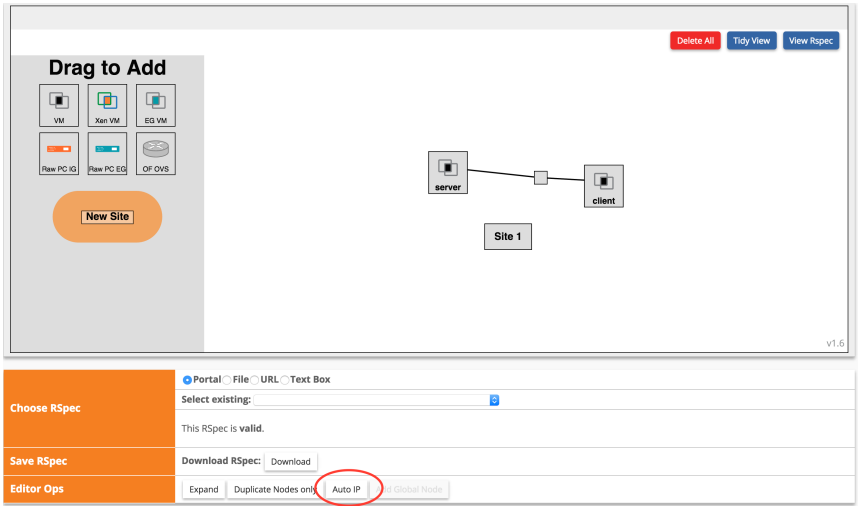


Figure 3-6 *Assign IP addresses to the interfaces using Auto IP.*

k. Click the "Site 1" box and select from the pulldown menu the aggregate you wish to request these resources from. If completing this tutorial with a group, select the aggregate you've been assigned, otherwise select any aggregate with InstaGENI or ExoGENI in its name. Make note of whether or not your aggregate is an ExoGENI or InstaGENI aggregate. This information may be useful later when running the experiment. Also note that some aggregates may be more busy than others. If you experience difficulties, it is suggested that you repeat the steps with a new slice and select a different aggregate.

l. The "Reserve Resources" button at

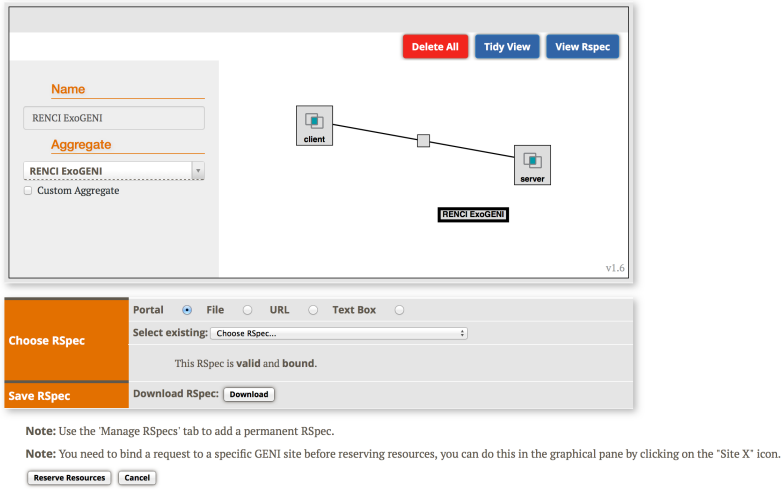


Figure 3-7 *Binding the topology to an aggregate.*

the bottom of the pane should now be clickable, Click it.

3.4 Check Whether Virtual Machines are Ready to be Used

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

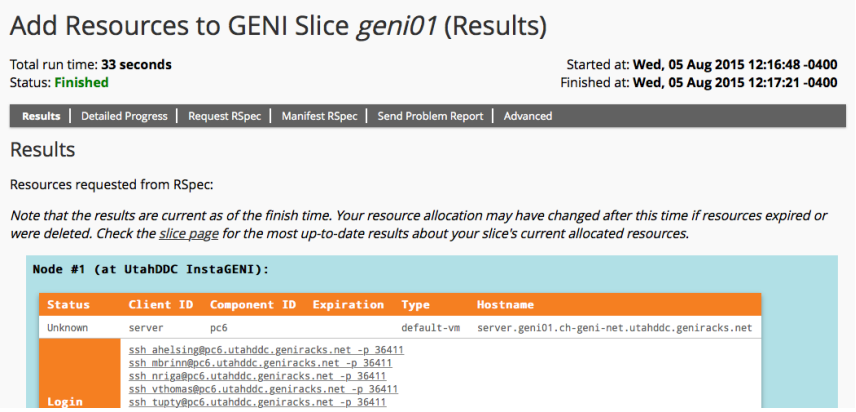


Figure 3-8 *Reservation complete.*

c. Return to the **Slice** page.
d. Wait until all of the nodes turn green. The page should now look like the picture on the right.

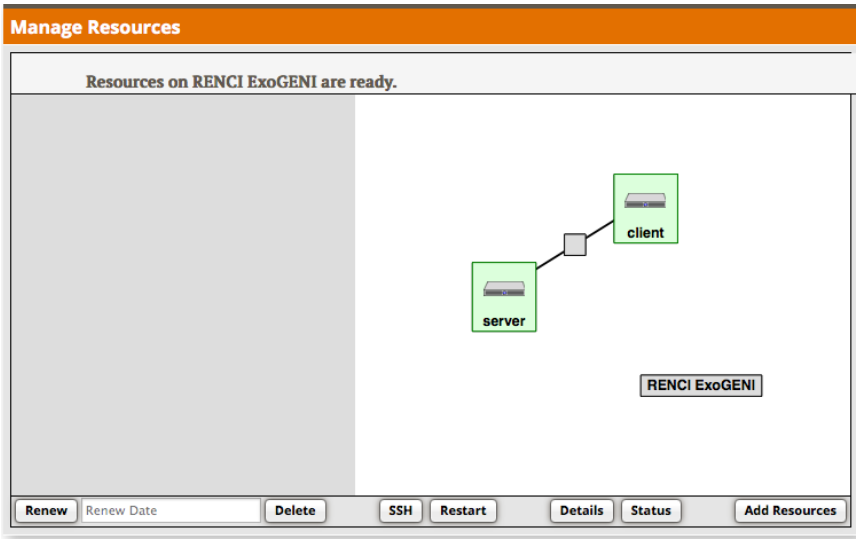


Figure 3-9 *Nodes are ready to login.*

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

Note the login information for the two nodes (client and server) on the **Slice** page. Either click on the "Details" button or click on each node and find the SSH to information on the left (in the format

Mac OS X/Linux

a. In a command line terminal, start SSH by typing:

```
ssh <username>@<hostname> -p <port number>
```

or alternatively, if your key is not added to the authentication agent

```
ssh -i <private key location> <username>@<hostname> -p <port number>
```

b. Enter your passphrase you chose when generating your key pair when prompted. Note: If you are prompted for a password then something went wrong. Make sure that the login information and passphrase are correct.

Windows PuTTY

a. Run PuTTY.
b. On the Basic options screen, in the Host Name field enter: `<username>@<hostname>`
c. In the Port field enter: <port number>
d. Make sure Connection type is: SSH
e. Under the settings categories on the left navigate to Connection-> **SSH ->Auth**.
f. Next to the "Private key file for authentication" field at the bottom, click **Browse...** and select the private key file you saved to your computer, and click **Open**.
g. Click **Open** to establish the SSH connection.
h. If prompted about whether you trust the host (key not cached in registry), click Yes.
i. When prompted for the Passphrase enter the passphrase you chose when generating your key pair.

Windows FireSSH

a. Load this URL into firefox (with the FireSSH plugin installed): `ssh://<username>@<hostname>:<port number>`
b. In the pop-up window, enter the passphrase you chose when generating your key pair in the (mislabeled) password field, and click **Browse...**
c. Select the private key, and click **Open**.
d. Click **OK**.
e. If prompted about whether you trust the host (host key not cached in registry), click Yes.

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 each terminal type:

```
sudo 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. (likely something like 172.17.1.9)
- 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.** (likely something like 10.10.1.2)

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 10.10.1.2 -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:

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

b. On both nodes run the hash command to ensure the new iperf command is accessable from the command line:

```
hash
```

c. Start an `iperf` server on the server node:

```
iperf -s
```

d. Run an `iperf` client via the data plane:

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

For example:

```
iperf -c 10.10.1.2
```

What is the bandwidth of this link?
Why?

e. 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?

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

5.3 Bring down the server's data interface

a. (Only run this step if you selected an ExoGENI aggregate when requesting resources) 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?

In general, in order to recover from a situation like this where you've lost the ability to login to your nodes, the best 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

a. Press the "Delete" button on the bottom.

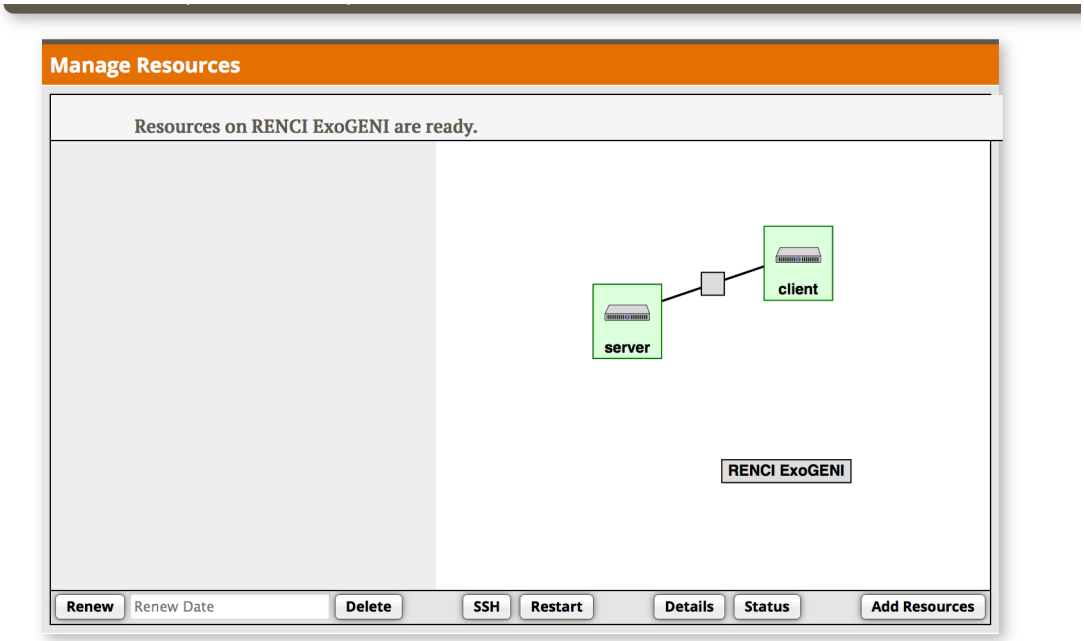

Figure 12-1 *Delete resources at aggregate.*

b. Press the "OK" button on the pop up

window confirming that you want to delete resources at the aggregates you used.

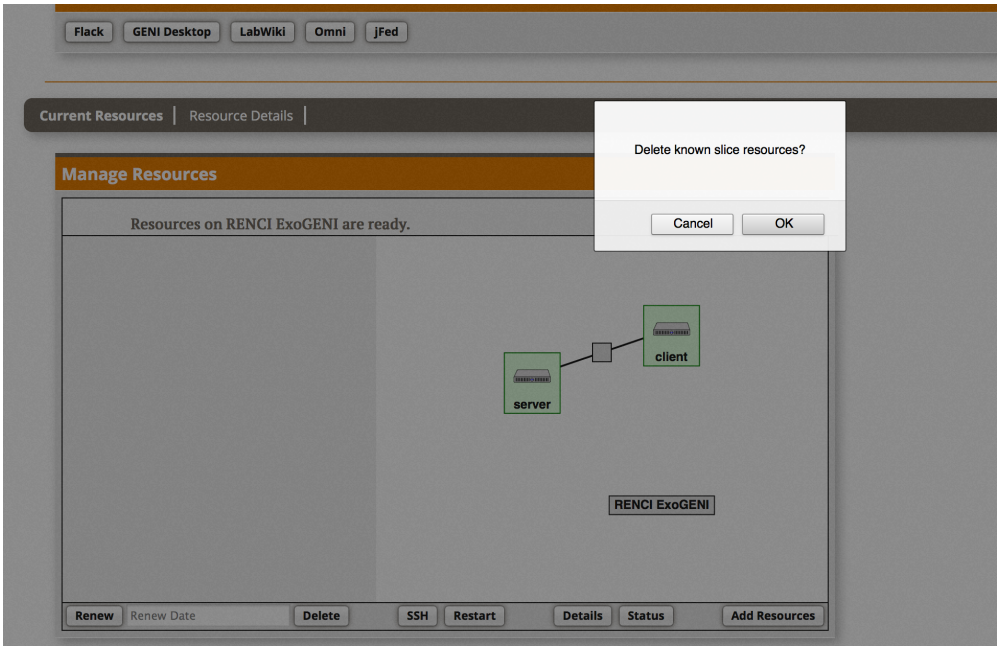

Figure 12-2 *Delete resources at aggregate.*

8. Archive Experiment

Congratulations you have successfully completed your first GENI experiment!

Introduction