

Lab Zero: A First Experiment Using GENI

[http://groups.geni.net/geni/wiki/GENIExperimenter/Tutorials/jacks/GettingStarted_PartI/Procedure
<20150916>](http://groups.geni.net/geni/wiki/GENIExperimenter/Tutorials/jacks/GettingStarted_PartI/Procedure%2020150916)



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

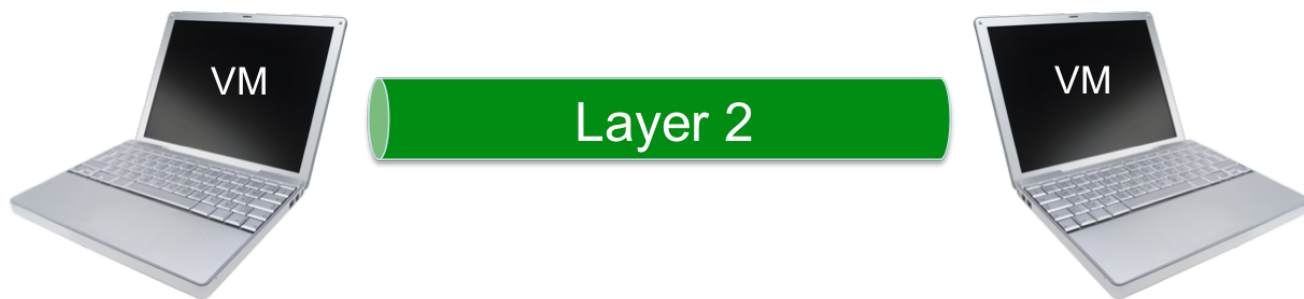
The high levels goals for this exercise are to:

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

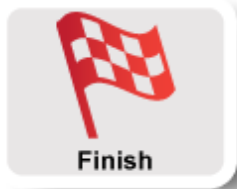
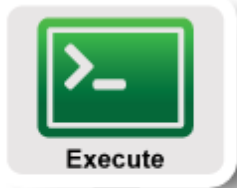


Reserve two VMs at the same location connected by a Layer 2 circuit.

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

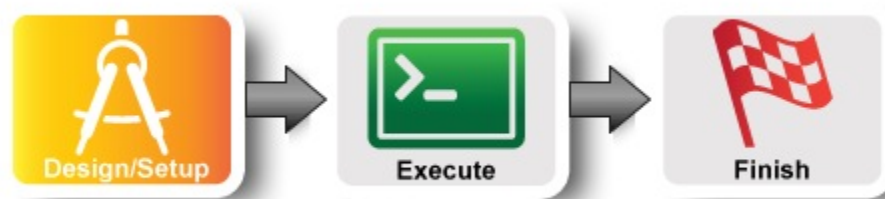
- **Part II: Execute**

- 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

- 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

- Go to <https://portal.geni.net> and press the **Use GENI** button
- 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.

- You will be transferred to the Login Page of your institution. Fill in your username and password.
- Complete the form that appears after you have successfully logged in and press **Continue**.
- 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.

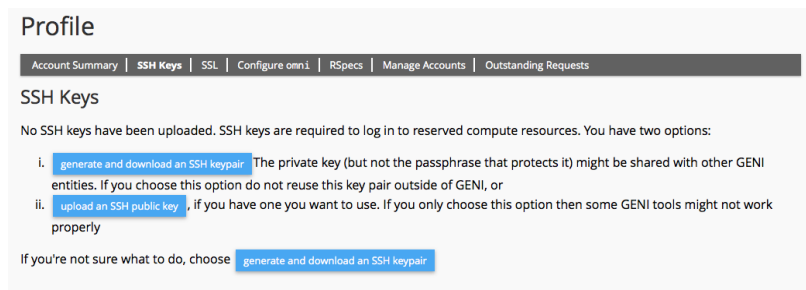


Figure 2-2 On the SSH Keys page, select the "generate and download an SSH keypair" button.

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

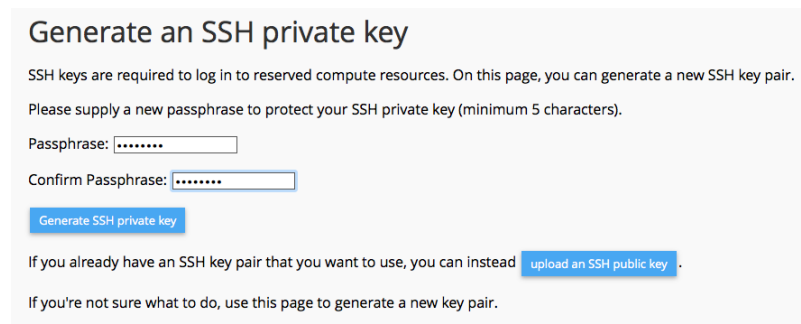


Figure 2-3 Enter passphrase twice, then generate SSH private key.

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

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

Later in the tutorial, this will allow you to log into your nodes securely without a password. (Users of GUI based ssh clients, such as PuTTY, should skip this step.)

Profile

Account Summary | SSH Keys | SSL | Configure omni | RSpecs | Manage Accounts | Outstanding Requests

SSH Keys

Name	Description	Public Key	Private Key	PuTTY	Edit	Delete
id_geni_ssh_rsa 93:9e:2d:43:7e:35:02:83:62:37:b2:83:c6:f3:b2:ed	Generated SSH keypair	Download Public Key	Download Private Key	Download PuTTY Key	Edit	Delete

On Linux and Mac systems and for most Windows SSH clients (not PuTTY), do:

Download your private key.
On Windows, just point your SSH client (not PuTTY) to the downloaded private key.
On Linux and Mac, open a terminal.
Store your key under `~/.ssh/` :
If the directory does not exist, create it:

```
mkdir ~/.ssh
```

Move the key to `~/.ssh/` :

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

Change the file permissions:

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

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**

Create New Slice

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

Project name: tutorial

Slice name: -- Required

Slice description:

Note: Slice names must not contain whitespace. Use at most 19 alphanumeric characters or hyphen (no leading hyphen): "a-zA-Z0-9-".

Note: Slice names are public and must be unique across your project.

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 to the right. 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

GENI Slice: *geni01*

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

Extend slice expiration

Slice Actions: Add Resources, Manage Resources, Manage Slice Members, Slice Identifiers, Recent Actions

Renew Slice

Project does not have an expiration date
Slice expires on 2015-08-12 16:14:27 Z

Renew slice only slice & known resources until 2015-08-12 **Renew**

Slice Tools: GENI Desktop, LabWiki, Omni, jFed, Geo Map

Graphical View | Aggregate View | Geographic View

Manage Resources

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.

- 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.

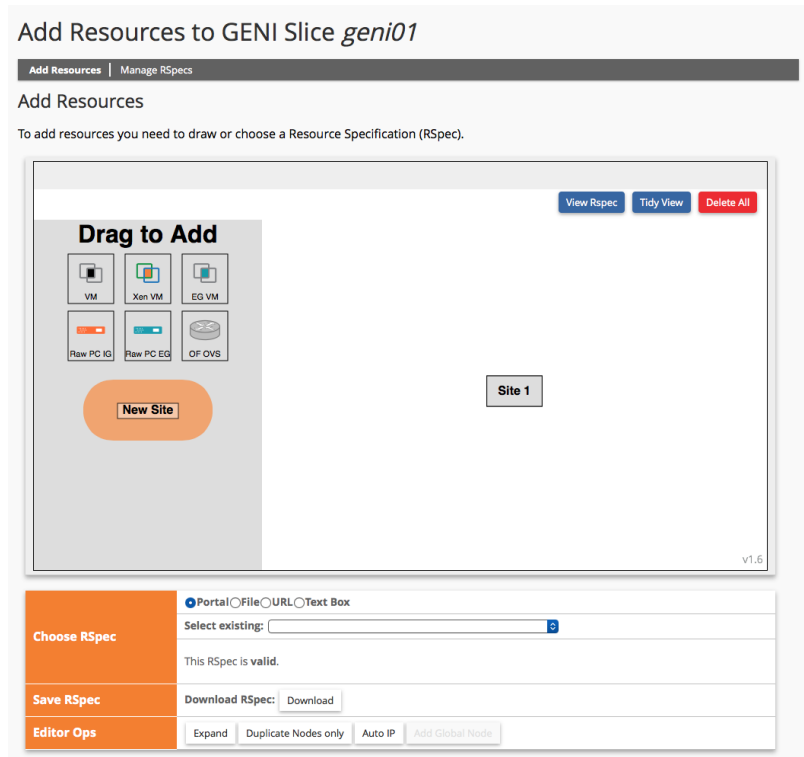


Figure 3-3 *Jacks after it has loaded.*

- 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.

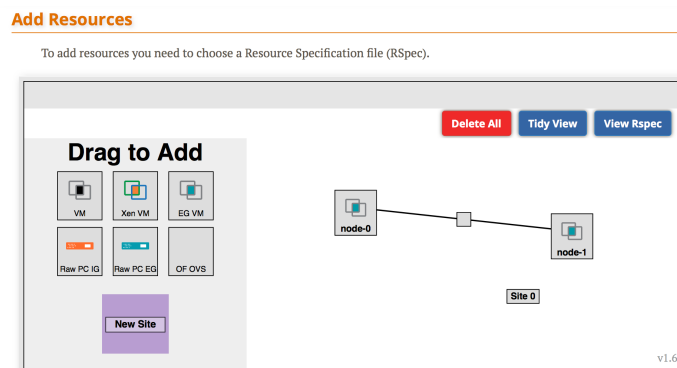


Figure 3-4 *Two VMs connected by a link.*

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.

Add Resources to GENI Slice *geni01* (Results)

Total run time: **33 seconds** Started at: **Wed, 05 Aug 2015 12:16:48 -0400**
Status: **Finished** Finished at: **Wed, 05 Aug 2015 12:17:21 -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 UtahDDC InstaGENI):

Status	Client ID	Component ID	Expiration	Type	Hostname
Unknown	server	pc6		default-vm	server.geni01.ch-geni-net.utahddc.geniracks.net
ssh_ahelsing@pc6.utahddc.geniracks.net -p 36411					
ssh_mbrinn@pc6.utahddc.geniracks.net -p 36411					
ssh_nriga@pc6.utahddc.geniracks.net -p 36411					
ssh_vthomas@pc6.utahddc.geniracks.net -p 36411					
ssh_tupty@pc6.utahddc.geniracks.net -p 36411					

Login

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.

Manage Resources

Resources on RENCI ExoGENI are ready.

The diagram shows a server icon connected to a client icon, both within a network labeled 'RENCI ExoGENI'. The server and client icons are green, indicating they are ready for use.

Renew Renew Date Delete SSH Restart Details Status Add Resources

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

- a. To get login information for a VM from the **Slice** page, either click on the "Details" button or 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. **If you are using ExoGENI resources, you may need to reload the Slice page in your browser to see SSH information.**

Resources on slice: geni01

Queried 1 of 1 aggregates.

[Refresh All Details](#) [Refresh Status Only](#)

Status	Aggregate
READY	Wisconsin InstaGENI

Aggregate Wisconsin InstaGENI's Resources:

Node #1:

Status	Client ID	Component ID	Expiration	Type	Hostname
READY	client	pc2	2015-08-12T16:14:27.000Z	default-vm	client.geni01.ch-geni-net.instageni.wisc.edu
Login	ssh_ahelsing@pc2.instageni.wisc.edu -p 31034 ssh_mbrinn@pc2.instageni.wisc.edu -p 31034 ssh_nriga@pc2.instageni.wisc.edu -p 31034 ssh_vthomas@pc2.instageni.wisc.edu -p 31034 ssh_tupty@pc2.instageni.wisc.edu -p 31034 ssh_asydne01@pc2.instageni.wisc.edu -p 31034 ssh_clsecu03@pc2.instageni.wisc.edu -p 31034 ssh_sedwards@pc2.instageni.wisc.edu -p 31034 ssh_rrhain@pc2.instageni.wisc.edu -p 31034				
Interfaces	MAC		Layer 3		
interface-0	pc2:1a0	02232ca93a63	ipv4: 10.10.1.1		

Node #2:

Status	Client ID	Component ID	Expiration	Type	Hostname
READY	server	pc2	2015-08-12T16:14:27.000Z	default-vm	server.geni01.ch-geni-net.instageni.wisc.edu
Login	ssh_ahelsing@pc2.instageni.wisc.edu -p 31035 ssh_mbrinn@pc2.instageni.wisc.edu -p 31035 ssh_nriga@pc2.instageni.wisc.edu -p 31035 ssh_vthomas@pc2.instageni.wisc.edu -p 31035 ssh_tupty@pc2.instageni.wisc.edu -p 31035 ssh_asydne01@pc2.instageni.wisc.edu -p 31035 ssh_clsecu03@pc2.instageni.wisc.edu -p 31035 ssh_sedwards@pc2.instageni.wisc.edu -p 31035 ssh_rrhain@pc2.instageni.wisc.edu -p 31035				
Interfaces	MAC		Layer 3		
interface-1	pc2:1a0	023f73bc7b60	ipv4: 10.10.1.2		

Link #1:

Client ID	Endpoint #0	Endpoint #1
link-0	interface-0	interface-1

Figure 4-1 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:

- 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 **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:

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

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

```
iperf -s
```

- c. 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?



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

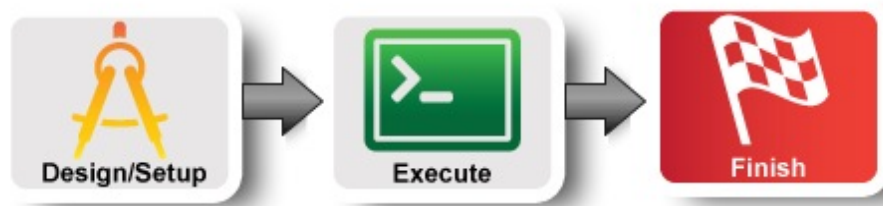
- Then type `exit` in your open terminal.

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.

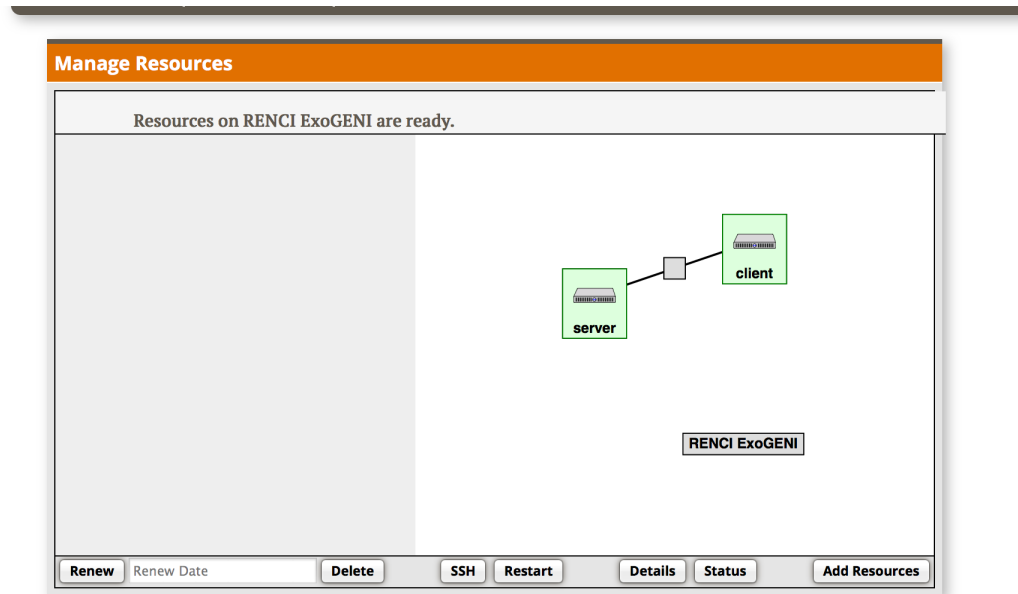


Figure 12-1 Delete resources at aggregate.

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

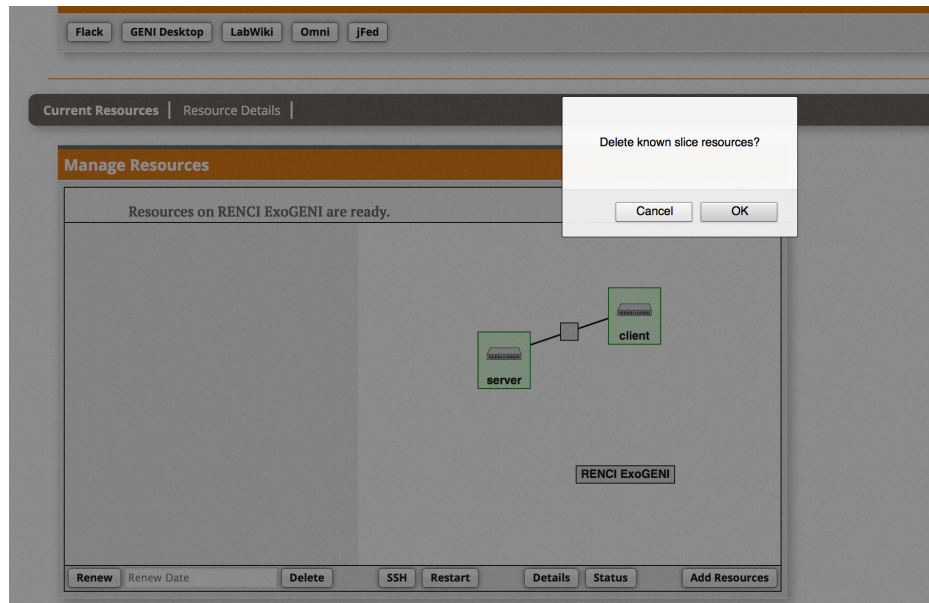


Figure 12-2 Delete resources at aggregate.

8. Archive Experiment

Congratulations you have successfully completed your first GENI experiment!

Introduction