



Chameleon Cloud Tutorial

National Science Foundation

Program Solicitation # NSF 13-602

CISE Research Infrastructure: Mid-Scale Infrastructure - NSFCloud (CRI: NSFCloud)

Cloud - Getting Started

Objectives

In this tutorial, you will learn how to create a Chameleon account and use the Chameleon resource leasing process to create on-demand bare metal servers using the Chameleon user interface.

#	Action	Detail	Time (min)
1	Register for a Chameleon User Account	You will learn how to register for your own Chameleon account, and how to utilize its basic features.	10
2	Create a Sample Project	To begin, we will walk through the Chameleon user interface capabilities, such as reservation, leasing, server provisioning, private/public IP addresses, networks, and more.	5
3	Add Users to the Project	To begin, we will walk through the Chameleon user interface capabilities, such as reservation, leasing, server provisioning, private/public IP addresses, networks, and more.	5
4	Launch a Chameleon Cloud Bare Metal Server	Lastly, you will learn how to create and log in to a new bare metal instance on Chameleon Cloud using your new Chameleon Cloud account.	15

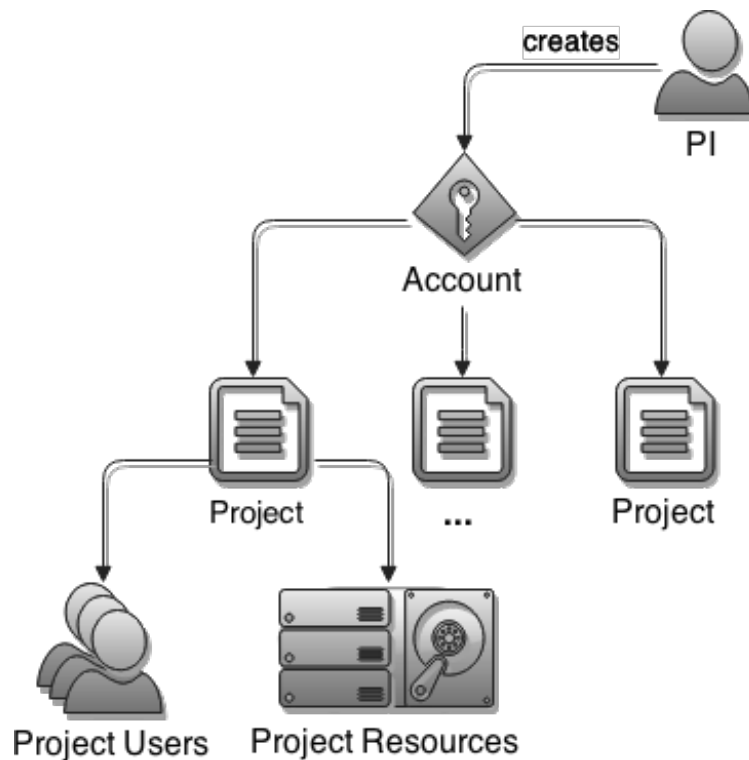
Prerequisites

The following prerequisites are expected for successful completion of this tutorial:

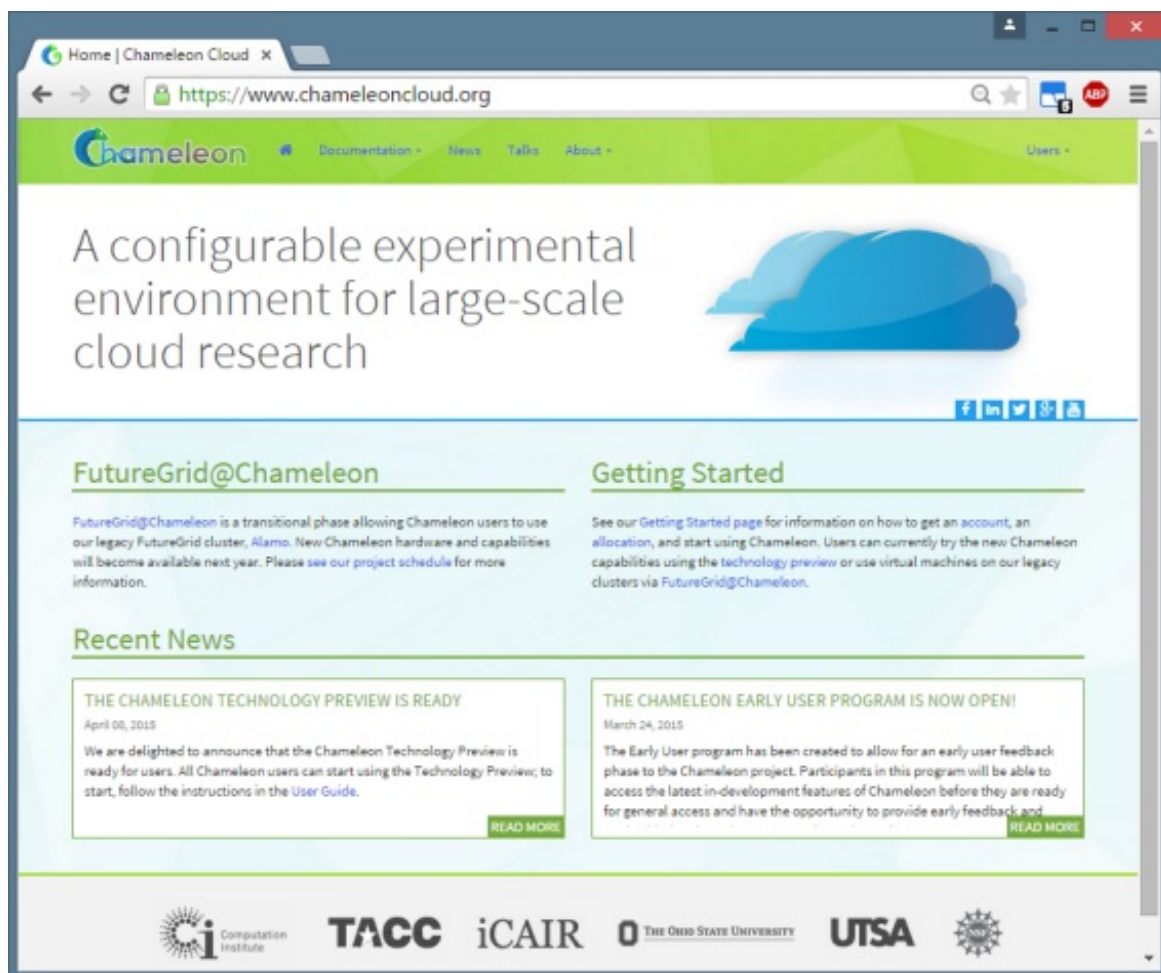
- An SSH client (Windows users: download PuTTY (<http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html>))
- A basic knowledge of Linux

Step 1: Register for a Chameleon Cloud user account

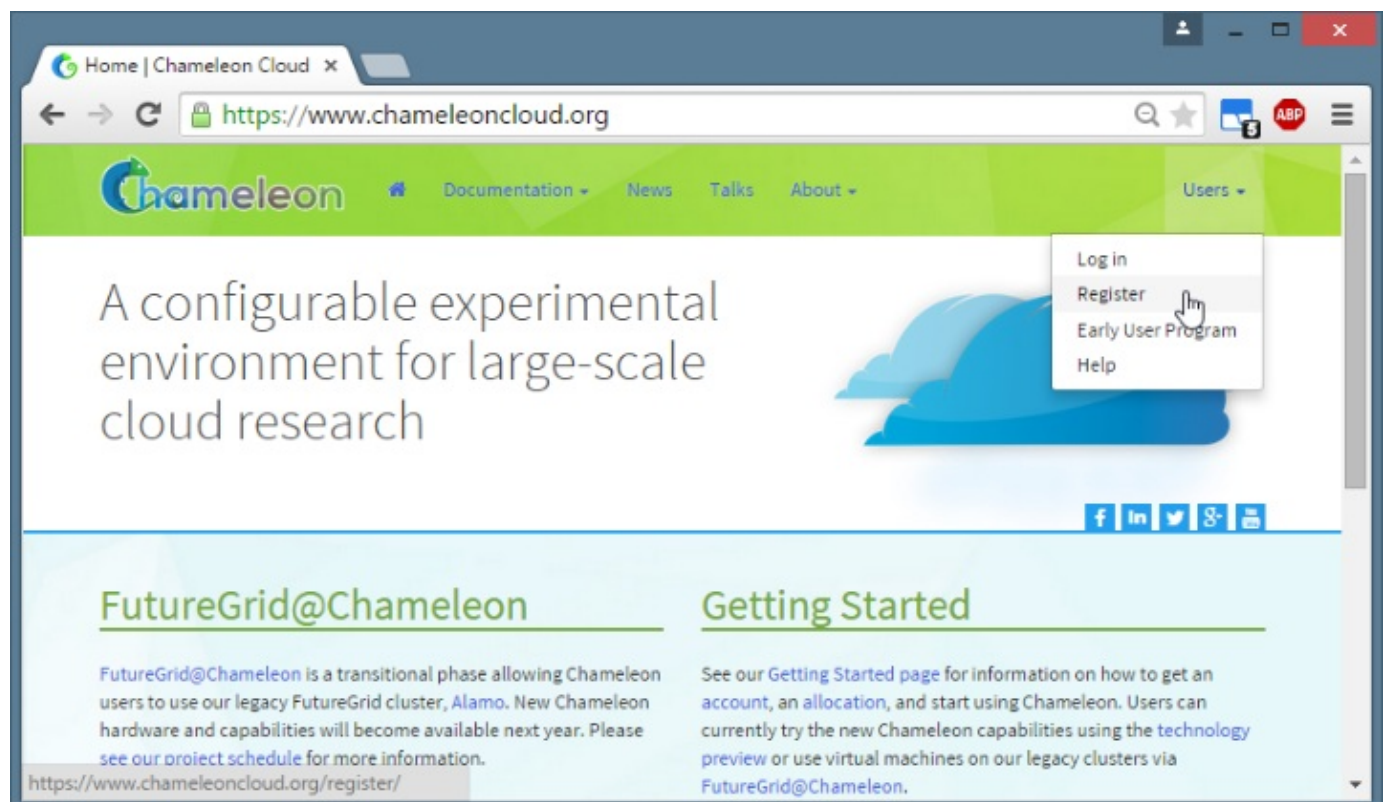
In this step, you will create your very own Chameleon Cloud user account. However, before we begin, it will be useful to define some Chameleon Cloud terminology and the relationship between these entities. A Chameleon user account, which we will register for below, is required to create projects. A project, in turn, can have any number of other Chameleon users associated with it. As such, users added to a project are known as “project users” for that project. Projects will also have resources, such as a number of bare metal servers, associated with them. Together, these concepts form a hierarchy:



To begin, Go to the Chameleon Cloud homepage (<https://www.chameleoncloud.org/>)



Find and click on the “Users” button located in the upper right-hand corner of the page. Click on “Register” from the pop-up menu that appears.



Complete the “Contact Information” and “Account Information” forms. You will be given the option called “PI Eligibility”. The PI (or Principal Investigator) of an institute has the ability to create projects. Non-PI users can be added to a project, but cannot create their own

projects. **When finished, click on “Save Profile”. You will soon receive an email notification regarding account creation completion.**

The screenshot shows a two-column form for account creation. The left column, titled 'Contact Information', includes fields for First name, Last name, Email address, Institution (a dropdown menu), Country of Residence (a dropdown menu), and Country of Citizenship (a dropdown menu). Below these is a section for 'PI Eligibility' with a radio button for 'PI Eligible' and a note: 'Faculty and Research Staff from U.S.-based institutions can request PI Eligibility on Chameleon.' The right column, titled 'Account Information', includes fields for Username, Password, and Confirm Password. A note specifies: 'Usernames must be 3-8 characters in length, start with a letter, and can contain only lowercase letters, numbers, or underscore.' Below the password fields, it states: 'Passwords must meet the following criteria:' followed by a bulleted list: 'Must not contain your account name or parts of your full name', 'Must be a minimum of 8 characters in length', and 'Must contain characters from at least three of the following: uppercase letters, lowercase letters, numbers, symbols'. At the bottom of the right column are 'Save Profile' and 'Cancel' buttons.

You will be taken back to the Chameleon Cloud homepage with a message notifying you to check your email for account verification.

Congratulations! Your account request has been received. Please check your email for account verification. X

You should receive an email instructing you to click on a link in order to confirm your email address. Upon doing so, you will be taken to an email confirmation page where you are asked to provide your Chameleon username. After doing so, click on “Verify”.

The screenshot shows the 'Email Confirmation' page on the Chameleon website. The page has a green header with the Chameleon logo and navigation links: Documentation, News, Talks, About, and Users. The main content area has a title 'Email Confirmation' and a message: 'Almost finished! Enter the verification code that you received via email and the username you registered with to activate your account.' Below this is a form with two input fields. The first field is labeled 'Enter Your Verification Code*' and contains the text 'GPXadxYMPRGnLNziQuqaJpifLMqYPmQySWfrvJhlmfSKLFdlJ'. The second field is labeled 'Enter Your Chameleon Username*' and contains the text 'Enter Your Chameleon Username'. At the bottom left of the form is a green 'Verify' button.

If your information matches, you will receive a message indicating successful verification, and will be directed to login to Chameleon for the first time.

Step 2: Create a Sample Project

If not already there, login to the Chameleon website (<https://chameleoncloud.org/login/>)

Congratulations, your email has been verified! Please log in now.

Login to Chameleon

Username*

Password*

[Log in](#) [Forgot your password?](#)

Upon successfully logging in, you will be asked to **accept the Chameleon User Terms and Conditions**. Click “Accept” to proceed.

Chameleon [Documentation](#) [News](#) [Talks](#) [About](#) Hello, Paul Rad

Please Accept Chameleon User Terms and Conditions

- I will only use Chameleon resources to perform research work consistent with the goals of my project. I will not use Chameleon resources for activities related to financial gain, any unlawful purpose, or in a way that makes the work of other users difficult.
- I also will acknowledge Chameleon in all publication presenting results or content obtained using Chameleon. The official acknowledgement is as follows: “Results presented in this paper were obtained using the Chameleon testbed supported by the National Science Foundation”.
- I understand that non-compliance with the terms above will result in suspension of my account.

[Accept](#)

[Print Terms & Conditions](#)

Each time you log in, you will be taken to your Dashboard, where you can manage your projects, help desk tickets, as well as your account settings. As we wish to create a new project, **click on the “Manage your Projects” button**.

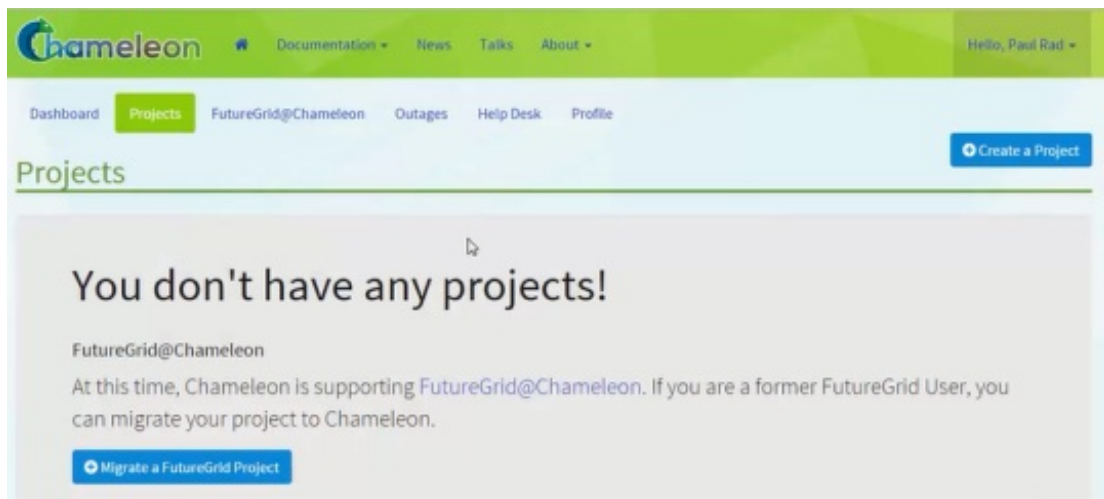
Chameleon [Documentation](#) [News](#) [Talks](#) [About](#) [User](#)

[Dashboard](#) [Projects](#) [FutureGrid@Chameleon](#) [Outages](#) [Help Desk](#) [Profile](#)

Dashboard

[Manage your Projects](#) [Help Desk Tickets](#) [Manage Your Account](#)

You will be told you do not currently have any projects. **Click on the “Create Project” button** in the upper right-hand corner of the page to continue.



You should then be presented with and asked to **accept the Project Lead Terms and Conditions**. Click “Accept” to proceed.

 This is a modal dialog box titled 'Please Accept Project Lead Terms and Conditions'. It contains three bullet points of terms:

- As a project lead I take responsibility for ensuring that users conducting work on the Chameleon testbed as part of my project observe the user terms and conditions.
- I further agree to provide the Chameleon team with reports on the progress of my project as requested (at most bi-annually).
- I understand that non-compliance with the terms above will result in suspension of my project and suspension of access to all the users holding allocations under this project.

 At the bottom left is a green 'Accept' button, and at the bottom right is a link to 'Print Terms & Conditions'.

You will then need to **complete the “Create a New Project” form** by providing a title, description, and type. A Project ID will be automatically generated and assigned – it is displayed on this page for your reference. When you are satisfied with your input, **click on “Create Project”**.

 The screenshot shows the 'Create a New Project' form on the Chameleon website. The form has several sections:

- Title***: A text input field with placeholder text 'Research into how...'.
- Abstract***: A large text area with placeholder text 'We propose to...'.
- Type***: A dropdown menu currently showing 'Choose One'. Below it is a note: 'Please select the project type.'
- Field of Science***: A dropdown menu currently showing 'COMPUTER AND INFORMATION SCIENCE AND ENGINEERING (CISE)'. Below it is a note: 'Please indicate a primary field of science for this research'.
- Project ID**: A text input field showing 'CH-300000X'. Below it is a note: 'Project ID will be assigned upon creation'.

 At the bottom of the form are two buttons: 'Create Project' (in green) and 'Cancel'.

You will then be taken to view the new project’s details. It is on this page that you can add project users. **At this point, the project’s “Allocation” status will be reported as “Chameleon Pending”**. Check in regularly to see when your project’s allocation has been approved.

Chameleon

Documentation News Talks About

Dashboard **Projects** FutureGrid@Chameleon Outages Help Desk Profile

Your project has been created!

training | CH-816738

PI	Paul Rad <paul.rad@gmail.com>, University of Texas at San Antonio
Abstract	To provide training and teaching materials for Chameleon Cloud users.
Type	Startup
Field of Science	COMPUTER AND INFORMATION SCIENCE AND ENGINEERING (CISE)
Allocation	Chameleon Pending

Project Users

Add a User to Project*

Step 3: Add Users to the Project

If you have not done so already, as a PI user, login to the Chameleon website (<https://chameleoncloud.org/login/>).

On your Dashboard, **click on the “Manage Your Projects” button.**

Chameleon

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Dashboard

Manage your Projects Help Desk Tickets Manage Your Account

Click on the desired project’s “View Project” button.

Chameleon

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Dashboard **Projects** FutureGrid@Chameleon Outages Help Desk Profile

Projects

GEC Tutorial Project | CH-816752 **View Project**

PI	Paul Rad <paul.rad@utsa.edu>
Abstract	GEC Tutorial Project

Scroll down to view the “Project Users” area. **In the textbox labeled “Add a User to Project”, enter the username of the user you would like to add to the project, then click the “Add user” button.**

The screenshot shows a web interface for a project titled "GEC Tutorial Project" with ID "CH-816752". It contains a table with project details and a section for managing users.

GEC Tutorial Project CH-816752	
PI	Paul Rad <paul.rad@utsa.edu>, University of Texas at San Antonio
Abstract	GEC Tutorial Project
Type	Research
Field of Science	COMPUTER AND INFORMATION SCIENCE AND ENGINEERING (CISE)
Allocation	Chameleon <i>Pending</i>

Project Users

Add a User to Project

Current Users

paulrad (PI)

Repeat this process as necessary until all desired users have been added to the project.

Step 4: Launch a Chameleon Cloud Bare Metal Server

In this section, we will show you how to launch your own bare metal servers on Chameleon. The technology preview of Chameleon gives access to bare-metal compute resources on which users can have administrative access to run cloud computing experiments with a high degree of customization and repeatability. Typically, an experiment will go through several phases:

4.0 Discovering resources

All physical resources available to users through the Chameleon technology preview are described in the Chameleon resource registry (<https://www.chameleoncloud.org/user/discovery/>) where users may browse and learn about all the resources available in the Chameleon technology preview. By default, the resource discovery web interface displays all nodes of the test bed. They can be filtered using the controls on the right side of the page.

Resource Discovery | Chameleon Cloud

https://www.chameleoncloud.org/user/discovery/

Chameleon Documentation News Talks About Users

Nodes

45 nodes

1. **0a5b61b2-dc1c-4bee-86f7-247c9689ea88**

Site:	tacc
Cluster:	alamo
UID:	0a5b61b2-dc1c-4bee-86f7-247c9689ea88
Version:	547815582085deb7b703d76a51e082c53aa9d9b4
GPU:	false

Processor

Vendor:	Intel
Model:	Intel Xeon
Version:	X5550
Clock Speed:	2.66 GHz
Instruction Set:	x86-64
Description:	Intel(R) Xeon(R) CPU X5550 @ 2.67GHz
Cache L1:	n/a
Cache L1d:	32 KB
Cache L1i:	32 KB
Cache L2:	256 KB
Cache L3:	8,192 KB

Architecture

Platform Type:	x86_64
SMP Size:	2
SMT Size:	8

Memory

Facets

Search

Site

☐ TACC (45)

Cluster

☐ alamo (45)

Virtual Support

☐ ivt (45)

Besteffort Support

☐ unknown (45)

Deploy Support

☐ true (45)

Network adapter interface #1

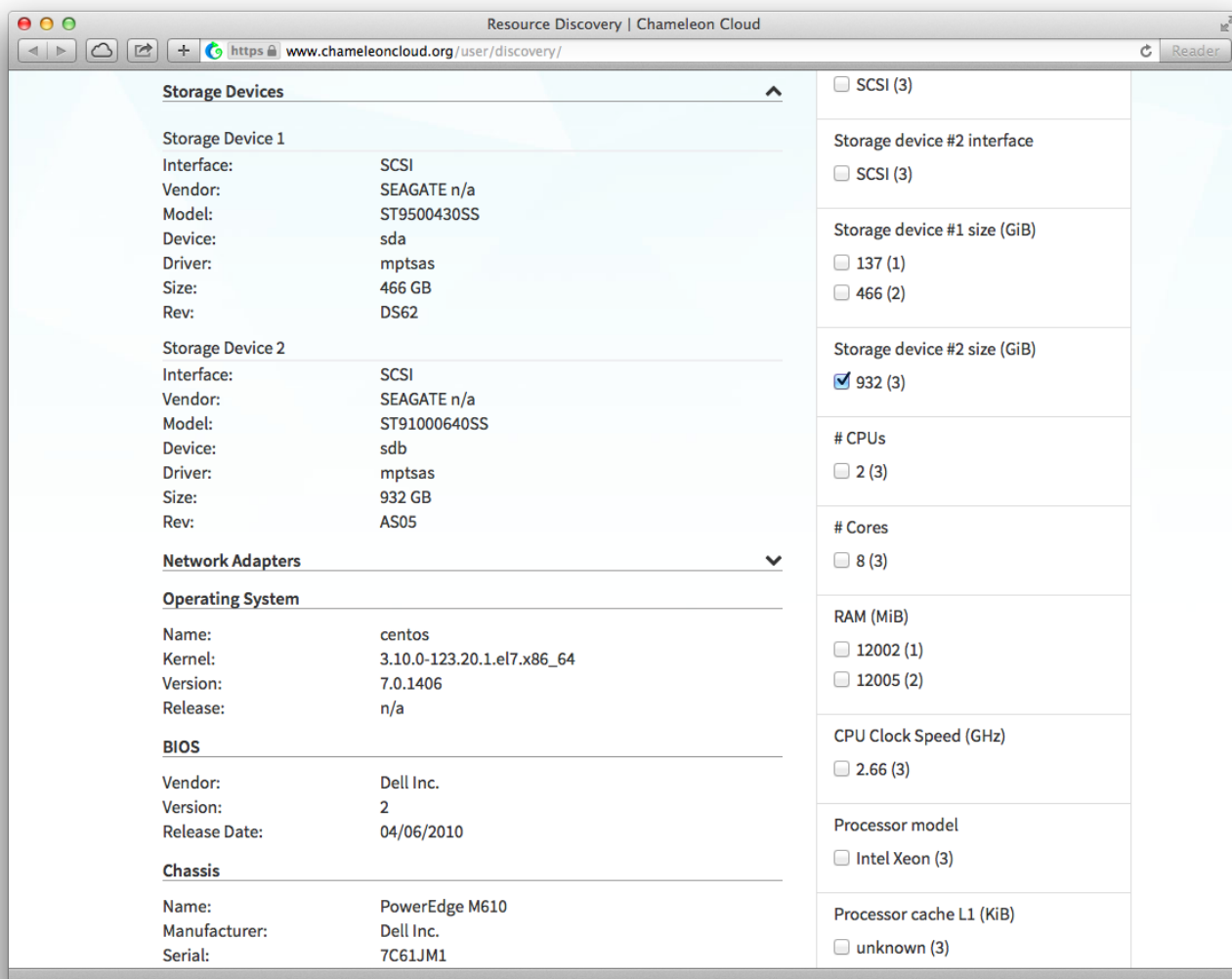
☐ Ethernet (45)

Network adapter interface #2

☐ Ethernet (45)

Network adapter interface #3

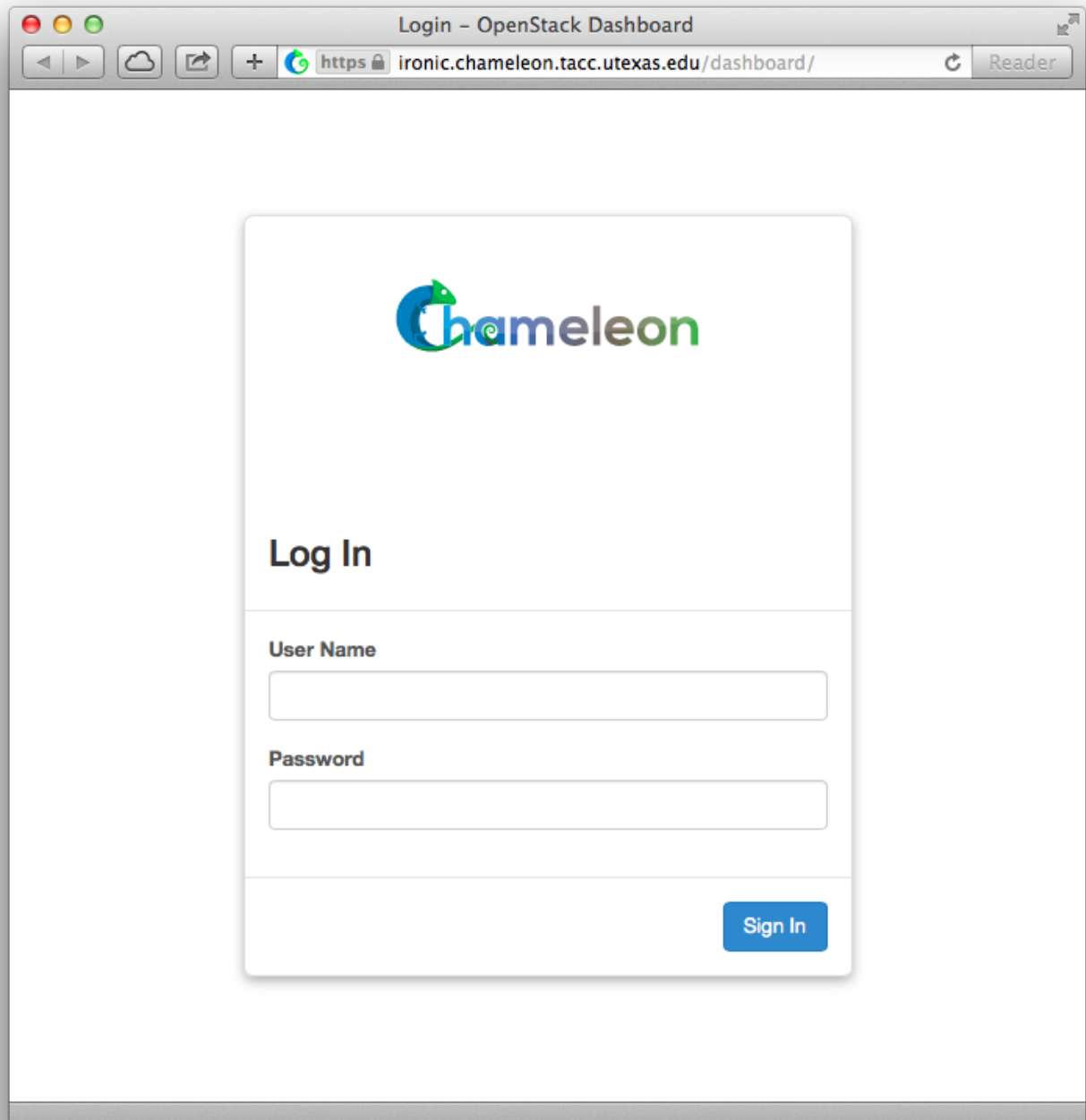
For example, three nodes of the Alamo cluster have a 1 TB disk as a second drive. To list information for only these nodes, click on the corresponding checkbox:



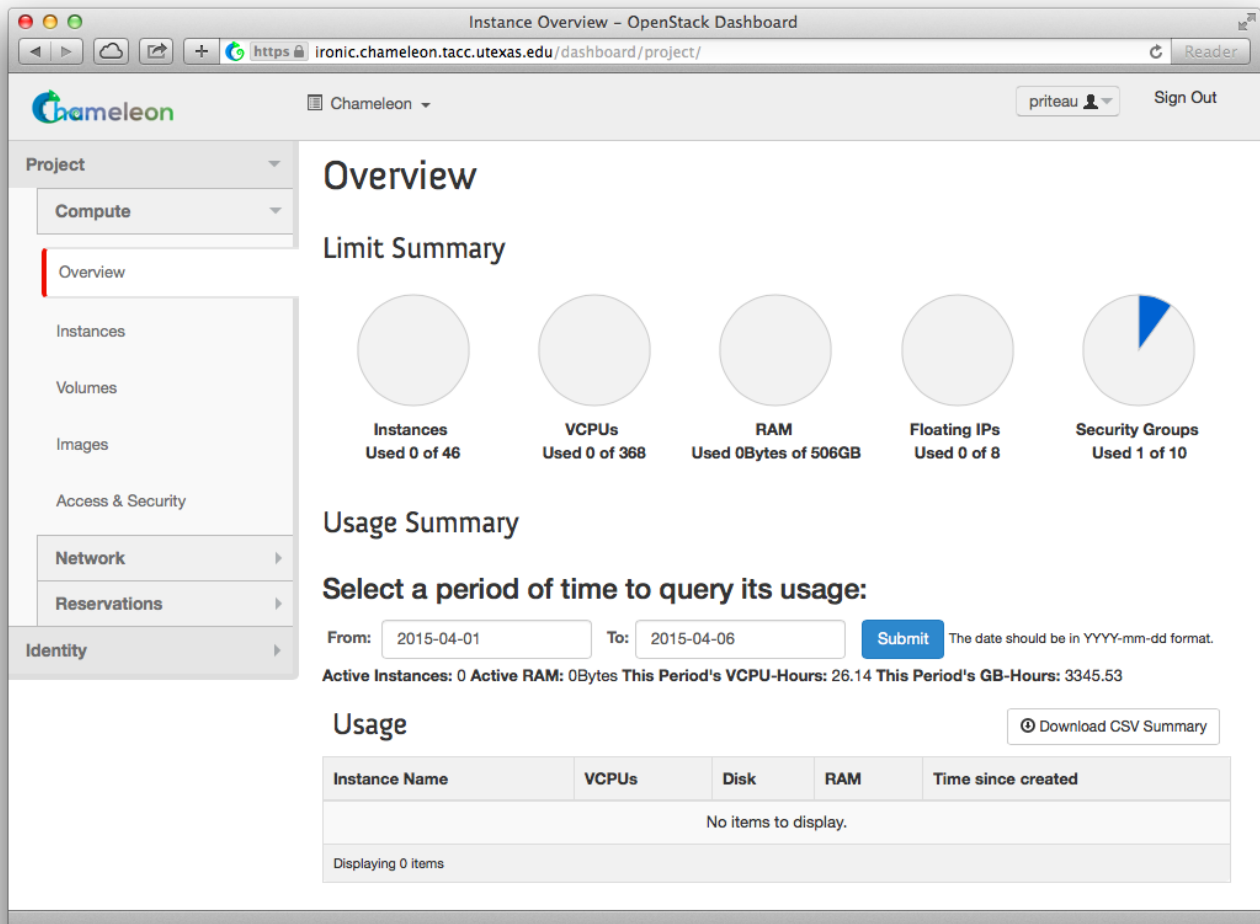
4.1 Create a reservation lease

Physical resources on the Chameleon technology preview must be reserved before using them for an experiment. Once a reservation has been accepted, users are guaranteed that resources will be available at the time they chose (except in extraordinary circumstances such as hardware or platform failures), which will help to run large scale experiments.

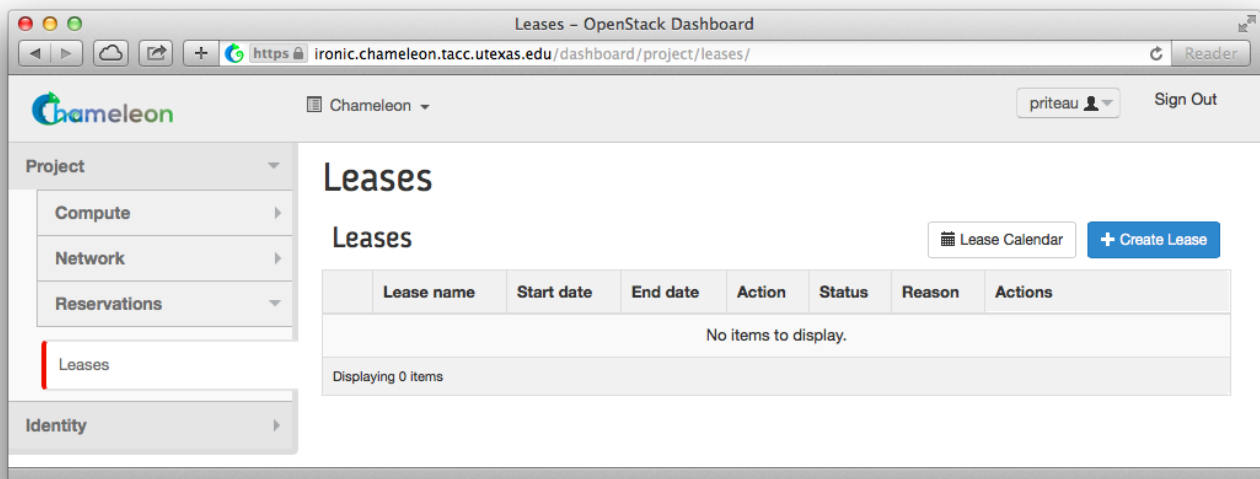
To begin, login to the Chameleon Resource Provisioning Dashboard (<https://ironic.chameleon.tacc.utexas.edu/dashboard/auth/login/>).



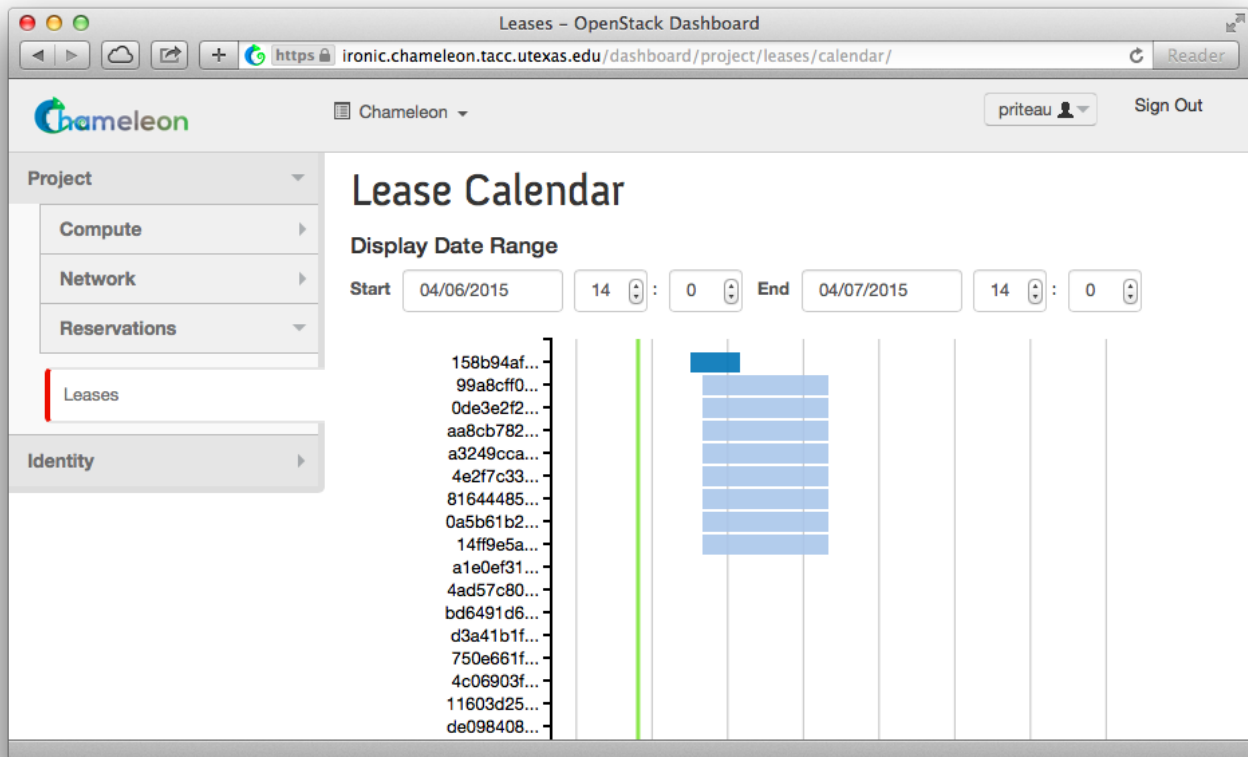
You should land on the Compute overview page for your default project. The pie charts on the page will show you what the current usage of things like instances and floating IPs is relative to the limit for your project. The usage summary will show historical usage of your project for a time period that can be selected. The usage box will show information about the instances currently running in your project.



To access the reservation system, click on “Reservations”, then “Leases”.



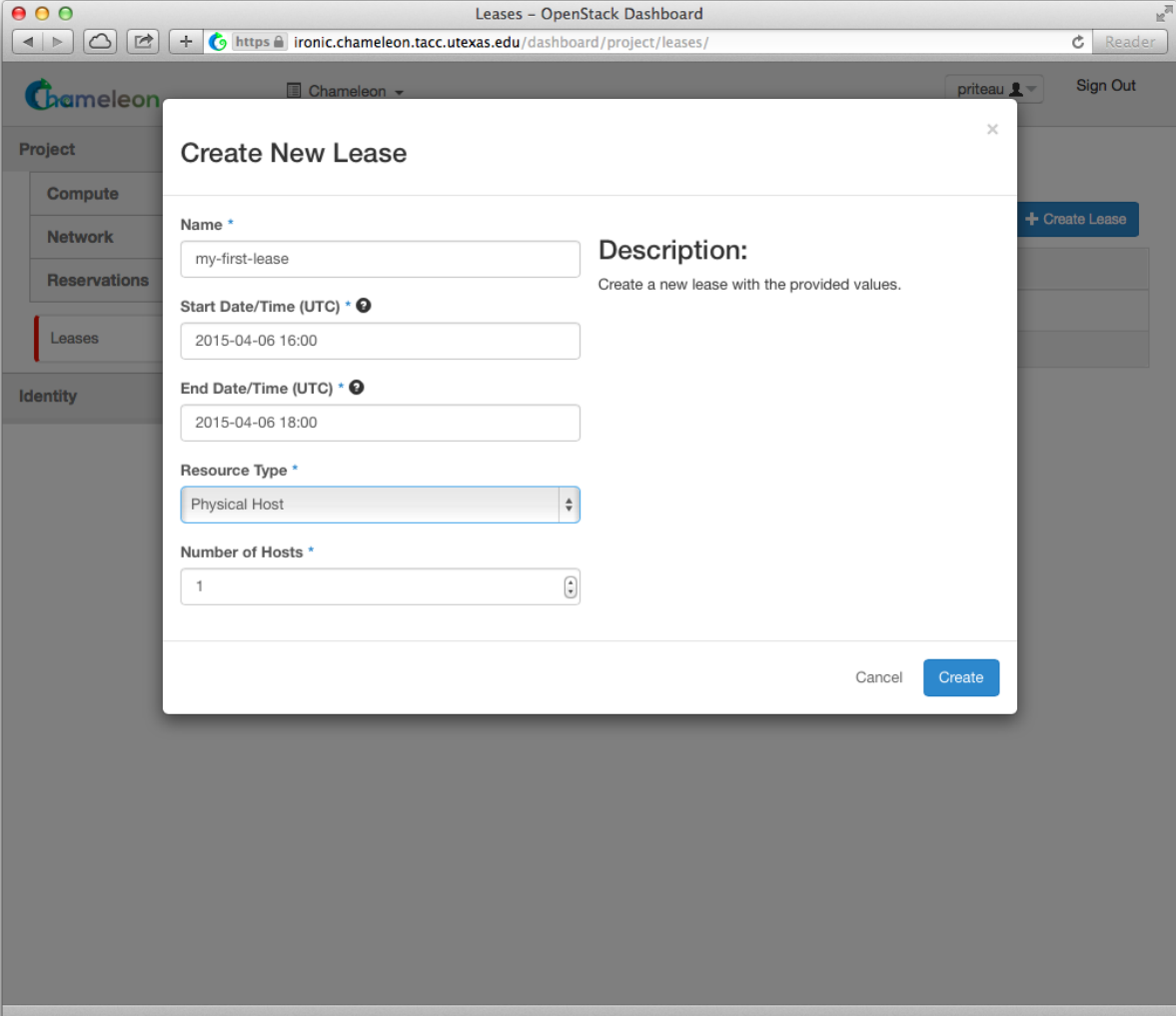
To discover when resources are available, you may access the lease calendar. This will display a Gantt chart of the reservations which allows you to find when resources are available. The Y axis represents the different physical nodes in the system and the X axis represents time.



Once you have chosen a time period when you want to reserve resources, go back to the Leases screen and **click on “Create Lease”**. It should bring up the window displayed below:

1. Pick a name for the lease. This name needs to be unique across your project. This example uses the name my-first-lease.

2. Pick a start time; if you want to create your lease soon pick a start time in the near future. Note that it must be entered in UTC! You can get the UTC time by running “date -u” in your terminal.
3. Pick an end time. Similarly, you must use UTC.
4. Choose the number of hosts, it is 1 by default.
5. **After completing the “Create New Lease” form, click on the “Create” button.**



The screenshot shows a web browser window titled "Leases - OpenStack Dashboard" with the URL "https://ironic.chameleon.tacc.utexas.edu/dashboard/project/leases/". The page features a sidebar with navigation links for "Project", "Compute", "Network", "Reservations", and "Leases" (which is highlighted). The main content area displays a "Create New Lease" modal form. The form includes the following fields: "Name" (text input with value "my-first-lease"), "Description" (text area with placeholder "Create a new lease with the provided values."), "Start Date/Time (UTC)" (text input with value "2015-04-06 16:00"), "End Date/Time (UTC)" (text input with value "2015-04-06 18:00"), "Resource Type" (dropdown menu with "Physical Host" selected), and "Number of Hosts" (text input with value "1"). At the bottom right of the form are "Cancel" and "Create" buttons.

Once created the lease details will be displayed. At the bottom of the page are the details about the reservation. Initially the reservation is in the Pending status, and stays in this state until we reach the start time.

Lease Detail - OpenStack Dashboard

https://ironic.chameleon.tacc.utexas.edu/dashboard/project/leases/c9c980bb-a13b-4a89-a8ad-ebc8f6797f1c/ Reader

Reservations

Leases

Identity

Lease Overview

Lease

Name
my-first-lease

Id
c9c980bb-a13b-4a89-a8ad-ebc8f6797f1c

Project Id
Chameleon

Start date
-

End date
-

Action
CREATE

Status
COMPLETE

Status Reason
Successfully created lease

Events

start_lease
Status: Undone
Created at: -
Updated at: -

end_lease
Status: Undone
Created at: -
Updated at: -

Reservations

physical:host
Id: 58fa6bde-bb27-4759-b5b2-422f5ee108c8
Status: Pending
Resource Id: 135
Created at: -
Updated at: -

Once the start time of the lease is reached, the lease will be started and its reservation will change to “Active”; you may need to refresh the page to see this.

Action
CREATE
Status
COMPLETE
Status Reason
Successfully created lease

Events

start_lease
Status: Undone
Created at: -
Updated at: -

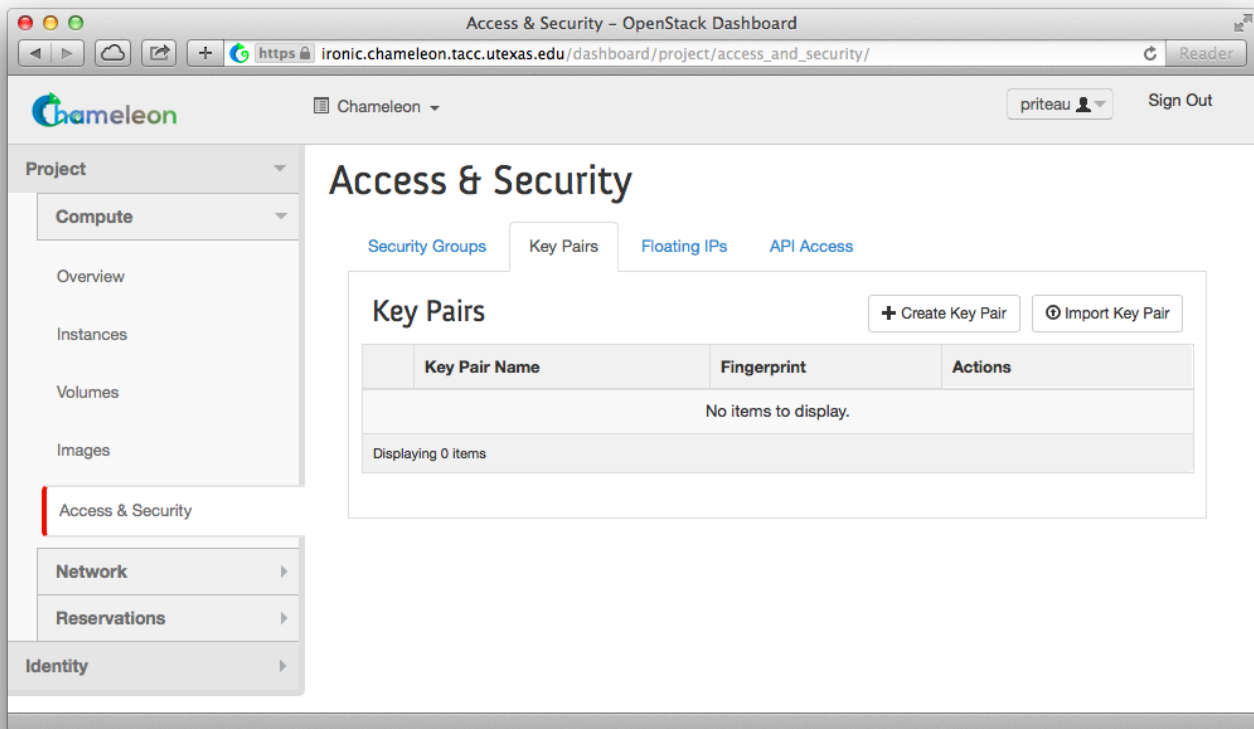
end_lease
Status: Undone
Created at: -
Updated at: -

Reservations

physical:host
Id: 58fa6bde-bb27-4759-b5b2-422f5ee108c8
Status: Pending
Resource Id: 135
Created at: -
Updated at: -

4.2) Import Public Key Pair

Once your lease is started, you are almost ready to start an instance. But first, you need to make sure that you will be able to connect to it by setting up a key pair. This only has to be done once per user per project. **Click on the “Access & Security” section, then click the “Key Pairs” tab.

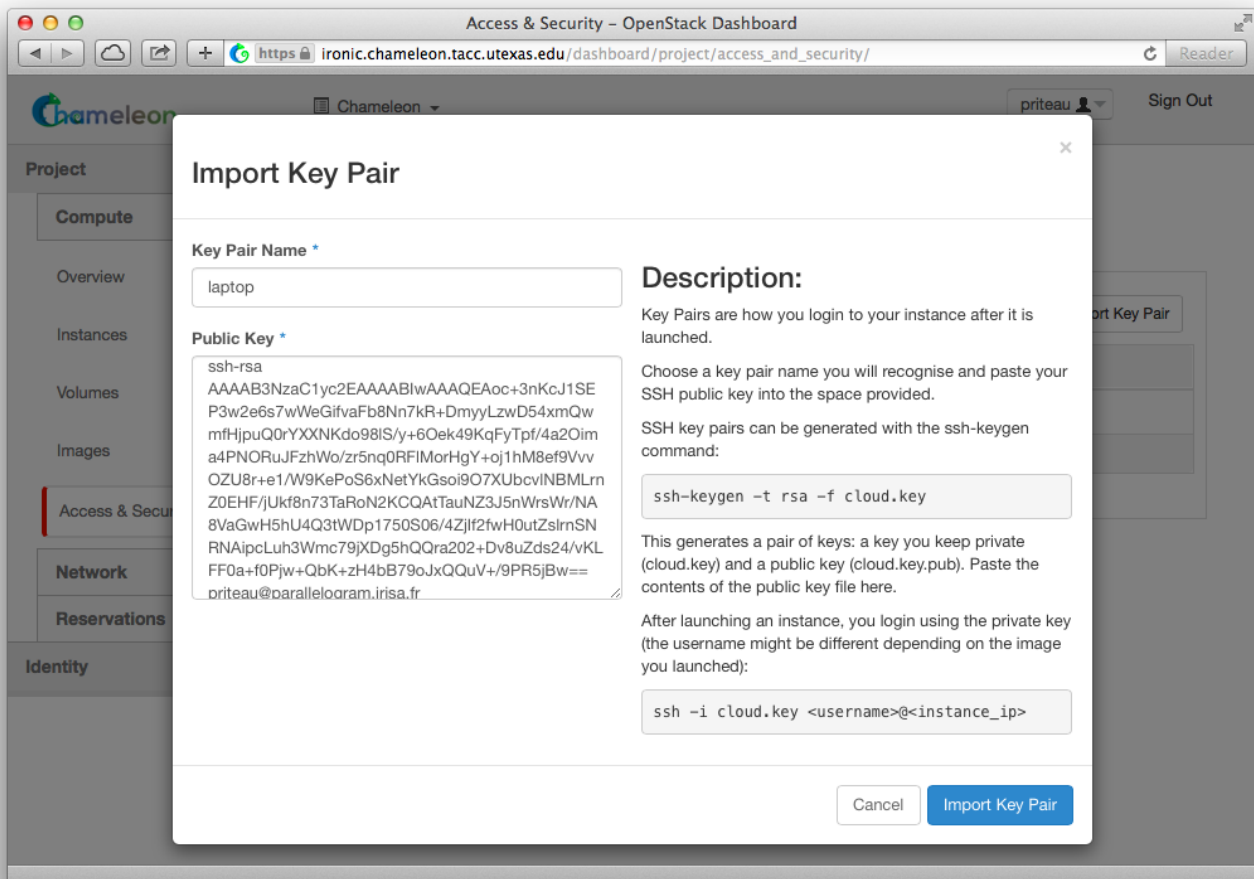


Here you can either get Chameleon to create an SSH key pair for you via the “Create Key Pair” button. If you already have an SSH key pair on your machine and are happy to use it, **click on “Import Key Pair”**.

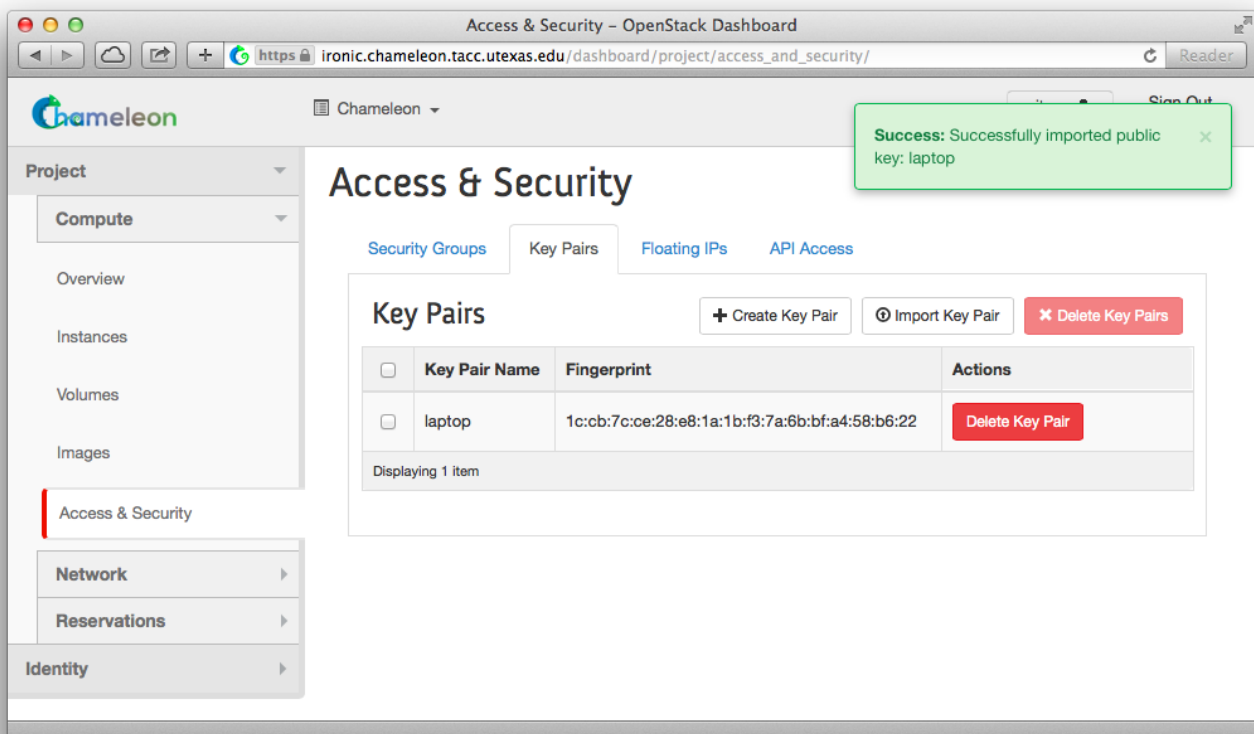
Enter a name for the key pair, for example “laptop”. In the “Public Key” box, copy the content of your SSH public key. Typically it will be at `~/.ssh/id_rsa.pub`. To create your own key pair, execute the command:

```
ssh-keygen -t rsa -f cloud.key
```

Copy the contents of the cloud.key.pub file, then simply paste into the “Public Key” box and click on “Import Key Pair”.

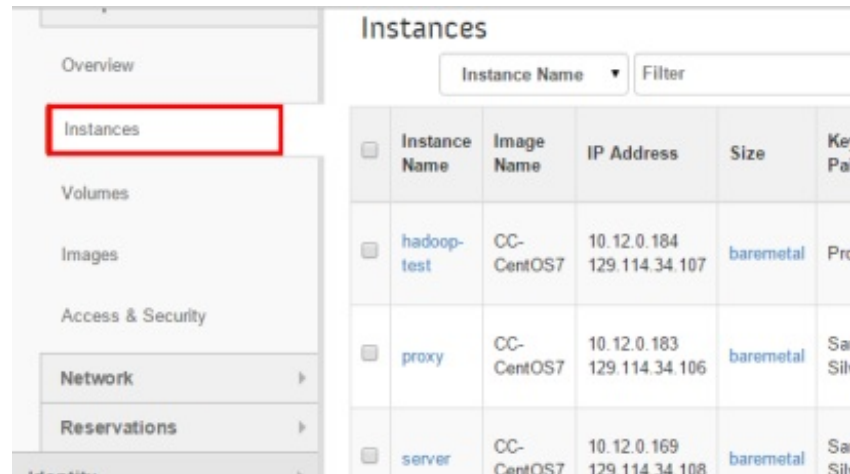


You should now see a list of known key pairs, with the one you just added.

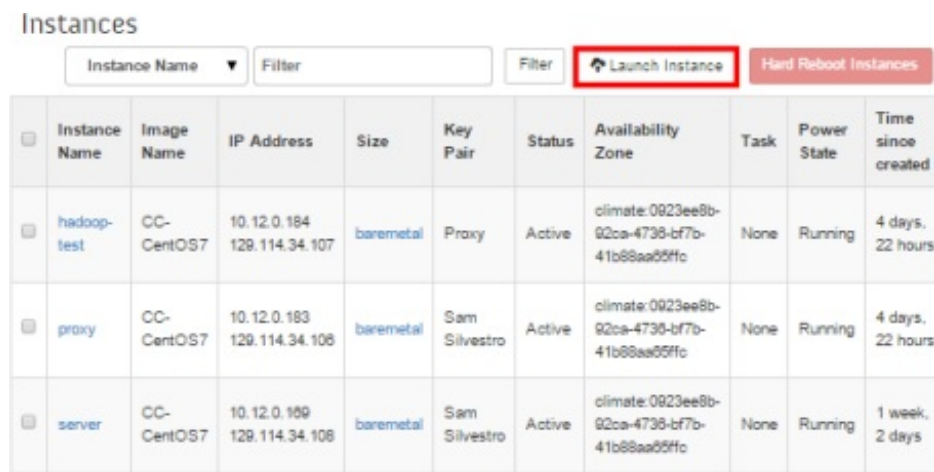


4.3) Launch an Instance using Public Key Pair

Now that we have a valid key pair published, we can proceed with creating a new server. **Click on the “Instances” tab** under “Compute”, where we can create, manage, and delete servers on demand.



Next, **click on the “Launch Instance” button**.



Create a Chameleon server with the following attributes.

1. Instance name: ****test****
2. Availability zone: **Any Availability Zone**
3. Reservation: *******
4. Flavor: **baremetal**
5. Instance count: **1**
6. Instance boot source: **Boot from image**
7. Image name: **CC-CentOS7**
8. Click on the **“Access & Security”** tab
9. Select *your key pair* from the list.
10. Click: **Launch**

Launch Instance

Details *

Access & Security *

Networking *

Post-Creation

Availability Zone

Any Availability Zone

Reservation ⓘ

TestLease (c0fec26-6765-4785-8af5-54)

Instance Name *

Hadoop-test

Flavor * ⓘ

baremetal

Instance Count * ⓘ

1

Instance Boot Source * ⓘ

Boot from image

Image Name

CC-CentOS7 (749.5 MB)

Specify the details for launching an instance.

The chart below shows the resources used by this project in relation to the project's quotas.

Flavor Details

Name	baremetal
VCPUs	8
Root Disk	128 GB
Ephemeral Disk	0 GB
Total Disk	128 GB
RAM	11,264 MB

Project Limits

Number of Instances

2 of 20 Used

Number of VCPUs

16 of 160 Used

Total RAM

22,528 of 225,280 MB Used

Cancel

Launch

Launch Instance

Details *

Access & Security *

Networking *

Post-Creation

Key Pair ⓘ

Proxy

Security Groups * ⓘ

☒ default

Control access to your instance via key pairs, security groups, and other mechanisms.

Cancel

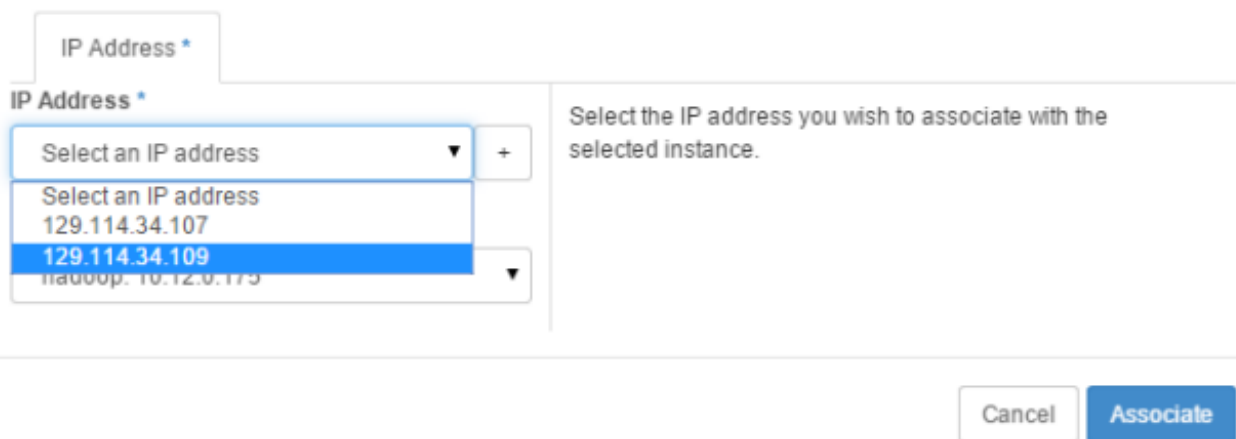
Launch

Your Chameleon Cloud server will begin building.

4.4) Assign Floating IP for Public Access

When the server becomes available, **click on the “Associate Floating IP” button** at the end of its row. Select an available IP address from the list and **click on “Associate”**. Make note of this new IP address, as we will need it to complete the next step.

Manage Floating IP Associations



Now SSH into your new server using the new floating IP address.

```
[proxyuser@proxy ~]$ ssh cc@your.floating.ip.address
The authenticity of host 'your.floating.ip.address (your.floating.ip.address)' can't be
established.
ECDSA key fingerprint is 3d:4e:d1:a0:e8:d9:e6:19:a2:8a:79:48:66:c5:01:1d.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'your.floating.ip.address' (ECDSA) to the list of known hosts.
[cc@Hadoop-test ~]$
```

Ensure you are logging in using the cc account on any servers you create using this method.

Appendix A: Generating and Using SSH Key Pairs on Windows Platforms

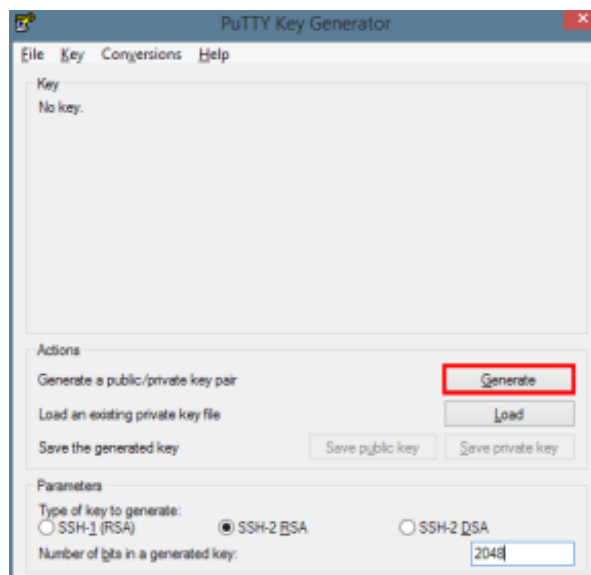
First, we will need to download tools to generate our key pair, as well as an SSH client that can make use of them. These tools are called PuTTYGen and PuTTY, respectively.

The location to download PuTTYGen is:

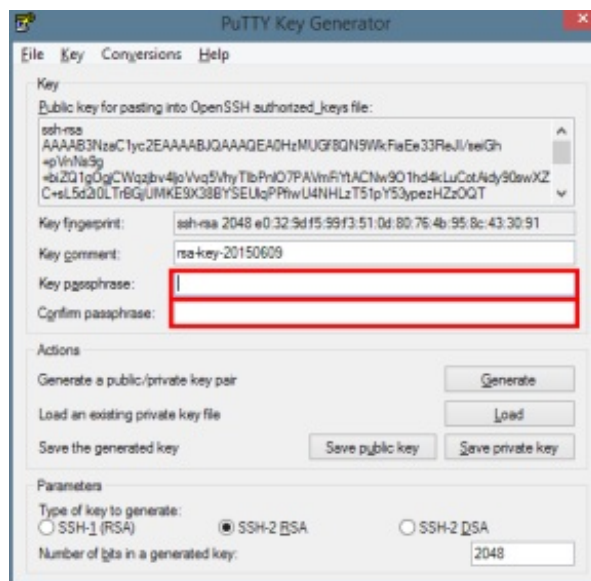
<http://the.earth.li/~sgtatham/putty/latest/x86/puttygen.exe>
(<http://the.earth.li/~sgtatham/putty/latest/x86/puttygen.exe>)

The location to download PuTTY is: <http://the.earth.li/~sgtatham/putty/latest/x86/putty.exe>
(<http://the.earth.li/~sgtatham/putty/latest/x86/putty.exe>)

Download and run the PuTTYGen executable:

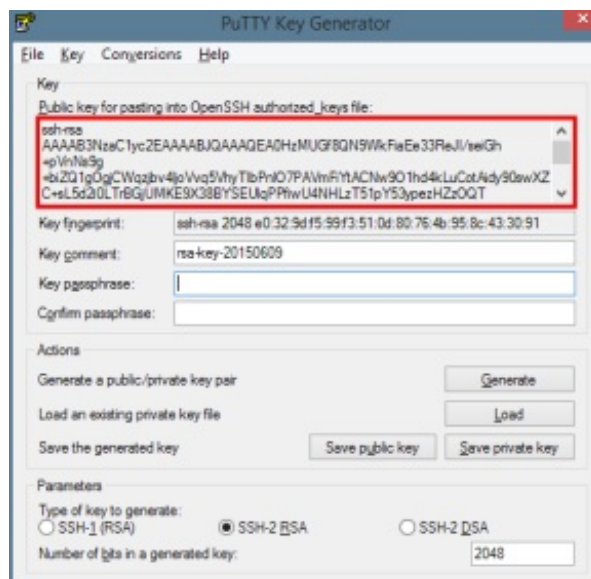


Click on the “Generate” button and move your mouse as indicated in order to generate enough random movement with which to help create your new key pair. When the process has completed, you may enter a password into the “Key passphrase” input box in order to protect your private key.

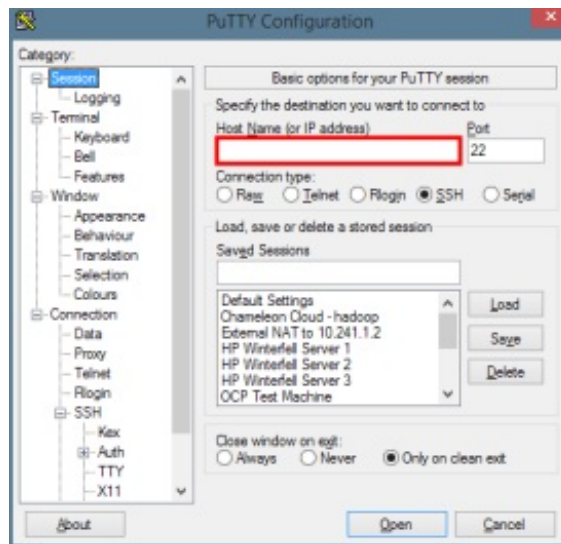


Click on the “Save private key” button and save this file to a location you can easily recall later.

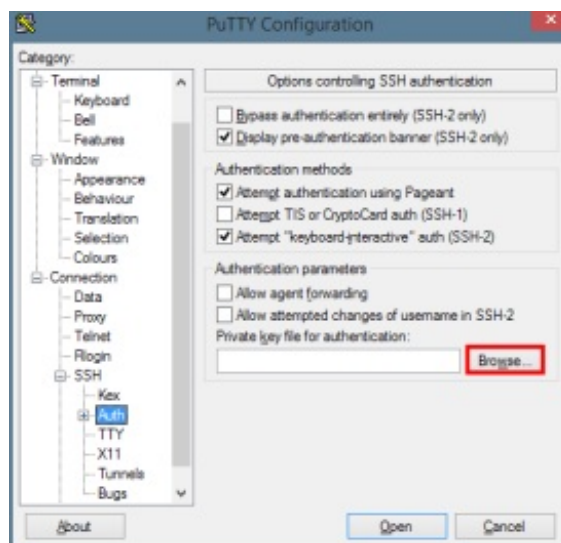
Copy the text in the “Public key for pasting into OpenSSH authorized_keys file:” input field. This is your public key that will be input into the Chameleon cloud web interface.



To connect to a Chameleon server, download and execute the PuTTY tool. Enter the public IP address into the “Host Name (or IP address)” input box.



Next, in order to specify a private key file, click on the Connection → SSH → Auth menu item on the left. Click on the “Browse” button and select your private key file.



Finally, click the “Open” button to connect using this key.