

Cloud Computing

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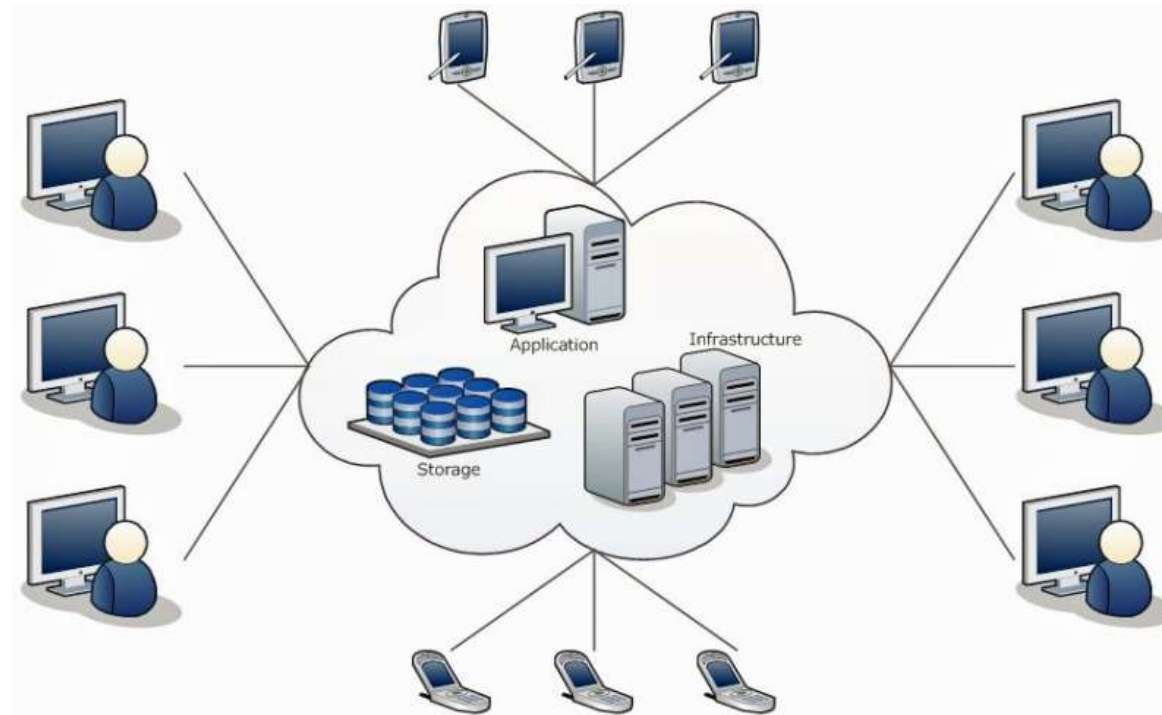
Overview

- What is Cloud Computing
- What Can I Use It For
- Choosing Systems
- Images vs. Bare Metal
- Using the Resources



What is a Cloud?

- ▶ A “cloud” is a computer system that provides users with shared access to on-demand computing resources via the internet.





Why is it Useful?

- Resource Utilization
- Scalability and Elasticity
- Reproducibility by way of Programmability
- Reliability through redundancy



Cloud vs. HPC

Cloud

- Availability
- Multi-level API Interactions
- On-demand/Interactive Use
- Using Commodity Components

HPC

- Utilization
- Capability or Capacity Science
- Checkpoint/Restart I/O
- Memory/Network Bandwidth & Latency



Who Uses Clouds?

System Administrators

- Help automate operations

Software Developers

- Build applications on cloud servers and platforms

Computational Scientists

- Write codes to analyze scientific data that resides in the cloud



Service Models

- ▶ Infrastructure-as-a-service (IaaS)
 - Virtual servers, networks, firewalls, etc. (AWS, Azure)
- ▶ Platform-as-a-service (PaaS)
 - Deploy application without managing virtual servers (Google App Engine, Heroku)
- ▶ Software-as-a-service (SaaS)
 - Ready to use software applications (Gmail, Office365)
- ▶ Functions-as-a-service (FaaS)
 - Run on demand without knowing the infrastructure (hook.io, AWS Lambda)



IaaS with Virtual Machines

▶ Emulations

- Gives the appearance of any typical personal machine
- Simulates architectures

▶ Operating Systems

- Generally Linux in scientific communities but proprietary ones available through branded IaaS options

▶ Software

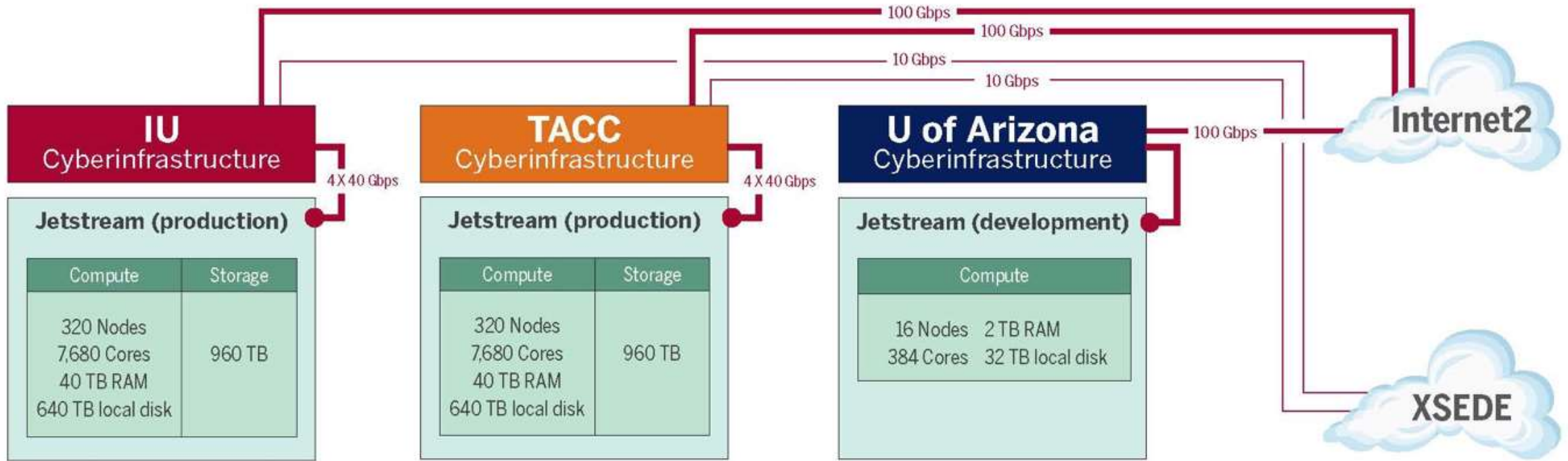
- Allows for installation of software in a way that generally doesn't require building from the binary



Jetstream

- NSF funded production cloud facility
- On-demand interactive computing and analysis
- Configurable environments
- User-friendly, widely accessible cloud environment
- Library of preconfigured virtual machines

Architecture Overview





Getting Started



Launch New Instance

Browse Atmosphere's list of available images and select one to launch a new instance.



Browse Help Resources

View a video tutorial, read the how-to guides, or email the Atmosphere support team.



Change Your Settings

Modify your account settings, view your resource quota, or request more resources.

Resources Used

NEED MORE ?

Allocation Source

0 Instances





Virtual Machines

- These configurations are available when choosing a VM.
- You should always request the smallest VM size that can accommodate your work.
- Local storage is ephemeral and will be lost when your session dies.
- For long term storage you will need an XSEDE-allocated Volume.

VM Size	vCPUs	RAM (GB)	Local Storage (GB)	SU cost per hour*	Can be saved as an image?
m1.tiny	1	2	8	1	✓ yes
m1.small	2	4	20	2	✓ yes
m1.medium	6	16	60	6	✓ yes
m1.large	10	30	60	10	✓ yes
m1.xlarge	24	60	60	24	✓ yes
m1.xxlarge	44	120	60	44	✓ yes
s1.large	10	30	120	10	✗ No
s1.xlarge	24	60	240	24	✗ No
s1.xxlarge	44	120	480	44	✗ No

This allocation information may be subject to changes in the future.

Please note that s1.* based customized instances will NOT be able to be used to create images in Atmosphere.

Images







Dashboard
Projects
Images
Help
vtrue

Image Search

Showing 100 of 181 images

Featured Images

 <p>CentOS 6 (6.9) Development GUI Jan 10th 18 03:36 by jfischer</p>	<p>Based on CentOS 6 (6.9) Development</p> <ul style="list-style-type: none"> ◦ updated from 6.8 to 6.9 <p>Installation size ~ 4.4GB</p> <p>CentOS desktop development Featured gui IRODS vnc</p>	☆
 <p>BioLinux 8 Jan 10th 18 01:39 by jfischer</p>	<p>Based on Ubuntu 14.04.3 -Trusty Tahr - server - cloudimg</p> <p>--**REQUIRES m1.small instance ...</p> <p>bioinformatics desktop Featured gui m1_small Ubuntu x2go</p>	☆
 <p>Centos 7 (7.4) Development GUI Jan 4th 18 02:30 by jfischer</p>	<p>Centos 7 (7.4) Development GUI</p> <p>Installation size ~ 4.5GB</p> <p>CentOS development docker docker-compose Featured gui IRODS</p>	☆
 <p>Intel Development (CentOS 7) Jan 4th 18 01:54 by jfischer</p>	<p>Intel compilers and development environment</p> <p>***REQUIRES a m1.small or larger VM to la ...</p>	☆

Images cont.

Launch an Instance / Basic Options

Basic Info

Instance Name

MATLAB (Based on CentOS 6)

Base Image Version

1.11

Project

demos

Resources

Allocation Source

TG-TRA160003

Provider

Jetstream - Indiana University

Instance Size

m1.medium (CPU: 6, Mem: 16 GB, Disk: 60 GB)

Allocation Used

89% of 5500000 SUs from TG-TRA160003

Resources Instance will Use

A total 6 of 132 allotted CPUs

A total 16 of 360 allotted GBs of Memory

Advanced Options

CANCEL

LAUNCH INSTANCE

Images cont.





Modifying an Image

The screenshot shows a Linux desktop with a blue background. A terminal window titled 'vtrue@js-169-27:~/Downloads/Python-2.7.14' is open. The terminal displays the following commands and output:

```
[vtrue@js-169-27 Python-2.7.14]$ which samtools
/usr/bin/which: no samtools in (/usr/lib64/qt-3.3/bin:/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin)
[vtrue@js-169-27 Python-2.7.14]$ sudo su - root
[js-169-27] root -->yum install samtools
```

The desktop also shows icons for 'Computer', 'vtrue's Home', and 'Trash' on the left side. The top panel includes 'Applications', 'Places', and 'System' menus, along with a clock showing 'Thu Jan 11, 22:15' and the username 'vtrue'.



Modifying an Image cont.

```
vtrue@js-169-27:~/Downloads/Python-2.7.14
File Edit View Search Terminal Help

Transaction Summary
=====
Install      1 Package(s)

Total download size: 421 k
Installed size: 1.0 M
Is this ok [y/N]: y
Downloading Packages:
Setting up and reading Presto delta metadata
Processing delta metadata
Package(s) data still to download: 421 k
samtools-0.1.18-2.el6.x86_64.rpm                | 421 kB    00:00
Running rpm_check_debug
Running Transaction Test
Transaction Test Succeeded
Running Transaction
  Installing : samtools-0.1.18-2.el6.x86_64      1/1
  Verifying  : samtools-0.1.18-2.el6.x86_64      1/1

Installed:
  samtools.x86_64 0:0.1.18-2.el6

Complete!
[js-169-27] root --->which samtools
/usr/bin/samtools
[js-169-27] root --->exit
logout
[vtrue@js-169-27 Python-2.7.14]$ which samtools
/usr/bin/samtools
[vtrue@js-169-27 Python-2.7.14]$
```




Saving an Image

Jetstream Dashboard Projects Images Help vtrue

demos

[Resources](#) > CentOS 6 (6_9) Development GUI



CentOS 6 (6_9) Development GUI

Allocation Source

TG-TRA160003

Allocation Used

89% of 5500000 SUs from TG-TRA160003

Instance Details

Status	● Shutoff
Activity	N/A
Size	m1.tiny (CPU: 1, Mem: 2 GB, Disk: 8 GB)
IP Address	N/A

Actions

- Report
- Image**
- Start
- Reboot
- Delete

Links

- Open Old Web Shell
- Open Old Web Desktop
- Open Web Shell



In Summary

- The longer your instance runs the more SUs you consume
- Be aware that you are on a shared resource
- You have root access, but the original image stays intact
- This is only the basic level of what you can do with Jetstream; there are many more options available in the Wiki



IaaS with Bare Metal

Direct access to the node

- Choose how you want to interact with the system

Build your own interface

- Select and install your own OS
- Install software to your exact specifications

OpenStack

- Cloud based OS to help control your environment
- Provides dashboard based management in addition to command line




Chameleon

- ▶ Select the hardware you want
 - Instead of images you can select 'flavors' to determine memory, cpus, root disk, etc
- ▶ Network options
 - Generate IPs for external access
- ▶ Develop APIs
 - Use APIs to provide dashboards, monitor activity, etc



OpenStack

TACC-HPC vtrue

Project

Compute

Overview

Instances

Volumes

Images

Access & Security

Network

Identity

Images

Project (0)

Shared with Me (0)

Public (61)

+ Create Image

Delete Images

<input type="checkbox"/>	Image Name	Type	Status	Public	Protected	Format	Size	Actions
<input type="checkbox"/>	CC-Ubuntu16.04	Image	Active	Yes	No	QCOW2	679.7 MB	Launch Instance
<input type="checkbox"/>	CC-Ubuntu14.04	Image	Active	Yes	No	QCOW2	507.8 MB	Launch Instance
<input type="checkbox"/>	CC-CentOS7	Image	Active	Yes	No	QCOW2	755.6 MB	Launch Instance
<input type="checkbox"/>	CC-Ubuntu16.04-20180413	Image	Active	Yes	No	QCOW2	677.8 MB	Launch Instance
<input type="checkbox"/>	CC-Ubuntu14.04-20180410	Image	Active	Yes	No	QCOW2	507.5 MB	Launch Instance
<input type="checkbox"/>	CC-CentOS7-1802.1	Image	Active	Yes	No	QCOW2	754.4 MB	Launch Instance
<input type="checkbox"/>	CC-Ubuntu14.04-20180330	Image	Active	Yes	No	QCOW2	503.4 MB	Launch Instance



APIs, SSH, and IPs

The screenshot shows the Chameleon cloud management interface. The left sidebar contains a navigation menu with 'Project', 'Compute', 'Network', and 'Identity'. The 'Compute' section is expanded, showing 'Overview', 'Instances', 'Volumes', and 'Images'. The 'Access & Security' section is highlighted in green. The main content area is titled 'Access & Security' and has tabs for 'Security Groups', 'Key Pairs', 'Floating IPs', and 'API Access'. The 'API Access' tab is selected. Below the tabs are three buttons: 'Download OpenStack RC File', 'Download EC2 Credentials', and 'View Credentials'. A table lists the service endpoints for various OpenStack services.

Service	Service Endpoint
Compute	https://openstack.tacc.chameleoncloud.org:8774/v2/TACC-HPC
Network	https://openstack.tacc.chameleoncloud.org:9696
Volumev2	https://openstack.tacc.chameleoncloud.org:8776/v2/TACC-HPC
Computev3	https://openstack.tacc.chameleoncloud.org:8774/v3
Image	https://openstack.tacc.chameleoncloud.org:9292



Command Line Access

▶ Install OpenStack

- Install python
- `pip install python-openstackclient`

▶ Download an RC File

- Pull from your Chameleon account
- `source <path/to/openstack_rc_file>`
- If you are a Windows user you'll need to manually provide environment variables



```
vtrue-mbpr:~ vtrue$ python --version
Python 2.7.15
vtrue-mbpr:~ vtrue$ pip install python-openstackclient
Collecting python-openstackclient
  Downloading
https://files.pythonhosted.org/packages/33/84/c739b13aacc47d887cae58acc7dd921240918aa20a9
add6ab64d932d1a6a/python_openstackclient-3.15.0-py2.py3-none-any.whl (823kB)
  100% |████████████████████████████████████████████████████████████████████████████████| 829kB 8.0MB/s
Collecting oslo.utils>=3.33.0 (from python-openstackclient)
  Downloading
https://files.pythonhosted.org/packages/6c/bb/308293b06400625b721795657c0c50c8a5942fde58d
9532b40f57758a158/oslo.utils-3.36.2-py2.py3-none-any.whl (91kB)
  100% |████████████████████████████████████████████████████████████████████████████████| 92kB 4.6MB/s
Collecting osc-lib>=1.8.0 (from python-openstackclient)
  Downloading
https://files.pythonhosted.org/packages/de/b7/91ed1a58756390fa006a5777ceb44578f021a9b67ff
ec0729f5037fff51a/osc_lib-1.10.0-py2-none-any.whl (81kB)
  100% |████████████████████████████████████████████████████████████████████████████████| 81kB 17.4MB/s
Collecting python-glanceclient>=2.8.0 (from python-openstackclient)
```



For Windows

```
▶ openstack --os-auth-url <OS_AUTH_URL> \  
▶ --os-project-id <OS_PROJECT_ID> \  
▶ --os-project-name <OS_PROJECT_NAME> \  
▶ --os-user-domain-name <OS_USER_DOMAIN_NAME> \  
▶ --os-username <OS_USERNAME> \  
▶ --os-password <OS_PASSWORD> \  
▶ --os-region-name <OS_REGION_NAME> \  
▶ --os-interface <OS_INTERFACE> \  
▶ --os-identity-api-version <OS_IDENTITY_API_VERSION>
```



On the Command Line

```
vtrue-mbpr:~ vtrue$ openstack
```

Readline features including tab completion have been disabled since no supported version of readline was found. To resolve this, install pyreadline on Windows or gnureadline on Mac.

```
(openstack)
```

There are options available in the command line that are not available in the GUI

- Gnocchi metrics
- Advanced networking

Selecting Hardware

Chameleon Resource Browser

Filter nodes using the options below, then generate a reservation script to reserve those nodes.

Applied Filters: None

428 nodes

Compute (291)

Infiniband Support (41)

GPU (24)

Storage (26)

Storage Hierarchy (2)

FPGA (4)

Low Power Xeon (8)

Atom (8)

ARM64 (24)

Site

☐ Tacc (337)

☐ Uc (91)

Cluster

☒ Chameleon (428)

Platform Type

☐ Aarch64 (24)

☐ X86 #64 (404)

CPUs

☐ 1 (40)

☐ 2 (388)

Threads

☐ 40 (26)

☐ 48 (358)

☐ 56 (4)

☐ 8 (40)

RAM Size

☐ 128 GiB (360)

☐ 32 GiB (16)

☐ 512 GiB (2)

☐ 64 GiB (50)

[Show Advanced Filters](#)

428 nodes

Reserve

View

Reset




Check on Resources with REST API

```
▶ vtrue-mbpr:~ vtrue$ curl -i https://api.chameleoncloud.org/  
▶ HTTP/1.1 200 OK  
▶ Server: nginx/1.6.2  
▶ Date: Tue, 12 Jun 2018 22:35:34 GMT  
▶ Content-Type: application/vnd.grid5000.item+json; charset=utf-8  
▶ Content-Length: 757  
▶ Connection: keep-alive  
▶ Allow: GET  
▶ ...  
▶ {"type":"grid","uid":"chameleoncloud","version":"0aa787fa5c97c34bd0b7a583  
d4e2fab693010daa","release":"3.5.7","timestamp":1528842934,"links":[{"rel  
":"sites","href":"/sites","type":"application/vnd.grid5000.collection+jso  
n"}, {"rel":"self","type":"application/vnd.grid5000.item+json","href":"/"
```



Reservations

 CH-819870 ▼ jchuah ▼

Project ▼

Compute >

Network >

Orchestration >

Object Store >

Reservations ▼

Leases

Identity >

Project / Reservations /

Leases

Lease Calendar

+ Create Lease

Delete Leases

Displaying 1 item

<input type="checkbox"/>	Lease name	Start date	End date	Action	Status	Reason	Actions
<input type="checkbox"/>	my-custom-lease	2018-03-08 17:00 UTC	2018-03-08 18:00 UTC	STOP	COMPLETE	Successfully stopped lease	<div>Delete Lease</div>

Displaying 1 item



Complex Appliances

- ▶ *Complex Appliances* allow you to specify not only what image you want to deploy but also on how many nodes you want to deploy that image, what roles the deployed instances should boot into (such as e.g., head node and worker node in a cluster), what information from a specific instance should be passed to another instance in that *Complex Appliance*, and what scripts should be executed on boot so that this information is properly used for configuring the “one click” cluster.



[+ Add an appliance](#)

Appliance Catalog

ARM64 (Ubuntu 16.04)

Chameleon-supported Ubuntu 16.04 LTS image for ARM64 machines



CentOS 7

The default Chameleon appliance



COMPSS 1.3

COMPSS is a task based programming model for distributed platforms.



CUDA 7.5

CUDA appliance based on CentOS 7



Managing and Monitoring

- Need to be launched the same way an Image is
- Select the Stack from the GUI once it is up
- SSH to it with a floating IP just like with an Image
- You can also do this from the command line with OpenStack