

Introduction to Cloud and Virtual Machines

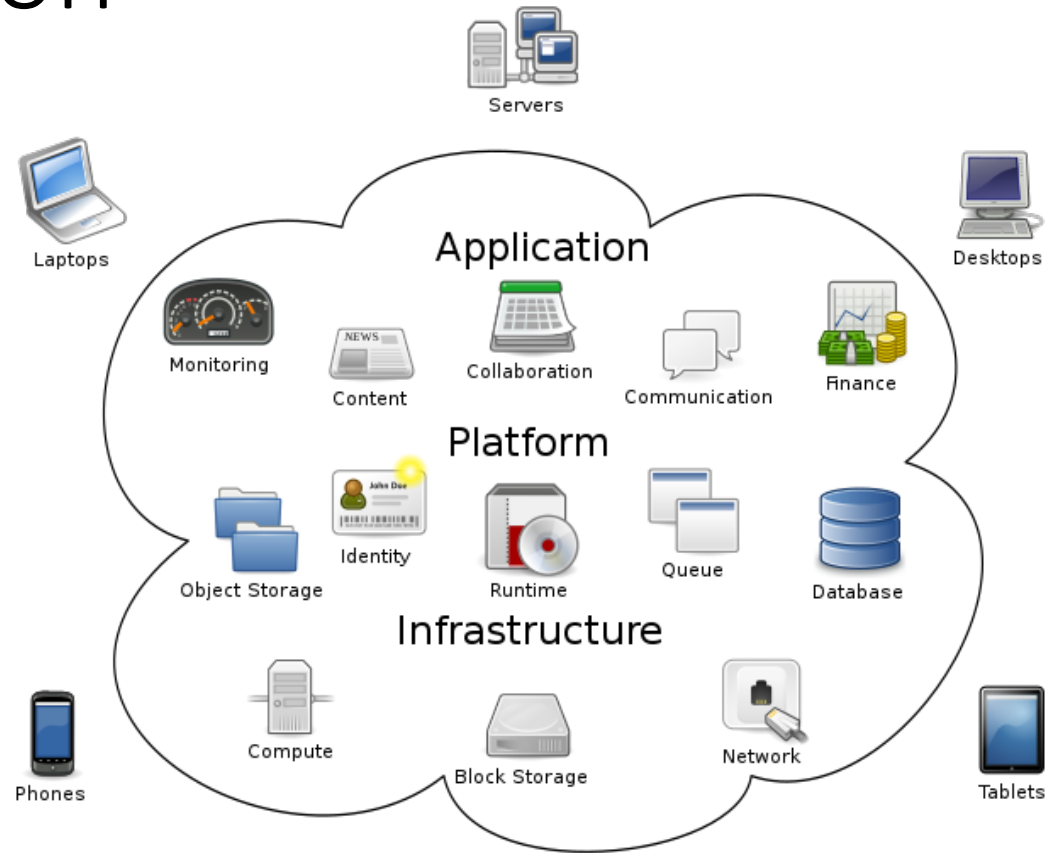
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UBC Advanced Research Computing

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Introduction



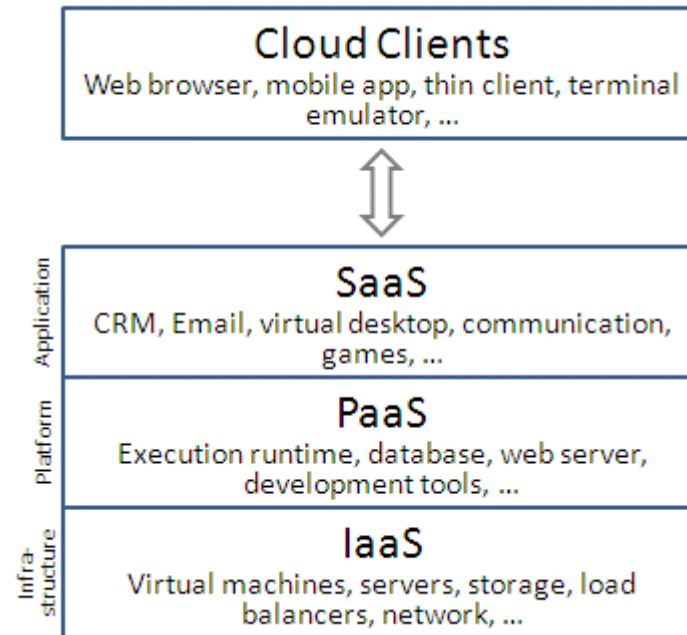
https://commons.wikimedia.org/wiki/File:Cloud_computing.svg

Author: Sam Johnston

Introduction (cont.)

- Delivers high level services and access to system resources over the Internet.
- Services: collaboration (E-mail, calendaring, etc.), web, Dropbox-like file hosting, etc.
- System resources i.e. infrastructure: compute, disk, networking, load balancing, etc.

Introduction (cont.)



https://commons.wikimedia.org/wiki/File:Cloud_computing_layers.png

Digital Research Alliance of Canada (The Alliance) Cloud

Arbutus cloud (arbutus.cloud.computecanada.ca)

Node count ↕	CPU ↕	Memory (GB) ↕	Local (ephemeral) storage ↕	Interconnect ↕	GPU ↕	Total CPUs ↕	Total vCPUs ↕
156	2 x Gold 6248	384	2 x 1.92TB SSD in RAID0	1 x 25GbE	N/A	6,240	12,480
8	2 x Gold 6248	1024	2 x 1.92TB SSD in RAID1	1 x 25GbE	N/A	320	6,400
26	2 x Gold 6248	384	2 x 1.6TB SSD in RAID0	1 x 25GbE	4 x V100 32GB	1,040	2,080
32	2 x Gold 6130	256	6 x 900GB 10k SAS in RAID10	1 x 10GbE	N/A	1,024	2,048
4	2 x Gold 6130	768	6 x 900GB 10k SAS in RAID10	2 x 10GbE	N/A	128	2,560
8	2 x Gold 6130	256	4 x 1.92TB SSD in RAID5	1 x 10GbE	N/A	256	512
240	2 x E5-2680 v4	256	4 x 900GB 10k SAS in RAID5	1 x 10GbE	N/A	6,720	13,440
8	2 x E5-2680 v4	512	4 x 900GB 10k SAS in RAID5	2 x 10GbE	N/A	224	4,480
2	2 x E5-2680 v4	128	4 x 900GB 10k SAS in RAID5	1 x 10GbE	2 x Tesla K80	56	112

Location: University of Victoria

Total CPUs: 16,008 (484 nodes)

Total vCPUs: 44,112

Total GPUs: 108 (28 nodes)

Total RAM: 157,184 GB

5.3 PB of Volume and Snapshot [Ceph](#) storage.

12 PB of Object/Shared Filesystem [Ceph](#) storage.

The Alliance Cloud (cont.)

Cedar cloud (cedar.cloud.computecanada.ca)

Node count	CPU	Memory (GB)	Local (ephemeral) storage	Interconnect	GPU	Total CPUs	Total vCPUs
28	2 x E5-2683 v4	256	2 x 480GB SSD in RAID1	1 x 10GbE	N/A	896	1,792
4	2 x E5-2683 v4	256	2 x 480GB SSD in RAID1	1 x 10GbE	N/A	128	2,560

Location: Simon Fraser University

Total CPUs: 1,024

Total vCPUs: 4,352

Total RAM: 7,680 GB

500 TB of persistent [Ceph](#) storage.

The Alliance Cloud (cont.)

Graham cloud (graham.cloud.computecanada.ca)

Node count	CPU	Memory (GB)	Local (ephemeral) storage	Interconnect	GPU	Total CPUs	Total vCPUS
6	2 x E5-2683 v4	256	2x 500GB SSD in RAID0	1 x 10GbE	N/A	192	
2	2 x E5-2683 v4	512	2x 500GB SSD in RAID0	1 x 10GbE	N/A	64	
8	2 x E5-2637 v4	128	2x 500GB SSD in RAID0	1 x 10GbE	N/A	256	
8	2 x Xeon(R) Gold 6130 CPU	256	2x 500GB SSD in RAID0	1 x 10GbE	N/A	256	
3	2 x E5-2640 v4	256	2x 500GB SSD in RAID0	1 x 10GbE	N/A	120	
12	2 x Xeon(R) Gold 6248 CPU	768	2x 1TB SSD in RAID0	1 x 10GbE	N/A	480	

Location: University of Waterloo

Total CPUs: 1,368

Total vCPUs:

Total RAM: 15,616 GB

84 TB of persistent [Ceph](#) storage.

The Alliance Cloud (cont.)

Béluga cloud (beluga.cloud.computecanada.ca)

Node count	CPU	Memory (GB)	Local (ephemeral) storage	Interconnect	GPU	Total CPUs	Total vCPUs
96	2 x Intel Xeon Gold 5218	256	N/A, ephemeral storage in ceph	1 x 25GbE	N/A	3,072	6,144
16	2 x Intel Xeon Gold 5218	768	N/A, ephemeral storage in ceph	1 x 25GbE	N/A	512	10,240

Location: École de Technologie Supérieure

Total CPUs: 3,584

Total vCPUs: 16,384

Total RAM: 36,864 GiB

200 TiB of replicated persistent SSD [Ceph](#) storage.

1.7 PiB of erasure coded persistent HDD [Ceph](#) storage.

The Alliance Cloud (cont.)

- There is also the NextCloud service which provides 50GB of backed up Dropbox-like storage (<https://docs.alliancecan.ca/wiki/Nextcloud>).

The Alliance Cloud (cont.)

- The IaaS clouds are built on OpenStack.
- OpenStack is an open-source software platform for deploying clouds i.e. build your own cloud environment.
- Can work with a variety of hardware, network switches, hypervisors.

The Alliance Cloud (cont.)

- Various commercial vendors provide OpenStack:
 - SUSE
 - Redhat
 - Ubuntu
 - Mirantis
- Also exists a free implementation called OpenStack-Ansible which is in use by The Alliance:
 - <https://github.com/openstack/openstack-ansible>

Cloud Resources

Attributes	Compute Cloud ^[1]	Persistent Cloud ^[1]
Who can request	PIs only	PIs only
VCPUs (see VM flavours)	80	25
Instances ^[2]	20	10
Volumes ^[2]	2	10
Volume snapshots ^[2]	2	10
RAM (GB)	300	50
Floating IP	2	2
Persistent storage (TB)	10	
Object storage (TB) ^[3]	10	
Shared filesystem storage (TB) ^[3]	10	
Default duration	1 year ^[4] , with 1 month wall-time	1 year (renewable) ^[4]
Default renewal	April ^[4]	April ^[4]

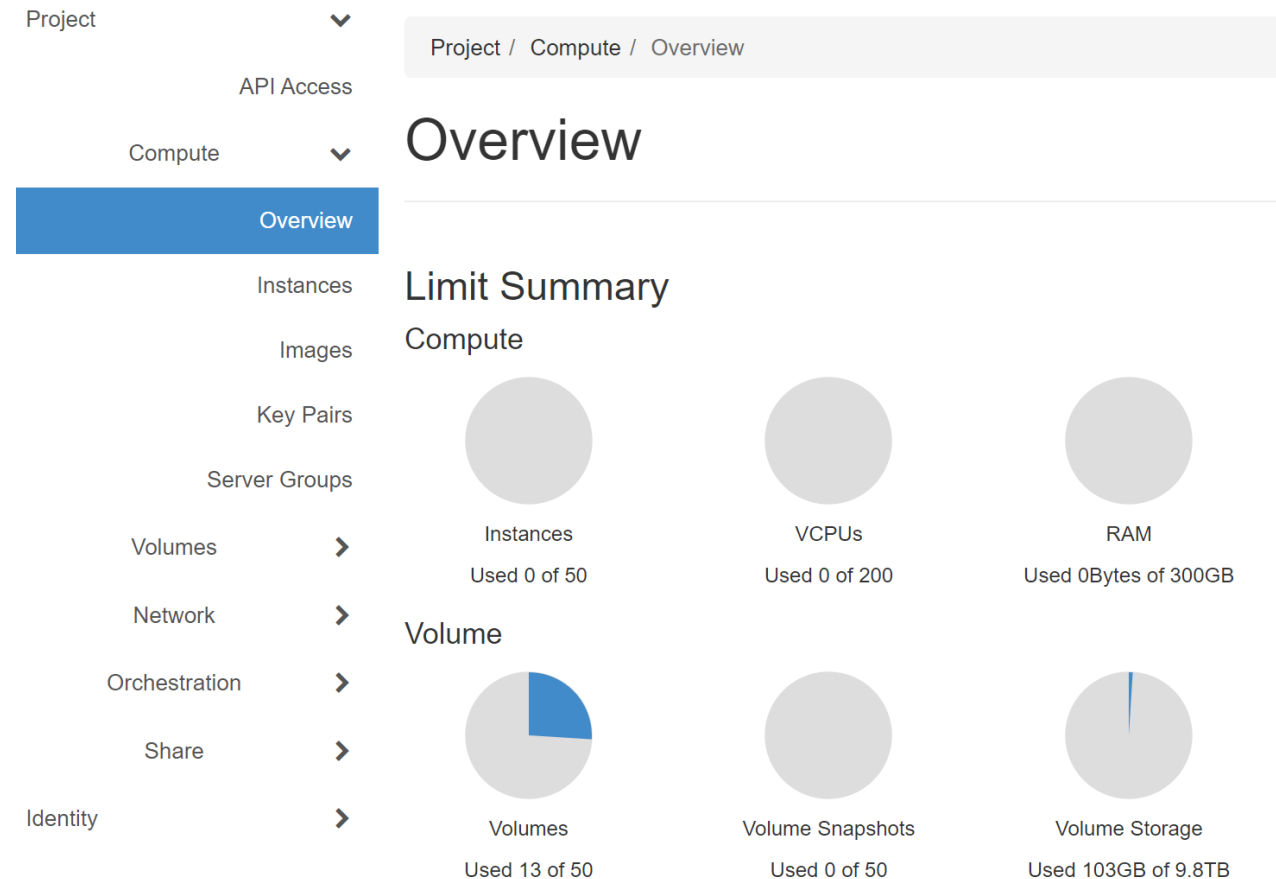
Cloud Resources (cont.)

- You can request resources via the Rapid Access Service (RAS) or Resource Allocation Competition (RAC):
- <https://alliancecan.ca/en/services/advanced-research-computing/research-portal/accessing-resources>

Other Free Services

- <https://www.infoworld.com/article/3179785/aws-vs-azure-vs-google-cloud-which-free-tier-is-best.html>
- Amazon Web Services: <https://aws.amazon.com/free/>; 1-2 VCPU free for 12 months (t2.micro or t3.micro instances depending on region).
- Data egress is typically charged.

Hands-On



Create SSH Key Pair and Download Private Key

Project

API Access

Compute

Overview

Instances

Images

Key Pairs

Server Groups

Project / Compute / Key Pairs

Key Pairs

Click here for filters or full text search.

+ Create Key Pair

Import Public Key

Delete Key Pairs

Displaying 1 item

<input type="checkbox"/>	Name ^	Type
<input type="checkbox"/>	> mobaxterm key	ssh

Create Key Pair



Key Pairs are how you login to your instance after it is launched. Choose a key pair name you will recognize. Names may only include alphanumeric characters, spaces, or dashes.

Key Pair Name *

Key Type *



Create Keypair

Copy Private Key to Clipboard

Done

Launch Instance of a Virtual Machine

Project

API Access

Compute

Overview


Instances

Images

Key Pairs

Project / Compute / Instances

Instances

Instance ID = Filter  Launch Instance

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
No items to display.										

Launch Instance



Details

Source *

Flavor *

Networks

Network Ports

Security Groups

Key Pair

Configuration

Please provide the initial hostname for the instance, the availability zone where it will be deployed, and the instance count. Increase the Count to create multiple instances with the same settings.

Instance Name *

Description

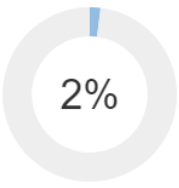
Availability Zone

Any Availability Zone

▼

Count *

Total Instances
(50 Max)



- 0 Current Usage
- 1 Added
- 49 Remaining

Launch Instance



Details

Source

Flavor *

Networks

Network Ports

Security Groups

Instance source is the template used to create an instance. You can use an image, a snapshot of an instance (image snapshot), a volume or a volume snapshot (if enabled). You can also choose to use persistent storage by creating a new volume.

Select Boot Source

Image

▼

Create New Volume

Yes

No

Allocated

Name	Updated	Size	Type	Visibility	
▶ CentOS-7-x64-2020-11	5/26/21 4:01 PM	847.81 MB	qcow2	Public	⬇

Launch Instance



Details

Source

Flavor

Networks

Flavors manage the sizing for the compute, memory and storage capacity of the instance.

Allocated

Name	VCPUS	RAM	Total Disk	Root Disk	Ephemeral Disk	Public	
➤ p1-1.5gb	1	1.5 GB	20 GB	20 GB	0 GB	No	⬇



- Details
- Source *
- Flavor *
- Networks
- Network Ports
- Security Groups
- Key Pair**
- Configuration
- Server Groups


A key pair allows you to SSH into your newly created instance. You may select an existing key pair, import a key pair, or generate a new key pair.

+ Create Key Pair

 Import Key Pair

Allocated

Displaying 1 item

Name	Type	
> mobaxterm key	ssh	

Displaying 1 item

▼ Available 0

Select one



Click here for filters or full text search.



Displaying 0 items

Launch the Instance

- Click Launch Instance to launch the virtual machine. Make sure to note the name of your instance.
- OpenStack will boot the VM and insert the SSH key into it.
- Once the VM is booted, we can try to access it remotely.
- But need to configure security and public networking first.

Configuring Remote Access

Project

API Access

Compute

Overview

Instances

Images

Key Pairs

Server Groups

Volumes

Network

Project / Compute / Instances

Instances

Instance ID = Filter Launch Instance Delete Instances More Actions

Displaying 1 item

<input type="checkbox"/>	Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
<input type="checkbox"/>	myinstance	CentOS-7-x64-2020-11	192.168.181.218	p1-1.5gb	coursekey	Active	Persistent_01	None	Running	0 minutes	<button>Create Snapshot</button>

Displaying 1 item

<input type="checkbox"/>	Instance Name	Image Name	IP Address	Flavor	Key Pair	Status		Availability Zone	Task	Power State	Age	Actions
<input type="checkbox"/>	myinstance	CentOS-7-x64-2020-11	192.168.181.218	p1-1.5gb	coursekey	Active		Persistent_01	None	Running	0 minutes	<div>Create Snapshot</div> <div> Associate Floating IP Attach Interface Detach Interface Edit Instance Attach Volume Detach Volume Update Metadata Retrieve Password Edit Security Groups Edit Port Security Groups </div>

Displaying 1 item

Manage Floating IP Associations



IP Address *

206.12.88.135



Select the IP address you wish to associate with the selected instance or port.

Port to be associated *

myinstance: 192.168.181.218



Cancel

Associate

- Project
- API Access
- Compute
- Volumes
- Network
- Network Topology
- Networks
- Routers
- Security Groups

Project / Network / Security Groups

Security Groups

Filter

+ Create Security Group

Delete Security Groups

Displaying 1 item

<input type="checkbox"/>	Name	Security Group ID	Description	Actions
<input type="checkbox"/>	default	18a91f32-0989-4855-93ec-71c978fc562e	Default security group	Manage Rules

Displaying 1 item

This can be ignored, it has already been pre-configured but is here for informational purposes

Add Rule



Rule *

SSH

Remote * ?

CIDR

CIDR ?

0.0.0.0/0

Description:

Rules define which traffic is allowed to instances assigned to the security group. A security group rule consists of three main parts:

Rule: You can specify the desired rule template or use custom rules, the options are Custom TCP Rule, Custom UDP Rule, or Custom ICMP Rule.

Open Port/Port Range: For TCP and UDP rules you may choose to open either a single port or a range of ports. Selecting the "Port Range" option will provide you with space to provide both the starting and ending ports for the range. For ICMP rules you instead specify an ICMP type and code in the spaces provided.

Remote: You must specify the source of the traffic to be allowed via this rule. You may do so either in the form of an IP address block (CIDR) or via a source group (Security Group). Selecting a security group as the source will allow any other instance in that security group access to any other instance via this rule.

Add

This can be ignored, it has already been pre-configured but is here for informational purposes

Network

Network Topology

Networks

Routers

Security Groups

Floating IPs

Orchestration

Share

Identity

+ Add Rule

Delete Rules

Displaying 7 items

<input type="checkbox"/>	Direction	Ether Type	IP Protocol	Port Range	Remote IP Prefix	Remote Security Group	Description	Actions
<input type="checkbox"/>	Egress	IPv4	Any	Any	0.0.0.0/0	-	-	Delete Rule
<input type="checkbox"/>	Egress	IPv6	Any	Any	::/0	-	-	Delete Rule
<input type="checkbox"/>	Ingress	IPv4	Any	Any	-	default	-	Delete Rule
<input type="checkbox"/>	Ingress	IPv4	TCP	22 (SSH)	0.0.0.0/0	-	-	Delete Rule
<input type="checkbox"/>	Ingress	IPv4	TCP	80 (HTTP)	0.0.0.0/0	-	-	Delete Rule
<input type="checkbox"/>	Ingress	IPv4	TCP	443 (HTTPS)	0.0.0.0/0	-	-	Delete Rule
<input type="checkbox"/>	Ingress	IPv6	Any	Any	-	default	-	Delete Rule

Displaying 7 items

This can be ignored, it has already been pre-configured but is here for informational purposes

Connect to the Instance via SSH

```
ssh -i <key>.pem centos@<public ip>
```

If using MobaXTerm, see:

[https://docs.alliancecan.ca/wiki/Connecting_with_MobaXTerm#Using a Key Pair](https://docs.alliancecan.ca/wiki/Connecting_with_MobaXTerm#Using_a_Key_Pair)

If using Windows Subsystem for Linux, you may need to do:

```
chmod 600 <name of private key file>
```

Installing RStudio

```
sudo yum install epel-release -y
```

```
sudo yum install R -y
```

```
<< will take a while >>
```

```
sudo yum install wget -y
```

```
wget https://download2.rstudio.org/server/centos7/x86_64/rstudio-server-rhel-1.4.1717-x86_64.rpm
```

```
sudo yum install rstudio-server-rhel-1.4.1717-x86_64.rpm -y
```

```
sudo systemctl status rstudio-server.service
```

```
sudo systemctl enable rstudio-server.service
```

Add Security Rule

Rule *

Custom TCP Rule ▼

Description ?

Direction

Ingress ▼

Open Port *

Port ▼

Port* ?

8787

Remote* ?

CIDR ▼

CIDR ?

0.0.0.0/0


This can be ignored, it has already been pre-configured but is here for informational purposes


Add User

```
sudo useradd rstudiouser
```

```
sudo passwd rstudiouser
```

Done

← → ↻ 🏠  206.12.88.135:8787

 Studio

Sign in to RStudio

Username:

Password:

☐ Stay signed in when browser closes

You will automatically be signed out after 60 minutes of inactivity.

Maintaining Your Instance

- Install updates to the OS, e.g. for CentOS do “yum -y update”.
- Install application updates regularly for RStudio and other applications.

Resources

- The Alliance Cloud
 - https://docs.alliancecan.ca/wiki/Cloud_RAS_Allocations
 - https://docs.alliancecan.ca/wiki/Cloud_Quick_Start
- UBC Advanced Research Computing
 - <https://www.arc.ubc.ca>