Introduction to Grid’5000

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What is Grid’5000 and why would you use it?

This is a large-scale and flexible testbed for experiment-driven research.

We mainly interested in its large amount of resources:

- when you want to run a GPU-required machine learning task but you don't have GPU in your own computer
- when you run a time-consuming calculation and wish not to occupy 90% of your CPU all the time, *etc*.

For detailed description, refer to this link

Outline

- Part 1: 22/09 16H-18H
  - Get an account of Grid’5000
  - Connection with SSH key
  - Basic concepts (cluster, node, host, core...)
  - File/folder transfer
- Part 2: 01/10 16H-18H
  - Resources visualisation
  - Resources reservation and management with OAR
  - *TBD*

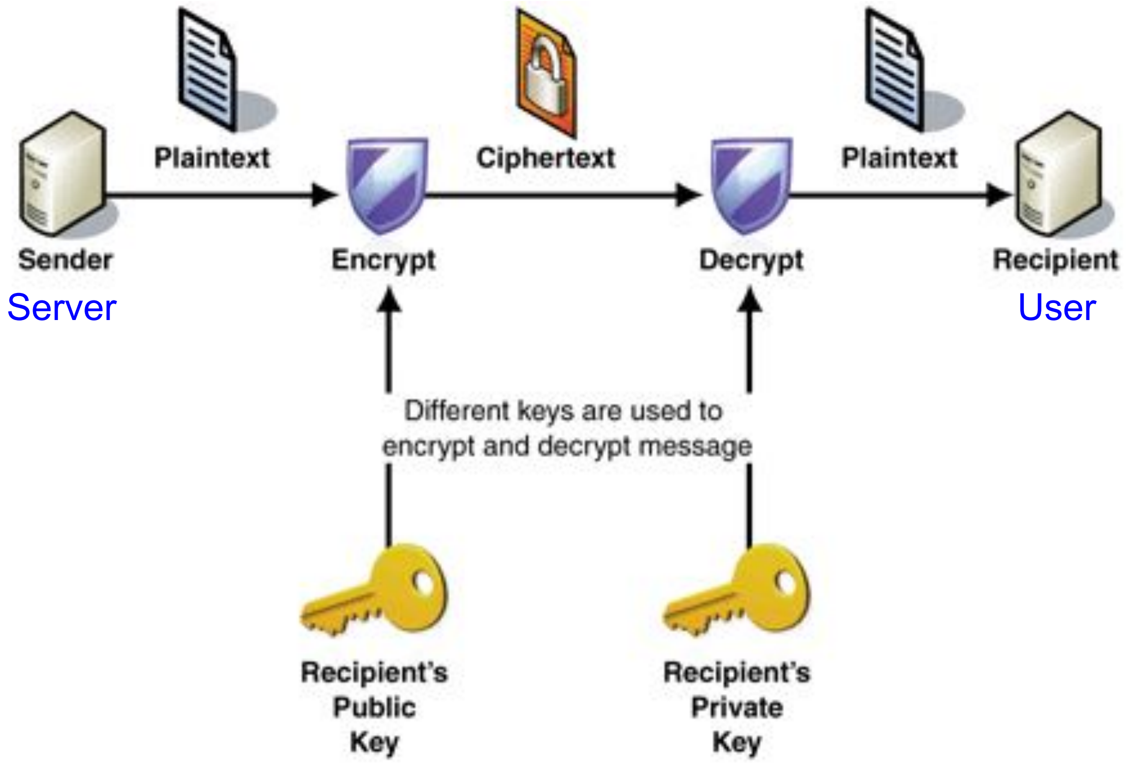
Before we start...

- Do you have an account and activated?
  - Open a terminal
  - type: ssh login@access.grid5000.fr
- Sites you will frequent:
  - Get started: https://www.grid5000.fr/w/Getting_Started
  - UMS: https://api.grid5000.fr/stable/users/
  -

Basic SSH

Authenticating

- SSH = Secure SHell
- Standard network protocol and service, establish a secure communication channel between 2 machines
- Relies on cryptography
- Public-key authentication
  - general idea: asymmetric cryptography
  - **public key** is used to **encrypt** something
  - only the **private key** can **decrypt** it
  - user owns a private key, stored on the local machine
  - server has the public key corresponding to the private key
  - authentication = server proves that you own that private key



Different keys are used to encrypt and decrypt message

Server

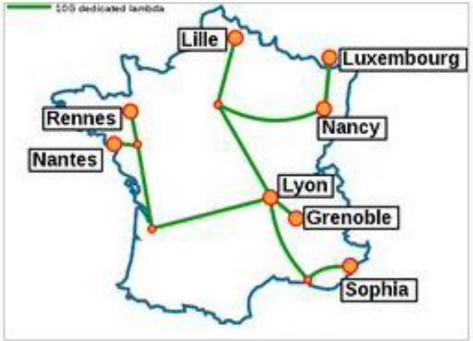
User

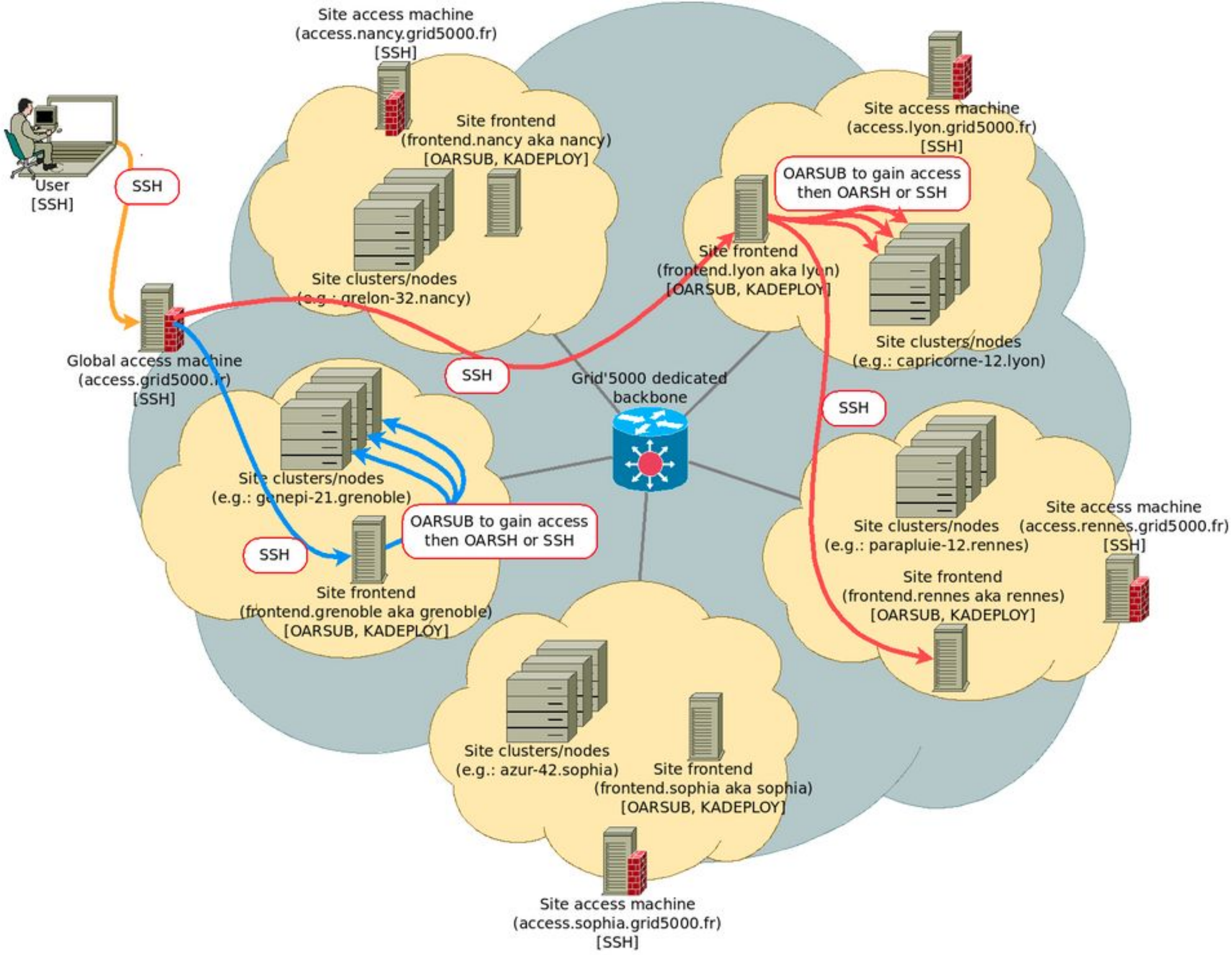
SSH basic usage

- Most basic usage: get shell access on a remote machine
- Many advanced usages:
  - data transfer (`scp`, `sftp`, `rsync`)
  - connect to specific services (such as Git or SVN servers), *etc*.
- Connecting to a remote server
  - $ ssh login@remote-server
  - this provides a shell on remote-server
- Copying data
  - $ scp local-file login@remote-server:remote-directory/
  - $ scp login@remote-server:remote-dir/file local-dir/
  - $ rsync -avzP localdir login@server:path-to-rem-dir/
- Know more here and here

Big picture

Concept map





User
[SSH]

SSH

Global access machine
(access.grid5000.fr)
[SSH]

Site access machine
(access.nancy.grid5000.fr)
[SSH]

Site frontend
(frontend.nancy aka nancy)
[OARSUB, KADEPLOY]

Site clusters/nodes
(e.g.: grelon-32.nancy)

SSH

Site access machine
(access.lyon.grid5000.fr)
[SSH]

OARSUB to gain access
then OARSH or SSH

Site frontend
(frontend.lyon aka lyon)
[OARSUB, KADEPLOY]

Site clusters/nodes
(e.g.: capricorne-12.lyon)

Grid'5000 dedicated
backbone

SSH

Site clusters/nodes
(e.g.: genepi-21.grenoble)

OARSUB to gain access
then OARSH or SSH

SSH

Site frontend
(frontend.grenoble aka grenoble)
[OARSUB, KADEPLOY]

Site clusters/nodes
(e.g.: parapluie-12.rennes)

Site access machine
(access.rennes.grid5000.fr)
[SSH]

Site frontend
(frontend.rennes aka rennes)
[OARSUB, KADEPLOY]

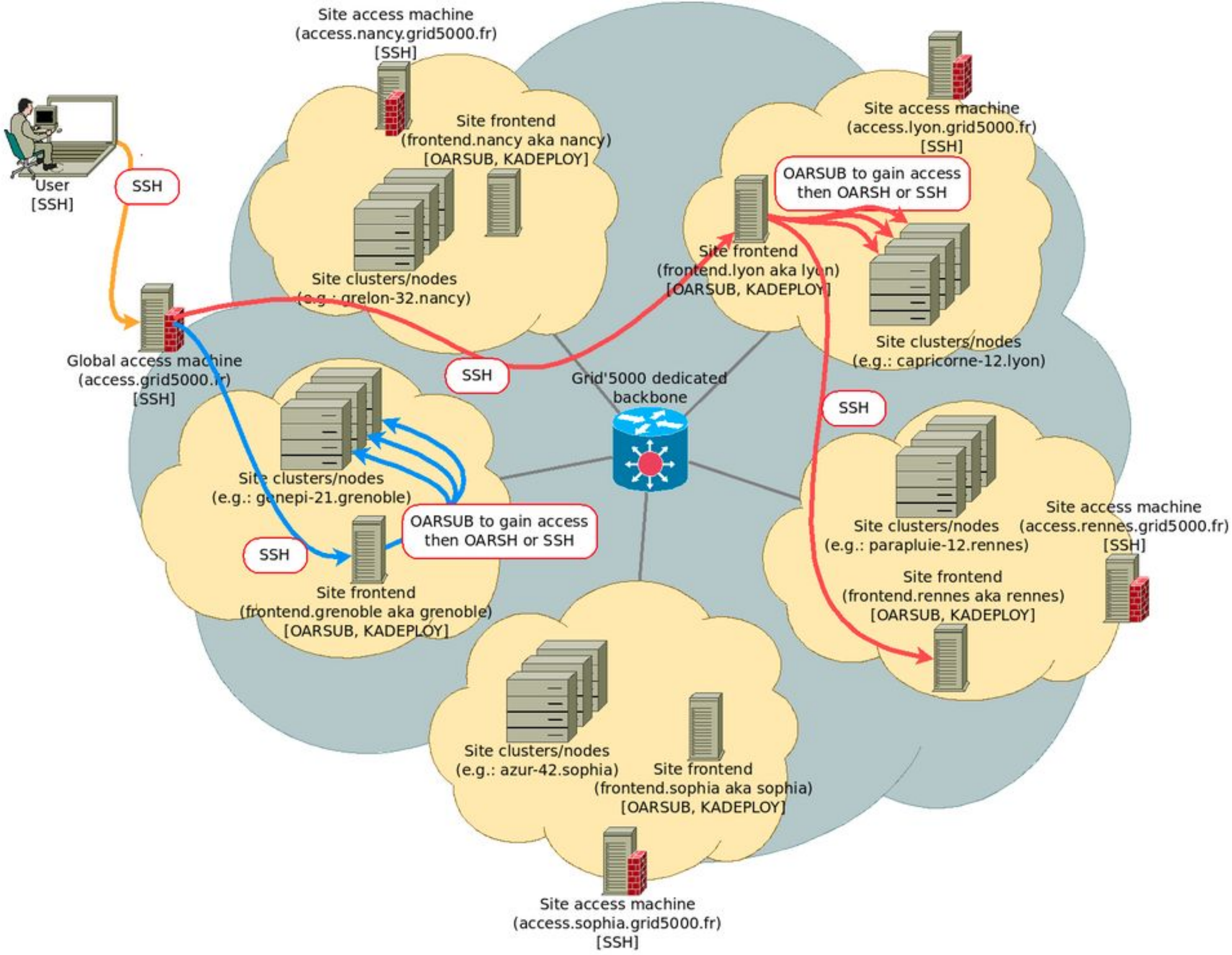
Site clusters/nodes
(e.g.: azur-42.sophia)

Site frontend
(frontend.sophia aka sophia)
[OARSUB, KADEPLOY]

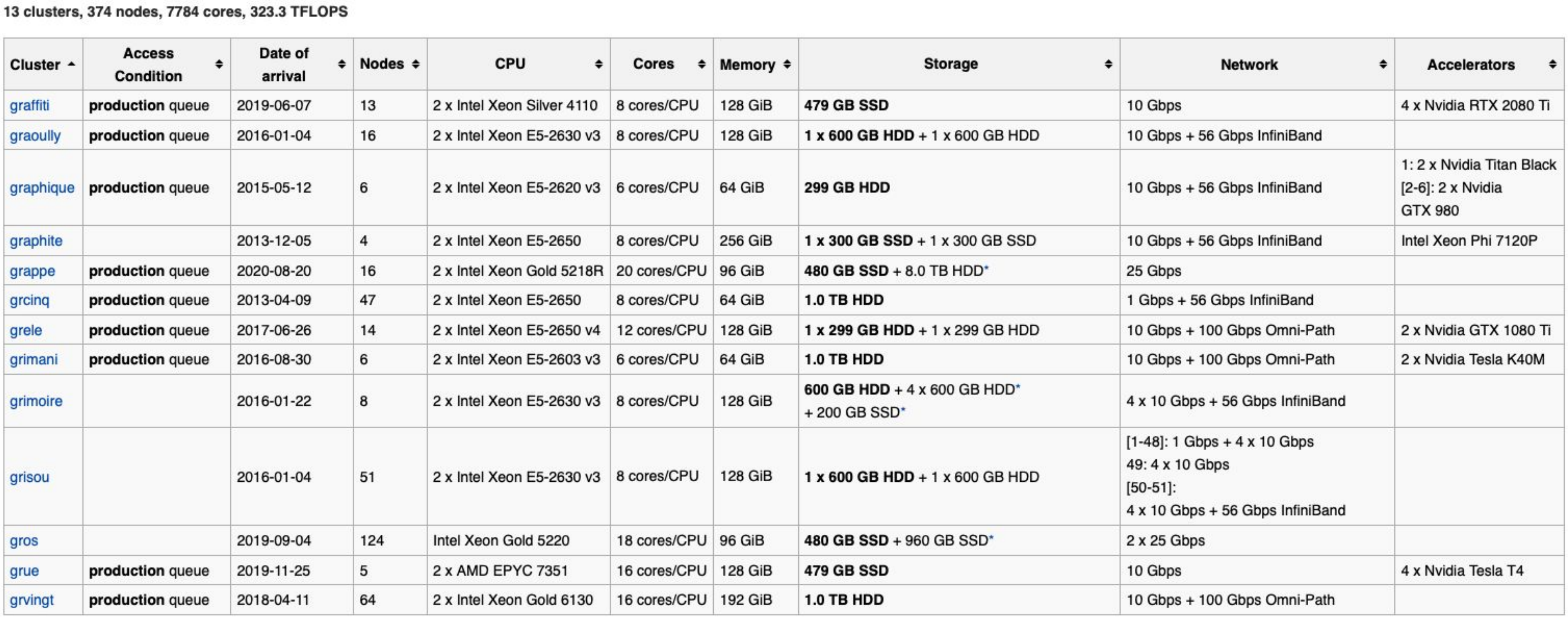
Site access machine
(access.sophia.grid5000.fr)
[SSH]

Concept map

- cluster
- node
- host



Hardware in Nancy site



13 clusters, 374 nodes, 7784 cores, 323.3 TFLOPS

Cluster	Access Condition	Date of arrival	Nodes	CPU	Cores	Memory	Storage	Network	Accelerators
graffiti	**production** queue	2019-06-07	13	2 x Intel Xeon Silver 4110	8 cores/CPU	128 GiB	**479 GB SSD**	10 Gbps	4 x Nvidia RTX 2080 Ti
graoully	**production** queue	2016-01-04	16	2 x Intel Xeon E5-2630 v3	8 cores/CPU	128 GiB	**1 x 600 GB HDD** + 1 x 600 GB HDD	10 Gbps + 56 Gbps InfiniBand	
graphique	**production** queue	2015-05-12	6	2 x Intel Xeon E5-2620 v3	6 cores/CPU	64 GiB	**299 GB HDD**	10 Gbps + 56 Gbps InfiniBand	1: 2 x Nvidia Titan Black [2-6]: 2 x Nvidia GTX 980
graphite		2013-12-05	4	2 x Intel Xeon E5-2650	8 cores/CPU	256 GiB	**1 x 300 GB SSD** + 1 x 300 GB SSD	10 Gbps + 56 Gbps InfiniBand	Intel Xeon Phi 7120P
grappe	**production** queue	2020-08-20	16	2 x Intel Xeon Gold 5218R	20 cores/CPU	96 GiB	**480 GB SSD** + 8.0 TB HDD*	25 Gbps	
grcinq	**production** queue	2013-04-09	47	2 x Intel Xeon E5-2650	8 cores/CPU	64 GiB	**1.0 TB HDD**	1 Gbps + 56 Gbps InfiniBand	
grele	**production** queue	2017-06-26	14	2 x Intel Xeon E5-2650 v4	12 cores/CPU	128 GiB	**1 x 299 GB HDD** + 1 x 299 GB HDD	10 Gbps + 100 Gbps Omni-Path	2 x Nvidia GTX 1080 Ti
grimani	**production** queue	2016-08-30	6	2 x Intel Xeon E5-2603 v3	6 cores/CPU	64 GiB	**1.0 TB HDD**	10 Gbps + 100 Gbps Omni-Path	2 x Nvidia Tesla K40M
grimoire		2016-01-22	8	2 x Intel Xeon E5-2630 v3	8 cores/CPU	128 GiB	**600 GB HDD** + 4 x 600 GB HDD* + 200 GB SSD*	4 x 10 Gbps + 56 Gbps InfiniBand	
grisou		2016-01-04	51	2 x Intel Xeon E5-2630 v3	8 cores/CPU	128 GiB	**1 x 600 GB HDD** + 1 x 600 GB HDD	[1-48]: 1 Gbps + 4 x 10 Gbps 49: 4 x 10 Gbps [50-51]: 4 x 10 Gbps + 56 Gbps InfiniBand	
gros		2019-09-04	124	Intel Xeon Gold 5220	18 cores/CPU	96 GiB	**480 GB SSD** + 960 GB SSD*	2 x 25 Gbps	
grue	**production** queue	2019-11-25	5	2 x AMD EPYC 7351	16 cores/CPU	128 GiB	**479 GB SSD**	10 Gbps	4 x Nvidia Tesla T4
grvingt	**production** queue	2018-04-11	64	2 x Intel Xeon Gold 6130	16 cores/CPU	192 GiB	**1.0 TB HDD**	10 Gbps + 100 Gbps Omni-Path	

Link: https://www.grid5000.fr/w/Nancy:Hardware

Queues and Usage Policy

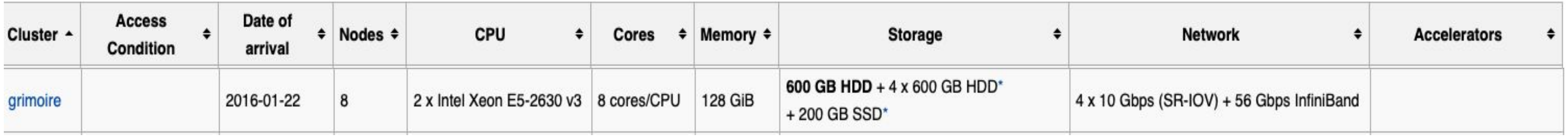
- *Default* queue
  - Daytime is dedicated to smaller-scale experiments
  - Large-scale jobs must be executed during nights or weekends
  - generally, using advance reservations
  - **Read carefully the rules** in case of violation of usage
- Production queue
  - Smaller set of resources
  - Only in Nancy site
  - More suited to long-running, non-interactive jobs
- More information, ref to UsagePolicy

Exercise (1) How many hours can I reserve?

According to Usage Policy for Default queue:

> *Between 09:00 and 19:00 during working days (Monday to Friday, excluding public holidays in France), you should not use more than the equivalent of 2 hours on all the cores of the cluster during a given day (e.g. on a 64 bi-processor (quad core) cluster, you should not use more than (2 hours)*(2 CPU)*(4 cores)*(64 nodes)= 1024 core.hours).*

For cluster grimoire, if i want to reserve 32 cores for a task, how long can I reserve?



Cluster ▴	Access Condition ⬍	Date of arrival ⬍	Nodes ⬍	CPU ⬍	Cores ⬍	Memory ⬍	Storage ⬍	Network ⬍	Accelerators ⬍
grimoire		2016-01-22	8	2 x Intel Xeon E5-2630 v3	8 cores/CPU	128 GiB	**600 GB HDD** + 4 x 600 GB HDD* + 200 GB SSD*	4 x 10 Gbps (SR-IOV) + 56 Gbps InfiniBand	

Queues and Usage Policy

- discover daily allowance with:

```
`usagepolicycheck -l [--sites site1,sites2]`
```

- check the jobs that have been counted using:

```
usagepolicycheck -v --start '2021-06-01 11:00:24 +0200' --end '2021-06-20 10:00:24 +0100'
```

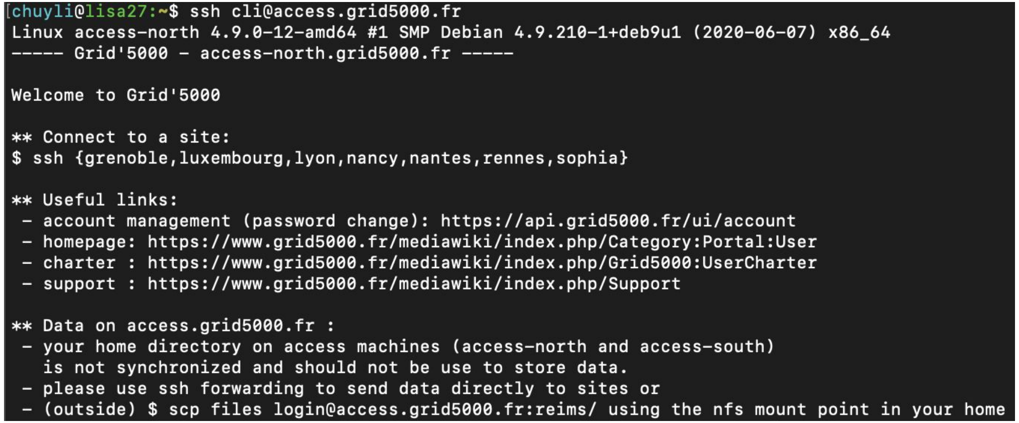
First connection

Connecting and moving around

- Basic steps to get in a site:
  - open a terminal
  - connect to access machine: `outside: ssh login@access.grid5000.fr`
  - specify a site: `access: ssh site`
  - put in your password
  - then we can view machine list in this site

Connecting and moving around

- Basic steps to get in a site:
  - connect to access machine: `outside: ssh login@access.grid5000.fr`

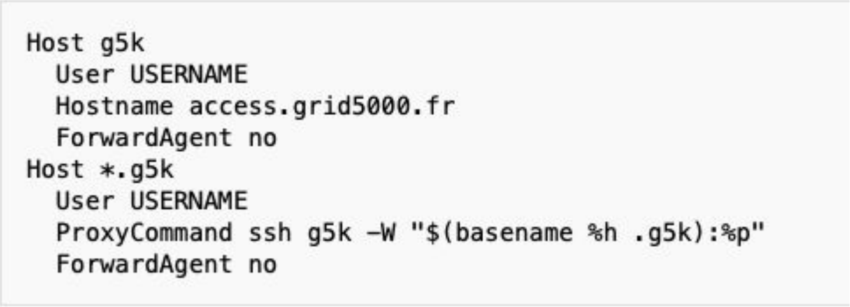


```
[chuyli@lisa27:~$ ssh cli@access.grid5000.fr
Linux access-north 4.9.0-12-amd64 #1 SMP Debian 4.9.210-1+deb9u1 (2020-06-07) x86_64
----- Grid'5000 - access-north.grid5000.fr -----

Welcome to Grid'5000

** Connect to a site:
$ ssh {grenoble,luxembourg,lyon,nancy,nantes,rennes,sophia}

** Useful links:
 - account management (password change): https://api.grid5000.fr/ui/account
 - homepage: https://www.grid5000.fr/mediawiki/index.php/Category:Portal:User
 - charter : https://www.grid5000.fr/mediawiki/index.php/Grid5000:UserCharter
 - support : https://www.grid5000.fr/mediawiki/index.php/Support

** Data on access.grid5000.fr :
 - your home directory on access machines (access-north and access-south)
   is not synchronized and should not be use to store data.
 - please use ssh forwarding to send data directly to sites or
 - (outside) $ scp files login@access.grid5000.fr:reims/ using the nfs mount point in your home
```

  - specify a site: `access: ssh nancy`
  - Move around with ssh: global access -> nancy -> grenoble -> rennes…
  - `exit` to get out

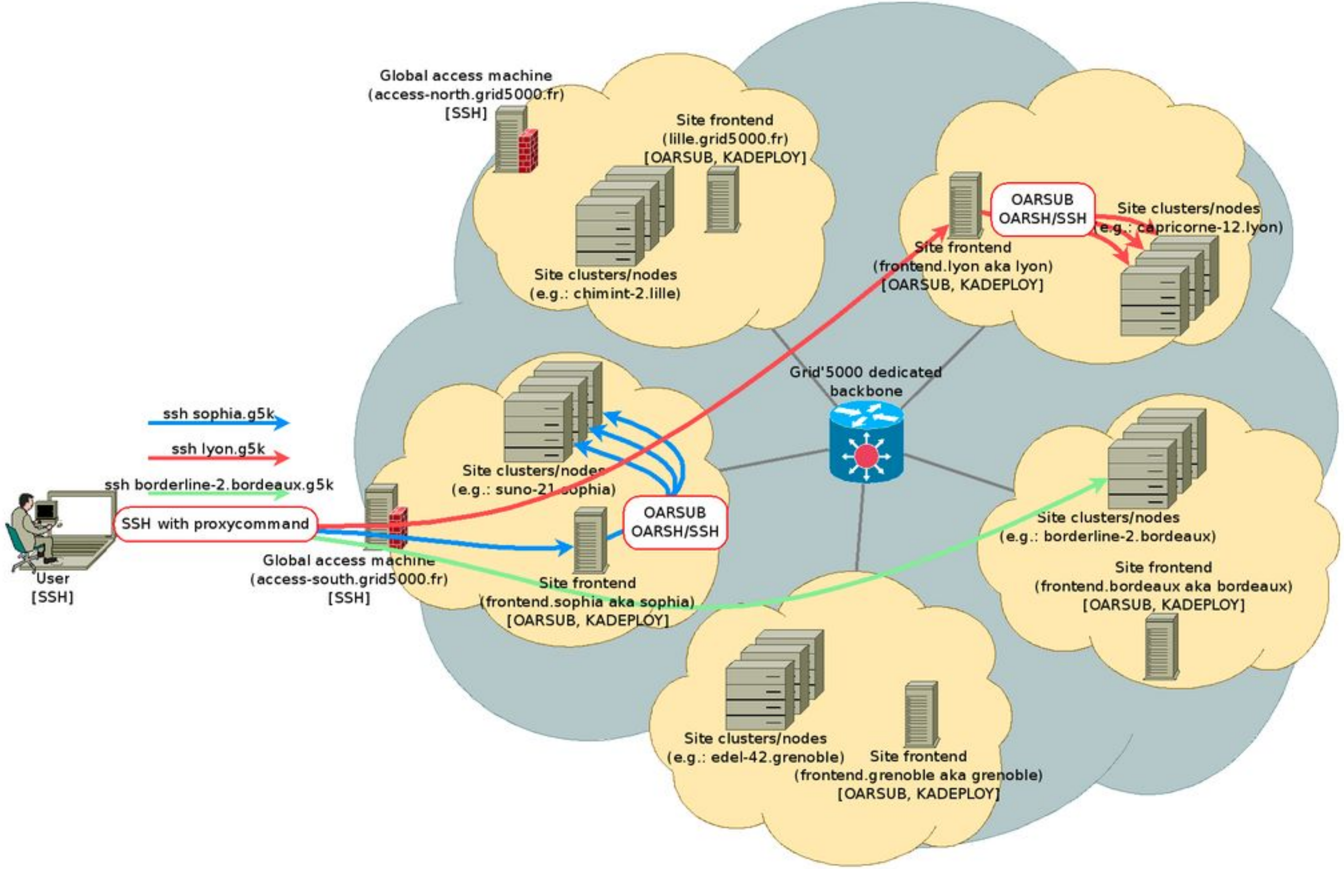
Tip: use SSH ProxyCommand

- In ~/.ssh/config:



```
Host g5k
  User USERNAME
  Hostname access.grid5000.fr
  ForwardAgent no
Host *.g5k
  User USERNAME
  ProxyCommand ssh g5k -W "$(basename %h .g5k):%p"
  ForwardAgent no
```

- Only works is login shell is bash, otherwise need to adapt it
- For windows users, different options see: https://www.grid5000.fr/w/SSH#Windows_users
- Connect to any Grid5k node in one command
  - $ ssh nancy.g5k
  - $ ssh lyon.g5k



Global access machine
(access-north.grid5000.fr)
[SSH]

Site frontend
(lille.grid5000.fr)
[OARSUB, KADEPLOY]

Site clusters/nodes
(e.g.: chimint-2.lille)

OARSUB
OARSH/SSH

Site clusters/nodes
(e.g.: capricorne-12.lyon)

Site frontend
(frontend.lyon aka lyon)
[OARSUB, KADEPLOY]

Grid'5000 dedicated
backbone

ssh sophia.g5k

ssh lyon.g5k

ssh borderline-2.bordeaux.g5k

Site clusters/nodes
(e.g.: suno-21.sophia)

User
[SSH]

SSH with proxycommand

OARSUB
OARSH/SSH

Global access machine
(access-south.grid5000.fr)
[SSH]

Site frontend
(frontend.sophia aka sophia)
[OARSUB, KADEPLOY]

Site clusters/nodes
(e.g.: borderline-2.bordeaux)

Site frontend
(frontend.bordeaux aka bordeaux)
[OARSUB, KADEPLOY]

Site clusters/nodes
(e.g.: edel-42.grenoble)

Site frontend
(frontend.grenoble aka grenoble)
[OARSUB, KADEPLOY]

Transferring files to/from Grid’5000

- no BACKUP in g5k, so make sure your important files are stored somewhere outside
- In each site, by default 25 GiB storage
  - If needed, can demand for more space
  - *manage account -> homedir quotas -> request quota extension*
- ProxyCommand works with everything SSH-based
  - scp, sftp, rsync
- Prefer **rsync** than scp
  - Pipelined file transfers
  - More efficient on networks with large BDP (bandwidth * latency)

Transferring files to/from Grid’5000

- scp
  - Copy file from local to remote:
    - `scp local_file remote_username@remote_ip:remote_file`
  - Copy folder from local to remote:
    - `scp -r local_folder remote_username@remote_ip:remote_folder`
  - Copy file from remote to local:
    - `scp remote_username@remote_ip:remote_file local_file`
  - Copy folder from remote to local:
    - `scp -r remote_username@remote_ip:remote_folder local_folder`
- Example
  - `local: $ scp -r /Users/chuyli/g5k_tuto/ cli@nancy.g5k:/home/cli/g5ktuto`
  - `local: $ scp -r /Users/chuyli/g5k_tuto/ cli@access.grid5000.fr:nancy/g5ktuto`
  - `local: $ scp cli@nancy.g5k:/home/cli/g5ktuto/show1.sh /Users/chuyli/g5k_tuto/`

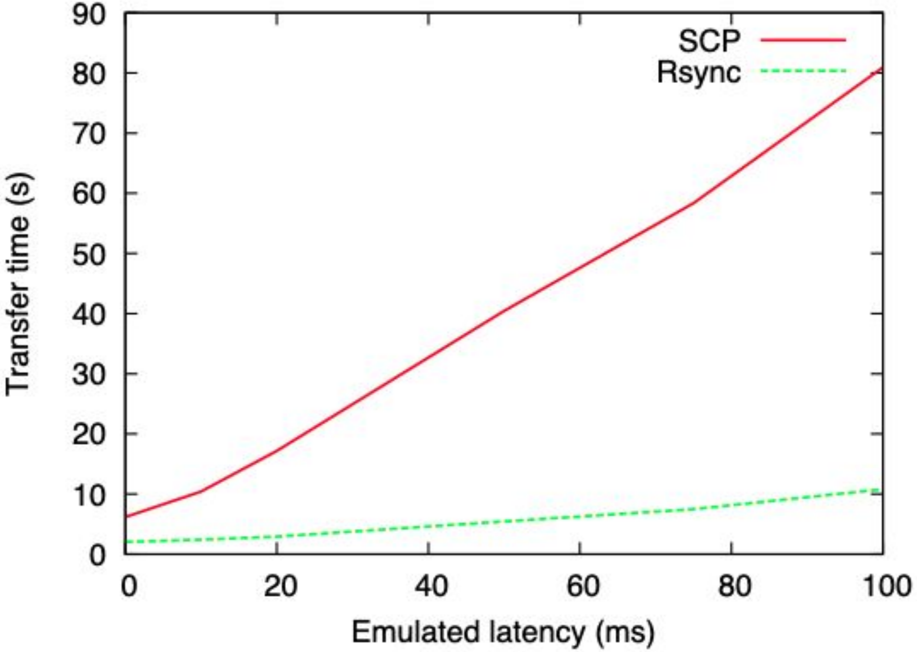
Transferring files to/from Grid’5000

- rsync
  - Copy folder from local to remote:

    -
      ```
      rsync -avzP local_folder remote_username@remote_ip:remote_folder
      ```
  - Example:
    - `local: $ rsync -avzP /Users/chuyli/g5k_tuto cli@nancy.g5k:/home/cli/`
    - `local: $ rsync -avzP /Users/chuyli/g5k_tuto/ cli@nancy.g5k:/home/cli/`
    - Mind the difference between *local_folder* and *local_folder/*

  - Much faster than scp for large files, recommend for folder transfer
  - Syntaxe more complicated
  - To know more, check official link rsync

Transfer of 120 files (total : 2.1 MB) with SCP and Rsync Bandwidth and Latency controlled using network emulator



Exercise (2)

- Transfer from local to remote a folder called g5ktest/ with 2 files inside with rsync, remote folder should contain the same folder
- Transfer from remote to local a file called *remote2local.txt* with scp