Uni.lu HPC School 2019

PS1: Preliminaries

Uni.lu High Performance Computing (HPC) Team

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http://hpc.uni.lu

Latest versions available on Github:

UL HPC tutorials: https://github.com/ULHPC/tutorials

UL HPC School: http://hpc.uni.lu/hpc-school/

PS1 tutorial sources: ulhpc-tutorials.rtfd.io/en/latest/beginners

Summary

Main Objectives of this Session

- Understand SSH
- Connect to the UL HPC Platform
  - ↪ SSH configuration
  - ↪ Generate your SSH key pair
  - ↪ overcome port filtering
- Discovering, visualizing and reserving UL HPC resources
  - ↪ Working environment
  - ↪ Web monitoring interfaces
  - ↪ SLURM Batch Scheduler
  - ↪ Job management
  - ↪ Software / Environement Modules

Summary

Vocabulary related to HPC (1/2)

Compute node physical server on which we run the computation (your code)

Cluster group of compute nodes interconnected to each others

Processor/CPU Central Processing Unit usually refers to a processor, chip of the server that process the instructions of the program

Core 1 processor chip usually contains several CPUs named cores

GPU Graphics Processing Unit, chip designed for image processing and computer graphics

Vocabulary related to HPC (2/2)

Resources	Every component of the cluster that you have access. Can refer to CPU, core, memory, network switch...
Job	Allocation resources for a specific user and a specific amount of time
Reservation	Allocate a job in the future, in advance in respect with rules (priority, job type...)
Walltime	Maximum time allocated for a specific job
Job Scheduler	Software that schedule all the jobs according to their priority.
Job queue	Before being scheduled, jobs are waiting in a queue for being processed by the scheduler
Partition	Set of resources (nodes) with the same policies applied to it

Summary

SSH: Secure Shell

- Ensure **secure** connection to remote (UL) server
  - ↪ establish **encrypted** tunnel using **asymmetric keys**
    - ✓ **Public** `id_rsa.pub` **vs. Private** `id_rsa` (**without** `.pub`)
    - ✓ typically on a non-standard port (**Ex**: 8022) *limits kiddie script*
    - ✓ Basic rule: 1 machine = 1 key pair
  - ↪ the private key is **SECRET**: **never** send it to anybody
    - ✓ Can be protected with a passphrase

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- SSH is used as a secure backbone channel for **many** tools
  - ↪ Remote shell **i.e** remote command line
  - ↪ File transfer: `rsync`, `scp`, `sftp`
  - ↪ versionning synchronization (`svn`, `git`), github, gitlab etc.

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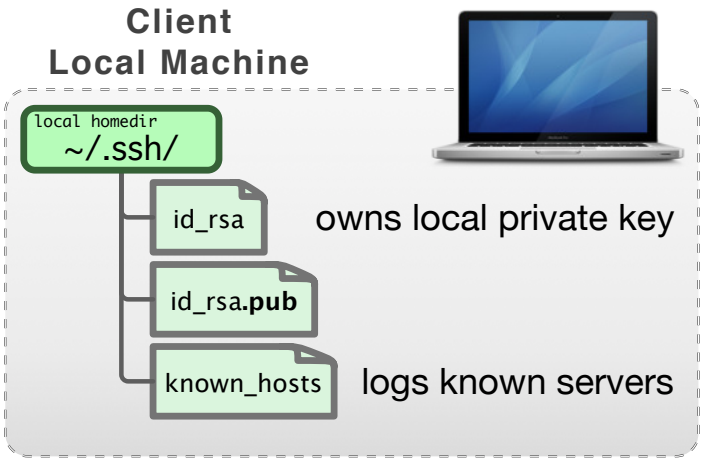
- Authentication:
  - ↪ ~~password~~ (disable if possible)
  - ↪ (*better*) **public key authentication**

SSH: Public Key Authentication



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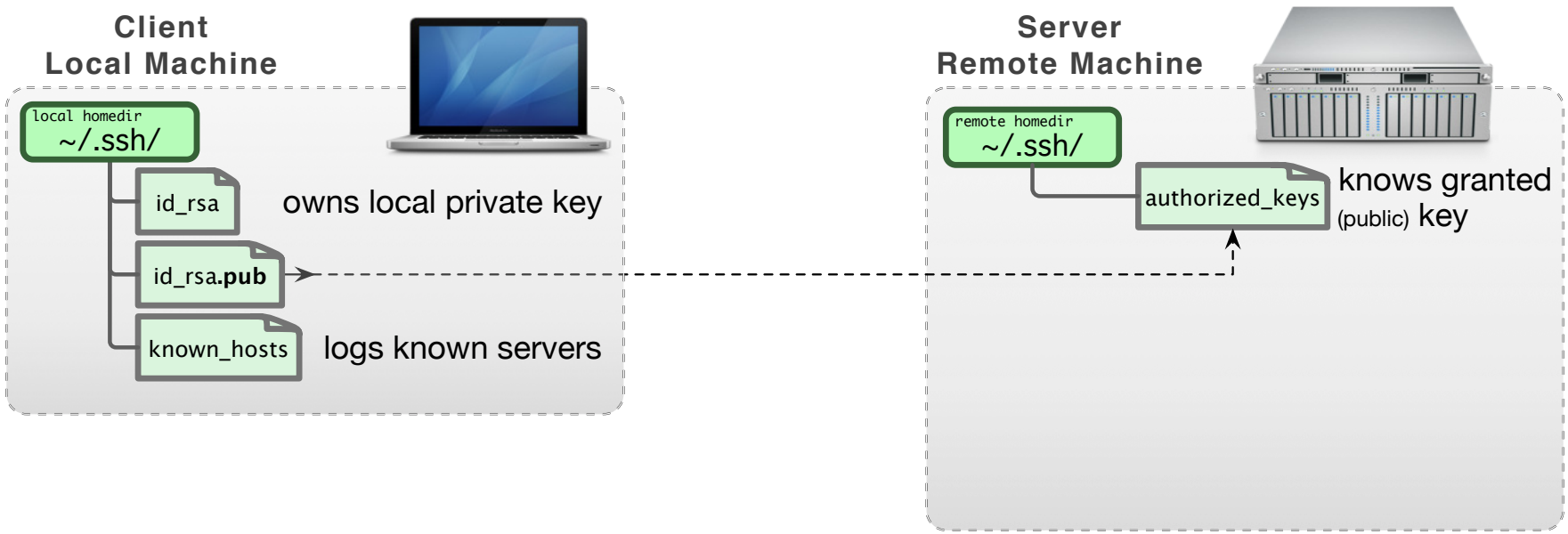

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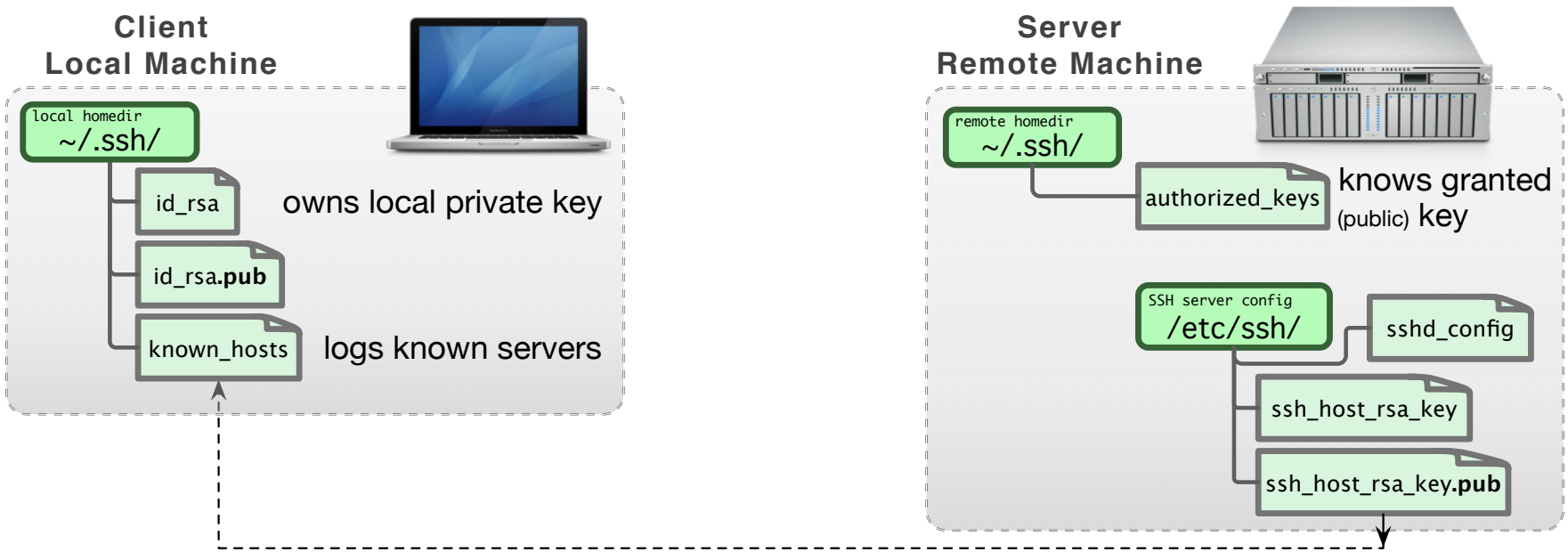

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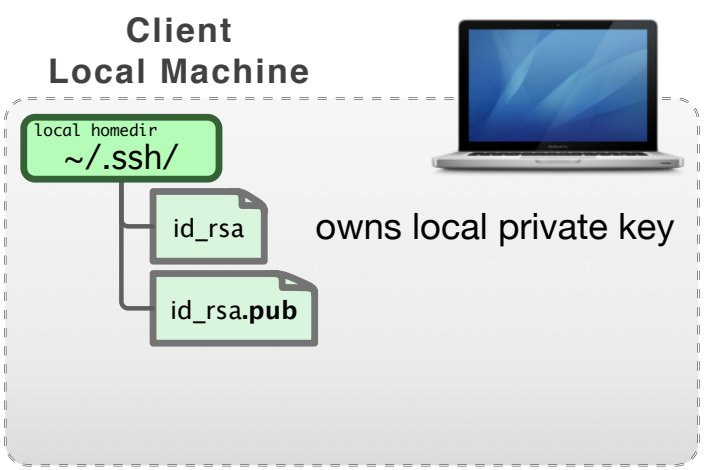

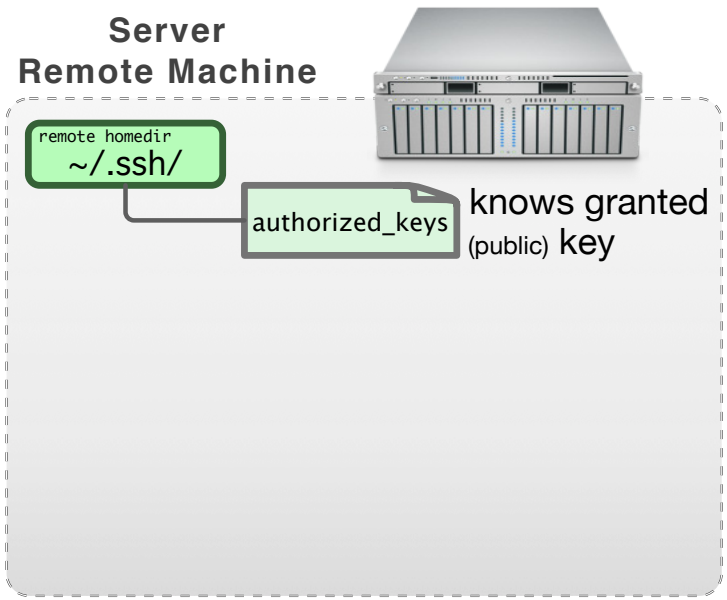

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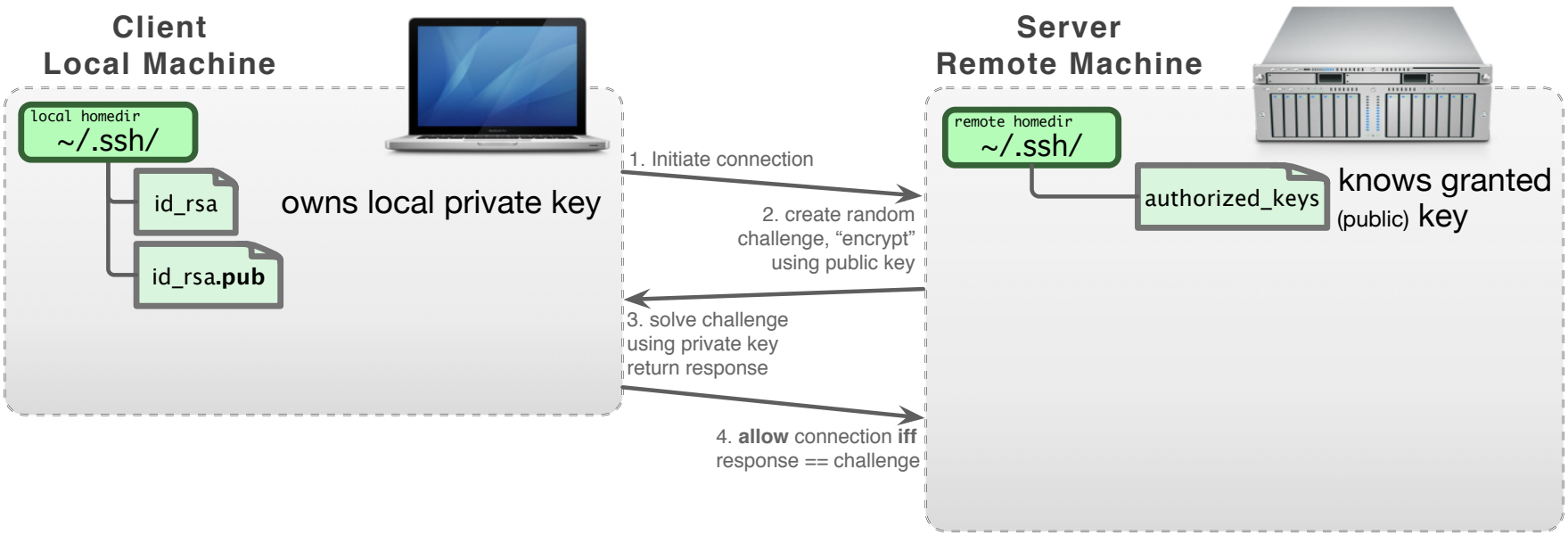

- **Restrict** to public key authentication: `/etc/ssh/sshd_config`:

```
PermitRootLogin no
# Disable Passwords
PasswordAuthentication no
ChallengeResponseAuthentication no
```

```
# Enable Public key auth.
RSAAuthentication yes
PubkeyAuthentication yes
```

SSH Setup on Linux / Mac OS

- OpenSSH natively supported; configuration directory : `~/.ssh/`
  - ↪ package `openssh-client` (Debian-like) or `ssh` (Redhat-like)
- SSH Key Pairs (public vs private) generation: `ssh-keygen`
  - ↪ specify a **strong** passphrase
    - ✓ protect your **private** key from being stolen **i.e.** impersonation
    - ✓ **drawback:** passphrase must be typed to use your key

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```
$> ssh-keygen -t rsa -b 4096 -o -a 100          # 4096 bits RSA
(better)  $> ssh-keygen -t ed25519 -o -a 100    # new sexy Ed25519
```

Private (identity) key

`~/.ssh/id_{rsa,ed25519}`

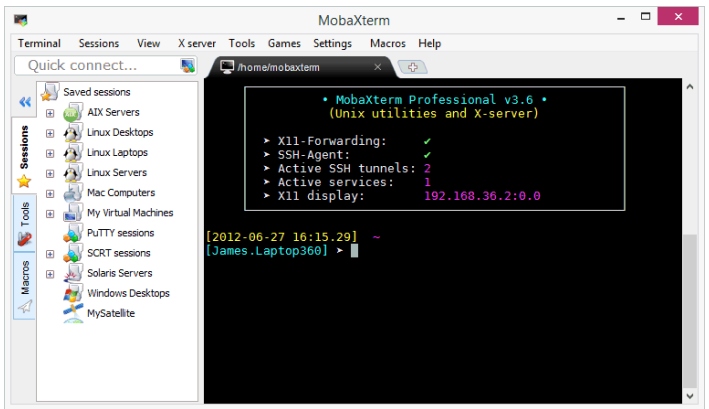
Public Key

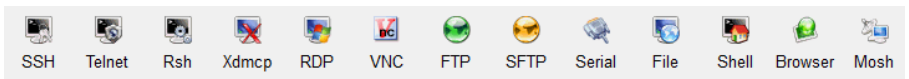
`~/.ssh/id_{rsa,ed25519}.pub`

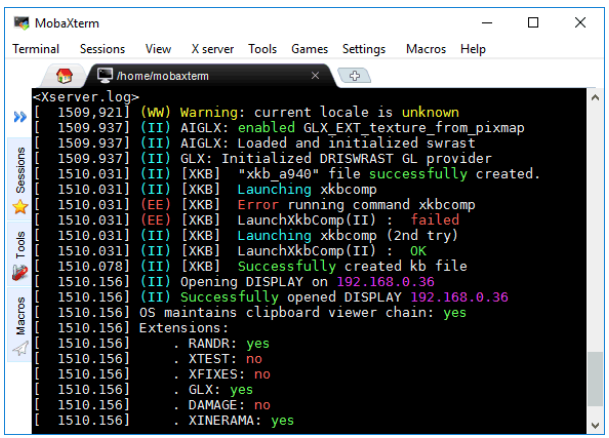
SSH Setup on Windows

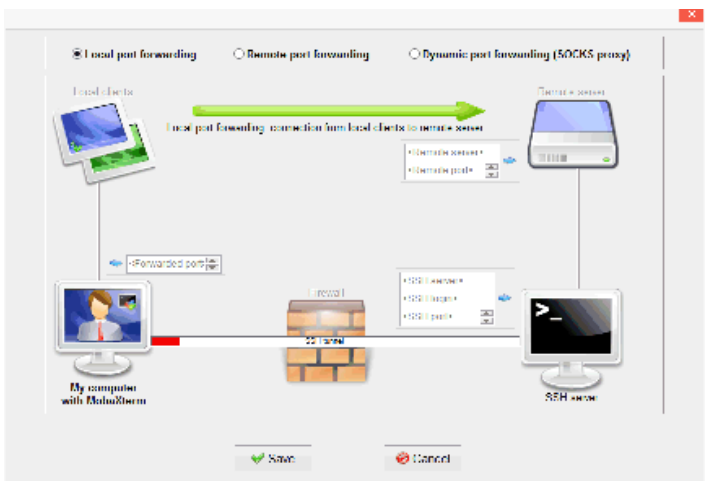
- Use MobaXterm!
  - ↪ [tabbed] Sessions management
  - ↪ X11 server w. enhanced X extensions
  - ↪ Graphical SFTP browser
  - ↪ SSH gateway / tunnels wizards
  - ↪ [remote] Text Editor
  - ↪ ...

http://mobaxterm.mobatek.net/

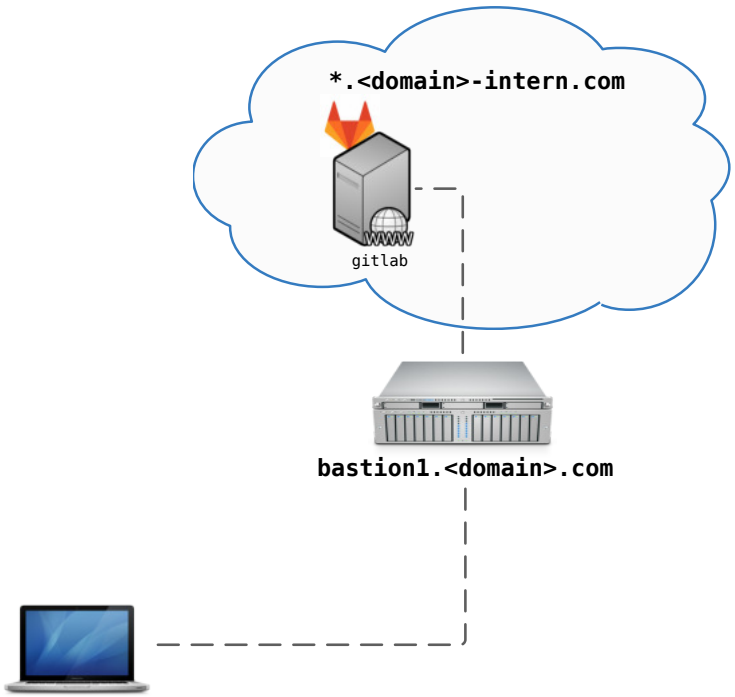








SSH Basic Usage



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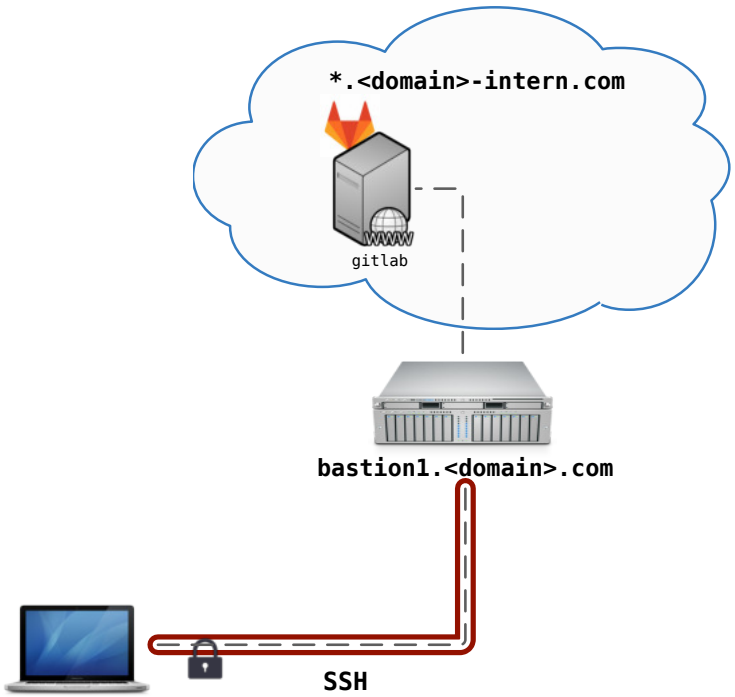
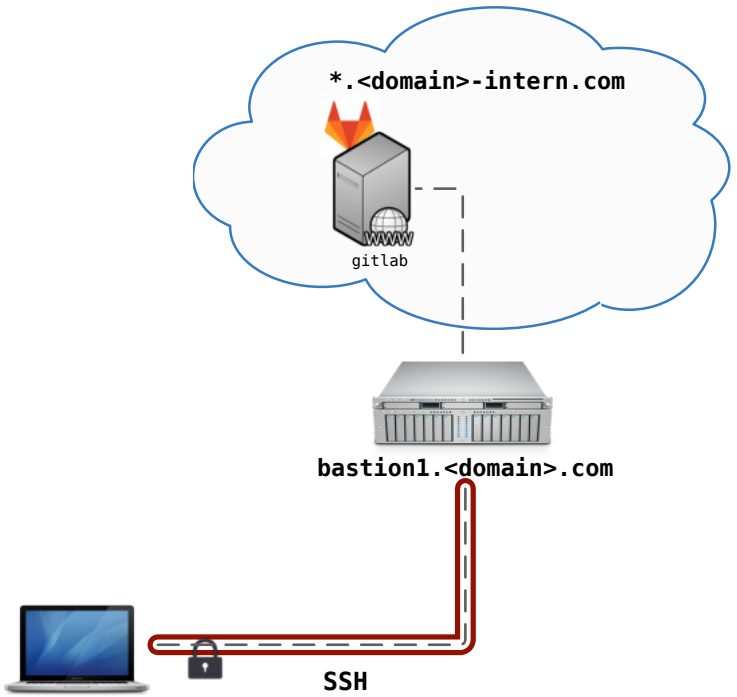


SSH Basic Usage

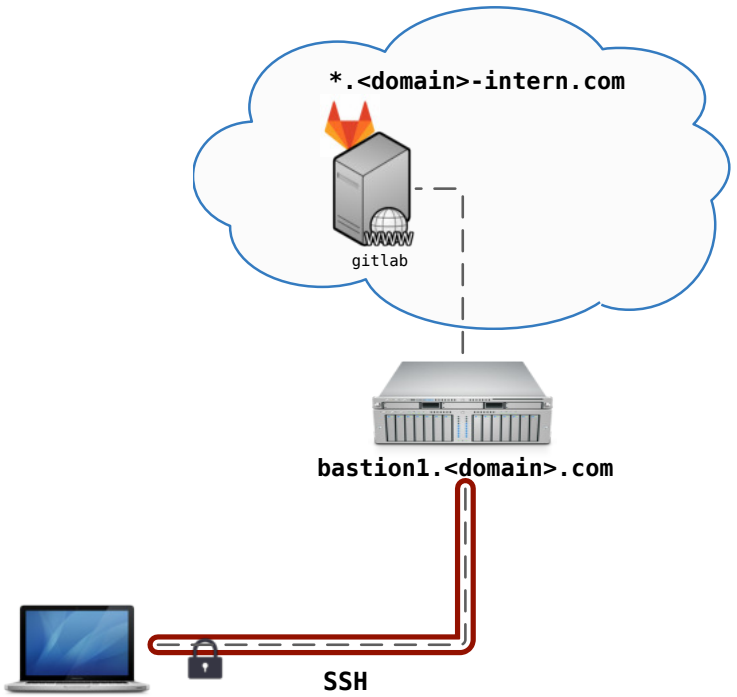


OpenSSH ~/.ssh/config (Mac / Linux)

```
Host uni_*
    User <LOGIN>
    Port 8022

Host uni_bastion1
   Hostname bastion1.<domain>.com
```

SSH Basic Usage



PuTTY / PLink / Pageant (Windows)

```
Session "uni_bastion1"
- Hostname: bastion1.<domain>.com
- Port: 8022
- Connection/Data: username: <LOGIN>
```

OpenSSH ~/.ssh/config (Mac / Linux)

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SSH in Practice ~/.ssh/config

```
$> ssh [-X] [-p <port>] <login>@<hostname>
# Example:  ssh -p 8022 svarrette@access-iris.uni.lu
```

```
Host <shortname>
    Port <port>
    User <login>
    Hostname <hostname>
```

- ~/.ssh/config:
  - ↪ Simpler commands
  - ↪ Bash completion

    $> ssh iri<TAB>

SSH in Practice ~/.ssh/config

```
$> ssh [-X] [-p <port>] <login>@<hostname>
# Example:  ssh -p 8022 svarrette@access-iris.uni.lu
```

```
Host *.ext_ul
    ProxyCommand ssh -q iris-cluster \
         -W `basename %h .ext_ul`:%p
# UL HPC Platform -- http://hpc.uni.lu
Host iris-cluster
    Hostname      access-iris.uni.lu
Host *-cluster
    User          login #ADAPT accordingly
    Port          8022
    ForwardAgent no
```

```
Host <shortname>
    Port <port>
    User <login>
    Hostname <hostname>
```

- ~/.ssh/config:
  - ↪ Simpler commands
  - ↪ Bash completion

    $> ssh iri<TAB>

SSH in Practice ~/.ssh/config

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$> ssh [-X] [-p <port>] <login>@<hostname>
# Example:  ssh -p 8022 svarrette@access-iris.uni.lu
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```
Host <shortname>
    Port <port>
    User <login>
    Hostname <hostname>
```

- ~/.ssh/config:
  - ↪ Simpler commands
  - ↪ Bash completion

```
$> ssh iri<TAB>
$> ssh iris-cluster
$> ssh work
$> ssh work.ext_ul
```

Summary

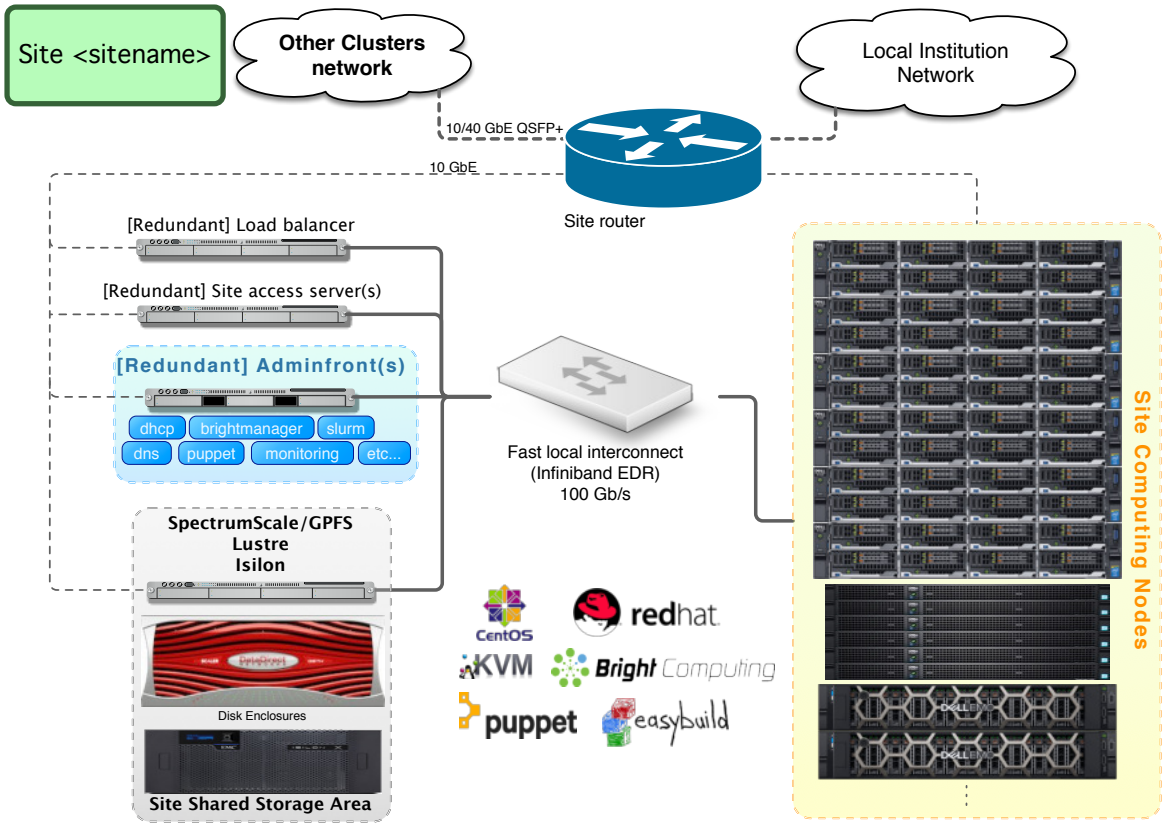
Reference Tutorial Source

Tutorial Page:

http://ulhpc-tutorials.readthedocs.io/en/latest/beginners/

Platform overview.

- Quick presentation of **UL HPC platform** and the new **Iris cluster**
  - ↪ as of 2018: **346.652 TFlops, 9852.4TB (shared)**
  - ↪ For more details: `http://hpc.uni.lu`



First connection & SSH setup

- **Obj**: Connecting for the 1st time & preparing your SSH environment

  - **Step 1a**: Connect to UL HPC (Linux / Mac OS / Unix)
  - **Step 1b**: Optional - using SSH `proxycommand` to access the clusters
    - ↪ allow access from everywhere despite port filtering
    - ↪ use of *SSH aliases* to easier connection
  - **Step 1c**: Connect to UL HPC (Windows)
    - ↪ using **MobaXTerm** (or **Putty**).
  - **Step 2**: Transferring data files
    - ↪ from your laptop to the clusters
    - ↪ cover both Linux / Mac and Windows users

First connection & SSH setup

- **Step 2a**: Transferring data files on Linux / OS X / Unix
  ↪ use **command line tools** (**SCP**, **Rsync**)
- **Step 2b**: Windows [MobaXterm] file transfert

Discovering & reserving HPC resources

- **Obj**: How to reserve resources & use them to **run your code** on it ?

Step 1: the working environment

- What **software** is installed on the nodes
- **where can I put my files**, my data, my results ?
  - ↪ How many **space** is available ?

Step 2: web monitoring interfaces

- What is the **status of the platform** ?
- **How many resources** are available and when ?
- Why is my job in pending state ?

Discovering & reserving HPC resources

Step 3: Reserving resources with Slurm

- Now I want to **run my script on the platform**.
  - ↪ What should I do ?
  - ↪ How to use **Slurm** scheduler on **iris** cluster ?

Discovering & reserving HPC resources

Step 4: Using modules

- I want to run a specific **version of my software**.
  - ↪ What software is available ?
  - ↪ How can I use them ?

Step 5 (advanced): Job management and Persistent Terminal Sessions using GNU Screen

- Each time I close my SSH connection, my job is killed.
  - ↪ How can I **make persistent terminal sessions**
  - ↪ . . . to execute my code without disconnections.
    - ✓ Pre-requisite: screen configuration file `~/.screenrc`
    - ✓ Basic commands
    - ✓ Sample Usage on the UL HPC platform: Kernel compilation

Application

Step 6: Embarrassingly parallel use case

- object recognition with Tensorflow and Python Imageai
  - ↪ Passive job submission
  - ↪ Parallel execution of a sequential task
  - ↪ Usage of GNU/Parallel
  - ↪ Execution time comparison
  - ↪ File transfer

Summary

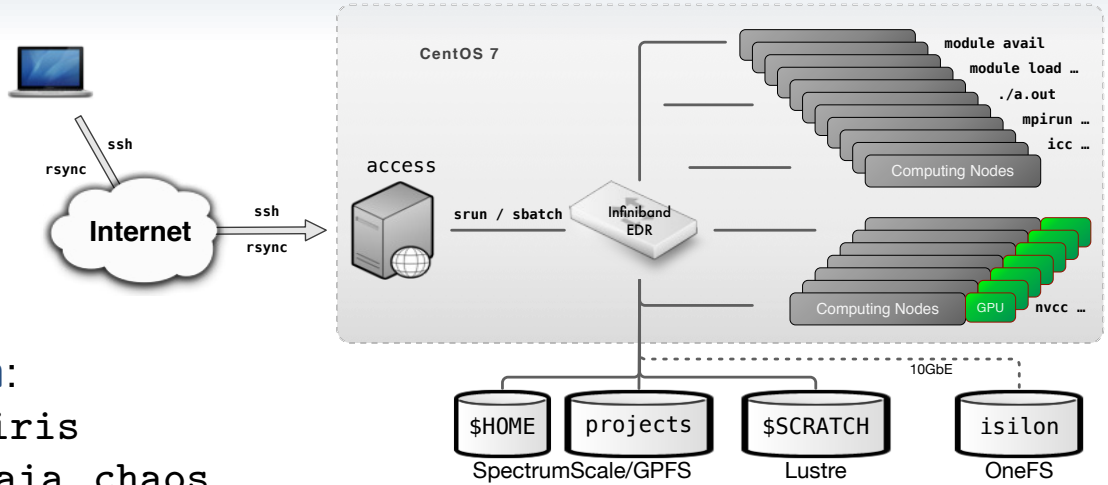
Hands-On 1: SSH Setup

https://ulhpc-tutorials.readthedocs.io/en/latest/beginners/

Your Turn!

- **Generating you SSH Key pair**
- **Connect** to UL HPC (Linux / Mac OS / Unix / Windows)
  - ↪ Connect from your laptop/workstation to UL HPC access
  - ↪ Connect from one cluster to the other
- **Transferring files**

Hands-on 2: First steps on UL HPC

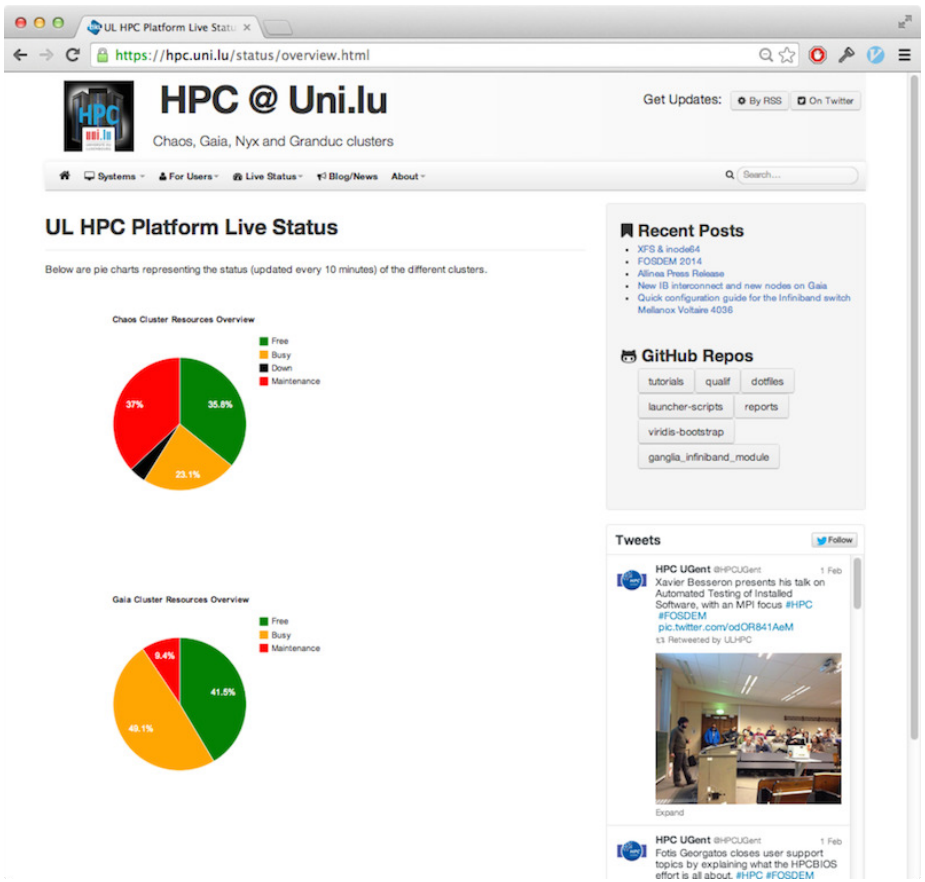


- UL HPC Environment
  - ↪ **Operating System**:
    - ✓ CentOS 7 on `iris`
    - ✓ Debian 7 on `gaia`, `chaos`
  - ↪ **Job Management**: `{ oarsub | srun/sbatch }`
  - ↪ **Environment modules**: `modules`
    - ✓ **Not** available on frontends, ***Only*** on compute nodes
  - ↪ (advanced) discovering GNU screen

Directory	Max size	Max #files	Backup
`$HOME` (`iris`)	500 GB	1.000.000	YES
`$SCRATCH`	10 TB		NO

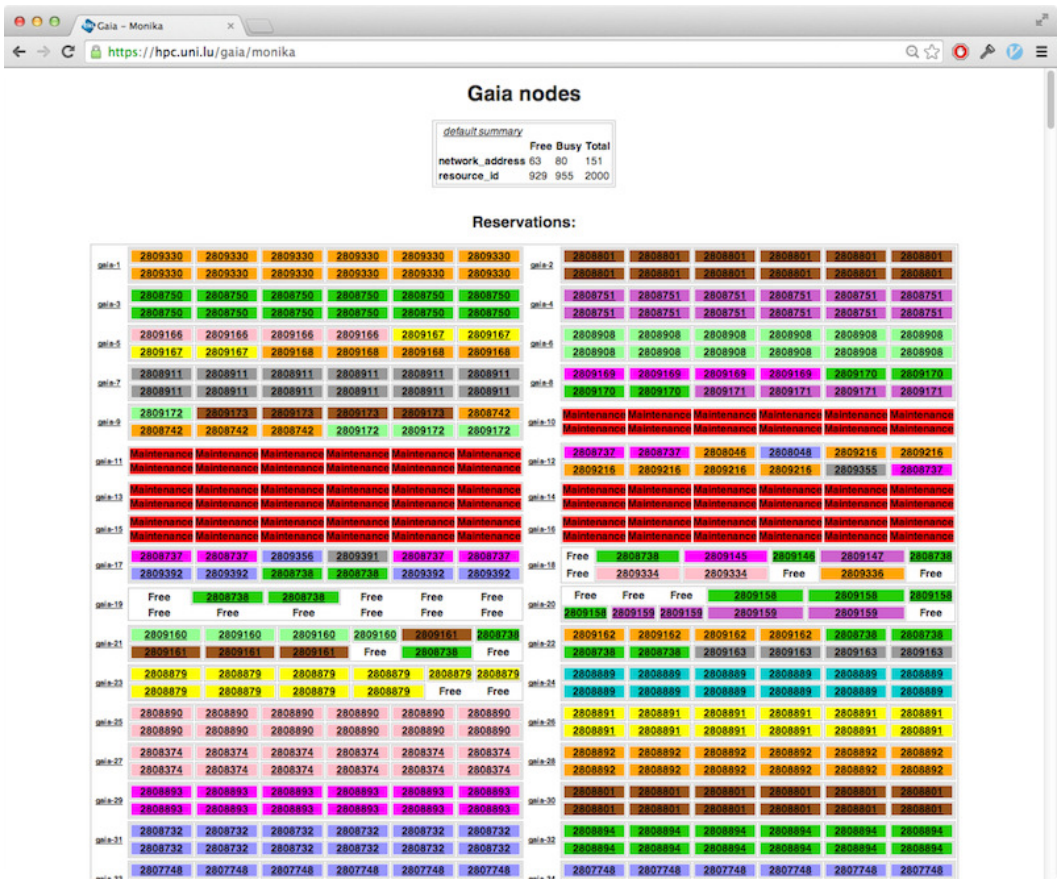
ULHPC Web monitoring interfaces

http://hpc.uni.lu/status/overview.html



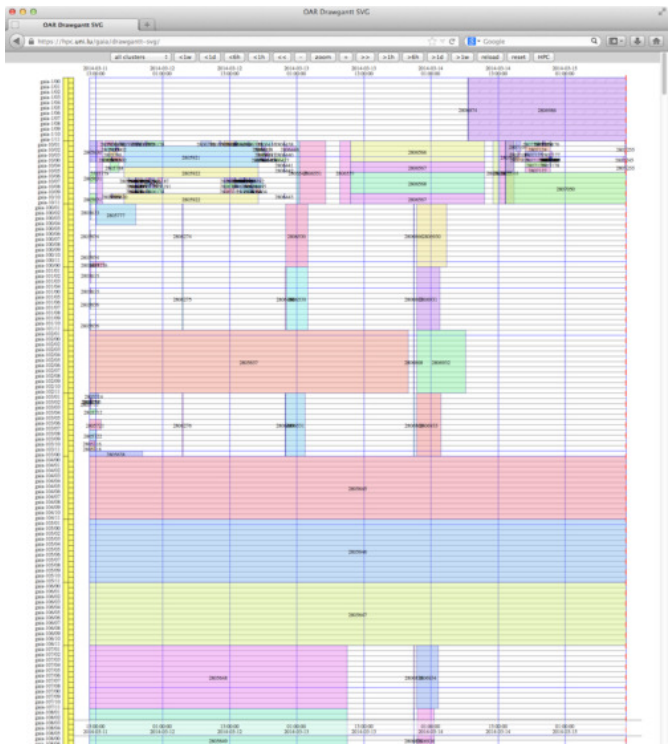
ULHPC Web monitoring interfaces

http://hpc.uni.lu/{iris,gaia,chaos,g5k}/monika



ULHPC Web monitoring interfaces

`http://hpc.uni.lu/{iris,gaia,chaos,g5k}/drawgantt`

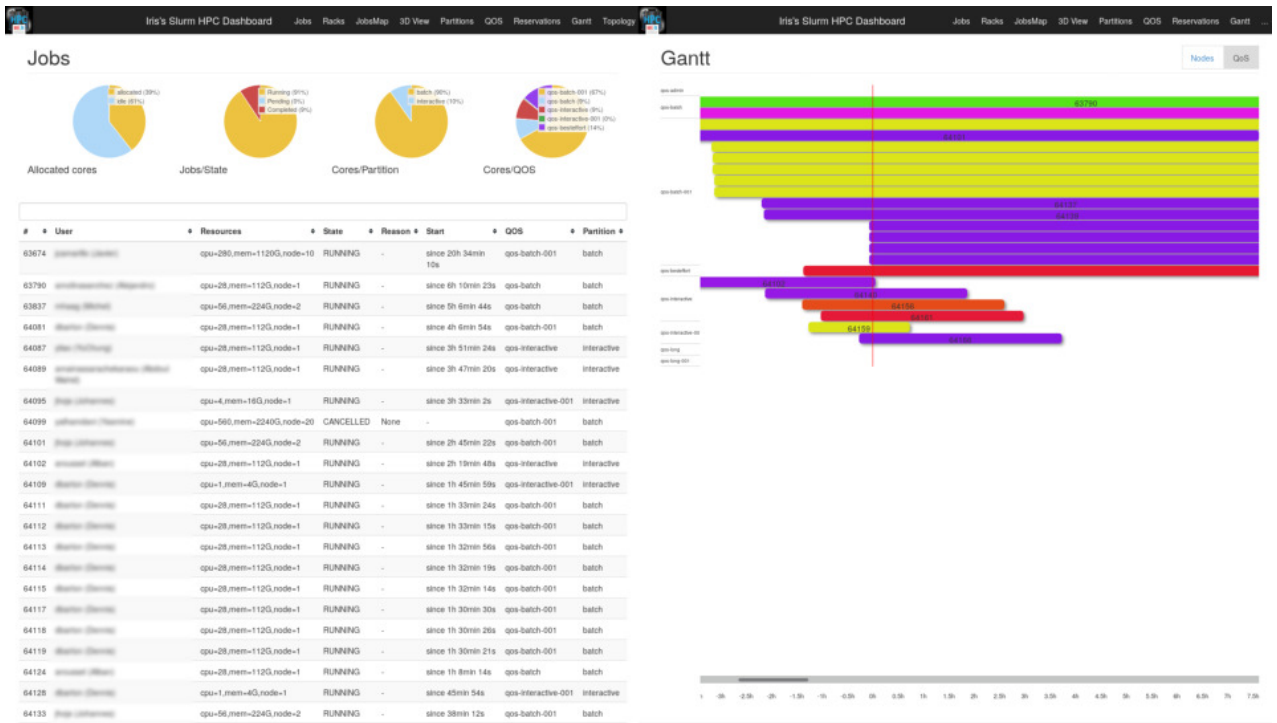


ULHPC Web monitoring interfaces

http://hpc.uni.lu/{iris,gaia,chaos,g5k}/ganglia

ULHPC Web monitoring interfaces

https://access-iris.uni.lu/slurm



Job management

If there are not enough resources available, use our reservations, add the parameters in red to your submission commands:

- SLURM (Iris)

```
$> srun -reservation=hpcschool -pty bash
```

Programming, quick start

- choose a command line text editor
- load modules
- run a Matlab script
- run a R script
- use the available compilers
- compile and run a simple MPI program

Questions?

http://hpc.uni.lu

High Performance Computing @ uni.lu

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1. **Introduction**
2. **Vocabulary**
3. **SSH Secure Shell**
4. **UL HPC Tutorial: Getting Started**
   Step by step program of this practical session
5. **Hands-On: Getting Started on ULHPC**