



## C3E project

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- Present the C3E cloud environment
- Illustrate how openStack environment allows you to provide the remote visualization
- Discuss in some details “virtualization of GPUs”
- Install and test remote visualization tools on virtual machines.



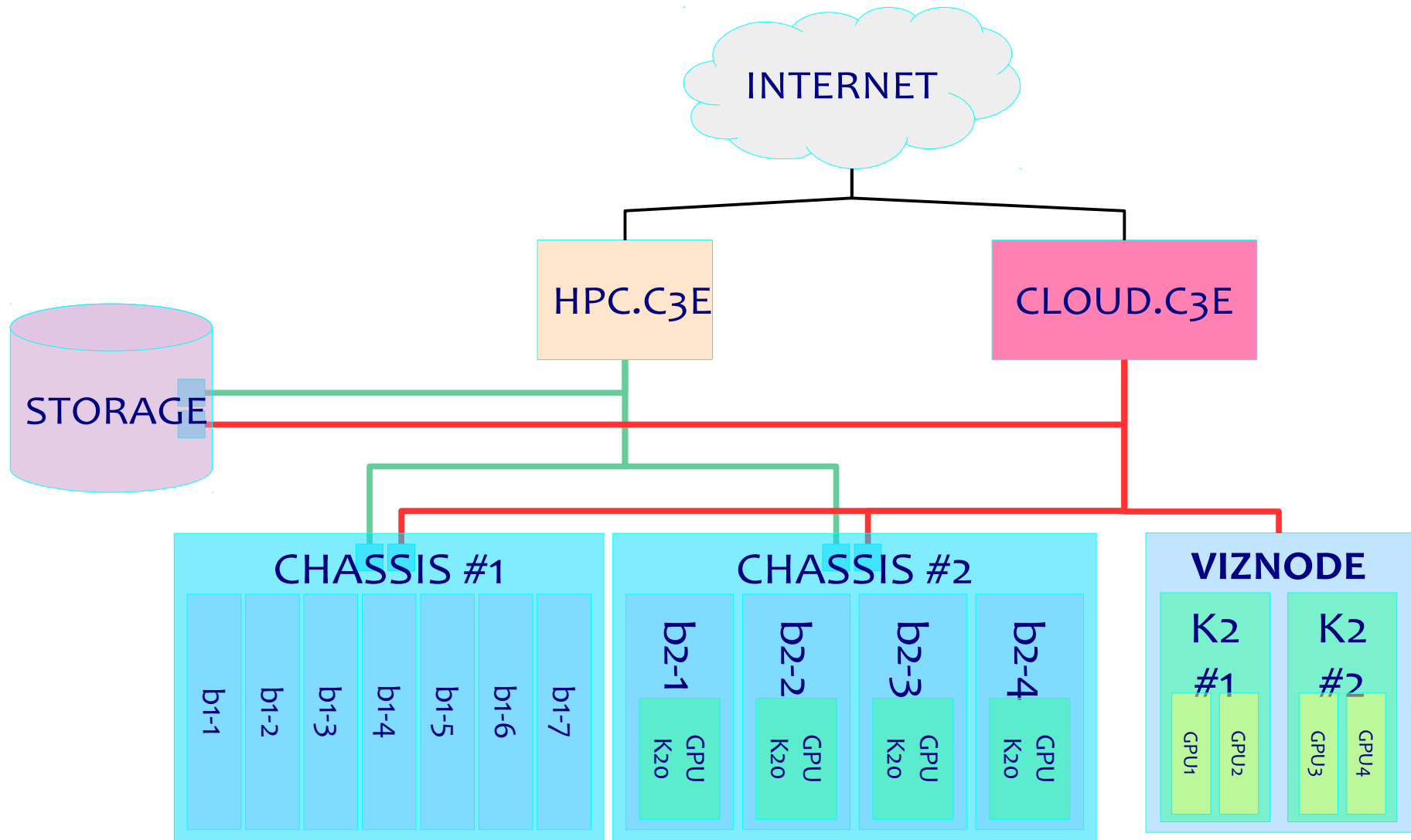
The purpose of the C<sup>3</sup> Project is to make available efficient infrastructure for supercomputing to companies and entities through CLOUD COMPUTING.

It is an initiative by eXact lab srl in collaboration with COSILT. In addition to this, the idea is to allow the development of a center of expertise and knowledge on the issues of business development through the use of High Performance Computing systems, actively involving companies, industrial and academic partners.

[www.c3hpc.com](http://www.c3hpc.com)



# C3 hardware/logical structure





Front-end nodes: Cloud/HPC  
Dual Intel 40 core @2.3GHz  
32 GB RAM  
2 Tb storage

Computational nodes: BXX  
Dual Intel Xeon E5 -2697/v2  
24 core @2.7GHz  
64 GB RAM  
1 Tb storage

GPU: 2 K20X



Viznode: Dual Intel(R) Xeon(R) CPU E5-2630 v2  
12 cores @2.60GHz  
128 GB RAM  
2 NVIDIA GRID K2 (2 GPUs on a each

card\_




# C3 project login




  


## Log in

**User Name**

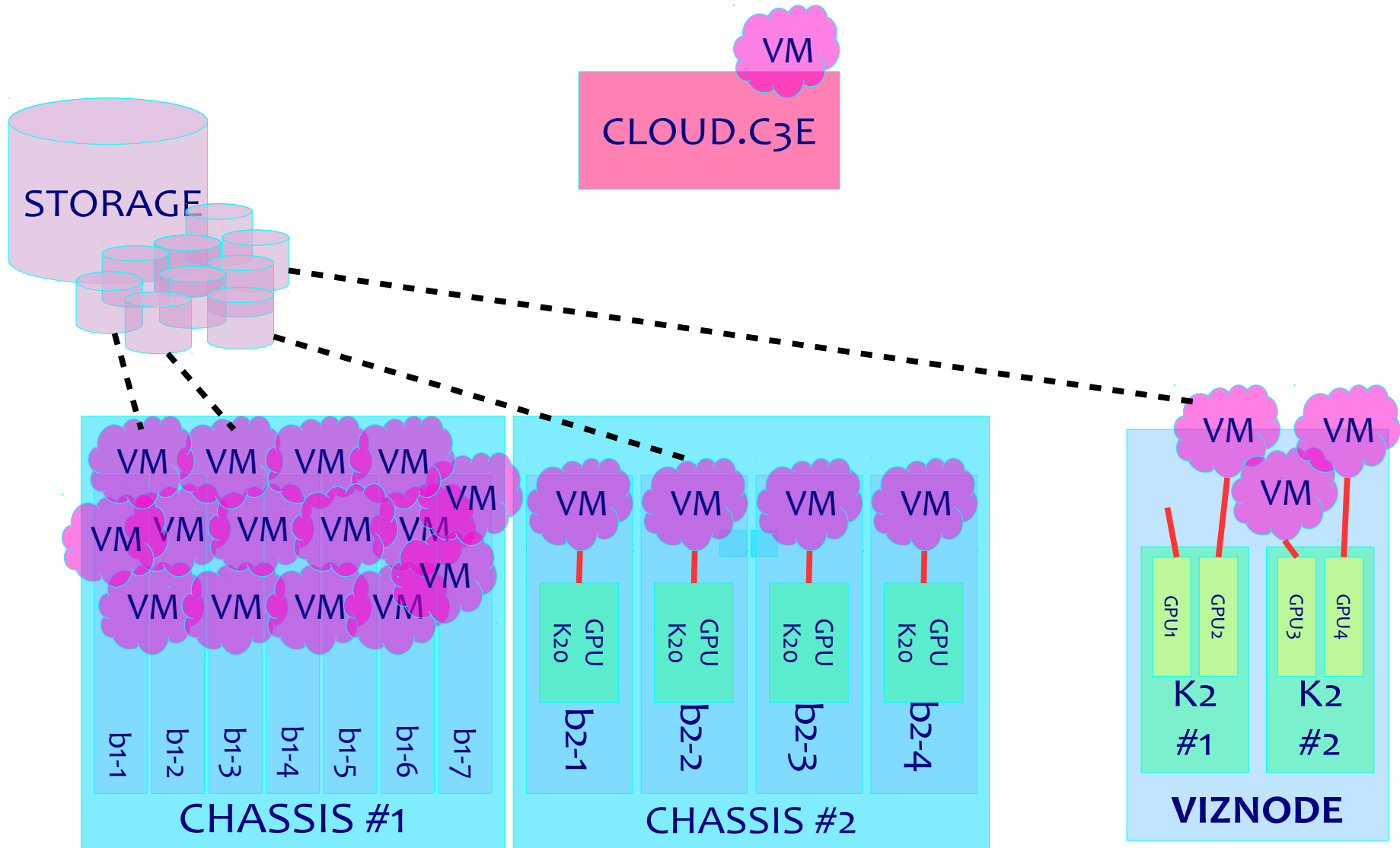


**Password**



Connect

# C3 VM provisioning..



- Provide VM with GPGPU facilities
  - a VM can have direct access to the GPU on the compute node and so provide hardware acceleration
- Done through enabling at hypervisor level “PCI passthrough” linux kernel mechanism.
- This allows QEMU-KVM (the virtualization hypervisor used in this case by OpenStack) to assign each single GPU exclusively to a single virtual machine



# Get the GPU flavor

The screenshot shows the eXact cloud management interface. The browser address bar indicates the URL is `cloud.c3e.exact-lab.it/dashboard/project/images/`. The sidebar on the left contains a navigation menu with the following items: Project, Compute, Overview, Instances, Volumes, Images (highlighted in red), Access & Security, Network, Orchestration, Object Store, Admin, and Identity. The main content area is titled 'Images' and features a table of image resources. Above the table, there are filters for 'Project (1)', 'Shared with Me (0)', and 'Public (5)', along with buttons for '+ Create Image' and 'Delete Images'. The table has the following columns: Image Name, Type, Status, Public, Protected, Format, Size, and Actions. A single image is displayed: 'CentOS 7 for Passthrough', which is a Snapshot, Active, not Public, not Protected, in QCOW2 format, and 3.0 GB in size. The Actions column for this image contains a 'Launch' button and a dropdown arrow. Below the table, it says 'Displaying 1 item'.

<input type="checkbox"/>	Image Name	Type	Status	Public	Protected	Format	Size	Actions
<input type="checkbox"/>	CentOS 7 for Passthrough	Snapshot	Active	No	No	QCOW2	3.0 GB	Launch <span>▼</span>

# C3 VMs for today

cloud.c3e.exact-lab.it/dashboard/project/instances/

exact

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## Instances

Instance Name =  Filter [Launch Instance](#) [Delete Instances](#) [More Actions](#)

<input type="checkbox"/>	Instance Name	Image Name	IP Address	Size	Key Pair	Status	Availability Zone	Task	Power State	Time since created	Actions
<input type="checkbox"/>	<a href="#">MHPC Passthrough 1</a>	CentOS 7 for Passthrough	192.168.42.20 Floating IPs: 46.254.238.148	<a href="#">m1.medium-TESLA</a>	chiave ssh per vm	Active	nova	None	Running	1 week, 2 days	<a href="#">Create Snapshot</a>
<input type="checkbox"/>	<a href="#">MHPC Passthrough 2</a>	CentOS 7 for Passthrough	192.168.42.21 Floating IPs: 46.254.238.149	<a href="#">m1.medium-TESLA</a>	chiave ssh per vm	Active	nova	None	Running	1 week, 2 days	<a href="#">Create Snapshot</a>
<input type="checkbox"/>	<a href="#">MHPC Passthrough 3</a>	CentOS 7 for Passthrough	192.168.42.22 Floating IPs: 46.254.238.150	<a href="#">m1.medium-TESLA</a>	chiave ssh per vm	Active	nova	None	Running	1 week, 2 days	<a href="#">Create Snapshot</a>
<input type="checkbox"/>	<a href="#">MHPC Passthrough 4</a>	CentOS 7 for Passthrough	192.168.42.23 Floating IPs: 46.254.238.151	<a href="#">m1.medium-TESLA</a>	chiave ssh per vm	Active	nova	None	Running	1 week, 2 days	<a href="#">Create Snapshot</a>

Displaying 4 items

Project

Compute

Overview

Instances

Volumes

Images

Access & Security

Network

Orchestration

Object Store

Admin

Identity

- The internal network is where the virtual network are spawned.
- A virtual network belongs to a tenant and can be shared.
- It is possible to assign a floating IP to a VM spawned on the virtual network
- The security of the VM is managed by the security groups (it is still possible to have a firewall on the VM, but only the connections allowed by the security groups will arrive to the VM)

## Network Topology

Resize the canvas by scrolling up/down with your mouse/trackpad on the topology. Pan around the canvas by clicking and dragging the space behind the topology.

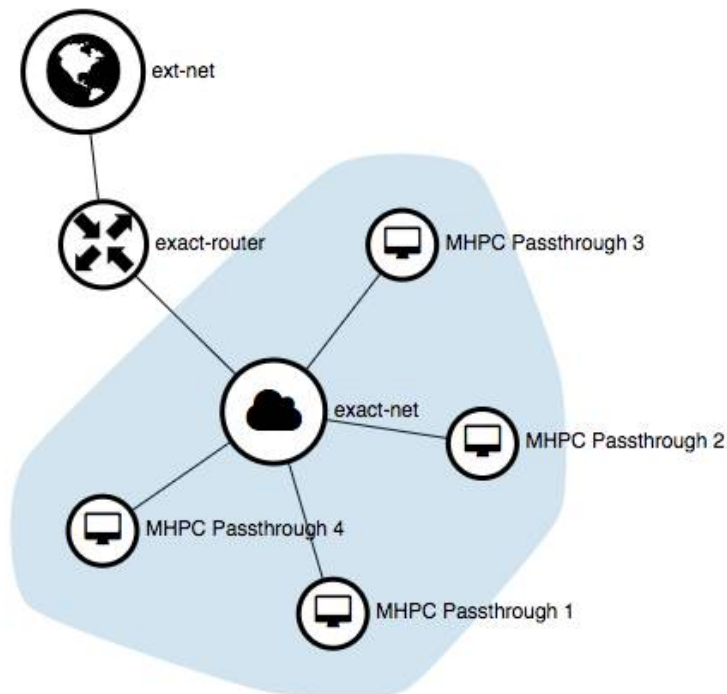
Toggle labels

Toggle Network Collapse

Launch Instance

+ Create Network

+ Create Router





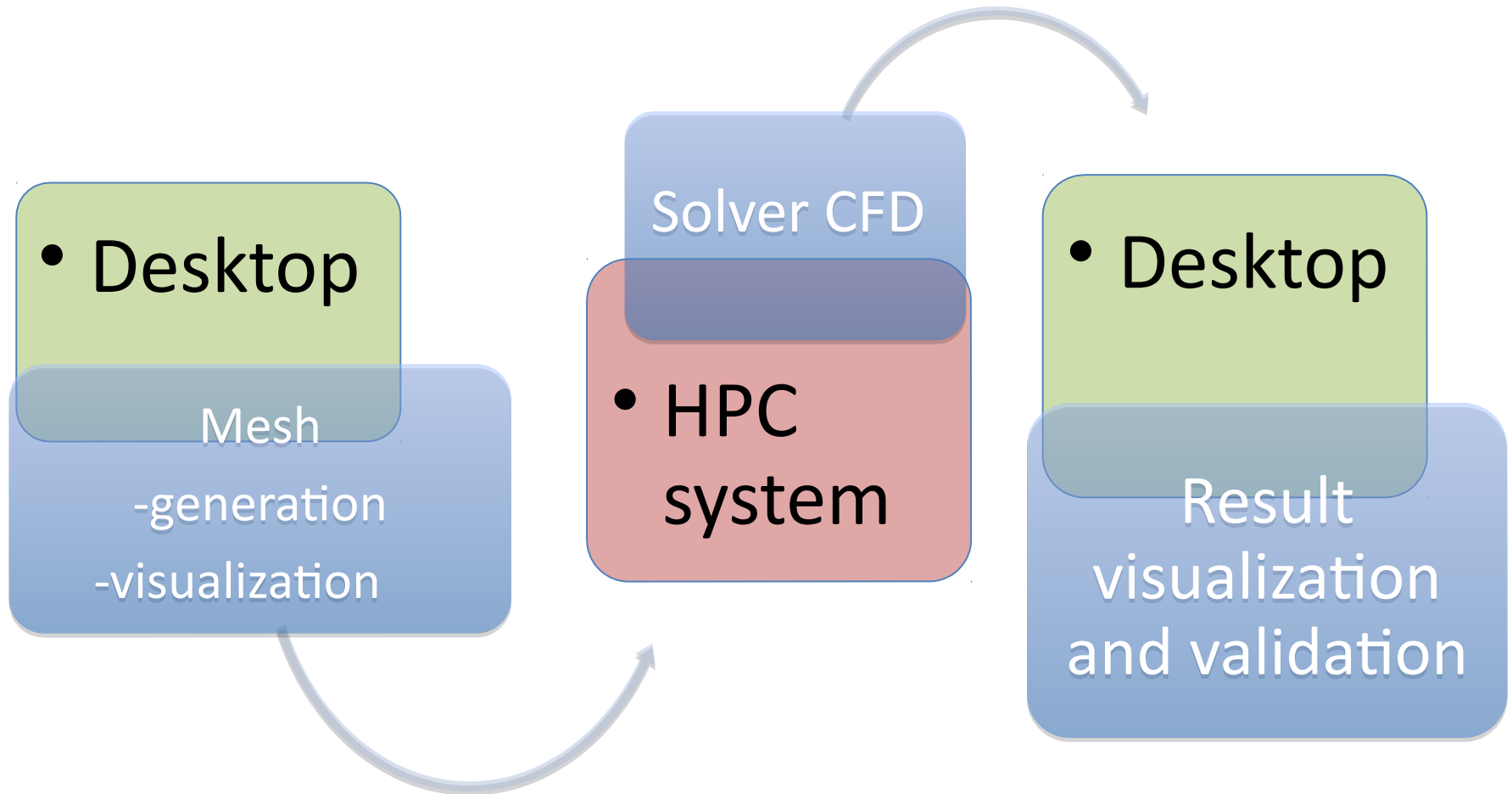
FVG funded joint industrial/academic project - **Leaded/Proposed by eXact lab**

## GOAL

Setup an **integrated computational ecosystem** for hydrodynamics simulations for naval industrial sector in FVG region



# The cumbersome workflow..



# Our proposed solution

## HPC SYSTEM + REMOTE VISUALIZATION GRAPHICAL NODES

Mesheres  
- Generate  
- Visualize



Solver CFD



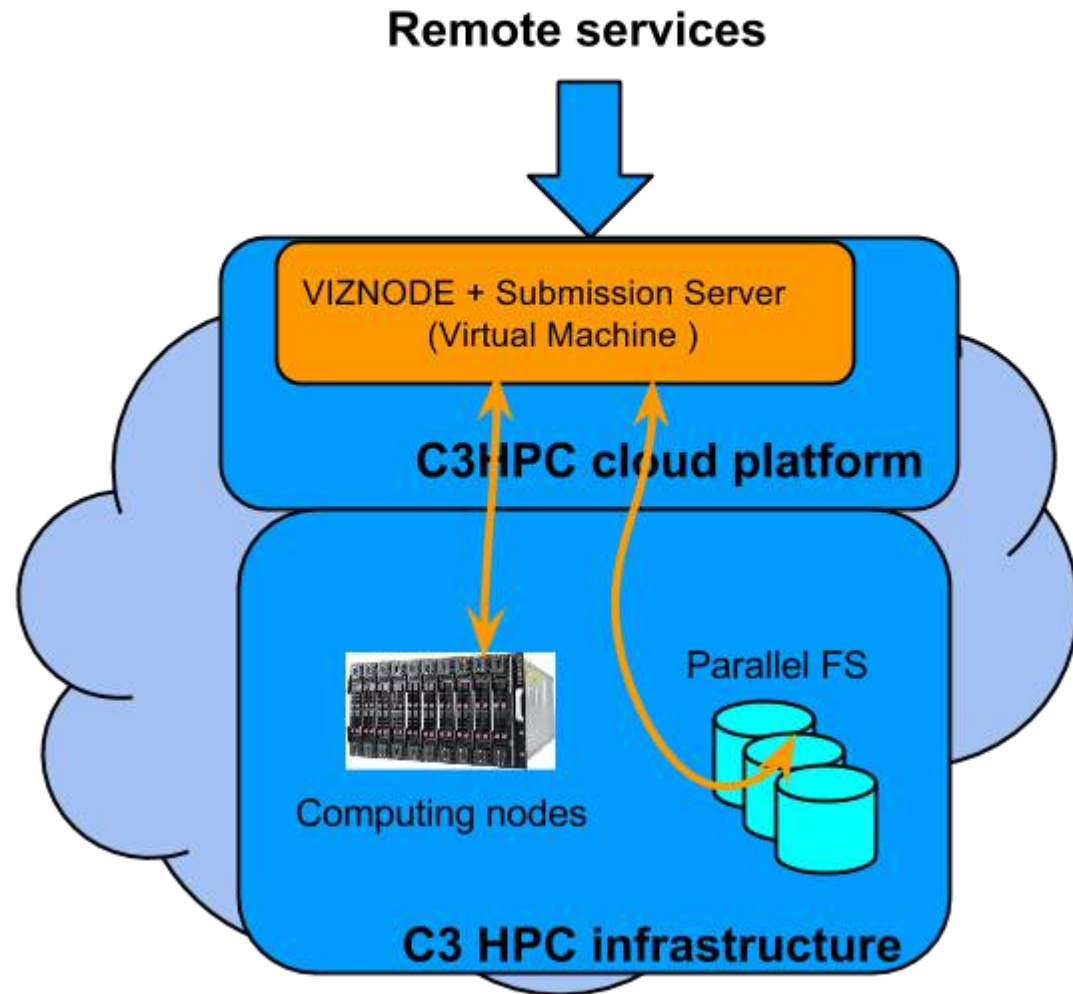
visualize  
results and  
validate them

Productivity increases...

# The overall picture



- Access can be provided by VM running on cloud.
- Vm could be any OS (windows) and can host any specific/ad hoc software
- Submission done via any kind of portal/mechanism directly to the queue system on HPC platform
- Data are available from VM on the Lustre parallel FS.
- Remote visualization done by means of DCV. Virtual machine able to share GPU resource for graphical intensive tasks



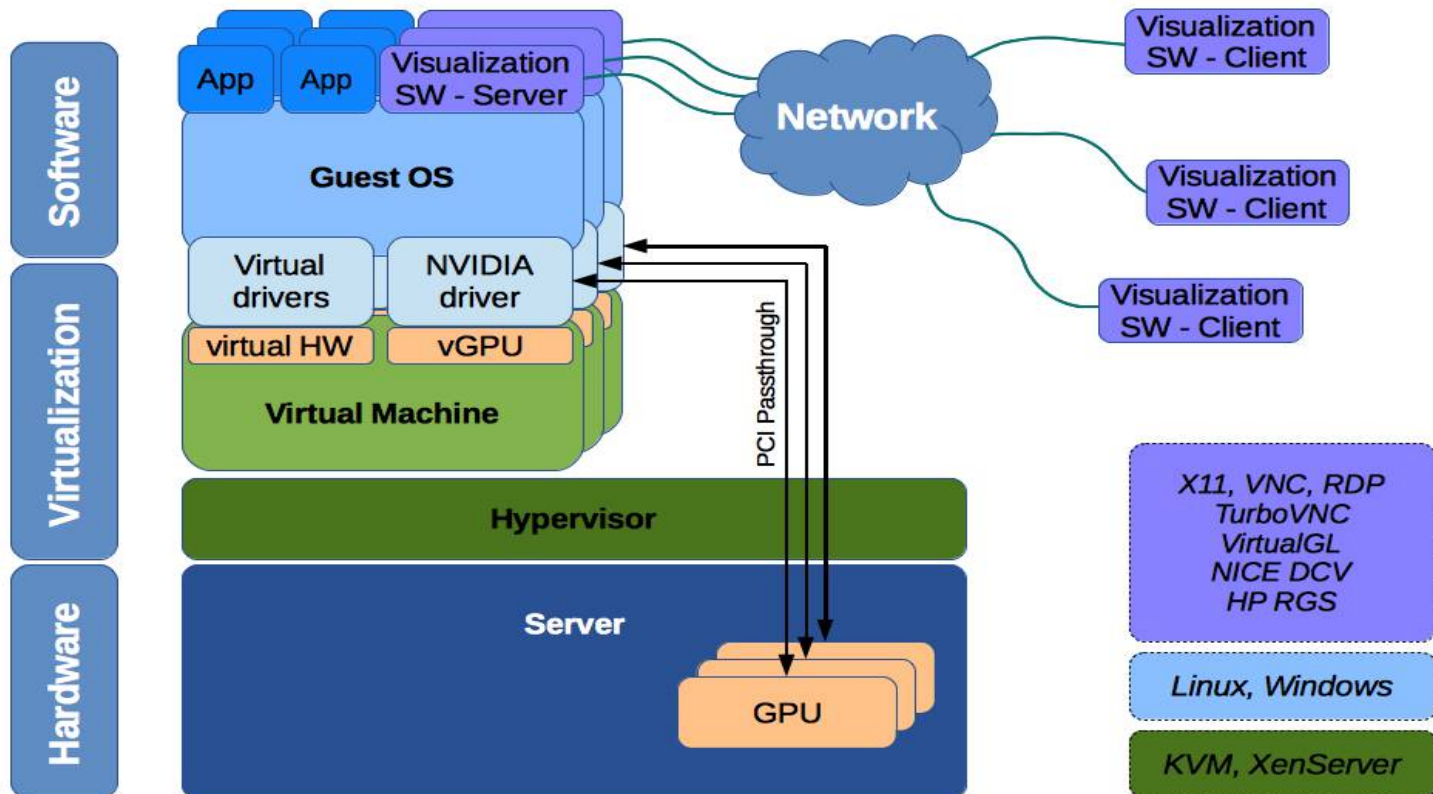


- Developed by eXact in collaboration via Nvidia
- Tested by openViewSHIP partners
  - 1 Viznode integrated in Coca cluster (UNITS)
  - 1 Viznode integrated in c3hpc cluster via openstack cloud
- Driving idea:
  - Open source solution as much as possible
  - Usage transparent to the users

- Nvidia K2 cards
- 1U Multicore node

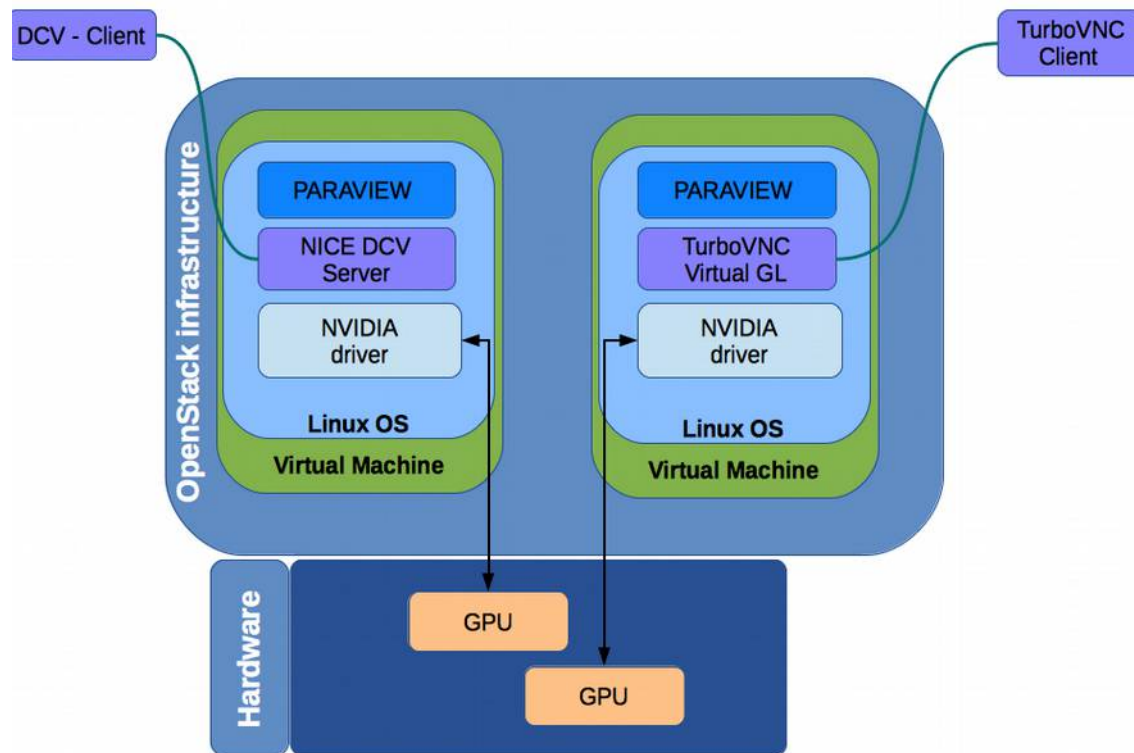


# VizNode: the software stack



- Nice DCV
  - proprietary, based on realVNC for remotization, it supports Linux and Windows for the server and Linux, Windows and MacOS for the client.
- HP RGS
  - proprietary, it supports Linux and Windows for the server and Linux, Windows and MacOS for the client.
- VirtualGL with TurboVNC and libjpeg-turbo
  - open-source software collection, it supports Linux, Windows and MacOS for both the server and the client.

# VizNode: the c3hpc setup



- Log into the VM machine..
- Install the remote visualization software and some testing software
- Compare visualization performance by means of standard X11 forwarding and the remote visualization software.
- See rst file in the github repo (D9 folder)