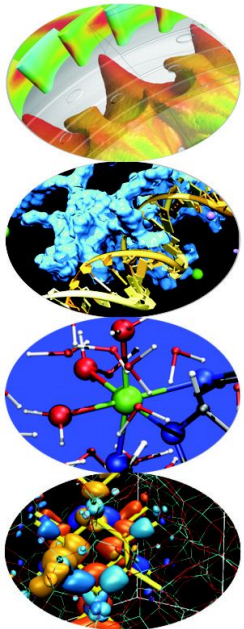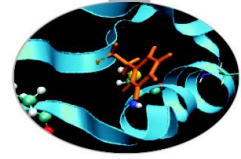# Remote Visualization @ Cineca via RCM

Roberto Mucci r.mucci@cineca.it,

SCAI - Cineca
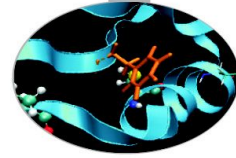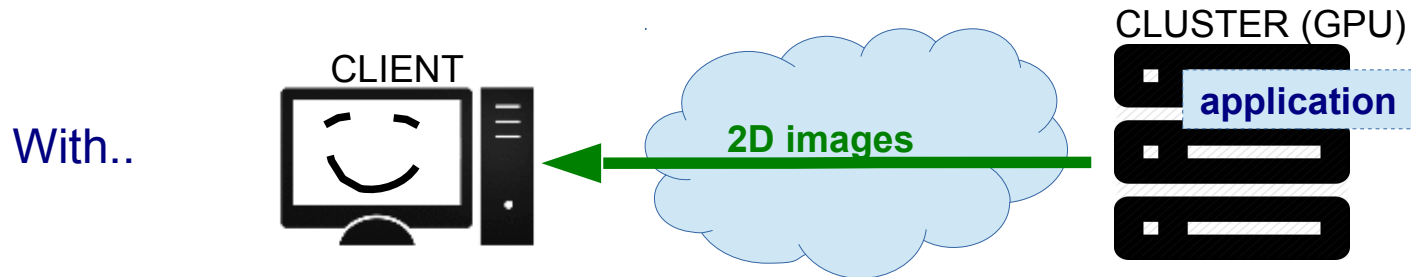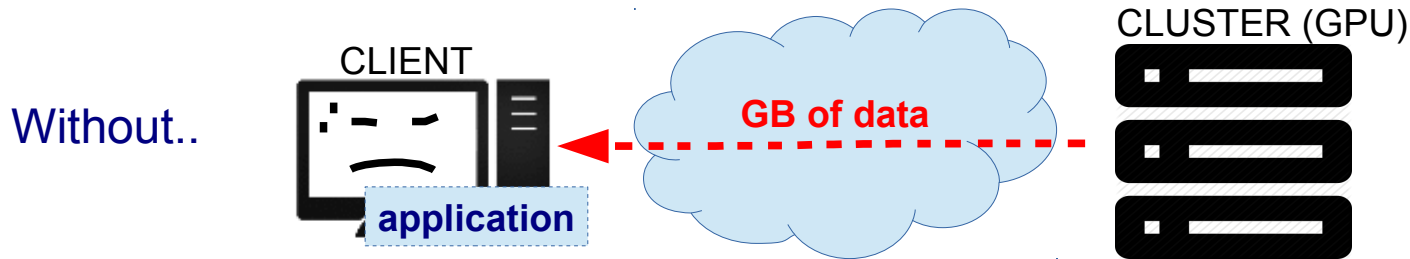
19/06/2015

Outline

1. Why a remote visualization service?
2. RCM: Remote Connection Manager
3. Technologies
4. Infrastructure
5. Demo

Why a remote viz service?

Without..

CLIENT

application

GB of data

CLUSTER (GPU)

With..

CLIENT

CLUSTER (GPU)

application

2D images
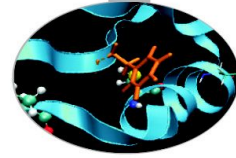
- To **avoid transferring GB** of data produced on Cineca HPC systems
- To allow users to **perform visualization** e post-processing activities **on HPC machines** (GPU, high memory and fast CPU)

"Move the application near the data"

# Once upon a time..

..the classic remote visualization service:

1. Download the vncviewer
2. Login the cluster: *$ ssh login03.galileo.cineca.it*
3. Load the vncserver module: *$ module load profile/advanced turbovnc*
4. Start the vncserver: *$ vncserver -geometry 1024x900*
5. Get the the "display number" from the vncserver output
6. Locally run the "vncviewer" to connect to the display: *$ vncviewer node001:3*
7. Kill the remote display once finished!

..and things could be more complicated if nodes are not reachable via ssh (as often happens for the nodes of an HPC cluster..)
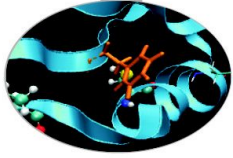
..but we wanted something more

1. Make the access to the visualization service "straightforward"
2. Give users a user-friendly tool to easily manage their remote displays
3. Avoid the proliferation of "orphan" displays
4. Avoid "anarchic" use of the resources (PBS Cgroups to control resource allocation)
5. Enable the usage of compute nodes (non-routable IP)
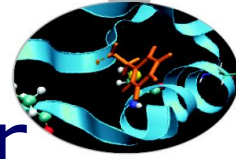
RCM: Remote Connection Manager
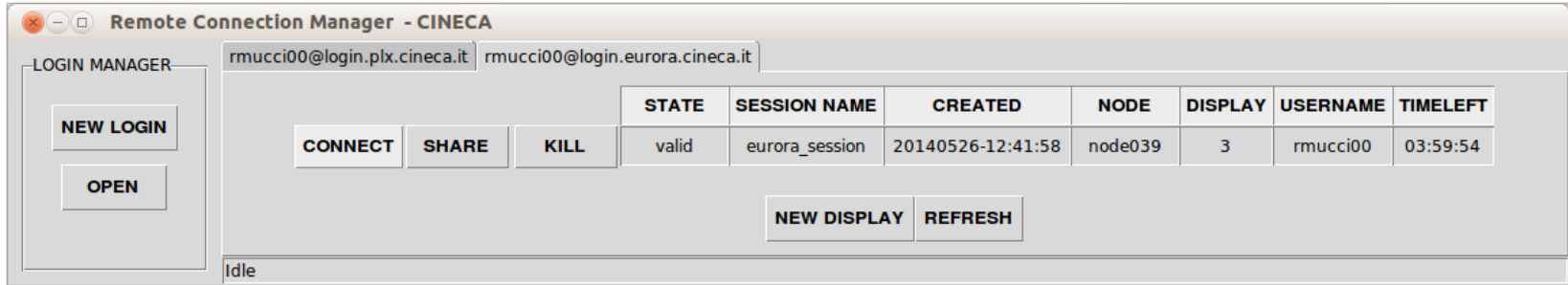
1. Cross platform client/server GUI application

2. Automates operations needed to set up a remote visualization access to the Cineca clusters

3. Simplify the management of the remote displays

4. Integrates of existing open-source technologies:

   - TurboVNC: desktop sharing software
   - VirtualGL: gives any linux vnc software the ability to run OpenGL application with full 3D acceleration
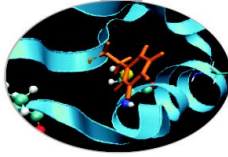
RCM: Open source technologies

TURBOVNC http://www.turbovnc.org/

- Free remote control software package based on TightVNC optimized to work with VirtualGL. TurboVNC performs very well on high-latency, low-bandwidth networks. (The client "vncviewer" is embedded in RCM)

VirtuaGL
3D Without Boundaries
http://www.virtualgl.org/

- Open source package that gives any Unix or Linux remote display software the ability to run OpenGL applications with full 3D hardware acceleration. It optimizes user experience of remote 3D applications by rendering on remote GPU while streaming only the resulting 2D images.
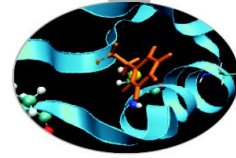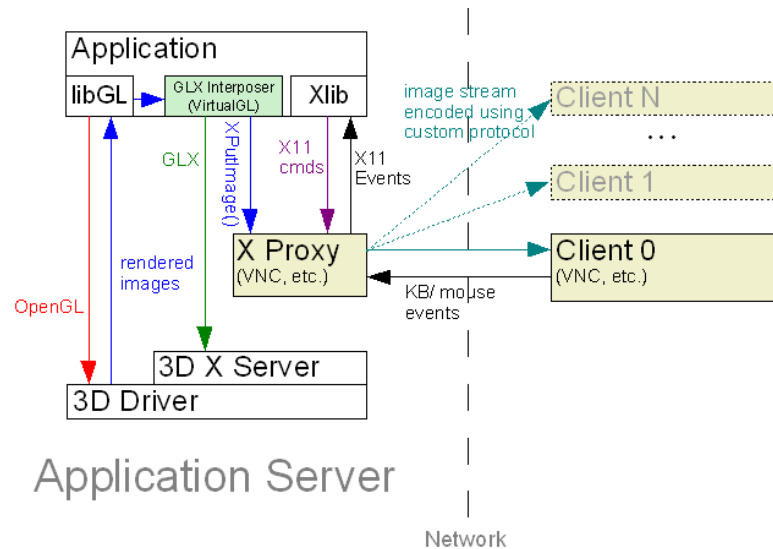
Indirect rendering VS VirtualGL
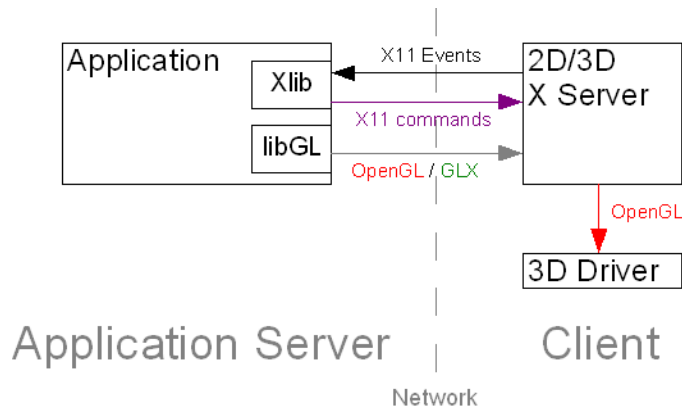
Indirect rendering

The OpenGL commands are encapsulated inside of the X-Windows protocol stream and sent to an X-Windows server running on the client machine. The X server then passes the OpenGL commands to the local 3D rendering system, which may or may not be hardware-accelerated.
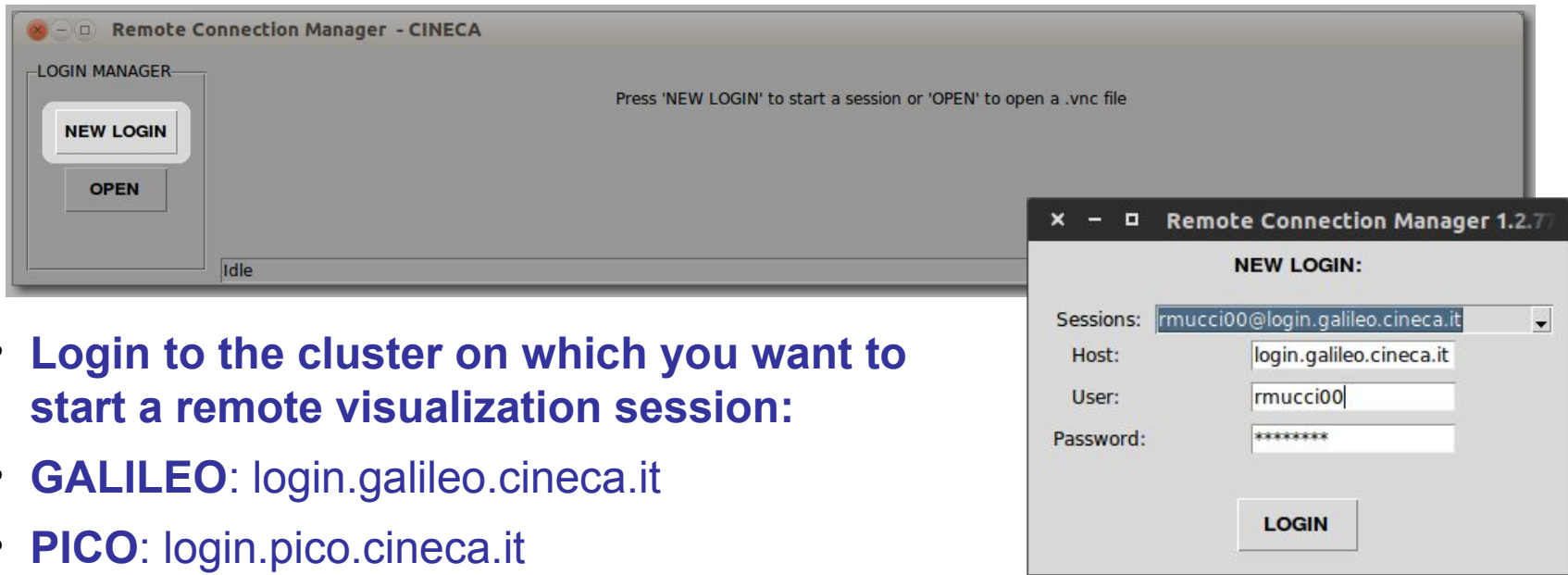
VirtualGL

"Split rendering" to force the 3D commands and data from the application to go to a GPU in the application server. When the application attempts to use an X window for OpenGL rendering, VirtualGL intercepts the request and passes it to the local GPU ($ vglrun + application)
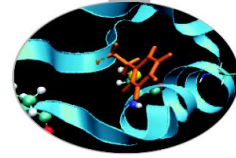
RCM: Login to a cluster

- **Login to the cluster on which you want to start a remote visualization session:**
- **GALILEO**: login.galileo.cineca.it
- **PICO**: login.pico.cineca.it
- **EURORA**: login.eurora.cineca.it
- **FERMI**: login.fermi.cineca.it
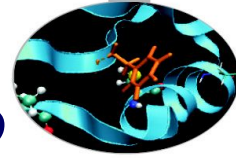
RCM: Create a remote display 1/2

- Users can choose:
- The session's name
- The queue (different profiles with different resource allocation)
- The VNC Server and the desktop manager
- Remote display dimensions

RCM: Create a remote display 2/2

RCM *client*

RCM *server*

CLIENT

CLUSTER (GPU)

1. Ask for a new remote display

2. Submit a job on the chosen queue which runs *vncserver*

4. Run *vncviewer* to connect to the display

(ssh tunnel)

3. The **display number** is sent to the RCM client

network

Remote Connection
Session name: mysession
Select queue: medium_8gb
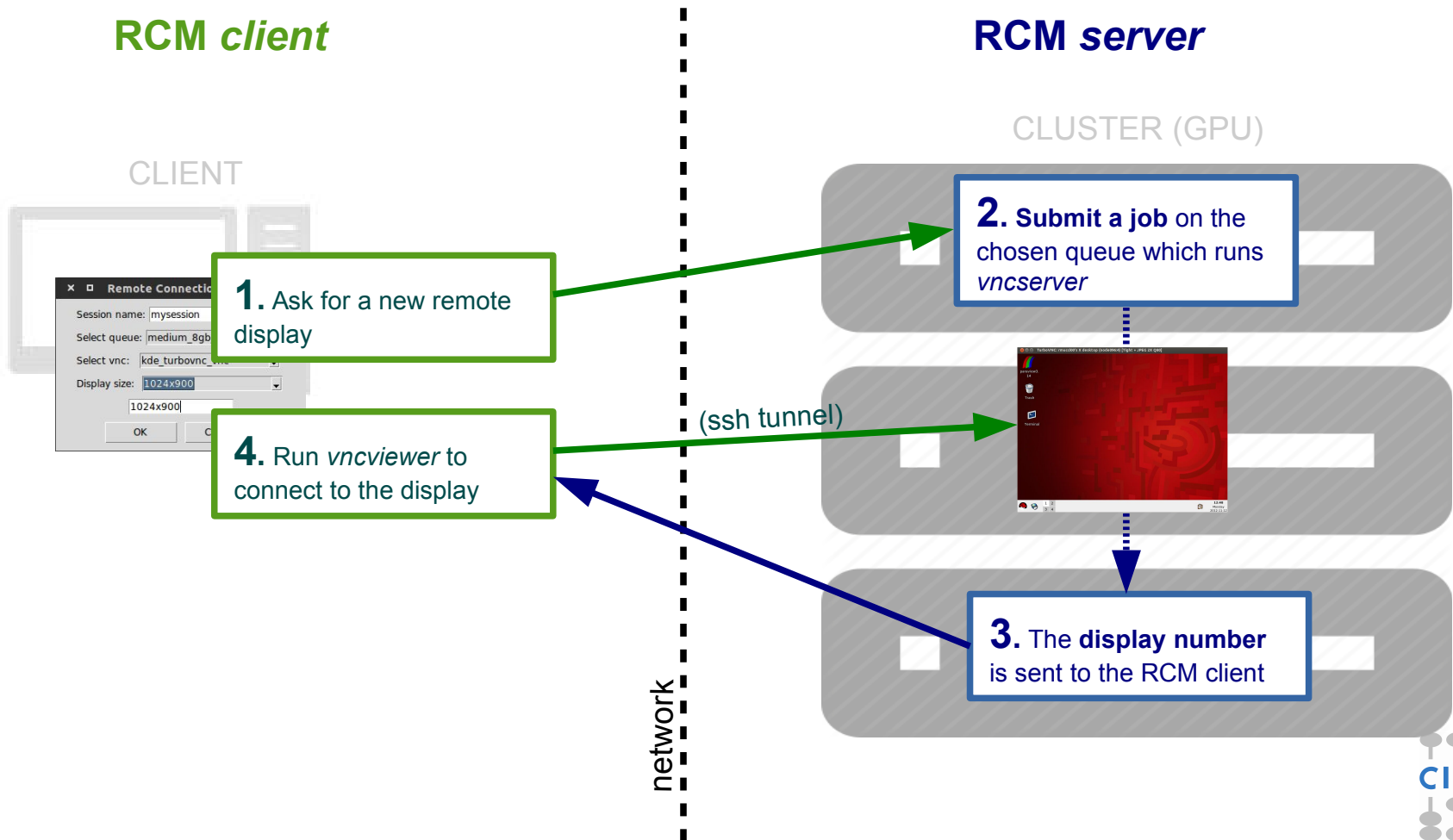Select vnc: kde_turbovnc_vnc
Display size: 1024x900
1024x900
OK
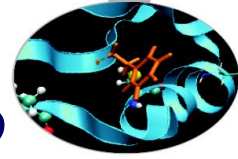
RCM: Displays information
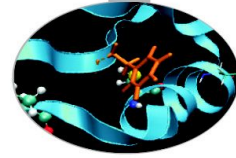

- List of all the available displays on the cluster

- Information related to each remote display

- **TIMELEFT**: the time remaining before the display will be killed (depends on time limit of the underlying job)
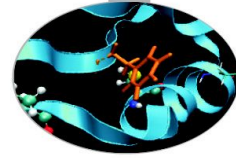
RCM: Connect, Share and Kill
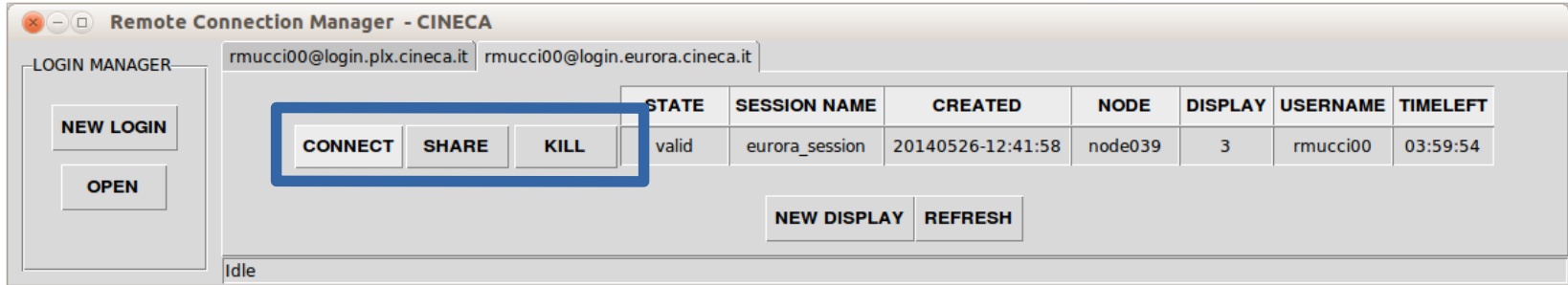
- **CONNECT** Starts the connection to the remote dislpay (running the embedded vncviewer by TurboVNC)

- **SHARE** Generates a ".vnc" file with the display info that can be open by another RCM (or vncviewer) to share with another user a remote display

- **KILL** Kills the remote display (the job running the vncserver is killed)
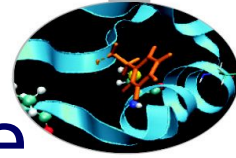
Remote visualization infrastructure

GALILEO

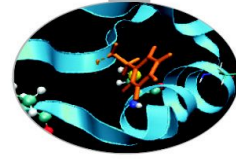| HOST	RESOURCES	LIMITS
login.galileo.cineca.it	3 nodes with 16 cores @ 2.4Ghz, 128GB, 2 GPU Nvidia K40 per node (different profiles available with different quantity of memory and number of cores)	walltime: from 2h to 12h

PICO

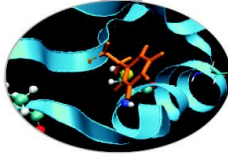| HOST	RESOURCES	LIMITS
login.pico.cineca.it	2 nodes with 20 cores @ 2.5Ghz, 128GB, 2 GPU Nvidia K40 per node	walltime: 12h

- The infrastructure is **scalable**: more nodes can be added and other nodes are available on demand (e.g big mem nodes)
- Common home and scratch filesystem mounted by login node, compute nodes and visualization nodes
- One GPFS partition shared between Galileo and Pico

Viz software available

- **Paraview** - http://www.paraview.org/

- **Blender** - http://www.blender.org/

- **Tecplot** - http://www.tecplot.org/

- **StartCCM+** - http://www.cd-adapco.com/products/star_ccm_plus/

- **PointWise** - http://www.pointwise.com/

- **VMD** - http://www.ks.uiuc.edu/Research/vmd/

- **Chimera** - http://www.cgl.ucsf.edu/chimera/

- **Matlab** - http://it.mathworks.com/products/matlab/

- **Vaa3d** - http://www.vaa3d.org/

- **Vapor** - https://www.vapor.ucar.edu/

- **Stata** - http://www.stata.com/

- **RStudio** - http://www.rstudio.com/

References

- **RCM user documentation and download page**: http://www.hpc.cineca.it/content/remote-visualization

- For any issues:
  - **User support**: superc@cineca.it

- For any comment/suggestion/information:
  - **Roberto Mucci -** r.mucci@cineca.it
  - **Luigi Calori -** l.calori@cineca.it