



HPC and CAE: the CINECA offer

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Agenda

- CINECA 2.0: the italian infrastructure for HPC
- CINECA services for industry
- Improving your competitiveness choosing CINECA



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CINECA is a non profit Consortium, made up of 54 Italian universities, The National Institute of Oceanography and Experimental Geophysics - OGS, the CNR (National Research Council), and the Ministry of Education, University and Research (MIUR).



CINECA is the largest Italian computing centre, one of the most important worldwide.

It operates in the technological transfer sector through high performance scientific computing, the management and development of networks and web based services, and the development of complex information systems for treating large amounts of data.

It develops advanced Information Technology applications and services, acting like a trait-d'union between the academic world, the sphere of pure research and the world of industry and Public Administration.





The Story

- 1969: CDC 6600 1st system for scientific computing
- 1975: CDC 7600 1st supercomputer
- 1985: Cray X-MP / 4 8 1st vector supercomputer
- 1989: Cray Y-MP / 4 64
- 1993: Cray C-90 / 2 128
- 1994: Cray T3D 64 1st parallel supercomputer
- 1995: Cray T3D 128
- 1998: Cray T3E 256 1st MPP supercomputer
- 2002: IBM SP4 512 1 Teraflops
- 2005: IBM SP5 512
- 2006: IBM BCX 10 Teraflops
- 2009: IBM SP6 100 Teraflops
- 2012: IBM BG/Q 2 Petaflops**





CINECA and TOP500

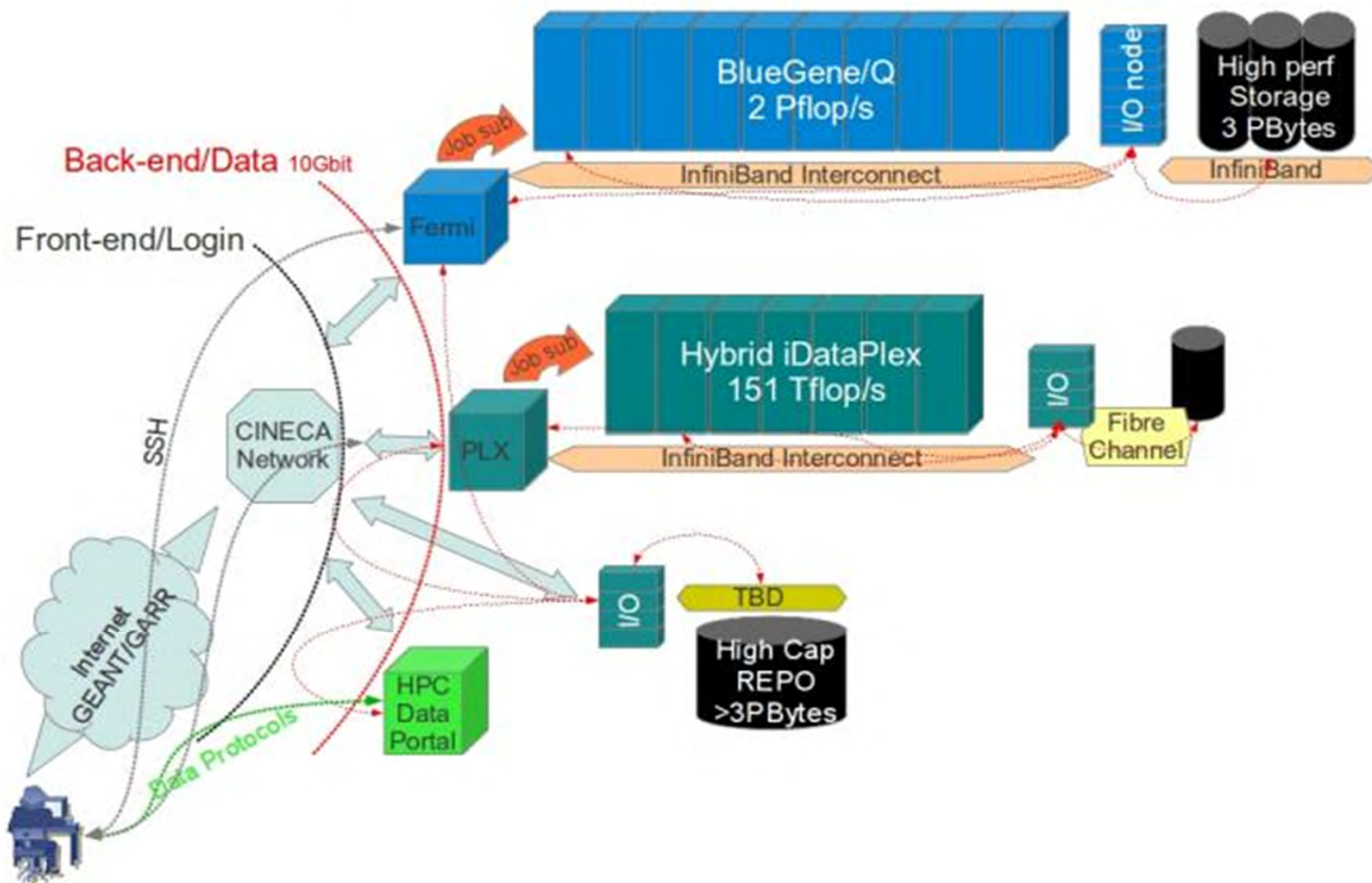
#7 June 2012



Rank	Organization	Computer
1	DOE/NNSA/LLNL United States	Sequoia - BlueGene/Q, Power BQC 16C 1.60 GHz, Custom IBM
2	RIKEN Advanced Institute for Computational Science (AICS) Japan	K computer, SPARC64 Villix 2.0GHz, Tofu interconnect Fujitsu
3	DOE/SC/Argonne National Laboratory United States	Mira - BlueGene/Q, Power BQC 16C 1.60GHz, Custom IBM
4	Leibniz Rechenzentrum Germany	SuperMUC - iDataPlex DX360M4, Xeon E5-2680 8C 2.70GHz, Infiniband FDR IBM
5	National Supercomputing Center in Tianjin China	Tianhe-1A - NUDT YH MPP, Xeon X5670 6C 2.93 GHz, NVIDIA 2050 NUDT
6	DOE/SC/Oak Ridge National Laboratory United States	Jaguar - Cray XK6, Opteron 6274 16C 2.200GHz, Cray Gemini interconnect. NVIDIA 2090
7	CINECA Italy	Fermi - BlueGene/Q, Power BQC 16C 1.60GHz, Custom IBM
8	Frankfurt University of Applied Sciences (FH) Germany	Frankfurt - BlueGene/Q, Power BQC 16C 1.60GHz, Custom IBM
9	CEA/TGCC-GENCI France	Curie thin nodes - Bullx B510, Xeon E5-2680 8C 2.700GHz, Infiniband QDR Bull
10	National Supercomputing Centre in Shenzhen (NSCS) China	Nebulae - Dawning TC3600 Blade System, Xeon X5650 6C 2.66GHz, Infiniband QDR, NVIDIA 2050 Dawning



CINECA HPC Infrastructure





FERMI@CINECA

Architecture: 10 BG/Q Frames

Model: IBM-BG/Q

Processor type: IBM PowerA2 @1.6 GHz

Computing Cores: 163840

Computing Nodes: 10240

RAM: 1GByte / core (163 PByte total)

Internal Network: 5D Torus

Disk Space: 2PByte of scratch space

Peak Performance: 2PFlop/s

N. 7 in Top 500 rank (June 2012)

National and PRACE Tier-0 calls





IBM Cluster linux

PLX@CINECA

Processor type: 2 six-cores Intel Xeon (Exa-Core Westmere)

X 5645 @ 2.4 GHz, 12MB Cache

N. of nodes / cores: 274 / 3288

RAM: 48 GB/Compute node (14 TB in total)

Internal Network: Infiniband with 4x QDR switches (40 Gbps)

Accelerators: 2 GPUs NVIDIA M2070 per node

548 GPUs in total

Peak performance: 32 TFlops

565 TFlops SP GPUs

283 TFlops DP GPUs





Visualization system

Visualization and computer graphics

Virtual Theater

6 video-projectors BARCO SIM5

Audio surround system

Cylindric screen 9.4x2.7 m, angle 120°

Ws + Nvidia cards

RVN nodes and HP DL980 on PLX system





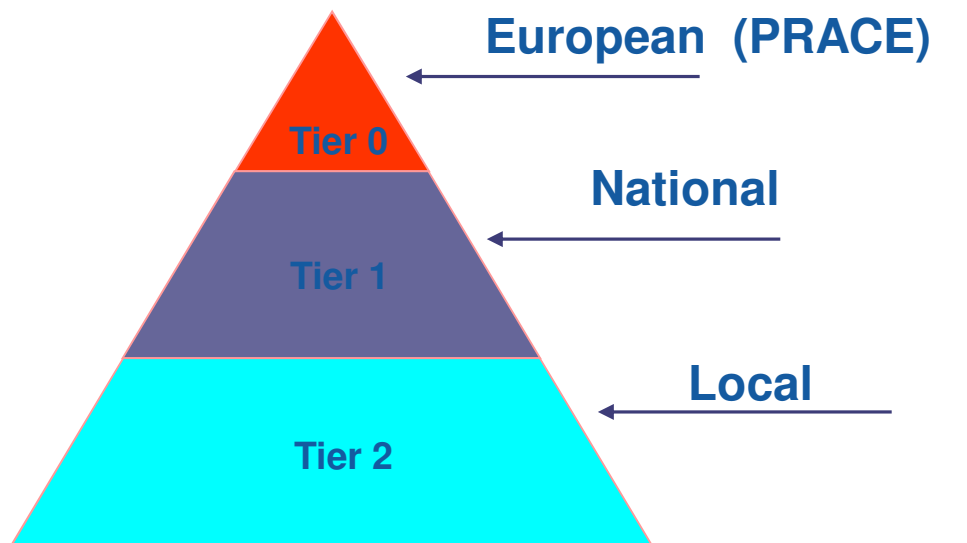
Storage Infrastructure

System	Available bandwidth (GB/s)	Space (TB)	Connection Tecnology	Disk Tecnology
2 x S2A9500	3,2	140	FCP 4Gb/s	FC
4 x S2A9500	3,2	140	FCP 4Gb/s	FC
6 x DCS9900	5,0	540	FCP 8Gb/s	SATA
4 x DCS9900	5,0	720	FCP 4Gb/s	SATA
3 x DCS9900	5,0	1500	FCP 4Gb/s	SATA
Hitachi Ds	3,2	360	FCP 4Gb/s	SATA
3 x SFA1000	10,0	2200	QDR	SATA
1 x IBM5100	3,2	66	FCP 8Gb/s	FC
		> 5,6 PB		



The European HPC-Ecosystem

PRACE Research Infrastructure (www.prace-ri.eu): the top level of the European HPC ecosystem



Creation of a European HPC ecosystem involving all stakeholders

- ✓ HPC service providers on all tiers
- ✓ Scientific and industrial user communities
- ✓ The European HPC hw and sw industry

CINECA:

- represents Italy in PRACE
- hosting member in PRACE
 - Tier-0 system
BG/Q 2 PFlop/s
 - Tier-1 system
> 5 % PLX
- involved in PRACE 1IP, 2IP, 3IP
- PRACE 2IP prototype EoI



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CINECA and Industry

CINECA provides:

- ***Infrastructure*** (CPU cycles, visualization, data, housing)
- ***Support and consulence*** (in collaboration with Enginsoft)
- ***Training***



CINECA and Industry



Who are our main customers:

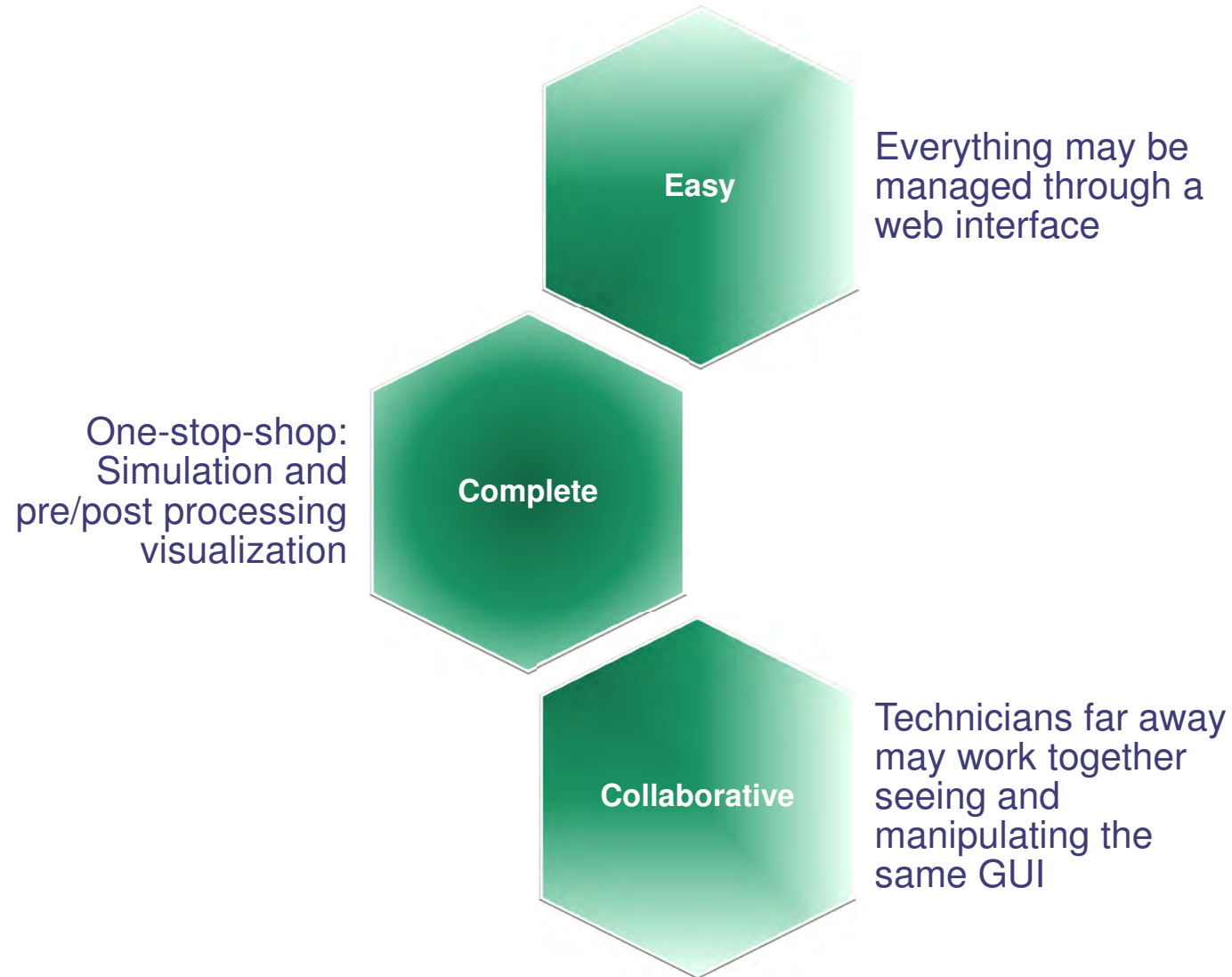
- ENI (geophysics)
- Luna Rossa (America's Cup, CFD)
- BMW-Oracle (America's cup, CFD, structure)
- ARPA (meteo forecasts, climatology)
- Dompé (pharma)

CINECA hosts and manages HPC infrastructure of ENI:

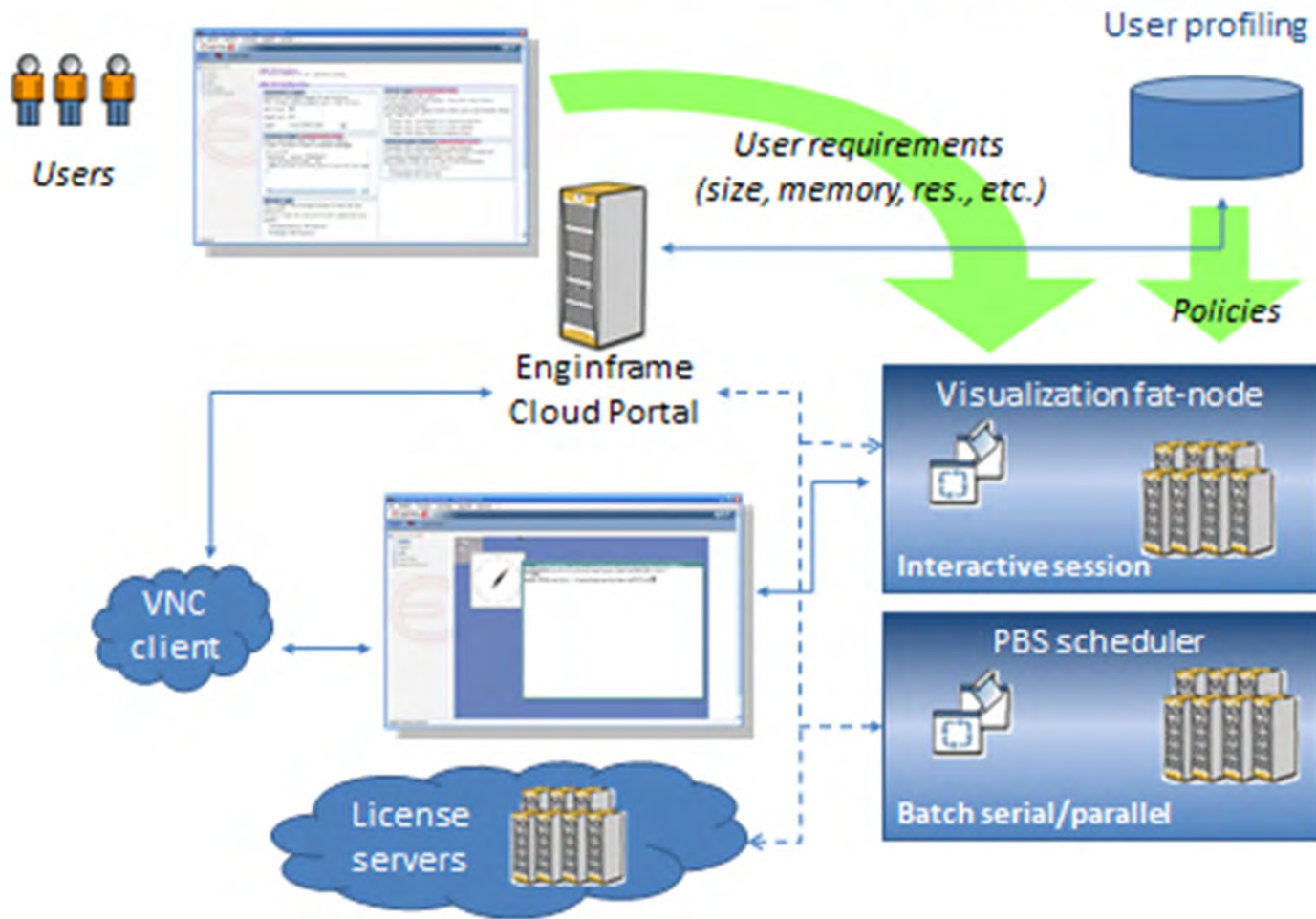
*HP ProLiant SL390s G7 Xeon 6C X5650, Infiniband,
Cluster Linux HP, 15360 cores*

N. 60 Top 500 (June 2011) 163.43 Tflop/s Peak, 131.2 Linpack

HPC cloud offering



Desktop Cloud Visualization



- CFD
 - ANSYS Fluent
 - Remote User
 - Local User
 - 6
 - v7
- Structural Analysis
 - Abaqus
 - NASTRAN
 - DYTRAN
- Interactive
 - Utilities
 - ANSYS CFD
 - Fluent 13
 - ANSYS WorkBench
 - ICEM
 - CFX
 - NEXUS
 - 6
 - 7
 - Gocad
 - ParaView
 - MSC-PATRAN
 - ABAQUS CAE
 - Pointwise
 - VisIt

Remote User

Welcome to the Fluent page for Remote test! You must use this page if your input files are on your remote cluster.

Please insert:

Journal File

A file with the command lines for your Fluent test.

Input Files

*Input Files: *.cas and/or *.dat and all the additional files you need*

Version

You must select one of these versions: 2d, 3d, 2ddp, 3ddp

Number of CPUs

How many CPUs do you want to use ?

Other Parameters

*If you are an expert user, you should use some usefull other parameters.
Please type "-help" in the box in order to get some information.*

Queue

*name of the queue your job will be submitted to
PRIVATE USERS MUST USE the queue "reserved"!!*

Journal File

Input Files

Version

2d
 3d
 2ddp
 3ddp

Number of CPUs

1 ▼

Other Parameters

queue

reserved ▼

Managing own runs

Using My Jobs panel you have the list of your batch jobs (executing/in wait) and you may interact with them with:

- a) Kill
- b) Suspend
- c) Resume
- d) Refresh

The screenshot shows the CINECA web interface. The browser address bar displays the URL: `lagrange.cilea.it/cilea/runyourjob/it.cilea.runyourjob.xml?_uri=//com.enginframe.grid/list.jobs`. The page title is "RUN YOUR JOB - Computin x". The CINECA logo and "Consorzio Interuniversitario" are visible at the top. Below the logo is a navigation menu with tabs: "HPC Services", "Home", "My Sessions", "My Data", "My Jobs", "All Jobs", "Cluster Load", "File Manager", and "Help Desk". The "My Jobs" tab is selected. Below the navigation menu is a sidebar with a tree view of services: "CFD" (containing "OpenFOAM" with "Remote User" and "Local User" sub-items), "ANSYS Fluent", "STAR-CCM+ v6", "STAR-CCM+ v7", "Phoenics", "Structural Analysis", "Interactive", and "Utilities". The main content area shows a table of jobs with columns: "ID", "Status", "Queue", "Submission Time", and "Running on". Above the table, there are four buttons: "Kill", "Suspend", "Resume", and "Refresh", which are circled in green. A green arrow points from the "My Jobs" tab to this area. The table contains five rows of job data:

ID	Status	Queue	Submission Time	Running on
311048	Running	lisa_exe01	Sep 12 18:58:00	72 Hosts
311454	Running	lisa_exe02	Sep 14 10:07:00	cn288/0*12
311558	Running	lisa_exe02	Sep 14 16:32:00	3 Hosts
311751	Running	lisa_exe01	Yesterday 11:49:00	9 Hosts
311901	Running	lisa_exe01	Today 10:36:00	6 Hosts

At the bottom right of the page, there is a pagination control showing "Page 1 of 1" and a dropdown menu set to "25".

Visualizing like on your own workstation

HPC Services | Home | My Sessions | My Data | My Jobs | File Manager | Help Desk

CFD | ANSYS Fluent | Remote User | Local User

Structural Analysis | Abaqus | NASTRAN | DYTRAN

Interactive | Utilities | ANSYS CFD | Fluent 13 | ANSYS WorkBench | ICFM | CFX

NEXUS | Gocad | ParaView | MSC-PATRAN | ABAQUS CAE | Pointwise | VisIt

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VNC Viewer: cn3384 (ponzini)

flat FLUENT@cn338 [3d, dp, pbns, lam, transient]

File | Mesh | Define | Solve | Adapt | Surface | Display | Report | Parallel | View | Help

Problem Setup

- General
- Models
- Materials
- Phases
- Cell Zone Conditions
- Boundary Conditions
- Mesh Interfaces
- Dynamic Mesh
- Reference Values

Solution

Graphics and Animations

- Graphics
 - Mesh
 - Contours
 - Vectors**
 - Pathlines
 - Particle Tracks

Set Up...

Vectors

Options

- Global Range
- Auto Range
- Clip to Range
- Auto Scale
- Draw Mesh

Style: arrow

Scale: 35 | Skip: 100

Vector Options... | Custom Vectors...

Surface Name Pattern: [] Match

Vectors of: Velocity

Color by: Velocity...

Velocity Magnitude

Min (m/s): 2.328602e-05 | Max (m/s): 0.90559

Surfaces: aao, dao, **default-interior**, out1, out2, out3

Surface Types: axis, clip-surf, exhaust-fan, fan

Display | Compute | Close | Help

1: Velocity Vectors Color

Velocity Vectors Colored By Velocity Magnitude (m/s) (Time=1.1130e+00)
ANSYS FLUENT 13.0 (3d, dp, pbns, lam, transient)

Nov 05, 2012

```
domains,
mixture
zones,
default-interior
surface3
aao
dao
out1
out2
out3
blood
Done.
Preparing mesh for displa
```




Using My sessions panel you may share the GUI with other users who will not only see what we are seeing but even interact.

The screenshot shows a web browser window with the URL `lagrange.cilea.cineca/runyourjob/it.cilea.runyourjob.xml?_uri=//com.engineframe.grid/list.jobs`. The CINECA logo and navigation menu are visible. The "My Sessions" tab is highlighted with a green circle and a green arrow pointing to it. Below the navigation menu, there is a sidebar with a file tree containing folders like "CFD", "OpenFOAM", "ANSYS Fluent", "STAR-CCM+ v6", "STAR-CCM+ v7", "Phoenics", "Structural Analysis", "Interactive", and "Utilities". The main content area displays a VNC viewer window titled "cn338:4 (ponzini) - VNC Viewer". The VNC viewer shows the ANSYS FLUENT GUI with a 3D visualization of a velocity vector field. The "Graphics and Animations" panel is active, showing "Vectors" selected under "Graphics". The "Vectors" panel has "Global Range" and "Auto Range" checked, and "Velocity" selected for "Vectors of". A color scale legend is visible on the left side of the 3D view.



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Reduce infrastructural costs

- Computing is paid on-demand
 - Starting from 15 Euro-cent per hour
- Our computing systems are constantly upgraded
 - A new Intel Sandy Bridge-cpus cluster in 1Q2013
- Even pre/post may be handled remotely
 - 10 fat-nodes with 128 GB di RAM e 1 with 512 GB
- We have the most performing infrastructure for each software
 - 2 GPU M2070 per node
 - Xeon Phi arriving



Reducing training costs

- Our training courses have an unbeatable price
- If you know how to use a browser you know how to use our supercomputer



Accelerating time-to-market

- Dare going up with parallelism!
 - We tested real cases with ANSYS solvers efficient up to >1000 parallel processes
- Dare the optimization!
 - Not only high performance but high throughput
- GPU-enabled solvers arrive every day on the market
 - For CAE codes a typical gain is 2-5X



You want more?

- Ask your ISV a cloud-like licensing model!