CARRIOCAS
Collaborative High Performance Scientific Visualization

Special focus on the experimental results of VisuPortal : the first prototype of the CARRIOCAS web portal for remote collaborative scientific visualisation

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CARRIOCAS

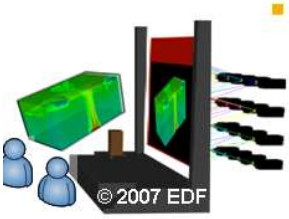
- **« Distributed Computation Over Ultra High Speed Optical Internet Network »**
- **In french : « CAlcul Réparti sur Réseau Internet Optique à CApacité Surmultipliée »**

- A 3-year project in the frame of the French SYSTEM@TIC Competivity Cluster : Oct. 2006 – Sept. 2009

CARRIOCAS : Ambition

- **40 Gbits to model and simulate en real time**

  - **Adaptation of optic technics to assume this ultra high bit rate**
  - **Integration and validation on an experimental network at the top level bit rate od 40Gb/s**
  - **Applications development for :**
    - **Distributed storage of massive data on remote servers**
    - **Remote Collaborative High Performance visualisation**



Partnership

Project leader
WP (40Gb/s transmission) and
WP 2 (protocols and network architecture)

Academics

91
92
78
75

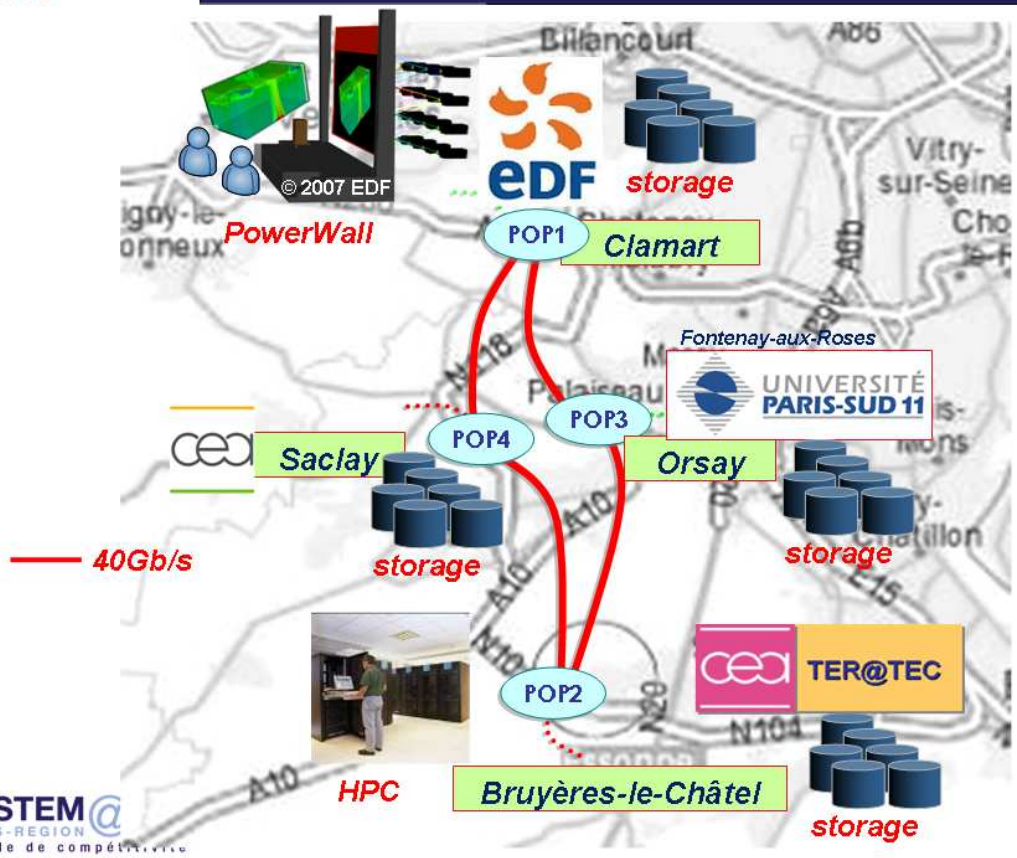
WP4 leader
(Distributed applications)

176 people.year
Oct 2006-Sept 2009

WP 3 leader
(experimental network)

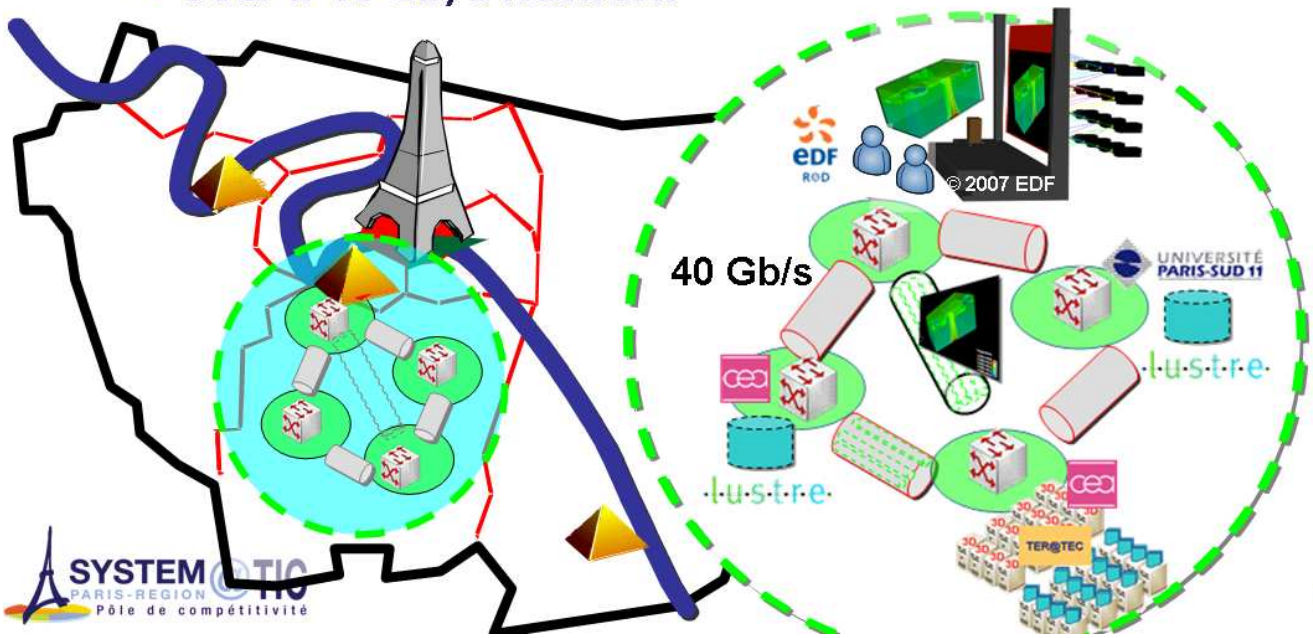
With the financial support of:

Experimental Network



Distributed Computation Over Ultra High Speed Optical Internet Network

- **CARRIOCAS in 3 lines**
  - A Distributed Massive Filesystem (LUSTRE)
  - Remote High Performance Visualisation
  - **Over a 40 Gb/s Network**



EDF's involvment in the CARRIOCAS project?

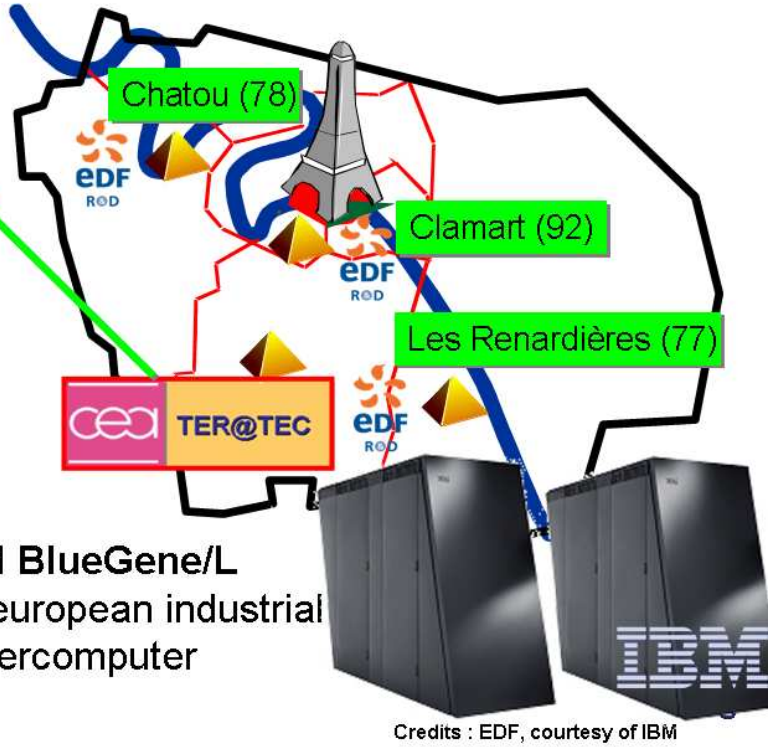
EDF is the 2d contributor of CARRIOCAS in terms of investments and human ressources

High Performance Computing

EDF R&D : 600 researchers using HPC ressources

09/07 CCRT-B 43 TFlops
EDF Use = ¼ CPU Time

EDF HPC Power Use
2003 : 0,4 TeraFlops
2004 : 1,5 TeraFlops
2005 : 2,5 TeraFlops
2006 : 17,5 TeraFlops
2007 : 39,5 TeraFlops

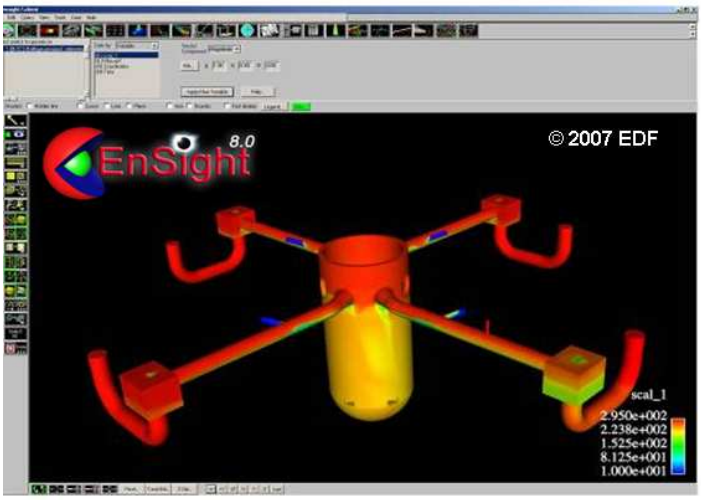


IBM BlueGene/L
1st european industrial supercomputer

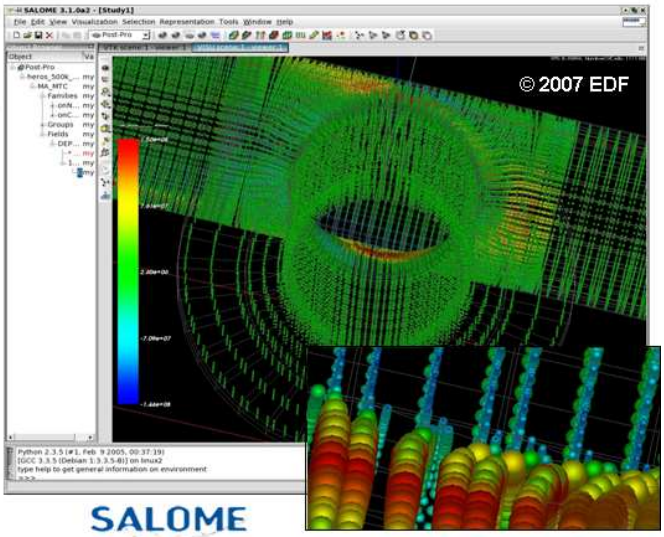
Credits : EDF, courtesy of IBM

HPC to acheive EDF NextGen challenges

- **Top level studies and HPC simulations**



NextGen Power Reactor

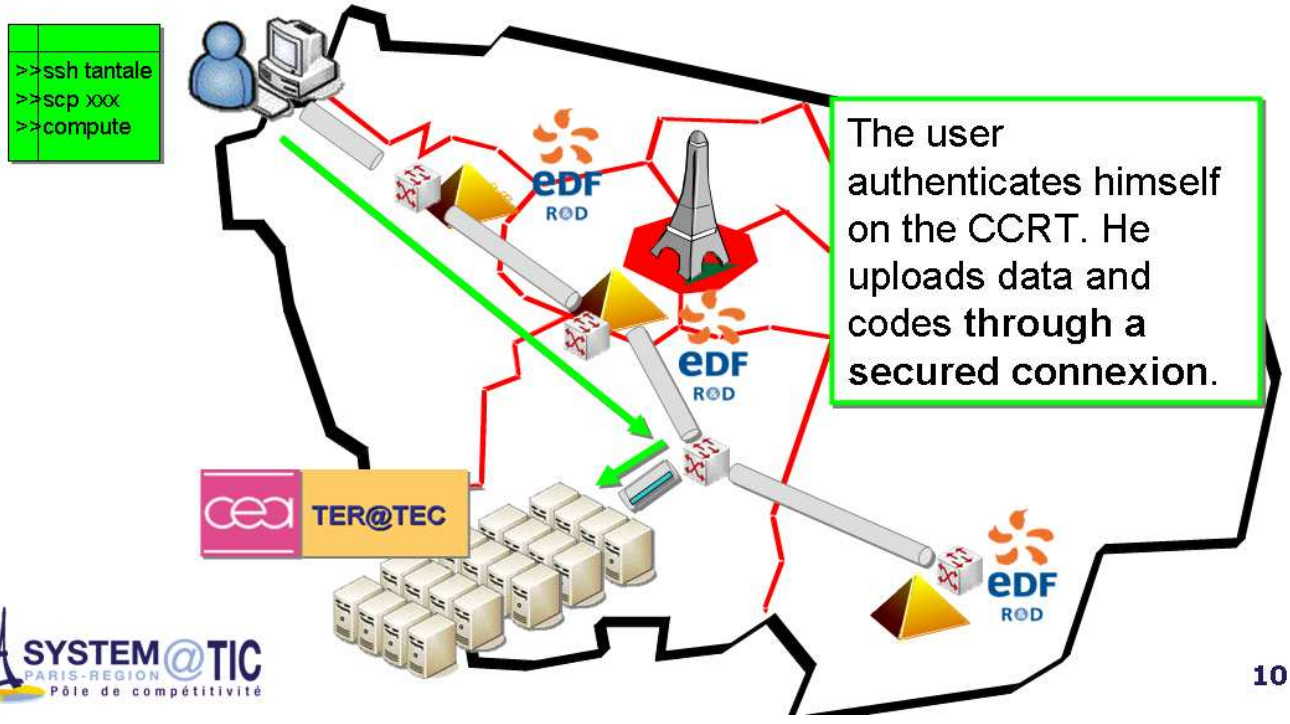


SALOME

2006 : Gauss points Visualization,
First industrial use by EDF.

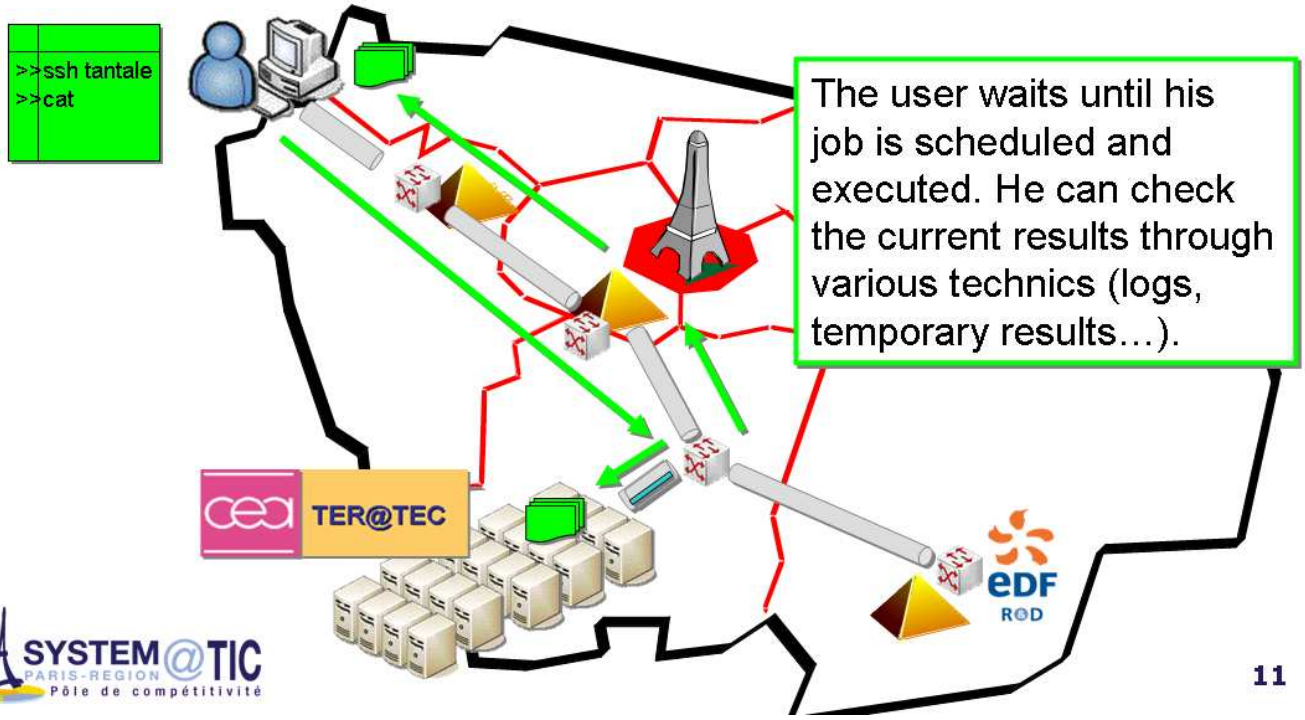
Today HPC Use Case

- **An example from the CFD world : everyday use of the CCRT HPC ressources**



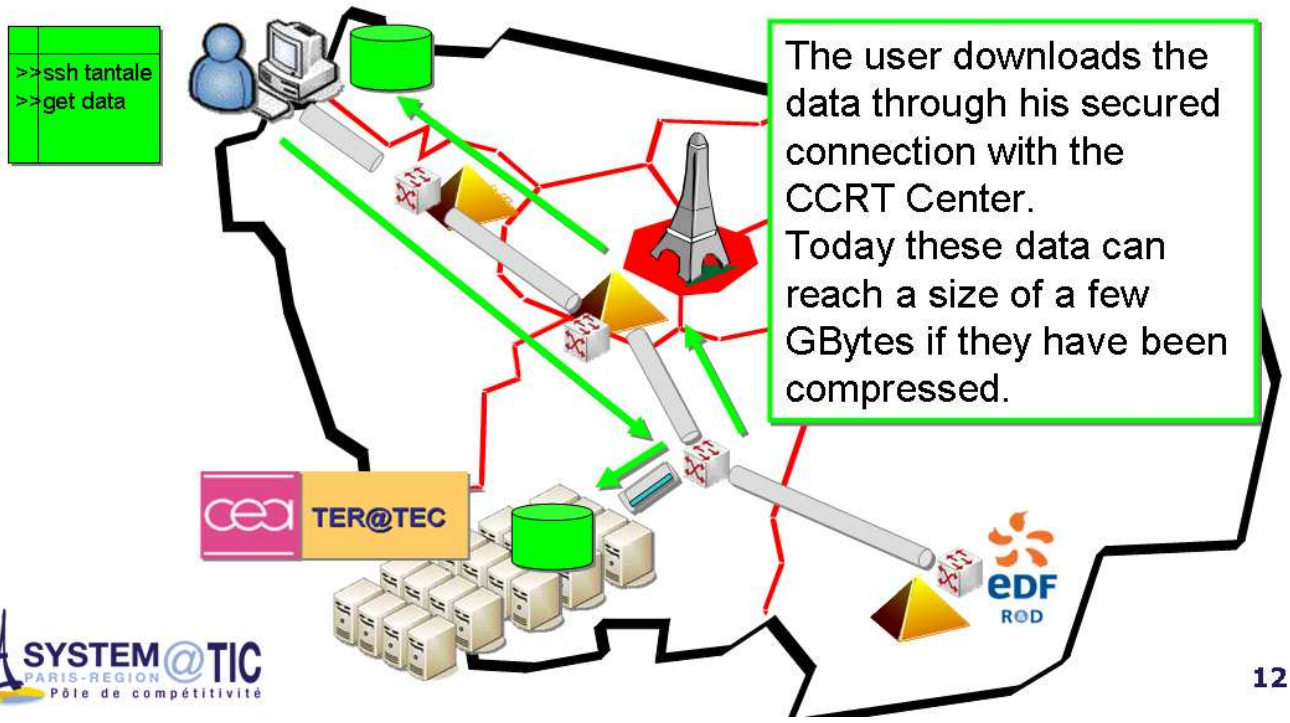
Today HPC Use Case

- Computation monitoring



Today HPC Use Case

- When the computation is finished…



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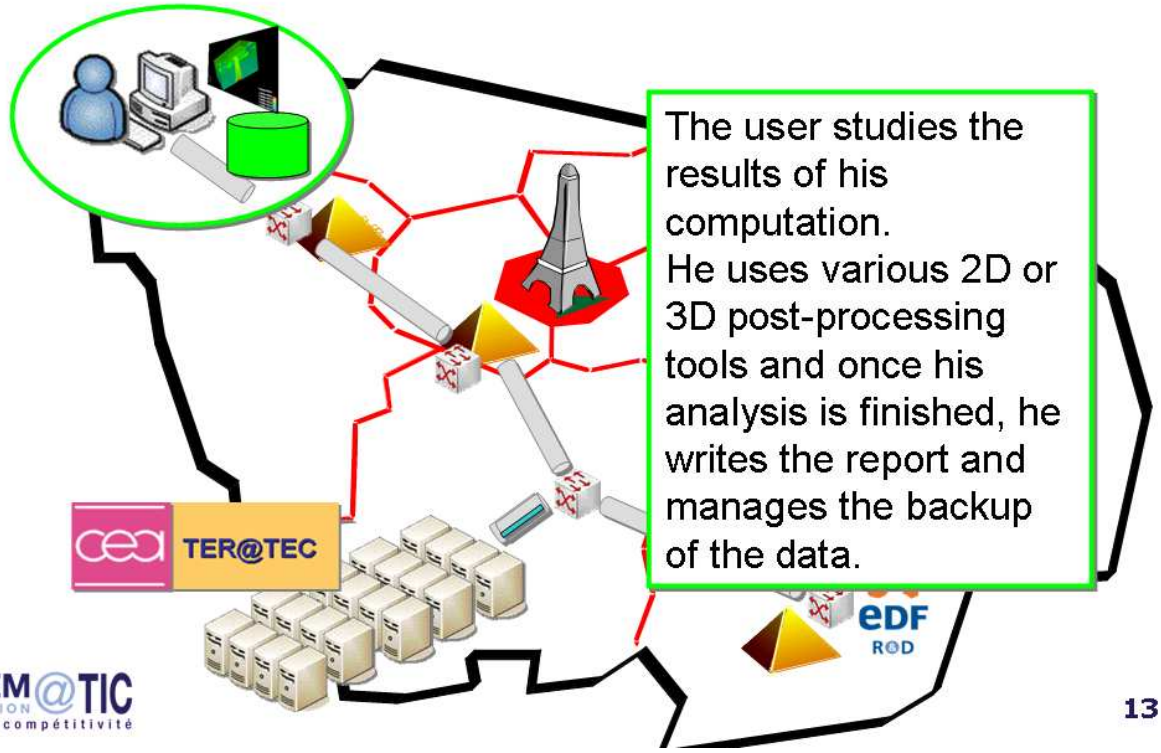
Today HPC Use Case

- Post-Processing on the user workstation

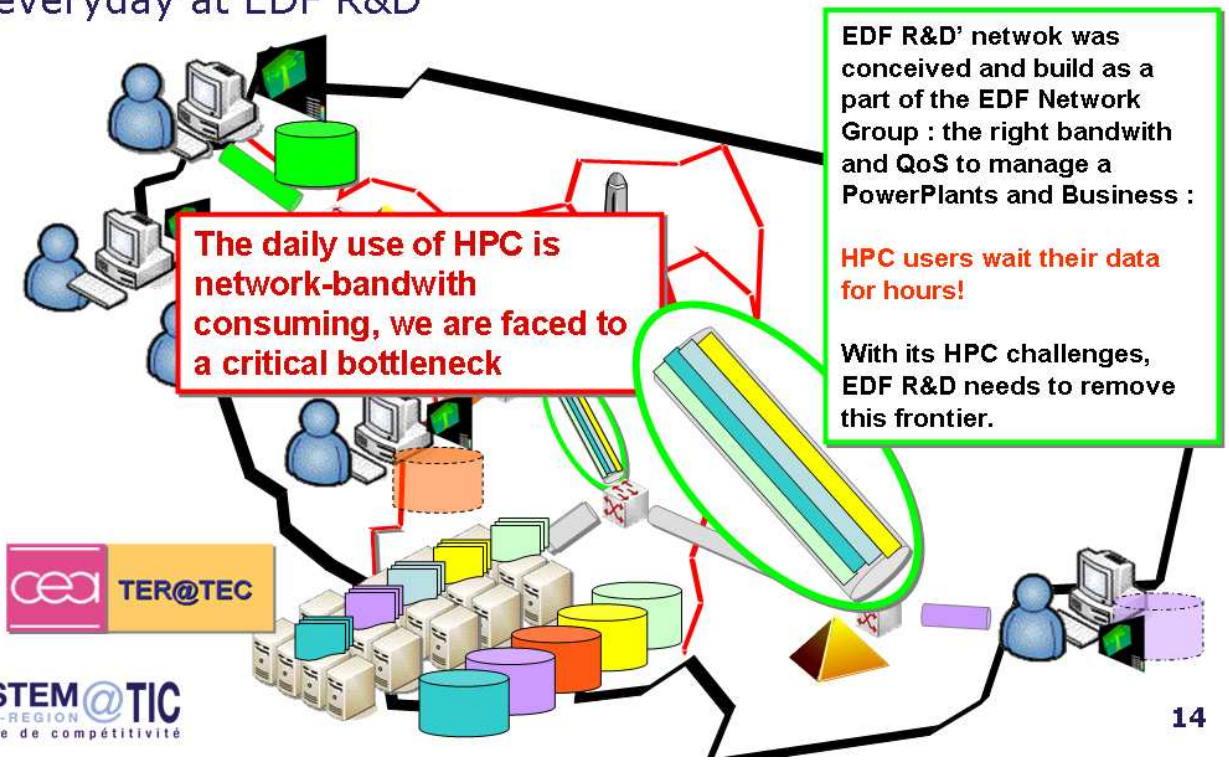


SYSTEM@TIC PARIS-REGION Pôle de compétitivité

CARRIOCAS

But we met new frontiers (1)

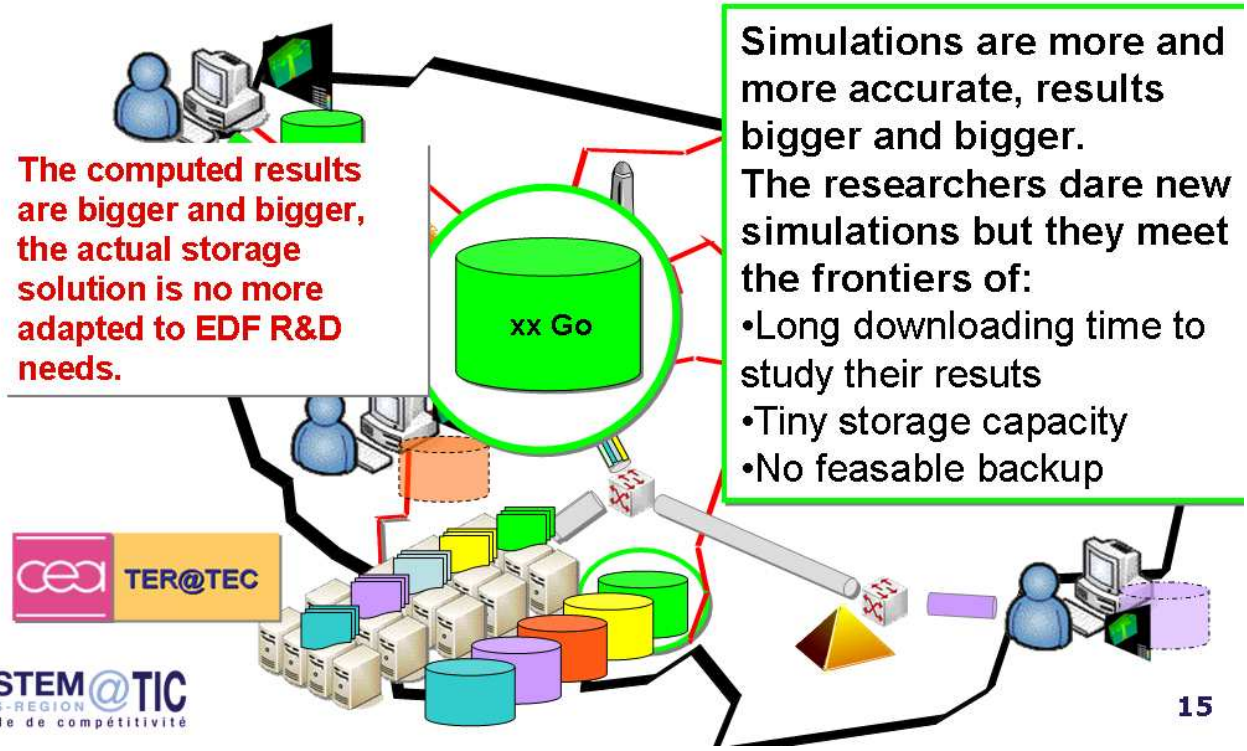
- One example but it's simultaneously 600 scenarii like this everyday at EDF R&D



SYSTEM@TIC PARIS-REGION Pôle de compétitivité

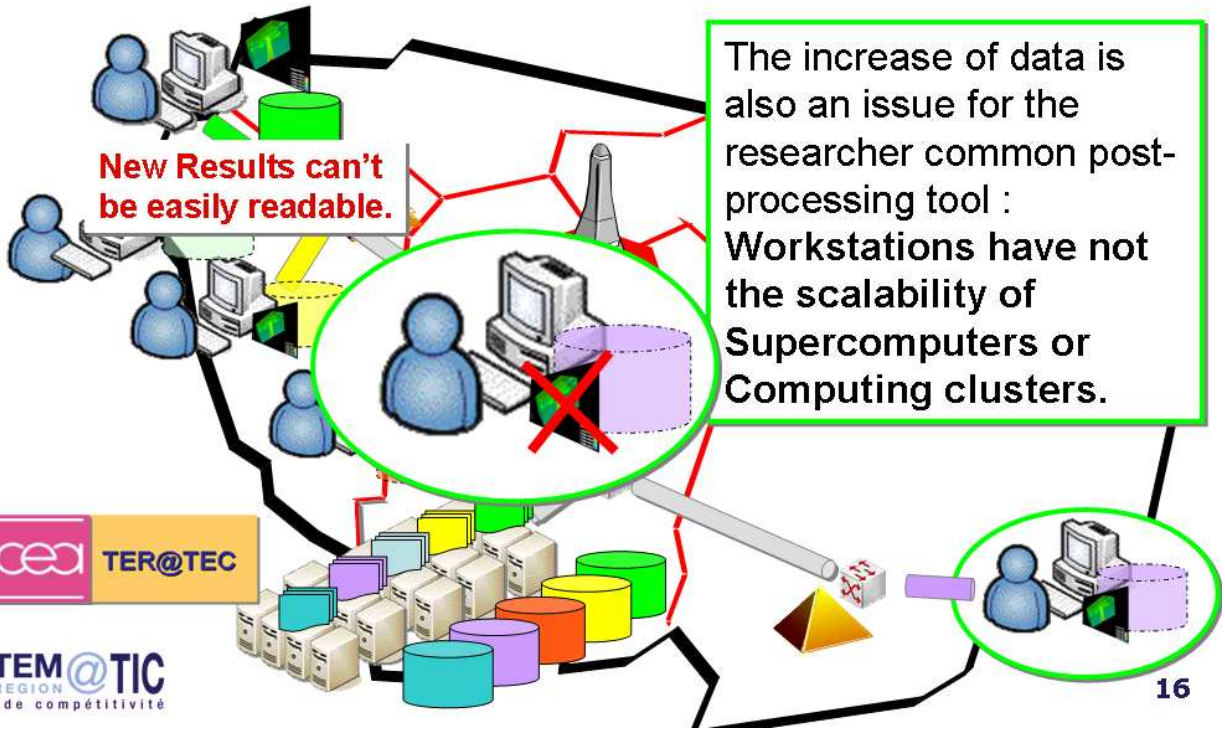
But we met new frontiers (2)

- Hom to manage these data?



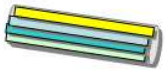
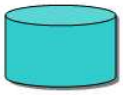
But we met new frontiers (2)

- How to analyse these new data?



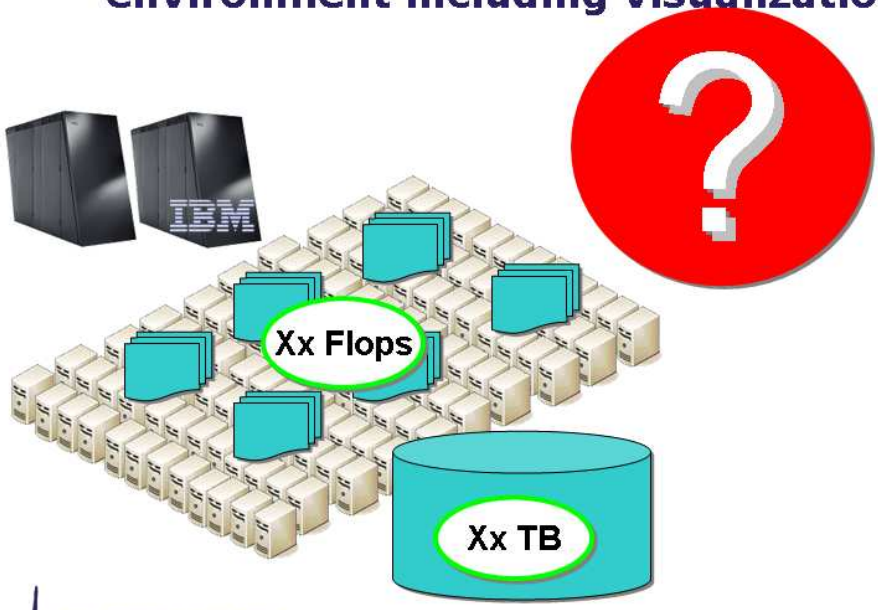
Technological Bottlenecks

- To manage dozens of GBytes of simulations data for one user between hundreds implies to conceive a global solution to solve the problems of :
  - **Networks (QoS, Bandwith..)**
  - **Storage and Backup**
  - **Analysis software and hardware ressources**
  - **Remote Collaborative expertise?**
  - Realtime Simulation Monitoring?


CARRIOCAS : Technological challenges

- **How to acheive a complete and easy industrial HPC environment including visualization?**



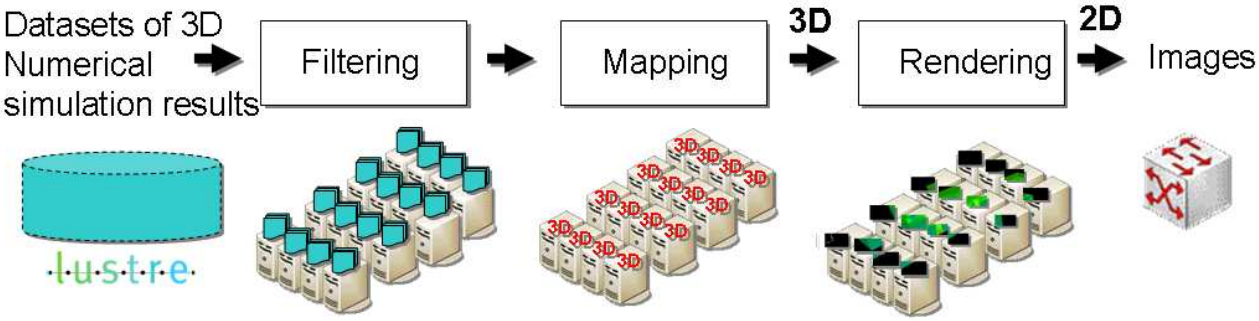
CARRIOCAS WP 4 : R&D for Distributed applications

Special Focus on Collaborative High Performance

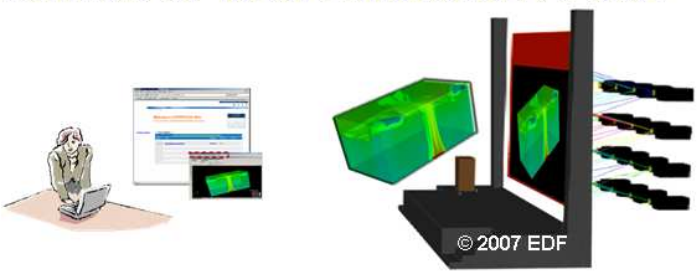
Scientific Visualisation

High Performance Visualization?

- What does it mean for us?



- For an easy remote or local collaborative use

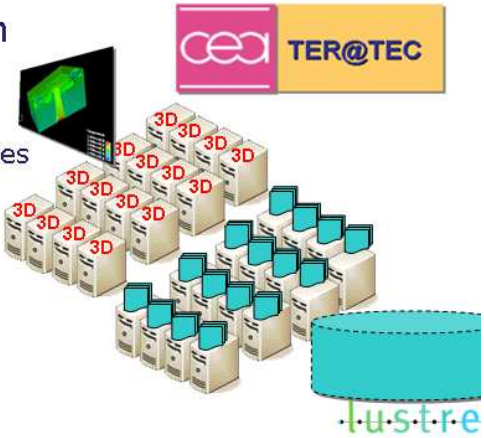


CARRIOCAS

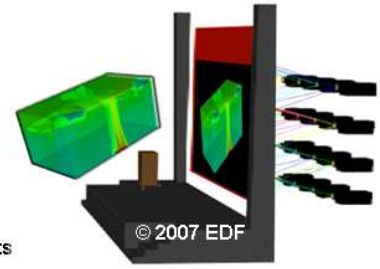
High Performance Collaborative Visualization?

From HPC to High Performance Visualisation

- **Remote and Collaborative Visualisation**
  - Remote access to HPC ressources
    - Data stored at the Computational Center
    - Clusters of graphics and computational nodes

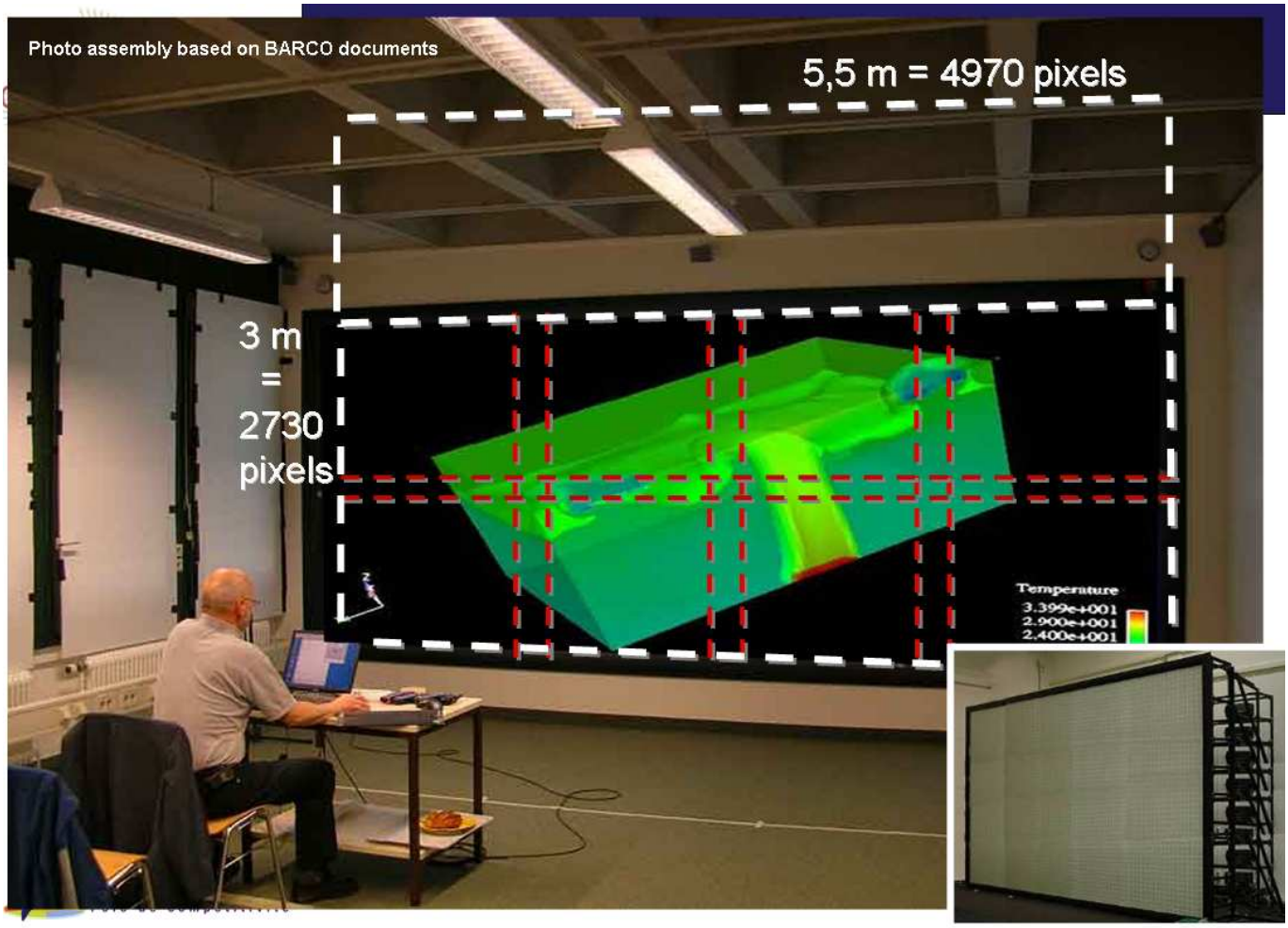


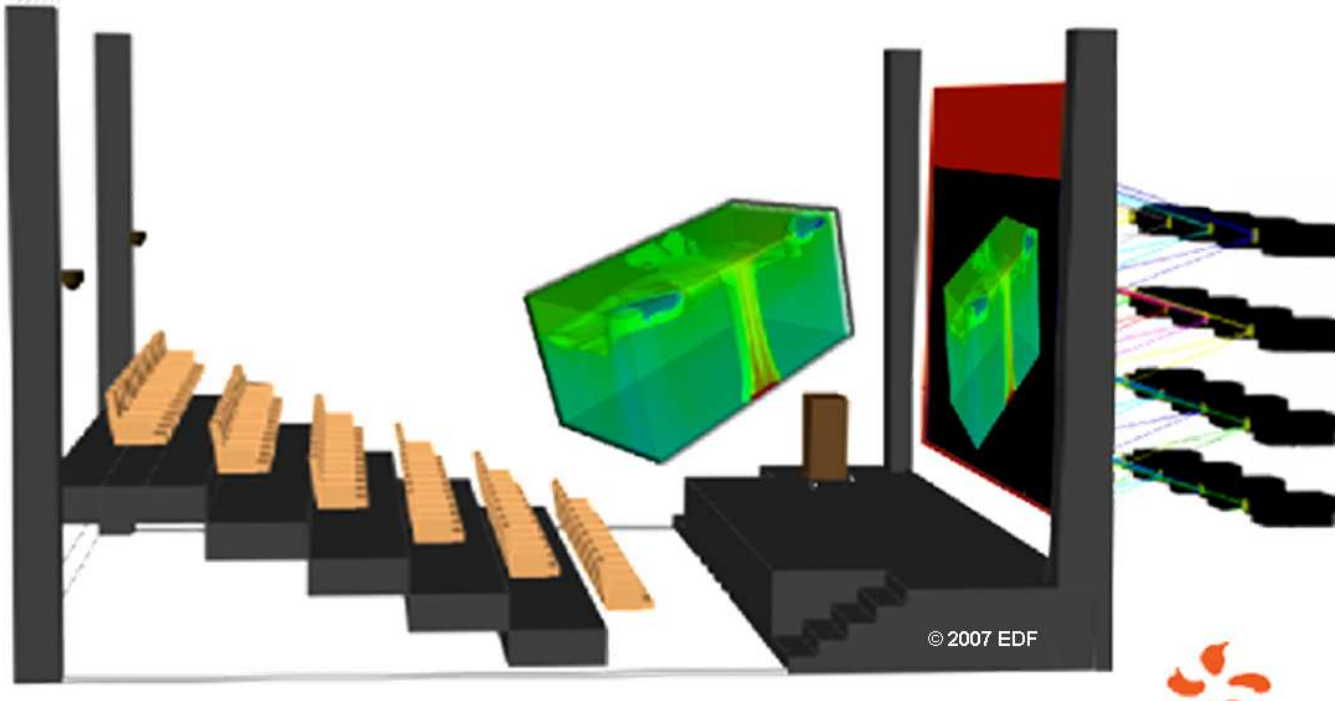
- **High Resolution Visualisation**
  - High Resolution display : Powerwall
    - 16 videoprojectors
    - One giant screen of 6 x 3 meters
    - More than 20 millions of pixels



SYSTEM@TIC PARIS-REGION Pôle de compétitivité

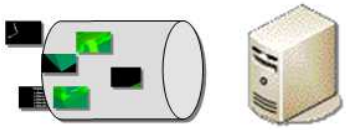
Photomontage réalisée à l'aide de documents
Fournis par la société BARCO



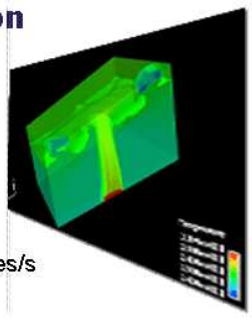


Collaborative High Performance Scientific Visualisation

- Technological innovations :
  - For High Performance and Remote Visualisation
    - **Clusters : parallelism (treatments/graphics) and real-time compression**



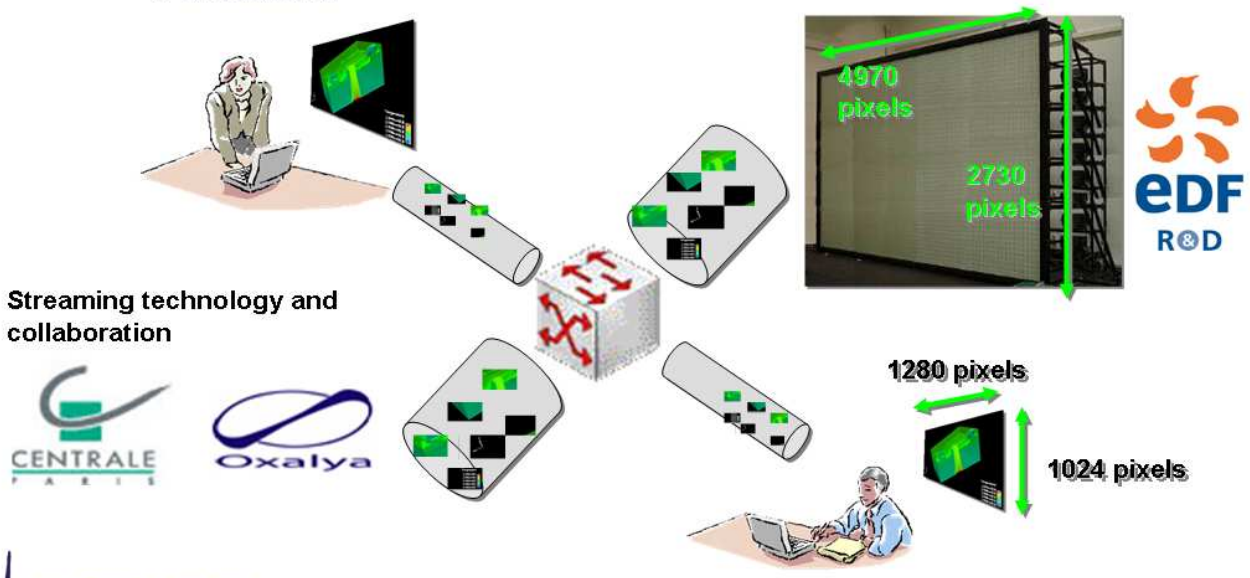
Estimated bandwith :
13 .106 pixels x 32 bits/pixel x 24 frames/s
= 9,98 Gb/s



- **Thanks to Ecole Centrale Paris with the opensource VLC software**

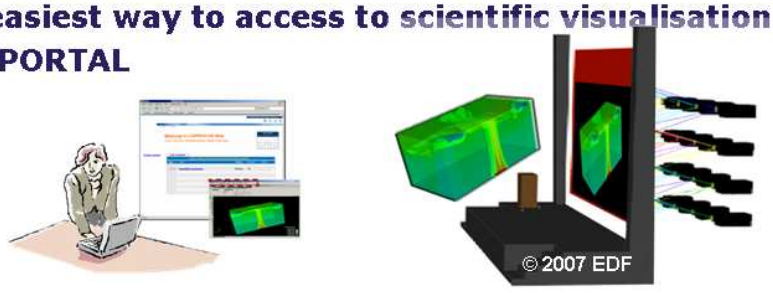
Collaborative High Performance Scientific Visualisation

- Technological innovations :
  - **For High Resolution Remote and Collaborative visualisation :**
    - A collaborative system between the high resolution display and researchers workstations

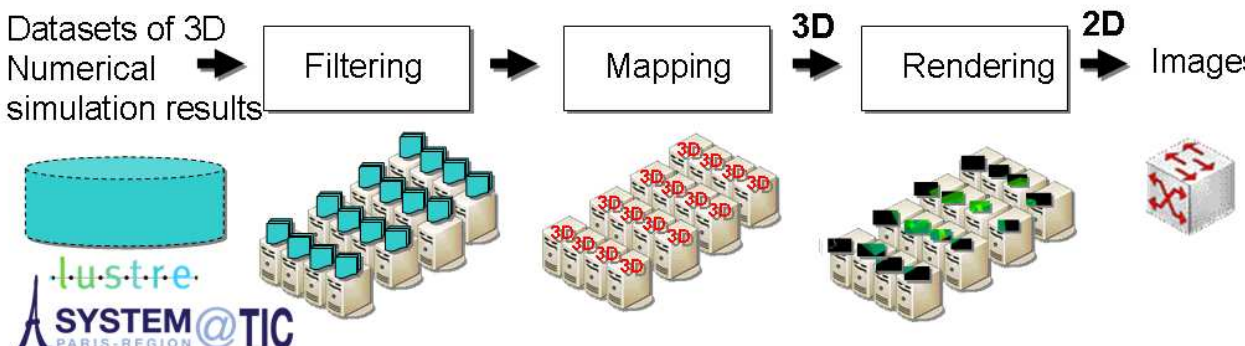


Collaborative High Performance Scientific Visualisation

- For a new way of visualisation: no more commands lines!
  - **Convergence of two worlds : IT and HPC**
    - **The easiest way to access to scientific visualisation services : VISUPORTAL**

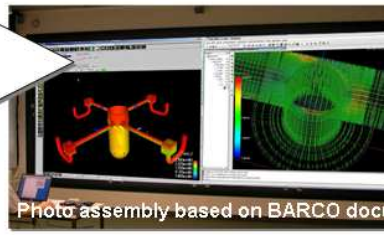


Automatic configuration of HPC ressources for the scientific visualisation pipeline



EDF CARRIOCAS Roadmap

2007

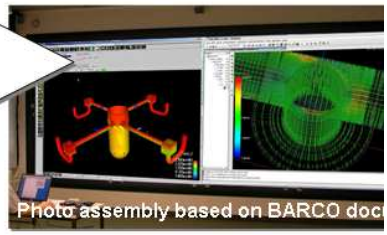


1. **Hardware and Software conception**
   - Computational clusters for distributed filtering of datasets
   - Graphics clusters for distributed 3D rendering
   - Benchmarking of EnSight DR software and optimisation with CEI
   - Server for Streaming video HD++ and remote interactions

2. **installation of the Alcatel 40Gbit/s Point Of Presence (POP) and first hardware infrastructure for High Performance Scientific Visualisation**

EDF CARRIOCAS Roadmap

2008

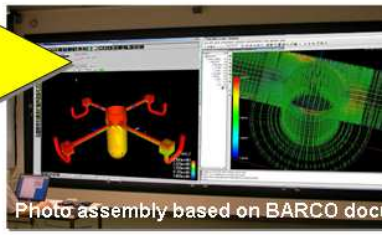


1. **Installation of the High Resolution Display**

2. **Implementation of the first software prototypes**
   - Automatic configuration of the computational clusters for distributed filtering of the data
   - Management of graphics and computational clusters for distributed rendering
   - **Optimisation and deployment of distributed scientific visualisation softwares**
   - Server for Streaming video HD++ and remote interactions

EDF CARRIOCAS Roadmap

2009



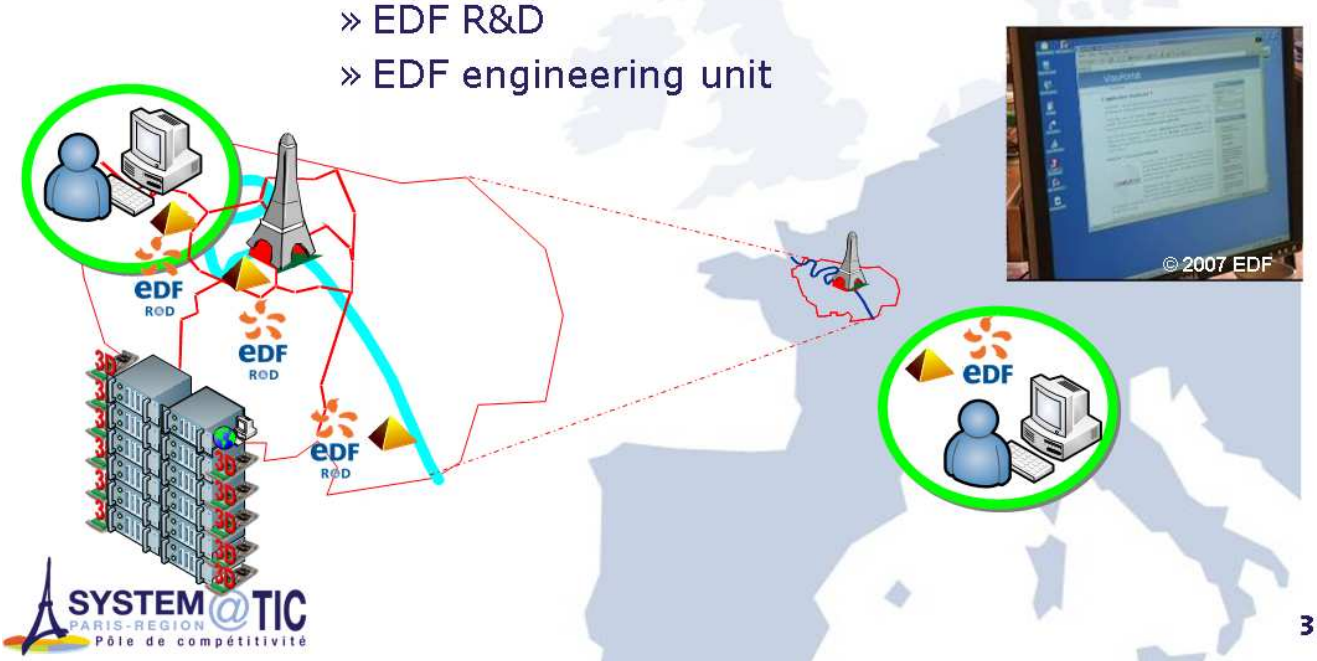
1. Operational High Resolution Display
2. Installation of hardwares at TERATEC BULL computational Center
3. Runs computational jobs for the datasets of the final demonstration
4. Finalize software implementations
5. **Demonstration of Remote High Performance Scientific Visualisation over a 40Gbit/s Optic network on datasets stored on a LUSTRE distributed Filesystem**

VisuPortal : 2007 EDF CARRIOCAS experiment

The first experimental results of VisuPortal :the first prototype of the CARRIOCAS web portal for remote collaborative scientific visualisation

VisuPortal : from the concept to the prototype

- **Remote scientific visualization** (EnSight software) on **Graphic Cluster** based in Clamart through a **Web portal**
- Between two entities (500 km):
  - » EDF R&D
  - » EDF engineering unit

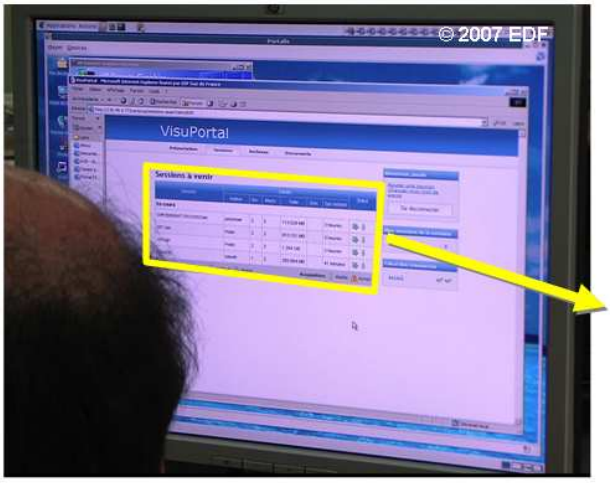


CARRIOCAS Visuportal : Main features

- **A web portal allowing users**
  - To browse their home directory (for ensight datasets)
  - To manage an EnSight visualisation session (date and hour)
  - To Invite colleagues to the session (emails notfication)
- **An automatic and data-adaptative configuration of cluster nodes for the best use of EnSight software :**
  - Automatic Test of the datasets to determine the right number of computing and rendering nodes
  - Check of the nodes availability
  - Configuration of nodes : ensight servers/client
- **Distant visualisation through HP Remote Graphics** from the dedicated client node to one or several users

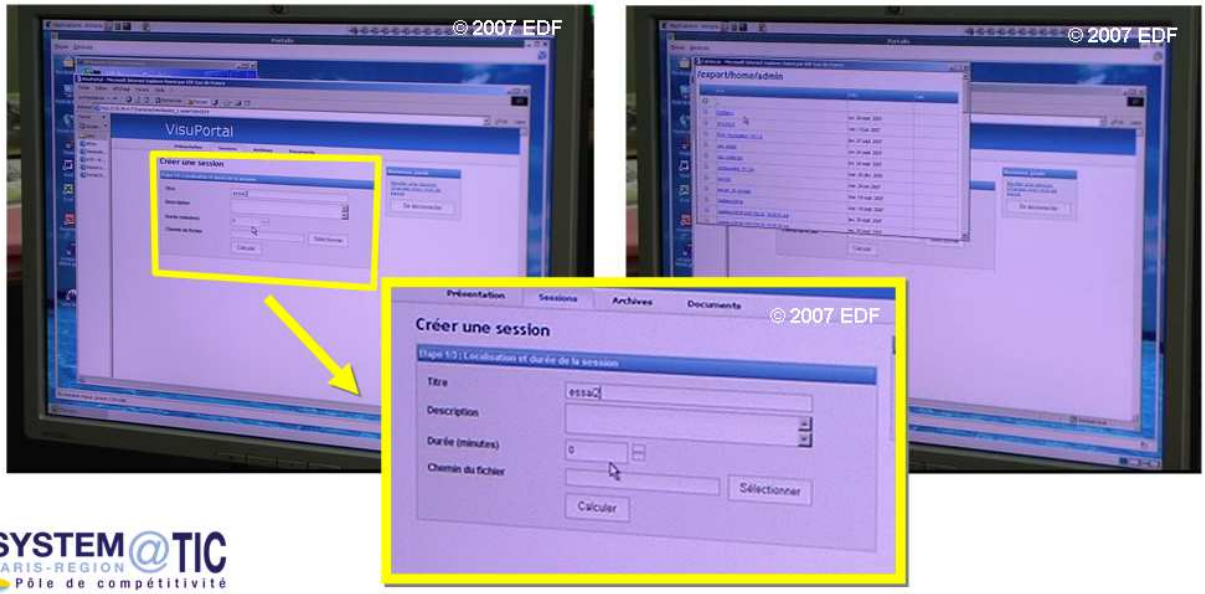
CARRIOCAS Visuportal : Main features

- **A web portal allowing users**
  - **To organise their calendar of visualisation sessions**



CARRIOCAS Visuportal : Main features

- **A web portal allowing users**
  - To create a new collaborative visualisation session
  - To browse their home directory (for ensight datasets)
  - To select their ensight datasets



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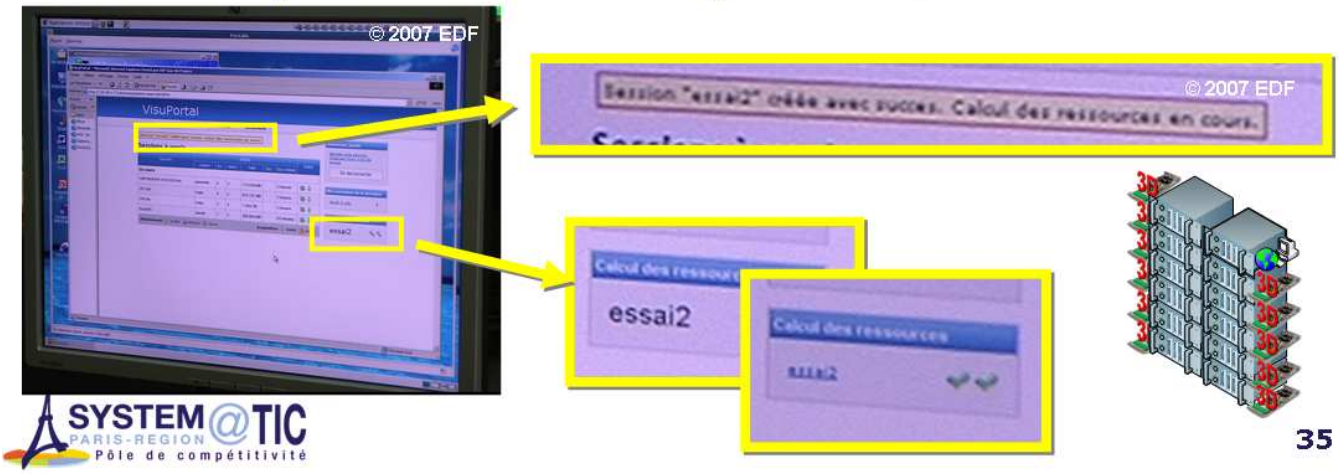

SYSTEM@TIC PARIS-REGION Pôle de compétitivité

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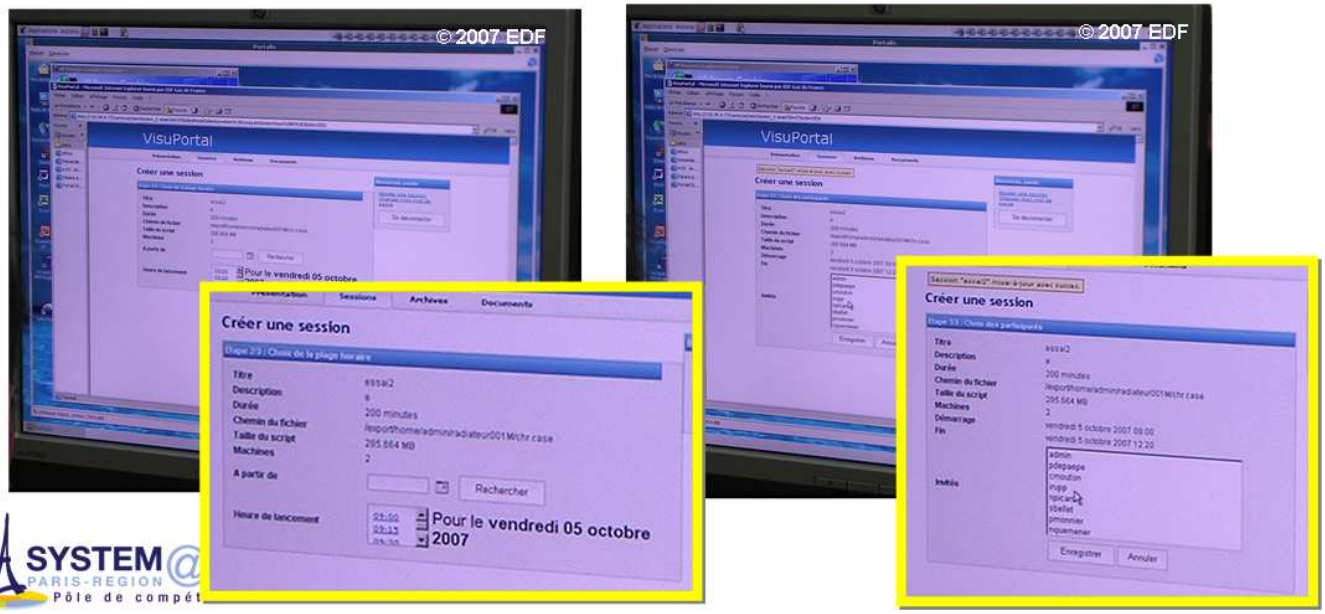
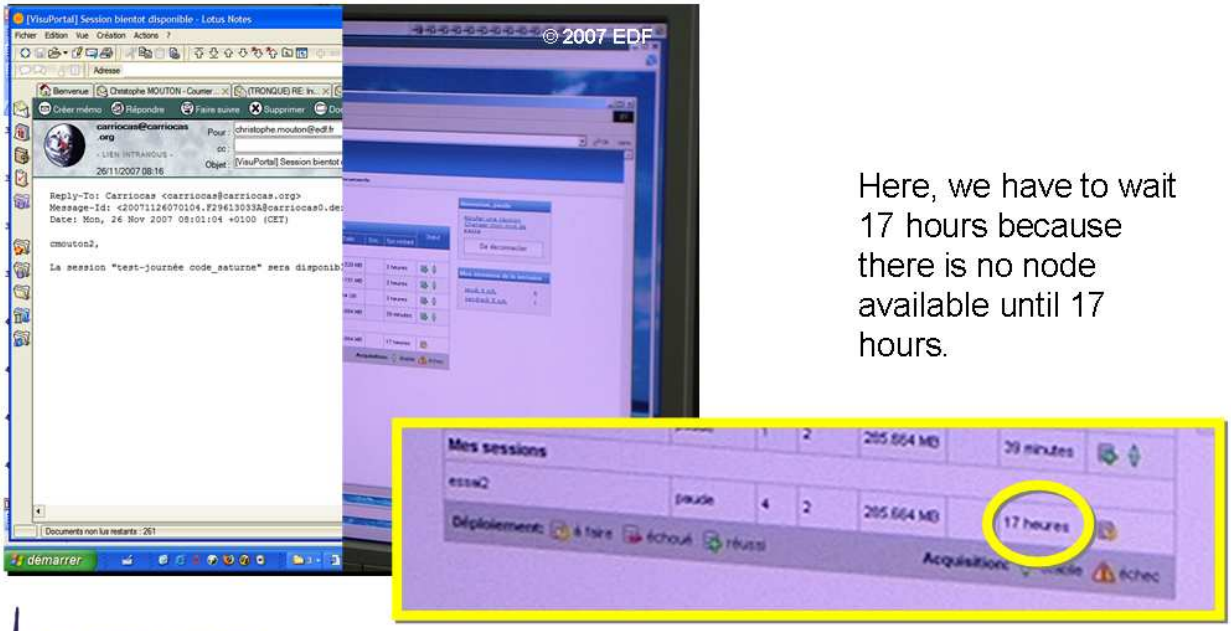


SYSTEM@ PARIS-REGION Pôle de compét

CARRIOCAS Visuportal : Main features

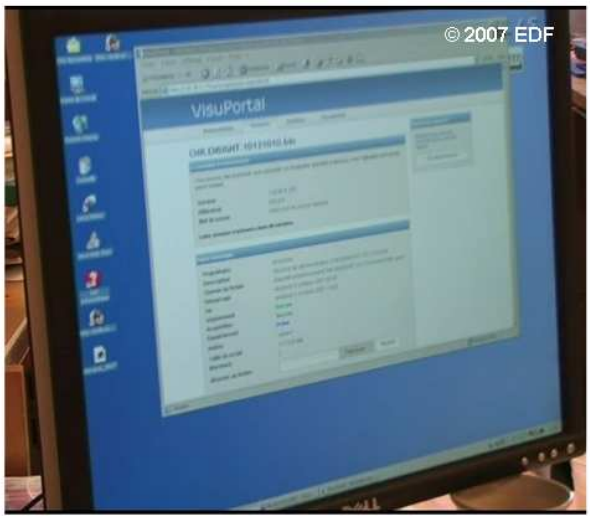
- **A web portal allowing users**
  - To be informed when session is ready (email notification)

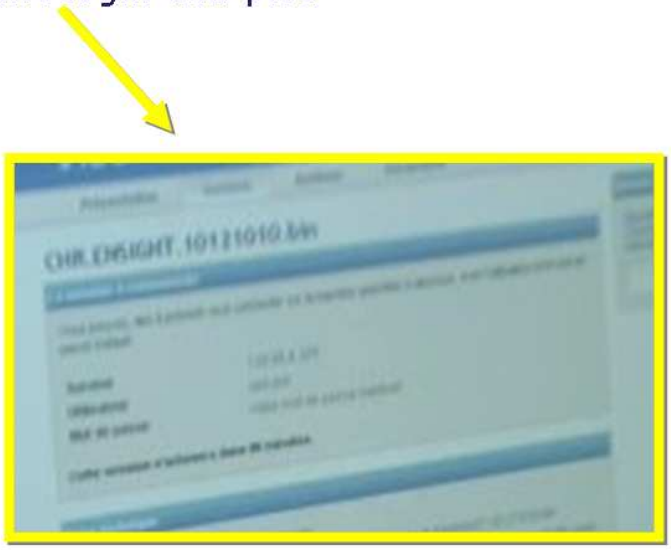


Here, we have to wait 17 hours because there is no node available until 17 hours.

CARRIOCAS Visuportal : Main features

- **A web portal allowing users**
  - When session is ready, to obtain the information to join the session : IP address, specific login and pwd





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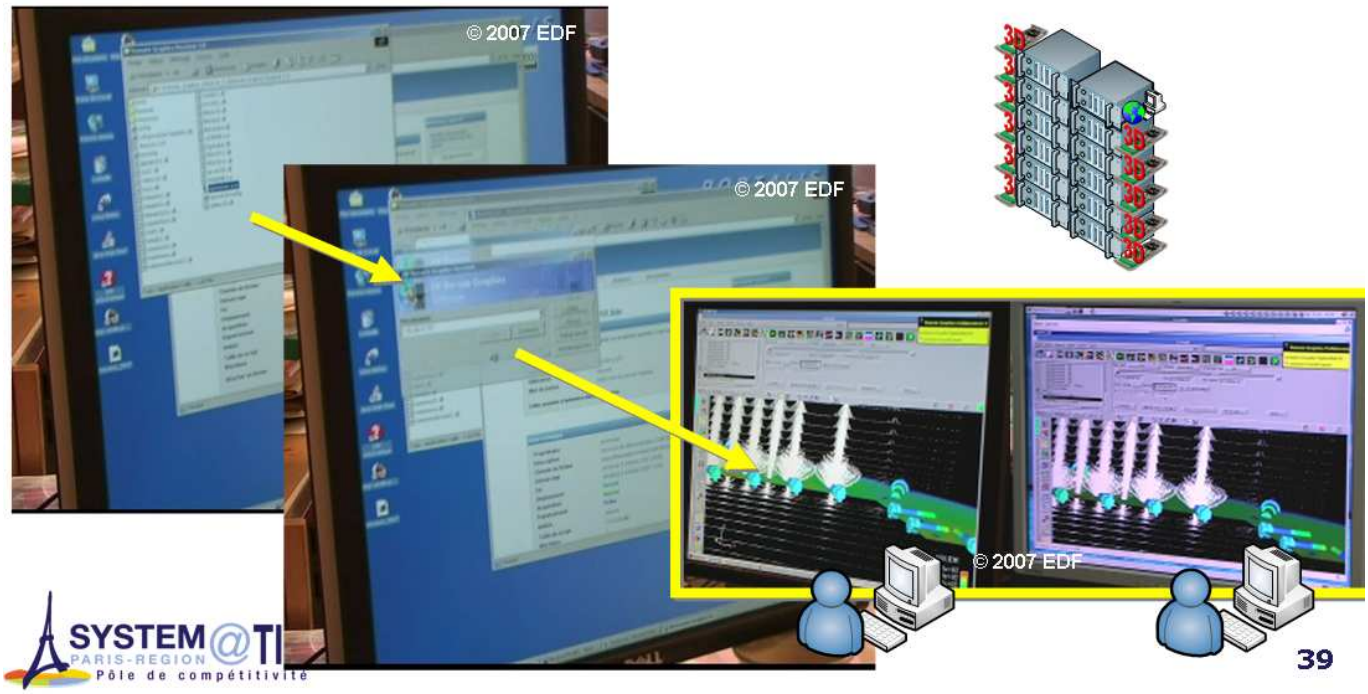
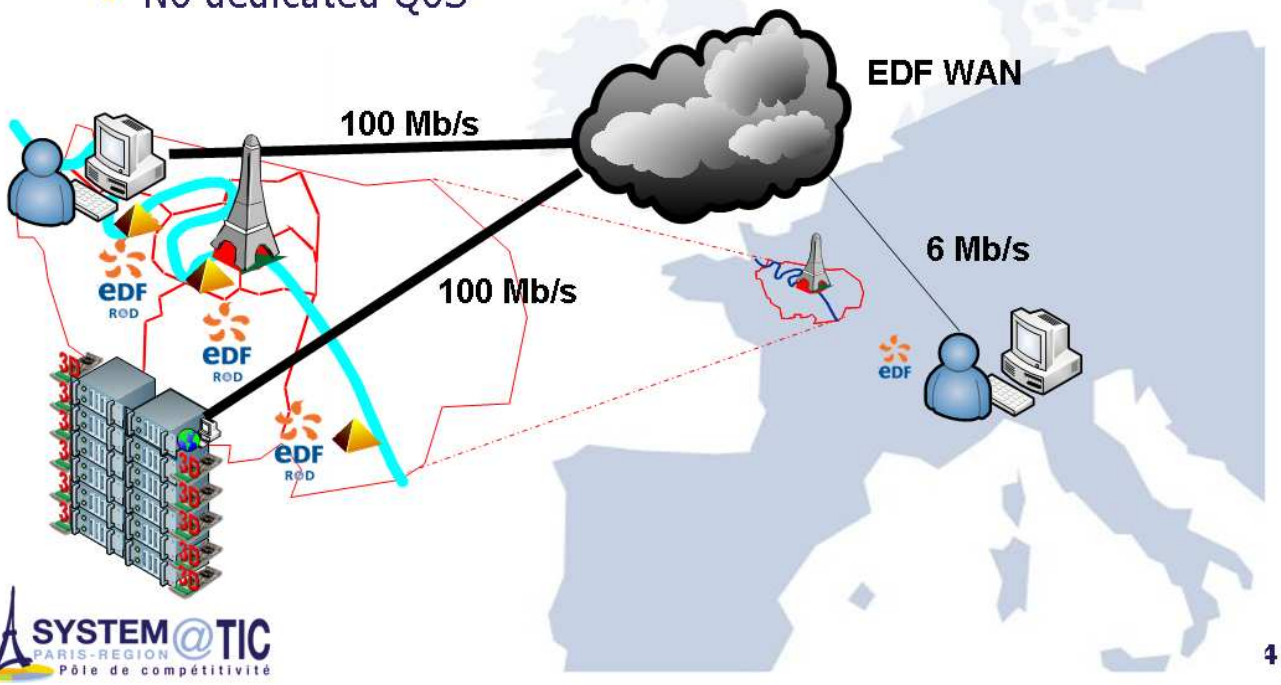


VisuPortal : who did it?

- **EDF leads**
  - **the users requirements and scenarii**
  - **The hardware part :**
    - Clusters (HP xw6400 nodes with Nvidia Geforce 8800 GTX)
    - Logistics (room, HVAC…)
  - **The Ensight Software and Paraview benchmarks on:**
    - Compute clusters
    - Graphics clusters
- **Oxalya (http://www.oxalya.fr) leads**
  - **The software implementation**
    - **VisuPortal Web server (EJB)**
    - Cluster management with CentOS, Rocks, Hurricane ©
  - **Integration and Performance expertise**

Networking aspects

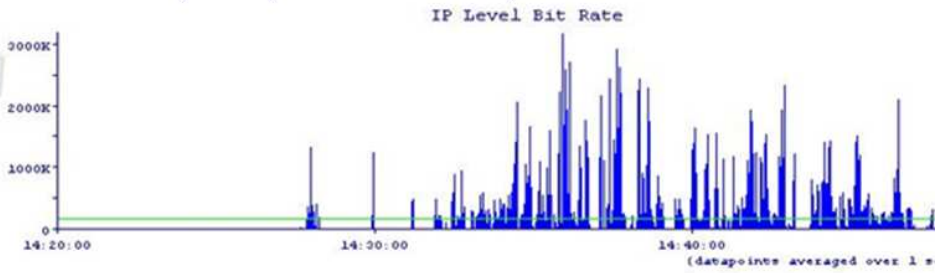
- **EDF : A constrained WAN**
  - A narrow network bandwith with distant entities
  - No dedicated QoS



The experiment context

- 3 pairs of distant users :
  - Researcher (EDF R&D) /Engineer (EDF)
- On real EDF case studies (nuclear safety studies)

- Filmed and Networking measured/monitored on both sites
  - Two HD cameras,
  - Two Network traffic Analysers (Niksun NetVCR)



Movies

- Short extracts of the video records of the experiment

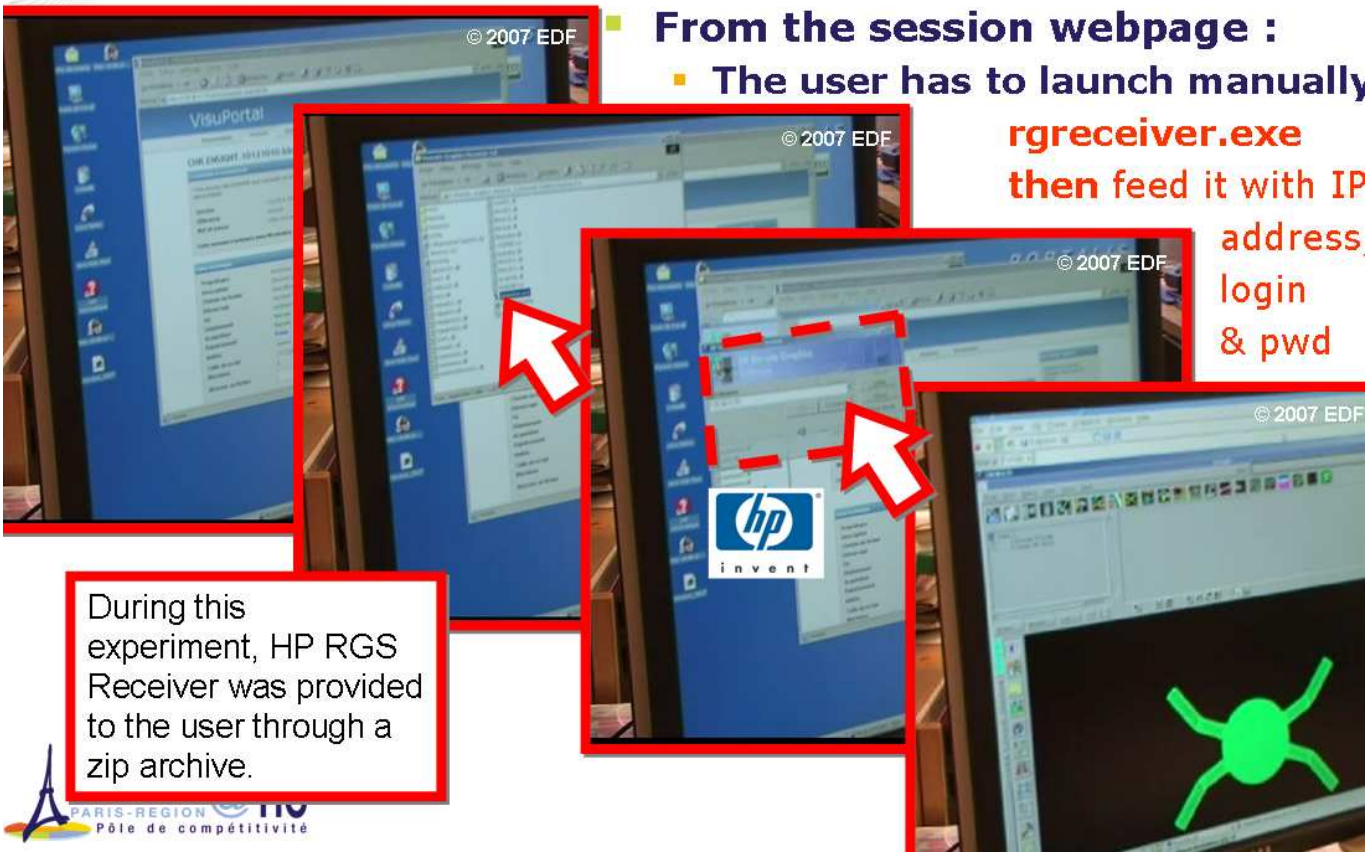
CARRIOCAS Visuportal experimentation
The first main results

- **« Is it possible to keep it ? »**
  - The « experimental »users are definitely convinced by
    - the « easy of use » of the Visuportal system
    - The cluster performance of EnSight software
    - the performance of HP RGS (even if **the maximum measured network bandwith was 2 Mb/s** (peak) for RGS)
  - **Users want it now!**
  - The users never notice that they were using a distant graphic cluster.
- **But… a few disappointments :**
  - No HP RGS easy-login system to connect to the distant linux cluster nodes
  - No easy way to deploy HP RGS for new users.
  - Collaboration GUI HP RGS menus are not enough intuitive

HP RGS : What should be improved!

- **Easy deployement :**
  - EDF use a debian based OS for scientific and engineering users (arount 2000 people) : **HP RGS receiver is not provided for debian 32 bit or 64 bit**
  - EDF use Microsoft Windows 2000 OS for office applications for all other users (around 150000 people), but without any rights for the user to install any software : **HP RGS receiver for windows can not be installed with the provided installer.**
  - **What EDF/CARRIOCAS needs : a killer-application javawebstart-like « installer »**
  - **What does it mean : to embed the RGS receiver binaries for debian 32/64 bit and windows into a javawebstart-like deploiement package**

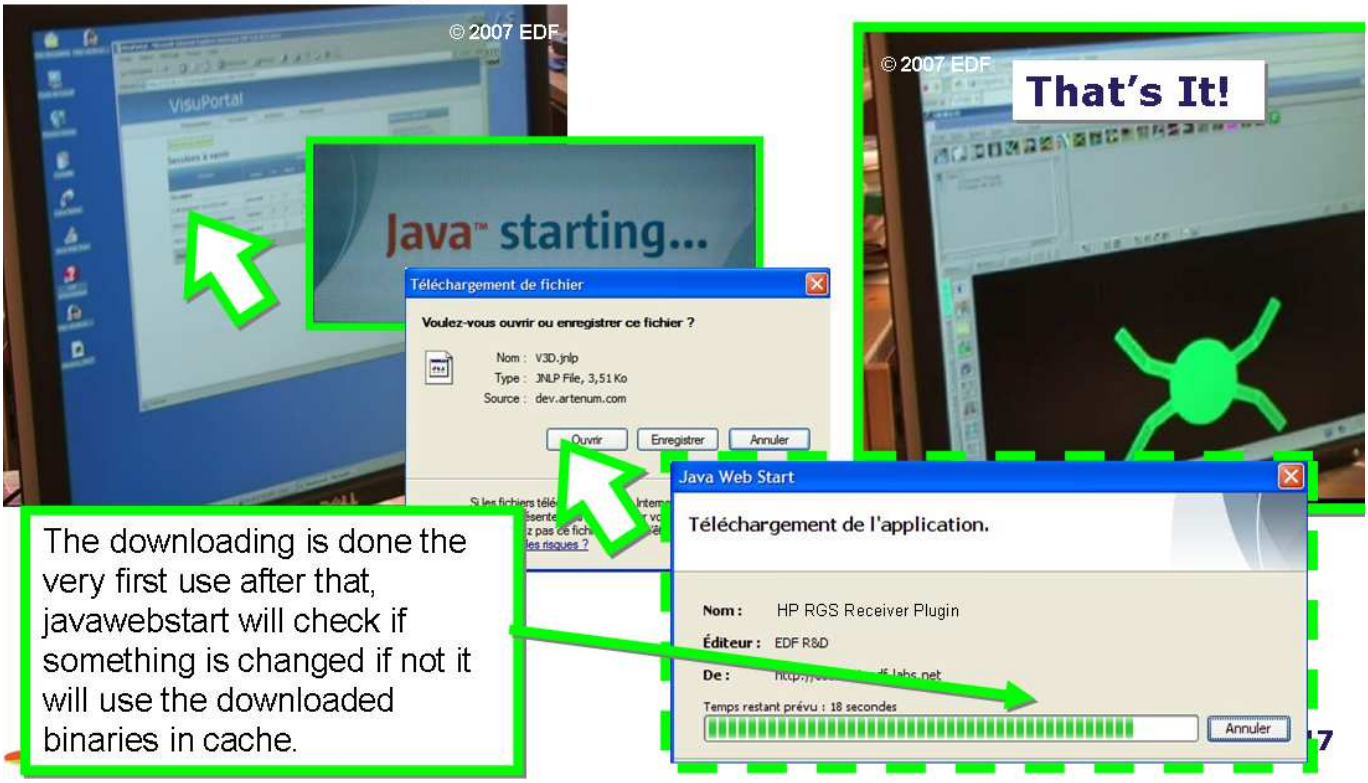
Debian 32/64 bit lack of support and non easy without-administrator rights deploiement



- **From the session webpage :**
  - **The user has to launch manually rgreceiver.exe then** feed it with IP address login & pwd

A complete cross-platform support with a killer-app plugin/javawebstart-like deploiement capability

- **The user will just click on the session name and…**



HP RGS : What should be improved!

- **Easy login :**
  - EDF has built, with Visuportal, the first Web access to scientific visualisation management ressources **but nowadays it's impossible to share transparently the nodes IP and user authentication information between Visuportal and HP RGS receiver** without retyping the IP, login and Password informations.
  - **What EDF/CARRIOCAS need : to launch transparently HP RGS receiver from the Visuportal without retyping authentication information**
  - **What does it mean : to permit HP RGS receiver to be execute with defined information provided by the Visuportal** as the « easy-login » concept for MS windows.

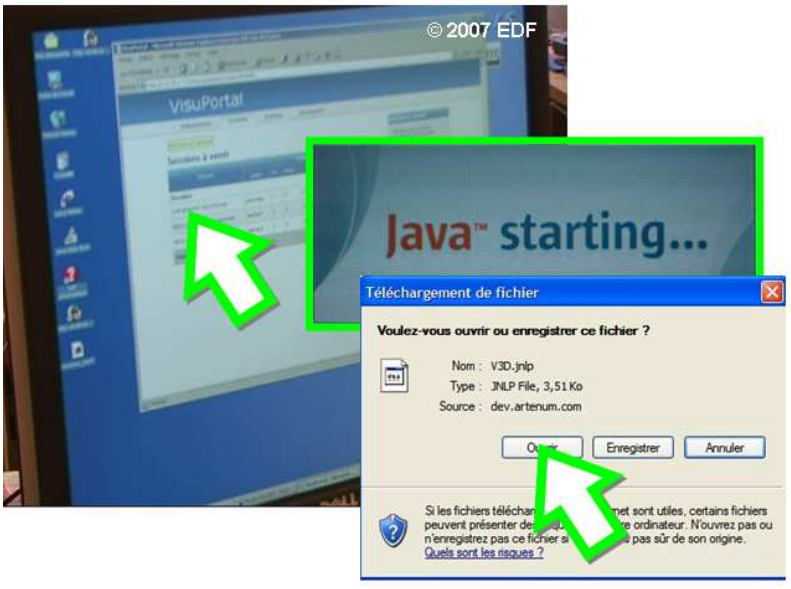
Redundant information and authentication to launch HP RGS receiver

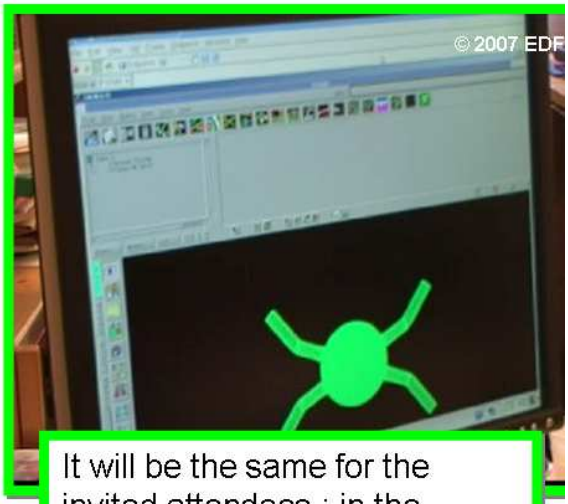
- The user has for security reason to use a onetime root-rights login, when rgsreceiver.exe is launched , he has to
  - Re-type every informations given by Visuportal :
    - IP address of the cluster node running ensight client software
    - Login & pwd

The users didnt' understand why they have to re-type these informations : **it's painful and difficult** because of the **too short delay time in RGS login even with copy&paste**.

A killer-app plugin/javawebstart-like transparent launch of HP RGS receiver

- **The user will just click on the session name in Visuportal and… that's it!!!!**





It will be the same for the invited attendees : in the webportal session list or in the notification email **it will be just a link and it's ready to work!!!**

HP RGS : What should be improved!

- **Collaboration GUI troubles :**
  - **The experimental users didn't find how to collaborate with the HP RGS « & » panel :**
    - **They didn't see the « & » because it is displayed behind the applications**
    - **They didn't guess to right-click on the « & » to access to the options**
  - **The « connected users » panel disturb the users :** this panel masks information before its above applications display

  - **What EDF/CARRIOCAS needs :**
    - **An intuitive and visible panel for the mean features of collaboration**
    - **A not-disturbing way to be aware of the connected users**

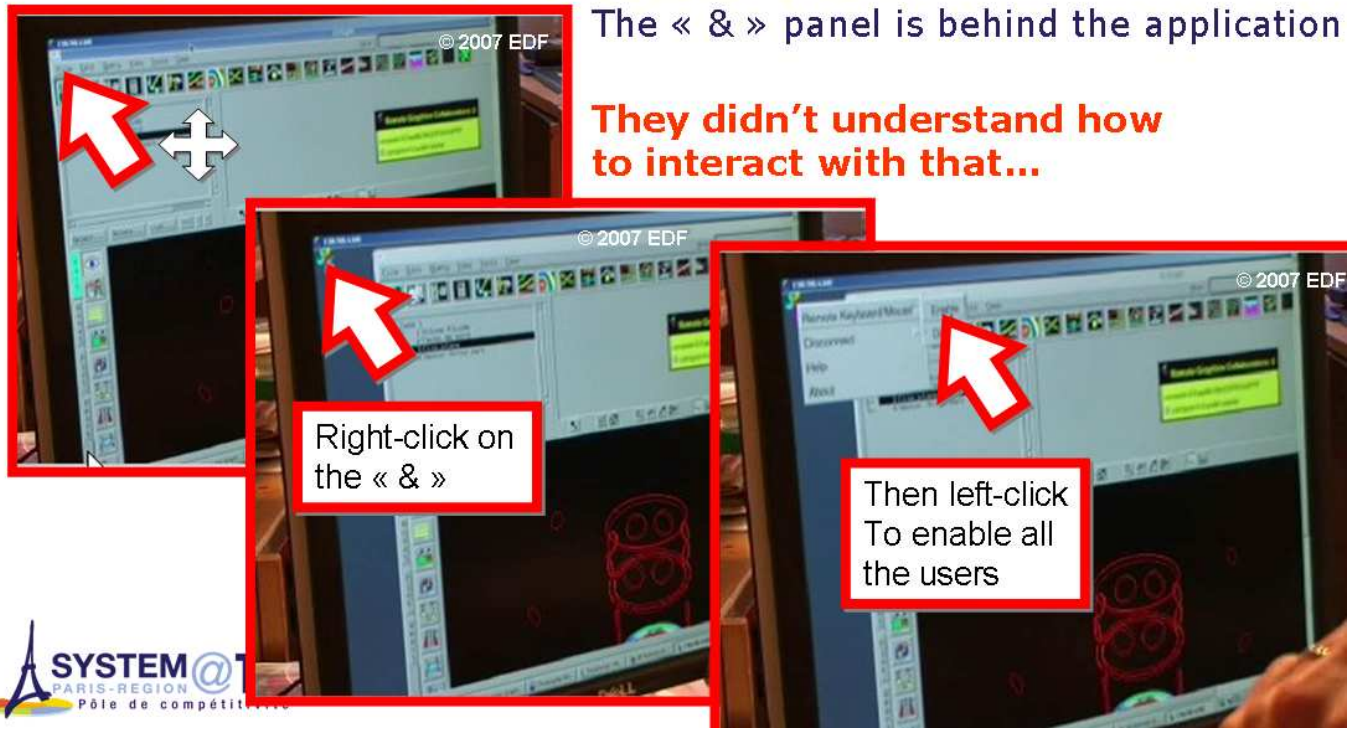
  - **What does it mean :**
    - **to have an explicit connection panel showing the main features : authorising people…**
    - **To render the « connected users » panel on a transparent background**

Hidden « & » panel

- **The users didn't see the « & » icon/panel** because of the launch of Ensight Software in full screen.

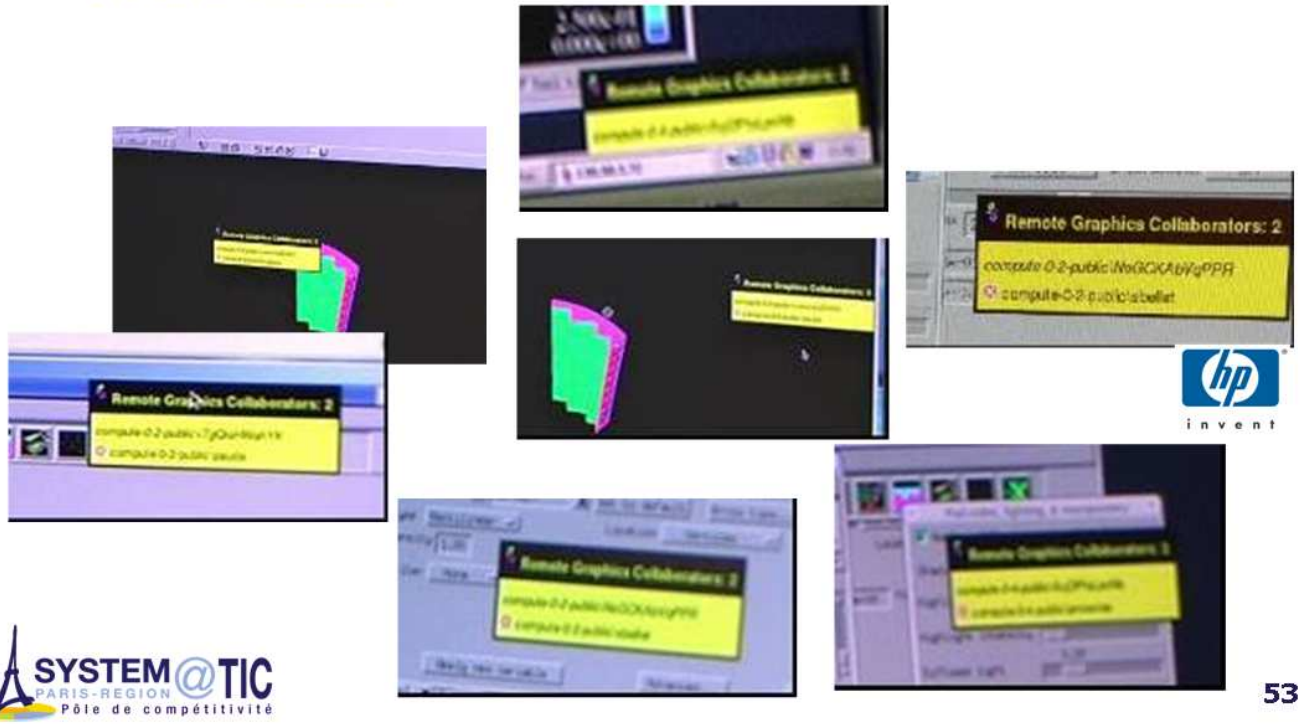
The « & » panel is behind the application

They didn't understand how to interact with that…



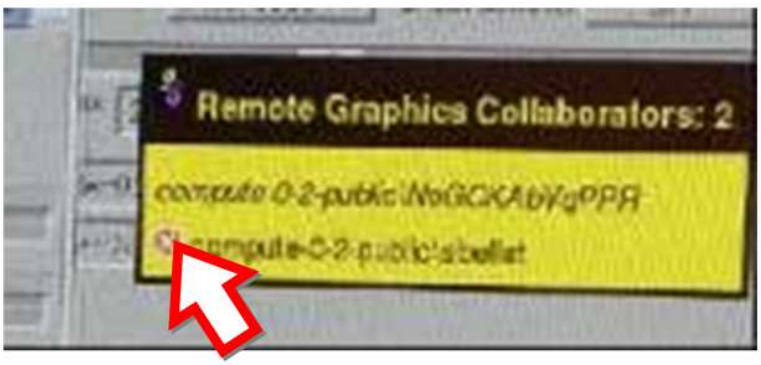
The « RG collaborators » panel

- **The users didn't know where to put this panel, it sticks on the front…**



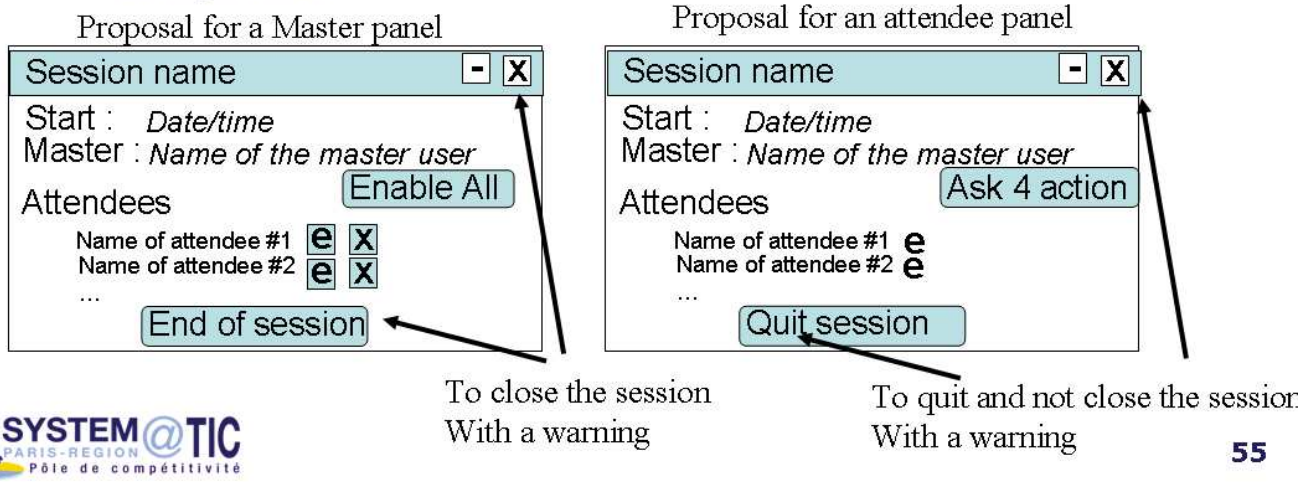
The « RG collaborators » panel

- **Conflicts of use :**
  - The users didn't understand very well how to interact with this panel and the « & » panel.
  - The « computer node name/login » information disturbs the users
  - A few users closed the RGS connection in clicking in the red crossed box because they didn't understand the information on this



What EDF ergonomists suggests

- Two senior ergonomists have looked carefully this VisuPortal experiment, their suggestions/guidelines are the following :
  - To merge the two panels in only one « collaboration » panel
  - To provide an easy way to display it, and, to avoid the positionning issue, to put it on a smart transparent background



HP RGS : What should be improved!

- **Networking issues :**
  - **How to manage IP address to connect HP RGS to a graphic node through the frontal node of a cluster**
    - **The node is on the private network of the cluster**
    - **NAT?**
  - **How to configure securely a firewall for HP RGS**
    - Is SSH encapsulation feasable?

Conclusion

- This Visuportal experiment is definitely a tremendous result for the CARRIOCAS team
- **So thank you again to all the colleagues EDF and partners : CEA, ECP, OXALYA!**

- EDF is leading the R&D in the CARRIOCAS project of the future of using high performance visualization ressources. EDF shares this view with other industrials and Academics.

- **Don't hesitate to contact us !**

- **The team will appreciate any feedbacks/questions about :**
  - **The results of the Visuportal's experiment**
  - **The EDF/CARRIOCAS requirements and recommendations**

Thank you for your attention

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