Grid'5000 :
Une plate-forme pour l'expérimentation

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ministère éducation nationale enseignement supérieur recherche — ministère délégué à la recherche

Liberté · Égalité · Fraternité
RÉPUBLIQUE FRANÇAISE
MINISTÈRE DE LA RECHERCHE

ACI GRID

Action Concertée Incitative [ACI]
Globalisation des Ressources Informatiques
et des Données [GRID]

AGENCE NATIONALE DE LA RECHERCHE
ANR

INRIA

CNRS
CENTRE NATIONAL
DE LA RECHERCHE
SCIENTIFIQUE

Renater

Universities

Histoire des initiatives françaises

Michel Bidoit, Michel Cosnard, Antoine Petit, Brigitte Rozoy....

01-02 ACI : Globalisation des ressources de calcul et des données : a donné une impulsion déterminante

03-04 ACI GRID : besoin dun instrument GRID'5000

03-05 ACI Masse de données

06-07 ANR appel ouvert Masse de Données et de Connaissances, Calcul intensif et Grille de calcul-puis Calcul Intensif et Simulation

Maintenant :

MENRT - TGIR : très grands instruments de la recherche

CNRS IDG : Grille de production et grille de recherche

INRIA ALADDIN : Grille de recherche

ANR : Appel ARPEGE

History of european initiatives

FP6

Grid Technologies (W. Boch): CoreGRID (Th. Priol)
and E-Next, EuQos, Ec-Gin, Grid4all, QosCos& .
e-Infrastructure (M. Campolargo) : EGEE and DEISA

FP7

Grid Technologies with Services (EFIPS has been
submitted by F. Cappello)

Agenda

Motivation

The physical platform

The experimental platform as a challenge
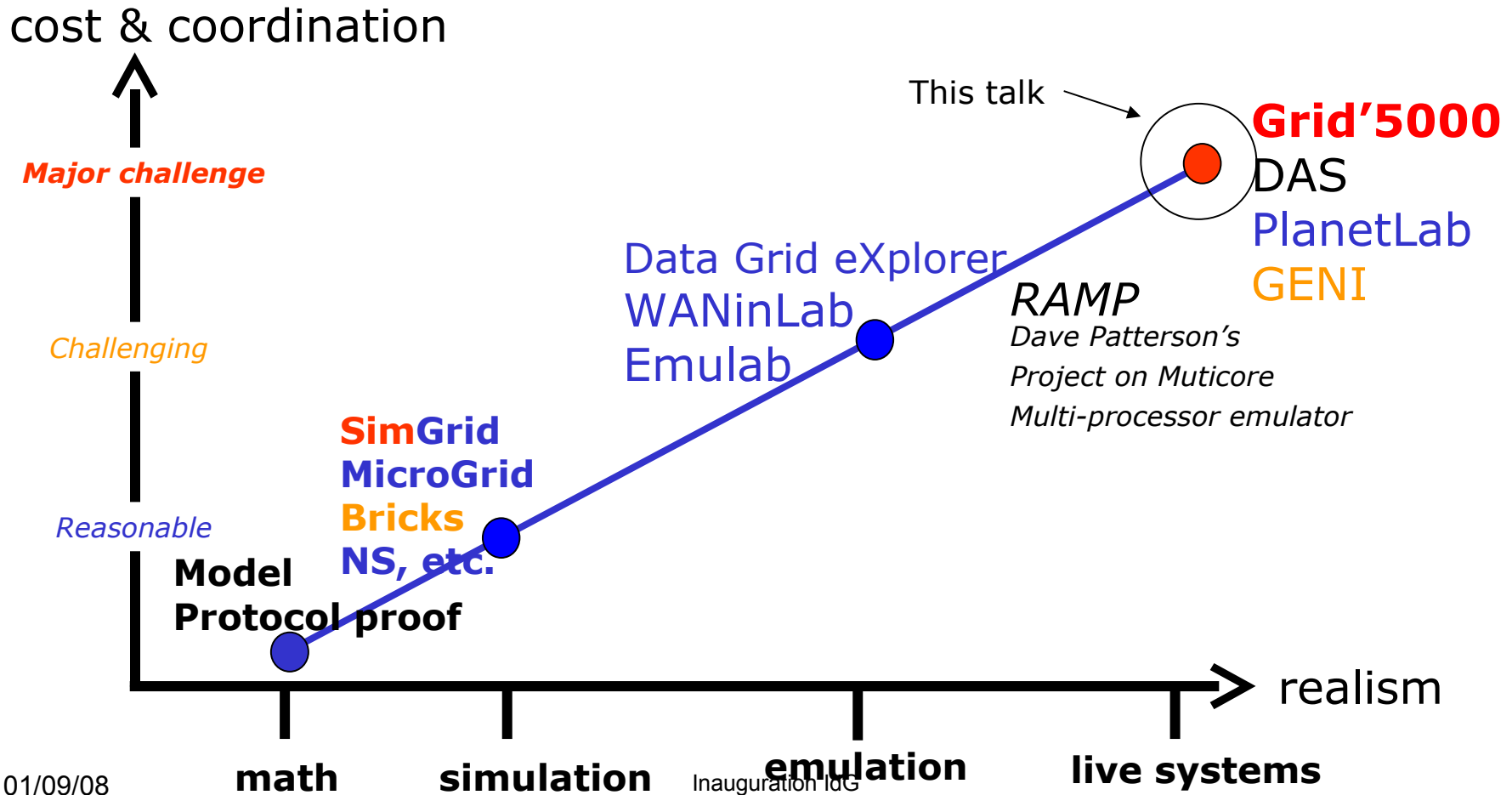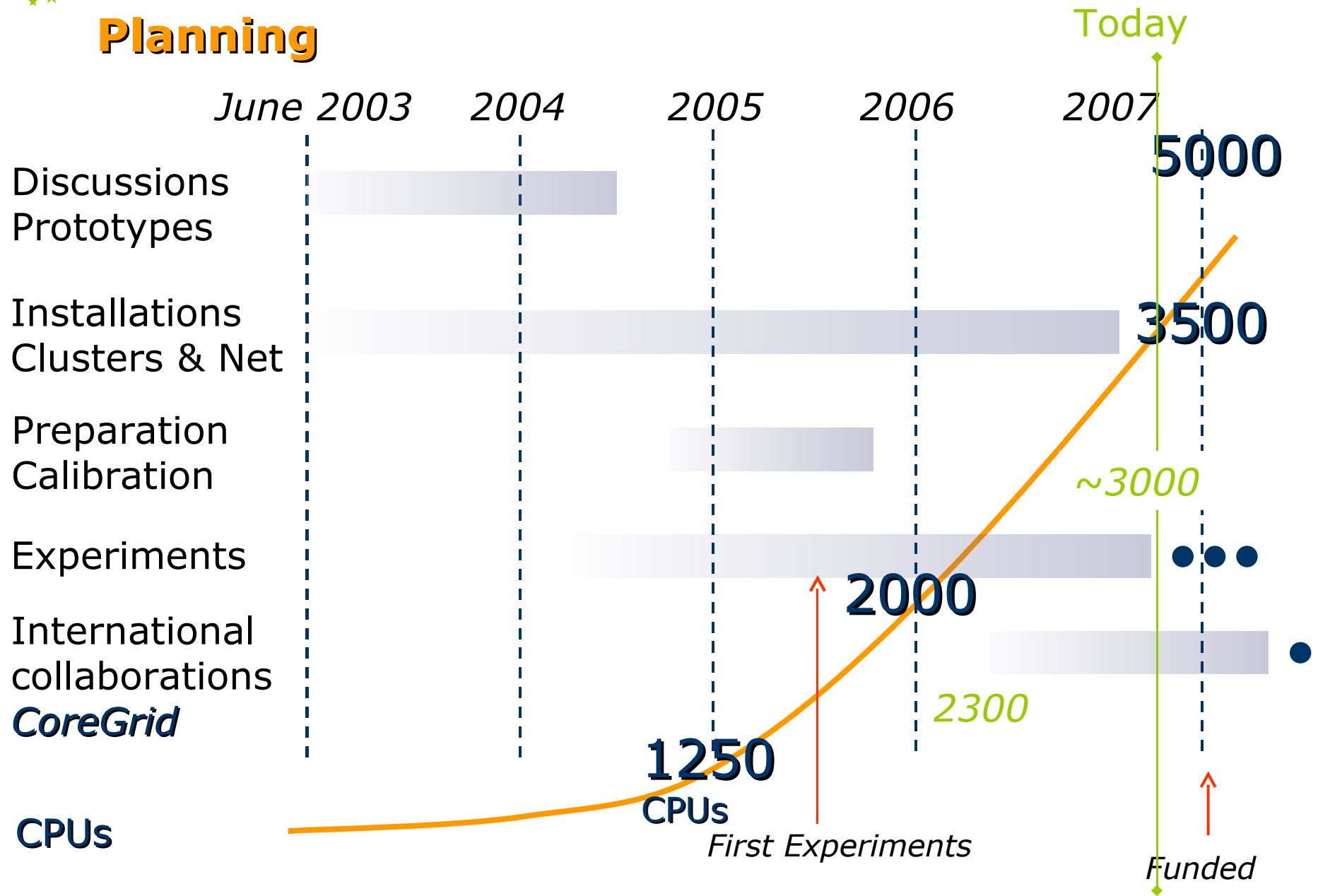
As a user

Achievements

Future

Inauguration IdG

ACI GRID projects

- **Peer-to-Peer**
  - CGP2P (F. Cappello, LRI/CNRS)
- **Application Service Provider**
  - ASP (F. Desprez, ENS Lyon/INRIA)
- **Algorithms**
  - TAG (S. Genaud, LSIIT)
  - ANCG (N. Emad, PRISM)
  - DOC-G (V-D. Cung, UVSQ)
- **Compiler techniques**
  - Métacompil (G-A. Silbert, ENMP)
- **Networks and communication**
  - RESAM (C. Pham, ENS Lyon)
  - ALTA (C. Pérez, IRISA/INRIA)
- **Visualisation**
  - EPSN (O. Coulaud, INRIA)
- **Data management**
  - PADOUE (A. Doucet, LIP6)
  - MEDIAGRID (C. Collet, IMAG)
- **Tools**
  - DARTS (S. Frénot, INSA-Lyon)
  - Grid-TLSE (M. Dayde, ENSEEIHT)
- **Code coupling**
  - RMI (C. Pérez, IRISA)
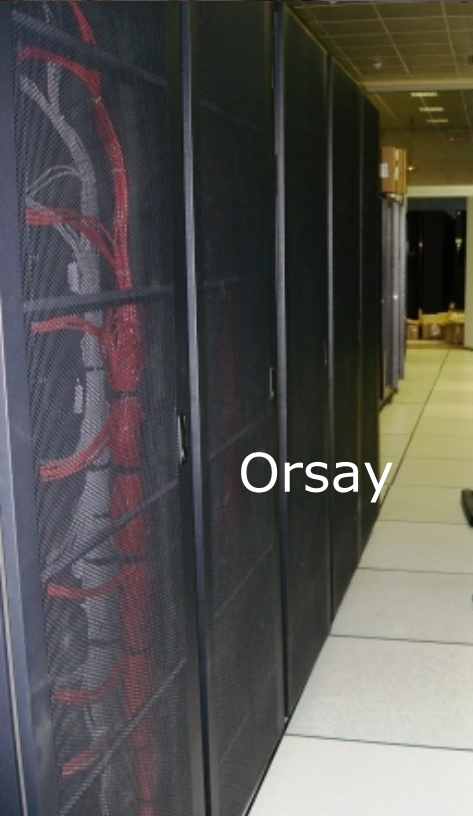 - CONCERTO (Y. Maheo, VALORIA)
  - CARAML (G. Hains, LIFO)

- **Applications**
  - COUMEHY (C. Messager, LTHE) - Climate
  - GenoGrid (D. Lavenier, IRISA) - Bioinformatics
  - GeoGrid (J-C. Paul, LORIA) - Oil reservoir
  - IDHA (F. Genova, CDAS) - Astronomy
  - Guirlande-fr (L. Romary, LORIA) - Language
  - GriPPS (C. Blanchet, IBCP) -Bioinformatics
  - HydroGrid (M. Kern, INRIA) - Environment
  - Medigrid (J. Montagnat, INSA-Lyon) - Medical
- **Grid Testbeds**
  - CiGri-CIMENT (L. Desbat, UjF)
  - Mecagrid (H. Guillard, INRIA)
  - GLOP (V. Breton, IN2P3)
  - GRID5000 (F. Cappello, INRIA)
- **Support for disseminations**
  - ARGE (A. Schaff, LORIA)
  - GRID2 (J-L. Pazat, IRISA/INSA)
  - DataGRAAL (Y. Denneulin, IMAG)

Need of experimental tools

A nation wide experimental platform for large scale Grid & P2P experiments,

competitive at the international level

Based on a dynamics of results and researches on clusters

cost & coordination

Major challenge

Challenging

Reasonable

Model
Protocol proof

SimGrid
MicroGrid
Bricks
NS, etc.

Data Grid eXplorer
WANinLab
Emulab

RAMP
Dave Patterson's
Project on Muticore
Multi-processor emulator

This talk

Grid'5000
DAS
PlanetLab
GENI

realism

math   **simulation**   **emulation**   **live systems**

Grid'5000

Planning

	June 2003	*2004*	*2005*	*2006*	*2007*

5000

Discussions
Prototypes

Installations
Clusters & Net
3500

Preparation
Calibration

~3000

Experiments ● ● ●

2000

International
collaborations ●

CoreGrid

2300

1250
CPUs

CPUs

First Experiments

Funded

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Grid'5000 map

A large scale Instrument to study Grid issues
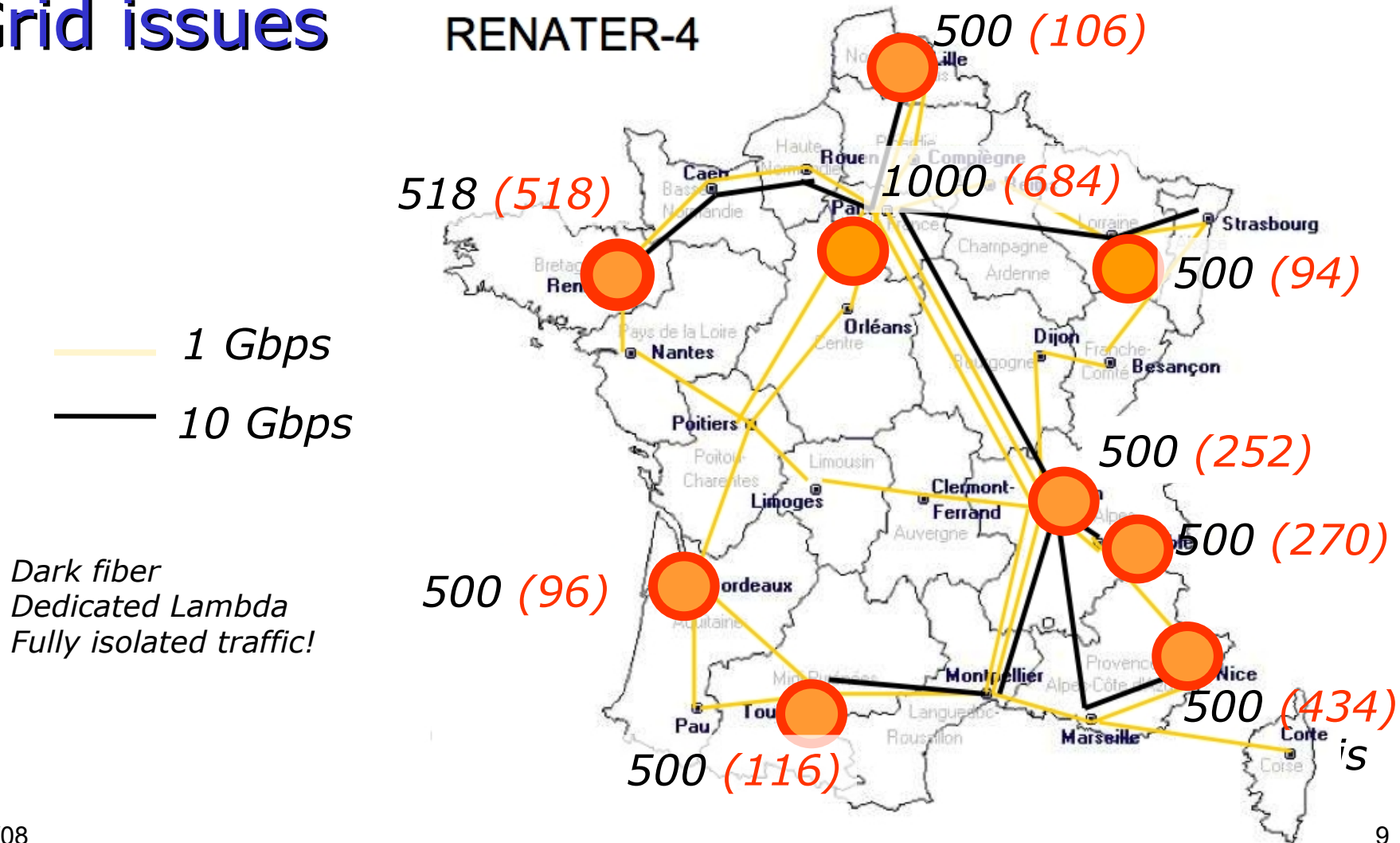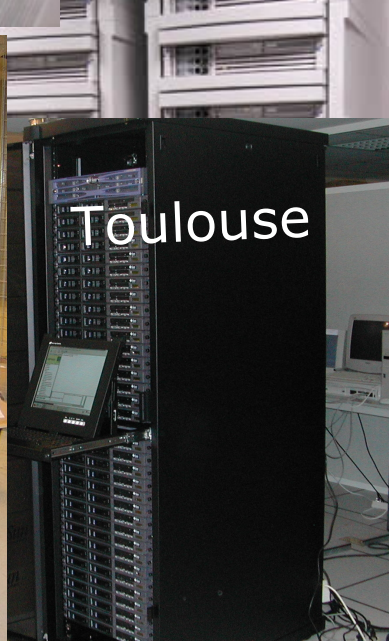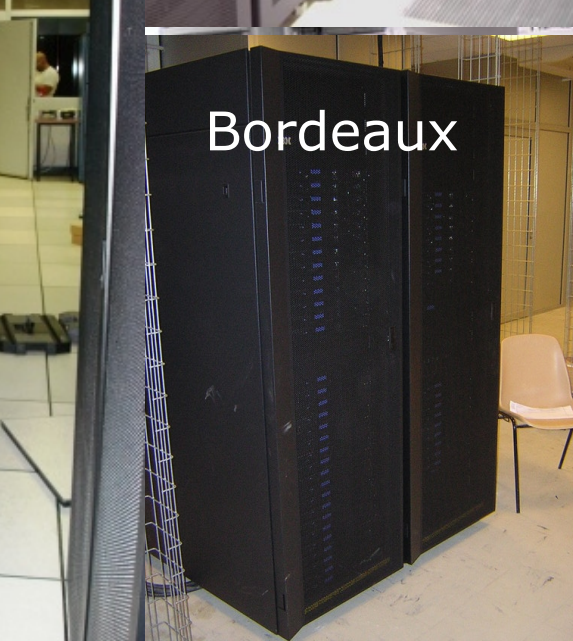
RENATER-4

1 Gbps

10 Gbps

Dark fiber
Dedicated Lambda
Fully isolated traffic!

500 (106)
518 (518)
1000 (684)
500 (94)
500 (252)
500 (270)
500 (96)
500 (434)
500 (116)

Rennes

Sophia

Lyon

Grenoble

Orsay

Bordeaux

Toulouse

Agenda

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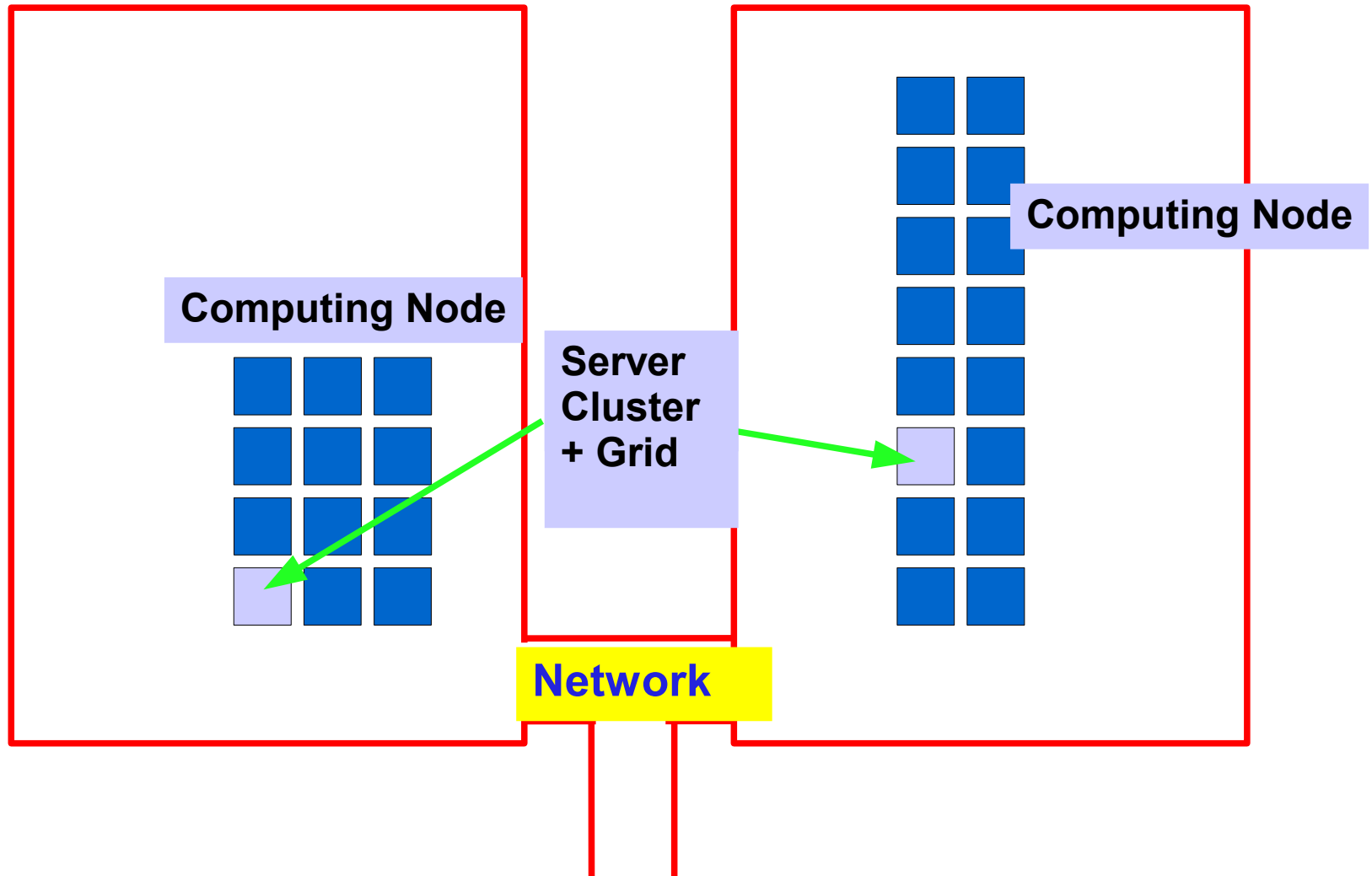
As a user

Achievements

Future

Grid'5000 principle
A highly reconfigurable experimental platform

Experimental conditions injector	Application	Measurement tools
	Programming Environments	
	Application Runtime	
	Grid or P2P Middleware	
	Operating System	
	Networking	
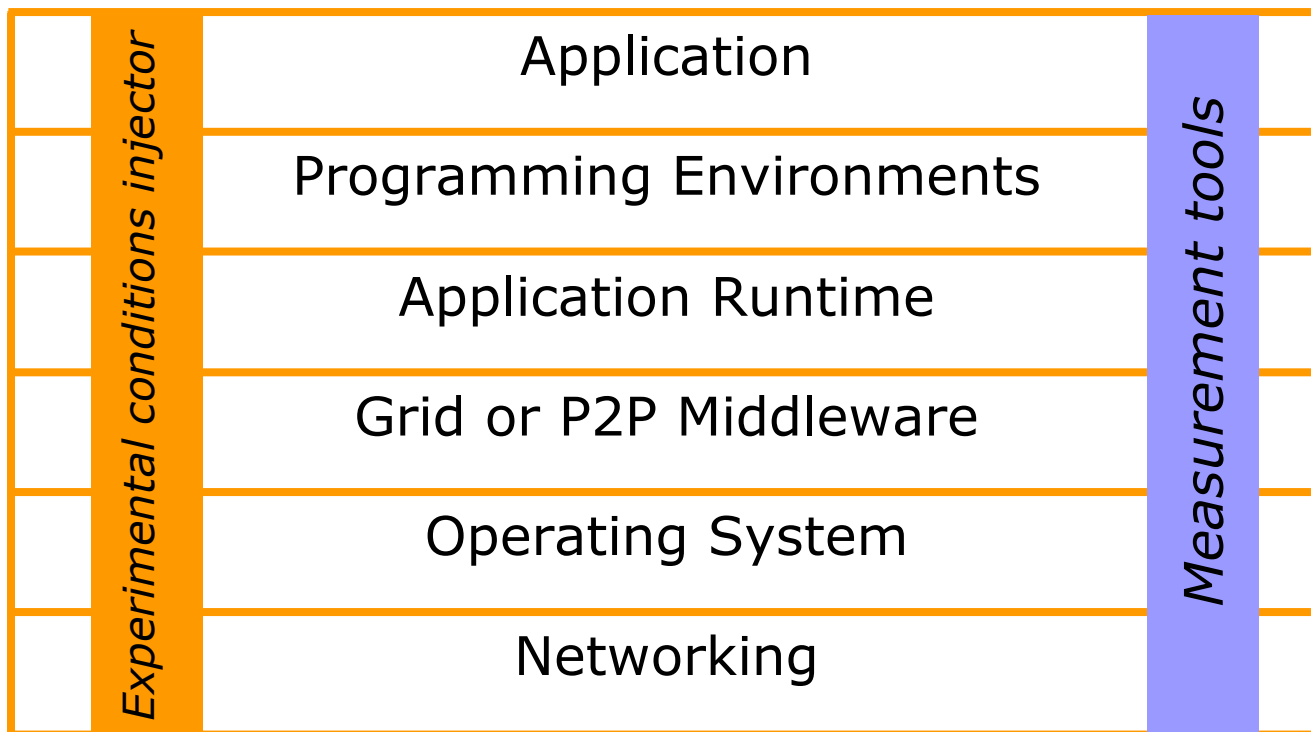
➡ Let users create, deploy and run their software stack, including the software to test and their environment + measurement tools + experimental conditions injectors

Inauguration IdG

Grid'5000

Grid'5000 as an Instrument

4 main features:

- A high security for Grid'5000 and the Internet, despite the deep reconfiguration feature

  --> Grid'5000 is confined: communications between sites are isolated from the Internet and Vice versa (Dedicated lambda, firewall).

- A software infrastructure allowing users to access Grid'5000 from any Grid'5000 site and have simple view of the system

  --> A user has a single account on Grid'5000, Grid'5000 is seen as a LIGHTWEIGHT GRID, 9 (1 per site) unsynchronized home directories

- A reservation/scheduling tools allowing users to select nodes and schedule experiments

  →   a reservation engine + batch scheduler (1 per site) + tool for scheduling exp. and virtual resource allocation

- A user toolkit to reconfigure the nodes

  ->   software image deployment and node reconfiguration tool (extensions to virtual machines or delegation)

01/

Grid'5000 versus PlanetLab

PLANETLAB
An open platform for developing, deploying, and accessing planetary-scale services

	Grid'5000	PlanetLab
Cluster of clusters	V	-
Distributed PC		V
Capability to reproduce experimental conditions	V	?
Capability for dedicated usage for precise measurement	V	-
Experiments on virtual machines technologies	V	-
Precise network monitoring	V	-
Planet wide	-	V

Grid'5000

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Experiment workflow

```
                          ┌─────────────────────────┐
                          │   Log into Grid'5000     │
                          │   Import data/codes      │
                          └─────────────────────────┘
           yes                      ◇ Build an env. ?
                                           no
```

Log into Grid'5000 Import data/codes

Build an env. ? — yes / no

Reserve 1 node

Reserve nodes corresponding to the experiment

Reboot node (existing env.*)

Reboot the nodes in the user experimental environment (optional)

Adapt env.

Transfer params + Run the experiment

Reboot node

Collect experiment results

Env. OK ? — yes

Available on all sites:
Fedora4all
Ubuntu4all
Debian4all

Exit Grid'5000

Inauguration IdG

A Grid'5000 Cluster

Computing Nodes

Proxy

Site Distribution

http

Users

ssh

Server

Login

Firewall

to other Grid'5

Renater G5

Server : OAR, Kadeploy, NFS, Hardware Remote Mangment,Console
Proxy : Http, apt-cacher

A Grid Experiment

Cluster 1

Cluster 2
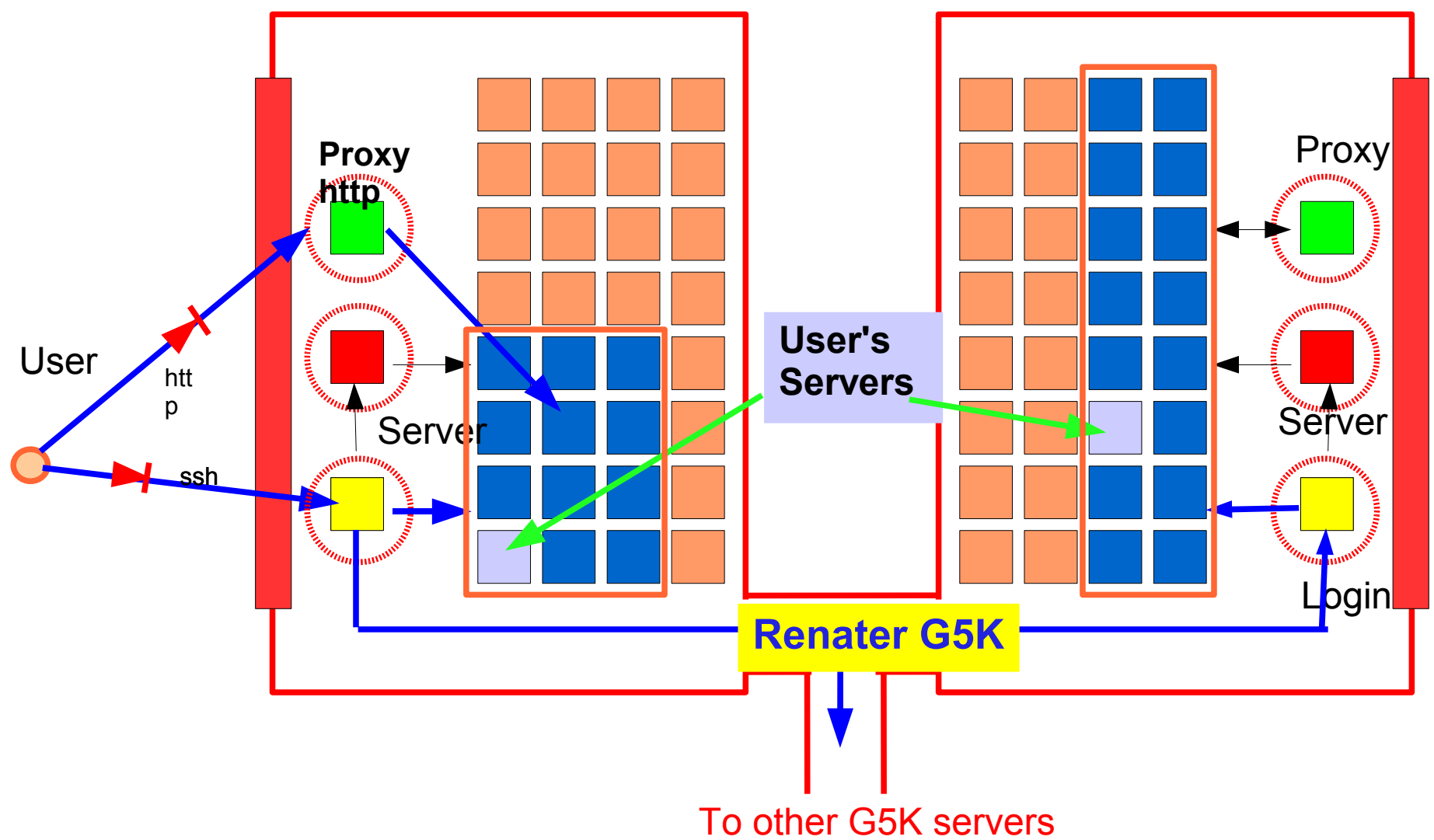
Computing Node

Computing Node

Server Cluster + Grid

Network

Inauguration IdG

Grid'5000

A Grid Experiment

Inauguration IdG

Activity > 70%
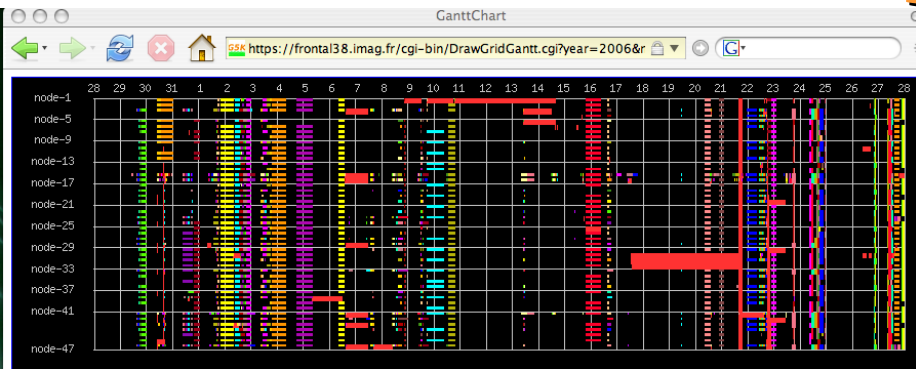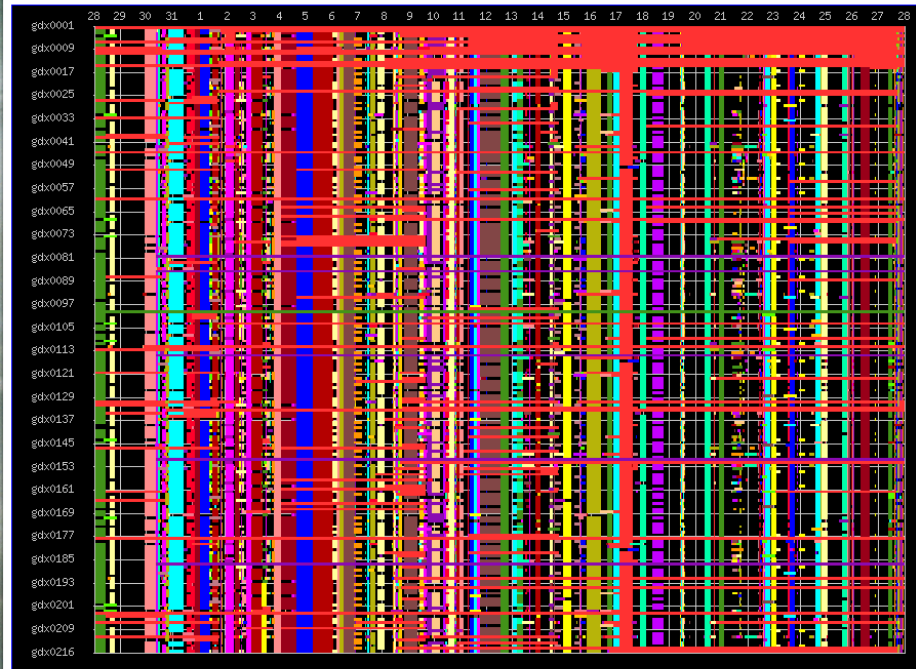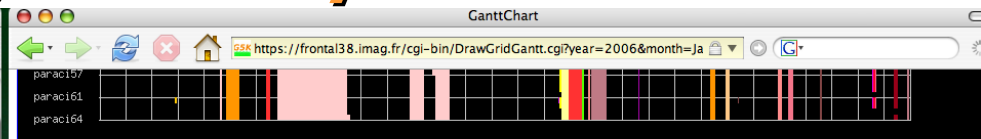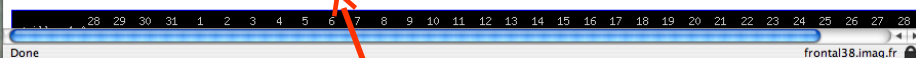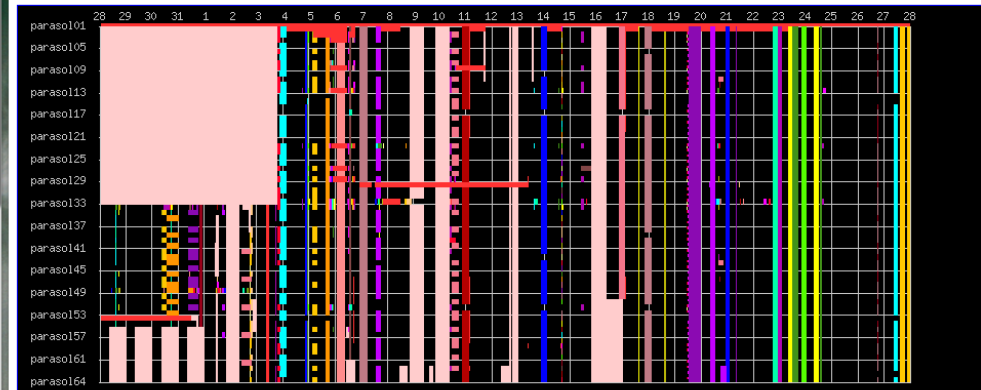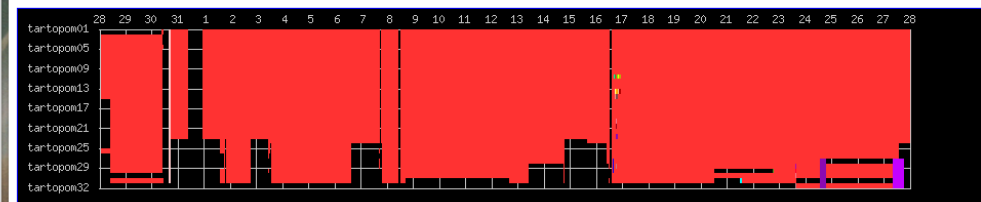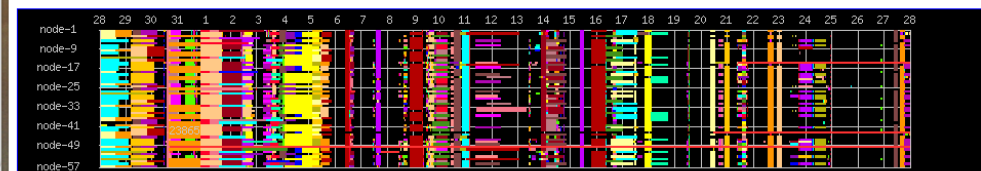
Community: Grid'5000 users

~280 active
Users
Coming from
60 Laboratories.

2DRMP .uk
AIST.jp
BRGM
CEDRAT
CERFACS
CDS
CICT
CIRIMAT
CS-VU.nl
EADS CCR
EC-Lyon
eDAM
ENS-Lyon
ENSEEIHT
ENSIACET
EPFL.ch
FEW-VU.nl
France-telecom

HPCS .jp
I3S
IBCP
ICPS-Strasbourg
IDRIS
IECN
IMAG
IME/USP.br
IN2P3
INF/UFRGS .br
INP-Toulouse
INRIA
INSA-Lyon
INT
IRISA
IRIT

LAAS
LABRI
LAGA
LBP
LEN7
LGCT
LICA
LIFC
LIFL
LIFO
LINA
LIP6
LIPN-Paris XIII
LIRIS
LMA
LORIA
LPC
LSR
LRI

Prism-Versailles
RENATER
SUPELEC
UCD.ie
UFRJ.br
UHP-Nancy
UTK .edu

Browser window

File   Edit   View   Go   Bookmarks   Tools   Window   Help

Mozilla Firefox

- Joining
- News
- Time line
- Experiments
- Publications
- Press releases
- Softwares

users portal
- Users portal
- Platform events
- Platform status
- User Reports
- Documentation
- FAQ

committees portal
- Agenda
- Members
- Meetings
- Workgroups
- Administration

wiki special pages
- Recent changes
- All pages
- Upload file
- Wiki help

search

[Go] [Search]

toolbox
- Upload file
- Special pages

All Grid'5000 reports:

- Hamza Adamou (M2R), MESCAL ID IMAG Grenoble
- Guillaume ALLEON (Engineer), EADS CRC
- Lamine Aouad (PhD student), Grand Large LIFL Lille
- Carlos Jaime BARRIOS HERNÁNDEZ (PhD Student), MESCAL ID-IMAG Montbonnot Saint-Martin (Grenoble-France)
- Janet Bertot (ingé devexp), service Dream INRIA Sophia
- Raphaël Bolze (PhD student), GRAAL LIP-ENSL Lyon
- Hinde Lilia Bouziane (PhD student), PARIS IRISA/INRIA Rennes
- Jeremy BUISSON (PhD student), PARIS IRISA Rennes
- CHRISTOPHE CERIN (professor), Grid eXplorer LIPN Paris XIII, Villetaneuse
- Arnaud Contes (Phd), OASIS INRIA Sophia
- Cedric Dalmasso (Internship), Oasis INRIA Sophia
- Alexandre di Costanzo (PhD student), OASIS INRIA Sophia
- Fabrice Dupros (engineer), IGS BRGM Orleans
- Thierry Gautier (CR INRIA), MOAIS ID-IMAG Grenoble
- Stéphane Genaud (Maitre de Conférences), TAG ICPS-LSIIT Strasbourg
- Yiannis Georgiou, Mescal ID-IMAG Grenoble
- Olivier GLUCK (Associate Professor), INRIA RESO LIP ENS-LYON
- Jens Gustedt (directeur de recherche), Algorille INRIA Lorraine & LORIA Nancy, France
- Christophe Hamerling (Engineer), GRID-TLSE IRIT-ENSEEIHT Toulouse
- Thomas Hérault (Assistant Professor), Grand-Large LRI Orsay
- Samir Jafar (PhD Student), MOAIS ID-IMAG Grenoble
- Emmanuel Jeannot (Chargé de recherche), Algorille LORIA Nancy
- Emmanuel Jeanvoine (PhD student), PARIS IRISA Rennes
- Peyrard Johann (developer), Kaapi Imag Montbonnot
- Nicolas LARRIEU (Postdoct fellow), Grid-eXplorer LAAS-CNRS Toulouse
- Adrien Lebre (Phd Student), MESCAL ID IMAG Montbonnot (Grenoble-France)
- Julien Leduc (Research Engineer), RESO LIP Lyon
- Laurent Lefevre (INRIA CR1 Researcher), RESO LIP Lyon
- Oleg Lodygensky (Phd student), Grand-Large LRI orsay, france
- Eric MAISONNAVE (Engineer), (submitted) Cerfacs Toulouse
- Maxime Martinasso (Phd student), Mescal ID-Imag Grenoble
- Sébastien Monnet (PhD student), PARIS IRISA Rennes
- Thierry Monteil (Assistant professor), MOAIS LAAS-CNRS Toulouse
- Matthieu Morel (Ingénieur expert), Oasis INRIA Sophia Antipolis
- Grégory Mounié (Assistant Professor), MOAIS ID-IMAG Grenoble
- Frederic NIVOR (PhD), STM LAAS-CNRS Toulouse, France

Main information
- Main information
- Experiments
- Publications
- Collaboration
- Results
- Benefits

- Render report
- List all reports

Done

www.grid5000.fr

Agenda

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About 340 Experiments

300 Publications

Including:

-5 HDR

-14 Ph.D.

-200 international publications

Grid@work 2005, 2006, 2007...

Grid'5000

- Grid PlugTest (N-Queens and Flowshop Contests).

The objective of this event was to bring together ProActive users, to test the deployment and interoperability of ProActive Grid applications on various Grids.

Winner 2007:
NQueens N=22 in 3 mn 21s on GRID'5000
NQueens N=23 in 35 mn 7s on GRID'5000 and deployment of all processes in less than few minutes using proActive and the Kaapi launcher karun on top of taktuk.
1600 CPUs in total: 1200 provided by Grid'5000 + 50 by the other Grids (EGEE, DEISA, NorduGrid) + 350 CPUs on clusters.

A series of Events

Grid5000:News – Grid5000

https://www.grid5000.fr/mediawiki/index.php/Grid5000:News

Amazon France Apple ▾ eBay France Yahoo! Informations (1779) ▾

- Hardware
- Network
- Software
- Experiments
- Publications
- Press releases

users portal

- Community Home
- Users Charter
- Users Reports
- Platform events
- Platform status
- Bugzilla / Support
- Users Docs
- FAQ

committees portal

- Todo
- Meetings
- Members
- Admins Docs
- Reference Docs

wiki special pages

- Recent changes
- Wanted pages
- Upload files
- All pages
- Wiki help

toolbox

- What links here
- Related changes
- Upload file
- Special pages
- Printable version

Forthcoming events

October 2006: Grid eXplorer days

October 12th and 13th, IDRIS, Orsay. Grid eXplorer users will present their lastest research results obtained with the Grid eXplorer platform.

November 2006: SC'06

SuperComputing 2006 will take place in Tampa, Florida (USA) from November 11th to 17th.

November 2006: Paristic 2006

The 2006's edition of Parsitic will be hosted by the LORIA in Nancy, from November 22th to 24th.

November 2006: PlugTest 2006

GRIDS@work: CoreGRID Conference, Grid Plugtests and Contest will take place in ETSI Headquarters, Sophia-Antipolis from November, 27th to December, 1st.

January 2007: EGO-2006

The *Operational Grids winter School* will take place in Rouen (France) in January 2007. Grid'5000 will provide the grid platform and the assistance staff during the event.

Past

Augus

After Franck

June 2006: Grid'5000 Workshop

The event will take place in Paris (France) in conjunction with HPDC'2006.

More information at IEEE HPDC'2006

March 2006: Grid'5000 Spring School

The event took place in Grenoble (France) between March 6th and March 10th 2006.
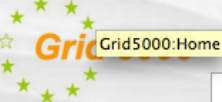
More information on Grid5000:School2006

1 Keynote address at CCGRID'2007

7 invited talks

Inauguration IdG

The Grid'5000 Newsletter

Key Results

- The instrument is a major result, by this originality, and one of the first "Computer Science Large Scale Instrument" in France

- Scalability results for software prototypes : DIET and LSCAN (Lyon), XtremWeb and MPIC-V (Orsay), ProActive (Nice), Kadeploy and Kaapi (Grenoble), Jxta and Vignes (Rennes), Runtime (Bordeaux)

- Computing larger results : B&B on Flowshop scheduling and bio-info (Lille), CFD and Health (Nice), sparse matrix and Climatology (Toulouse), Atomistic simulations (Bordeaux), geophysics and sparse computaions (Nancy)

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Toward a European
Computer Science Grid, and more
Connection to other Grid experimental platforms
Netherlands (2006), Luxembourg, Japan and Brasil (discussion)
Towards a European "Computer Science Grid"?

Future of research Grid platforms

Grid and clusters for HPC for sciences and technologies : usage, middleware, programming models and language, librairies, ….

But much more! Research for

Software for new architectures (multi-all) of machines and clusters

Middleware for large multi-scale distributed and dynamic systems

Support or Web intelligence, Data centers, Services platforms

Reliability, security, privacy as key issues

Grid'5000 Région Rhône-Alpes

=> Sites Grid'5000 de LYON (LIP/INRIA) et Grenoble (INRIA/LIG/CIMENT)

Grenoble :

  - Des ressources communes entre la grille CIMENT et site

  Grid'5000 de Grenoble.

  - Partage/mutualisation essentiellement par l'approche exploitation

  des ressources inutilisées (CIGRI/job BestEffort).

  - Concept de Grille Légère

Lyon:

  - Middleware DIET (

  - Présence d'équipement réseaux spécifiques (mesure).

Fortes expertises dans les middleware d'exploitation de ressources calcul et

des couches réseaux :

  DIET, OAR, Kadeploy...

Grid'5000

Une plate-forme pour l'expérimentation en production !

- Une référence dans les plate-formes d'expérimentation
- En forte évolution (2eme cycle de vie)
- ADT ALLADIN (INRIA)
- Permet l'étude d'infrastructure complexe (Globus, GLITE)
- C'est une grille légère (comme la grille CIMENT)
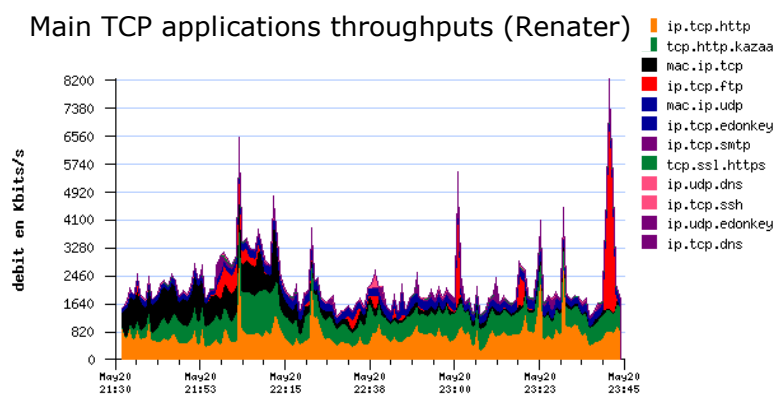- Pas de problème de passage à l'échelle connu pour l'instant
- Pas stokage de masse

Thank you for your attention

https://www.grid5000.fr/

many thanks to the computer scientists
grid actors….

Experimental Condition injectors

Network traffic generator

Main TCP applications throughputs (Renater)

Legend:
- ip.tcp.http
- tcp.http.kazaa
- mac.ip.tcp
- ip.tcp.ftp
- mac.ip.udp
- ip.tcp.edonkey
- ip.tcp.smtp
- tcp.ssl.https
- ip.udp.dns
- ip.tcp.ssh
- ip.udp.edonkey
- ip.tcp.dns

A non Gaussian long memory model
Gamma + Farima:

$$\Gamma_{\alpha,\beta} - \text{farima}(\phi, d, \theta)$$

Normal $\Delta=10ms$

$\Delta=400ms$

DOS attack $\Delta=32ms$

Flash Crowd $\Delta=2ms$
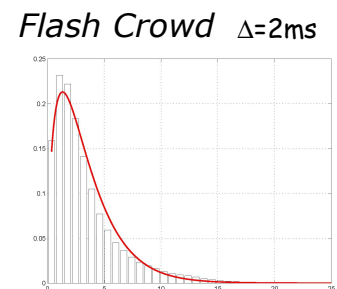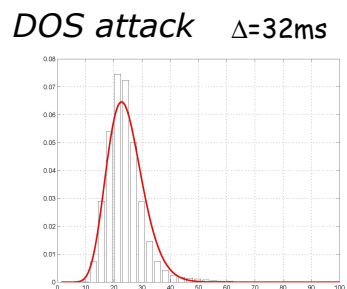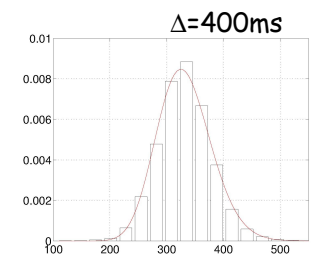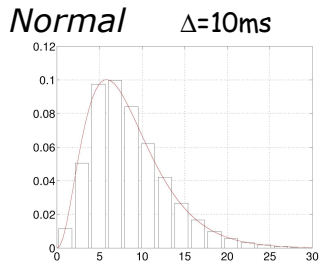
Faults injector

FAult **I**njection **L**anguage

- crash every 5 seconds
- crash every 10 seconds

execution time (in seconds) vs probability for a worker to crash