GRID Standardization GCM and ProActive Ref. Implementation

Sophia Antipolis, December 6th

Denis Caromel, et al.

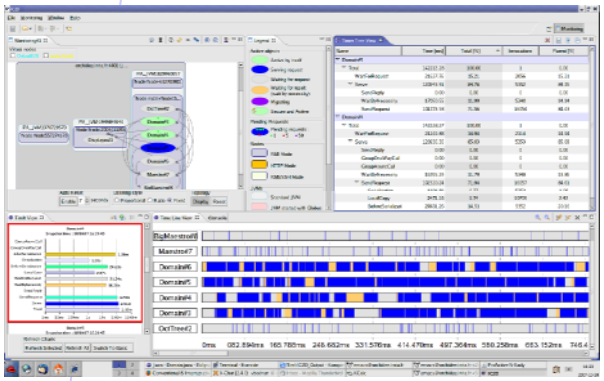
http://ProActive.ObjectWeb.org

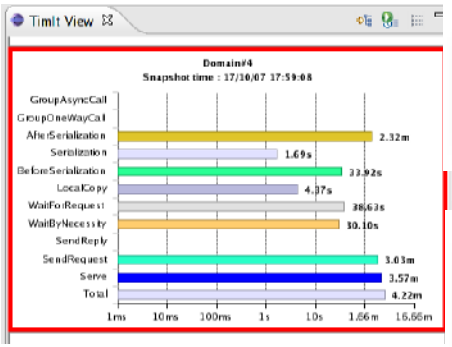
OASIS Team

INRIA -- CNRS - I3S -- Univ. of Nice Sophia-Antipolis, IUF

ProActive
Programming, Composing, Deploying on the Grid

Overview





Applications

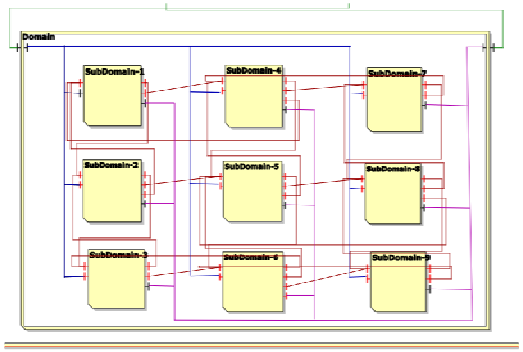
Developer Tools
&
Eclipse IDE Plugins

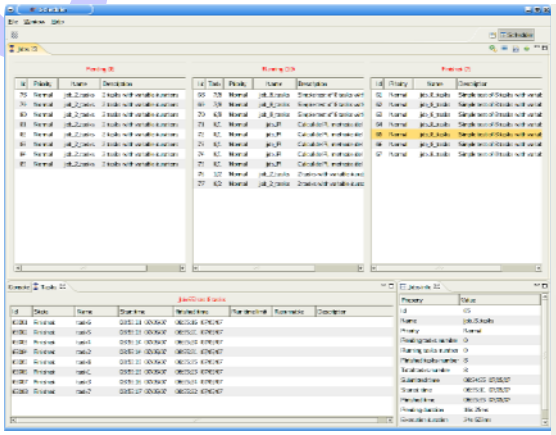
Programming & Composing

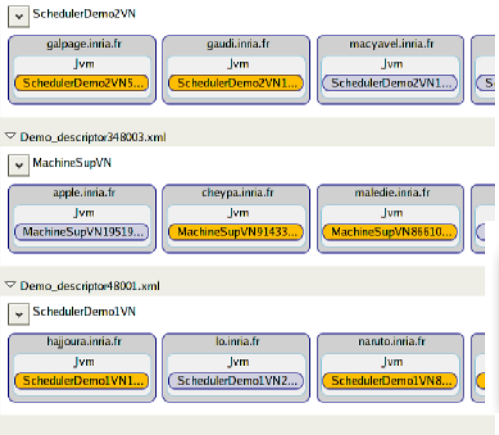
Deployment & Virtualization

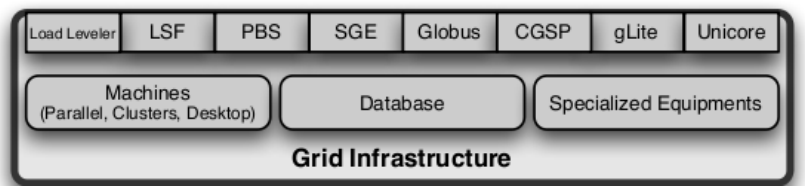
Services

GCM: Grid Component Model

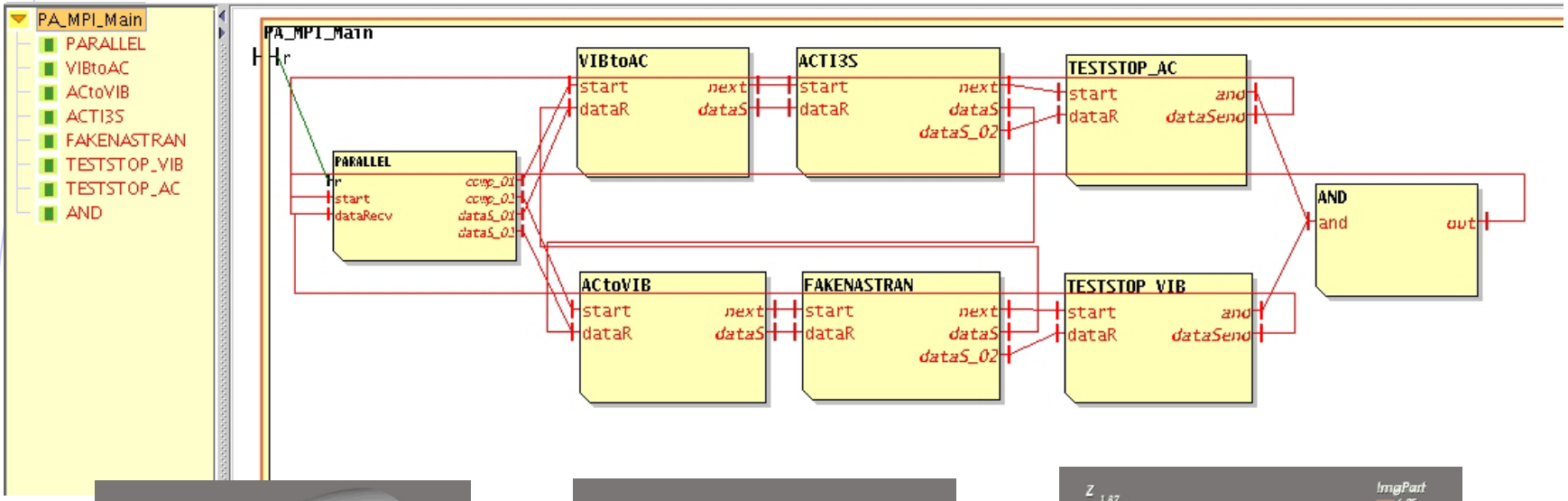


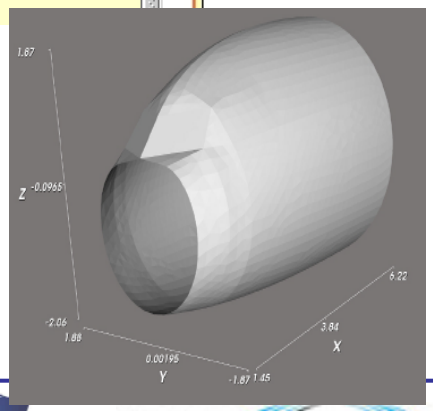


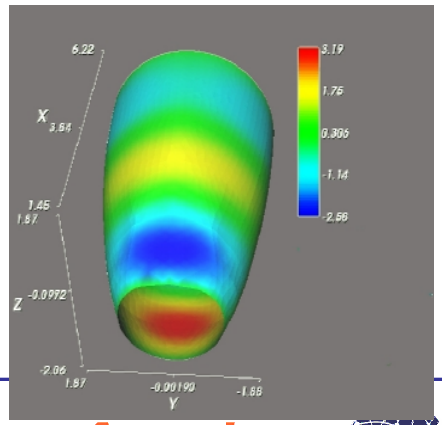


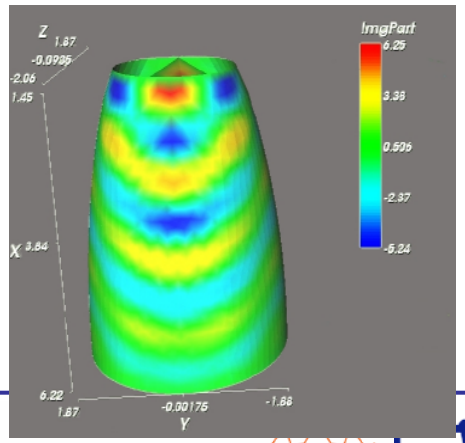


Code Coupling : Vibro Acoustic (courtesy of EADS)









European Commission World Class Standards

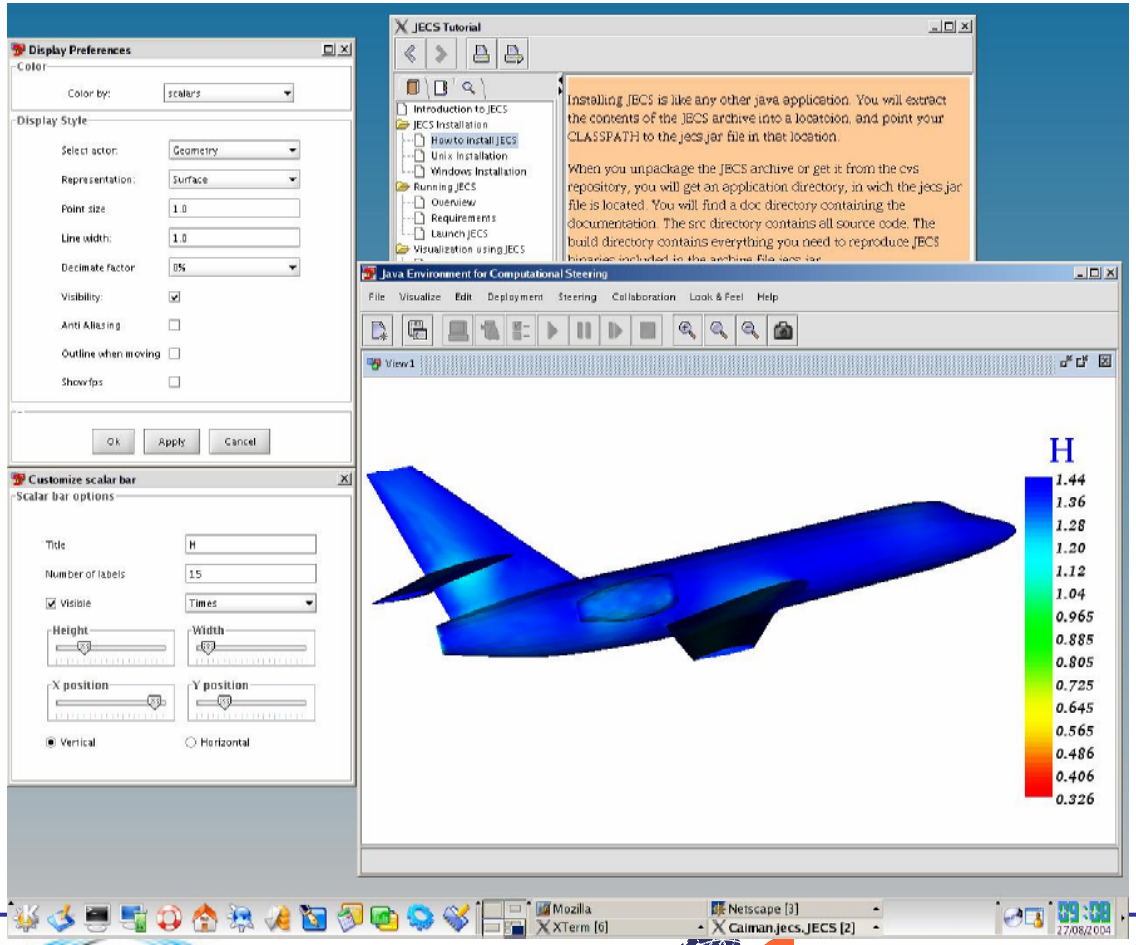
ETSI

ProActive
Programming, Composing, Deploying on the Grid

GridCOMP
Effective Components for the Grids

Information Society

JECS : 3D Electromagnetism
Radar Reflection on Planes



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GridCOMP
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Information Society

ProActive
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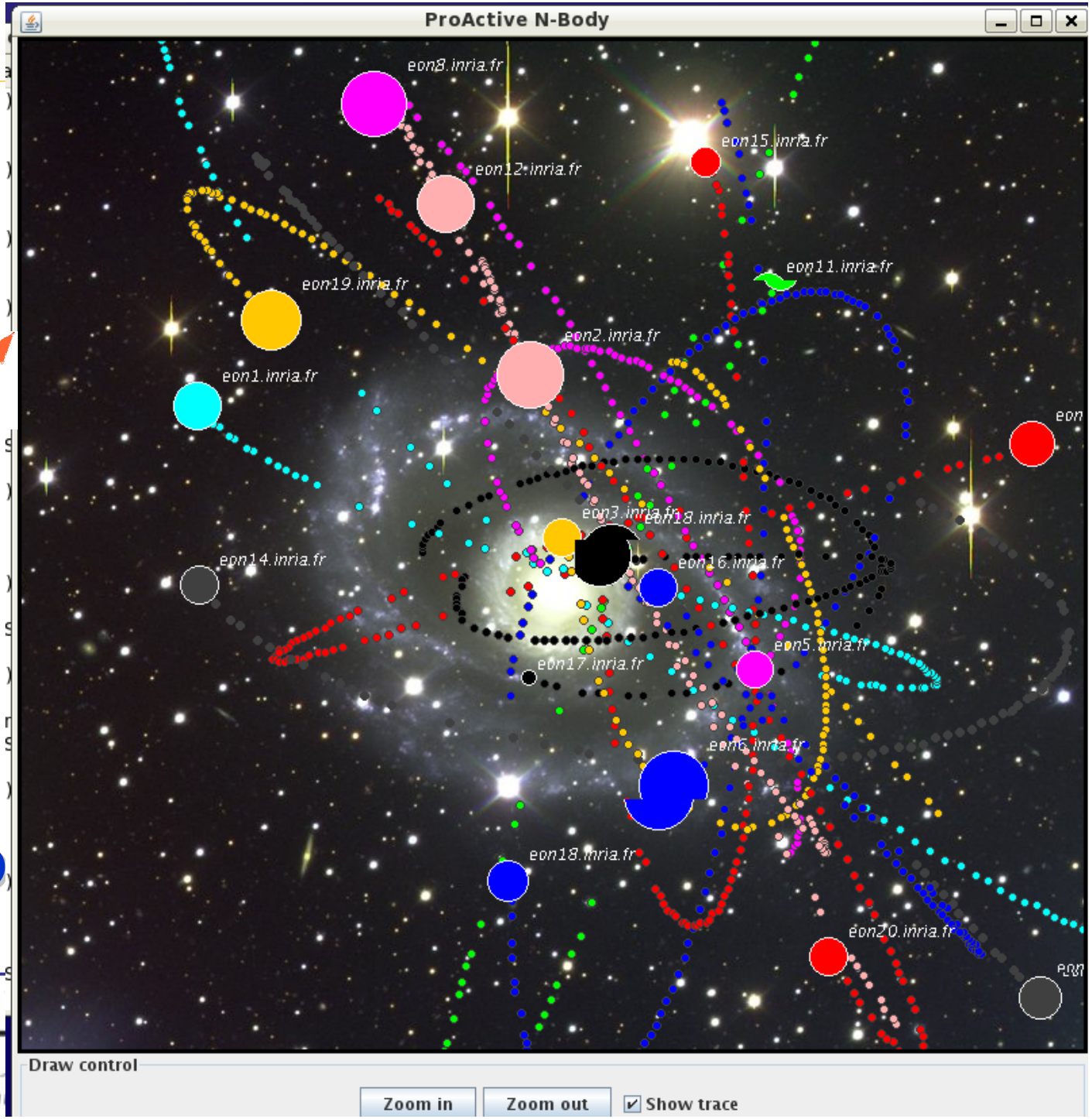
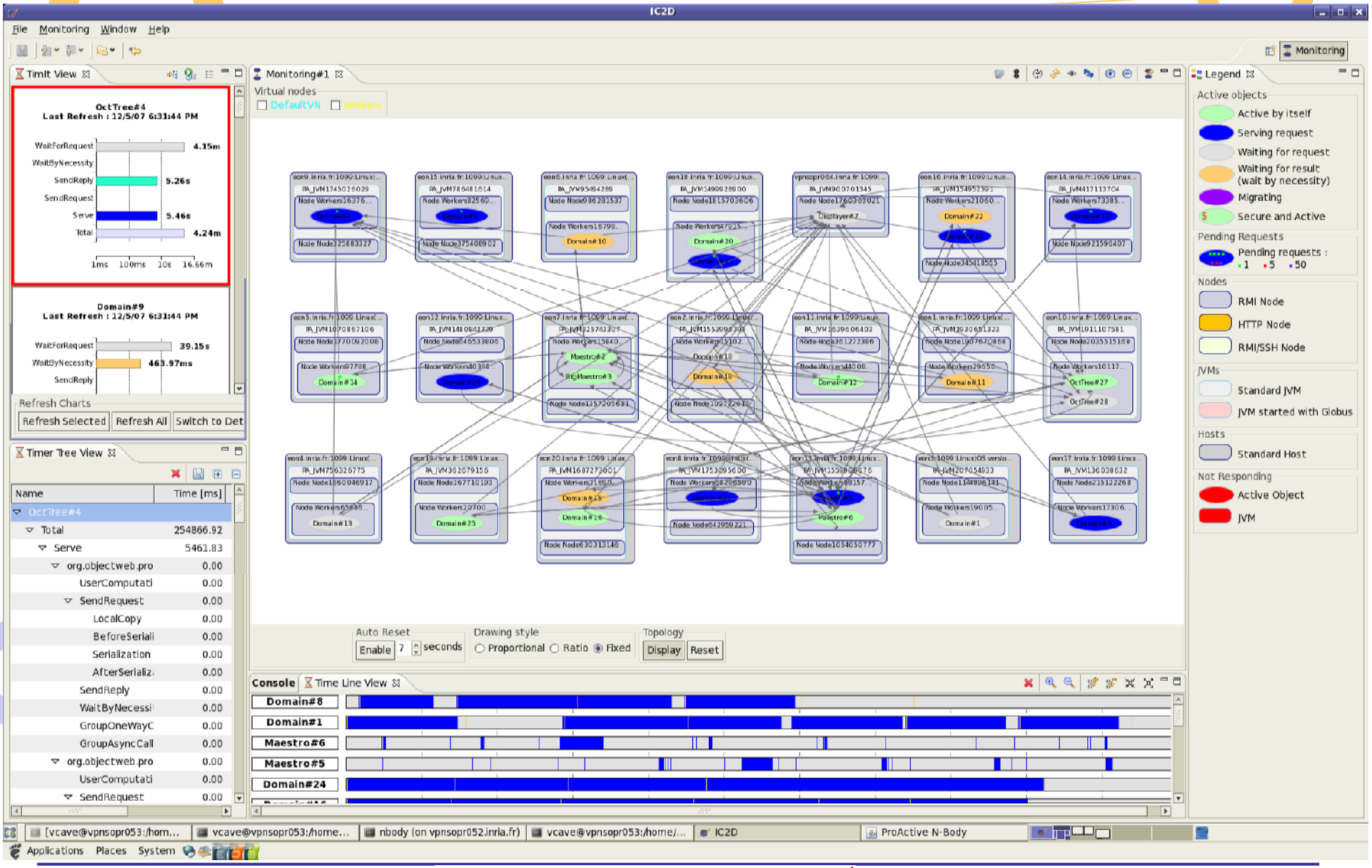
Demo Upstairs

V. Cavé
B. Amédro



European Commission
ETSI World Class Sta



European Commission World Class Standards

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ProActive

Programming, Composing, Deploying on the Grid

GridCOMP

Effective Components for the Grids

Information Society

GCM Origin

- **GCM: Grid Component Model**
  - ⇨ GCM Being defined in the NoE CoreGRID (42 institutions)
  - ⇨ Open Source ObjectWeb *ProActive* implements a preliminary version of GCM
  - ⇨ Autonomic Features
  - ⇨ Service Oriented: NESSI-Grid (Services come to life from Cp)
- **ETSI 3 GRID Plugtets**
- **GridCOMP EU project:**
  - ⇨ GCM as a first specification
  - ⇨ *Further assess and refine GCM*
- **EchoGrid EU project:**
  - ⇨ Asses GCM in 2007, 2008 Grid Plugtests

GCM planned parts:

Work Item

- GCM Interoperability Deployment

- GCM Application Description

Work Item to come

- GCM Fractal ADL

  (Architecture Description Language)

- GCM Management (Java, C, WSDL API)

Scope of
GCM Interoperability Deployment

- Describing Application, Components and Deployment in a Standard manner
- To be used as building blocks for Grid applications.
- To be used for Virtualization
- Targeting different frameworks:
  - ⇨ Grid, Clusters, SMP Parallel machines, Servers, Multi-Cores
- XML based

ETSI GRID Plugtest

2004, 2005, 2006, 2007

ObjectWeb
Open Source Middleware

ETSI Grid Plugtests, 04, 05, 06, 07

PLUGTESTS
THE INTEROPERABILITY SERVICE

Amsterdam
Belfast
Fribourg
Grenoble
Lille
Manchester
Melbourne
Merida
Metz
Bombay
Nancy
Napoli
Nice
Metz
Paris
Pise
Rennes
Santiago
San Diego
Beijing

2007: N-Queens - 6 TEAMS

- “ACT” - Beihang University – China
- “BUPT N-Queens” – China
- “OutPUT N-Queens” – POZNAN – Poland
- “KAAPI-MOAIS” – France
- “Grid-TU” - Tsinghua University - China
- “ChinaGRID-TU” - Tsinghua University – China

Interoperability achieved with this technology : ETSI Grid Plugtests, 04, 05, 06, 07

- Between 20 to 40 sites around the world:
  - ⇨ **2006: 4130 cores**
  - ⇨ **Total power: ~ 1700 GFlops (100 Giga Flops in 04)**
  - ⇨ **2007: about 7 000 cores**
- Highly heterogeneous :
  - ⇨ **Machines:** **IBM, SGI, Sun, Bull, Mac**
  - ⇨ **OS:** **Linux, Windows, Solaris, MacOS, SGI Irix**
  - ⇨ **JVMs:** **Sun, SGI, BEA**
  - ⇨ **Protocols:** **ssh, rsh, sshGSI, rcp, scp, Unicore, Globus Gram**
  - ⇨ **Job Schedulers:** **PBS, LSF, Sun Grid Engine, Oar, Prun, EGEE gLite, NorduGrid, Globus, IBM Load Leveler**

    Recently added: CGSP China Grid

Grid Plugtests IV 2007: Result Analysis

- **Nb. Of Workers:**
  - ⇨ 3 888 by ACT, Beihang University (BUAA), China
  - ⇨ 3 654 by MOAIS, Grenoble, Fr.

  → **Compared to last year: x2**
- **Nb. of Solutions:**
  - ⇨ N=23 + 6 times N=22, MOAIS, Grenoble, Fr.
  - ⇨ N=22 + N=21 + 6 times N=20, BUPT

  → **Compared to last year: x6.5**

  (2006: N=22 in 50mn on 2193 workers)

Keeping (or even improving) Moore's Law:

⇨ x2 in middleware (Nb. Nodes) x2 Solution Quality

Grid Plugtests V -- 2008

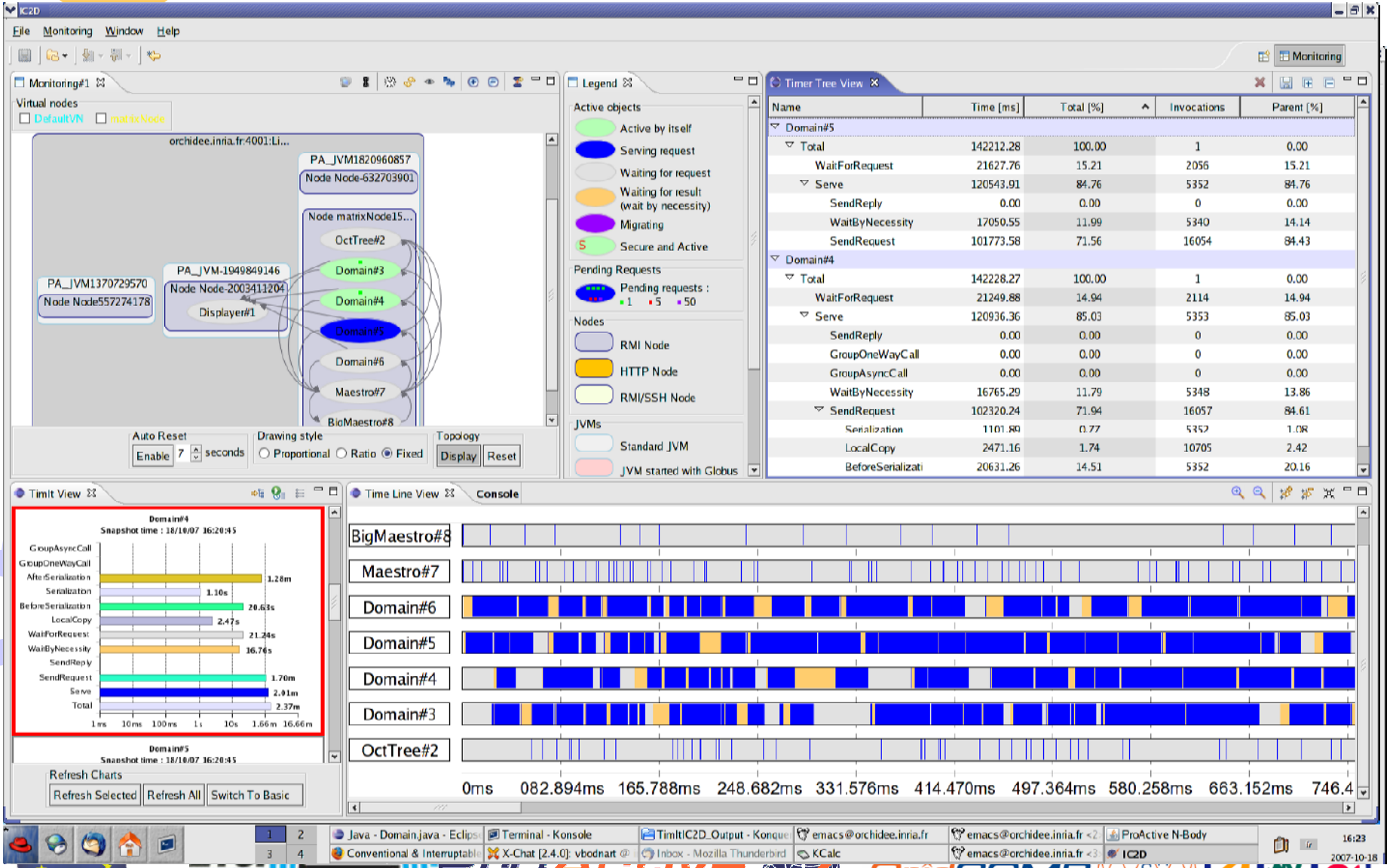
- **Agreed dates:**
  - ⇨Monday October 20th to Friday 24th, 2008
- **Location:**
  - ⇨Sophia Antipolis, French Riviera, France,
  - ⇨ETSI / INRIA
    - ➔ Technical Committee On GRID, ETSI

Laurent Vreck

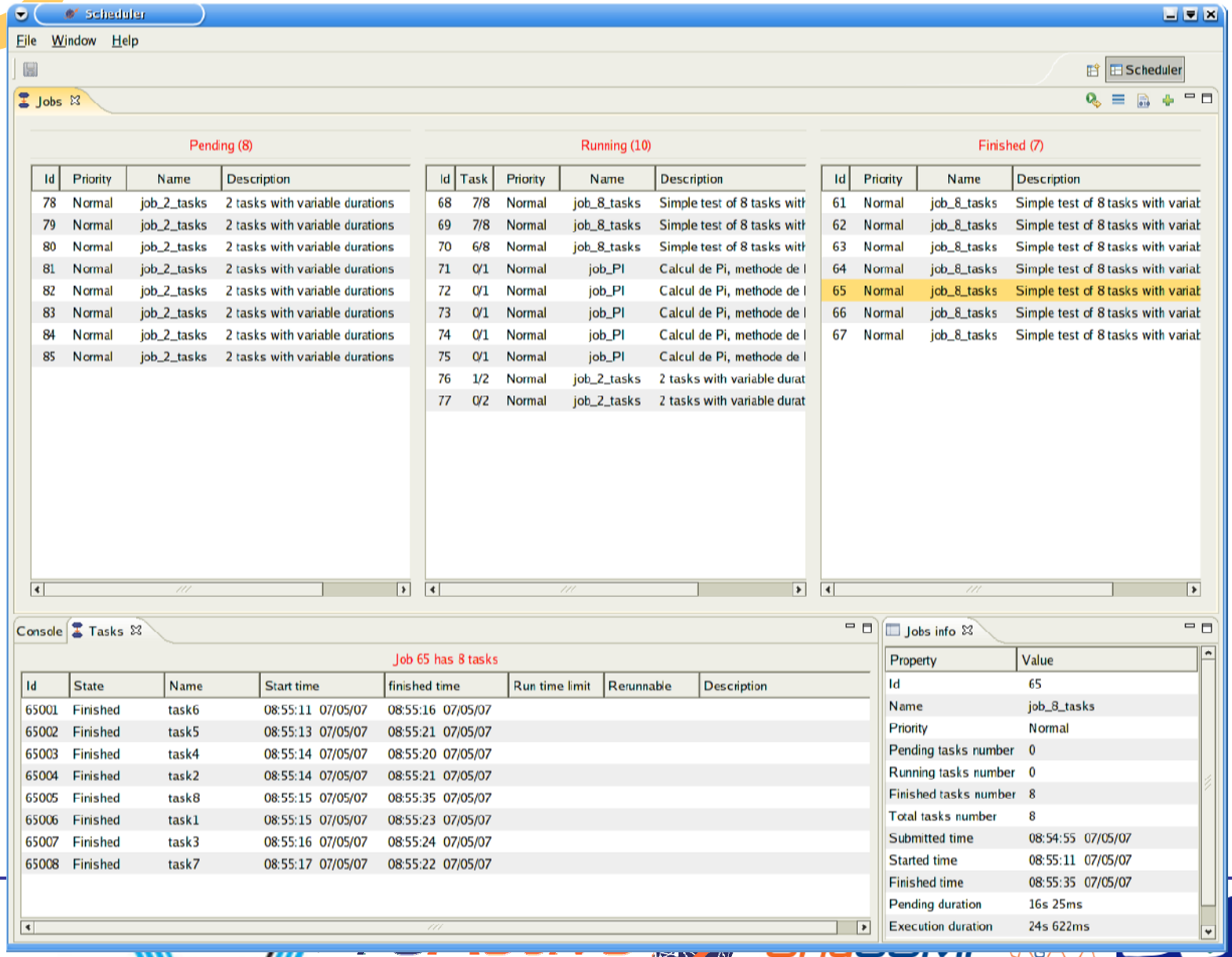
DEMO

- GCM – ProActive
- In the lobby !

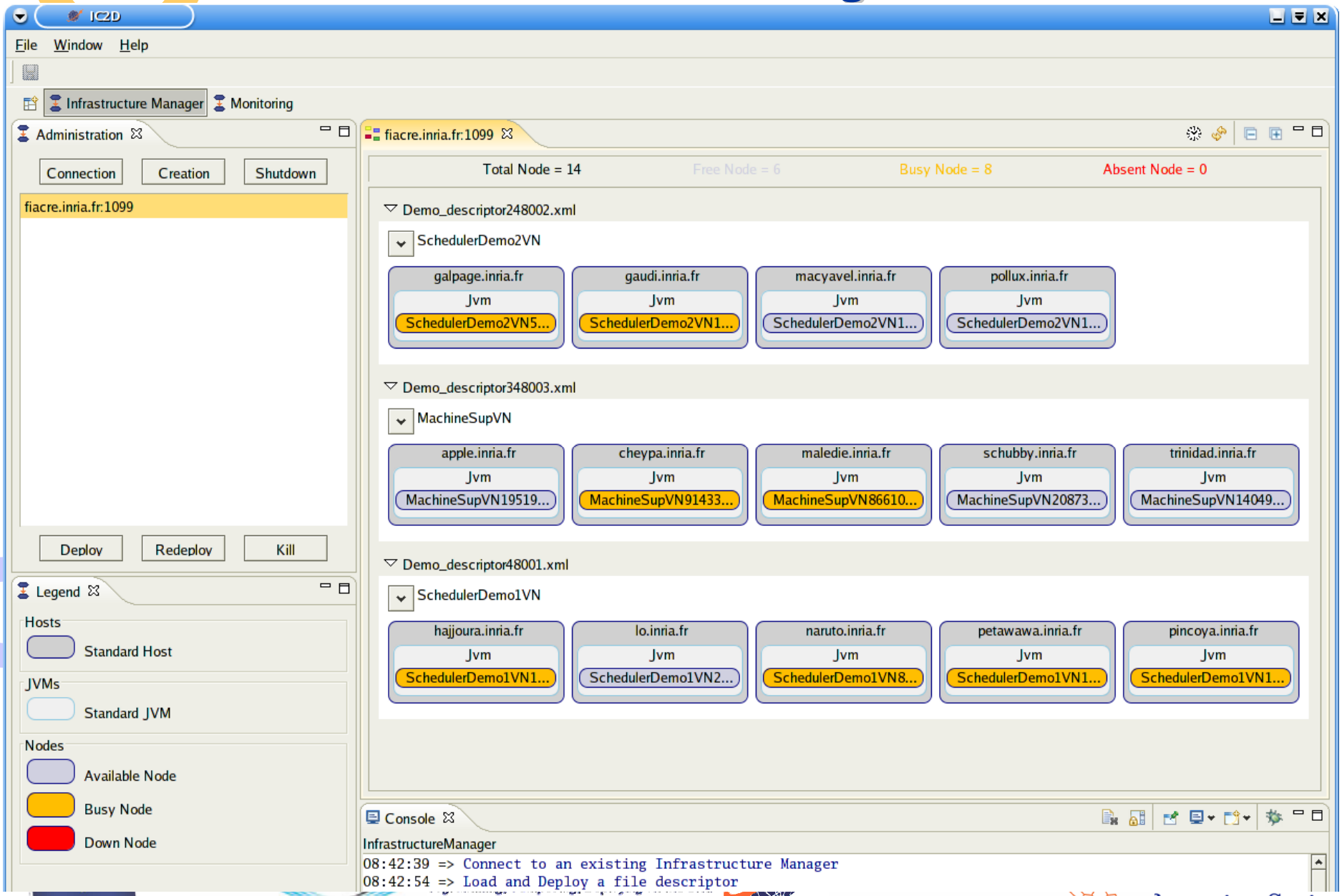
IC2D


IC2D
File Monitoring Window Help
Monitoring
Monitoring#1
Virtual nodes
DefaultVN matrixNode
orchidee.inria.fr:4001:Li...
PA_JVM1820960857
Node Node-632703901
Node matrixNode15...
OctTree#2
Domain#3
Domain#4
Domain#5
Domain#6
Maestro#7
BioMaestro#8
PA_JVM-1949849146
Node Node-2003411204
Displayer#1
PA_JVM1370729570
Node Node557274178
Auto Reset
Enable 7 seconds
Drawing style
Proportional Ratio Fixed
Topology
Display Reset
Legend
Active objects
Active by itself
Serving request
Waiting for request
Waiting for result (wait by necessity)
Migrating
Secure and Active
Pending Requests
Pending requests : 1 5 50
Nodes
RMI Node
HTTP Node
RMI/SSH Node
JVMs
Standard JVM
JVM started with Globus
Timer Tree View
Name | Time [ms] | Total [%] | Invocations | Parent [%]
Domain#5
Total 142212.28 100.00 1 0.00
WaitForRequest 21627.76 15.21 2056 15.21
Serve 120543.91 84.76 5352 84.76
SendReply 0.00 0.00 0 0.00
WaitByNecessity 17050.55 11.99 5340 14.14
SendRequest 101773.58 71.56 16054 84.43
Domain#4
Total 142228.27 100.00 1 0.00
WaitForRequest 21249.88 14.94 2114 14.94
Serve 120936.36 85.03 5353 85.03
SendReply 0.00 0.00 0 0.00
GroupOneWayCall 0.00 0.00 0 0.00
GroupAsyncCall 0.00 0.00 0 0.00
WaitByNecessity 16765.29 11.79 5348 13.86
SendRequest 102320.24 71.94 16057 84.61
Serialization 1101.89 0.77 5352 1.08
LocalCopy 2471.16 1.74 10705 2.42
BeforeSerializati 20631.26 14.51 5352 20.16
TimIt View
Domain#4
Snapshot time : 18/10/07 16:20:45
GroupAsyncCall
GroupOneWayCall
AfterSerialization 1.28m
Serialization 1.10s
BeforeSerialization 20.63s
LocalCopy 2.47s
WaitForRequest 21.24s
WaitByNecessity 16.76s
SendReply
SendRequest 1.70m
Serve 2.01m
Total 2.37m
1ms 10ms 100ms 1s 10s 1.66m 16.66m
Domain#5
Snapshot time : 18/10/07 16:20:45
Refresh Charts
Refresh Selected Refresh All Switch To Basic
Time Line View
Console
BigMaestro#8
Maestro#7
Domain#6
Domain#5
Domain#4
Domain#3
OctTree#2
0ms 082.894ms 165.788ms 248.682ms 331.576ms 414.470ms 497.364ms 580.258ms 663.152ms 746.4
Java - Domain.java - Eclips
Terminal - Konsole
TimItIC2D_Output - Konque
emacs@orchidee.inria.fr
emacs@orchidee.inria.fr <2
ProActive N-Body
Conventional & Interruptable
X-Chat [2.4.0]: vbodnart @
Inbox - Mozilla Thunderbird
KCalc
emacs@orchidee.inria.fr <3
IC2D
16:23
2007-10-18

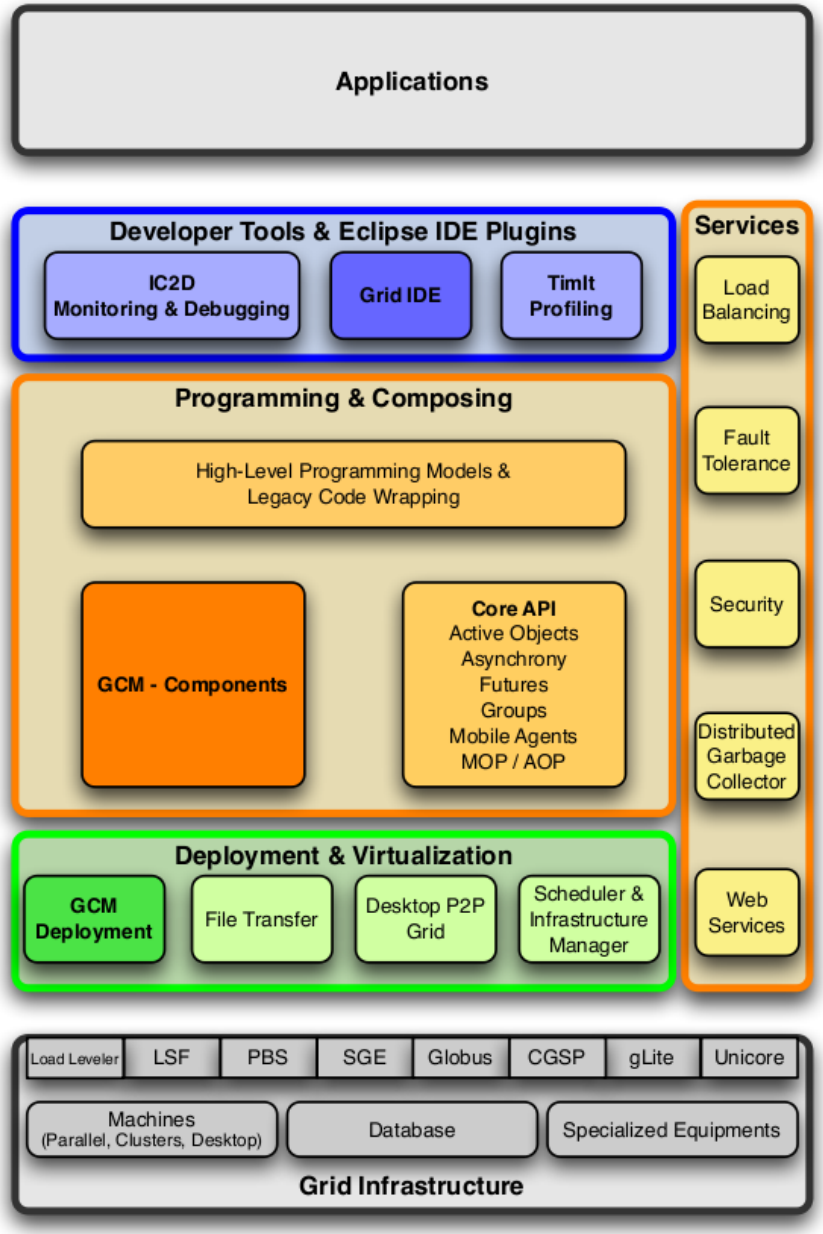
Scheduler: User Interface



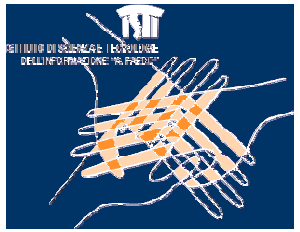
Scheduler: Resource Manager Interface

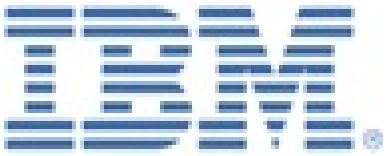


ProActive Parallel Suite (1)



GridCOMP Partners





THE UNIVERSITY OF
MELBOURNE

Partners

ERCIM	ERCIM - GEIE ERCIM
	National Technical University of Athens - ICCS/NTUA
Atos Origin	ATOS Origin SAE - ATOS
ENGINEERING INGEGNERIA INFORMATICA	Engineering Ingegneria Informatica S.p.A. - ENG
THALES	THALES
北京航空航天大學 BEIHANG UNIVERSITY	Beihang University - BUAA
ICT	Institute of Computing Technology, Chinese Academy of Sciences - ICT
中国科学院 计算机网络信息中心	Computer Network Information Center, Chinese Academy of Sciences - CNIC
	National University of Defence Technology - NUDT
HUAWEI	Huawei Technologies Co.,Ltd - HUW

European Commis

nation Society

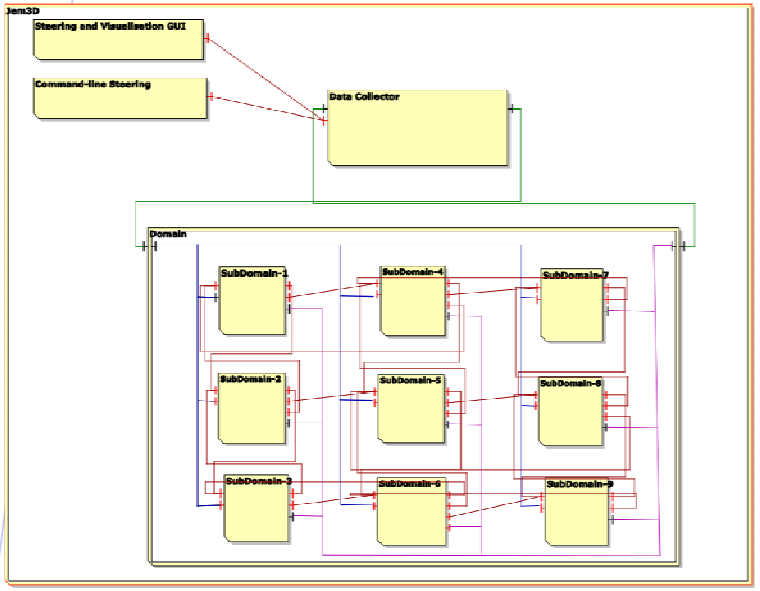
GCM Technical Structure

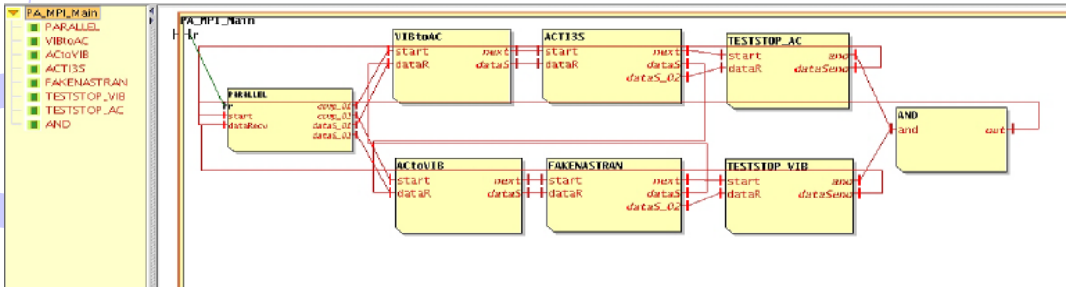
1. Component Specification as an XML schema or DTD
2. Run-Time API defined in several languages
   C, Java
3. Packaging described as an XML schema
4. Information for Deployment
   (Virtual Nodes, … Variables, File Transfer, …)

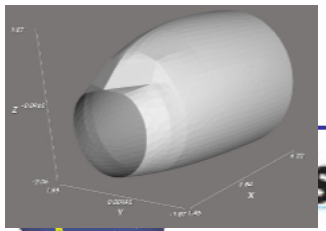
Status of GCM in ProActive

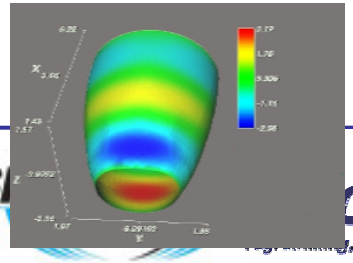
- **Improved implementation:**
  - ⇨ADL schema, API, Multicast, Gathercast, VN Deploy etc.
  - ⇨Autonomicity (Unipi)
  - ⇨Component GUI (prototype Westminster)
- **Distributed components for various applications:**
  - ⇨Numerical, Legacy, …
- **On-going experiments:**
  - ⇨up to 300+ CPUs

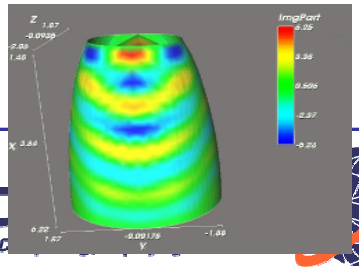
Current GCM experiments in ProActive











- JEM3D: 3D electromagnetic application:

  a single Cp on 300+ CPUs on Grid

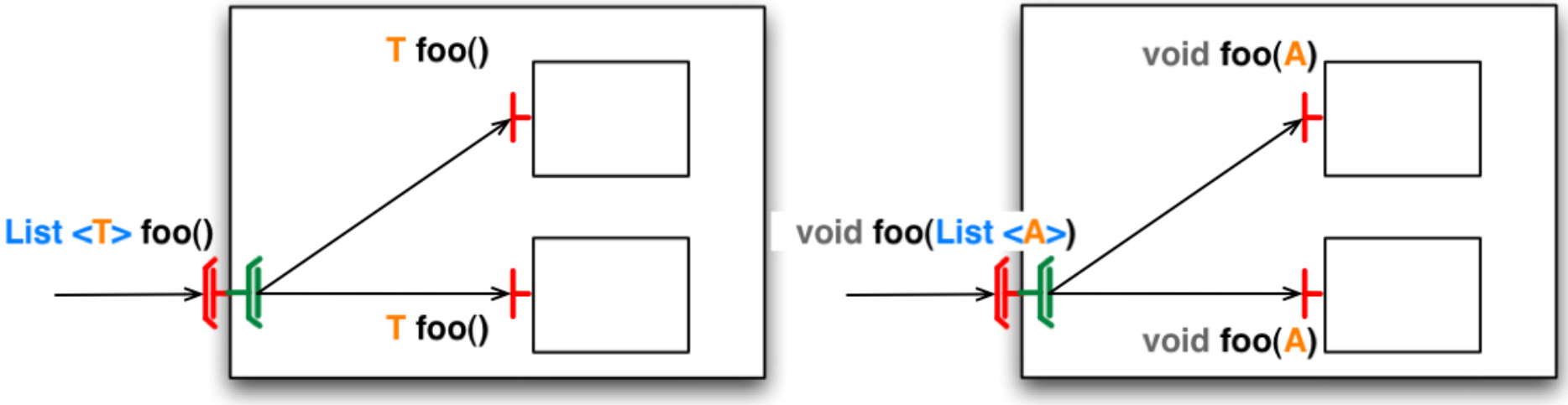
- Vibro-Acoustic application with EADS (legacy MPI coupling)

On-going experiments

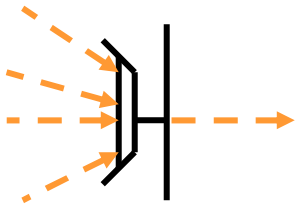
- **GridSystems:**
  - ⇨Wing design (Numerical, parameter sweeping)
  - ⇨EDR processing (Telecom)
- **ATOS:**
  - ⇨PL/SQL wrapping and acceleration
- **IBM:**
  - ⇨ Real-Time Fingerprint recognition
- **China Tsinghua:**
  - ⇨MPI wrapping, Deployment, Autonomicity

Multicast interfaces

- Results as lists of results
- Invocation parameters may also be distributed from lists



Gathercast interfaces



Transform

a list of invocations into

a single invocation

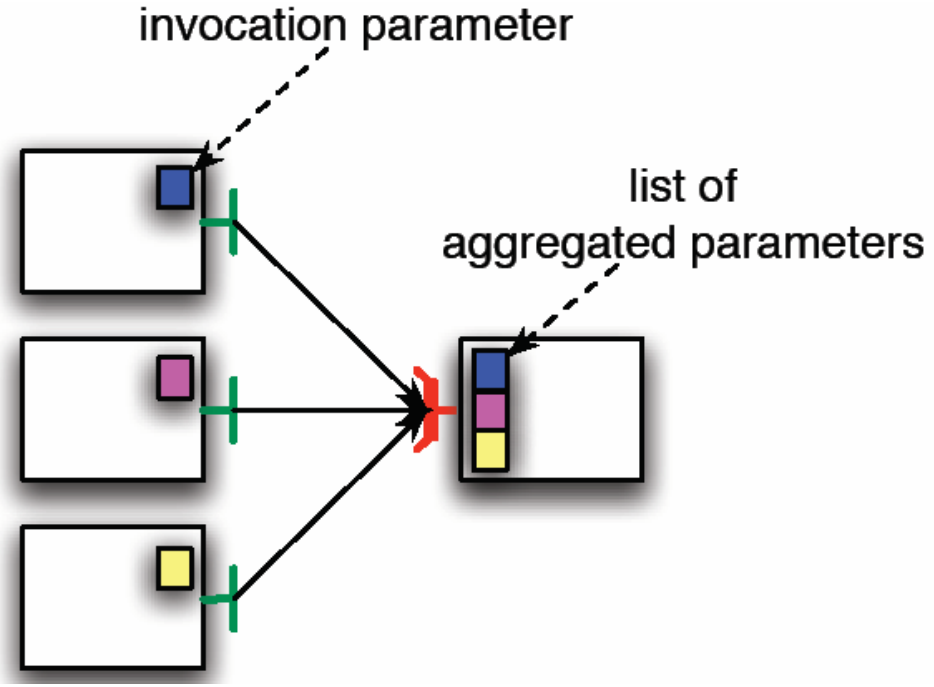
- **Synchronization of incoming invocations**
  - ⇨ ~ “join” invocations
  - ⇨ Timeout / Drop policy
  - ⇨ Bidirectional Bindings (callers ⇔ callee)
- **Data gathering**

  Aggregation of parameters into lists

- **Result:**

  Redistribution of results

  Redistribution function



Update on ProActive and GCM

- **Recent versions:**
  - ⇨ June 2006: ProActive V 3.1 : first GCM version
  - ⇨ November 2006: ProActive V 3.2 Beta
  - ⇨ January 2007: ProActive V 3.2 (After PlugTests' Learning)
  - ⇨ April 2007: ProActive 3.2.1

Update on ProActive and GCM (2)

⇨ New features in 3.2 release (January 2007):

- Conformance tests for Fractal, towards conformance tests for GCM
- IC2D Eclipse Plugin
- ***TimIt*** (Hierarchical, Visual)
- Skeleton (improved, with File Transfer, Documentation)
- gLite EGEE deployment updated
- Support for Java 1.5 Generics:
  - ⇨ Active Objects can be instantiated from Generic Classes
  - ⇨ Some Warnings removed
- Improvements in OSGi integration
- Prototype TTools for UML modeling of GCM components (TBC)

What's new in April 3.2.1 1/2

- **JMX support**
  - ⇨ Java Management Extensions, a standard
  - ⇨ ProActive/GCM JMX connector i.e. remotely accessible JVM, Active Objects, Components
  - ⇨ Towards component Monitoring, Steering, …
  - ⇨ Easier separation between GCM implementations and tools (IDE, …)
- **New ProActive/GCM source layout**
  - ⇨ Clear separation between ProActive core library including GCM implementation and additional ProActive features
  - ⇨ Ease development of new features (WP2 and WP3)

What's new in April 3.2.1 2/2

- **Initial experiments on NF components:**

  Composite-Membrane Component

  ⇨ **Allow Components in the membrane as controllers**

- **Upgrade of GCM deployment**

  ⇨ **Rewriting deployment descriptor parser**

  ⇨ **At the same time of GCM standardization (TC Grid WI 1)**

- **Legacy Code Wrapping and Interoperability**

  ⇨ **First specification proposed by Tsinghua University**

  ⇨ **GCM proposed API and ADL extension (see video)**

Improvements and Fixes 1/2

- **Bug Fixes:**
  - ⇨ **Multicast parameter dispatching**
    - Correct multicast parameter dispatching with Round Robin mode
    - Customization of multicast parameters dispatch
      - ⇨ Quick fix made, a rewrite is needed to complete support of customization (end of summer)
  - ⇨ **Controller**
    - Multicast: support interceptor with the bindFcMulticast method
    - Binding: *getFcInterfaces()* method return the right interfaces according to Fractal specifications
  - ⇨ **Example *Helloworld* works with the ProActive/GCM jar!**

Improvements and Fixes 1/2

- **Pending improvement/fix**
  - ⇨ **Some Multicast results with Round Robin dispatch mode could be missing**
  - ⇨ **Multicast aggregation result**
    - Add an annotation allowing aggregation between List<T> and T results
    - Needed in case of multicast and simple interface connected to a same Multicast interface
  - ⇨ **Multicast interface and Virtual Node cardinality**
    - Give a way to create (using ADL) as many components as nodes in a virtual node and connect them to a multicast interface.

Work Item number: DTS/GRID-0004

GCM: Grid Component Model
GCM Interoperability Deployment

Manchester, May 11 2007

ETSI TC GRID Meeting # 3

Potential GCM parts could include:

Work Item

- GCM Interoperability Deployment
- GCM Application Description
- GCM Fractal ADL
  (Architecture Description Language)
- GCM Management (Java, C, WSDL API)

Scope of
GCM Interoperability Deployment

- Describing Components and Deployment in a Standard manner
- To be used as building blocks for Grid applications.
- Targeting different Grid frameworks.
- XML based

ETSI Grid Plugtests:

2004, 2005, 2006

Technology successfully tested in 3 event!

ObjectWeb
Open Source Middleware

ETSI Grid Plugtests, 04, 05, 06

PLUGTESTS
THE INTEROPERABILITY SERVICE

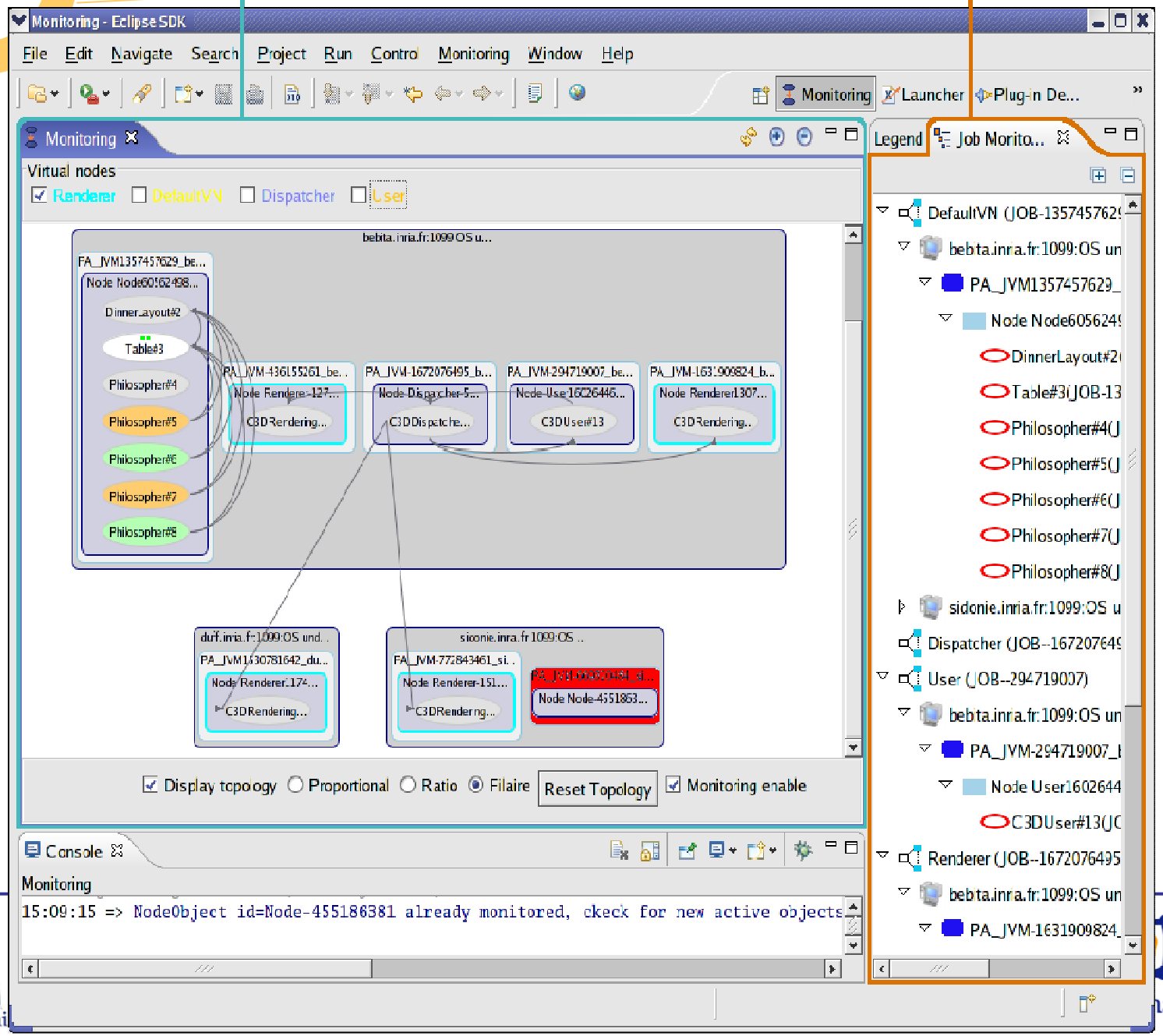
Amsterdam
Belfast
Fribourg
Grenoble
Lille
Manchester
Melbourne
Merida
Metz
Bombay
Nancy
Napoli
Nice
Metz
Paris
Pise
Rennes
Santiago
San Diego
Beijing

ETSI Work schedule: Progress milestone

- **Date of creation of Work Item:**
  - ⇨ 11-may-2007
- **Date Work Item adopted by Technical Body:**
  - ⇨ 11-may-2007
- **Start of work date:**
  - ⇨ 11-may-2007
- **ToC and Scope:**
  - ⇨ 11-june-2007
- **Stable Draft:**
  - ⇨ 11-sep-2007
- **WG approval: Technical Body approval:**
  - ⇨ oct-2007, Right after 4th ETSI GRID PlugTests in Beijing (co-organized by EchoGrid project)

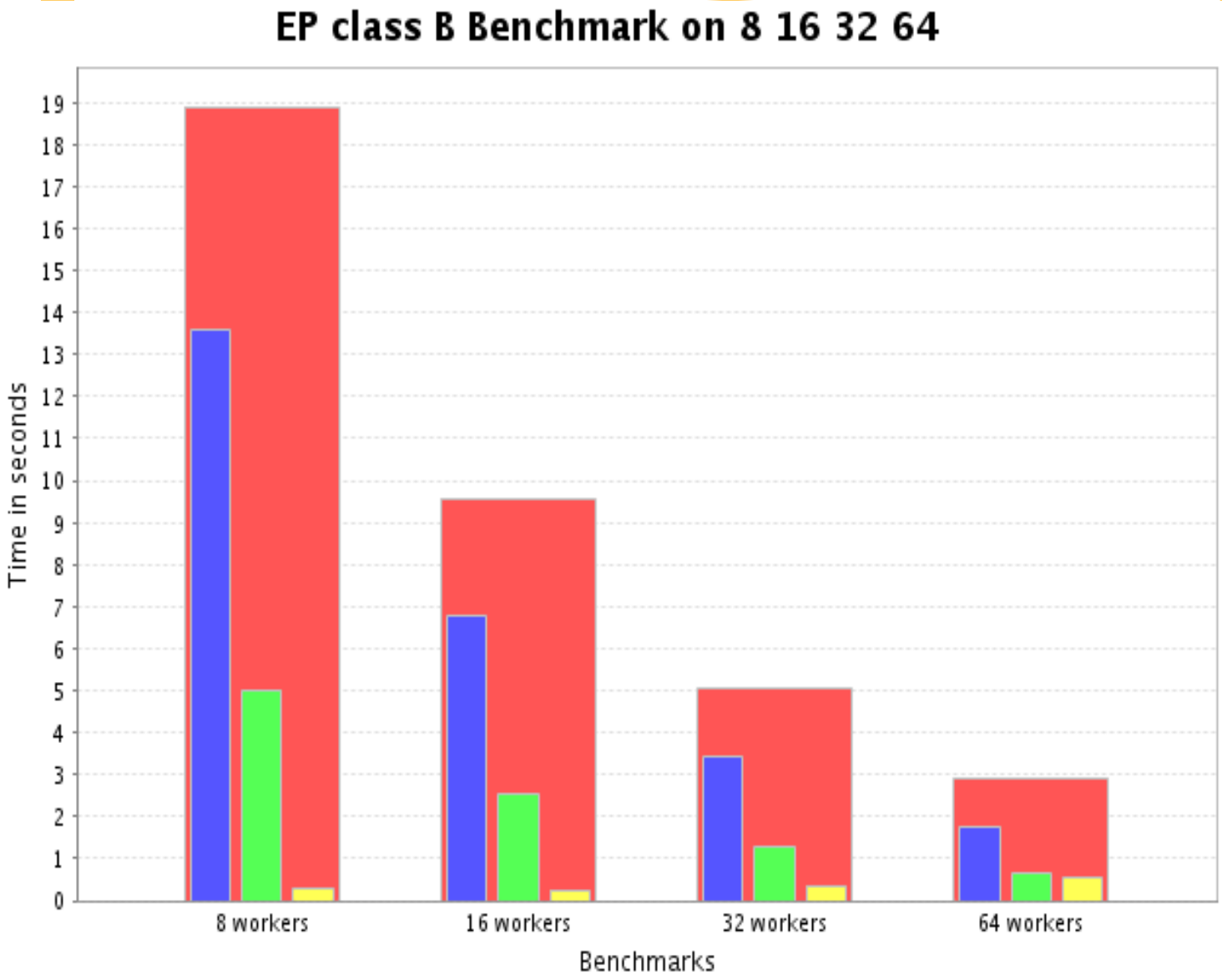
Upcoming Version

- **Current GCM ProActive version always accessible:**
  - ⇨ SVN repository from ProActive page
- **Next Stable release: end of July – Sept. 2007**
  - ⇨ Stable Cp. In membrane
  - ⇨ New improved deployment (XML)
  - ⇨ IC2D: JMX integration, Step/Step debug
- **Should integrate with:**
  - ⇨ Composition IDE (Westminster)
  - ⇨ Autonomic framework (Unipi)
  - ⇨ InnerGrid (Fura) GridSystems



European Commi

nation Society



Towards Integrated GCM/*ProActive Debug*