

# From Multi-Cores to Clouds with ProActive Parallel Suite: UC in Biotech, IT, Finance, and Engineering

D. Caromel, et al.

## Agenda

1. Background: INRIA, ActiveEon
2. CLOUD Computing
3. ProActive Parallel Suite  
*Programming, Scheduling, Resourcing*
4. Use Cases & Demos
5. Conclusion: Cloud Revolution ?

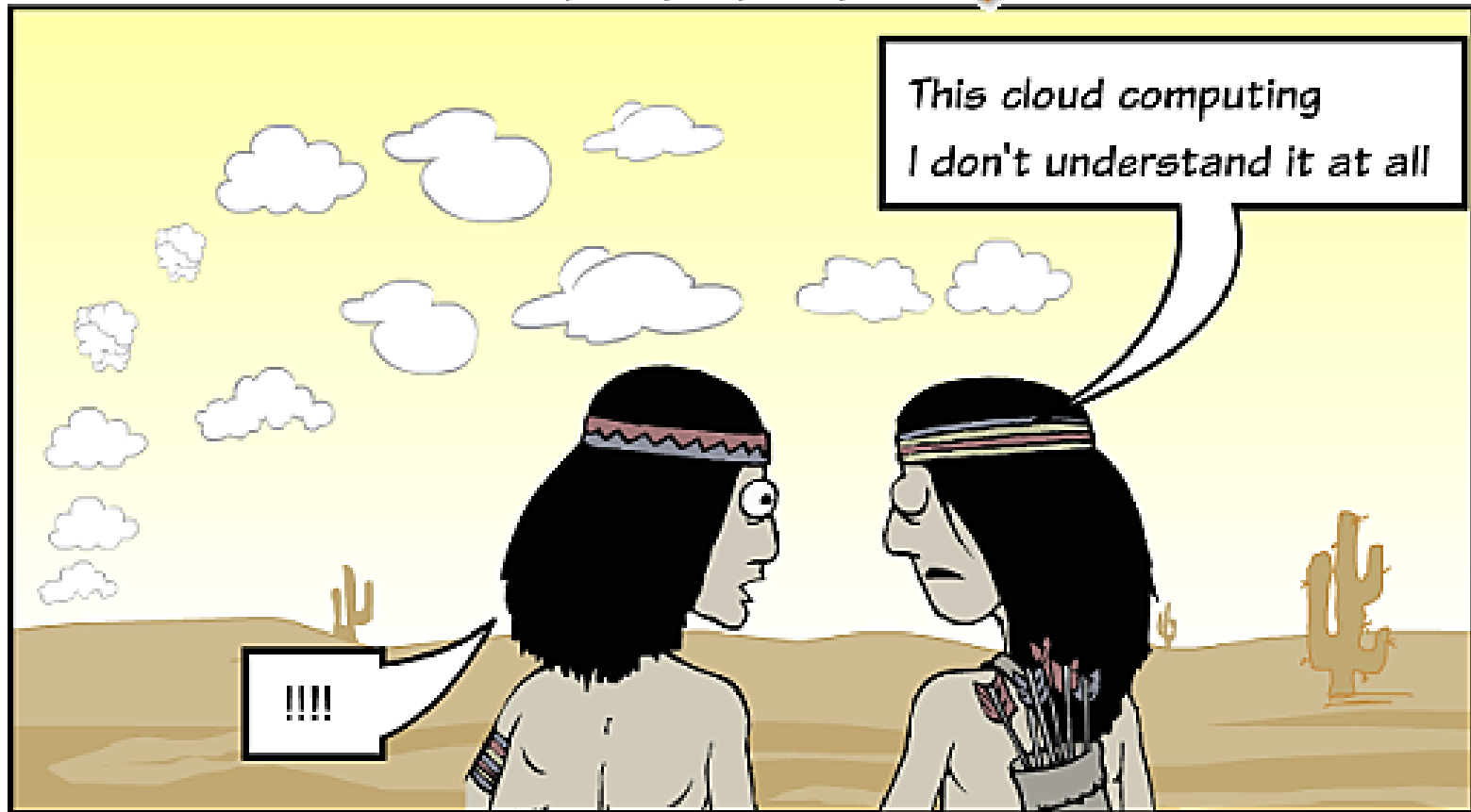


## Cloud Computing Revolution ?

**CLOUD COMPUTING - BY ROBERT BRAVERY**



WWW.TOONDOO.COM



# CLOUD Revolution ?

- ❑ 1990: PCs
- ❑ 2000: Internet for Companies
- ❑ 2010: Cloud for Companies

Concept: John McCarthy in 1961 originally coin the expression  
“Utility Computing” (Electricity, Water, Gas)

Today: How could we do without Internet and Google Search ?  
In 2020: we will not imagine working without Clouds

Today: We buy Network, Hardware, Software, Services  
Tomorrow: Cloud Services (hiding N, H, S)



# 1. Background

## □ Researchers (5):

- D. Caromel (UNSA, Det. INRIA)
- E. Madelaine (INRIA)
- F. Baude (UNSA)
- F. Huet (UNSA)
- L. Henrio (CNRS)

## □ PhDs (11):

- Antonio Cansado (INRIA, Conic)
- Brian Amedro (SCS-Agos)
- Cristian Ruz (INRIA, Conicyt)
- Elton Mathias (INRIA-Cordi)
- Imen Filali (SCS-Agos / FP7 SC)
- Marcela Rivera (INRIA, Conicyt)
- Muhammad Khan (STIC-Asia)
- Paul Naoumenko (INRIA/Région)
- Viet Dung Doan (FP6 Bionets)
- Virginie Contes (SOA4ALL)
- Guilherme Pezzi (AGOS, CIFR)

## □ + Visitors + Interns



Located in Sophia Antipolis, between  
Nice and Cannes,

Visitors Welcome and PhD Scholarship Avail. !

# 8 INRIA's Research Centres

INRIA Lille  
Nord Europe



**3 800 HC, 217 M Euro**

INRIA Paris  
Rocquencourt



2 900 Scientists

1200 Researchers, Faculty members

1200 Doctoral students

500 Post-Doct & Visiting scientists

1 000 Engineers, Technicians and Staff

INRIA Nancy  
Grand Est



INRIA  
Saclay  
Île-de-France

INRIA Rennes  
Bretagne Atlantique



8 Research Centres in France

68 Associated Teams worldwide

INRIA Grenoble  
Rhône-Alpes



4 000 Scientific Publications / year

230 Active patents

INRIA Bordeaux  
Sud-Ouest



89 Innovative companies created



# Startup Company Born of INRIA



**ACTIVEeon**  
SCALE BEYOND LIMITS

Some Customers:



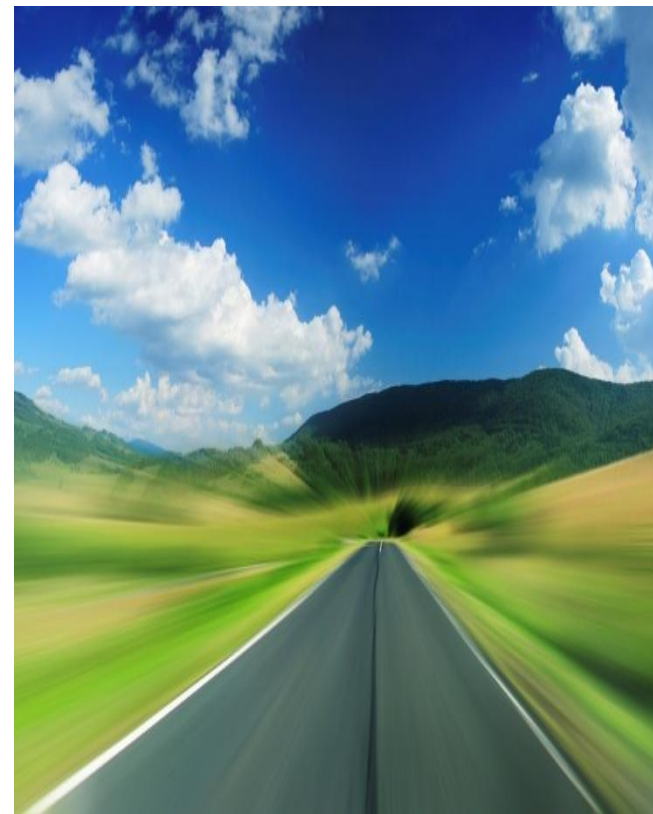
**THALES**



Some Partners:



**ORACLE** **Microsoft** **CARRI**  
Systems



- ❑ Co-developing, Support for [ProActive Parallel Suite](#)
- ❑ Worldwide Customers: Fr, UK, Boston USA

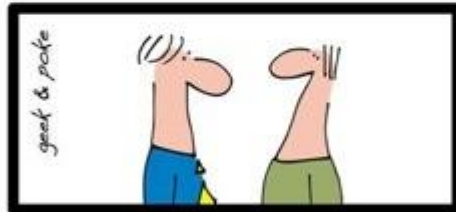


# 2. Cloud Computing

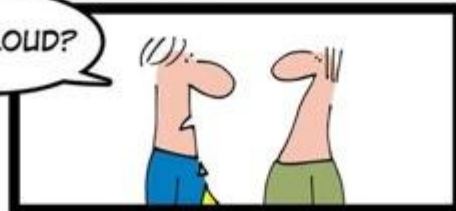


# The CLOUD Solution

MY DAUGHTER SMOKES, MY SON IS IN JAIL AND MY WIFE AND MY GIRLFRIEND HAVE LEFT ME. DO YOU HAVE ANY ADVISE FOR ME?



THE CLOUD?



A GOOD CONSULTANT IS ALWAYS ON DUTY



Source: ScienceDaily

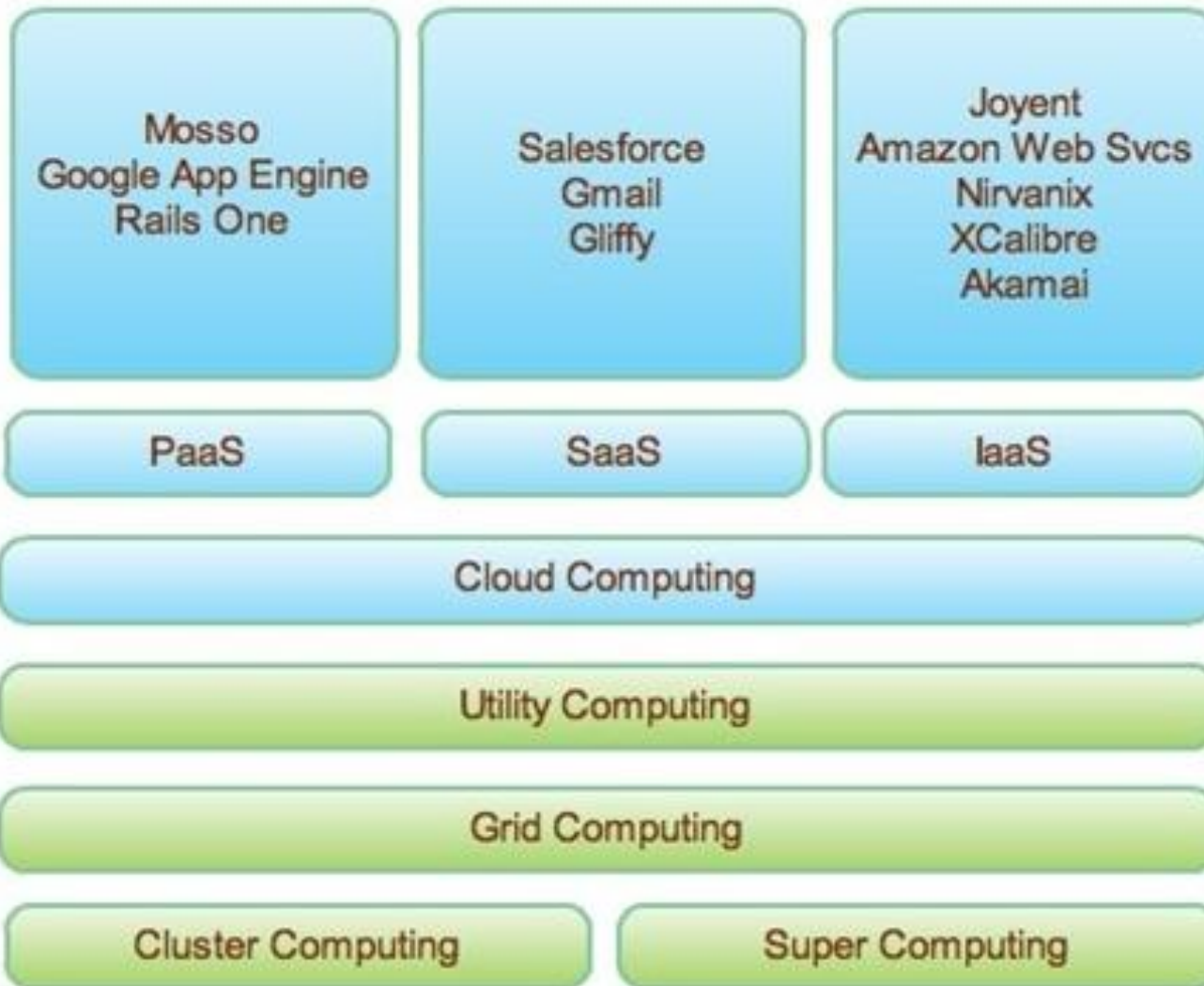
# Clouds: Basic Definition

- ❑ Dynamically scalable, often virtualized resources
- ❑ Provided as a service over the Internet
- ❑ Users need not have knowledge of, expertise in, or control over the technology infrastructure

## XaaS: Anything as a Service

- ❑ Software as a service (SaaS), CRM, ERP
- ❑ Platform as a service (PaaS), Google App Engine
- ❑ Infrastructure as a service (IaaS), Amazon EC2

# Clouds in Picture



# From Grids to Clouds

## ❑ Grid Computing

- Several administrative Domains
- Virtual Organizations
- Trading not based on Currency

➔ (Too) Hard

## ❑ Cloud solves the issue:

- Pay as you Go

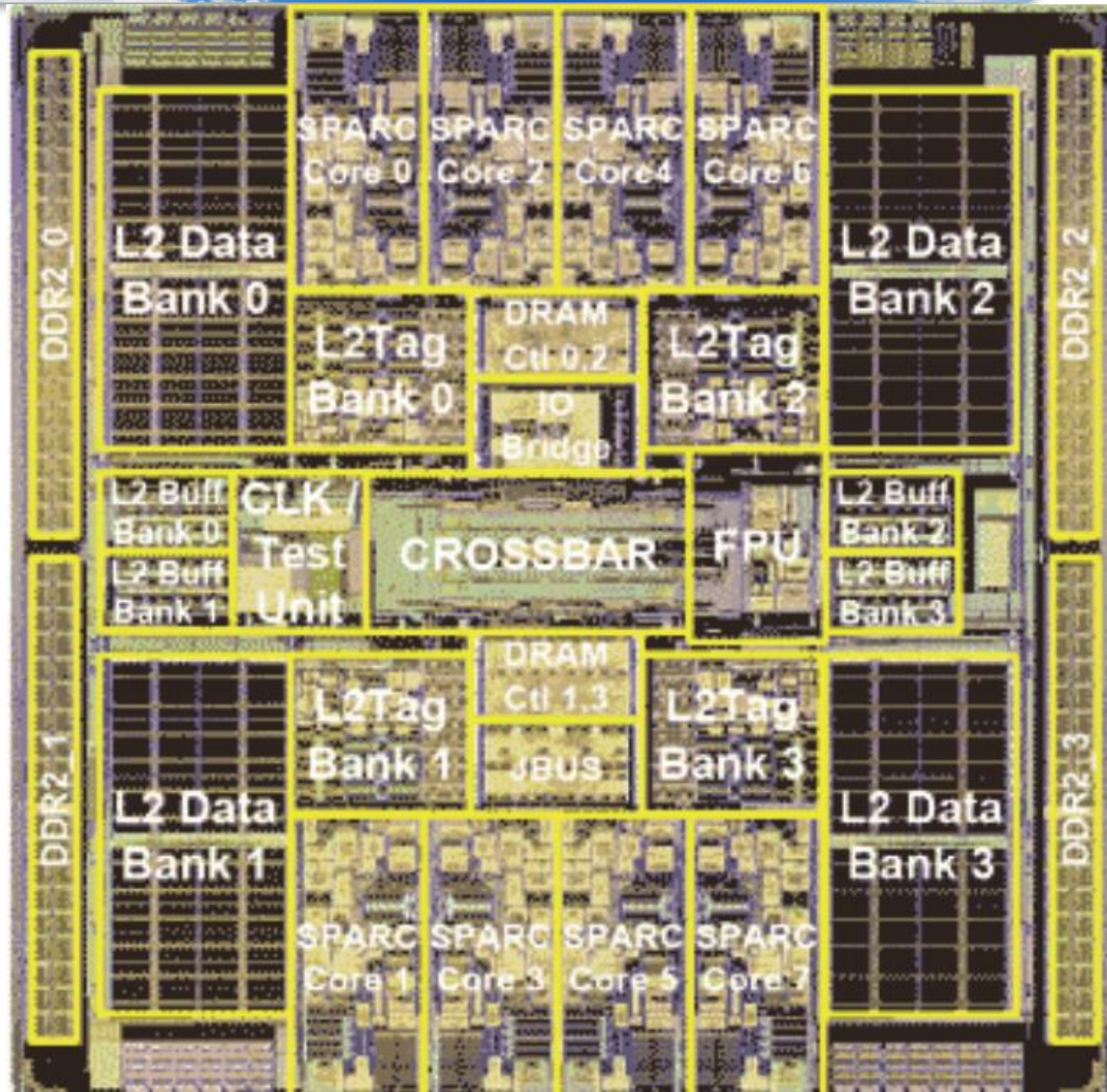
## Distributed, //, & Grid Technologies for Clouds



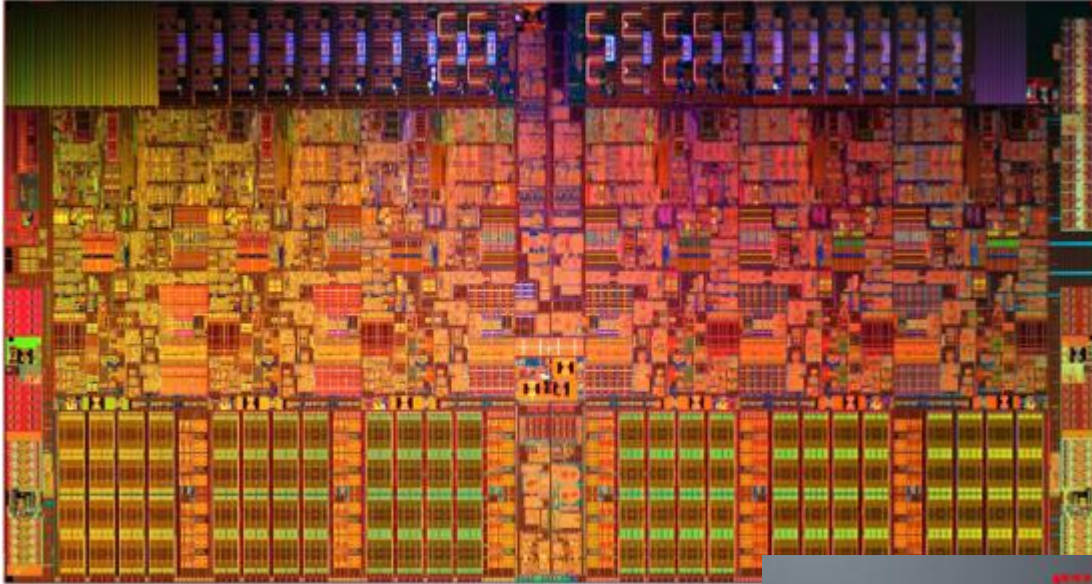
Multi-Core Push

# Symmetrical Multi-Core: 8-ways Niagara II

- ❑ 8 cores
- ❑ 4 Native threads per core
- ❑ Linux see 32 cores!

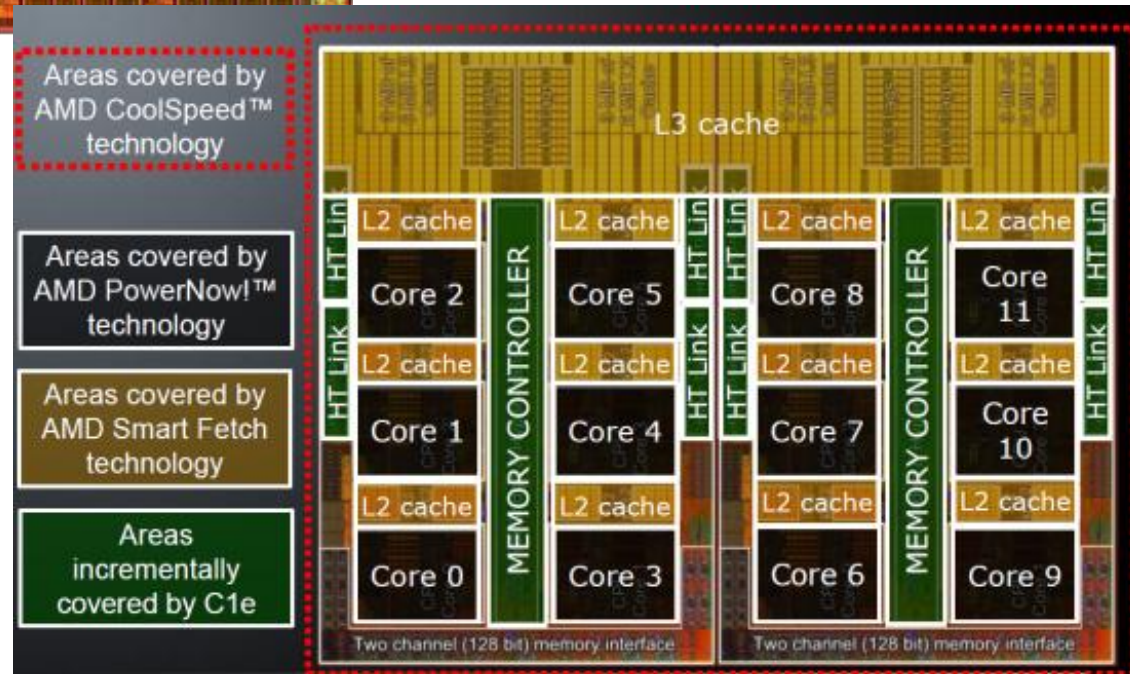


# Today Off The Shelf Multi-Cores, 3 GHz



AMD's Opteron 6174,  
"Magny-Cours",  
12 cores

Intel Xeon 5670,  
6 cores



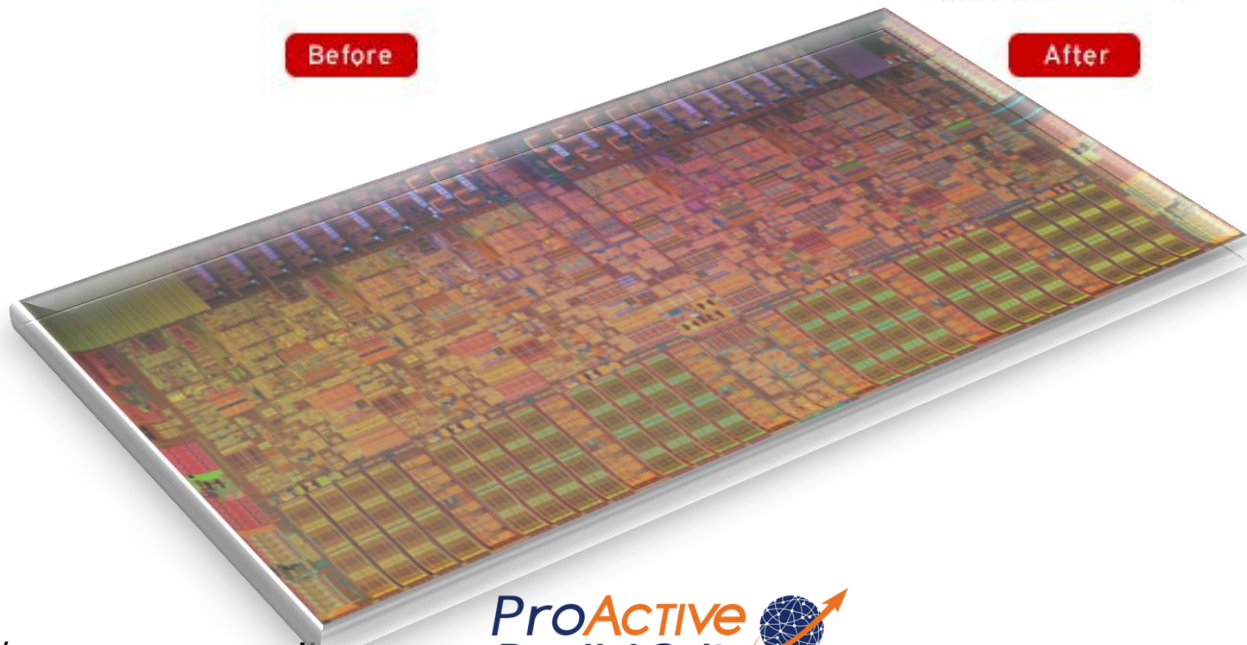
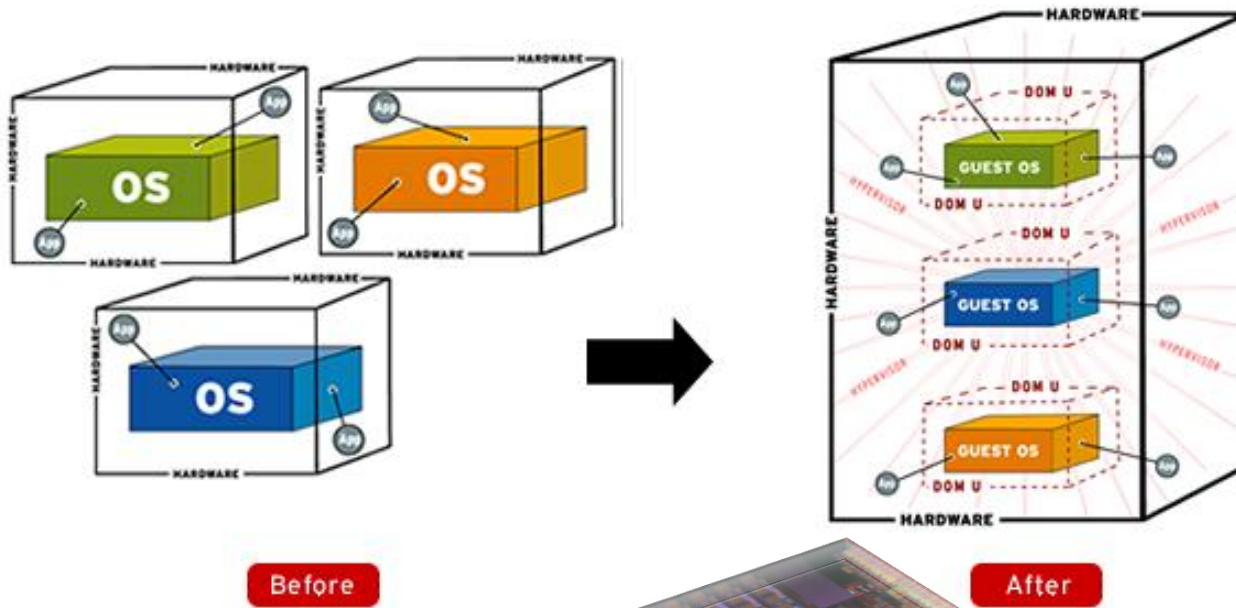
# Multi-Cores: A Few Key Points

- ❑ Moore's Law rephrased:  
Nb. of Cores double every 18 to 24 months
  
- ❑ Key expected Milestones: Cores per Chips (OTS)
  - 2012: 32 to 64
  - 2014: 64 to 128
  
- ❑ 1 Million Cores Parallel Machines in 2014
- ❑ 100 M cores coming in 2020
  
- ❑ Multi-Cores are NUMA, and turning Heterogeneous (GPU)
- ❑ They are turning into SoC with NoC





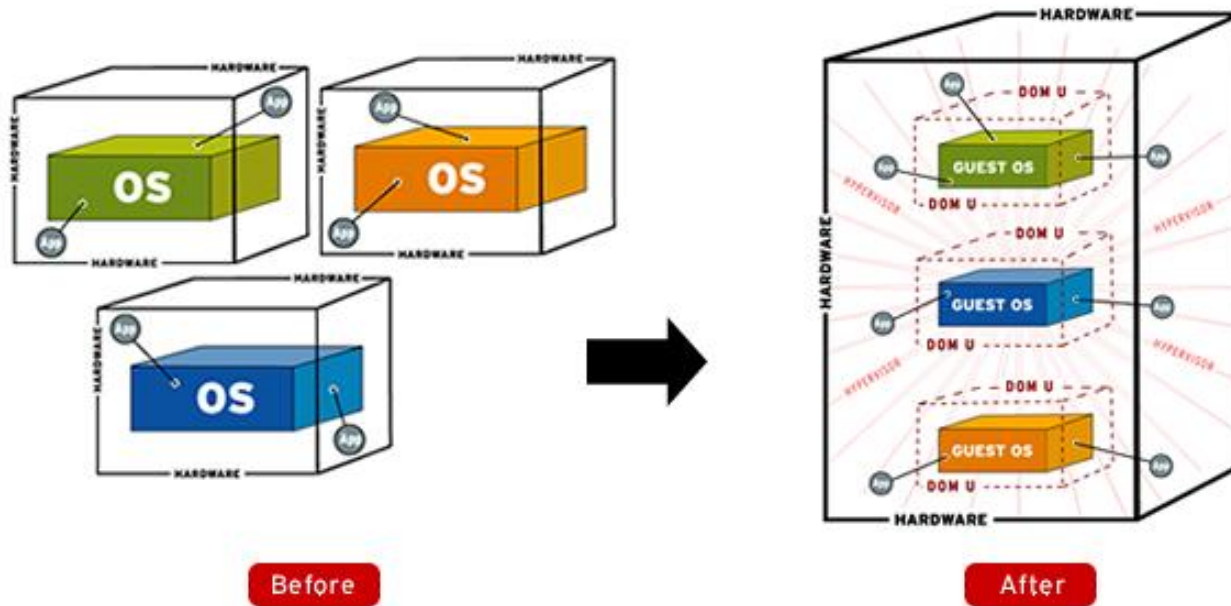
# Virtualization



# Virtualization



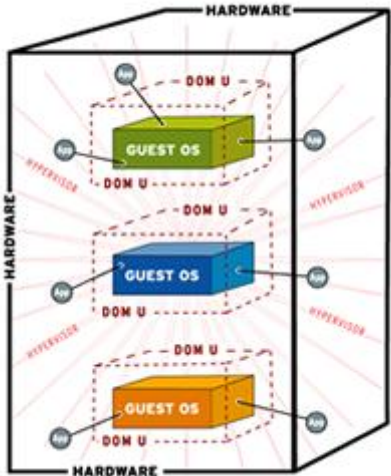
# Virtualization



# What we Used to do as Syst. Admin.

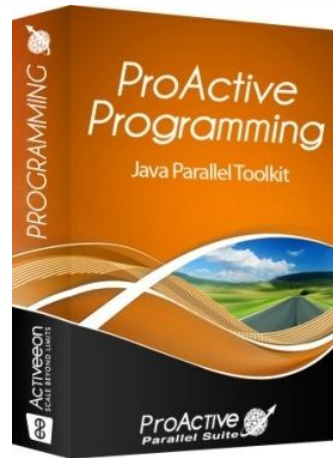


# With Virtualization + Software Appliance

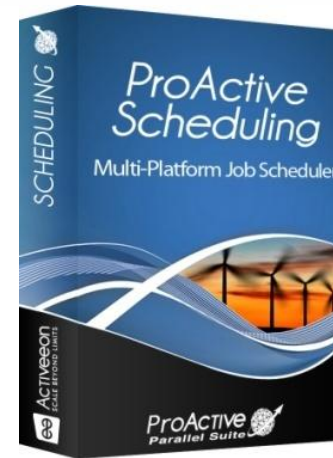


# 3. ProActive Parallel Suite

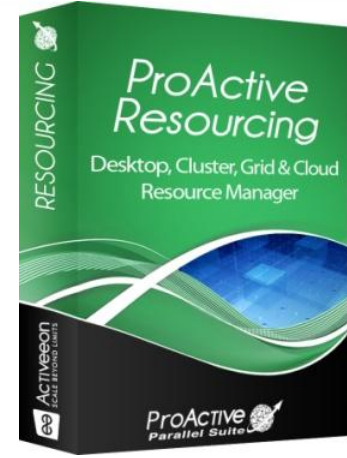
# Cloud Solution: ProActive Parallel Suite



Java Parallel Toolkit



Multi-Platform Job Scheduler



Resource Manager

**amaDEUS**  
Your technology partner

**Used in Production Today:**  
**50 Cores → 300 Cores 2010**

Strong Differentiation:

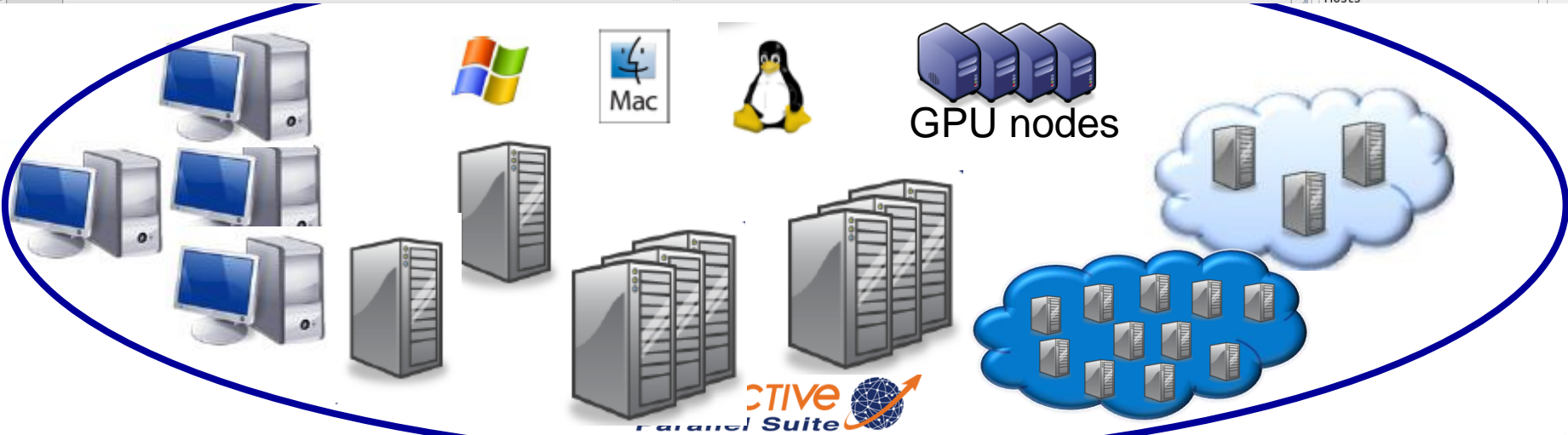
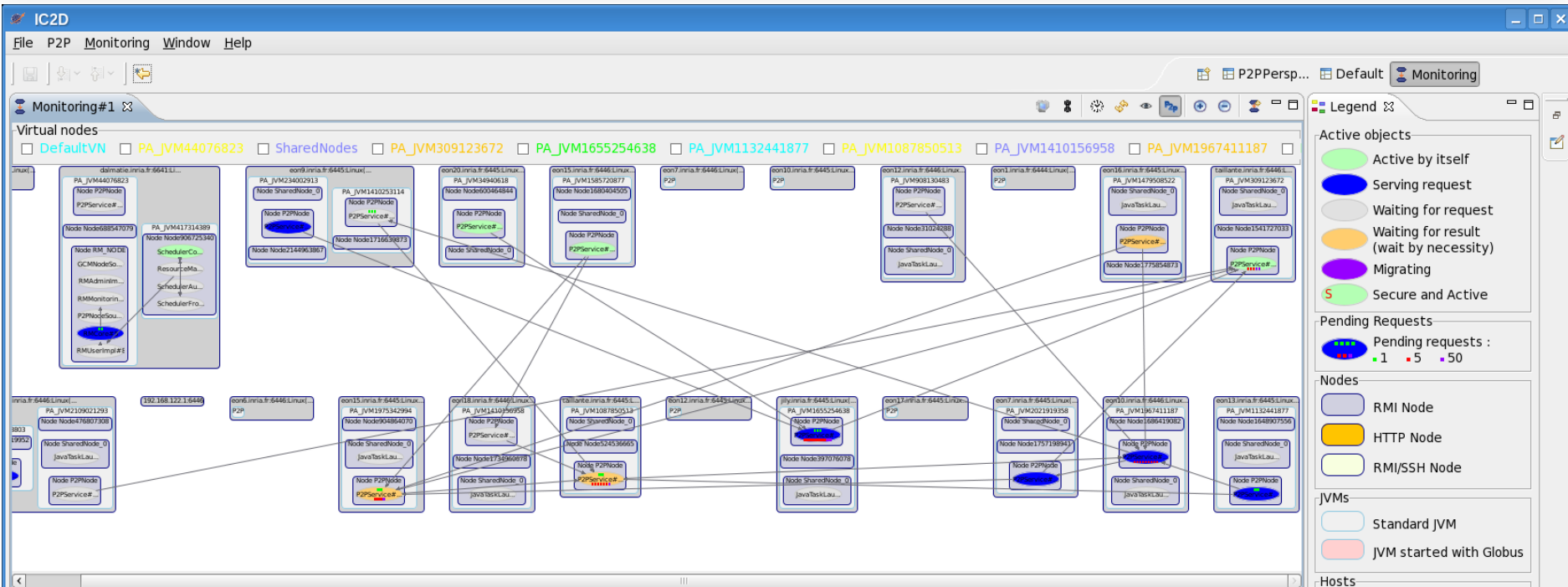
- Java Parallel Programming + Integration +
- Portability: Linux, Windows, Mac +
- Versatility: Desktops, Cluster, Grid, Clouds = Perfect Flexibility



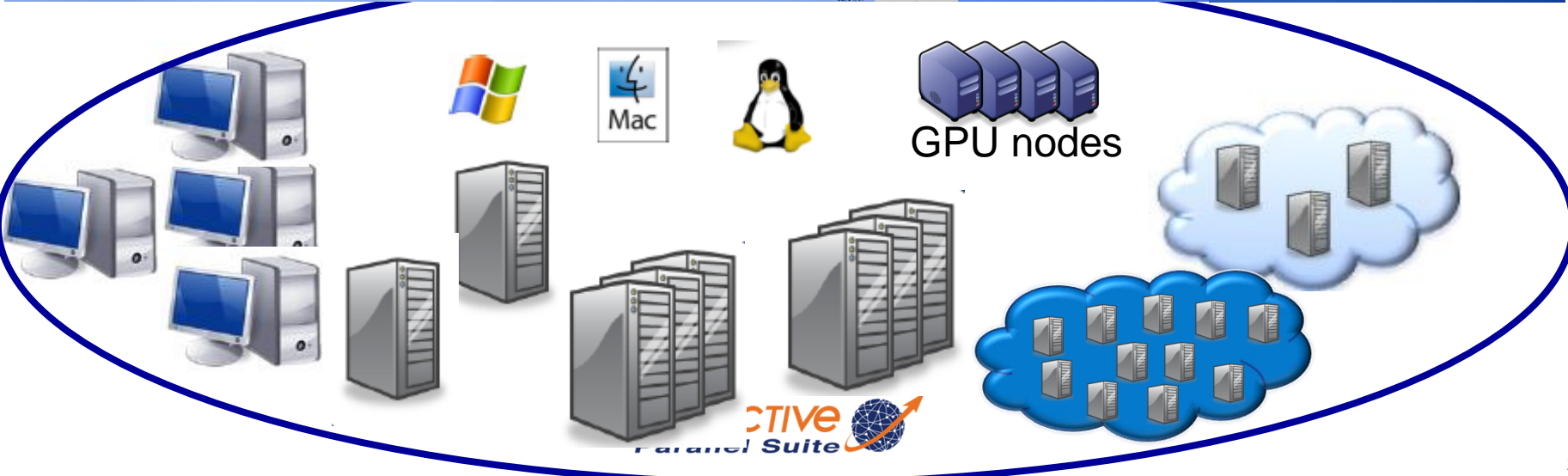
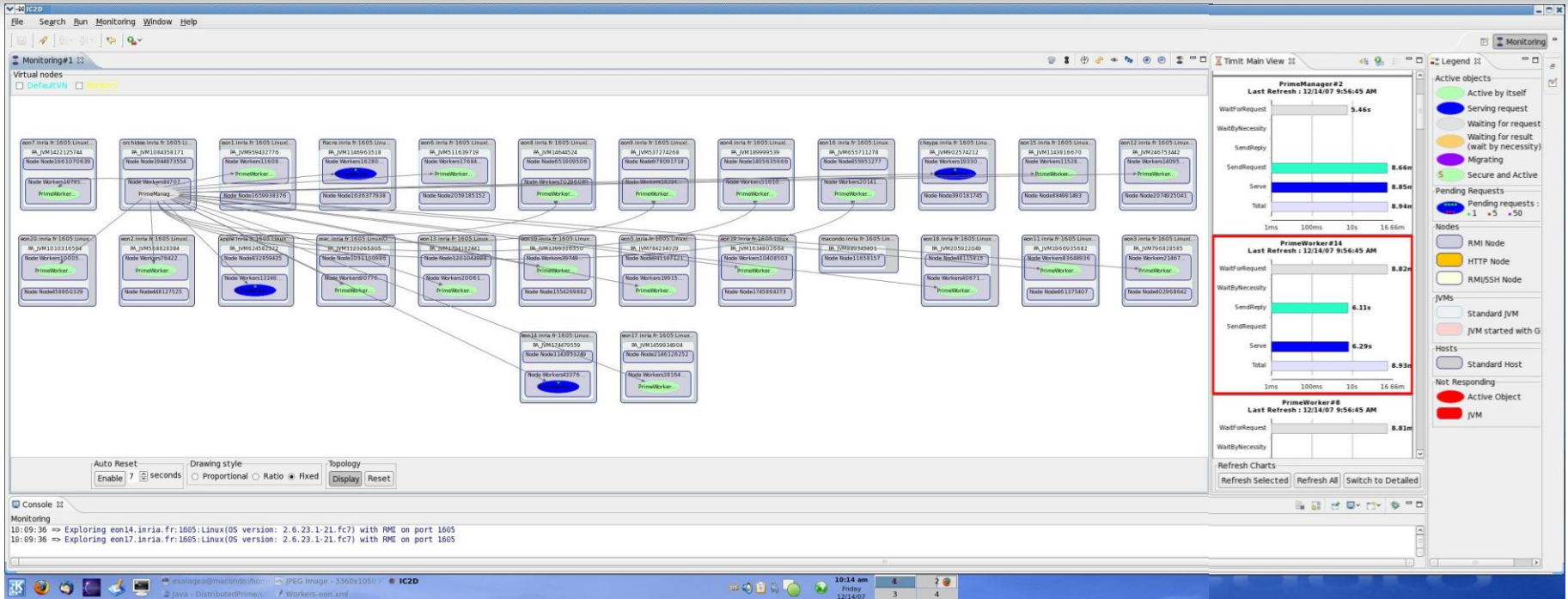


# ProActive Programming: Active Objects

# ProActive Programming View

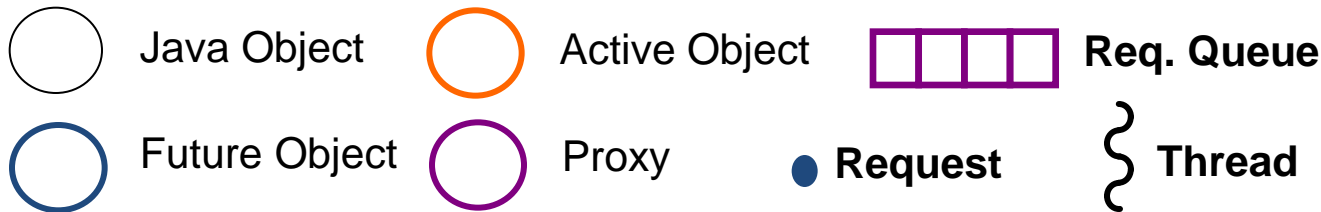
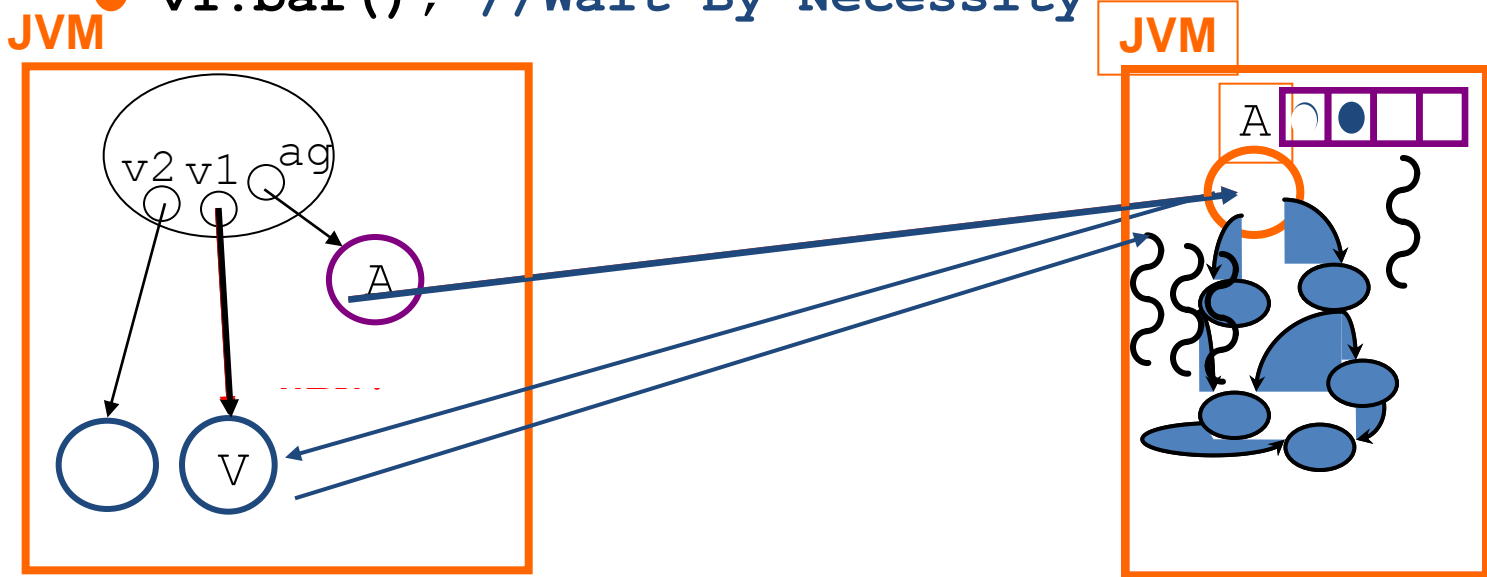


# ProActive Programming View



# ProActive: Active objects

- A ag = `newActive` ("A", [...], VirtualNode)
- V v1 = ag.foo (param);
- V v2 = ag.bar (param);
- ...
- v1.bar(); //Wait-By-Necessity

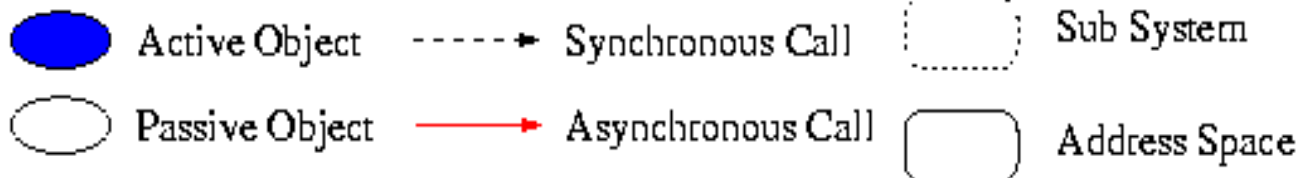
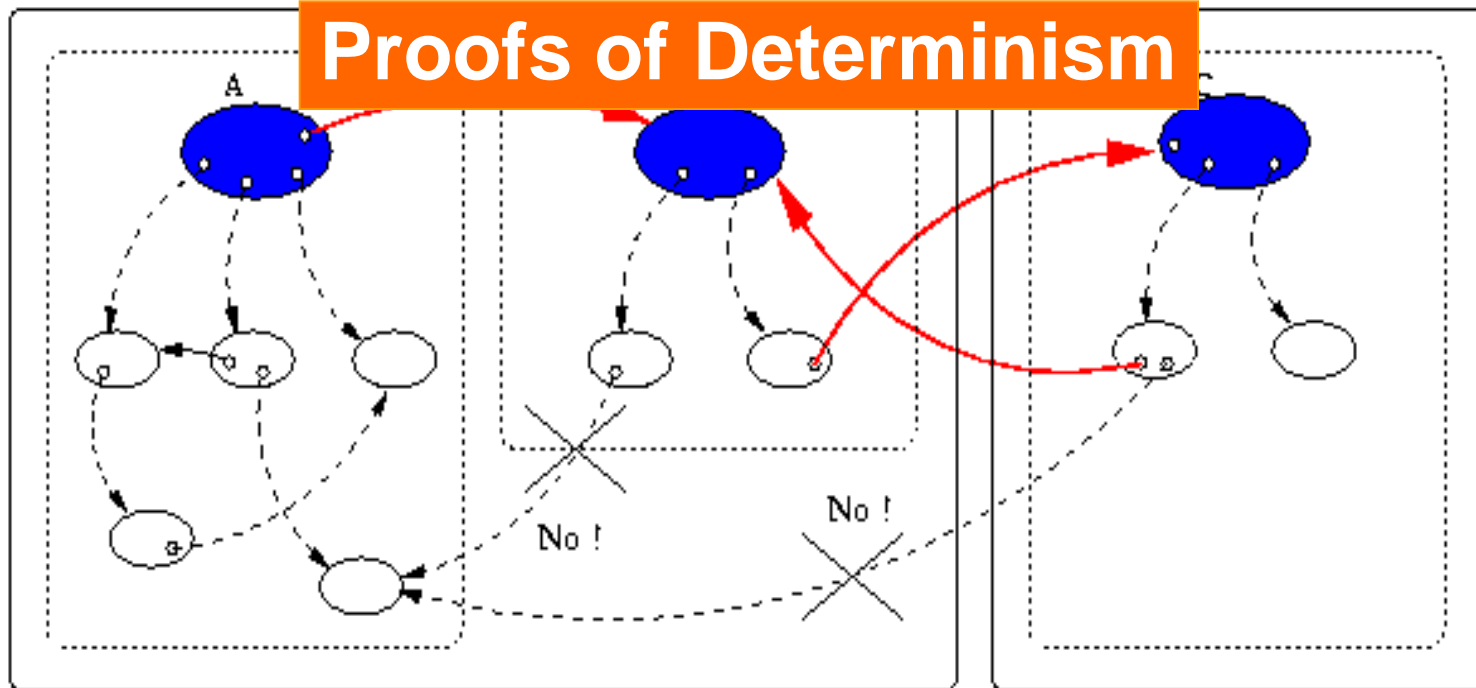


**Wait-By-Necessity**  
is a  
**Dataflow**  
**Synchronization**

# Standard system at Runtime: No Sharing

## NoC: Network On Chip

### Proofs of Determinism



# ASP: Asynchronous Sequential Processes

$$\frac{(a, \sigma) \rightarrow_S (a', \sigma')}{\alpha[a; \sigma; \iota; F; R; f] \parallel P \longrightarrow \alpha[a'; \sigma'; \iota; F; R; f] \parallel P} \text{ (LOCAL)}$$

Local

$$\frac{\begin{array}{l} \gamma \text{ fresh activity} \quad \iota' \notin \text{dom}(\sigma) \quad \sigma' = \{\iota' \mapsto AO(\gamma)\} :: \sigma \\ \sigma_\gamma = \text{copy}(\iota'', \sigma) \quad \text{Service} = (\text{if } m_j = \emptyset \text{ then } \text{FifoService} \text{ else } \iota''.m_j()) \end{array}}{\alpha[\mathcal{R}[\text{Active}(\iota'', m_j)]; \sigma; \iota; F; R; f] \parallel P \longrightarrow \alpha[\mathcal{R}[\iota']; \sigma'; \iota; F; R; f] \parallel \gamma[\text{Service}; \sigma_\gamma; \iota''; \emptyset; \emptyset; \emptyset] \parallel P} \text{ (NEWACT)}$$

Creating an Activity

$$\frac{\begin{array}{l} \sigma_\alpha(\iota) = AO(\beta) \quad \iota'' \notin \text{dom}(\sigma_\beta) \quad f_i^{\alpha \rightarrow \beta} \text{ new future} \quad \iota_f \notin \text{dom}(\sigma_\alpha) \\ \sigma'_\beta = \text{Copy\&Merge}(\sigma_\alpha, \iota' ; \sigma_\beta, \iota'') \quad \sigma'_\alpha = \{\iota_f \mapsto \text{fut}(f_i^{\alpha \rightarrow \beta})\} :: \sigma_\alpha \end{array}}{\alpha[\mathcal{R}[\iota.m_j(\iota')]; \sigma_\alpha; \iota_\alpha; F_\alpha; R_\alpha; f_\alpha] \parallel \beta[a_\beta; \sigma_\beta; \iota_\beta; F_\beta; R_\beta; f_\beta] \parallel P \longrightarrow \alpha[\mathcal{R}[\iota_f]; \sigma'_\alpha; \iota_\alpha; F_\alpha; R_\alpha; f_\alpha] \parallel \beta[a_\beta; \sigma'_\beta; \iota_\beta; F_\beta; R_\beta :: [m_j; \iota''; f_i^{\alpha \rightarrow \beta}]; f_\beta] \parallel P} \text{ (REQUEST)}$$

Sending a Request

$$\frac{R = R' :: [m_j; \iota_r; f'] :: R'' \quad m_j \in M \quad \forall m \in M, m \notin R'}{\alpha[\mathcal{R}[\text{Serve}(M)]; \sigma; \iota; F; R; f] \parallel P \longrightarrow \alpha[\iota.m_j(\iota_r) \uparrow f, \mathcal{R}[\Box]; \sigma; \iota; F; R' :: R''; f'] \parallel P} \text{ (SERVE)}$$

Service

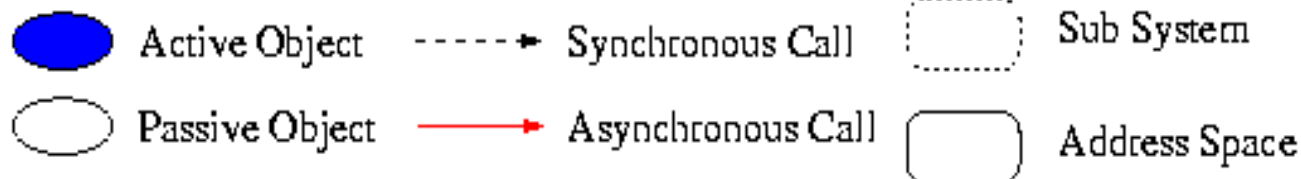
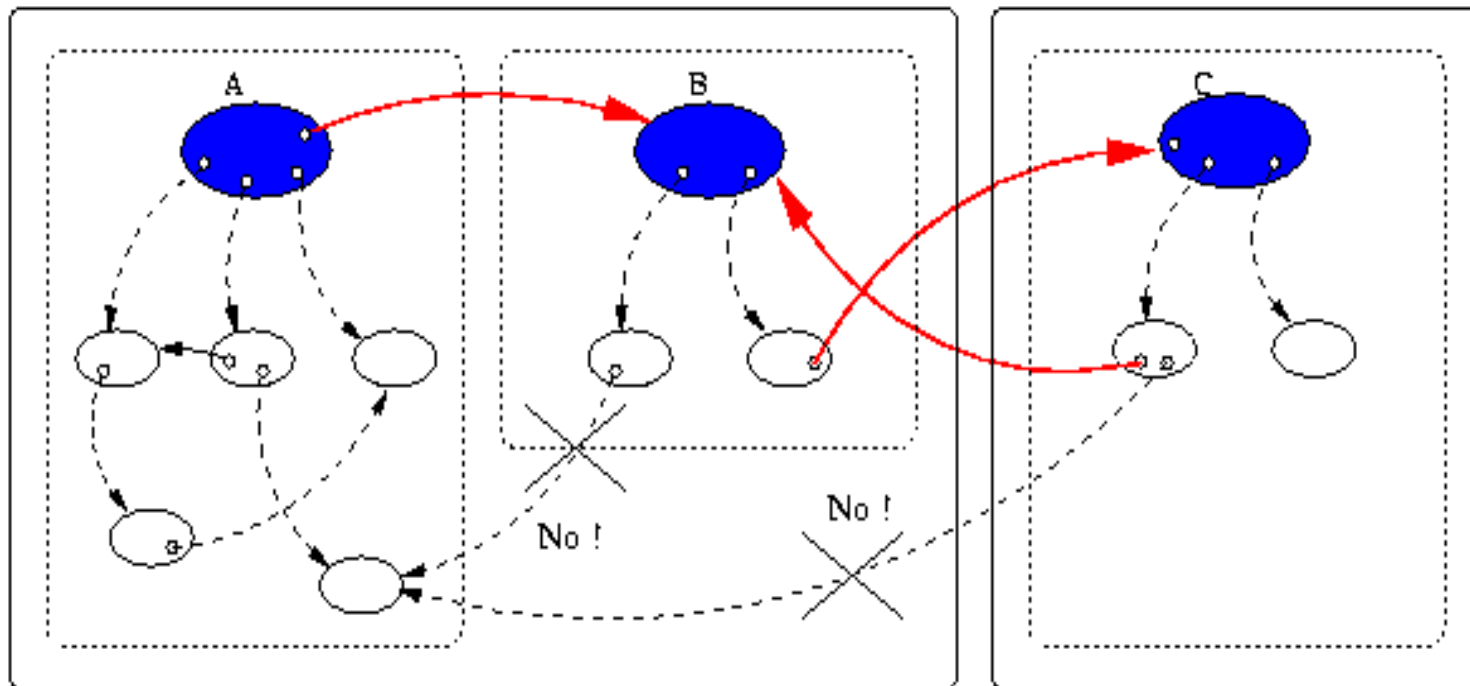
$$\frac{\iota' \notin \text{dom}(\sigma) \quad F' = F :: \{f \mapsto \iota'\} \quad \sigma' = \text{Copy\&Merge}(\sigma, \iota ; \sigma, \iota')}{\alpha[\iota \uparrow (f', a); \sigma; \iota; F; R; f] \parallel P \longrightarrow \alpha[a; \sigma'; \iota; F'; R; f'] \parallel P} \text{ (ENDSERVICE)}$$

$$\frac{\sigma_\alpha(\iota) = \text{fut}(f_i^{\gamma \rightarrow \beta}) \quad F_\beta(f_i^{\gamma \rightarrow \beta}) = \iota_f \quad \sigma'_\alpha = \text{Copy\&Merge}(\sigma_\beta, \iota_f ; \sigma_\alpha, \iota)}{\alpha[a_\alpha; \sigma_\alpha; \iota_\alpha; F_\alpha; R_\alpha; f_\alpha] \parallel \beta[a_\beta; \sigma_\beta; \iota_\beta; F_\beta; R_\beta; f_\beta] \parallel P \longrightarrow \alpha[a_\alpha; \sigma'_\alpha; \iota_\alpha; F_\alpha; R_\alpha; f_\alpha] \parallel \beta[a_\beta; \sigma_\beta; \iota_\beta; F_\beta; R_\beta; f_\beta] \parallel P} \text{ (REPLY)}$$

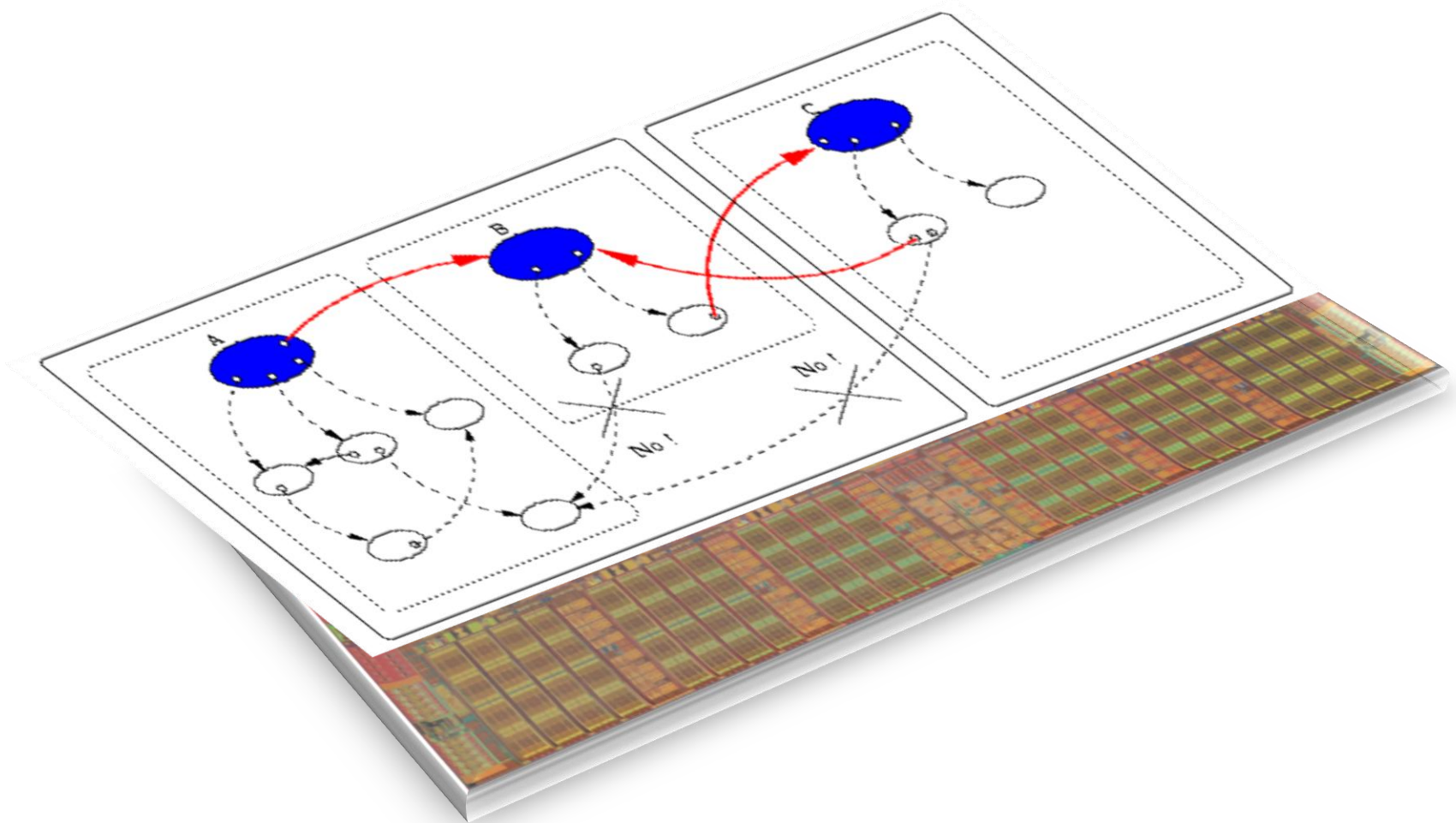
Sending a Reply

# Standard system at Runtime: No Sharing

## NoC: Network On Chip



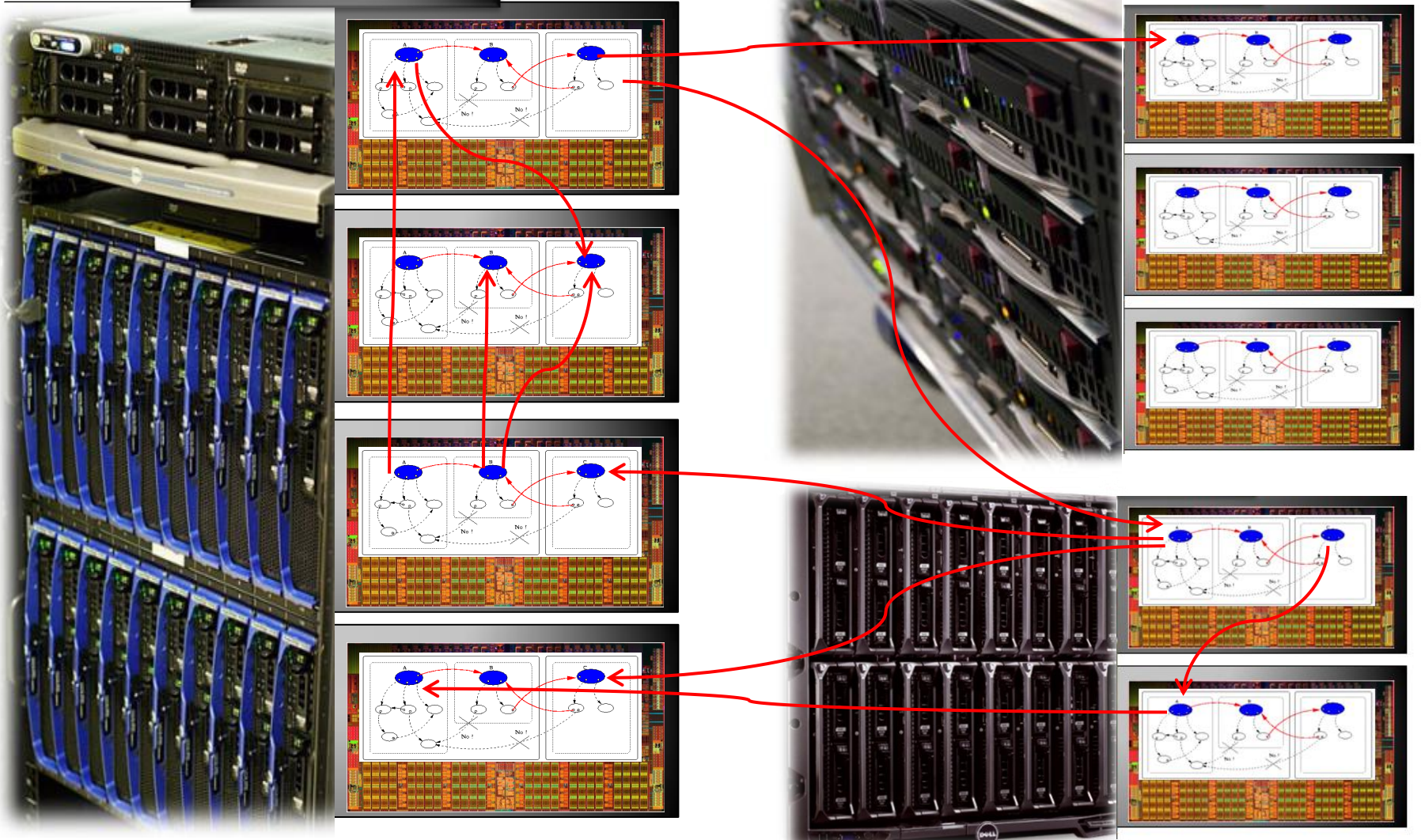
# Distributed Objects On Chip





# Distributed Objects On Chip, Boards, Clouds

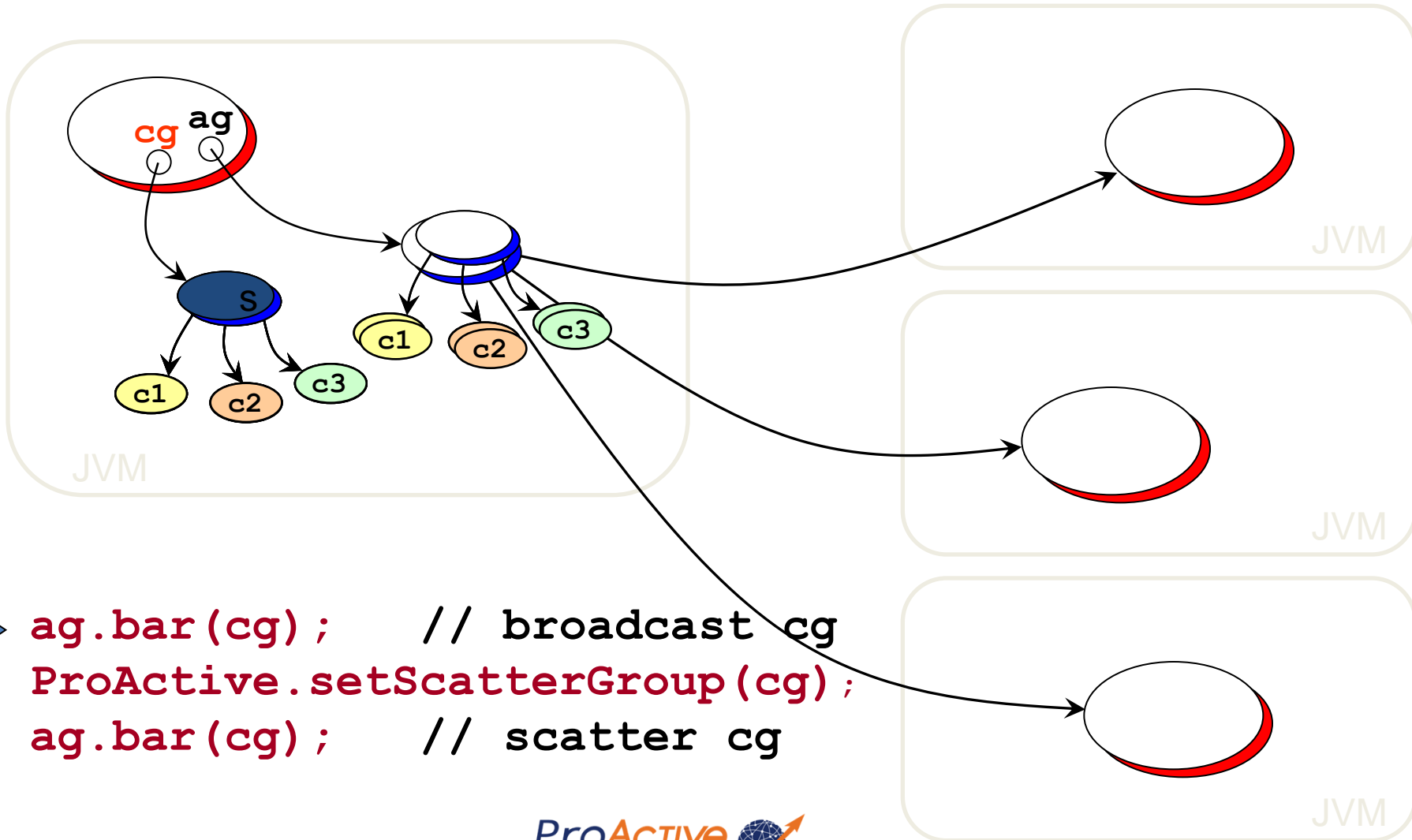
## Bi-Socket Board



# Broadcast and Scatter

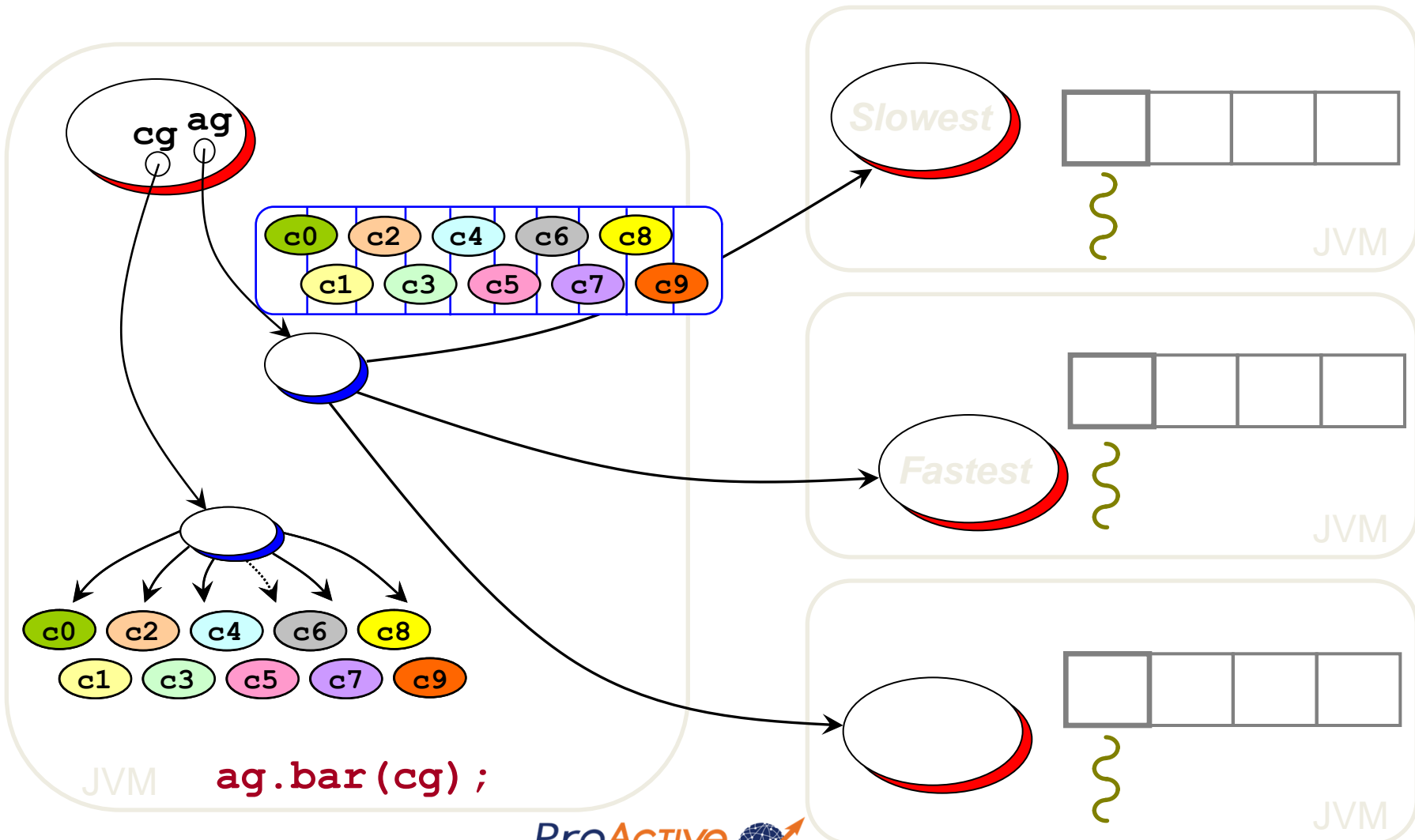
Broadcast is the default behavior

Use a group as parameter, Scattered depends on rankings



**ag.bar (cg) ; // broadcast cg**  
**ProActive.setScatterGroup (cg) ;**  
**ag.bar (cg) ; // scatter cg**

# Dynamic Dispatch Group



# IC2D: Optimizing

The screenshot displays the Eclipse IDE interface with two main views: **Monitoring** and **Job Monitoring**.

**Monitoring View:** Shows a network diagram of virtual nodes. The main window is titled "Monitoring - Eclipse SDK" and contains a menu bar (File, Edit, Navigate, Search, Project, Run, Control, Monitoring, Window, Help) and a toolbar. The main area displays a diagram of virtual nodes (Virtual nodes) with checkboxes for **Renderer**, **DefaultVN**, **Dispatcher**, and **User**. The diagram shows a central node "Node Node60562498..." connected to several other nodes, including "DinnerLayout#2", "Table#3", "Philosopher#4", "Philosopher#5", "Philosopher#6", "Philosopher#7", and "Philosopher#8". Below the main diagram, there are two smaller diagrams showing "Node Renderer1174..." and "Node Renderer151..." connected to "C3DRendering..." nodes. At the bottom of the Monitoring view, there are checkboxes for "Display topology", "Proportional", "Ratio", "Filaire", and "Monitoring enable", along with a "Reset Topology" button.

**Job Monitoring View:** Shows a tree structure of jobs and nodes. The tree is titled "Legend" and "Job Monito...". It displays a hierarchy of jobs and nodes, including "DefaultVN (JOB-135745762)", "bebita.inria.fr:1099:OS un", "PA\_JVM1357457629\_", "Node Node6056249...", "DinnerLayout#2", "Table#3(JOB-13", "Philosopher#4(J", "Philosopher#5(J", "Philosopher#6(J", "Philosopher#7(J", "Philosopher#8(J", "sidonie.inria.fr:1099:OS u", "Dispatcher (JOB--167207649", "User (JOB--294719007)", "bebita.inria.fr:1099:OS un", "PA\_JVM-294719007\_l", "Node User1602644", "C3DUser#13(JC", "Renderer (JOB--1672076495", "bebita.inria.fr:1099:OS un", "PA\_JVM-1631909824\_".

**Console View:** Shows the output of the monitoring process. The text in the console is: "15:09:15 => NodeObject id=Node-455186381 already monitored, ckeck for new active objects".

# IC2D

IC2D Monitoring Window Help

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\_JVM1949849146  
Node Node-2003411204  
Displayer#1

PA\_JVM1370729570  
Node Node557274178

Auto Reset: Enable 7 seconds

Drawing style:  Proportional  Ratio  Fixed

Topology:

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 (red), 5 (yellow), 50 (blue)

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

Time View: Domain#4 Snapshot time: 18/10/07 16:20:45

Operation	Time
GroupAsyncCall	1.28m
GroupOneWayCall	1.10s
AfterSerialization	20.63s
BeforeSerialization	2.47s
LocalCopy	21.24s
WaitForRequest	16.76s
WaitByNecessity	1.70m
SendReply	2.01m
SendRequest	2.37m
Serve	2.37m
Total	2.37m

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

Refresh Charts: Refresh Selected Refresh All Switch To Basic

Taskbar: Java - Domain.java - Eclipse Terminal - Konsole TimlIC2D\_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

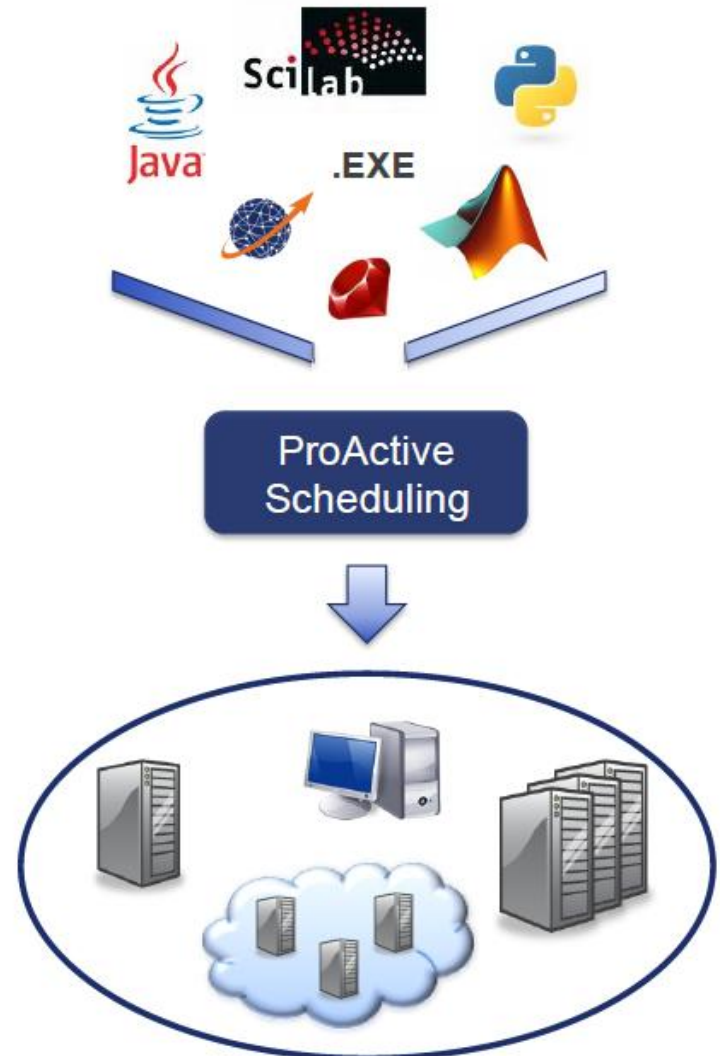
# Video 1: IC2D Optimizing Monitoring, Debugging, Optimizing



# Scheduling & Resourcing



# ProActive Scheduling



# ProActive Scheduling Big Picture

ProActive Scheduler

File Window Help

Scheduler

Jobs

Pending (674) Running (60) Finished (31)

Id	State	User	Priority	Name
1996	Pending	jl	Normal	job_with_dep
1997	Pending	jl	Normal	job_with_dep
1998	Pending	jl	Normal	job_with_dep
1999	Pending	jl	Normal	job_with_dep
2000	Pending	jl	Normal	job_with_dep
2001	Pending	jl	Normal	job_with_dep
2002	Pending	jl	Normal	job_with_dep
2003	Pending	jl	Normal	job_with_dep
2004	Pending	jl	Normal	job_with_dep
2005	Pending	jl	Normal	job_with_dep
2006	Pending	jl	Normal	job_with_dep
2007	Pending	jl	Normal	job_with_dep
2008	Pending	jl	Normal	job_with_dep
2009	Pending	jl	Normal	job_with_dep
2010	Pending	jl	Normal	job_with_dep

Id	State	Progress	# Finished	User	Prior
1313	Running	<div style="width: 25%;"></div>	4/8	user1	Norr
1314	Running	<div style="width: 25%;"></div>	4/8	user1	Norr
1315	Running	<div style="width: 25%;"></div>	7/8	admin	Norr
1316	Running	<div style="width: 25%;"></div>	4/8	user1	Norr
1317	Running	<div style="width: 25%;"></div>	7/8	admin	Norr
1318	Running	<div style="width: 25%;"></div>	4/8	user1	Norr
1319	Running	<div style="width: 25%;"></div>	7/8	admin	Norr
1320	Running	<div style="width: 25%;"></div>	3/8	user1	Norr
1321	Running	<div style="width: 25%;"></div>	7/8	admin	Norr
1322	Running	<div style="width: 25%;"></div>	3/8	user1	Norr
1323	Running	<div style="width: 25%;"></div>	7/8	admin	Norr
1324	Running	<div style="width: 25%;"></div>	2/8	user1	Norr
1325	Running	<div style="width: 25%;"></div>	2/8	user1	Norr
1326	Running	<div style="width: 25%;"></div>	2/8	user1	Norr
1327	Running	<div style="width: 25%;"></div>	2/8	user1	Norr

Id	State	User	Priority	Name
010	Finished	jl	Low	job_proActive
008	Finished	jl	Low	job_proActive
005	Finished	jl	Low	job_proActive
001	Finished	jl	Low	job_proActive
006	Finished	jl	Low	job_proActive
004	Finished	jl	Low	job_proActive
003	Finished	jl	Low	job_proActive
009	Finished	jl	Low	job_proActive
007	Finished	jl	Low	job_proActive
002	Finished	jl	Low	job_proActive
245	Finished	user1	Normal	job_with_dep
246	Finished	user1	Normal	job_with_dep
247	Finished	user1	Normal	job_with_dep
252	Finished	admin	Normal	job_with_dep
253	Finished	admin	Normal	job_with_dep

RESUMED

Console Tasks

Job Info Result Preview

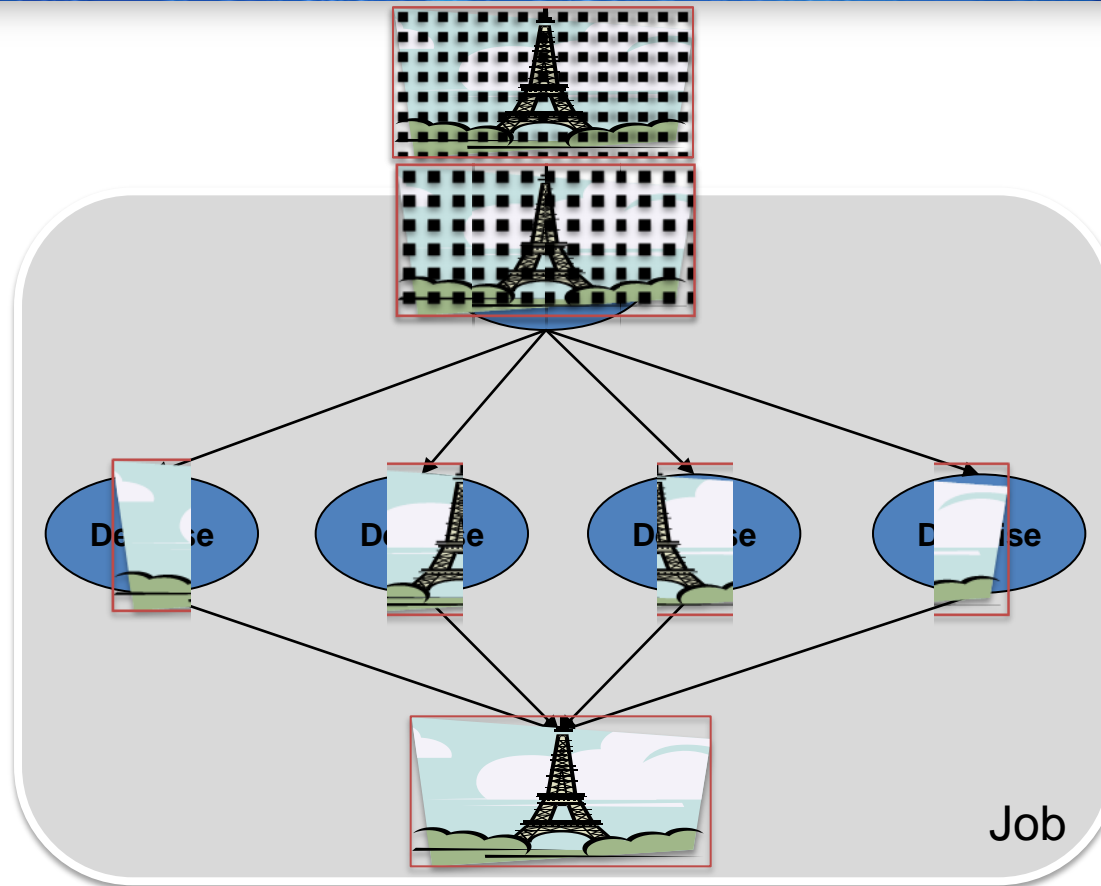
Job 2008 has 8 tasks

Id	State	Name	Host name	Start time	Finished time	Re-run	Description
200800	Submitted	task4	n/a	Not yet	Not yet	0/2	This task will sleep 5s
200800	Submitted	task2	n/a	Not yet	Not yet	0/1	This task will sleep 10s
200800	Submitted	task6	n/a	Not yet	Not yet	0/1	This task will sleep 8s
200800	Submitted	task1	n/a	Not yet	Not yet	0/2	This task will sleep 6s
200800	Submitted	task5	n/a	Not yet	Not yet	0/1	This task will sleep 2s
200800	Submitted	task7	n/a	Not yet	Not yet	0/2	This task will sleep 6s
200800	Submitted	task3	n/a	Not yet	Not yet	0/1	This task will sleep 4s
200800	Submitted	task8	n/a	Not yet	Not yet	0/1	This task will sleep 6s

Property	Value
Id	2008
State	Pending
Name	job_with_dep
Priority	Normal
Pending tasks number	0
Running tasks number	0
Finished tasks number	0
Total tasks number	8
Submitted time	09:40:06 03/12/08
Started time	Not yet
Finished time	Not yet

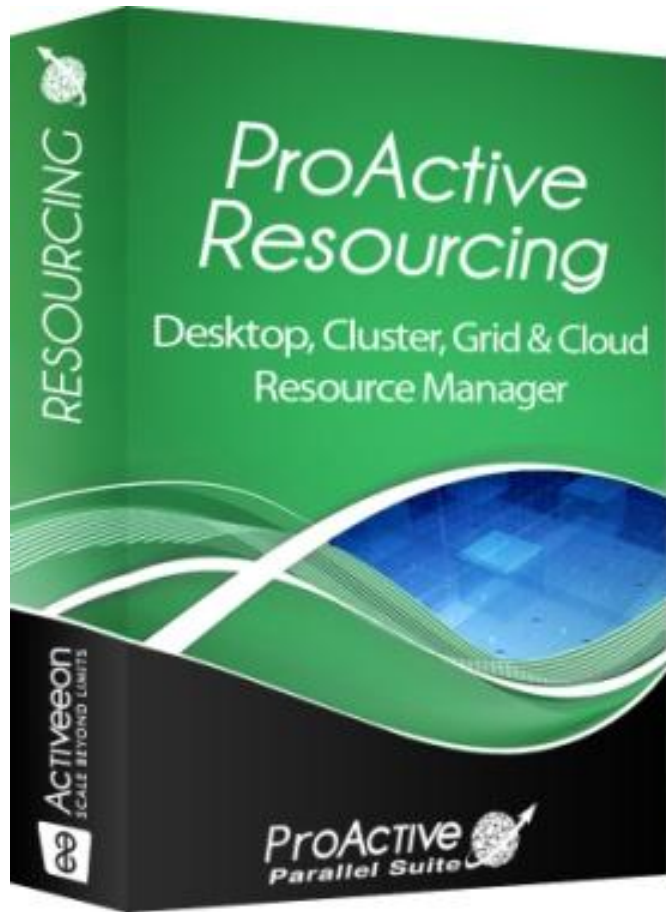
RES

# Workflow Example : Picture Denoising



- with **selection** on native executable availability (ImageMagik, GREYstoration)
  - Multi-platform selection and command generation
- with **file transfer** in pre/post scripts

# ProActive Resourcing



# RESOURCING User Interface

The screenshot displays the ProActive Resource Manager (PA) User Interface. The main window is titled "ProActive Resource Manager" and includes a menu bar (File, Connection, Actions, Help, Window) and a toolbar with a "Shutdown" button. The interface is divided into several panes:

- Tree Explorer:** Shows a hierarchical view of resources. The tree structure is as follows:
  - PA\_JVM2114960478
    - rmi://eon14.inria.fr:1099/PA\_JVM2114960478\_GCMNode-0
    - rmi://eon14.inria.fr:1099/PA\_JVM2114960478\_GCMNode-1
    - rmi://eon14.inria.fr:1099/PA\_JVM2114960478\_GCMNode-2
  - PA\_JVM477486534
  - PA\_JVM2003420561
    - rmi://eon14.inria.fr:1099/PA\_JVM2003420561\_GCMNode-0
    - rmi://eon14.inria.fr:1099/PA\_JVM2003420561\_GCMNode-1
    - rmi://eon14.inria.fr:1099/PA\_JVM2003420561\_GCMNode-2
- Compact View:** A grid of colored circles representing the state of individual nodes. Most nodes are green, indicating they are free. Some nodes are yellow, and a small cluster of nodes is red, indicating they are busy or down.
- JMX Monitoring:** Contains three charts:
  - Activity History:** A line graph showing activity over time from 16:40 to 17:00. The activity starts at approximately 10.0, rises to a peak of about 16.5 at 16:50, and then gradually declines to around 14.0 by 17:00.
  - Node States Peaks:** A bar chart showing the maximum number of nodes in different states. The "Max Free" state has a value of 330 (blue bar), "Max Busy" has a value of 80 (red bar), "Max ToBeReleased" is 0, and "Max Down" is 0.
  - Free Nodes History:** A line graph showing the number of free nodes over time. The number of free nodes starts at approximately 200 at 16:40, rises to about 300 by 16:45, and then fluctuates between 250 and 300 until 17:00.
- Overview/Charts:** A section with tabs for "Statistics" and "Info". The "Statistics" tab is active, showing a table of resource counts:

state	aggregate
# free nodes	272
# busy nodes	52
# down nodes	6

The status "connected" is displayed in the bottom right corner of the interface.

# Clusters to Grids to Clouds: e.g. on Amazon EC2

# Private, Public & Hybrid Clouds



ProActive Scheduler

ProActive Resource Manager

**“ Cloud Bursting! ”**

Static Policy

LSF

Timing Policy  
12/24

Desktops

Dynamic Workload Policy

EC2



Dedicated resources



Desktops



Amazon EC2

# *Cloud Seeding with ProActive*

- ❑ Amazon EC2 Execution
- ❑ *Cloud Seeding* strategy to mix heterogeneous computing resources :
  - External GPU resources

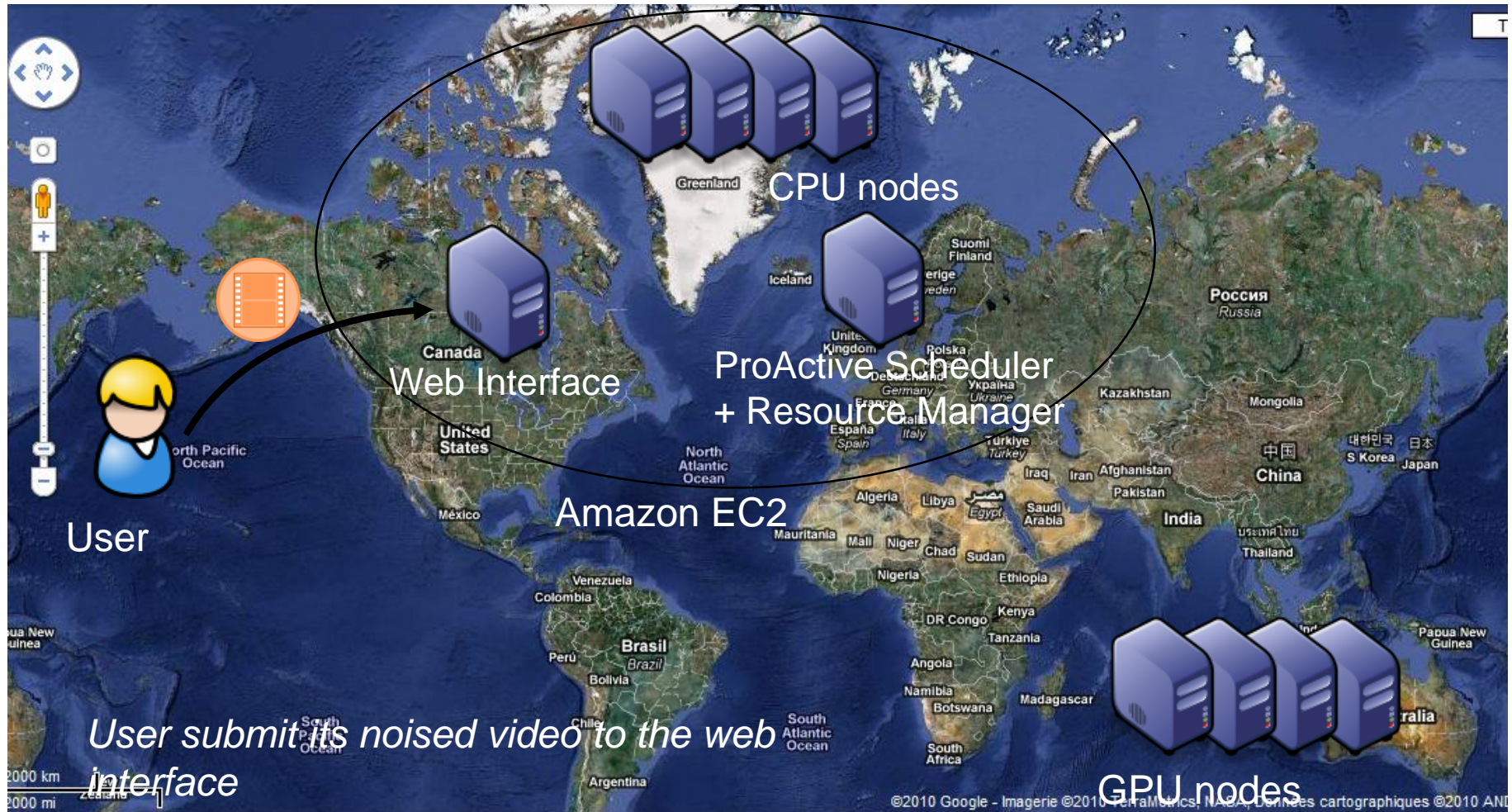
*“ Cloud Seeding ”*



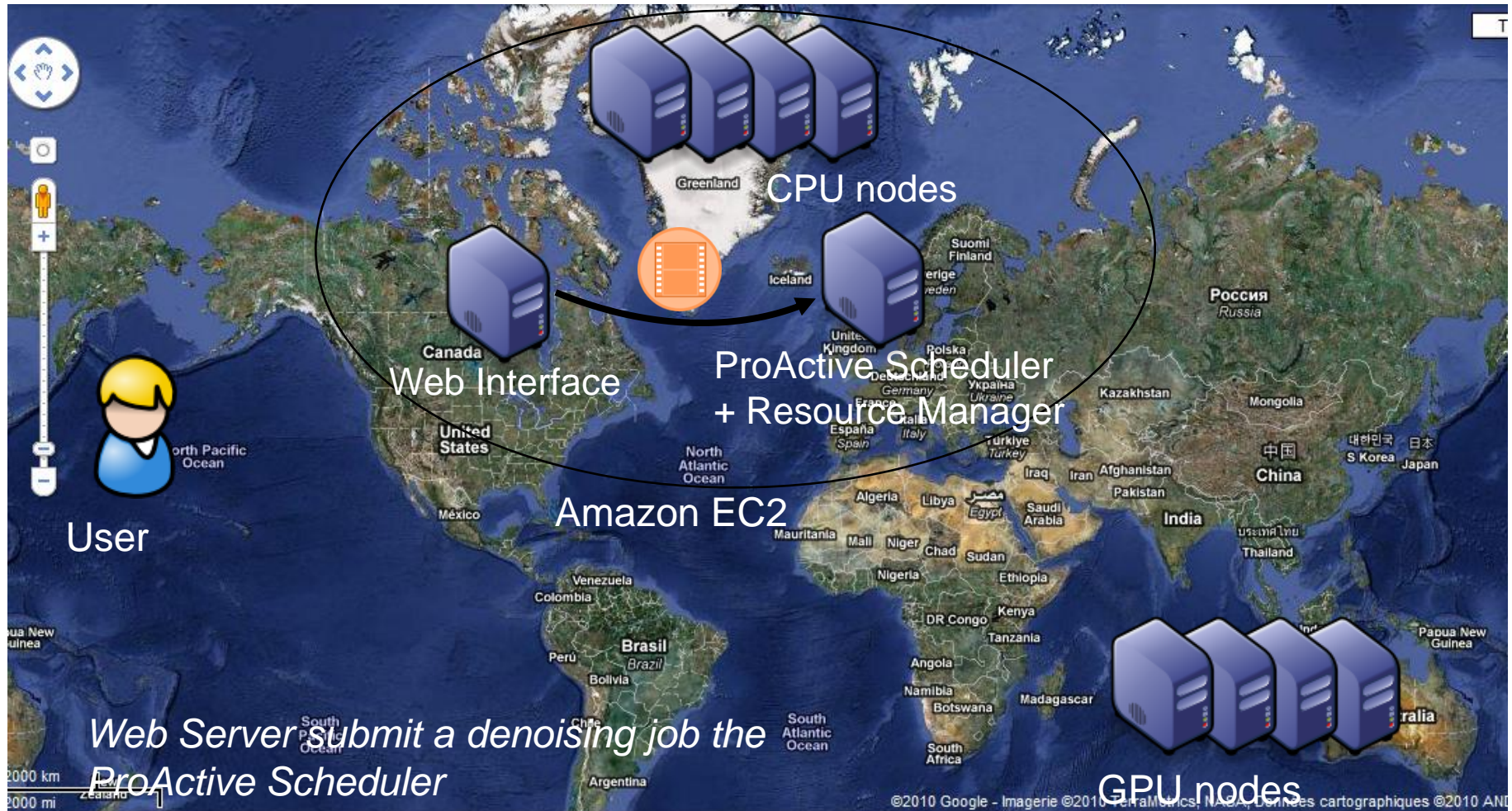
# Cloud Seeding with ProActive



# Cloud Seeding with ProActive

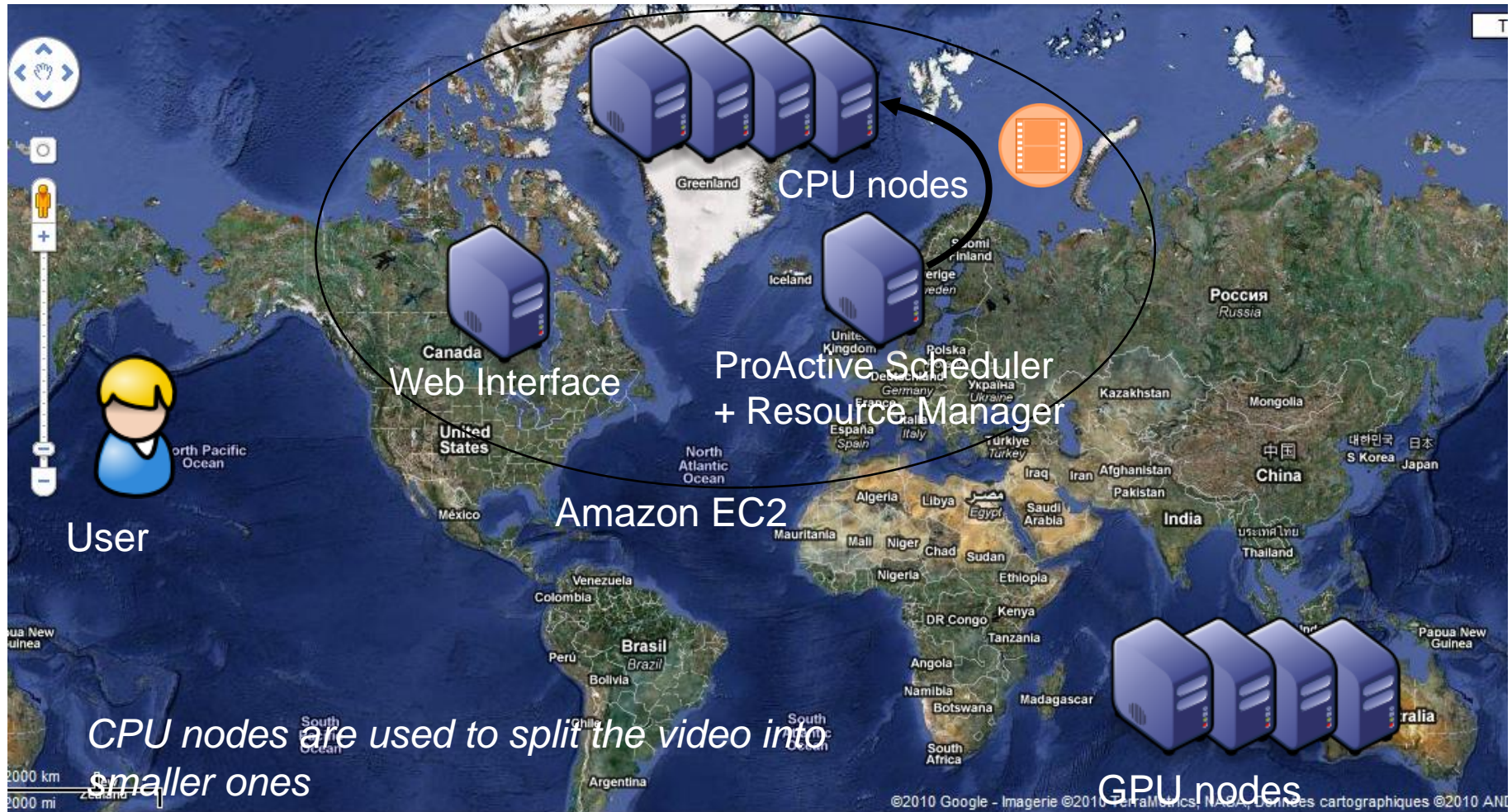


# Cloud Seeding with ProActive

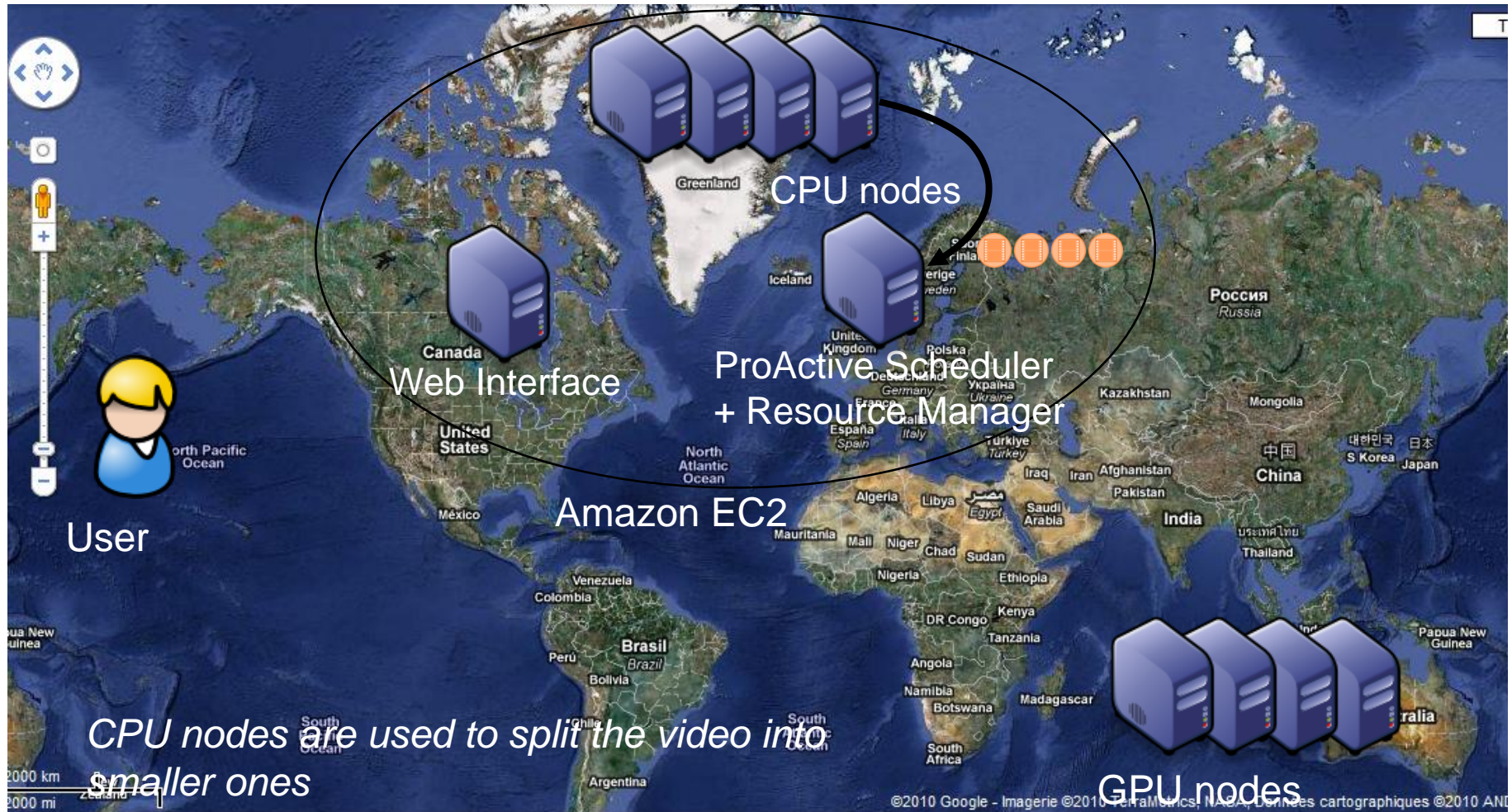


Web Server Submit a denoising job the ProActive Scheduler

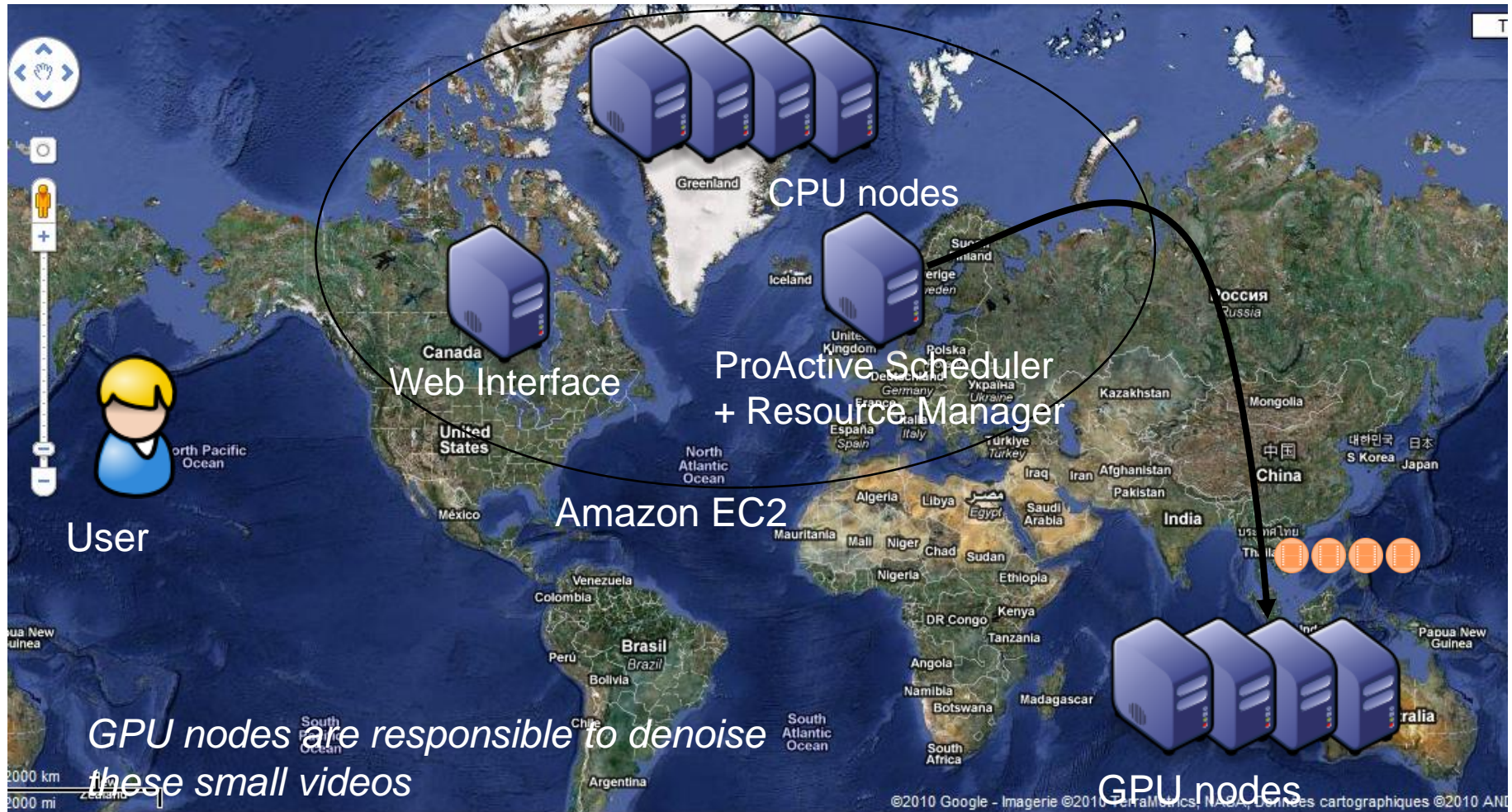
# Cloud Seeding with ProActive



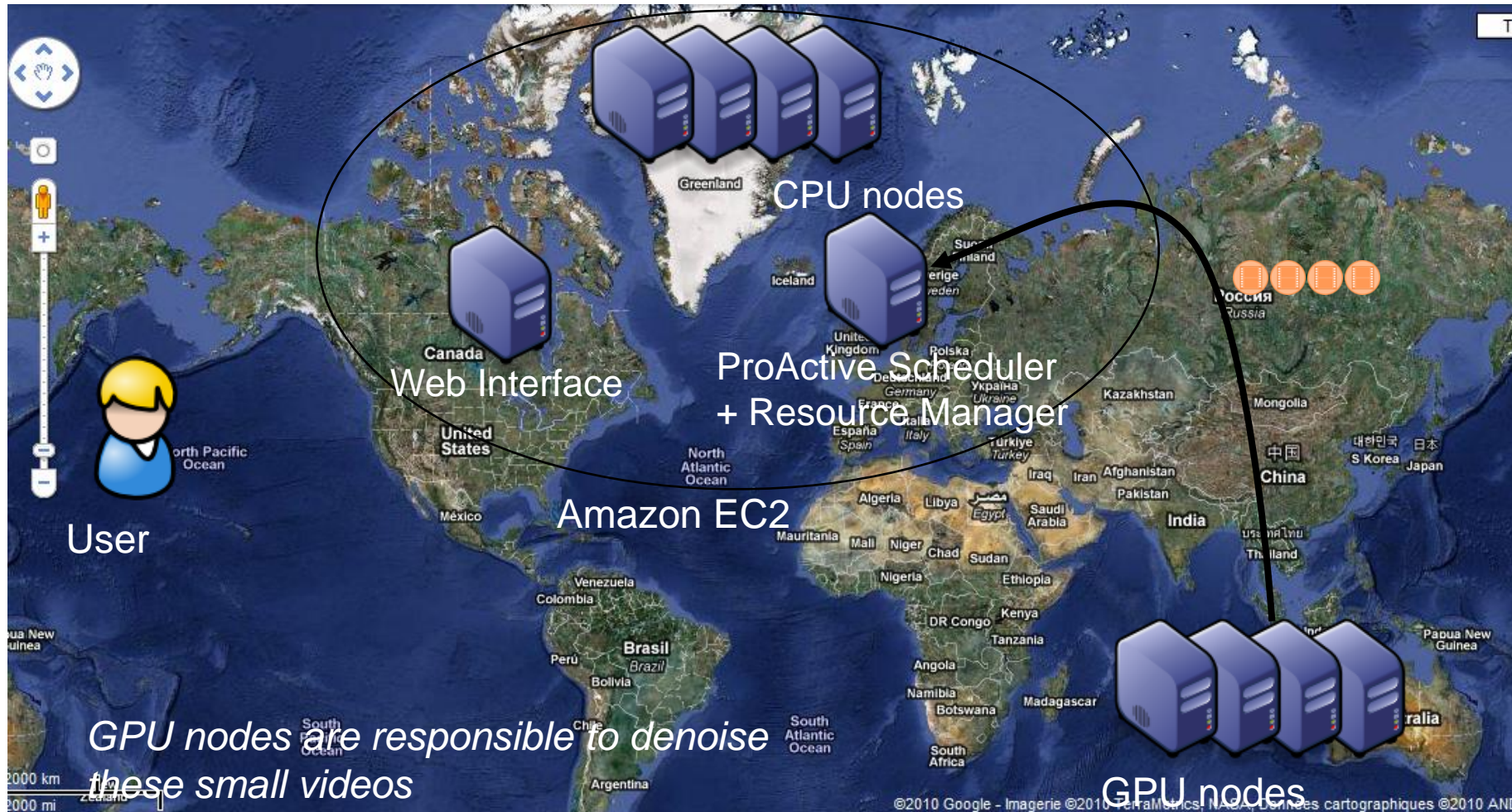
# Cloud Seeding with ProActive



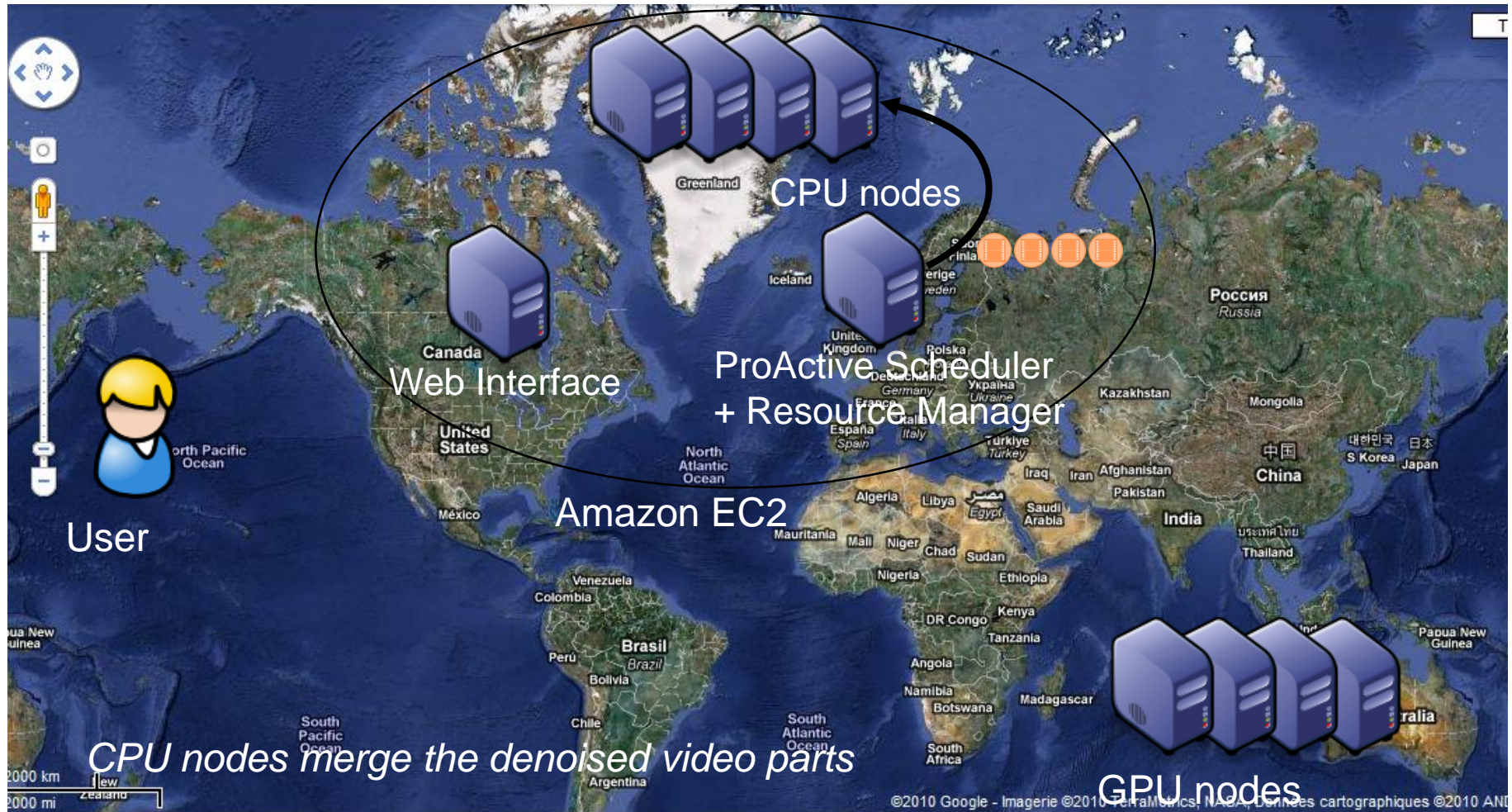
# Cloud Seeding with ProActive



# Cloud Seeding with ProActive

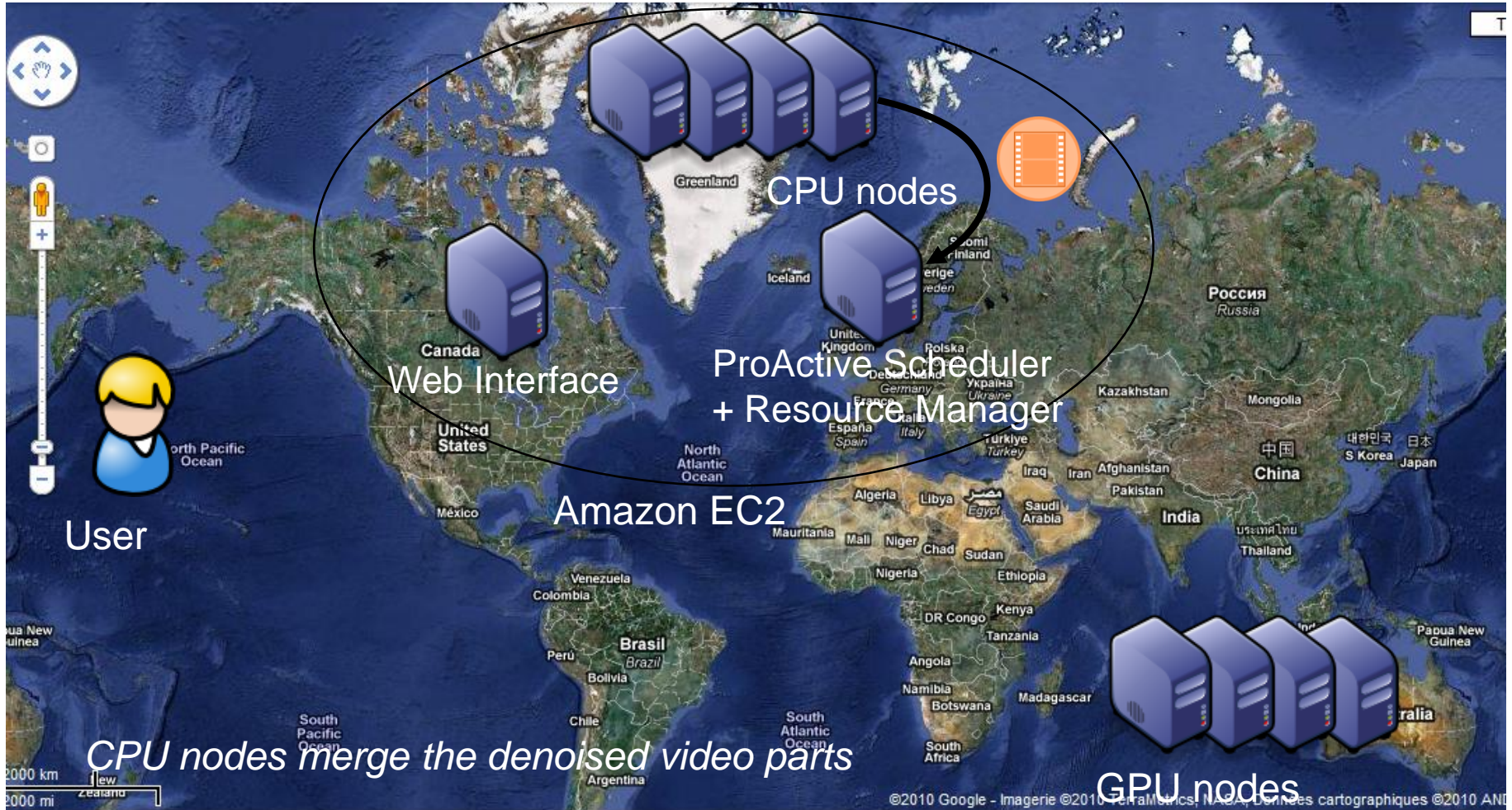


# Cloud Seeding with ProActive

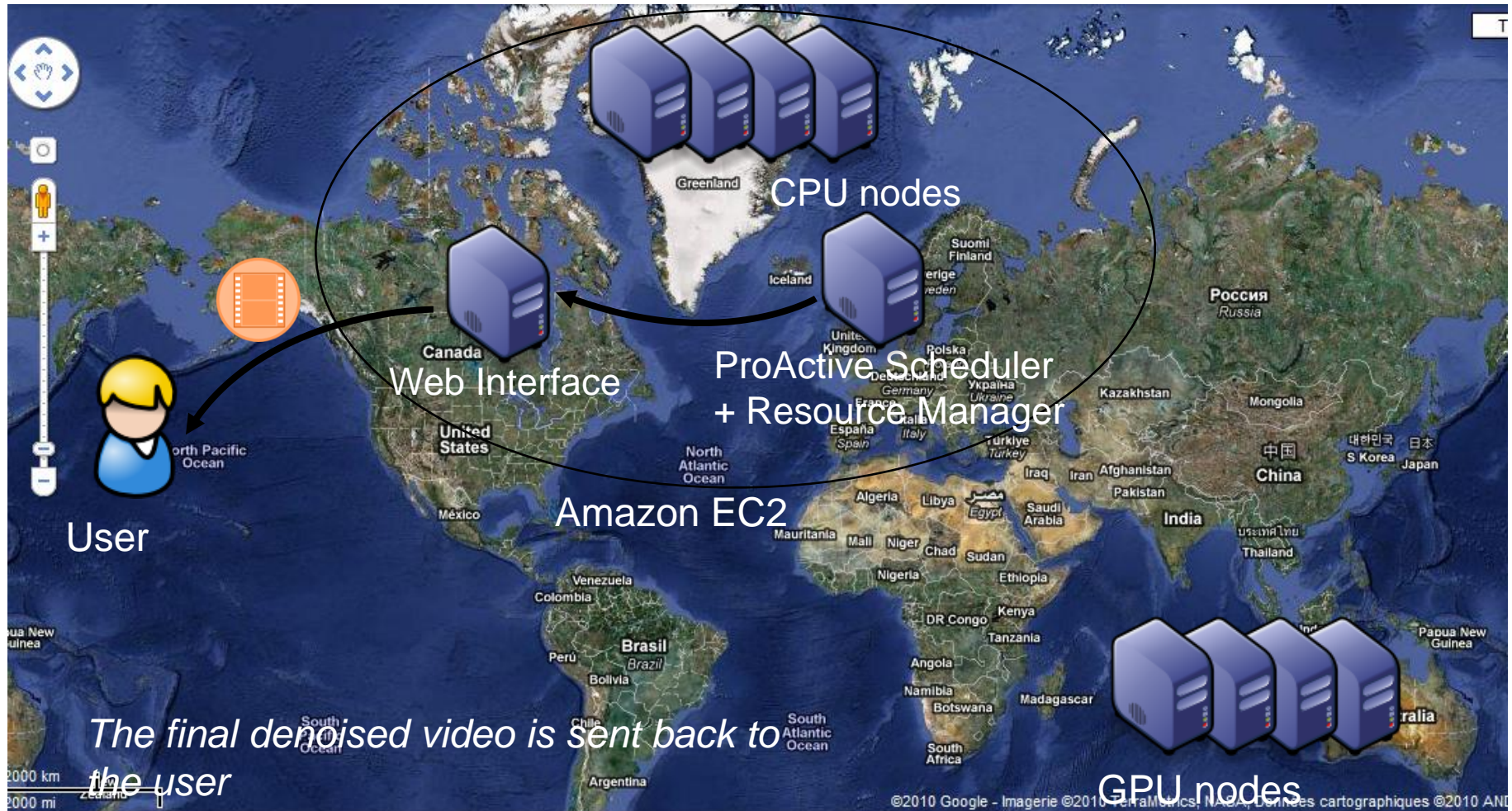




# Cloud Seeding with ProActive



# Cloud Seeding with ProActive



# Real Live Demo: ProActive Scheduler & Resource Manager

# Use Case 1: BioTechs

# IPMC Use Case and Collaboration

**SOLID**  
machine from  
**AB Applied Biosystems**

**ProActive**  
Parallel Suite

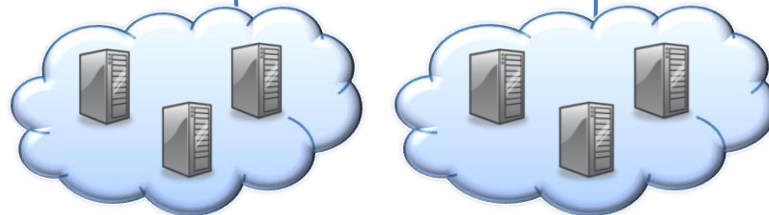


*Cluster*



*Desktops*

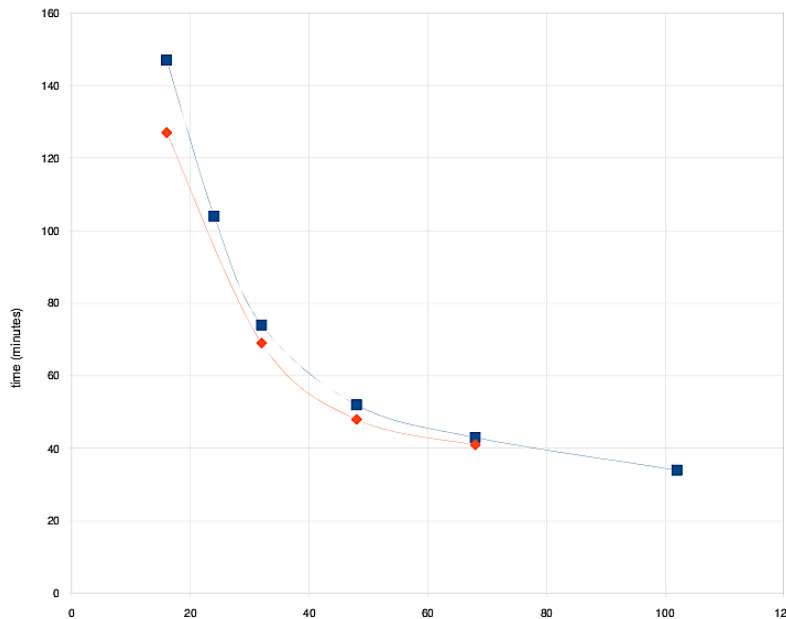
**Nodes  
can be  
dynamically  
added!**



*Clouds*

# Benchmarks

- ❑ The distributed version with ProActive of Mapreads has been tested on the INRIA cluster with two settings: the Reads file is split in either 30 or 10 slices
- ❑ Use Case: Matching 31 millions Sequences with the Human Genome (M=2, L=25)



4 Time FASTER from 20 to 100  
Speed Up of 80 / Th.  
Sequential : 50 h → 35 mn

EC2 only test: nearly the same  
performances as the local  
SOLiD cluster (+10%)

**For only \$3,2/hour, EC2 has nearly the same perf. as  
the local SOLiD cluster (16 cores, for 2H30)**

# UC 2: IT

## SOA Analysis of Web Server Logs



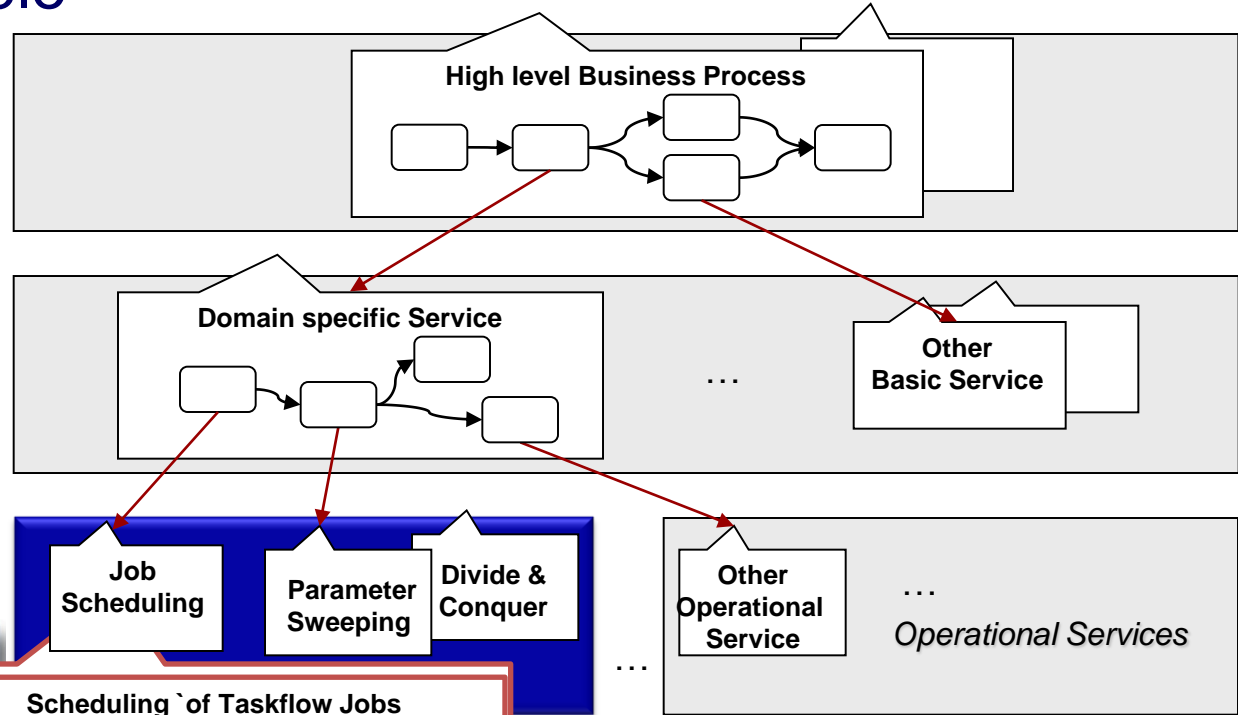
Activeeon  
SCALE BEYOND LIMITS



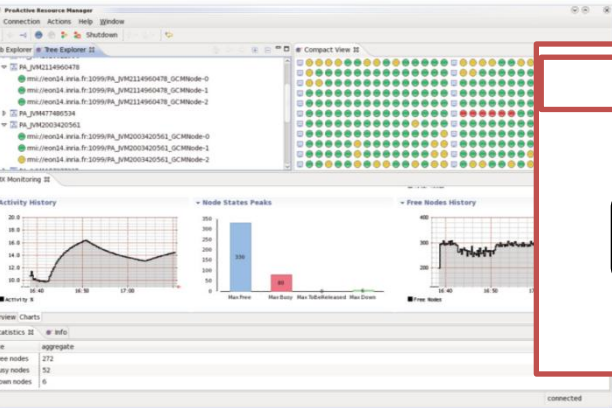
ORACLE®

# Parallel Services

- Separation: BPEL – Parallel Serv. – Task Flow
- Standards et Portable
- Flexibility



ID	State	User	Priority	Name	id	State	Progress	#	Finished	User	Priority	Name
1996	Pending	J	Normal	job_wt0_step	2122	Running	0%	0	0	user1	Normal	job_wt0_step
1997	Pending	J	Normal	job_wt0_step	2124	Running	0%	0	0	user1	Normal	job_wt0_step
1998	Pending	J	Normal	job_wt0_step	2125	Running	0%	0	0	user1	Normal	job_wt0_step
1999	Pending	J	Normal	job_wt0_step	2126	Running	0%	0	0	user1	Normal	job_wt0_step
2000	Pending	J	Normal	job_wt0_step	2127	Running	0%	0	0	user1	Normal	job_wt0_step
2001	Pending	J	Normal	job_wt0_step	2128	Running	0%	0	0	user1	Normal	job_wt0_step
2002	Pending	J	Normal	job_wt0_step	2129	Running	0%	0	0	user1	Normal	job_wt0_step
2003	Pending	J	Normal	job_wt0_step	2130	Running	0%	0	0	user1	Normal	job_wt0_step
2004	Pending	J	Normal	job_wt0_step	2131	Running	0%	0	0	user1	Normal	job_wt0_step
2005	Pending	J	Normal	job_wt0_step	2132	Running	0%	0	0	user1	Normal	job_wt0_step
2006	Pending	J	Normal	job_wt0_step	2133	Running	0%	0	0	user1	Normal	job_wt0_step
2007	Pending	J	Normal	job_wt0_step	2134	Running	0%	0	0	user1	Normal	job_wt0_step
2008	Pending	J	Normal	job_wt0_step	2135	Running	0%	0	0	user1	Normal	job_wt0_step
2009	Pending	J	Normal	job_wt0_step	2136	Running	0%	0	0	user1	Normal	job_wt0_step
2010	Pending	J	Normal	job_wt0_step	2137	Running	0%	0	0	user1	Normal	job_wt0_step
2011	Pending	J	Normal	job_wt0_step	2138	Running	0%	0	0	user1	Normal	job_wt0_step





# AGOS Platform Management

## HP- Business Availability Center (HP-BAC)

## Tasks Scheduler & Resources manager

- Monitoring of entire platform
- Cover all layers in the scope
- Monitoring dashboard and reports

- Integration with grid
- Indicator on running jobs
- Hypervisor & VM management

HP Business Availability Center - Dashboard

System Status

Updated: Fri, 2/19/2010, 1:11 PM CET

0 Critical 4 Major 0 Minor 12 Normal 0 Disabled 0 Unknown Total: 18

System Name	System Type	System Address	Product Name	OS Name
ib-c3000-1	Server	192.168.2.223	ProLiant DL385 G2	Microsoft(R) Windows(R)...
ib-c3000-2	Management Processor	192.168.1.211	Integrated Lights-Out ...	Embedded
ib-c3000-2	Management Processor	192.168.1.212	Integrated Lights-Out ...	Embedded
ib-c3000-5	Management Processor	192.168.1.215	Integrated Lights-Out ...	Embedded
ib-c3000-6	Management Processor	192.168.1.216	Integrated Lights-Out ...	Embedded
ib-c3000-6	Management Processor	192.168.1.222	Integrated Lights-Out ...	Embedded
ib-c3000-6	Management Processor	192.168.1.220	Integrated Lights-Out ...	Embedded
ibnti37	Server	192.168.2.213	ProLiant BL680c G5	LINUX
ibnti4	Server	192.168.2.214	ProLiant BL480c G1	LINUX
ibnti6	Server	192.168.2.230	ib4	HP-LUX B.11.31
ibnti1	Server	192.168.2.11	Virtual Platform	LINUX
ibnti2	Server	192.168.2.220	ProLiant DL380 G4	Microsoft(R) Windows(R)...
ibnti3	Server	192.168.2.211	ProLiant BL480c G1	Linux - XenServer Ente...
ibnti4	Server	192.168.2.212	ProLiant BL480c G1	Linux - XenServer Ente...
ibnti5	Server	192.168.2.215	ProLiant BL480c G1	Linux - XenServer Ente...

HP Business Service Management - Universal CMDB Administration

Agos-Pool Overview

Name	CPU Usage	Used Memory	Disks (avg / max KBs)	Network (avg / max KBs)	Address	Uptime
vm11	3% of 4 CPUs	28% of 4 GB	1/1	0/0	192.168.2.211	59 days 0 hours 54 minutes
vm12	0% of 1 CPU	90% of 256 MB	1/1	0/0	192.168.2.111, 192.168...	15 days 0 hours 20 minutes
vm21	0% of 1 CPU	90% of 256 MB	1/1	0/0	192.168.1.101, 192.16...	15 days 0 hours 20 minutes
vm51	0% of 4 CPUs	-	-	-	192.168.2.215	59 days 0 hours 54 minutes
vm52	0% of 2 CPUs	-	-	-	192.168.2.215	36 days 20 hours 11 minutes
vm61	0% of 1 CPU	-	-	-	192.168.2.216	59 days 0 hours 55 minutes
vm62	0% of 2 CPUs	-	-	-	192.168.2.216	36 days 20 hours 8 minutes
vm63	0% of 4 CPUs	-	-	-	192.168.2.216	59 days 0 hours 55 minutes
vm64	0% of 1 CPU	-	-	-	192.168.2.216	3 minutes
vm65	0% of 2 CPUs	-	-	-	192.168.2.216	36 days 20 hours 10 minutes

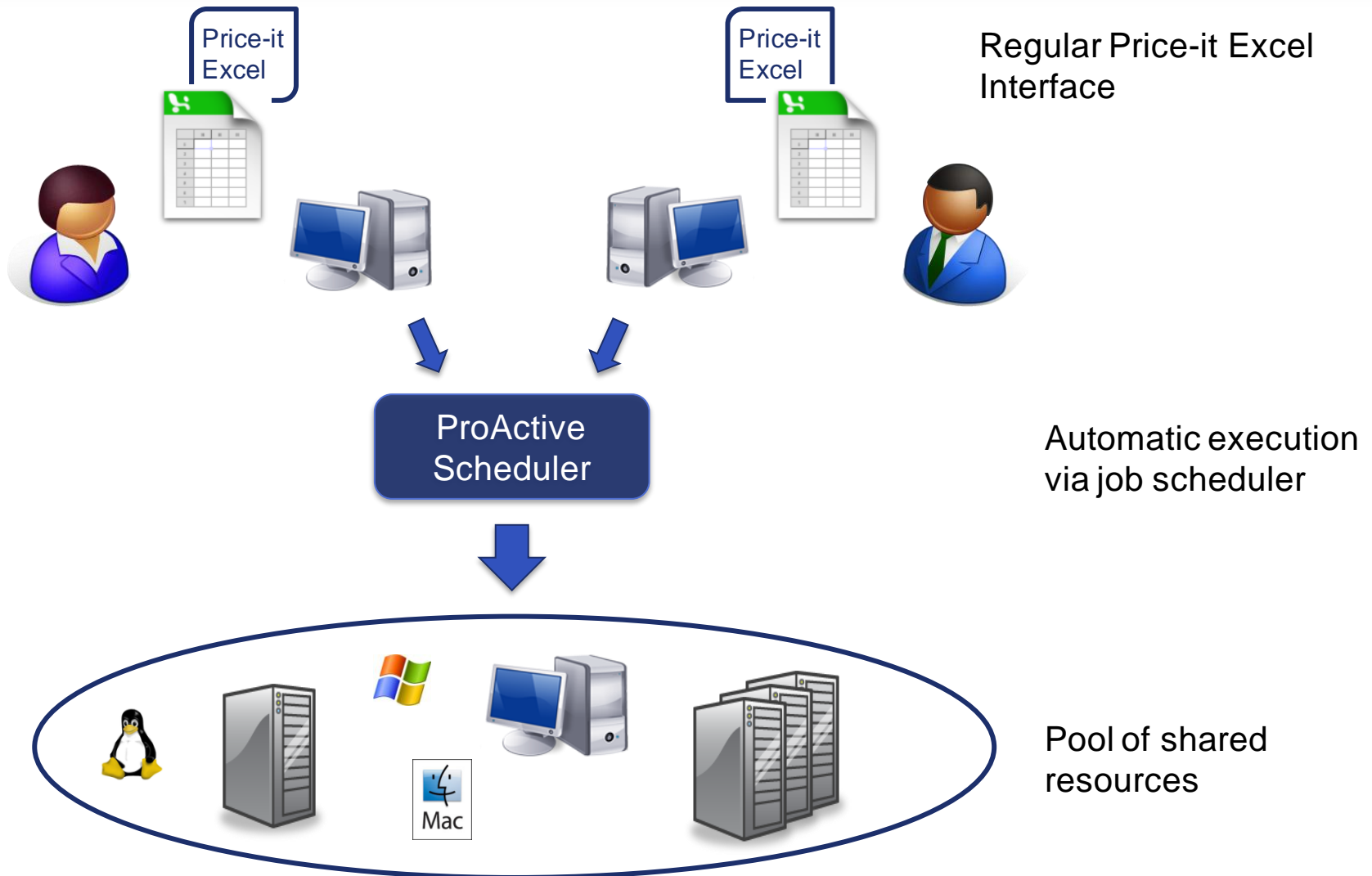


# UC 3: Acceleration of Financial Valuations

C++ library developed by Pricing Partners  
Pricing solution dedicated to highly complex derivatives,  
Greek computation

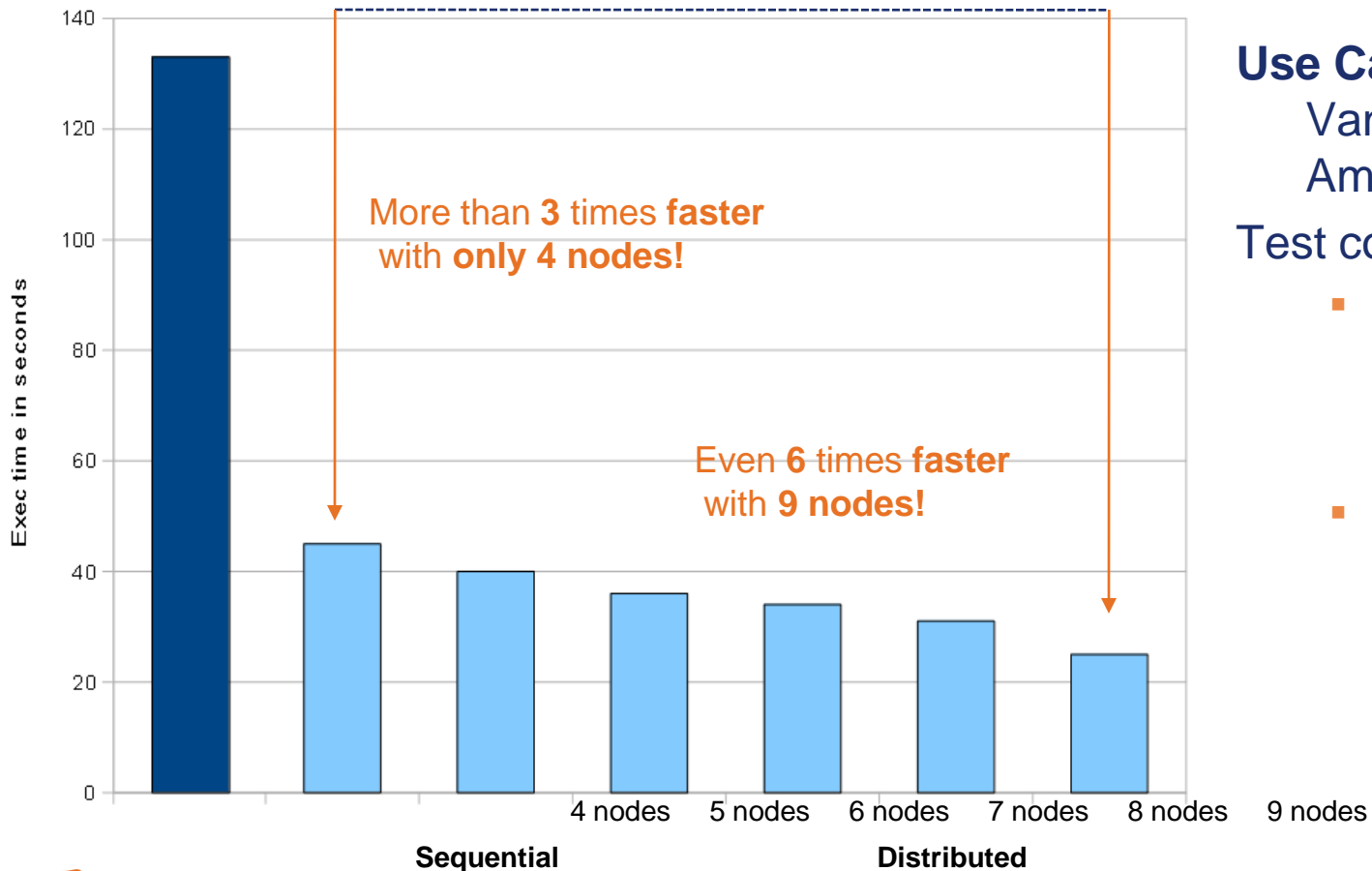
# How Does it Work?

## Price-it Computing Distribution



# Accelerated Price-it Performances

- ❑ **Increased Productivity:** Reduces Price-it Execution Time by 6 or more!



**Use Case:** Bermuda Vanilla, Model American MC

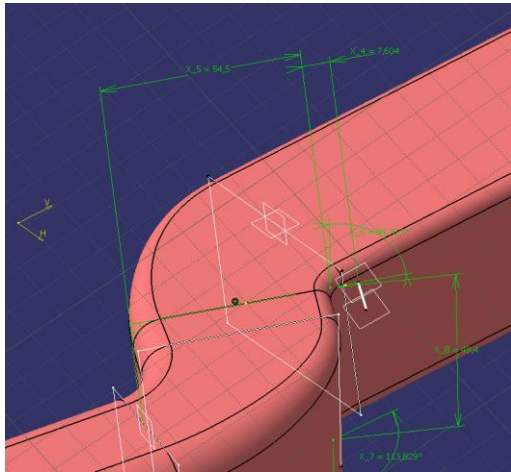
**Test conditions:**

- One computation is split in 130 tasks that are distributed
- Each task uses 300ko

# **Use Case 4: OMD2**

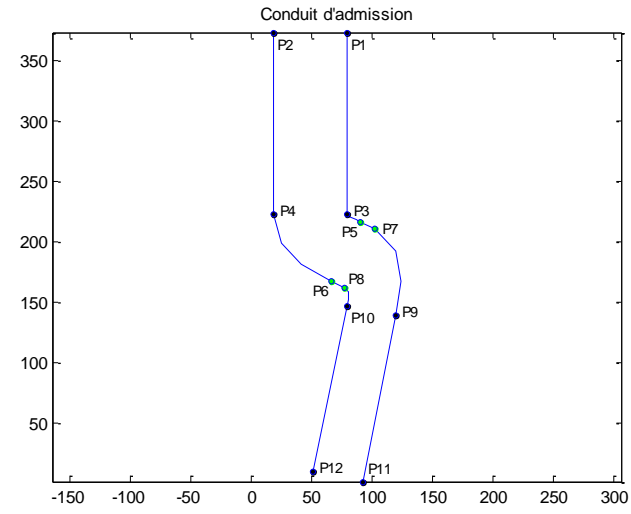
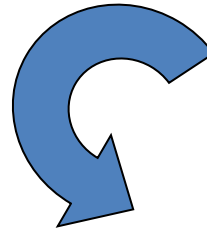
## **Distributed Multi-Disciplinary Optimizations**

# Coupling Mechanics, Aerodynamics ...



3D Air Conditionning

10min  
CPU



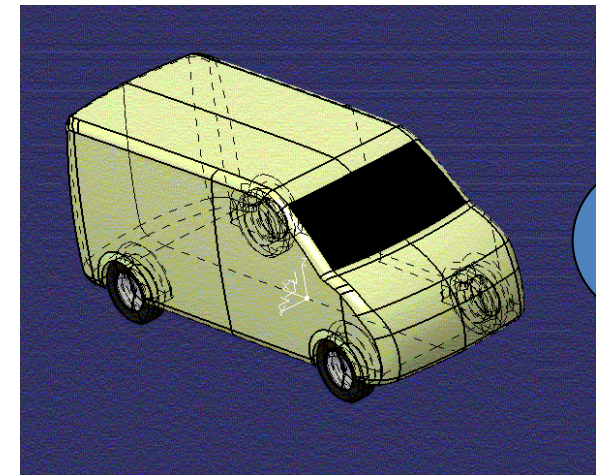
2D Air Conditionning

<1min  
CPU



Cylinder Head

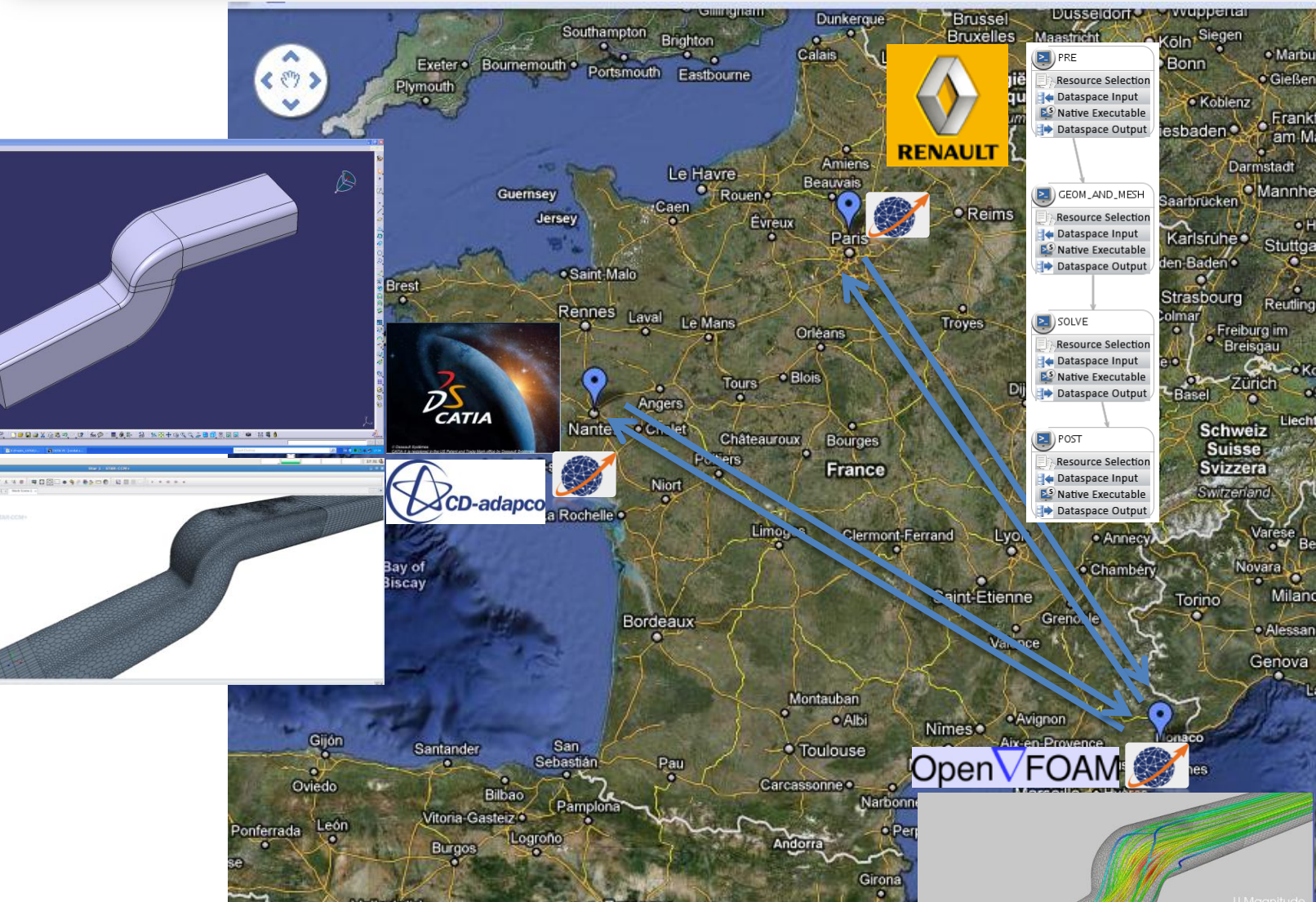
100h  
CPU



External  
Aerodynamic

1000h  
CPU

# ProActive OMD2 Demo



1000 Cores  
Production  
Cloud Portal



# Use Case 4-Bis: Hydrodynamic with K-Epsilon and FineMarine

**K-EPSILON**  
HYDRODYNAMIC & AERODYNAMIC



# Hydrodynamic Optimization: Workflow generated from a GUI

*ProActive Studio* → Graphical Workflow Editor

The screenshot displays the ProActive Studio graphical workflow editor. The main workspace shows a workflow diagram with the following structure:

- Pre\_computation (Start)
- Computation\_setup (Parent of Pre\_computation)
- Test\_case\_speed\_1 (Child of Computation\_setup)
- Test\_case\_speed\_2 (Child of Computation\_setup)
- Post\_processing\_speed\_1 (Child of Test\_case\_speed\_1)
- Post\_processing\_speed\_2 (Child of Test\_case\_speed\_1)
- Post\_processing\_speed\_3 (Child of Test\_case\_speed\_1)
- Test\_case\_speed\_3 (Child of Test\_case\_speed\_1)
- Post\_processing\_speed\_4 (Child of Test\_case\_speed\_2)
- Test\_case\_speed\_4 (Child of Test\_case\_speed\_2)

The Job Properties panel at the bottom is configured as follows:

Property	Value
Project Name	
Job Name	job_finemarine_1Host
Job Description	
Input Space URL:	
Output Space URL:	
Log File	\${ LOGS }/job_finemarine107Core2Host.log
Max number of executions for tasks	
Cancel Job On Error Policy	Cancel job as soon as one task fails
If an error occurs restart task	anywhere
Job Priority	Normal

Additional buttons in the Job Properties panel include: generic information, job classpath, and job variables.

# Real Live Demo: CFD Distributed // Workflow

# Hydrodynamic Optimization: Execution

The image displays a multi-panel software interface for hydrodynamic optimization. The top-left panel shows a workflow diagram with nodes for 'Post\_computation', 'Computation\_setup', and 'Test\_case\_speed'. The top-right panel is the 'FINE/Marine' application window, showing 'Project Mesh Solver' and 'CFView 8.8-2-3 : Subof\_computation\_1.cfv'. The bottom-left panel contains 'Job Properties' for 'job\_finemarine\_1host'. The bottom-right panel is a 3D visualization of a submarine in a fluid flow simulation, with a control panel on the left listing quantities like Pressure, Turbulent Kinetic Energy, and Mass Fraction. The bottom status bar shows execution results: 'Macro 'store/workspaces/yroux/simus/Subof/Subof\_computation\_1/post\_processing.py' has been executed.' and 'Mass Fraction : -6.87489e-21 -> 1' and 'Volume(<- iso): 218.561, Volume(>- iso): 741.107'.

Applications Places System | cmorandin@node2:/store/workspaces/yroux/simus | Cedric Morandin Tue Sep 21, 11:47 AM

FINE/Marine version 2.2-2 /store/workspaces/yroux/simus/Subof/Subof.1ec

Project Mesh Solver

CFView 8.8-2-3 : Subof\_computation\_1.cfv

File Edit Geometry Render Quantity Representation Update View Window Preferences Macros

sub\_marine  
 D1.B1.S12 Mirror  
 D1.B1.S13 External  
 D1.B1.S14 External  
 D1.B1.S15 External  
 D1.B1.S16 External  
 D1.B1.S17 External  
 ISO Mass Fraction=C

Filter (regexp)

Quantities

- Pressure (normal stress)
- Turbulent Kinetic Energy
- Turbulent Frequency
- Mass Fraction
- Turbulent Viscosity
- Velocity
- Relative velocity
- Solid Data
- Mechanics

Representations

Grid

Plots & Values

Contours & Iso Values

Integrals

Opacity

0.58

Lighting & shadows

Material

Macro 'store/workspaces/yroux/simus/Subof/Subof\_computation\_1/post\_processing.py' has been executed.

Mass Fraction : -6.87489e-21 -> 1 | Volume(<- iso): 218.561, Volume(>- iso): 741.107

# Hydrodynamic: Remote Steering during execution

The screenshot shows a remote VNC session. On the left, a terminal window displays the following commands and output:

```
total 8
drwxr-xr-x 2 cmorandi
-rw-r--r-- 1 cmorandi
cmorandi@epoch:~/git/c
cmorandi@epoch:~/git/c
cmorandi@epoch:~/git/c
total 4
-rw-r--r-- 1 cmorandi
cmorandi@epoch:~/git/c
cmorandi@epoch:~/git/c
.vim/ .viminfo .v
cmorandi@epoch:~/git/c
.vim/ .viminfo .v
cmorandi@epoch:~/git/c
ftdetect/ ftdplugins/
cmorandi@epoch:~/git/c
total 20
drwxr-xr-x 2 cmorandi
drwxr-xr-x 2 cmorandi
drwxr-xr-x 2 cmorandi
drwxr-xr-x 2 cmorandi
drwxr-xr-x 2 cmorandi
cmorandi@epoch:~/git/c
ftdetect/ ftdplugins/
cmorandi@epoch:~/git/c
ftdetect/ ftdplugins/
cmorandi@epoch:~/git/c
total 56
-rw-r--r-- 1 cmorandi
cmorandi@epoch:~/git/c
total 4
-rw-r--r-- 1 cmorandi
cmorandi@epoch:~/git/c
total 4
-rw-r--r-- 1 cmorandi
cmorandi@epoch:~/git/c
r vnc-testVNC:0

TigerVNC Viewer for X
Copyright (C) 2002-200
Copyright (C) 2000-200
Copyright (C) 2004-200
See http://www.tigervn

Wed Oct 6 15:47:13 20
CConn: connecte
CConnection: Server s
CConnection: Using RF
TXImage: Using de
CConn: Using pi
CConn: Using Ti
```

The main window is CFView 8.8-2-3: Subof\_computation\_1.cfv. It displays a 3D model of a submarine with streamlines. The sidebar contains the following sections:

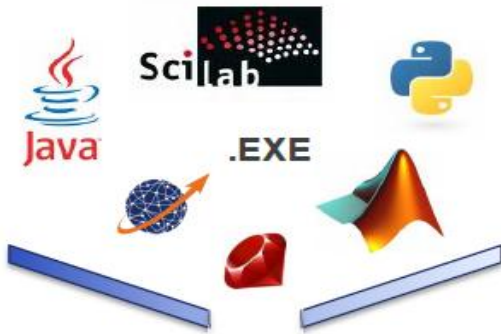
- Surfaces**
  - sub\_marine
  - D1.B1.S12 Mirror
  - D1.B1.S13 External
  - D1.B1.S14 External
  - D1.B1.S15 External
  - D1.B1.S16 External
  - D1.B1.S17 External
  - ISO Mass Fraction=0.5 .D1
- Quantities**
  - Pressure (normal stress)
  - Turbulent Kinetic Energy
  - Turbulent Frequency
  - Mass Fraction
  - Turbulent Viscosity
  - Velocity
  - Relative velocity
  - Solid Data
  - Mechanics
- Representations**
  - Grid
  - Plots & Values
  - Contours & Iso Values
  - Integrals
  - Opacity

The status bar at the bottom of the CFView window shows: Mass Fraction : -6.87489e-21 -> 1 and X: 1.34192 Y: 1.28157 Z: -1.65029.

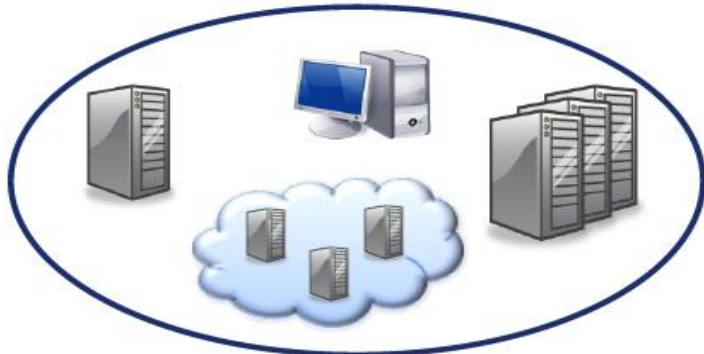
# Conclusions



# Conclusion: Technology Preview



ProActive  
Scheduling



❑ ProActive Fine Grain CLOUD management:

➔ Pricing at the second (like GSM)

❑ Open Source Cloudware Initiative (OSCi)



➔ Elastic Clouds

<http://ProActive.inria.fr>



# Industrial (1750) & Cloud Revolution Compared

	Industrial Revolution	Cloud Revolution
<b>Concept</b>	Mechanization and centralization of manufacturing activities	Computing as a Utility Centralization of Data Center
<b>Technology</b>	Supporting new technos (Mechanic, Tool Machines, etc.)	Distributed Computing Virtualization Multi-Cores Network
<b>Socio Economical Factors</b>	Large new demand was ready to use the new offer. (A change in business attitude & organization)	IT Cost Reduction Pressure CIO Nightmare CEO Out-of-DataCenter CapEx

→ All elements converge for a strong Cloud Revolution

Sources & Inspiration: Simon Wardley (CSC) Scott Stewart







<http://proactive.inria.fr>