Cloud Computing Revolution

D. Caromel, et al.

Agenda

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

Cloud: Pay as you Go
Opex vs. Capex

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)

ProActive Parallel Suite

1. Background

ProActive Parallel Suite

OASIS (HC: 35)

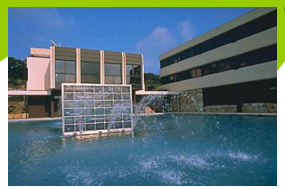
ProActive Parallel Suite

- Researchers (5):
  - D. Caromel (UNSA, Det. INRIA
  - E. Madelaine (INRIA)
  - F. Baude (UNSA)
  - F. Huet (UNSA)
  - L. Henrio (CNRS)
- PhDs (11):
  - Antonio Cansado (INRIA, Coni
  - Brian Amedro (SCS-Agos)
  - Cristian Ruz (INRIA, Conicyt)
  - Elton Mathias (INRIA-Cordi)
  - Imen Filali (SCS-Agos / FP7 S
  - Marcela Rivera (INRIA, Conicy
  - Muhammad Khan (STIC-Asia)
  - Paul Naoumenko (INRIA/Régio
  - Viet Dung Doan (FP6 Bionets)
  - Virginie Contes (SOA4ALL)
  - Guilherme Pezzi (AGOS, CIFR
- + Visitors + Interns

Located in Sophia Antipolis, between Nice and Cannes,
Visitors Welcome!

Activeeon SCALE BEYOND LIMITS

8 INRIA's Research Centres



INRIA Lille
Nord Europe

INRIA Paris
Rocquencourt

INRIA Nancy
Grand Est

INRIA
Saclay
Île-de-France

INRIA Rennes
Bretagne Atlantique

INRIA Grenoble
Rhône-Alpes

INRIA Bordeaux
Sud-Ouest

3 800 HC, 217 M Euro

2 900 Scientists
- 1200 Researchers, Faculty members
- 1200 Doctoral students
- 500 Post-Doct & Visiting scientists

1 000 Engineers, Technicians and Staff

8 Research Centres in France
68 Associated Teams worldwide

4 000 Scientific Publications / year
230 Active patents

89 Innovative companies created

Startup Company Born of INRIA

ActiveEon
SCALE BEYOND LIMITS

Some Customers: CEA, THALES, orange

Some Partners: HP, BULL Architect of an Open World, Intel Software Partner, NVIDIA, ORACLE, Microsoft, CARRI Systems

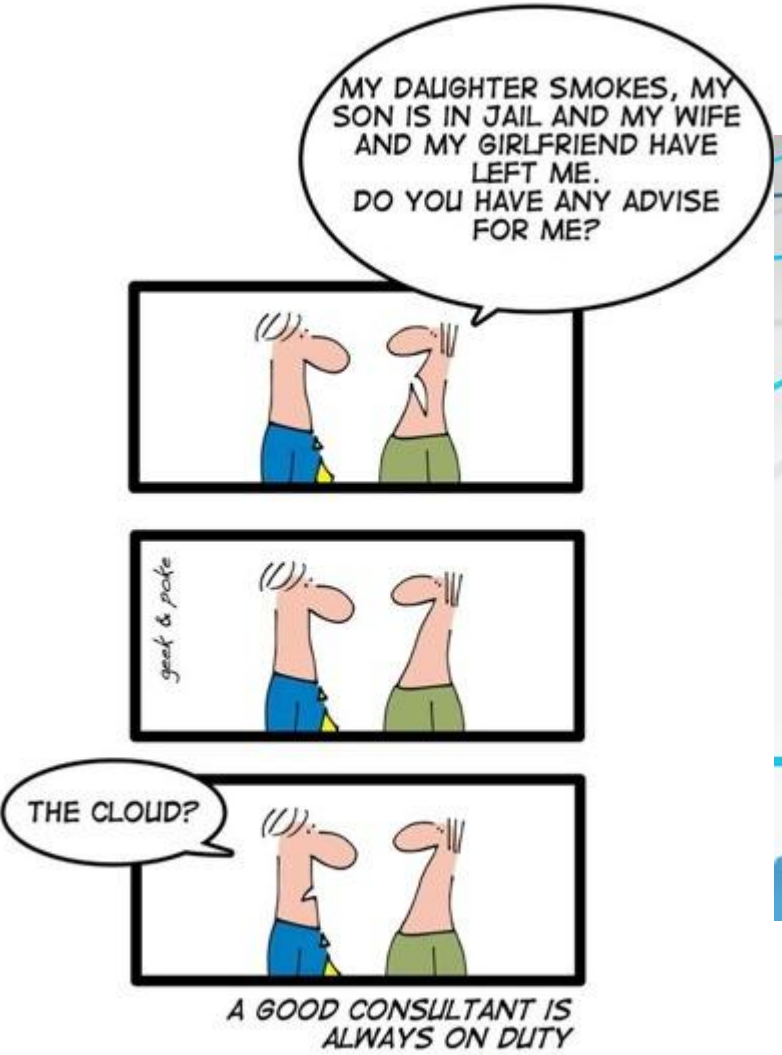
- Co-developing, Support for ProActive Parallel Suite
- Worldwide Customers: Fr, UK, Boston USA

ProActive Parallel Suite

2. Cloud Computing

ProActive Parallel Suite

The CLOUD Solution



Source: ScienceDaily

ProActive Parallel Suite

Clouds: Basic Definition

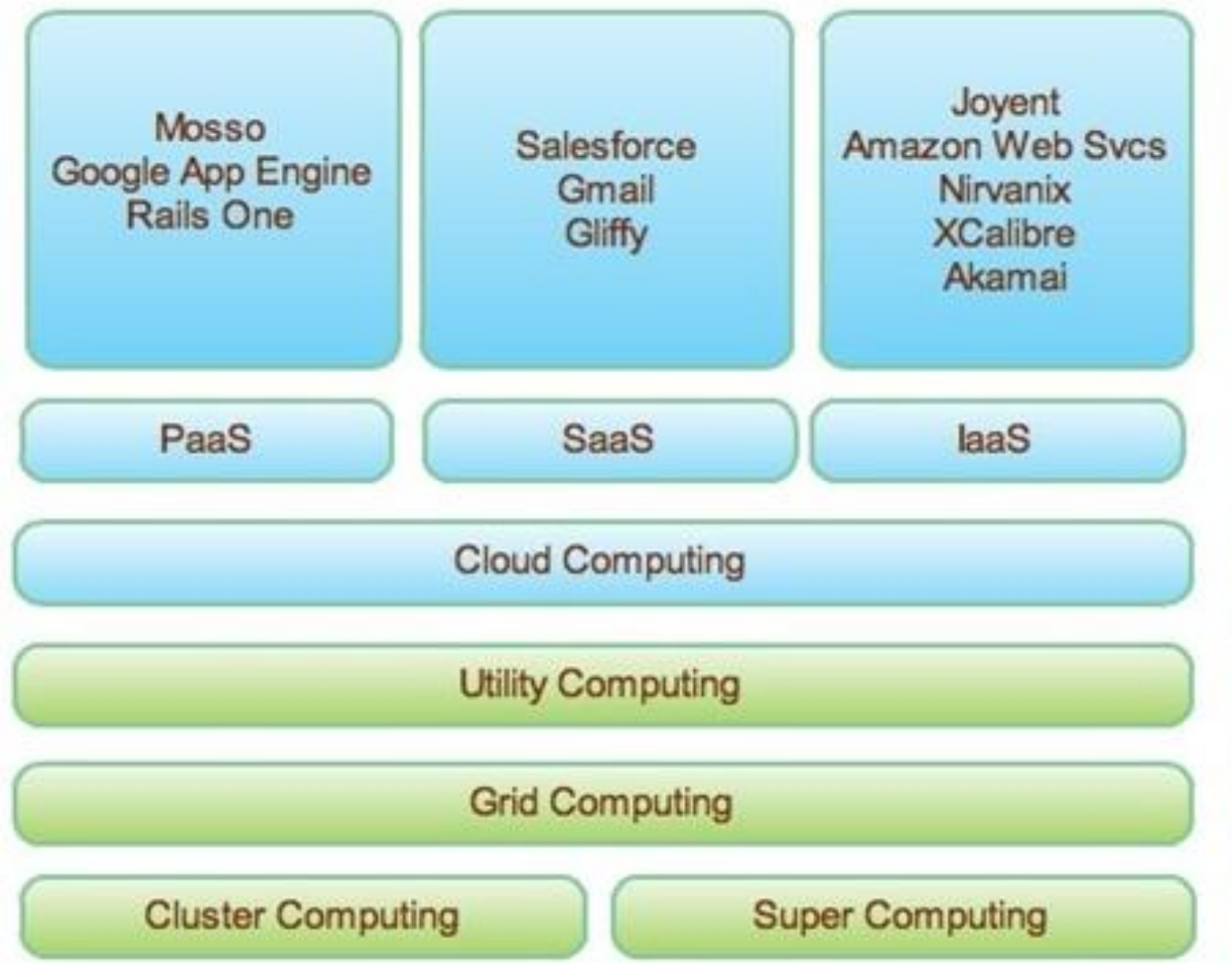
- Dynamically scalable, often virtualized resources
- Provided as a service over the Internet
- Users need not have knowledge of, expertise in, or control over the technology infrastructure

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

ProActive Parallel Suite

Clouds in Picture



From [Joseph Kent Langley]

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

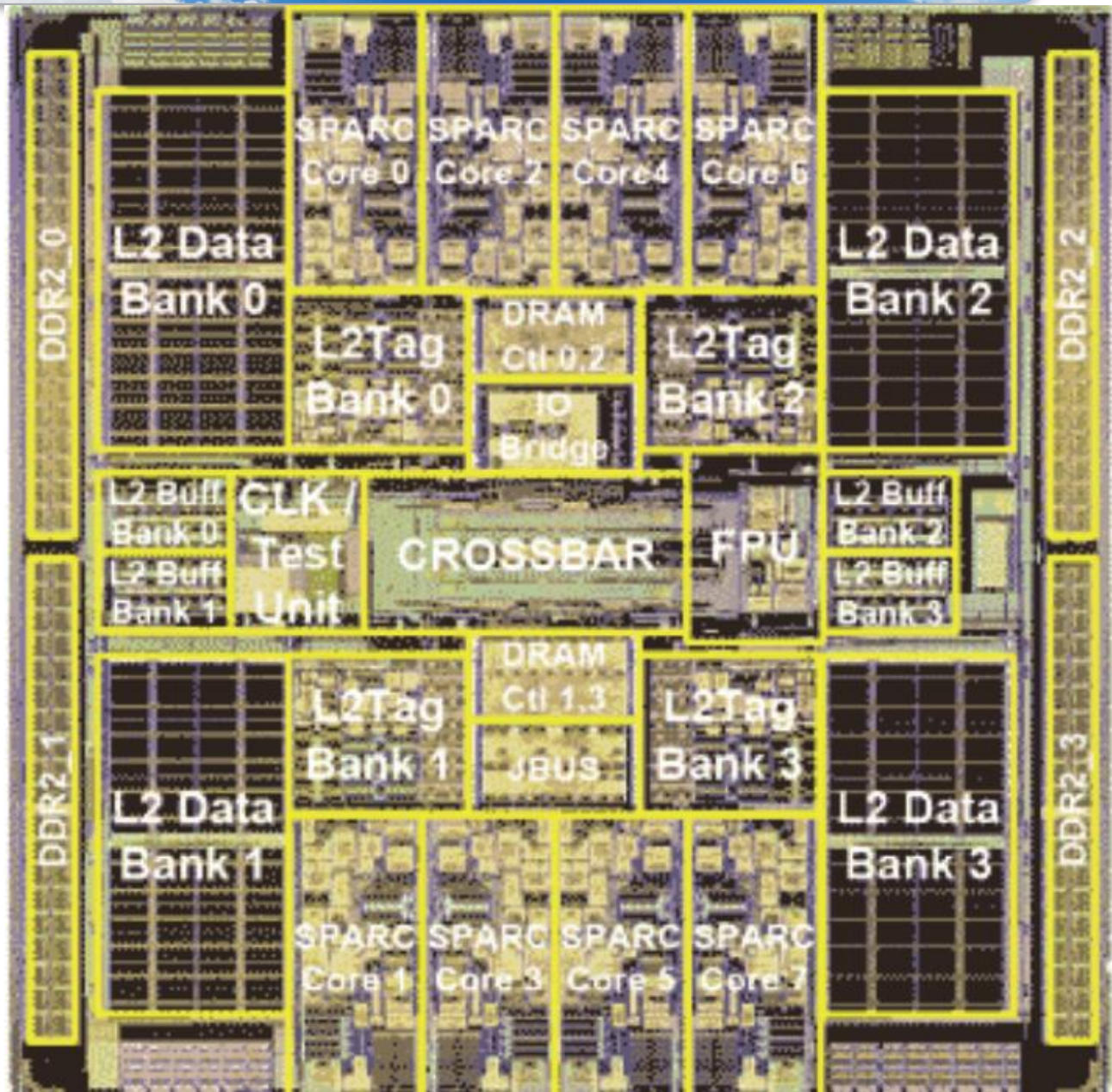
ProActive Parallel Suite


Multi-Core Push

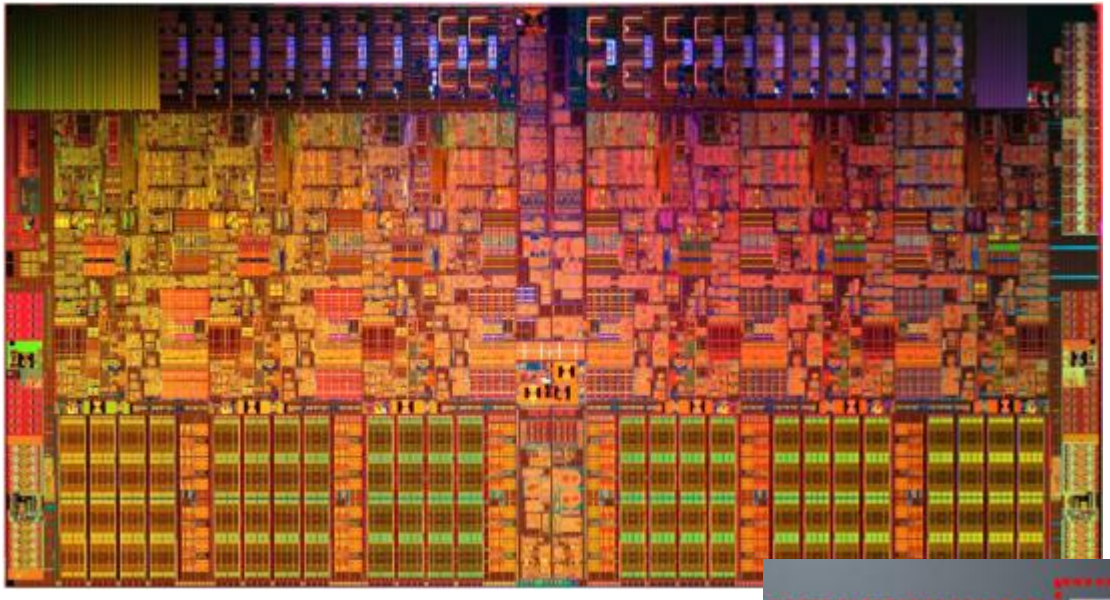
Symetrical Multi-Core: 8-ways Niagara II

- 8 cores
- 4 Native threads per core

- Linux see 32 cores!

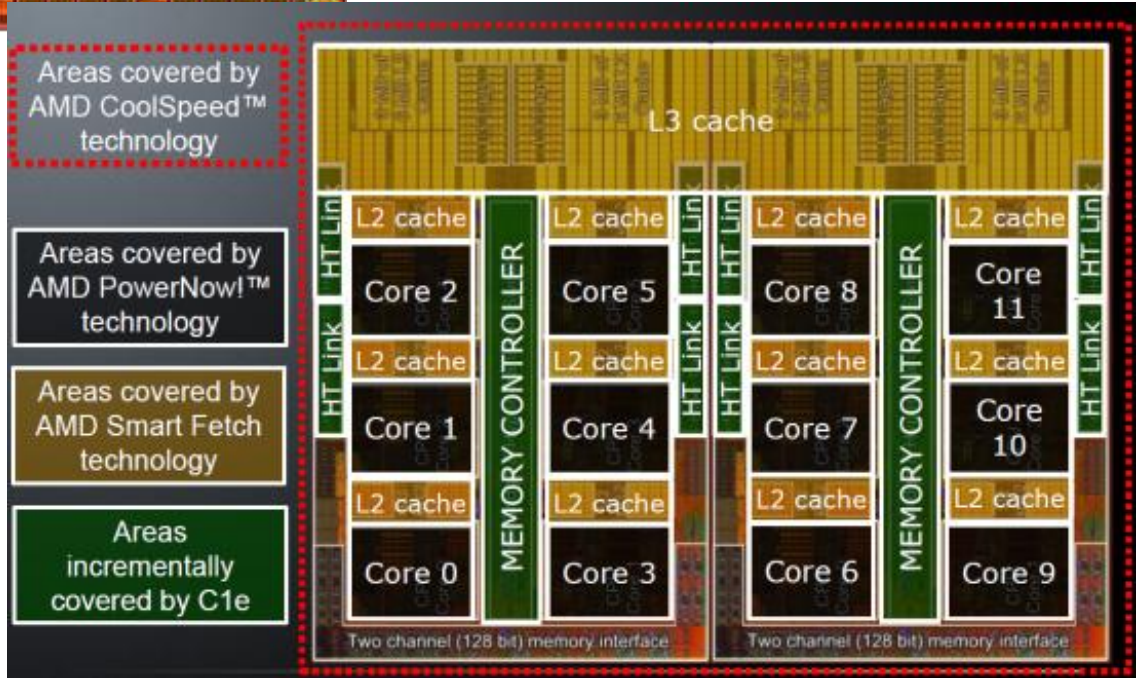


Today Off The Shelf Multi-Cores, 3 GHz



Intel Xeon 5670,
6 cores

AMD's Opteron 6174,
“Magny-Cours”,
12 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

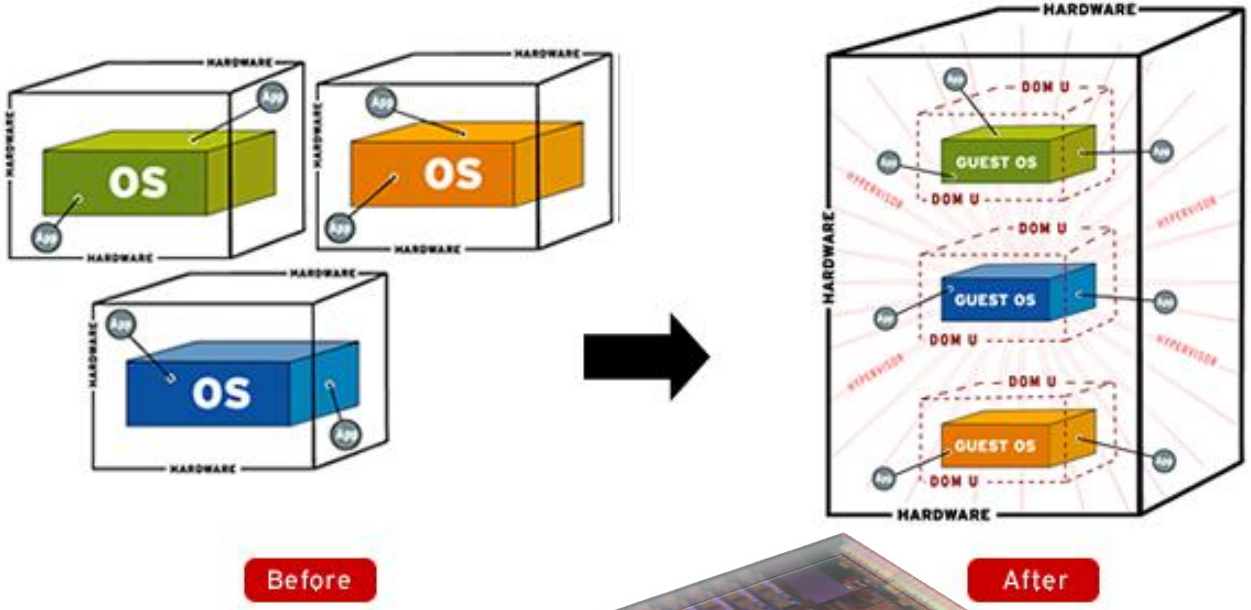
- 1 Million Cores Parallel Machines in 2014
- 100 M cores coming in 2020

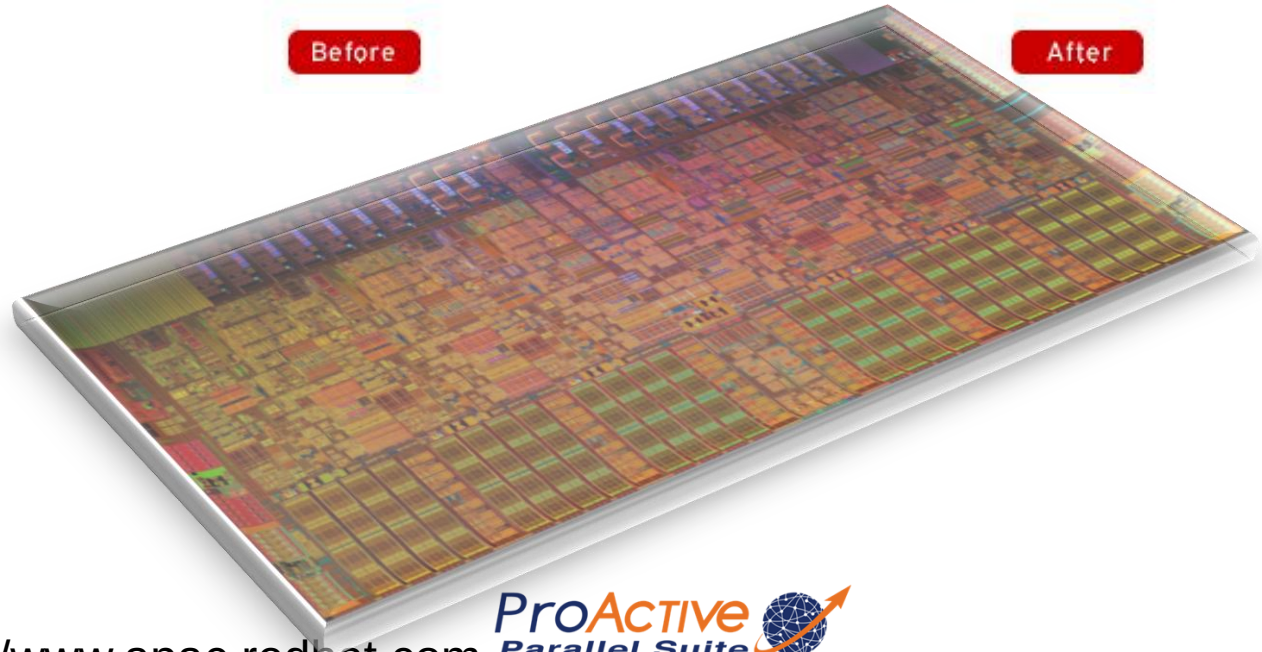
- Multi-Cores are NUMA, and turning Heterogeneous (GPU)
- They are turning into SoC with NoC

ProActive Parallel Suite

ProActive Parallel Suite

Virtualization





Source: http://www.apac.redhat.com

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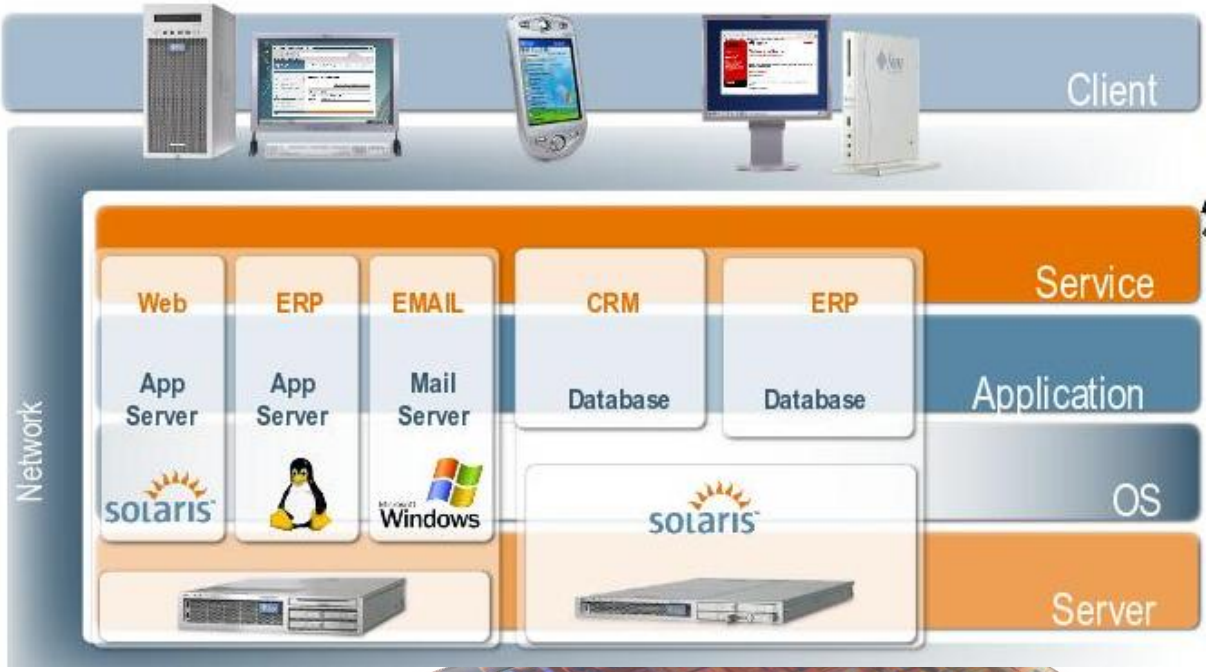
Virtualization



Sun, Blog [Marc Hamilton]

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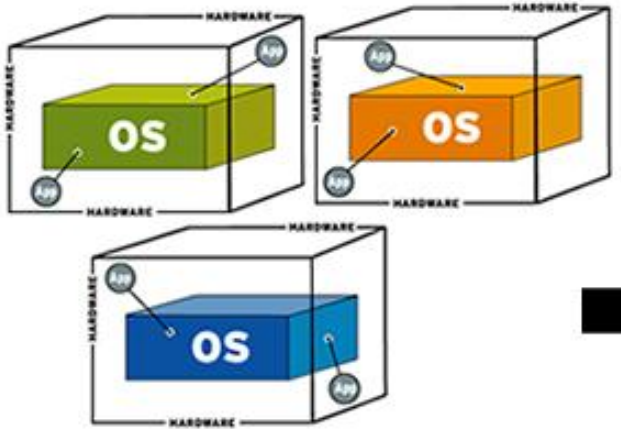
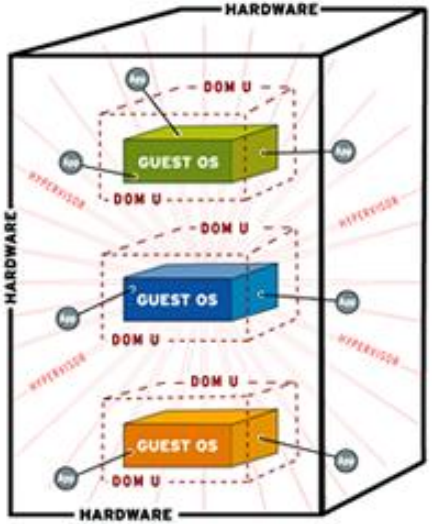
Virtualization





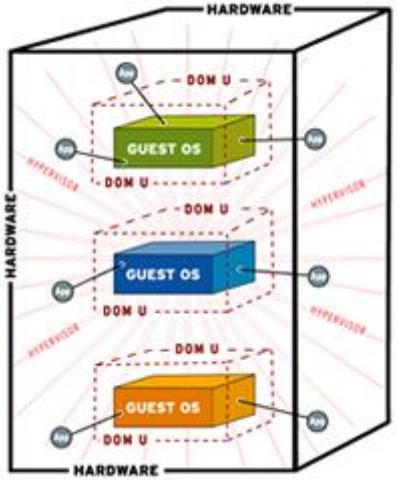
Before

After

What we Used to do as Syst. Admin.

ProActive Parallel Suite

With Virtualization + Software Appliance



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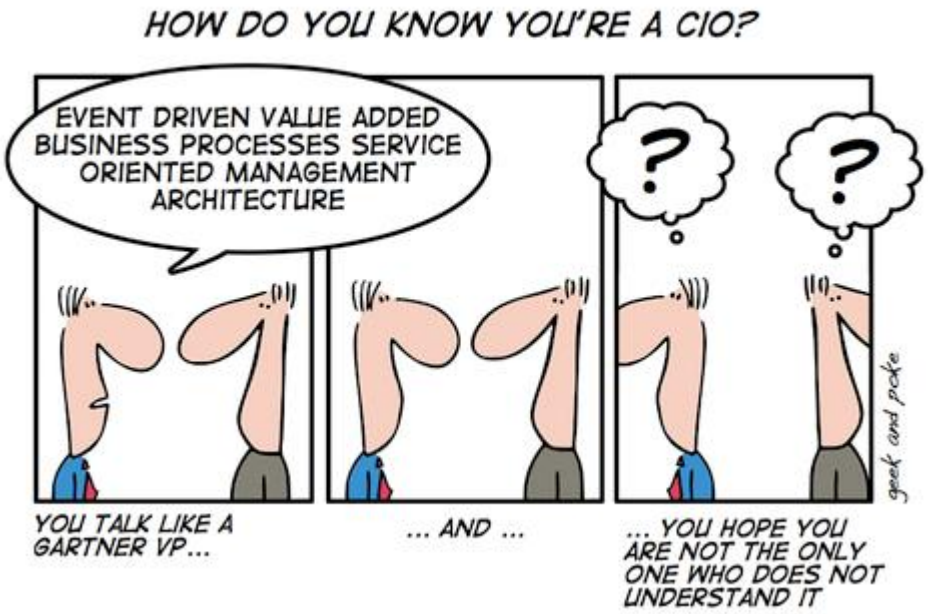
Attitude and Behavior Shifts: CIO Nightmare



- Technology is getting too complex … even for CIO (not for CTO)
- No longer want to buy rack of servers or storage or network device
- Want to by Services
- Want to Pay per Use

- CBA Australian bank Group Executive and CIO, Michael Harte, announced their move to cloud computing.
- "We *will never buy another data center*"

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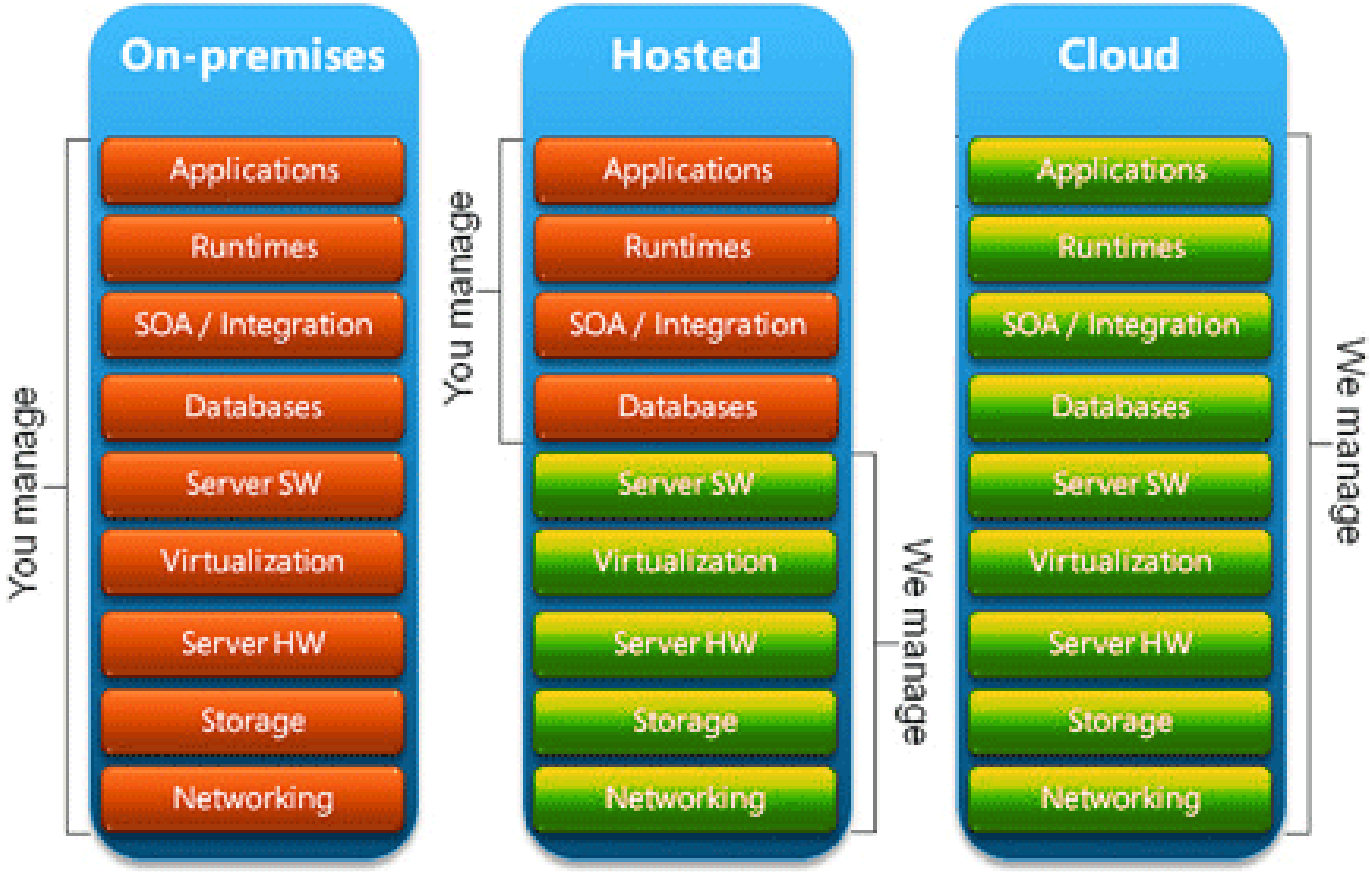
Administration Burden



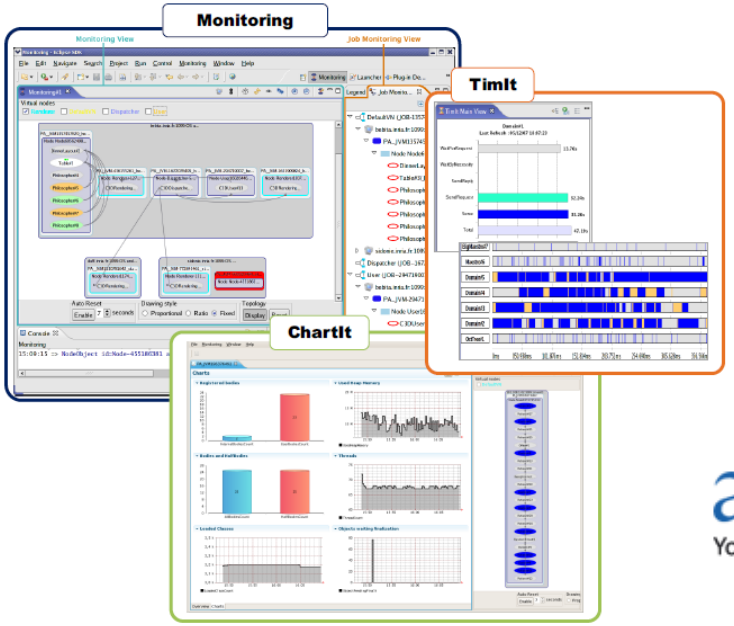
ProActive Parallel Suite

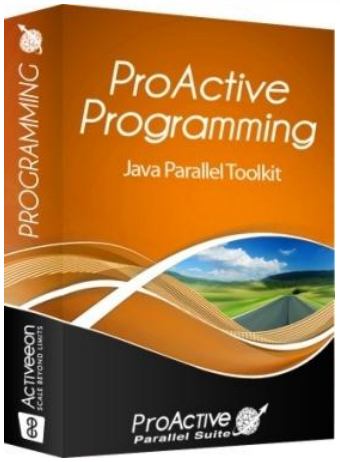
Source: Save9

3. ProActive Parallel Suite

Cloud Solution: ProActive Parallel Suite

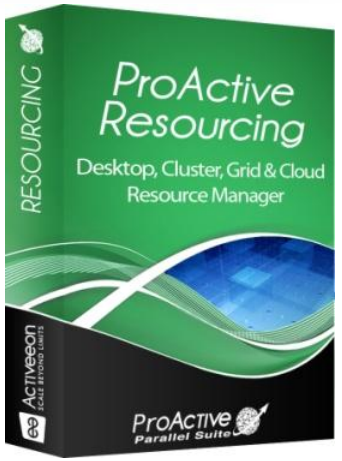
ProActive Parallel Suite





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

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ProActive Programming: Active Objects

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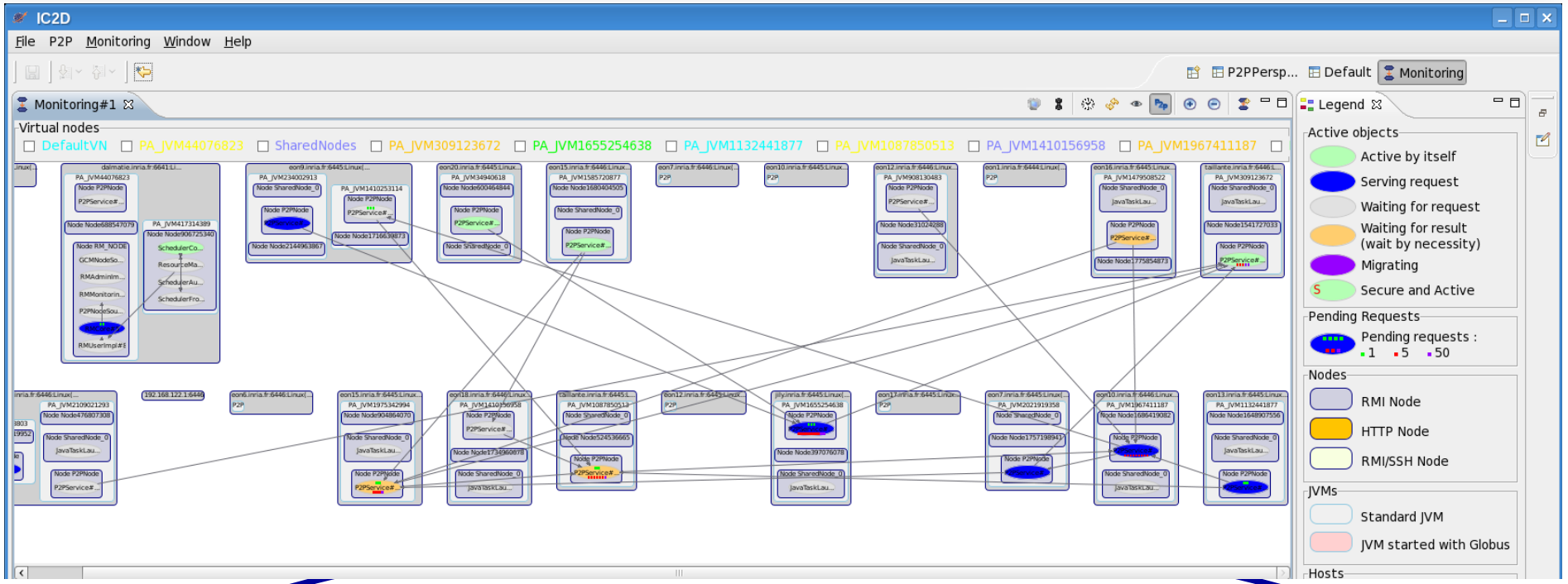
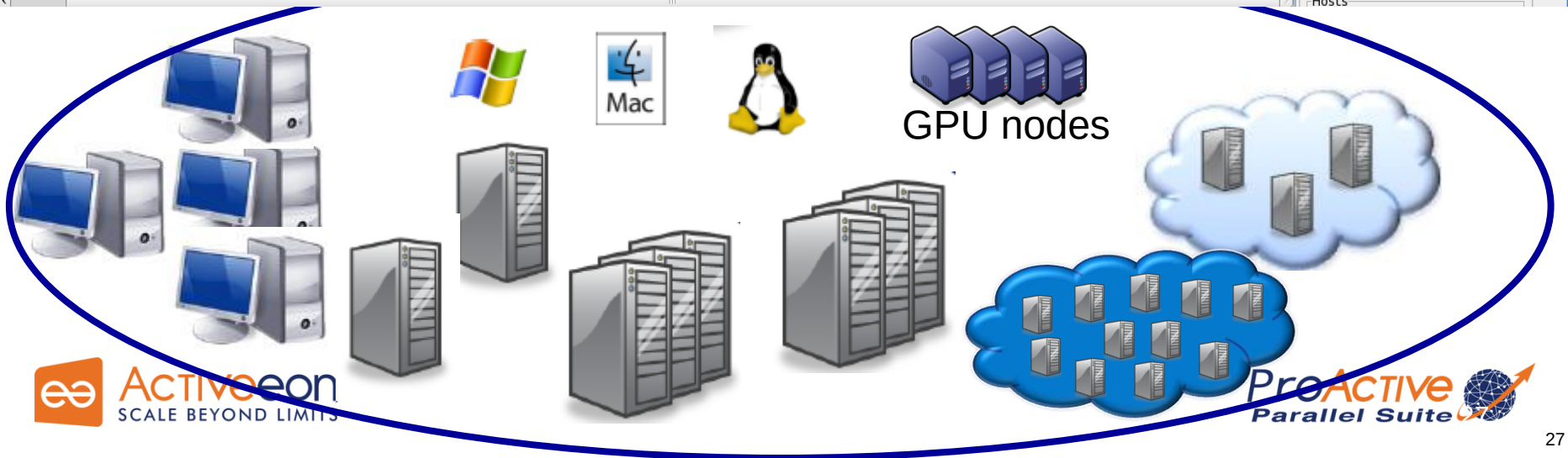
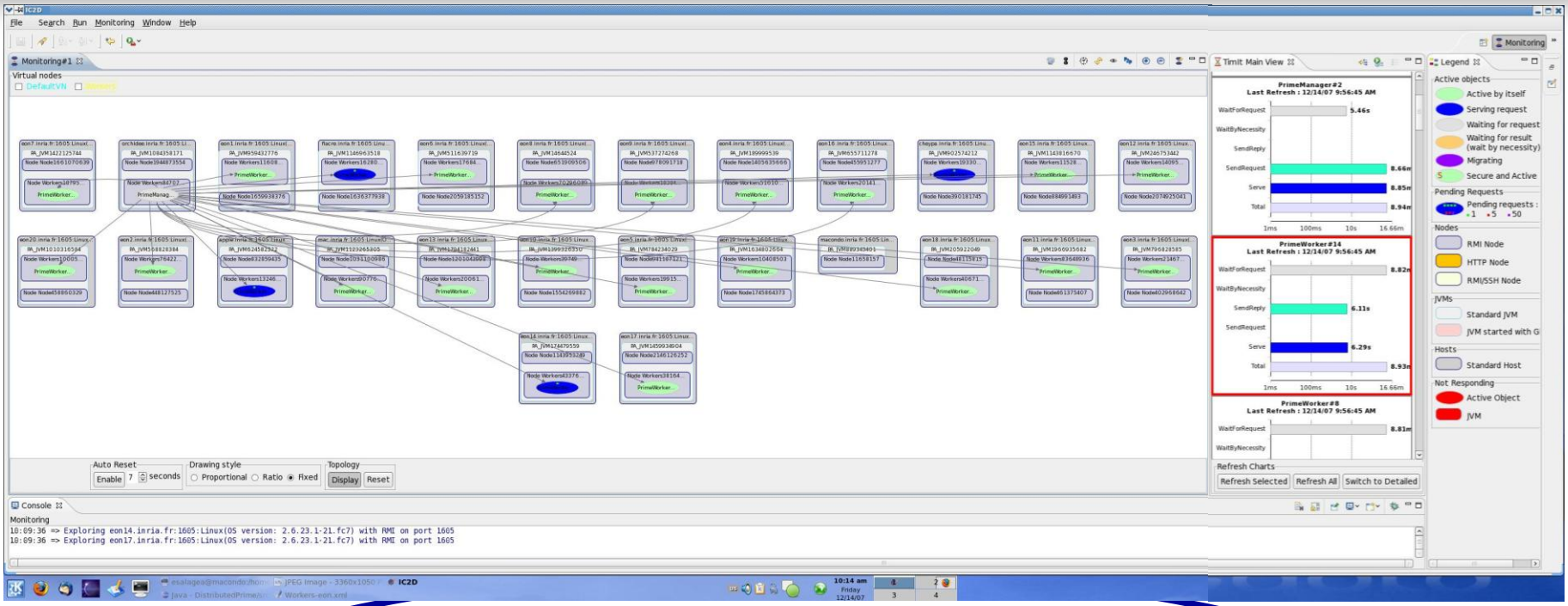
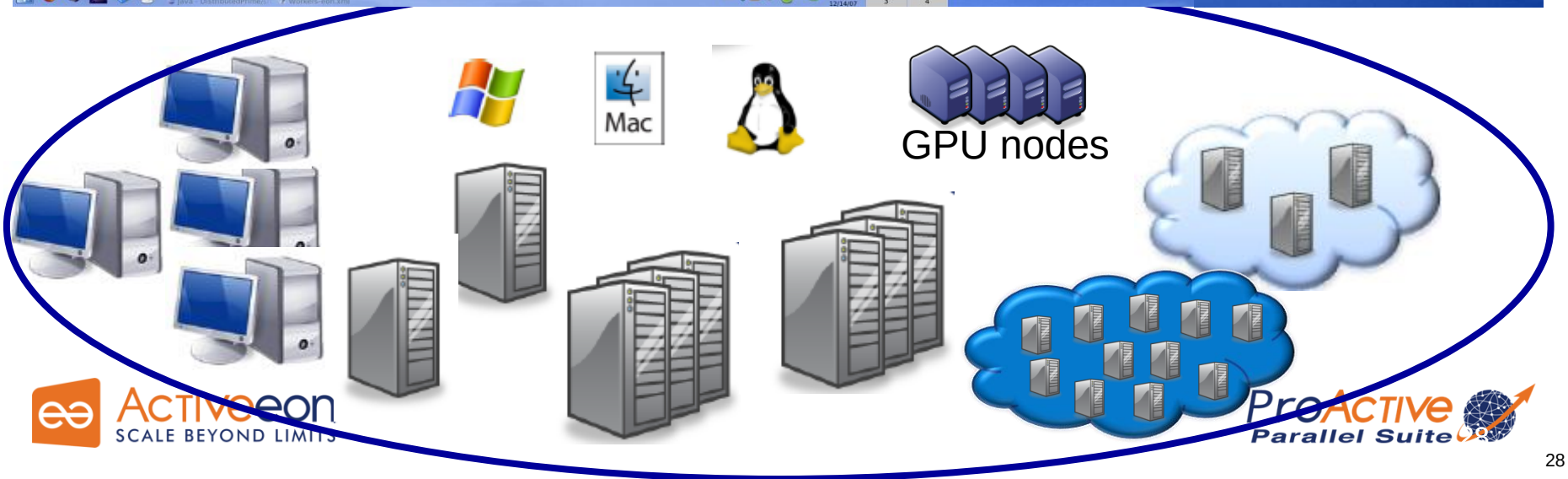
ProActive Programming View





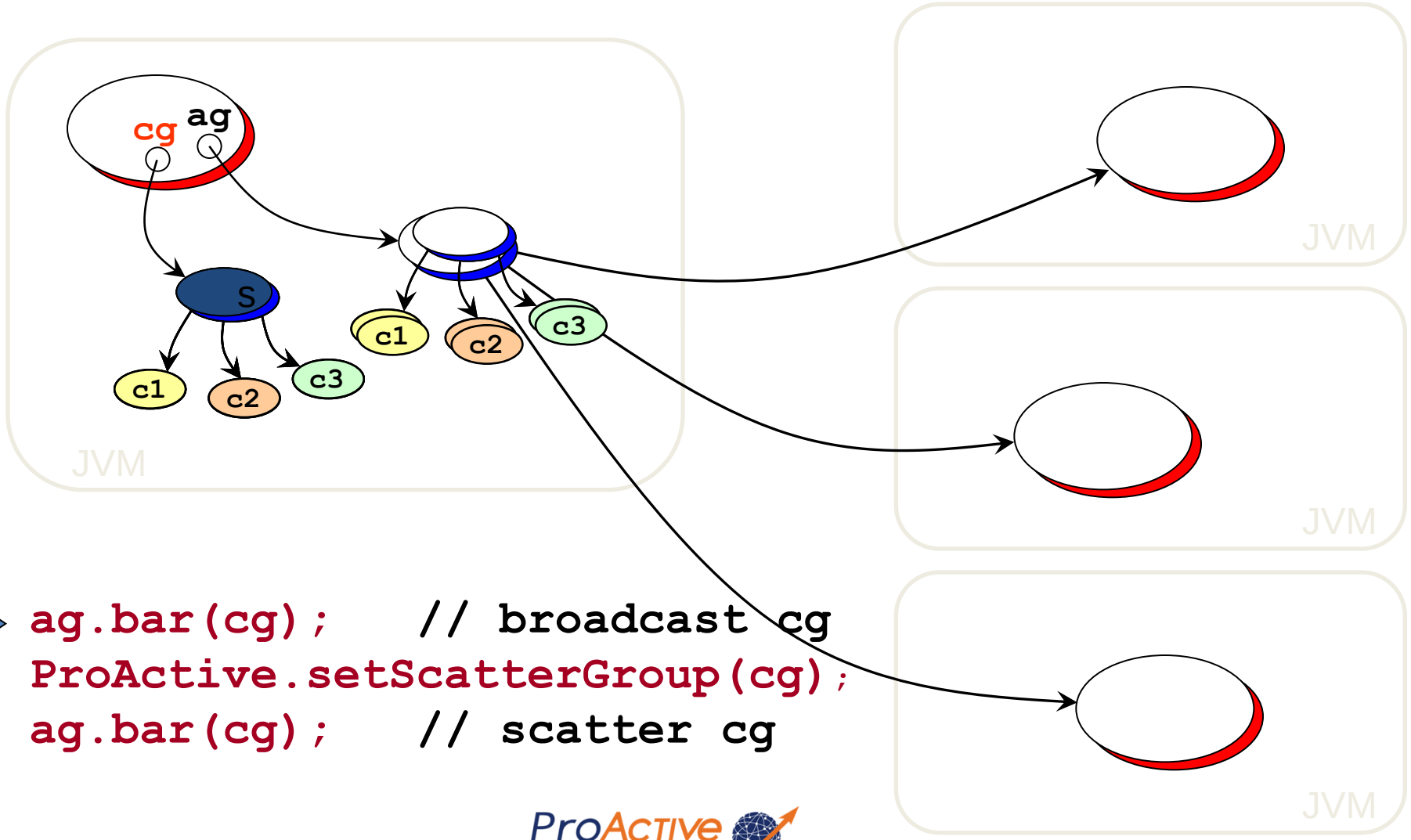
ProActive Programming View





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
```

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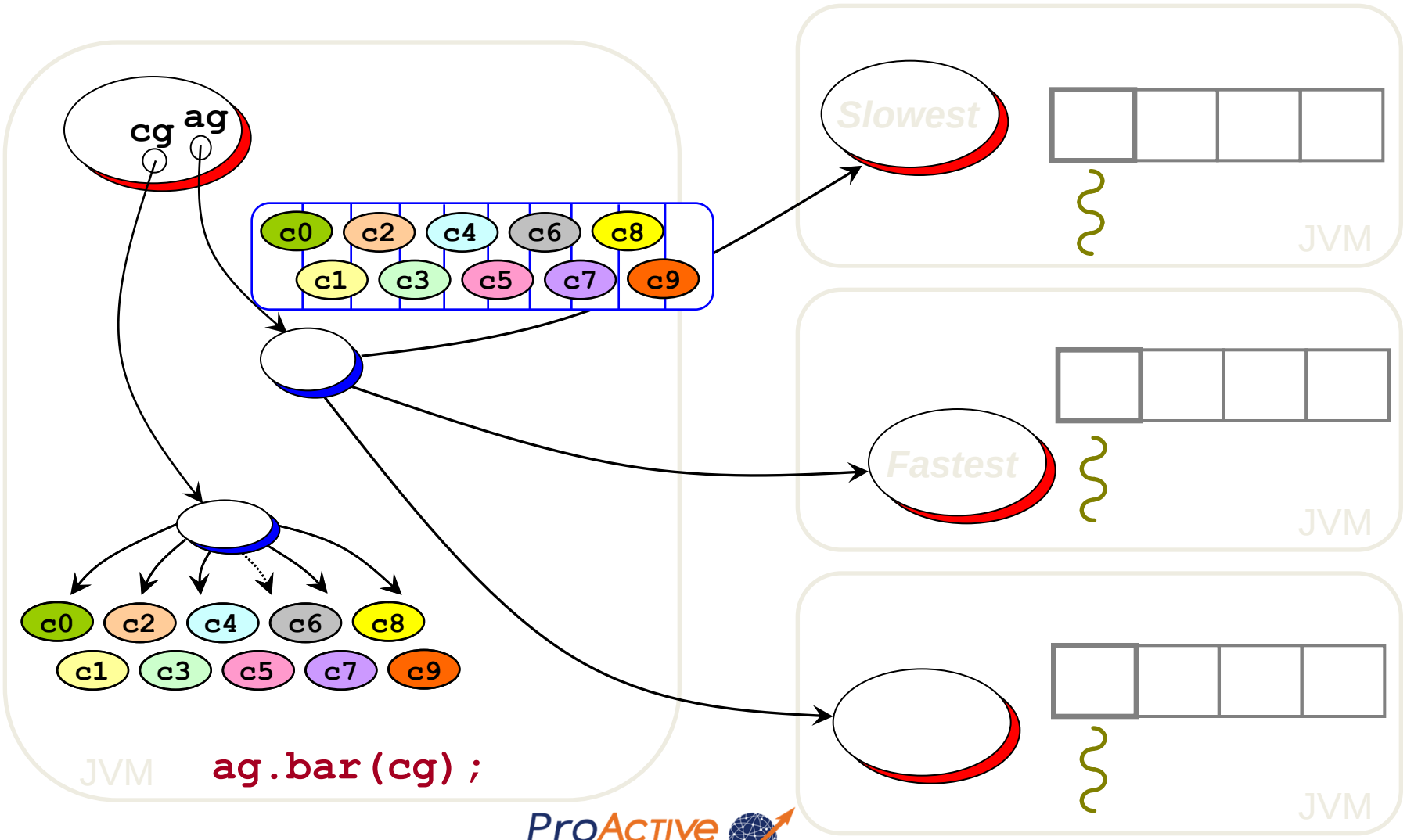
Dynamic Dispatch Group



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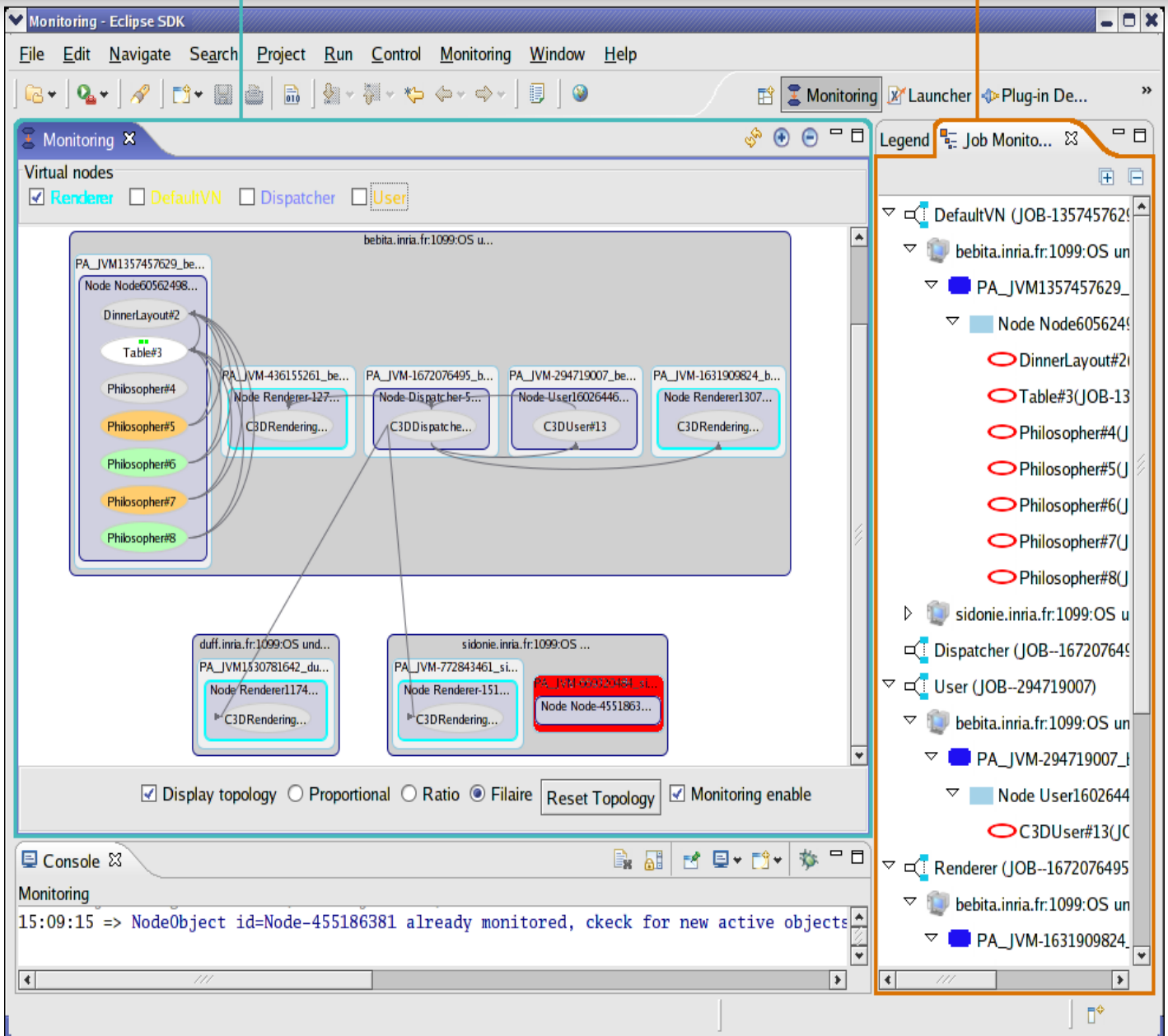
IC2D: Optimizing

ProActive Parallel Suite

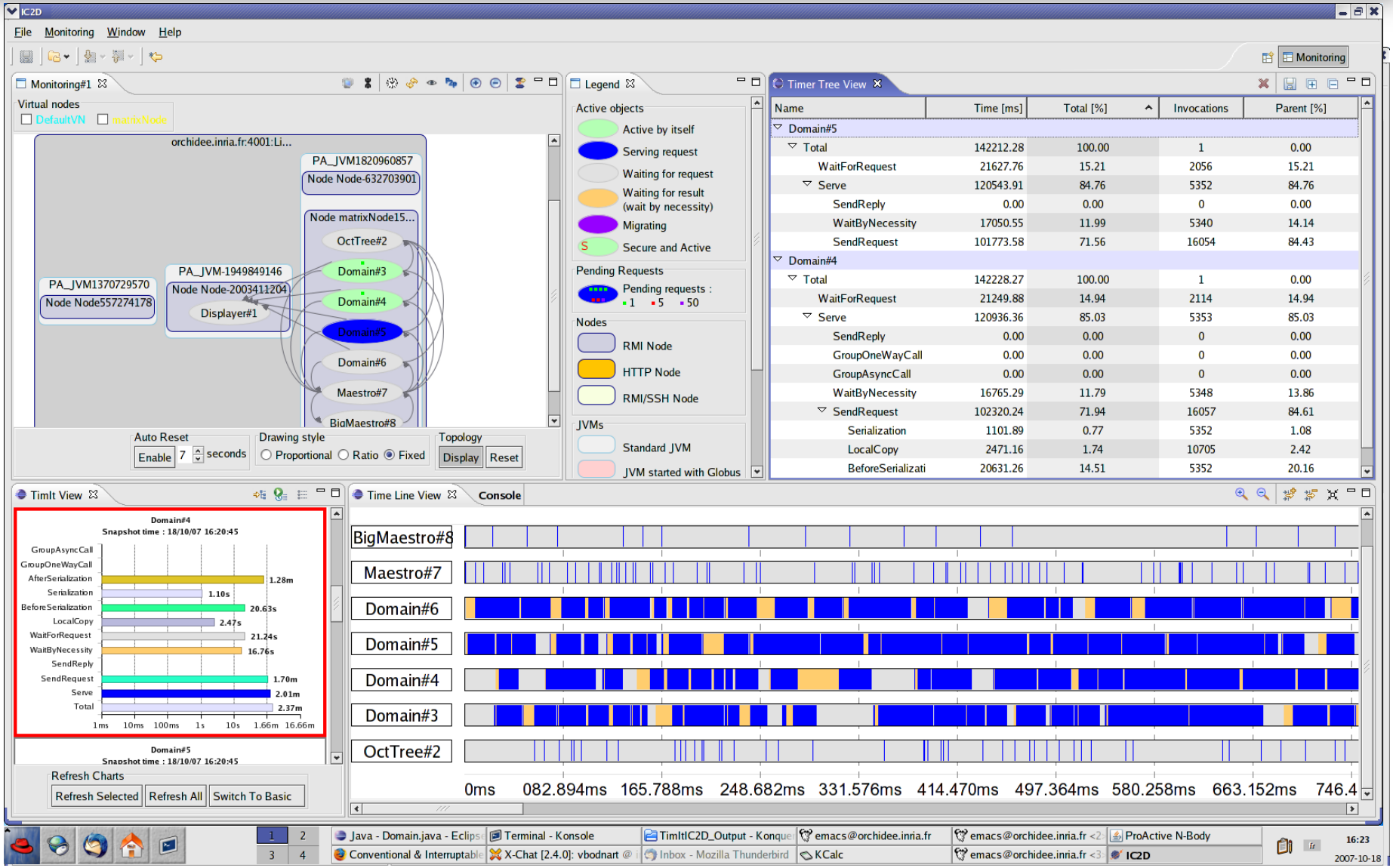
IC2D

Monitoring View

Job Monitoring View



IC2D



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Video 1:
IC2D Optimizing
Monitoring, Debugging, Optimizing

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Scheduling & Resourcing

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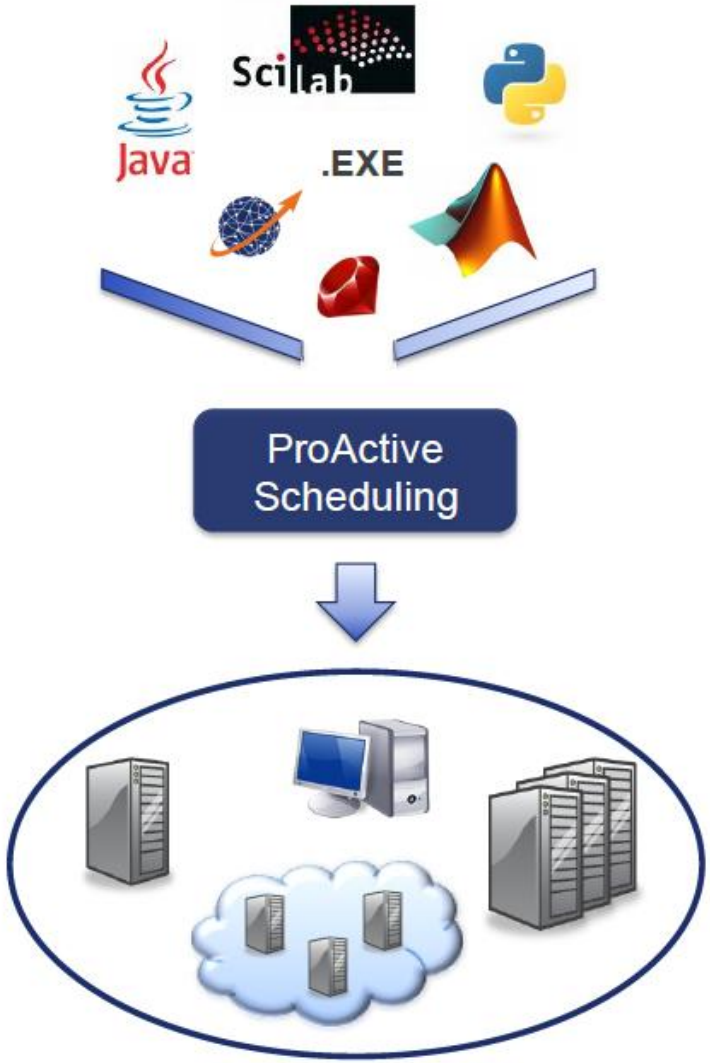
ProActive Scheduling



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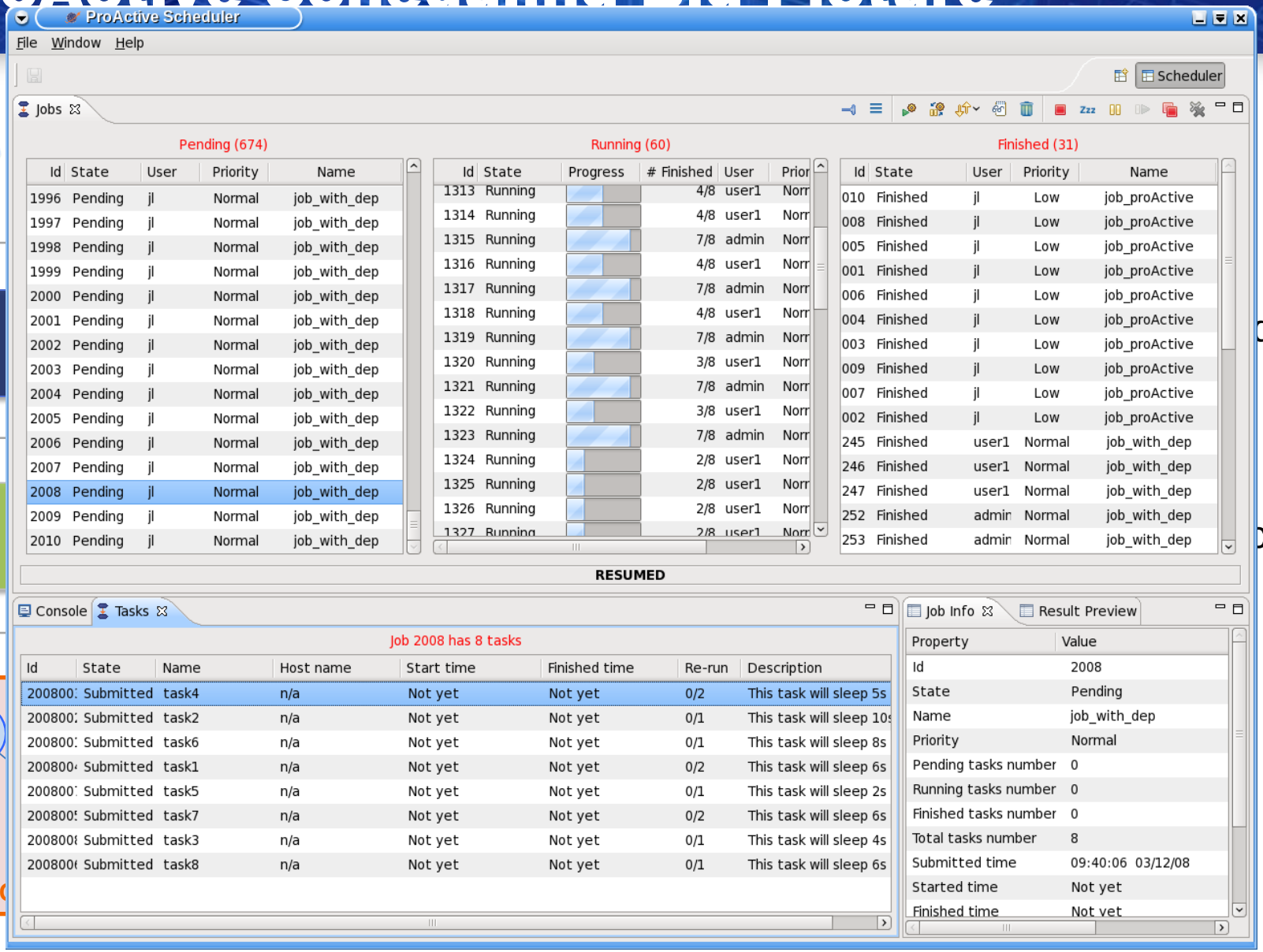
ProActive Scheduling Big Picture



RESO

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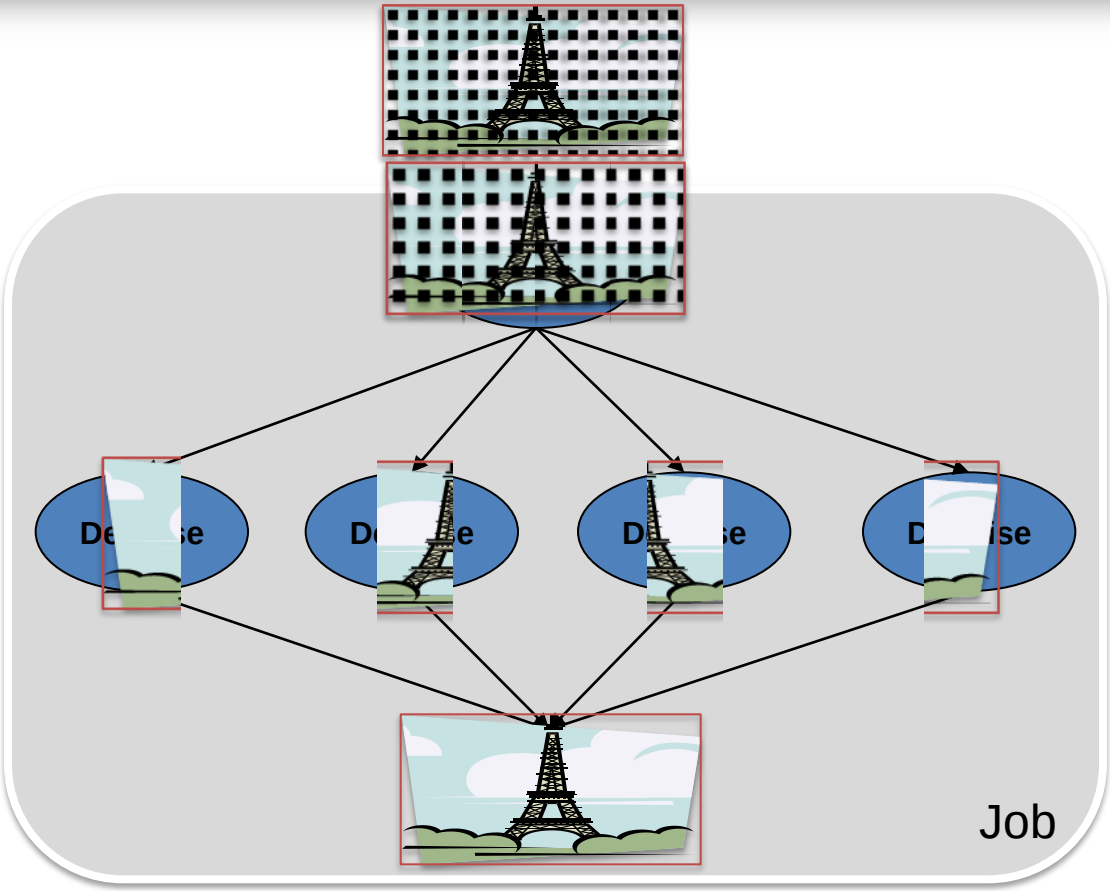
Workflow Example : Picture Denoising



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

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ProActive Resourcing

ProActive Parallel Suite

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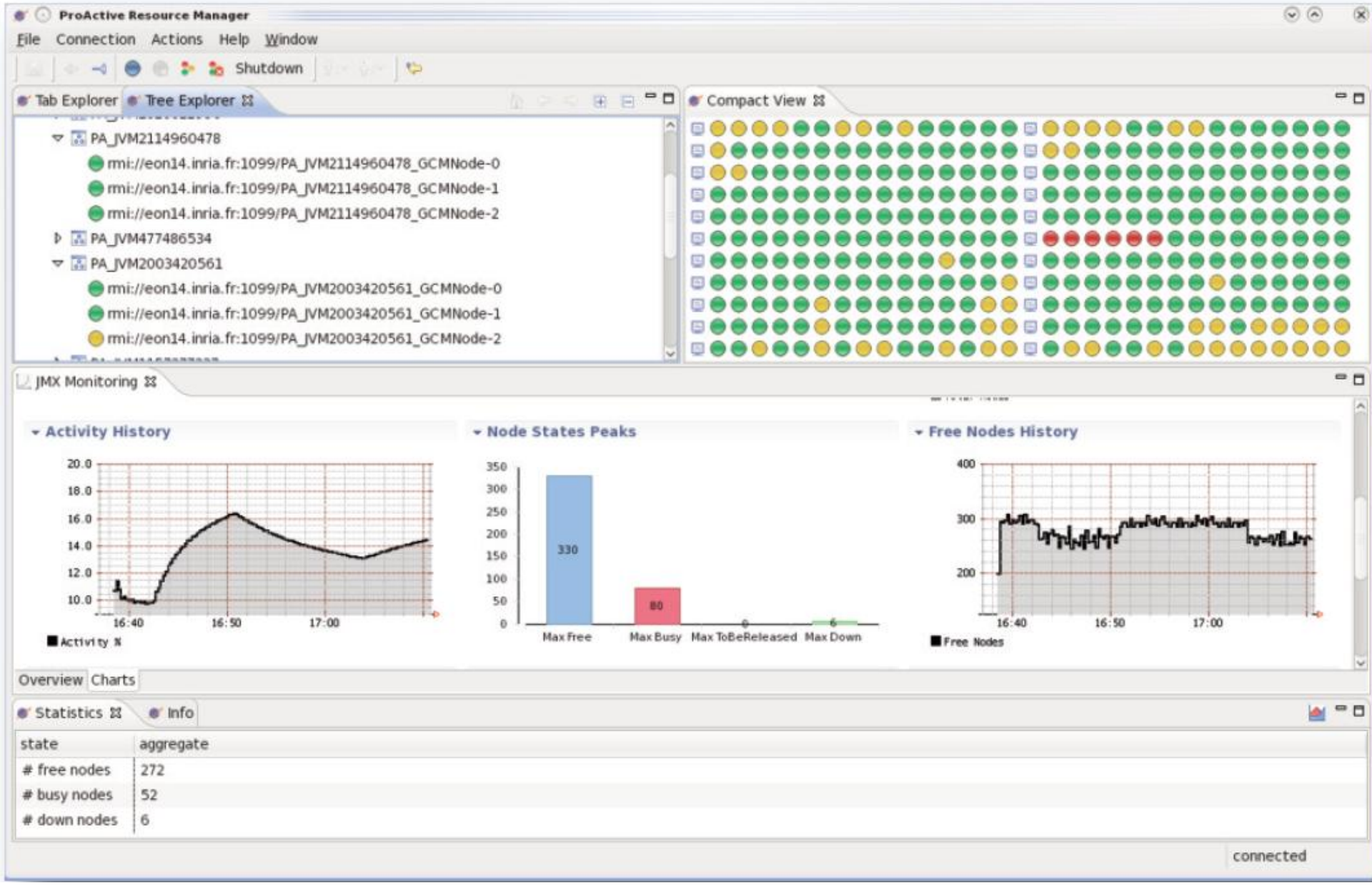
RESOURCING User Interface



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

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Private, Public & Hybrid Clouds

ProActive Scheduler

ProActive Resource Manager

“ Cloud Bursting! ”

Static Policy

LSF

Timing Policy 12/24

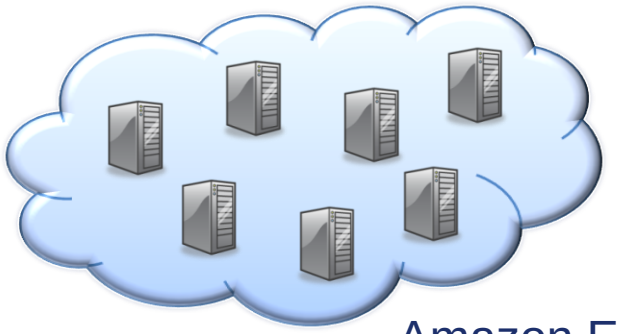
Desktops

Dynamic Workload Policy

EC2

Dedicated resources

Desktops



Amazon EC2

ProActive Parallel Suite

Cloud Seeding with ProActive

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

“ *Cloud Seeding* ”

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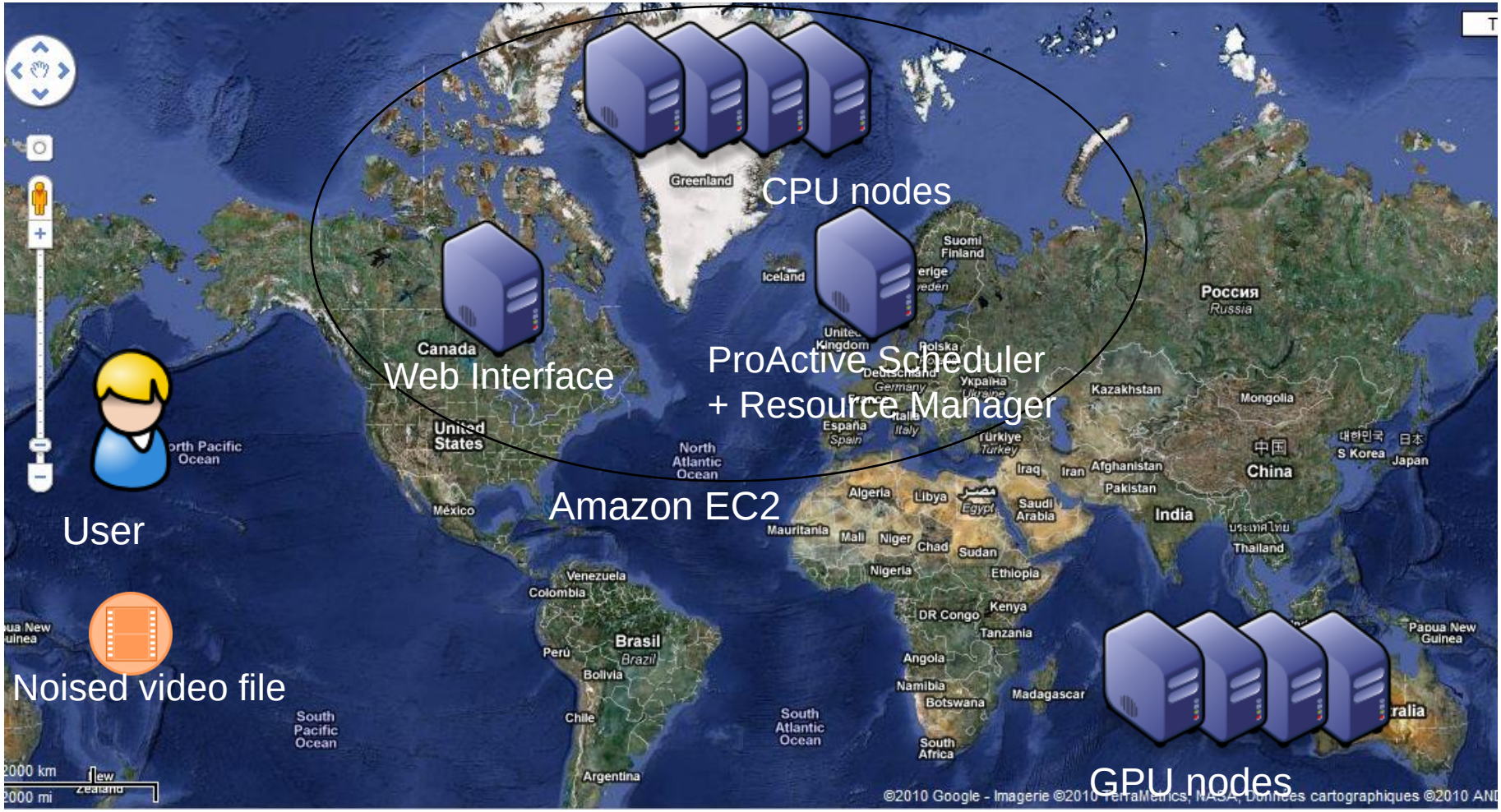
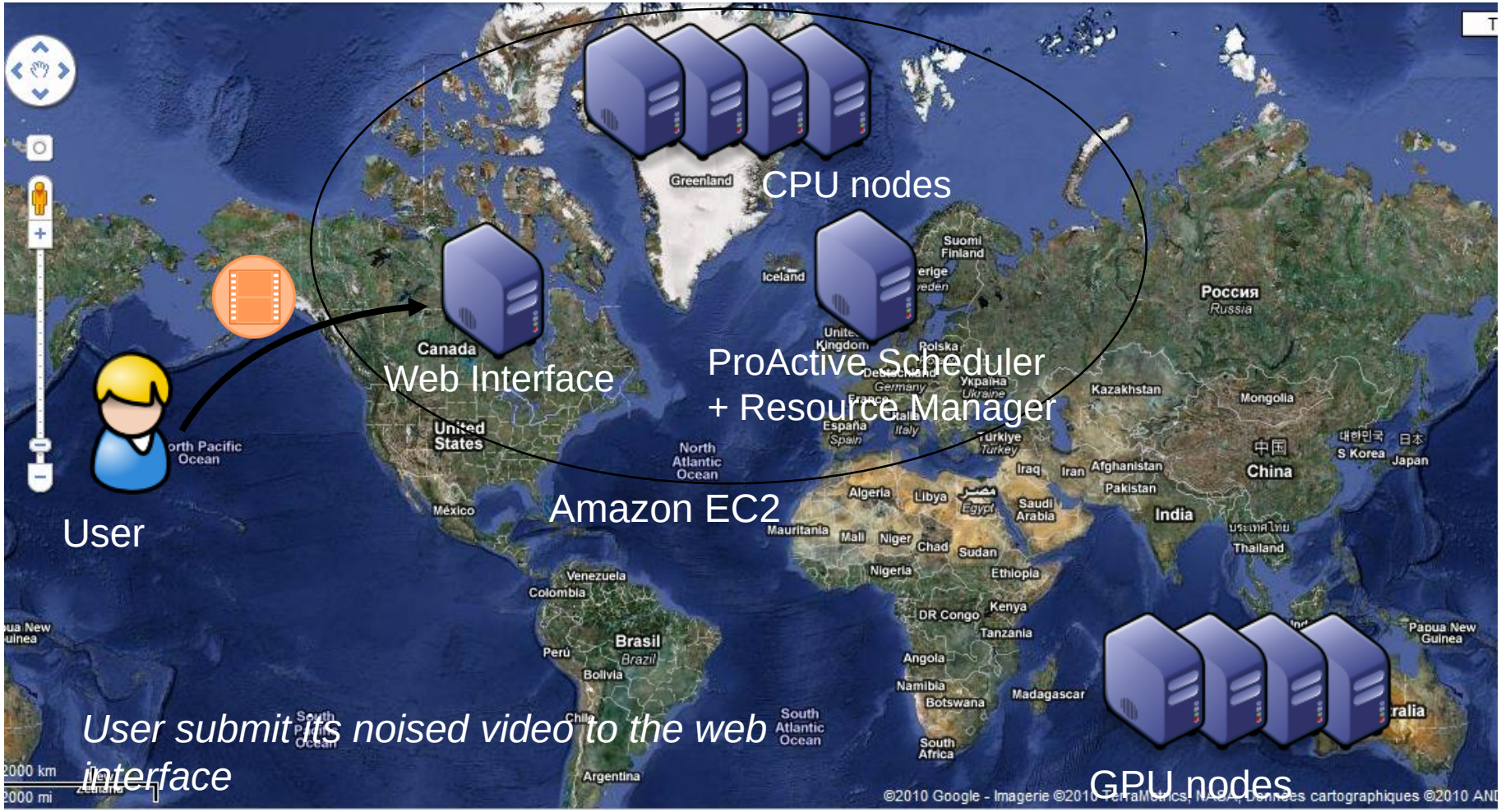
Cloud Seeding with ProActive



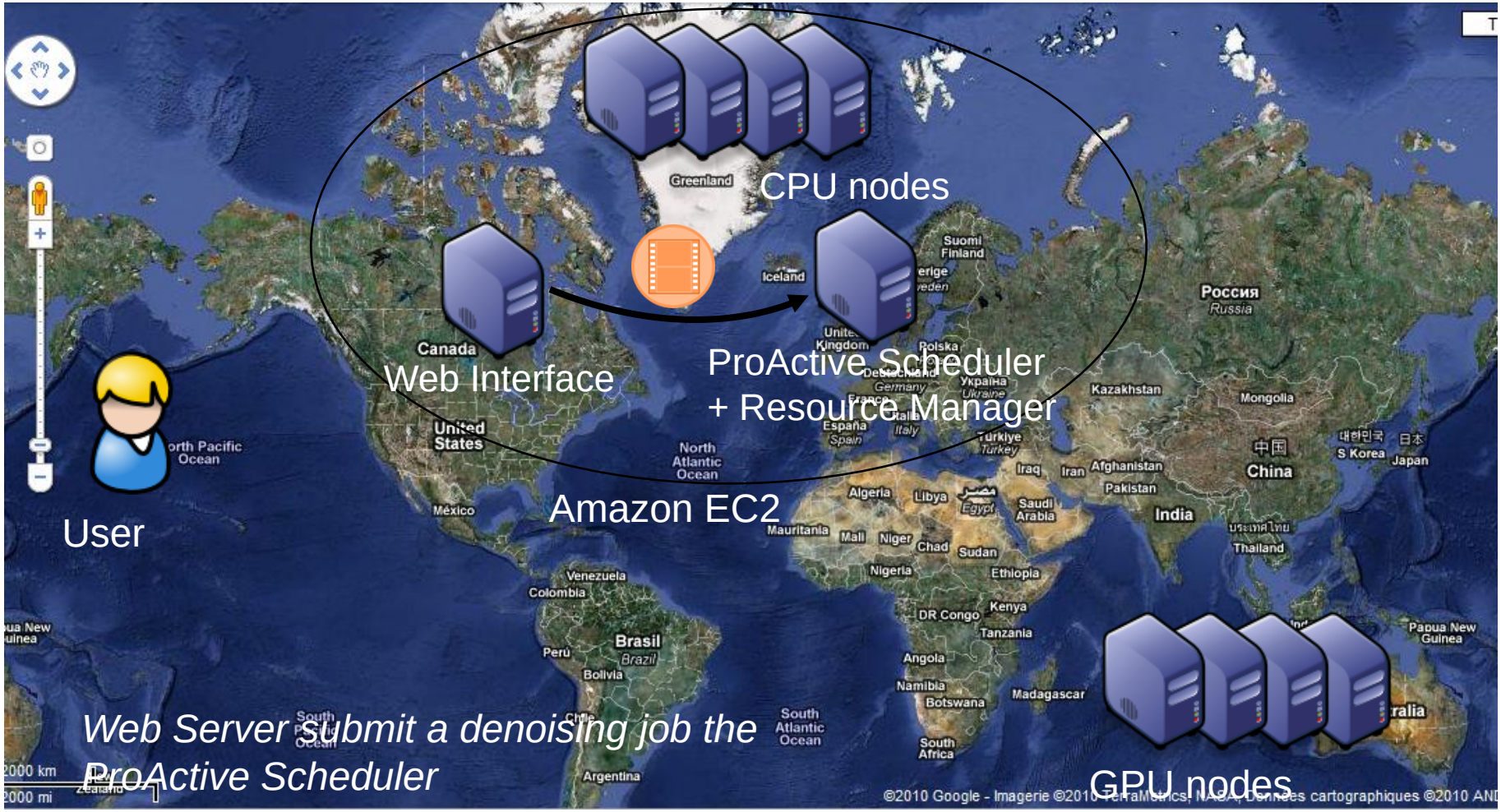
ProActive Parallel Suite

Cloud Seeding with ProActive



ProActive Parallel Suite

Cloud Seeding with ProActive



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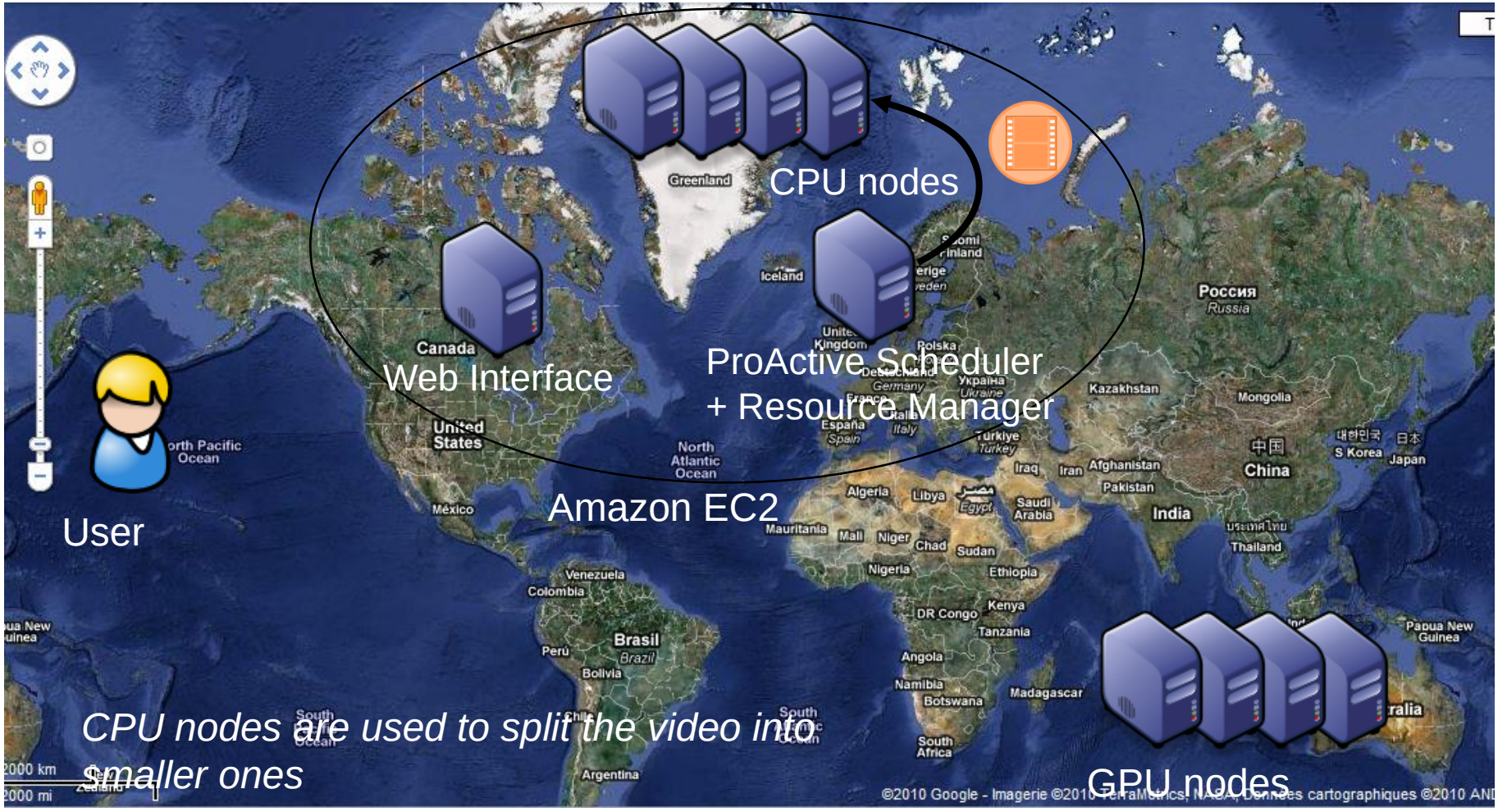
Cloud Seeding with ProActive



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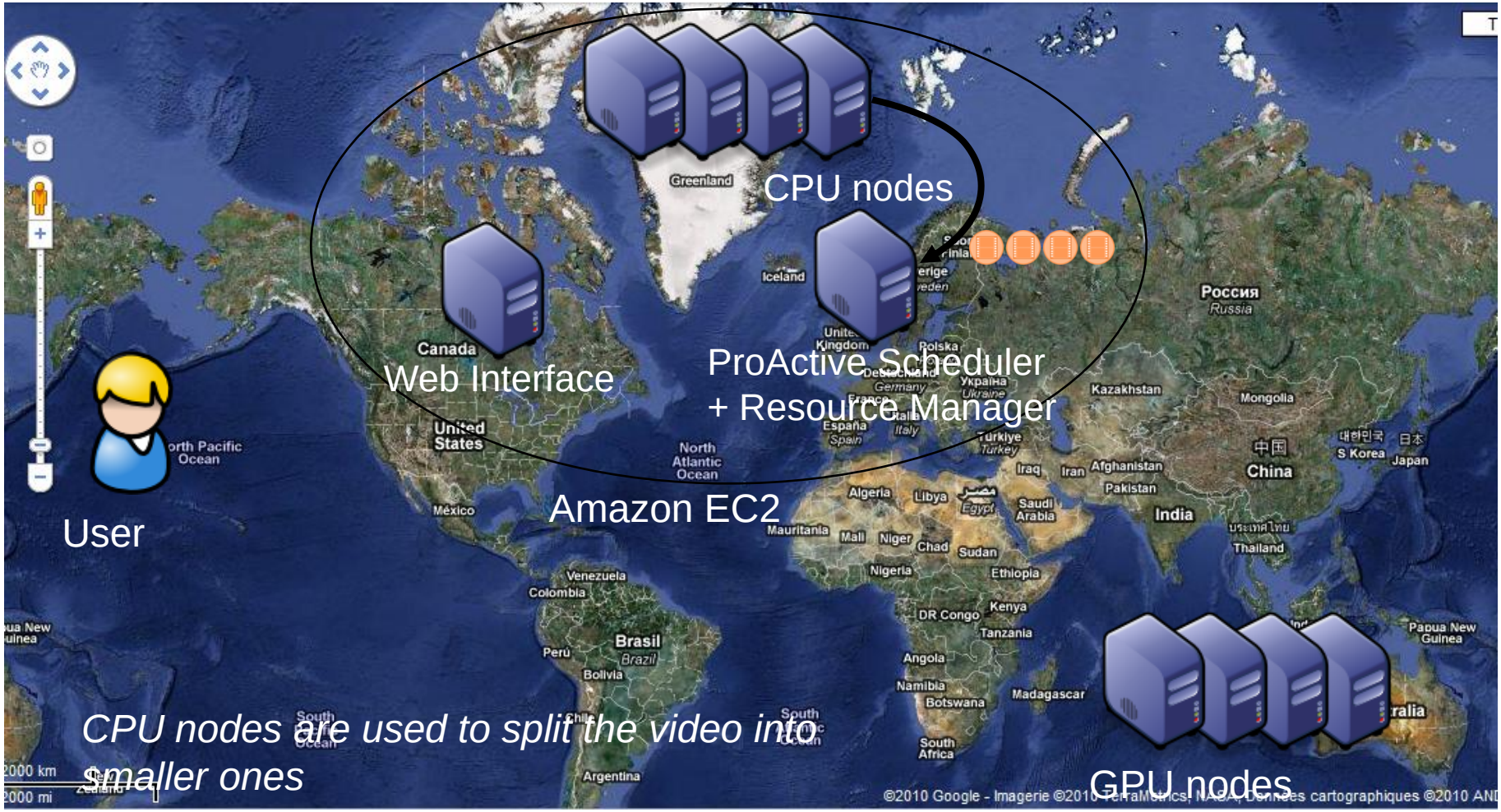
Cloud Seeding with ProActive



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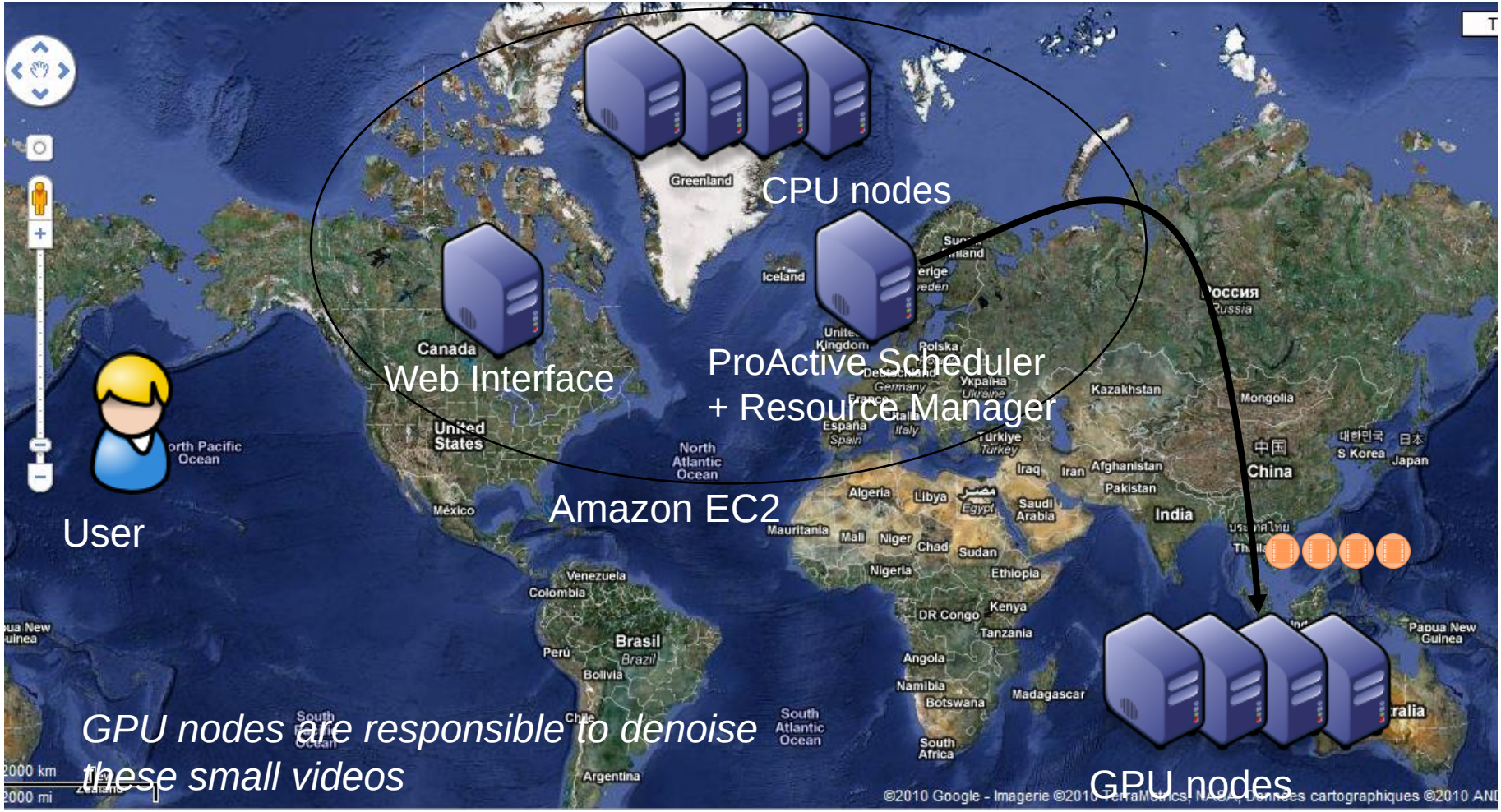
Cloud Seeding with ProActive



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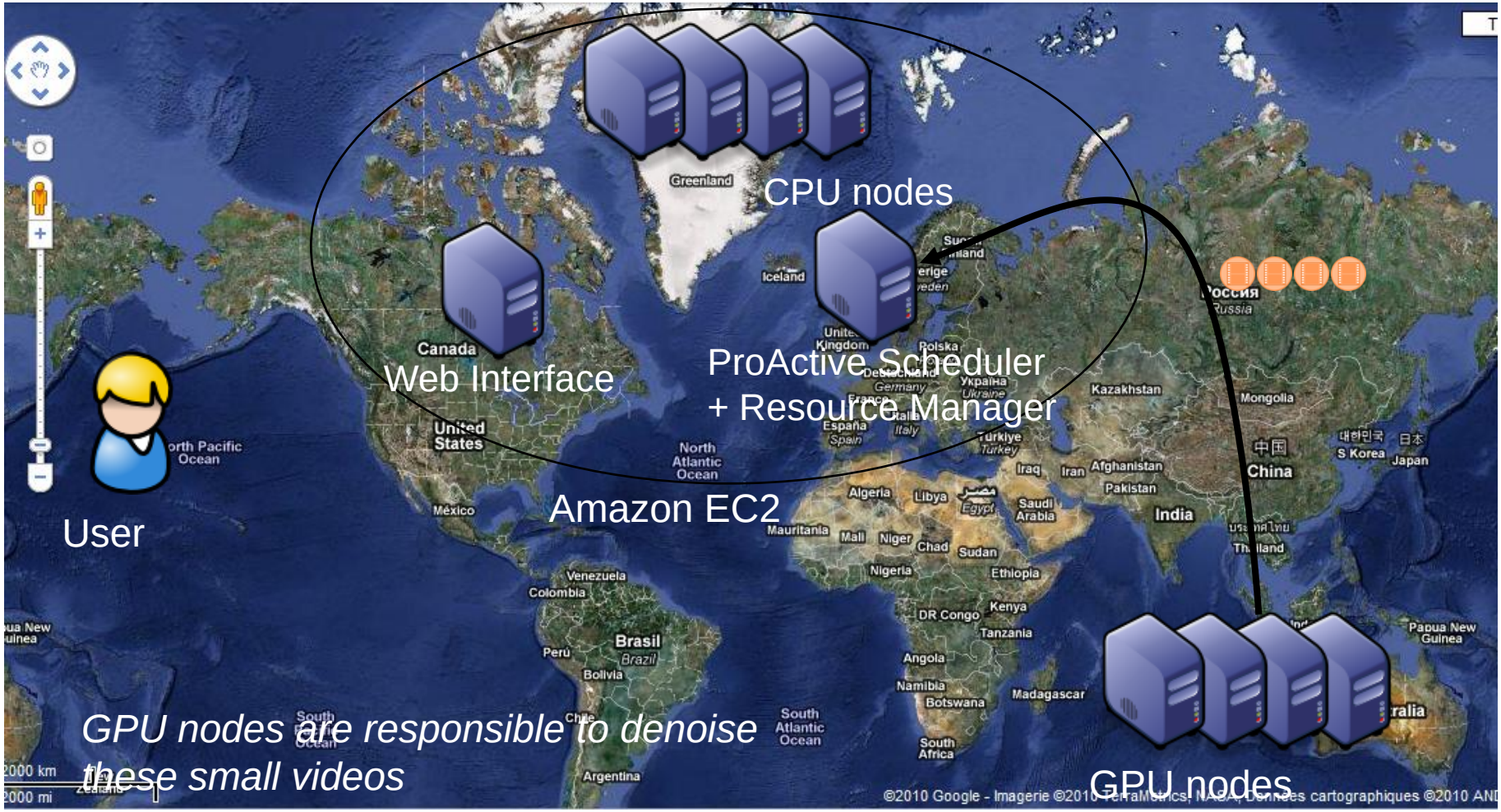
Cloud Seeding with ProActive



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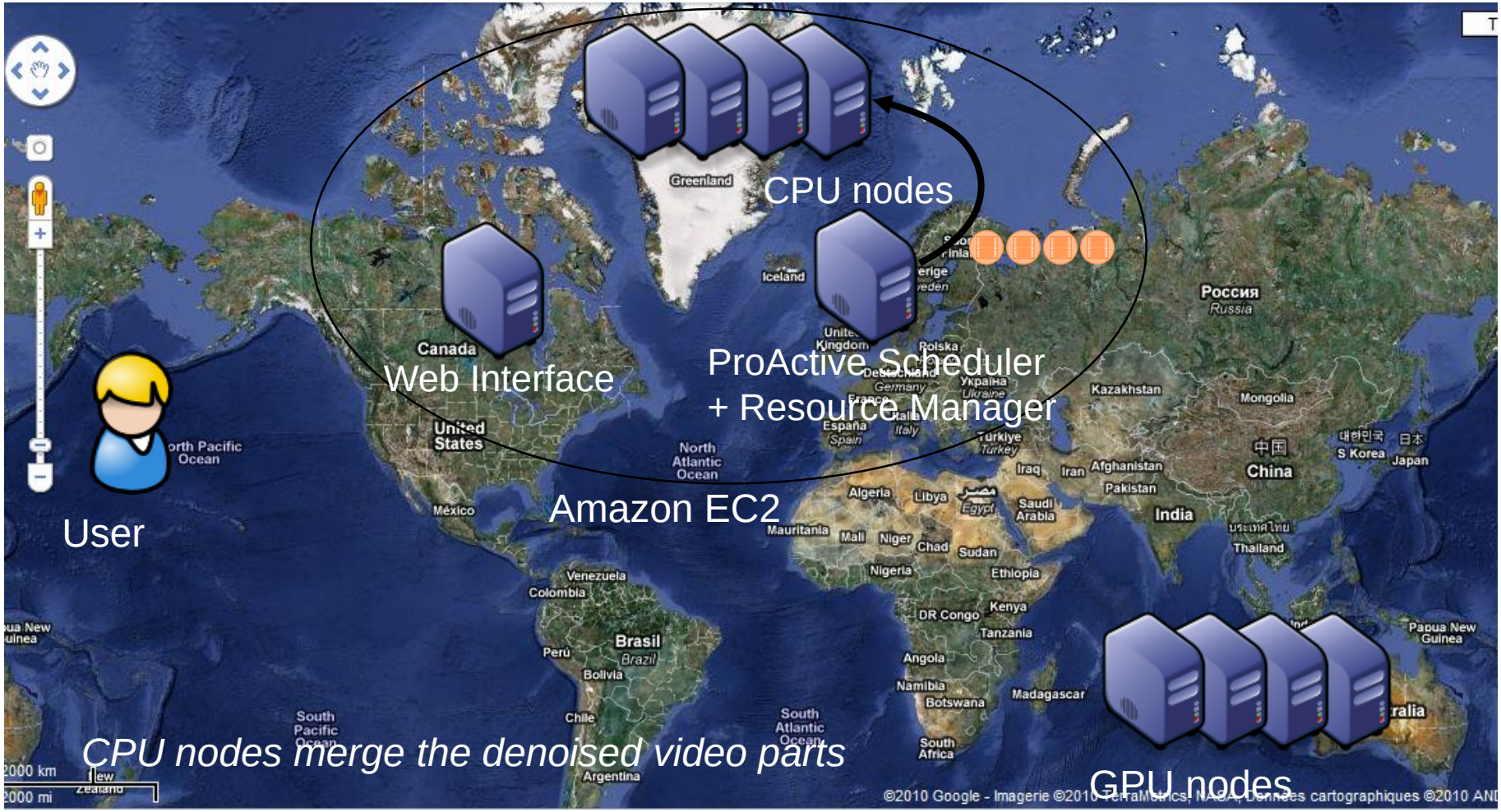
Cloud Seeding with ProActive



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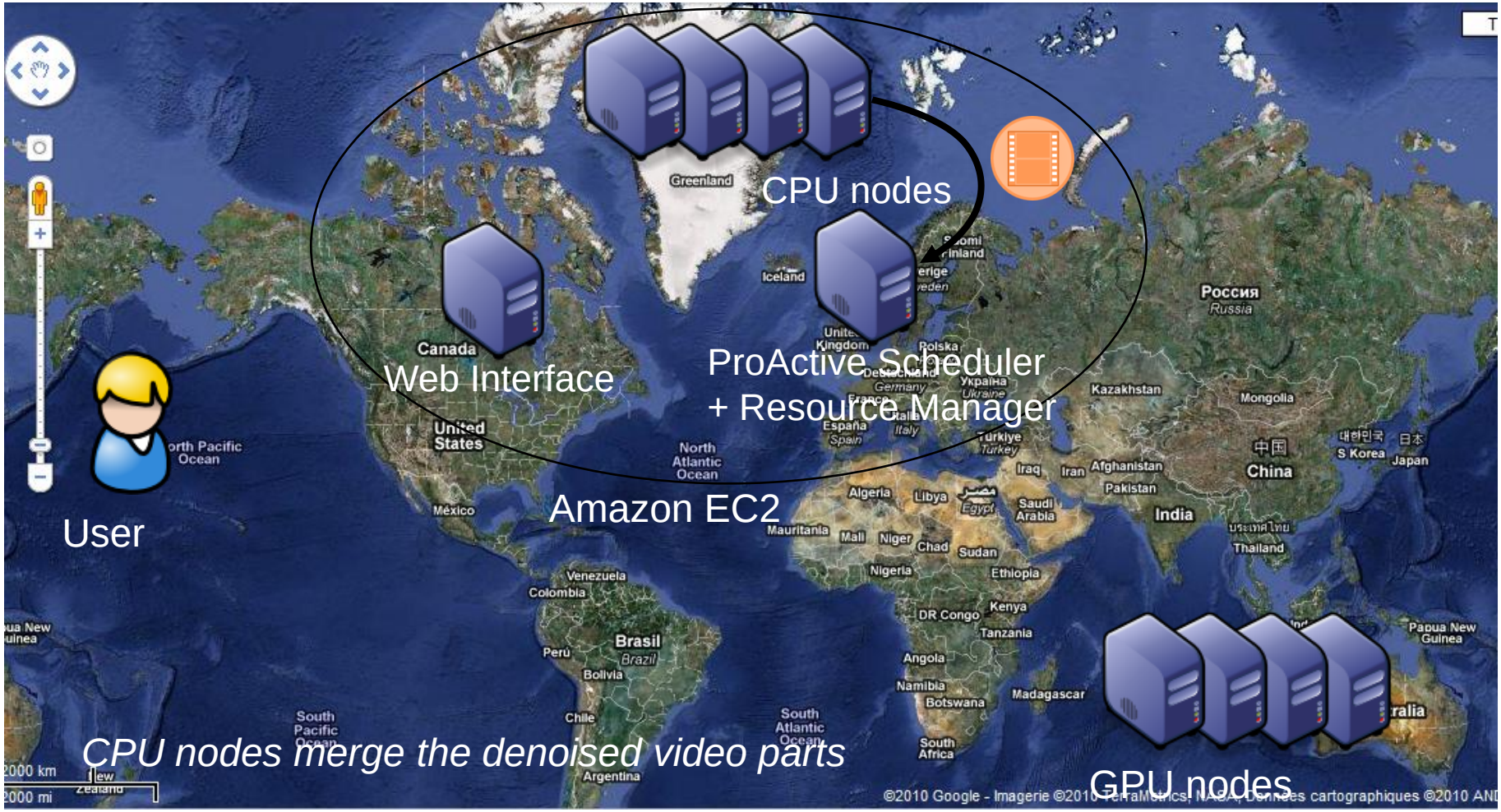
Cloud Seeding with ProActive



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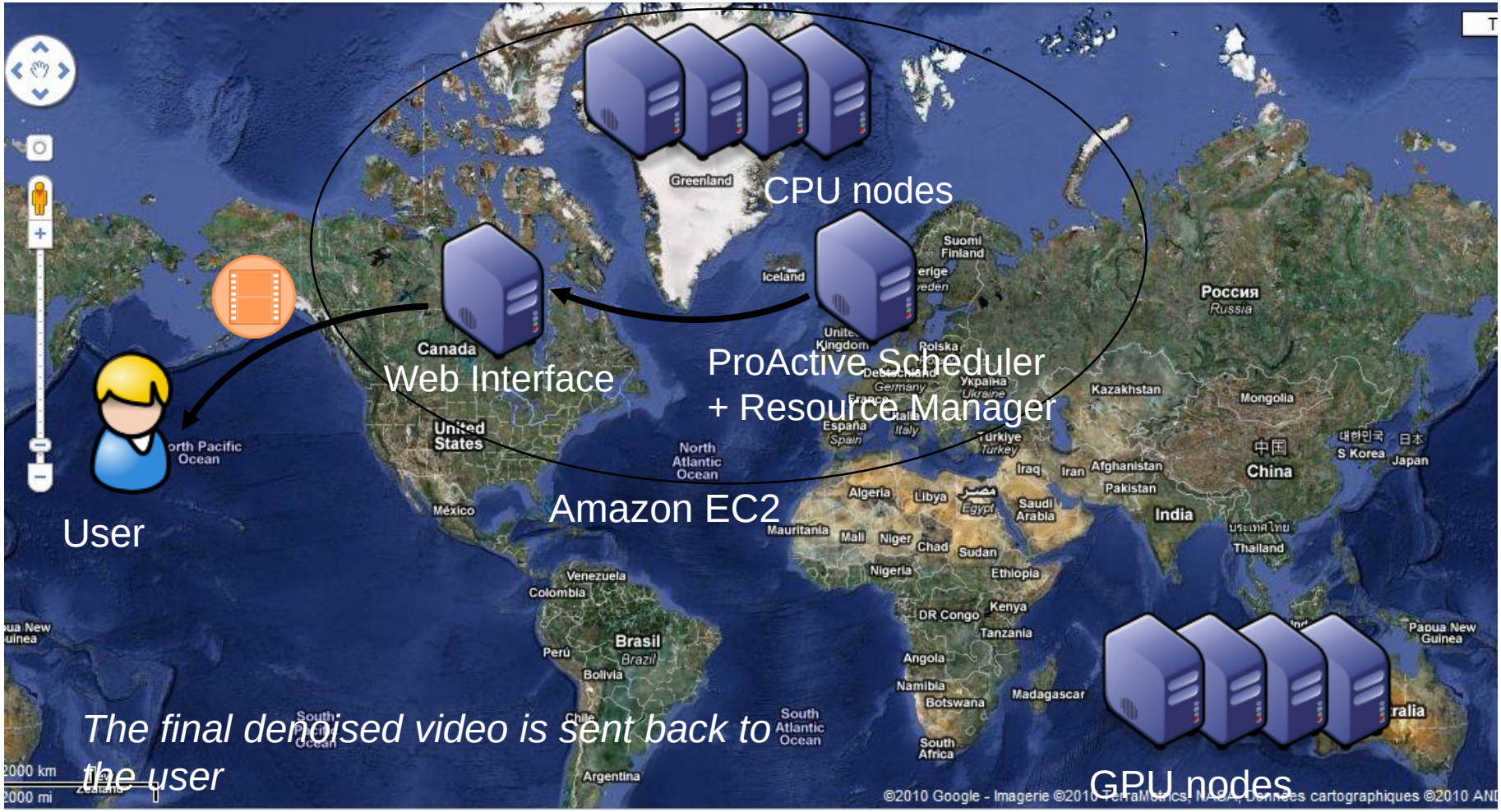
Cloud Seeding with ProActive



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Use Cases: Genomics - Sequencing

IPMC Use Case and Collaboration

SOLID machine from Applied Biosystems

16 nodes

ProActive Parallel Suite

PBS

Cluster

Desktops

amazon web services™

EC2

Clouds

Nodes can be dynamically added!

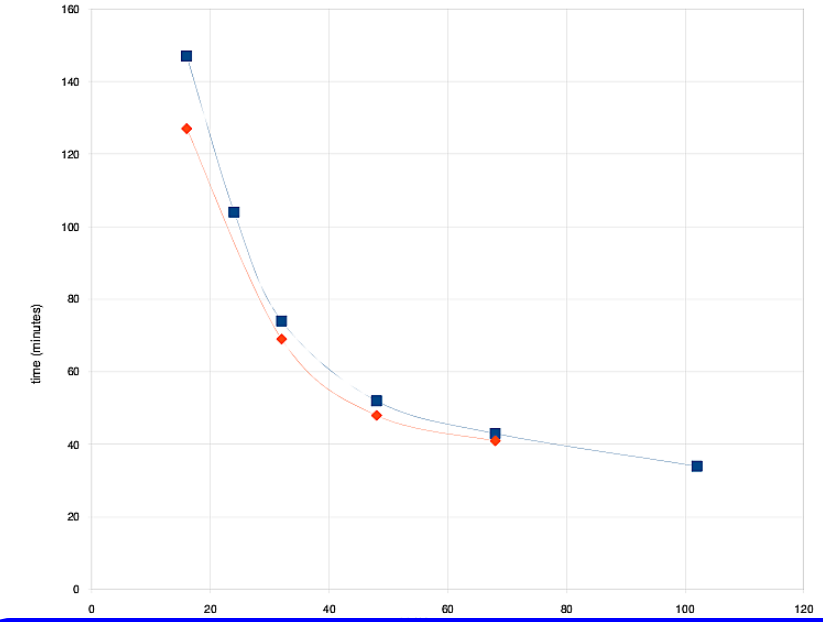
Activeeon SCALE BEYOND LIMITS

ProActive Parallel Suite

OW2 Consortium

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%)

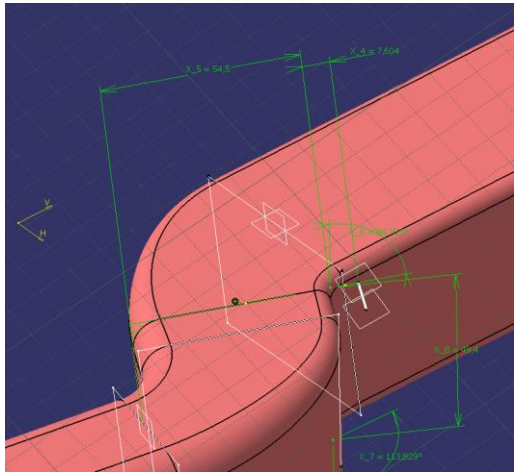
For only $3,2/hour, EC2 has nearly the same perf. as the local SOLiD cluster (16 cores, for 2H30)

Use Case: OMD2

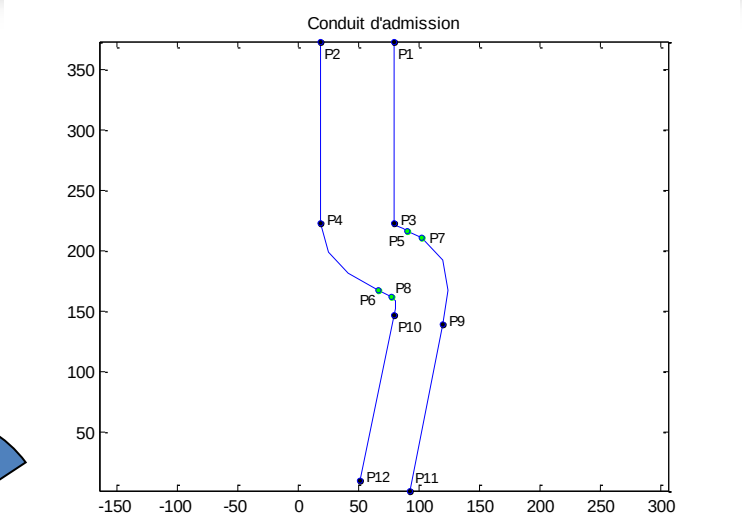
Distributed Multi-Disciplinary Optimizations

ProActive Parallel Suite

Coupling Mechanics, Aerodynamics ...



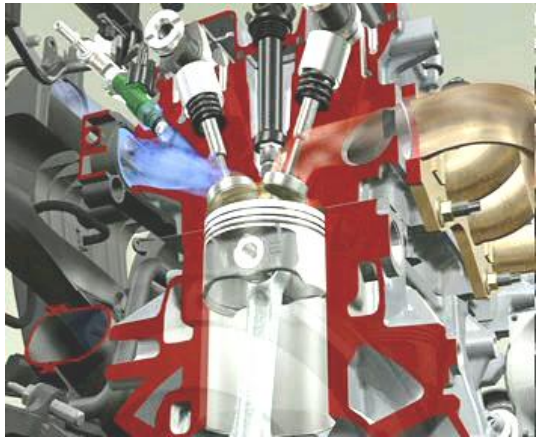
10min CPU



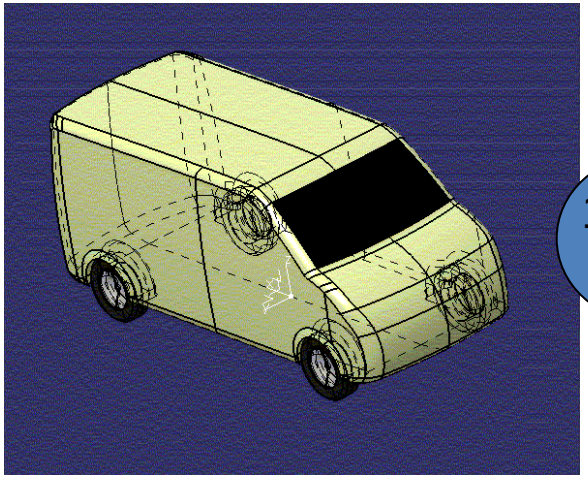
<1min CPU

3D Air Conditionning

2D Air Conditionning



100h CPU



1000h CPU

Cylinder Head

External Aerodynamic

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ProActive OMD2 Demo

1000 Cores
Production
Cloud Portal

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Video: Distributed Workflow

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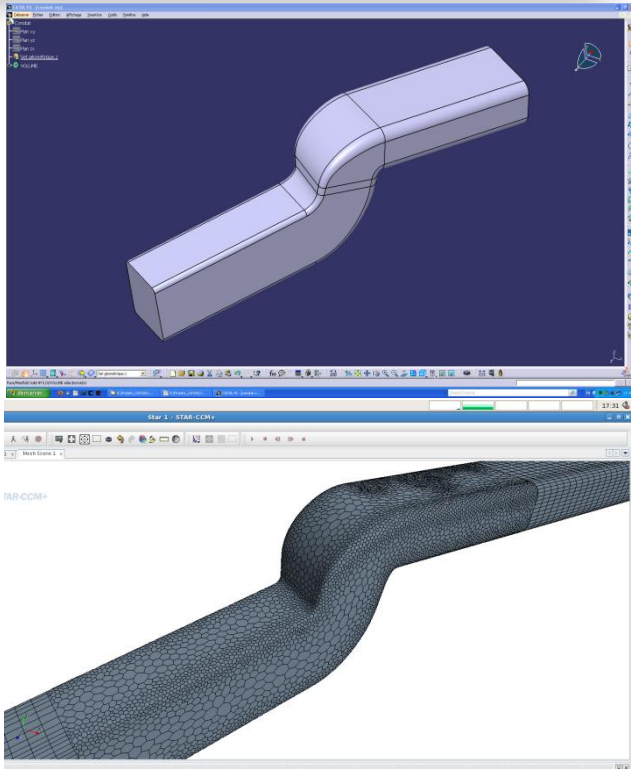
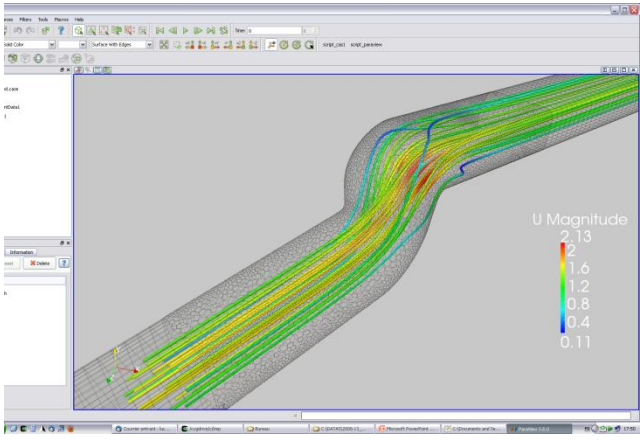
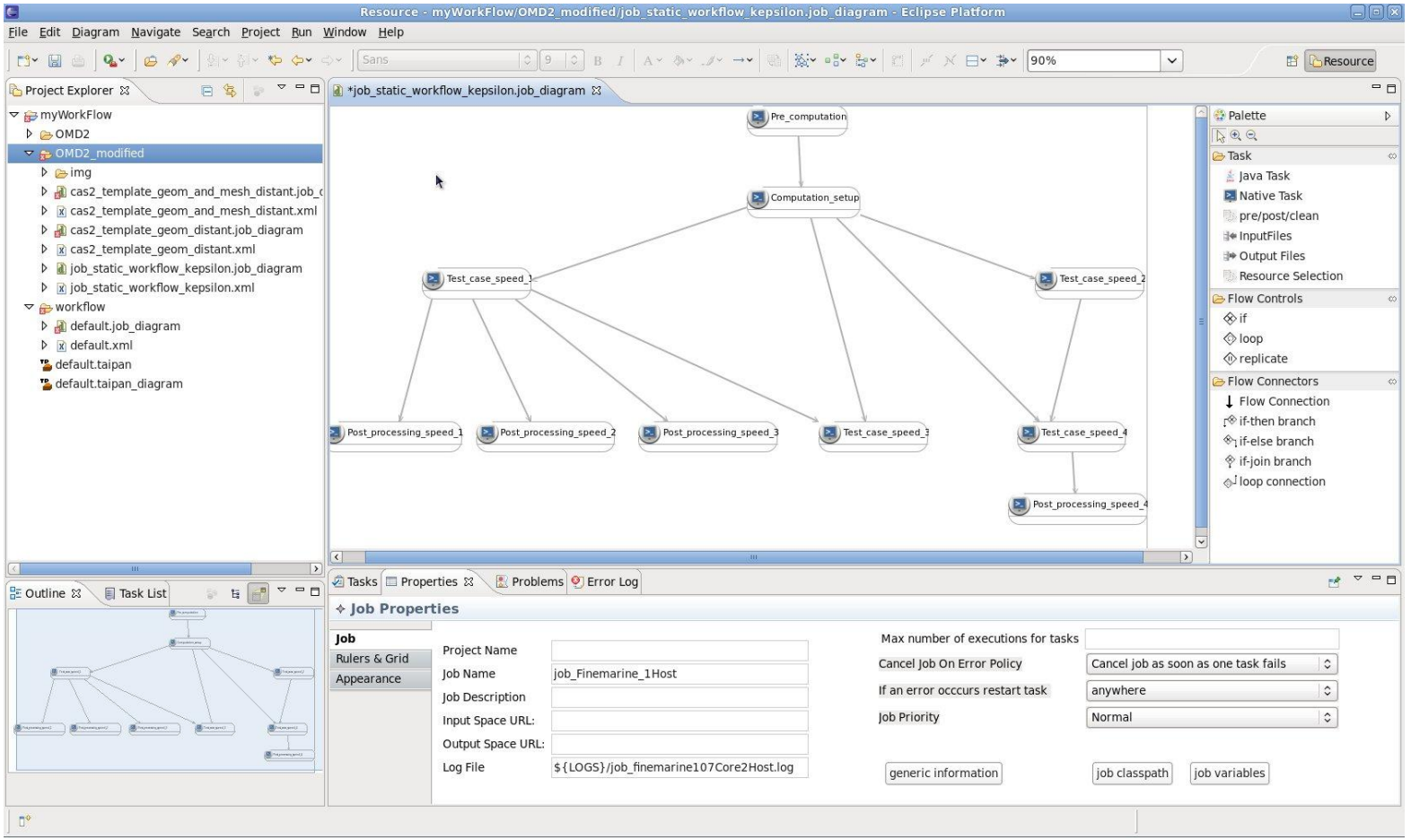
Engineering Optimizations: Renault UC



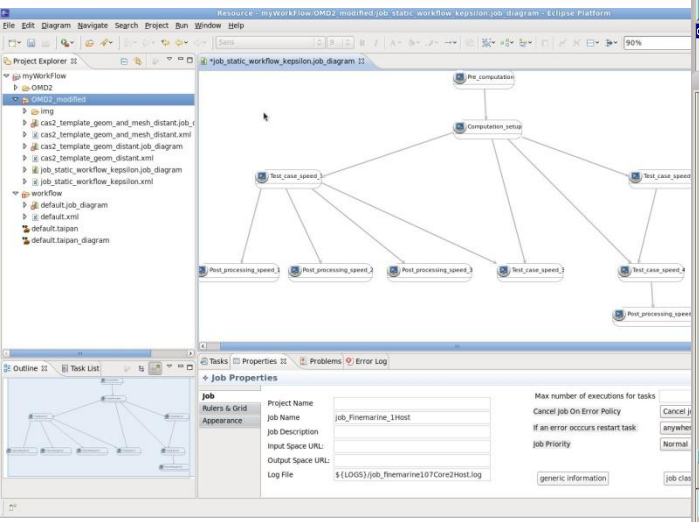


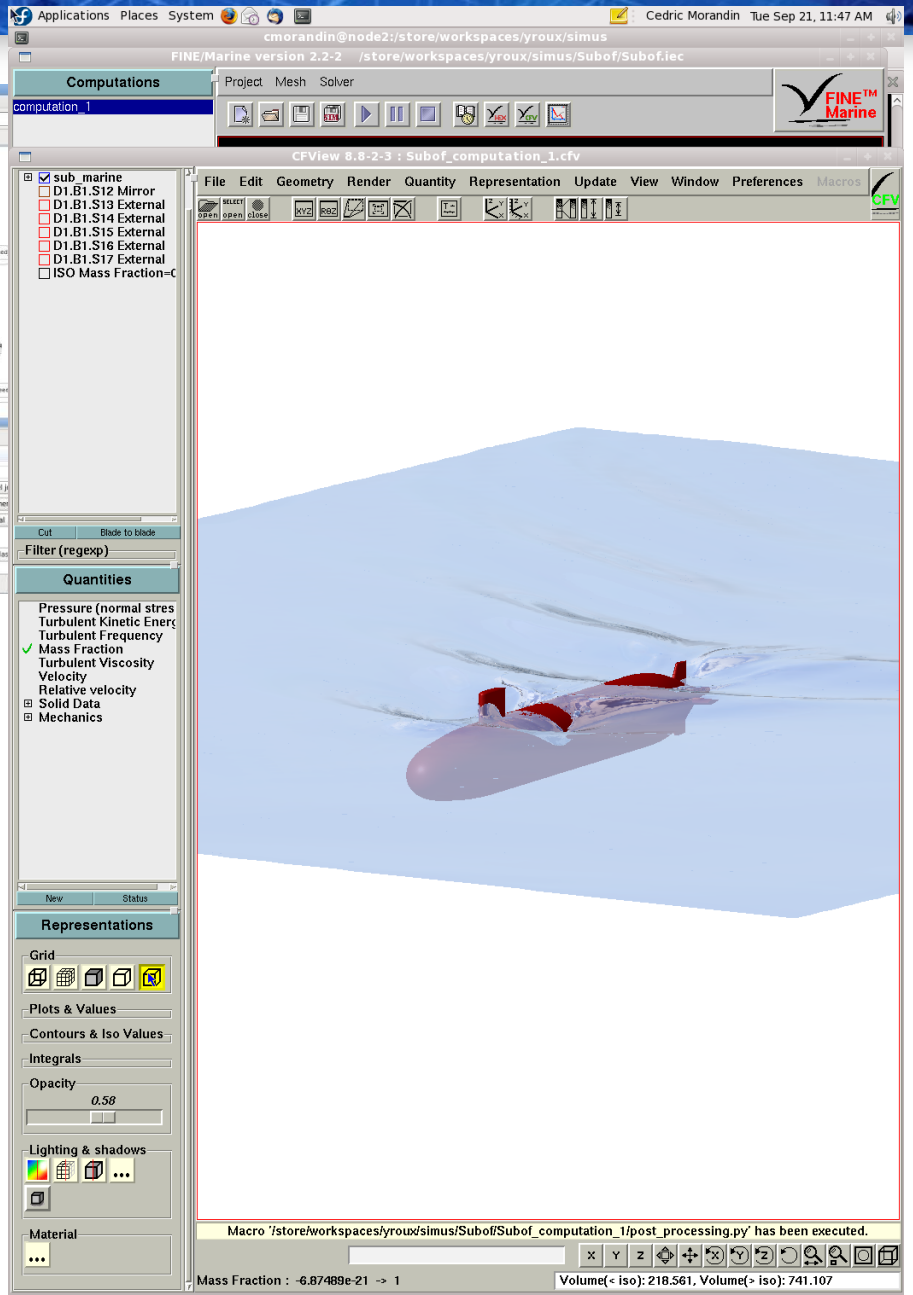
Use Case 3: Hydrodynamic with K-Epsilon and FineMarine

Hydrodynamic Optimization: Workflow generated from a GUI



Hydrodynamic Optimization: Execution

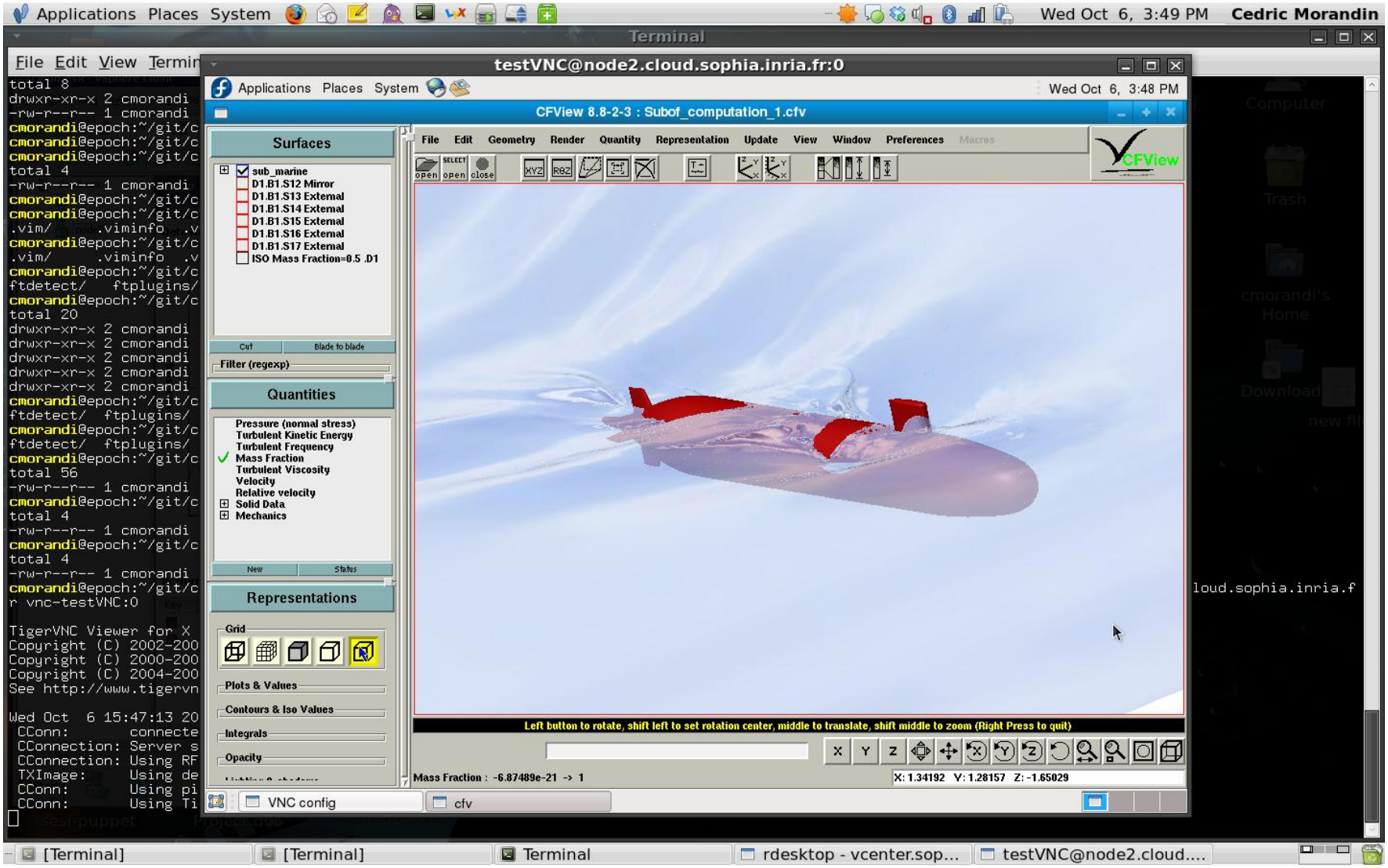




Activeeon
SCALE BEYOND LIMITS

OW2 Consortium

Hydrodynamic:
Remote Steering during execution



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Conclusions

Conclusion: Technology Preview

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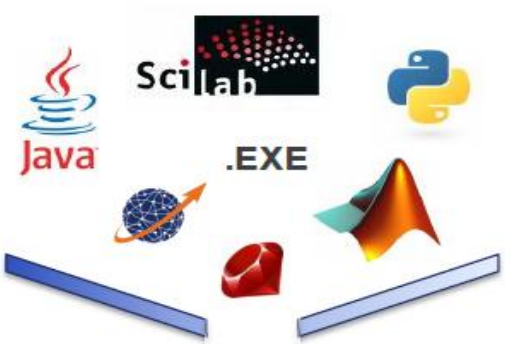

ProActive Scheduling

- ProActive Fine Grain CLOUD management:
  - ➔Pricing at the second (like GSM)
- Open Source Cloudware Initiative (OSCi)

OW2 Consortium

➔ Elastic Clouds

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Industrial (1750) & Cloud Revolution Compared

	Industrial Revolution	Cloud Revolution
Concept	Mechanization and centralization of manufacturing activities	Computing as a Utility Centralization of Data Center
Technology	Supporting new technos (Mechanic, Tool Machines, etc.)	Distributed Computing Virtualization Multi-Cores Network
Socio Economical Factors	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

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proactive.inria.fr

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Conclusion

- **Business revolution:**

  Not selling Hardware, nor Software, but Services

  Also a Marketing Revolution:

  ➔ Big thing is SLA, no longer ~~*Features Insides*™~~

- **Scientific Revolution:**
  - Capacity to use large Public facilities
  - Capabilities: CERN-like EGEE no longer needed ?
  - Large Workflows: SpeedUp of Discoveries
- **Social Revolution:**
  - What will happen to CIOs ?
  - What will happen to outsourcing companies ?
  - Personal and Business facility convergence (like PC, Internet)

➔ Impact ?

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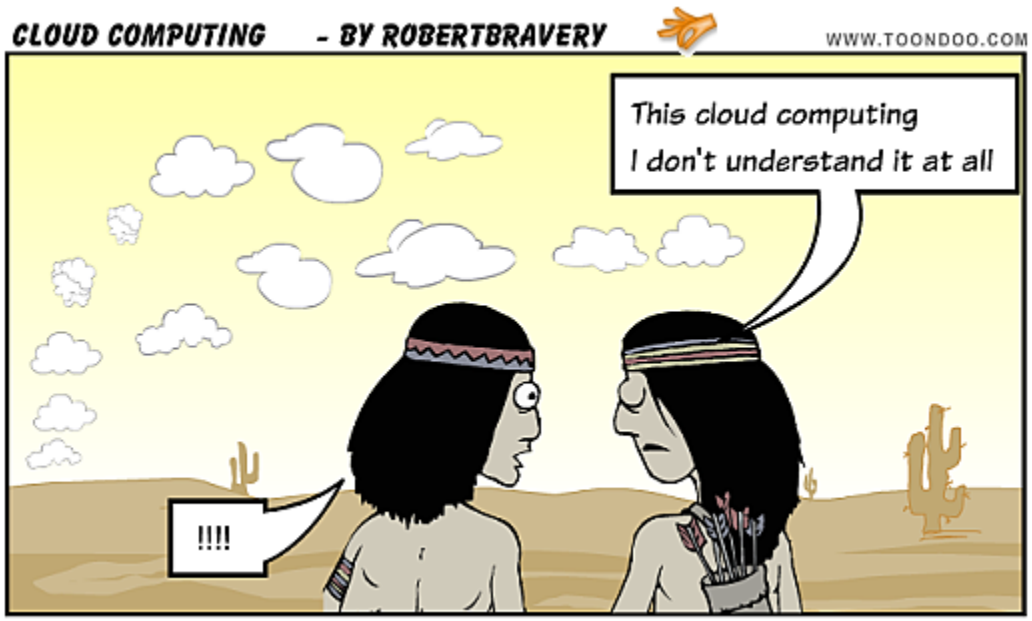
Thank you for your attention!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This cloud computing
I don't understand it at all
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