Cloud Computing Revolution

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
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):
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- F. Baude (UNSA)
- F. Huet (UNSA)
- L. Henrio (CNRS)

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- Elton Mathias (INRIA-Cordi)
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- Marcela Rivera (INRIA, Conicyt)
- Muhammad Khan (STIC-Asia)
- Paul Naoumenko (INRIA/Région PACA)
- Viet Dung Doan (FP6 Bionets)
- Virginie Contes (SOA4ALL)
- Guilherme Pezzi (AGOS, CIFRE SCP)

Visitors Welcome!
8 INRIA’s Research Centres

3 800 HC, 217 M Euro

2 900 Scientists
1 200 Researchers, Faculty members
1 200 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
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?

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 Joseph Kent Langley
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
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

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

Source: http://www.apac.redhat.com
Virtualization
What we Used to do as Syst. Admin.
With Virtualization + Software Appliance
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”
Administration Burden

On-premises
- Applications
- Runtimes
- SOA / Integration
- Databases
- Server SW
- Virtualization
- Server HW
- Storage
- Networking

You manage

Hosted
- Applications
- Runtimes
- SOA / Integration
- Databases
- Server SW
- Virtualization
- Server HW
- Storage
- Networking

We manage

Cloud
- Applications
- Runtimes
- SOA / Integration
- Databases
- Server SW
- Virtualization
- Server HW
- Storage
- Networking

We manage

Source: Save9
3. ProActive Parallel Suite
Cloud Solution: ProActive Parallel Suite

ProActive Parallel Suite

Java Parallel Toolkit

Multi-Platform Job Scheduler

Resource Manager

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 View
ProActive Programming View

GPU nodes
Broadcast and Scatter

Broadcast is the default behavior
Use a group as parameter, Scattered depends on rankings

```java
ag.bar(cg); // broadcast cg
ProActive.setScatterGroup(cg);
ag.bar(cg); // scatter cg
```
Dynamic Dispatch Group

```java
ag.bar(cg);
```
Video 1:
IC2D Optimizing
Monitoring, Debugging, Optimizing
Scheduling & Resourcing
ProActive Scheduling

ProActive Scheduling
Multi-Platform Job Scheduler
ProActive Scheduling Big Picture

- Multi-platform Graphical Client (RCP)
- File-based or LDAP authentication
- Static Workflow Job Scheduling, Native and Java tasks, Retry on Error, Priority Policy, Configuration Scripts, ...
- Dynamic and Static node sources, Resource Selection by script, Monitoring and Control GUI, ...
- ProActive Deployment capabilities: Desktops, Clusters, Clouds, ...

ProActive Scheduler

ProActive Resource Manager
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

ProActive Resource Manager

ProActive Resourcing
Desktop, Cluster, Grid & Cloud Resource Manager

ProActive Parallel Suite
RESOURCING User Interface
Clusters to Grids to Clouds: e.g. on Amazon EC2
Private, Public & Hybrid Clouds

ProActive Scheduler

ProActive Resource Manager

Static Policy
LSF

Timing Policy 12/24
Desksops

Dynamic Workload Policy
EC2

Cloud Bursting!

Dedicated resources

Desksops

Amazon EC2
Amazon EC2 Execution

Cloud Seeding strategy to mix heterogeneous computing resources:
- External GPU resources
Cloud Seeding with ProActive

User

Web Interface

Noised video file

Amazon EC2

CPU nodes

ProActive Scheduler + Resource Manager

GPU nodes

ProActive

Parallel Suite
Cloud Seeding with ProActive

User submit its noised video to the web interface

ProActive Scheduler + Resource Manager

Web Interface

Amazon EC2

CPU nodes

GPU nodes
Cloud Seeding with ProActive

Web Server submit a denoising job the ProActive Scheduler

ProActive Scheduler + Resource Manager

User

Web Interface

Amazon EC2

CPU nodes

GPU nodes

ProActive
Parallel Suite
Cloud Seeding with ProActive

CPU nodes are used to split the video into smaller ones.
Cloud Seeding with ProActive

CPU nodes are used to split the video into smaller ones.
**Cloud Seeding with ProActive**

GPU nodes are responsible to denoise these small videos.
Cloud Seeding with ProActive

GPU nodes are responsible to denoise these small videos.
Cloud Seeding with ProActive

User

Web Interface

ProActive Scheduler + Resource Manager

Amazon EC2

CPU nodes

GPU nodes

CPU nodes merge the denoised video parts
Cloud Seeding with ProActive

User

Web Interface

ProActive Scheduler + Resource Manager

Amazon EC2

GPU nodes

CPU nodes

CPU nodes merge the denoised video parts
Cloud Seeding with ProActive

The final denoised video is sent back to the user.
Use Cases: Genomics - Sequencing
**IPMC Use Case and Collaboration**

- **SOLID** machine from Applied Biosystems
- Cluster
- Desktops
- Clouds
- Nodes can be dynamically added!

**ProActive Parallel Suite**

**Amazon Web Services** (EC2)

**Activeeon** Scale Beyond Limits

**ProActive**
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
Coupling Mechanics, Aerodynamics ...

3D Air Conditionning

100h CPU

Cylinder Head

2D Air Conditionning

10min CPU

<1min CPU

External Aerodynamic

1000h CPU
ProActive OMD2 Demo

1000 Cores Production Cloud Portal
Video: Distributed Workflow
Engineering Optimizations: Renault UC

- PRE
  - Resource Selection
  - Dataspase Input
  - Native Executable
  - Dataspase Output

- GEOM_AND_MESH
  - Resource Selection
  - Dataspase Input
  - Native Executable
  - Dataspase Output

- SOLVE
  - Resource Selection
  - Dataspase Input
  - Native Executable
  - Dataspase Output

- POST
  - Resource Selection
  - Dataspase Input
  - Native Executable
  - Dataspase Output

- OpenFOAM
- OpenCFD
Use Case 3: Hydrodynamic with K-Epsilon and FineMarine
Hydrodynamic Optimization: Workflow generated from a GUI
Hydrodynamic Optimization: Execution
Hydrodynamic: Remote Steering during execution
Conclusions
Conclusion: Technology Preview

- ProActive Fine Grain CLOUD management:
  - Pricing at the second (like GSM)

- Open Source Cloudware Initiative (OSCi)

  ➔ Elastic Clouds
## Industrial (1750) & Cloud Revolution Compared

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

Sources & Inspiration: Simon Wardley (CSC) Scott Stewart
proactive.inria.fr
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?
Thank you for your attention!
This cloud computing
I don't understand it at all

!!!!