Grid and Cloud computing, a place for virtualisation?

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Outline

• Introduction
• Virtualisation
• Definition - Pros & Cons - Market trends
• Grid computing for e-Science and virtualisation?
• Cloud computing adopting virtualisation
• Virtualisation: “Green” IT?
• Conclusions
White paper overview

1st eIRG meeting
Athens
June, 10th 2003

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Rome, December 10th, 2003
What is Virtualization?

Virtualization is the isolation of one computing resource from the others:

- **Virtual Applications**: Any application on any computer on-demand
- **Virtual Presentation**: Presentation layer separate from process
- **Virtual Machine**: OS can be assigned to any desktop or server
- **Virtual Storage**: Storage and backup over the network
- **Virtual Network**: Localizing dispersed resources

*Slide Courtesy of Neil Sanderson, UK Product Manager, Virtualisation and Management, Microsoft Ltd.*
Virtualisation: Pros

Control costs

- Optimize utilisation of servers
- Reduce costs: hardware, power, space
- Reduce overall system complexity
- Reduce application compatibility conflicts

Improve Availability

- Disaster recovery capabilities
- Streamline server maintenance, and isolate risk
- Enable access to any desktop application anywhere

Drive Agility

- Dynamic resource allocation
- Faster provisioning of services / workloads to support business growth and meet SLAs
Virtualisation: Cons?

• New technology
• Management overhead
• Single Point of Failure
• Software Licensing?
• Performance?
• Policy issues
• Security Concerns
Virtualisation market: The game is only starting (1/2) Only 5% of servers are virtualised

- Computerworld
  - “Although virtualization has been the buzz among technology providers, only 6% of enterprises have actually deployed virtualization on their networks, said Levine, citing a TWP Research report. That makes the other 94% a wide-open market.”
  - “We calculate that roughly 6% of new servers sold last year were virtualized and project that 7% of those sold this year will be virtualized and believe that less than 4% of the X86 server installed base has been virtualized to date.
- Pat Gelsinger, Intel VP Sept. 2007
  - “Only 5% of servers are virtualized.”
FTN Midwest Securities analyst Trip Chowdhry said that the problem is that investors wrongly believed that VMware itself was the trend. Now, he says, they are realizing that virtualization is the trend.
The experience of the Grid 1/3

• Grids for e-Science: a success story so far?
  – Several mature Grid Middleware stacks
  – Many HPC applications using the Grid
    • Some of them (HEP, Bio) in production use
    • Some of them still in testing phase: more effort still required to make the Grid their day-to-day workhorse
  – e-Health applications also part of the Grid
  – Some industrial applications:
    • CGG Earth Sciences

• Virtualisation not much exploited in e-Science
The experience of the Grid 2/3

- Grids beyond e-Science?
  - Slower adoption: different priorities and requirements, different tools and different business models and TCOs
    - Intra grids, dedicated clusters, cloud computing
  - e-Business applications
    - Finance, Enterprise Resource Planning, SMEs
  - Industrial applications
    - Automotive, Aerospace, Pharmaceutical industry, Telecom
  - e-Government applications
    - Earth Observation, Civil protection:
      - e.g. The Cyclops project

- Virtualisation exploited beyond e-Science?
Industry also demonstrated interest in becoming an HPC infrastructure provider:

- On-demand infrastructures:
  - Cloud and Elastic computing, pay as you go...
  - Data centers: Data getting more and more attention
- Service hosting: outsourced integrated services

**Virtualisation being exploited in Cloud and Elastic computing (e.g. Amazon EC2 virtual instances)**

- “Pre-commercial procurement”
  - Research-industry collaboration in Europe to achieve new leading-edge products
    - Example: PRACE building a PetaFlop Supercomputing Centre in Europe
Cloud computing and storage on demand (1/2)


Amazon, IBM, Google, Microsoft, Sun, Yahoo, major ‘Cloud Platform’ potential providers

Operating compute and storage facilities around the world

Have developed middleware technologies for resource sharing

First services already operational - Examples:
Amazon Elastic Computing Cloud (EC2) - Simple Storage Service (S3)
Cloud computing and storage on demand (2/2)

Sun's Grid Utility Expands Beyond the United States

Published: May 3, 2007
by Timothy Prickett Morgan

Nearly two months ago, Sun Microsystems announced that it was putting its Sun Grid out onto its network.com Sun Grid computer architecture, and the company said that it was solving a problem that Sun had, however, is that only certain enterprises can afford to have such a large capacity.

Starting today, however, the Sun Grid utility, which by default is now available in 24 additional countries, is now allowing customers to log in and buy online Grid services from Sun in Australia, Austria, Belgium, Canada, China, Czech Republic, Denmark, Finland, France, Greece, Hungary, India, Ireland, Italy, Japan, the Netherlands, Norway, Poland, Portugal, Sweden, and the United Kingdom. To help promote this, Sun is giving away 200 CPU hours of compute time every week to an individual—well, several individuals—who starts up an account. This is something Sun has never done before:

Google, IBM Partner on Utility Computing Cloud

Published: October 8, 2007
by Timothy Prickett Morgan

Search engine and Web advertising giant Google and server maker and supercomputing giant IBM are teaming up with some prominent American universities to set up vast and sophisticated computing services that will be used to research the future of corporate computing some day.

They say that the grid-based computing (or utility computing) in which software is designed to utilize as much of a company's own processing power as possible (or may be utilized on the fly as workloads change) or cloud seems to imply utility-style infrastructure as well as the size of the computing resources dedicated to a single task. A cloud service can encompass many different kinds of utilities, with varying degrees of available resources, and a workload would make use of the computing resources in the cloud.

Supercomputing at less than the cost of a gallon of gas

New service allows users to offload computational work to supercomputer

By Patrick Thibodeau

April 1, 2008 (Computerworld) A supercomputing, pay-per-use service that would make supercomputing affordable to small and midsize businesses, as well individuals who need added computation power, was announced today.

Interactive SuperComputing Inc., a Waltham, Mass.-based company said its new Grid On-Demand lets users tap into 188 processor cores on Intel Xeon processors.

This is not a software-as-a-service model where users access to the

http://www.itjungle.com/bns/bns100807-story02.html
http://www.itjungle.com/tug/tug050307-story05
http://www.computerworld.com/action/article.do?command=viewArticleBasic&taxonomyName=mainframes_and_supercomputers&articleId=9073758&taxonoyId=67&intsrc=kc_top

09/10/2008
Amazon EC2 and S3

- EC2 Beta Service: Web-Services based at
  - $0.10 per hour - Small Instance (Default)
    - 1.7 GB of memory, 1 EC2 Compute Unit (1 virtual core with 1 EC2 Compute Unit), 160 GB of instance storage, 32-bit platform
    - EC2 Compute Unit (ECU) - One EC2 Compute Unit (ECU) provides the equivalent CPU capacity of a 1.0-1.2 GHz 2007 Opteron or 2007 Xeon processor

- S3 storage services: WS-based (REST and SOAP)
  - Storage: $0.15 per GB-Month of storage used
  - Data Transfer: $0.10 per GB - all data transfer IN
    - $0.18 per GB - first 10 TB / month data transfer OUT
    - $0.16 per GB - next 40 TB / month data transfer OUT
    - $0.13 per GB - data transfer out / month over 50 TB

*Services may be given below actual cost for various reasons*
Virtualization and Cloud Computing

• "There’s Grid in them than clouds!"
  • I. Foster’s blog, ANL & UC, Jan. 8, 2008
• Clouds have a very simple user API effectively hiding all the complexity of an ad hoc grid on the back-end
  • e.g., Amazon’s EC2 & S3, IBM’s Blue Cloud and others …

• If so, will this enable mass-market grids?
  • Users don’t have to be aware of using “a grid”
• If so, what does “cloud interoperability” require?
  • Is virtualization a means of achieving this?
• Major opportunity for synergy
Switching Gears: “To Distribute or Not To Distribute”

• Prof. Satoshi Matsuoka, TITech
• Keynote at Mardi Gras Conference, Baton Rouge, Jan.31, 2008

• In the late 90s, petaflops were considered very hard and at least 20 years off ...

• … while grids were supposed to happen right away

• After 10 years (around now) petaflops are “real close” but there's still no “global grid”

• What happened?
What Happened?

- It was easier to put together massive clusters than to get people to agree about how to share their resources.
- For tightly coupled HPC applications, tightly coupled machines are still necessary.
- Grids are inherently suited for loosely coupled apps (e.g., Monte Carlo, Parameter Sweep), or enabling access to machines and data, and the integration of the two.

- With Gilder's Law, bandwidth to the compute resources will promote thin client approach.
- Example: *Tsubame* machine in Tokyo.
Microsoft virtualisation: More Green IT?

- Production Use
  - Virtual Server in heavy use for 18+ months
  - 1,250+ virtual machines
  - Consolidation Ratios
    - 8 servers to 1 server

- Test/Development Use
  - Virtual Server in heavy use for 18+ months
  - 500+ virtual machines
  - Consolidation Ratios
    - 16 servers to 1 server

- Test/Development Savings:

<table>
<thead>
<tr>
<th>Item</th>
<th>Physical System Cost</th>
<th>Virtual Server Build Cost</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of servers required</td>
<td>477 systems @ a cost of $5k each Total $2.3 million</td>
<td>16 physical host systems @ $20k each Total: $320 thousand</td>
<td>Just under 2 million dollars</td>
</tr>
<tr>
<td>Hard drive space</td>
<td>19 terabytes</td>
<td>8 terabytes</td>
<td>11 terabytes</td>
</tr>
<tr>
<td>Rack space</td>
<td>30 racks</td>
<td>2 racks</td>
<td>28 racks</td>
</tr>
<tr>
<td>Power</td>
<td>525 amps</td>
<td>8 amps</td>
<td>517 amps</td>
</tr>
</tbody>
</table>
• Virtualisation: A promising technology
• It’s not only about virtual machines...
• Virtualisation not much exploited in e-Science so far
• However exploited in Cloud computing and hosted services
  – Which emerge as the next incarnation of distributed computing
• Virtualisation is a better Green technology!
  – Less space, less energy consumption
• Microsoft: a player in the field
  – HyperVisor
http://www.microsoft.com/virtualisation
Online Resources

- Microsoft Virtualization Home:
  - http://www.microsoft.com/virtualization

- Windows Server Virtualization Blog Site:

- Windows Server Virtualization TechNet Site:

- TS Blog:
  - http://blogs.msdn.com/ts

- Windows Server 2008 TS site:

- TS TechNet Site:
  - http://technet.microsoft.com/ts

- TS 2008 Resources
Thanks to e-IRG for the kind invitation and to all of you for your attention

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