Experience the GRID Today
with Oracle9i RAC

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Agenda

- Introduction
  - What is the Grid
  - The Database Grid
- Oracle9i RAC Technology
- 10g vs. 9iR2 Comparison
- Benefits of RAC on Linux
- Summary
The best thing about the Grid is that it is unstoppable.

The Economist, June 21, 2001
Key IT Imperatives

- Highest Quality of Service
  - Maximum Availability
  - Maximum Scalability
- Most Efficient Management
  - Do much more ...
- Lowest Cost
  - ... with much less
Grid Vision

- Computing as a utility
  - A network of clients and service providers
- Client-side: Simplicity
  - Request computation or information and receive it
- Server-side: Sophistication
  - Availability, reliability, security
  - Capacity on demand, load balancing
- Virtualization
  - Storage
  - Networks
  - Computing Resources
Benefits of the Grid

- Better information faster
  - Perform more work with fewer resources
  - Spread work across resources
  - Access to resources on demand
- Faster response to changing business priorities
  - Instantly and dynamically realign IT resources as business needs change
- Reduced IT costs
  - Improve utilization of existing resources
  - Utilize less expensive commodity platforms
Reducing IT Costs

Large Dedicated Server

- Expensive components
- High incremental costs
- Configured for peak
- Single point of failure
- Enterprise service at high cost

Oracle Grid Computing

- Low cost modular components
- Low incremental costs
- Capacity on demand
- Fault tolerant
- Enterprise service at low cost
Technology Trends

- **Blades:** Every vendor offering them
  - Huge cost advantages
  - Software vendors have to enable usage
  - IBM BladeCenter, HP Proliant BL-Series, etc.

- **Linux:** Fastest growing OS
  - Commodity OS
  - Ready for blades today
  - Linux and blades naturally complement each other

- NAS, SAN, and Infiniband provide storage access from any blade
Roadmap

- Oracle9i RAC HA & Scalability
- Highest Quality Service
- Lowest Cost
- Low Cost Clusters
- Most Efficient Management
- RAC 10g For Everyone
- Adaptive Proactive Agile
- Enterprise Grids

15 December, 2003
**Grid Computing Eliminates Islands of Computation**

<table>
<thead>
<tr>
<th>IT Problem</th>
<th>Grid Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate servers</td>
<td>Shared servers</td>
</tr>
<tr>
<td>High h/w &amp; s/w costs</td>
<td>Low cost components</td>
</tr>
<tr>
<td>Configured for peak</td>
<td>Capacity on demand</td>
</tr>
<tr>
<td>Single point of failure</td>
<td>Fault tolerant</td>
</tr>
<tr>
<td>Rigid</td>
<td>Flexible</td>
</tr>
<tr>
<td>Difficult to manage</td>
<td>Unified management</td>
</tr>
</tbody>
</table>

Coordinated use of many small servers acting as one large computer.
Should I wait for 10g?
An Oracle9i RAC Database

- High Speed Switch or Interconnect
- Clustered Database Servers
- Hub or Switch Fabric
- Mirrored Disk Subsystem
- Network
- Low Latency Interconnect
- Storage Area Network
- Shared Cache
- Users
Why Clustering?
Scalability Alternatives

Scale-up
- More CPUs
- Faster CPUs
- More Memory

Scale-out
- More Nodes
## Clusters Reduce Costs

### Hardware Cost Comparison

<table>
<thead>
<tr>
<th></th>
<th>Solaris</th>
<th>AIX</th>
<th>Linux</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SMP</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 x Sun E15K</td>
<td>$1,474,930</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 x IBM p690</td>
<td>$1,006,154</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Clustered</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 x Sun V480</td>
<td>$187,980</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 x HP DL580</td>
<td>$86,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SMP</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 x IBM p650</td>
<td>$215,980</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Clustered</strong></td>
<td></td>
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</tr>
</tbody>
</table>

*Source OEM Website - Mid Range SMP vs Clustered hardware*
Oracle 9i RAC Distributions
Oracle 9i RAC Distributions

Maturity

End of beta

Q4 2003
Q1 2004
Q2 2004
Q3 2004
Q4 2004

10g R1

10g R2

15 December, 2003
## Oracle9i RAC HA

<table>
<thead>
<tr>
<th>Failover Operation</th>
<th>RAC</th>
<th>‘Cold’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reconfigure Group Membership</td>
<td>15 sec</td>
<td>0 sec</td>
</tr>
<tr>
<td>Reconfigure Distributed Locks</td>
<td>5 sec</td>
<td>0 sec</td>
</tr>
<tr>
<td>Failover Disk Volumes</td>
<td>0 sec</td>
<td>Up to 20 min</td>
</tr>
<tr>
<td>Restart Oracle</td>
<td>0 sec</td>
<td>Up to 5 min</td>
</tr>
<tr>
<td>Recover Oracle</td>
<td>20 sec</td>
<td>20 sec</td>
</tr>
<tr>
<td>Warm Buffer Cache</td>
<td>0 sec</td>
<td>5 + min</td>
</tr>
<tr>
<td>Total Failover Time</td>
<td>&lt; 60 sec*</td>
<td>&gt; 30 min</td>
</tr>
</tbody>
</table>

* Oracle RAC 10g failover time < 8 sec
Oracle 9i Cluster Stack vs. Oracle 10g
10g moving to an Integrated clusterware

9i RAC
Linux          Solaris
Oracle DB    Clusterware  CFS
Clusterware  CFS    LVM
OS          OS

10g RAC
Linux          Solaris
Oracle DB    Clusterware  CFS/ASM
Clusterware  CFS/ASM  ASM
LVM          LVM    OS
OS          OS
Automatic Storage Management (ASM)

- Eliminates need for conventional file system and volume manager
- Capacity on demand
  - Add/drop disks online
- Automatic I/O load balancing
  - Stripes data across disks to balance load
  - Best I/O throughput
- Automatic mirroring
- Virtualizes the storage resources
ASM - How it Works

- No volumes: just a pool of storage.
- Partitions total disk space into uniform 1 megabyte extents.
- Online add/remove of disk with automatic load balancing.
ASM Architecture

RAC or Non-RAC Databases

Clustered Servers

Clustered Pool of Storage

ASM Instance
Oracle DB Instance

ASM Instance
Oracle DB Instance

ASM Instance
Oracle DB Instance

ASM Instance
Oracle DB Instance

Disk Group

Disk Group
The Operational Stack

TODAY

- Tables
- Tablespace
- Files
- File System
- Logical Vol
- Disks

ASM

- Tables
- Tablespace
- Files
- File System
- Logical Vol
- Disk Group

Oracle ASM
RAC 10g and ASM Synergy

- Simplified Cluster Environment
- Easier Management
- Higher Availability
- Smoother Growth
- Adaptable Resources
Automatic Service Provisioning

- Hands-free allocation and re-allocation of servers to workloads (services) based on rules
  - Automated routing of service requests to appropriate server with lowest load
  - On server failure, automated re-allocation of surviving servers to services
Automatic Service Provisioning

Order Entry  Supply Chain  HR  Financials

Normal Server Allocation
Automatic Service Provisioning

Order Entry  Supply Chain  HR  Financials

End of Quarter
Automatic Service Provisioning

Order Entry  Supply Chain  HR  Financials

Normal Server Allocation
Automatic Service Provisioning

Order Entry  Supply Chain  HR  Financials

Server Fails
Automatic Service Provisioning

Order Entry  Supply Chain  HR  Financials

Reallocate HR server to Order Entry
Automatic Service Provisioning

Order Entry  Supply Chain  HR  Financials

Order Entry on Two Servers
RAC 10g - Services

- Policy based behavior
- Performance
- Availability
- Uses Automatic Workload Repository Statistics
- Created and managed with existing tools
  - OEM
  - DBCA
  - SRVCTL
Database Server Consolidation with Oracle 9i RAC

**Phase 1**
Mixed Apps and Database Environment

**Phase 2**
Mixed Apps with common Database but separate data models

**Phase 3**
Mixed Apps with common Database with ‘single source of truth’

9i RAC will support mixed workloads (OLTP/DSS) within common DB
How many nodes?

- Depends on the underlying platform
- 2-8 nodes is realistic in 9i
- 10g supports up to 64 nodes
- Scalability - test your own application TODAY
TPC-C 10g vs. 9iR2 on Superdome

On the same HP PA-RISC Superdome,
10g was 28% faster than 9iR2

Rolling Patch Upgrade using RAC

1. Initial RAC Configuration
   - Clients on A, Patch B

2. Upgrade Complete
   - Clients on B, Patch A

3. Clients on A, Patch B

Confidential Material
Will I need my old Oracle management tools when I migrate to Oracle 10g?
Oracle 9i RAC on Linux

- Clustering consists of 2 Oracle-supplied components
  - Clusterware
    - Cluster Manager (oracm)
      - responsible for process level cluster status
    - hangcheck-timer
      - monitors the Linux kernel for system hangs
      - resets node from within kernel if abnormal hangs occur
  - Cluster Files System (OCFS)
    - overcomes limits and management issues of using RAW
    - comparable performance to RAW IO
Unbreakable Linux - New Support Model

- Oracle takes first call; provides direct support for the operating system
- Oracle has ability to provide relief patches for OS
- Integrated development teams allow adoption of patches in future releases
Summary: Why (and When) RAC?

- Protection from local site system failures
- Why not pure HW cluster?
  - Fast Failover
    - Faster than cold cluster failover solution
- Scalability
  - Add and remove nodes transparently - scale-out
- Cost
Back to Basics

- What problems are you trying to solve?
- What are the alternatives from a technical/technology perspective
  - Ask the tough questions and test
  - Feature comparison
  - Pay attention to the “fine print” ... (unsupported datatype, ...)
  - Understand the limitations of the solution and of the implementation
- What is the cost of the solution?
  - Product licensing
  - Additional components needed
  - Don’t forget associated cost: application migration, staff training, ...
Industry leaders chose Oracle 9i RAC

- High availability
- High scalability
- Pay as you grow

9i RAC IS PROVEN
Questions and Answers