Best Practices for Oracle Database on Windows
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Agenda

- Oracle Architecture on Windows
- Increasing Addressable Process Memory
- Tuning Memory with AWE/PAE, ORASTACK and Shared Server
- Monitoring Memory Usage
- 64-bit Environments
- General Tips on Running Oracle/Windows
- High Availability Solutions for Scalability
- Maximum Availability Architecture (MAA)
- Patching
## Windows 32-bit Platform Support

<table>
<thead>
<tr>
<th>OS</th>
<th>9iR2</th>
<th>10gR1</th>
<th>10gR2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 2000</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Windows XP Professional</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Windows Server 2003</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Windows Vista</td>
<td>No</td>
<td>No</td>
<td>Yes*</td>
</tr>
</tbody>
</table>

*Requires special 10203 client/server release for Vista*
## Windows 64-bit Platform Support

<table>
<thead>
<tr>
<th>OS</th>
<th>9iR2</th>
<th>10gR1</th>
<th>10gR2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows Server 2003 for Itanium (64-bit DB)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>32-bit Windows XP &amp; Windows Server 2003 on EM64T (32-bit DB)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Windows XP &amp; Windows Server 2003 x64 (32-bit DB)</td>
<td>Yes (client only)</td>
<td>Yes (client only)</td>
<td>Yes (client only)</td>
</tr>
<tr>
<td>Windows XP &amp; Windows Server 2003 x64 (64-bit DB)</td>
<td>Developer Release (May 04)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Windows Vista x64</td>
<td></td>
<td></td>
<td>Planned later CY2007</td>
</tr>
</tbody>
</table>
Database Architecture

- Unlike UNIX ports, Oracle on Windows is implemented as a single operating system process.
- Typical “processes” such as PMON and LGWR have been converted to native Windows threads running in a single process.
- One process exists per instance on a Windows server.
Architecture: Thread Model

Oracle process

3GB or 8TB total

SGA contains db buffers, log buffers shared pool, other memory allocations

Each thread consists of PGA, stack, other memory allocations

SGA contains db buffers, log buffers shared pool, other memory allocations

Background and foreground threads

Code
32-Bit Address Space

Virtual Memory Address Space is limited to 4 GB in 32-bit architecture
4GT RAM Tuning

- Increase addressable memory available to the Oracle process by adding \(/3GB switch to boot.ini file:
  
  ```
  multi(0)disk(0)rdisk(0)partition(1)\WINNT="Microsoft Windows 2000 Advanced Server" /fastdetect /3GB
  ```

- Reboot server to enable
- Must monitor kernel memory closely to prevent instability of operating system
- See Metalink Notes 46001.1 and 297498.1
- See Microsoft KB article 297812
Monitoring Memory

- Key Items to Monitor for Memory Usage:
  - Performance Monitor - Virtual Bytes for oracle.exe to see total memory used by the process
  - Total Pool Non-Paged Bytes – Memory Counter
  - Total Pool Paged Bytes – Memory Counter
  - Free System Page Table Entries (PTE’s) – Memory Counter
- In addition to Perfmon, the Process Explorer tool from Windows Sysinternals is invaluable:
  http://www.microsoft.com/technet/sysinternals/default.mspx
Performance Monitor
Process Explorer
OS Tools

- tasklist, taskkill
- tlist (Shows command line args with -c)
- driverquery
- diskpart
- sc (sc query state= all)
- regmon, filemon, procexp, tcpview
- Windows Services for Unix
32-bit: VLM Support

Windows Server 2003
Memory Limits (32-bit)
- Standard Edition: 4GB
- Enterprise Edition: 32GB
- Datacenter Edition: 64GB

rest of RAM

For O/S, other apps

3GB

SGA
database threads/memory

Code
32-bit: VLM Support

For O/S, other apps

Window on db buffers in AWE mem

Extended memory available for db buffers via AWE calls

Memory from AWE calls used for db buffers only. The amount of AWE memory allocated equals \( \text{db_block_size} \times \text{db_block_buffers} \).

SGA minus db buffers

Oracle operating system process. Normally limited to 3GB of address space. With VLM, Oracle can get up to 12GB of database buffers.

rest of RAM

3GB

Code
Implementing AWE

- Use AWE with Oracle by adding initialization parameter USE_INDIRECT_DATA_BUFFERS
- Use DB_BLOCK_BUFFERS instead of DB_CACHE_SIZE
- With AWE, database buffer cache can be increased up to roughly 12 GB
- Default value for AWE_WINDOW_MEMORY is 1 GB
- See Metalink Note 225349.1 for more information
Using ORASTACK

- Each thread within Oracle process is provided 1MB reserved stack space
- Reduce to 500k without consequence:
  C:\ orastack tnslsnr.exe 500000
  C:\ orastack oracle.exe 500000
- See Metalink Note 46001.1 for more information
Using Shared Server

- With Shared Server, client connections are ultimately sent to a Dispatcher, which binds the client to an already established virtual circuit.
- Implement Shared Server in tnsnames.ora:
  ```ora
  (DESCRIPTION=
   (ADDRESS=(PROTOCOL=tcp)
     (HOST=sales-server)(PORT=1521))
   (CONNECT_DATA= (SERVICE_NAME=sales.us.acme.com)
     (SERVER=shared) ))
  ```
- See Net Admin Guide for more details
Best Practices for 32-Bit Memory Optimization

- Implement the /3GB switch
- Combine /3GB with /USERVA switch
- Run orastack to reduce stack size for both tnslsnr.exe and oracle.exe – be aware that patches change the executables, so run it again after patching.
- Use shared servers in implementations where large#’s of users connect in to the database.
- Control PGA Memory by using PGA_AGGREGATE_TARGET parameter
Best Practices for 32-bit Memory Optimization (continued)

- Verify Monitor Kernel Memory and Oracle Memory by using Perfmon or other tools that accurately measure Virtual Bytes.
- Use Automatic Workload Repository (AWR) to monitor cache hit ratios and shared_pool stats, etc. Make sure that values are not overstated.
- If large buffer cache is needed, implement AWE, but be aware that using AWE disables Automatic Memory Management features (SGA_TARGET cannot be used when USE_INDIRECT_DATA_BUFFERS is set).
64-Bit Address Space

Virtual Memory Address Space is limited to 7-8 TB in 64-bit architecture (depending on chip)
64-bit Oracle Releases

- Oracle has a long history of supporting 64-bit databases on other platforms
- Interoperability between 32-bit clients and 64-bit servers and vice versa
- Improved performance, availability and scalability
- Itanium is supported with 9.2.0.3 and higher
- x64 (AMD/EM64T) is supported with 10.2.0.1 and higher
Migration to 64-bit

- 32-bit to 64-bit upgrade process is simple
  - 32-bit data files are compatible with 64-bit DB
- No need to recreate the database
- Full export and import not required
- Database Upgrade Assistant automates process
- Transparent migration for end-user applications
  - No changes required to existing client applications when running against 64-bit database
64-Bit Best Practices

- Run correct 64-Bit version of Oracle for the architecture – i.e. 64-Bit Oracle for AMD or 64-Bit Oracle for Itanium.
- 32-Bit Oracle RDBMS not supported on 64-Bit platforms
- Use MBR disks instead of GPT disks
- For RAC environments with SGA’s > 4GB, apply latest Oracle patchset.
- Enable Large Pages (Note 422844.1)
Additional General Best Practices

- Take Advantage of Hyperthreading, which allows a single CPU to look like 2 CPU’s
- Don’t set ORACLE_HOME in environment – Oracle gets the environment via the Registry. Oracle.key file in OH\bin points to correct registry key.
- SQLNET.AUTHENTICATION_SERVICES=(NTS) this is a default value in sqlnet.ora for a reason – it should be left at default.
- In 10.2.x, SQLNET.INBOUND_CONNECT_TIMEOUT defaults to 60 – this may need to be set to 0 in some situations. Prior to 10.2 this is not an issue. (Note 363705.1 explains)
- Use Automatic Storage Management (ASM) whether running single-instance or RAC
High Availability Solutions

• HA becomes essential as databases are critical component of business

• HA Goals: Minimize downtime to your company and your customers

• Solutions for Windows Environments
  • Oracle Fail Safe
  • Real Application Clusters (RAC)
  • Data Guard (DG)
  • Maximum Availability Architecture (MAA)
Oracle Fail Safe

- Integrated with Microsoft Clustering, Fail Safe is a core feature included with every Oracle 10g and Oracle9i license for Windows NT, Windows 2000, and Windows 2003
- In the event of a system failure, Oracle Fail Safe works with Microsoft Cluster Server to restart Oracle databases and applications on a surviving cluster node
- MSCS and Fail Safe uses “share-nothing” architecture (only one node can access shared datafiles at any time)
Fail Safe Architecture

Before Failover

Node A

Cluster Disks

Node B

RAID Array

After Failover

Node A

Cluster Disks

Node B

RAID Array
Fail Safe Manager
Fail Safe Best Practices

• One database per group
  • Separate production from non-production databases into different groups
• Multiple physical disks to be separated into different groups
• Failback and Restart properties should be reviewed for business needs

Real Applications Clusters

- Use RAC for scalability
  - Add instances against same database files providing more Oracle processes and increasing number of users
  - Provides unique scalability on Windows that no other vendor offers
- Clustered databases supported on Windows platforms since version 7.3.3
- Uses Oracle’s own clustering software, not MSCS
- Oracle 10g provides platform independent Cluster Ready Services (CRS) to handle failover of services to surviving nodes
RAC Instance Architecture

- **Public Network**

  - **Node 1**
    - Nodeapps: Vip, ons, gsd
    - ASM instance
    - DB instance 1
    - CRS
  - **Node 2**
    - Nodeapps: Vip, ons, gsd
    - ASM instance
    - DB instance 2
    - CRS
  - **Node 3**
    - Nodeapps: Vip, ons, gsd
    - ASM instance
    - DB instance 3
    - CRS

- **Private Network**

  - **Node 1**
    - Nodeapps: Vip, ons, gsd
  - **Node 2**
    - Nodeapps: Vip, ons, gsd
  - **Node 3**
    - Nodeapps: Vip, ons, gsd
RAC/CRS Install Options

• Oracle Home can be on local NTFS drives or Oracle Cluster File System (OCFS)
  • Vast majority of installs use local NTFS homes
  • CRS home must be local NTFS drive
• Datafiles can reside on OCFS, RAW, or Automatic Storage Management (ASM)
• OCR and Voting file can reside on OCFS or RAW
• Refer to documentation for recommended partition sizes
Shared Storage

- Automount must be enabled in Windows 2003
  - Diskpart.exe can be used:
    ```
diskpart> automount enable
    ```
- Creating Partitions
  - Create all partitions on one node
  - Extended Partitions, w/logical drives
  - Use Basic disks: Dynamic Disks not supported
  - Windows 2003 requires a reboot
    - Remove drive letter assignments
  - Verify all nodes see all shared partitions
RAC Network Checklist

- Public adapter should be first
- Private adapter should be second
- Ping node’s public hostname to verify
- Ping each node’s public & private hostname

Network Connections
Advanced-> Advanced Setting
RAC Best Practices

• Eliminate Single Points of Failure
  • NIC’s, Switches, Interconnect, Shared Storage, Power Supplies
  • Understand cost vs. availability tradeoff

• Use fastest switch available for private interconnect
  • Disable additional protocols such as spanning tree protocol
  • Increase MTU size as high as switch allows – i.e. 9000
  • Allow cards and switch ports to autonegotiate speed.

• Use static IP addresses
  • Public LAN resolved by DNS and hosts file
  • For cluster interconnect use non-routable IP (10.X or 192.168.X)
RAC Best Practices

• On 10gR1, be sure to manually backup Voting Disk/File.

• Backups of files on RAW devices can be done via ‘ocopy’ utility on windows – i.e.:
  • Ocopy \\votedsk C:\backups\votedsk.bak
  • Backups of OCR can be taken manually as well, but CRS backs up OCR every 4 hours (on 10.1.0.4)

• 10gR2 allows mirroring of OCR and Voting Disks
Oracle Data Guard

- Data Guard is Oracle’s Disaster Recovery product which maintains and monitors one or more standby databases to protect enterprise data from failures, disasters, errors, and corruptions.
- Standby databases, which can be located across large geographic regions away from the primary database, can be switched to the production role if a problem occurs with the primary.
- DG is free with Enterprise Edition of RDBMS.

Data Guard Architecture
Maximum Availability Architecture (MAA)

- RAC + DataGuard
  - Eliminates physical location as SPOF

Data Guard

- Single Instance
  - Boston
  - Standby

- RAC Cluster
  - NYC
  - Primary
Patching Best Practices

• Apply CRS Patchset before RDBMS install
  • Simplifies process
  • Install patch to all nodes in the cluster
  • Apply patch to each node
  • Provides the ability for rolling updates

• For new installs on patched Oracle Homes, run catpatch after creating cloned databases with DBCA
Patching Best Practices

- For existing installs, make plans to test and apply future patchsets
- At minimum, CPU patches are released quarterly
- Fifth-digit patches provided on Windows platforms which bundle one-off patches
- For fixing new issues, applying latest patchset and fifth-digit patches available will help in eliminating known bugs
More Information

• Windows Server Technology Center
  • [http://otn.oracle.com/windows](http://otn.oracle.com/windows)

• Oracle Documentation on OTN: Windows tab at [http://www.oracle.com/pls/db102/homepage](http://www.oracle.com/pls/db102/homepage)

• [http://www.oratips.com](http://www.oratips.com) - debut edition in October contains article on Oracle/Windows by Scott Jesse

• “Oracle9i for Windows 2000 Tips & Techniques”
  • Authors: Scott Jesse, Matthew Hart, Michael P. Sale

• For more questions
  • [karin.brandauer@oracle.com](mailto:karin.brandauer@oracle.com)
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