Best Practices for Oracle Database Performance on Windows

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Program Agenda

1. Overview
2. Architecture
4. Best Practices for RAC on Windows
5. Q+A: Ask the Experts
Slide deck for this session

• Within a week, slides will be linked to on OTN Windows page:
  – http://otn.oracle.com/windows
Overview
Windows 8.1 and Windows Server 2012 R2

Supported Editions

• Windows 8.1 Editions
  – Pro
  – Enterprise

• Windows Server 2012 R2 Editions
  – Essentials
  – Foundation
  – Standard
  – Datacenter
# Windows 32-bit Platform Support

<table>
<thead>
<tr>
<th>OS</th>
<th>11gR1</th>
<th>11gR2 #1</th>
<th>12cR1 client</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 7</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Windows Server 2008</td>
<td>11.1.0.7</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Windows Server 2008 R2</td>
<td>11.1.0.7</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Windows 8</td>
<td>No</td>
<td>11.2.0.4</td>
<td>Yes</td>
</tr>
<tr>
<td>Windows 8.1</td>
<td>No</td>
<td>11.2.0.4</td>
<td>12.1.0.2</td>
</tr>
<tr>
<td>Windows Server 2012</td>
<td>No</td>
<td>11.2.0.4</td>
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#1

RAC not supported for 32-bit Windows in 11gR2 and later
## Windows 64-bit (x64) Platform Support

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<tr>
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<td>Yes</td>
</tr>
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<td>No</td>
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</tr>
<tr>
<td>Windows Server 2012</td>
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<td>12.1.0.2</td>
</tr>
<tr>
<td>Windows Server 2012 R2</td>
<td>No</td>
<td>11.2.0.4 (Planned #2)</td>
<td>12.1.0.2</td>
</tr>
</tbody>
</table>

1. RAC and some other features not supported on Windows client
2. Single Instance and Client support now; RAC support planned in CY2014

Oracle Client (Windows 32-bit version) is also supported on Windows x64 systems
Hyper-V Certification

• Windows Server 2012
  – DB 12.1 (Single Instance) and DB 11.2.0.4 (Single Instance)
    • Certified on Windows 2012 guest OS
    • Certified on Windows 2008 R2 guest OS

• Windows Server 2012 R2
  – DB 12.1.0.2 (SI and RAC)
    • Certified on Windows 2012 R2 guest OS
  – DB 11.2.0.4 (SI and RAC)
    • Planned certification on Windows 2012 R2 guest OS
Architecture
Database on Windows Architecture

• Thread model, not a straight port of Oracle’s process architecture
• 8TB maximum memory per database instance
• Runs as a Windows service process
• No limits on memory, connections, resources except those imposed by the operating system
File I/O

• Supports asynchronous I/O to all types of files
  – Asynch IO support on Windows is very good for both file system and raw devices.
  – No need to set INIT.ORA parameter “filesystemio_options”
  – Default value of “asynch” is the recommended setting

• Logical and physical raw files and partitions are fully supported
  – Faster than NTFS
Memory - Large Pages

• Large Page support
  – For instances with large memory requirements, large page support can improve performance.
  – To enable, set registry parameter ORA_LPENABLE
  – x64 – 4kb default page size – will now be 2 MB

• In 12c, if Oracle Home User is a standard Windows account, the administrator must grant the "Lock pages in memory" privilege to Oracle Home User or Service SID of Oracle Database Service (NTAUTHORITY\OracleService<sid>)
Memory - Large Pages

Memory Fragmentation issues

• Windows Server may be slow to allocate a huge amount of memory when using large pages especially if memory is already fragmented. Start Oracle before other processes if this affects you.

• Oracle Database 12c introduces a new option to allow use of large pages but it will fall back to small pages if OS is not able to allocate large pages.
Memory - Large Pages

New in 12c: “Mixed Mode”

• Under HKEY_LOCAL_MACHINE\SOFTWARE\ORACLE\KEY_HOMENAME
  – Create ORA_LPENABLE or ORA_SID_LPENABLE
  – Set the value to 1 for regular mode and 2 for mixed mode
  – Mixed mode is a new 12c option to allow use of large pages but fall back to small
    pages if OS is not able to allocate large pages
  – ORA_SID_LPMAXTIME is the optional time parameter for mixed mode
Memory - NUMA

Non Uniform Memory Access

• NUMA support for memory/scheduling
• Database intelligently allocates memory and schedules threads based on node configuration
• Test well before going into production. Work with your hardware vendor and Oracle support to enable NUMA.
Hyperthreading

• Circuitry added to Intel CPUs resulting in single CPU functioning as 2 CPUs
• All versions of Oracle are supported in Hyperthreaded environments.
Additional Integration with Windows

• Integration with Performance Monitor
• Integration with Event Log
Direct NFS Client on Windows

- Network Attached Storage (NAS) uses Network File System (NFS)
- As of 11g, Oracle Database allows direct Windows NFS v3 access
- Part of DB kernel in Oracle Disk Manager library
Direct NFS Client on Windows

- Bypasses a lot of software layers in OS
- Tailored for the specific I/O patterns that Oracle uses
Direct NFS Client on Windows

• Linear scalability of direct NFS can be achieved with inexpensive NICS
• Does not require expensive switches which support link aggregation
  – Oracle does load balancing rather relying on a switch.
• Parallel network paths
  – More NICS – more bandwidth
• Direct NFS is a good solution from low to high end database servers
Direct NFS Client on Windows

`dnfs_batch_size`

- In Database 12c Release 1, `dnfs_batch_size` allows Windows systems that don't have enough bandwidth to throttle the number of IOs that can be queued by an Oracle process, which may improve overall performance.
  - Start at 128 and increase or decrease it based on NFS server performance.
Best Practices for Windows
Diagnostic Tools - Performance Monitor
OS Tools

• tasklist, taskkill
• tlist (Shows command line args with -c)
• driverquery
• diskpart
• sc (sc query state= all)
• process monitor (regmon, filemon, procexp) tcpview
• Windows Services for Unix
Client Diagnosability

• OCI and Net tracing and logging uses ADR by default
• First Failure Capture
  – No need to reproduce a second time to get a dump
• Client and Server trace file correlation
• Reduce one-off diagnostic patches
• Structure Dump Facility
  – Dumps more than just a stack
• Client-Side Crash Handler
  – Generates error message & stack trace, and controls core dump location
12c Auto-Tuning

• Automatically tune client-side OCI Statement Cache size
  • Low value will cause more soft parses on server, and higher network and CPU getting cursor meta-data to client repeatedly
  • High value will cause more memory usage on client

• Auto tuning continuously monitors various parameters and adjusts size internally to optimal performance given memory constraints specified

• Enable during deployment via oraaccess.xml
  – Out-of-the-box solution that can be used by all OCI applications to improve performance
  – Frees OCI drivers and applications from custom implementations
ODP.NET Integration with Performance Monitor

- Monitor ODP.NET Connection Pools
- Enable in HKEY_LOCAL_MACHINE\SOFTWARE\ORACLE\ODP.NET\Assembly_Version \PerformanceCounters
ODP.NET Integration with Performance Monitor

Counters include (among many):

• HardConnectsPerSecond
• HardDisconnectsPerSecond
• SoftConnectsPerSecond
• SoftDisconnectsPerSecond
• NumberOfActiveConnection
• NumberOfFreeConnections
CPU Tuning

• ORACLE_AFFINITY registry value can be set to tell Oracle which threads to run on which processors (same setting for all instances)

• ORACLE_AFFINITY must be set if more than 64 CPUs
Support for Multiple Processor Groups

• Support a max of 10 processor groups with up to 64 CPUs in each group in 12.1.0.2 (12.1.0.1 supports 4 processor groups)

• ORACLE_AFFINITY enhanced to enable affinity of Oracle threads to cpus in multiple processor groups
  – processorgroup is an optional parameter designating Windows CPU group. On systems with 64+ logical CPUs, Windows divides all available CPUs into 4 groups (0,1,2,3) with each group containing no more than 64 logical CPUs
CPU Tuning

• Use Database Resource Manager to set CPU usage for different classes of users
  – For example, one can configure the db to use 50% CPU for gold customers, 30% for silver and 20% for rest

• Thread priorities can be set in the registry using the ORACLE_PRIORITY variable
CPU Tuning – Diagnosing High CPU

• Process Explorer: drill down to threads

• Get thread id of high CPU thread and then query
  – SELECT a.spid, b.username FROM v$process a, v$session b WHERE a.addr = b.paddr AND a.spid = <thread number>
Networking Best Practices

• Download slides for Openworld 2014 session:
  – Oracle Net Services 12c: Best Practices for Database Performance and Scalability [CON7245]

• Slide can be downloaded from Net Services page on OTN
Networking Best Practices

• Use one listener per system

• The default queue-size for Windows Server is 50 – increase to 200 or 300 using QUEUESIZE parameter in LISTENER.ORA – prevents errors during login storms

• Listener Logon Storm Handler
  – Configurable on server side in LISTENER.ORA (RATE_LIMIT = <max conn/sec>)
  – Use only if you have logon storm issues
Networking Best Practices

• Increase “DEFAULT_SDU_SIZE” in SQLNET.ORA or “SDU” in TNSNAMES.ORA
  – Controls SQL*Net packet size (Session Data Unit)
  – Default SDU size in 11g, 12c is 8k. For bulk data transfer scenarios, increase DEFAULT_SDU_SIZE in sqlnet.ora or SDU in tnsnames.ora. It can be increased up to 2 MB in 12.1, 64K as of 11.2.0.2 and 32k for earlier versions.
Networking Best Practices

– Any mix of 12c, 11g/10g will cause it to negotiate down to lower of the two peers (pre-11g default is 2K)
  • For 10g increase DEFAULT_SDU_SIZE to 8k or higher.
– Common misperception: Do not set to match MTU!
Networking Best Practices: Connection Timeouts

• Client Side connection timeouts: Achieve fast failover when you have multiple addresses in connect string
  – TCP.CONNECT_TIMEOUT – as of 11g – Constrains only time required to go from client to listener (no db processing). It can be a few seconds. (60 Seconds default in 11.2). Tune down from there. Too low – false positives
  – SQLNET.OUTBOUND_CONNECT_TIMEOUT – Constrains time required to go from client to database (including db processing) - from 10gR2 and later. Not set by default.
  – These two timeouts can be used individually or at the same time
Networking Best Practices: Connection Timeouts

• Server Side connection timeouts:
  – SQLNET.INBOUND_CONNECT_TIMEOUT – available in 10gR1 and later - default 60 secs for 10gR2 and later, not enabled by default for 10gR1; this can also be used along with the client side timeouts mentioned on the last slide.
Networking Best Practices

• **SQLNET.AUTHENTICATION_SERVICES=(NTS)**
  – This is a default value in SQLNET.ORA, needed for OS authentication (connect / as SYSDBA)
  – It should be left at default on server side.

• Use SecureFile LOBs
  – NET stack optimizations provide very high throughput limited only by the underlying hardware
File System Best Practices - ASM

• Use Oracle Automatic Storage Management (ASM) – whether single-instance or RAC – use most recent version

• Benefits
  – Don’t need to move datafiles around
  – Don’t need to take tablespaces offline
  – Add disks with no downtime

• If you don’t use ASM, but want to use raw devices:
  – Use volume mount points to mount raw devices onto directories
  – Use this mount point as the file name for raw devices.
File System Best Practices - ASM

• ASM provides equivalent performance to RAW
  – Database instance directly accesses data on disks
  – ASM not in path between instance and storage

• Sun ASM vs RAW benchmark
  – ASM supported 80% more throughput with 50% shorter response

• CERN testing on 11.2 Beta: “ACFS much faster than ext3 with comparable or less CPU usage”
Stores All Data
ASM Cluster File System (ACFS)

- General purpose scalable file system
- Accessible through NAS protocols (NFS, CIFS)
- Multi OS platform (Linux and Windows at initial release)
- Dynamic Volume Management Supported
- Read Only Snapshots Supported
Memory - Best Practices

• If system has more than 4G of SGA use sga_target (and not memory_target).

• Use Large Pages: Having a fixed, non-pageable SGA with large pages (compared to dynamically growing SGA) has many benefits, in particular, stability.
Using ORASTACK

• Each thread within Oracle process is provided 1MB reserved stack space
• When needed use orastack to increase stack size:
  C:\orastack oracle.exe 8000000
• Some Oracle apps installations have required Oracle.exe stacks as large as 32mb
Using ORASTACK

- Stop processes before running Orastack
- If you apply a patch, you must re-run Orastack
Migration from 32-bit Windows

- 32-bit to 64-bit upgrade process is simple
  - 32-bit data files are compatible with 64-bit DB
  - Only recreate control file if necessary (e.g., file location changes)
- 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
Best Practices for RAC on Windows
Real Applications Clusters

• Use RAC for scalability and High Availability
  – 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 7.3.4
Real Applications Clusters

• Oracle provides platform independent Oracle Clusterware to handle failover of services to surviving nodes

• Uses Oracle’s own clustering software, it does not depend on MSCS
RAC Best Practices for Performance

• Read “RAC and Oracle Clusterware Best Practices and Starter Kit (Windows) (Doc ID 811271.1)”
• Installation and performance best practices
• Also contains excellent attached illustrated installation walkthrough.
Anti-Virus

• Disable Anti-Virus software running on cluster nodes during installation of Oracle on Windows (be mindful of manual reboots during this time).

• After install, the following should be excluded from being scanned:
  – Oracle Software directories
  – OCFS filesystems
  – ACFS filesystems
  – Network scanning of the private interconnect
Anti-Virus Symptoms

• Some examples of how AV issues can manifest:
  – Installation freezing
  – Voting File Disk being locked
  – Node eviction issues
/USEPMTIMER

• Set /USEPMTIMER in the boot.ini to prevent excessive LMD and LMS trace generation and to prevent connectivity issues as described in Document 437101.1.
Non-Interactive Desktop Heap Size

• Increase size of the default Non-Interactive Desktop Heap to 1MB to prevent instability due to Desktop Heap exhaustion. See Document 744125.1 and KB947246.

• Consult with Microsoft for further tuning of the Non-Interactive Desktop Heap beyond 1MB.
Generate .BLG files

• Run Perfmon to monitor CPU, Memory, Network, Disk IO Rates - To aid in troubleshooting, configure Perfmon to monitor these OS statistics and to generate binary log files (.BLG). Instructions for implementing this change can be found on the Microsoft support website using the following link: http://support.microsoft.com/kb/146005

• Expensive – don’t run all the time
Memory Allocation

• Keep memory allocation under 80%.
• Shoot for 75% allocated (e.g., more than 20-25% free)
• This will allow for ample memory needed for Windows OS operations (including collection of physical memory dumps if required).
Scalable Networking Pack

• Turn off default Scalable Networking Pack (SNP) features. On a computer that has a TCP/IP Offload-enabled network adapter, you may experience many network-related problems like network adapters consuming lots of nonpaged pool memory or adapters requesting large blocks of contiguous memory -- causing interference with internode communication.

• See Document 988008.1 and KB Articles KB948496 and KB951037 for instructions on how to fix.
ORAcchk

• Health check tool
  – Currently in beta
• Supports Windows 2008 and 2012
• Requires Cygwin to be installed.
Upcoming Windows Sessions and Demogrounds

• Microsoft Active Directory and Windows Security Integration with Oracle Database
  – Wednesday - 4:45 PM - 5:30 PM Moscone South – 308

• Visit Windows experts at the Demogrounds:
  Oracle Database 12c on Windows
  – Monday through Wednesday
  – Moscone South Exhibition Hall, Far Left Middle in Oracle Database Section
  – Booth SLD-164
Additional Oracle .NET Resources

OTN
otn.oracle.com/dotnet

Twitter
twitter.com/OracleDOTNET

YouTube
youtube.com/OracleDOTNETTeam

Email
christian.shay@oracle.com
Questions and Answers: Ask the Experts
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