

# Oracle Database 12c & Oracle Database 12c RAC on IBM AIX

*Tips and Considerations*



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## Abstract

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*This paper consolidates the information necessary for planning and implementing Oracle Database 12c Release 1 & 2 (12.1 and 12.2) single instance database or Oracle Database 12c Release 1 & 2 Real Application Cluster (RAC) on the IBM AIX® operating system.*

*This paper summarizes the information available at the time of publication. It will be updated as changes (eg. new certifications) occur. It is meant to be used only as a guide. For any official Oracle certification information, please consult Oracle's "My Oracle Support" website.*

*This paper is written to a level of detail that assumes readers have an in-depth knowledge of AIX, Oracle Database 12c Release 1 & 2, Oracle Database 12c Release 1 & 2 RAC and the related products.*

## Introduction

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There are many technical topics to consider when running Oracle Database 12c Release 1 & 2 and Oracle Database 12c Release 1 & 2 RAC on AIX such as: status of Oracle certifications, 12c Release 1 & 2 patch sets, AIX code levels, tuning and related software components - just to name a few. The documentation for these topics is spread across many websites, documents, presentations and forums. This paper consolidates that information for easy reference.

This paper focuses on AIX 6.1, AIX 7.1 and AIX 7.2, since these are the AIX versions supported for Oracle Database 12c Release 1 & 2 (Stand-alone) and Oracle Database 12c Release 1 & 2 RAC.

This is a companion paper to three other papers.

- For 9i and 10gR1, *Oracle 9i & 10gR1 on IBM AIX5L: Tips and Considerations*, <http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100556>
- For 10gR2, *Oracle Database 10gR2 and Oracle RAC 10gR2 on IBM AIX: Tips and Considerations*, <http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101089>
- For 11g, *Oracle Database 11g R2 and Oracle RAC 11g R2 on IBM AIX: Tips and Considerations*, <http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101176>.

The IBM Oracle International Competency Center (ICC) works closely with the IBM Oracle Center (IOC) in Montpellier, France and the IBM Oracle Competency Center in Tokyo, Japan.

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**Note:** Some of the "My Oracle Support" notes and web links referenced in this document for Oracle Database 12c Release 1 & 2 on IBM Power Systems/AIX are still being updated to reflect the up-to-date information.

For question or feedback, please send a note to the IBM Oracle International Competency Center at [ibmoracl@us.ibm.com](mailto:ibmoracl@us.ibm.com).



## Terminology

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In 2008, the System p™ and System i™ product families were combined to create the IBM Power™ Systems product family. The IBM Power Systems product family includes systems previously referred to as System p, System p5™, eServer™ pSeries®, RS6000®, System i™, System i5™, eServer iSeries®, AS/400®, Flex System, IBM PureFlex and IBM PureSystems.

The brand name of “AIX 5L™” is no longer used. The term “AIX 5L” will still appear in some places in this document, mostly in document titles which have yet to be updated.

High Availability Cluster Multi-Processing (HACMP™) has been renamed to the PowerHA™ and PowerHA SystemMirror. This version of the document will use the name HACMP for version up to 5.4.1, PowerHA for version 5.5 and PowerHA SystemMirror for the version 6.1 and up.

## IBM AIX

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IBM AIX is an open standards-based, UNIX operating system. AIX in combination with IBM's virtualization offerings provides new levels of flexibility and performance to allow you to consolidate workloads on fewer servers, which can increase efficiency and conserve energy. AIX delivers high levels of security, integration, flexibility, scalability and reliability—essential for meeting the demands of today's information technology environments. AIX operates on IBM Systems based on Power Architecture technology. For more information about AIX, see this web page: <http://www-03.ibm.com/systems/power/software/aix/>

IBM and Oracle are advancing to focus on supporting AIX6.1, AIX7.1 and AIX 7.2 for Oracle Database 12c Release 1 & 2. IBM's latest certified AIX version for Oracle Database is AIX 7.2. It contains new features for virtualization, security, availability and manageability. AIX 7.2 is binary compatible with AIX 7.1, AIX 6.1 and AIX 5.x. AIX 7.2 includes supporting POWER9™, high-end POWER8 servers (E880) with 192 CPUs can provide 1536 logical processors with the use of SMT8 and POWER7 servers with 256 CPUs can provide up to 1024 logical processors with use of SMT 4 .

For additional information and new features of AIX 7.2, and AIX 7.1 visit this web page:

<https://www.ibm.com/it-infrastructure/power/os/aix>

Most of the new features of AIX 7.2 and AIX 7.1 are available on earlier POWER™ platforms. However, the best capabilities are delivered on systems based on POWER9, POWER8™, POWER7+™ , POWER7™ and POWER6™ processors. POWER7 and later processors built for Smarter Planet and automatically optimize work load performance and capacity. New intelligent threads technology in POWER9, POWER8, POWER7+ and Power7 dynamically switches the processor threading mode to deliver optimal performance—either the highest per-thread performance or the maximum system throughput based on application requirements.

POWER9, POWER8 and POWER7+ Hardware Accelerator improve the efficiency of memory expansion even more effectively allowing more memory expansion.

On March 20, 2018 IBM introduced the next generation of new Power Systems servers, S924, S922, and S914 with POWER9 processor technology.

These new Power Systems servers with POWER9 processors come with large memory footprint up to 4 TB of DDR4 memory, up to 24 high speed POWER9 processor cores in one or two Single Chip Module

(SCM) sockets, PCIe Gen4 to add more performance and flexibility for I/O configurations and Storage backplane options. This system is designed to run commercial, cognitive, and database workloads.

Customers can continue to choose IBM POWER8 processor based servers from one socket scale out server with up to 8 cores to 16 sockets enterprise class servers up to 192 cores.

For information about the POWER9, POWER8 processors, see this web page: <https://www.ibm.com/it-infrastructure/power>

Refer My Oracle Support Note 1587357.1, “Oracle Database (RDBMS) on Unix AIX,HP-UX, Linux, Solaris and MS Windows Operating Systems Installation and Configuration Requirements Quick Reference “ also for AIX pre-requisite requirement for Oracle Database 12c Release 1 & 2.

IBM also produces benchmark reports that demonstrate the performance results of Power Systems running AIX. These benchmarks are run using Oracle E-Business Suite, yet they provide valuable data about Oracle Database and Oracle RAC. The benchmark results are published at

<http://www.oracle.com/us/solutions/benchmark/apps-benchmark/index.html>

IBM will also provide sizing estimations to help predict the system resources necessary to support a given workload. To start the sizing process, visit this web page,

<https://www-935.ibm.com/services/oracle/sizing/>

Additional documentation resources for AIX can be found at:

- IBM Power Systems and AIX Information Center, <http://publib16.boulder.ibm.com/pseries/index.htm>
- IBM developerWorks AIX, <https://www.ibm.com/developerworks/aix/>

## AIX support

The latest fixes and updates for your system’s hardware and operating system can be found at the **Fix Central** web page: <https://www-933.ibm.com/support/fixcentral/> .

Be sure to review My Oracle Support note **282036.1**, “Minimum Software Versions and Patches Required to Support Oracle Products on IBM pSeries”, for the latest, up-to-date issues regarding AIX and Oracle Database. This My Oracle Support note is the primary mechanism used to broadcast any breaking news, such as PTF’s or bug fixes, about AIX and Oracle Database.

In general, the ICC recommends that you keep your TL’s and SP’s up to date for your AIX installation. Monitor My Oracle Support note **282036.1** and Fix Central for the latest issues. Always perform thorough testing on an OS update before deploying to production.

### **Oracle Database 12c software Online Patching (Hot Patching) on AIX 6.1, AIX 7.1 and AIX 7.2**

From Oracle Database 11g Release 2, Oracle introduced a new feature called “online patching” for some qualified interim Oracle DB patches. This “online patching” integrated with OPatch tool and provides the ability to patch the running processes of an Oracle instance without bringing down it. Each

process associated with the Oracle instance checks for the patched code at a safe execution point, and then copies the code into its process space.

The “online patching” of Oracle Database 12c Release 1 is also available for AIX 6.1 TL07 SP03 with APAR IV16716 and above, AIX 7.1 TL01 SP03 with APAR IV16737 and above, and AIX 7.2

For more detailed information on the “online patching” on AIX, refer the following flash document,

<http://w3-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102085>

## Recommended Code Levels

There are two tools to help determine the recommended code levels among AIX and Power Systems related components.

1. The Fix Level Recommendation Tool (FLRT) can determine the recommended code levels among a mixture of AIX, HMC, Server firmware, VIOS, GPFS™ and PowerHA®. The FLRT web page is: <http://www14.software.ibm.com/webapp/set2/flrt/home>. Note, the FLRT recommendation provides a minimum acceptable level of compatibility.
2. The POWER code matrix indicates the recommended code levels for the HMC and Server firmware. The POWER code matrix web page is: <http://www14.software.ibm.com/webapp/set2/sas/f/power5cm/home.html>. Note, the POWER code matrix recommendation provides the maximum stability code combinations.

## Service Strategy

To review the latest *IBM AIX Operating System Service Strategy Details and Best Practices* document, see this website: <http://www14.software.ibm.com/webapp/set2/sas/f/best/home.html>.

## C and C++ compilers

XL C/C++ is a standards-based, high performance C and C++ compiler with advanced optimizing and debugging features. It gives you the ability to optimize and tune applications for optimal execution on systems using POWER7™, POWER8™ and the latest POWER9™ processors from IBM. The compiler is focused on IBM Power Systems servers capable of running IBM AIX 6.1, 7.1 and 7.2.

To determine the **current certifications** for compilers on 12c Release 1 & 2, please review My Oracle Support note **43208.1**, “Certified Compilers”. Currently, XL C/C++ 11.1.0.4 and later are supported for Oracle Database 12c Release 1. XL C/C++ 13.1 is supported by Oracle Database 12c Release 2 (12.2.0) If necessary, read My Oracle Support note **335569.1**, “How to Find C or C++ version on AIX Platform” to determine your XL C/C++ compiler version.

The XL C/C++ runtime environment is installed during the installation of base AIX. To update to the latest runtime environment, go to the web page [Fix list for XL C/C++ Runtime for AIX](#).

If the XL C/C++ Enterprise Edition for AIX compiler is installed, to get the latest updates, visit the product’s web page, [Fix list for XL C/C++ for AIX](#).

## Oracle Database 12c Release 1 & 2 (Non RAC)

This section contains the Oracle Database 12c non-RAC technical information that needs to be considered in an AIX installation. Oracle 11g Release 2 introduced the Grid Infrastructure installation for both stand alone and Real Application Cluster (RAC) databases. In Oracle Database 12c, Grid Infrastructure is also an option which includes Automatic Storage Management (ASM) and Oracle Restart. Oracle Restart is a new feature that provides the ability to monitor, manage, and automatically restart the Oracle components, including the Oracle database Single Instance, Oracle Net Listener, database services and Oracle ASM. Grid infrastructure is needed for the stand alone database server if the ASM is selected as a storage option for the database files

In May, 2017, Oracle released 12c Database Release 2 for IBM AIX. The Oracle Database 12c Release 2 new features can be found in a document available at,

<https://docs.oracle.com/database/122/NEWFT/NEWFT.pdf>

These are the basic documents to refer for an Oracle Database 12c installation on AIX.

### Oracle Database 12c Release 2:

- Oracle Grid Infrastructure Installation and Upgrade Guide 12c Release 2 (12.2) for IBM AIX on POWER Systems (64-Bit)  
E85691-02, <https://docs.oracle.com/database/122/CWAIX/toc.htm>
- Oracle Database Installation Guide 12c Release 2 (12.2) for IBM AIX on POWER Systems (64-bit)  
E85764-03 <https://docs.oracle.com/database/122/AXDBI/title.htm>
- Oracle Database Release Notes - 12c Release 2 (12.2) for IBM AIX on POWER Systems (64-Bit)  
E85844-01 <https://docs.oracle.com/database/122/AXDBN/toc.htm>
- Oracle Database Licensing Information User Manual – Oracle Database 12c Release 2.  
E85683-03 <https://docs.oracle.com/database/122/DBLIC/toc.htm>

### Oracle Database 12c Release 1:

- Oracle Grid Infrastructure Installation Guide 12c Release 1 (12.1) for IBM AIX Based Systems (64-bit)  
E51133-07, <http://docs.oracle.com/database/121/CWAIX/toc.htm>
- Oracle Database Installation Guide 12c Release 1 (12.1) for AIX on POWER Systems (64-bit) ,  
E52188-06, <https://docs.oracle.com/database/121/AXDBI/toc.htm>
- Oracle Database Release Notes 12c Release 1 (12.1) for AIX on POWER Systems (64-bit),  
E52118-06, <http://docs.oracle.com/database/121/AXDBN/toc.htm>
- Oracle Database product Editions and Options,  
<https://docs.oracle.com/database/121/DBLIC/editions.htm#DBLIC109>
- My Oracle Support note **282036.1**, “Minimum Software Versions and Patches Required to Support Oracle Products on IBM pSeries” for the latest, up-to-date issues regarding Oracle Database 12c Release 1 and AIX.

## Current certifications

To determine the **current certifications** for Oracle Database 12c Release 1 on AIX,

- Sign into Oracle’s My Oracle Support website (UserID/Password is required) at <https://support.oracle.com/CSP/ui/flash.html> and click on “Certifications” tab, look for “Certification

Search” section. In the “Product” field. Type “Oracle Database”, the second field is “Release”. Select one of them from the list. It has the release 12.1.0.2.0., next field is “Platform”, select ”IBM AIX on POWER Systems (64-bit) 7.1” or ”IBM AIX on POWER Systems (64-bit) 6.1, Then click “Search” button. The search result will show the certification status in the link “See Certification Details for Notes and Support information”

Additionally, refer “My Oracle Support” document **1307544.1** for the latest certification information for Oracle Database on IBM AIX on Power Systems.

IBM and Oracle recommend using the following versions of the AIX to minimize the number of AIX patches for Oracle Database 12c Release 1 & 2.

OS	Product	Status
AIX 6.1 TL09 or later AIX 7.1 TL03 or later AIX 7.2 TL0 or later	Oracle Database 12c Release 1 (64-bit) <sup>1</sup> Oracle Database 12c Release 2 (64-bit) <sup>2</sup>	Certified

*Table 1: Oracle Database Enterprise Edition 12c Release 1 certifications of AIX as of publication date*

- <sup>1</sup> The minimum recommended AIX version which is supported to use with Oracle Database 12c Release 1 is AIX6.1 TL07 SP03 or AIX7.1 TL01 SP03 or AIX7.2 TL0 SP01.
- <sup>2</sup> The minimum recommended AIX version which is supported to use with Oracle Database 12c Release 2 is AIX6.1 TL09 SP04 or AIX7.1 TL03 SP04 or AIX7.2 TL0 SP01.

The IBM Power System servers with POWER9 processor need minimum recommended AIX levels as shown below,

- AIX 7.2 TL2 SP02 or later
- AIX 7.1 TL05 SP02 or later
- AIX 6.1 TL09 SP11 or later

The same certifications are in place for Standard Edition 2 (SE2) as Enterprise Edition (EE) of 12.1 and 12.2. There is no current Standard Edition for Oracle Database version 12.1 and 12.2. IBM and Oracle recommend Oracle Database version 12.1 and 12.2 to use with the above certified AIX versions.

For Oracle Database **12.1.0.2 on AIX 7.2 TL0 SP01**, download the following APARs from IBM fix central and apply.

- IV79639 - after live update ifix state may be left as Q; reboot required
- IV79848 - mirrorvg/syncvg on minimal and migration install fails
- V80412 - system crash application sets signal mask
- IV81482 - MULTIBOS MAY FAIL TO MOUNT OR REMOVE A STANDBY INSTANCE
- IV82224 - CORE DUMP IN MANY COMMANDS WHEN USING NIS

For Oracle Database **12.1 and 12.2 on AIX 7.2 TL1 SP01**, download the following APARs from IBM fix central and apply.



IV94362: SOME APPLICATIONS MAY FAIL AFTER BEING LINKED ON AIX 7.2 TL1 APPLIES TO AIX 7200-01

For Oracle Database **12.1 and 12.2 on AIX 7.1 TL02 SP03** obtain and apply the following APARs,

IV48895: A SPECIAL-PURPOSE LINKER FLAG WORKS INCORRECTLY. APPLIES TO AIX 7100-02

IV48898: ADD ABILITY TO REORDER TOC SYMBOLS IN LIMITED CIRCUMSTANCES APPLIES TO AIX 7100-02

For Oracle Database **12.1 and 12.2**, obtain the following Interim fix (ifix) and apply on the AIX versions,

AIX 7.2 TL02: **IJ04933**: GETSOCKNAME RETURNS INVALID PATH NAME FOR AF\_UNIX SOCKETS

AIX 7.1. TL05: **IJ04311**: GETSOCKNAME RETURNS INVALID PATH NAME FOR AF\_UNIX SOCKETS

Be aware of the following issue which might occur to the Database Release from 11.2 to 12.2, and obtain the fix to resolve the issue.

**Database Corruption ORA-600 ORA-7445 errors after applying AIX SP patches** - AIX 6.1TL09 SP08 or AIX 7.1 TL03 SP08 or AIX 7.1 TL04 SP03 or AIX 7.2.TL0 SP03 or AIX 7.2.TL01 SP01

- Refer My Oracle Support note 2237498.1

Affected AIX Levels	Fixed In	iFix / APAR ( <a href="ftp://aix.software.ibm.com/aix/ifixes/">ftp://aix.software.ibm.com/aix/ifixes/</a> )
o 6100-09-08	6100-09-09	IV93840
o 7100-03-08	7100-03-09	IV93884
o 7100-04-03	7100-04-04	IV93845
o 7200-00-03	7200-00-04	IV93883
o 7200-01-01	7200-01-02	IV93885

Here are some certification details to be aware of:

- These products are certified for AIX 6.1, 7.1, and 7.2 on all Power Systems servers supported by those versions of AIX.
- 64-bit hardware is required for a 64-bit application such as Oracle Database 12c for AIX.
- Servers capable of more than 4 processors are certified only for EE.
- Logical Partitioning (LPARs) and Micro-Partitioning™ are supported.
- Virtual IO Server (VIOS) is supported.

## Oracle Database Latest patch set

Oracle has released Component-Specific release, version 12.1.0.2.0 on Nov 2014 for AIX. It has many new features such as Full Database Caching, In-Memory Column Store, and so on. All new features of Oracle Database 12c version 12.1.0.2.0 can be found at

<https://docs.oracle.com/database/121/NEWFT/chapter12102.htm#NEWFT003>.

Oracle Database 12c version 12.1.0.2.0 and 12.2.0.1.0 are released as Enterprise Edition and Standard Edition 2.

To find the documentation for the latest Oracle Database 12c Release 1 & 2 patch sets, sign into Oracle's My Oracle Support website at <https://support.oracle.com/CSP/ui/flash.html>. In the Quick Find pull down, specify "Document ID". Then specify Document Number **161818.1**, "Oracle Server (RDBMS) Releases Support Status Summary". Then click on "12.1.0.X", this will bring up My Oracle Support note **1565065.1**,

“Support Status and Alerts for Oracle 12c Release 1(12.1.0.X)”. My Oracle Support note **2239821.1**, “Oracle 12c Release 2 (12.2) Support Status and Alerts” shows availability and known issues for 12.2.0.1.

### Critical Patch Update schedule

The Critical Patch Update (CPU) program is the method by which Oracle delivers security patch updates and security fixes for all their products. A CPU is a collection of patches for multiple security vulnerabilities. It also includes non-security fixes that are required (because of interdependencies) by those security patches. Oracle provides CPUs for all product offerings on a quarterly schedule.

For more information about CPUs and watch for Critical Patch Updates at this site:

<http://www.oracle.com/technology/deploy/security/alerts.htm>.

### Patch Set Update (PSU)

Beginning with October 2009 Critical Patch Update release, Oracle delivers Patch Set Updates for all platforms on the release date. PSUs are proactive cumulative patches containing recommended bug fixes that are released on a regular and predictable schedule. PSUs are on the same quarterly schedules as the Critical Patch Update (CPU). From Oracle Database version 12.1.0.1 onwards PSUs also consist of Security Patch Update (SPU) along with CPU, generic patch bundles, RAC patch bundle, and Data Guard patch bundles. Refer My Oracle Support note 1962125.1.

### Release Update (RU) and Release Update Revisions (RUR)

Starting with Database 12.2.0.1, the Quarterly Release Updates (RUs) will replace Bundle patches and Quarterly Release Update Revisions (RURs) will replace the PSU's to improve the quality and experience of proactive maintenance. For more information on Database Release Update (RU) and Release Update Revision (RUR) see My Oracle Support [Note 2285040.1](#) Release Update and Release Update Revisions for Database Proactive Patch Program.

Which Patching Method to use?

Oracle makes the following recommendation for which patch method to use for Database related installations:

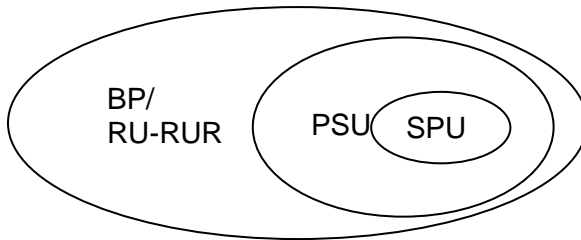
- Every customer should at least install PSUs. Minimal testing required.
- 12.1.0.2 Customers wanting a more comprehensive set of fixes should install the Database Proactive Bundle patch. This requires a bit more testing than a Patch Set Update (PSU), but delivers a larger set of fixes.

Release	Non RAC	RAC
12.2.0.1	Release Update(RU)/Release Update Revision(RUR)	Release Update(RU)/Release Update Revision(RUR)
12.1.0.2	<ul style="list-style-type: none"> <li>• Database Proactive Bundle Patch <a href="#">1</a> (DBBP)</li> <li>• PSU</li> </ul>	Database Proactive Bundle Patch <a href="#">1</a> (DBBP)

12.1.0.1	Database PSU	Database Grid Infrastructure PSU (GI PSU)

<sup>1</sup> The "Database Proactive Bundle Patch" requires a bit more testing than a Patch Set Update (PSU) as it delivers a larger set of fixes.

Database patch content for the various pro-active patch methods might be visualized like this:



- Security Patch Update (SPU) contains only the CPU program security fixes
- PSU contains the CPU program security fixes and additional high-impact/low-risk critical bug fixes
- BP includes all PSU fixes along with fixes targeted at the specific BP environment for 12.1
- RU-RUR includes all PSU fixes along with fixes targeted at the specific BP environment for 12.2 and higher
- An installation can only use **one** of the SPU, PSU, BP, or RU-RUR patching methods.

You cannot mix BP and DB PSU (or SPU) patching methods in the same ORACLE\_HOME.

For example, If you install "Database Proactive Bundle Patch" on a system then you cannot subsequently install a later "Database PSU" (DB PSU) on top of that. You would need to stay on the DBBP path **OR** fully roll out the DBBP patches and apply DB PSU patches to switch patching methods. It is not generally advisable to switch from "Database PSU" to "Database SPU" method.

For more information on patching methods, refer My Oracle Support note "Overview of Database Patch Delivery Methods (Doc ID 1962125.1)".

**Refer My Oracle Support note 2394520.1 for latest PSU, Proactive bundle patch, Release Update and Release Update Revision patches.**

Also refer the note **756671.1** for Oracle recommended patches for Oracle Database versions from 11.2.0.4 and later.

## Virtualization for Oracle Database 12c Release 1 & 2 (Non RAC)

As mentioned in the Current Certifications sub-section (see above) for Oracle Database 12c Release 1 & 2, IBM PowerVM™ features such as LPARs, Micro-Partitioning and VIOS are supported. PowerVM is the family of technologies, capabilities and offerings that deliver industry-leading virtualization on IBM POWER processor-based systems.

Power System features	Certified With	Status
Dedicated processor LPAR Shared processor LPAR Workload Partition (WPAR)	Oracle DB 12c R1 & R2	Certified
Dynamic Logical Partitions (DLPAR)	Oracle DB 12c R1	Certified
Live Partition Mobility with Oracle- ASM Live Partition Mobility with IBM Spector Scale (formerly GPFS)	Oracle DB 12c R1	Certified
Virtual I/O server	Oracle DB 12c R1 & R2	Certified

- **Logical Partitions** subdivide a computer's processors, memory, and hardware resources into multiple environments so that each environment can be operated independently with its own operating system and applications.
  - **Dedicated processor partitions** are LPARs that use dedicated processors.
    - **Dedicated processors** are whole physical processors that are assigned to a single LPAR.
  - **Shared Processor partitions** are LPARs that use Micro-Partitioning in conjunction with a shared processor pool.
    - **Micro-Partitioning** divides a physical processor's computing power into fractions of a processing unit and shares them among logical partitions. Processing capacity can be configured in fractions of 1/100 of a processor. The minimum amount of processing capacity that has to be assigned to a partition is 1/10 of a processor.
    - A **shared processor pool** is a group of physical processors that are not dedicated to any LPAR.
  - **Dynamic Logical Partitions (DLPAR)** is the capability of an LPAR to be configured dynamically, without having to shut down the AIX operating system that runs on that LPAR. DLPAR is a shared or dedicated LPAR to which changes can be made dynamically to the amount of processors, memory and virtual or physical adapters without requiring a reboot. Oracle Database version 12.1.0.2 is certified with DLPAR on IBM Power Systems.
  - **Live Partition Mobility (LPM)** allows you to migrate running AIX and Linux LPARs and their hosted applications from one physical server to another without disrupting infrastructure services. The migration transfers the entire partition state, including the processor context, memory, attached virtual devices, and connected users. The LPM is certified to use with Oracle Database version 12.1.0.2 on AIX 6.1 with a minimum service level of TL08 SP01, on AIX 7.1 with a minimum service level of TL03 SP03, and on AIX 7.2 with a minimum service level of TL0 SP1 ("7200-00-01 ") or later.

For more information on LPM, see the IBM PowerVM Virtualization - Introduction and Configuration <http://www.redbooks.ibm.com/redbooks/pdfs/sq247940.pdf>

- **Virtual I/O Server** allows sharing of physical resources between logical partitions (LPARs) including virtual SCSI and virtual networking. This allows more efficient utilization of physical resources through sharing between LPARs and facilitates server consolidation.

VIOS 2.2.2.3 and above is recommended with AIX 7.2, 7.1 and AIX 6.1 for Oracle Database 12c R1 & R2.

VIOS 2.2.6.21, or later is recommended for IBM Power Systems with POWER9 processors.

With certified VIOS combinations customers may use virtual SCSI with or without “N Port ID virtualization (NPIV) to attach disk for data storage and associated voting files or OCR. This may be done for both ASM and GPFS.

The VIOS Support web page is <http://www14.software.ibm.com/webapp/set2/sas/f/vios/home.html>

- **Workload Partition (WPAR)** is a software-based virtualization feature. WPARs subdivide an AIX instance into multiple environments, each hosting applications and providing isolation from applications executing in other environments. **Live Application Mobility** allows you to relocate running WPARs from one LPAR to another. For more information on WPARs, see Exploiting IBM AIX Workload Partitions - IBM Redbooks, [www.redbooks.ibm.com/redbooks/pdfs/sg247955.pdf](http://www.redbooks.ibm.com/redbooks/pdfs/sg247955.pdf)

Customers should monitor the latest Oracle Certification information to be aware of the ongoing certification of new features.

For additional, detailed PowerVM information, see these documents and websites:

<http://www.oracle.com/technetwork/database/virtualizationmatrix-172995.html>

- PowerVM webpage, <http://www-03.ibm.com/systems/power/software/virtualization/index.html>
- PowerVM Virtualization on IBM System p: Introduction and Configuration Fourth Edition, <http://www.redbooks.ibm.com/abstracts/sg247940.html?Open>
- IBM System p PowerVM Best Practices, <http://www.redbooks.ibm.com/abstracts/redp4194.html?Open>

## Oracle Database 12c Release 1 & 2 RAC

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This section contains the Oracle Database 12c Release 1 & 2 RAC technical information that needs to be considered in an AIX installation. Starting with Oracle Database 11g Release 2, Oracle has packaged Oracle Clusterware, Automatic Storage Management and the listener as a single package called “Oracle Grid Infrastructure”.

The following are the basic documents to review for an Oracle Database 12c Release 2 RAC installation on AIX.

### Oracle Database 12c Release 2:

- Oracle Grid Infrastructure Installation and Upgrade Guide 12c Release 2 (12.2) for IBM AIX on POWER Systems (64-Bit)  
E85691-02, <https://docs.oracle.com/database/122/CWAIX/toc.htm>
- Oracle Database Installation Guide 12c Release 2 (12.2) for IBM AIX on POWER Systems (64-bit)  
E85764-03, <https://docs.oracle.com/database/122/AXDBI/title.htm>

#### Oracle Database 12c Release 1:

- Oracle Grid Infrastructure Installation Guide 12c Release 1 (12.1) for IBM AIX Based Systems (64-bit)E51133-07. <http://docs.oracle.com/database/121/CWAIX/toc.htm>
- Oracle Database Installation Guide 12c Release 1 (12.1) for IBM AIX on POWER Systems (64-Bit),E52188-06. <http://docs.oracle.com/database/121/AXDBI/toc.htm>
- My Oracle Support note **282036.1**, “Minimum Software Versions and Patches Required to Support Oracle Products on IBM pSeries” for the latest, up-to-date issues regarding Oracle Database 12c and AIX.

Note, these documents apply equally well to AIX 6.1, 7.1, and 7.2.

Consider the following additional requirement for a successful installation of Oracle 12c Grid infrastructure software.

- Install “bash” tool on all of the RAC nodes prior to Oracle GI installation.
  - bash-4.2-1 (This can be downloaded from the following link, <http://www-03.ibm.com/systems/power/software/aix/linux/toolbox/date.html>)

#### I/O Completion Ports:

On AIX on POWER systems, enable I/O completion ports (IOCP) to ensure successful database and grid infrastructure installation.

To check if the IOCP module is enabled, run the following command and look for status “Available” in the output,

```
$ lsdev |grep iocp
```

```
iocp0 Available I/O Completion Ports.
```

If IOCP is in “Defined” state, enable it using “smitty” tool,

```
$ smitty iocp
```

## Current certifications

To determine the **current certifications** for Oracle Database 12c Release 1 & 2 RAC on AIX,

Sign into Oracle’s My Oracle Support website (UserID and Password required) at <https://support.oracle.com/CSP/ui/flash.html> and click on “Certifications” tab, look for “Certification Search” section. In the “Product” field. type “Oracle Real Application Clusters”, the second field is “Release”. Select one of them from the list, 12.1.0.2.0, next field is “Platform”, select “IBM AIX on POWER Systems (64bit) 7.1”, it actually lists the AIX versions from 5.3 to 7.2.Choose one of them. Then click

“Search” button. The search result will show the certification status in the link “See Certification Details for Notes and Support information” in the search result page.

This lists the information with Certification status for the above input.

From February 17, 2015 onwards, IBM General Parallel File System (GPFS) is rebranded as IBM Spectrum Scale.

To find the latest certification information of IBM Spectrum Scale, PowerHA System Mirror with Oracle Database, refer certification section of My Oracle Support.

The IBM Power System servers with POWER9 processor need minimum recommended AIX levels and VIOS version as shown below,

AIX 7.2 TL2 SP02 or later

AIX 7.1 TL05 SP02 or later

AIX 6.1 TL09 SP11 or later

VIOS 2.2.6.21, or later

By following the navigation instructions in the first paragraph of this sub-section, the RAC Technologies Compatibility Matrix will also be visible. This matrix supplies details about storage technologies, network interconnect technologies and other platform-specific information.

<http://www.oracle.com/technetwork/database/clustering/tech-generic-unix-new-166583.html>

For Oracle Database and Server virtualization features support, look at the information for “IBM AIX Power Systems” in the following link.

<http://www.oracle.com/technetwork/database/virtualizationmatrix-172995.html>

## Oracle Redundant Interconnect usage feature

Oracle 12c Release 1 & 2 continue to support Oracle’s integrated Redundant Interconnect Usage feature, which provides a Highly Available (HA) IP network functionality for the Oracle interconnect. Previous to the version 11g Release 2, Oracle RAC and Oracle Clusterware depended on AIX and respective OS features to provide a highly available network interface for the Oracle interconnect. With Oracle Database 11g Release 2 Patch Set One and later, customers have the choice to either continue to use the AIX provided HA network interface, or to use Oracle’s integrated Redundant Interconnect Usage feature, which will provide full high availability for an Oracle RAC Database and Oracle ASM of version 11.2.0.2 or higher.

Oracle’s Redundant Interconnect Usage feature will protect production RAC databases where instances of the same database are not co-located on the same physical frame.

For upgrade customers, it is recommended to maintain their current, typically Etherchannel based, configuration as with pre-11.2.0.2 releases during upgrades. This will allow the Redundant Interconnect Usage to allocate an (HA)IP on top of the Etherchannel device, but will not enable load balancing or network failover based on the Oracle Redundant Interconnect Usage feature. Load balancing as well as network failover will continue to be managed by Etherchannel in this case; no further configuration steps required.

In order to fully enable Redundant Interconnect Usage to manage load balancing and network failover for the Oracle cluster interconnect, the Etherchannel configuration used for the Oracle interconnect should

be removed and Oracle Redundant Interconnect Usage should be enabled directly on the devices formerly managed by Etherchannel. For more information refer to the Oracle Documentation on how to enable Redundant Interconnect Usage.

Hosting more than one instance of a production Oracle RAC in the same physical environment or frame with a single point of failure (sharing components required for network connectivity, storage access, common Hypervisor, or other critical components) at the same time is generally not recommended by Oracle for a complete High Availability solution, as a failure of any of those shared components inevitably affects more than one instance of the production Oracle RAC database. Under certain circumstances, virtualization solutions and other techniques provided by the hardware or OS vendor may mitigate these negative effects, however, for critical and production deployments, clustering within the same frame, if it has a single point of failure, is discouraged. Furthermore, at this point in time, when enabling Redundant Interconnect Usage, avoid co-location of Oracle RAC instances belonging to the same production database on the same frame as described above, when configured with virtual Ethernet, as certain failures (e.g. the loss of a physical network and one VIO server) in the frame could lead to losing the majority of the Oracle RAC database instances. Oracle and IBM are working to integrate the Redundant Interconnect Usage feature so that optimized high availability can be ensured. Alternatively, physical devices (as opposed to virtual or VIO based devices) can be used and managed by the Redundant Interconnect Usage feature directly to avoid such scenarios.

## Oracle Clusterware

In a RAC environment Oracle Clusterware provides the high availability functionality. This includes monitoring or restarting the nodes of the cluster, for the database instances, for the listeners and for the database services. Oracle Clusterware is required for Oracle Database 12c Release 1 RAC. For more information on Oracle Clusterware, visit:

<http://www.oracle.com/technology/products/database/clustering/index.html>.

## IBM PowerHA (formerly High Availability Cluster Multi-Processing)

Note: High Availability Cluster Multi-Processing (HACMP) has been renamed to the PowerHA System Mirror for the version 7.1. This version of the document will use the term PowerHA.

With the release of 12cR1 & 12cR2 Oracle no longer supports the use of raw logical volumes with the DB and RAC see My Oracle Support note “Announcement of De-Support of using RAW devices in Oracle Database Version 12.1” (Doc ID 578455.1). Oracle continues to support the coexistence of PowerHA with Oracle clusterware.

## IBM Spectrum Scale (formerly General Parallel File System)

If using a file system for your Oracle Database 12c Release 1 and Release 2 RAC data files (rather than ASM), you'll need to use a cluster file system (CFS). Oracle ACFS allows file system access by all members in a cluster at the same time. That requirement precludes JFS and JFS2 from being used for Oracle Database 12c RAC data files. The IBM Spectrum Scale is an Oracle RAC 12c certified CFS.





IBM Spectrum Scale is a high-performance shared-disk file system that can provide fast, reliable data access from all nodes in a homogenous or heterogeneous cluster of IBM UNIX servers running either the AIX or the Linux® operating system.

To determine the **current certifications** for IBM Spectrum Scale on Oracle RAC, refer “Certification” section in My Oracle Support page.

IBM Spectrum Scale 4.2 is certified to Oracle 12c R1 with AIX 7.1 and 7.2

The following stacks are recommended

- IBM Spectrum Scale 4.2.0.4
- Oracle Database 12c R1 RAC version 12.1.0.2.0
  - AIX7.2 TL1 SP01
  - AIX7.1 TL04 SP02
- VIOS 2.2.4

IBM Spectrum Scale 4.1 is certified to Oracle 12c R1 & R2 with AIX 6.1, 7.1 and 7.2

The following stacks are recommended

- IBM Spectrum Scale 4.1.0.6
- Oracle Database 12c R2 RAC version 12.2.0.1.0
  - AIX7.2 TL0 SP01 with APARs IV79639, IV79848, and IV80412
  - AIX7.1 TL03 SP04
  - AIX6.1 TL09 SP04
- Oracle Database 12c R1 RAC version 12.1.0.2.3
  - AIX7.2 TL0 SP01 with APARs IV79639, IV79848, and IV80412
  - AIX7.1 TL03 SP03
  - AIX6.1 TL09 SP03
- VIOS 2.2.3.3 or later

Refer the “My Oracle support” note **1376369.1** for more information on GPFS for Oracle RAC.

The GPFS web site is <http://www-03.ibm.com/systems/clusters/software/gpfs.html>. Make sure to review the **current GPFS advisories** in the GPFS FAQ available from the GPFS web site.

See the GPFS sub-section in the Tuning Tips section (below) for GPFS tuning information.

## Virtualization for Oracle Database 12c Release 1 & 2 RAC

As mentioned in the Current Certifications sub-section (see above) for Oracle Database 12c Release 1 & 2 RAC; LPARs and Micro-Partitioning are supported in Oracle Database 12c Release 1 & 2 RAC environments. LPARs, Micro-Partitioning and VIOS are part of IBM PowerVM. PowerVM is the family of technologies, capabilities and offerings that deliver industry-leading virtualization on IBM POWER pro-

cessor-based systems. The PowerVM capabilities supported in Oracle Database 12c Release 1 & 2 RAC are:

Power System features	Certified With	Status
Dedicated processor LPAR Shared processor LPAR Workload Partition (WPAR)	Oracle DB 12c R1 & R2 RAC	Certified
Dynamic Logical Partitions (DLPAR)	Oracle DB 12c R1 RAC	Certified
Live Partition Mobility with Oracle- ASM Live Partition Mobility with IBM Spector Scale (formerly GPFS)	Oracle DB 12c R1 RAC	Certified
Virtual I/O server	Oracle DB 12c R1 & R2 RAC	Certified

- **Logical Partitions** subdivide a computer's processors, memory, and hardware resources into multiple environments so that each environment can be operated independently with its own operating system and applications.
- **Dedicated processor partitions** are LPARs that use dedicated processors.
  - **Dedicated processors** are whole processors that are assigned to a single LPAR.
  - **Shared Processor partitions** are LPARs that use Micro-Partitioning in conjunction with a shared processor pool.
- **Micro-Partitioning** divides a physical processor's computing power into fractions of a processing unit and shares them among logical partitions. Processing capacity can be configured in fractions of 1/100 of a processor. The minimum amount of processing capacity that has to be assigned to a partition is 1/10 of a processor.
- A **shared processor pool** is a group of physical processors that are not dedicated to any LPAR.
- **Dynamic LPARs (DLPAR)** are a shared or dedicated LPAR to which changes can be made to the amount of processors, memory and virtual or physical adapters without requiring a re-boot.
- For dedicated processor partitions, it is only possible to dynamically add, move or remove whole processors. When a processor is removed from a dedicated processor partition, it is then assigned to the shared processor pool.
- For a shared processor partition, it is also possible to dynamically change the shared processor capacity, the weight of the uncapped attribute, virtual processors and capped/uncapped mode.
- **Virtual I/O Server** allows sharing of physical resources between logical partitions (LPARs) including virtual SCSI and virtual networking. This allows more efficient utilization of physical resources through sharing between LPARs and facilitates server consolidation. These VIOS features are specifically supported in Oracle Database 12c Release 1 RAC:

- Virtual LAN for public and private interconnects and all supported data storage options.
- Two VIO servers are necessary to improve serviceability and provide the availability required for an Oracle Database 12c Release 1 & 2 RAC implementation.
- VIOS can be used for non-RAC functions such as Virtual SCSI based root volume groups (rootvg), and Virtual SCSI & NPIV (N port ID Virtualization) for ASM data storage.
- VIOS with ASM and GPFS in Oracle Database 12c Release 1 & 2 RAC is supported

In VIOS environment, NPIV feature allows multiple N\_Port IDs to share a single Physical N\_Port, which means multiple client LPARs can access external storage LUNs through the same Fibre channel adapter assigned to VIOS LPAR.

Note: With certified VIOS combinations customers may use either Virtual SCSI (vSCSI) or N Port Id Virtualization (NPIV) to attach disk for data storage and OCR. This may be done for both ASM and GPFS 3.4 and above. Customer must confirm IBM support of the configuration, and install any required AIX and Oracle updates before using.

VIOS 2.2.2 and above are supported with Oracle Database 12c Release 1 & 2 RAC with AIX 6.1, 7.1 and 7.2 respectively.

The VIOS Support web page is: <http://www14.software.ibm.com/webapp/set2/sas/f/vios/home.html>.

- **Live Partition Mobility (LPM)** allows you to migrate running AIX and Linux LPARs and their hosted applications from one physical server to another without disrupting infrastructure services. The migration transfers the entire partition state, including the processor context, memory, attached virtual devices, and connected users.

Oracle Database with RAC 12cR1 version 12.1.0.2 is certified to be used with the IBM PowerVM Live Partition Mobility (LPM) feature on AIX 6.1 with a minimum of service level of TL08 SP01, on AIX 7.1 with a minimum of service level of TL03 SP03 and on AIX 7.2 with a minimum of service level of TL0 SP1 ("7200-00-01 ") or later, 64-bit kernel

- PowerVM webpage, <http://www-03.ibm.com/systems/power/software/virtualization/index.html>
- PowerVM Virtualization on IBM System p: Introduction and Configuration Fourth Edition, <http://www.redbooks.ibm.com/abstracts/sg247940.html?Open>
- IBM PowerVM Best Practices <http://www.redbooks.ibm.com/redbooks/pdfs/sg248062.pdf>

## Network interconnects

To determine the **current certifications** for network interconnects on Oracle RAC, browse to the “General Notes for RAC for Unix on IBM AIX based Systems (RAC only)” web page, as described in the beginning of the Current Certifications sub-section (see above) for Oracle Database 12c Release 1 & 2 RAC. Then select the link for the RAC Technologies Compatibility Matrix (RTCM). Within RTCM, Network Interconnect certifications are listed. Currently, the following are supported and certified with AIX 6.1, 7.1, and 7.2.

- 1 Gigabit
- 10 Gigabit Ethernet
- 40 Gigabit Ethernet
- RDSv3 is supported on AIX 7.2 Power (64-bit) with Oracle 12c (12.1.0.2) using RoCE Adapters (Requires physical adapters for the interconnection).
- RDSv3 over IB is supported on IBM POWER systems and Oracle RAC 12.1.0.2.5 (+ patch 12909465) with AIX 7.1 TL03 SP06: 7100-03-06-1543 (2016/02/26) or newer.
- RDSv3 over IB is supported on IBM POWER systems and Oracle RAC 12.1.0.2.5 (+ patch 12909465) with AIX 7.2 TL00 SP05: 7200-00-05-1720 (2017/09/29) or newer.

### Integrated Virtual Ethernet

The Integrated Virtual Ethernet (IVE) is a collection of POWER6, POWER7 and POWER7+ hardware, software and hypervisor features that provides integrated high-speed Ethernet adapter ports with virtualization capabilities. The IVE appears in AIX system commands as the Host Ethernet Adapter (HEA) or Local HEA (LHEA). The IVE offers:

- IVE Adapter Ethernet port options:
  - Two 1 Gbps ports or
  - Four 1 Gbps ports or
  - Two 10 Gbps ports
- External network connectivity for LPARs using dedicated ports without the need of a VIOS.
- Industry standard hardware acceleration, loaded with flexible configuration possibilities.
- The speed and performance of the GX+ bus, faster than PCI Express x16.

For additional information about IVE/HEA:

- [Integrated Virtual Ethernet Adapter, Technical Overview and Introduction \(Redbook\), http://www.redbooks.ibm.com/redpapers/pdfs/redp4340.pdf](http://www.redbooks.ibm.com/redpapers/pdfs/redp4340.pdf)

Ensure your IVE/HEA is deployed consistent with the instructions in My Oracle Support note 282036.1, “Minimum Software Versions and Patches Required to Support Oracle Products on IBM pSeries”.

For supported Interconnect Network Technologies for Oracle RAC on UNIX, refer the following link, <http://www.oracle.com/technetwork/database/clustering/tech-generic-unix-new-166583.html>

Refer the IBM technical document for “Setting up IBM POWER6 10 Gigabit Ethernet ports and AIX 6.1 Etherchannel for Oracle RAC private interconnectivity” , Document ID : WP101734

<http://www-03.ibm.com/support/techdocs/atmastr.nsf/WebIndex/WP101734>

Some additional consideration as part of the 10 GigE setup as follows,

- LACP timeout: Use the “long timeout” switch setting for the amount of time to wait before sending LACPDUs.

- Flow control: Enable flow control at the switch port and on the server side ports (using HMC) for the 10GE adapter or 10GE HEA configuration.
- UDP tuning: The RAC interconnect uses UDP for interprocess communications. Tune the `udp_sendspace` and `udp_recvspace` parameters until the “`netstat -s`” command indicates there are no “socket buffer overflows”. See the Network Tuning section of the “Oracle Architecture and Tuning on AIX” document:

<http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100883>

- Jumbo frames: Enable Jumbo frames on the RAC interconnect: Configure Jumbo frames at the switch port. In the certification project we set Jumbo frames to 9252 at the switch.

Configure Jumbo frames on the server side ports (using HMC) for the 10GE adapter or 10GE HEA configuration. Configure Jumbo frames in the Etherchannel (network interface) definition.

Note: When using Gigabit Ethernet, 10 Gigabit Ethernet and IP over InfiniBand customers may configure the network routing using either EtherChannel or AIX VIPA based on their requirements. Customer must confirm IBM support of the configuration, and install any required AIX and Oracle updates before using.

### Important Oracle fixes or issues specific to AIX releases

While creating an ASM diskgroup with more than one disk or adding a disk to an existing diskgroup ORA-15020 is encountered in Oracle Database 12c Release 2 (12.2.0.1).

Solution: Add the 'name' clause to the 'alter diskgroup" command.

Example: `ALTER DISKGROUP DATA ADD DISK '/dev/ASM_hdisk2' NAME DATA_02;`

Refer My Oracle Support note 2355979.1 for more update.

**Grant DBA to user can cause latch row cache objects:** Granting “DBA” role to all application users resulting a huge wait with an event “latch: row cache objects” which affects performance of the database. To resolve this issue, refer My Oracle support note 1639293.1. If this issue occurs, explicitly grant access to the underlying object to the user (not through a Role).

For more issues and tuning recommendations, refer “Oracle 12.1.x and 11.2.0.4 Database Performance Considerations with AIX on POWER8” paper found in the link: <http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102608>

## Tuning tips

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Most of the AIX OS tuning tips recommended for Oracle Database 11g Release 2 are applicable to Oracle Database 12c Release 1 & 2.

The tuning items chosen for inclusion in this section are those where the defaults are sub-optimal, or settings that require special consideration. Instead of repeating the existing documentation, this section will consolidate references to the existing documentation. The URLs of the documents referenced in this section are listed at the end of the section.

## Automatic Storage Management

Automatic Storage Management (ASM) is a feature in Oracle Database 12c Release 1 that provides the database administrator with a simple storage management interface that is consistent across all server and storage platforms.

Starting with Oracle Database 11g Release 2, Oracle Clusterware OCR and voting disk files can be stored in Oracle ASM disk group.

ASM becomes a complete storage management solution for both Oracle Database and non-database files and has many extended functions for not only storing database files, but also storing binary files, report files, trace files, alert logs and other application data files.

ASM Cluster File Systems (ACFS) extends ASM by providing cluster file system scaled to a large number of nodes and uses extend-based storage allocation for improved performance. ACFS can be exported to remote clients through NFS and CIFS.

ASM Dynamic Volume Manager (DVM), ASM FS Snapshot, ASM Intelligent Data Placement, ASM Storage Management Configuration Assistant (ASMCA), ASM File Access Control and ASMCMD are some of the extended functions of ASM.

In Oracle Database 12c, Oracle has introduced several new capabilities in ASM. Oracle Flex ASM is one of the major features which protects Oracle 12c Database instances that were relying on a failing ASM instance by reconnecting to another surviving ASM instance on a different server.

For more information on ASM new features , refer to the Oracle document “*Oracle Database New Features Guide 12c Release 1 (12.1)*” at <http://docs.oracle.com/database/121/NEWFT/toc.htm>

and refer to “*Oracle Database 12c Release 2 (12.2) New Features*” at

<https://docs.oracle.com/en/database/oracle/oracle-database/12.2/newft/toc.htm>

### Managing Raw disks in AIX to use with ASM

To prevent the accidental use of disks which are assigned to ASM disk group in AIX for some other purpose, there are two new AIX commands introduced in AIX 6.1, 7.1 and AIX 7.2

The two commands “lkdev” and “rendev” are introduced to effectively use the disks for ASM disk groups. The “lkdev” command is used to lock the disk to prevent the device from inadvertently being altered by a system administrator at a later time. It locks the device so that any attempt to modify the device attributes (chdev, chpath) or remove the device or one of its paths (rmdev, rmpath) will be denied.

The “rendev” can be used to assign a meaningful name to the disks used by Oracle Database, ASM, Cluster Ready Services and Voting files. This is useful in identifying disk usage because there is no indication in output from AIX disk commands indicating that a disk is being used by Oracle

For more details of using these commands, refer the “My Oracle Support” note 1445870.1. For information about ASM, see Oracle’s ASM web page:

<http://docs.oracle.com/database/121/OSTMG/toc.htm>

## Asynchronous I/O

Asynchronous I/O (AIO) allows a program to initiate an I/O operation then continue with other work in parallel to the I/O operation. Oracle Database 12c often requires multiple server and user processes running at the same time. Therefore Oracle Database 12c takes full advantage of AIO services provided by AIX. AIO is implemented with AIO server processes. The configuration values of: minservers, maxservers and maxreqs control the AIO server configuration of AIX. Refer "Tuning Resources" section of this document for many whitepapers. The IBM whitepaper *Tuning IBM AIX 5L for an Oracle Database* has an "Asynchronous I/O" section that describes recommendations for the configuration values. GPFS configuration recommendations are also supplied. There is also a "Using Asynchronous I/O" section in the *Oracle Architecture and Tuning on AIX* whitepaper.

In AIX 5.3 AIO is disabled by default. However, in AIX 6.1 AIO is enabled by default. When upgrading to AIX 6.1, the AIO setting will not be changed.

Note, if you use the AIX filemon command, the AIO API calls of aio\_read, aio\_write and lio\_listio are not included in the filemon report.

## Concurrent I/O and direct I/O

The "Tuning Resources" section of this document has many useful links for whitepapers such as file system I/O tuning information in the *Tuning IBM AIX 5L for an Oracle Database*, the *Oracle Architecture and Tuning on AIX* and the *Direct I/O or Concurrent I/O on AIX 5L* My Oracle Support note [272520.1]. For Oracle Database 12c, the database defaults to asynchronous I/O (AIO) enabled and concurrent I/O (CIO) disabled. In general, a good starting point is to set the filesystemio\_options=setall, in your init\*.ora configuration file. This setting will enable AIO (which is the default) and CIO operation. CIO operation is built upon direct I/O (DIO) with the additional function of inode locking. Note, there may be workloads (eg. sequential reads) where cached I/O performs better than CIO.

When using CIO/DIO, the Oracle setting of DB\_FILE\_MULTIBLOCK\_READ\_COUNT (the maximum number of blocks read in one I/O operation during a sequential scan) needs to be considered. Also, the alignment of the database blocksize and the file system block size (agblksize) has to be considered.

When not using CIO/DIO, look at the suggested settings in the "AIX sequential read ahead" section of the *Oracle Architecture and Tuning on AIX* whitepaper.

From Oracle Database 11g Release 2 version 11.2.0.2 and later, Oracle opens the files using "O\_CIOR" which is similar to "O\_CIO", but allows subsequent open calls without CIO, so that you no longer need to mount the JFS2 filesystems with mount option "-o cio" and other OS tools and third part tools can access the database files without any issues.

## File system cache size

In AIX 6.1 the Virtual Memory Manager (VMM) defaults have been changed to be much more suitable for a database workload. When upgrading from AIX 5.3 to AIX 6.1, the VMM settings will not be changed. So, VMM settings need to be changed in the upgraded AIX 6.1 as needed for Oracle database. Refer the following section "Tuning resources" and the document "Tuning IBM AIX 5.3 and AIX 6.1 for Oracle Database (whitepaper) link.

For an Oracle Database workload, we need to ensure the computational pages used for Oracle code, SGA and PGA remain resident in memory. The Oracle Database buffer cache already provides caching of database files. Therefore, the file system cache size should be tuned (using the VMM settings) to favor computational pages over file pages. Check the “Memory and Paging” chapter in the *Oracle Architecture and Tuning on AIX* whitepaper for recommended VMM settings. Note, these settings are a **suggested starting point**. If you have already tuned your system, do not revert to these VMM settings.

### IBM Power Systems – Server Side Caching

The Server Side Caching is a new feature introduced in AIX 7.1 TL04 SP02 and AIX 7.2. This feature is supported to use with Oracle Database to improve the performance of read I/O intensive workloads on AIX and Power Systems environment. Server-side caching provides the capability to cache the application data stored in SAN to Solid State Devices (SSD) or Flash Storage LUNs or Virtual Disks provided by VIOS on the AIX server. After Server Side Caching is enabled in AIX, all the read I/O requests are first redirected to the caching area created with the fast SSDs or Flash Storage or VIOS virtual disk on the server. This feature can be enabled or disabled dynamically, no reboot is required and changes are transparent to the running application or workload.

To take advantage of this feature for Oracle Database Release 1, no changes are needed in the database configuration side. This works only with Oracle Database Non-RAC environment.

A sample IBM lab test with this feature for Oracle Database can be found in the following link,

<https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=TSW03489USEN&>

### RAC IPC

Oracle RAC 12c uses the User Datagram Protocol (UDP) for inter-process communication (IPC) between nodes. The *Oracle Architecture and Tuning on AIX* whitepaper <http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100883> indicates how to tune the UDP kernel settings in the “Network Tuning” section.

### IBM Spectrum Scale (formerly General Parallel File System)

The IBM Spectrum Scale *Concepts, Planning and Installation Guide* [https://www-01.ibm.com/support/knowledgecenter/STXKQY\\_4.1.1/ibmspectrumscale411\\_content.html](https://www-01.ibm.com/support/knowledgecenter/STXKQY_4.1.1/ibmspectrumscale411_content.html) contains a “GPFS use with Oracle” chapter that contains Oracle configuration and tuning considerations. My Oracle Support note 1376369.1 contains IBM GPFS and Oracle RAC certification information.

### Oracle process memory footprint

The AIXTHREAD\_SCOPE environment variable can be used for control if an AIX process runs with process-wide contention scope (the default) or with system-wide contention scope. System-wide contention scope significantly reduces the memory required for each database process. AIX operates most effectively with Oracle Database 12c and Oracle RAC when using system-wide contention scope (AIXTHREAD\_SCOPE=S). See the “Tuning Memory” chapter of the *Tuning IBM AIX 5L for an Oracle Database* whitepaper for a detailed description of the AIXTHREAD\_SCOPE parameter.



## Tuning resources

These are the documents referenced throughout this section. The same tuning of AIX for Oracle Database 11gR2 applies to Oracle Database 12cR1 and 12cR2.

1. Oracle Database 11g and 12c on IBM Power Systems S924, S922 and S914 with POWER9 processors  
<https://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102750>
2. Tuning IBM AIX 5.3 and AIX 6.1 for Oracle Database (whitepaper),  
<http://public.dhe.ibm.com/partnerworld/pub/whitepaper/162b6.pdf>
3. Oracle 12.1.x and 11.2.0.4 Database Performance Considerations with AIX on POWER8  
<https://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102608>
4. Oracle RAC on IBM AIX best practices in memory tuning and configuring for system stability
5. [https://www.ibm.com/developerworks/community/blogs/fd4076f7-7d3d-4080-a198-e62d7bb263e8/entry/oracle\\_real\\_application\\_clusters\\_on\\_ibm\\_aix\\_best\\_practices\\_in\\_memory\\_tuning\\_and\\_configuring\\_for\\_system\\_stability?lang=en](https://www.ibm.com/developerworks/community/blogs/fd4076f7-7d3d-4080-a198-e62d7bb263e8/entry/oracle_real_application_clusters_on_ibm_aix_best_practices_in_memory_tuning_and_configuring_for_system_stability?lang=en)
6. Oracle Architecture and Tuning on AIX (whitepaper),  
<http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100883>
7. Oracle's USLAHEAP patches available on AIX  
<http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102066>
8. Disabling unshared segment aliasing on AIX for Oracle Database 11.2.0.3  
<http://www-01.ibm.com/support/docview.wss?uid=tss1wp102172&aid=1>
9. IBM POWER7 AIX and Oracle Database performance considerations  
<http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102171>
10. IBM Knowledge Center , IBM Spectrum Scale 4.1.1  
[https://www-01.ibm.com/support/knowledgecenter/STXKQY\\_4.1.1/ibmspectrumscale411\\_content.html](https://www-01.ibm.com/support/knowledgecenter/STXKQY_4.1.1/ibmspectrumscale411_content.html)
11. GPFS: Concepts, Planning and Installation Guide (GPFS document)  
<http://publib.boulder.ibm.com/infocenter/clresctr/vrxr/index.jsp?topic=/com.ibm.cluster.gpfs.doc/gpfsbooks.html>
12. Managing AIX Devices used by Oracle Automatic Storage Management (ASM)  
<http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102158>
13. Direct I/O or Concurrent I/O on AIX 5L (My Oracle Support note 272520.1)  
<https://support.oracle.com/CSP/ui/flash.html>
14. Oracle 9i & 10g on IBM AIX5L: Tips and Considerations (whitepaper)
15. <http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100556>
16. Oracle DB 11g and 12c on IBM Power Systems built with POWER8 technology and IBM Flash System 840  
<https://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102440>

These are supplemental tuning resources.

- AIX 7.1 differences guide
- <http://www.redbooks.ibm.com/redbooks/pdfs/sg247910.pdf>

- AIX 6 Performance Management (AIX documentation),  
<http://publib.boulder.ibm.com/infocenter/systems/scope/aix/topic/com.ibm.aix.doc/doc/base/performance.htm>
- Optimizing AIX 7 memory performance: Part 1, Memory overview and tuning memory parameters  
<http://www.ibm.com/developerworks/aix/library/au-aix7memoryoptimize1/>
- Performance Management for System p,  
<http://www-01.ibm.com/support/docview.wss?uid=isg3T1026749>
- Diagnosing Oracle Database Performance on AIX Using IBM NMON and Oracle Statspack Reports (whitepaper),  
<http://www-01.ibm.com/support/docview.wss?uid=tss1wp101720>

## Summary

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This document gathers together the key technical topics that need to be considered in planning or implementing Oracle Database 12c R1 & R2 or Oracle Database 12c R1 & R2 RAC with AIX. In almost all cases, there are reinforcing references included in each section. The resources appendix below contains pointers to general documentation and additional supporting documents.

## Resources

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These Web sites and documents provide useful references to supplement the information contained in this document:

- Oracle Database 12c Documentation Library,  
<http://docs.oracle.com/en/database/>
- Oracle RAC SIG,  
<http://www.oracleracsig.org>
- Oracle My Oracle Support note 341507.1: Oracle Products on Linux on IBM POWER,  
<https://support.oracle.com/CSP/ui/flash.html>.
- Oracle and IBM System Storage  
<http://www-03.ibm.com/systems/storage/solutions/compatibility/oracle/index.html>

## About the author

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