Oracle Database 11*g* and 12*c* on IBM Power Systems S924, S922 and S914 with POWER9 processors

Tips and considerations

Ravisankar Shanmugam
Moshe Reder, Wayne Martin
IBM Oracle International Competency Center

April 2018

Table of contents

Abstract

This paper consolidates available information about running the Oracle Database on the new IBM Power® System S924, S922 and S914 servers with POWER9™ processors with the AIX® operating system. This paper also demonstrates that Oracle Database 12c Release 2 was tested on a new Power Systems™ server in order to confirm the readiness of these new servers for implementing Oracle Database products.

This paper summarizes the information available at the time of this publication. It might be updated as changes, such as new certifications, are available. It is meant to be used only as a guide. For any official Oracle certification information refer to the Oracle "My Oracle Support" website.

Topics covered in this document include high level configurations of the new Power Systems servers that are based on the new POWER9 processor technology, Oracle Database versions certified, AIX and Linux® versions supported, and new capabilities and the performance values of the POWER9 architecture.

Introduction

On February 13, 2018 IBM announced the new Power Systems servers, S924, S922, and S914 with POWER9 processor technology. Each of the servers deliver high security and reliability and are cloud-enabled with integrated virtualization capabilities. They became generally available on March 20, 2018.

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.

The Power S924 server supports two SCM processor sockets offering 8-cores or 16-cores at 3.8 to 4.0 GHz (max), 10-cores or 20-cores at 3.5 to 3.9 GHz (max), or 24-cores at 3.4 to 3.9 GHz (max) configurations in a 19-inch rack-mount, 4U (EIA units) drawer configuration. All the cores are active. Maximum system memory is 4 TB.

The Power S922 server supports two SCM processor sockets that offer up to 20 activated cores, 4-cores at 2.8 to 3.8 GHz (max), 8-cores at 3.4 to 3.9 GHz (max), and 10-cores at 2.9 to 3.8 GHz (max) configurations in a 19-inch rack-mount, 2U (EIA units) form factor. Maximum system memory is 4 TB of memory.

The Power S914 server supports one SCM processor socket that offers up to 8-cores, 4-cores at 2.3 to 3.8 GHz (max), 6-cores at 2.3 to 3.8 GHz (max), 8-cores at 2.8 to 3.8 GHz (max), supporting up to 1 TB of DDR4 memory.

The systems support IBM AIX®, IBM i and Linux® operating systems. Each core can run up to eight simultaneous multithreads (SMT) to meet the requirements of resource-hungry and mission- critical applications and maximize the workload throughput of the system to provide improved cost of ownership.

The Oracle Database 12*c* Release 1 & 2 and Oracle Database 11*g* Release 2 products are supported on new Power System servers with POWER9 processor technologies based on the current AIX OS and Oracle Database certifications.

The new Power Systems scale-out servers are built with IBM POWER9 processor technology, SMT8, Hot-plug PCIe Gen4 and Gen3 I/O slots, enhanced reliability, availability, serviceability (RAS) features and storage backplane options packaged together to provide efficient consolidation of workloads through virtualization and a reliable environment for business applications.

The new Power Systems “S” class servers easily integrate into your organization's cloud and cognitive strategy and deliver industry-leading price/performance for mission-critical workloads.

For detailed information about the new IBM Power Systems servers built with POWER9 processor technology and their features, refer to the following links:

- **ibm.com**/common/ssi/cgi-bin/ssialias?infotype=AN&subtype=CA&htmlfid=872/ENUSAL18-0006
- **ibm.com**/systems/power/hardware/enterprise.html

New IBM Power Systems product line

On February 13, 2018 IBM introduced the next generation of Power Systems S class servers with POWER9 technology, designed from the ground up for data-intensive workloads like databases and analytics.

The new Power Systems servers are designed to be housed in a 19-inch rack and managed by the Hardware Management Console (HMC) or Virtual HMC (vHMC).

The following table shows the list of new POWER9 processor-based servers. The letter “S” stands for Scale-Out.

New Power Systems server	Number of sockets, cores, and speed	Memory (Max)	OS support	Server image
Power S924	**2 sockets, each with:** 8-cores x 3.8 to 4.0 GHz 10-cores x 3.5 to 3.9 GHz 12-cores x 3.4 to 3.9 GHz	4TB DDR4	AIX IBM i Linux	
Power S922	**2 sockets, each with:** 4-cores x 2.8 to 3.8 GHz 8-cores x 3.4 to 3.9 GHz 10-cores x 2.9 to 3.8 GHz	4TB DDR4	AIX IBM i Linux	
Power S914	**1 socket :** 4-cores x 2.3 to 3.8 GHz 6-cores x 2.3 to 3.8 GHz 8-cores x 2.8 to 3.8 GHz	1TB DDR4	AIX IBM i Linux	

Table 1. New Power Systems server Scale-Out models

For full specifications of the new IBM Power Systems servers, refer to the following link:

For **Power S924** – **ibm.com**/common/ssi/cgi-bin/ssialias?htmlfid=65012865USEN&appname=skmwww

For **Power S922** - **ibm.com**/common/ssi/cgi-bin/ssialias?htmlfid=33013033USEN&appname=skmwww

For **Power S914** - **ibm.com**/common/ssi/cgi-bin/ssialias?htmlfid=29013029USEN&appname=skmwww

IBM AIX and Linux support

IBM AIX is an open standards-based UNIX® operating system. AIX, in combination with IBM's virtualization offerings, provide 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 that are essential for meeting the demands of today's information technology environments. AIX operates on IBM systems based on IBM Power Architecture® technology. For more information about AIX, refer to the following web page:

ibm.com/systems/power/software/aix/

The Oracle product support for IBM Power Systems servers is based on AIX operating system support. Oracle does not directly certify IBM server hardware for their software, they certify a specific level of AIX.

For fully leveraging new features and capabilities of the new Power Systems servers, the following AIX, Linux, and virtualization software versions are supported.

IBM AIX and Virtual I/O Server (VIOS)	AIX 7.2 TL02 SP02
	PowerVM VIOS 2.2.6.21, or later

Table 2. Supported AIX and virtualization software

IBM also provides support for earlier technology levels or service packs for AIX 7.2, 7.1 and 6.1 for the POWER9 family of servers. When running on these or lower TL levels not all of the new features and capabilities will be available.

IBM AIX and Virtual I/O server (VIOS)	**Partition with all virtual resources via VIOS :** Minimum : • AIX 7.1 TL3 SP01 or later **Other partitions :** Minimum : • AIX 7.2 TL0, TL1 (P8 Compatibility Mode) • AIX 7.1 TL4, TL5 (P8 Compatibility Mode)
	Partition with all virtual resources via VIOS : Minimum : • AIX 6.1 TL09 SP01 or later

Table 3. Supported earlier versions

The following versions of Linux are supported with the new POWER9 servers.

Linux	• RedHat RHEL 7.4 LE (P8 Compatibility Mode) • SuSE SLES 11 SP4 (P8 Compatibility Mode) • SuSE SLES 12 SP3 • Ubuntu 16.04.4 LTS (P8 Compatibility Mode)

Table 4. Supported Linux versions

Starting with Oracle Database 11*g* Release 2 (11.2.0.4), Oracle Database **Instant Client** is supported on Linux on Power (32-Bit) and (64-Bit). Customers currently using the Oracle Database Instant Client 10*g* Release 2 can upgrade to the 11*g* Release 2 version by simply replacing the 10*g* Release 2 libraries with the newer 11*g* Release 2 version. The Instant Client version of the Oracle Database is also supported on the 12c version of the database. With Oracle Database 12*c* Release 1, support for little-endian was introduced for the Instant Client running on Linux on Power and with 12*c* Release 2 support is for little-endian only.

Refer to the *Instant Client Releases Section of My Oracle Support (see resources) note "Release Schedule of Current Database Releases* ***(Doc ID 742060.1)****"* for the latest status.

Recommended code levels

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

- The Fix Level Recommendation Tool (FLRT) can determine the recommended code levels among a mixture of AIX, HMC, server firmware, VIOS, IBM Spectrum Scale (formerly, General Parallel File System (GPFS™)) and IBM PowerHA®. The FLRT web page is at:
  http://www14.software.ibm.com/webapp/set2/flrt/home
  Note, the FLRT recommendation provides a minimum acceptable level of compatibility.
- The IBM POWER® code matrix indicates the recommended code levels for the HMC and server firmware. The POWER code matrix web page is at:
  http://www14.software.ibm.com/webapp/set2/sas/f/power5cm/home.html
  Note that the POWER code matrix recommendations can provide the maximum stability code combinations.

Service strategy

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

C and C++ compilers

The XL C/C++ compiler family includes several versions of standards-based, high performance C and C++ compilers with advanced optimizing and debugging features. They provide you the ability to optimize and tune applications for optimal execution on systems using all types of IBM POWER processors. The

compiler family supports IBM Power Systems servers capable of running IBM AIX 7.2, AIX 7.1, and AIX 6.1.

XL C/C++ V13.1 fully supports the IBM Power Systems servers. Applications compiled with earlier supported compiler versions are able to run on the new IBM Power Systems servers with POWER9 processors, but the XL C/C++ V13.1 compiler can be used to optimize and tune the application further for Power Systems servers.

C++ applications might have dependency on C++ runtime; and the XL C/C++ runtime environment is installed during the installation of base AIX. To update to the latest runtime environment, go to the XL C/C++ web page at: **ibm.com**/software/products/en/ccompfami, and click the product support link under XLC/C++ for AIX link, then click the "Latest XL C/C++ Updates (PTFs)" link. Then select "All XL C/C++ for AIX and XL C++ Runtime for AIX downloads" in the AIX/PTF Search Results section.

If the XL C/C++ Enterprise Edition for AIX compiler is installed, confirm that the latest updates are applied by visiting the product support link under XLC/C++ for AIX link, then click the "Latest XL C/C++ Updates (PTFs)" link, then select from the AIX section the appropriate compiler updates.

IBM XL C/C++ for Linux, V13.1.6 supports application development Power Systems servers with POWER9 processors that run the little-endian Linux distributions.

A single XL C/C++, V13.1.1 offering contains two C/C++ compilers that support:

- Big-endian Linux distributions and IBM Power Systems servers configured for big-endian mode
- Little-endian Linux distributions and IBM Power Systems servers configured for little-endian mode

XL C/C++ V13.1.6 supports Ubuntu 16.04.4 for POWER9 processors, and SUSE Linux Enterprise Server 12 for Power Systems servers includes exploitation of the little-endian architecture on the POWER9 processor.

For more information on XL C/C++ compiler version for POWER9 based servers, refer to:

ibm.com/support/docview.wss?uid=swg27007322

Oracle Database and IBM Power Systems

Oracle Database 12*c* Release 2 is the currently available version (at the time of this publication) leading a nearly two-decade long series of releases of the database on the AIX operating system. Oracle Database 12*c* includes many new features over its previous database versions. The letter "c" in "12*c*" stands for "cloud".

Oracle Database 12*c* provides a multitenant architecture that simplifies the process of consolidating databases into a private cloud model. Oracle Database 12*c* allows each database plugged into the multitenant architecture to look and feel as a standard database to the applications.

Oracle Real Application Clusters (RAC) is an option of Oracle Database that allows a database to be installed across multiple servers (RAC nodes). Oracle RAC uses the shared disk method of clustering databases. Oracle RAC processes running in each node access the same data residing on shared data disk storage.

Refer to the following two white papers for the latest certifications, support information for Oracle Database 12*c* Release 1 & 2 and Oracle Database 11*g* Release 2 on AIX and IBM Power Systems servers.

- For Oracle Database 11*g*: Oracle *Database 11g R2 and Oracle RAC 11g R2 on IBM AIX: Tips and Considerations*:
  ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101176
- For Oracle Database 12*c: Oracle Database 12c R1 and Oracle RAC 12c R1 on IBM AIX: Tips and Considerations*:
  ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102425

The following table shows the versions of Oracle Database supported on the new IBM Power Systems servers built with POWER9 processor technology.

Oracle Database	Oracle Database 12c Release 2 (12.2.0.1.0) Oracle Database 12c Release 1 (12.1.0.2.0)
	Oracle Database 11g Release 2
	Oracle Database 10g Release 2 (Note - Oracle Database 10g Release 2 is supported on AIX 6.1 only. So, it can run in the IBM POWER7 compatibility mode on the new IBM Power Systems servers.)

Table 5. Supported Oracle Database versions

Current certifications

To determine the most *current certifications* for Oracle Database on AIX:

Sign in to the Oracle *My Oracle Support* website (a valid user ID and password is required) at https://support.oracle.com/CSP/ui/flash.html and click the **Certifications** tab. In the **Certification Search** section, in the **Product** field, type **Oracle Database**, and in the second field type **Release**. Then select the required release (for example, release 12.2.0.1.0). Select **IBM AIX on POWER Systems (64-bit) 7.2** or **IBM AIX on POWER Systems (64-bit) 7.1** as the platform, and then click **Search**. The search result shows the certification status in the **See Certification Details for Notes and Support information** link.

IBM and Oracle recommend using the following versions of AIX to minimize the number of AIX patches for Oracle Database 12*c* Release 1 & 2 and Oracle Database 11*g* Release 2, and to use the new features and capabilities of the new IBM Power Systems servers built with POWER9 processor technology.

OS	Product	Status
AIX 7.2 TL2 SP02 or later AIX 7.1 TL05 SP02 or later(2) AIX 6.1 TL09 SP11 or later(1)	Oracle Database 12c Release 2	Certified
AIX 7.2 TL2 SP02 or later AIX 7.1 TL05 SP02 or later(2) AIX 6.1 TL09 SP11 or later(1)	Oracle Database 12c Release 1	Certified
AIX 7.2 TL2 SP01 or later	Oracle Database 11*g* Release 2(3)	Certified

AIX 7.1 TL05 SP02 or later(2) AIX 6.1 TL09 SP11 or later(1)		

Table 6. Recommended AIX versions

(1) Running on AIX 6.1 requires POWER7 compatibility mode on the new IBM Power Systems servers.

(2) The AIX versions AIX 7.1 TL04, AIX 7.2 TL0 can be used with POWER9 based server in POWER8 compatibility mode only, even though they are certified to use with Oracle Database versions 11g R2, 12c R1 & R2.

(3) The required minimum AIX version which is supported to use with Oracle Database 11*g* Release 2 is AIX 6.1 TL02 SP01 or AIX 7.1 TL0 SP01 or AIX 7.2 TL0 SP01 (Oracle Database version 11.2.0.4 only). The required minimum AIX version to use with Oracle Database 11g Release1 on a POWER9 based servers is AIX6.1 TL09 SP11 or higher.

The same certifications are in place for Oracle Database Standard Edition (11g R2 only) and Oracle Database Standard Edition 2 (SE2) as for Oracle Database Enterprise Edition (EE).

Note: Get the following interim fix (ifix) and apply on the AIX versions 7.1 TL05 and 7.2 TL02,

AIX 7.2 TL02 : **IJ04933**: GETSOCKNAME RETURNS INVALID PATH NAME FOR AF_UNIX SOCKETS

AIX 71. TL05 : **IJ04311**: GETSOCKNAME RETURNS INVALID PATH NAME FOR AF_UNIX SOCKETS

Testing with an IBM POWER9 based servers and Oracle Database

At the IBM laboratory, Oracle Database 12*c* Release 2 was verified on a S924 server with the IBM FlashSystem 840 configured as follows:

IBM Power S924 Configuration	PCI Express 8 Gb 2-Port Fibre Channel Adapters PCIe3 2-Port 16Gb FC Adapters for SAN connectivity.
	PCIe3 100/1000 Base-TX 4-port for Public Network
AIX Logical Partition (LPAR) for Oracle Database.	AIX 7.2 TL02 SP02 (AIX boot from SAN – IBM Flash Storage FS840)
HMC version	HMC V9R1 SP910

Table 7. Tested Power S924 configuration

Oracle Database 12*c* Release 2 on IBM Power S924 experiences

Oracle Database 12*c* Release 2 (version 12.2.0.1.0) was successfully installed on the Power S924 server and tested with Oracle Single Instance Database. No patches of Oracle or AIX were required to complete this step on the Power S924.

Because Oracle certifications are done to the AIX operating system, Oracle fully supports the Oracle Database running on Power Systems servers with POWER9 processors. IBM's commitment to binary

compatibility across all Power Systems servers allows customers to run with confidence on any of the new Power Systems servers built with POWER9 processor technology.

An IBM in-house test of analytical queries was used to generate large number Online Transaction Processing (OLTP) type of transactions and long running queries on the database. The Power S924 server proved that it can easily handle this test workload without any problems.

Tuning tips

The same AIX OS tuning tips are applicable for both Oracle Database 11*g* Release 2 and Oracle Database 12*c* Release 1 & 2. For a list of resources that can be useful when tuning an Oracle Database on IBM Power Systems servers, refer to the "Resources" section at the end of this paper.

Power Systems SMT8 benefits

The Power Systems SMT capability enables concurrent execution of instruction streams, or threads, on the same core. In the new IBM Power Systems servers built with POWER9 processors, up to eight threads (SMT8) can concurrently run on a single core.

The benefit of SMT8 on POWER9 is significantly higher than on the previous generation of POWER8 servers.

For this reason it is recommended that customers moving to POWER9 evaluate changing from the default SMT4 setting of an AIX 7.x logical partition by tuning it to SMT8. The decision should be made based on the nature of the application and characteristics of the workload being used in the LPAR.

Database software such as Oracle Database is capable of using multi-threading processor cores and can make use of the POWER9 SMT8 configuration option to take full advantage of the available cores.

Based on in-house tests of OLTP, using Oracle Database 12*c* Release 2 on a Power S924 server with SMT8 significantly boosted the throughput performance of Oracle Database transactions.

When maximizing the utilization of the POWER9 processor based server we found that the use of the SMT8 provided positive benefits consistent with the results published in the IBM Power Systems Performance Report.

For updated SMT8 performance information on Power Systems servers with POWER9 processors running Oracle Database, please contact the IBM Oracle International Competency Center at *ibmoracle@us.ibm.com*.

Oracle Database licensing on IBM Power Systems

Oracle's licensing policies can be found at Oracle's "Oracle Global Pricing and Licensing" website at: https://www.oracle.com/corporate/pricing/index.html

Generally speaking, Oracle's licensing policy applies equally to any hardware platform with a few exceptions. For the purpose of this white paper, the Core Factor table is a critical document since Oracle applies different core factors to different hardware platforms in order to calculate the price of its software per core. In some cases Oracle software can be licensed by number of users instead of licensing per core. The Oracle core factor table is available at:

http://www.oracle.com/us/corporate/contracts/processor-core-factor-table-070634.pdf.

At the time of this publication, Oracle has not yet announced the core factor for the IBM POWER9 processor based server.

The new Power System Scale-Out servers with POWER9 technology are all configured with one or two sockets, where each socket is populated with a SCM**.** A 2-socket servers can be configured with up to 24 cores.

Three versions of the Oracle Database are available for use on IBM Power Systems servers:

- **Oracle Database Standard Edition** is only applicable on the servers with Oracle Database 11*g* Release 2 based on current Oracle product support. It allows use on up to four sockets.
- **Oracle Database Standard Edition 2** is supported on servers or clusters of servers with up to two sockets. Because Oracle defines each chip as a socket for the purposes of licensing, the Power S914, S922 and S924 servers are eligible to run with Oracle Database Standard Edition 2. To be eligible, a server cannot have more than 2 sockets at any time. When using the Oracle RAC capability of Oracle Database Standard Edition 2, the number of sockets in the entire cluster must be no more than two.
- **Oracle Database Enterprise Edition** is licensed by the number of physical cores available in the logical partitions that the Oracle Database is running in, when virtualization is being used. This is because Oracle accepts Dynamic Logical Partitions (DLPAR) as hard partitioning and charges for the maximum number of physical cores that the Oracle Database is capped to run on. Any Power Systems server can run Oracle Database Enterprise Edition.

IBM and IBM Business Partners can contact the IBM Oracle International Competency Center (ibmoracle@us.ibm.com) for help with evaluating the number of cores available in an LPAR.

The document at the following link shows Oracle's partitioning policies:
http://www.oracle.com/us/corporate/pricing/partitioning-070609.pdf

Oracle core factors are applied to licenses of Oracle Database Enterprise Edition. To calculate the number of EE licenses required the core factor is applied to the total number of cores Oracle will run on and the factored value is used to calculate the number of licenses required. Oracle uses the core factor, to adjust for the performance of the processor, with more powerful processors having a higher core factor. However, this determination is exclusively the responsibility of Oracle Corporation and a customer planning to install Oracle software on any hardware platform needs to discuss licensing terms and conditions with their Oracle representative.

Summary

This paper discusses the key technical topics that help the reader understand the support of AIX versions, Oracle Database versions, and IBM virtualization software version for the new IBM Power Systems servers built with POWER9 processor technology. This document also demonstrates the readiness of IBM Power System server with POWER9 "S" class servers for implementing an Oracle Database.

About the authors

Ravisankar Shanmugam is an Advisory Software Engineer with the IBM Oracle enablement based in Foster City, California. He writes technical sales collateral and gathers sizing information for Oracle products on AIX. He also provides support for AIX and Power Systems projects at the IBM Oracle enablement team and IBM Oracle International Competency Center and onsite at Oracle headquarters in Redwood Shores and Pleasanton, CA.

Co-Authors:

Moshe Reder is a Global Solutions Specialist at the IBM Oracle International Competency Center. Moshe has over 30 years of experience with the IT industry. Most of his career was spent in the IBM Sales organization as a technical sales support for IBM Large Systems (IBM Brazil and IBM USA). He also spent a few years at the IBM Programming Laboratory (performance and benchmark for S/390 – now IBM System z®). Moshe has been with the ICC since 1997, the year of its establishment and he focuses on Oracle technology for IBM systems.

Wayne Martin is the IBM Systems and Technology Group Technology Solutions Manager responsible for the technology relationship between IBM and the developers of Oracle Corporation Database and Fusion Middleware for all IBM server brands. His responsibilities include driving mutual understanding between IBM and Oracle on technology innovations that can generate benefits for mutual customers, managing the process of getting that technology implemented in products, and insuring that availability of the products to customers is timely. Wayne has held a variety of technical and management roles at IBM that have focused on driving enhancements of ISV software that uses IBM mainframe, workstation, and scalable parallel products.

Resources

The following references are useful when tuning an Oracle Database environment. The same tuning of AIX for Oracle Database 11*g* Release 2 applies to Oracle Database 12*c* Release 1 & 2.

IBM Power Systems Scale-Out servers with POWER9 processor technology announcement letters

S924: https://www-01.ibm.com/common/ssi/rep_ca/0/897/ENUS118-020/ENUS118-020.PDF
S922: https://www-01.ibm.com/common/ssi/rep_ca/1/897/ENUS118-021/ENUS118-021.PDF
S914: https://www-01.ibm.com/common/ssi/rep_ca/3/897/ENUS118-023/ENUS118-023.PDF

- IBM Power Systems Performance Report
  https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?infotype=PM&subtype=RG&appname=STGE_PO_PO_USEN&htmlfid=POO03017USEN&attachment=POO03017USEN.PDF

IBM XL C/C++ compilers features
http://www-01.ibm.com/support/docview.wss?uid=swg27007322

- IBM AIX “From Strength to Strength – A summary of upgrade benefits for each release of AIX”
  https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=POO03022USEN

- Oracle RAC on IBM AIX best practices in memory tuning and configuring for system stability
  http://www.oracle.com/technetwork/database/clusterware/overview/rac-aix-system-stability-131022.pdf

- AIX 7.2 Performance Management
  ftp://public.dhe.ibm.com/systems/power/docs/aix/72/prftungd_pdf.pdf

- AXI 7.1 Performance Management
  ftp://ftp.www.ibm.com/systems/power/docs/aix/71/prftungd_pdf.pdf

- Oracle Architecture and Tuning on AIX (white paper)
  ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100883

- IBM POWER7 AIX and Oracle Database performance considerations
  ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102171

- Managing AIX Devices used by Oracle Automatic Storage Management (ASM)
  ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102158

The following are links to supplemental tuning resources.

- RAC Starter Kit and Best Practices:
  “My Oracle Support” (see resources) note 811293.1

- My Oracle Support (userid and password are required to sign in)
  https://support.oracle.com/

Trademarks and special notices

References in this document to IBM products or services do not imply that IBM intends to make them available in every country.

IBM, the IBM logo, AIX, GPFS, PowerHA, PowerVC, PowerVM, PowerVP, POWER, Power, Power Architecture, Power Systems, POWER6, POWER7, POWER7+, POWER8, POWER9, System z, IBM Z , and ibm.com are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. If these and other IBM trademarked terms are marked on their first occurrence in this information with a trademark symbol (® or ™), these symbols indicate U.S. registered or common law trademarks owned by IBM at the time this information was published. Such trademarks may also be registered or common law trademarks in other countries. A current list of IBM trademarks is available on the Web at "Copyright and trademark information" at www.ibm.com/legal/copytrade.shtml.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Linux is a trademark of Linus Torvalds in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.

The information provided in this document is distributed “AS IS” without any warranty, either express or implied.

The information in this document may include technical inaccuracies or typographical errors.

All customer examples described are presented as illustrations of how those customers have used IBM products and the results they may have achieved. Actual environmental costs and performance characteristics may vary by customer.

Information concerning non-IBM products was obtained from a supplier of these products, published announcement material, or other publicly available sources and does not constitute an endorsement of such products by IBM. Sources for non-IBM list prices and performance numbers are taken from publicly available information, including vendor announcements and vendor worldwide homepages. IBM has not tested these products and cannot confirm the accuracy of performance, capability, or any other claims related to non-IBM products. Questions on the capability of non-IBM products should be addressed to the supplier of those products.

All statements regarding IBM future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only. Contact your local IBM office or IBM authorized reseller for the full text of the specific Statement of Direction.

Some information addresses anticipated future capabilities. Such information is not intended as a definitive statement of a commitment to specific levels of performance, function or delivery schedules with respect to any future products. Such commitments are only made in IBM product announcements. The information is presented here to communicate IBM's current investment and development activities as a good faith effort to help with our customers' future planning.

Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput or performance improvements equivalent to the ratios stated here.

Photographs shown are of engineering prototypes. Changes may be incorporated in production models.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk.