ORACLE

Oracle Server X9-2 and X9-2L System Architecture

Oracle Technical Paper

Purpose statement

This document provides an overview of features and enhancements included in the initial release Oracle Server X9 systems. It is intended solely to help you assess the business benefits of upgrading to the new servers and to plan your I.T. projects.

Disclaimer

This document in any form, software or printed matter, contains proprietary information that is the exclusive property of Oracle. Your access to and use of this confidential material is subject to the terms and conditions of your Oracle software license and service agreement, which has been executed and with which you agree to comply. This document and information contained herein may not be disclosed, copied, reproduced or distributed to anyone outside Oracle without prior written consent of Oracle. This document is not part of your license agreement nor can it be incorporated into any contractual agreement with Oracle or its subsidiaries or affiliates.

This document is for informational purposes only and is intended solely to assist you in planning for the implementation and upgrade of the product features described. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, and timing of any features or functionality described in this document remains at the sole discretion of Oracle. Due to the nature of the product architecture, it may not be possible to safely include all features described in this document without risking significant destabilization of the code.

ORACLE

Table of contents

ORACLE

Introduction

Oracle Server X9-2 and Oracle Server X9-2L, Oracle's latest two-socket servers are additions to Oracle's family of x86 servers that are purpose-built to be best for running private cloud solutions. Oracle Server X9-2 is a 1U server that is an ideal platform for infrastructure as a service (IaaS) and for small or medium flash-optimized instances of Oracle Database. Oracle Server X9-2L is a 2U server that is optimized for customers requiring a robust and reliable platform for running instances of Oracle Database with large amounts of direct-attached storage and as a consolidation platform capable of handling the I/O requirements of large numbers of virtual machines (VMs).

System Overview

Oracle Server X9-2 and Oracle Server X9-2L support up to two third generation Platinum, Gold or Silver Intel® Xeon® Scalable Processors, each containing up to 32 cores and up to 48 MB of cache. With 32 DDR4 dual inline memory module (DIMM) slots, the servers provide up to 2 TB of main memory using 64 GB DIMMs with memory bandwidth of up to 3200 MT/sec.

Oracle Server X9-2 has three PCI EXPRESS® (PCIe®) 4.0 16-lane slots plus two optional Ethernet ports capable of up to 100 GbE speeds. Oracle Server X9-2 can be configured with up to four NVMe solid-state drives (SSDs) in the small form factor (SFF) drive bays.

Oracle Server X9-2L has ten PCIe 4.0 slots (two 16-lane and eight 8-lane slots) and 12 large form factor (LFF) drive bays. The base Oracle Server X9-2L can be configured with up to eight NVMe SSDs, expandable to twelve with an optional hardware expansion. Alternatively, up to twelve 18 TB SAS-3 hard disk drives (HDD) are supported with the optional SAS RAID host bus adapter (HBA). In total, over 260 TB of internal storage capacity is supported.

Both Oracle Server X9-2 and Oracle Server X9-2L include integrated 1GBase-T and USB 3.0 ports as standard features. Also, two optional internal 240 GB M.2 flash devices are available for booting. Table 1 provides a feature comparison of the Oracle Server X9-2 and X9-2L systems.

Oracle Server X9-2 and Oracle Server X9-2L key features.

FEATURE	ORACLE SERVER X9-2	ORACLE SERVER X9-2L
Form Factor	1U, 737 mm / 29" deep	2U, 759 mm / 29.9" deep
Processors	Intel® Xeon® Platinum 8358 processor: 2.6 GHz, 32 cores, 250 watts, XCC, 48 MB cache Intel Xeon Gold 6354 processor: 3.0 GHz, 18 cores, 205 watts, XCC, 39 MB cache Intel Xeon Gold 5318Y processor: 2.1 GHz, 24 cores, 165 watts, HCC , 36 MB cache Intel Xeon Silver 4314 processor: 2.4 GHz, 16 cores, 135 watts, HCC, 24 MB cache	
Processor quantity	1 or 2	
Maximum cores	64	
Maximum threads	128	
Memory	32 GB DDR4-3200 registered DIMM 64 GB DDR4-3200 registered DIMM	

ORACLE

Memory capacity	2 TB, up to 16 DIMMs pert processor	
Internal disk drives	Four 2.5-inch hot-plug drive bays 3.84 TB or 6.8 TB NVMe SSDs	Twelve 3.5-inch hot-plug drive bays 3.84 TB or 6.8 TB NVMe SSDs 18 TB SAS-3 HDDs
NVMe support for internal drive bays	Four drive bays, standard	Eight drive bays standard Up to twelve with optional retimer card
SAS support for internal drive bays	-	Up to twelve drive bays supported with optional SAS RAID HBA
Oracle Flash Accelerator F640 PCIe Card v3	-	Up to eight
Management ports	Network management: One 1 Gb Ethernet port and one serial RJ-45 port Host management: One 1 Gb Ethernet port	
USB ports	One rear USB 3.0 port	
Ethernet	Optional dual 100 GbE, with QSFP28 slots	Network Interface Cards in PCIe slots
PCIe 4.0 low-profile expansion slots	Three 16-lane slots	Ten slots, eight 8-lane and two 16-lane slots
Redundant power supplies	Two redundant (1+1) hot-swappable AC 1,200 W power supplies	
N+1 redundant hot-swappable fans	Four dual-fan modules	Four dual-fan motor modules
Operating environments	Oracle Linux, Oracle Solaris, Oracle, Windows Server, VMware ESXi	

Table 1. Oracle Server X9-2 and Oracle Server X9-2L key features

Reimagining Database Storage with All-Flash Configurations

Demand for flash storage continues to grow as its cost per capacity is reduced. Oracle Server X9-2 is an all-flash system with up to 27.2 TB of internal NVMe storage. The all-flash configuration of the Oracle Server X9-2L provides up to 132.8 TB of NVMe flash storage with twelve SSDs and eight Oracle Flash Accelerator F640 PCIe Cards v3.

With such large amounts of flash, it is now possible to store any part of the database on flash instead of on slower, rotating drives. By storing the entire database on flash, enterprises can remove a major I/O bottleneck and dramatically improve performance. This is especially important for instances of Oracle Database in branch or remote offices away from a corporate SAN.

Oracle Server X9-2 is offered only in all-flash configurations and Oracle Server X9-2L offers the choice of forgoing conventional internal SAS drives and HBA in favor of an all-flash NVMe configuration. Oracle's NVMe devices have a much lower latency and higher bandwidth compared to the SAS-3 drives. Each NVMe SSD is connected directly with a

ORACLE

4-lane PCIe 4.0 interface and a raw bandwidth of 16 GB/s. That translates to a theoretical aggregate raw bandwidth of 192 GB/s supporting twelve NVMe SSDs. In contrast the SAS-3 interface has a nominal bandwidth of 12 Gb/s (1.5 GB/s) per drive. Aggregate bandwidth for the twelve SAS-3 drives is limited to 16 GB/s by the SAS RAID HBA which uses an 8-lane PCIe 3.0 interface. In addition, the SAS HBA adds a latency due to the data and communication processing. The direct interface between the NVMe drives and the PCIe subsystem does not suffer from similar latency.

Oracle's x86 servers also provide an NVMe performance advantage by co-engineering the NVMe flash with the servers. Because flash technologies are temperature-sensitive, most high-performance flash drives will throttle down their I/O speeds as temperatures rise in order to protect the flash from damage. Oracle's NVMe SSDs, on the other hand, include multiple temperature sensors that are monitored by the servers' Oracle Integrated Lights Out Manager (Oracle ILOM) service processor to ensure the drive maintains optimum operating temperature. Oracle ILOM modulates the fan speed to ensure enough cooling for maximum system performance. The benefits of this are that the servers consistently operate at maximum performance across their full operating temperature range independent of the system configuration.

Extreme Memory and I/O for IaaS

As organizations face growing IT expenses while at the same are time moving toward modern, private cloud architectures, it is essential to be able to do more with less. Server virtualization is the foundation of private cloud infrastructures and serves as the consolidation mechanism for heterogeneous workloads. Oracle Server X9-2 and Oracle Server X9-2L are the ideal platforms for virtualization, providing the ability to get the most out of each server by simultaneously maximizing memory capacity, I/O, and compute density.

The best virtualization platforms allow for high VM density while providing fast live migration, reliability, and performance. While core count is an important metric for estimating VM density is, there are many other factors—such as memory capacity, memory bandwidth, and I/O bandwidth—that are equally important in determining how many VMs can be consolidated onto one server. Enterprise-class VM environments rely heavily on I/O bandwidth networks to be able to migrate VMs for load balancing as well as failover scenarios. In addition, the two integrated 100 GbE ports dedicated interface to the processor on Oracle Server X9-2 provide additional I/O bandwidth without consuming a PCIe slot.

The memory architecture has been yet again improved with the latest generation of Oracle x86 servers. First, there are now eight memory channels per processor, up from six in the previous generation. The additional memory channels, as well as the increased memory transfer rates of 3,200 MT/sec, increase the per processor memory bandwidth to 410 GB/sec, up from 256 GB/sec in previous generation systems. Second, memory capacity is increased with memory DIMM slots per processor being increased from 12 to 16. This allows for significant performance increases due to the additional memory bandwidth and capacity. Third, the motherboard design supports three Intel® Ultra Path Interconnect (Intel® UPI) links between the two processors, each link operating at up to 11.2 GT/sec. The improved connections between processors reduce the latency when nonlocal memory is accessed, and remote I/O operations are performed.

With a balance among core density, memory footprint, and I/O bandwidth, Oracle Server X9-2 and Oracle Server X9-2L are optimized to be deployed into existing data centers as the building block of a private cloud or IaaS implementation. With a total aggregated raw I/O bandwidth of up to 512 GB/s, a 167% increase over previous generation system, Oracle Server X9-2L maximizes I/O operations for virtualized cloud environments to take advantage of increased number of cores. The ten PCIe 4.0 slots with 384 GB/s bandwidth allow for a very high VM consolidation factor by eliminating any I/O bottlenecks and providing proportional I/O bandwidth to complement the large number of cores, up to 64, in the latest processors.

ORACLE

Best for Oracle Software

Oracle Server X9-2 and Oracle Server X9-2L systems are ideal x86 platforms for running Oracle software. Only Oracle provides customers with an optimized hardware and software stack that comes complete with choice of operating system, virtualization software, and cloud management tools—all at no extra charge. Running Oracle software on Oracle's x86 systems provides performance, reliability, and supportability advantages not found on third-party x86 servers. The combination of Oracle Database, Oracle Linux, and Oracle's x86 systems represents an integrated stack that has been designed and tested to deliver maximum performance and reliability in enterprise IT environments.

Oracle invests heavily in engineering and quality assurance for its Oracle Linux operating environment. While many customers choose Oracle Linux to support their mission-critical applications, Oracle Cloud Applications, Oracle Cloud Platform, and Oracle Cloud Infrastructure also run on Oracle Linux. The Unbreakable Enterprise Kernel (UEK) for Oracle Linux provides the latest open source innovations, key optimizations, and security to cloud and on-premises workloads.

Oracle Linux is the development standard across the Oracle Database and application product portfolio and is tightly coupled with Oracle Database and application testing, which hardens software releases throughout each product's lifecycle. And before any database or application software is made available, Oracle engineering teams conduct formal stress tests on Oracle Linux to certify Oracle Database and Oracle Real Application Clusters (RAC), along with an extensive battery of system verification and performance tests on Oracle's x86 servers and engineered systems to ensure optimum functionality. This extensive testing ensures that the combination of Oracle Server X9 systems with Oracle Linux provides an extremely reliable, robust, and high-performance server for database and enterprise applications.

As part of Oracle's commitment to security, Oracle Ksplice offers zero-downtime patching for Linux kernels, hypervisors, and critical user space libraries. This aids IT administrators in staying up to date with the latest security-related patch releases.

Oracle's x86 systems and Oracle Linux are co-engineered with Oracle Database so that the combined hardware and software stack, benefiting from numerous optimizations, produces advantages that are greater than the sum of the individual advantages. This yields an increased return on Oracle software investments as well as a system-wide lowering of operating and management costs.

Also, users of an Oracle hardware and software stack realize better quality and higher reliability. Oracle Linux and Oracle's x86 systems are used by Oracle developers and quality assurance teams to write and test the database and application code. With every daily software build by Oracle's product development team, testing provides one more opportunity to examine edge cases and to improve the extensive quality review of Oracle software on Oracle hardware.

Using the combination of Oracle Database, Oracle Linux, and Oracle's standalone x86 servers, customers also realize the benefits from Oracle's highly optimized engineered systems such as Oracle Exadata, which delivers a 10x improvement in large-scale database performance. These engineered systems start with Oracle's x86 standalone servers as core building blocks for compute and storage servers within the overall system architecture.

Oracle's approach to x86 system hardware design is distinctive. Other tier-1 vendors use an off-the-shelf, or a slightly modified off-the-shelf, x86 motherboard design. Only Oracle starts with the standard Intel® Xeon® line of processors and a clean sheet of paper. Oracle's focus is to design a system that runs both Oracle software best and provides capabilities demanded by enterprise and cloud usage. An Oracle-on-Oracle solution provides assurance that the Oracle software is deployed in a thoroughly tested and optimized environment, increasing reliability and performance, and thereby reducing business risk.

ORACLE

The Unsettling Reality of Firmware-Based Attacks

With service processors becoming more powerful and system firmware increasing in complexity, the possibility that firmware can be maliciously attacked and exploited is becoming more likely. As these systems are deployed to the cloud, the fear that attacks originating in a guest operating system could escape past the hypervisor to a privileged domain is becoming a reality. Once it is in a privileged domain, malicious code can then infect the firmware and survive across disk wipes and across tenants and potentially further spread to the control plane of the cloud, wreaking havoc.

Because firmware-based attacks operate at a lower level than can be detected by traditional virus scan software or network-based security tools, the only method for combating these threats is from within the server itself using a defense-in-depth approach. Protective measures in hardware and firmware are necessary to adequately defend against and detect firmware-based attacks. This requires hardware-based mechanisms to validate the integrity of firmware as well as modern, hardened interfaces across all firmware-based attack surfaces.

Defense-In-Depth Security

Oracle's philosophy on security in depth is based on the philosophy that "security needs to be built in, not bolted on." Oracle has a company-wide initiative to incorporate security features across all of its products, starting with the design and manufacturing of its servers, through the operating systems layers, and extending into the database, middleware, and application layers. Oracle's Global Product Security group is chartered with the goal of setting, auditing, and enforcing security policies across all Oracle products. It also performs periodic security audits and ensures compliance with the latest threat profiles. This organization also publishes regular security alerts to users of Oracle products.

Security and Oracle Cloud

Oracle Cloud is the industry's broadest and most integrated public cloud. It offers best-in-class services across software as a service (SaaS), platform as a service (PaaS), and IaaS, and even lets you put Oracle Cloud in your own data center. Oracle Cloud helps organizations drive innovation and business transformation by increasing business agility, lowering costs, and reducing IT complexity.

Oracle's x86 servers are used as the hardware building blocks of Oracle Cloud solutions and, therefore, must provide the highest levels of security. Because Oracle Cloud runs some of the most mission-critical applications of any cloud, it is essential that it be protected from security threats at all levels. This protection would not be possible using commercial off-the-shelf hardware. Instead, Oracle engineers use its own hardware in order to satisfy the unique security requirements of Oracle Cloud.

Oracle Server X9-2 and Oracle Server X9-2L offer best-in-breed security features, leveraged from Oracle's own cloud offerings, for customers building their own cloud solutions. This technical paper discusses these new features and enhancements.

Oracle Integrated Lights Out Manager 5.0

Oracle Server X9-2 and Oracle Server X9-2L includes the latest generation of cloud-ready service processor that is designed for today's security challenges. The latest generation Oracle ILOM 5.0 is a modern service processor that uses advanced service processor hardware with built-in hardening and encryption. In order to make server management more secure, Oracle ILOM 5.0 has a set of modern APIs that are based on latest technologies and are more secure by eliminating older, insecure interfaces. In addition, Oracle ILOM 5.0 uses only industry-leading strong ciphers to encrypt communications and data.

Oracle ILOM 5.0 includes a hardened code base at all levels in order to minimize the potential of malicious code to exploit defects in the kernel, operating system, and other parts of the firmware. In addition, Oracle ILOM 5.0 includes

ORACLE

improved firmware image signing to further guarantee the integrity of firmware. This prevents any third-party modification of the firmware and guarantees that only firmware created and signed by Oracle can be use on the servers.

Oracle ILOM 5.0 Development Process and Security Assurance

The advanced security features of Oracle ILOM 5.0 are the result of an industry-leading development and security-assurance process. This process extends throughout the development of Oracle ILOM firmware as well as after the firmware has been released. Oracle's dedicated security team tracks and finds security vulnerabilities and assesses their impact to Oracle ILOM firmware. These vulnerabilities are fixed with regular updates to the kernel and distribution underlying Oracle ILOM. The result is a modern, hardened code base that is maintained through a vigilant software development process that includes fixing security vulnerabilities that are listed in the Common Vulnerabilities and Exposures (CVE) list.

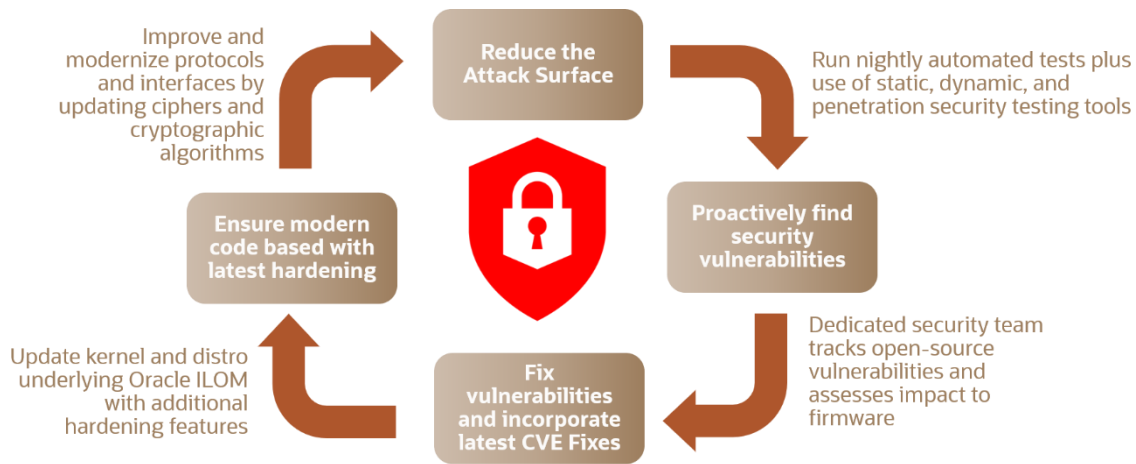The diagram below shows this process:

Figure 1. Oracle ILOM 5.0 Engineered for Extreme Security

Oracle ILOM Secure Verified Boot

One of the most important new security features in Oracle ILOM 5.0 is secure verified boot. This feature anchors validation of the Oracle ILOM firmware in hardware to guarantee its integrity upon every boot. Specifically, Oracle ILOM's firmware signature is validated on every boot by code that is hardware-protected and cannot be modified or compromised by malicious code. By cryptographically preventing the service processor from booting malicious Oracle ILOM firmware, the secure verified boot feature ensures that only firmware created by Oracle can be booted.

The secure verified boot feature is part of a chain of trust that ensures integrity from the hardware up the stack. Specifically, Oracle ILOM 5.0's boot code is validated by hardware-protected code. That validated boot code then validates Oracle ILOM's file system and other components such as the embedded BIOS image to ensure validity.

Oracle ILOM 5.0 Security Features at a Glance

The features described above are only some of the many Oracle ILOM 5.0 security features. Because security is only as strong as its weakest link, Oracle ILOM 5.0 includes security enhancements in many areas, as outlined in Table 2.

ORACLE

Oracle ILOM 5.0 security features at a glance

SECURITY FEATURE	DESCRIPTION
Hardening	• Processes run at the lowest required privileges • Role base access for ILOM daemons • Runs on OL 7.5 and UEK 5 • Restricted Shell Hardening
FIPS 140-2 Update	• FIPS 140-2 certification with updated object module version
Strong Ciphers	• Ciphers and versions negotiated in compliance with Oracle Global Security approved TLS list
Oracle ILOM Secure Verified Boot	• Firmware validation by hardware-protected code prior to each boot • REST APIs designed for secure, cloud deployments • Private, secure communication between host and ILOM
Firmware Integrity	• Firmware image signing with 2048-bit DSA key • Ensures only Oracle authentic firmware is used • Firmware downgrade check
Weak Protocols Disabled	• TLS 1.1 support removed • HTTP redirect to HTTPS • Disable IPMI 2.0 by default • SNMPV2 GET operations disabled

Table 2. Oracle ILOM 5.0 security features at a glance

Trusted Operating System Boot

In addition to the many firmware and Oracle ILOM 5.0 security enhancements, Oracle Server X9-2 and Oracle Server X9-2L also provide features that secure the host boot process. These features provide built-in security for the BIOS boot loader and operating systems, as described in Table 3.

Trusted Operating System Boot features

FEATURE	DESCRIPTION
UEFI Secure Boot	• Validates the authenticity of the host's boot loader • Protects Oracle Server X9-2 and Oracle Server X9-2L against malicious code being loaded and executed early in the boot process
Intel® Trusted Execution Technology (Intel® TXT)	• Validates that the operating system is authentic and is running in a trusted environment • Hardens the servers from the emerging threats of hypervisor attacks, BIOS, or other firmware attacks, malicious root kit installations, or other software-based attacks

Table 3. Trusted Operating System Boot features

ORACLE

Innovative Reliability, Availability, and Serviceability

Reliability, availability, and serviceability (RAS) are extremely important to customers who demand maximum system uptime when running business-critical applications. If a fault occurs in a server, revenue can be lost.

Oracle Server X9-2 and Oracle Server X9-2L are designed completely in house from the ground up, and they are engineered to be easily serviceable while maximizing reliability. In particular, the chassis design has special features that improve performance while also improving reliability and serviceability. Oracle engineers designed a rigorous testing process for all components of the servers such as memory DIMMs, disk drives, power supplies, and so on. These quality assurance tests are supplementary to those conducted by the component suppliers. All components of the system have to pass these tests prior to the release of the product to market.

Hardware Designed for Advanced RAS

Oracle Server X9-2 and Oracle Server X9-2L are designed for maximum uptime with enterprise-grade availability features. All internal disk drives are hot-swappable and. The RAID SAS controller supports RAID 0, 1, 5, 6, 10, 50, and 60 and has 2 GB of onboard cache memory, and power fail backup support. It uses an energy storage module to save data in flash upon a server power failure. The power supplies and fans are also redundant and hot-swappable, ensuring that a failure to any single component does not affect the running systems. With two power supplies, the servers offer N+N power redundancy.

The chassis and motherboard are designed to eliminate as many cables as possible; for example, the power supplies mate directly to connectors on the motherboard, eliminating a power distribution cable and a single point of failure. The fans also mount directly to the motherboard, eliminating cables and, hence, improving reliability.

Fault Management and Diagnostics

With higher levels of integration among various subsystems in servers, it is becoming more complex to diagnose faults down to the component level. A key element of serviceability that is taken into consideration in Oracle Server X9-2 and Oracle Server X9-2L is automatic fault diagnosis with accurate identification of faulty components. This results in significant reductions in time and effort for debugging problems and waiting on service personnel to replace faulty components.

Oracle Server X9-2 and Oracle Server X9-2L include built-in fault management and diagnostic tools that increase system availability and enable faster service response times that increase server uptime. Oracle Server X9-2 and Oracle Server X9-2L include Oracle ILOM, which performs advanced health monitoring of the server operating environment (power and cooling), CPUs, and memory subsystems. This advanced diagnosis engine is resident in the embedded service processor firmware and constantly monitors the state of these subsystems without interfering with the functionality of the host. Automatic notifications are generated in the event of problems. Building on the fault management infrastructure, Oracle ILOM has the ability to raise automatic service requests (ASRs). This ability enables service requests to be generated automatically with important fields prepopulated for use by Oracle service personnel. The elimination of human intervention in the service-request generation process improves the accuracy of problem notification to Oracle.

On a typical server, the host operating system and the service processor have mutually exclusive (although sometimes partially overlapping) subsystems that they manage. The host operating system has ownership of the CPU, memory, and I/O subsystems while the service processor presides over the fans, power supplies, DIMMs, and other miscellaneous chassis components. For these reasons, data center managers are often forced to monitor the health of the host operating system and the service processor as if they are separate entities.

Oracle Server X9-2 and Oracle Server X9-2L overcome the above limitations by enabling a bidirectional communication path between Oracle ILOM and Oracle Linux or Oracle Solaris. This path facilitates the exchange of

ORACLE

critical health information between the host and the service processor. Having a dedicated interconnect between the host operating system and Oracle ILOM allows a holistic and single view of all problems in a system. Data center managers and administrators can depend on this operating system and hardware integration for complete system diagnosis, eliminating the need to connect to multiple management entities.

Oracle Linux and Oracle Solaris include a set of diagnosis diagnostic? engines that process raw error events from the hardware and provide an automated and intelligent method for problem diagnosis and fault isolation. These engines are part of the overall Fault Management Architecture feature of Oracle Linux and Oracle Solaris and include a set of agents that respond to fault events, such as off-lining a faulty CPU thread or retiring a memory page on a DIMM. These advanced, self-healing features help reduce unplanned downtime by isolating a problem at runtime and keeping applications running.

Running Oracle Linux or Oracle Solaris on Oracle Server X9-2 and Oracle Server X9-2L ensures maximum system availability by providing early warnings of potential failures, fault visibility, and dynamic off-lining of faulty hardware. All of these functions are available at no additional cost.

System Details

Oracle Server X9-2 and X9-2L feature one or two of the latest Intel Intel® Xeon® Scalable Processors (a.k.a. Ice Lake) in a 1U and 2U rackmount enclosures, respectively. Up to 2 TB of system memory is supported with sixteen 64 GB DDR4-3200 DIMMs per processor. A 32 GB DDR4-3200 memory DIMM is also available. Memory transfer speed is up to 3,200 MT/sec and is dependent on processor's capability. See table 4 for more information.

Available Intel Xeon processors in Oracle Server X9-2 and X9-2L

INTER XEON PROCESSOR	MAX # CORES	BASE CORE SPEED (GHZ)	CACHE	MAX DDR4 BANDWIDTH (MT/SEC)	THERMAL DESIGN POWER IN WATTS
Platinum 8358	32	2.6	48	3,200	250
Gold 6354	18	3.0	39	3,200	205
Gold 5318Y	24	2.1	36	2,933	165
Silver 4314	16	2.4	24	2,667	135

Table 4. Available Intel Xeon processors in Oracle Server X9-2 and X9-2L

The IO subsystem is based on PCIe 4.0 which provides a 100% increase in bandwidth compared to previous generation systems. In addition, the new Intel Xeon Processor has 16 additional PCIe lanes compared to previous generation. This enables support of all four NVMe SSD in the Oracle Server X9-2 and to the first eight NVMe SSDs in the Oracle Server X9-2L without consuming any of the PCIe expansion slots. Each PCIe expansion slot in the rear of the enclosures support up to 75-watt power consumption as per the PCIe 4.0 specification.

A pair of M.2 SATA SSD is available for use as alternate, independent boot devices. The M.2 devices in the Oracle Server X9-2L do support hot-plug operations. However, the M.2 devices in the Oracle Server X9-2 1U enclosure are not hot-pluggable due to mechanical constraints.

A Direct Media Interface (DMI) using a 4-lane PCIe connection from the first processor supports the Lewisburg southbridge. The M.2 SATA SSDs as well as the Service processor (SP) subsystem are connected to Lewisburg chip. See the system block diagrams below for more details.

ORACLE

Oracle Server X9-2

Oracle Server X9-2 includes three low-profile PCIe 4.0 expansion slots, accessible from the rear of the enclosure. All three PCIe slots are supported with a 16-lane interface. In addition, there is one optional mezzanine card slot on the motherboard with a dual 100 GbE network adapter installed at the factory. Two QSFP28/56 connectors are provided in the rear of the system enclosure and with proper transceivers, two 10 GbE, 25 GbE, 40 GbE, or 100 GbE connections are supported

The four 2.5-inch SFF front-loading NVMe drive bays are supported by the first processor with a 4-lane PCIe 4.0 interface for each drive, providing a raw bandwidth of 16 GB/s per drive. Two NVMe SSD capacities are offered at the time of launch: 3.84 TB and 6.8 TB.

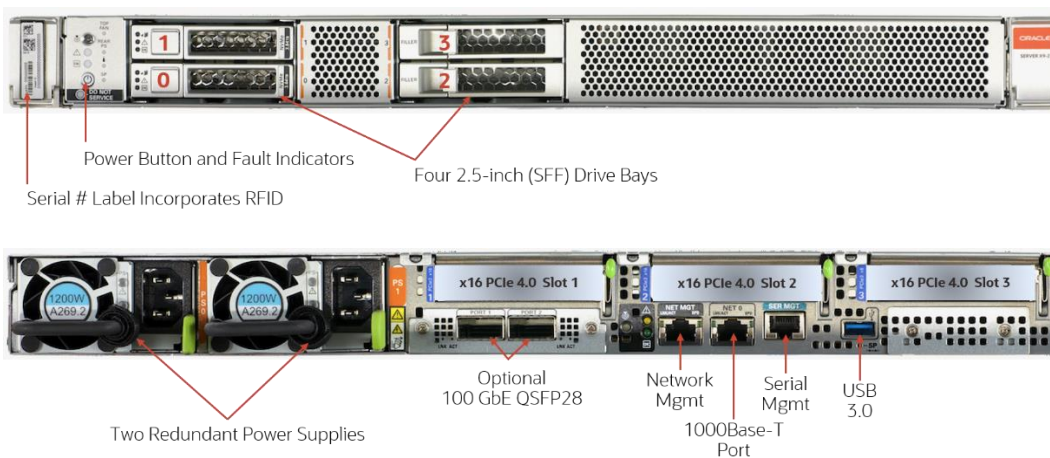Figure 2 illustrates devices and connections in the front and rear of the server.

Figure 2. Oracle Server X9-2 front and rear perspectives

Only one of the three PCIe expansion slots is disabled in a single processor configuration. See the system block diagram in Figure 3 for visual presentation of the PCIe connections.
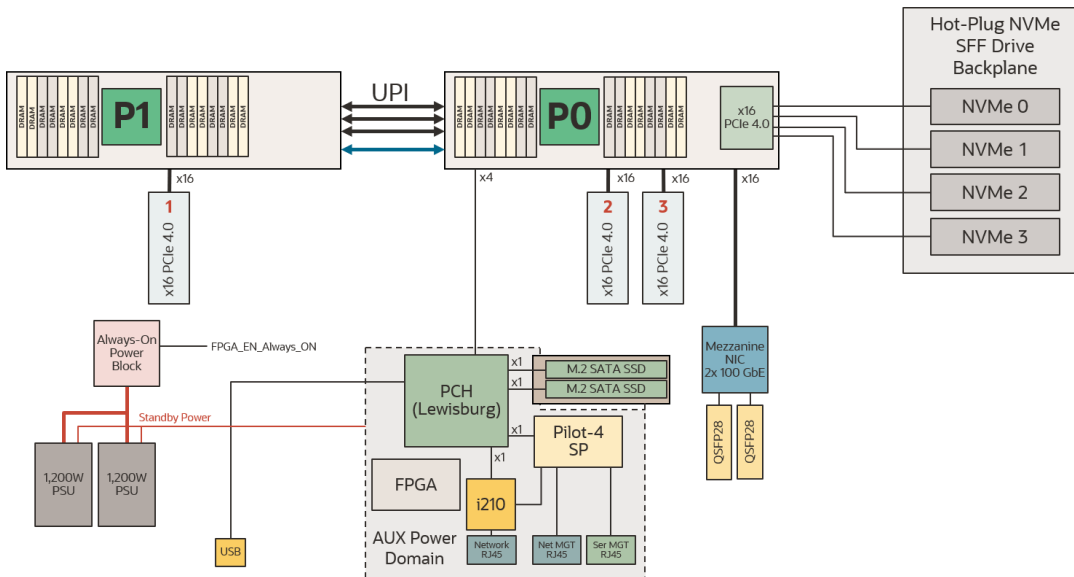

Figure 3. Oracle Server X9-2 block diagram

ORACLE

Oracle Server X9-2L

Oracle Server X9-2L provides a total of ten low-profile PCIe 4.0 expansion slots. Two of the PCIe expansion slots (#3 and #10) are supported with a 16-lane interface and eight with an 8-lane connection. Two of the 8-lane PCIe slots ((#1 and #2) can physically support adapter cards with the longer 16-lane connector which will be limited to use up to 8 lanes.

Up to 100 Gbps network connections are provided with Ethernet network adapter which are installed into the PCIe expansion slots.

The twelve 3.5-inch LFF front-loading disk bays support NVMe and SAS-3 drives. Disk options include 3.84 TB and 6.8 TB NVMe SSDs and 18 TB SAS-3 HDD. The disk bays are configured either with all NVMe drives, or all SAS HDDs.

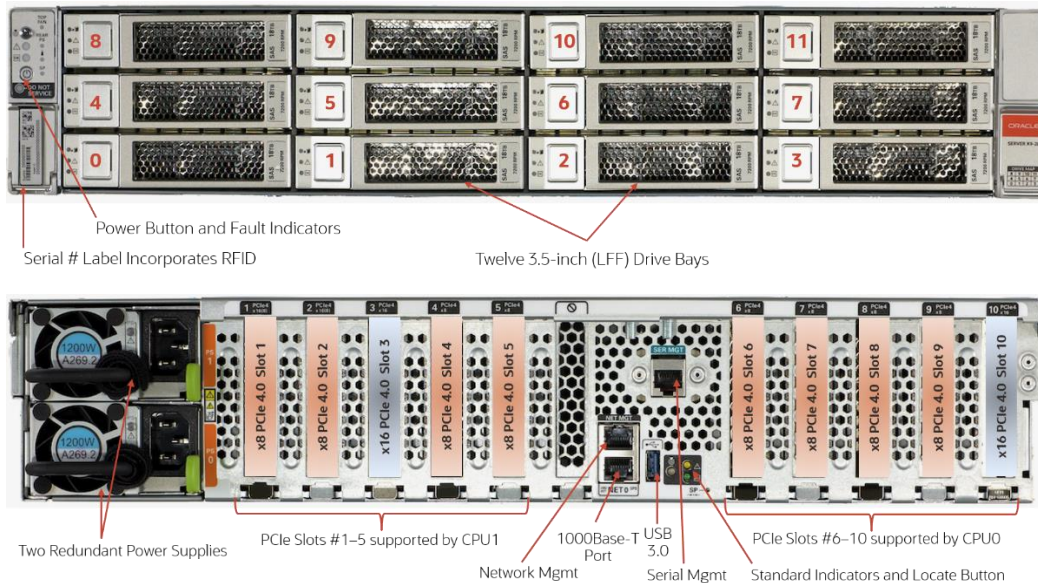Figure 4 illustrates devices and connections in the front and rear of the server.

Figure 4. Oracle Server X9-2L front and rear perspectives

Base configuration supports four NMVe SSD per processor. An optional retimer card is offered to expand the system to up to twelve NVMe SSDs. Every NVMe SSD is connected with a 4-lane PCIe 4.0 interface (16 GB/s raw bandwidth per drive). Additional eight Oracle Flash Accelerator F640 PCIe Cards v3 are supported in such all-flash configuration. This provides up to 107.2 TB of flash storage.

Up to 216 TB of SAS-3 HDD storage capacity is supported with twelve 18 TB SAS-3 HDDs. This is enabled with the optional SAS RAID PCIe Host Bus Adapter (HBA) that provides a 12 Gb/s (1.5 GB/s) connection per drive.

In a single processor configuration, five PCIe expansion slots and up to eight NVMe SSDs are available. Also, all twelve SAS HDDs can be supported in a single processor configuration. See the system block diagram in Figure 3 for more details.
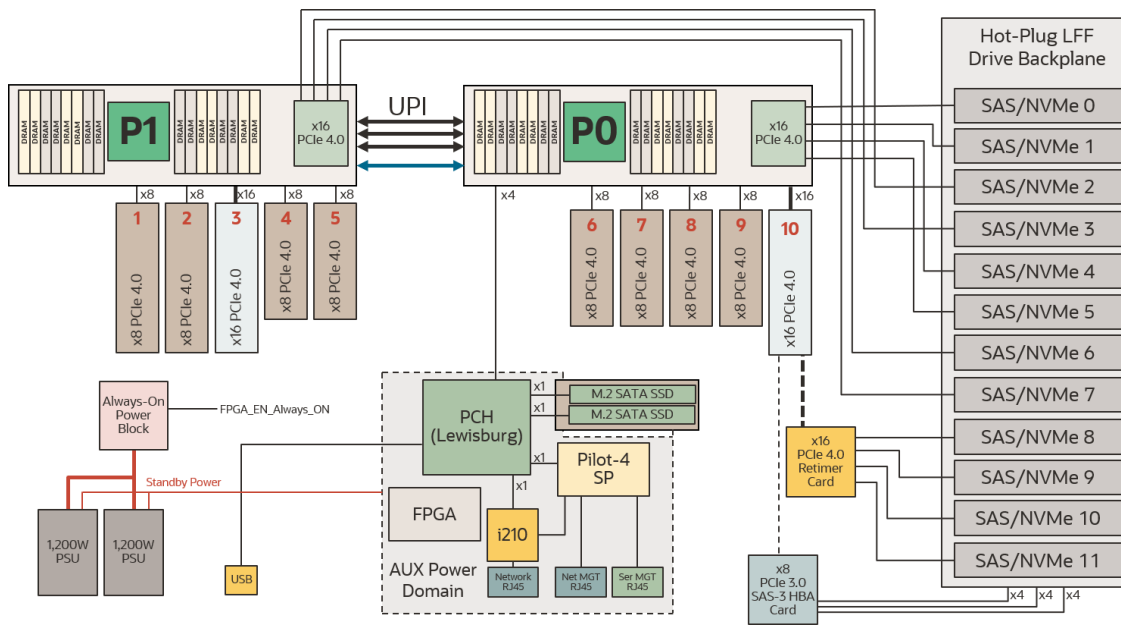
Figure 5. Oracle Server X9-2L block diagram

Conclusion

As enterprises continue to build out their private cloud solutions, IT departments are looking to provide a secure software and hardware infrastructure—one that delivers responsive performance, scalable capacity, and secure "always-on" availability. Oracle Server X9-2 and Oracle Server X9-2L are designed to simplify field installation, reduce cabling, minimize power consumption, maximize system uptime, and improve storage density, making them an ideal choice for system deployment.

Oracle Server X9-2 and Oracle Server X9-2L include many enhancements that improve cloud implementations. The key features incorporated in Oracle Server X9-2 and Oracle Server X9-2L—such as an improved memory architecture, additional CPU links between processors, and extreme I/O configurations—significantly improve performance for virtualized cloud environments compared to the previous generation. Combining these features with built-in, proactive fault detection and advanced diagnostics ensures Oracle's new x86 servers provide extreme reliability for enterprise cloud solutions.

Oracle's x86 systems serve as a key building block for Oracle's engineered systems, such as Oracle Exadata, which have achieved unprecedented performance gain through integration and optimization. These optimizations have been incorporated into the design of Oracle Server X9-2 and Oracle Server X9-2L as applicable, further improving their performance and reliability—making them an ideal choice for enterprises that value the quality, system availability, and server efficiency that reduce total cost of ownership.

More information about Oracle Server X9-2 and Oracle Server X9-2L can be found at oracle.com/servers/x86 or an Oracle representative can be reached at +1.800.ORACLE.

ORACLE