

# **Introduction to Oracle Solaris 11.1 Virtualization Environments**

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# Introduction to Oracle Solaris 11.1 Virtualization Environments

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Server virtualization provides a way to bypass interoperability constraints. Using virtualization enables you to improve server utilization by using server resources more efficiently and reduce the power consumption of your data center. Virtualization is driven by the need to consolidate multiple hosts and services on a single machine by sharing hardware, infrastructure, and administration tasks.

Virtualization technologies are implemented through hardware, software, and firmware. This document covers the following topics:

- “Oracle Solaris 11.1 Virtualization Technologies” on page 5
- “Oracle Solaris Zones Overview” on page 7
- “Oracle VM Server for SPARC Overview” on page 9
- “Oracle VM Server for x86 Overview” on page 10

## Oracle Solaris 11.1 Virtualization Technologies

The goal of virtualization is to move from managing individual data center components to managing pools of resources. Server virtualization is important for successful server consolidation projects that require you to maintain the isolation of separate systems.

Successful server virtualization can lead to the following benefits:

- Increasing the utilization of hardware
- Enabling greater flexibility in resource allocation
- Reducing data center power requirements
- Minimizing management costs
- Lowering the cost of ownership
- Providing administrative and resource boundaries between applications on a system

## Virtualization Technology Models

The virtualization models are described by means of the following competing characteristics:

- The amount of execution environment isolation
- The amount of resource flexibility

The more isolation that a model provides, the less resource flexibility it provides. The more resource flexibility that a model provides, the less isolation it provides. Because these characteristics compete, they *cannot* be maximized by a single model.

Oracle Solaris 11.1 can be used with any of the following virtualization technology models:

- *Operating system (OS) virtualization* provides one or more isolated execution environments in a single OS instance. Each environment contains what appears to be a private copy of the OS in a container. The OS virtualization model provides near-native performance and flexibility, and has a much smaller disk, RAM, and CPU footprint than either virtual machines or physical domains. However, the OS virtualization model provides the least amount of execution environment isolation.

Oracle Solaris 11.1 provides this virtualization model by means of the Oracle Solaris Zones product.

- *Virtual machines* can be used to run multiple OS instances with a single set of hardware resources. Each virtual machine that you create runs its own OS. You can run various operating systems in this way. A software or firmware hypervisor creates the illusion that each guest OS instance is running on its own separate system. Virtual machines provide less resource flexibility than a machine that uses OS virtualization, but virtual machines do provide more isolation.

Oracle Solaris 11.1 provides this virtualization model by means of Oracle VM Server for SPARC, Oracle VM Server for x86, and Oracle VM VirtualBox.

For information about using Oracle VM VirtualBox, see the [Oracle VM VirtualBox documentation](https://www.virtualbox.org/wiki/Documentation) (<https://www.virtualbox.org/wiki/Documentation>).

- *Hardware partitions*, also known as *physical domains*, provide physical separation between the running OS and its separate set of resources and power. Because this model does not use a hypervisor, it provides bare-metal performance. This virtualization model provides the most isolation, but it is much less flexible with resource configuration than either the virtual machines or OS virtualization model.

Oracle provides this type of virtualization on Oracle's Sun SPARC Enterprise M-Series servers. For more information, see the [Oracle SPARC M-Series Server documentation](http://www.oracle.com/technetwork/documentation/sparc-mseries-servers-252709.html) (<http://www.oracle.com/technetwork/documentation/sparc-mseries-servers-252709.html>).

## Choosing Your Virtualization Model

The following describes how you might use each Oracle Solaris 11.1 virtualization technology in your environment:

- Use Oracle Solaris Zones to maximize the efficiency and scalability of workloads, and to migrate Solaris 8, Solaris 9, Oracle Solaris 10, and Oracle Solaris 11 workloads to new hardware systems.
- Use Oracle VM Server for SPARC to deploy different Oracle Solaris 10 and Oracle Solaris 11 environments on SPARC chip multithreading (CMT) systems.
- Use Oracle VM Server for x86 to deploy a server with heterogeneous operating systems, including the Oracle Solaris 10 OS and the Oracle Solaris 11 OS as guests.
- Use Oracle VM VirtualBox to develop and test software in heterogeneous environments. Oracle VM VirtualBox enables you to run unmodified 32-bit and 64-bit operating systems as virtual machines on Intel and AMD processors directly on your existing OS.
- Use Oracle SPARC M-Series servers to deploy different Oracle Solaris 10 and Oracle Solaris 11 operating systems to isolated domains. Each domain provides separation and isolation from the other domains on the M-Series server at the socket level, or at the board level to provide electrical isolation. Each domain can run a different version of the Oracle Solaris 10 or Oracle Solaris 11 OS.

You can also mix virtualization technologies to maximize workload density. For example, you could configure multiple zones to run within an Oracle Solaris virtual machine or domain to leverage the strengths of the different virtualization technologies.

## Oracle Solaris Zones Overview

The Oracle Solaris Zones partitioning product virtualizes OS services and provides an isolated and secure environment for running applications. A *zone* is a virtualized OS environment that is created within a single instance of the Oracle Solaris OS.

When you create a zone, you produce an application execution environment in which processes are isolated from the rest of the system. This isolation prevents processes that are running in one zone from monitoring or affecting processes that are running in other zones. Even a process that runs with root credentials *cannot* view or affect activity in other zones. With Oracle Solaris Zones, you can maintain the one-application-per-server deployment model while simultaneously sharing hardware resources.

A zone also provides an abstract layer that separates applications from the physical attributes of the machine on which they are deployed. An example of an attribute is the physical device path.

Zones can be used on any machine that runs the Oracle Solaris 10 OS or the Oracle Solaris 11 OS. The upper limit for the number of zones on a system is 8192. The number of zones that can be effectively hosted on a single system is determined by the following:

- The size of the system
- The total resource requirements of the application software that runs in all of the zones

Oracle Solaris Zones and Oracle Solaris 10 Zones are complete runtime environments for applications. A zone provides a virtual mapping from the application to the platform resources. Zones permit application components to be isolated from one another even though the zones share a single instance of the Oracle Solaris OS. The Oracle Solaris resource management feature permits you to explicitly allocate the amount and type of resources that a workload receives.

A zone establishes boundaries for resource consumption, such as CPU usage. You can expand these boundaries to adapt to the changing processing requirements of the application that runs in the zone.

Because zones do not use a hypervisor, they can provide near-native performance. Having no hypervisor means that there is no layer of overhead required to pass virtual I/O requests to physical devices and no emulation of privileged instructions. Also, because there is only one kernel, only one copy of the kernel must be kept on disk and in RAM.

For additional isolation and security, you can configure *immutable zones*, which are zones that have a read-only root (/) file system. Immutable zones enable you to “lock down” zones, which means that system files cannot be modified, even by a privileged user in a zone.

Oracle Solaris 10 Zones use BrandZ technology to run Oracle Solaris 10 applications on the Oracle Solaris 11 OS. Applications run unmodified in the secure environment that is provided by the non-global zone. Using a `solaris10` branded non-global zone enables you to use an Oracle Solaris 10 system to develop, test, and deploy applications. Workloads that run within these branded zones can take advantage of the enhancements made to the kernel and use some of the innovative technologies available only in the Oracle Solaris 11 release.

For more information about using Oracle Solaris Zones, Oracle Solaris 10 Zones, and resource management, see *Oracle Solaris 11.1 Administration: Oracle Solaris Zones, Oracle Solaris 10 Zones, and Resource Management* and *Resource Management, Oracle Solaris Zones, and Oracle Solaris 10 Zones Developer's Guide*.

# Oracle VM Server for SPARC Overview

Oracle VM Server for SPARC (formerly Sun Logical Domains) is the SPARC hypervisor virtualization solution for simultaneously running multiple OS instances on a single SPARC T-Series server. Using the Oracle VM Server for SPARC software, you can create up to 128 virtual servers, called *logical domains*, on a single machine. This kind of configuration enables you to take advantage of the massive thread scale offered by SPARC T-Series servers and the Oracle Solaris OS. You can also use OS-level virtualization features, such as zones or resource management, with Oracle VM Server for SPARC.

Each logical domain has its own operating system and identity within a single machine, and is comprised of a discrete logical grouping of resources, such as:

- Kernel, patches, and tuning parameters
- User accounts and administrators
- Disks
- Network interfaces, MAC addresses, and IP addresses

You can create, destroy, reconfigure, stop, start, reboot, and live migrate each domain independently of one another without requiring a power cycle of the server.

You can run a variety of application software in different domains and keep them independent for performance and security purposes. Each domain is only permitted to monitor and interact with those server resources that are made available to it by the hypervisor. The Logical Domains Manager enables you to create virtual machines and assign hardware resources to them. The Logical Domains Manager runs in the *control domain*. The hypervisor partitions the server and provides subsets of server resources to each independent virtual machine. This partitioning and provisioning is the fundamental mechanism for creating logical domains.

The hypervisor software also provides logical domain channels (LDCs) that enable logical domains to communicate with each other. Oracle VM Server for SPARC uses LDCs to off-load I/O handling for guest virtual machines to Oracle Solaris *service domains* to provide virtual network and disk device services. These service domains leverage the Oracle Solaris features for performance and availability to provide virtual I/O, and make it possible to use a small, efficient hypervisor kernel compared to monolithic designs. You can configure more than one service domain to eliminate single points of failure and to provide high availability. For information about the domain roles, see “Roles for Domains” in *Oracle VM Server for SPARC 2.2 Administration Guide*.

The *service processor (SP)*, also known as the *system controller (SC)*, monitors and runs the physical machine, but it does not manage the logical domains. The Logical Domains Manager manages the logical domains.

For more information about Oracle VM Server for SPARC, see the [Oracle VM Server for SPARC documentation \(http://www.oracle.com/technetwork/documentation/vm-sparc-194287.html\)](http://www.oracle.com/technetwork/documentation/vm-sparc-194287.html).

## Oracle VM Server for x86 Overview

Oracle VM Server for x86 is the x86 virtualization solution for simultaneously running multiple OS instances on a single machine. Oracle VM Server for x86 is based on the open source Xen project. The Oracle VM Server for x86 software supports a privileged domain (`dom0`) to manage guest domains and unprivileged guest domains (also called `domUs`) to run workloads. As with the Oracle VM Server for SPARC control domain, the `dom0` domain permits the use of a small and efficient hypervisor and enhances availability. The Oracle VM Server for x86 software supports the running of the Oracle Solaris OS in guest domains. Oracle Solaris guest domains can use OS-level virtualization features, such as zones or resource management.

Oracle VM Server for x86 includes a browser-based administration tool called Oracle VM Manager. Use Oracle VM Manager to provision and manage virtual machines, physical server pools, and networks.

For more information about the Oracle VM Server for x86 product, see the [Oracle VM Server for x86 documentation \(http://www.oracle.com/technetwork/documentation/vm-096300.html\)](http://www.oracle.com/technetwork/documentation/vm-096300.html).