

Parallels® Virtuozzo Containers

White Paper

Advanced Virtualization and Workload Management on Itanium® 2-Based Servers

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Table of Contents

Executive Summary	3
The Power of Virtualization.....	3
OS Virtualization—Ideal for Many Deployments.....	4
Reccommended Usage Models	5
Parallels Virtuozzo Containers on Itanium-Based Servers.....	6
Conclusion	8

Abstract

Virtualization and workload management are essential technologies for maximizing scalability, availability and value on high-end computing systems, and Itanium® 2-based servers offer many options. One is Parallels Virtuozzo Containers, a proven, software-based virtualization solution for consolidating Linux and Windows applications. It provides granular control of workloads, along with exceptional performance and scalability—factors that make it ideal for many mission-critical environments.

Executive Summary

Server virtualization and workload management have become essential capabilities for optimizing utilization, availability and agility in business computing environments. Itanium® 2-based solutions support virtualization on all levels—in the processor, in individual vendor's system architectures and in software-based solutions. This enables IT organizations to choose the best virtualization strategy for their particular requirements, at lower cost and with greater flexibility than traditional RISC architectures.

This paper will discuss the virtualization options on Itanium-based servers, focusing primarily on Parallels Virtuozzo Containers, a software-based virtualization solution optimized for servers running Windows or Linux. By enabling multiple application stacks to be consolidated safely and securely on a single OS instance, Parallels provides a lean and efficient virtualization architecture that allows businesses to host large numbers of applications and heavy workloads on each physical server, and to achieve near-native response times. Workloads can be moved very quickly between virtual partitions, and server resources can be allocated with exceptional granularity and without interrupting production environments. With just a single OS image per server, the software environment is also consolidated, which further reduces complexity and simplifies management.

These advantages make Virtuozzo running on Itanium-based servers ideal for many mission-critical environments, either as the primary virtualization technology, or in addition to the hard and soft partitioning capabilities provided by many system vendors. The relatively low cost of Virtuozzo also complements the flexibility and affordability of Itanium-based servers. With the combined solution, IT organizations have important new options for supporting their most data-intensive and missioncritical applications on an affordable, industry-standard server architecture.

The Power of Virtualization

In just a few years, virtualization has evolved from a relatively obscure mainframe capability to a mainstream technology that is helping hundreds of thousands of companies improve business responsiveness and IT efficiency. By enabling multiple applications to be hosted safely and securely on a single server, virtualization increases server utilizations rates, often by a factor of ten or more. This not only reduces capital costs, but also cuts down on power, cooling and management expenditures, and helps to extend the life of existing data centers.

Just as importantly, virtualization cuts the link that binds a particular software stack to a particular hardware platform. With appropriate management tools, new applications can be deployed more quickly, workloads can be migrated without downtime between servers, and hardware resources (CPU, memory, I/O, etc.) can be adjusted as needed. These capabilities enable IT organizations to provide higher availability at lower cost, and to deliver consistent service levels despite unpredictable workloads.

MULTI-LEVEL SUPPORT ON ITANIUM-BASED SERVERS

Itanium-based servers support virtualization at multiple levels:

- **Today's Dual-Core Intel® Itanium® 2 processors** include Intel® Virtualization Technology, which provides silicon-level support for fundamental virtualization functions. This helps to reduce virtualization complexity, improve performance and increase compatibility across diverse operating systems.
- **Many Itanium-based server vendors** support virtualization at the system level— including both hard and soft partitioning capabilities—so IT organizations can consolidate and manage diverse operating systems and applications with considerable flexibility.
- **Software-based virtualization solutions** are also available, providing consistent, cross-vendor capabilities across all Itanium-based servers. IT organizations can deploy these solutions on top of virtualized hardware architectures, to extend builtin capabilities; or they can deploy them on any Itanium-based server as the primary foundation for virtualization and workload management. Two types of software-based virtualization solutions are particularly important: “hardware virtualization,” which enables multiple operating systems to be consolidated on each physical server; and “OS virtualization,” which enables multiple applications to be consolidated on a single OS instance per physical server.

OS Virtualization—Ideal for Many Deployments

The majority of today's most popular software-based virtualization solutions are examples of hardware virtualization. They allow IT organizations to run multiple operating systems and applications on a single physical server, by isolating each software stack in a virtual partition. Though the value of this approach has been well documented in many environments, users will typically see a performance overhead due to running many simultaneous OSs¹.

“OS virtualization” is an alternative approach that is embodied in Parallels Virtuozzo Containers[®]. Like other approaches, OS virtualization enables multiple applications to run safely and securely on the same physical server. However, with OS virtualization, only one OS instance is required per server to support any number of virtual partitions (Figure 1). This approach offers a number of benefits.

- **Better Performance and Scalability**—OS virtualization improves performance and scalability in two fundamental ways. First, the overhead of running multiple OSs per virtualized server is eliminated. Second, the virtualization software does not have to provide a complete, emulated hardware environment for each partition. Instead, it merely controls the allocation of resources through the single host OS and existing hardware drivers. This reduces the performance overhead and enables near-native performance for hosted applications (the performance overhead for Virtuozzo is typically between 1 and 3 percent).
- **Enhanced Platform Compatibility**—Since hardware virtualization software must emulate all of the hardware on the physical server, it may not be compatible with some hardware configurations. In contrast, OS virtualization software sits on top of a standard OS. As long as the OS is compatible with the underlying hardware, so is the virtualization software.

¹ In a mid-2006 survey of IT professionals, Forrester Research reports that 40 percent of respondents used hardware virtualization on database servers, but the authors believe that this percentage refers to “small and non-core databases, not core transaction databases that are sensitive to performance.” Source: Pragmatic Approaches To Server Virtualization, by Frank E. Gillett and Galen Schreck, Forrester Research, June 19, 2006. Available for purchase at: <http://www.forrester.com/Research/Document/Excerpt/0,7211,38751,00.html>

- **Faster Workload Transfers (and Failover)**—As with hardware virtualization, OS virtualization enables a partition to be cloned very easily and transferred over the network without application downtime. However, since there is already a running OS on the target server, less data has to be transferred, and there is no need to boot a new OS.
- **A Simpler Software Environment**—With a single OS per virtualized server, software maintenance requirements are reduced, often dramatically.

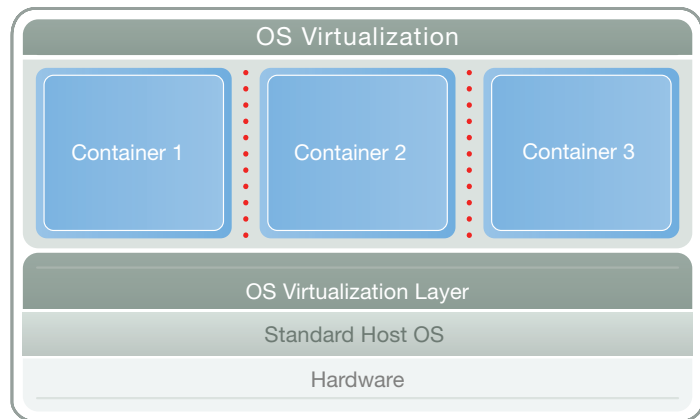


Figure 1. OS virtualization requires just one operating system per virtualized server. This enables near-native performance and scalability. It also reduces software maintenance requirements.

Recommended Usage Models

The following provides a more detailed look at a number of environments that are well-suited to OS virtualization, and can be supported with Parallels Virtuozzo Containers running on Itanium-based servers.

MISSION-CRITICAL APPLICATIONS

In most mission-critical environments, performance and scalability are primary considerations, so the leaner and more efficient architecture of OS virtualization is a fundamental advantage. OS virtualization also tends to place fewer restrictions on the amount of resources that can be devoted to each partition. For example, Virtuozzo supports full SMP capability up to 16 processors and 64GB per virtual partition. IT organizations can run more applications and heavier workloads per server and per partition, and will generally be able to realize better throughput and response times.

High availability is also essential in mission-critical environments. OS virtualization includes kernel protection, which makes it nearly impossible to crash the OS. It also enables faster failover, since the OS on the target system is already running, and better control over resource allocation, so unexpected workload peaks are less likely to overwhelm the server (a common cause of failure). Finally, OS virtualization simplifies the software environment by reducing the number and variety of OS versions, which helps to reduce the likelihood of human error.

CONSOLIDATION

As already discussed, OS virtualization provides exceptional performance and scalability, but requires that all applications run on a single OS. It therefore tends to be the best choice for consolidating homogeneous applications. (Note: Homogeneity is much less of a requirement when running Parallels Virtuozzo Containers for Linux, since any virtual environment can appear as any Linux distribution, as long as all distributions use the same Linux kernel version.²) It also tends to be the best choice for consolidating applications that are already running on the same OS or where migration to a common OS is a cost-effective alternative.

² Some kernel variation is allowed in some scenarios. Contact Parallels for more information.

HIGH PERFORMANCE COMPUTING (HPC)

HPC administrators tend to be strongly focused on getting the best possible performance and utilization from their systems. The one to three percent performance overhead of Virtuozzo may be acceptable in exchange for the flexibility of carving an HPC server into virtual partitions that can be accessed securely by multiple, simultaneous users. The large SMP and memory support per virtual partition, and the granular and dynamic allocation of server resources, can also be of considerable value in HPC environments. Administrators have the flexibility to tailor resources to any number of applications and workloads, yet they can still allocate the full capacity of the system to a single application whenever necessary.

Parallels Virtuozzo Containers on Itanium-based Servers

“...Parallels Virtuozzo Containers is an outstanding choice for companies with large infrastructures.”
—InfoWorld, 2007 Technology of the Year Awards³

According to InfoWorld, Virtuozzo 3.0 is “a well-designed and well-implemented OS-level virtualization solution at a surprisingly low cost.” Virtuozzo delivers all of the fundamental advantages of OS virtualization technology. It also offers a robust and proven set of management tools for controlling virtualized environments (see below).

Virtuozzo is optimized for Itanium-based servers running either Windows or Linux, and allows IT organizations to extend these operating systems into more demanding environments. They can take advantage of the high-end scalability and availability of Itanium-based servers, while driving utilization rates to mainframe levels. In combination with the hardware partitioning provided in many Itanium-based servers, Virtuozzo provides a high level of flexibility for partitioning and managing workloads. IT organizations can run a different OS or OS version in each hardware partition, and then deploy virtual partitions on each OS to optimize consolidation and control in each operating environment.

FLEXIBLE WORKLOAD MANAGEMENT

Parallels' management tools have been developed and refined over the past five years, and have been optimized to deliver value in very demanding and unpredictable computing environments. Full SMP support and live migration capabilities (zero downtime) are included. Additional tools are available that enable flexible management of both virtual and physical servers, both through a dedicated management console and through a secure, Web-based interface.

GUI-based controls provide easy to use options, and a sophisticated command-line interface enables a higher level of automation for large installations. IT organizations can provide end-users with controlled access to their virtual partitions, so individual business units can manage their server environment without risking other partitions on the same physical server. IT administrators will also find that Virtuozzo tools and interfaces make management across Windows and Linux servers very similar, so many processes can be consolidated.

Specific capabilities include:

- **Fast Provisioning**—An easy-to-use wizard enables quick provisioning of new virtual partitions. For example, a Windows virtual environment running on Intel Itanium architecture can be created in less than a minute. Customizable templates support even faster provisioning (a few clicks) and also allow a single instance of a software application to be leveraged across multiple virtual partitions. This can help IT organizations consolidate management processes and use server resources even more efficiently.

3 See the InfoWorld Web site. http://www.infoworld.com/slideshow/2007/01/29-2007_technology-3.html

- **Configuration and profile management**—Any number of virtual partitions on any number of physical servers can be monitored and managed from a single console. Administrators get a centralized view of server information and software versions across all systems, and can adjust profiles, including security settings, in real time. Adjustments can be made individually for each partition, or applied to groups of partitions. This capability replaces the traditional server management tracking tool—a spread-sheet—to provide centralized, real-time information and automated control.
- **Physical to Virtual Migration (VZP2V)**—Administrators can automatically monitor resource usage on the original server, analyze the results, and create a customizable virtual configuration. This simplifies migrations and reduces performance risk when moving applications from dedicated servers into virtual partitions.
- **Resource control and monitoring**—Administrators can monitor utilization in real time and dynamically adjust the allocation of CPU, memory, network, disk and I/O resources. They can also establish policies that trigger alerts and/or automatically adjust resources to help ensure required service levels.
- **Cloning, copying and migrating virtual partitions**—Virtual partitions can be cloned, copied and migrated without downtime across standard networks (Storage Area Networks are supported but not required). All active processes are preserved, and the change is transparent to end-users. This provides flexible support for both planned and unplanned downtime, and makes it easy to test patches and other software changes in an exact mirror of the production environment.
- **Online backup and restore**—Virtuozzo comes with a complete set of backup and restore tools with similar functionality to full backup software packages. Administrators have full control and can schedule automatic backups, single file restores and much more.

BETTER PERFORMANCE AND UTILIZATION IN THE DATA CENTER

These capabilities make it easy for administrators to manage resources and optimize performance and utilization across the data center. One common strategy for optimizing server utilization is to combine applications that have peak processing requirements at different times of the day (such as transactional applications that have peak workloads during the day and batch applications that are performed at night). Another strategy is to combine a number of smaller applications with one or more mission-critical applications. The non-critical applications help to keep server utilization high, while the mission-critical application(s) always have top priority to ensure appropriate service levels.

Many organizations also have a number of demanding business or technical applications that are used only occasionally. With Parallels Virtuozzo Containers on Itanium-based servers, these applications can be consolidated together on a single server. Since there is very little performance overhead for Virtuozzo, the full capacity of the system can be shared among multiple applications or it can be allocated to a single application, as needs dictate. As a result, organizations no longer need dedicated servers for their most demanding applications.

Whatever strategy is used, Virtuozzo running on Itanium-based servers can help IT organizations achieve many of the advantages of traditional mainframe systems—high utilization, flexible workload management and mission-critical availability. At the same time, it gives them the flexibility and TCO advantages that can only be realized when running applications on an affordable, industry-standard server architecture.

Conclusion

OS virtualization, as exemplified by Parallels Virtuozzo Containers running on Itanium-based servers, is well suited for consolidating mission-critical applications running in Windows or Linux operating environments. Since it enables multiple, isolated application stacks to run on a single OS instance, it reduces software complexity, delivers near-native performance and scalability, and supports fast response times for consolidated applications. It also provides very granular and dynamic allocation of server resources, along with rapid, live migration of applications between virtual partitions on the same or a different server.

In combination with the high-end scalability and availability of Itanium-based systems, these capabilities are well suited to hosting mission-critical applications in enterprise data centers. IT organizations can take advantage of mainframe-class virtualization capabilities on industry-standard servers running the world's most widely supported operating systems. As businesses grow their core applications to meet ever more demanding business needs, this flexibility will deliver increasing advantages.