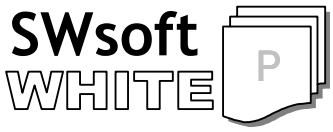
Virtuozzo

AN INTRODUCTION TO OS SERVER VIRTUALIZATION AND A NEW APPROACH TO SERVER CONSOLIDATION



www.virtuozzo.com

SWsoft

1. INTRODUCTION

Today's IT organizations are dealing with the consequences of exploding IT infrastructure growth and complexity. Multiple platforms, increasing numbers of dedicated servers, and sporadic and unpredictable application growth all contribute to lower server utilization rates and higher related infrastructure costs. With its growing complexity and volume, the cost of managing the infrastructure from simple patch management to skill sets requirements for IT administrators is increasing exponentially. In order to address these critical challenges, IT organizations have to find ways to accomplish the following:

- Increase the return from their infrastructure investment by better utilizing resources
- Provide higher levels of service to their end users
- Decrease complexity to improve manageability of their systems
- Increase flexibility and responsiveness

Virtuozzo empowers IT organizations to keep up with increasing demands on IT infrastructure and management. Virtuozzo was designed to enable IT organizations to maximize server resources through advanced virtualization technology, and manage the IT infrastructure easily with an advanced set of administration tools. Virtuozzo makes scalability and manageability a reality in distributed platforms computing, in many cases providing an immediate or very fast return on investment.

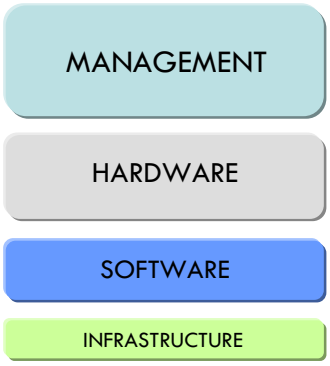
Virtuozzo creates multiple isolated Virtual Private Servers (VPSs) on a single physical server to share hardware, licenses and management effort with maximum possible efficiency. Each VPS performs and executes exactly like a stand-alone server. Virtuozzo virtualization is unique because it is the only virtualization technology designed and implemented primarily for use with production servers with live applications and data.

2. OVERVIEW

ENTERPRISE IT TODAY

During the last two decades, enterprises experienced explosive IT infrastructure growth, both in number of servers and complexity of configurations. The typical organization currently has to manage a complex heterogeneous environment consisting of 100s to 1000s of Windows, Linux, UNIX and other servers.

Historically, most enterprises have deployed a dedicated server for each application or department.



IT analysts attribute 10-12%† of the total cost of owning a server to the hardware. IT organizations often overlook the majority of costs-software and management.

The dedicated server model is extremely costly due to:

- **Infrastructure Cost** Housing, cooling, connecting and providing power to servers can be extremely expensive as servers grow to large numbers. Server electricity requirements alone can be a large cost component, 1000 servers in a data center are estimated at over $45,000 yearly*.
- **Hardware Cost** Every year servers increase in capacity and computing power. As servers become more powerful it becomes increasingly difficult to maximize utilization of these powerful resources. IT organizations and application owners have become accustomed to dedicating a server to each application to ensure complete control over the application. In almost every case, dedicating these powerful servers results in over provisioning from 50-500%.
- **Software Cost** A typical server requires licenses and support from the OS and application software vendors.
- **Management Cost** Management costs are by far the largest portion of server costs; analysts estimate management costs at 50-70% of the total cost of server ownership†. The IT staff has to upgrade, patch, back-up and fix hardware and software, provision new servers and applications, maintain user accounts and perform many other tasks. As the number of servers increase, IT departments find it challenging to meet the demands of the associated server management.

In addition to the aforementioned costs, IT organizations today face the following issues:

- **High Complexity** Most IT departments support numerous OSs. Windows is broadly deployed in 4 major releases and 4 different editions. Linux and UNIX servers are also

* Redefining Server Economics White Paper, RLX Technologies; May 2001; http://www.rlxtechnologies.com

† IDC The Evolution of the Virtual Environment April 2003

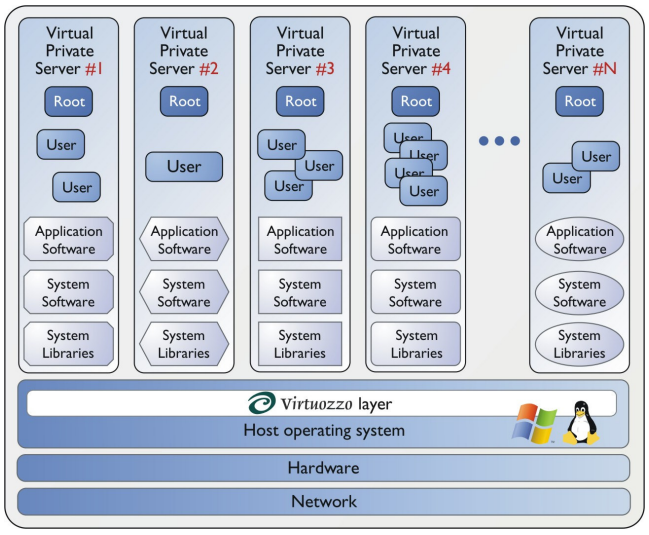
deployed in several types and versions from many different vendors. Adding applications into IT department support requirements and the complexity is overwhelming. Most IT departments cannot afford sophisticated IT infrastructure management software solutions; these complex solutions have long or no ROIs and still do not manage the broad range of IT challenges. Most IT departments see IT infrastructure management as a luxury, and consequently do nothing to maximize server ROI through management tools.

- **Low Service Levels** Many enterprises are requiring Service Level Agreements (SLAs) of its IT departments. Even with dedicated servers, it is difficult to dedicate, measure and report on guaranteed performance indicators.
- **Low Flexibility** Any change in the existing network can create a service breakdown or outage. Moving an application server to more powerful hardware as needs grow often involves significant planned downtime. Low flexibility is directly linked to high cost and high complexity. Rather than risk interruptions in service or frequent application migrations, servers are consistently heavily over-provisioned which greatly decreases the utilization of servers and increases associated costs as multiple servers continue to be deployed.

Various studies summarizing the issues reported by enterprise IT departments expose common problems such as:

- Increasing number of under-utilized dedicated servers (high cost)
- Majority of the servers are provisioned for worst-case workload scenarios (high cost)
- Incomplete information on hardware status and ownership (high complexity)
- Slow provisioning of new servers and services (high complexity, management costs)
- Slow response to change requests (low flexibility)
- Inability or difficulty of migrating servers (low flexibility)

Most enterprises continue to struggle with the high cost and complexity and low flexibility of IT infrastructure. Virtualization and automation software can help enterprises solve these critical problems.



1.1 VIRTUOZZO OVERVIEW

Virtuozzo is an established automation and virtualization product, which has been operating on production servers since 2001. The light overhead and efficient design of Virtuozzo makes it the best virtualization choice for production servers with live applications and data. Virtuozzo empowers IT organizations to keep up with increasing demands on IT infrastructure and management. Virtuozzo

creates multiple isolated Virtual Private Servers (VPSs) on a single physical server to share hardware, licenses and management effort with maximum possible efficiency. Each VPS performs and executes exactly like a stand-alone server. A VPS can be rebooted independently and has its own root access, users, files, processes, memory, IP addresses, applications, system libraries and configuration files.

The Virtuozzo low-overhead architecture maximizes server resources. VPSs reside on a common OS introducing only a small percentage of overhead and allowing up to 100s of VPSs to run on a physical server. The enhanced design of the virtualization technology enables any VPS on any network to be easily and transparently moved to another server with near-zero downtime, enabling IT departments to more fully utilize existing servers and minimize or eliminate planned downtime.

Commodity operating systems (COSs) do not meet the requirements of today's datacenters. Rather than develop a new OS to address these needs and increase an additional layer of complexity and potential instability, SWsoft created a portable layer to existing operating systems which adds a dynamic partition or Virtual Private Server (VPS). With the single thin Virtuozzo layer, the architecture allows a much more flexible, efficient and cost-effective solution for server management.

BUILDING THE COMPLETE SERVER VIRTUALIZATION SOLUTION

Virtuozzo was designed to enable IT organizations to maximize server resources through advanced virtualization technology and manage the IT infrastructure easily with an advanced set of administration tools. In order to meet the virtualization and automation requirements of today's IT departments, a virtualization solution must meet a series of requirements: isolation, flexibility and control of computer resources, abstraction from hardware and finally efficient, powerful management.

DYNAMIC ISOLATED PARTITIONS

The most basic component of a virtualization solution is partitioning. An application loaded in a VPS must be secure, isolated and unaffected from other VPSs on the same physical server. Virtuozzo has a patent-pending technology, Kernel Service Abstraction Layer (KSAL) that mediates activity to the kernel and prevents any single server from taking the entire server down. Virtuozzo also has a proprietary file system that makes the view appear like a regular server to the VPS user, but cannot be seen by any other VPS on the server.

Virtuozzo also has very powerful partition configuration capabilities. Partitions can be changed in real-time without affecting the VPS or its application.

FLEXIBILITY AND CONTROL OF COMPUTER RESOURCES

Virtuozzo includes sophisticated resource management for CPU, memory, network I/O, disk space and other system resources. Resources can be controlled with simple minimums (guarantees), maximums (limits), shares or more sophisticated allocations that allow for specified overages.

Virtuozzo assigns, monitors, accounts and controls resource levels in real-time and alerts administrators according to pre-defined criteria. Should adjustments in resources be required, simply change the resources in real-time without affecting VPS or application performance. A unique feature of Virtuozzo resource management is the ability to allow VPSs to use resources that are currently unused on the server, this allows the full processing power of the server.

HARDWARE ABSTRACTION

Virtuozzo virtualization provides separation of the VPSs from the physical server hardware; any VPS and application can reside on any x86 hardware. To migrate a VPS to another piece of hardware is simple as long as Virtuozzo is the underlying infrastructure. Virtuozzo moves the VPSs and any corresponding application(s) between any networked servers transparently with near-zero downtime. The abstraction from the hardware also makes the underlying hardware irrelevant, no application testing on different hardware is required.

As VPSs begin to multiply, this increases the dependence on a single point of failure- the underlying server. With Virtuozzo, the underlying OS is always running; therefore, VPSs are always accessible and recoverable through VPS owner self-management Virtuozzo Power Panel. While hardware accounts for only 10% of all downtime[*], this can be further minimized by justifying and purchasing a better quality of server with the higher utilization rate provided by Virtuozzo. Virtualization allows the migration of VPSs immediately upon threat of a hardware problem.

POWERFUL MANAGEMENT

Finally, Virtuozzo was designed to provide efficient management as VPSs are deployed. Virtuozzo comes complete with three options for the administrator management: command line, Virtuozzo Management Center (VZMC) and Virtuozzo Control Center (VZCC). The VZMC manages both Linux and Windows servers from a single GUI interface providing wizards and an intuitive interface for easy management and monitoring. The VZCC is a web-based interface for anywhere access without loading software. The command line interface is used heavily by large Virtuozzo shops to automate tasks. Using the interfaces, the server administrator can efficiently manage, script and monitor 100s of VPSs that appear as a collection of applications and processes on a single server.

VPS owners can use the browser-based Virtuozzo Power Panel (VZPP) to start/stop, backup/restore, repair and remotely reinstall the VPS without IT support. IT administrators at any skill level can provision multiple VPSs at once, move VPSs to other physical servers and start/stop and reboot as many VPSs as required. Even better, using the VZPP, VPS owners can perform these same functions without ever requesting the help of IT resources.

The VZMC helps administrators manage multiple servers efficiently. Applications can be deployed and updated on many servers simultaneously. OS updates and patches can also be managed centrally. The VZMC provides a centralized look at server information and software versions across

[*] Gartner October 2000

all server resources, facilitating versioning and patch management. Virtuozzo replaces the most popular server resource management tool- the spreadsheet. Virtuozzo has a well documented API and accessible to other infrastructure management tools, which see and manage Virtuozzo VPSs because VPSs operate as standalone servers.

VIRTUOZZO BENEFITS

- **High performance**- thin technology that adds no overhead
- **Expansive hardware and software support**- interacts with existing OS and hardware; fully supports native 32 bit and 64 bit systems, 16 CPUs SMP support and 64 GB RAM
- **High scalability and density**- Server utilization up to 80% instead of the typical 5-10%
- **Time savings**- Instant provisioning of new servers, applications and resources
- **Flexible migration**- Near-zero downtime migration to any networked Virtuozzo server
- **Small learning curve-** Uniform provisioning of services and resources, monitoring and management across multiple OS platforms
- **Increased IT responsiveness**- Change requests and provisioning completed in seconds
- **Robust resource management**- complete control over CPU, memory, disk and network I/O
- **Powerful management tools**- easilty manage large groups of servers and VPSs
- **Rapid ROI**- Drive lower hardware, software, and management cost to achieve a rapid ROI

VIRTUOZZO FACTS

Virtuozzo is a proven virtualization technology with a complete set of features and tools needed for daily administration.

	CUSTOMER FACTS
300,000+	Virtuozzo VPS used in production systems worldwide
500+	Customers worldwide
	CONFIGURATION/PERFORMANCE FACTS
Most flexible hardware support	Virtuozzo supports up to 64 GB RAM and 16 CPU with full SMP. The unique architecture enabled the quick adaptation to the 64 bit platform, and multi-core technology is also supported.
5000+	Number of VPSs with web servers supported on a single Intel x86
35 minutes	Total VPS migration time (based on 5Gb of user data)
3/0* seconds	Typical VPS downtime during migration from one hardware box to another (*zero downtime is a feature for the next Virtuozzo release)
1-3 seconds	Typical VPS start/stop time
15 minutes	VPS cloning time for a VPS with 5Gb of user data (database files)
1-3%	Overhead added by the Virtuozzo virtualization layer

3. OS VIRTUALIZATION

OS VIRTUALIZATION

The Virtuozzo OS virtualization implementation solves the challenge of deploying multiple production application and storage servers on a single physical server. Typically when applications are deployed, they are grouped on the same OS for ease of management and maintenance. OS virtualization is the perfect virtualization solution for production applications and servers, the common OS affords a much more efficient server resource design and smaller overhead. 100s of Virtuozzo VPSs run well on a single physical server..

The performance factors that make Virtuozzo OS virtualization technology ideal for production environments include:

- **System Calls** Virtuozzo has a common kernel, no additional systems calls are created between excess layers.
- **Filesystem** Common data is stored only once and is available to multiple environments, significantly improving the efficiency of both the disk space and system memory. The disk space for caching is also used efficiently, caching payload rather than duplicated data.
- **Filesystem Performance** Virtuozzo's filesystem and efficient system call design create very small CPU usage overhead.
- **Filesystem buffers/cache in memory** Virtuozzo places a single instance of data and cache across the server, maximizing memory efficiency.
- **Memory Management** Virtuozzo handles memory allocation requests dynamically. Virtuozzo environments can use a lot of memory during load peaks, and users will fully benefit from running Virtuozzo on high-end servers. Applications in Virtuozzo environments can show very high peak performance. Also, when environment resource demand grows gradually in time, Virtuozzo's dynamic resource management allows increasing the resource allocation with no downtime.

4. CONCLUSION

Virtualization and automation technology is a major advance in enterprise IT infrastructure management. By leveraging the capability of abstracting software and data from the hardware and

treating the hardware as a pool of resources, virtualization and automation technology decreases overall IT infrastructure costs, provides enterprise IT users with better levels of service, significantly increases IT flexibility, and dramatically lowers the complexity of IT infrastructure.

Virtuozzo is the only virtualization and automation solution that was developed specifically for virtualizing production servers. Virtuozzo allows enterprises to implement server consolidation, increase manageability and service levels, and dramatically lower total cost of ownership (TCO).