Parallels® Cloud Server

White Paper

Key Features and Benefits

Parallels®

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Introduction

Parallels Cloud Server 6 is the only virtualization solution available today that allows you to deploy both containers and hypervisors on the same physical server. This flexibility lets you take advantage of the scalability and streamlined operations of operating system virtualization (containers), while also making use of high-performance virtual machines (hypervisors) for isolated applications or simultaneous heterogeneous environments.

Parallels Cloud Server 6 comes with two virtualization options:

- **Parallels Containers for Linux**, which sets the hosting industry standard for profitable, secure, and flexible VPS and cloud server offerings. Uniquely suited to cloud server virtualization, it enables near-instant provisioning and on-the-fly modification of hosting and cloud server plans, while delivering up to three times better density and up to 350% better performance than leading hypervisors.
- **Parallels Hypervisor**, which gives you the flexibility to create virtual machines for customers who prefer to deploy and maintain a variety of operating systems simultaneously.

By combining both virtualization technologies in a single solution, Parallels Cloud Server 6 provides you with the freedom to choose the most efficient technology for each virtual server. In addition, Parallels Cloud Server 6 comes with Parallels Cloud Storage — a distributed, shared solution that decouples storage from computation, eliminating downtime due to hardware failures and significantly reducing operating costs.

Parallels Cloud Server 6 includes important new virtualization features that improve both the density and performance of containers and virtual machines (VMs). This document provides an overview of these features, together with the benefits they offer service providers.

Key Features

Some of the most important new features available in Parallels Cloud Server 6 include:

- Distributed cloud storage
- The ability to update the kernel without rebooting
- Storage of all of a container's data as a single image
- A more robust deduplication technique

DISTRIBUTED CLOUD STORAGE (CONTAINERS AND HYPERVISORS)

Parallels Cloud Storage, a key component of Parallels Cloud Server 6, decouples computation from storage, enabling containers and virtual machines to be instantly migrated to an operational physical server if the original physical server becomes unavailable. In the same way, if a hard drive in an operational server fails, Parallels Cloud Storage enables containers and virtual machines on that server to continue to operate using data replicated on other hard drives in the storage cluster thus eliminating downtime due to hardware failures and reducing server maintenance and support costs. In short, Parallels Cloud Storage provides SAN-like storage capabilities for hosting providers' data centers without the high price of SAN storage. Its storage can also be used for snapshots, backup images, large log and media files, and shared hosting scenarios.

REBOOTLESS KERNEL UPDATE (CONTAINERS AND HYPERVISORS)

Parallels Cloud Server 6 provides a rebootless kernel update capability that eliminates the inconvenience to customers that is normally part of a kernel update. With Parallels Cloud Server 6, all operational containers and virtual machines are very briefly suspended during kernel updates and then immediately resumed, rather than being shut down and restarted. In most cases, the suspension is so brief that the end user doesn't even notice it. In addition, the applications inside containers and virtual machines maintain their states, and network connections are not dropped. This approach virtually eliminates any service outage or negative impact on end users.

The rebootless feature is a result of two key improvements: the ability to load a new kernel without reinitializing the hardware, and the preservation of containers' and virtual machines' memory data during kernel load operations. Figure 1 shows the comparison between server (SRV) downtimes with and without rebootless kernel update (RKU), for both containers and virtual machines — a downtime of less than 40 seconds with RKU, vs. over 100 seconds when the server has to be rebooted.

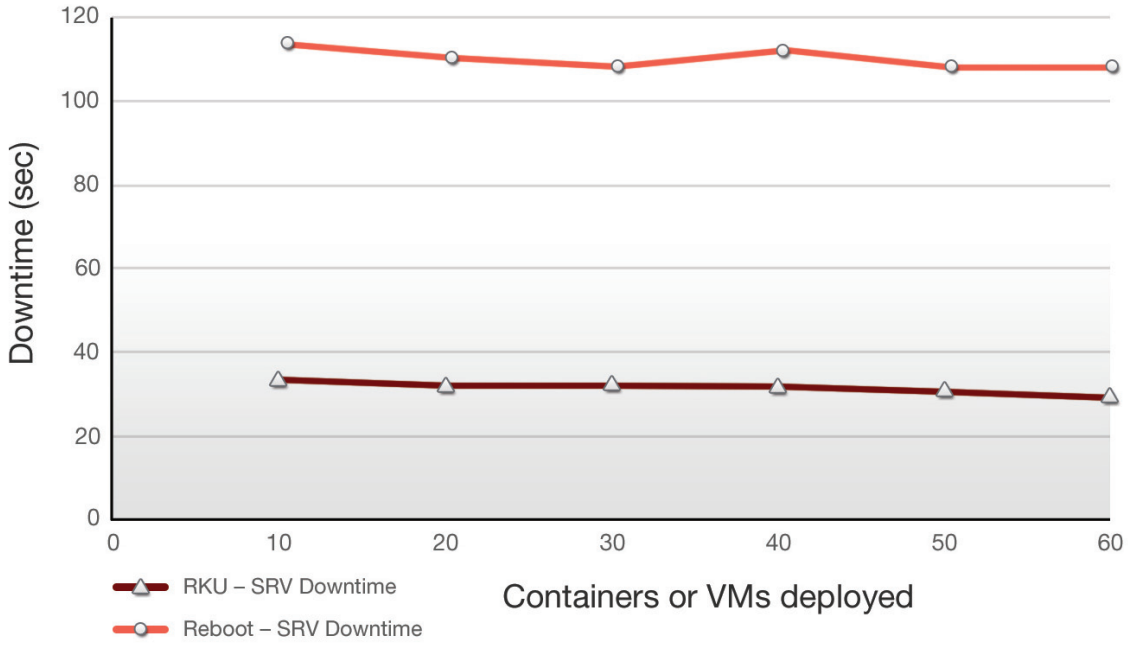

Figure 1. Comparison of server downtimes with rebootless vs. normal kernel updates for both containers and virtual machines.

Figure 2 makes the same comparison just for containers. As the figure shows, regardless of the number of containers deployed, downtime with RKU remains constant at about 50 seconds. In contrast, when rebooting is required, downtime increases as containers are added, reaching over 600 seconds with deployment of 60 containers.

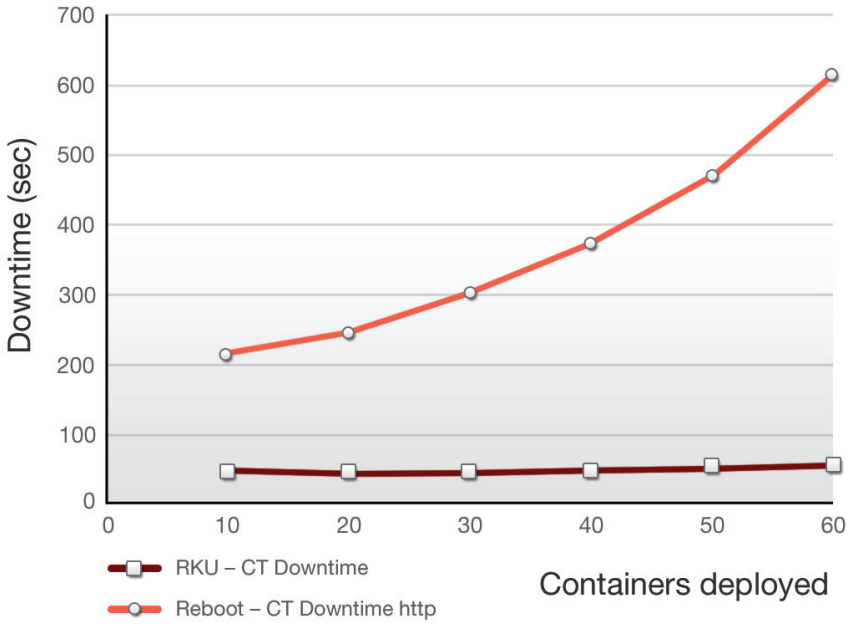

Figure 2. Comparison of server downtimes with rebootless vs. normal kernel updates when only containers are deployed.

Figure 3 makes the same comparison just for virtual machines. Again, regardless of the number of virtual machines deployed, downtime with RKU remains constant at about 50 seconds. In contrast, when rebooting is required, downtime increases as virtual machines are added, reaching over 400 seconds when 30 virtual machines are deployed.

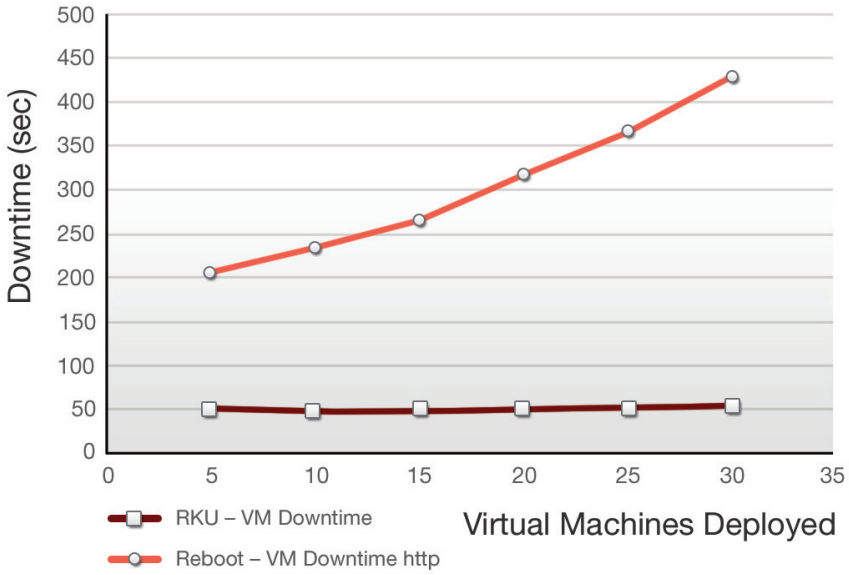

Figure 3. Comparison of server downtimes with rebootless vs. normal kernel updates when only virtual machines are deployed.

NEW FORMAT: CONTAINER-IN-A-FILE (CONTAINERS)

Parallels Cloud Server features a new format that stores all of a container's data in a single image; the image has its own private file system journal. This format is implemented through a new storage technique called ploop (Parallels loopback device). By giving each container its own private file system journal, ploop eliminates the conflicts that can occur when multiple container operations request file journal access at the same time. This results in faster migration and backup, as well as enhanced performance. Other benefits gained from storing all of a container's data in a single image include:

- The ability to take consistent snapshots of the container file system, which you can use for incremental backups or provide to end users for test purposes.
- The ability to make backups on top of snapshots using conventional cp or tar, rather than requiring special backup tools like Acronis True Image.
- A significant reduction in the time required to back up and migrate containers, since sequential reading of a single image is an order of magnitude faster than reading multiple separate small files on rotational drives.

With ploop each container stores its files in its own private disk location. In order to prevent this from causing excessive IO operations and memory usage by similar containers, Parallels Cloud Server also provides a deduplication mechanism described in the next section.

MEMORY AND IOPS DEDUPLICATION (CONTAINERS)

Previous releases of Parallels Cloud Server implemented deduplication of container data via the VZFS file system, which centralized storage of template data on each hardware node and linked the container's shared files to it. When containers modified files, a procedure called Copy-On-Write gave them their own private copy of the template files.

Parallels Cloud Server 6 has a more robust approach. It collects file-usage statistics to determine which files are most frequently accessed by containers, and puts commonly used files in cache. That way, if a container needs to access a commonly used file, it can go straight to the cache instead of the disk — an approach that improves performance by reducing the number of I/O operations. For even better performance, the cache can be placed on a solid-state drive (SSD).

The benefits of this approach to deduplication are multiple. The approach is:

- **Reliable and robust**, since it removes the need to download old templates (which may no longer be available) in order to restore older versions of containers.
- **Configurable**, with the ability to apply parameters to specify factors such as cache size, directories to be used for caching, and expiration times for cached files.
- **Always up to date**, because a daemon that tracks file access ensures that the cache always has the most frequently accessed data.
- **Easy to keep at top performance**, because it comes with a configuration tool that lets you modify various options to enhance performance.

SUMMARY OF ADDITIONAL FEATURES

Table 1 lists additional features in Parallels Cloud Server 6 that improve server performance and usability.

Table 1: **Additional Features and Benefits of Parallels Cloud Server 6**

Feature	CT*	VM	Description	Benefit
Can update with Yellowdog Updater, Modified (YUM)	✓	✓	The vzup2date utility has been replaced with the standard YUM utility.	Greatly simplifies system updates; lets you fine-tune templates before installing; allows centralized server upgrades using existing YUM infrastructure.
Provides access to CTs via console	✓		Native Linux console lets you log into running CTs and view startup and shutdown process status.	Makes it easier to investigate complex maintenance issues.
Lets you use pre-installed templates	✓		You can create CTs with preinstalled OS and application templates.	Significantly decreases CT creation time.
Increases VM limits		✓	You can create VMs with up to 32 CPU cores, 128 GB of RAM, and 5 TB of virtual disk space.	Allows you to have larger VMs.
Supports Open vSwitch	✓	✓	Lets you use multi-layer software network switches that function as virtual switches.	Provides CTs and VMs with network connectivity.
Supports CPU identification masks		✓	Controls the CPU features available to VMs.	Enables live migration between servers with different CPU feature sets.
Provides a unified command-line interface (CLI)	✓	✓	Lets you create, start, stop, destroy, or change the configuration of CTs and VMs using a single CLI utility.	Simplifies maintenance and configuration.
Lets you set IOPS limits	✓	✓	Lets you limit the I/O activity of a CT or VM by specifying maximum number of IOPS.	Prevents performance degradation in situations where high disk I/O activities in one CT or VM could slow the performance of other CTs or VMs.
Provides sample files for VM configuration		✓	Lets you quickly and easily change a VM's configuration by applying a new configuration sample file — no need to manually change settings.	Simplifies maintenance and configuration.
Supports encrypted passwords)	✓		Enables end users to use encrypted passwords during CT or VM provisioning	Improves security.
Lets you resize Linux VM disks with Linux Volume Manager (LVM) inside		✓	Enables you to resize LVM volumes using the prl_disk_tool command from PCS hostnode.	Can manage LVMs without detailed knowledge — plus it handles LVM and standard partitions inside guest the same way.

Table 1: **Additional Features and Benefits of Parallels Cloud Server 6**

Feature	CT*	VM	Description	Benefit
Provides performance analysis tools to measure I/O bottlenecks	✓	✓	Provides tools to determine if applications are CPU-, memory-, or IO-intensive: extended vzstat for CTs; pstat for VMs; and vziotop, a new CT utility that determines which applications create bottlenecks and affect the performance of other CTs.	Lets you fine-tune CT and VM configurations based on the applications the customer is using.
Lets you specify JavaScript Object Notation (JSON) output for prlctl	✓	✓	Lets you change the output format of prlctl on the fly between plain text and JSON, so you can exchange data with JSON-compatible applications.	Simplifies development for those who develop applications (e.g., monitoring systems) around prlctl by making data exchange easier in situations where JSON is already in use for other tasks.
Lets you configure priorities for Out-of-Memory (OOM) situations	✓		Lets node administrator or CT owner define which processes should be killed last if CT exceeds its memory limit, and how much memory a process can use without being killed. Processes can be defined by command name, parent command name, or task UID. Node administrator can set default OOM group priorities for CTs on the node; CT owner can override the defaults for that particular CT.	Helps to ensure that mission-critical services are not affected by issues caused by less-important applications running inside the same CT.

*CT = container.

Conclusion

Parallels Cloud Server 6 is the ideal solution for service providers because of its unprecedented virtualization flexibility. Its two virtualization options — Parallels Containers for Linux and Parallels Hypervisor — not only enable servers running containers and hypervisors to coexist on the same physical server, but also allow data to be migrated between them. As a result, service providers can take advantage of the scalability and stream-lined operations available through containers, while also providing hypervisors for customers who want to deploy and maintain multiple operating systems simultaneously.

Parallels Cloud Server 6 also comes with Parallels Cloud Storage, a distributed solution that decouples storage from computation, eliminating downtime due to hardware failures and significantly reducing operating costs. Other new capabilities, including rebootless kernel updates, single-image data storage, and memory and IOPS deduplication, further improve performance and enhance the quality of service you can deliver to your customers.

For more information on Parallels Cloud Server 6, please see
www.parallels.com/products/pcs

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