



# Parallels Server Bare Metal 5.0

User's Guide

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# CHAPTER 1

## Introduction

Parallels Server Bare Metal 5.0 is a virtualization solution that allows you to run multiple virtual machines and Containers on a single physical server.

This chapter provides general information about Parallels Server Bare Metal and this guide. You will learn

- [goals and target audience of the guide](#) (p. 9)
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- [documentation conventions used in the guide](#) (p. 10)
- [resources to consult to get more information on Parallels Server Bare Metal](#) (p. 11)
- [way to submit feedback to the Parallels documentation team](#) (p. 12)

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## About This Guide

The *Parallels Server Bare Metal 5.0 User's Guide* provides comprehensive information on Parallels Server Bare Metal 5.0, high-end virtualization software for bare metal servers. The guide covers the necessary theoretical concepts as well as practical aspects of working with Parallels Server Bare Metal.

**Note:** The guide does not explain how to install and configure your Parallels Server Bare Metal 5.0 system. For detailed information on these operations, see the *Parallels Server Bare Metal 5.0 Installation Guide*.

The primary audience for this guide is administrators responsible for managing systems that run Parallels Server Bare Metal 5.0. The guide assumes that you have a working knowledge of Linux operating systems (command line, system administration, and so on).

## Organization of This Guide

This guide is organized in the following way:

**Chapter 1, Introduction** (p. 9), gives an overview of the Parallels Server Bare Metal product and this guide.

**Chapter 2, Learning Parallels Server Bare Metal 5.0 Basics** (p. 13), explains the general principles of Parallels Server Bare Metal operation.

**Chapter 3, Managing Virtual Machines and Containers** (p. 25), covers those operations that you can perform on a virtual machine and Container: creating and deleting virtual machines and Containers, starting and stopping them, backing up and restoring, etc. You will also learn how to perform different kinds of migration: migrate virtual machines and Containers between Parallels servers, migrate a physical server to a virtual machine and Container, and migrate a Container to a virtual machine.

**Chapter 4, Managing Resources** (p. 87), focuses on configuring and monitoring the resource control parameters for virtual machines and Containers. These parameters comprise disk quotas, network accounting and shaping, CPU and system resources.

**Chapter 5, Managing Services and Processes** (p. 123), familiarizes you with the operations you can perform on processes and services in Parallels Server Bare Metal.

**Chapter 6, Managing Parallels Server Bare Metal Network** (p. 131), familiarizes you with the Parallels Server Bare Metal network structure and explains how to manage networks in Parallels Server Bare Metal systems.

**Chapter 7, Managing Licenses** (p. 156), provides detailed information on managing licenses in Parallels Server Bare Metal.

**Chapter 8, Keeping Your System Up To Date** (p. 163), informs you of the ways to keep all the software components of a Parallels server up to date.

**Chapter 9, Advanced Tasks** (p. 173), enumerates those tasks that are intended for advanced system administrators who would like to obtain deeper knowledge about Parallels Server Bare Metal capabilities.

**Chapter 10, Troubleshooting** (p. 198), suggests ways to resolve common inconveniences should they occur during your work with Parallels Server Bare Metal.

## Documentation Conventions

Before you start using this guide, it is important to understand the documentation conventions used in it.

The table below presents the existing formatting conventions.

Formatting convention	Type of Information	Example
<b>Special Bold</b>	Items you must select, such as menu options, command buttons, or items in a list.	Go to the <b>Resources</b> tab.

	Titles of chapters, sections, and subsections.	Read the <b>Basic Administration</b> chapter.
<i>Italics</i>	Used to emphasize the importance of a point, to introduce a term or to designate a command-line placeholder, which is to be replaced with a real name or value.	These are the so-called <i>EZ templates</i> . To destroy a Container, type <code>vzctl destroy <i>ctid</i></code> .
Monospace	The names of commands, files, and directories.	Use <code>vzctl start</code> to start a Container.
Preformatted	On-screen computer output in your command-line sessions; source code in XML, C++, or other programming languages.	<code>Saved parameters for Container 101</code>
Monospace Bold	What you type, as contrasted with on-screen computer output.	<code># rpm -V virtuozzo-release</code>
Key+Key	Key combinations for which the user must press and hold down one key and then press another.	Ctrl+P, Alt+F4

Besides the formatting conventions, you should also know about the document organization convention applied to Parallels documents: chapters in all guides are divided into sections, which, in their turn, are subdivided into subsections. For example, **About This Guide** is a section, and **Documentation Conventions** is a subsection.

## Getting Help

In addition to this guide, there are a number of other resources available for Parallels Server Bare Metal which can help you use the product more effectively. These resources include:

### Manuals:

- *Parallels Server Bare Metal 5.0 Installation Guide*. This guide provides detailed information on installing Parallels Server Bare Metal on your server, including the pre-requisites and the stages you shall pass.
- *Getting Started With Parallels Server Bare Metal 5.0*. This guide provides basic information on how to install Parallels Server Bare Metal on your server, create new Containers and virtual machines, and perform main operations on them. As distinct from the *Parallels Server Bare Metal 5.0 Installation Guide*, it does not contain detailed description of all the operations needed to install and set Parallels Server Bare Metal to work (e.g. installing Parallels Server Bare Metal in text mode).
- *Parallels Server Bare Metal 5.0 Templates Management Guide*. This guide is meant to provide complete information on Parallels templates - an exclusive Parallels technology allowing you to efficiently deploy standard Linux applications inside your Containers and to greatly save the physical server resources (physical memory, disk space, etc.).
- *Parallels Command Line Reference Guide*. This guide is a complete reference on all Parallels Server Bare Metal configuration files and command line utilities.

- *Deploying Clusters in Parallels-Based Systems*. This guide describes the process of creating Parallels failover and GFS clusters using the Red Hat Cluster Suite (RHCS) software.

### **Help systems:**

- *Getting Started with Parallels Management Console*. This help system provides information on how to start working in Parallels Management Console. You will learn how to install this application on your computer, connect to a server running Parallels Server Bare Metal, and perform the basic operations on your virtual machines.
- *Parallels Management Console User's Guide*. This help system provides detailed information on Parallels Management Console - a graphical user interface tool for managing physical servers and their virtual machines.

## Feedback

If you spot a typo in this guide, or if you have an opinion about how to make this guide more helpful, you can share your comments and suggestions with us by completing the Documentation Feedback form on our [website](http://www.parallels.com/en/support/usersdoc/) (<http://www.parallels.com/en/support/usersdoc/>).

## CHAPTER 2

# Learning Parallels Server Bare Metal 5.0 Basics

This chapter provides a brief description of Parallels Server Bare Metal 5.0, Parallels virtual machines and Containers, their specifications and underlying technologies.

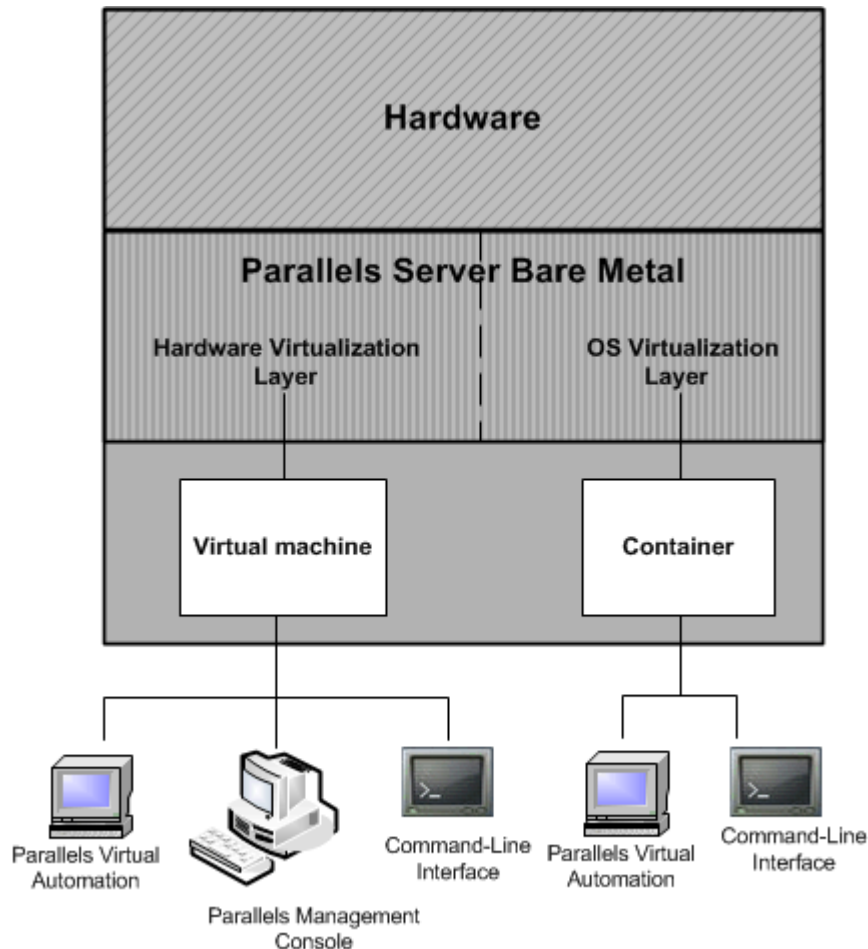
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## Parallels Server Bare Metal 5.0 Overview

Parallels Server Bare Metal 5.0 allows you to simultaneously run multiple Parallels virtual machines and Containers on a single physical server. Using this software, you can efficiently use your server's hardware resources by sharing them among virtual machines and Containers.

Graphically, a server with the Parallels Server Bare Metal software installed can be represented as follows:



At the base resides server hardware. Next is the Parallels Server Bare Metal software which is installed directly on the server hardware and does not need any operating system for its functioning. Parallels Server Bare Metal includes two virtualization layers:

- **Hardware virtualization layer.** This layer provides the necessary environment for creating and managing Parallels virtual machines.
- **OS virtualization layer.** This layer provides the necessary environment for creating and managing Parallels Containers.

For more information on both layers, see **OS Virtualization Layer** (p. 15) and **Hardware Virtualization Layer** (p. 18).

Effectively uniting both virtualization technologies, Parallels Server Bare Metal provides the best value for cost conscious organizations enabling them to:

- standardize server hardware platforms
- effectively consolidate server resources
- consolidate and support legacy OSs and applications

- streamline server and application deployment, maintenance, and management
- simplify software testing and development
- optimize server and application availability

Parallels Server Bare Metal allows you to create virtual machines and Containers and Containers and manage them using the same tools you would use on systems running Parallels Server 3.0 and Parallels Virtuozzo Containers 4.0. These tools include:

- **Command line interface (CLI).** This tool comprises a set of Parallels command line utilities and can be used to manage virtual machines and Containers both locally and remotely.
- **Parallels Management Console.** Parallels Management Console is a remote management tool for Parallels Server Bare Metal with a graphical user interface. This tool can be used to manage physical servers and Parallels virtual machines residing on them.

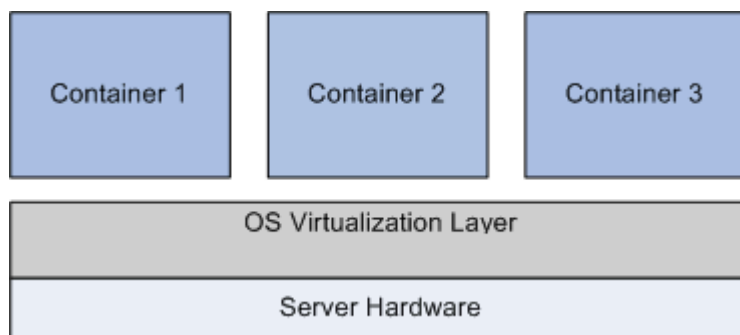
**Note:** In this version of Parallels Server Bare Metal, you cannot use Parallels Management Console to create and manage Parallels Containers.

## OS Virtualization Layer

This section provides detailed information on the OS virtualization layer, one of the two components of Parallels Server Bare Metal, responsible for providing support for Parallels Containers.

### Basics of OS Virtualization

The OS virtualization allows you to virtualize physical servers on the operating system (kernel) layer. The diagram below shows the basic architecture of OS virtualization.



The OS virtualization layer ensures isolation and security of resources between different Containers. The virtualization layer makes each Container appear as a standalone server. Finally, the Container itself houses its own applications and workload. OS virtualization is streamlined for the best performance, management, and efficiency. Its main advantages are the following:

- Containers perform at levels consistent with native servers. Containers have no virtualized hardware and use native hardware and software drivers making its performance unbeatable.

- Each Container can seamlessly scale up to the resources of an entire physical server.
- OS virtualization technology provides the highest density available from a virtualization solution. You can create and run up to 100s of Containers on a standard production physical server.
- Containers use a single OS, making it extremely simple to maintain and update across Containers. Applications may also be deployed as a single instance.

## Parallels Containers

From the point of view of applications and Container users, each Container is an independent system. This independence is provided by the Parallels Server Bare Metal OS virtualization layer. Note that only a negligible part of the CPU resources is spent on virtualization (around 1-2%). The main features of the virtualization layer implemented in Parallels Server Bare Metal are the following:

- A Container looks like a normal Linux system. It has standard startup scripts; software from vendors can run inside Containers without any modifications or adjustment.
- A user can change any configuration file and install additional software inside Containers.
- Containers are fully isolated from each other (file system, processes, `sysctl` variables) and Parallels virtual machines.
- Containers share dynamic libraries, which greatly saves memory.
- Processes belonging to a Container are scheduled for execution on all available CPUs. Consequently, Containers are not bound to only one CPU and can use all available CPU power.

## Virtuozzo File System

Virtuozzo File System (VZFS) is a file system that allows sharing common files among multiple Containers without sacrificing flexibility. It is possible for Container users to modify, update, replace, and delete shared files. When a user modifies a shared file, VZFS creates a private copy of the file transparently for the user. Thus, the modifications do not affect the other users of the file. Main benefits of VZFS are the following:

- VZFS saves memory required for executables and libraries. A typical Container running a simple web site might consume around 20–30 MB of RAM just for executable images. Sharing this memory improves scalability and total system performance.
- VZFS saves disk space. A typical Linux OS installation occupies several hundred megabytes of disk space. Sharing the files allows you to save up to 90% of disk space.
- VZFS does not require having different physical partitions for different Containers or creating a special “file system in a file” setup for a Container. This significantly simplifies disk administration.
- Disk quota enables the administrator to limit disk resources available to a Container on the fly. Disk quota for users and groups inside Containers is also supported.



## Templates

A template (or a package set) in Parallels Server Bare Metal is a set of original application files repackaged for mounting over Virtuozzo File System. Usually it is just a set of RPM packages for Red Hat like systems. Parallels Server Bare Metal provides tools for creating templates, installing, upgrading, adding them to and removing them from a Container. Using templates lets you:

- share the RAM among similar applications running in different Containers to save hundreds of megabytes of memory
- share the files comprising a template among different Containers to save gigabytes of disk space
- deploy applications simultaneously in many Containers
- use different versions of an application on different Containers (for example, perform an upgrade only in certain Containers)

There are two types of templates: OS templates and application templates. An OS template is an operating system and the standard set of applications to be found right after the installation. Parallels Server Bare Metal uses OS templates to create new Containers with a preinstalled operating system. An application template is a set of repackaged software packages optionally accompanied with configuration scripts. Application templates are used to add extra software to existing Containers. For example, you can create a Container on the basis of the `redhat` OS template and add the MySQL application to it with the help of the `mysql` template.

For detailed information on Parallels templates, see the *Parallels Server Bare Metal Templates Management Guide*.

## Parallels Server Bare Metal Configuration

Parallels Server Bare Metal allows you to flexibly configure various settings for the physical server in general as well as for each and every Container. Among these settings are disk and user quota, network parameters, default file locations and configuration sample files, and others.

Parallels Server Bare Metal stores all OS virtualization-related configuration information in two types of files: the global configuration file `/etc/vz/vz.conf` and Container configuration files `/etc/vz/conf/<CT_ID>.conf`. The global configuration file defines global and default parameters for Container operation, for example, logging settings, enabling and disabling disk quota for Containers, the default configuration file and OS template on the basis of which a new Container is created, and so on. On the other hand, a Container configuration file defines the parameters for a given particular Container, such as disk quota and allocated resources limits, IP address and hostname, and so on. If a parameter is configured both in the global configuration file and in the Container configuration file, the Container configuration file takes precedence. For a list of parameters constituting the global configuration file and the Container configuration files, refer the *Parallels Server Bare Metal 5.0 Command Line Reference Guide*.

The configuration files are read when the Parallels Server Bare Metal software and/or Containers are started. However, Parallels Server Bare Metal standard utilities (for example, `pct1`) allow you to change many configuration settings on the fly, either without modifying the corresponding configuration files or with their modification (if you want the changes to apply the next time the Parallels Server Bare Metal software and/or Containers are started).

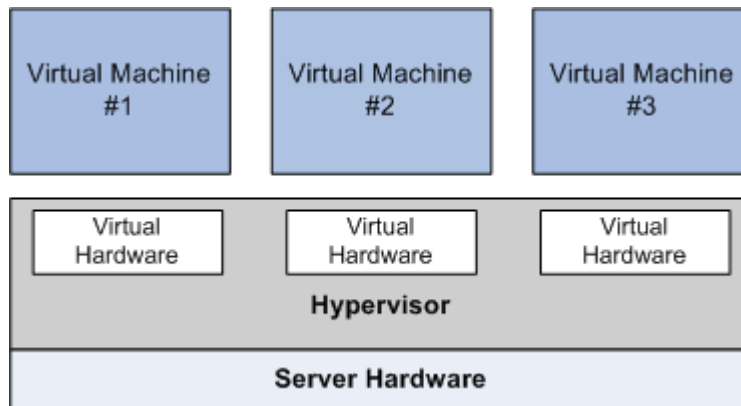
## Hardware Virtualization Layer

This section familiarizes you with the second component of Parallels Server Bare Metal - the hardware virtualization layer. This layer provides the necessary environment for creating and managing Parallels virtual machines.

### Basics of Hardware Virtualization

Parallels Server Bare Metal is based on the concept of *hardware virtualization*. Hardware virtualization has a base layer—a hypervisor. This layer is loaded directly on the bare server and acts as an intermediary between the server hardware and virtual machines. To allocate hardware and resources to virtual machines, Parallels Server Bare Metal virtualizes all hardware on the server. Once virtualized, hardware and resources can be easily assigned to virtual machines. Based on the virtual hardware, a virtual machine runs its own complete copies of an operating system and applications.

The following diagram shows the basic architecture of hardware virtualization.



Like OS virtualization, hardware virtualization also provides many benefits the main of which are listed below:

- Create multiple virtual machines with different operating systems on a single physical computer.
- Manage several physical servers at a time using Parallels Management Console, an integrated GUI-based multi-server and cross-platform management tool.
- Run several guest operating systems and their applications simultaneously on a single physical computer without rebooting.

- Consolidate and virtualize the computing environment, reduce hardware costs, lower operating expenses, and increase productivity.
- Use open APIs and SDK to extend management integration with in-house and third-party applications.

## Parallels Virtual Machines

From the point of view of applications and virtual machine users, each virtual machine is an independent system with an independent set of virtual hardware. This independence is provided by the Parallels Server Bare Metal hardware virtualization layer. The main features of the virtualization layer are the following:

- A virtual machine looks like a normal computer. It has its own virtual hardware, and software applications can run in virtual machines without any modifications or adjustment.
- A user can easily change the virtual machine configuration (e.g. add a new virtual disk or increase memory).
- Virtual machines are fully isolated from each other (file system, processes, `sysctl` variables) and Parallels Server Bare Metal.
- Install any of the supported operating systems in the virtual machine. The guest operating system and its applications are isolated inside a virtual machine and share physical hardware resources with other virtual machines.

### Intel and AMD Virtualization Technology Support

Parallels Server Bare Metal provides support for Intel and AMD virtualization technologies comprising a set of processor enhancements and improving the work of virtualization solutions. Utilizing these technologies, Parallels Server Bare Metal can offload some workload to the system hardware, which results in the "near native" performance of guest operating systems.

## Virtual Machine Hardware

A Parallels virtual machine works like a stand-alone computer with the following hardware:

<b>CPU</b>	Up to 24-core Intel/AMD CPU
<b>Motherboard</b>	Intel i965 chipset-based motherboard
<b>RAM</b>	Up to 96 GB of main memory
<b>Video Adapter</b>	VGA and SVGA with VESA 3.0 compatible video adapter
<b>Video RAM</b>	Up to 256 MB of video memory
<b>Floppy Disk Drive</b>	1.44 MB floppy disk drive mapped to an image file or to a physical floppy drive
<b>IDE Devices</b>	Up to 4 IDE devices
<ul style="list-style-type: none"> <li>• <b>Hard Disk</b></li> <li>• <b>CD/DVD-ROM Drive</b></li> </ul>	<p>Hard disk drive mapped to an image file (up to 5 TB each)</p> <p>CD/DVD-ROM drive mapped to a physical drive or to an image file</p>

<b>SCSI Devices</b> <ul style="list-style-type: none"> <li>• <b>Hard Disk</b></li> <li>• <b>Generic SCSI Device</b></li> </ul>	Up to 15 SCSI devices Hard disk drive mapped to an image file (up to 5 TB each) Generic SCSI device
<b>Network Interfaces</b>	Up to 16 network interfaces, including Ethernet virtual network cards compatible with RTL8029
<b>Serial (COM) Ports</b>	Up to 4 serial (COM) ports mapped to a socket or to an output file
<b>Parallel (LPT) Ports</b>	Up to 3 parallel (LPT) ports mapped to an output file, to a real port, or to a printer
<b>Sound Card</b>	AC'97-compatible sound card, sound recording support
<b>Keyboard</b>	Generic PC keyboard
<b>Mouse</b>	PS/2 wheel mouse

## Virtual Machine Files

A virtual machine has at least two files: a configuration file (PVS file) and a hard disk image file (HDD file). It can also have additional files: a file for each additional virtual hard disk and output files for virtual ports. By default, the virtual machines files are stored in the `/var/parallels` directory on the Parallels server.

The list of files related to a virtual machine is given in the table below:

File Name	Description
<code>.pvm</code>	A bundle that contains the virtual machine files.
<code>.pvs</code>	A virtual machine configuration file. It defines the hardware and resources configuration of the virtual machine. The configuration file is automatically generated during the virtual machine creation.
<code>.sav</code>	A dump file created when you suspend the virtual machine. This file contains the state of the virtual machine and its applications at the moment the suspend was invoked.
<code>.mem</code>	A file containing the memory dump for the suspended virtual machine. For a running virtual machine, it is a temporary virtual memory file.
<code>.hdd</code>	A file representing a virtual hard disk. When you create a virtual machine, you can create it with a new virtual hard disk or use an existing one. A virtual machine can have several hard disks.
<code>.iso</code>	An image file of a CD or DVD disc. Virtual machines treat ISO images as real CD/DVD discs.
<code>.txt</code>	Output files for serial and parallel ports. The output <code>.txt</code> files are generated when a serial or parallel port connected to an output file is added to the virtual machine configuration.

## Support of Virtual and Real Media

This section lists the types of disks that can be used by Parallels virtual machines and provides the information about basic operations you can perform on these disks.

### Supported Types of Hard Disks

Parallels virtual machines can use only virtual hard disks image files as their hard disks.

#### Virtual Hard Disks

The capacity of a virtual hard disk can be set from 100 MB to 5 TB.

Virtual hard disks can be of either *plain* or *expanding* format. When you create a virtual machine in **Express Windows** or **Typical** mode (in the New Virtual Machine wizard), the disk is created in the *expanding* format.

<b>plain</b>	A plain virtual hard disk image file has a fixed size. The size is determined when the disk is created. Plain disks can be created with the help of New Virtual Machine wizard (the <b>Custom</b> mode.)
<b>expanding</b>	An expanding virtual hard disk image file is small initially. Its size grows as you add applications and data to the virtual hard disk in the guest OS.

#### Split disks

A virtual disk of either format can be a single-piece disk or a split disk. A split disk is cut into 2 GB pieces and is stored as a single `.hdd` file.

### CD/DVD Discs and Their Images

Parallels Server can access real CD/DVD discs and images of CD/DVD discs.

Parallels Server has no limitations on using multi-session CD/DVD discs. A virtual machine can play back audio CDs without any limitations on copy-protected discs.

If your server has a recordable optical drive, you can use it to burn CD or DVD discs in a virtual machine.

Parallels Server supports CD/DVD disc images in ISO, CUE, and CCD formats.

### Floppy Disks and Floppy Disk Images

Parallels Server can use two types of floppy disks:

- Real diskettes inserted into a real floppy disk drive that is connected to the virtual machine.
- Floppy disk image files having the `.fdd` extension and connected to the virtual machine.

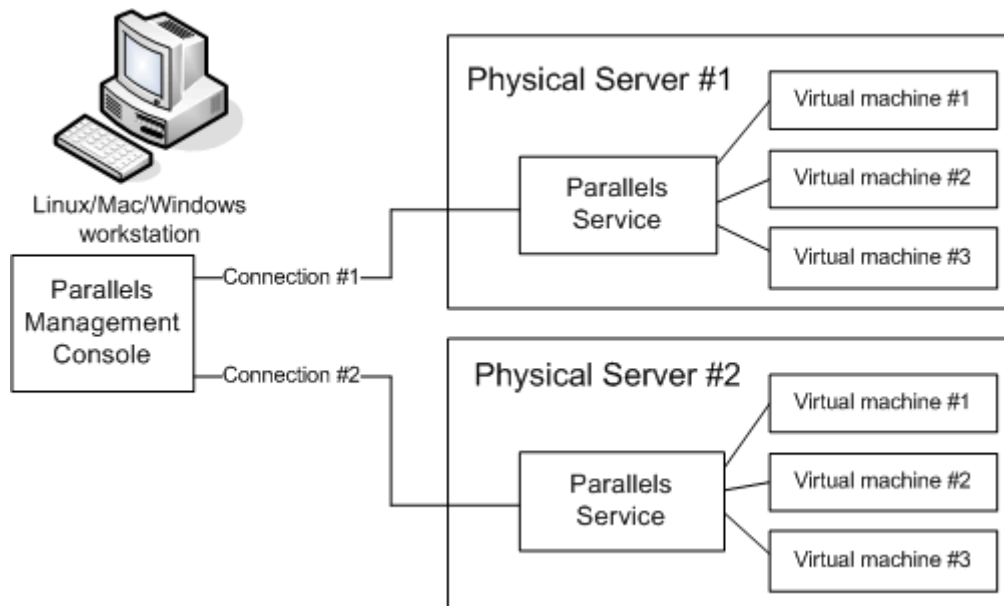
Parallels Server treats floppy disk images like real diskettes. Parallels Server supports floppy disk image files that have the .fdd extension and are 1.44 MB in size.

With Parallels Server, you can also create an image of a blank floppy using the Floppy Disk pane of the **Virtual Machine Configuration** dialog.

**Note:** Parallels Server cannot create images of real diskettes.

## Parallels Management Console

Parallels Management Console is a remote tool with a graphical user interface (GUI) for managing your physical servers with Parallels Server Bare Metal and virtual machines residing on them. This tool uses a typical client-server architecture.



The client application with the graphical user interface is installed on a computer running one of the supported Linux or Windows operating systems. Once the client application is up and running, it can connect to the Parallels Server Bare Metal software on a physical server. The client application can control multiple physical servers simultaneously (e.g. *Physical Server #1* and *Physical Server #2* as shown in the picture above). After the connection to the required physical server has been established, you can start managing this server and its virtual machines using the intuitive and comfortable GUI.

## Resource Management

*Parallels Server Bare Metal resource management* controls the amount of resources available to virtual machines and Containers. The controlled resources include such parameters as CPU power, disk space, a set of memory-related parameters. Resource management allows you to:

- effectively share available physical server resources among virtual machines and Containers
- guarantee Quality-of-Service in accordance with a service level agreement (SLA)
- provide performance and resource isolation and protect from denial-of-service attacks
- simultaneously assign and control resources for a number of virtual machines and Containers
- collect usage information for system health monitoring

Resource management is much more important for Parallels Server Bare Metal than for a standalone server since server resource utilization in such a system is considerably higher than that in a typical system.

## Understanding Licensing

To start using the Parallels Server Bare Metal software, you need a special license - *Parallels Server Bare Metal license*. You must install this license on your server after or when installing Parallels Server Bare Metal on it. Every physical server hosting virtual machines and Containers must have its own license. Licenses are issued by Parallels and define a number of parameters in respect of your physical server. The main licensed parameters are listed below:

- The number of CPUs which can be installed on the physical server. Keep in mind that each of the Dual Core and Hyperthreading processors is regarded as one CPU.
- The license expiration date. Any license can be time-limited or permanent.

Parallels Server Bare Metal licenses have a start date, and if they are time-limited, can also have an expiration date specified in them. You must set up your system clock correctly; otherwise, the license validation may fail.

- The number of virtual machines and Containers that can simultaneously run on the physical server.
- The platform and architecture with which the Parallels Server Bare Metal software is compatible.

## Physical Server Availability Considerations

The availability of a physical server running Parallels Server Bare Metal is more critical than the availability of a typical PC server. Since it runs multiple virtual machines and Containers providing a

number of critical services, physical server outage might be very costly. It can be as disastrous as the simultaneous outage of a number of servers running critical services.

To increase physical server availability, we suggest that you follow the recommendations below:

- Use a RAID storage for critical virtual machines and Containers. Do prefer hardware RAIDs, but software mirroring RAIDs might suit too as a last resort.
- Do not run any software on the server itself. Create special virtual machines and Containers where you can host necessary services such as BIND, FTPD, HTTPD, and so on. On the server, you need only the SSH daemon. Preferably, it should accept connections from a pre-defined set of IP addresses only.
- Do not create users on the server itself. You can create as many users as you need in any virtual machine and Container. Remember: compromising the server means compromising all virtual machines and Containers as well.



## CHAPTER 3

# Managing Virtual Machines and Containers

This chapter describes how to perform day-to-day operations on virtual machines and Containers.

**Note:** We assume that you have successfully installed, configured, and deployed your Parallels Server Bare Metal system. If you have not, refer to the *Parallels Server Bare Metal Installation Guide* for detailed information on these operations.

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## Creating a Virtual Machine and Container

This section explains how to create a new Parallels virtual machine and Container. The options you should pass to this command differ depending on whether you want to create a virtual machine or Container.

### Creating a Container

To create a Container, you can use the `pctl create` command. This command requires the following parameters:

Argument	Description
Container ID	A numeric ID associated with a Container (101, 403, and so on). The Container ID should be an integer greater than 100 and unique for a given Parallels server.
OS template name	The name of the OS template to base your Container on. Parallels Server Bare

Metal is shipped with a number of ready-to-use OS templates. To find out the names of the available templates, use the `vzpkg list -o` command.

For the list of operating systems you can run in your virtual machines and Containers, see **Supported Guest Operating Systems** (p. 27).

Configuration file

The name of the sample configuration file that will be used for setting all the Container resource control parameters. The sample configuration files are residing in the `/etc/vz/conf` directory on the physical server and have names with the following mask: `ve-<configname>.conf-sample`. The most commonly used sample is the `ve-basic.conf-sample` file. This sample file has resource control parameters suitable for most Containers.

Thus, for example, you can create a new Container by executing the following command:

```
# pct1 create 101 --ostemplate fedora-core-14-x86 --config basic
Creating Container private area (fedora-core-14-x86)
...
Container private area was created
```

In this case Parallels Server Bare Metal will create a Container with ID 101, the Fedora 14 OS installed inside, and the configuration parameters taken from the `ve-basic.conf-sample` sample configuration file.

**Note:** For more information on options you can pass to `pctl create` when creating Containers, see the *Parallels Command Line Reference Guide*.

## Creating a Virtual Machine

The process of creating a new virtual machine includes the following steps:

- 1 Creating a virtual machine configuration. To create a virtual machine configuration, you can use either the `pctl create` command or Parallels Management Console.
- 2 Installing an operating system in the virtual machine. This operation can be performed using Parallels Management Console only.
- 3 Installing Parallels Tools in the virtual machine, a set of special utilities that facilitate your work with virtual machines. This operation can be performed using Parallels Management Console only.

**Note:** For detailed information on completing steps 2 and 3, consult the *Parallels Management Console User's Guide*.

The example below shows you how to create a new virtual machine configuration using `pctl create`:

```
# pctl create MyVM --distribution win-2008
Creating the virtual machine...
Generate the VM configuration for win-2008.
The VM has been successfully created.
```

This creates a virtual machine with the name of `MyVM`, adjusts its configuration for installing the Windows Server 2008 operating system in it, and places all virtual machine-related files in the

`/vz/vmprivate` directory. Now you can use Parallels Management Console to install Windows Server 2008 OS and Parallels Tools in this virtual machine.

**Note:** For more information on options you can pass to `pctl create` when creating virtual machines, see the *Parallels Command-Line Reference Guide*.

## Supported Guest Operating Systems

Listed below are the operating systems that you can run in your virtual machines and Containers:

Operating System	Virtual Machine	Container
<b>Windows</b>		
Windows 7 with Service Pack 1 (x86, x64)	+	-
Windows Server 2008 R2 with Service Pack 1 (x64)	+	-
Windows Server 2003 R2 with Service Pack 2 (x86, x64)	+	-
Windows Vista with Service Pack 2 (x86, x64)	+	-
Windows XP Professional with Service Pack 2 (x64) and with Service Pack 3 (x86)	+	-
Windows 2000 with Service Pack 4 (x86)	+	-
<b>Linux</b>		
Red Hat Enterprise Linux 6.1 (x86, x64)	+	+
Red Hat Enterprise Linux 5.6 (x86, x64)	+	+
Red Hat Enterprise Linux 4.8 (x86, x64)	+	-
Fedora 15 (x86, x64)	+	+
Fedora 14 (x86, x64)	-	+
CentOS 6 (x86, x64)	+	+
CentOS 5.6 (x86, x64)	+	+
CentOS 4.8 (x86, x64)	+	-
SUSE Linux Enterprise Server 11 with Service Pack 1 (x86, x64)	+	+
SUSE Linux Enterprise Server 10 (x86, x64)	-	+
openSUSE 12.3 (x86, x64)	+	-
openSUSE 12.2 (x86, x64)	+	-
openSUSE 11.4 (x86, x64)	+	+
openSUSE 11.3 (x86, x64)	-	+
Debian GNU/Linux 7.0 (x86, x64)	+	-
Debian GNU/Linux 6.0 (x86, x64)	+	+
Debian GNU/Linux 5.0 (x86, x64)	+	+
Ubuntu Linux 13.04 (x86, x64)	+	-
Ubuntu Linux 11.04 (x86, x64)	+	+

Ubuntu Linux 10.10 (x86, x64)	+	+
Ubuntu Linux 10.04 (x86, x64)	+	+
Ubuntu Linux 8.04 (x86, x64)	-	+
<b>BSD</b>		
FreeBSD 8.1 (x86, x64)	+	-
FreeBSD 7.3 (x86, x64)	+	-
<b>Oracle</b>		
Oracle Enterprise Linux 5.5 (x86, x64)	+	-
Oracle Enterprise Linux 5.6 (x86, x64)	-	+

## Compatibility With Parallels Products

You can use virtual machines created in Parallels Server Bare Metal 5.0 with the following Parallels products:

- Parallels Desktop 6 for Mac
- Parallels Server for Mac 4.0
- Parallels Server for Mac 4.0 Bare Metal Edition
- Parallels Desktop 4 for Windows and Linux
- Parallels Workstation 4.0 Extreme

All products must have the latest updates installed.

## Choosing a Container ID

Every Container has a numeric ID, also known as Container ID, associated with it. The ID is a 32-bit integer number beginning with zero and unique for a given Parallels server. When choosing an ID for your Container, please follow the simple guidelines below:

- ID 0 is used for the Parallels server itself. You cannot and should not try to create a Container with ID 0.
- Parallels Server Bare Metal reserves the IDs ranging from 0 to 100. *Please do not create Containers with IDs below 101.*

The only strict requirement for a Container ID is to be unique for a particular Parallels server. However, if you are going to have several computers running Parallels Server Bare Metal, we recommend assigning different Container ID ranges to them. For example, on server 1 you create Containers within the range of IDs from 101 to 1000; on server 2 you use the range from 1001 to 2000, and so on. This approach makes it easier to remember on which server a Container has been created, and eliminates the possibility of Container ID conflicts when a Container migrates from one Parallels server to another.

Another approach to assigning Container IDs is to follow some pattern of Container IP addresses. Thus, for example, if you have a subnet with the 10.0.x.x address range, you may want to assign the 17015 ID to the Container with the 10.0.17.15 IP address, the 39108 ID to the Container with the 10.0.39.108 IP address, and so on. This makes it much easier to run a number of Parallels utilities eliminating the necessity to check up the Container IP address by its ID and similar tasks. You can also think of your own patterns for assigning Container IDs depending on the configuration of your network and your specific needs.

Before you decide on a new Container ID, you may want to make sure that no Container with this ID has yet been created on the server. The easiest way to check this is to run the following command:

```
# vzlist -a 101
Container not found
```

This output shows that Container 101 does not exist on the server; otherwise it would be present in the list.

**WARNING!** When deciding on a Container ID, do not use IDs that were once assigned to Containers unless you are sure that no data belonging to the old Containers remains on the server. Otherwise, the administrator of the newly-created Container may get access to this data—that is, to the backups of the old Container, its logs, statistics, and so on.

## Choosing OS EZ Template

Before starting to create a Container, you shall decide on which OS EZ template your Container will be based. There might be several OS EZ templates installed on the server and prepared for the Container creation; use the `vzpkg list` command to find out what OS EZ templates are available on your system:

```
# vzpkg list -O
redhat-e15-x86          2010-05-21 23:59:44
fedora-core-13-x86     2010-12-11 12:45:52
```

The `-O` option passed to the `vzpkg list` command allows you to list only OS EZ templates installed on the server. As you can see, the `redhat-e15-x86` and `fedora-core-13-x86` OS EZ templates are currently available on the server. The time displayed next to OS EZ templates indicates when these templates were cached.

You can also use the `--with-summary` option to display brief information on the installed OS EZ templates:

```
# vzpkg list -O --with-summary
redhat-e15-x86      :Red Hat Enterprise Linux v.5 Server EZ OS template
fedora-core-13-x86 :Fedora 13 EZ OS template
```

For detailed information on the `vzpkg list` command, consult the *Parallels Command Line Reference Guide*.

## Performing Initial Configuration

Before starting your newly created virtual machine and Container, you first need to configure it. This section describes the main configuration steps for virtual machines and Containers.

### Configuring Network Settings

To make virtual machines and Containers accessible from the network, you need to assign valid IP addresses to them and configure DNS servers. The session below illustrates setting these parameters for the `MyVM` virtual machine and Container `101`:

- Assigning IPv4 and IPv6 addresses:

```
# pct1 set MyVM --device-set net0 --ipadd 10.0.186.100/24
# pct1 set MyVM --device-set net0 --ipadd fe80::20c:29ff:fe01:fb07
# pct1 set 101 --ipadd 10.0.186.101/24 --save
# pct1 set 101 --ipadd fe80::20c:29ff:fe01:fb08 --save
```

`net0` in the commands above denotes the network card in the `VM` virtual machine to assign the IP address to. You can view all network cards of a virtual machine using the `pctl list VM_name -i` command.

- Setting DNS server addresses:

```
# pct1 set MyVM --nameserver 192.168.1.165
# pct1 set 101 --nameserver 192.168.1.165 --save
```

When running commands for a Container, you need to use the `--save` flag to save the specified parameters to the Container configuration file. If you omit this option, the applied values will be valid only until the Container shutdown. Omit the `--save` flag when executing commands for a virtual machine; the parameters are automatically saved to the virtual machine configuration file without this flag.

#### Notes:

1. You can configure the network settings only for virtual machines that have Parallels Tools installed.
2. To assign network masks to Containers operating in the `venet0` networking mode, you must set the `USE_VENET_MASK` parameter in the `/etc/vz/vz.conf` configuration file to `yes`.

### Setting Passwords for Virtual Machines and Containers

In Parallels Server Bare Metal, you can use the `--userpasswd` option of the `pctl set` command to create new accounts in your virtual machines and Containers directly from the Parallels server. The created account can then be used to log in to the virtual machine and Container. The easiest way of doing it is to run this command:

```
# pct1 set MyVM --userpasswd user1:2wsx123qwe
```

This command creates the `user1` account in the `MyVM` virtual machine and sets the `2wsx123qwe` password for it. Now you can log in to the `MyVM` virtual machine as `user1` and administer it in the same way you would administer a standalone server: install additional software, add users, set up services, and so on.

The `pctl set` command can also be used to change passwords for existing accounts in your virtual machines and Containers. For example, to change the password for `user1` in the `MyVM` virtual machine to `0pi65jh9`, run this command:

```
# pctl set MyVM --userpasswd user1:0pi65jh9
```

When setting passwords for virtual machines and Containers, keep in mind the following:

- You can use `manage user` accounts only inside virtual machines that have Parallels Tools installed.
- You should use passwords that meet the minimum length and complexity requirements of the respective operating system. For example, for Windows Server 2008, a password must be more than six characters in length and contain characters from three of the following categories: uppercase characters, lowercase characters, digits, and non-alphabetic characters.
- You should not create accounts with empty passwords for virtual machines and Containers running Linux operating systems.

## Setting Startup Parameters

The `pctl set` command allows you to define the `onboot` startup parameter for virtual machines and Containers. Setting this parameter to `yes` makes your virtual machine and Container automatically boot at the physical server startup. For example, to enable Container 101 and the `MyVM` virtual machine to automatically start on your server boot, you can execute the following commands:

- For Container 101:

```
# pctl set 101 --onboot yes --save
Saved parameters for Container 101
```

- For the `MyVM` virtual machine:

```
# pctl set MyVM --onboot yes
```

Notice that the `onboot` parameter will have effect only on the next server startup.

## Starting, Stopping, and Querying Status of a Virtual Machine and Container

After a virtual machine and Container has been created, it can be managed like an ordinary computer.

### Starting a Virtual Machine and Container

You can use the `pctl start` command to start your virtual machines and Containers:

- To start Container 101:

```
# pctl start 101
Starting the Container ...
```

- To start a virtual machine with the name of `MyVM`:

```
# pctl start MyVM
Starting the VM ...
```

### Stopping a Virtual Machine and Container

The `pctl stop` command is used to stop your virtual machines and Containers:

- To stop Container 101:

```
# pctl stop 101
Stopping the Container ...
```

- To stop a virtual machine with the name of `MyVM`:

```
# pctl stop MyVM
Stopping the VM ...
```

### Checking the Status of a Virtual Machine and Container

To check the status of a Container or a virtual machine, you can use the `pctl status` command:

- To know the status of Container 101:

```
# pctl status 101
VEID 101 exists mounted running
```

- To know the status of the `MyVM` virtual machine:

```
# pctl status MyVM
Vm MyVM exists stopped
```

### Restarting a Virtual Machine and Container

Sometimes, you may need to restart a virtual machine and Container. To do this, use the following commands:

- To restart a Container, use the `pctl restart` command:

```
# pctl restart 101
Stopping Container ...
Container was stopped
Container is unmounted
Starting Container ...
Container is mounted
Adding IP address(es): 10.0.186.101
Container start in progress...
```

- To restart a virtual machine, use the `pctl reset` command:

```
# pctl reset MyVM
```



## Listing Virtual Machines and Containers

To get an overview of the virtual machines and Containers existing on the physical server and to get additional information about them - their IP addresses, hostnames, current resource consumption, and so on - use the `pctl list` command. In the most general case, you can get a list of all virtual machines and Containers by issuing the following command:

```
# pctl list -a
STATUS  IP_ADDR  NAME
started 10.10.1.101 101
stopped 10.10.100.1 MyVM
```

The `-a` option tells the `pctl list` command to output both running and stopped virtual machines and Containers. By default, only running virtual machines and Containers are shown. The default columns inform you of the Container IDs and virtual machine names, the virtual machine and Container status and IP addresses. This output can be customized as desired by using `pctl list` command line options. For example:

```
# pctl list -a -o name,ctid -a
NAME          ID
-             101
MyVm         {b8cb6d99-1af1-453d-a302-2fddd8f86769}
```

This command displays only the names and IDs of the virtual machines and Containers existing on the physical server. The full list of the `pctl list` command options for virtual machines and Containers is available in the *Parallels Command Line Reference Guide*.

## Storing Extended Information on a Virtual Machine and Container

Sometimes, it may be difficult to remember the information on certain virtual machines and Containers. The probability of this increases together with the number of virtual machines and Containers and with the time elapsed since their creation. Parallels Server Bare Metal allows you to set the description of any virtual machine and Container on the physical server and view it later on, if required. The description can be any text containing any virtual machine and Container-related information. For example, you can include the following in the virtual machine and Container description:

- the owner of the virtual machine and Container
- the purpose of the virtual machine and Container
- the summary description of the virtual machine and Container

Let us assume that you are asked to create a virtual machine for a Mr. Johnson who is going to use it for hosting the MySQL server. So, you create the `MyVM` virtual machine and, after that, execute the following command on the physical server:

```
# pctl set MyVM --description "MyVM"
```

```
> owner - Mr. Johnson
> purpose - hosting the MySQL server" -
The VM has been successfully configured.
```

This command saves the following information related to the virtual machine: its name, owner, and the purpose of its creation. At any time, you can display this information by issuing the following command:

```
# pct1 list -o description MyVM
MyVM
owner - Mr. Johnson
purpose - hosting the MySQL server
```

When working with virtual machine and Container descriptions, keep in mind the following:

- You can use any symbols you like in the virtual machine and Container description (new lines, dashes, underscores, spaces, etc.).
- If the virtual machine and Container description contains one or more spaces or line breaks (as in the example above), it must be put in single or double quotes.
- As distinct from a virtual machine and Container name and ID, a description cannot be used for performing virtual machine and Container-related operations (e.g. for starting or stopping a virtual machine and Container) and is meant for reference purposes only.

## Copying a Virtual Machine and Container Within the Server

Parallels Server Bare Metal allows you to create a complete copy of a particular virtual machine and Container (in respect of all the virtual machine and Container data and resources parameters), or a *clone*. This saves your time because you do not have to think of setting up the virtual machine and Container configuration parameters and the like. Moreover, you can create a number of virtual machine and Container clones at a sitting.

In Parallels Server Bare Metal-based systems, you can use the following commands to copy a virtual machine and Container within the given physical server:

- `vzmlocal` to clone a Container. For example, you can create Container 111 and make it be a complete copy of Container 101 by running this command:

```
# vzmlocal -C 101:111
Moving/copying Container#101 -> Container#111, [], [] ...
...
Successfully completed
```

You can clone both running and stopped Containers.

- `pctl clone` to clone a virtual machine. For example, you can create a clone of the `MyVM` virtual machine and assign the `Cloned_VM` name to it as follows:

```
# pctl clone MyVM --name ClonedVM
Clone the MyVM VM to the VM ClonedVM...
The VM has been successfully cloned.
```

You can create clones of stopped virtual machines only.

## Checking the Cloned Virtual Machine and Container

To check that your virtual machine and Container has been successfully moved, run this command:

```
# pct1 list -a
STATUS      IP_ADDR      NAME
stopped     10.0.10.101  101
stopped     10.0.10.101  111
stopped     10.0.10.115  MyVM
stopped     10.0.10.115  ClonedVM
```

As you can see from the example above, the clones of Container 101 (Container 111) and the MyVM virtual machine (ClonedVM) have been successfully created. However, before starting to use the clones, you should assign different IP addresses to them which are currently identical to those of Container 101 and MyVM. Refer to **Performing Initial Configuration** (p. 30) to learn how you can do it.

**Note:** If you are cloning a running Container, the created clone is stopped to prevent an IP address conflict.

## Configuring the Default Directories

When cloning a virtual machine and Container, you can also override the following default directories:

- `/vz/dest_VM_Name.pvm` storing the files of a cloned virtual machine (where `dest_VM_Name` denotes the name of the resulting virtual machine). For example, for the ClonedVM virtual machine, this directory is `/vz/ClonedVM.pvm`. To store the files of the ClonedVM virtual machine in a custom directory, you can run the following command:

```
# pct1 clone MyVM --name ClonedVM --location /vz/VM_directory
```

In this case all virtual machine files will be placed to the `/vz/VM_directory` directory. Notice that the specified directory must exist on the server; otherwise, the command will fail.

- `/vz/private/<dest_CTID>` and `/vz/root/<dest_CTID>` defining the Container private area and root paths, respectively (where `<dest_CTID>` denotes the ID of the resulting Container). In the case of Container 111, these paths are `/vz/private/111` and `/vz/root/111`. To define custom private area and root paths for Container 111, you can execute the following command:

```
# vzmlocal -C 101:111:/vz/private/dir_111:/vz/root/ct111
Moving/copying Container#101 -> Container#111, [], [] ...
Syncing private area '/vz/private/101'->'/vz/private/dir_111'
...
Successfully completed
# ls /vz/private
1 101 dir_111
# ls /vz/root
1 101 ct111
```

## Suspending a Virtual Machine and Container

Parallels Server Bare Metal allows you to suspend a running virtual machine and Container on the physical server by saving its current state to a special file. Later on, you can resume the virtual machine and Container and get it in the same state the virtual machine and Container was at the time of its suspending. Suspending your virtual machines and Containers may prove useful, for example, if you need to restart the physical server, but do not want to:

- quit the applications currently running in the virtual machine and Container
- spend much time on shutting down the guest operating system and then starting it again

You can use the `pctl suspend` command to save the current state of a virtual machine and Container. For example, you can issue the following command to suspend the `MyVM` virtual machine:

```
# pctl suspend MyVM
Suspending the VM...
The VM has been successfully suspended.
```

At any time, you can resume the `MyVM` virtual machine by executing the following command:

```
# pctl resume MyVM
Resuming the VM...
The VM has been successfully resumed
```

Once the restoration process is complete, any applications that were running in the `MyVM` virtual machine at the time of its suspending will be running again and the information content will be the same as it was when the virtual machine was suspended.

## Running Commands in a Virtual Machine and Container

Parallels Server Bare Metal allows you to execute arbitrary commands inside virtual machines and Containers by running them on the physical server, i.e. without the need to log in to the respective virtual machine and Container. For example, this can be useful in these cases:

- If you do not know the virtual machine and Container login information, but need to run some diagnosis commands to verify that it is operational.
- If network access is absent for a virtual machine and Container.

In both these cases, you can use the `pctl exec` command to run a command inside the respective virtual machine and Container. The session below illustrates the situation when you run the stopped SSH daemon inside a Linux virtual machine with the name of `My_Linux`:

```
# pctl exec My_Linux /etc/init.d/sshd status
sshd is stopped
# pctl exec My_Linux /etc/init.d/sshd start
```

```
Starting sshd:[OK]
# pctl exec My_Linux /etc/init.d/sshd status
sshd (pid 26187) is running...
```

**Notes:**

1. You can use the `pctl exec` command only inside virtual machines that have Parallels Tools installed.
2. The `pctl exec` command is executed inside a virtual machine and Container from the `/` directory rather than from the `/root` one.

## Deleting a Virtual Machine and Container

You can delete a virtual machine and Container that is not needed anymore using the `pctl delete` command. Notice that you cannot delete a running or mounted virtual machine and Container. The example below illustrates deleting Container 101 and the `MyVM` virtual machine:

### Deleting Container 101

```
# pctl delete 101
Deleting Container private area: /vz/private/101
Container is currently mounted (unmount first)
# pctl stop 101
Stopping Container...
Container was stopped
Container is unmounted
# pctl delete 101
Deleting Container private area: /vz/private/101
Container private area was deleted
```

### Deleting the MyVM virtual machine:

```
# pctl delete MyVM
Deleting the VM...
VM is currently running
# pctl stop MyVM
Stopping the VM...
VM was stopped
# pctl delete MyVM
Deleting the VM...
Container was deleted
```

## Managing Virtual Machine and Container Backups

A regular backing up of the existing virtual machines and Containers is essential for any physical server reliability. In Parallels Server Bare Metal, you can use the following utilities to back up and restore your virtual machines and Containers:

- `pctl`

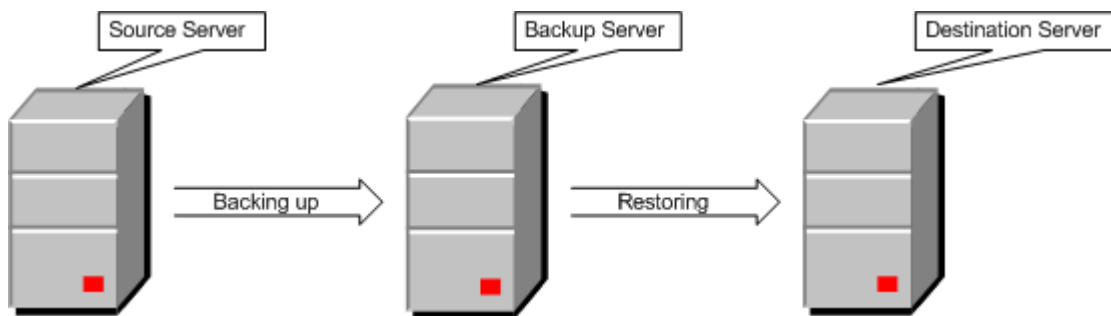
- `pbackup`
- `prestore`

Detailed information on these utilities is provided in the following subsections.

## Backups Overview

Parallels Server Bare Metal backup utilities deal with three kinds of servers:

- *Source Server*. This is the server where virtual machines and Containers are hosted during their backing up.
- *Backup Server*. This is the server where virtual machine and Container backups are stored. A Backup Server can be any server running the Parallels Server Bare Metal software and having sufficient space for storing virtual machine and Container backups.
- *Destination Server*. This is the server where virtual machine and Container backups are restored.



These servers are singled out by their functionality only. In reality, one and the same physical server can perform two or even three functions. Usually, the Source and Destination Servers are represented by one and the same server because you will likely want the virtual machines and Containers you back up to be restored to their original server. However, setting up a dedicated Backup Server is recommended.

## Creating Consistent Backups of Virtual Machines

Parallels Server Bare Metal allows you to back up both running and stopped virtual machines. However, to create a consistent backup of a running virtual machine, the virtual machine must meet the following requirements:

- Have Parallels Tools installed.
- Run one of the following operating systems:

### **Windows operating systems**

- Windows Server 2003
- Windows Server 2008

- Windows Vista
- Windows 7

### Linux operating systems

- Suse, version 9.0 and higher
- RHEL, version 4.0 and higher
- CentOS, version 4.0 and higher
- Fedora Core, version 3 and higher
- Debian, version 3.1 and higher
- Ubuntu, version 4.10 and higher

## Using `pctl backup` and `pctl restore`

This section describes how to perform the basic backup-related operations using the `pctl` utility.

### Creating a Virtual Machine and Container Backup

You can use the `pctl backup` command to back up virtual machines and Containers. This command is executed on the Source Server and can store the created virtual machine and Container backup on both the Source and Backup Servers. When creating a backup on the Source Server, you only need to specify the name of the virtual machine and Container to back up. For example, you can execute the following command to back up the `MyVM` virtual machine and store its backup archive on the Source Server:

```
# pctl backup MyVM
Backing up the VM MyVM
Operation progress 100%
The virtual machine has been successfully backed up with backup ID {746dba2a-3b10-4ced-9dd6-76a2b1c14a69}
```

The command output informs you that the virtual machine backup has been successfully created and assigned ID `746dba2a-3b10-4ced-9dd6-76a2b1c14a69`. You can use this ID when managing the backup archive (e.g. remove the backup).

At the same time, you can run the following command to back up the `MyVM` virtual machine and store its backup archive on the Backup Server with the IP address of `129.129.10.10`:

```
# pctl backup MyVM -s root:1qaz2wsx@129.129.10.10
```

`root:1qaz2wsx` before the Destination Server IP address denotes the root credentials used to log in to this server. If you do not specify these credentials, you will be asked to do so during the command execution.

By default, all newly created backups are placed to the following directories:

- `/vz/backups` for Containers
- `/vz/vmprivate/backups` for virtual machines

For Containers, you can configure the default directory by changing the value of the `BACKUP_DIR` parameter in the `/etc/vzbackup.conf` configuration file. In turn, to set the default backup directory for virtual machines, you should use the `prlsrvctl set` command.

### Notes:

1. A Backup Server can be any server running the Parallels Server Bare Metal software and having sufficient space for storing virtual machine and Container backups.
2. For more information on the options you can pass to `pctl backup`, refer to the *Parallels Server Bare Metal 5.0 Command Line Reference Guide*.

## Listing the Existing Backups

You can use the `pctl backup-list` command to view the backups existing on the physical server. For example:

```
# pctl backup-list
      ID  Backup_ID      Node      Date              Type Size
{c1dee22f...} {209d54a0...} test.com 2011-05-30 10:19:32 f    411566405
[The ID and Backup ID are reduced for better readability.]
```

This command lists the backups existing on the Source Server. If you want to list the backups on the Backup Server, you need to specify the IP address of this server.

The command output shows that currently only one backup exists on the Source Server. This backup was assigned the ID of `c1dee22f-8667-4870-9e11-278f1398eab0` (the full ID is skipped in the command output). The information on the backup is presented in the following table:

Column Name	Description
ID	The ID uniquely identifying the virtual machine and Container.
Backup ID	The ID assigned to the backup archive. You need to specify this ID when performing any backup-related operations.
Node	The hostname of the physical server storing the backup archive.
Date	The date and time when the backup archive was created.
Type	The backup type. Currently, you can create two types of backups: <ul style="list-style-type: none"><li>• A full backup indicated by <code>f</code>.</li><li>• An incremental backup indicated by <code>i</code> and containing only the files changed since the previous full or incremental backup. This is the default backup type.</li></ul>
Size	The size of the backup archive, in bytes.

## Removing a Virtual Machine and Container Backup

At any time, you can remove a backup that you do not need any more using the `pctl backup-delete` command. To do this, you need to specify the ID of the backup to remove and the ID of



the respective virtual machine and Container. If you do not know these IDs, use the `pctl backup-list` and check the ID and Backup ID columns. For example:

```
# pctl backup-list
      ID Backup_ID      Node      Date              Type Size
{c1dee22f...} {209d54a0...} test.com 2011-05-30 10:19:32 f    411566405
[The ID and Backup ID are reduced for better readability.]
# pctl backup-delete c1dee22f-8667-4870-9e11-278f1398eab0 -t 209d54a0-e3b8-4a03-9ca8-d4cc7a2a27ca
Delete the VM backup
The VM backup has been successfully removed.
```

You can also specify the virtual machine and Container name instead of its ID:

```
# pctl backup-delete MyVM -t 209d54a0-e3b8-4a03-9ca8-d4cc7a2a27ca
```

If you have several backups of a particular virtual machine and Container and want to delete them all at once, indicate only the virtual machine and Container name or ID:

```
# pctl backup-delete MyVM
```

This command removes all backups of the `MyVM` virtual machine from the local Backup Server. To remove backups stored remotely, you also need to specify the IP address of the remote Server:

```
# pctl backup-delete MyVM -s root:lqaz2wsx@129.129.10.10
```

## Restore a Virtual Machine and Container

To restore a backup of a virtual machine and Container, you can use the `pctl restore` command. This command supports restoring backups to the Source Server only. For example, to restore a backup of the `MyVM` virtual machine stored on the Backup Server with the IP address of `10.10.100.1`, you can run this command on the Source Node:

```
# pctl restore MyVM -s root:lqaz2wsx@10.10.100.1
```

If you have two or more backups of the `MyVM` virtual machine, the latest backup is restored. If you want to restore a particular virtual machine and Container backup, you need to specify the ID of this backup. You can use the `pctl backup-list` command to list the existing backups and the IDs assigned to them:

```
# pctl backup-list -s root:lqaz2wsx@10.10.100.1
      ID Backup_ID      Node      Date              Type Size
{c1dee22f...} {209d54a0...} test.com 2011-05-30 10:19:32 i    11566405
{c1dee22f...} {24a3011c...} test.com 2011-05-21 11:12:35 f    356798701
[The ID and Backup ID are reduced for better readability.]
```

You can now indicate the desired ID after the `-t` option to tell `pctl backup` to restore this particular backup. For example, to restore the backup for the virtual machine with the ID of `c1dee22f-8667-4870-9e11-278f1398eab0` that was created on the 21st of May, you can execute this command:

```
# pctl restore -t {24a3011c-8667-4870-9e11-278f1398eab0} -s root:lqaz2wsx@10.10.100.1
```

**Note:** Virtual machines created on servers running Parallels Server Bare Metal 5.0 cannot be restored on servers with Parallels Server 4 Bare Metal.

## Using pbackup and prestore

Along with `pctl`, you can use the following utilities to create and manage backups of your virtual machines and Containers:

- `pbackup`. This utility is used to create backups of individual virtual machines and Containers or entire Parallels servers.
- `prestore`. This utility is used to manage the existing backups of virtual machines and Containers.

### Backing Up Virtual Machines and Containers

The `pbackup` utility is run on the Backup Server connecting via SSH to the Parallels server and backing up one or more virtual machines and Containers on this server. By default, the created Container backups are placed to the `/vz/backups` directory and the backups of virtual machines are put to the `/vz/vmprivate/backups` directory. You can change the default backup directories

- for Containers, by editing the `/etc/vzbackup.conf` file
- for virtual machines, by using the `--backup-path` option of the `prlsrvctl set` command

Let us assume that you want to back up the entire Parallels server (that is, all virtual machines and Containers on this server) with the `test.com` hostname. In this case, you can run the following command on the Backup Server:

```
# pbackup test.com
```

During the command execution, you will be asked to provide the `test.com` credentials. After doing so, the command will back up all virtual machines and Containers on the `test.com` and put

- all backed up Containers to the Backup Server
- all backed up virtual machines to the Source Server

To save the backed up virtual machines also on the Backup Server, you should additionally specify the `-n` option. This option is used to indicate the IP address or hostname of the Backup Server and its credentials:

```
# pbackup -n root:7ujn6yhb@192.168.10.199 test.com
```

If you wish to back up not all, but specific virtual machines and Containers from the specified server, use the `-e` or `-x` switches (to include or exclude the specified virtual machines and Containers, respectively). For example:

```
# pbackup -n root:7ujn6yhb@192.168.10.199 test.com -e 101 MyVM
```

In this session, only Container 101 and the `MyVM` virtual machine residing on the Source Server with the `test.com` hostname will be included in the backup, and their backups will be stored on the Backup Server.

**Notes:**

1. A Backup Server can be any server running the Parallels Server Bare Metal software and having sufficient space for storing virtual machine and Container backups.
2. For the full list of configuration parameters and command line options for `pbackup`, consult the *Parallels Server Bare Metal 5.0 Command Line Reference Guide*.

## Restoring Backups

To restore any individual virtual machines and Containers or entire Parallels servers, you may want to view first the information about them. This can be done using the `prestore -l` command:

```
# prestore -l -n test.com test.com
root@test.com's password:
...
Backups for node test.com:
      ID Backup_ID      Node      Date              Type Size
      101 2011-05-...    test.com 2011-05-30 09:42:19 f    18721280
{cd91b90b...} {4ef87485...} test.com 2011-05-16 17:15:47 f    92617398
[The ID and Backup ID are reduced for better readability.]
```

The command output shows that currently only two backups exist for the `test.com` server on the Backup Server. If you omit the `-n test.com` option, the command will list:

- all Container backups for the `test.com` server stored on the Backup Server
- all virtual machine backups for the `test.com` server stored on the `test.com` server

The information on the backups is presented in the following table:

Column Name	Description
ID	The ID uniquely identifying the virtual machine and Container.
Backup ID	The ID assigned to the backup archive. You need to specify this ID when performing any backup-related operations.
Node	The hostname of the Source Server.
Date	The date and time when the backup archive was created.
Type	The backup type. Currently, you can create two types of backups: <ul style="list-style-type: none"> <li>• A full backup indicated by <code>f</code>.</li> <li>• An incremental backup indicated by <code>i</code> and containing only the files changed since the previous full or incremental backup. This is the default backup type.</li> </ul>
Size	The size of the backup archive, in bytes.

To restore Container 101 and the `{cd91b90b-469d-42c6-acf4-fefee09cfa61}` virtual machine, run this command:

```
# prestore -n test.com -e 101 {cd91b90b-469d-42c6-acf4-fefee09cfa61}
```

This command will restore the Container and the virtual machine to their Source Server.

You can also use the `-d` option to restore Container 101 to a Parallels server other than the Source Node. For example, this command

```
# prestore -d 192.168.10.199 test.com -e 101
```

restores Container 101 to the Destination Server with IP address `192.168.10.199`. If you want to restore all Containers backups for the `test.com` Parallels server, just skip the `-e` option.

### Notes:

1. The current version of Parallels Server Bare Metal supports restoring virtual machines to the Source Server only.
2. Virtual machines created on servers running Parallels Server Bare Metal 5.0 cannot be restored on servers with Parallels Server 4 Bare Metal.
3. The `prestore` utility can also manage (list, restore, etc.) backups created using the `pctl backup` command. However, you are highly recommended to use the same utility (either `pctl` or `prestore`) during the life cycle of a particular backup.
4. For the full list of command line options for `prestore`, refer to the *Parallels Server Bare Metal 5.0 Command Line Reference Guide*.

## Configuring Passwordless Access to the Source Node

You need to provide the Source Node credentials each time you execute the `pbackup` and `prestore` commands. However, you can allow these utilities to log in to the Source Node without having to enter the `root` password. To do this, you need to provide each Source Node with authorized public SSH RSA keys:

- 1 Log in to the Backup Server as `root`, and generate a pair of SSH keys - public and private:

```
# ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/root/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /root/.ssh/id_rsa.
Your public key has been saved in /root/.ssh/id_rsa.pub.
The key fingerprint is:
c6:19:a8:2c:67:31:15:e6:30:23:2b:8a:b0:63:77:8f root@dhcp-130.parallels.com
```

Note that you must leave an empty passphrase in the above procedure. The private key is saved by default in `/root/.ssh/id_rsa`, and the public key is saved in `/root/.ssh/id_rsa.pub`.

- 2 Transfer your public key to the `/root/.ssh` directory on each Source Node (use some intermediary name for the file not to overwrite the corresponding file on the Source Node):

```
# scp /root/.ssh/id_rsa.pub root@dhcp-129.parallels.com:/root/.ssh/temp_name
The authenticity of host 'dhcp-129.parallels.com (192.168.1.129)' can't be established.
RSA key fingerprint is 01:fc:b6:e9:26:40:1f:1a:41:5f:7a:fb:cf:14:51.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'dhcp-129.parallels.com,192.168.1.129' (RSA) to the list of
known hosts.
```

```
root@dhcp-129.parallels.com's password:
id_rsa.pub      100% |*****|      235      00:00
```

**3** Add the contents of the transferred file to the `authorized_keys` file in this very directory on the Source Node. To do this, log in to the Source Node, change to the `/root/.ssh` directory, and issue the following command:

```
# cat temp_name >> authorized_keys
```

Now the `pbackup/prestore` utilities should be able to log in to the Source Node as `root` without having to provide the `root` password.

## Migrating Virtual Machines and Containers

The Parallels physical server is the system with higher availability requirements in comparison with a typical system. If you are running your company mail server, file server, and web server in different virtual machines and Containers on one and the same physical server, then shutting it down for hardware upgrade will make all these services unavailable at once. To facilitate hardware upgrades and load balancing between several Parallels servers, the Parallels Server Bare Metal software provides you with the ability to migrate virtual machines and Containers from one physical server to another.

Parallels Server Bare Metal is shipped with a special utility—`pmigrate`—allowing you to perform different types of migration. Using this utility, you can migrate

- Containers from one physical server to another
- Parallels virtual machines from one physical server to another
- a Container to a Parallels virtual machine
- a Parallels virtual machine to a Container
- a physical server to a virtual machine and Container
- Xen virtual machines to Parallels virtual machines

All these operations are described in the following subsections.

### General Migration Requirements

Before deciding on the type of migration to perform, make sure that the source computer (i.e. the computer that you will migrate or that stores the virtual machine and Container before its migration) and the destination computer (i.e. the computer that runs Parallels Server Bare Metal and that will host the resulting virtual machine and Container) meet the requirements below.

#### Requirements for the source computer

The source computer can be a physical computer, a virtual machine, or a Container. The software requirements for source computers are given in the following table:

Operating System	Physical Computer	Virtual Machine	Container
<b>Windows</b>			
Windows 7 (x32, x64)	+	+	-
Windows Server 2003 (x32, x64)	+	+	+
Windows Server 2008 (x32, x64)	+	+	+
Windows 2000 Server (x32)	+	+	-
Windows XP (x32, x64)	+	+	-
Windows Vista (x32, x64)	+	+	-
<b>Linux</b>			
Red Hat Enterprise Linux 5 (x32, x64)	+	+	+
Red Hat Enterprise Linux 4 (x32, x64)	+	+	+
CentOS 5 (x32, x64)	+	+	+
CentOS 4 (x32, x64)	+	+	+
Fedora 11 (x32, x64)	+	+	+
Fedora 10 (x32, x64)	+	+	+
SUSE Linux Enterprise Server 10 (x32, x64)	+	+	+
Debian GNU/Linux 5 (x32, x64)	+	+	+
Debian GNU/Linux 4 (x32, x64)	+	+	+
Ubuntu Linux 9.04 Server (x32, x64)	+	+	+
Ubuntu Linux 8.10 Server (x32, x64)	+	+	+

**Note:** In the current version of Parallels Server Bare Metal, you cannot migrate Containers running Windows Server 2008 to virtual machines.

### Requirements for the destination server

The destination server must meet the following requirements:

- Has enough hard disk space to store the resulting virtual machine and Container.
- Has enough memory and CPU power to run the resulting virtual machine and Container.
- Has a stable network connection with the source server.

## Migrating Virtual Machines and Containers Between Parallels Servers

In Parallels Server Bare Metal, you can choose one of the following ways to migrate virtual machines and Containers:

- Migrating virtual machines and Containers using the standard migration technology.
- Migrating virtual machines and Containers using the zero-downtime migration technology.

Both ways of migrating virtual machines and Containers are described in the following subsections in detail.

## Standard Migration

Using the standard migration technology, you can move

- stopped, running, and suspended Containers
- stopped and suspended virtual machines

Standard migration includes copying all files of a virtual machine or Container from one Parallels server to another and does not differ from copying a number of files from one server to another over the network. For a running Container, the migration procedure is a bit more complicated and is described below:

- 1 Once you start the migration, all Container data are copied to the destination server. During this time, the Container on the source server continues running.
- 2 The Container on the source server is stopped.
- 3 The Container data copied to the destination server are compared with those on the source server, and if any files were changed during the first migration step, they are copied to the destination server again and rewrite the outdated versions.
- 4 The Container on the destination server is started.

There is a short downtime needed to stop the Container on the source server, copy the changed data to the destination server, and start the Container on the destination server.

**Note:** Before the migration, you may need to detach the Container from its caches. For more information on cached files, see the **Cleaning Up Containers** subsection (p. 98).

## Migrating Containers

The following session moves Container 101 from the source server to the destination server `ts7.test.com`:

```
# pmigrate c 101 c root:1qasdeqw3@ts7.test.com/101
root@ts7.test.com's password:
vzmsrc: Connection to destination server (ts7.test.com) is successfully established
...
Successfully completed
```

The `c` option in the command above tells `pmigrate` that you are moving a Container to a Container. If you do not indicate the credentials to log in to the destination server, you will need to do so during the migration.

**Important!** For the command to be successful, a direct SSH connection (on port 22) must be allowed between the source and destination servers.

By default, after the migration process is completed, the Container private area and configuration file are renamed on the source server by receiving the `.migrated` suffix. However, if you want the Container private area on the source server to be removed after the successful Container migration, you can override the default `pmigrate` behavior by changing the value of the `REMOVEMIGRATED` variable in the Parallels Server Bare Metal global configuration file (`/etc/vz/vz.conf`) to `yes` or by using the `-r yes` switch with the `pmigrate` command.

### Migrating Virtual Machines

In turn, to migrate a virtual machine from the source server to `ts7.test.com`, you need just to specify `v` instead of `c` and the name of the resulting virtual machine instead of Container ID 101:

```
# pmigrate v MyVM v ts7.test.com/MyVM
Migrate the VM MyVM to test.com
root@ts7.test.com's password:
Operation progress 100%
The VM has been successfully migrated.
```

This command moves the `MyVM` virtual machine from the local server to the destination server `ts7.test.com`. Once the migration is complete, the original virtual machine is removed from the source server. However, you can use the `--keep-src` option to leave the original virtual machine intact.

For virtual machines, `pmigrate` also supports the migration from a remote Parallels server to the local one:

```
# pmigrate v ts7.test.com/MyVM v localhost
root@ts7.test.com's password:
Migrate the VM MyVM to localhost
Operation progress 100%
The VM has been successfully migrated.
```

This command moves the `MyVM` virtual machine from the `ts7.test.com` server to the local server.

**Note:** For more information on options that you can pass to `pmigrate`, refer to the *Parallels Server Bare Metal 5.0 Command Line Reference*.

### Zero-Downtime Migration

Using the zero-downtime migration technology, you can migrate paused and running virtual machines and running Containers from one Parallels server to another with zero downtime. The zero-downtime migration technology has the following main advantages over the standard one:

- The migration time is greatly reduced. In fact, the migration eliminates the service outage or interruption for end users.
- The process of migrating a virtual machine or Container to another Parallels server is transparent for you and the Container applications and network connections. This means that no modifications of system characteristics and operational procedures inside the Container are performed on the source and destination servers.



- The virtual machine or Container is restored on the destination server in the same state as it was at the beginning of the migration.
- You can move virtual machines and Containers running applications that you do not want to be rebooted during the migration.

**Note:** Zero-downtime migration is not supported for virtual machines and Containers that have open sessions established with the `pctl enter` command.

### Migration requirements and restrictions

When performing a zero-downtime migration, take into account the requirements and restrictions below:

- Before performing zero-downtime migration, it is recommended to synchronize the system time on the source and destination servers, for example, by means of NTP (<http://www.ntp.org>). The reason for this recommendation is that some processes running in virtual machines and Containers might rely on the system time being monotonic and thus might behave unpredictably if they see an abrupt step forward or backward in the time once they find themselves on the new server with different system clock parameters.
- Your network must support data transfer rates of at least 1 Gb/s.
- The source and destination servers must belong to the same subnetwork.
- The CPUs on the source and destination servers must be manufactured by the same vendor, and the CPU capabilities on the destination server must be the same or exceed those on the source server.
- virtual machine and Container disks can be located on local disks, shared NFS and GFS2 storages, and iSCSI raw devices.

### Migration process overview

The process of migrating virtual machines and Containers using the zero-downtime migration technology includes the following main steps:

- 1** Once you start the migration, Parallels Server Bare Metal checks whether the destination server meets all migration requirements and the virtual machine or Container can be migrated to this server.
- 2** All virtual memory and disks of the virtual machine or Container are migrated to the destination server.
- 3** The virtual machine or Container on the source server is suspended.
- 4** The changed memory pages and virtual disk blocks, if any, are migrated to the destination server.
- 5** The virtual machine or Container is resumed on the destination server.

The virtual machine or Container continues running during steps 1 and 2 and is not available to the end user during steps 3-5. But since the amount of memory pages and virtual disk blocks changed during step 2 is small, the service outage time for the end user is almost imperceptible.

### Migrating virtual machines and Containers

Depending on whether you are migrating a virtual machine or Container, the command-line options you pass to the `pmigrate` slightly differ. For example, you can migrate Container 101 from the local server to the destination server `destserver.com` by executing the following command on the local server:

```
# pmigrate c 101 c --online destserver.com
Enter password:
Connection to destination server (192.168.1.57) is successfully established
...
Successfully completed
```

At the same time, to migrate the `MyVM` virtual machine to the same destination server `destserver.com`, you can run this command on the local server:

```
# pmigrate v MyVM v destserver.com
Migrate the VM MyVM to test.com
...
The VM has been successfully migrated.
```

As you can see, to migrate a virtual machine, you skip the `--online` option and use the `v` option to specify that you are migrating a virtual machine.

#### Notes:

1. For more information on options you can use with the `pmigrate` utility, see the *Parallels Server Bare Metal 5.0 Command-Line Reference Guide*.
2. After migration, the moved virtual machine may not be accessible over the network for several minutes due to latencies in the network equipment reconfiguration (for example, when switches need to update their dynamic VLAN membership tables).

### Migrating Containers to Virtual Machines

The `pmigrate` utility allows you to migrate Containers to virtual machines. The source server, i.e. the server where the Container resides before its migration, can be one of the following:

- a local server running Parallels Server Bare Metal
- a remote server running Parallels Server Bare Metal
- a remote server running Parallels Virtuozzo Containers

Currently, the destination server, i.e. the server where the resulting virtual machine will be created, can be only a local server with Parallels Server Bare Metal.

The process of migrating a Container to a virtual machine differs depending on whether the server where the Container resides is running the Parallels Server Bare Metal or Parallels Virtuozzo Containers software.

## Migrating Containers

You can use the `pmigrate` utility to migrate Containers that reside on both local and remote servers running Parallels Server Bare Metal. When migrating a Container from a local server, you only need to specify the Container ID and the name of the resulting virtual machine. For example, the following command migrates Container 101 to the `VM_101` virtual machine on the same Parallels server:

```
# pmigrate c 101 v VM_101
Connecting to local agent...
Querying configuration...
Migrating...
Operation progress 100%
Registering VM...
PVC to VM /var/parallels/VM_101.pvm/config.pvs migration succeeded.
```

The resulting virtual machine will be put to the `/var/parallels` directory on the destination server.

If you want to migrate a Container from a remote Parallels server, you should additionally indicate the source server IP address and the credentials of the root user on this server:

```
# pmigrate c root:8uhytv4@192.168.12.12/101 v VM_101
Connecting to local agent...
Querying configuration...
Migrating...
Operation progress 100%
Registering VM...
PVC to VM /var/parallels/VM_101.pvm/config.pvs migration succeeded.
```

This command migrates Container 101 residing on the Parallels server with the IP address of `192.168.12.12` to the `VM_101` virtual machine on the local server. If you do not specify the root credentials on the source server, you will be asked to do so during the command execution.

## Migrating Containers from a Server with Parallels Virtuozzo Containers

You can use the `pmigrate` utility to migrate Containers that reside on remote servers running the following versions of the Parallels Containers software:

- Parallels Virtuozzo Containers 4.0 for Linux with update TU-4.0.0-464 or higher
- Parallels Virtuozzo Containers 4.6 for Linux
- Parallels Virtuozzo Containers 4.5 for Windows
- Parallels Virtuozzo Containers 4.6 for Windows

Moving a Container from a remote Parallels Containers server to a virtual machine on the local server with Parallels Server Bare Metal involves completing the following steps:

- 1 Installing the Parallels agent on the server with Parallels Containers.

- 2 Running the `pmigrate` utility on the destination server to migrate the Container.

### Installing the Parallels for Containers Agent

First, you must install the Parallels agent on the source Parallels Containers server. During migration, this agent collects essential information on the Container to be moved and transfers it to the `pmigrate` utility on the destination server. To install the Parallels agent, do the following:

- 1 Log in to the source Parallels Containers server as a user with administrative rights.
- 2 Copy the Parallels agent installation file to the source server. The installation file is located in the `/usr/share/pmigrate/tools` directory on the server with Parallels Server Bare Metal:
  - `parallels-transporter-for-containers-XXXX.run`. Use this file to install the Parallels agent on servers running Parallels Virtuozzo Containers 4.0 or 4.6 for Linux.
  - `ParallelsTransporterForContainers-parallels-XXXX.exe`. Use this file to install the Parallels agent on servers running Parallels Virtuozzo Containers 4.5 or 4.6 for Windows.
- 3 Execute the installation file on the source server.
- 4 Follow the instructions of the wizard to install the Parallels agent.

### Migrating the Container

Once the Parallels agent is installed, you can use the `pmigrate` utility to move a Container to a virtual machine. For example, you can run the following command on the destination server to migrate Container 101 from the remote server with IP address `192.168.12.12` to the `VM_101` virtual machine:

```
# pmigrate c root:8uhytv4@192.168.12.12/101 v VM_101
Connecting to local agent...
Querying configuration...
Migrating...
Operation progress 100%
Registering VM...
PVC to VM /var/parallels/VM_101.pvm/config.pvs migration succeeded.
```

The resulting virtual machine will be put to the `/var/parallels` directory on the destination server. If you do not specify the administrative credentials on the source server (for `root` on Linux servers and `Administrator` on Windows servers), you will be asked to do so during the command execution.

## Migrating Physical Computers to Virtual Machines and Containers

You can use the `pmigrate` utility to migrate a standalone physical computer to a virtual machine or Container. The procedure includes copying the entire contents of a physical computer, including all files, directories, quota limits, settings, and so on, to a virtual machine or Container on a Parallels server. Migration of a computer produces its exact copy in the form of a virtual machine or Container, including operating system, assigned IP addresses, disk space, memory capacity, etc.

Migrating a physical computer to a virtual machine or Container involves completing the following steps:

- 1 Installing the Parallels agent on the source physical computer (required for migrating to virtual machines only).
- 2 Running the `pmigrate` utility on the destination server.

## Installing Parallels Agent

The Parallels agent collects essential system data on the source physical computer and supplies it to the `pmigrate` utility on the destination Parallels server. To install the agent, do the following:

- 1 Make sure that the source physical computer meets the requirements for installing the agent. See **Requirements for Migrating to Virtual Machines** (p. 55) for details.
- 2 Log in to the source physical computer as administrator.
- 3 Copy the correct agent installation file to the source physical computer from the `/usr/share/pmigrate/tools` directory on the destination Parallels server:
  - For a Linux OS, choose `parallels-transporter-agent-XXXX.run`.
  - For a Windows OS, choose `ParallelsTransporterAgent-parallels-XXXX.exe`.
- 4 Run the installation file on the source physical computer and follow the wizard's instructions.
- 5 Restart the source physical computer to complete the installation.

**Note:** The Parallels agent is launched automatically after restart. You do not need to run in manually.

## Migrating Source Physical Computer

Once the source physical computer is up and running, you can migrate it to a virtual machine or Container on the destination Parallels server. For example, to migrate a physical computer to a virtual machine, run the following command on the destination server:

```
# pmigrate h root:1qsde34rt@192.168.1.130 v MyVM
```

Where:

- `h` indicates that the migration source is a physical computer.
- `root:1qsde34rt@192.168.1.130` contains the source physical computer credentials and IP address.  
If you omit credentials, you will be asked to provide them during command execution.
- `v` indicates that the migration destination is a virtual machine.
- `MyVM` is the name of the resulting virtual machine on the destination Parallels server.

Once the procedure is complete, you will find the resulting virtual machine in the `/var/parallels` directory on the destination Parallels server.

To migrate the same physical computer to a Container, just replace `v` with `c` and `MyVM` with a Container ID (e.g. 101). For example:

```
# pmigrate h root:1qsde34rt@192.168.1.130 c 101
```

### Notes:

1. Migrating physical computers running Windows to Containers is not supported.
2. Migrating physical computers with ReiserFS system volumes is not supported.

## Requirements for Migrating to Containers

To avoid delays and problems when migrating a physical server to a Container, make sure that the following requirements are met:

- The Linux distribution installed on the source physical computer is supported by Parallels Server Bare Metal. To find that out, check the `/etc/vz/conf/dists` directory on the destination Parallels server and look for a corresponding `Linux_Distribution_Name-version.conf` configuration file (e.g., `redhat-5.conf`). If there is none, you can do one of the following:
  - Create a new distribution configuration file and place it in the `/etc/vz/conf/dists` directory on the destination Parallels server. For more details, see **Creating Configuration Files for New Linux Distribution** (p. 189).
  - Start migration without a configuration file. In this case `unknown.conf` from the `/etc/vz/conf/dists` directory will be used to configure the resulting Container. However, you will not be able to use standard Parallels Server Bare Metal utilities (e.g. `pctl`) to perform main operations on the newly created Container (e.g., set its IP address or configure DNS parameters) and have to do that manually from inside the Container.
- `ssh` is installed on both the source physical computer and the destination Parallels server to provide secure encrypted and authenticated communication between the two. You can check if the `ssh` package is already installed by executing the `ssh -v` command.
- `rsync` is installed on the source physical computer to copy the source contents to the resulting Container. If `rsync` on the source physical computer is incompatible with that on the destination Parallels server, use the latter, which is located in the `/usr/local/share/vzlinmigrate` directory.

## Migration Restrictions for Containers

Listed below are the limitations you should take into account when migrating physical computers to Containers.

- During migration, all file systems available on the source physical computer are joined into VZFS (Virtuozzo File System) inside the Container. For more details, see **Virtuozzo File System** (p. 16).

- If the source physical computer has several IP addresses assigned to it, all of those are reassigned to the same `vnet0` device on the destination Parallels server. This virtual network adapter is used to interconnect all Containers on a Parallels server and the server itself. After migration, you can create additional virtual network adapters inside the resulting Container and assign necessary IP addresses to network adapters as you see fit. For more details, see **Managing Adapters in Containers** (p. 144).
- During migration, you may specify only one partition on the source physical computer that will be migrated to a Container together with all its quotas. All other partitions will be copied without their quota limits. Moreover, the quota limits of the selected partition will be applied to the entire Container after migration.
- While migrating a physical server running a Linux operating system with a security-enhanced (SE) Linux kernel, keep in mind that Parallels Server Bare Metal currently does not support SE Linux kernels, and the resulting Container will not support the SE features of the source.
- If any of your files and/or directories on the source physical computer have extended attributes associated with them, these attributes will be lost after migration.
- Raw devices on the source physical computer cannot and will not be migrated to the resulting Container on the destination Parallels server.
- Any applications bound to the MAC address of the source physical computer will not run inside the resulting Container after migration. In this case, you can do one of the following:
  - Obtain new licenses for applications that require them and install those anew inside the Container.
  - Try to reconfigure applications which do not require a license for working without being bound to a MAC address.
- If migration fails at a stage when `rsync` is transferring files and directories from the source physical computer to the resulting Container, the already copied files and directories will remain in the `/vz/private/Container_ID` directory on the destination Parallels server, probably occupying much disk space. You can keep this directory to speed up a new migration attempt, or you can delete it manually by using the `rm` utility.
- Migrating physical computers with system volumes formatted as ReiserFS is not supported.
- Migration of GUID Partition Table (GPT) disks is not supported.

## Requirements for Migrating to Virtual Machines

Any physical computer to be migrated to a virtual machine must have the Parallels agent installed, for which the following requirements must be met.

### Hardware Requirements

- 700 MHz or faster x86 or x64 processor (Intel or AMD).
- 256 MB or more RAM.
- 50 MB of free hard disk space for the Parallels agent.

- Ethernet or Wi-Fi network adapter.

### Software Requirements

See **General Migration Requirements** (p. 45).

### Additional Requirements for Migrating Servers with Parallels Server Bare Metal

To migrate a server running the Parallels Server Bare Metal software, you should first make sure that the `snapapi26` and `snumbd26` modules are not loaded on that server. To check this, you can use the following commands:

```
# lsmod | grep snapapi26
# lsmod | grep snumbd26
```

If necessary, unload the modules by running the `rmmod` command. You may need to stop the Parallels Server Bare Metal service first, as explained below:

- 1 Stop the Parallels Server Bare Metal service:

```
# /etc/init.d/vz stop
```

- 2 Unload the modules:

```
# rmmod snapapi26
# rmmod snumbd26
```

- 3 Start the Parallels Server Bare Metal service again:

```
# /etc/init.d/vz start
```

Once the modules are unloaded, proceed with migration.

### Migration Restrictions for Virtual Machines

Listed below are the limitations you should take into account when migrating physical computers to virtual machines.

- Migrating Windows dynamic volumes and Linux logical volumes (LVM) is not supported.
- Migrating Windows software RAID configurations is not supported.
- Migrating GUID Partition Table (GPT) disks is not supported.
- Migrating physical computers with ReiserFS system volumes is not supported.

### Migrating Virtual Machines to Containers

The process of migrating a virtual machine to a Container on the Parallels server is the same as migrating a physical computer to a Container. For example, you can execute the following command to move a virtual machine with the IP address of 192.168.1.130 to Container 101 on your Parallels server:

```
# pmigrate h root:1qsde34rt@192.168.1.130 c 101
```

You can omit the virtual machine credentials in the command above. In this case you will be asked to provide them during the command execution.



**Notes:**

1. For more information on migrating physical computers to Containers, see **Migrating Physical Computers to Virtual Machines and Containers** (p. 52).
2. The requirements a virtual machine must meet are the same as for migrating physical computers; they are described in **Requirements for Migrating to Containers** (p. 54).

## Migrating Xen Virtual Machines

You can use the `pmigrate` utility to migrate Xen virtual machines to virtual machines on the Parallels server. Moving a Xen virtual machine to a Parallels virtual machine involves completing the following steps:

- 1 Installing the Parallels agent on the physical server hosting the Xen virtual machine.
- 2 Migrating the Xen virtual machine by running the `pmigrate` utility on the server.

Both steps are described below in detail.

### Installing the Agent

Before you start migrating a Xen virtual machine, you need first to install the Parallels agent on the Xen server where the virtual machine is residing. To install the Parallels agent, do the following:

- 1 Log in to the Xen server as a user with administrative rights.
- 2 Copy the Parallels agent installation file to the Xen server. The installation file is located in the `/usr/share/pmigrate/tools` directory on the Parallels server and has the name `parallels-transporter-agent-parallels-en_US-XXXX.run`.
- 3 Execute the copied file, and follow the instructions to install the Parallels agent.
- 4 Start the Parallels agent:

```
# parallels-transporter-agent -c
```

### Migrating the Xen virtual machine

Once the Parallels agent is running on the Xen server, you can migrate the Xen virtual machine. Let us assume the following:

- You want to migrate the `XenVM` virtual machine from the Xen server to the `MigratedVM` virtual machine on the Parallels server.
- `root:1qsde34rt@192.168.1.130` is the IP address and credentials of the Xen server where the `MigratedVM` virtual machine resides.

To migrate the `XenVM` virtual machine, you can run the following command:

```
# pmigrate x root:1qsde34rt@192.168.1.130/XenVM v MigratedVM
```

In this command, `x` denotes that you are migrating a Xen virtual machine, and `v` indicates that the Xen virtual machine is to be moved to a Parallels virtual machine. If you omit the credentials in the command above, you will be asked to provide them during the command execution. Once the migration is complete, you can find the resulting virtual machine in the `/var/parallels` directory on the Parallels server.

**Note:** You are recommended to check the settings of the migrated virtual machine (for example, memory and network settings) and, if necessary, configure them to meet your needs.

### Troubleshooting the migration of paravirtualized Xen virtual machines

When migrating a paravirtualized Xen virtual machine, `pmigrate` first copies the whole of the virtual machine to the Parallels server and then replaces the paravirtualized kernel of the copied machine with a normal kernel from the corresponding Linux distribution. If it cannot replace the kernel, `pmigrate` displays an error but does not delete the virtual machine from the Parallels server. In this case, you can do the following:

- Remove the copied virtual machine from the Parallels server and try to migrate the virtual machine again.
- Configure the copied virtual machine on the Parallels server manually.

If you choose the second way, do the following:

- 1 Boot into the virtual machine in rescue mode using an ISO image of the Linux OS corresponding to the OS installed in the virtual machine.
- 2 Detect where on the disk the root partition is located, and mount it.
- 3 Detect all other partitions on the disk (`/boot`, `/usr`, and so on), and mount them to the corresponding directories on the root partition; also mount the `/proc` file system.
- 4 Install a normal Linux kernel (for example, from the ISO image you used to boot into the virtual machine). The normal kernel must be of the same architecture as the paravirtualized Xen kernel.
- 5 Create the `initrd` image for the normal kernel if you have not already done so when installing the kernel.
- 6 Configure the bootloader to load the normal kernel if you have not already done so when installing the kernel.
- 7 Configure the `/etc/inittab` file to start `getty` and `tty1-tty6`.
- 8 Unmount the partitions.
- 9 Restart the virtual machine, and boot into the normal kernel.

## Performing Container-Specific Operations

This section provides the description of operations specific for your Containers.

## Setting Name for Container

You can assign an arbitrary name to a Container and use it, along with the Container ID, to perform Container-related operations. For example, you can start or stop a Container by specifying the Container name instead of its ID.

You can assign names to Containers using the `--name` option of the `pctl set` command. For example, to set the `computer1` name for Container 101, run this command:

```
# pctl set 101 --name computer1 --save
Name computer1 assigned
Saved parameters for Container 101
```

You can also set a name for Container 101 by editing its configuration file:

- 1 Open the configuration file of Container 101 (`/etc/vz/conf/101.conf`) for editing, and add the following string to the file:

```
NAME="computer1"
```

- 2 In the `/etc/vz/names` directory on the server, create a symbolic link with the name of `computer1` pointing to the Container configuration file. For example:

```
# ln --symbolic /etc/vz/conf/101.conf /etc/vz/names/computer1
```

When specifying names for Containers, keep in mind the following:

- Names may contain the following symbols: a-z, A-Z, 0-9, underscores (`_`), dashes (`-`), spaces, the symbols from the ASCII character table with their code in the 128-255 range, and all the national alphabets included in the Unicode code space.
- Container names cannot consist of digits only. Otherwise, there would be no way to distinguish them from Container IDs.
- If it contains one or more spaces, the Container name must be put in single or double quotes.

Once you assign the `computer1` name to Container 101, you can start using it instead of ID 101 to perform Container-related operations. For example:

- You can stop Container 101 with the following command:

```
# pctl stop computer1
Stopping Container ...
Container was stopped
Container is unmounted
```

- You can start Container 101 anew by running the following command:

```
# pctl start computer1
Starting Container ...
...
```

You can find out what name is assigned to Container 101 in one of the following ways:

- Using the `vzlist` utility:

```
# vzlist -o name 101
NAME
computer1
```

- Checking the NAME parameter in the Container configuration file (`/etc/vz/conf/101.conf`):

```
# grep NAME /etc/vz/conf/101.conf
NAME="computer1"
```

- Checking the NAME parameter in the `/etc/vz/names/computer1` file which is a symlink to the Container configuration file:

```
# grep NAME /etc/vz/names/computer1
NAME="computer1"
```

## Moving Container Within the Parallels Server

The `vzlocal` utility allows you to move Containers within your server. Moving a Container within one and the same server consists in changing the Container ID and its private area and root paths. You can use `vzlocal` to change the ID of the corresponding Container only or to additionally modify its private area and root path.

Let us assume that you want to change the ID of your Container from 101 to 111 and modify its private area and root paths from `/vz/private/101` to `/vz/private/my_dir` and from `/vz/root/101` to `/vz/root/ct111`, respectively. To do this, execute the following command on the server:

```
# vzlocal 101:111:/vz/private/my_dir:/vz/root/ct111
Moving/copying Container#101 -> Container#111,
[/vz/private/my_dir], [/vz/root/ct111] ...
...
Successfully completed
```

To check if Container 101 has been successfully moved to Container 111, you can use the following commands:

```
# vzlist -a
CTID      NPROC STATUS  IP_ADDR      HOSTNAME
  1         43 running 10.0.10.1    localhost
 111         - stopped 10.0.10.101  myContainer
# ls /vz/private
1 my_dir
# ls /vz/root
1 ct111
```

The commands output shows that the ID of Container 101 has been changed to 111, its private area is now located in the `/vz/private/my_dir` directory on the server, and the path to its root directory is `/vz/root/ct111`.

### Notes:

1. You can use the `vzlocal` utility to move several Containers simultaneously.

2. You can run the `vzlocal` utility on both running and stopped Containers.

## Disabling Container

There may appear situations when you need to forbid Container owners to use their Containers. For example, it may happen if the Container owner uses it for unallowed purposes: intruding into computers of other users, participating in DoS attacks, and so on.

In such cases, you can disable a Container, thus making it impossible to start the Container once it was stopped. For example, you can execute the following command to disable Container 101:

```
# pct1 set 101 --disabled yes
```

Once Container 101 is stopped, the user will not be able to start it again until you enable the Container again:

```
# pct1 set 101 --disabled no
```

You can also use the `--force` option to start a disabled Container. For example:

```
# pct1 start 101
Container start disabled
# pct1 start 101 --force
Starting Container...
Container is mounted
Adding port redirection to Container(1): 4643 8443
Adding IP address(es): 10.144.144.101
Hostname for Container set: Container_101
Container start in progress...
```

## Reinstalling Container

Reinstalling a Container is used if a Container administrator has inadvertently modified, replaced, or deleted any file that is part of an application or OS template, which has brought about the Container malfunction. You can reinstall the Container in the two following ways:

- 1 The `pctl recover` command restores the original VZFS symlinks of the Container private area to the OS and/or application template(s) as they were at the time when the Container was created and/or when the application template(s) were added to the Container. This command does not deal with any user files on the Container:

```
# pctl recover 101
Optimizing Container private area...
vzquota : (warning) Quota is running for id 101 already
Setting quota ...
Container is mounted
Container is unmounted
Recover OS template: redhat-el5-x86
Creating Container private area (redhat-el5-x86)
...
Recovering Container completed successfully
```

- 2 The `pctl reinstall` command creates a new private area for the problem Container from scratch using its configuration files and its OS and application templates. Thus, a clean working copy of the Container is created:

```
# pctl reinstall 101
Optimizing Container private area...
Calculating Container disk usage...
```

```
Creating Container private area (redhat-el5-x86)
Starting Container ...
Initializing quota...
Container is mounted
Container start in progress...
Calculating Container disk usage...
Copying Container credentials...
Stopping Container ...
Container was stopped
Container is unmounted
Old Container file system has been moved to /old
Initializing quota...
Container reinstallation completed successfully
```

**Note:** If any of the Container application templates cannot be added to the Container in a normal way, the reinstallation process will fail. This may happen, for example, if an application template was added to the Container using the `--force` option of the `vzpkgadd` or `vzpkg install` command (for more information on these commands, see the *Parallels Command Line Reference Guide*).

In order to retain the personal data inside the old Container, the utility also copies the contents of the old private area to the `/old` directory of the new private area (unless the `--skipbackup` option is given). The personal data can then be copied to the corresponding directories of the new private area and the `/old` directory eventually deleted:

```
# pct1 start 101
Starting Container ...
Container is mounted
Setting devperms 20002 dev 0x7d00
Adding port redirection to Container(1): 4643 8443
Adding IP address(es) to pool:
Adding IP address(es): 10.14.14.101
Hostname for Container set: localhost.localdomain
Container start in progress...
# pct1 exec 101 ls /
bin
boot
dev
[...other directories...]
old
[...other directories...]
tmp
usr
var
```

Both the `pctl recover` and `pctl reinstall` commands retain the users' credentials base, unless the `--resetpwdb` option is specified.

## Customizing Container Reinstallation

The default reinstallation, as performed by the `pctl reinstall` command, creates a new private area for the broken Container as if it were created by the `pctl create` command and copies the private area of the broken Container to the `/old` directory in the new private area so that no file is lost. There is also a possibility of deleting the old private area altogether without copying or mounting it inside the new private area, which is done by means of the `--skipbackup` option. This way of reinstalling corrupted Containers might in certain cases not correspond exactly to your particular needs. It happens when you are accustomed to creating new Containers in some other

way than just using the `pctl create` command. For example, you may install additional software licenses into new Containers, or anything else. In this case you would naturally like to perform reinstallation in such a way so that the broken Container is reverted to its original state as determined by you, and not by the default behavior of the `pctl create` command.

To customize reinstallation, you should write your own scripts determining what should be done with the Container when it is being reinstalled, and what should be configured inside the Container after it has been reinstalled. These scripts should be named `vps.reinstall` and `vps.configure`, respectively, and should be located in the `/etc/vz/conf` directory on the server. To facilitate your task of creating customized scripts, the Containers software is shipped with sample scripts that you may use as the basis of your own scripts.

When the `pctl reinstall <CT_ID>` command is called, it searches for the `vps.reinstall` and `vps.configure` scripts and launches them consecutively. When the `vps.reinstall` script is launched, the following parameters are passed to it:

<code>--veid</code>	The ID of the Container.
<code>--ve_private_tmp</code>	The path to the Container temporary private area. This path designates where a new private area is temporarily created for the Container. If the script runs successfully, this private area is mounted to the path of the original private area after the script has finished.
<code>--ve_private</code>	The path to the Container original private area.

You may use these parameters within your `vps.reinstall` script.

If the `vps.reinstall` script finishes successfully, the Container is started, and the `vps.configure` script is called. At this moment the old private area is mounted to the `/old` directory inside the new one irrespective of the `--skipbackup` option. This is done in order to let you use the necessary files from the old private area in your script, which is to be run inside the running Container. For example, you might want to copy some files from there to regular Container directories.

After the `vps.configure` script finishes, the old private area is either dismounted and deleted or remains mounted depending on whether the `--skipbackup` option was provided.

If you do not want to run these reinstallation scripts and want to stick to the default `pctl reinstall` behavior, you may do either of the following:

- 1 Remove the `vps.reinstall` and `vps.configure` scripts from the `/etc/vz/conf` directory, or at least rename them;
- 2 Modify the last line of the `vps.reinstall` script so that it would read

```
exit 128
```

instead of

```
exit 0
```

The 128 exit code tells the utility not to run the scripts and to reinstall the Container with the default behavior.

## Performing Virtual Machine-Specific Operations

This section focused on operations specific for your virtual machines.

### Viewing Detailed Information About Virtual Machines

To view detailed information about a virtual machine, you can use the `pctl list -i` command. For example, the following command lists all information about the `MyVM` virtual machine:

```
# pctl list -i MyVM
ID: {5c1fb1bb-4364-4b42-86b2-c584bdd2223b}
EnvID: 2075205468
Name: MyVM
Description:
State: running
OS: win-7
Uptime: 21:49:55 (since 2011-05-19 12:25:19)
Home: /var/parallels/MyVM.pvm/
Owner: root@.
Effective owner: owner
GuestTools: state=installed
Autostart: off
Autostop: shutdown
Boot order: hdd0 cdrom0 fdd0
Remote display: mode=off port=6500 address=0.0.0.0
Remote display state: stopped
Hardware:
  cpu 1 VT-x accl=high mode=32 ioprio=4 iolimit=0
  memory 1024Mb
  video 32Mb
  memory_quota auto
  fdd0 (+) real='/dev/fd0' state=disconnected
  hdd0 (+) sata:0 image='/var/parallels/MyVM.pvm/MyVM-0.hdd' 65536Mb
  cdrom0 (+) sata:1 real='D: ' state=disconnected
  parallel0 (+) real='/dev/lp0'
  usb (+)
  net0 (+) dev='vme7bb11f5c.0' network='Bridged' mac=001C427B68E3 card=e1000
Host Shared Folders: (+)
SmartMount: (-)
VirtualUsbMouse: state=disabled
Encrypted: no
Offline management: (-)
```

The following table describes the main options displayed by `pctl list -i`.

Option Name	Description
ID	Virtual machine identifier. Usually, you use this ID, along with the virtual machine name, when performing an operation on the virtual machine.
EnvID	Kernel virtual machine identifier. This is the ID the kernel on the physical server uses to refer to a virtual machine when displaying some information on this virtual machine.
Name	Virtual machine name.



Description	Virtual machine description.
State	Virtual machine state.
OS	Guest operating system installed in a virtual machine.
Uptime	Time a virtual machine has been up and running from its last start.
Home	Directory storing virtual machine files.
Guest Tools	Shows whether Parallels Tools are installed in a virtual machine.
Autostart	Shows whether a virtual machine is automatically started when you turn on the physical server.
Boot order	Order in which the virtual machine devices are checked for an operating system.
Hardware	Devices available in a virtual machine.

## Pausing a Virtual Machine

Pausing a running virtual machine releases the resources, such as RAM and CPU, currently used by this virtual machine. The released resources can then be used by the Parallels server or other running virtual machines and Containers.

To pause a virtual machine, you can use the `pctl pause` command. For example, the following command pauses the `My_VM` virtual machine:

```
# pctl pause My_VM
Pause the VM...
The VM has been successfully paused.
```

You can check that the virtual machine has been successfully paused by using the `pctl list -a` command:

```
# pctl list -a
STATUS  IP_ADDR      NAME
running 10.10.10.101 101
paused  10.10.10.201 My_VM
```

The command output shows that the `My_VM` virtual machine is paused at the moment. To continue running this virtual machine, execute this command:

```
# pctl start My_VM
Starting the VM...
The VM has been successfully started.
```

## Managing Snapshots

In Parallels Server Bare Metal, you can save the current state of a virtual machine by creating a snapshot. You can then continue working in your virtual machine and return to the saved state any time you wish. For example, you can make use of snapshots in the following cases:

- You are going to configure an application with a lot of settings. In this case, you may first wish to play with settings before applying them to your application. So, you create a snapshot before starting to experiment with the application settings.
- You are involved in a large development project. In this case, you may wish to mark milestones in the development process by creating a snapshot after each milestone. If anything goes wrong, you can easily revert to the previous milestone and start the development anew.

In Parallels Server Bare Metal, you can manage snapshots as follows:

- create a new snapshot of a virtual machine
- list the existing snapshots of a particular virtual machine
- revert to a snapshot
- remove a snapshot

All these operations are described in the following subsections in detail.

### Creating a Snapshot

To create a snapshot of a virtual machine in Parallels Server Bare Metal, you can use the `pctl snapshot` command. For example, you can execute the following command to create a snapshot of the `MyVM` virtual machine:

```
# pctl snapshot MyVM
Creating the snapshot...
The snapshot with ID {12w32198-3e30-936e-a0bbc104bd20} has been successfully created.
```

A newly created snapshot is saved to the `/vz/VM_Name.pvm/Snapshots/Snapshot_ID.pvs` file where `VM_Name` denotes the name of the corresponding virtual machine and `Snapshot_ID` is a random ID assigned to the snapshot. In the command above, the snapshot is assigned the ID of `{12w32198-3e30-936e-a0bbc104bd20}` and saved to the `/vz/MyVM/Snapshots/{12w32198-3e30-936e-a0bbc104bd20}.pvs` file.

```
# ls /vz/MyVM.pvm/Snapshots/
{063615fa-f2a0-4c14-92d4-4c935df15840}.pvc
```

The ID assigned to the snapshot can be used to manage this snapshot (e.g. get detailed information on the snapshot or delete it).

When creating a snapshot, you can also set a name for it and provide its description:

```
# pctl snapshot MyVM -n Clean_System -d "This snapshot was created right after
installing the Windows XP operating system"
Creating the snapshot...
The snapshot with ID {0i8798uy-1e00-786d-nn9ic106b9ik} has been successfully created.
```

You can then view the set name and description in the `/vz/MyVM/Snapshots.xml` file or in Parallels Management Console.

When working with snapshots, keep in mind the following:

- If a virtual machine name contains spaces, use quotation marks to specify the name in `pctl` commands (e.g. "Windows XP").

- Before creating a snapshot, it is recommended that you complete all operations of installing, downloading, or writing to external devices. You should also complete or cancel any transactions performed via the virtual machine in external databases.

## Creating Branches

The branches are created when you do the following:

- 1 Create several sequential snapshots.
- 2 Revert to an intermediate snapshot.
- 3 Make some changes to the virtual machine.
- 4 Save the virtual machine state by creating a new snapshot.

In this case, the newly created snapshot will start a new branch using the intermediate snapshot from **Step 2** as the baseline.

## Listing Snapshots

To list all snapshots of a particular virtual machine, use the `pctl snapshot-list` command:

```
# pctl snapshot-list MyVM
PARENT_SNAPSHOT_ID          SNAPSHOT_ID
{989f3415-3e30-4494-936e-a0bbc104bd20} {989f3415-3e30-4494-936e-a0bbc104bd20}
{989f3415-3e30-4494-936e-a0bbc104bd20} *{063615fa-f2a0-4c14-92d4-4c935df15840}
```

This command shows that currently two snapshots exist for the `MyVM` virtual machine. The snapshot with ID `{063615fa-f2a0-4c14-92d4-4c935df15840}` is based on the snapshot with ID `{989f3415-3e30-4494-936e-a0bbc104bd20}`, i.e. the latter acts as the parent for the snapshot with ID `{063615fa-f2a0-4c14-92d4-4c935df15840}`. The `*` sign before `{063615fa-f2a0-4c14-92d4-4c935df15840}` denotes that this is the current snapshot for the given virtual machine.

You can also view the relationship between snapshots by specifying the `-t` option:

```
# pctl snapshot-list MyVM -t
_{989f3415-3e30-4494-936e-a0bbc104bd20}__{063615fa-f2a0-4c14-92d4-4c935df15840}
\*_{712305b0-3742-4ecc-9ef1-9f1e345d0ab8}
```

The command output shows you that currently 2 branches exist for the `MyVM` virtual machine. The snapshot with ID `{989f3415-3e30-4494-936e-a0bbc104bd20}` is the baseline used as a starting point for these branches.

You can get detailed information on a particular snapshot using the `-i` option and specifying the snapshot ID:

```
# pctl snapshot-list MyVM -i {063615fa-f2a0-4c14-92d4-4c935df15840}
ID: {063615fa-f2a0-4c14-92d4-4c935df15840}
Name: Clean_System
Date: 2009-07-22 22:39:06
Current: yes
State: power_off
```

```
Description: <![CDATA[This snapshot was created right after installing Windows XP operating system]]>
```

The `pctl snapshot-list` command displays the following information about snapshots:

Field	Description
ID	The ID assigned to the snapshot.
Name	The name assigned to the snapshot.
Date	The date and time when the snapshot was created.
Current	Denotes whether this is the current snapshot of the virtual machine.
State	The state the virtual machine was in at the time you took the snapshot.
Description	The description set for the snapshot.

## Reverting to a Snapshot

You can use the `pctl snapshot-switch` command to revert to a snapshot. When you revert to a snapshot, the current state of the virtual machine is discarded, and all changes made to the system since the previous snapshot are lost. So, before returning to a specific snapshot, you may first wish to save these states by creating a new snapshot. Refer to the [Creating a Snapshot subsection](#) (p. 66) for information on how you can do it.

The `pctl snapshot-switch` command requires the virtual machine name and the snapshot ID to be specified as arguments:

```
pctl snapshot-switch "Windows XP" --id {cedbc4eb-dee7-42e2-9674-89d1d7331a2d}
Switch to the snapshot...
The VM has been successfully switched.
```

This command restores the snapshot with ID `{cedbc4eb-dee7-42e2-9674-89d1d7331a2d}` for the `Windows XP` virtual machine.

## Deleting a Snapshot

In Parallels Server Bare Metal, you can use the `pctl snapshot-delete` command to delete those snapshots that you do not need any more. Assuming that you want to delete the snapshot with ID `{903c12ea-f6e6-437a-a2f0-a1d02eed4f7e}` for the `MyVM` virtual machine, you can run this command:

```
# pctl snapshot-delete MyVM --id {903c12ea-f6e6-437a-a2f0-a1d02eed4f7e}
Deleting the snapshot...
The snapshot has been successfully deleted.
```

When you delete a parent snapshot, its children are not deleted, and the information the parent snapshot contains is merged into them.

For example, the following session demonstrates the process of deleting the snapshot with ID `{903c12ea-f6e6-437a-a2f0-a1d02eed4f7e}` acting as a parent for another snapshot:

```
# pctl snapshot-list MyVM
PARENT_SNAPSHOT_ID          SNAPSHOT_ID
```

```

{989f3415-3e30-4494-936e-a0bbc104bd20} {989f3415-3e30-4494-936e-a0bbc104bd20}
{063615fa-f2a0-4c14-92d4-4c935df15840} {063615fa-f2a0-4c14-92d4-4c935df15840}
{063615fa-f2a0-4c14-92d4-4c935df15840} *{58c9941e-f232-4273-892a-82e836536889}
# pctl snapshot-delete MyVM --id {903c12ea-f6e6-437a-a2f0-a1d02eed4f7e}
Deleting the snapshot...
The snapshot has been successfully deleted.
# pctl snapshot-list MyVM
PARENT_SNAPSHOT_ID          SNAPSHOT_ID
{063615fa-f2a0-4c14-92d4-4c935df15840} {063615fa-f2a0-4c14-92d4-4c935df15840}
{063615fa-f2a0-4c14-92d4-4c935df15840} *{58c9941e-f232-4273-892a-82e836536889}

```

## Managing Templates

A template in Parallels Server Bare Metal is a pre-configured virtual machine that can be easily and quickly deployed into a fully functional virtual machine. Like any normal virtual machine, a template contains hardware (virtual disks, peripheral devices) and the operating system. It can also have additional software installed. In fact, the only main difference between a virtual machine and a template is that the latter cannot be started.

In Parallels Server Bare Metal, you can perform the following operations on templates:

- create a new template
- list the existing templates
- create a virtual machine from a template

These operations are described in the following subsections in detail.

### Create a Template

In Parallels Server Bare Metal, you can create a virtual machine template using the `pctl clone` utility. Making a template may prove useful if you need to create several virtual machines with the same configuration. In this case, your steps can be as follows:

- 1 You create a virtual machine with the required configuration.
- 2 You make a template on the basis of the created virtual machine.
- 3 You use the template to create as many virtual machines as necessary.

Let us assume that you want to create a template of the `My_VM` virtual machine. To do this, you can run the following command:

```

# pctl clone My_VM --name template1 --template
Clone the My_VM VM to VM template template1...
Operation progress 98%
The VM has been successfully cloned.

```

This command clones the `My_VM` virtual machine and saves it as the `template1` template. After the template has been successfully created, you can use it for creating new virtual machines.

### Listing Templates

Sometimes, you may need to get an overview of the virtual machine templates available on your Parallels server. For example, this may be necessary if you plan to create a virtual machine from a specific template, but do not remember its exact name. In this case, you can use the `pctl list` command to list all templates on the Parallels server and find the necessary one:

```
# pctl list -t
{4ad11c28-9f0e-4086-84ea-9c0487644026} win-2003      template1
{64bd8fea-6047-45bb-a144-7d4bba49c849} rhel         template3
{6d3c9d6f-921a-484d-9772-bc7096f68df1} win-2003      template2
```

In this example, 3 virtual machine templates exist on the Parallels server. The information on these templates is presented in the form of a table with the following columns (from left to right): the template ID, the operating system contained in the template, and the template name.

### Deploying a Template

Though a template has the same components as a virtual machine (hardware, software, etc.), it cannot be started. To run a template as a virtual machine, you need first to convert the template. By converting a template, you create a virtual machine with the configuration identical to that of the template.

To convert a template into a virtual machine, use the `--ostemplate` option of the `pctl create` command. For example, to convert the `template1` template to a virtual machine with the `Converted_VM` name, you can run this command:

```
# pctl create Converted_VM --ostemplate template1
Creating the VM on the basis of the template1 template...
Clone the template1 VM to the VM Converted_VM...
Operation progress 99%
The VM has been successfully cloned.
```

To check that the `Converted_VM` virtual machine has been successfully created, use the `pctl list -a` command:

```
# pctl list -a
STATUS      IP_ADDR      NAME
running     10.12.12.101 111
stopped     10.12.12.34  Converted_VM
running     10.30.17.149 Windows XP
```

The template itself is left intact and can be used for creating other virtual machines:

```
# pctl list -t
{4ad11c28-9f0e-4086-84ea-9c0487644026} win-2003      template1
{64bd8fea-6047-45bb-a144-7d4bba49c849} rhel         template2
```

### Managing Virtual Machine Disks

In Parallels Server Bare Metal, you can manage virtual machine disks as follows:

- change the type of your virtual disks
- increase the capacity of your virtual disks

- reduce the capacity of your virtual disks
- reduce the size occupied by your virtual disks on the physical hard drive

All these operations are described in the following subsections in detail.

## Changing the Disk Type

A virtual disk can be one of the two types:

- `plain`. A plain virtual hard disk has a fixed size from the moment of its creation.
- `expanding`. An expanding virtual hard disk is small initially. Its size grows as you add applications and data to it.

A new virtual machine is created with an expanding virtual disk. However, you can change the type of the virtual disk using either the `pctl` or `prl_disk_tool` utility. Let us assume that the current type of the `hdd0` virtual disk in the `MyVM` virtual machine is expanding and you want to change it to plain. To do this, you can execute one of the following commands:

```
# pctl set MyVM --device-set hdd0 --type plain
```

or

```
# prl_disk_tool convert --hdd /vz/vmprivate/MyVM/harddisk.hdd --plain
```

The main difference between these two commands is that `pctl` requires for its execution the disk name as it is shown by the `pctl list --info` command (`hdd0`) while `prl_disk_tool` needs the full path to the virtual disk drive (`/vz/vmprivate/MyVM/harddisk.hdd`).

To change the disk type back to expanding, run one of the following commands:

```
# pctl set MyVM --device-set hdd0 --type expand
```

or

```
# prl_disk_tool convert --hdd /vz/vmprivate/MyVM/harddisk.hdd --expanding
```

## Increasing the Disk Capacity

If you find that the capacity of your virtual machine's hard disk does not fit your needs anymore, you can increase it using the `prl_disk_tool` utility. For example, you can execute the following command to set the capacity for the `MyVM-0.hdd` disk to 80 GB:

```
# prl_disk_tool resize --size 80000 --hdd /vz/MyVM.pvm/MyVM-0.hdd/
Operation progress 100%
```

This command adds additional disk space as unallocated space. You can use standard means (e.g. the Disk Management tool in Windows-based virtual machines) to allocate this space by creating a new partition or expanding an existing one.

At the same time, you can use the `--resize_partition` option to automatically add additional space to the last partition on the virtual disk:

```
# prl_disk_tool resize --size 80000 --hdd /vz/MyVM.pvm/MyVM-0.hdd/ --resize_partition
Operation progress 100%
```

When increasing the disk capacity, keep in mind the following:

- You cannot increase the capacity of a virtual disk if the virtual machine using this disk is running.
- The virtual machine using the virtual disk you want to configure must not have any snapshots. Otherwise, the operation will fail:

```
# prl_disk_tool resize --size 68000 --hdd /vz/MyVM.pvm/MyVM-0.hdd/  
This disk has one or more snapshots and cannot be resized.  
You need to delete snapshots using the pctl tool before resizing the disk.
```

In this case, you should delete all existing snapshots and run the command again. To learn how to delete virtual machine snapshots, refer to **Deleting a Snapshot** (p. 68).

- The capacity of an expanding virtual disk shown from inside the virtual machine and the size the virtual disk occupies on the server's physical disk may differ.

## Reducing the Disk Capacity

Parallels Server Bare Metal provides a possibility to reduce the size of an expanding virtual disk by setting the limit the disk cannot exceed. In general, the process of reducing a virtual disk includes these steps:

- 1 Finding out the minimum capacity to which the disk can be reduced.
- 2 Running the `prl_dsk_tool resize` command to reduce the disk.

## Checking the Minimum Disk Capacity

Before reducing a virtual disk, you may wish to see the minimum capacity to which it can be reduced. To do this, use the `prl_disk_tool resize --info` command. For example, you can run the following command to get detailed information on the `MyVM-0.hdd` disk:

```
# prl_disk_tool resize --info --hdd /vz/MyVM.pvm/MyVM-0.hdd  
Operation progress 100 %  
Disk information:  
    Size:                               65537M  
    Minimum:                             2338M  
    Minimum without resizing the last partition: 65523M
```

The information on the virtual disk is presented in the form of the following table:

Column Name	Description
Size	The virtual disk capacity, in megabytes, as it is seen from inside the virtual machine.
Minimum	The virtual disk capacity, in megabytes, after resizing the disk using the <code>prl_disk_tool</code> utility with the <code>--resize_partition</code> option.
Minimum without resizing the last partition	The virtual disk capacity, in megabytes, after resizing the disk using the <code>prl_disk_tool</code> utility without the <code>--resize_partition</code> option.



## Reducing the Disk Size

Once you know the minimum capacity of the virtual disk, you can start reducing it. For example, to reduce the `MyVM-0.hdd` disk to 30 GB, you can execute the following command:

```
# prl_disk_tool resize --size 30G --hdd /vz/MyVM.pvm/MyVM-0.hdd --resize_partition
Operation progress 100 %
```

When reducing the disk capacity, keep in mind the following:

- You cannot reduce the capacity of a virtual disk if the virtual machine using this disk is running.
- The virtual machine using the virtual disk you want to configure must not have any snapshots. Otherwise, you will be informed of this fact:

```
# prl_disk_tool resize --size 68000 --hdd /vz/MyVM.pvm/MyVM-0.hdd/
This disk has one or more snapshots and cannot be resized.
You need to delete snapshots using the pct1 tool before resizing the disk.
```

In this case, you should delete all existing snapshots and run the command again. To learn how to delete virtual machine's snapshots, refer to **Deleting a Snapshot** (p. 68).

- The capacity of an expanding virtual disk shown from inside the virtual machine and the size the virtual disk occupies on the server's physical disk may differ.

## Compacting Disks

In Parallels Server Bare Metal, you can decrease the space your virtual machines occupy on the Parallels server's disk drive by compacting their virtual disks. Compacting virtual disks allows you to save your server's disk space and host more virtual machines and Containers on the server.

**Note:** Plain disk cannot be compacted.

To compact a virtual disk, you can use the `prl_disk_tool compact` command. For example, to compact the `MyVM-0.hdd` disk, you can run this command:

```
# prl_disk_tool compact --hdd /vz/MyVM.pvm/MyVM-0.hdd/
Operation progress 100 %
```

To check the space that was freed by compacting the virtual disk, you can use standard Linux utilities (for example, the `df` utility).

## Managing Disk Interfaces

By default, any virtual machine is created with a SATA (Serial Advanced Technology Attachment) virtual hard disk. If necessary, you can change the interface type of a disk from SATA to SCSI (Small Computer System Interface) or IDE (Integrated Drive Electronics). For example, to change the interface type of the default disk (`hdd0`) in the `MyVM` virtual machine from SATA to SCSI, you can run the following command:

```
# pct1 set MyVM --device-set hdd0 --iface scsi
The VM has been successfully configured
```

To check that the interface type has been successfully changed, use this command:

```
# pct1 list -i MyVM | grep hdd0
Boot order: hdd0 cdrom0 fdd0 net0
hdd0 (+) scsi:0 image='/var/parallels/VM_SCSI.pvm/harddisk.hdd' 65536Mb
```

The command output shows that now the interface type of the hdd0 disk is SCSI.

You can create additional disks for the MyVM virtual machine. For example, to add a new disk of the SCSI type to the virtual machine, execute the following command:

```
# pct1 set MyVM --device-add hdd --iface scsi
Creating hdd1 (+) scsi:1 image='/var/parallels/MyVM.pvm/harddisk1.hdd' 65536Mb
Create the expanding image file, 65536Mb...
The VM has been successfully configured.
```

You can also create an IDE disk. To do this, specify `--iface ide` instead of `--iface scsi` in the command above. If you omit the `--iface` option, a SATA disk is created by default.

The maximum number of devices (both virtual hard disks and CD/DVD-ROM drives) you can add to a virtual machine is given below:

- 4 IDE devices
- 6 SATA devices
- 15 SCSI devices

At any time, you can remove the hdd1 disk from the MyVM virtual machine:

```
# pct1 set MyVM --device-del hdd1
Remove the hdd1 device.
The VM has been successfully configured.
```

### Notes:

1. SATA virtual disks can be added to or removed from both running and stopped virtual machines while operations with IDE and SCSI disks can be performed on stopped virtual machines only.
2. You need to initialize a newly added disk before you can start using it. To initialize the disk, use standard means provided by your guest operating system.
3. For more information on the `pct1` utility and its options, see the *Parallels Server Bare Metal 5.0 Reference Guide*.

## Managing Virtual Machine Devices

Parallels Server Bare Metal allows you to manage the following virtual machine devices:

- hard disk drives
- CD/DVD-ROM drives
- floppy disk drives
- network adapters
- serial and parallels ports

- sound cards
- USB controllers

The main operations you can perform on these devices are:

- adding a new device to the virtual machine
- configuring the device properties
- removing a device from the virtual machine

## Adding a New Device

This section provides information on adding new devices to your virtual machines. You can add new virtual devices to your virtual machine using the `pctl set` command. The options responsible for adding particular devices are listed in the following table:

Option Name	Description
<code>hdd</code>	Adds a new hard disk drive to the virtual machine. You can either connect an existing image to the virtual machine or create a new one.
<code>cdrom</code>	Adds a new CD/DVD-ROM drive to the virtual machine.
<code>net</code>	Adds a new network adapter to the virtual machine.
<code>fdd</code>	Adds a new floppy disk drive to the virtual machine.
<code>serial</code>	Adds a new serial port to the virtual machine.
<code>parallel</code>	Adds a new parallel port to the virtual machine.
<code>sound</code>	Adds a new sound device to the virtual machine.
<code>usb</code>	Adds a new USB controller to the virtual machine.

**Note:** SATA disks can be added to running and stopped virtual machines while IDE and SCSI disks—to stopped virtual machines only.

For example, you can execute the following command to add a new virtual disk to the `MyVM` virtual machine:

```
# pctl set MyVM --device-add hdd
Creating hdd1 (+) sata:0 image='/var/parallels/MyVM.pvm/harddisk1.hdd
Create the expanding disk, 65536...
The VM has been successfully configured.
```

This command creates a new virtual disk with the following default parameters:

- name: `hdd1`
- disk type: SATA
- image file name and location: `/var/parallels/MyVM.pvm/harddisk1.hdd`
- disk format: `expanding`
- disk capacity: 65536 MB

You can redefine some of these parameters by specifying specific options during the command execution. For example, to create an IDE virtual disk that will have the capacity of 84 GB, you can run this command:

```
# pct1 set MyVM --device-add hdd --size 84000 --iface ide
Creating hdd1 (+) ide:l image='/var/parallels/MyVM.pvm/harddisk1.hdd
Create the expanding disk, 84000Mb...
The VM has been successfully configured.
```

The virtual disk has been added to your virtual machine. However, before starting to use it, you must initialize the disk. Refer to the next subsection for information on how you can do it.

When managing devices, keep in mind the following:

- Detailed information on all options that can be passed to `pctl set` when creating a new virtual machine device is provided in the *Parallels Server Bare Metal 5.0 Reference Guide*.
- You can connect up to 4 IDE devices, 6 SATA devices, and 15 SCSI devices (virtual disks or CD/DVD-ROM drives) to a virtual machine.
- If you want to use an existing image file as a virtual CD/DVD-ROM drive, keep in mind that Parallels Server Bare Metal supports `.iso`, `.cue`, `.ccd` and `.dmg` (non-compressed and non-encrypted) image files.
- A virtual machine can have only one floppy disk drive.
- A virtual machine can have up to 16 virtual network adapters.
- A virtual machine can have up to four serial ports.
- A virtual machine can have up to three parallel ports.
- Any virtual machine can have only one sound device.
- A virtual machine can have only one USB controller.

### Initialize the Newly Added Disk

After you added a new blank virtual hard disk to the virtual machine configuration, it will be invisible to the operating system installed inside the virtual machine until the moment you initialize it.

### Initializing the New Virtual Hard Disk in Windows

To initialize a new virtual hard disk in a Windows guest OS, you will need the Disk Management utility available. For example, in Windows 7 and Windows XP you can access this utility by doing the following:

- In Windows 7, click **Start > Control Panel > System and Security > Administrative Tools > Computer Management Storage > Disk Management**.
- In Windows XP, click **Start > Control Panel > Administrative Tools > Computer Management > Storage > Disk Management**.

When you open the Disk Management utility, it automatically detects that a new hard disk was added to the configuration and launches the **Initialize and Convert Disk** wizard:

- 1 In the introduction window, click **Next**.
- 2 In the **Select Disks to Initialize** window, select the newly added disk and click **Next**.
- 3 In the **Select Disks to Convert** window, select the newly added disk and click **Finish**.

The added disk will appear as a new disk in the Disk Management utility window, but its memory space will be unallocated. To allocate the disk memory, right-click this disk name in the Disk Management utility window and select **New Simple Volume** in Windows Vista or **New Volume** in Windows XP. The **New Simple Volume Wizard/New Volume Wizard** window will appear. Follow the steps of the wizard and create a new volume in the newly added disk.

After that your disk will become visible in **Computer/My Computer** and you will be able to use it as a data disk inside your virtual machine.

### Initializing the New Virtual Hard Disk in Linux

Initializing a new virtual hard disk in a Linux guest OS comprises two steps: (1) allocating the virtual hard disk space and (2) mounting this disk in the guest OS.

To allocate the space, you need to create a new partition on this virtual hard disk using the `fdisk` utility:

**Note:** To use the `fdisk` utility, you need the `root` privileges.

- 1 Launch a terminal window.
- 2 To list the IDE disk devices present in your virtual machine configuration, enter:

```
fdisk /dev/hd*
```

**Note:** If you added a SCSI disk to the virtual machine configuration, use the `fdisk /dev/sd*` command instead.

- 3 By default, the second virtual hard disk appears as `/dev/hdc` in your Linux virtual machine. To work with this device, enter:

```
fdisk /dev/hdc
```

**Note:** If this is a SCSI disk, use the `fdisk /dev/sdc` command instead.

- 4 To get detailed information about the disk, enter:

```
p
```

- 5 To create a new partition, enter:

```
n
```

- 6 To create the primary partition, enter:

```
p
```

- 7 Specify the partition number. By default, it is 1.

- 8 Specify the first cylinder. If you want to create a single partition on this hard disk, use the default value.

**9** Specify the last cylinder. If you want to create a single partition on this hard disk, use the default value.

**10** To create a partition with the specified settings, enter:

```
w
```

When you allocated the space on the newly added virtual hard disk, you should format it by entering the following command in the terminal:

```
mkfs -t <FileSystem> /dev/hdc1
```

**Note:** <FileSystem> stands for the file system you want to use on this disk. It is recommended to use `ext3` or `ext2`.

When the added virtual hard disk is formatted, you can mount it in the guest OS.

**1** To create a mount point for the new virtual hard disk, enter:

```
mkdir /mnt/hdc1
```

**Note:** You can specify a different mount point.

**2** To mount the new virtual hard disk to the specified mount point, enter:

```
mount /dev/hdc1 /mnt/hdc1
```

When you mounted the virtual hard disk, you can use its space in your virtual machine.

## Configuring Virtual Devices

In Parallels Server Bare Metal, you can use the `--device-set` option of the `pctl set` command to configure the parameters of an existing virtual device. As a rule, the process of configuring the device properties includes two steps:

- 1** Finding out the name of the device you want to configure.
- 2** Running the `pctl set` command to configure the necessary device properties.

## Finding Out Device Names

To configure a virtual device, you need to specify its name when running the `pctl set` command. If you do not know the device name, you can use the `pctl list` command to learn it. For example, to obtain the list of virtual devices in the `MyVM` virtual machine, run this command:

```
# pctl list --info MyVM
...
Hardware:
  cpu 2 VT-x accl=high mode=32
  memory 256Mb
  video 46Mb
  fdd0 (+) real='/dev/fd0' state=disconnected
  hdd0 (+) sata:0 image='/var/parallels/MyVM.pvm/harddisk.hdd' 27000Mb
  hdd1 (+) scsi:0 image='/var/parallels/MyVM.pvm/harddisk1.hdd' 32768Mb
  cdrom0 (+) ide:1 real='Default CD/DVD-ROM'
  parallel0 (+) real='/dev/lp0'
  usb (+)
  net0 (+) type=bridged iface='eth1' mac=001C4201CED0
...
```

All virtual devices currently available to the virtual machine are listed under `Hardware`. In our case the `MyVM` virtual machine has the following devices: 2 CPUs, main memory, video memory, a floppy disk drive, 2 hard disk drives, a CD/DVD-ROM drive, a parallel port, a USB controller, and a network card.

## Configuring Virtual Devices

Once you know the virtual device name, you can configure its properties. For example, you can execute the following command to configure the current type of the virtual disk `hdd1` in the `MyVM` virtual machine from SATA to SCSI:

```
# pct1 set MyVM --device-set hdd1 --iface scsi
The VM has been successfully configured.
```

To check that the virtual disk type has been successfully changed, use the `pctl list --info` command:

```
# pctl list --info MyVM
...
  hdd0 (+) scsi:1 image='/var/parallels/MyVM.pvm/harddisk.hdd' 85000Mb
...
```

## Connecting and Disconnecting Virtual Devices

In Parallels Server Bare Metal, you can connect or disconnect certain devices when a virtual machine is running. These devices include:

- SATA hard drives
- CD/DVD-ROM drives
- floppy disk drives
- network adapters
- printer ports
- serial ports
- sound devices
- USB devices
- shared folders

Usually, all virtual devices are automatically connected to a virtual machine when you create them. To disconnect a device from the virtual machine, you can use the `pctl set` command. For example, the following command disconnects the CD/DVD-ROM drive `cdrom0` from the `MyVM` virtual machine:

```
# pctl set MyVM --device-disconnect cdrom0
Disconnect device: cdrom0
The VM has been successfully configured.
```

To connect the CD/DVD-ROM drive back, you can run the following command:

```
# pctl set MyVM --device-connect cdrom0
```

```
Connect device: cdrom0
The VM has been successfully configured.
```

### Deleting a Device

You can delete a virtual device that you do not need any more in your virtual machine using the `--device-del` option of the `pctl set` command. The options responsible for removing particular devices are listed in the following table:

Option Name	Description
<code>hdd</code>	Deletes the specified hard disk drive from the virtual machine.
<code>cdrom</code>	Deletes the specified CD/DVD-ROM drive from the virtual machine.
<code>net</code>	Deletes the specified network adapter from the virtual machine.
<code>fdd</code>	Deletes the floppy disk drive from the virtual machine.
<code>serial</code>	Deletes the specified serial port from the virtual machine.
<code>parallel</code>	Deletes the specified parallel port from the virtual machine.
<code>sound</code>	Deletes the sound device from the virtual machine.
<code>usb</code>	Deletes the USB controller from the virtual machine.

**Note:** SATA disks can be removed from running and stopped virtual machines while IDE and SCSI disks—from stopped virtual machines only.

As a rule deleting a virtual device involves performing two operations:

- 1 Finding out the name of the device to be deleted.
- 2 Deleting the device from the virtual machine.

### Finding Out the Device Name

To remove a virtual device, you need to specify its name when running the `pctl set` command. If you do not know the device name, you can use the `pctl list` command to learn it. For example, to obtain the list of virtual devices in the `MyVM` virtual machine, run this command:

```
# pctl list --info MyVM
...
Hardware:
cpu 2 VT-x accl=high mode=32
memory 256Mb
video 46Mb
fdd0 (+) real='/dev/fd0' state=disconnected
hdd0 (+) ide:0 image='/var/parallels/MyVM.pvm/harddisk.hdd' 27Mb
hdd1 (+) scsi:0 image='/var/parallels/MyVM.pvm/harddisk1.hdd' 32768Mb
cdrom0 (+) ide:1 real='Default CD/DVD-ROM'
parallelo (+) real='/dev/lp0'
usb (+)
net0 (+) type=bridged iface='eth1' mac=001C4201CED0
...
```



All virtual devices currently available to the virtual machine are listed under `Hardware`. In our case the `MyVM` virtual machine has the following devices: 2 CPUs, main memory, video memory, a floppy disk drive, 2 hard disk drives, a CD/DVD-ROM drive, a parallel port, a USB controller, and a network card.

## Deleting a Virtual Device

Once you know the virtual device name, you can remove it from your virtual machine. For example, you can execute the following command to remove the virtual disk `hdd1` from the `MyVM` virtual machine:

```
# pct1 set MyVM --device-del hdd1
Remove the hdd1 device.
The VM has been successfully configured.
```

When deleting virtual machine devices, keep in mind the following:

- If you do not want to permanently delete a virtual device, you can temporarily disconnect it from the virtual machine using the `--disable` option.
- Detailed information on all options that can be used with `pctl set` when deleting a device is given in the *Parallels Command Line Reference Guide*.

## Making Screenshots

In Parallels Server Bare Metal, you can use the `pctl capture` command to capture an image (or screenshot) of your virtual machine screen. You can take screenshots of running virtual machines only. The session below demonstrates how to take a screenshot of the `My_VM` virtual machine screen and save it to the `/usr/screenshots/image1.png` file:

**1** Make sure that the virtual machine is running:

```
# pct1 list
STATUS  IP_ADDR      NAME
running 10.10.10.101 101
running 10.10.10.201 My_VM
```

**2** Take the virtual machine screenshot:

```
# pct1 capture My_VM --file /usr/screenshots/image1.png
Capture the VM screen...
The VM screen has been saved to /usr/screenshots/image1.png
```

**3** Check that the `image1.png` file has been successfully created:

```
# ls /usr/screenshots/
image1.png
```

## Assigning USB Devices to Virtual Machines

In Parallels Server Bare Metal, you can assign a USB device to a virtual machine so that the device is automatically connected to the virtual machine when you connect the USB device to the Parallels server or start the virtual machine. To assign a USB device to a virtual machine, you need to specify two parameters:

- *ID of the USB device.* To get this information, use the `prlsrvctl info` command, for example:

```
# prlsrvctl info
...
Hardware info:
  hdd                                '/dev/sda'
hdd-part NTFS                        '/dev/sda2'
hdd-part Linux                       '/dev/sda3'
hdd-part Linux                       '/dev/sda5'
hdd-part Linux swap                  '/dev/sda6'
cdrom Optiarc DVD RW AD-7260S       '/dev/scd0'
net eth0                             'eth0'
usb Broadcom - USB Device 3503      '2-1.4.3|0a5c|3503|full|KM|Empty'
usb Broadcom - USB Device 3502      '2-1.4.2|0a5c|3502|full|KM|Empty'
usb LITEON Technology - USB Multimedia Keyboard '1-1.6|046d|c312|low|KM|Empty'
serial /dev/ttyS0                    '/dev/ttyS0'
serial /dev/ttyS1                    '/dev/ttyS1'
```

All USB devices available on the Parallels server are listed in the **Hardware info** section and start with `usb`.

- *ID of the virtual machine.* To get this information, use the `pctl list --info` command, for example:

```
# pctl list --info
ID: {d8d516c9-dba3-dc4b-9941-d6fad3767035}
Name: Windows 7
...
```

The first line in the command output indicates the virtual machine ID; in our case, it is `{d8d516c9-dba3-dc4b-9941-d6fad3767035}`.

Once you know the USB device and virtual machine IDs, you can use the `prlsrvctl usb set` command to assign the USB device to the virtual machine. For example:

```
# prlsrvctl usb set '1-1.6|046d|c312|low|KM|Empty' {d8d516c9-dba3-dc4b-9941-d6fad3767035}
The server has been successfully configured.
```

This command assigns the USB device `LITEON Technology - USB Multimedia Keyboard` with ID `'1-1.6|046d|c312|low|KM|Empty'` to the virtual machine with ID `{d8d516c9-dba3-dc4b-9941-d6fad3767035}`. When running the command, remember to specify the single quotes and curly brackets with the USB device and virtual machine IDs, respectively.

To check that the USB device has been successfully assigned to the virtual machine, use the `prlsrvctl usb list` command:

```
# prlsrvctl usb list
Broadcom - USB Device 3503          '2-1.4.3|0a5c|3503|full|KM|Empty'
Broadcom - USB Device 3502          '2-1.4.2|0a5c|3502|full|KM|Empty'
LITEON Technology - USB Multimedia Keyboard '1-1.6|046d|c312|low|KM|Empty'
                                     {d8d516c9-dba3-dc4b-9941-d6fad3767035}
```

The command output shows that the USB device with ID `'1-1.6|046d|c312|low|KM|Empty'` is now associated with the virtual machine with ID `{d8d516c9-dba3-dc4b-9941-d6fad3767035}`. This means that the device is automatically

connected to the virtual machine every time you start this virtual machine and connect the device to the Parallels server.

To remove the assignment of the USB device with ID '1-1.6|046d|c312|low|KM|Empty', use the `prlsrvctl usb del` command:

```
# prlsrvctl usb del '1-1.6|046d|c312|low|KM|Empty'
The server has been successfully configured.
```

When assigning USB devices to virtual machines, keep in mind the following:

- You cannot migrate a running virtual machine having one or more USB devices assigned.
- After migrating a stopped virtual machine, all its assignments are lost.
- All USB assignments are preserved if you restoring a virtual machine to its original location and are lost otherwise.
- The USB device assignment and a virtual machine is created for the user currently logged in to the system.

## Mounting Virtual Machines

In Parallels Server Bare Metal, you can mount virtual machines using the `pctl mount` command. Once you mount a virtual machine, its contents appears in the `/vz/mnt/VM_ID` directory on the Parallels server. You can then explore this directory and manage the necessary files and subdirectories. Let us assume that you want to mount the `MyVM` virtual machine that

- runs Windows XP
- has the ID of `{36ecc3c5-ec50-6044-8c59-241ea5d7183d}`
- contains two disks (C: and D:)

To mount the `MyVM` virtual machine, run the following command:

```
# pctl mount MyVM
Mounting the VM...
The VM has been successfully mounted.
```

Once the virtual machine is successfully mounted, the directory `/vz/mnt/{36ecc3c5-ec50-6044-8c59-241ea5d7183d}` appears on the Parallels server. As the `MyVM` virtual machine has two disks, this directory contains two subdirectories: `volume_1` corresponding to the C: disk of the virtual machine and `volume_2` corresponding to the D: disk. By default, the disks are mounted in the read-write mode; so you can go to any of the directories and view or change their contents as necessary. You can also mount the disks in the read-only mode by using the `-o` option:

```
# pctl mount MyVM -o ro
Mounting the VM...
The VM has been successfully mounted.
```

You can use the `--info` option of the `pctl mount` command to view the information about the mounted disks:

```
# pctl mount MyVM --info
Volume 1:      /vz/vmprivate/MyVM.pvm/config.pvs
  filesystem   NTFS
  size         63 G
  free space   61 G
  ID: /vz/mnt/{36ecc3c5-ec50-6044-8c59-241ea5d7183d}/volume_1
Volume 2: ...
```

This command outputs the following information for each mounted disk:

- full path to the virtual machine configuration file
- file system on the disk
- free space available on the disk
- full path to the mounted disk

**Note:** To start a mounted virtual machine, you need to unmount it first.

## Configuring IP Address Ranges for Host-Only Networks

All virtual machines connected to networks of the host-only type receive their IP addresses from the Parallels DHCP server. This DHCP server is set up during the Parallels Server Bare Metal installation and includes by default IP addresses from 10.37.130.1 to 10.37.130.254. You can redefine the default IP address range for host-only networks and make virtual machines get their IP addresses from different IP address ranges. For example, you can run the following command to set the start and end IP addresses for the `Host-Only` network (this network is automatically created during the Parallels Server Bare Metal installation) to 10.10.11.1 and 10.10.11.254, respectively:

```
# prlsrvctl net set Host-Only --ip-scope-start 10.10.11.1 --ip-scope-end 10.10.11.254
```

You can also specify a custom IP address range directly when creating a new network of the host-only type. Assuming that you want to create a network with the `Host-Only2` name and define for this network the IP addresses range from 10.10.10.1 to 10.10.10.254, you can execute the following command:

```
# prlsrvctl net add Host-Only2 -t host-only --ip-scope-start 10.10.10.1 --ip-scope-end 10.10.10.254
```

When working with IP address ranges, pay attention to the following:

- The start and end IP addresses of an IP address range must belong to the same subnetwork.
- IP address ranges can be defined for each network of the host-only type separately. For example, you can set the IP address range from 10.10.11.1 to 10.10.11.254 for the `Host-Only` network and from 10.10.10.1 to 10.10.10.254 for the `Host-Only2` network.

## Converting Third-Party Virtual Machines and Disks

In Parallels Server Bare Metal, you can convert third-party virtual machines and their disks to Parallels virtual machines and disks. Currently, you can convert the following third-party virtual machines and disks:

- Microsoft Hyper-V
- Microsoft Virtual PC
- Virtual Box
- VMware

### Converting Virtual Machines

Let us assume that you want to convert a VMware virtual machine that runs the CentOS 5 operating system and has the name `centos5`. As the `pctl convert` command can work only with virtual machines and disks that are available locally, you first need to copy the virtual machine to the Parallels server. Once the virtual machine is on your local server, you can start the conversion. Assuming that you have copied the virtual machine to the `/var/parallels` directory on the Parallels server and the full path to its configuration file is `/var/parallels/centos5/config.xml`, you can run the following command to perform the conversion:

```
# pctl convert /var/parallels/centos5/config.xml
```

Once the conversion is complete, you can start the virtual machine and manage it in the same way you would manage a native Parallels virtual machine.

### Converting Disks

You can also convert third-party virtual disks to Parallels virtual machines and disks using the `prl_convert` utility. Once you run the utility, it checks the disk and, depending on its type, does one of the following:

- If the disk is a system disk—that is, has an operating system installed, `prl_convert` converts it to a Parallels virtual machine. If the utility cannot create a virtual machine for the disk (for example, it fails to detect the operating system on the disk), the disk is converted to a Parallels virtual disk. You can also specify the `--allow-no-os` option to force the conversion, but in this case you may have problems with starting and using the resulting virtual machine.
- If the disk is a data disk, `prl_convert` converts it to a Parallels virtual disk.

When converting third-party virtual disks, you need to specify the full path to the original disk file. For example, to convert the system disk of the `centos5` virtual machine (that is, the disk where the CentOS 5 operating system is installed) that has the full path of `/var/parallels/centos5/centos5.vhd`, you can use this command:

```
# prl_convert /var/parallels/centos5/centos5.vhd
```

This command creates a ready-to-use Parallels virtual machine with the name `centos5`. You can start this virtual machine and manage it in the same way you would manage a native Parallels virtual machine. At the same time, if you convert a third-party virtual data disk, you will need first to add the resulting disk to an existing Parallels virtual machine using the `pctl set` command.

### Notes:

1. When adding a converted virtual disk to an existing Parallels virtual machine or creating a new virtual machine on its basis, make sure that the interface type of the disk is the same as it was in the source virtual machine.

For example, if the original disk had the SCSI interface type, ensure that the interface type of the converted disk is also set to SCSI. If you do not configure the disk interface type, it will be set to SATA (this is the default interface type in Parallels virtual machines), which may cause your virtual machine to malfunction.

2. In the current version of Parallels Server Bare Metal, Hyper-V virtual machines can be converted using the `prl_convert` utility only. That means that you first need to convert all Hyper-V virtual disks and then add them to an existing virtual machine.

## Enabling VNC Access to Virtual Machines

By default, you cannot connect to a virtual machine using a VNC client. To enable VNC access to a virtual machine, you need to configure the following settings:

- 1 Enable the VNC support in the virtual machine.
- 2 Specify the TCP port number on the physical server that will be used to listen to VNC connections for the virtual machine.

**Note:** A unique port number must be specified for each virtual machine where you plan to connect via VNC.

- 3 Set a password to secure your VNC connection. Anyone trying to connect to the virtual machine will need to specify this password before they will be logged in to the virtual machine.

Let us assume the following:

- You want to enable VNC access to the `MyVM` virtual machine.
- The server will listen on port 5901 for VNC connections to the virtual machine.
- The `XXXXXXXXXX` password will be used to access the virtual machine.

To enable VNC access to the `MyVM` virtual machine and set the parameters above, you can run the following command:

```
# pctl set MyVM --vnc-mode manual --vnc-port 5901 --vnc-passwd XXXXXXXXX
Configure VNC: mode>manual port=5901
Success. The operation was successfully completed.
```

The changes will come into effect on the next virtual machine start.

## Managing Resources

The main goal of resource control in Parallels Server Bare Metal is to provide Service Level Management or Quality of Service for virtual machines and Containers. Correctly configured resource control settings prevent serious impacts resulting from the resource over-usage (accidental or malicious) of any virtual machine and Container on the other virtual machines and Containers. Using resource control parameters for resources management also allows you to enforce fairness of resource usage among virtual machines and Containers and better service quality for preferred virtual machines and Containers, if necessary.

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## What are Resource Control Parameters?

The system administrator can control the resources available to a virtual machine and Container through a set of resource management parameters. All these parameters can be set and configured using Parallels command-line utilities.

## Managing CPU Resources

In the current version of Parallels Server Bare Metal, you can configure and monitor the following CPU resource parameters for Containers:

- CPU units
- number of virtual CPUs
- CPU limits
- [CPU affinity](#) (p. 91)

- [NUMA nodes](#) (p. 92)

Detailed information on these parameters is given in the following sections.

## Managing CPU Shares and Limits

The Parallels Server Bare Metal CPU resource control utilities allow you to guarantee any virtual machine or Container the amount of CPU time this virtual machine or Container receives. The virtual machine or Container can consume more than the guaranteed value if no other virtual machines and Containers are competing for the CPU and the `cpuLimit` parameter is not defined.

**Note:** The CPU time shares and limits are calculated on the basis of a one-second period. Thus, for example, if a virtual machine or Container is not allowed to receive more than 50% of the CPU time, it will be able to receive no more than half a second each second.

To get a view of the optimal share to assign to a virtual machine or Container, check the current server CPU utilization:

```
# vzcpucheck
Current CPU utilization: 11142
Power of the node: 125504
```

The output of this command displays the total number of the so-called CPU units consumed by all running virtual machines and Containers and server processes. This number is calculated by Parallels Server Bare Metal with the help of a special algorithm. The above example illustrates the situation when the server is underused. In other words, the running virtual machines and Containers can receive more CPU time than is guaranteed to them.

In the following example, the `MyVM` virtual machine is guaranteed to receive about 4% of the CPU time even if the server is fully used—that is, if the current CPU utilization equals the power of the server. Besides, this virtual machine will not receive more than 25% of the CPU time even if the CPU is not fully loaded:

```
# pct1 set MyVM --cpuunits 5000 --cpulimit 25
set cpuunits 5000
set cpulimit 25%
The VM has been successfully configured.
```

To set the CPU time share and limit for Containers, just specify a Container ID instead of the virtual machine name and use the `--save` option to save the changes in the Container configuration file, for example:

```
# pct1 set 101 --cpuunits 5000 --cpulimit 25 --save
Saved parameters for Container 101
```

## Setting CPU limits in megahertz

In the example above, you set the CPU limit for Container 101 and the `MyVM` virtual machine to 25% of the whole CPU power of the Parallels server. That means that if the server CPU power is 2000 megahertz (MHz), Container 101 and the `MyVM` virtual machine can get up to 500 MHz each.



Now, imagine the situation when you migrate Container 101 to another server whose CPU power equals 4000 MHz. On this server, Container 101 can get 25% of 4000 MHz—that is, 1000 MHz. To deal with such situations, you can set CPU limits for virtual machines and Containers in MHz. Once you set the CPU limit in MHz, it remains the same, irrespective of the server total CPU power. For example, to make Container 101 and the `MyVM` virtual machine consume no more than 500 MHz on any Parallels server, you can run the following commands:

```
# pct1 set MyVM ---cpulimit 500m
set cpulimit 500 MHz
The VM has been successfully configured.
# pct1 set 101 --cpulimit 500m --save
Saved parameters for Container 101
```

## Configuring the Number of CPUs

If your server has more than one physical processor installed, you can control the number of CPUs which will be used to handle the processes running in virtual machines and Containers. By default, a virtual machine and Container is allowed to consume the CPU time of all processors on the server, i.e. any process in any virtual machine and Container can be executed on any processor on the server. However, you can modify the number of physical CPUs which will be simultaneously available to a virtual machine or Container using the `--cpus` option of the `pctl set` command. For example, if your server has 4 physical processors installed, i.e. any virtual machine and Container on the server can make use of these 4 processors, you can set the processes in Container 101 and in the `MyVM` virtual machine to be run on 2 CPUs only by issuing the following commands:

```
# pct1 set 101 --cpus 2 --save
Saved parameters for Container 101
# pct1 set MyVM --cpus 2
set cpus(4): 2
The VM has been successfully configured.
```

### Notes:

1. The number of CPUs for a virtual machine or Container must not exceed the number of physical CPUs installed on the server. In this case, the 'physical CPUs' notation designates the number of CPUs the Parallels Server Bare Metal kernel is aware of (you can view this CPU number using the `/proc/cpuinfo` command).
2. Before configuring the number of CPUs for a running virtual machine, make sure that the CPU hotplug support is enabled for this virtual machine. For detailed information on the CPU hotplug feature, see [Enabling CPU Hotplug for Virtual Machines](#) (p. 90).

To make sure that the number of CPUs has been successfully changed, you can log in to Container 101 and the `MyVM` virtual machine and check the number of available CPUs. If the Container and virtual machine are running a Linux operating system, you can also use the `cat /proc/cpuinfo` command to view the available CPUs, for example:

```
# pct1 exec 101 cat /proc/cpuinfo
processor       : 0
vendor_id     : GenuineIntel
cpu family    : 15
model        : 4
```

```
model name      : Intel(R) Xeon(TM) CPU 2.80GHz
stepping       : 1
cpu MHz        : 2793.581
cache size     : 1024 KB
...

processor      : 1
vendor_id     : GenuineIntel
cpu family    : 15
model        : 4
model name    : Intel(R) Xeon(TM) CPU 2.80GHz
stepping     : 1
cpu MHz      : 2793.581
cache size   : 1024 KB
...
```

The output shows that Container 101 is currently bound to only two processors on the server instead of 4 available for the other Containers on this server. It means that, from this point on, the processes of Container 101 will be simultaneously executed on no more than 2 physical CPUs while the other Containers on the server will continue consuming the CPU time of all 4 server processors, if needed. Also notice that the physical CPUs proper of Container 101 might not remain the same during the Container operation; they might change for load balancing reasons, the only thing that cannot be changed is their maximal number.

## Enabling CPU Hotplug for Virtual Machines

If a guest operating system supports the CPU hotplug functionality, you can enable this functionality for the virtual machine. Once the CPU hotplug functionality is turned on, you can increase the number of CPUs available to your virtual machines even if they are running.

**Note:** Decreasing the number of CPUs available to a running virtual machine is not supported in the current version of Parallels Server Bare Metal.

Currently, the following systems come with the CPU hotplug support:

### **Linux** (both x86 and x64 versions)

- Linux operating systems based on the RHEL 5 kernel and higher (Red Hat Linux Enterprise 5, CentOS 5, and so on)

### **Windows**

- x64 version of Windows Server 2008 (Standard Edition)
- x64 version of Windows Server 2008 (Enterprise Edition)
- x64 version of Windows Server 2008 (Datacenter Edition)
- x64 version of Windows Server 2008 R2 (Datacenter Edition)

By default, the CPU hotplug support is disabled for all newly created virtual machines. To enable this functionality, you can use the `--cpu-hotplug` option of the `pctl set` command. For example, to enable the CPU hotplug support in the `MyVM` virtual machine that runs one of the supported operating systems, stop the `MyVM` virtual machine and run this command:

```
# pctl set MyVM --cpu-hotplug on
```

```
set cpu hotplug: 1
The VM has been successfully configured.
```

Once the functionality is enabled, you can increase the number of CPUs in the `MyVM` virtual machine even it is running. Assuming that your physical server has 4 CPUs installed and the processes in the `MyVM` virtual machine are set to be executed on two CPUs, you can run the following command to assign 3 CPUs to the virtual machine:

```
# pct1 set MyVM --cpus 3
set cpus(4): 3
The VM has been successfully configured.
```

To disable the CPU hotplug support in the `MyVM` virtual machine, use this command:

```
# pct1 set MyVM --cpu-hotplug off
set cpu hotplug: 0
The VM has been successfully configured.
```

The changes will come into effect on the next virtual machine start.

## Configuring CPU Affinity for Virtual Machines and Containers

If your physical server has several CPUs installed, you can bind a virtual machine or Container to specific CPUs so that only these CPUs are used to handle the processes running in the virtual machine or Container. The feature of binding certain processes to certain CPUs is known as *CPU affinity*. Establishing CPU affinity between virtual machines and Containers and physical processors can help you increase your system performance up to 20%.

By default, any newly created virtual machine and Container can consume the CPU time of all processors installed on the physical server. To bind a virtual machine or Container to specific CPUs, you can use the `--cpumask` option of the `pctl set` command. Assuming that your physical server has 8 CPUs, you can make the processes in the `MyVM` virtual machine and Container 101 run on CPUs 0, 1, 3, 4, 5, and 6 by running the following commands:

```
# pct1 set MyVM --cpumask 0,1,3,4-6
The VM has been successfully configured.
# pct1 set 101 --cpumask 0,1,3,4-6 --save
Saved parameters for Container 101
```

You can specify the CPU affinity mask—that is, the processors to bind to virtual machines and Containers—as separate numbers (0,1,3) or as ranges (4-6). If you are setting the CPU affinity mask for a running virtual machine or Container, the changes are applied on the fly.

To undo the changes made to the `MyVM` virtual machine and Container 101 and set their processes to run on all available CPUs on the server, run these commands:

```
# pct1 set MyVM --cpumask all
The VM has been successfully configured.
# pct1 set 101 --cpumask all --save
Saved parameters for Container 101
```

### Binding CPUs to NUMA Nodes

On systems with a NUMA (Non-Uniform Memory Access) architecture, you can configure Containers to use CPUs from specific NUMA nodes only. Let us assume the following:

- Your physical server has 8 CPUs installed.
- The CPUs are divided into 2 NUMA nodes: NUMA node 0 and NUMA node 1. Each NUMA node has 4 CPUs.
- You want the processes in Container 101 to be executed on the processors from NUMA node 1.

To set Container 101 to use the processors from NUMA node 1, run the following command:

```
# pct1 set 101 --nodemask 1 --save
Saved parameters for Container 101
```

To check that Container 101 is now bound to NUMA node 1, use this command:

```
# vzlist 101 -o nodemask
      NODEMASK
      1
```

To unbind Container 101 from NUMA node 1, execute this command:

```
# pct1 set 101 --nodemask all -save
Saved parameters for Container 101
```

Now Container 101 should be able to use all CPUs on the server again.

**Note:** For more information on NUMA, visit <http://lse.sourceforge.net/numa>.

### Managing Disk Quotas

This section explains the basics of disk quotas, defines disk quota parameters, and describes how to perform the following disk quota related operations:

- turning on and off per-Container (first-level) disk quotas
- setting up first-level disk quota parameters for a Container
- turning on and off per-user and per-group (second-level) disk quotas inside a Container
- setting up second-level quotas for a user or for a group
- checking disk quota statistics
- cleaning up Containers

## What are Disk Quotas?

Disk quotas enable system administrators to control the size of Linux file systems by limiting the amount of disk space and the number of inodes a Container can use. These quotas are known as per-Container quotas or first-level quotas in Parallels Server Bare Metal. In addition, the Parallels Server Bare Metal software enables the Container administrator to limit disk space and the number of inodes that individual users and groups in that Container can use. These quotas are called per-user and per-group quotas or second-level quotas.

By default, first-level quotas on your server are enabled (which is defined in the `/etc/vz/vz.conf` configuration file), whereas second-level quotas must be turned on for each Container separately (in the corresponding Container configuration files). It is impossible to turn on second-level disk quotas for a Container if first-level disk quotas are off for that Container.

Parallels Server Bare Metal keeps quota usage statistics and limits in `/var/vzquota/quota.<CT_ID>` - a special quota file. The quota file has a special flag indicating whether the file is “dirty”. The file becomes dirty when its contents become inconsistent with the real Container usage. This means that when the disk space or inodes usage changes during the Container operation, these statistics are not automatically synchronized with the quota file, the file just gets the “dirty” flag. They are synchronized only when the Container is stopped or when the server is shut down. After synchronization, the “dirty” flag is removed. If the server has been incorrectly brought down (for example, the power switch was hit), the file remains “dirty”, and the quota is re-initialized on the next Container startup. This operation may noticeably increase the server startup time. Thus, it is highly recommended to shut down the server properly.

## Disk Quota Parameters

The table below summarizes the disk quota parameters that you can control. The **File** column indicates whether the parameter is defined in the global configuration file (G), in the Container configuration files (V), or it is defined in the global configuration file but can be overridden in a separate Container configuration file (GV).

Parameter	Description	File
DISK_QUOTA	Indicates whether first-level quotas are on or off for all Containers or for an individual Container.	GV
DISKSPACE	Total size of disk space the Container may consume, in 1-Kb blocks.	V
DISKINODES	Total number of disk inodes (files, directories, and symbolic links) the Container can allocate.	V
QUOTATIME	Grace period for the disk quota overusage, in seconds. The Container is allowed to temporarily exceed its quota soft limits for no more than the <code>QUOTATIME</code> period.	V
QUOTAUGIDLIMIT	Maximum aggregate number of user IDs and group IDs for which disk quota inside the given Container will be accounted. If set to 0, the UID and GID quota are disabled.	V

## Turning On and Off Per-Container Disk Quotas

The parameter that defines whether to use first-level disk quotas is `DISK_QUOTA` in the global configuration file (`/etc/vz/vz.conf`). By setting it to “no”, you will disable disk quotas completely.

This parameter can be specified in the Container configuration file (`/etc/vz/conf/<CT_ID>.conf`) as well. In this case, its value will take precedence of the one specified in the global configuration file. If you intend to have a mixture of Containers with quotas turned on and off, it is recommended to set the `DISK_QUOTA` value to `yes` in the global configuration file and to `no` in the configuration file of that Container which does not need quotas.

The session below illustrates a scenario when first-level quotas are on by default and are turned off for Container 101:

```
[checking that quota is on]
# grep DISK_QUOTA /etc/vz/vz.conf
DISK_QUOTA=yes

[checking available space on /vz partition]
# df /vz
Filesystem          1k-blocks      Used Available Use% Mounted on
/dev/sda2            8957295      1421982   7023242  17% /vz

[editing Container configuration file to add DISK_QUOTA=no]
# vi /etc/vz/conf/101.conf

[checking that quota is off for Container 101]
# grep DISK_QUOTA /etc/vz/conf/101.conf
DISK_QUOTA=no

# pct1 start 101
Starting Container ...
Container is mounted
Adding IP address(es): 10.0.16.101
Hostname for Container set: ve101
Container start in progress...
# pct1 exec 101 df
Filesystem          1k-blocks      Used Available Use% Mounted on
vzfs                8282373       747060   7023242  10% /
```

As the above example shows, the only disk space limit a Container with the quotas turned off has is the available space and inodes on the partition where the Container private area resides.

## Setting Up Per-Container Disk Quota Parameters

Three parameters determine how much disk space and inodes a Container can use. These parameters are specified in the Container configuration file:

`DISKSPACE`            The total size of disk space that can be consumed by the Container, in 1-Kb blocks. When the space used by the Container hits the soft limit, the Container can allocate additional disk space up to the hard limit during the grace period specified by the `QUOTATIME` parameter.

DISKINODES	The total number of disk inodes (files, directories, and symbolic links) the Container can allocate. When the number of inodes used by the Container hits the soft limit, the Container can create additional file entries up to the hard limit during the grace period specified by the QUOTATIME parameter.
QUOTATIME	The grace period of the disk quota, in seconds. The Container is allowed to temporarily exceed the soft limit values for the disk space and disk inodes quotas for no more than the period specified by this parameter.

The first two parameters have both soft and hard limits (or, simply, barriers and limits). The hard limit is the limit that cannot be exceeded under any circumstances. The soft limit can be exceeded up to the hard limit, but as soon as the grace period expires, the additional disk space or inodes allocations will fail. Barriers and limits are separated by colons (":") in Container configuration files and in the command line.

The following session sets the disk space available to Container 101 to approximately 1 GB and allows the Container to allocate up to 90,000 inodes. The grace period for the quotas is set to 10 minutes:

```
# pct1 set 101 --diskspace 1000000:1100000 --save
Saved parameters for Container 101
# pct1 set 101 --diskinodes 90000:91000 --save
Saved parameters for Container 101
# pct1 set 101 --quotatime 600 --save
Saved parameters for Container 101
# pct1 exec 101 df
Filesystem          1k-blocks      Used Available Use% Mounted on
vzfs                 1000000       747066   252934   75% /
# pct1 exec 101 stat -f /
  File: "/"
  ID: 0          0          Namelen: 255      Type: UNKNOWN (0x565a4653)
Blocks: Total: 1000000  Free: 252934  Available: 252934  Size: 1024
Inodes: Total: 90000   Free: 9594
```

It is possible to change the first-level disk quota parameters for a running Container. The changes will take effect immediately. If you do not want your changes to persist till the next Container startup, do not use the `--save` switch.

## Turning On and Off Second-Level Quotas for a Container

The parameter that controls the second-level disk quotas is `QUOTAUGIDLIMIT` in the Container configuration file. By default, the value of this parameter is zero and this corresponds to disabled per-user and per-group quotas.

If you assign a non-zero value to the `QUOTAUGIDLIMIT` parameter, this action brings about the two following results:

- 1 Second-level (per-user and per-group) disk quotas are enabled for the given Container.
- 2 The value that you assign to this parameter will be the limit for the number of file owners and groups of this Container, including Linux system users. Notice that you will theoretically be able to create extra users of this Container, but if the number of file owners inside the Container has already reached the limit, these users will not be able to own files.

Enabling per-user and per-group quotas for a Container requires restarting the Container. The value for it should be carefully chosen; the bigger value you set, the bigger kernel memory overhead this Container creates. This value must be greater than or equal to the number of entries in the Container `/etc/passwd` and `/etc/group` files. Taking into account that a newly created Red Hat Linux-based Container has about 80 entries in total, the typical value would be 100. However, for Containers with a large number of users, this value should be increased.

When managing the `QUOTAUGIDLIMIT` parameter, keep in mind the following:

- If you delete a registered user but some files with their ID continue residing inside your Container, the current number of uuids (user and group identities) inside the Container will not decrease.
- If you copy an archive containing files with user and group IDs not registered inside your Container, the number of uuids inside the Container will increase by the number of these new IDs.

The session below turns on second-level quotas for Container 101:

```
# pct1 set 101 --quotaugidlimit 100 --save
Unable to apply new quota values: ugid quota not initialized
Saved parameters for Container 101
# pct1 restart 101
Stopping Container ...
Container was stopped
Container is unmounted
Starting Container ...
Container is mounted
Adding IP address(es): 192.168.1.101
Hostname for Container set: ct101
Container start in progress...
```

## Setting Up Second-Level Disk Quota Parameters

Parallels Server Bare Metal provides the standard Linux `quota` package for working inside Containers:

```
# pct1 exec 101 rpm -q quota
quota-3.03-1.1.parallels
```

This command shows that the `quota` package installed in the Container is built and shipped by Parallels. Use the utilities from this package (as is prescribed in your Linux manual) to set second-level quotas for the given Container. For example:

```
# ssh ct101
root@ct101's password:
Last login: Sat Jul 5 00:37:07 2009 from 10.100.40.18
[root@ct101 root]# edquota root
Disk quotas for user root (uid 0):
  Filesystem  blocks      soft   hard   inodes     soft   hard
   /dev/vzfs  38216      50000 60000   45454     70000  70000
[root@ct101 root]# repquota -a
*** Report for user quotas on device /dev/vzfs
Block grace time: 00:00; Inode grace time: 00:00
User          used      Block limits          File limits
              used    soft  hard  grace  used  soft  hard  grace
```



```

-----
root      --   38218   50000   60000           45453 70000 70000
[the rest of repquota output is skipped]

[root@ct101 root]# dd if=/dev/zero of=test
dd: writing to `test': Disk quota exceeded
23473+0 records in
23472+0 records out
[root@ct101 root]# repquota -a
*** Report for user quotas on device /dev/vzfs
Block grace time: 00:00; Inode grace time: 00:00
      Block limits                File limits
User      used      soft    hard  grace    used  soft  hard  grace
-----
root      +-   50001   50000   60000   none    45454 70000 70000
[the rest of repquota output is skipped]

```

The above example shows the session when the `root` user has the disk space quota set to the hard limit of 60,000 1KB blocks and to the soft limit of 50,000 1KB blocks; both hard and soft limits for the number of inodes are set to 70,000.

It is also possible to set the grace period separately for block limits and inodes limits with the help of the `/usr/sbin/setquota` command. For more information on using the utilities from the `quota` package, consult the system administration guide shipped with your Linux distribution or online manual pages included in the package.

## Checking Quota Status

As the server administrator, you can check the quota status for any Container with the `vzquota stat` and `vzquota show` commands. The first command reports the status from the kernel and shall be used for running Containers. The second command reports the status from the quota file (located at `/var/vzquota/quota.<CT_ID>`) and shall be used for stopped Containers. Both commands have the same output format.

The session below shows a partial output of Container 101 quota statistics:

```

# vzquota stat 101 -t
  resource      usage      softlimit      hardlimit      grace
  1k-blocks     38281     1000000     1100000
  inodes       45703      90000      91000
User/group quota: on,active
Ugids: loaded 34, total 34, limit 100
Ugid limit was exceeded: no

User/group grace times and quotafile flags:
  type block_exp_time inode_exp_time dqf_flags
  user                               0h
  group                              0h

User/group objects:
ID  type  resource  usage  softlimit  hardlimit  grace  status
0   user  1k-blocks 38220  50000    60000    loaded
0   user  inodes   45453  70000    70000    loaded
[the rest is skipped]

```

The first three lines of the output show the status of first-level disk quotas for the Container. The rest of the output displays statistics for user/group quotas and has separate lines for each user and group ID existing in the system.

If you do not need the second-level quota statistics, you can omit the `-t` switch from the `vzquota` command line.

## Cleaning Up Containers

The first-level quota assigned to this or that Container essentially shows how much space may be occupied by the Container *private* files, i.e. not by the OS or common applications files. The real OS and application files reside in the `/vz/template` directory on the server and practically do not add up to the Container quota (except for the symlinks to them located inside the Container and occupying insignificant space).

However, there are situations when one and the same application or application update is installed not as a template, but separately inside each and every Container. A good example of this is the CPanel application with its robust auto-update features. If a certain version of CPanel is installed in a number of Containers, and then an update is released, CPanel automatically updates itself in all these Containers, thus creating a vast amount of identical files (not symlinks already) throughout the Containers. These files greatly affect Container quotas. You can avoid such situations by putting all the identical files to the server template area and creating symlinks instead of real files inside the affected Containers.

The problem like the one described above can be solved in two ways:

- 1 A special subarea is created inside the server template area - `/vz/template/vc` - for housing the files identical among multiple Containers with the help of the `vzcache` utility.
- 2 If the application or application update installed directly into one or more Containers has a corresponding application template or template update installed on the server, the real files inside the Containers are replaced with symlinks to the template files on the server with the help of the `vzpkg link` utility. This utility is used to create symlinks to application EZ templates.

## Moving Container Files to the Cache Area

We will illustrate the effect produced by `vzcache` by copying one and the same huge dummy file into two Containers. First, let us learn the disk space occupied by the whole `/vz` partition and by the two Containers - Container 101 and Container 102:

```
# df /vz
Filesystem            1K-blocks      Used Available Use% Mounted on
/dev/hda3              13756796    1348292  11622123  11% /vz
# pct1 exec 101 df
Filesystem            1K-blocks      Used Available Use% Mounted on
vzfs                   1048576        22311  1026265   3% /
# pct1 exec 102 df
Filesystem            1K-blocks      Used Available Use% Mounted on
vzfs                   1048576        22311  1026265   3% /
```

After that, we copy the dummy file, which is around 600 MB in size, to the root of these Containers:

```
# cp foo /vz/root/101
# cp foo /vz/root/102
```

Now check the disk space once again:

```
# df /vz
Filesystem            1K-blocks      Used Available Use% Mounted on
/dev/hda3              13756796    2569060  10401355  20% /vz
# pct1 exec 101 df
Filesystem            1K-blocks      Used Available Use% Mounted on
vzfs                   1048576      632430   416146   61% /
# pct1 exec 102 df
Filesystem            1K-blocks      Used Available Use% Mounted on
vzfs                   1048576      632430   416146   61% /
```

We see that around 600 MB has been added to the space occupied by each Container and, consequently, around 1.2 GB has been added to the space used on the `/vz` partition. Now it's time to resort to `vzcache` to get rid of identical files inside the Containers:

```
# vzcache -v 101 102
Processing VZFSv2 Container 101
VZFSv2 Container 101      78 regular files
Processing VZFSv2 Container 102
VZFSv2 Container 102      78 regular files
```

During the command execution, `vzcache` does the following:

- Looks for identical files inside Container 101 and Container 102.
- Creates the `CT_UUID` subdirectory (where `CT_UUID` denotes the Container unique identifier and can be determined by viewing the `UUID` parameters in the Container configuration file) within the server template area (`/vz/template/vc` by default) for each Container.
- Moves the identical files to the created subdirectories in the server template area.

Let us now take the final look at the disk space usage:

```
# df /vz
Filesystem            1K-blocks      Used Available Use% Mounted on
/dev/hda3              13756796    1953053  11017362  16% /vz
# pct1 exec 101 df
Filesystem            1K-blocks      Used Available Use% Mounted on
vzfs                   1048576      15105   1033471   2% /
# pct1 exec 102 df
Filesystem            1K-blocks      Used Available Use% Mounted on
vzfs                   1048576      15138   1033438   2% /
```

As you can see, both the server and the Containers have each gained more than 600 MB of disk space. In real life, the disk space is gained by caching not one huge file in two Containers but a number of identical files across many Containers.

The operation of the `vzcache` utility may be customized to a certain extent by using `vzcache` command line switches (see the *Parallels Command Line Reference Guide* for details).

## Associating Container Files With Application Templates

It may often happen that a security update should immediately be applied to a package installed as a template on the server and added to a number of Containers hosted there. However, it takes certain time to prepare a template update, so the server and/or Container administrators are not inclined to wait for it and they install the original security update directly inside the Containers. As to the template update, it becomes available a few days afterwards. In other cases, a Container administrator might not know that there is a certain template installed on the server, so they install the corresponding application directly inside their Container.

To eliminate cluttering up the Container disk space with application files that are present as part of an application template on the server, the `vzpkg link` utility is used. When executed, this utility links your Container to the application EZ templates installed on the server. Assuming that you manually installed the `openssl` application inside Container 101 running Fedora 8, you can use the following command to replace the `openssl` files inside this Container with symlinks to these files in the `/vz/template/fedora-core/8/x86/config/app/openssl` directory on the server:

```
# vzpkg link 101
```

## Detaching Containers From Caches

Whereas the `vzcache` utility helps effectively gain disk space both on the Parallels server and within Containers, there may be situations when it is necessary to detach a Container from its cache and copy the cached files back to the Container private area. A typical example of this is migrating a Container to another Parallels server. The migration is not possible if there are links in the Container private area pointing to the `/vz/template/vzcaches` directory on the server.

To copy the cached files back to the Container private area, the `vzuncache` utility is used:

```
# vzuncache 101 -a
[Optimization messages skipped...]
Container 101                53 magic symlinks to convert

Container 101 will be detached from the following caches:
Cache name                    Size
dhcp0-84.sw.ru-2005030316237  607972K
```

Now Container 101 can safely be migrated to another Parallels server. Note that unlike `vzcache`, the `vzuncache` utility shall be called for only one Container at a time. The `-a` switch tells the utility to detach the Container from all the cache directories specified in its configuration file as the value of the `VZCACHE` parameter.

## Managing Network Accounting and Bandwidth

This section explains how to perform the following tasks in Parallels Server Bare Metal:

- configuring network classes

- viewing network traffic statistics
- turning on and off network bandwidth management
- configuring bandwidth limits

## Network Traffic Parameters

The table below summarizes the network traffic parameters that you can control in Parallels Server Bare Metal.

Parameter	Description
<code>traffic_shaping</code>	If set to <code>yes</code> , traffic limitations for outgoing traffic are set for virtual machines and Containers. The default is <code>no</code> .
<code>bandwidth</code>	This parameter lists all network adapters installed on the server and their bandwidth.
<code>totalrate</code>	This parameter defines the bandwidth to allocate for each network class. It is active if traffic shaping is turned on.
<code>rate</code>	If traffic shaping is turned on, this parameter specifies the bandwidth guarantee for virtual machines and Containers.
<code>ratebound</code>	If this parameter is set to <code>yes</code> , the bandwidth guarantee (the global <code>rate</code> parameter) is also the limit for the virtual machine or Container, and the virtual machine or Container cannot borrow the bandwidth from the <code>totalrate</code> bandwidth pool.

## Configuring Network Classes

Parallels Server Bare Metal allows you to track the inbound and outbound network traffic as well as to shape the outgoing traffic for a virtual machine and Container. To provide the ability to distinguish between domestic and international traffic, a concept of network classes is introduced. It is important to fully understand this notion, because network classes IDs are used in the values of some network traffic parameters. A network class is a range of IP addresses for which Parallels Server Bare Metal counts and shapes the traffic.

Classes are specified in the `/etc/vz/conf/networks_classes` file. The file is in the ASCII format, and all empty lines and lines starting with the `#` sign are ignored. Other lines have the following format:

```
<class_id> <IP_address>/<prefix_length>
```

where `<class_id>` defines the network class ID, and the `<IP_address>/<prefix_length>` pair defines the range of IP addresses for this class. There may be several lines for each class.

Classes 0 and 1 have special meanings:

- Class 0 defines the IP address range for which no accounting is performed. Usually, it corresponds to the server subnet (the server itself and its virtual machines and Containers). Setting up class 0 is not required; however, its correct setup improves performance.

- Class 1 is defined by Parallels Server Bare Metal to match any IP address. It must be always present in the network classes definition file. Therefore, it is suggested not to change the default line in the `networks_classes` file.

```
1 0.0.0.0/0
```

If your virtual machines and Containers are using IPv6 addresses, you can also add the following line to this file:

```
1 ::/0
```

Other classes should be defined after class 1. They represent exceptions from the "matching-everything" rule of class 1. The example below illustrates a possible configuration of the network classes definition file containing rules for both IPv4 and IPv6 addresses:

```
# server networks
0 192.168.0.0/16
0 fe80::/64

# any IP address (all traffic)
1 0.0.0.0/0
1 ::/0

# class 2 - addresses for the "foreign" traffic
2 10.0.0.0/8
2 2001:db88::/64

# inside "foreign" network there
# is a hole belonging to "local" traffic
1 10.10.16.0/24
1 2001:db88:3333::/64
```

In this example, IPv4 addresses in the range of `192.168.0.0` to `192.168.255.255` and IPv6 addresses in the range of `fe80::` to `fe80::ffff:ffff:ffff:ffff` are treated as class 0 addresses and no accounting is done for the traffic from virtual machines and Containers destined to these addresses.

Class 2 matches the following IP addresses:

- IPv4 addresses from `10.0.0.0` to `10.255.255.255` with the exception of addresses in the sub-range of `10.10.16.0` to `10.10.16.255`, which are treated as class 1.
- IPv6 addresses from `2001:db88::` to `2001:db88::ffff:ffff:ffff:ffff` with the exception of addresses in the sub-range of `2001:db88:3333::` to `2001:db88:3333::ffff:ffff:ffff:ffff`, which are also treated as class 1.

All other IP addresses (both IPv4 and IPv6) belong to class 1.

**Note:** After editing the `/etc/vz/conf/networks_classes` file, execute either the `/etc/init.d/vz accrestart` or `service vz accrestart` command for the changes made to the file to take effect.

## Viewing Network Traffic Statistics

In Parallels Server Bare Metal, you can view the current network traffic statistics using the following utilities:

- `vznetstat` to view the statistics for Containers
- `pnetstat` to view the statistics for virtual machines

### Viewing network statistics for Containers

To view the network statistics for Containers, execute the `vznetstat` utility:

```
# vznetstat
CTID      Net.Class  Input(bytes)  Input(pkts)  Output(bytes)  Output(pkts)
101       1          2202448       19527        9081832        19584
101       2          0             0            0              0
102       0          0             0            0              0
102       1          0             0            0              0
```

In this example, the traffic statistics for two Containers with IDs 101 and 102 is shown. Keep in mind that the `vznetstat` utility displays statistics only on Containers that were started at least once. So, some of your Containers may be not listed in the output.

The command output displays the following information:

- Around 2 MB of data were uploaded to Container 101 and about 9 MB were downloaded from it.
- All the traffic was exchanged with servers from class 1 networks.
- Container 102 has not yet exchanged any traffic with any network.

You can also view the network traffic statistics for a particular Container:

```
# vznetstat -v 101
CTID  Net.Class  Input(bytes)  Input(pkts)  Output(bytes)  Output(pkts)
101   1          2202448       19527        9081832        19584
101   2          0             0            0              0
```

The command above displays the network statistics for Container 101.

### Viewing network statistics for virtual machines

To view the network traffic statistics for virtual machines, use the `pnetstat` utility:

```
# pnetstat
UUID          Net.Class  Input(bytes)  Input(pkts)  Output(bytes)  Output(pkts)
5747d4a9-d4ed...  0          0             0            0              0
5747d4a9-d4ed...  1          0             0            0              0
```

The `pnetstat` output is the same as the one produced by the `vznetstat` utility, except for the first output column that displays virtual machine IDs. If you do not remember which ID is assigned to which virtual machine, run the `pctl list -i` command.

**Note:** In the current version of Parallels Server Bare Metal, you cannot view network traffic statistics for individual virtual machines.

## Turning On and Off Network Bandwidth Management

Traffic shaping (also known as network bandwidth management) allows you to control what network bandwidth a virtual machine or Container receives for outgoing traffic. Traffic shaping is off by default in Parallels Server Bare Metal and is controlled by the `TRAFFIC_SHAPING` parameter in the `/etc/vz/vz.conf` global configuration file.

**Note:** Incoming traffic cannot be controlled for virtual machines and Containers in Parallels Server Bare Metal.

To turn traffic shaping on, you need to complete the following steps:

- 1 Set the value of `TRAFFIC_SHAPING` to `yes` in the global configuration file.
- 2 Correctly set up the `BANDWIDTH` and `TOTALRATE` parameters values.
- 3 Start traffic shaping with the `/etc/init.d/vz shaper on` command.

The `BANDWIDTH` variable is used for specifying the network rate, in kilobits per second, of available network adapters. By default, it is set to `eth0:100000`, which corresponds to a 100Mb/s Fast Ethernet card. If your server has more network adapters installed, update this parameter by listing all the adapters participating in shaping. For example, if you have two Fast Ethernet cards, set the parameter to `eth0:100000 eth1:100000`.

The `TOTALRATE` variable specifies the size of the so-called bandwidth pool for each network class being shaped. The bandwidth from the pool can be borrowed by virtual machines and Containers when they need more bandwidth for communicating with hosts from the corresponding network class. It is used to limit the total available outgoing traffic virtual machines and Containers can consume. The format of this variable is

`<NIC>:<network_class>:<bandwidth_in_Kbits_per_second>` and defines the pool size per network class for a given network adapter. Multiple entries for different network classes and adapters can be separated by spaces. The default value for `TOTALRATE` is `eth0:1:4000`, which corresponds to the pool size of 4Mb/s for Network Class 1 on the first Ethernet adapter.

In the `/etc/vz/vz.conf` configuration file, you can also define the `RATE` variable whose value amounts to the number of kilobits per second any virtual machine and Container is guaranteed to receive for outgoing traffic with a network class on an Ethernet device. The default value of this parameter is `eth0:1:8`, which means that any virtual machine and Container is guaranteed to receive the bandwidth of at least 8 Kb/s for sending data to Class 1 hosts on the first Ethernet device. This bandwidth is not the limit for a virtual machine and Container (unless the `RATEBOUND` parameter is enabled for the virtual machine or Container); the virtual machine or Container can take the needed bandwidth from the `TOTALRATE` bandwidth pool if it is not used by other virtual machines and Containers.



After setting up the above parameters, start bandwidth management as follows:

```
# /etc/init.d/vz shaperon
Starting shaping: Ok
Set shaping on running Container :
vz WARNING: Can't get tc class for Container(101).
vz WARNING: Can't access file /var/run/vz_tc_classes. \
Creating new one.
vz WARNING: Can't get tc class for Container(1).
```

Now you have activated the network bandwidth limits. To turn traffic shaping off temporarily, use the `/etc/init.d/vz shaperoff` command. If you want to disable bandwidth management permanently, set the `TRAFFIC_SHAPING` variable to `no` in the `/etc/vz/vz.conf` configuration file.

## Configuring Network Bandwidth Management

The network bandwidth for outgoing traffic a virtual machine and Container receives is controlled by two parameters: `RATE` and `RATEBOUND`.

**Note:** Incoming traffic cannot be controlled in the current version of Parallels Server Bare Metal.

The `RATE` parameter specifies the guaranteed outgoing traffic rate that a virtual machine or Container receives. This rate can be specified differently for different network classes. Bandwidth values are specified in Kb/s. It is recommended to increase this value in 8 Kb/s chunks and to set it no lower than 8 Kb/s. The example below demonstrates how to set the `RATE` parameter for the `MyVM` virtual machine and Container 101 to 16 Kb/s for network class 1 on the `eth0` network adapter:

```
# pct1 set MyVM --rate 1:16
The VM has been successfully configured.
# pct1 set 101 --rate eth0:1:16 --save
Saved parameters for Container 101
```

**Note:** For Containers, you can also configure the `RATE` parameter for different network adapters. For virtual machines, you can set this parameter for the default network adapter (usually `eth0`) only. The rates for all other network adapters can be configured in the `/etc/vz/vz.conf` global configuration file.

The `RATEBOUND` parameter specifies whether the network bandwidth available to virtual machine or Container for outgoing traffic is limited by the bandwidth specified in the `RATE` variable. By default, this parameter is turned off for all newly created virtual machines and Containers. That means that virtual machines and Containers are allowed to take free bandwidth from the `TOTALRATE` pool. You can turn the `RATEBOUND` parameter on by using the `--ratebound` option of the `pctl set` command, for example:

```
# pct1 set MyVM --ratebound on
The VM has been successfully configured.
# pct1 set 101 --ratebound yes --save
Saved parameters for Container 101
```

The actual network bandwidth available to virtual machines and Containers depends on the number of virtual machines and Containers and the total sum of the `RATE` values, and normally does not coincide with the bandwidth specified in their own `RATE` parameters. If the `RATEBOUND` parameter is turned on, the virtual machine or Container bandwidth is limited by the value of the `RATE` parameter.

If the the `RATE` and `RATEBOUND` parameters are not set for individual virtual machines and Containers, the values from the `/etc/vz/vz.conf` configuration file are taken. By default, Parallels Server Bare Metal does not set `RATEBOUND`, which corresponds to `no`, and `RATE` is set to `eth0:1:8`.

The network bandwidth management in Parallels Server Bare Metal works in the following way. The bandwidth pool for a given network class (configurable through the `TOTALRATE` variable in the global configuration file) is divided among the virtual machines and Containers transmitting data proportionally to their `RATE` settings. If the total value of the `RATE` variables of all virtual machines and Containers transmitting data does not exceed the `TOTALRATE` value, each virtual machine or Container gets the bandwidth equal or greater than its `RATE` value (unless the `RATEBOUND` variable is enabled for this virtual machine or Container). If the total value of the `RATE` variables of all virtual machines and Containers transmitting data exceeds the `TOTALRATE` value, each virtual machine or Container may get less than its `RATE` value.

The example below illustrates the scenario when Containers 101 and 102 have `RATEBOUND` set to `no`, and the `MyVM` virtual machine has `RATEBOUND` set to `yes`. With the default `TOTALRATE` of 4096 Kb/s and `RATE` of 8 Kb/s, the bandwidth pool will be distributed according to the following table:

Container 101	Container 102	MyVM	Consumed bandwidth
transmits	idle	idle	Container 101: 4096 Kb/s
idle	idle	transmits	MyVM: 8 Kb/s
transmits	transmits	idle	Container 101: 2048 Kb/s Container 102: 2048 Kb/s
transmits	idle	transmits	Container 101: 4032 Kb/s MyVM: 8 Kb/s
transmits	transmits	transmits	Container 101: 2016 Kb/s Container 102: 2016 Kb/s Container 103: 8 Kb/s

Once you configure the bandwidth settings, activate your changes by running the following command:

```
# /etc/init.d/vz shaperrestart
Stopping shaping: Ok
Starting shaping: Ok
Set shaping on running Container: Ok
```

This command clears off all existing shaping settings and sets them again using the configuration files of running virtual machines and Containers.

## Managing Disk I/O Parameters

This section explains how to manage disk input and output (I/O) parameters in Parallels Server Bare Metal systems.

### Configuring Priority Levels for Virtual Machines and Containers

In Parallels Server Bare Metal, you can configure the disk I/O (input/output) priority level of virtual machines and Containers. The higher the I/O priority level, the more time the virtual machine or Container will get for its disk I/O activities as compared to the other virtual machines and Containers on the server. By default, any virtual machine and Container on the server has the I/O priority level set to 4. However, you can change the current I/O priority level in the range from 0 to 7 using the `--ioprio` option of the `pctl set` command. For example, you can issue the following command to set the I/O priority of Container 101 and the `MyVM` virtual machine to 6:

```
# pctl set 101 --ioprio 6 --save
Saved parameters for Container 101
# pctl set MyVM --ioprio 6
set ioprio 6
The VM has been successfully configured.
```

To check the I/O priority level currently applied to Container 101 and the `MyVM` virtual machine, you can execute the following commands:

- For Container 101:

```
# grep IOPRIO /etc/vz/conf/101.conf
IOPRIO="6"
```

- For the `MyVM` virtual machine:

```
# pctl list --info | grep ioprio
cpu 2 VT-x accl=high mode=32 cpuunits=1000 ioprio=6 iolimit=0
```

### Configuring the Disk I/O Bandwidth

In Parallels Server Bare Metal, you can configure the bandwidth virtual machines and Containers are allowed to use for their disk input and output (I/O) operations. Limiting the disk I/O bandwidth can help you prevent the situations when high disk activities in one virtual machine or Container (generated, for example, by transferring huge amounts of data to/from the virtual machine or Container) can slow down the performance of other virtual machines and Containers on the Parallels server.

By default, the I/O bandwidth limit for all newly created virtual machines and Containers is set to 0, which means that no limits are applied to any virtual machines and Containers. To limit the disk I/O bandwidth for a virtual machine or Container, you can use the `--iolimit` option of the `pctl set` command. For example, the following command sets the I/O bandwidth limit for the `MyVM` virtual machine to 10 megabytes per second (MB/s):

```
# pctl set MyVM --iolimit 10
Set up iolimit: 10
```

The VM has been successfully configured.

To set the limit for a Container, just specify its ID instead of the virtual machine name and the `--save` option to save the changes to the Container configuration file, for example:

```
# pct1 set 101 --iolimit 10 --save
Set up iolimit: 10485760
Saved parameters for Container 101
```

By default, the limit is set in megabytes per second. However, you can use the following suffixes to use other measurement units:

- G: sets the limit in gigabytes per second (1G).
- K: sets the limit in kilobytes per second (10K).
- B: sets the limit in bytes per second (10B).

**Note:** In the current version of Parallels Containers, the maximum I/O bandwidth limit you can set for a virtual machine and Container is 2 GB per second.

To check that the I/O speed limit has been successfully applied to the `MyVM` virtual machine and Container 101, use the `pctl list` command:

```
# pctl list MyVM -o iolimit
10
# pctl list 101 -o iolimit
IOLIMIT
10485760
```

At any time, you can remove the I/O bandwidth limit set for the `MyVM` virtual machine and Container 101 by running these commands:

```
# pctl set MyVM --iolimit 0
Set up iolimit: 0
The VM has been successfully configured.
# pctl set 101 --iolimit 0 --save
Set up iolimit: 0
Saved parameters for Container 101
```

## Viewing Disk I/O Statistics

In Parallels Containers 4.6, you can view disk input and output (I/O) statistics for virtual machines and Containers. To display the I/O statistics for all running virtual machines and Containers on the physical server, you can run the `pstat` utility with the `-a` option. For example:

```
# pstat -a
7:18pm, up 1 day, 1:29, 2 users, load average: 0.00, 0.01, 0.00
CTNum 1, procs 127: R 2, S 125, D 0, Z 0, T 0, X 0
CPU [ OK ]: CTs 0%, CT0 1%, user 0%, sys 2%, idle 98%, lat(ms) 12/0
Mem [ OK ]: total 1560MB, free 627MB/402MB (low/high), lat(ms) 0/0
ZONE0 (DMA): size 16MB, act 0MB, inact 0MB, free 11MB (0/0/0)
ZONE1 (Normal): size 880MB, act 76MB, inact 104MB, free 616MB (3/4/5)
ZONE2 (HighMem): size 684MB, act 116MB, inact 153MB, free 402MB (0/1/1)
Mem lat (ms): A0 0, K0 0, U0 0, K1 0, U1 0
Slab pages: 65MB/65MB (ino 43MB, de 9MB, bh 2MB, pb 0MB)
Swap [ OK ]: tot 2502MB, free 2502MB, in 0.000MB/s, out 0.000MB/s
Net [ OK ]: tot: in 0.005MB/s 45pkt/s, out 0.000MB/s 1pkt/s
```

```

      lo: in 0.000MB/s   0pkt/s, out 0.000MB/s   0pkt/s
      eth0: in 0.005MB/s 45pkt/s, out 0.000MB/s   1pkt/s
      sit0: in 0.000MB/s   0pkt/s, out 0.000MB/s   0pkt/s
Disks [ OK ]: in 0.000MB/s, out 0.000MB/s

  CTID      ST  IOUSED%  IOWAIT%  IOSPEED      IP
    101     OK    0.00    0.00    2/100MB/s  10.10.11.101
2004838458 OK    0.00    0.00    0.0/---KB/s 10.10.11.201

```

The information related to the virtual machines and Containers disk I/O statistics is at the end of the command output. The table below explains the displayed I/O parameters:

Parameter	Description
IOUSED%	The percentage of time the disks are used by the virtual machine or Container.
IOWAIT%	The percentage of time when at least one I/O transaction in the virtual machine or Container is waiting for being served.
IOSPEED	The current speed of disk I/O operations in the virtual machine or Container and the I/O limit set for this virtual machine or Container, if any. The value can be displayed in bytes, kilobytes, megabytes, or gigabytes per second, depending on the units you used to set the I/O limit.

The `pstat -a` command outputs the disk I/O statistics for all virtual machines and Containers that are currently running on the physical server. In the example output above, this statistics is shown for Container 101 and for the virtual machine with ID 2004838458. Note that the displayed ID is the kernel virtual machine ID (that is, the ID the kernel on the physical server uses to refer to this virtual machine) and is different from the unique identifier of the virtual machine. To view both identifiers of a virtual machine, you can use the `pctl list -i` command, for example:

```

# pctl list -i MyVM
ID: {5c1fb1bb-4364-4b42-86b2-c584bdd2223b}
EnvID: 2075205468
Name: MyVM
...

```

This output shows that the `MyVM` virtual machine has the unique identifier of `5c1fb1bb-4364-4b42-86b2-c584bdd2223b` and the kernel virtual machine ID of `2075205468`.

**Notes:** For more information on `pstat` and its options, see the *Parallels Server Bare Metal 5.0 Reference Guide*.

## Managing Memory Parameters for Containers

This section describes the VSwap memory management system introduced in Parallels Server Bare Metal 5.0. You will learn to do the following:

- [Configure the main VSwap parameters for Containers](#) (p. 110).
- [Set the memory allocation limit in Containers](#) (p. 111).
- [Enhance the VSwap functionality](#) (p. 112).

If you have upgraded to Parallels Server Bare Metal 5.0, you will also learn how the system [calculates the new VSwap values](#) (p. 112) from the memory parameters that were applied to Containers before the upgrade.

## Configuring Main VSwap Parameters

Parallels Server Bare Metal 5.0 introduces a new scheme for managing memory-related parameters in Containers—VSwap. Like many other memory management schemes used on standalone Linux computers, this scheme is based on two main parameters:

- *RAM*. This parameter determines the total size of RAM that can be used by the processes of a Container.
- *swap*. This parameter determines the total size of swap that can be used by a Container for swapping out memory once the RAM is exceeded.

### Notes:

1. In Parallels Server Bare Metal 5.0, the new VSwap memory management scheme has replaced the SLM scheme.

2. You can also set memory limits for and provide memory guarantees to Containers by configuring multiple UBC (User Beancounter) parameters (*numproc*, *numtcpsock*, *vmguarpages*, and so on). These parameters provide you with comprehensive facilities of customizing the memory resources in respect of your Containers. However, this way of managing system resources is more complex and requires more effort to be made on your part to adopt it to your system. For detailed information on UBC parameters, refer to the *Administrator's Guide to Managing UBC Resources* available at <http://www.parallels.com/products/pvcl/resources/docs>.

The new memory management scheme works as follows:

- 1 You set for a Container a certain amount of RAM and swap space that can be used by the processes running in the Container.
- 2 When the Container exceeds the RAM limit set for it, the swapping process starts.  
The swapping process for Containers slightly differs from that on a standalone computer. The Container swap file is virtual and, if possible, resides in the Node RAM. In other words, when the swap-out for a Container starts and the Node has enough RAM to keep the swap file, the swap file is stored in the Node RAM rather than on the hard drive.
- 3 Once the Container exceeds its swap limit, the system invokes the OOM Killer for this Container.
- 4 The OOM Killer chooses one or more processes running in the affected Container and forcibly kills them.

By default, any newly created Container starts using the new memory management scheme. To find out the amount of RAM and swap space set for a Container, you can check the values of the `PHYS_PAGES` and `SWAP_PAGES` parameters in the Container configuration file, for example:

```
# grep PHYS_PAGES /etc/vz/conf/101.conf
```

```
PHYSPAGES="65536:65536"
# grep SWAPPAGES /etc/vz/conf/101.conf
SWAPPAGES="65536"
```

In this example, the value of the `PHYSPAGES` parameter for Container 101 is set to 65536. The `PHYSPAGES` parameter displays the amount of RAM in 4-KB pages, so the total amount of RAM set for Container 101 equals to 256 MB. The value of the `SWAPPAGES` parameter is also set to 256 MB.

To configure the amounts of RAM and swap space for Container 101, use the `--ram` and `--swap` options of the `vzctl set` command. For example, you can execute the following command to set the amount of RAM and SWAP in Container 101 to 1 GB and 512 MB, respectively:

```
# pct1 set 101 --ram 1G --swap 512M --save
Saved parameters for Container 101
```

You can also use the `--physpages` and `--swappages` options to set the amount of RAM and swap space for Containers. For more information on all VSwap options, consult the *Parallels Containers 4.6 Reference Guide*.

## Configuring the Memory Allocation Limit

When an application starts in a Container, it allocates a certain amount of memory for its needs. Usually, the allocated memory is much more than the application actually requires for its execution. This may lead to a situation when you cannot run an application in the Container even if it has enough free RAM. To deal with such situations, the VSwap memory management scheme introduces a new parameter—`VM_Overcommit`. Using this parameter, you can configure the amount of memory applications in a Container may allocate, irrespective of the amount of RAM and swap space assigned to the Container.

The amount of memory that can be allocated by applications of a Container is the sum of RAM and swap space set for this Container multiplied by a memory overcommit factor. In the default (basic) Container configuration file, this factor is set to 1.5. For example, if a Container is based on the default configuration file and assigned 1 GB of RAM and 512 MB, the memory allocation limit for the Container will be 2304 MB. You can configure this limit and set it, for example, to 3 GB by running this command:

```
# vzctl set 101 --vm_overcommit 2 --save
Saved parameters for Container 101
```

This command uses the factor of 2 to increase the memory allocation limit to 3 GB:

```
(1 GB of RAM + 512 MB of swap) * 2 = 3 GB
```

Now applications in Container 101 can allocate up to 3 GB of memory, if necessary.

**Note:** For more information on Container configuration files, see **Managing Container Resources Configurations** (p. 118).

### Tuning VSwap

The new management scheme can be extended by using UBC parameters. For example, you can set the `numfile` parameter to configure the maximal number of processes and threads a Container may create or the `numproc` parameter to specify the number of files that may be opened by all processes in the Container. For detailed information on using UBC parameters, consult the *Administrator's Guide to Managing UBC Resources*.

### Configuring Legacy Containers

If you upgrade from an earlier version of Parallels Server Bare Metal 5.0, all Containers automatically start using the new memory management scheme after the upgrade. The system automatically calculates the values of RAM and swap from the memory parameters that are applied to a Container before the upgrade.

#### SLM

If a Container uses only SLM parameters:

- The amount of RAM is set to the value of the `slmmemorylimit` parameter.
- The amount of swap is set to 0.
- The memory allocation limit is set to the value of the `slmmemorylimit` parameter multiplied by 1.5.

For example, if the `slmmemorylimit` parameter for Container 101 is set to 1 GB, then the Container will have them set to the following values after the upgrade: RAM = 1 GB, swap = 0, memory allocation limit = 1.5 GB.

#### UBC

If a Container uses only UBC parameters:

- The amount of RAM is set to the soft limit of the `privvmpages` parameter.
- The amount of swap is set to 0.
- The memory allocation limit is set to the hard limit of the `privvmpages` parameter

For example, if the soft limit of `privvmpages` for Container 101 is set to 65536 pages and the hard limit to 131072, then the Container will have the following parameters: RAM = 256 MB, swap = 0, memory allocation limit = 2.

#### SLM and UBC

If a Container uses both SLM and UBC parameters:

- The amount of RAM is set to the value of the `slmmemorylimit` parameter.
- The amount of swap is set to 0.



- The memory allocation limit is set to the value of the `slmmemorylimit` parameter multiplied by 1.5.

For example, if the `slmmemorylimit` parameter for Container 101 is set to 1 GB, then the Container will have them set to the following values after the upgrade: RAM = 1 GB, swap = 0, memory allocation limit = 1.5 GB.

## Managing Memory Parameters for Virtual Machines

This section describes the process of managing memory parameters for virtual machines. You will learn how to do the following:

- [Configure the main and video memory for virtual machines](#) (p. 113).
- [Configure memory limits and quota for virtual machines](#) (p. 114).
- [Enable the memory hotplug functionality for virtual machines](#) (p. 117).

### Configuring Main Memory Parameters

The main memory resources for virtual machines include the following:

- main memory
- video memory

The process of managing these resources is described below.

#### Configuring Main Memory

To configure the amount of memory that will be available to the virtual machine, use the `--memsize` option of the `pctl set` command. The following session shows how to change the amount of memory for the `MyVM` virtual machine from 512 MB to 756 MB and to check that the new value has been successfully set:

```
# pctl list -i MyVM | grep memory
memory 512Mb
# pctl set MyVM --memsize 756
Set the memsize parameter to 756Mb
The VM has been successfully configured.
# pctl list -i MyVM | grep memory
memory 756Mb
```

You can configure the memory size for both running and stopped virtual machines.

### Configuring Video Memory

To set the amount of video memory to be available to the virtual machine's video card, use the `--videosize` option of the `pctl set` command. Assuming that the current video memory size of the `MyVM` virtual machine is set to 32 MB, you can increase it to 64 MB by running the following command:

```
# pctl set MyVM --videosize 64
Set the --videosize parameter to 64Mb.
The VM has been successfully configured.
```

To check that the new value has been successfully set, use this command:

```
# pctl list -i MyVM | grep video
video 64Mb
```

### Configuring Additional Memory Parameters

Parallels Server Bare Metal 5.0 comes with an improved memory management scheme. This scheme is driven by two parameters:

- *Reserved memory limit*. The reserved memory limit defines the amount of memory on a Parallels server that can be used by all virtual machines hosted on this server.
- *Memory quota*. The memory quota controls the memory consumption by a particular virtual machine. This parameter is composite and includes the guarantee, limit, priority, and ballooning settings.

The sections below describe how to configure both parameters.

#### Configuring the Reserved Memory Limit

The reserved memory limit defines the amount of memory that can be consumed by all virtual machines on a Parallels server. The remaining memory on the server is reserved for applications that run on the server itself.

By default, the reserved memory limit is calculated automatically and depends on the amount of memory installed on a Parallels server:

- If the server has less than 3 GB of memory installed, this formula is used: "total RAM on the server" multiplied by 0.7. So if the server has 2 GB of memory, the reserved limit is set to 1.4 GB.
- If the server has more than 3 GB of memory installed, this formula is used: "total RAM on the server" minus 1 GB. So if the server has 16 GB of memory, the reserved limit is set to 15 GB.

To configure the default reserved memory limit, you can use the `--mem-limit` option of the `prlsrvctl set` command. For example, the following command reserves 14 GB of memory for use by virtual machines:

```
# prlsrvctl set --mem-limit 14336
Set memory limit: 14336Mb
```

```
The Server has been successfully configured.
```

To revert to the default settings, use this command:

```
# prlsvctl set --mem-limit auto
Set memory limit: auto
The Server has been successfully configured.
```

## Configuring the Memory Quota

The memory quota allows you to control the memory consumption by a particular virtual machine. The quota control parameters include the following:

- *Guarantee*. The amount of memory a virtual machine is guaranteed to get on demand. If the virtual machine requests more memory than is guaranteed, the memory allocation may fail (for example, if there is no free memory on the Parallels server at the moment). Moreover, if the guaranteed amount of memory of all virtual machines running on the server plus their overhead exceeds the reserved limit, you will not be able to start another virtual machine. By default, the guaranteed memory is calculated on the basis of RAM and video memory assigned to a virtual machine and is about a half of its total memory.

**Note:** The overhead of a virtual machine depends on its configuration. For example, the overhead of a virtual machine that has 1024 MB of RAM, 2 CPUs, 256 MB of video memory, a network adapter, a sound card, and a USB controller and runs on modern hardware does not usually exceed 35-40 MB. To check the overhead of a running virtual machine, open the `/proc/parallels/vm/VM_ID/meminfo` file and look for the value of the `Unreclaimable` parameter. Keep in mind, however, that this value may change over time.

- *Limit*. The maximum amount of memory a virtual machine is allowed to consume. The virtual machine cannot exceed this limit even if the Parallels server has a lot of free memory and the virtual machine requires this memory. By default, no limit is set for all newly created virtual machines, and any virtual machine may consume all free memory on the server.
- *Priority*. The priority (from 1 to 100) that defines which virtual machine will get memory first. The higher the priority of a virtual machine, the more chances it has to get memory when the Parallels server has insufficient memory resources. By default, the priority is set to 50.
- *Ballooning*. The maximum amount of memory the balloon driver in a virtual machine may allocate for its needs. Memory ballooning is a technique that allows your system to reclaim memory from virtual machines. To do this, a special balloon driver is loaded into each running virtual machine. When the system requires free memory but does not have any, it sends a command to the balloon driver in the virtual machine to increase its size. The balloon driver inflates by allocating the requested amount of memory in the virtual machine and then gives this memory to the system.

By default, the balloon driver can allocate up to 60% of RAM set for a virtual machine. For example, if the amount of RAM for a virtual machine is set to 2 GB, the balloon driver can allocate the maximum of 1.2 GB of memory.

To configure these quota control parameters for a specific virtual machine, you can use the `--memquota` parameter of the `pctl set` command. For example, the following command sets for the `MyVM` virtual machine the memory guarantee to 512 MB, the limit to 2 GB, the priority to 70, and the ballooning limit to 50% of RAM:

```
# pctl set MyVM --memquota 512:2048:70:50
Disable the memquota auto calculation.
Set the memquota_min parameter to 512Mb.
Set the memquota_max parameter to 1024Mb.
Set the memquota_prio parameter to 70.
Set the memquota_maxballoon parameter to 50.
```

The VM has been successfully configured.

To check that all parameters have been successfully set, use this command:

```
# pctl list -i MyVM | grep memory_quota
memory_quota min=512Mb max=2048Mb priority=70 maxballoon=50%
```

To revert to the default settings, run this command:

```
# pctl set MyVM --memquota auto
Enable the memquota auto calculation.
```

The VM has been successfully configured.

### Possible Usage Scenarios

Below you can find three examples that demonstrate how the new management scheme can help service providers optimize their business.

#### **"Ghetto" (payable RAM)**

You have a number of non-priority customers whose virtual machines use only a fraction of the RAM assigned to them. The virtual machines are stored on different physical servers. To optimize the resources usage, you decide to migrate all underutilized virtual machines to one "Ghetto" server. You then set (a) the guarantee for the migrated virtual machines to the minimum values recommended for the operating systems running in these VMs plus the VM overhead and (b) the memory limit to their RAM values. In this scenario:

- You host a large number of virtual machines on a single physical server.
- You ensure that all virtual machines can get enough memory for non-intensive operations, but do not guarantee the optimal performance of memory-intensive operations (the limit is equal to the RAM).
- You charge customers for the amount of RAM assigned to their virtual machines.

#### **"What you pay is what you get" (payable guarantee and limit)**

You have a number of customers whose virtual machines require a certain amount of memory all the time. For these customers, you configure their virtual machines by setting the memory guarantee to the requested amount plus the VM overhead. You also set the memory limit equal to the guarantee. In this scenario:

- You charge customers for the set memory guarantee.
- Customers can get only the memory they pay for (the guarantee is equal to the limit).
- You ensure that every virtual machine can get the required amount of memory defined by its guarantee.

- No virtual machine can affect the performance of the host and other virtual machines on this host. To meet this requirement, you need to make sure that all virtual machines on the host are configured for use in the "What you pay is what you get" scenario.

### **"Burstable memory" (payable guarantee)**

You have a number of customers whose virtual machines consume small amounts of memory most of the time. Sometimes, memory-intensive operations may also run in the virtual machines. For these virtual machines, you set the memory guarantee to the values that are high enough to run non-intensive memory operations and the memory limit to "unlimited". In this scenario:

- You charge customers for the set memory guarantee.
- You ensure that all virtual machines can get enough memory for non-intensive operations, and such operations are running in the affected virtual machines most of the time.
- When virtual machines require more memory than is defined by their guarantee, they get free memory available on the host (the limit is set to "unlimited"). If the host does not have enough memory, the virtual machines start competing for free memory.

## Enabling Memory Hotplug for Virtual Machines

If a guest operating system supports the memory hotplug functionality, you can enable this functionality for the virtual machine. Once the memory hotplug functionality is turned on, you can increase the amount of memory available to your virtual machines even if they are running.

**Note:** Decreasing the amount of memory available to a running virtual machine is not supported in the current version of Parallels Server Bare Metal.

Currently, the following systems come with the memory hotplug support:

### **Linux** (both x86 and x64 versions)

- CentOS 5.3 and higher
- Red Hat Enterprise Linux 5.3 and higher
- Fedora 13 and higher
- SUSE Linux Enterprise Server 10 and higher
- Ubuntu 10.04 and higher

### **Windows**

- x64 version of Windows Server 2008 R2 (Datacenter Edition)
- x86 and x64 versions of Windows Server 2008 (Standard Edition)
- x86 and x64 versions of Windows Server 2008 (Enterprise Edition)
- x86 and x64 versions of Windows Server 2008 (Datacenter Edition)
- x86 and x64 versions of Windows Server 2003 (Enterprise Edition)

By default, memory hotplug support is disabled for all newly created virtual machines. To enable this functionality, you can use the `--mem-hotplug` option of the `pctl set` command. For example, to enable the memory hotplug support in the `MyVM` virtual machine that runs one of the supported operating systems, stop the `MyVM` virtual machine and run this command:

```
# pctl set MyVM --mem-hotplug on
set mem hotplug: 1
The VM has been successfully configured.
```

Once the functionality is enabled, you can increase the amount of memory for the `MyVM` virtual machine even it is running.

To disable the memory hotplug support in the `MyVM` virtual machine, use this command:

```
# pctl set MyVM --mem-hotplug off
set mem hotplug: 0
The VM has been successfully configured.
```

The changes will come into effect on the next virtual machine start.

## Managing Container Resources Configuration

Any Container is configured by means of its own configuration file. You can manage Container configurations in a number of ways:

- 1 Using configuration sample files shipped with Parallels Server Bare Metal. These files are used when a new Container is being created (for details, see **Creating and Configuring New Containers**). Currently, the following configuration sample files are provided:
  - `basic`. Use it for creating standard Containers.
  - `confixx`. Use it for creating Containers that are to run the Confixx control panel.
  - `slm.plesk`. Use it for creating Containers with the Plesk control panel.
  - `slm.256MB`. Use it for creating Containers with 256 MB of main memory.
  - `slm.512Mb`. Use it for creating Containers with 512 MB of main memory.
  - `slm.1024Mb`. Use it for creating Containers with 1024 MB of main memory.
  - `slm.2048Mb`. Use it for creating Containers with 2048 MB of main memory.

**Note:** Configuration sample files cannot contain spaces in their names.

Any sample configuration file can also be applied to an existing Container. You would do this if, for example, you want to upgrade or downgrade the overall resources configuration of a particular Container:

```
# pctl set 101 --applyconfig basic --save
```

This command applies all the parameters from the `ve-basic.conf-sample` file to Container 101.

When you install Parallels Server Bare Metal on your server, the default Container samples are put to the `/etc/vz/conf` directory. They have the following format: `ve-<name>.conf-sample` (for example, `ve-basic.conf-sample`). In this connection you should keep in mind the following when working with Container samples:

- When you create a Container using the `pctl create` command utility and base it on some Container sample, this sample is taken from the `/etc/vz/conf` directory.
- 2 Using specific utilities for preparing configuration files in their entirety. The tasks these utilities perform are described in the following subsections of this section.
  - 3 The direct creating and editing of the corresponding Container configuration file (`/etc/vz/conf/<CT_ID>.conf`). This can be performed with the help of any text editor. The instructions on how to edit Container configuration files directly are provided in the four preceding sections. In this case you have to edit all the configuration parameters separately, one by one.

## Splitting Server Into Equal Pieces

It is possible to create a Container configuration roughly representing a given fraction of the server. If you want to create such a configuration that up to 20 fully loaded Containers would be able to be simultaneously running on the given server, you can do it as follows:

```
# cd /etc/vz/conf
# vzsplit -n 20 -f mytest
Config /etc/vz/conf/ve-mytest.conf-sample was created
```

Notice that the configuration produced depends on the given server resources. Therefore, it is important to validate the resulted configuration file before trying to use it, which is done with the help of the `vzcfgvalidate` utility. For example:

```
# vzcfgvalidate ve-mytest.conf-sample
Recommendation: kmemsize.lim-kmemsize.bar should be > 253952 \
(currently, 126391)
Recommendation: dgramrcvbuf.bar should be > 132096 (currently, 93622)
```

The number of Containers you can run on the server is actually several times greater than the value specified in the command line because Containers normally do not consume all the resources that are guaranteed to them. To illustrate this idea, let us look at the Container created from the configuration produced above:

```
# pctl create 101 --ostemplate redhat-el5-x86 --config mytest
Creating Container private area (redhat-el5-x86)
Container is mounted
Postcreate action done
Container is unmounted
Container private area created
Container registered successfully
# pctl set 101 --ipadd 192.168.1.101 --save
Saved parameters for Container 101
# pctl start 101
Starting Container ...
Container is mounted
...
# vzcalc 101
Resource      Current(%)  Promised(%)  Max(%)
```

Memory	0.53	1.90	6.44
--------	------	------	------

As is seen, if Containers use all the resources guaranteed to them, then around 20 Containers can be simultaneously running. However, taking into account the **Promised** column output, it is safe to run 40-50 such Containers on this server.

**Note:** If you generate a Container configuration sample using the `vzsplit` command line utility, the resulting Container sample is put to the `/etc/vz/conf` directory. This sample can then be used by `pctl create` when creating a new Container on its basis.

## Scaling Container Configuration

Any configuration or configuration sample file can prove insufficient for your needs. You might have an application which does not fit into existing configurations. The easiest way of producing a Container configuration is to scale an existing one.

Scaling produces a “heavier” or “lighter” configuration in comparison with an existing one. All the parameters of the existing configuration are multiplied by a given number. A heavier configuration is produced with a factor greater than 1, and a lighter one – with a factor between 0 and 1.

**Note:** If you create a new sample on the basis of an existing sample using the `vzcfgscale` command line utility, the resulting Container sample is put to the `/etc/vz/conf` directory. This sample can then be used by `pctl create` when creating a new Container on its basis.

The session below shows how to produce a configuration sample 50% heavier than the `basic` configuration shipped with Parallels Server Bare Metal:

```
# cd /etc/vz/conf
# vzcfgscale -a 1.5 -o ve-improved.conf-sample ve-basic.conf-sample
# vzcfgvalidate ve-improved.conf-sample
Recommendation: kmemsize.lim-kmemsize.bar should be > 245760 \
(currently, 221184)
Recommendation: dgramrcvbuf.bar should be > 132096 (currently, 98304)
Validation completed: success
```

Now `improved` can be used in the `pctl create` command for creating new Containers.

It is possible to use the same technique for scaling configurations of the existing Containers. Notice that the output file cannot be the same as the file being scaled. You have to save the scaling results into an intermediate file.

## Validating Container Configuration

The system resource control parameters have complex interdependencies. The violation of these interdependencies can be catastrophic for the Container. In order to ensure that a Container does not break them, it is important to validate the Container configuration file before creating Containers on its basis.

The typical validation scenario is shown below:



```
# vzcfgvalidate /etc/vz/conf/101.conf
Error: kmemsize.bar should be > 1835008 (currently, 25000)
Recommendation: dgramrcvbuf.bar should be > 132096 (currently, 65536)
Recommendation: othersockbuf.bar should be > 132096 \
(currently, 122880)
# pct1 set 101 --kmemsize 2211840:2359296 --save
Saved parameters for Container 101
# vzcfgvalidate /etc/vz/conf/101.conf
Recommendation: kmemsize.lim-kmemsize.bar should be > 163840 \
(currently, 147456)
Recommendation: dgramrcvbuf.bar should be > 132096 (currently, 65536)
Recommendation: othersockbuf.bar should be > 132096 \
(currently, 122880)
Validation completed: success
```

The utility checks constraints on the resource management parameters and displays all the constraint violations found. There can be three levels of violation severity:

Recommendation	This is a suggestion, which is not critical for Container or server operations. The configuration is valid in general; however, if the system has enough memory, it is better to increase the settings as advised.
Warning	A constraint is not satisfied, and the configuration is invalid. The Container applications may not have optimal performance or may fail in an ungraceful way.
Error	An important constraint is not satisfied, and the configuration is invalid. The Container applications have increased chances to fail unexpectedly, to be terminated, or to hang.

In the scenario above, the first run of the `vzcfgvalidate` utility found a critical error for the `kmemsize` parameter value. After setting reasonable values for `kmemsize`, the resulting configuration produced only recommendations, and the Container can be safely run with this configuration.

## Applying New Configuration Sample to Container

Parallels Server Bare Metal allows you to change the configuration sample file a Container is based on and, thus, to modify all the resources the Container may consume and/or allocate at once. For example, if Container 101 is currently based on the `basic` configuration sample and you are planning to run the Plesk application inside the Container, you may wish to apply the `slm.plesk` sample to it instead of `basic`, which will automatically adjust the necessary Container resource parameters for running the Plesk application inside Container 101. To do this, you can execute the following command on the server:

```
# pct1 set 101 --applyconfig slm.plesk --save
Saved parameters for Container 101
```

This command reads the resource parameters from the `ve-slm.plesk.conf-sample` file located in the `/etc/vz/conf` directory and applies them one by one to Container 101.

When applying new configuration samples to Containers, keep in mind the following:

- All Container sample files are located in the `/etc/vz/conf` directory on the server and are named according to the following pattern: `ve-<name>.conf-sample`. You should specify only the `<name>` part of the corresponding sample name after the `--applyconfig` option (`s1m.plesk` in the example above).
- The `--applyconfig` option applies all the parameters from the specified sample file to the given Container, except for the `OSTEMPLATE`, `TEMPLATES`, `VE_ROOT`, `VE_PRIVATE`, `HOSTNAME`, `IP_ADDRESS`, `TEMPLATE`, `NETIF` parameters (if they exist in the sample file).
- You may need to restart your Container depending on the fact whether the changes for the selected parameters can be set on the fly or not. If some parameters could not be configured on the fly, you will be presented with the corresponding message informing you of this fact.

# Managing Services and Processes

This chapter provides information on what services and processes are, how they influence the operation and performance of your system, and what tasks they perform in the system.

You will learn how to use the command line utilities in order to manage services and processes in Parallels Server Bare Metal. In particular, you will learn how to monitor active processes in your system, change the mode of the `xinetd`-dependent services, identify the Container ID where a process is running by the process ID, start, stop, or restart services and processes, and edit the service run levels.

**Note:** In the current version of Parallels Server Bare Metal, you cannot manage services and processes in virtual machines using Parallels Server Bare Metal utilities. However, you can log in to a particular virtual machine (e.g. via RDP to a Windows virtual machine and SSH to a Linux virtual machine) and manage its services and processes in the same way you would manage them on a standalone computer.

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## What Are Services and Processes

Instances of any programs currently running in the system are referred to as processes. A process can be regarded as the virtual address space and the control information necessary for the execution of a program. A typical example of a process is the `vi` application running on your server or inside your Linux-based Containers. Along with common processes, there are a great number of processes that provide an interface for other processes to call. They are called services. In many cases, services act as the brains behind many crucial system processes. They typically spend most of their time waiting for an event to occur or for a period when they are scheduled to perform some task. Many services provide the possibility for other servers on the network to connect to the given one via various network protocols. For example, the `nfs` service provides the NFS server functionality allowing file sharing in TCP/IP networks.

You may also come across the term "daemon" that is widely used in connection with processes and services. This term refers to a software program used for performing a specific function on the server system and is usually used as a synonym for "service". It can be easily identified by "d" at the end of its name. For example, `httpd` (short for the HTTP daemon) represents a software program that runs in the background of your system and waits for incoming requests to a web server. The

daemon answers the requests automatically and serves the hypertext and multimedia documents over the Internet using HTTP.

When working with services, you should keep in mind the following. During the lifetime of a service, it uses many system resources. It uses the CPUs in the system to run its instructions and the system's physical memory to hold itself and its data. It opens and uses files within the file systems and may directly or indirectly use certain physical devices in the system. Therefore, in order not to decrease your system performance, you should run only those services on the Parallels server that are really needed at the moment.

Besides, you should always remember that running services in the Host OS is much more dangerous than running them in virtual machines and Containers. In case violators get access to one of the virtual machines and Containers through any running service, they will be able to damage only the virtual machine and Container where this service is running, but not the other virtual machines and Containers on your server. The Parallels server itself will also remain unhurt. And if the service were running on the Parallels server, it would damage both the server and all virtual machines and Containers residing on it. Thus, you should make sure that you run only those services on the server that are really necessary for its proper functioning. Launch all additional services you need at the moment inside separate virtual machines and Containers. It can significantly improve your system safety.

## Main Operations on Services and Processes

The ability to monitor and control processes and services in your system is essential because of the profound influence they have on the operation and performance of your whole system. The more you know about what each process or service is up to, the easier it will be to pinpoint and solve problems when they creep in.

The most common tasks associated with managing services running on the Parallels server or inside a virtual machine and Container are starting, stopping, enabling, and disabling a service. For example, you might need to start a service in order to use certain server-based applications, or you might need to stop or pause a service in order to perform testing or to troubleshoot a problem.

For `xinetd`-dependent services, you do not start and stop but enable and disable services. The services enabled in this way are started and stopped on the basis of the corresponding state of the `xinetd` daemon. Disabled services are not started whatever the `xinetd` state.

In Parallels Server Bare Metal, you can manage services on the Parallels server and inside Containers by means of special Linux command-line utilities. You can do it either locally or from any server connected on the network.

As for processes, such Parallels Server Bare Metal utilities as `vzps`, `vztop`, `vzpid` enable you to see what a process is doing and to control it. Sometimes, your system may experience problems such as slowness or instability, and using these utilities can help you improve your ability to track down the causes. It goes without saying that in Parallels Server Bare Metal you can perform all

those operations on processes you can do in a normal system, for example, kill a process by sending a terminate signal to it.

## Managing Processes and Services

In Parallels Server Bare Metal, services and processes can be managed using the following Parallels command line utilities:

- `vzps`
- `vzpid`
- `vztop`
- `vzsetxinetd`.

With their help, you can perform the following tasks:

- print the information about active processes on your Parallels server
- view the processes activity in real time
- change the mode of the services that can be either `xinetd`-dependent or standalone
- identify the Container ID where a process is running by the process ID

**Note:** In the current version of Parallels Server Bare Metal, you cannot use Parallels Server Bare Metal utilities for managing services and processes in virtual machines. However, you can log in to a particular virtual machine (e.g. via RDP to a Windows virtual machine and SSH to a Linux virtual machine) and manage its services and processes in the same way you would manage them on a standalone computer.

## Viewing Active Processes and Services

The `vzps` utility provides certain additional functionality related to monitoring separate Containers running on the Parallels server. For example, you can use the `-E` switch with the `vzps` utility to:

- display the Container IDs where the processes are running
- view the processes running inside a particular Container

`vzps` prints the information about active processes on your Parallels server. When run without any options, `vzps` lists only those processes that are running on the current terminal. Below is an example output of the `vzps` run:

```
$ vzps
  PID TTY          TIME CMD
 4684 pts/1        00:00:00 bash
 27107 pts/1        00:00:00 vzps
```

Currently, the only processes assigned to the user/terminal are the `bash` shell and the `vzps` command itself. In the output, the PID (Process ID), TTY, TIME, and CMD fields are contained. TTY

denotes which terminal the process is running on, TIME shows how much CPU time the process has used, and CMD is the name of the command that started the process.

**Note:** The IDs of the processes running inside Containers and displayed by running the `vzps` command on the Parallels server does not coincide with the IDs of the same processes shown by running the `ps` command inside these Containers.

As you can see, the standard `vzps` command just lists the basics. To get more details about the processes running on your server, you will need to pass some command line arguments to `vzps`. For example, using the `aux` arguments with this command displays processes started by other users (`a`), processes with no terminal or one different from yours (`x`), the user who started the process and when it began (`u`). Besides, you can pass `vzps` the `-E` switch to sort the processes by the Container IDs where they are running.

```
# vzps aux -E
USER  PID  %CPU  %MEM  VSZ  RSS  TTY   STAT  START  TIME  COMMAND
root   1    0.0   0.0   1516  128  ?    S     Jul14  0:37  init
root   5    0.0   0.0    0    0  ?    S     Jul14  0:03  [ubstatd]
root   6    0.0   0.0    0    0  ?    S     Jul14  3:20  [kswapd]
#27   7    0.0   0.0    0    0  ?    S     Jul14  0:00  [bdflush]
root   9    0.0   0.0    0    0  ?    S     Jul14  0:00  [kinoded]
root  1574  0.0   0.1   218  140  pts/4 S     09:30  0:00  -bash
```

There is a lot more information now. The fields USER, %CPU, %MEM, VSZ, RSS, STAT, and START have been added. Let us take a quick look at what they tell us.

The USER field shows you which user initiated the command. Many processes begin at system start time and often list root or some system account as the USER. Other processes are, of course, run by individuals.

The %CPU, %MEM, VSZ, and RSS fields all deal with system resources. First, you can see what percentage of the CPU the process is currently utilizing. Along with CPU utilization, you can see the current memory utilization and its VSZ (virtual memory size) and RSS (resident set size). VSZ is the amount of memory the program would take up if it were all in memory; RSS is the actual amount currently in memory. Knowing how much a process is currently eating will help determine if it is acting normally or has spun out of control.

You will notice a question mark in most of the TTY fields in the `vzps aux` output. This is because most of these programs were started at boot time and/or by initialization scripts. The controlling terminal does not exist for these processes; thus, the question mark. On the other hand, the `bash` command has a TTY value of `pts/4`. This is a command being run from a remote connection and has a terminal associated with it. This information is helpful for you when you have more than one connection open to the machine and want to determine which window a command is running in.

STAT shows the current status of a process. In our example, many are sleeping, indicated by an S in the STAT field. This simply means that they are waiting for something. It could be user input or the availability of system resources. The other most common status is R, meaning that it is currently running.

**Note:** For detailed information on all `vzps` parameters, output fields, states of processes, etc., please consult the `vzps` manual pages.

You can also use the `vzps` command to view the processes inside any running Container. The example below shows you how to display all active processes inside Container 101:

```
# vzps -E 101
CTID  PID TTY          TIME CMD
101 27173 ?           00:00:01 init
101 27545 ?           00:00:00 syslogd
101 27555 ?           00:00:00 sshd
101 27565 ?           00:00:00 xinetd
101 27576 ?           00:00:03 httpd
101 27583 ?           00:00:00 httpd
101 27584 ?           00:00:00 httpd
101 27587 ?           00:00:00 crond
101 27596 ?           00:00:00 saslauthd
```

## Monitoring Processes in Real Time

The `vztop` utility is rather similar to `vzps` but is usually started full-screen and updates continuously with process information. This can help with programs that may infrequently cause problems and can be hard to see with `vzps`. Overall system information is also presented, which makes a nice place to start looking for problems.

The `vztop` utility can be run on the server just as the standard Linux `top` utility. The only features that distinguish the `vztop` utility from `top` are the following:

- `vztop` allows you to use the `-E` option that monitors only the processes belonging to the Container whose processes you want to display.
- You can use the `e` interactive command to temporarily view/hide the CTIDs where the processes are running.
- You can use the `E` interactive command to set the filter on the CTID field that helps you display only the processes belonging to the given Container.

The `vztop` utility usually has an output like the following:

```
# vztop -E 101
17:54:03 up 20 days, 23:37, 4 users, load average: 2.13, 1.89, 1.75
305 processes: 299 sleeping, 3 running, 3 zombie, 0 stopped
CPU0 states: 20.1% user 51.2% system 0.0% nice 0.0% iowait 28.1% idle
CPU1 states: 21.2% user 50.0% system 0.0% nice 0.0% iowait 28.1% idle
Mem: 1031088k av, 969340k used, 61748k free, 0k shrd, 256516k buff
     509264k active,           330948k inactive
Swap: 4056360k av,   17156k used, 4039204k free   192292k cached
CTID  PID USER PR  NI  VIRT  RES  SHR S %CPU %MEM  TIME+  COMMAND
101 27173 root 16  0   1616  604 1420 S  0.0  0.1  0:01.86 init
101 27545 root 16  0   1520  624 1356 S  0.0  0.1  0:00.34 syslogd
101 27555 root 25  0   4008 1700 3632 S  0.0  0.4  0:00.04 sshd
101 27565 root 25  0   2068  860 1740 S  0.0  0.2  0:00.05 xinetd
101 27576 root 16  0   7560 3180 6332 S  0.0  0.7  0:03.78 httpd
101 27587 root 16  0   2452 1036 1528 S  0.0  0.2  0:00.34 crond
101 27596 root 25  0   4048 1184 3704 S  0.0  0.2  0:00.01 saslauthd
```

As you can see, `vztop` provides an ongoing look at the processor activity in real time (the display is updated every 5 seconds by default, but you can change that with the `d` command-line option or the `s` interactive command). It displays a list of the most CPU-intensive tasks on the system and can provide an interactive interface for manipulating processes. It can sort the tasks by CPU usage, memory usage, and runtime. Specifying 101 after the `-E` option allows you to display only those processes that are running inside Container 101 only. Besides, most features can be selected by an interactive command, for example, the `e` and `E` commands described above.

**Note:** In the current version of Parallels Server Bare Metal, you cannot use the `vztop` utility for monitoring processes in virtual machines.

## Changing Services Mode

`xinetd` is a service used to start and stop a variety of data communication services. `xinetd` starts on the Parallels server startup and waits for a connection request from a remote client that wants to connect to the server. There can be a number of remote clients in the network, and each of them can use different network protocols to establish connection to the server. In order not to run all network services responsible for a specific protocol, which will negatively influence the system performance, the system starts only the `xinetd` service. This service controls all other network services and, at the connection time, it starts the corresponding service to process this connection. In such a way, `xinetd` saves system resources allowing you to run only those network services in the system that are really needed at the moment.

The `vzsetxinetd` utility allows you to switch Container services between the standalone and `xinetd` mode. The services that can be either standalone or dependent on `xinetd` are `sendmail`, `sshd`, `proftpd`, and `courier-imap`. Whereas they are `xinetd`-dependent by default, in order to consume less resources, you may want to make them standalone due to the following reasons:

- The CPanel application does not recognize `sshd` if it is dependent on `xinetd`;
- `sendmail` does not process some rules correctly if it is dependent on `xinetd`;
- A number of control panel applications and some others are not able to manage `xinetd`-based services at all.

The `courier-imapd`, `courier-imapds`, `courier-pop3d`, and `courier-pop3ds` services are provided by the `courier-imap` service, thus `vzsetxinetd` can manage these services via the `courier-imap` service.

Let us assume that you wish to check the mode of the `sendmail` service and set it to standalone if it is in the `xinetd` mode. First, you should check the current status of the `sendmail` service. To this effect, type the following command in the command line:

```
# vzsetxinetd -s 222 sendmail
```



where 222 is the Container ID, `sendmail` denotes the name of the corresponding service, and the `-s` option gets the status of the `sendmail` service of the Container with ID 222. The output will tell you if this service has the standalone or `xinetd` mode:

```
sendmail is xinetd service
```

In our case it is in the `xinetd` mode. Now you can change the mode of the `sendmail` service to standalone. To make it standalone, type the following line:

```
# vzsetxinetd 222 sendmail off
sendmail is standalone service
```

where `off` specifies that the `sendmail` service should be set to the standalone mode. The output confirms that the `sendmail` service is now standalone.

For more information on the `vzsetxinetd` utility, consult the corresponding man pages or refer to the *Parallels Command Line Reference Guide*.

**Notes:**

1. You cannot use the `vzsetxinetd` utility to change the mode of the `xinetd`-dependent services in Containers where the Debian 3.0 OS template is installed.
2. In the current version of Parallels Server Bare Metal, you cannot use the `vzsetxinetd` utility for managing services in virtual machines.

## Determining Container Identifiers by Process IDs

Each process is identified by a unique PID (process identifier), which is the entry of that process in the kernel's process table. For example, when you start Apache, it is assigned a process ID. This PID is then used to monitor and control this program. The PID is always a positive integer. In Parallels Server Bare Metal, you can use the `vzpid` (retrieve process ID) utility to print the Container ID the process with the given id belongs to. Multiple process IDs can be specified as arguments. In this case the utility will print the Container number for each of the processes.

The typical output of the `vzpid` utility is shown below:

```
# vzpid 12
Pid  VEID  Name
12   101    init
```

In our example the process with the identifier 12 has the name 'init' and is running in the Container with ID 101.

**Note:** You can also display the Container ID where the corresponding process is running by using the `vzps` utility.

## Starting, Stopping, and Restarting Services

You can manage (i.e. start, stop, and restart) services by using the command line. For example, you wish to start the `httpd` service. To do this, execute the following command:

```
[root@ct222 /]# service httpd start
```

where `service` is the standard Linux command, `httpd` denotes the name of the corresponding service, and `start` is the command that will launch this service. In order to check that the `httpd` service was successfully launched, you can either type the following Linux command:

```
[root@ct222 /]# service httpd status
```

or use the `vzps` utility when working on your server or the `ps` utility when working inside your Containers and passing them the `x` argument. The output will tell you if the `httpd` service is running in your system or not.

# Managing Parallels Server Bare Metal Network

The given chapter familiarizes you with the Parallels Server Bare Metal network structure, enumerates Parallels networking components, and explains how to manage these components in your working environments. In particular, it provides the following information:

- How you can manage network adapters on the Parallels server.
- What Virtual Networks are and how you can manage them on the Parallels server.
- How to create virtual network adapters inside your virtual machines and Containers and configure their parameters.
- How to connect virtual machines and Containers to different networks.

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# Managing Network Adapters on the Parallels Server

Network adapters installed on the Parallels server are used to provide virtual machines and Containers with access to each other and to external networks. During the installation, Parallels Server Bare Metal registers all physical and VLAN network adapters available on the server. In addition to that, it creates a number of VLAN adapters on the server. Once Parallels Server Bare Metal has been successfully installed, you can perform the following operations on network adapters:

- List the adapters currently available on the server.
- Create new VLAN adapters on the server.

**Note:** For more information on Virtual Networks, refer to **Managing Virtual Networks** (p. 140).

These operations are described in the following subsections in detail.

## Listing Adapters

You can view the physical, virtual, and VLAN network adapters on your Parallels server using the `vznetcfg` utility. For example, you can execute the following command to list the available adapters:

```
# vznetcfg if list
Name  Type      Network ID  Addresses
eth0  nic       Bridged    10.30.18.41/16, fe80::20c:29ff:fee8:9419/64, dhcp
br1   bridge   Bridged    fe80::200:ff:fe00:0/64
br0   bridge   Host-Only  fe80::200:ff:fe00:0/64
```

The information on adapters is presented in the table with the following columns:

Column Name	Description
Name	Adapter name.
Type	Type of the network adapter. It can be one of the following: <ul style="list-style-type: none"> <li><code>nic</code> denotes a physical adapter.</li> <li><code>vlan</code> stands for a VLAN adapter.</li> <li><code>bridge</code> is a virtual bridge automatically created for each Virtual Network on the Parallels server.</li> <li><code>vethX</code> is a virtual network adapter automatically created for each <code>veth</code> network adapter in each Container.</li> <li><code>vmeN</code> is a virtual network adapter automatically created for each network adapter that exists in a virtual machine and operates in the virtual network mode.</li> </ul>
Network ID	ID of the Virtual Network to which the network adapter is connected. Detailed information on Virtual Networks is provided in <b>Managing Virtual Networks</b> (p. 140).
Addresses	IP address and subnet mask assigned to the network adapter. <code>dhcp</code> denotes that the adapter gets its network parameters from a DHCP server.

## Creating VLAN Adapters

Parallels Server Bare Metal allows you to create new VLAN adapters on the Parallels server. You can use these adapters later on to connect your virtual machines and Containers to any of the available Virtual Networks (for more information on Virtual Networks, see **Managing Virtual Networks (p. 140)**). VLAN adapters can be made using the `vznetcfg vlan add` command. To create a new VLAN adapter, you need to specify two parameters.

- VLAN ID—an arbitrary integer number which will uniquely identify the virtual LAN among other VLANs on the server.
- Physical network adapter on the server to which the VLAN is to be bound.

For example, you can execute the following command to make a new VLAN adapter, associate it with a VLAN having the ID of 5 (i.e. with VLAN 5), and attach the VLAN adapter to the `eth0` physical adapter on the server:

```
# vznetcfg vlan add eth0 5
```

To check that the VLAN adapter has been successfully created, execute the following command:

```
# vznetcfg if list
Name      Type      Network ID  Addresses
eth0      nic       192.168.0.150/22,dhcp
eth0.5    vlan
...
```

VLAN adapters can be easily identified by the `vlan` designation shown in the `Type` column of the command output. As you can see, only one VLAN adapter currently exists on the server. It is assigned the name of `eth0.5`. This name is generated automatically on the basis of the specified VLAN ID and the name of the physical adapter to which the VLAN adapter is tied.

At any time, you can delete the `eth0.5` VLAN adapter and thus destroy VLAN 5 by issuing the following command:

```
# vznetcfg vlan del eth0.5
```

## Networking Modes in Parallels Server Bare Metal

In Parallels Server Bare Metal, any virtual machine and Container can operate in one of the two networking modes:

- *host-routed*
- *virtual network*

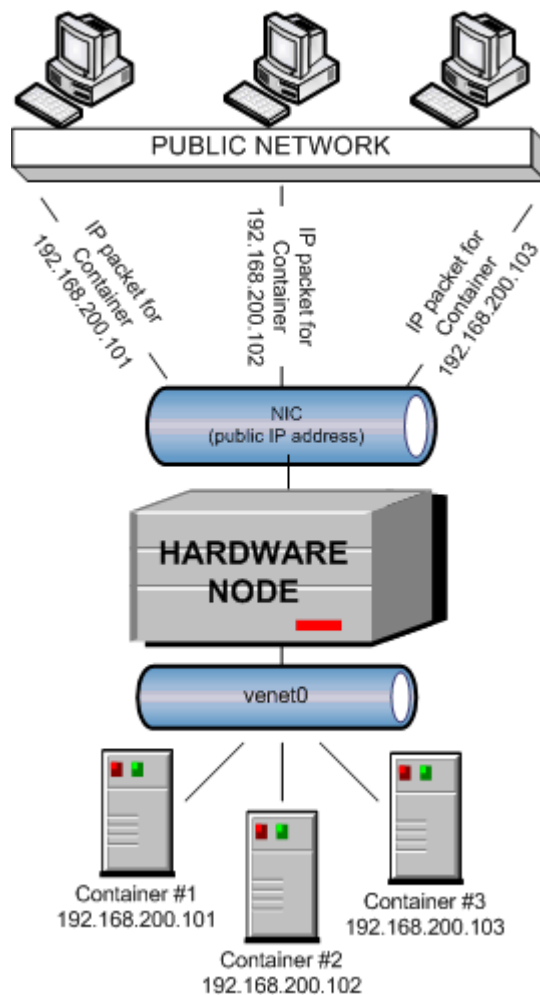
Detailed information on these modes is given in the following sections.

### Host-Routed Mode

The implementations of host-routed mode for Containers and virtual machines have much in common but also show some differences. Therefore, we describe them in different sections.

#### Host-routed mode for Containers

By default, a newly created Container starts operating in the host-routed mode. In this mode, the Container is connected with the other Containers on the server and with the server itself using a special virtual network adapter called `vnet0`. The picture below provides an example of the network structure when all Containers (*Container #1*, *Container #2*, *Container #3*) are functioning in the host-routed mode.



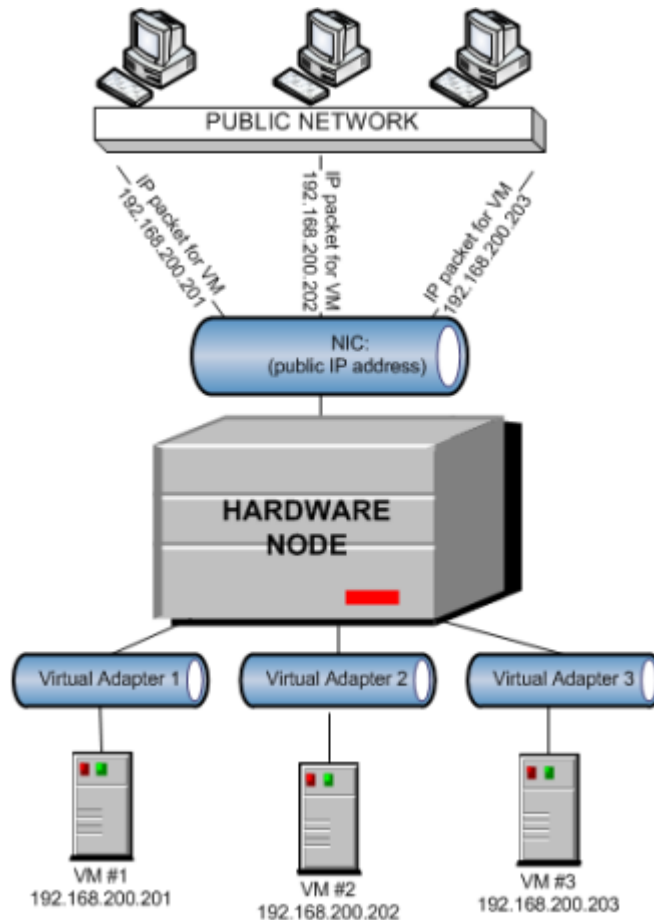
All Containers use the `venet0` virtual adapter as the default gateway to send and receive data to/from other networks (shown as the *PUBLIC NETWORK* in the picture above). The procedure of handling incoming and outgoing IP packets can be described as follows:

- All IP packets from Containers come to the `venet0` adapter and are redirected through a public IP address of the server to the corresponding server on the public network.
- All IP packets coming from external networks and destined for Container IP addresses reach the public IP address of the server first and, afterwards, are sent through `venet0` to the IP addresses of the corresponding Containers.

The `venet0` adapter is also used to exchange the traffic among Containers. All network traffic of a Container is isolated from that of the other Containers—that is, all Containers are protected from each other in the way that makes traffic snooping impossible.

## Host-routed mode for virtual machines

By default, a new virtual machine is created with the network adapter that operates in the virtual network mode. To change the mode to host-routed, you can use the `pctl set` command or Parallels Management Console. In the host-routed mode, all virtual machines use special virtual adapters on the server to connect to each other, the server, and computers on external networks. The picture below demonstrates an example network structure when all virtual machines (VM #1, VM #2, and VM #3) are operating in the host-routed mode.



In this network:

- All virtual machines use special networks adapters (*Virtual Adapter 1*, *Virtual Adapter 2*, and *Virtual Adapter 3*) as the default gateways to send and receive data to/from other networks. The default gateways are assigned the IP address of 169.255.30.1. This special IP address is from the Automatic Private IP Addressing (APIPA) range and is used to deliver data packets from virtual machines to the physical network adapter (NIC), and vice versa.
- All IP packets from virtual machines come to the corresponding adapters and are redirected through a public IP address of the server to the destination computer.

- All IP packets coming from external networks and destined for virtual machines reach the public IP address of the first and, afterwards, are sent through virtual adapters to the IP addresses of the destination virtual machine.

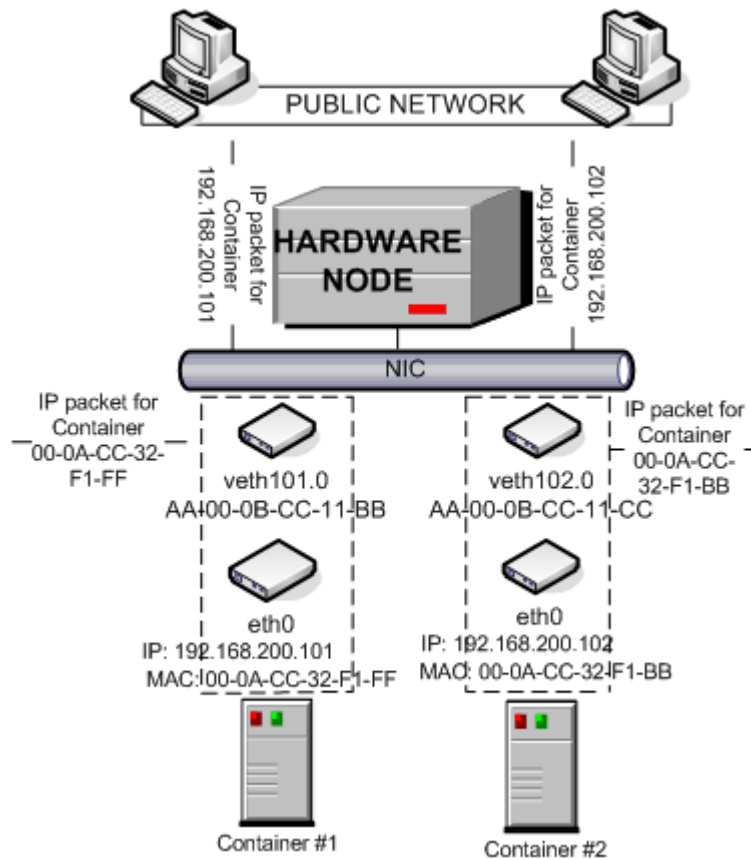
Virtual adapters are also used to exchange the traffic among virtual machines. All network traffic of a virtual machine is isolated from that of the other virtual machines—that is, all virtual machines are protected from each other in the way that makes traffic snooping impossible.

## Virtual Network Mode

The implementations of virtual network mode for Containers and virtual machines have much in common but also show some differences. Therefore, we describe them in different sections.

### Virtual network mode for Containers

You can create `veth` virtual adapters in Containers and make them operate in the virtual network mode. The following figure represents an example of the network structure where all Containers (*Container #1* and *Container #2*) are operating in the virtual network mode.



In the virtual network mode, a separate `veth` virtual adapter is created for each Container. Any `veth` virtual adapter consists of two interfaces:

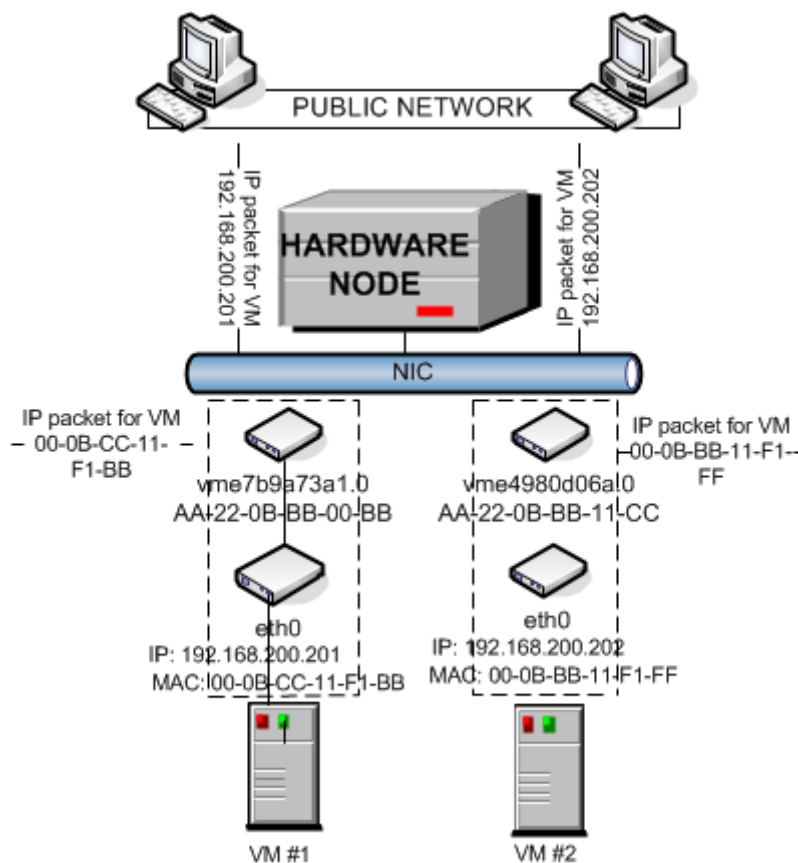


- *An Ethernet interface in the Container.* This interface represents a counterpart of a physical network adapter installed on a standalone server. As any other physical adapter, it has a MAC address, can be assigned one or more IP addresses and included in different network environments, and so on. Refer to the **Configuring veth Adapter Parameters** section (p. 145) for detailed information on configuring Ethernet interfaces in Containers.
- *An Ethernet interface on the server.* This interface is responsible for the adapter operation in the server context and mostly used to maintain the interaction and communication between the server and the Ethernet interface in the Container. Each Ethernet interface is assigned a MAC address. Detailed information on managing Ethernet interfaces on the server is provided in the **Configuring veth Adapter Parameters** section (p. 145).

Both interfaces are closely linked to each other, which means that an IP packet entering one interface will always come out from the other one.

### Virtual network mode for virtual machines

By default, a new virtual machine is created with the network adapter that operates in the host-only mode. The figure below demonstrates an example network structure where all virtual machines are operating in the virtual network mode.



In the virtual network mode, a separate `vme` virtual adapter is created for each Container. Any `vme` virtual adapter consists of two interfaces:

- *An Ethernet interface in the Container.* This interface represents a counterpart of a physical network adapter installed on a standalone server. As any other physical adapter, it has a MAC address, can be assigned one or more IP addresses and included in different network environments, and so on. Refer to the **Configuring veth Adapter Parameters** section (p. 145) for detailed information on configuring Ethernet interfaces in virtual machine.
- *An Ethernet interface on the server.* This interface is responsible for the adapter operation in the server context and mostly used to maintain the interaction and communication between the server and the Ethernet interface in the virtual machine. Each Ethernet interface is assigned a MAC address. Detailed information on managing Ethernet interfaces on the server is provided in the **Configuring veth Adapter Parameters** section (p. 145).

Both interfaces are closely linked to each other, which means that an IP packet entering one interface will always come out from the other one.

## Differences Between Host-Routed and Virtual Network Modes

The virtual network mode demonstrates a number of differences as compared to the host-routed mode:

- Each `veth` or `vme` virtual adapter has a MAC address assigned to it while a host-routed adapter does not have any. Thanks to this fact:
  - Any virtual machine and Container can see all broadcast and multicast packets received from or sent to the selected network adapter on the server.
  - Using `veth` or `vme` virtual adapters in virtual machines and Containers allows you to host DHCP or Samba servers in these virtual machines and Containers.
- There is no more need to assign all network settings (IP addresses, subnet mask, gateway, and so on) to virtual machines and Containers from the server. All network parameters can be set from inside virtual machines and Containers.
- `veth` and `vme` adapters can be bridged among themselves and with other devices. If several `veth` and `vme` adapters are united into a bridge, this bridge can be used to handle network traffic for the virtual machines and Containers whose `veth` and `vme` adapters are included in the bridge.
- Due to the fact that `veth` and `vme` adapters act as full members on the network (rather than 'hidden' beyond virtual networks adapters on the server), they are more prone to security vulnerabilities: traffic sniffing, IP address collisions, and so on. Therefore, `veth` and `vme` adapters are recommended for use in trusted network environments only.

## Configuring Virtual Machines and Containers in Host-Routed Mode

You can configure the following parameters of network adapters that operate in the host-routed mode:

- IP addresses and network masks
- DNS servers
- DNS search domains

### Setting IP addresses

The session below shows how to set IP addresses for the `MyVM` virtual machine and Container 101

```
# pct1 set MyVM --device-set net0 --ipadd 10.0.186.100/24
# pct1 set MyVM --device-set net0 --ipadd fe80::20c:29ff:fe01:fb07
# pct1 set 101 --ipadd 10.0.186.101/24 --save
# pct1 set 101 --ipadd fe80::20c:29ff:fe01:fb08 --save
```

`net0` in the commands above denotes the network card in the `VM` virtual machine to assign the IP address to. You can view all network cards of a virtual machine using the `pctl list VM_name -i` command. For Container 101, you do not need to specify the network card name; `pctl set` automatically performs the operation on the default adapter that always operates in the host-routed mode.

### Setting DNS server addresses

To set a DNS server for the `MyVM` virtual machine and Container 101, you can use the following commands.

```
# pct1 set MyVM --device-set net0 --nameserver 192.168.1.165
# pct1 set 101 --nameserver 192.168.1.165 --save
```

### Setting DNS search domains

To set a DNS search domain for the `MyVM` virtual machine and Container 101, run these commands:

```
# pct1 set MyVM --device-set net0 --searchdomain 192.168.10.10
# pct1 set 101 --searchdomain 192.168.10.10 --save
```

#### Notes:

1. You can configure the network settings only of virtual machines that have Parallels Tools installed.
2. Network adapters operating in the routed mode must have at least one static IP address assigned.
3. To assign network masks to Containers operating in the `venet0` networking mode, you must set the `USE_VENET_MASK` parameter in the `/etc/vz/vz.conf` configuration file to `yes`.
4. Containers can have only one network adapter operating in the host-routed mode. This adapter is automatically created when you create a virtual machine.

### Switching network adapters to the host-routed mode

By default, a virtual adapter in any newly created virtual machine starts operating in connected to the virtual network mode (see the **Connecting Virtual Machines to Virtual Networks** (p. 149) for details). To change the current network mode to host-routed, you can run the following command:

```
# pct1 set VM_Name --device-set Net_ID --type routed
```

For example, to set the net0 adapter in the MyVM virtual machine to operate in the host-routed mode, use this command:

```
# pct1 set MyVM --device-set net0 --type routed
Configure net0 (+) dev='vme417795ba.0' type=routed mac=001C424BD617 card=e1000
state=disconnected
```

```
The VM has been successfully configured.
```

## Configuring Virtual Machines and Containers in Virtual Network Mode

This section describes all operations related to configuring virtual machines and Containers that operate in virtual network mode.

### Managing Virtual Networks

A virtual network acts as a binding interface between a virtual network adapter in a virtual machine and Container and the corresponding network adapter on the Parallels server. Using virtual networks, you can include virtual machines and Containers in different networks. Parallels Server Bare Metal enables you to manage virtual networks as follows:

- Create a new Virtual Network and remove an existing one.
- Configure the parameters of an existing Virtual Network.
- List the existing Virtual Networks.
- Delete a Virtual Network that you do not need any more.

These operations are described in the following subsections in detail.

### Creating a Virtual Network

Virtual networks serve as binding interfaces between the virtual network adapters in virtual machines and Containers and the physical, VLAN, and virtual network adapters on the Parallels server. Using virtual networks, you can connect virtual machines and Containers to different networks.

By default, Parallels Server Bare Metal creates the following virtual networks on the server:

- *Bridged*. This virtual network is connected to one of the physical adapters on the Parallels server (as a rule, `eth0`) and provides virtual machines and Containers included in this virtual network with access to the network behind this physical adapter.
- *Host-only*. This virtual network is connected to a special virtual adapter on the server and allows the virtual machines and Containers joined to this virtual network to access only the server and the other virtual machines and Containers on this network.

You can also create your own virtual networks using the `prlsrvctl` or `vznetcfg` utility. For example, to make a new virtual network with the name of `vznetwork1`, you can run one of the following commands:

```
# vznetcfg net new vznetwork1
```

or

```
# prlsrvctl net add vznetwork1
```

By default, both commands create host-only virtual networks. However, you can change their types using the `prlsrvctl` utility; see **Configuring Virtual Network Parameters** (p. 141) for details.

In the current version of Parallels Server Bare Metal, you can create

- Up to 16 host-only virtual networks.
- One or more bridged virtual networks. The number of virtual networks depends on the number of physical and VLAN adapters available on the Parallels server. One virtual network can be connected to only one physical or VLAN adapter.

## Viewing Bridges

A virtual network is associated with a bridge that is automatically made on the Parallels server when you create the virtual network and serves as the basis for the virtual network operation. To find out what bridge is associated with what virtual network, you can run the following command:

```
# vznetcfg if list
Name Type Network ID Addresses
eth0 nic Bridged 10.31.252.116/16, fe80::2a9:40ff:fe0f:b6f2/64, dhcp
br1 bridge Bridged fe80::200:ff:fe00:0/64
br0 bridge Host-Only 10.37.130.2/24, fdb2:2c26:f4e4::1/64, fe80::200:ff:fe00:0/64
```

The bridges existing on the Parallels server are listed in the `Name` column and can be easily identified by the `br` prefix.

**Note:** Detailed information on the `vznetcfg` and `prlsrvctl` utilities is provided in the *Parallels Server Bare Metal 5.0 Command Line Reference Guide*.

## Configuring Virtual Network Parameters

Parallels Server Bare Metal allows you to configure the following parameters for a virtual network:

- the name assigned to the virtual network
- the networking mode in which the virtual network is operating

- the description of the virtual network

All these operations can be performed using the `prlsrvctl` utility. Let us assume that you want to configure the `psbmnet1` virtual network. This virtual network is currently configured as a host-only network and has the following description set: `This is a host-only virtual network`. To change these parameters, you can execute the following command:

```
# prlsrvctl net set vznetwork1 -n psbm_network1 -t bridged --ifname eth1 -d "This is now a bridged virtual network"
```

This command configured the `psbmnet1` virtual network as follows:

- 1 Changes the virtual network name to `psbm_network1`.
- 2 Changes the virtual network type to `bridged`.
- 3 Changes the virtual network description to the following: `This is a now bridged virtual network`.

For more information on the `prlsrvctl` utility, refer to the *Parallels Server Bare Metal 5.0 Command Line Reference Guide*.

## Listing Virtual Networks

To list the virtual networks existing on the Parallels server, you can use either the `vznetcfg` or `prlsrvctl` utility.

### Listing virtual networks with `vznetcfg`

To list the virtual networks on your server using the `vznetcfg` utility, execute the following command:

```
# vznetcfg net list
Network ID      Status      Master Interface  Slave Interfaces
Host-Only       active
Bridged         active      eth0
psbmnet1        active      eth1
```

In the example above, three virtual networks—`psbmnet1` and two default virtual networks—exist on the Parallels server. The information on these virtual networks is presented in the table with the following columns:

Column Name	Description
Network ID	The ID assigned to the virtual network.
Status	Indicates the status of the virtual network. It can be one of the following: <ul style="list-style-type: none"><li>• <code>active</code>: the virtual network is up and running.</li><li>• <code>configured</code>: the information on the virtual network is present in the <code>/etc/vz/vznet.conf</code> file on the server, but the bridge to which the virtual network is bound is down or does not exist.</li></ul>

**Note:** Detailed information on the `vznet.conf` file is given in the

*Parallels Server Bare Metal 5.0 Command Line Reference Guide.*

Master Interface	Displays the adapter on the server connected to the virtual network, if any.
Slave Interfaces	Lists the adapters in virtual machines and Containers joined to the virtual network, if any.

## Listing virtual networks with `prlsrvctl`

You can also use the `prlsrvctl` utility to list the virtual networks existing on your server. To do this, run the following command:

```
# prlsrvctl net list
Network ID      Type           Bound To
Host-Only      host-only
Bridged        bridged        eth0
psbmnet1       bridged        eth1
```

This utility displays the following information on virtual networks:

Column Name	Description
Network ID	The name assigned to the virtual network.
Type	The networking mode set for the virtual network.
Bound To	The adapter on the Parallels server connected to the virtual networks, if any.

## Connecting Virtual Networks to Adapters

By connecting an adapter on the physical server to a virtual network, you can join all virtual machines and Containers included in the virtual network to the network to which the corresponding adapter is connected.

Let us assume the following:

- The `eth1` physical adapter and the `psbmnet1` virtual network exist on the Parallels server. For information on creating virtual networks, see **Creating a Virtual Network** (p. 140).
- The `eth1` physical adapter is connected to the local network.
- The `MyVM` virtual machine is connected to the `psbmnet1` virtual network. Detailed information on joining virtual machines and Containers to virtual networks is given in **Connecting Containers to Virtual Networks** (p. 146) and **Connecting Virtual Machines to Virtual Networks** (p. 149).

To connect the `eth1` adapter to the `psbmnet1` virtual network and thus to join the `MyVM` virtual machine to the network behind `eth1`, run this command on the server:

```
# vznetcfg net addif psbmnet1 eth1
```

To check that the `eth1` physical adapter has been successfully added to the `psbmnet1` virtual network, you can execute the following command:

```
# vznetcfg if list
```

```
Name      Type      Network ID  Addresses
eth1      nic       psbmnnet1  10.31.252.116/16, fe80::2a9:40ff:fe0f:b6f2/64, dhcp
...
```

As you can see, the `eth1` adapter is now joined to the `psbmnnet1` virtual network. That means that the `MyVM` virtual machine whose virtual network adapter is connected to `psbmnnet1` can access the local network behind `eth1`.

At any time, you can disconnect the `eth1` physical adapter from the `psbmnnet1` virtual network (and thus detach the `MyVM` virtual machine from the local network) by running the following command:

```
# vznetcfg net delif eth1
```

### Deleting Virtual Networks

At any time, you can remove a virtual network that you do not need any more from the physical server. To do this, you can use both the `vznetcfg` and `prlsrvctl` utilities. For example, you can delete the `psbmnnet1` virtual network by running one of the following commands:

```
# vznetcfg net del psbmnnet1
```

or

```
# prlsrvctl net del psbmnnet1
```

To check that `psbmnnet1` has been successfully removed, execute one of these commands:

```
# vznetcfg net list
Network ID      Status      Master Interface  Slave Interfaces
Host-Only      active
Bridged        active      eth0
```

or

```
# prlsrvctl net list
Network ID      Type      Bound To
Host-Only      host-only
Bridged        bridged   eth0
```

**Note:** Detailed information on the `vznetcfg` and `prlsrvctl` utilities is provided in the *Parallels Server Bare Metal 5.0 Command Line Reference Guide* and their manual pages.

## Managing Adapters in Containers

Parallels Server Bare Metal provides you with ample opportunities of configuring `veth` virtual network adapters in Containers and including them in different network environments. This section shows you the way to perform the following operations:

- Create new virtual network adapters in Containers and delete existing ones.
- Configure the parameters of an existing virtual network adapter.
- Join Container virtual network adapters to virtual networks.

All these operations are described in the following subsections in detail.



## Creating and Deleting veth Network Adapters

By default, any Container on the Parallels server starts functioning in the `venet0` mode right after its creation. However, at any time you can create additional virtual adapters for Containers and set them to work in the virtual network mode. You can do this using the `--netif_add` option of the `pctl set` command.

Let us assume that you wish to create a new virtual adapter with the name of `eth1` in Container 101 and make it function in the virtual network mode. To do this, run the following command :

```
# pctl set 101 --netif_add eth1 --save
Saved parameters for Container 101
```

The settings of the newly created virtual adapter are saved as the value of the `NETIF` parameter in the configuration file of Container 101 (`/etc/vz/conf/101.conf`). So, you can use the following command to display the parameters assigned to the `veth` network adapter in Container 101:

```
# grep NETIF /etc/vz/conf/101.conf
NETIF="ifname=eth1,mac=00:10:41:F0:AA:B6,host_mac=00:18:51:A0:8A:D7"
```

As you can see, the parameters set for the `veth` virtual network adapter during its creation are the following:

- `ifname`: the name set for the `veth` Ethernet interface in Container 101. You specified this name when creating the Container virtual network adapter. Usually, names of Ethernet interfaces in Containers are set in the form of `ethAd_N` where `Ad_N` denotes the index number of the created adapter (for example, `eth0` or `eth1`). However, you can choose any other name you like and specify it during the virtual adapter creation.
- `mac`: the MAC address assigned to the `veth` Ethernet interface in Container 101.
- `host_mac`: the MAC address assigned to the `veth` Ethernet interface on the Parallels server.

`ifname` is the only mandatory parameter that you need to specify when creating a Container virtual network adapter. All the other parameters are optional and generated by Parallels Server Bare Metal automatically, if not indicated.

At any time, you can remove the `veth` virtual network adapter from Container 101 by executing the following command:

```
# pctl set 101 --netif_del eth1 --save
Saved parameters for Container 101
```

## Configuring veth Adapter Parameters

While functioning in the virtual network mode, each Container virtual network adapter appears as a full participant on the network to which it is connected and needs to have its own identity on this network.

First of all, to start functioning on a TCP/IP network, a `veth` virtual adapter should be assigned an IP address. This can be done as follows:

```
# pctl set 101 --ifname eth1 --ipadd 192.168.144.123 --save
```

```
Saved parameters for Container 101
```

This command sets an IP address of 192.168.144.123 for the `eth1` adapter in Container 101. If you want to use the Dynamic Host Configuration Protocol (DHCP) to make the `eth1` adapter of Container 101 automatically receive TCP/IP configuration settings, you can issue the following command instead:

```
# pct1 set 101 --ifname eth1 --dhcp yes --save
Saved parameters for Container 101
```

Any static IP address assigned to the Container virtual network adapter can be removed by executing the following command:

```
# pct1 set 101 --ifname eth1 --ipdel 192.168.144.123 --save
Saved parameters for Container 101
```

You can also delete all IP addresses set for Container 101 at once:

```
# pct1 set 101 --ifname eth1 --ipdel all --save
Saved parameters for Container 101
```

You may also wish to set the following parameters for a Container network adapter:

- A DNS server that the Container virtual adapter is supposed to use:

```
# pct1 set 101 --ifname eth1 --nameserver 192.168.100.111 --save
Saved parameters for Container 101
```

- A gateway to be used for routing the traffic of the Container virtual adapter:

```
# pct1 set 101 --ifname eth1 --gateway 192.168.111.1 --save
Saved parameters for Container 101
```

Detailed information on all options which can be used with the `pctl set` command to manage Container adapter parameters is given in the *Parallels Server Bare Metal 5.0 Command Line Reference Guide* and the `pctl` manual pages.

## Connecting Containers to Virtual Networks

With the implementation of `veth` virtual adapters allowing Containers to function as full participants on the network, it has become possible to include Containers in a wide range of network configurations the most common of which are Ethernet networks and VLANs (virtual local area networks). The process of connecting `veth` virtual network adapters to an Ethernet network or to a VLAN is carried out using certain physical and VLAN adapters, respectively, available on the server and involves completing the following tasks:

- 1 Creating a virtual network that will act as an intermediary between the `veth` adapters and the physical/VLAN adapter.
- 2 Connecting the `veth` virtual adapter you want to include in an Ethernet network/VLAN to the virtual network.
- 3 Joining the virtual network where the `veth` virtual adapters are included to the corresponding physical/VLAN adapter.

After completing these tasks, the Container virtual network adapters will be able to communicate with any computer on the network (either Ethernet or VLAN) where they are included and have no direct access to the computers joined to other networks.

The process of creating new virtual networks and joining physical and VLAN adapters to them is described in the **Creating a Virtual Network** (p. 140) and **Connecting Virtual Networks to Adapters** (p. 143) sections, respectively. In the example below we assume the following:

- The eth0 physical adapter and the psbmnnet1 virtual network exist on the server.
- The eth0 physical adapter is connected to the local Ethernet network and to the psbmnnet1 virtual network.
- You want to connect Container 101 and Container 102 to the local Ethernet network.

To join Container 101 and 102 to the local Ethernet network behind the eth0 adapter, you need connect these Containers to the psbmnnet1 virtual network. To do this:

**1** Find out the name of the veth Ethernet interfaces in Container 101 and 102:

```
# vzlist -a -o ctid,ifname
CTID  IFNAME
 101  eth1
 102  eth0
 103  -
```

The command output shows that the veth Ethernet interfaces in Container 101 and 102 have the names of eth1 and eth0, respectively.

**Note:** To add a veth adapter to a virtual network, you must use the name of its Ethernet interface in the Container.

**2** Join the veth adapters to the psbmnnet1 virtual network:

- Add the veth adapter of Container 101 to the virtual network:

```
# pct1 set 101 --ifname eth1 --network psbmnnet1 --save
Saved parameters for Container 101
```

- Add the veth adapter of Container 102 to the virtual network:

```
# pct1 set 102 --ifname eth0 --network psbmnnet1 --save
Saved parameters for Container 102
```

After completing these tasks, Container 101 and Container 102 will be able to access any of the servers in the network where the eth0 physical adapter is connected.

At any time, you can disconnect the veth virtual network adapters of Container 101 and 102 from the psbmnnet1 virtual network by executing the following commands:

- To disconnect the veth adapter of Container 101 from the virtual network:

```
# pct1 set 101 --ifname eth1 --network "" --save
Saved parameters for Container 101
```

- To disconnect the veth adapter of Container 102 from the virtual network:

```
# pct1 set 102 --ifname eth1 --network "" --save
Saved parameters for Container 102
```

## Managing Adapters in Virtual Machines

This section provides information on how you can manage virtual network adapters in virtual machines. You will learn to do the following:

- Create new virtual network adapters and delete existing ones.
- Configure the parameters of an existing virtual network adapter.
- Join virtual network adapters to virtual networks.

All these operations are described in the following subsections in detail.

### Creating and Deleting Virtual Adapters

A virtual machine can have up to 16 virtual network adapters. Each adapter can be connected to a different network. Let us assume that you want to create a new virtual adapter for the `MyVM` virtual machine. To do this, you can execute the following command :

```
# pct1 set MyVM --device-add net
Creating net1 (+) type=host-only iface='default' mac=001C42AF3D69
The VM has been successfully configured.
```

To check that the network adapter (`net1`) has been successfully added to the virtual machine, run this command:

```
# pct1 list --info MyVM
ID: {f3b3d134-f512-324b-b0b1-dbd642f5220b}
Name: Windows XP
...
net0 (+) type=host-only iface='default' mac=001C42566BCF
net1 (+) type=host-only iface='default' mac=001C42AF3D69
```

At any time, you can remove the newly created network adapter (`net1`) by executing the following command:

```
# pct1 set MyVM --device-del net1
Remove the net1 device.
The VM has been successfully configured.
```

For the full list of options that can be used when creating a new virtual network adapter, see the *Parallels Server Bare Metal 5.0 Command Line Reference Guide*.

### Configuring Virtual Adapter Parameters

Parallels Server Bare Metal allows you to configure the following parameters of virtual machine adapters:

#### Configuring MAC Addresses

If you need for some reason to regenerate the current MAC address of a network adapter, you can use the following command:

```
# pct1 set MyVM --device-set net1 --mac 00:1C:42:2D:74:00
```

```
Creating net1 (+) network=Bridged mac=001C422D7400  
The VM has been successfully configured.
```

This command sets the MAC address of `00:1C:42:2D:74:00` for the `net1` adapter in the `MyVM` virtual machine. If do not know what MAC address to assign to your virtual adapter, you can make `pctl set` automatically generate a new MAC address. To do this, run the following command:

```
# pctl set MyVM --device-set net1 --mac auto  
Creating net1 (+) network=Bridged mac=001C42C84F3E  
The VM has been successfully configured.
```

### Configuring IP Parameters

As any other standalone server, each virtual machine must have a number of TCP/IP settings configured in the proper way to successfully operate on the network. These settings include:

- IP address
- default gateway
- DNS server

Usually, you define all these settings when you create the virtual machine. However, if you have not yet set any of the settings or want to modify any of them, you can use the `pctl set` command. For example, you can execute the following command to assign the IP address of `192.129.129.20` to the `net1` adapter in the `MyVM` virtual machine, set the default gateway to `192.129.129.1` and the DNS server to `192.192.192.10`:

```
# pctl set MyVM --device-set net1 --ipadd 192.129.129.20 --gw 192.129.129.1 --  
nameserver 192.192.192.10
```

Along with a static assignment of network parameters to a virtual adapter, you can make the adapter receive its TCP/IP settings automatically using the Dynamic Host Configuration Protocol (DHCP). For example, you can run this command to make the `net1` adapter in the `MyVM` virtual machine get its IP settings through DHCP:

```
# pctl set MyVM --device-set net1 --dhcp yes  
Creating net1 (+) network=Bridged mac=001C42C84F3E  
Enable automatic reconfiguration for this network adapter.  
The VM has been successfully configured.
```

#### Notes:

1. You can configure the network parameters only of those virtual machines that have Parallels Tools installed.
2. Detailed information on all options which can be used with the `pctl set` command to manage virtual machine adapter parameters is given in the *Parallels Server Bare Metal 5.0 Command Line Reference Guide* and the `pctl` manual pages.

### Connecting Virtual Machines to Virtual Networks

In Parallels Server Bare Metal, you can connect virtual machines to virtual networks of the following types:

- *Bridged*. This type of virtual network allows the virtual machine to use one of the physical server's network adapters, which makes it appear as a separate computer on the network the corresponding adapter belongs to.
- *Host-only*. This type of virtual network allows the virtual machine to access only the Parallels server and the virtual machines joined to this network.

By default, any newly created adapter is connected to the `Bridged` network. To join a virtual machine to another network, use the `pctl set` command. For example, the following session demonstrates how you can connect the `net0` adapter of the `MyVM` virtual machine to the `psbmnet1` virtual network.

Before connecting the `MyVM` virtual machine to the `psbmnet1` virtual network, you may wish to check the network adapter associated with this virtual network. You can do it, for example, using the following command:

```
# prlsrvctl net list
Network ID      Type           Bound To
Host-Only       host-only
Bridged         bridged        eth0
psbmnet1        bridged        eth1
```

From the command output, you can see that the `psbmnet1` virtual network is attached to the `eth1` physical adapter on the Parallels server. That means that, after connecting the `MyVM` virtual machine to the `psbmnet1` virtual network, the virtual machine will be able to access all computers on the network where the `eth1` adapter is connected.

Now you can run the following command to join the `net1` adapter of the `MyVM` virtual machine to the `psbmnet1` virtual network:

```
# pctl set MyVM --device-set net0 --network psbmnet1
Creating net0 (+) network=psbmnet1 mac=001C422D7493
The VM has been successfully configured.
```

## Managing Private Networks

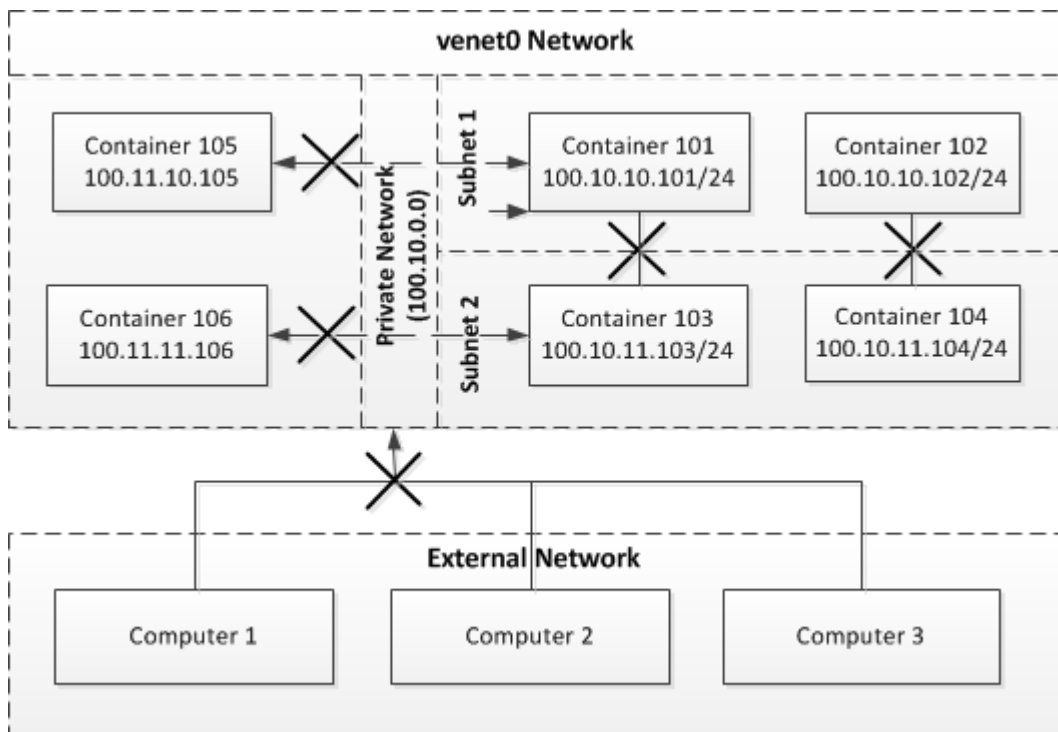
This section describes how to manage private networks and subnetworks in Parallels Server Bare Metal 5.0.

### Learning Private Networks

By default, all virtual machines and Containers on the physical server operating in the host-routed mode can access each other even if you connect them to different subnets. For example, if Container 101 has the IP address of 100.10.10.101 and the `MyVM` virtual machine has the IP address of 100.10.11.102 and you set the subnet mask for them to 255.255.255.0, the virtual machine and Container will be able to communicate with each other, though they technically belong to different subnets: 100.10.10.0 and 100.10.11.0.

**Note:** You can also include virtual machines and Containers operating in the virtual network mode in private networks. For information on how you can do this, see **Setting Up Private Networks** (p. 153).

In Parallels Server Bare Metal 5.0, you can create the so-called *private networks*. Within these private networks, you can make subnets and connect virtual machines and Containers to these subnets so that the virtual machines and Containers from one subnet will not be able to access virtual machines and Containers from other subnets, virtual machines and Containers outside the private network, and computers on external networks. The following figure demonstrates a system containing a private network:



In this example, the network is configured as follows:

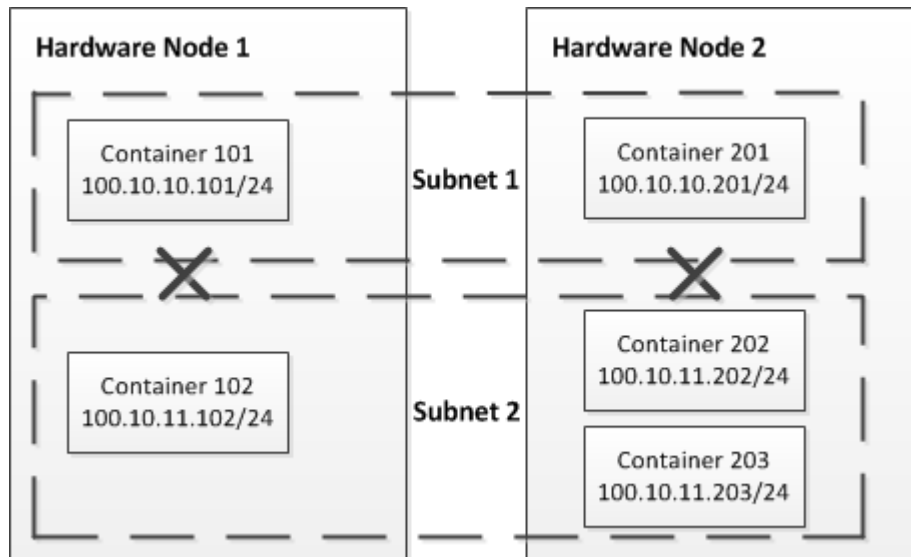
- A private network (*Private Network*) is created within the physical server network (*Host Network*).
- The private network contains two private subnets: *Subnet 1* and *Subnet 2*.
- Container 101 and VM1 are connected to Subnet 1, and Container 103 and VM2 are joined to Subnet 2.
- Container 105 and VM3 do not belong to the private network.
- The physical server network is connected to an external network (*External Network*) that contains computers *Computer 1*, *Computer 2*, and *Computer 3*.

In this network, Container 101 and VM1 can access each other, but cannot connect to Container 103, Container 105, VM2, and VM3. Container 103 and VM2, in turn, can also access each other,

but cannot connect to Container 101, Container 105, VM1, and VM3. None of the virtual machines and Containers in the private network can access computers on the external network.

## Network Across Several Nodes

The example above deals with a private network created within one physical server. However, private networks can span virtual machines and Containers on two or more servers. The following figure demonstrates such a network:



In this figure, the private network also includes two private subnets—Subnet 1 and Subnet 2, but the virtual machines and Containers included in these subnets reside on two physical servers. Container 101 and VM1 are joined to Subnet 1, and Container 102, Container 203, and VM2 are joined to Subnet 2. The virtual machine and Container on Subnet 1 can connect to each other but cannot access the virtual machines and Containers on Subnet 2, and vice versa.

## Weak Private Networks

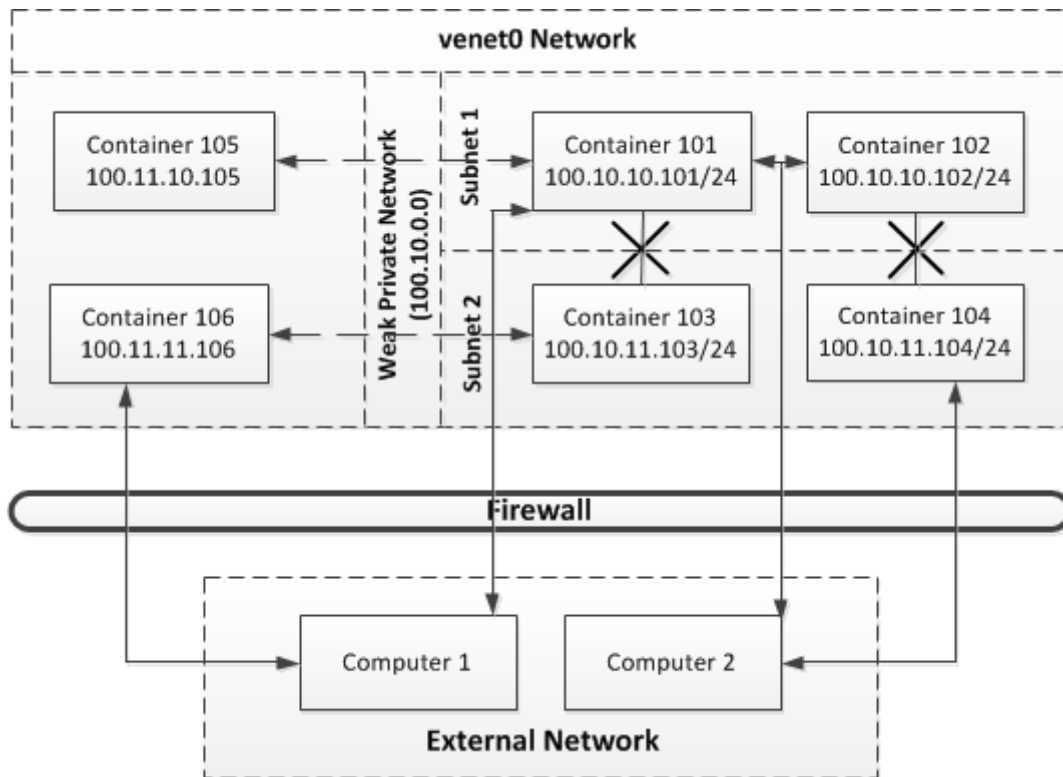
By default, when you create a private network, no virtual machine or Container on this network can access

- virtual machines and Containers that are joined to other subnets in the private network
- virtual machines and Containers that are not part of the private network
- computers that are located on external networks

However, you can configure a private network so that its virtual machines and Containers cannot communicate with virtual machines and Containers on other subnets in the private network but can connect to virtual machines and Containers outside the private network and to computers on external networks. Such private networks are called *weak private networks*. "Weak" in this context means that these networks can be accessed by computers on external networks and are,



therefore, more prone to security vulnerabilities and threats. The following picture demonstrates a system with a weak private network:



In this example, the private network on the physical server is divided into two subnets: *Subnet 1* and *Subnet 2*. Container 101 and VM1 are connected to Subnet 1, and Container 103 and VM2 are joined to Subnet 2. Container 105 and VM3 do not belong to the private network. Container 101 and VM1 can access each other, but cannot connect to Container 103 and VM2. Container 103 and VM2, in turn, can also access each other, but cannot connect to Container 101 and VM1.

All virtual machines and Containers in the private network can communicate with Container 105 and VM3 and, as they have public IP addresses assigned, can also access computers on other networks (for example, the computers *Computer 1* and *Computer 2* on the external network *External Network*). To protect the virtual machines and Containers from possible security vulnerabilities and threats, the firewall is configured on the physical server, blocking unauthorized access to the virtual machines and Containers.

## Setting Up Private Networks

Before you start setting up a private network, you need to decide on the following:

- 1 The name to assign to the private network.
- 2 The range of IP addresses to allocate to the private network.
- 3 The number of subnets and hosts in the private network.

Let us assume that you want to create two private networks with the following parameters:

- The first network has the name `privnet1` and includes the IP addresses from 10.10.0.0 through 10.10.255.255.
- The second network has the name `privnet2` and includes the IP addresses from 10.11.0.0 through 10.11.255.255.

To create these two networks, you can run the following commands on the physical server:

```
# prlsrvctl privnet add privnet1 --ipadd 10.10.0.0/16
# prlsrvctl privnet add privnet2 --ipadd 10.11.0.0/16
```

Now if you assign to one virtual machine or Container an IP address from the range 10.10.0.0 through 10.10.255.255 and to another virtual machine or Container from the range 10.11.0.0 through 10.11.255.255, they will not be able to access each other because they will belong to different private networks.

If you want to create a private network for several virtual machines and Containers only, you can omit the network mask and specify only the required IP addresses:

```
# prlsrvctl privnet add privnet3 --ipadd 10.12.0.101
# prlsrvctl privnet add privnet3 --ipadd 10.12.0.102
```

The commands above create the private network `privnet3` and include only two IP addresses in this network: 10.12.0.101 and 10.12.0.102. You can then assign these IP address to the two of your virtual machines and Containers, thus isolating their network traffic from that of other virtual machines and Containers and external computers.

### Enabling Private Networks for virtual machines and Containers Operating in Virtual Network Mode

By default, you can include in private networks only virtual machines and Containers operating in the host-routed mode. If you want to connect to a private network some of virtual machines and Containers operating in the virtual network mode, you need first to enable the private network support on the physical server. To do this, change the value in the `/proc/sys/net/vzpriv_handle_bridge` file from 0 to 1:

```
# echo 1 > /proc/sys/net/vzpriv_handle_bridge
```

**Note:** Enabling the support for private networks may affect the network performance of virtual machines and Containers that operate in the virtual network mode and are assigned IPv4 addresses.

### Creating Weak Private Networks

In a weak private network, any virtual machine or Container on the network can communicate with the other virtual machines and Containers in the same subnet, virtual machines and Containers outside the private network, and computers on external networks. To create a weak private network, you can run the following command:

```
# prlsrvctl privnet set privnet_name --ipadd ''
```

where *privnet\_name* is the name of the private network you want to configure as a weak one. For example, to configure the `privnet1` private network as a weak one, execute the following command:

```
# prlsrvctl privnet set privnet1 --ipadd '*'
```

To make sure that `privnet1` is now a weak network, check the contents of the `/proc/vz/privnet/sparse` file:

```
# cat /proc/vz/privnet/sparse
1: * 10.10.0.0/16
2: 10.11.0.0/16
```

The asterisk before `10.10.0.0/16` denotes that `privnet1` is now acting as a weak network. To revert the changes made to the `privnet1` file, run this command:

```
# prlsrvctl privnet set privnet1 --ipdel '*'
```

### Connecting virtual machines and Containers to Private Subnets

Once you set up a private network, you can connect Containers to different subnets within this network. Assuming that you followed the instructions above, you now have two private networks. The `privnet1` network includes the IP addresses from `10.10.0.0` through `10.10.255.255`, and the `privnet2` network contains the IP addresses from `10.11.0.0` through `10.11.255.255`. Let us join Container 101 to `privnet1` and the `MyVM` virtual machine to `privnet2`. To do this:

**1** Assign IP address `10.10.10.101` to Container 101:

```
# pct1 set 101 --ipadd 10.10.10.101 --save
```

**2** Assign the IP address of `10.11.10.101` to the `MyVM` virtual machine:

```
# pct1 set MyVM --device-set net0 --ipadd 10.11.10.101
```

Now Container 101 and the `MyVM` virtual machine belong to different subnets and cannot access each other.

### Removing Private Networks

At any time, you can remove `privnet1` and `privnet2` by running these commands:

```
# prlsrvctl privnet del privnet1
# prlsrvctl privnet del privnet2
```

Once you execute these commands, all virtual machines and Containers that were included in the `privnet1` network should be able to connect to the virtual machines and Containers that were joined to the `privnet1` network.

## CHAPTER 7

# Managing Licenses

The given chapter provides information on managing Parallels Server Bare Metal licenses. In particular, you will know how to view the current license status, to install a new license on your server or to update an existing one, to transfer the license from one server to another, etc.

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## Installing the License

Depending on the way you have obtained your Parallels Server Bare Metal license, the process of installing the license slightly differs:

- If you have obtained the license in the form of a product key, you can install it on the server using the `-p` option of the `vzlicload` command. For example, you can execute the following command to install the `xxxxxx-xxxxxx-xxxxxx-xxxxxx-xxxxxx` product key:

```
# vzlicload -p 5BVMF2-560MM0-D28DQA-B59NTE-10H4HG
Processing product key "xxxxxx-xxxxxx-xxxxxx-xxxxxx-xxxxxx"...
License VZSRV was loaded successfully
---
1 of 1 licenses was loaded
```

**Note:** You can also use the `vzlicload` utility to upgrade the license. For example, this may be necessary if your current license does not support using Parallels Virtual Automation for managing Parallels servers.

- If you have obtained the license in the form of an activation code, you can install it on the server using the `-a` option of the `vzlicupdate` command. For example:

```
# vzlicupdate -a xxxxxx-xxxxxx-xxxxxx-xxxxxx-xxxxxx
```

where `xxxxxx-xxxxxx-xxxxxx-xxxxxx-xxxxxx` is your activation code. When executed, `vzlicupdate` connects to the Parallels Key Authentication (KA) licensing server and transmits the specified activation code there. The licensing server, in turn, generates a license file, sends it back to the server from where the activation code has been dispatched, and automatically installs it on this server. So, before executing the aforementioned command, make sure that your Parallels server is connected to the Internet.

If you are activating your installation by means of an activation key, you must have an active Internet connection to successfully complete the license installation. Otherwise, you will be presented with the corresponding warning message informing you of the steps you have to take to activate your license. As a rule, these steps are the following:

- 1 Visiting the <http://www.parallels.com/en/support/virtuozzo/activate> web page and activating the license manually.
- 2 Providing the following information on this web page:
  - In the **Product Code** field, specify your license activation code.
  - In the **HWID** field, provide the ID of your server.
  - In the **Enter following digits** field, type the digits displayed next to this field.
- 3 Clicking the **ACTIVATE LICENSE** button.

If you have entered the correct information on the **Virtuozzo License Activation** page, you will be provided with a link to a license file that you should download to and install on the server. For example, you can run this command to install the obtained license file

```
# vzlicload -f /etc/vzlicense
```

This command will install the license file with the name of `vzlicense` on your server.

## Updating the Current License

In Parallels Server Bare Metal, you can use the `vzlicupdate` utility to update the license currently installed on the Parallels server. When executed, the utility tries to connect to the Parallels Key Authentication (KA) server and to retrieve a new license and install it on the server. To update your license, do the following:

- 1 Make sure that the Parallels server where you wish to update the license is connected to the Internet.
- 2 Execute the following command on the server:

```
# vzlicupdate
Start updating license [6E62.3D01.6BEC.E8D7.CE42.4517.68CB.E102]
...
```

By default, `vzlicupdate` tries to access the KA server having the hostname of `ka.parallels.com`. However, you can explicitly specify what KA server to use using the `--server` option:

```
# vzlicupdate --server ka.server.com
```

In this case, the `vzlicupdate` utility will try to connect to the KA server with the hostname of `ka.server.com`, to get a new license from this server, and to install it on the server where `vzlicupdate` has been executed.

**Note:** Your physical server must be assigned at least one public IPv4 address for the correct operation of the `vzlicupdate` utility.

# Transferring the License to Another Server

Sometimes, you may wish to transfer licenses from one Parallels server (*source server*) to another (*destination server*). For example, this may be the case if the server where the license is installed starts experiencing problems or requires the hardware upgrade.

The procedure of transferring a license from one Parallels server to another depends on the license type and can be one of the following:

### Activation with a product key

If you have activated your Parallels Server Bare Metal installation by means of a product key, you can transfer the installed license from the source to the destination server as follows:

- 1 Remove the installed license from the source server (e.g., using the `vzlicload -r product_key` command).
- 2 Log in to the destination server.
- 3 Install the product key on the destination server. Detailed information on how to install Parallels Server Bare Metal licenses is provided in **Installing a License** (p. 156).

### Activation with an activation code

If you have activated your Parallels Server Bare Metal installation by means of an activation code, you can use the `vzlicupdate` utility to move licenses between Parallels servers. For example, to transfer a license that has been installed using the `xxxxxx-xxxxxx-xxxxxx-xxxxxx-xxxxxx` activation code, do the following:

- 1 Ascertain that the source server is shut down, or the license is removed from this server.
- 2 Make sure that the destination server is up and connected to the Internet.
- 3 Log in to the destination server (e.g., via `ssh`).
- 4 Execute the following command on the destination server:

```
# vzlicupdate -t -a xxxxxx-xxxxxx-xxxxxx-xxxxxx-xxxxxx
```

When executed, `vzlicupdate` sends the activation code to the Parallels KA server, thus informing the server of its intention to transfer the license to a new Parallels server. The KA server verifies the received code, generates a new license file, sends it back to the destination server, and installs it there.

**Note:** Your physical server must be assigned at least one public IPv4 address for the correct operation of the `vzlicupdate` utility.

You can check that the license transferal has completed successfully using the `vzlicview` utility. For example:

```
# vzlicview
Show installed licenses...
VZSRV
    status="ACTIVE"
    version=X.X
    serial="XXXXXX-XXXXXX-XXXXXX-XXXXXX-XXXXXX"
    expiration="05/01/2012 23:59:59"
    ...
```

Detailed information on the `vzlicview` utility and its output is provided in **Viewing Current License** (p. 159).

## Viewing the Current License

The given subsection familiarizes you with the way to view the information on the license installed on your Parallels server.

### Viewing the License

In Parallels Server Bare Metal, you can use the `vzlicview` utility to view the information on the installed license and find out its current status. When executed, this utility processes the license currently installed on the Parallels server and prints the license contents along with its status. A sample output of `vzlicview` is given below:

```
# vzlicview
Searching for installed licenses...
VZSRV
    status="ACTIVE"
    version=X.X
    serial="XXXXXX-XXXXXX-XXXXXX-XXXXXX-XXXXXX"
    expiration="12/01/2012 23:59:59"
    graceperiod=86400 (86400)
    key_number="PSBM.00000001.0000"
    cpu_total=64 (1)
    ct_total=100 (1)
    max_vzmcPMC_users=128
    max_pim_users=260
    platform="Any"
    product="PSBM"
    vzpp_allowed=1
    backup_mgmt_allowed=1
    workflow_mgmt_allowed=1
    vzagent_allowed=1
    nr_vms=10 (2)
    architecture="Any"
```

The command output shows the full information about the license. The main license parameters are listed in the following table:

Column Name	Description
status	The license status. The information on all possible license statuses is provided in <b>License Statuses</b> (p. 161).
version	The version of Parallels Server Bare Metal for which the license was issued.
serial	The license serial number.
expiration	The license expiration date, if it is time-limited.
graceperiod	The period, in seconds, during which Parallels Server Bare Metal continues functioning if <ul style="list-style-type: none"><li>the license has expired</li><li>the number of running virtual machines and Containers exceeds the limit defined by the license</li></ul>
key_number	The number under which the license is registered on the Parallels Key Authentication server.
cpu_total	The total number of CPUs you are allowed to install on the Parallels server.
ct_total	The total number of Containers you are allowed to simultaneously run on the Parallels server.
max_vzmc_users	The number of users able to simultaneously connect to the server using Parallels Management Console.
max_vzcc_users	The number of users able to simultaneously connect to the server using Parallels Virtual Automation (formerly, Parallels Infrastructure Manager).
platform	The operating system with which the license is compatible.
product	The product name for which the license has been issued.
vzpp_allowed	Indicates whether you can manage virtual machines and Containers using Parallels Power Panel: <ul style="list-style-type: none"><li>1: the 'Parallels Power Panel' functionality is enabled</li><li>0: the 'Parallels Power Panel' functionality is disabled</li></ul>
backup_mgmt_allowed	Indicates whether the 'backup' functionality is enabled for the given server: <ul style="list-style-type: none"><li>1: the 'backup' functionality is enabled</li><li>0: the 'backup' functionality is disabled</li></ul>
workflow_mgmt_allowed	Indicates whether the 'virtual machine and Container requesting' functionality is enabled for the given server: <ul style="list-style-type: none"><li>1: the 'virtual machine and Container requesting' functionality is enabled</li><li>0: the 'virtual machine and Container requesting' functionality is disabled</li></ul>
vzagent_allowed	Indicates whether you are allowed to use the Parallels Agent functionality on the given server: <ul style="list-style-type: none"><li>1: the Parallels Agent functionality is enabled</li><li>0: the Parallels Agent functionality is disabled</li></ul>
nr_vms	The number of virtual machines you are allowed to simultaneously run on the Parallels server.



<code>architecture</code>	The system architecture with which the license is compatible.
<code>concerto</code>	If this field is present, the license supports the ability to use the Plesk application in Containers.

## Licenses with a combined limit on virtual machines and Containers

Some licenses shipped with Parallels Server Bare Metal 5.0 define a combined limit on the number of virtual machines and Containers you are allowed to simultaneously run on the Parallels server rather than set limits separately for virtual machines and Containers. In this case, the license output is as follows:

```
# vzlicview
Searching for installed licenses...
VZSRV
  status="ACTIVE"
  version=X.X
  serial="XXXXXX-XXXXXX-XXXXXX-XXXXXX-XXXXXX"
  expiration="12/01/2012 23:59:59"
  graceperiod=86400 (86400)
  key_number="PSBM.00000001.0000"
  cpu_total=64 (1)
  ct_total=100 (1)
  max_vzmpmc_users=128
  max_vzcc_users=260
  platform="Any"
  product="PSBM"
  vzpp_allowed=1
  backup_mgmt_allowed=1
  workflow_mgmt_allowed=1
  vzagent_allowed=1
  nr_vms="combined" (2)
  servers_total=100
  architecture="Any"
```

As you can see, the output now contains one more parameter—`servers_total`. This parameter defines the total number of virtual machines and Containers you can simultaneously run on the Parallels server. For example, according to the license above, you can run 100 Containers, or 100 virtual machines, or 50 Containers and 50 virtual machines on the server at the same time.

## License Statuses

When viewing information on your license, pay special attention to the license status that can be one of the following:

ACTIVE	The license installed on the server is valid and active.
VALID	The license the utility parses is valid and can be installed on the server.
EXPIRED	The license has expired and, therefore, could not be installed on the server.
GRACED	The license has been successfully installed on the server; however, it is currently on the grace period because <ul style="list-style-type: none"> <li>the license has expired</li> <li>the number of running virtual machines and Containers exceeds the limit defined by the license</li> </ul>

INVALID            The license is invalid (for example, because of the server architecture mismatch) or corrupted.

## CHAPTER 8

# Keeping Your System Up To Date

This chapter explains the ways to keep your Parallels server up to date. The components you need to take care of are the following:

- Parallels Server Bare Metal software
- virtual machines and Containers created on the Parallels server

### In This Chapter

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## Updating Parallels Server Bare Metal Software

Parallels Server Bare Metal is constantly developing: there appear new versions of the Parallels Server Bare Metal core and of existing utilities, OS and application templates are perfected, new templates and utilities are also added from time to time. Thus, Parallels Server Bare Metal may sometimes be repackaged to include the latest changes in any of its parts. As these changes grow in number, new product versions are released.

Parallels Server Bare Metal provides a special utility, `vzup2date`, allowing you to easily and quickly update your Parallels server. The main components that need to be updated are the following:

- Parallels Server Bare Metal system software (packages built by Parallels)
- Parallels Server Bare Metal templates

The `vzup2date` utility can be launched in two modes:

- Graphical mode. In this mode, you use a special wizard to update either the Parallels Server Bare Metal system files or templates depending on the options passed to `vzup2date`.
- Command line mode containing two submodes:
  - the *batch* submode
  - the *messages* submode

In comparison to the graphical mode, the command line mode provides more possibilities for the Parallels Server Bare Metal updates management (e.g. the ability to use special filters while selecting updates for your system).

Both modes are described in the following subsections in detail.

**Note:** Your physical server must be assigned at least one public IPv4 address for the correct operation of the `vzup2date` utility.

### Updating in Graphical Mode

In the graphical mode, the `vzup2date` utility can be launched in two submodes. If invoked without any parameters or with the `-s` switch, it is supposed to check and, if necessary, download and install Parallels Server Bare Metal system files. On the other hand, specifying the `-z` option when invoking the utility tells it to perform the same operations for OS and application EZ templates. There is no single interface for checking system files and templates at once, as these operations are different in nature. Therefore, you should consecutively call the `vzup2date` utility with and without the `-z` option, if you wish to check for all available system and template updates.

**Note:** You can explicitly specify that the `vzup2date` utility is to be run in the graphical mode by passing the `-m interactive` switch to it.

The `vzup2date` utility is implemented as a wizard, the first few steps of which are common for both modes. After you launch the utility from the command line, you will be presented with the **Welcome** screen. In this window, you can do one of the following:

- Click the **Next** button to connect to the Parallels default repository.
- Click the **Configure** button to display the current settings used to connect to the repository housing Parallels Server Bare Metal updated packages and templates and to configure it, if necessary:

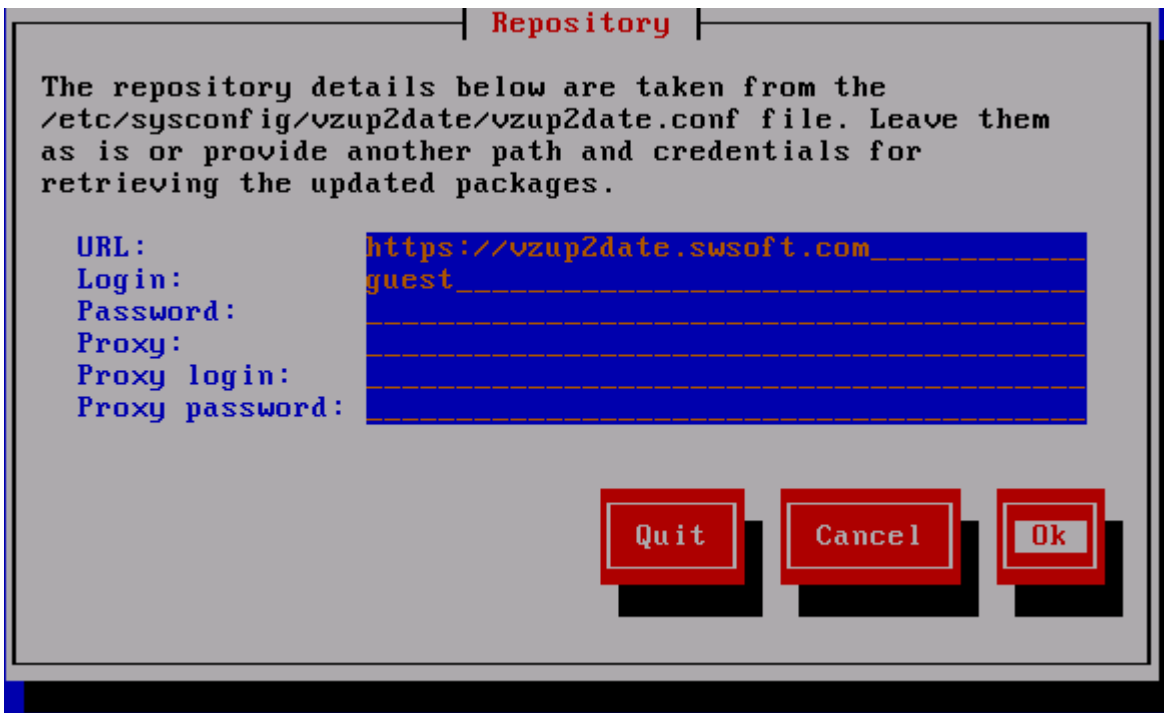


Figure 1: Updating System - Specifying Repository

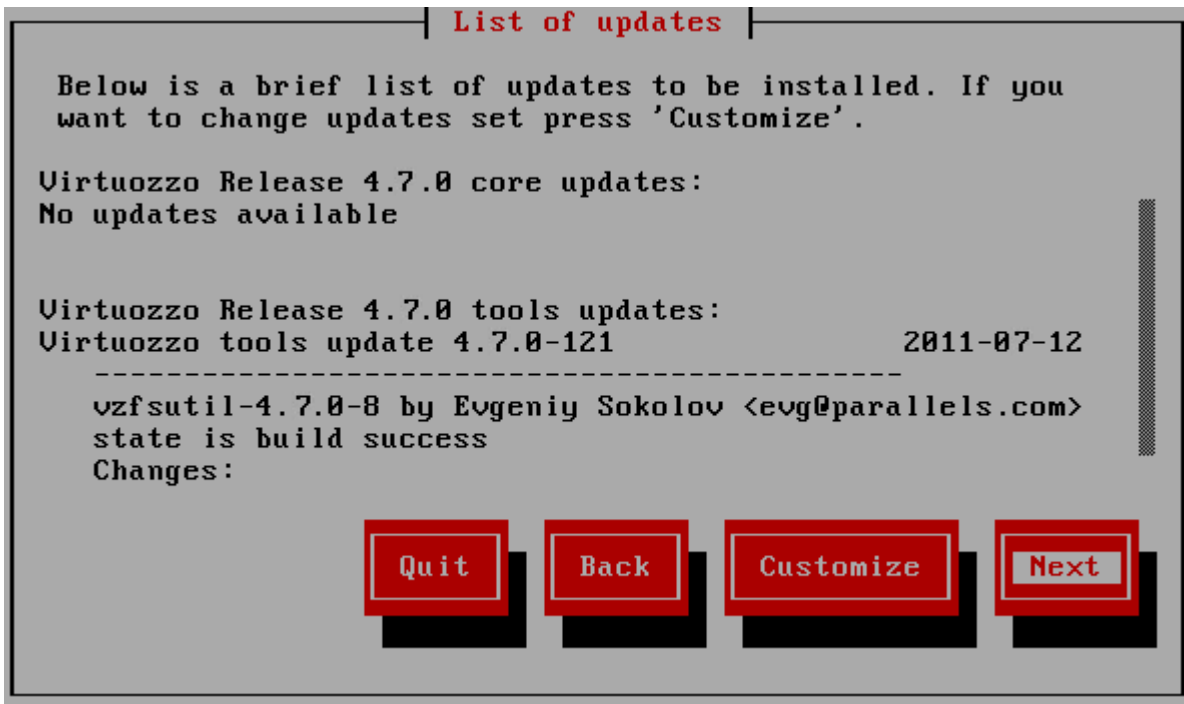
The information on this screen is taken from the `/etc/sysconfig/vzup2date/vzup2date.conf` file on the Parallels server. If you wish to change this information and save the changes to the configuration file, enter the correct settings into the fields provided, and press **OK**.

Once you press **Next** in the **Welcome** window, the utility will try to connect to the specified repository (either the Parallels default repository or your own one) and, if the connection is successful, display the next screen, which will vary depending on the mode of the `vzup2date` invocation. First, we will describe the mode of updating Parallels Server Bare Metal system files and then proceed with updating your EZ templates.

**Note:** The `vzup2date` utility might see that the selected update includes an updated version of the `vzup2date` utility itself. In this case you will first have to perform an update of this utility and then to re-launch it and select the desired Parallels Server Bare Metal system update once again.

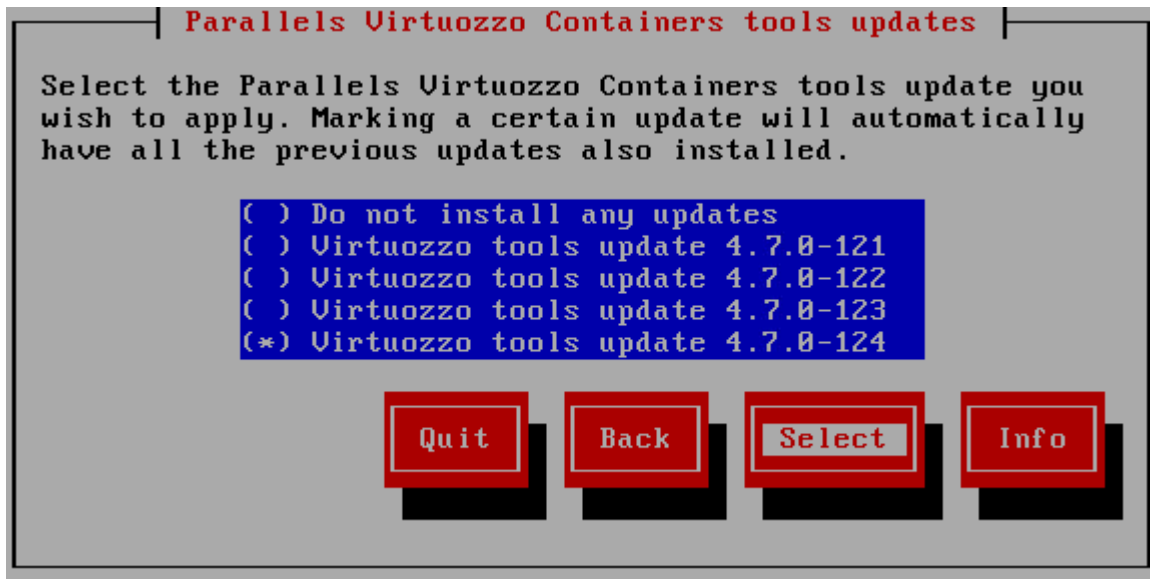
## Updating System Files

After the `vzup2date` utility has checked the repository and found any updates, you are presented the following window:



This window displays the list of updates that can be installed on your Parallels server. If you want to update to the latest Parallels Server Bare Metal core and utilities versions, just press **Next** on this screen, and the `vzup2date` utility will download and install them asking your confirmation before each action.

On the other hand, if you have a reason not to install the latest updates for both the Parallels Server Bare Metal core and utilities, press **Customize**. In this case, you will be able to choose whether to perform customization on the Parallels Server Bare Metal core or utilities. This step will be skipped if updates are currently available either only for the core or only for utilities. On the next step, you will be asked to choose the desired core or utilities updates, in case there are many.

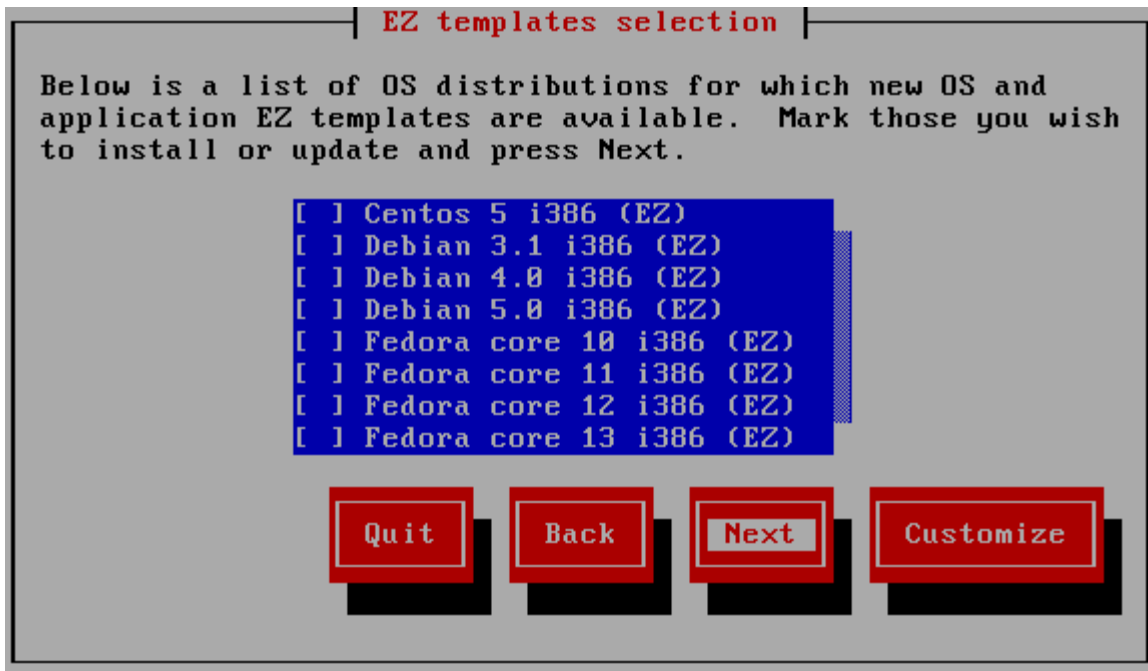


Notice that the bottommost update includes the functionality of all the other updates. You can select any of the intermediary updates and press **Select** to go back to the **List of Selected Updates** screen and read the information on this update. You will be able to perform customization more than once until you finally decide on the set of updates to be applied and press **Next**.

Downloading and installing the necessary updates is straightforward.

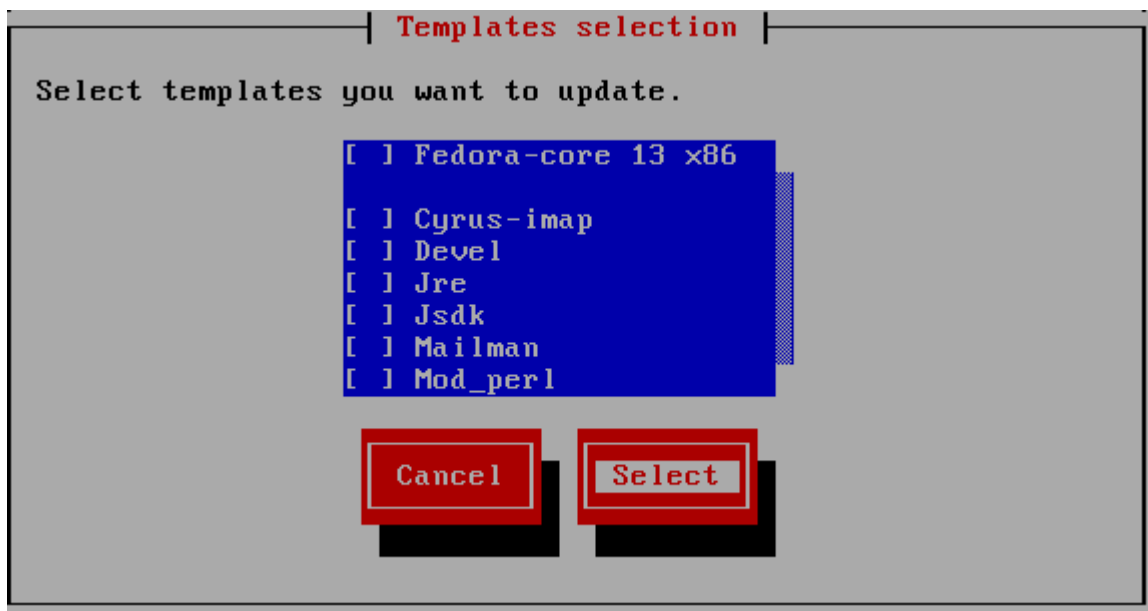
## Updating EZ Templates

Updating EZ templates consists in updating one or more EZ templates configuration files located in the `/vz/template/<os_name>/<os_version>/<arch>/config` directory on the Parallels server and takes place if you have launched the `vzup2date` utility with the `-z` option. The first few steps of the wizard were described in the [Updating in Graphical Mode subsection](#) (p. 164). As soon as you press **Next** in the **Welcome...** window, the utility will try to connect to the EZ templates repository (either the Parallels default repository or your own one) and, if the connection is successful, display the **EZ Templates Selection** window listing all EZ templates that have one or more updates available or that are not installed on your server at all.



In this window, you can do one of the following:

- If you wish to download and install all available EZ templates/template updates for a certain Linux distribution, select this distribution by placing the cursor beside it and pressing the space bar on your keyboard; then click **Next**.
- If you wish only certain EZ templates of the corresponding Linux distribution to be installed/updated on the Parallels server, place the cursor beside this distribution and press F2 on your keyboard. You will be presented with the **Templates selection** window where you can select the corresponding EZ templates.



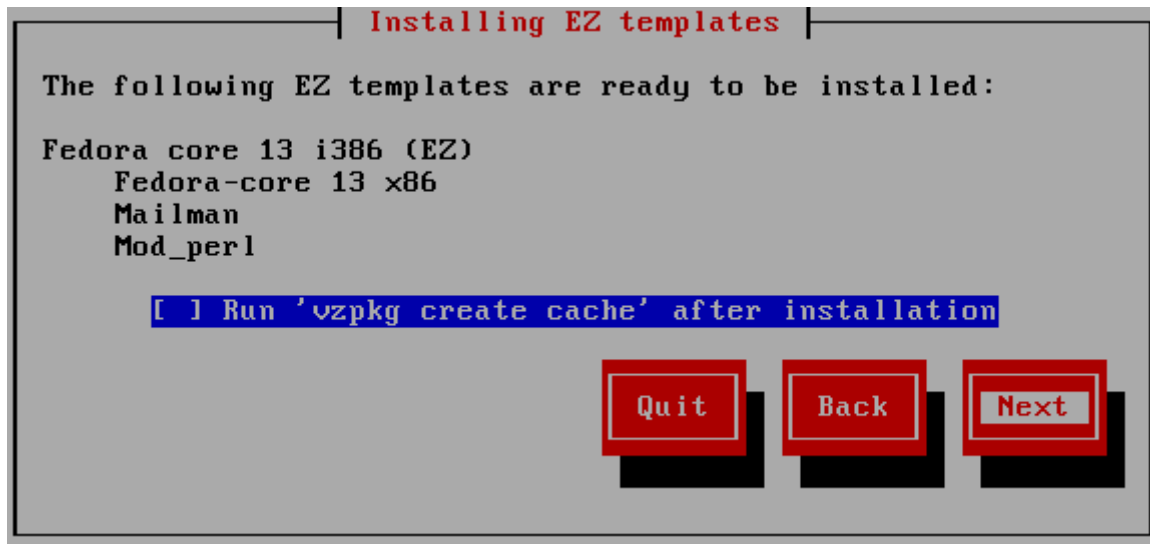


After choosing the right EZ templates, click the **Select** button to close the displayed window, and then click **Next** to proceed with the wizard.

**Note:** New application EZ templates for a Linux distribution can be installed on the Parallels server only if the corresponding OS EZ template is already installed on this server.

In the next step, you can review the EZ templates/template updates you selected on the previous step and scheduled for downloading and installing on your server. If you are not satisfied with the chosen templates/template updates, click the **Back** button to return to the previous step and modify the set of templates; otherwise, click **Next** to start downloading the templates/template updates.

After the EZ templates/templates have been successfully downloaded to the server, the **Installing EZ template** window is displayed.



In this window, you can view the templates/template updates ready to be installed on your server. If you are installing a new OS EZ template/OS EZ template update, you can select the **Run vzpkg cache after installation** option and specify whether to cache the corresponding OS EZ template/template update right after its installation on the server or to do it at a later time. By default, all OS EZ templates are just installed on the Parallels without being cached. However, you can select the provided check box and schedule your OS EZ template/template update for caching. Clicking **Next** starts installing the EZ templates on the server. By the time the wizard finishes, you should have updated OS and application templates on your system.

## Updating in Command-Line Mode

Another way of updating your Parallels Server Bare Metal system files and templates is to run the `vzup2date` utility in the command line mode and to pass the corresponding commands, switches, and options to it. While executing `vzup2date` in the command line mode, you can choose between the batch and messages submodes. Both submodes can be used to update either the Parallels Server Bare Metal system files or EZ templates and have the identical syntax.

However, the output produced by these commands is different. The messages submode output is less user friendly than that of the batch submode and is mostly suitable for machine processing.

To run the `vzup2date` utility in the command line mode, you can use either the `-m batch` switch or the `-m messages` switch intended for executing `vzup2date` in the batch and messages submodes, respectively.

Let us assume that you wish to update Parallels Server Bare Metal system files by installing the latest core in the batch submode. To do this, you can issue the following command on the Parallels server:

```
# vzup2date -m batch install --core
```

This will check the Parallels Server Bare Metal repository for the latest core updates and, in the case of finding any, download and install them on your server.

To update your Parallels Server Bare Metal installation, you may need to edit the `/etc/sysconfig/vzup2date/vzup2date.conf` file to specify the repository from where the updates are to be downloaded or configure a number of other parameters. Detailed information on the `vzup2date.conf` file is provided in the *Parallels Command Line Reference Guide*.

You can also execute the `vzup2date` utility in the batch mode to update the EZ templates installed on the Parallels server. For example, you can issue the following command

```
# vzup2date -t -m batch install --all-os
```

to update all OS templates installed on your server. Detailed information on all options that can be passed to the `vzup2date` utility is given in the *Parallels Command Line Reference Guide*.

**Note:** To perform the aforementioned operations in the messages submode, you should pass the `-m messages` option to the `vzup2date` utility instead of `-m batch`.

## Updating Software In Virtual Machines

To keep software in your virtual machines up to date, you can use the same means you would use on standalone computers running the corresponding operating systems:

- In Linux-based virtual machines, you can use the native Linux updaters (`up2date`, `yum`, or `yast`).
- In Windows-based virtual machines, you can use the native Windows updaters (e.g. the Windows Update tool).

You should regularly run these updaters to ensure that your system has the latest updates and fixes (including security patches) installed. For more information on native updaters, refer to the documentation shipped with your operating system.

## Updating Containers

Parallels Server Bare Metal provides two facilities to keep your Containers up to date. These facilities include:

- Updating EZ templates software packages inside a particular Container by means of the `vzpkg` utility. Using this facility, you can keep any of the Containers existing on your Parallels server up to date.
- Updating caches of the OS EZ templates installed on the Parallels server. This facility allows you to create new Containers already having the latest software packages installed.

### Updating EZ Template Packages Inside a Container

Parallels Server Bare Metal allows you to update packages of the OS EZ template a Container is based on and of any application EZ templates applied to the Container. You can do it by using the `vzpkg update` utility. Assuming that Container 101 is based on the `redhat-e15-x86` OS EZ template, you can issue the following command to update all packages included in this template:

```
# vzpkg update 101 redhat-e15-x86
...
Updating: httpd                ##### [ 1/4 ]
Updating: vzdev                ##### [ 2/4 ]
Cleanup  : vzdev                ##### [ 3/4 ]
Cleanup  : httpd               ##### [ 4/4 ]

Updated: httpd.i386 0:2.0.54-10.2 vzdev.noarch 0:1.0-4.swsoft
Complete!
Updated:
httpd          i386          0:2.0.54-10.2
vzdev         noarch         0:1.0-4.swsoft
```

#### Notes:

1. Updating EZ templates is supported for running Containers only.
2. If you are going to update the cache of a commercial OS EZ template (e.g. Red Hat Enterprise Server 5 or SLES 10), you should first update software packages in the remote repository used to handle this OS EZ template and then proceed with updating the EZ template cache. Detailed information on how to manage repositories for commercial Linux distributions is provided in the *Parallels Server Bare Metal Templates Management Guide*.

As you can see from the example above, the `httpd` and `vzdev` applications have been updated for the `redhat-e15-x86` OS EZ template. If you wish to update all EZ templates (including the OS EZ template) inside Container 101 at once, execute this command:

```
# vzpkg update 101
...
Running Transaction
Updating  : hwdata            ##### [ 1/2 ]
Cleanup   : hwdata            ##### [ 2/2 ]
```

```
Updated: hwdata.noarch 0:1.0-3.swsoft
Complete!
Updated:
  hwdata                noarch      0:0.158.1-1
```

In the example above, only the `hwdata` package inside Container 101 was out of date and updated to the latest version.

## Updating OS EZ Template Caches

With the release of new updates for the corresponding Linux distribution, the created OS EZ template cache can become obsolete. Parallels Server Bare Metal allows you to quickly update your OS EZ template caches using the `vzpkg update cache` command.

**Note:** If you are going to update the cache of a commercial OS EZ template (e.g. Red Hat Enterprise Server 5 or SLES 10), you should first update software packages in the remote repository used to handle this OS EZ template and then proceed with updating the EZ template cache. Detailed information on how to manage repositories for commercial Linux distributions is provided in the *Parallels Command Line Reference Guide*.

When executed, `vzpkg update cache` checks the cache directory in the template area (by default, the template area is located in `/vz/template`) on the Parallels server and updates all existing tarballs in this directory. However, you can explicitly indicate the tarball for what OS EZ template should be updated by specifying the OS EZ template name. For example, to update the tarball for the `fedora-core-8-x86` OS EZ template, you should issue the following command:

```
# vzpkg update cache fedora-core-8-x86
Loading "rpm2vzrpm" plugin
Setting up Update Process
Setting up repositories
base0          100% |=====| 951 B  00:00
base1          100% |=====| 951 B  00:00
base2          100% |=====| 951 B  00:00
base3          100% |=====| 951 B  00:00
...
```

Upon the `vzpkg update cache` execution, the old tarball is renamed by receiving the `-old` suffix (e.g. `fedora-core-8-x86.tar.gz-old`):

```
# ls /vz/template/cache
fedora-core-8-x86.tar.gz  fedora-core-8-x86.tar.gz-old
```

You can also pass the `-f` option to `vzpkg update cache` to remove an existing tar archive and create a new one instead of it.

If the `vzpkg update cache` command does not find a tarball for one or several OS EZ templates installed on the server, it creates tar archives of the corresponding OS EZ templates and puts them to the `/vz/template/cache` directory.

## Advanced Tasks

This chapter describes those tasks that are intended for advanced system administrators who would like to obtain deeper knowledge about Parallels Containers capabilities.

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## Configuring Capabilities

Capabilities are sets of bits that permit of splitting the privileges typically held by the root user into a larger set of more specific privileges. The POSIX capabilities are defined by a draft IEEE standard (IEEE Std 1003.1e); they are not unique to Linux or Parallels Server Bare Metal. When the Linux or Parallels Server Bare Metal documentation says “requires root privileges”, in nearly all cases it really means “requires a specific capability”.

This section documents the tasks that can be achieved using per-Container capabilities in Parallels Server Bare Metal and all configurable capabilities.

### Creating VZFS Symlinks Inside a Container

Normally it is impossible to create a VZFS symlink from a Container. The ability to create VZFS symlinks presents a serious security concern explained further in this subsection. However, there may be a situation when you need such an ability, for example, for testing created templates or creating VZFS mounts.

A VZFS symlink is a symbolic link starting with four slashes. You can see VZFS symlinks in the private area of any Container, as is illustrated below:

```
# ls -l /vz/private/101/root/bin/bash
lrwxr-xr-x  1 root  root  37 Jul  9  2009 \
/vz/private/101/root/bin/bash -> \
:///redhat-as4/bash-3.0-19.2/bin/bash
```

VZFS symlinks have no special meaning if the private area is not mounted over VZFS (to the Container root directory). If it is, then instead of a VZFS symlink the users inside the Container will see the file located in the template directory (in this particular case, `/vz/template/redhat-as4/bash-3.0-19.2/bin/bash`) instead of the VZFS symlink.

If you try to create a VZFS symlink inside the Container, you will get an error:

```
[root@ct101 root]# ln -s ///redhat-as4/bash-3.0-19-2/bin/bash .
ln: creating symbolic link `./bash' to \
`:///redhat-as4/bash-3.0-19.2/bin/bash': Invalid argument
```

The reason for this restriction is security considerations. If an intruder can correctly guess where the template area (defined by the `TEMPLATE` variable in the global configuration file `/etc/sysconfig/vz`) is located, he/she can access any file on the server provided the path to the file is guessed correctly. However, in case it is necessary to allow the VZFS symlinks creation inside a Container, it is possible to make use of the `sys_rawio` capability:

```
# vzctl set 101 --capability sys_rawio:on --save
Unable to set capability on running Container
Saved parameters for Container 101
```

After restarting the Container, you can unpack VZRPMs inside the Container or simply create VZFS symlinks:

```
# ssh root@ct101
root@ct101's password:
Last login: Mon Oct 28 23:25:58 2008 from 10.100.40.18
[root@ct101 root]# rpm2cpio bash-3.0-19.2.i386.vz.rpm | cpio -id
94 blocks
[root@ct101 root]# ls -l bin/bash
-rwxr-xr-x  1 root  root  519964 Oct 29 23:35 bin/bash
[root@ct101 root]# ln -s ///redhat-as4/bash-3.0-19.2/bin/bash .
[root@ct101 root]# ls -l bash
-rwxrwxrwx  1 root  root  519964 Oct 29 23:35 bash
```

As you can see both VZFS symlinks look like regular files for Container users. If you need to unpack and work on symlinks themselves, you have to create a Container that has a directory bind-mounted over a regular file system such as EXT2FS, EXT3FS or ReiserFS.

Remember that assigning this capability to non-trusted Containers can lead to compromising the server. The session below shows how a malicious Container administrator can get a copy of the server password database files:

```
[root@ct101 root]# ln -s ///.../etc/passwd .
[root@ct101 root]# ln -s ///.../etc/shadow .
[root@ct101 root]# ls -l
total 3
-rwxrwxrwx  1 root  root  1252 Oct 29 23:56 passwd
-rwxrwxrwx  1 root  root   823 Oct 29 23:56 shadow
```

While there is no easy way to substitute the password files on the server, a malicious Container administrator could run a dictionary attack against the obtained files.

## Available Capabilities for Containers

This section lists all the capabilities that can be set with the `<pcctl>` command. The capabilities are divided into two tables: the capabilities defined by the POSIX draft standard and Linux-specific capabilities. For each capability, its description is given together with the default value for a Container.

Please note that it is easy to create a non-working Container or compromise your server security by setting capabilities incorrectly. Do not change any capability for a Container without a full understanding of what this capability can lead to.

### Capabilities Defined by POSIX Draft

Name	Description	Default
<code>chown</code>	If a process has this capability set on, it can change ownership on the files not belonging to it or belonging to another user. You have to set this capability on to allow the Container root user to change ownership on files and directories inside the Container.	on
<code>dac_override</code>	This capability allows to access files even if the permission is set to disable access. Normally leave this on to let the Container root access files even if the permission does not allow it.	on
<code>dac_read_search</code>	Overrides restrictions on reading and searching for files and directories. The explanation is almost the same as above with the sole exclusion that this capability does not override executable restrictions.	on
<code>fowner</code>	Overrides restrictions on setting the <code>S_ISUID</code> and <code>S_ISGID</code> bits on a file requiring that the effective user ID and effective group ID of the process shall match the file owner ID.	on
<code>fsetid</code>	Used to decide between falling back on the old <code>suser()</code> or <code>fsuser()</code> .	on
<code>kill</code>	Allows sending signals to processes owned by other users.	on
<code>setgid</code>	Allows group ID manipulation and forged group IDs on socket credentials passing.	on
<code>setuid</code>	Allows user ID manipulation and forged user IDs on socket credentials passing.	on

### Linux-Specific Capabilities

Name	Description	Default
<code>setpcap</code>	Transfer any capability in your permitted set to any process ID; remove any capability in your permitted set from any process ID.	off
<code>linux_immutable</code>	Allows the modification of the <code>S_IMMUTABLE</code> and <code>S_APPEND</code> file attributes. These attributes are implemented only for the EXT2FS and EXT3FS Linux file systems and, as such, this capability has no effect for Containers	on

	running on top of VZFS. However, if you bind mount a directory located on the EXT2FS or EXT3FS file system into a Container and revoke this capability, the root user inside the Container will not be able to delete or truncate files with these attributes on.	
<code>net_bind_service</code>	Allows to bind to sockets with numbers below 1024.	on
<code>net_broadcast</code>	Allows network broadcasting and multicast access.	on
<code>net_admin</code>	Allows the administration of IP firewalls and accounting.	off
<code>net_raw</code>	Allows to use the RAW and PACKET sockets.	on
<code>ipc_lock</code>	Allows to lock shared memory segments and <code>mlock/mlockall</code> calls.	on
<code>ipc_owner</code>	Overrides IPC ownership checks.	on
<code>sys_module</code>	Insert and remove kernel modules. Be very careful with setting this capability on for a Container; if a user has the permission of inserting kernel modules, this user has essentially full control over the server.	off
<code>sys_rawio</code>	Allows to create VZFS symlinks over VZFS.	off
<code>sys_chroot</code>	Allows to use <code>chroot ( )</code> .	on
<code>sys_ptrace</code>	Allows to trace any process.	on
<code>sys_pacct</code>	Allows to configure process accounting.	on
<code>sys_admin</code>	In charge of many system administrator tasks such as swapping, administering APM BIOS, and so on. Shall be set to off for Containers.	off
<code>sys_boot</code>	This capability currently has no effect on the Container behaviour.	on
<code>sys_nice</code>	Allows to raise priority and to set priority for other processes.	on
<code>sys_resource</code>	Override resource limits (do not confuse with user beancounters).	on
<code>sys_time</code>	Allows to change the system time.	off
<code>sys_tty_config</code>	Allows the configuration of TTY devices.	on
<code>mknod</code>	Allows the privileged aspects of <code>mknod ( )</code> .	on
<code>lease</code>	Allows to take leases of files.	on

## Creating Customized Containers

If you wish to run one or several customized applications inside your Containers and the number of such Containers is relatively large, you may think of a way to automate the process of creating Containers that already have a number of applications installed and tuned to meet your demands. So, you do not need to manually install and customize your applications every time you create a new Container.

Parallels Server Bare Metal allows you to create customized Containers having a certain set of customized applications installed inside them right after their creation in one of the following ways:

- By making a customized base OS EZ template and using it as the basis for Containers.
- By making a non-base OS EZ template and using it as the basis for Containers.
- By making a customized application EZ template, adding it to a new configuration sample file, and using this sample file as the basis for Containers.



All these operations are described in the following subsections in detail.

## Using Customized OS EZ Templates

Let us first start with making a customized base OS EZ template which can then be used to create Containers with a set of application already tuned to meet your demands. To make such a template, do the following:

- 1 Create a metafile that will serve as the basis for your customized base OS EZ template.

**Notes:**

1. Detailed information on how to create metafiles is given in the *Parallels Server Bare Metal 5.0 Templates Management Guide*.
2. While creating a metafile for a new OS EZ template, make sure that the value of either the `%osname` parameter or the `%version` parameter in the metafile differs from the names or versions of all base OS EZ templates installed on the server.

- 2 Create one or more scripts that will be executed on different stages of the OS EZ template lifecycle and customize your applications to meet your needs. For example, you can create a postinstall script with the name of `post_install.bash` and make it perform a number of customization operations on some application included in the OS EZ template after installing this application inside your Container.
- 3 Create a customized OS EZ template by running the `vzmktmp1` utility and passing the corresponding options to it. So, you can use the `--post-install` option and specify the path to the `post_install.bash` script from the example above to make an OS EZ template that will customize your application after installing it inside your Container.

**Note:** The full list of options allowing you to specify what scripts are to be executed on what stage of the EZ template lifecycle is provided in the **vzmktmp1** subsection of the *Parallels Containers 4.6 Line Reference Guide*.

- 4 Install the customized OS EZ template on the server using the `rpm -i` command.
- 5 Cache the created OS EZ template by running the `vzpkg create cache` command. Detailed information on how you can do it is provided in the *Parallels Server Bare Metal 5.0 Templates Management Guide*.
- 6 Create a Container based on the OS EZ template.

For example, to create a Container that will run CentOS 5 and have the customized `mysql` and `apache` applications installed right after its creation, you can do the following:

- 1 Create a metafile for the Cent OS EZ template, name it, for example, `centos_5_customized.metafile`, and save in the `/root/centos_5` directory on the server.
- 2 Make a script that will perform a number of custom operations after applying the `mysql` and `apache` application EZ templates to the Container, and name it `post_install.bash`.

**3** Copy the script to the `/root/centos_5` directory on the server.

**4** Execute the following command on the server to create the CentOS 5 OS EZ template:

```
# vzmktmpl /root/centos_5/centos_5_customized.metafile \  
--post-install /root/centos5/post_install.bash
```

This command will create an OS EZ template for CentOS and put it to the `/root` directory (for example, `/root/centos_customized-5-x86-ez-4.7.0-1.noarch.rpm`).

**5** Install the resulting OS EZ template on the server:

```
# rpm -i /root/centos_customized-5-x86-ez-4.7.0-1.noarch.rpm
```

**6** Cache the installed OS EZ template:

```
# vzpkg create cache centos_customized-5-x86
```

```
...  
Complete!  
Packing cache file centos_customized-5-x86.tar.gz ...  
Cache file centos_customized-5-x86.tar.gz [14M] created.
```

**7** Create Container 101 on the basis of the new OS EZ template:

```
# pct1 create 101 --ostemplate centos_customized-5-x86  
--config basic
```

```
Creating Container private area (centos_customized-5-x86)  
Container is mounted  
Postcreate action done  
Container is unmounted  
Container private area was created  
Delete port redirection  
Adding port redirection to Container(1): 4643 8443
```

So you have just created Container 101 having the customized `mysql` and `apache` applications installed inside it.

## Using EZ OS Template Sets

Another way of creating customized Containers is to make a non-base OS EZ template (also known as an OS EZ template set) differing from the corresponding base OS EZ template in the number of packages included in this template. For example, if you wish a Container to run CentOS 5 and to function as a Linux-based server only, you can create the `centos-5-x86-server` OS EZ template set and include only those packages in it that are needed for performing main server tasks. So, you can specify packages to be used for setting up file and print sharing and exclude all the packages for graphical interfaces (GNOME and KDE).

To create a non-base OS EZ template, do the following:

- 1** Create a metafile that will serve as the basis for your non-base OS EZ template. Any metafile for this kind of EZ template must contain the following information:
  - `%osname`: the name of the Linux distribution for which you are creating the OS EZ template set. This name must correspond to that specified in the base OS EZ template. For example, if you are creating an OS template set of the base OS EZ template for CentOS 5, set the value of this parameter to `centos`.

- `%osver`: the version of the Linux distribution specified as the value of the `%osname` parameter. This name must correspond to that specified in the base OS EZ template. For example, if you are creating an OS template set of the base OS EZ template for CentOS 5, set the value of this parameter to 5.
- `%osarch`: the system architecture where the EZ template is to be run. This name must correspond to that specified in the base OS EZ template. For example, if you are creating an OS template set of the base OS EZ template for CentOS 5, set the value of this parameter to `x86`.
- `%setname`: the name to be assigned to your non-base OS EZ template. You can specify any name you like for your OS template set:
  - a This name will be added to the name of the base OS EZ template after the indication of the architecture where the OS EZ template is to be run. For example, if you are creating an OS template set of the base OS EZ template for CentOS 5 that is supposed to run on x86 platforms, the name of your non-base OS EZ template should look like the following—`centos-5-x86-Template_Name-ez-1.0-1.noarch.rpm`—where `Template_Name` is the name you specify as the value of the `%setname` parameter.
  - b This name will also be assigned to the directory which will store the meta data of your non-base OS EZ template after the template installation on the server. For example, it will have the name of `/vz/template/centos/5/x86/config/os/my_non_base_template` if you set the value of this parameter to `my_non_base_template`, create a non-base OS EZ template for CentOS 5, and installed it on the server.
- `%packages`: a list of RPM packages to be included in the non-base OS EZ template. This parameter allows you to specify what applications will be present inside your Containers based on this OS EZ template set right after their installation. The names of the packages listed as the value of this parameter must correspond to the names of real RPM packages (without indicating the package version, release, architecture, and the `.rpm` extension) that are stored in the repository used for managing your EZ templates.

**Note:** You can also specify a number of additional parameters in your metafile. For example, you may wish to add one or several extra packages to your OS EZ template set which are not available in the repository used to handle the packages for the corresponding base OS EZ template. For this purpose, you will have to specify the `%mirrorlist` parameter providing information on the repository where these extra packages are kept. Detailed information on all parameters you can set in metafiles is given in the *Parallels Containers 4.6 Reference Guide*.

- 2 You can also (though you do not have to) create a number of scripts that will be executed on different stages of the non-base OS EZ template lifecycle and customize your applications to meet your demands. The path to these scripts should then be specified after the corresponding options while creating your OS template set. For example, you can create a preinstall script with the name of `pre_install.bash` and make it perform a number of customization operations on some application included in the non-base OS EZ template before installing this application in your Container.

**Note:** If there are no scripts for a non-base OS EZ template, the scripts available for the corresponding base OS EZ template will be executed.

- 3 Create the non-base OS EZ template by running the `vzmktmpl` utility and passing the corresponding options to it, if needed. So, if you created one or several scripts in the previous step, you can use special options and specify the path to these scripts during the command execution. For example, you can use the `--pre-install` option and specify the path to the `pre_install.bash` script to make an OS EZ template that will customize your application before installing it inside your Container.

**Note:** The full list of options allowing you to specify what scripts are to be executed on what stage of the EZ template lifecycle is provided in the **vzmktmpl** subsection of the *Parallels Containers 4.6 Reference Guide*.

- 4 Install the non-base OS EZ template on the server using the `rpm -i` command.
- 5 Cache the created OS EZ template by running the `vzpkg create cache` command. Detailed information on how you can do it is provided in the *Parallels Server Bare Metal 5.0 Templates Management Guide*.
- 6 Create a Container based on the OS EZ template.

## Using Customized Application Template

If the number of customized applications inside your Containers is relatively small, you can also use the following way of creating customized Containers:

- 1 Create a metafile that will serve as the basis for your customized application EZ template.

**Note:** Detailed information on how to create metafiles is given in the **Creating Metafiles for EZ Templates** section of the *Parallels Server Bare Metal 5.0 Templates Management Guide*.

- 2 Create one or more scripts that will be executed on different stages of the application EZ template lifecycle and customize your applications to meet your demands. For example, you can create a postinstall script with the name of `post_install.bash` and make it perform a number of customization operations on your application after installing this application in your Container.
- 3 Create a customized application EZ template by running the `vzmktmpl` utility and passing the corresponding options to it. So, you can use the `--post-install` option and specify the path to the `post_install.bash` script from the example above to customize your application in accordance with your needs after installing it in your Container.

**Note:** The full list of options allowing you to specify what scripts are to be executed on what stage of the EZ template lifecycle is provided in the **vzmktmpl** section of the *Parallels Containers 4.6 Reference Guide*.

- 4 Install the customized EZ template on the server using the `rpm -i` command.
- 5 Create a new Container configuration sample file and include the customized EZ template in this file. Detailed information on Container configuration sample files is provided in the **Managing Container Resources Configuration** [section](#) (p. 118).
- 6 Create a customized Container on the basis of the configuration sample.

The following example demonstrates how to create Container 101 that will run CentOS 5 and have the customized `mysql` application installed right after its creation:

- 1 Create a metafile for the `mysql` application, name it `mysql.metafile`, and save in the `/usr/mysql` directory on the server.
- 2 Make a script that will perform a number of custom operations after applying the `mysql` EZ template to the Container, and name it `post_install.bash`.
- 3 Copy the script to the `/usr/mysql` directory on the server.
- 4 Execute the following command on the server to create the `mysql` EZ template:

```
# vzmktmpl /usr/mysql/mysql.metafile \
  --post-install /usr/mysql/post_install.bash
```

This command will create an EZ template for the `mysql` application and put it to the `/root` directory (e.g., `/root/mysql-centos-5-x86-ez-4.0.0-17.swsoft.noarch.rpm`).

- 5 Install the `mysql` EZ template on the server. Using the example above, you can install the template as follows:

```
# rpm -ihv /root/mysql-centos-5-x86-ez-4.0.0-17.swsoft.noarch.rpm
```

- 6 Create a new Container configuration sample file and add the `mysql` EZ template to a list of templates that will be installed in Containers created on the basis of this configuration sample file.
- 7 Create Container 101 by using the `pctl create` command and the `mysql` sample file:

```
# pctl create 101 --ostemplate centos-5-x86 --config mysql
Creating Container private area (centos-5-x86)
Container is mounted
Postcreate action done
Container is unmounted
Container private area was created
Delete port redirection
Adding port redirection to Container(1): 4643 8443
```

So, you have just created Container 101 that already has the customized `mysql` application installed.

## Changing System Time From Containers

Normally, it is impossible to change the system time from a Container. Otherwise, different Containers could interfere with each other and could even break applications depending on the system time accuracy.

Normally only the server system administrator can change the system time. However, if you want to synchronize the time via Network Time Protocol (NTP), you have to run NTP software, which will connect to external NTP servers and update the system time. It is not advisable to run application software on the server itself, since flaws in the software can lead to compromising all Containers on this server. Thus, if you plan to use NTP, you should create a special Container for it and configure it to have the `sys_time` capability. The example below illustrates configuring such a Container:

```
# pct1 set 101 --capability sys_time:on --save
Unable to set capability on running Container
Saved parameters for Container 101
```

The output of the above command warns you that `pctl` cannot apply changes in the capabilities to a running Container. The Container has to be restarted before changes take effect:

```
# pctl stop 101; pctl start 101
Stopping Container ...
Container was stopped
Container is unmounted
Starting Container ...
Container is mounted
Adding IP address(es): 192.168.1.101
Hostname for Container set: Container101
Container start in progress...
# ssh root@ct101
root@ct101's password:
Last login: Mon Feb 28 23:25:58 2007 from 10.100.40.18
[root@ct101 root]# date
Mon Feb 28 23:31:57 EST 2007
[root@ct101 root]# date 10291300
Tue Feb 29 13:00:00 EST 2007
[root@ct101 root]# date
Tue Feb 29 13:00:02 EST 2007
[root@ct101 root]# logout
Connection to Container101 closed.
# date
Tue Feb 29 13:01:31 EST 2010
```

The command session above shows the way to change the system time from Container 101. The changes will affect all the Containers and the server itself. It is not advisable to have more than one Container with the `sys_time` capability set on.

NTP is described in Internet Standard RFC 1305; more information including client software can be obtained from the NTP web server (<http://www.ntp.org>).

## Obtaining Server ID From Inside a Container

The default Parallels Server Bare Metal installation does not allow users inside a Container to obtain any information specific to the Parallels server the Container is running on. The reason is that no Container shall have knowledge about the corresponding server. A Container can be transparently migrated to another server, and if this Container runs any applications depending on the particular server, these applications might fail after the migration.

In some situations, however, you need to provide a unique server ID to some applications. For example, you might want to license your application per server. In this case, after the migration your customer will need to re-apply the license for your application.

Parallels Server Bare Metal provides access to the unique server ID via the `/proc/vz/hwid` file. The default Parallels Server Bare Metal installation makes this file accessible to Containers from 1 to 100 (i.e. Containers with reserved IDs). It is possible to change this range in the global configuration file (`vz.conf`). For example, this is the way to make the file visible in Containers from 1 to 1000:

```
# vi /etc/vz/vz.conf
VZPRIVRANGE="1 1000"
# pct1 exec 101 cat /proc/vz/hwid
0C3A.14CB.391B.6B69.02C9.4022.3E2F.CAF6
```

The above example illustrates accessing the server ID from Container 101.

## Enabling VPN for Containers

Virtual Private Network (VPN) is a technology which allows you to establish a secure network connection even over an insecure public network. Setting up a VPN for a separate Container is possible via the TUN/TAP device. To allow a particular Container to use this device, the following steps are required:

- Make sure the `tun.o` module is already loaded before Parallels Server Bare Metal is started:

```
# lsmod
```

- Allow the Container to use the TUN/TAP device:

```
# pct1 set 101 --devices c:10:200:rw --save
```

- Create the corresponding device inside the Container and set the proper permissions:

```
# pct1 exec 101 mkdir -p /dev/net
# pct1 exec 101 mknod /dev/net/tun c 10 200
# pct1 exec 101 chmod 600 /dev/net/tun
```

Configuring the VPN proper is carried out as a common Linux administration task, which is out of the scope of this guide. Some popular Linux software for setting up a VPN over the TUN/TAP driver includes Virtual TUNnel <<http://vtun.sourceforge.net/>> and OpenVPN <<http://openvpn.sourceforge.net/>>.

## Managing Server Resources Parameters

Parallels Server Bare Metal allows you to configure a number of resource management parameters defining the amount of resources to be allocated to the Parallels server. These parameters include all standard UBC parameters (`VMGUARPPAGES`, `KMEMSIZE`, `OOMGUARPPAGES`, etc.) as well as the `ONBOOT` parameter.

You can edit any of these parameters in the `/etc/vz/conf/0.conf` file on the server using your favorite text editor (for example, `vi` or `emacs`) or using the `pctl set` command and specifying `0` after this command. For example:

```
# pct1 set 0 --kmemsize 12211840:14359296 --save
Saved parameters for Container 0
```

This command sets both the barrier and limit values of unswappable kernel memory (in bytes) which can be allocated to internal kernel structures of the processes on the server. The specified parameter values will be in force until the server restart. If you wish these values to be applied to the server on its next booting, you should additionally set the `ONBOOT` parameter in the `/etc/vz/conf/0.conf` file to `yes`. This can be done in one of the following ways:

- Passing the `--onboot` option to the `pctl set` command:

```
# pctl set 0 --onboot yes
Saved parameters for Container 0
```

- Editing the `/etc/vz/conf/0.conf` file with your favorite text editor (e.g. `vi`) and setting the value of the `ONBOOT` parameter in this file to `yes`.

**Note:** Detailed information on all resource parameters that can be changed in respect of your Parallels server is provided in the *Parallels Command Line Reference Guide*.

If you have made a number of changes to server resource management parameters and wish to reset them to the values specified in the `/etc/vz/conf/0.conf` file, you can run this command:

```
# pctl set 0 --reset_ub
UBC limits were set successfully
```

## Setting Immutable and Append Flags for Container Files and Directories

You can use standard Linux utilities—`chattr` and `lsattr`—to set extra flags for files and directories inside your Containers and to query their status, respectively. Currently, two of these extra flags—'append' and 'immutable'—are supported. For example, you can execute the following command to set the 'immutable' flag for the `/root/MyFile` file inside Container 101:

```
[root@ct101 root] chattr +i /root/MyFile
```

To check that the 'immutable' flag has been successfully set, use the following command:

```
[root@ct101 root] lsattr /root/MyFile
----i----- /root/MyFile
```

**Note:** For detailed information on the `chattr` and `lsattr` utilities, see their manual pages.

## Customizing the `/proc/meminfo` Output in Containers

The `/proc/meminfo` virtual file allows you to view the information about memory usage (both physical and swap) on the system. You can customize the output of this file inside a particular Container and set it to one of the following modes:

- *Non-virtualized*. In this case running the `cat /proc/meminfo` command inside a Container will display the information about the physical memory on the server (total, used, free, shared, etc.), in kilobytes.
- *Virtualized in pages*. Setting the `/proc/meminfo` output to this mode allows you to specify what amount of total memory (in kilobytes) will be displayed while running the `cat /proc/meminfo` command inside this or that Container.



- *Virtualized in privvmpages*. Setting the `/proc/meminfo` output to this mode also allows you to arbitrarily specify the amount of total memory (in kilobytes) to be displayed while running the `cat /proc/meminfo` command inside this or that Container. As distinct from the previous mode, the amount of memory to be shown in this mode is calculated on the basis of the value of the `PRIVVMPAGES` parameter set in the Container configuration file.

**Notes:**

1. In Parallels Containers 4.6, the functionality of customizing the `/proc/meminfo` output is obsolete.
2. Enabling a specific mode for a Container does not influence the real resources allocation to the Container. It is only used to modify the way the `/proc/meminfo` output is displayed in the Container.

During the Parallels Server Bare Metal installation, the output of the `/proc/meminfo` virtual file is set to the *'non-virtualized'* mode, i.e. running the `cat /proc/meminfo` command inside any Container will show the information about the memory usage on the Parallels server. You can use the `--meminfo` option with the `pctl set` command to switch between different modes:

- To set the output of `/proc/meminfo` inside Container 101 to the *'virtualized in pages'* mode, issue the following command:

```
# pctl set 101 --meminfo pages:2000 --save
```

The amount of memory that will be displayed by running the `cat /proc/meminfo` command inside Container 101 is defined by the data specified after the `--meminfo` option:

- `pages` tells the `pctl set` command to enable the *'virtualized in pages'* mode for the `/proc/meminfo` output and simultaneously denotes the units of measurement to be used for setting the amount of memory (e.g., 4-KB pages for Containers running 32-bit operating systems).
- `200` denotes the number of pages to be shown in the `/proc/meminfo` output.

In our case the `/proc/meminfo` output inside Container 101 may look like the following:

```
# pctl exec 101 cat /proc/meminfo
MemTotal:      8000 kB
MemFree:       5140 kB
LowTotal:      8000 kB
LowFree:       5140 kB
Buffers:       0 kB
Cached:        0 kB
SwapCached:    0 kB
HighTotal:     0 kB
HighFree:     0 kB
...
```

When working in this mode, keep in mind the following:

- The specified amount of memory (in our case it is 8000 KB) is always shown in the `MemTotal` and `LowTotal` fields of the `cat /proc/meminfo` output.
- The values in the `MemFree` and `LowFree` fields are calculated automatically by the system.
- All the other fields in the command output have the values set to 0.

- To set the output of `/proc/meminfo` inside Container 101 to the *'virtualized in privvmpages'* mode, execute the following command:

```
# pct1 set 101 --meminfo privvmpages:3 --save
```

The amount of memory that will be displayed by running the `cat /proc/meminfo` command inside Container 101 is calculated using the following formulas:

- $Privvmpages\_Value * 3 * 4\text{KB}$  if Container 101 is running a 32-bit operating system (OS) or an OS for x86-64 processors and
- $Privvmpages\_Value * 3 * 16\text{KB}$  if Container 101 is running an OS for IA-64 processors

where *Privvmpages\_Value* denotes the value of the `PRIVVMPAGES` parameter set in the Container configuration file and 3 is an arbitrary integer coefficient which you can modify to increase/decrease the amount of memory in the `/proc/meminfo` output. Assuming that the `privvmpages` parameter for Container 101 is set to 10000, your output may look as follows:

```
# pct1 exec 101 cat /proc/meminfo
MemTotal:      120000 kB
MemFree:       78248 kB
LowTotal:      120000 kB
LowFree:       78248 kB
Buffers:       0 kB
Cached:        0 kB
SwapCached:    0 kB
HighTotal:     0 kB
HighFree:     0 kB
...
```

As can be seen from the example above, the displayed records comply with the same rules as the records in the *'virtualized in pages'* mode.

- To revert the output of `/proc/meminfo` to the default mode, execute the following command:

```
# pct1 set 101 --meminfo none --save
```

**Note:** If the value specified after the `--meminfo` option exceeds the total amount of memory available on the Parallels server, the `cat /proc/meminfo` command executed inside a Container will display the information about the total physical memory on this server.

The `--save` flag in the commands above saves all the parameters to the Container configuration file. If you do not want the applied changes to persist, you can omit the `--save` option and the applied changes will be valid only till the Container shutdown.

## Managing iptables Modules

This section describes the process of managing iptables modules for both physical servers and Containers.

## Using iptables Modules on Servers

The process of filtering network packets on systems running Parallels Server Bare Metal does not differ from that on standalone Linux servers. You can use the standard *iptables* tool to control how network packets enter, move through, and exit the network stack within the Parallels Server Bare Metal kernel.

For your reference, below are several resources you can consult to get detailed information on using *iptables* on Linux servers:

- *Red Hat Enterprise Linux 6 Security Guide* ([http://docs.redhat.com/docs/en-US/Red\\_Hat\\_Enterprise\\_Linux/6/html/Security\\_Guide/index.html](http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Security_Guide/index.html)) contains a section focusing on packet filtering basics and explaining various options available for *iptables*.
- *Iptables Tutorial 1.2.2* (<http://www.frozentux.net/iptables-tutorial/iptables-tutorial.html>) explains in great detail how *iptables* is structured and how it works.

## Using iptables Modules in Containers

Using *iptables* modules in Containers requires additional configuration on your part.

### Defining the basic set of iptables modules for Containers

All modules you plan to use in a Container must be loaded on the physical server where the Container is hosted. So if you try to create in the Container a rule for a module that is not loaded on the server, *iptables* will return an error.

You define which *iptables* modules are allowed for use in Containers by using the *iptables* service of the physical server. To tell this service to load on the server the set of modules you plan to use in Containers, edit the `/etc/sysconfig/iptables-config` file and specify the desired modules as the value of the `IPTABLES_MODULES` parameter in this file.

Let us assume that you want to make the following modules automatically load on the server startup, thus allowing their use in Containers: `ipt_REJECT`, `iptable_filter`, `iptable_mangle`, `xt_length`, `xt_hl`, `xt_tcpmss`, `xt_TCPMSS`, `xt_multiport`, `xt_limit`, `xt_dscp`. To do this:

- 1 Open the `/etc/sysconfig/iptables-config` file for editing.
- 2 Set the value of the `IPTABLES_MODULES` parameter to the following:

```
IPTABLES_MODULES="ipt_REJECT iptable_filter iptable_mangle xt_length xt_hl xt_tcpmss
xt_TCPMSS xt_multiport xt_limit xt_dscp"
```

- 3 Restart the *iptables* service for the changes to the `/etc/sysconfig/iptables-config` file to come into effect:

```
# service iptables restart
```

**Note:** After loading some modules on the server, you may need to perform a number of additional configuration steps and restart a Container to allow the use of these modules in the Container (for details, see the information below).

### Using Parallels Server Bare Metal settings to configure iptables modules

You can use two configuration settings specific to Parallels Server Bare Metal to additionally define the set of `iptables` modules allowed for use in Containers:

- `IPTABLES` in the global configuration file (`/etc/vz/vz.conf`). This parameter, if set, is valid for all Containers on the server.
- `IPTABLES` in the configuration file of specific Containers (`/etc/vz/conf/<CT_ID>.conf`). This parameter is empty by default so that the settings from the `/etc/vz/vz.conf` global configuration file apply to all Containers. Setting the `IPTABLES` parameter in the configuration file of a specific Container will override the `IPTABLES` parameter in `/etc/vz/vz.conf`

Using `IPTABLES` parameters, you can forbid the use of some `iptables` modules in Containers. The list of such parameters is given below:

- `iptables_filter`: If set, this parameter allows the use of rules in both IPv4 and IPv6 filter tables in Containers.
- `iptables_mangle`: If set, this parameter allows the use of rules in both IPv4 and IPv6 mangle tables in Containers.
- `ip_conntrack`: If set, this parameter allows the use of `conntrack` rules in any tables in Containers.
- `iptables_nat`: If set, this parameter allows the use of rules in the NAT table in Containers. If `iptables_nat` is set, it also enables all `conntrack`-related modules even if `ip_conntrack` is not turned on.

#### Notes:

1. By default, the NAT table and `conntrack` rules are disabled in Containers. For information on how to enable them, see **Using conntrack Rules and NAT Tables in Containers** below.

2. If the `IPTABLES` parameters in the global and Container configuration files are not defined, the in-kernel default allows the use of `iptables_filter` and `iptables_mangle` modules in Containers, but forbids the use of `ip_conntrack` and `iptables_nat` modules.

All modules listed in the `IPTABLES` parameter in the `/etc/vz/vz.conf` global configuration file are loaded on the server during the `vz` service start, even if they are not listed in the `/etc/sysconfig/iptables-config` file. The default setting of `IPTABLES` in `/etc/vz/vz.conf` is configured to load typical `iptables` rules to allow their use in Containers, without making any changes to the `iptables` service of the physical server.

### Using conntrack Rules and NAT Tables in Containers

By default, the NAT table and `conntrack` rules are disabled and not allowed for use in Containers even if they are loaded on the server. To allow their use in Containers, do one of the following:

- Enable this functionality for all Containers on a server. To do this, open the `/etc/vz/vz.conf` global configuration file for editing and specify `ip_conntrack` and `iptables_nat` as the value of the `IPTABLES` parameter.
- Enable this functionality for a specific Container. To do this, open the configuration file of the Container (`/etc/vz/conf/CT_ID.conf`) for editing and specify `ip_conntrack` and `iptables_nat` as the value of the `IPTABLES` parameter.

## Creating Configuration Files for New Linux Distributions

Distribution configuration files are used to distinguish among Containers running different Linux versions and to determine what scripts should be executed when performing the relevant Container-related operations (e.g. assigning a new IP address to the Container). Detailed information on distributions configurations files is provided in the **Linux Distribution Configuration Files** subsection of the *Parallels Command Line Reference Guide*.

All Linux distributions shipped with Parallels Server Bare Metal have their own configuration files located in the `/etc/vz/conf/dists` directory on the Parallels server. However, you may wish to create your own distribution configuration files to support new Linux versions released. Let us assume that you wish your Containers to run the CentOS 5 Linux distribution and, therefore, have to make the `centos-5.conf` distribution configuration file to define what scripts are to be executed while performing major tasks with Containers running this Linux version. To do this:

- 1 In the Container configuration file (with the name of `/etc/vz/conf/CT_ID.conf`), specify `centos-5` as the value of the `DISTRIBUTION` variable (for example, `DISTRIBUTION="centos-5"`).
- 2 Create the `centos-5.conf` configuration file in the `/etc/vz/conf/dists` directory. The easiest way to do it is copy one of the existing configuration files by executing the following command in the `/etc/vz/conf/dists` directory:

```
# cp fedora.conf centos-5.conf
```

In the example above, we assume that the `fedora.conf` file is present in the `/etc/vz/conf/dists` directory on the Parallels server. In case it is not, you may use any other distribution configuration file available on your server.

- 3 Open the `centos.conf` file for editing with the help of any text editor:

```
# vi centos-5.conf
```

- 4 In the `centos-5.conf` file, go to the first entry and, in the right part of the entry, specify the name of the script you wish to be run on issuing the `pctl` command with the parameter specified in the left part of the entry. For example, if you wish the script to be executed while

assigning a new IP address to your Container and the script has the `my_centos_script` name, your entry should look as follows:

```
ADD_IP=my_centos_script-add_ip.sh
```

**Note:** The information on all acceptable parameters and their description are provided in the *Parallels Command Line Reference Guide*.

- 5 Repeat **Step 4** for all entries in the file.
- 6 Place the scripts for the new Linux distribution to the `/etc/vz/conf/dists/scripts` directory on the Node. Make sure the names of these scripts coincide with those specified in the `centos-5.conf` file.

## Monitoring Resources

In Parallels Server Bare Metal, you can use the `pstat` utility to monitor system resources in real time. When executed, the utility displays the status and load of the system: its disk, network, CPU, memory, and other parameters. It also provides the list of running virtual machines and Containers together with their resources consumption statistics. For example, you can run the following command on the server to view your current system resources:

```
# pstat -d 5
 5:39pm, up 4 days, 5:33, 2 users, load average: 1.08, 1.11, 1.05
CTNum 2, procs 268: R 1, S 265, D 1, Z 0, T 1, X 0
CPU [ OK ]: CTs 0%, CT0 0%, user 0%, sys 1%, idle 99%, lat(ms) 1/0
Mem [ OK ]: total 7831MB, free 4147MB/0MB (low/high), lat(ms) 1/0
  ZONE0 (DMA): size 9MB, act 0MB, inact 0MB, free 10MB (0/0/0)
  ZONE1 (DMA32): size 3238MB, act 42MB, inact 39MB, free 3118MB (4/5/6)
  ZONE2 (Normal): size 4661MB, act 2730MB, inact 606MB, free 1019MB (6/8/9)
Mem lat (ms): A0 0, K0 1, U0 0, K1 1, U1 0
Slab pages: 181MB/181MB (ino 39MB, de 13MB, bh 21MB, pb 40MB)
Swap [ OK ]: tot 2000MB, free 2000MB, in 0.000MB/s, out 0.000MB/s
Net [ OK ]: tot: in 0.027MB/s 233pkt/s, out 0.040MB/s 37pkt/s
             lo: in 0.000MB/s 0pkt/s, out 0.000MB/s 0pkt/s
             eth0: in 0.014MB/s 116pkt/s, out 0.020MB/s 19pkt/s
             sit0: in 0.000MB/s 0pkt/s, out 0.000MB/s 0pkt/s
             br0: in 0.000MB/s 0pkt/s, out 0.000MB/s 0pkt/s
             br1: in 0.013MB/s 116pkt/s, out 0.020MB/s 19pkt/s
Disks [ OK ]: in 0.000MB/s, out 0.000MB/s

ST  %VM  %KM  CPU  FCNT  MLAT  NAME
OK  0.0/27  0.0/-  0.00/33  0  0  1
OK  0.2/685  0.0/-  0.00/33  0  0  101
OK  0.4/685  0.0/-  0.00/33  0  0  102
OK  27/6.7  0.1/-  0.00/33  0  0  Windows7
```

The command output is updated with the time interval equal to the value specified after the `-d` (delay) option measured in seconds. In the session above, the statistics displayed is renewed every five seconds. If the `-d` option is not specified, the default interval equals 1 second.

As you can see, the utility provides real-time information on all main resources subsystems pertaining both to the physical server and to its virtual machines and Containers: the disk, network, CPU, and memory subsystems. You may want to shrink the output of the utility by specifying the `-`

b (brief) option instead of the `-v` (verbose) one, or to do without any options to use the “normal” mode of displaying.

The following information is displayed by default per each virtual machine or Container:

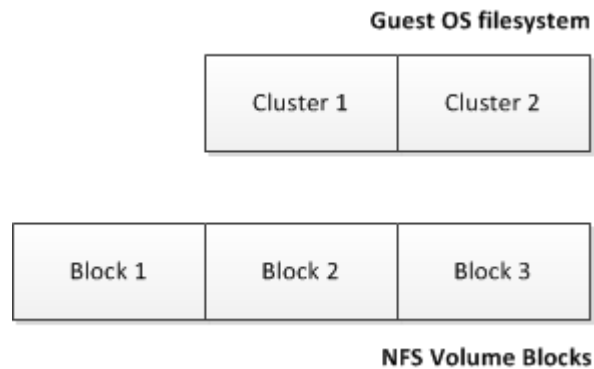
Column Name	Description
ST	virtual machine or Container status. If there are no failed counters and the latency values are normal, the status is “OK”. Otherwise, it is displayed in red as “!”. You can sort virtual machines and Containers by their status to see the problem virtual machines and Containers first.
%VM	Virtual memory usage, in per cent to the total memory. The first number is how much virtual memory is being used, and the second one is the virtual memory barrier.
%KM	Kernel memory usage, in per cent to the normal zone size. The first number is how much kernel memory is being used, and the second one is the kernel memory barrier.
CPU	CPU usage in per cent to all available CPUs. The first number is how much of the CPU power is being used by the virtual machine or Container, and the second one is its guaranteed share judging by the <code>cpuunits</code> parameter. Note that the actual CPU usage may be higher than the guaranteed one.
FCNT	The number of failed counters for all the resource parameters. In the standard mode of displaying, this number represents the increase of failed counters since the previous screen update, whereas in the average mode of displaying, it represents an absolute failed counters sum for the given virtual machine or Container.
MLAT	Maximal scheduling latency for the virtual machine or Container, in ms. This parameter shows the maximal scheduling latency inside the given virtual machine or Container, i.e. for how long (at the utmost) a process inside the virtual machine or Container awaits for the CPU.
NAME	virtual machine or Container name.

The **%VM**, **%KM**, and **CPU** columns provide two values per column separated by a slash for each virtual machine and Container. The first value indicates the real usage of the corresponding parameter by the virtual machine and Container, and the second one – the maximal value allowed for the virtual machine and Container.

For detailed information on options that you can use with the `psstat` utility, refer to the *Parallels Server Bare Metal Command Linux Guide*.

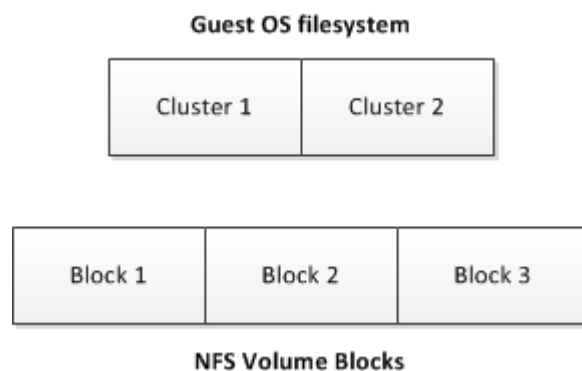
## Aligning Disks and Partitions in Virtual Machines

Most of the modern operating systems (Windows Server 2008, Red Hat Enterprise Linux 6, or Fedora 14) automatically align the partitions when you install them in virtual machines. For example, Windows Server 2008 creates a default partition offset of 1024 KB to satisfy the partition alignment requirements. The following figure shows an example of the correct partition alignment:



In this example, any cluster (the smallest unit of data) in the guest OS file system is aligned with the boundaries of an NFS block, and reading from or writing to a cluster requires only access to one NFS block. For example, reading from Cluster 1 causes only a read from Block 1.

At the same time, virtual machines running non-modern systems (for example, Windows Server 2003 or Red Hat Enterprise Linux 5) do usually have misaligned partitions, which is shown in the figure below:



In this example, clusters of the guest OS file system do not match the boundaries of NFS blocks, and reading from or writing to a cluster requires access to several NFS blocks. For example, reading from Cluster 1 causes two reads: from Block 1 and from Block 2. This results in a slower read time as compared to properly aligned partitions and leads to performance degradation.

### Aligning partitions

Basically, to align disks and partitions in virtual machines, you need to set an offset so that clusters in the guest OS file system match the volume block size on your NFS storage. Usually, the block size of most network storages is 512 bytes or a multiple of 512 bytes. As an example, the following sections describe the procedure of aligning disks and partitions for Linux and Windows virtual machines assuming that the size of your NFS blocks is 512 bytes.

When deciding on aligning disks and partitions, take into account that this process destroys all data on these disks and partitions. So if you want to have a correctly aligned system partition, you need to align your disks and partitions before creating a virtual machine and installing a guest operating



system in it. If you do not want an aligned system partition, you can first create a virtual machine and install a guest OS in it, and then align your data disks from inside the virtual machine.

The sections below demonstrate how to align disks and partitions before you start installing a guest OS. You can, however, use a similar procedure to align data disks and partitions from inside your virtual machines.

## Checking partition alignment in existing virtual machines

First of all, you may wish to know how you can check that the partitions of a virtual machine are not aligned. Depending on the operating system installed in the virtual machine, you can do the following.

### Linux virtual machines

To check the partition alignment in a Linux virtual machine, log in to this virtual machine and run the following command:

```
# fdisk -l -u /dev/device_name
```

For example, to check the partition alignment on the `sdc` device, you can run this command:

```
# fdisk -l -u /dev/sdc
```

```
Disk /dev/sdc: 73.0 GB, 73014444032 bytes
255 heads, 63 sectors/track, 8876 cylinders, total 142606336 sectors
Units = sectors of 1 * 512 = 512 bytes
```

Device	Boot	Start	End	Blocks	Id	System
/dev/sdc1	*	63	208844	104391	83	Linux
/dev/sdc2		208845	142592939	71192047+	8e	Linux LVM

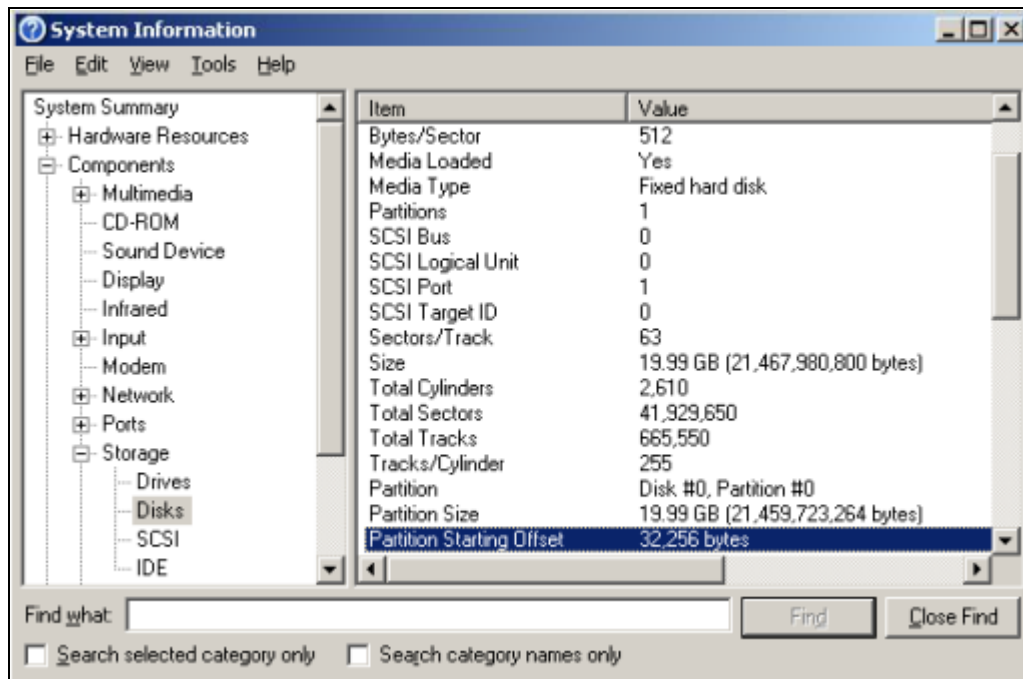
Pay attention to the number of sectors in the **Start** column. Usually, a sector contains 512 bytes, which makes up 32256 bytes for 63 sectors for the `/dev/sdc1` partition and 26105625 bytes for 208845 for the `/dev/sdc2` partition. For a partition to be properly aligned, it must align with 4096 byte boundaries (assuming that the block size of your storage is 4 KB). As 32256 and 106928640 is not a multiple of 4096, the partitions `/dev/sdc1` and `/dev/sdc2` are not aligned properly. To align them, you should offset

- the `/dev/sdc1` partition by 1 sector so that it starts at 64. In this case, 64 sectors each containing 512 bytes make up 32768 that is a multiple of 4096.
- the `/dev/sdc2` partition by 3 sectors so that it starts at 208848. In this case, 208848 sectors each containing 512 bytes make up 106930176 that is a multiple of 4096.

### Windows virtual machines

To check the partition alignment in a Windows virtual machine, do the following:

- 1 Click **Start > Run**, type `msinfo32.exe`, and press Enter to open System Information.
- 2 Navigate to **Components > Storage > Disks**, and look for the **Partition Starting Offset** field in the right part of the window.



To find out if the partition is aligned properly, use the method described above for Linux virtual machines.

## Aligning disks for Linux virtual machines

To align partitions for use in a Linux virtual machine, you need a working Linux virtual machine. Once you have it at hand, follow the steps below:

- 1 Create a new disk for the virtual machine.  
On this disk, you will create aligned partitions. Then you will connect the disk to a new virtual machine and install your Linux guest OS on this disk.
- 2 Start the virtual machine and log in to it using SSH.
- 3 Run the `fdisk` utility for the disk you want to align.
- 4 Create a primary partition, and set the starting block number for the created partition.
- 5 Repeat steps 4-6 to create and align all partitions you plan to have in your new virtual machine.

The following example creates partition #1 with the size of 1 GB on the `/dev/sda` device and uses the offset of 64 KB.

```
# fdisk /dev/sda
```

```
Device contains neither a valid DOS partition table, nor Sun, SGI or OSF disklabel
Building a new DOS disklabel. Changes will remain in memory only,
until you decide to write them. After that, of course, the previous
content won't be recoverable.
```

```
The number of cylinders for this disk is set to 1044.
There is nothing wrong with that, but this is larger than 1024,
and could in certain setups cause problems with:
1) software that runs at boot time (e.g., old versions of LILO)
2) booting and partitioning software from other OSs
   (e.g., DOS FDISK, OS/2 FDISK)
Warning: invalid flag 0x0000 of partition table 4 will be corrected by w(rite)

Command (m for help): n
Command action
  e   extended
  p   primary partition (1-4)
P
Partition number (1-4): 1
First sector (63-16777215, default 63): 64
Last sector or +size or +sizeM or +sizeK (64-16777215, default 16777215): 208848

Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
Syncing disks.
```

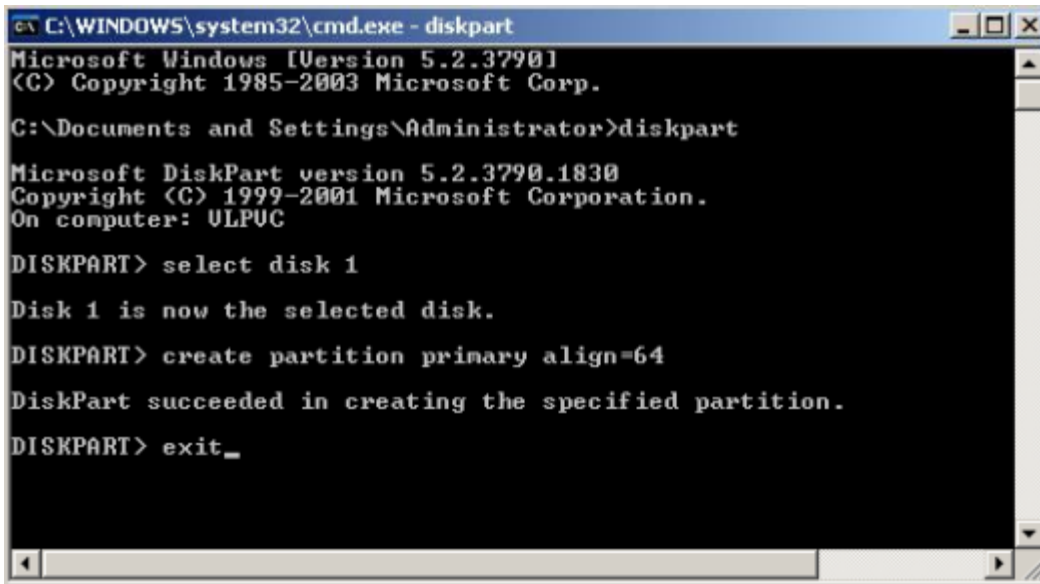
Once you align all the necessary partitions, disconnect the disk from the virtual machine. When creating a new virtual machine, choose this disk for use with this virtual machine.

## Aligning partitions for Windows virtual machines

To align a disk for a Windows virtual machine, you need a working Windows virtual machine. Once you have it at hand, you can use the `diskpart` or `diskpar` utility (depending on your operating system) to align the disk:

- 1 Create a new disk for the virtual machine.  
On this disk, you will create aligned partitions. Then you will connect the disk to a new virtual machine and install your Windows guest OS on this disk.
- 2 Open the command-line prompt, and run the `diskpart` or `diskpar` utility.
- 3 Select the disk you want to align.
- 4 Create the primary partition on the disk, and align it.
- 5 Exit the `diskpart` utility, and close the command-line prompt.

The following example demonstrates how to use the `diskpart` utility to align disk 1 by setting the offset of 64 for it:



```
ex C:\WINDOWS\system32\cmd.exe - diskpart
Microsoft Windows [Version 5.2.3790]
(C) Copyright 1985-2003 Microsoft Corp.

C:\Documents and Settings\Administrator>diskpart

Microsoft DiskPart version 5.2.3790.1830
Copyright (C) 1999-2001 Microsoft Corporation.
On computer: ULPUC

DISKPART> select disk 1

Disk 1 is now the selected disk.

DISKPART> create partition primary align=64

DiskPart succeeded in creating the specified partition.

DISKPART> exit_
```

Once you align the virtual disk, disconnect it from the virtual machine. When creating a new virtual machine, choose this disk for use with this virtual machine.

### Creating a template of a virtual machine with aligned partitions

To facilitate the procedure of creating virtual machines that have aligned system partitions, you can create a template of the aligned virtual machine and deploy new virtual machines from this template.

For example, if you align a disk by following the steps in **Aligning partitions for Windows virtual machines**, then create a new virtual machine that uses this disk, and then install Windows Server 2003 operating system in the virtual machine, you will have a clean Windows Server 2003 installation on the correctly aligned disk. Now you can create a template of this virtual machine and use this template each time you need to deploy a new virtual machine with Windows Server 2003.

## Running Parallels Server Bare Metal 5.0 in Virtual Machines

Starting with version 5, you can install Parallels Server Bare Metal in virtual machines. Running Parallels Server Bare Metal 5.0 in a virtual machine may prove useful if you want to evaluate the product but do not have a spare physical server.

To run virtual machines with Parallels Server Bare Metal 5.0, a physical server must meet the following requirements:

*Have the following architecture:*

- Intel with VT-x and EPT (Nehalem, Westmere, SandyBridge)

- AMD SVM and RVI (Barcelona, MagnyCore, Bulldozer)

*Run one of the following products:*

- Parallels Desktop for Mac 7
- Parallels Workstation for Windows 6
- Parallels Workstation for Linux 6
- VMware Fusion 3

## Recommended Virtual Machine Configuration

A virtual machine is best optimized for use with Parallels Server Bare Metal 5.0 if it has the following configuration:

- CPU:  
2 or more virtual CPUs
- Memory:  
2 GB or more RAM
- Hard disk:  
40 GB or more disk space; the disk must be of the plain type.

The process of installing Parallels Server Bare Metal in a virtual machine does not differ from that you use to install the product on a standalone server. For detailed installation instructions, refer to the *Parallels Server Bare Metal 5.0 Installation Guide*.

## Restrictions and Peculiarities

When using Parallels Server Bare Metal in a virtualized environment, keep in mind the following restrictions and specifics:

- Running Parallels Server Bare Metal in a virtual machine is intended for evaluation purposes only. You are not recommended to use such installations in production.
- If you change the configuration of a virtual machine where Parallels Server Bare Metal is installed, you may need to reactivate the product.
- VMware Fusion may show a warning when you start a virtual machine with Parallels Server Bare Metal that it requires full access to the network traffic. Ignore this message, and proceed with booting the virtual machine.
- To run in a virtualized Parallels Server Bare Metal environment, a virtual machine must have Parallels Tools installed. So before starting a virtual machine for the first time, make sure that you have installed Parallels Tools in it.
- Virtual machines may run only 32-bit operating systems and have only one CPU.

# Troubleshooting

This chapter provides the information about those problems that may occur during your work with Parallels Server Bare Metal and suggests the ways to solve them, including getting technical support from Parallels.

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## General Considerations

The general issues to take into consideration when troubleshooting your system are listed below. You should read them carefully before trying to solve more specific problems.

- Make sure a valid license is always loaded on the server. If your license has expired and the grace period is over, all the virtual machines and Containers on your server will be stopped.
- You should always remember where you are currently located in your terminal. Check it periodically using the `pwd`, `hostname`, `ifconfig`, `cat /proc/vz/veinfo` commands. One and the same command executed inside a virtual machine and Container and on the server can lead to very different results. You can also set up the `PS1` environment variable to show the full path in the `bash` prompt. To do this, add these lines to

`/root/.bash_profile:`

```
PS1="[ \u@\h \w]$ "
export PS1
```

- If the server slows down, use `vmstat`, `ps` (`ps axfw`), `dmesg`, `top` (`vztop`) to find out what is happening, never reboot the machine without investigation. If no thinking helps restore the normal operation, use the `Alt+SysRq` sequences to dump the memory (`showMem`) and processes (`showPc`).
- If the server was incorrectly brought down, on its next startup all the partitions will be checked and quota recalculated for each Container, which dramatically increases the startup time.
- Do not run any binary or script that belongs to a Container directly from the server, for example, do not ever do that:

```
cd /vz/root/99/etc/init.d
./httpd status
```

Any script inside a Container could have been changed to whatever the Container owner chooses: it could have been trojaned, replaced to something like `rm -rf`, etc. You can use only `pctl exec/pctl enter` to execute programs inside a Container.

- Do not use init scripts on the server. An init script may use `killall` to stop a service, which means that all similar processes will be killed in all Containers. You can check `/var/run/Service.pid` and kill the correspondent process explicitly.
- You must be able to detect any rootkit inside a Container. It is recommended to use the `chkrootkit` package for detection (you can download the latest version from [www.chkrootkit.org](http://www.chkrootkit.org)), or at least run

```
rpm -Va |grep "S.5"
```

to check up if the MD5 sum has changed for any RPM file.

You can also run `nmap`, for example:

```
# nmap -p 1-65535 192.168.0.1

Starting nmap V. 2.54BETA22 ( www.insecure.org/nmap/ )
Interesting ports on (192.168.0.1):
(The 65531 ports scanned but not shown below are in
state: closed)
Port      State      Service
21/tcp    open       ftp
22/tcp    open       ssh
80/tcp    open       http
111/tcp   open       sunrpc

Nmap run completed -- 1 IP address (1 host up) scanned
in 169 seconds
```

to check if any ports are open that should normally be closed.

That could however be a problem to remove a rootkit from a Container and make sure it is 100% removed. If you're not sure, create a new Container for that customer and migrate his/her sites and mail there.

- Check the `/var/log/` directory on the server to find out what is happening on the system. There are a number of log files that are maintained by the system and Parallels Server Bare Metal (the `boot.log`, `messages`, etc.), but other services and programs may also put their own log files here depending on your distribution of Linux and the services and applications that you are running. For example, there may be logs associated with running a mail server (the `maillog` file), automatic tasks (the `cron` file), and others. However, the first place to look into when you are troubleshooting is the `/var/log/messages` log file. It contains the boot messages when the system came up as well as other status messages as the system runs. Errors with I/O, networking, and other general system errors are reported in this file. So, we recommend that you read to the `messages` log file first and then proceed with the other files from the `/var/log/` directory.
- Subscribe to bug tracking lists. You should keep track of new public DoS tools or remote exploits for the software and install them into Containers or at servers.

- When using `iptables`, there is a simple rule for Chains usage to help protect both the server and its Containers:
  - use INPUT, OUTPUT to filter packets that come in/out the server
  - use FORWARD to filter packets that are designated for Containers

## Kernel Troubleshooting

### Using ALT+SYSRQ Keyboard Sequences

Press ALT+SYSRQ+H (3 keys simultaneously) and check what is printed at the server console, for example:

```
SysRq: unRaw Boot Sync Unmount showPc showTasks showMem loglevel0-8 tErm kIll killalL  
Calls Oops
```

This output shows you what ALT+SYSRQ sequences you may use for performing this or that command. The capital letters in the command names identify the sequence. Thus, if there are any troubles with the machine and you're about to reboot it, please press the following sequences before pressing the **Power** button:

ALT+SYSRQ+M to dump memory info

ALT+SYSRQ+P to dump processes states

ALT+SYSRQ+S to sync disks

ALT+SYSRQ+U to unmount filesystems

ALT+SYSRQ+L to kill all processes

ALT+SYSRQ+U try to unmount once again

ALT+SYSRQ+B to reboot

If the server is not rebooted after that, you can press the **Power** button.

### Saving Kernel Faults (OOPS)

You can use the following command to check for the kernel messages that should be reported to Parallels Server Bare Metal developers:

```
grep -E "Call Trace|Code" /var/log/messages*
```

Then, you should find kernel-related lines in the corresponding log file and figure out what kernel was booted when the oops occurred. Search backward for the "Linux" string, look for strings like that:



```
Sep 26 11:41:12 kernel: Linux version 2.6.18-8.1.1.el5.028stab043.1 (root@rhel5-32-
build) (gcc version 4.1.1 20061011 (Red Hat 4.1.1-30)) #1 SMP Wed Aug 29 11:51:58 MSK
2007
```

An oops usually starts with some description of what happened and ends with the Code string. Here is an example:

```
Aug 25 08:27:46 boar BUG: unable to handle kernel NULL pointer dereference at virtual
address 00000038
Aug 25 08:27:46 boar printing eip:
Aug 25 08:27:46 boar f0ce6507
Aug 25 08:27:46 boar *pde = 00003001
Aug 25 08:27:46 boar Oops: 0000 [#1]
Aug 25 08:27:46 boar SMP
Aug 25 08:27:46 boar last sysfs file:
Aug 25 08:27:46 boar Modules linked in: snapapi26(U) bridge(U) ip_vzredir(U) vzredir(U)
vzcompat(U) vzrst(U) i
p_nat(U) vzcpt(U) ip_contrack(U) nfnetlink(U) vzfs(U) vzlinkdev(U) vzetdev(U)
vzevent(U) vzlist(U) vznet(U) vzstat(U) vzmo
n(U) xt_tcpudp(U) ip_vznetstat(U) vznetstat(U) iptable_mangle(U) iptable_filter(U)
ip_tables(U) vztable(U) vzdquota(U) vzdev(U) autofs4(U) hidp(U) rfcomm(U) l2cap(U)
bluetooth(U) sunrpc(U) ipv6(U) xt_length(U) ipt_ttl(U) xt_tcpmss(U) ipt_TCPMSS(U)
xt_multiport(U) xt_limit(U) ipt_tos(U) ipt_REJECT(U) x_tables(U) video(U) sbs(U)
i2c_ec(U) button(U) battery(U) asus_acpi(U) ac(U) lp(U) floppy(U) sg(U) pcspkr(U)
i2c_piix4(U) e100(U) parport_pc(U) i2c_core(U) parport(U) cpqphp(U) eeepro100(U) mii(U)
serio_raw(U) ide_cd(U) cdrom(U) ahci(U) libata(U) dm_snapshot
(U) dm_zero(U) dm_mirror(U) dm_mod(U) megaraid(U) sym53c8xx(U) scsi_transport_spi(U)
sd_mod(U) scsi_mod(U) ext3(U) jbd(U) ehci_hcd(U) ohci_hcd(U) uhci_hcd(U)
Aug 25 08:27:46 boar CPU: 1, VCPU: -1.1
Aug 25 08:27:46 boar EIP: 0060:[<f0ce6507>] Tainted: P VLI
Aug 25 08:27:46 boar EFLAGS: 00010246 (2.6.18-028stab043.1-ent #1)
Aug 25 08:27:46 boar EIP is at clone_endio+0x29/0xc6 [dm_mod]
Aug 25 08:27:46 boar eax: 00000010 ebx: 00000001 ecx: 00000000 edx: 00000000
Aug 25 08:27:46 boar esi: 00000000 edi: b6f52920 ebp: c1a8dbc0 esp: 0b483e38
Aug 25 08:27:46 boar ds: 007b es: 007b ss: 0068
Aug 25 08:27:46 boar Process swapper (pid: 0, veid: 0, ti=0b482000 task=05e3f2b0
task.ti=0b482000)
Aug 25 08:27:46 boar Stack: 0b52caa0 00000001 00000000 b6f52920 00000000f0ce64de
00000000 02478825
Aug 25 08:27:46 boar 00000000 c18a8620 b6f52920 271e1a8c 024ca03800000000 00000000
00000000
Aug 25 08:27:46 boar 00000000 00000000 c18a3c00 00000202 c189e89400000006 00000000
05cb7200
Aug 25 08:27:46 boar Call Trace:
Aug 25 08:27:46 boar [<f0ce64de>] clone_endio+0x0/0xc6 [dm_mod]
Aug 25 08:27:46 boar [<02478825>] bio_endio+0x50/0x55
Aug 25 08:27:46 boar [<024ca038>] __end_that_request_first+0x185/0x47c
Aug 25 08:27:46 boar [<f0c711eb>] scsi_end_request+0x1a/0xa9 [scsi_mod]
Aug 25 08:27:46 boar [<02458f04>] mempool_free+0x5f/0x63
Aug 25 08:27:46 boar
Aug 25 08:27:46 boar [<f0c713c3>] scsi_io_completion+0x149/0x2f3 [scsi_mod]
Aug 25 08:27:46 boar [<f0c333b9>] sd_rw_intr+0x1f1/0x21b [sd_mod]
Aug 25 08:27:46 boar [<f0c6d3b9>] scsi_finish_command+0x73/0x77 [scsi_mod]
Aug 25 08:27:46 boar [<024cbfa2>] blk_done_softirq+0x4d/0x58
Aug 25 08:27:46 boar [<02426452>] __do_softirq+0x84/0x109
Aug 25 08:27:46 boar [<0242650d>] do_softirq+0x36/0x3a
Aug 25 08:27:46 boar [<024050b7>] do_IRQ+0xad/0xb6
Aug 25 08:27:46 boar [<024023fa>] default_idle+0x0/0x59
Aug 25 08:27:46 boar [<0240242b>] default_idle+0x31/0x59
Aug 25 08:27:46 boar [<024024b1>] cpu_idle+0x5e/0x74
Aug 25 08:27:46 boar =====
```

```
Aug 25 08:27:46 boar Code: 5d c3 55 57 89 c7 56 89 ce 53 bb 01 00 00 00 83 ec 0c 8b 68
3c 83 7f 20 00 8b 45 00 8b 00 89 44 24 04 8b 45 04 89 04 24 8b 40 04 <8b> 40 28 89 44
24 08 0f 85 86 00 00 00 f6 47 10 01 75 0a 85 c9
Aug 25 08:27:46 boar EIP: [<f0ce6507>] clone_endio+0x29/0xc6 [dm_mod]
SS:ESP0068:0b483e38
Aug 25 08:27:46 boar Kernel panic - not syncing: Fatal exception in interrupt
```

All you need is to put the oops into a file and then send this file as part of your problem report to the Parallels support team.

## Finding a Kernel Function That Caused the D Process State

If there are too many processes in the D state and you can't find out what is happening, issue the following command:

```
# objdump -Dr /boot/vmlinux-`uname -r` >/tmp/kernel.dump
```

and then get the process list:

```
# ps axfwln
 F UID  PID  PPID PRI  NI  VSZ  RSS  WCHAN  STAT  TTY  TIME  COMMAND
100  0  20418  20417  17  0  2588  684  - R    ?    0:00  ps axfwln
100  0  1      0  8  0  1388  524  145186 S    ?    0:00  init
040  0  8670   1  9  0  1448  960  145186 S    ?    0:00  syslogd -m 0
040  0  8713   1  10 0  1616  1140 11ea02 S    ?    0:00  crond
```

Look for a number under the **WCHAN** column for the process in question. Then, open `/tmp/kernel.dump` in an editor, find that number in the first column and then scroll backward to the first function name, which can look like this:

```
"c011e910 <sys_nanosleep>:"
```

Then you can tell if the process “lives” or is blocked into the found function.

## Problems With Container Management

This section includes recommendations on how to settle some problems with Containers.

### Failure to Start a Container

An attempt to start a Container fails.

#### Solution 1

If there is a message on the system console: `parameters missing`, and the list of missed parameters follows the message, set these parameters using the `pctl set --save` command (see **Performing Initial Configuration** (p. 30) for instructions). Try to start the Container once again.

#### Solution 2

If there is a message on the system console: `IP address is already used`, issue the `cat /proc/vz/veinfo` command. The information about the Container numeric identifier, Container class, number of Container's processes and Container IP address shall be displayed for each running Container. This shall also demonstrate that your Container is up, i.e. it must be running without any IP address assigned. Set its IP address using the command:

```
pctl set CT_ID --ipadd IP_addr --save
```

where `CT_ID` represents the Container numeric identifier and `IP_addr` represents an actual IP address.

### Solution 3

Poor UBC parameters might prevent the Container from starting. Try to validate the Container configuration (see **Validating Container Configuration** (p. 120)). See what configuration parameters have caused the error and set appropriate values using the `pctl set --save` command.

### Solution 4

The Container might have used all its disk quota (either disk space or disk inodes). Check the Container disk quota (see the **Managing Disk Quotas** section (p. 92) and **Chapter 4** for details) and increase the quota parameters if needed (see **Setting Up Per-Container Disk Quota Parameters** (p. 94)).

### Solution 5

Run the `vzfsutil` utility to make sure that the VZFS symlinks inside the Container work correctly. For example:

```
vzfsutil --call -t /vz/template /vz/private/<CT_ID>
```

The complete reference on the `vzfsutil` utility is provided in the *Parallels Command Line Reference Guide*.

### Solution 6

The Container administrator might have inadvertently modified, replaced, or deleted any file that is part of an application or OS template, which has brought about the Container malfunction. In this case, restore the file(s) with the `pctl recover` command (see the **Reinstalling Container** section (p. 61) for details).

### Solution 7

Restore the latest operable copy of the Container by means of the `vzrestore` utility (see the **Managing virtual machine and Container Backups** section (p. 37) for details).

## Failure to Access a Container From Network

### Solution 1

The IP address assigned to the Container might be already in use in your network. Make sure it is not. The problem Container address can be checked by issuing the following command:

```
# grep IP_ADDRESS /etc/vz/conf/<CT_ID>.conf
IP_ADDRESS="10.0.186.101"
```

The IP addresses of other Containers, which are running, can be checked by running

```
cat /proc/vz/veinfo
```

### Solution 2

Make sure the routing to the Container is properly configured. Containers can use the default router for your network, or you may configure the server as router for its Containers.

## Failure to Log In to a Container

The Container starts successfully, but you cannot log in.

### Solution 1

You are trying to connect via SSH, but access is denied. Probably you have not set the password of the `root` user yet or there is no such user. In this case, use the `pctl set --userpasswd` command. For example, for Container 101 you might issue the following command:

```
# pctl set 101 --userpasswd root:secret
```

### Solution 2

Check forwarding settings by issuing the following command:

```
# cat /proc/sys/ipv4/conf/venet0/forwarding
```

If it is 0 then change it to 1 by issuing the following command:

```
# echo 1 > /proc/sys/ipv4/conf/venet0/forwarding
```

## Getting Technical Support

This section provides information on how to get technical support from Parallels.

### Preparing and Sending Questions to Technical Support

In most cases, the support team must rely on the customer's observations and communications with the customer to diagnose and solve the problem. Therefore, the detailed problem report is extremely important. You can submit a support report by visiting the

<http://www.parallels.com/en/support/virtuozzo/request/> web page and filling in the Online Support Form. When describing the problem, please do mention the following:

- symptoms of the problem
- when the problem began including the circumstances of the failure
- any changes you made to your system
- other information that may be relevant to your situation (e.g. the installation method)
- specific hardware devices that may be relevant to your problem

You can also make use of the Parallels Helpdesk support tool. To do this:

- 1 Follow the <https://helpdesk.parallels.com/> link.
- 2 Register with the Parallels Helpdesk (if you have not done so before) by clicking the **Get Access to Parallels RT** link on the Helpdesk login page and following the instructions provided on the **Activate Your Support Account** screen.
- 3 Log in to the Helpdesk using the received credentials.
- 4 At the top of the **RT At Glance** screen, select the Parallels Server Bare Metal component your problem relates to on the drop-down menu, and click the **New Ticket in** button:
- 5 On the **Create New Ticket** screen, fill in the appropriate fields, describe your problem, and click the **Create** button to make a new support ticket.

Another way of getting help is to directly call us or visit one of our offices. The information about phone numbers, contact people and office addresses is available on the contact pages at <http://www.parallels.com/en/contact> and <http://www.parallels.com/en/support/phone/>.

## Submitting Problem Report to Technical Support

You can use the `prlctl problem-report` command to compile detailed reports for virtual machines and Containers experiencing problems and send them to the Parallels technical support. After receiving your report, the support team will closely examine your problem and make its best to solve it as quickly as possible.

**Important:** Reports contain only logs and the information on your system and network settings. They do not contain any private information.

To generate a report, specify the ID or name of the problem virtual machine or Container and the way to process the report:

- To automatically send the report to the Parallels technical support, pass the `-s` option to the command:

```
# prlctl problem-report <CT_ID|VM_name> -s
```

This is the recommended way of running the command. If you use a proxy server to connect to the Internet, you need to additionally specify its parameters after the `--proxy` option:

```
# prlctl problem-report <CT_ID|VM_name> -s --proxy [user[:password]@]<proxyhost>[:port]
```

- To display the report on your screen in the machine-readable format, pass the `-d` option to the command. You can pipe the output to a file and then send it to the Parallels technical support, for example:

```
# prlctl problem-report <CT_ID|VM_name> -d > problemReport
```

This command saves the generated report to the file `problemReport`.

## Establishing Secure Channel to Parallels Support

Parallels Server Bare Metal provides you with a special tool - *Support Tunnel* - which allows you to establish a private secure channel to the Parallels support team server. After establishing such a channel, the support team will be able to quickly and securely connect to your Parallels server and diagnose and solve your problem. The secure connection to your server is achieved through a Virtual Private Network (VPN) created between the Parallels support team server and your server.

To start using the *Virtuozzo Support Tunnel* tool:

- Make sure the `openvpn` (version 2.0 and above) and `vzvpn` packages are installed on your server. These packages are automatically installed during the Parallels Server Bare Metal installation.
- Make sure that port 80 is opened on the server.
- Edit the `/etc/vzvpn/vzvpn.conf` file to specify the correct parameters for your proxy server, if you use any. Detailed information on these parameters is given in the **vzvpn Configuration File** subsection of the *Parallels Command Line Reference Guide*.

After you have completed the tasks above and in case you encountered a problem, you can do the following to get assistance from the Parallels support:

- 1** Obtain a special certificate from Parallels which will uniquely identify you as a Parallels Server Bare Metal user. Certificates are issued by Parallels in the form of files and should be installed on your server by issuing the `vzvpn.sh key-install certificate` command where `certificate` denotes the name of the certificate file obtained from Parallels. You can get a certificate in one of the following ways:
  - Visit the <http://www.parallels.com/en/support/virtuozzo/certificates> web site, fill up the **Request Secure Virtuozzo Support Tunnel Certificate** form, and click the **Submit** button. After a while, a certificate will be generated and sent to the email address you provided in the **Request Secure Virtuozzo Support Tunnel Certificate** form.
  - Contact the Parallels support team via e-mail or by telephone and ask for a valid certificate.
- 2** After you are ready with the certificate installation, make sure your server is connected to the Internet.
- 3** On the server, execute the `/etc/init.d/vzvpn.sh start` command to establish a VPN between your server and the Parallels support server.
- 4** Contact the Parallels support team (by telephone or via e-mail) and inform them of the problem you encountered. You should also mention that you have launched the *Virtuozzo Support Tunnel* tool and established a VPN to the Parallels support server.

- 5 After that, the Parallels support team will connect to your server by using the secure VPN established, closely examine your problem, and make its best to solve the problem as quickly as possible.

**Notes:**

1. `Support Tunnel` is implemented as a standard Linux service running in the background of your system. Therefore, to have this service running after your server reboot, you should set it to the `autoboot` mode or start it manually again by executing the `/etc/init.d/vzvpn start` command.

2. To close the VPN session with the Parallels support server, you should issue the `/etc/init.d/vzvpn stop` command on the server.

## Glossary

This glossary defines terms and spells out abbreviations used in Parallels Server Bare Metal documentation. References to terms defined elsewhere in the glossary appear in italics.

**Application template.** A template used to install a set of applications in *Containers*. See also *Template*.

**Container (or regular Container).** A virtual private server, which is functionally identical to an isolated standalone server, with its own IP addresses, processes, files, its own users database, its own configuration files, its own applications, system libraries, and so on. Containers share one *Parallels server* and one OS kernel. However, they are isolated from each other. A Container is a kind of ‘sandbox’ for processes and users.

**Guest operating system (Guest OS).** An operating system installed inside a virtual machine and Container. It can be any of the supported Windows or Linux operating systems.

**Hardware virtualization.** A virtualization technology allowing you to virtualize physical servers at the hardware level. Hardware virtualization provides the necessary environment for creating and managing Parallels virtual machines.

**Operating system virtualization (OS virtualization).** A virtualization technology allowing you to virtualize physical servers at the operating system (kernel) level. OS virtualization provides the necessary environment for creating and managing Parallels Containers.

**OS template (Operating System template).** A template used to create new *Containers* with a pre-installed operating system. See also *Template*.

**Package set.** See *Template*.

**Parallels Management Console.** A Parallels Server Bare Metal management and monitoring tool with graphical user interface. Parallels Management Console is cross-platform and can run on Microsoft Windows and Linux computers.

**Parallels Server.** A hardware virtualization solution that enables you to efficiently use your physical server's hardware resources by sharing them between multiple virtual machines created on this server.

**Parallels server (physical server or server).** A server where the Parallels Server Bare Metal software is installed for hosting Parallels virtual machines and Containers. Sometimes, it is marked as Container 0.



**Parallels Server Bare Metal license.** A special license that you should install on the physical server to be able to start using Parallels Server Bare Metal. Every physical server must have its own license installed.

**Parallels Virtuozzo Containers for Linux.** An operating system virtualization solution allowing you to create multiple isolated Containers on a single physical server to share hardware, licenses, and management effort with maximum efficiency.

**Private area.** A part of the file system storing *Container* files that are not shared with other *Containers*.

**Template (package set).** A set of original application files (packages) repackaged for mounting over Virtuozzo File System. There are two types of templates. OS Templates are used to create new *Containers* with a pre-installed operating system. Application templates are used to install an application or a set of applications in *Containers*.

**UBC.** An abbreviation of *User Beancounter*.

**User Beancounter.** The subsystem of the Parallels Server Bare Metal software for managing *Container* memory and some system-related resources.

**Virtual Environment (VE).** An obsolete designation of a *Container*.

**Virtuozzo File System (VZFS).** A virtual file system for mounting to *Container* private areas. VZFS symlinks are seen as real files inside *Containers*.

**Virtual machine (VM).** A computer emulated by Parallels Server Bare Metal. Like a *Container*, a virtual machine is functionally identical to an isolated standalone computer, with its own IP addresses, processes, files, its own users database, its own configuration files, its own applications, system libraries, and so on. However, as distinct from *Containers*, virtual machines run their own operating systems rather than sharing one operating system kernel.

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