Parallels

Parallels Virtuozzo Containers

Evaluation Guide

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Introduction

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About Parallels Virtuozzo Containers

Parallels Virtuozzo Containers is a patented OS virtualization solution. It creates isolated partitions or Containers on a single physical server and OS instance to utilize hardware, software, data center and management effort with maximum efficiency. The basic Virtuozzo capabilities are:

- **Intelligent Partitioning** - Division of a server into as many as hundreds of Containers with full server functionality.
- **Complete Isolation** - Containers are secure and have full functional, fault and performance isolation.
- **Dynamic Resource Allocation** - CPU, memory, network, disk and I/O can be changed without rebooting.
- **Mass Management** - Suite of tools and templates for automated, multi-Container and multi-server administration.

The diagram below represents a typical model of the Virtuozzo-based system structure:

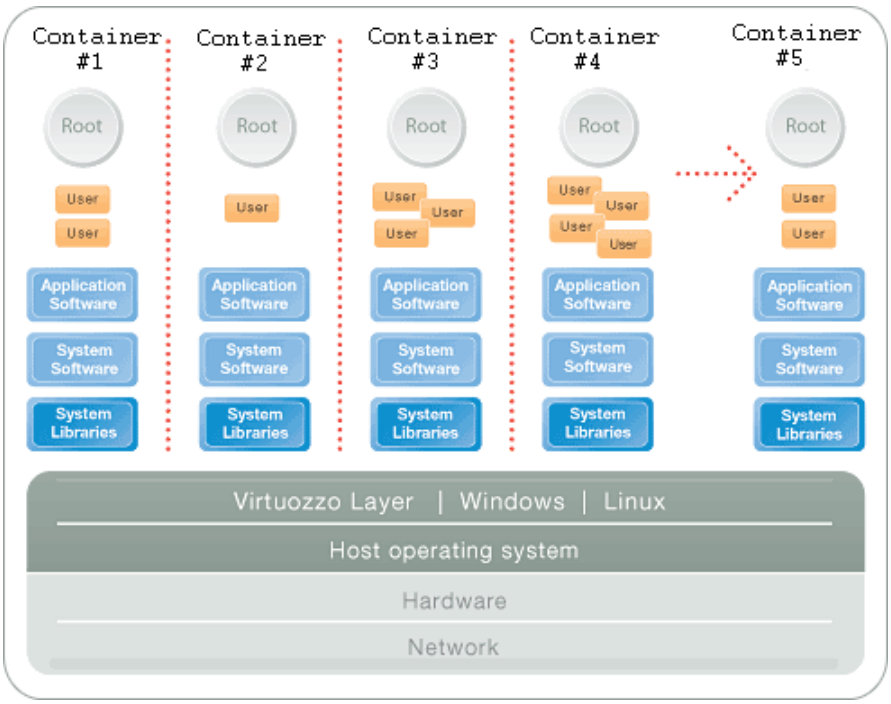

Figure 1: Virtuozzo Containers OS Virtualization

The Parallels Virtuozzo OS virtualization model is streamlined for the best performance, management, and efficiency. At the base resides a standard Host operating system which can be either Windows or Linux. Next is the virtualization layer with a proprietary file system and a kernel service abstraction layer that ensure the isolation and security of resources between different Containers. The virtualization layer makes each Container appear as a standalone server. Finally, the Container itself houses the application or workload.

The Parallels Virtuozzo OS virtualization solution has the highest efficiency and manageability making it the best solution for organizations concerned with containing the IT infrastructure and maximizing the resource utilization. The Parallels Virtuozzo complete set of management tools and unique architecture makes it the perfect solution for easily maintaining, monitoring, and managing virtualized server resources for consolidation and business continuity configurations.

About This Guide

This guide is destined to introduce you to the main features of the Parallels Virtuozzo Containers software and to its underlying technology, to help you set up an environment for evaluating the Virtuozzo major features, and to suggest the relevant procedures for this evaluation.

This guide should be read by anyone intended to evaluate the following versions of Parallels Virtuozzo Containers:

- Parallels Virtuozzo Containers 4.5 for Windows
- Parallels Virtuozzo Containers 4.0 for Linux

You can read this guide to:

- get acquainted with the Parallels Virtuozzo capabilities
- find the description of how other customers are using the Parallels Virtuozzo software in their working environments
- learn how to install and configure Parallels Virtuozzo
- familiarize yourself with the way to perform main operations in Parallels Virtuozzo-based systems

Minimal Windows or Linux administration skills are required in order to fully understand the guide and complete the evaluation exercises.

Organization of This Guide

Chapter 2, Introduction, centers on the mission and main features of the Parallels Virtuozzo Containers software, introduces major Virtuozzo notions, provides an outline of the Parallels Virtuozzo architecture, and familiarizes you with Virtuozzo Tools: Parallels Management Console, Parallels Infrastructure Manager, and Parallels Power Panel. Besides, it includes a brief description of how other customers benefit from using Parallels Virtuozzo in their working environments.

Chapter 3, Planning and Setting Up Evaluation Environment, enumerates all pre-requisites you must have for performing a test installation of Parallels Virtuozzo and provides complete instructions on how to do it.

Chapter 4, Understanding Parallels Virtuozzo Containers, helps you grasp the general principles of Parallels Virtuozzo operation. In particular, it provides an outline of Virtuozzo templates and licensing policy and explains the basics of resources management in Parallels Virtuozzo-based systems.

Chapter 5, Evaluating Parallels Virtuozzo Containers, guides you through the process of evaluation with the help of a number of step-by-step exercises allowing you to assess the Parallels Virtuozzo capabilities and demonstrating how easy it is to get started using the product in your working environments.

Documentation Conventions

Before you start using this guide, it is important to understand the documentation conventions used in it. For information on specialized terms used in the documentation, see the glossary at the end of this document.

Typographical Conventions

The following kinds of formatting in the text identify special information.

Formatting convention	Type of Information	Example
`Preformatted`	On-screen computer output in your command-line sessions; source code in XML, C++, or other programming languages.	`Saved parameters for Container 101`
`Preformatted Bold`	What you type, as contrasted with on-screen computer output.	**`C:\Documents and Settings\Administrator> vzlist`**
`Moonscape`	The names of commands, files, and directories.	Use `vzctl start` to start a Container.
`Monospace Italics`	Designates a command line placeholder, which is to be replaced with a real name or value.	To delete a Container, type `vzctl delete` *`CT_ID`*.
Special Bold	All elements of the graphical user interface (GUI): menu items, menu options, menu buttons, etc.	Go to the Resources tab.
	Titles of chapters, sections, and subsections.	Read the Basic Administration chapter.
Italics	Used to emphasize the importance of a point or to introduce a term.	*Host operating system* is an operating system installed on the Hardware Node.
CAPITALS	Names of keys on the keyboard.	SHIFT, CTRL, ALT
KEY+KEY	Key combinations for which the user must press and hold down one key and then press another.	CTRL+P, ALT+F4

General Conventions

Be aware of the following conventions used in this book.

- Chapters in this guide are divided into sections, which, in turn, are subdivided into subsections. For example, Documentation Conventions is a section, and General Conventions is a subsection.
- When following steps or using examples, be sure to type double-quotes (") and single-quotes (') exactly as shown.

Getting Help

In addition to this guide, there are a number of other resources shipped with the Parallels Virtuozzo Containers software which can help you use the product more effectively. These resources include:

- Manuals:
  - Getting Started With Parallels Virtuozzo Containers. This guide provides brief instructions on how to install and run the Parallels Virtuozzo Containers software on your server. It also explains the basics of working with Containers - how to create a Container, start and stop it, install additional software in it, and the like.
  - Parallels Virtuozzo Containers Installation Guide. This guide provides exhaustive information on the process of installing, configuring, and deploying your Parallels Virtuozzo system. As distinct from the Getting Started With Parallels Virtuozzo Containers guide, it contains a more detailed description of all the operations needed to install and set Parallels Virtuozzo to work including planning the structure of your Parallels Virtuozzo network, performing the product unattended installation, etc. Besides, it does not include the description of any Container-related operations.
  - Parallels Virtuozzo Containers User's Guide. This guide provides comprehensive information on Parallels Virtuozzo covering the necessary theoretical conceptions as well as all practical aspects of working with the product. However, it does not deal with the process of installing and configuring your Parallels Virtuozzo system.
  - Parallels Virtuozzo Containers Templates Management Guide. This guide is meant to provide complete information on Virtuozzo templates - an exclusive Parallels Virtuozzo technology allowing you to efficiently deploy standard applications inside your Containers and to greatly save the Hardware Node resources (physical memory, disk space, etc.).
  - Parallels Virtuozzo Containers Reference Guide. This guide is a complete reference on all Parallels Virtuozzo configuration files and Hardware Node command-line utilities.

  All these manuals exist in two flavors: one for Parallels Virtuozzo Containers 4.0 for Linux and another for Parallels Virtuozzo Containers 4.5 for Windows.
- Help systems:
  - Parallels Management Console Help. This help system provides detailed information on Parallels Management Console - a graphical user interface tool for managing Hardware Nodes running Parallels Virtuozzo and their Containers.
  - Parallels Infrastructure Manager Online Help. This help system shows you how to work with Parallels Infrastructure Manager - a tool providing you with the ability to manage Hardware Nodes running Parallels Virtuozzo and their Containers with the help of a standard web browser on any platform.
  - Parallels Power Panel Online Help. This help system deals with Parallels Power Panel - a means for administering individual Containers through a common web browser on any platform.

Feedback

If you spot a typo in this guide, or if you have thought of a way to make this guide better, we would love to hear from you!

The ideal place for your comments and suggestions is the Parallels documentation feedback page (http://www.parallels.com/en/support/usersdoc/).

Parallels Virtuozzo Business Solutions

The main Virtuozzo server virtualization solutions are listed below:

Server and OS Consolidation

Application and IT managers have become accustomed to dedicating a physical server to each application to ensure that there are no application conflicts and that there is sufficient room for growth. With today's high powered servers, the single application approach leads to extremely low utilization rates, and hardware is only a small subset of the total cost of server ownership and, this is why, server consolidation is becoming so important. Consolidation of the hardware has historically been the first step in consolidation projects. Parallels Virtuozzo Containers takes consolidation a step further by consolidating OSs for easy management and reducing costs and complexity while improving service levels.

Figure 2: Virtuozzo Business Solutions - Server Consolidation

Parallels Virtuozzo provides full isolation between applications and its lean architecture allows a high server density. The unique Parallels Virtuozzo architecture further accelerates the cost savings by reducing software licensing and support costs and through extensive management tools that help automate server management tasks.

Business Continuity

Ensuring that an application and data are safe and available is a requirement in every IT organization. Balancing the cost and resources required with the desired level of high availability or disaster recovery time produces a range of solutions and requirements. Parallels Virtuozzo Containers provides IT organizations with cost-effective options for making data highly available and recoverable:

- Parallels Virtuozzo can be a cost-effective component of any disaster recovery and high availability solution, from an always available solution, to a fast recovery or backup recovery solution. Parallels Virtuozzo is the perfect solution for housing redundant servers that can be activated as necessary. Virtuozzo mean time to repair (MTTR) is much shorter than many other options because of the smaller server virtualization footprint. It also has a much faster boot time because only the processes and data are booting, the operating system is already available.

- Parallels Virtuozzo migration capabilities allow Containers to be moved in real-time with near-0 downtime (keeping the application available through the migration until the last few seconds), and no SAN is required. Any threat of system failure or impending catastrophic event can be minimized by moving Containers to any Parallels Virtuozzo server with any hardware configuration in the time of data transfer.
- Applications virtualized on Parallels Virtuozzo enjoy complete flexibility of resource management, resources maybe added or reduced in real-time without service interruption. Overloaded applications can quickly and easily be provided with more resources.

Figure 3: Virtuozzo Business Solutions - Business Continuity

Centralized Desktop Management

IT organizations are centralizing desktop applications and making them available from virtualized servers. These virtualized applications are available on servers and are accessible to end users to provide a secure, controlled and manageable environment. Applications can be created and deployed in secure Containers which prevent viruses from spreading over computers. Applications are centralized for easy updates and ongoing management.

Dynamic Workload Management

Application or business requirements in most organizations change daily. Deploying an application used to require a certain amount of planning and commitment to configuration and server placement. With Parallels Virtuozzo, workloads in Containers can be easily moved with live migration or resources adjusted in real-time without downtime:

- *Application and Server Agility*. Pair applications that have peak processing at different times of the day to fully utilize high-performance servers.
- *Smart Configurations*. Load servers with many applications of varying types. As critical applications grow such as e-mail, move non-critical applications to other servers to provide space for growth. Never over-provision another server anticipating growth over the next several years.
- *Patch Testing and Deployment*. Use the tools and capabilities provided by Parallels Virtuozzo to effectively test, deploy and track software versions. Clone a virtualized server and applications to test a new patch or upgrade, and once it has been validated, deploy the change over an entire installation with a few clicks and in a few seconds.

Figure 4: Virtuozzo Business Solutions - Dynamic Workload Management

Parallels Virtuozzo Containers is the first virtualization solution that combines low-overhead and an amazing ROI that can actually be justified to support a single virtualized server on a physical server.

Internal and Commercial Hosting

IT organizations and businesses need to provide a simple, manageable infrastructure for offering hosted applications and data. Parallels Virtuozzo is perfect for hosting with its lean architecture and complete security and isolation, it provides a cost-effective multitenant solution. Parallels Virtuozzo and Container administrators have complete toolsets to provision, manage, monitor, and update virtual servers and environments.

Development and Testing

Parallels Virtuozzo Containers is a very powerful tool for development and QA departments. The ability to provision specific servers in seconds, and in potentially large quantities can help development operations increase quality and decrease time-to-market. Containers act in isolation just like regular servers; therefore, a change can be made on one virtual server without fear of harming any other virtual server eliminating the need for standalone servers for developers. Also the unique architecture of Parallels Virtuozzo enables the highest level of virtualized server density; quality assurance and testing departments can deploy 100s of Containers to provide realistic environments for stress testing with the massive provisioning, management and hardware investment that would be required with standalone servers.

Green Datacenters and Power Savings

Power consumption within datacenters has become a major concern due to the impact on the environment as well as the impact on costs due to rising energy prices. Using Parallels Virtuozzo Containers, datacenter owners have reduced power consumption by 60-80%.

Compared to other virtualization technologies, Parallels Virtuozzo’s high virtual environment density makes it the "greenest" virtualization solution. The highest density of Containers enables the best consolidation ratios and minimizes power consumption up to 10 times more than other virtualization technologies.

Virtuozzo Tools Overview

Parallels Virtuozzo Containers is equipped with as many as three different graphical tools to perform various administrative tasks:

- Parallels Management Console is a remote management tool for Parallels Virtuozzo with a graphical user interface. Management Console is designed for Hardware Node administrators having access to all the Containers on a particular Node. It allows the administrator to control multiple Hardware Nodes, to manage all sorts of Containers, and to monitor the system.
- Parallels Infrastructure Manager designed for Hardware Node administrators and providing you with the ability to manage any number of Hardware Nodes and all Containers residing on them with the help of a standard web browser on any platform. When describing the ways to perform this or that evaluation task, we have provided the corresponding procedures for Parallels Infrastructure Manager only.
- Parallels Power Panel is mainly regarded as a means for individual Container customers to manage their personal Containers.

Parallels Virtuozzo Containers also has a powerful command-line interface.

Parallels Management Console Overview

Parallels Management Console is a remote management tool for Parallels Virtuozzo Containers with a graphical user interface. It is intended to be installed on the administrator's server and allows the administrator to control multiple Hardware Nodes, to manage all their Containers, and to monitor the system. The main window of Management Console consists of two parts: the tree pane on the left, and view pane on the right. There is a list of Hardware Nodes in the tree pane. The Hardware Node subtree represents various aspects of its management, e.g. Logs, Services, and Templates. The content of the view pane depends on the selected item in the tree pane.

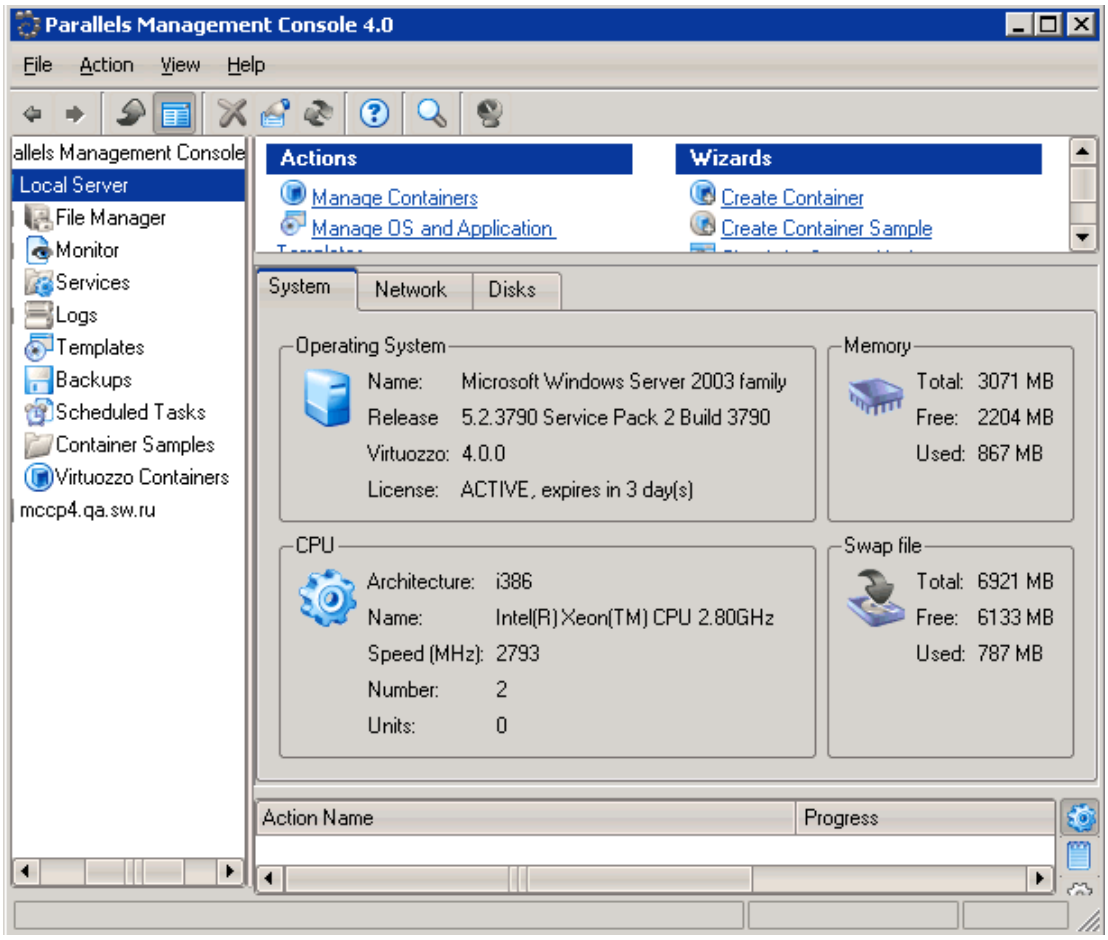

Figure 5: Management Console Main Window

Below the view pane on the right, there is also a small Actions/Messages/Operations pane. You may switch between the modes by clicking the corresponding buttons to the right of this pane. The Actions pane displays the progress of Parallels Management Console actions. The Messages pane displays the detailed diagnostics of various Management Console errors. The Operations pane shows the result of various asynchronous tasks performed with Hardware Nodes and their Containers.

Parallels Management Console uses a typical client/server architecture. The client Management Console program runs on Microsoft Windows 2000/XP/2003/2008 or Linux. The client application with the graphical user interface connects to the Parallels Agent software, which is running on the Hardware Node. Parallels Agent communicates with the client via the well-documented open Parallels Agent XML API and controls the Hardware Node itself and its Containers.

Note: For more information on Parallels Agent and on how to access its services by using XML, turn to the Parallels Agent documentation shipped with Parallels Virtuozzo.

The client can control multiple Hardware Nodes simultaneously by connecting to multiple Parallels Agents, one of which performs the master role of the Virtuozzo Group of Hardware Nodes. As the communications between the client and Parallels Agents are secure, the Management Console workstation may be located virtually anywhere on the network.

More detailed information on the Parallels Management Console installation and operating is provided in the Setting Virtuozzo Containers Tools to Work chapter of the *Parallels Virtuozzo Containers Installation Guide*.

Parallels Infrastructure Management Overview

Parallels Infrastructure Manager is designed for Hardware Node administrators and provides them with the ability to manage multiple Hardware Nodes and all Containers residing on them with the help of a standard web browser on any platform. A list of supported browsers is given below:

- Internet Explorer 6 and 7
- Mozilla 1.7 and above
- Firefox 1.0 and above
- Opera 8.0 and above

Chances are that you will also be able to use other browsers, but Parallels Virtuozzo Containers has not been extensively tested with them.

The Parallels Infrastructure Manager interface has been designed to let the Parallels Virtuozzo server administrator quickly perform all possible tasks through an intuitive navigation system:

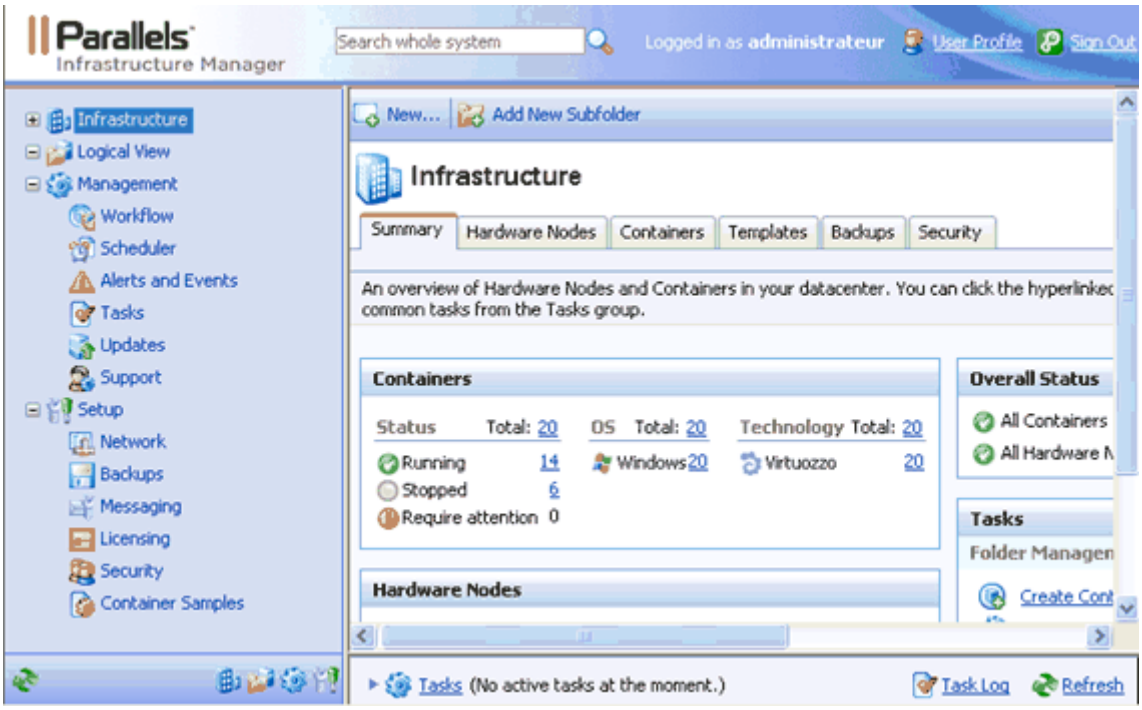

Figure 6: Infrastructure Manager Interface Overview

The main components the Parallels Infrastructure Manager interface include:

- The left menu frame listing and allowing to access all your Hardware Nodes and Containers and the main types of operations to be performed on them with the help of Parallels Infrastructure Manager.
- The toolbar on top of the right frame allowing to perform on your Hardware Nodes and Containers the actions most frequently called for in your routine management work and, when necessary, a few more buttons allowing to perform additional actions on the objects listed in the content part of the right frame (Container backups, packages updates, etc.).

- The content part on the right frame displaying the currently accessed Hardware Nodes or Containers, the key information (their statuses, configuration, etc.) and links to advanced actions.

Note: Detailed information on Parallels Infrastructure Manager is given in its comprehensive online help system and the *Parallels Infrastructure Manager Administrator's Guide* shipped with this tool.

Parallels Power Panel Overview

Wherever Parallels Virtuozzo is applied, there are people who are supposed to be administrators of particular Containers only, with no access rights to the Hardware Node. Such people can be subscribers to a hosting provider, university students, administrators of a particular server within an enterprise, etc. Personal Containers can be managed with the help of Parallels Power Panel. Parallels Power Panel is a means for administering personal Containers through a common browser - Internet Explorer, Mozilla, and others. It allows Container administrators to do the following:

- Start, stop, or restart the Container.
- Back up and restore the Container.
- Change the Administrator password of the Container.
- Start, stop, or restart certain services inside the Container.
- View the processes currently running in the Container and send signals to them.
- View the current resources consumption and resources overusage alerts.
- Connect to the Container by means of RDP.
- View the system logs.

The Parallels Power Panel interface has been designed for the Container administrator to quickly perform any of the aforementioned operations through an intuitive navigation system. All Parallels Power Panel pages have a *menu* on the left, a toolbar and a *status bar* on top, and the content part in the middle. If Parallels Power Panel is integrated in the Plesk control panel, the Parallels Power Panel menu is replaced with the Plesk menu. The Parallels Power Panel menu looks like this:

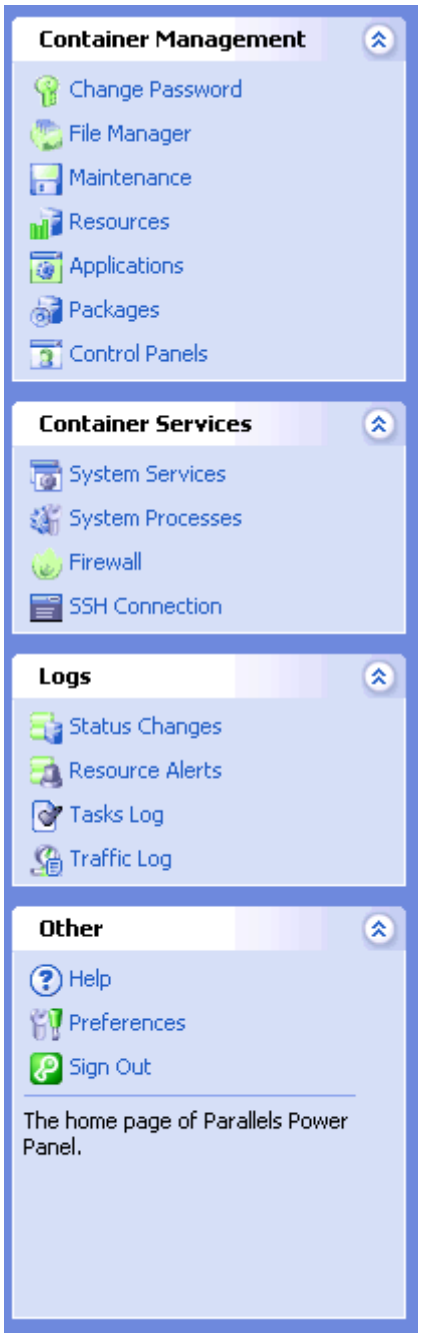

Figure 7: Power Panel Menu

It provides links to Parallels Power Panel pages where you can perform various tasks. To open any of these pages, move the cursor over the link, and click it. The link to the page currently open is highlighted. The description of the corresponding page is displayed at the bottom of the menu. All links are gathered into four groups: Container Management, Container Services, Logs, and Other, the names of the first three groups being links themselves. When performing a particular task, you may first click the name of the group to open the corresponding dashboard and then choose a task, or you may select the task at once on the menu under the corresponding group.

Note: For further information on Parallels Power Panel, turn to its help system or the *Parallels Power Panel Administrator's Guide*.

Example Customer Implementation

Listed below are some examples of the companies that have benefited from using Parallels Virtuozzo Containers in their working environments:

Company Name	Description	Additional Information
Cox Communications Inc. (http://www.cox.com)	Requiring a flexible and high-performance solution, Cox uses Parallels Virtuozzo to build a virtual server infrastructure to serve remote workers with a customized central desktop. By deploying the Parallels Virtuozzo software, it saved an immediate $100,000 in licensing costs and another $50,000 in secondary software licensing consolidation. Cox had an immediate ROI of 300%.	http://www.parallels.com/r/pdfs/SuccessStories/Cox_SWsoft_Virtuozzo_Case_Study.pdf
Murphy Oil Corporation (http://www.murphyoilcorp.com/)	Challenged to implement a new infrastructure quickly with more business continuity considerations, Murphy deploys the Virtuozzo Containers software across its server infrastructure. The Murphy Oil deployment of Parallels Virtuozzo Containers was successful and has already positively contributed to the effectiveness of their disaster recovery plan.	http://www.parallels.com/r/pdfs/SuccessStories/Murphy_SWsoft_Virtuozzo_Case_Study.pdf
Arvato Mobile (http://www.arvato-mobile.com)	Supporting a wide range of engineering, departmental and user requirements, Arvato Mobile leverages Vease server management demands. Today, Parallels Virtuozzo Containers is loaded on the majority of Arvato Mobile's hundreds of Linux servers and they are now deploying the Virtuozzo Containers software for Windows-based development database servers. The long-term goal of the IT department is to deploy Virtuozzo Containers on all production servers to significantly lower their overall management, software and hardware costs.	http://www.parallels.com/r/pdfs/SuccessStories/Arvato_SWsoft_Virtuozzo_Case_Study.pdf
BeneMetrix (http://www.benemetrix.com/)	Facing the management of many remote sites and a growing customer base, BeneMetrix selected Virtuozzo Containers to consolidate its production customer servers. BeneMetrix has standardized on Virtuozzo Containers for its current and new customer deployments. Measuring an ROI is difficult because the deployment has changed from a decentralized server model with associated travel to a centralized consolidated configuration. They estimate that its next quarter new customer deployment will be	http://www.parallels.com/r/pdfs/SuccessStories/BeneMetrix_SWsoft_Virtuozzo_Case_Study.pdf

	completed with Virtuozzo Containers with at least a $35K reduction in costs.	
SMS Central (http://www.smsc.com.au)	With intent to implement a disaster recovery solution across its global infrastructure, SMS Central turned to Parallels Virtuozzo Containers. With its flexibility, scalability and remote administration tools, the Virtuozzo Containers software was the optimal solution allowing to build a new server infrastructure with a dramatic 85% reduction in total costs. Parallels Virtuozzo Containers enabled the disaster recover solution and it ultimately eliminated the need to purchase redundant physical servers in every geographical location.	http://www.parallels.com/r/pdfs/SuccessStories/SMS_SWsoft_Virtuozzo_Case_Study.pdf

CHAPTER 2

Planning and Setting Up Evaluation Environment

This chapter presents a way to prepare custom Parallels Virtuozzo installations for you to seamlessly perform the demonstration exercises presented in the Evaluating Parallels Virtuozzo Containers chapter (p. 53).

In This Chapter

Planning Your Evaluation Environment

Before installing the Parallels Virtuozzo Containers software and starting with its evaluation, you should plan the structure of your Virtuozzo network environment and the roles the individual computers will perform in it. The principal roles of computers in a Parallels Virtuozzo network are the following:

1. Hardware Nodes. These are servers with Parallels Virtuozzo installed, each housing a certain number of Containers.
2. Parallels Management Console workstation. It is a computer running a Windows or Linux OS with Parallels Management Console installed. It may be located virtually everywhere on the Internet and serves for the remote administration of your Hardware Nodes.
3. Parallels Infrastructure Manager client. It is a computer providing you with the ability to manage Hardware Nodes and all their Containers with the help of a standard Web browser on any platform. The only requirement this computer should meet is to be able to connect to the Hardware Nodes and run a beb browser supported by Parallels Virtuozzo.
4. Backup Node. It is a server running the Parallels Virtuozzo Containers software and used to store Containers backups.

Graphically, a typical Parallels Virtuozzo system can be represented as follows:

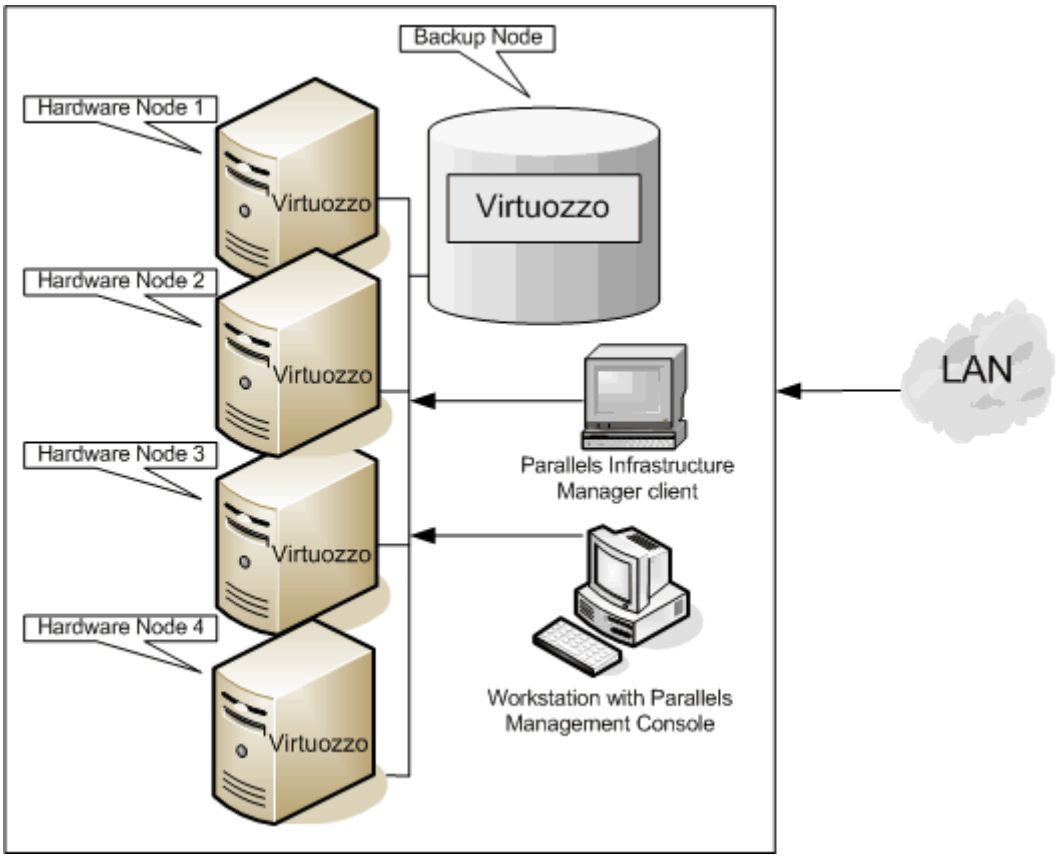

Figure 8: Virtuozzo Network Environment Structure

The picture shows the configuration with a network consisting of 4 Hardware Nodes and a server performing the functions of the Backup Node, respectively. Hardware Node 1 and 2 are running the Windows Server 2008 operating system (and, consequently, has Parallels Virtuozzo Containers 4.5 for Windows installed) and Hardware Nodes 3 and 4 has a Linux OS installed (and, consequently, are running Parallels Virtuozzo Containers 4.0 for Linux). Each of these Hardware Nodes has a separate Parallels Virtuozzo license installed and hosts a number of Containers.

This number of Hardware Nodes is needed to evaluate the following Parallels Virtuozzo functionality:

- Migrating Containers from one Hardware Node to another. You need at least two Hardware Nodes running one and the same operating system (either Windows or Linux) to move Containers between these Nodes. So, in our environment we can move Containers either from Hardware Node 1 to Hardware Node 2 or from Hardware Node 3 to Hardware Node 4. We also recommend that you keep all the Hardware Nodes in one subnet. In this case you will be able to transparently migrate Containers from one Node to another without having to modify the Containers IP addresses or the Hardware Node routing tables.
- Backing up Containers and storing them on the Backup Node. The Backup Node is a server intended for storing the backups of all your Containers. It should run Parallels Virtuozzo (either for Windows or Linux) and have high-capacity hard drives to be able to store the Containers backups on them. Generally, any Hardware Node irrespective of the OS (Windows or Linux) installed can be assigned an additional role of the Backup Node. For example, you can create backups of Containers residing on a Linux Hardware Node and store them either on the Backup Node or on any of the Linux or Windows Hardware Nodes.
- Uniting Hardware Nodes in a Virtuozzo Group. You can organize all your Linux and Windows Hardware Nodes into a single entity - *Virtuozzo Group* - and centrally manage them from one place in Parallels Management Console or Parallels Infrastructure Manager. To evaluate this functionality, you need to deploy at least two Hardware Nodes in your working environments.
- Creating a Virtuozzo failover cluster. On both Windows and Linux Nodes, you can create a cluster of two or more Virtuozzo Hardware Nodes that will host the Parallels Virtuozzo software including all its mission-critical services and Containers. If one Hardware Node fails, another Node will take its responsibilities. To evaluate this functionality, you will need at least:
  - two Hardware Nodes with Windows Server 2003 or 2008 installed to deploy a Windows failover cluster
  - two Hardware Nodes running a supported Linux distribution to deploy a Linux failover cluster

Apart from the aforementioned servers (Hardware Node 1, 2, 3, and 4 and the Backup Node), you can make use of the following computers to facilitate managing the Hardware Nodes in your network environment and all their Containers:

- A workstation with Parallels Management Console. This workstation allows you to control multiple Hardware Nodes, manage all their Containers, and monitor the system.
- A workstation where Parallels Infrastructure Manager is launched in a standard web browser. This workstation enables you to perform all the main operations on your Hardware Nodes and their Containers.

Note: In the picture above, the Parallels Infrastructure Manager client and the workstation with Parallels Management Console are located in one and the same local network with the other computers participating in the Parallels Virtuozzo network. This is done for your convenience only; in fact, both workstations may be located everywhere on the Internet and serve for the remote administration of your Hardware Nodes.

The picture shows only one of the possible configurations you can choose when planning your Parallels Virtuozzo network environment. You can hold to this scheme or work out your own one and build your own Virtuozzo environment. For example, you may deploy only two Hardware Nodes running either the Linux or Windows operating system, deploy Parallels Management Console and Parallels Infrastructure Manager on one of your Hardware Nodes, etc. You may, as a matter of fact, have only one dedicated server to effectively use Parallels. However, in this case you will not be able to evaluate some of the Virtuozzo Containers functionality (e.g. Container migration between Hardware Nodes). The only requirement that you must fulfill while planning any Virtuozzo network is to make sure that all the Nodes running Parallels Virtuozzo are accessible from the other participating computers.

Installation Requirements

After deciding on the structure of your Parallels Virtuozzo system, make sure that all the Hardware Nodes where you are planning to deploy the Parallels Virtuozzo Containers software meet the system and network requirements listed in this section.

System Requirements for Windows Hardware Nodes

This subsection focuses on the hardware and software requirements for Parallels Virtuozzo Containers 4.5 for Windows.

Hardware Compatibility

There are no special requirements for the physical server; if Windows Server 2003 or Windows Server 2008 can run on the given server, Parallels Virtuozzo Containers can be installed on it. The amount of hard disk space and memory present on the physical server will determine the number and performance of Containers you will be able to create and simultaneously run on the given server.

Software Compatibility

Parallels Virtuozzo Containers 4.5 can be installed on servers running the following versions of the Windows Server operating system:

x86 full versions of Windows Server 2008 with or without Hyper-V:

- Windows Server 2008 with Service Pack 1 or Service Pack 2, Enterprise Edition (US English)
- Windows Server 2008 with Service Pack 1 or Service Pack 2, Standard Edition (US English)
- Windows Server 2008 with Service Pack 1 or Service Pack 2, Datacenter Edition (US English)
- Windows Server 2008 with Service Pack 2, Enterprise Edition (French, German, Japan, Italian, Korean, Spanish, Russian, and Simplified Chinese)
- Windows Server 2008 with Service Pack 2, Standard Edition (French, German, Japan, Italian, Korean, Spanish, Russian, and Simplified Chinese)
- Windows Server 2008 with Service Pack 2, Datacenter Edition (French, German, Japan, Italian, Korean, Spanish, Russian, and Simplified Chinese)

x86 full versions of Windows Server 2008 without Hyper-V:

- Windows Server 2008 with Service Pack 1, Datacenter Edition (German and Simplified Chinese)

x86 versions of Windows Server 2003:

- Standard or Enterprise Edition of Windows Server 2003 Service Pack 1 with or without R2: US English, German, French, Korean, Spanish, Traditional Chinese, Simplified Chinese, or Japanese
- Standard or Enterprise Edition of Windows Server 2003 Service Pack 2 with or without R2: US English, German, French, Italian, Korean, Russian, Spanish, Traditional Chinese, Simplified Chinese, or Japanese
- Standard or Enterprise Edition of Windows Server 2003 Service Pack 2 (Russian)
- Datacenter Edition of Windows Server 2003 Service Pack 1 with or without R2 (US English)
- Datacenter Edition of Windows Server 2003 Service Pack 2 with or without R2 (US English)

x64 full versions of Windows Server 2008 with or without Hyper-V:

- Windows Server 2008 with Service Pack 1 or Service Pack 2, Enterprise Edition (US English)
- Windows Server 2008 with Service Pack 1 or Service Pack 2, Standard Edition (US English)
- Windows Server 2008 with Service Pack 1 or Service Pack 2, Datacenter Edition (US English)
- Windows Server 2008 with Service Pack 2, Enterprise Edition (French, Japan, Italian, Korean, Spanish, Russian, and Simplified Chinese)
- Windows Server 2008 with Service Pack 2, Standard Edition (French, German, Japan, Italian, Korean, Spanish, Russian, and Simplified Chinese)
- Windows Server 2008 with Service Pack 2, Datacenter Edition (French, German, Japan, Italian, Korean, Spanish, Russian, and Simplified Chinese)

X64 full versions of Windows Server 2008 without Hyper-V:

- Windows Server 2008 with Service Pack 1, Datacenter Edition (German and Simplified Chinese)

x64 versions of Windows Server 2003:

- Standard or Enterprise Edition of Windows Server 2003 x64 Service Pack 1 with or without R2 (US English or Japanese)
- Standard or Enterprise Edition of Windows Server 2003 x64 Service Pack 2 with or without R2 (US English, French, German, Japanese, Italian, Korean, Simplified Chinese, Spanish, or Traditional Chinese)
- Standard or Enterprise Edition of Windows Server 2003 x64 Service Pack 2 (Russian)
- Datacenter Edition of Windows Server 2003 x64 Service Pack 1 with or without R2 (US English)
- Datacenter Edition of Windows Server 2003 x64 Service Pack 2 with or without R2 (US English)
- Datacenter Edition of Windows Server 2003 x64 with Service Pack 2 (Japanese)

IA64 versions of Windows Server 2003:

- Standard or Enterprise Edition of Windows Server 2003 IA64 with Service Pack 2 (US English, German, French, or Japanese)

X86 versions of Windows Small Business Server 2003

- Windows Small Business Server 2003 with Service Pack 1 (US English)
- Windows Small Business Server 2003 with Service Pack 2 (French)

Before installing Virtuozzo Containers 4.5, make sure of the following:

- The Windows Server OS installation is activated.
- The Windows Server distribution kit is not patched, i.e. all the binaries inside the distribution kit are in their original state as they are supplied by Microsoft Corporation.

Notes:

1. During the Virtuozzo Containers installation, you may be presented with a warning message informing you that some Windows Server updates installed on your server are not compatible with Virtuozzo Containers 4.5. In this case you need to uninstall these updates from the server (e.g. using the Add/Remove Programs tool in Control Panel) and start the Virtuozzo Containers installation anew. You will be able to install all the necessary Windows Server updates on your Hardware Node after the Virtuozzo Containers installation.

2. After installing Virtuozzo Containers 4.5, do not remove any of the standard Windows components from the Hardware Node (e.g. Internet Information Services). Deleting an installed component might cause the corresponding application inside your Containers to malfunction. You can disable the unnecessary Windows components on the Node instead.

System Requirements for Linux Hardware Nodes

This subsection focuses on the hardware and software requirements for Parallels Virtuozzo Containers 4.0 for Linux.

Hardware Compatibility

The Hardware Node requirements for the standard 32-bit edition of Parallels Virtuozzo Containers 4.0 are the following:

- IBM PC-compatible server with 32-bit, x86-64-bit, and IA64-bit processors: Intel Celeron, Pentium D, Pentium Dual Core, Core 2 Duo, Xeon, AMD Athlon, etc.
- At least 128 MB of RAM.
- Hard drive(s) with at least 15 GB of free disk space.
- Network card. A complete list of network cards supported in Parallels Virtuozzo can be found at http://www.parallels.com/en/products/virtuozzo/hcl/network/. This list is constantly updated, so you may check back periodically.
- SCSI controllers. A complete list of SCSI controllers supported in Virtuozzo Containers 4.0 can be found at http://www.parallels.com/en/products/virtuozzo/hcl/other/. This list is constantly updated; so you may check back periodically.

The exact server configuration depends on how many Containers you are going to run on the server and what load these Containers are going to produce. Thus, in order to choose the right configuration, follow the recommendations below:

- CPUs. The more Containers you plan to run simultaneously, the more CPUs you need.
- Memory. The more memory you have, the more Containers you can run. The exact figure depends on the number and nature of applications you are planning to run in your Containers.
- Disk space. Each Container occupies 30-150 MB of hard disk space for system files in addition to the user data inside the Container (for example, web site content). You should consider it when planning disk partitioning and the number of Containers to run.

Software Compatibility

Parallels Virtuozzo Containers can be installed on the Hardware Node running one of the following Linux distributions with the 2.6 kernel:

- Red Hat Enterprise Linux 4
- Red Hat Enterprise Linux 5
- CentOS 4
- CentOS 5
- Fedora 7 (except for the 64-bit version of Virtuozzo Containers for IA-64-bit processors)
- Fedora 8 (except for the 64-bit version of Virtuozzo Containers for IA-64-bit processors)
- Suse Linux Enterprise Server 10 with or without Service Pack 1
- Suse Linux Enterprise Desktop 10 with or without Service Pack 1 (except for the 64-bit version of Virtuozzo Containers for IA-64-bit processors)

Network Requirements

The network pre-requisites enlisted in this subsection can help you avoid delays and problems with making Parallels Virtuozzo up and running. You should take care in advance of the following:

- Local area network (LAN) for the Hardware Node.
- Internet connection for the Hardware Node.
- A valid IP address for the Hardware Node as well as other IP parameters (default gateway, network mask, DNS configuration, etc.).
- At least one valid IP address for each ordinary Container you will be creating on the Node. The total number of IP addresses must be no less than the planned number of Containers.

Note: The IP addresses to be assigned to Containers must differ from those of the Hardware Node, i.e. any existing IP address of the Hardware Node network interface cards must not be assigned to any Container. The Container IP addresses are automatically assigned by Parallels Virtuozzo to the virtual adapters of the corresponding Containers; so, you only have to specify what IP address is to be applied to what Container.

Installing Parallels Virtuozzo Containers

The Parallels Virtuozzo Containers installation shall consist of the following major steps:

1. Installing the Host operating system:
   - On a Windows server, install and activate a Windows Server operating system. The full list of supported operating systems is listed in the Software Compatibility subsection (p. 31).
   - On a Linux server, install one of the Linux distributions listed in the Software Compatibility subsection (p. 33).
2. Installing the Parallels Virtuozzo Containers basic pack on the server. From the moment of Parallels Virtuozzo installation, this server is called *Hardware Node* in Parallels Virtuozzo terms.
3. Install Parallels Management Console - a graphical tool for administering Parallels Virtuozzo and performing main administrative tasks on Hardware Nodes and in the Container context - and register the needed Hardware Nodes.
4. Set Parallels Infrastructure Manager and Parallels Power Panel to work. These tools are intended for managing your Hardware Nodes and individual Containers, respectively, residing on them with the help of a standard Web browser.

Steps 2-4 are described below in this chapter.

Obtaining Parallels Virtuozzo License

You can obtain a license for the Parallels Virtuozzo Containers software in one of the following ways:

- Request a license from the Parallels sales representative.
- Visit the http://www.parallels.com/en/products/virtuozzo/linux_eval web site for Linux Nodes or the http://www.parallels.com/en/products/virtuozzo/windows_eval web site for Windows Nodes, fill up a special registration form there, and get a free evaluation license.

The license is needed to start using the Parallels Virtuozzo Containers software and all Virtuozzo management tools (Parallels Management Console, Parallels Infrastructure Manager, and Parallels Power Panel).

Setting Up Parallels Virtuozzo on Windows Hardware Nodes

The given section familiarizes you with the way to install Parallels Virtuozzo Containers 4.5 on Hardware Nodes running the Windows Server operating system.

Obtaining Virtuozzo Containers Distribution Set

You can use one of the following ways to obtain the Parallels Virtuozzo 4.5 distribution set:

- Use the `vzinstall.exe` utility to download Parallels Virtuozzo to your server and install it there. In this case you should download the `vzinstall.exe` file from the Parallels web site to your server and run it there. When executed, the utility launches the Parallels Virtuozzo Containers Autoinstall wizard which will ask you about the Parallels Virtuozzo components you wish to download and, after gathering the necessary information, start the downloading process. You can also make `vzinstall` initiate the Parallels Virtuozzo Containers Installation wizard right after the Virtuozzo components downloading and help you install the software on your server.
- Get a CD or DVD containing Parallels Virtuozzo Containers from Parallels.

Download the appropriate zip archive containing the Parallels Virtuozzo installation files from the Parallels web site to your server.

Installing Parallels Virtuozzo Containers Software

To install Parallels Virtuozzo Containers 4.5 for Windows on any given Hardware Node, perform the following operations:

1. Launch the Parallels Virtuozzo Containers Installation wizard by double-clicking the `virtuozzo4.5_<arch>.exe` installation file where `<arch>` denotes the system architecture of the Windows Server operating system under which Parallels Virtuozzo is to be run (e.g. `virtuozzo4.5_x64.exe` to install Parallels Virtuozzo on systems running the 64-bit version of Windows Server 2008).
2. On the Welcome screen, click Next to proceed with the installation.

   Note: The Welcome screen is skipped if you run the `vzinstall.exe` utility in the *Download and install* mode.
3. On the next screen, accept display the Parallels end user license agreement by selecting the I accept the terms in the license agreement radio button and clicking Next.
4. After accepting the license agreement, you will be presented with the Customer Experience Program window. This window allows you to join the Parallels Customer Experience Program. If you choose to participate in the program (select Yes, I want to participate and click Next), Parallels will periodically collect the information about your physical server and Containers configuration and use it to make the product better fit your needs.

   No private information like your name, e-mail address, phone number, and keyboard input will be collected. For more details about the Customer Experience Program, click the Learn more button.
5. In the User Information window, you are asked to provide your personal information in the User Name and Organizations fields. Enter the necessary information and click Next.
6. On the next step, you should specify the location for Virtuozzo program files and the folders for keeping all Container data and Virtuozzo backups:

   The three folders specified on the given step of the wizard mean the following:

   - The first folder with the default path of `C:\Program Files\Parallels\Containers` contains all program files including drivers, scripts, services, etc. specific for Parallels Virtuozzo 4.5. You can specify another path for the folder by clicking the Change button and selecting the desired path. Keep in mind that this folder is removed when Parallels Virtuozzo is uninstalled from the server.
   - The second folder is meant for storing all the data used by the Containers that you will be creating on the Node: private areas, installed templates, patches, logs, etc. By default, the `C:\vz` path is used. You can specify another path for the folder by clicking the Change button and selecting the desired path. While defining a path for this folder, take care of the following:

     - This folder cannot be a mount point, i.e. you cannot mount external disk partitions to this folder.

     - This folder cannot be a network share, i.e. it cannot be located on a server network drive.

     - The hard disk partition where this folder will be located must have no less than 10 Gb of free disk space.

As distinct from the previous folder, this folder remains intact when Parallels Virtuozzo is uninstalled from your server (unless you select the Remove Parallels Virtuozzo Containers data folder check box).

- The third folder is destined for keeping all Container backups created on the Node

a by using the `vzabackup` utility (consult the *Parallels Virtuozzo Containers 4.5 for Windows Reference Guide* for detailed information on this utility), or

b by means of Parallels Management Console and Parallels Infrastructure Manager/Parallels Power Panel if there is no default Backup Node or this Hardware Node is to serve as one. In the latter case, this folder will be used to store the Container backups from all Hardware Nodes registered in Parallels Management Console. Detailed information on the way to manage Container backups in Parallels Management Console and Parallels Infrastructure Manager/Parallels Power Panel is provided in the Operations on Containers chapter of the *Parallels Virtuozzo Containers 4.5 for Windows User's Guide* and Parallels Infrastructure Manager/Parallels Power Panel online help, respectively.

The folder has the default path of `C:\vz\Backups`. You can specify another path for the folder by clicking the Change button and selecting the desired path. While defining the backup folder, make sure that it has sufficient disk space for housing multiple Container backups.

7 On the Ready to Install the Program screen, you can review and, if necessary, change your installation settings using the Back button. Clicking the Install button starts the installation process. During the Parallels Virtuozzo installation, the following operations are performed:

Note: If you use the `vzinstall.exe` utility in the *Download and install* mode, the Ready to Install the Program screen is skipped and the installation is initiated after you click the Install button in the Locations of Virtuozzo Data and Program Files window.

- The Parallels Virtuozzo program files are installed on your server.
- The Parallels web site is checked for available updates. If any updates are found, you will be presented with the Recommended Updates window listing the detected updates. To download and install any of the listed updates, select its name, and click Next.
- The Virtuozzo tools are installed on the Hardware Node. These tools include Parallels Management Console, Parallels Infrastructure Manager, and Parallels Power Panel and are intended to facilitate your working with Parallels Virtuozzo 4.5.
- Additional Windows Server components are added to your Host operating system. The components installed on this step of the wizard represent standard Windows applications and are necessary to provide Containers you will create on the Hardware Node with the corresponding functionality. While adding Windows components, the wizard will ask you to provide a path to the Windows Server distribution files (either by inserting a CD with the Windows Server distribution kit or by clicking the OK button in the displayed window and specifying the path to the installation files).

Note: You must use the same Windows Server distribution kit as the one installed on your Hardware Node.

- A number of additional Parallels Virtuozzo components are installed on the Hardware Node. These components include the MSDE application template, the Windows OS template, and the Service Container and are needed to make your Parallels Virtuozzo installation fully operational. For example, you need the Windows OS template to create Containers on its basis, and the Service Container should be created to allow you to manage the created Containers by means of Parallels Management Console, Parallels Infrastructure Manager, and Parallels Power Panel.

8 Next, you are supposed to choose the set of Windows Server system services to be launched inside newly created Containers on their startup. You can choose one of the following options:

- Select the Standard set of Windows services used by Windows radio button to automatically launch the standard set of Windows Server system services inside each newly created Container on its startup.
- Leave the Minimal set of Windows services radio button selected to have the minimal set of Windows Server services running inside Containers after their startup. The minimal system services set differs from the standard one in the following:

a It has the startup type of the *Print Spooler*; *Remote Registry*; *DNS Client* services set to manual.

b The startup type of the *TCP/IP NetBIOS Helper*, *Computer Browser*, *Server* services in the minimal set corresponds to that of the version of Windows Server installed inside a Container, while in the standard set these services are always set to the automatic startup type.

As a result of these differences, the minimal set allows you to simultaneously run more Containers on the Hardware Node. However, you will have to manually start the aforementioned services each time you need them inside this or that Container.

Notes:

1. After a Container has been created, you can configure the set of Windows system services to be run inside this Container on its startup using standard Windows Server tools (e.g. the Services snap-in or the `Sc.exe` command line tool).

2. The differences listed above are valid for Containers running Windows Server 2003. The differences between the two sets of services may slightly differ for Containers running Windows Server 2008.

9 On the last step, you will be asked to install a valid license on the Hardware Node to start using Parallels Virtuozzo on your server. Every Hardware Node must have its own Virtuozzo license installed. Licenses are issued by Parallels and needed to start using Parallels Virtuozzo 4.5. Although you can complete some tasks on the Hardware Node without having a Virtuozzo license, you are not allowed to perform the majority of operations (e.g. start Containers) until you install a valid license to the Node. To install a Virtuozzo license, enter the Virtuozzo license key obtained from Parallels in the field provided, and click Next.

10 In the InstallShield Wizard Completed window, click the Finish button to exit the wizard.

Setting Up Parallels Virtuozzo on Linux Hardware Nodes

The given section familiarizes you with the way to install Parallels Virtuozzo Containers 4.0 on Hardware Nodes having one of the Linux distributions installed.

Obtaining Parallels Virtuozzo Containers Distribution Set

You can use one of the following ways to obtain the Parallels Virtuozzo Containers 4.0 distribution set:

- Use the `vzinstall-linux.bin` utility (or the `vzinstall-linux-ia64.bin` utility if you want to install the IA64-bit version of Parallels Virtuozzo) to download the Parallels Virtuozzo 4.0 distribution to your server and install it there. In this case you should download the `vzinstall-linux.bin` file from the Parallels web site to your server and run it there. When executed, the utility launches the Parallels Virtuozzo Containers Autoinstall wizard which will ask you about the Virtuozzo components you wish to download and, after gathering the necessary information, start the downloading process. You can also make the `vzinstall-linux.bin` utility initiate the Parallels Virtuozzo Containers Installation wizard right after the Virtuozzo components downloading and help you install Parallels Virtuozzo on your server.
- Get a CD or DVD containing Parallels Virtuozzo 4.0 from Parallels.

Installing and Configuring Host Operating System on Hardware Node

Follow these recommendations when installing the Host OS on your Hardware Node:

- Proceed in accordance with your Linux installation guide till the Disk Partitioning Setup window is displayed. In this window select the Manual partition check box and, on the next screen, create the following partitions on the Hardware Node:

Partition	Description	Typical size
/	The root partition containing all Host operating system and Virtuozzo Containers software files.	10-12 Gb
swap	The paging partition for the Linux operating system.	2 times RAM
/vz	The partition to host all Container data and Virtuozzo templates. You are recommended to allocate as much disk space as possible to this partition.	all the remaining space on the hard disk

We highly recommend that you use the ext3 file system for the /vz partition. We also recommend using the ext3 filesystem for other partitions on your server, if you are going to have any. Otherwise, these partitions may become invisible/inaccessible when the Virtuozzo kernel is loaded.

Note: Along with ext3, the Virtuozzo kernel also includes support for other conventional filesystems: reiserfs, jfs, xfs, etc. However, ext3 is the only filesystem that has been thoroughly tested with Parallels 4.0 and is officially supported by Parallels.

- While on the Network Configuration screen, you should ensure the correctness of the Hardware Node IP address, host name, DNS, and default gateway information. If you are using DHCP, make sure that it is properly configured. If necessary, consult your network administrator.
- On the Package Group Selection screen, clear the Software Development, Virtualization, and Web server check boxes and select the Customize now radio button.
- In the Package Group Details window, clear the check boxes of all package groups offered for installing on your server, except for the Base package group available on clicking the Base System item in the left part of the displayed window. For its functioning, Parallels Virtuozzo Containers does not need any additional packages to be installed on the Hardware Node.

After finishing the installation, please reboot the server.

Installing Parallels Virtuozzo Containers Software

To install the Parallels Virtuozzo Containers software on your server, perform the following operations:

1. Make sure that the Parallels Virtuozzo 4.0 distribution files are located on a persistent storage (e.g. on a local file system). This is needed to ensure their accessibility after the system reboot, which is performed on the last step of the installation.
2. Log in as root and run the `install` utility located in the root directory of your Parallels Virtuozzo CD, DVD, or distribution directory. For example, your session may look like below if you are installing the software from the CD:

```
# mount /media/cdrom
# /media/cdrom/install
```

Notes:

1. If you are running the `vzinstall-linux.bin` utility in the *Download and install* mode, the installation is launched automatically after the Parallels Virtuozzo distribution set has been successfully downloaded to your server.

2. If you have downloaded the Parallels Virtuozzo distribution using `vzinstall-linux.bin`, execute the `./virtuozzo-4.0.0-<build_version>.swsoft-<arch>.sfx` command to launch the Parallels Virtuozzo Containers Installation wizard.

3. On the Welcome screen, click Next to proceed with the installation.
4. The next screen will display the Parallels end user license agreement that you must accept to be able to install Parallels Virtuozzo 4.0 on the server.
5. After accepting the license agreement, the installation program starts installing packages from the Parallels Virtuozzo CD, DVD, or your local distribution directory. In case you did not follow completely the operating system installation instructions as was described earlier, the installation program can report unresolved dependencies in system package database. Review these dependencies, and if they are not critical to your system operation, continue with the installation.

Note: If you did not create a separate `/vz` partition during the Host OS installation (see the Installing and Configuring Host Operating System on Hardware Node section (p. 40) for more detail), you will be presented with a special message informing you of this fact before the Virtuozzo Containers packages are installed on your server. For performance and reliability reasons, we recommend that you allocate a separate partition for holding all Container data and Virtuozzo templates. To abort the Virtuozzo Containers installation and repartition your storage, click the Cancel button; otherwise, click OK.

6. Next, the installation program offers to install all the templates found on the Parallels Virtuozzo CD, DVD, or in your distribution directory.

Note: The Install Templates screen is skipped if you are installing Parallels Virtuozzo using the `vzinstall-linux.bin` utility. In this case `vzinstall-linux.bin` will install the OS and application templates specified by you on the Select Virtuozzo Components screen of the Parallels Virtuozzo Containers Autoinstall wizard.

Please keep in mind that before you can start using the installed EZ templates on your Hardware Node (e.g. as the basis for the Container creation), you may need to set up a package repository for them. For example, you have to build a special repository for all commercial versions of the Linux distributions (e.g. Red Hat Linux Enterprise 4 and 5). Detailed information on how to manage package repositories is provided in the Setting Up Repository for EZ Template section of the *Parallels Virtuozzo Templates Management Guide*.

7 On the next screen, you will be prompted to enter the Parallels Virtuozzo product key (license). Every Hardware Node must have its own Virtuozzo license installed. Licenses are issued by Parallels and needed to start using Parallels Virtuozzo Containers. Although you can complete some tasks on the Hardware Node without having a Virtuozzo license, you are not allowed to perform the majority of operations (e.g. all Container-related operations including the Container creation) until you install a valid license on the Node. In the Virtuozzo Product Key Installation window, you can do one of the following:

- Install a valid Virtuozzo license by entering the license key number in the field provided and clicking Next. When activating your Parallels Virtuozzo installation using an activation code:

a Make sure that your server is connected to the Internet. This is necessary for the Parallels Virtuozzo activation process to complete.

b If your Hardware Node uses a proxy server to connect to the Internet, use the Configure button to specify the necessary information about the proxy server.

- If you do not have a valid Virtuozzo license, follow the http://www.parallels.com/en/products/virtuozzo/linux_eval link and obtain a free Virtuozzo evaluation license. This license does not impose any restrictions on the Parallels Virtuozzo functionality; so, you can access and evaluate all Parallels Virtuozzo features to the full extent (however, for a limited period of time only). You can also click the Skip button to skip the step of installing a Virtuozzo license onto your Hardware Node. You will be able to install the license later on by means of Parallels Management Console, Parallels Infrastructure Manager, or the `vzlicload` utility. Please turn to the Managing Virtuozzo Licenses section of the *Parallels Virtuozzo Containers 4.0 for Linux User's Guide* to learn how you can do it.

8 On the last step, you are offered to check for available Parallels Virtuozzo updates. We recommend that you check for available updates right during the Parallels Virtuozzo installation, which allows you to keep the software at the most recent version (i.e. to have the latest Virtuozzo core, utilities, and templates installed). To this effect, leave the Launch Virtuozzo Containers software update wizard check box selected. In this case the Virtuozzo Up-To-Date wizard will be automatically launched after clicking either the Exit or Reboot button. Follow the instructions of the wizard to check for available updates, if any, and install them on your Node. If you do not wish to update your Parallels Virtuozzo installation for some reason or other, clear the check box. You will be able to update the Parallels Virtuozzo software later by means of the `vzup2date` utility or Parallels Management Console. Detailed information on how you can do it is provided in Parallels Virtuozzo Containers Reference Guide and the Keeping Your Virtuozzo System Up-to-Date chapter of the *Parallels Virtuozzo Containers 4.0 for Linux User's Guide*.

Note: The Virtuozzo Containers Online Update screen is skipped if you are running the `vzinstall-linux.bin` utility in the *Download and install* mode.

9 After the installation is complete, the installation program greets you with a success window. In this window, you can do the following:

- Click Exit to do a manual check of the Hardware Node before booting to the Virtuozzo kernel. Otherwise, click Reboot to reboot the Hardware Node.

- Get informed of your further steps to start working with Parallels Virtuozzo 4.0 after the Hardware Node reboot:

a Log in to the Hardware Node through Parallels Infrastructure Manager using the specified URL (`http://Hardware_Node_IP_Address:4643`) and the system administrative credentials (i.e. the `root` username and the password you specified for this user when installing the Host OS on your server).

b Log in to the Hardware Node through SSH (Secure Shell) and run the `man virtuozzo` command to get primary information on the main Parallels Virtuozzo utilities.

Setting Virtuozzo Tools to Work

To facilitate working with your Hardware Nodes and all their Containers, you can make use of the following Virtuozzo tools:

- Parallels Management Console - a remote management tool for Parallels Virtuozzo Containers with a graphical user interface. Management Console is designed for Hardware Node administrators having access to all the Containers on a particular Node. It allows the administrator to control multiple Hardware Nodes, to manage all sorts of Containers, and to monitor the system.
- Parallels Infrastructure Manager designed for Hardware Node administrators and providing them with the ability to manage a number of Hardware Nodes and all Containers residing on them with the help of a standard web browser on any platform.

The following subsections provide information on how to prepare both tools for working in Parallels Virtuozzo-based systems.

Installing Parallels Management Console

Parallels Management Console can be installed on a computer meeting the following requirements:

- Platform: 450 MHz or higher Intel Pentium-compatible CPU.
- Memory: 256 MB recommended. The required amount depends on the number of Hardware Nodes to be administered (minimum 5 MB per Hardware Node).
- Hard disk space: about 500 MB.
- Operating system:
  - Windows XP, Windows Server 2003, Windows Server 2008
  - Linux Fedora Core 4, Fedora Core 5, Fedora Core 6, or Fedora Core7, RHEL 4, RHEL 5, SUSE Linux Enterprise Desktop 10, Ubuntu 6

Depending on whether you are deploying the Parallels Virtuozzo Containers software on a Windows Hardware Node or a Linux one, the Parallels Management Console installation slightly differs:

- Parallels Management Console is automatically installed on your Node during the Parallels Virtuozzo installation on Hardware Nodes running the Windows Server operating. You can launch it by clicking Programs > Parallels > Virtuozzo Tools > Parallels Management Console on the Windows Start menu. If you wish to use Parallels Management Console on a dedicated computer for the remote administration of your Hardware Nodes, you should manually install it on this computer. To install Parallels Management Console on a dedicated workstation, execute the `pmc_setup.exe` file. To locate this file, select Programs > Parallels > Virtuozzo Tools > Parallels Management Console Setup File on the Windows Start menu of your Hardware Node. Copy the file to the computer where you wish to install Parallels Management Console, and execute it there.
- If you are deploying a Linux Hardware Node, you can find the Management Console installation files in the `client` subdirectory of your Parallels Virtuozzo Containers 4.0 for Linux distribution set. There are two subdirectories there containing the Management Console builds for Microsoft Windows 2000/XP/2003/2008 and Linux (Fedora Core 4, 5, 6, and 7; Red Hat Enterprise Linux 4 and 5; SUSE Linux Enterprise Desktop 10; Ubuntu 6):
  - `win32`: the Management Console build for Windows workstations.
  - `linux`: the Management Console build for Linux workstations. It can be installed on Fedora Core 4, 5, 6, and 7, RHEL 4 and 5, SUSE Linux Enterprise Desktop 10, and Ubuntu 6.

  To install Management Console for Linux:

  a Use the `rpm -i` command for all Linux distributions except for Ubuntu 6. For example, to install Management Console on the 32-bit version of Fedora Core 6, you can issue the following command:

```
# rpm -ihv pmc-<build_version>.swsoft.i386.rpm
```

  b Use the following commands to install Management Console on Ubuntu 6:

```
# sudo aptitude update
[you will be asked to provide the password of the root user]
# sudo aptitude install alien
# cd /client/linux
# sudo alien -i pmc-<build_version>.swsoft.<arch>.rpm
```

After the installation is complete, you can start Parallels Management Console by running the `pmc` command on Linux or by selecting Programs > Parallels > Virtuozzo Tools > Parallels Management Console on the Start menu in Windows.

Before you can start managing a Hardware Node in Parallels Management Console, you must register it there. To start the Node registration process, select the Register Hardware Node item on the Action menu. You will be presented with the Register New Hardware Node window where you should enter the following information in the fields provided:

- Friendly name. A friendly name for the Hardware Node which will be displayed in the Management Console left pane and help you easily find your Node among other Hardware Nodes registered in Management Console. You may specify any name you consider suitable for the Node. You can also leave this field blank; in this case the hostname assigned to the Hardware Node will be used as its name (e.g. `mynode.domain.com`).
- Address. The IP address of the Hardware Node.
- User name. The user name to log in to the Hardware Node. By default, you can log in to the Node with the `Administrator`/`root` credentials.ParallelsVirtuozzo Containers User's Guide
- Password. The password of the user specified in the User name field. Use the password you entered while installing the Host operating system on your Hardware Node.

  The Save my password check box, if selected, saves the provided password permanently on the computer where Management Console is installed; so, you will not have to enter the password each time when trying to access the Hardware Node.

After providing the necessary information, click the Connect button to establish a secure connection to the Hardware Node.

Setting Parallels Infrastructure Manager to Work

Along with Parallels Management Console, you can make use of Parallels Infrastructure Manager intended for managing your servers running the Parallels Virtuozzo Containers software. This tool is designed for Hardware Node administrators and provides you with the ability to manage multiple Hardware Nodes and all Containers residing on them with the help of a standard web browser on any platform.

To log in to Parallels Infrastructure Manager, launch the web browser that is compatible with Parallels Infrastructure Manager. A list of web browsers currently supported by Parallels Virtuozzo is given below:

- Internet Explorer 6 and 7
- Mozilla 1.7 and above
- Firefox 1.0 and above
- Opera 8.0 and above

Chances are that you will also be able to use other browsers, but Parallels Virtuozzo has not been extensively tested with them.

After you have opened a browser window, log in to Parallels Infrastructure Manager by typing the IP address (or hostname) of your Hardware Node and the `4643` TCP port. Assuming that the Node has the IP address of `197.158.201.100`, you can enter

```
https://197.158.201.100:4643
```

in the address line of your browser to log in to Parallels Infrastructure Manager. To connect to the Hardware Node, enter the Host OS credentials (i.e. `root` for Linux Nodes and `Administrator` for Windows Nodes and the corresponding password) in the fields provided on the Parallels Infrastructure Manager login screen, and click the Login button.

Note: If the Virtuozzo Hardware Node you wish to manage is part of a Virtuozzo Group, you should log in to the Master Node of this Group. Logging in at the IP address/hostname of a Slave Node is not allowed.

Parallels Infrastructure Manager and Parallels Power Panel use the Secure Sockets Layer (SSL) protocol to establish an encrypted connection to the Hardware Node and Containers, thus ensuring that this connection cannot be intercepted and used by unauthorized parties. For a client browser to successfully set up an SSL connection to a Node or a Container, this Node or Container should have the appropriate server certificate installed. The procedure of installing a server certificate on a Hardware Node or inside a Container does not differ from that on a standalone server and is described in detail in the following documentation sources:

- The Apache web server documentation (e.g. available at http://httpd.apache.org/docs/2.0/ssl/) for Hardware Nodes running Parallels Virtuozzo Containers 4.0 for Linux and their Containers.
- The Microsoft Internet Information Services (IIS) documentation shipped with your IIS web server for Hardware Nodes running Parallels Virtuozzo Containers 4.5 for Windows and their Containers.

When working with certificates, please keep in mind the following:

- You can also work in Parallels Infrastructure Manager and Parallels Power Panel without installing certificates on your Hardware Node and inside its Containers. However, in this case the corresponding warning message will be displayed each time you or your clients will try to connect to the Node and its Containers using their favorite web browsers.
- To set up a certificate for your Node, log in to the Service Container (also known as Container 1) and install and configure the certificate inside this Container.

CHAPTER 3

Understanding Parallels Virtuozzo Containers

The concept of Parallels Virtuozzo Containers is distinct from the concept of traditional virtual machines in the respect that Containers always run the same OS kernel as the host system (Linux on Linux, Windows on Windows, etc.). This single-kernel implementation technology allows to run Containers with a near-zero overhead. Thus, Containers offer an order of magnitude higher efficiency and manageability than traditional virtualization technologies.

In This Chapter

What Is Container

A Container is a virtual private server, which is functionally identical to an isolated standalone server:

- Each Container has its own processes, users, files and provides full administrative access.
- Each Container has its own IP addresses, port numbers, filtering and routing rules.
- Each Container can have its own configuration for the system and application software, as well as its own versions of system libraries, and registry. It is possible to install and customize software packages inside a Container independently from other Containers or the Host operating system. Multiple distributions of a package can be run on one and the same Windows or Linux box.
- Each Container has its own unique `Administrator` (for Windows Containers) or `root` (for Linux Containers) user with full control over the given Container and full access to other user accounts inside this Container.
- Windows Containers can be members of a Windows domain (e.g. access any of the network shares to which the Container user has rights). Moreover, any Container can act as a domain controller granting other Containers and standalone servers users access to a set of network resources (applications, printers, etc.).

OS Virtualization

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

- Container looks like a normal Windows or Linux system. Software from vendors can run inside any Container without Virtuozzo-specific modifications or adjustment.
- Container has its own unique `root`/`Administrator` user with full control over the given Container and can have a number of other local users with different rights and permissions assigned to them in respect of this Container.
- Users can install additional application and system software inside Containers.
- Windows Container can be a member of an Active Directory domain (e.g. access any of the network shares to which the Container user has rights). Moreover, any Container can act as an Active Directory domain controller granting other Containers and stand-alone servers users access to a set of network resources (applications, printers, etc.).
- Containers are fully isolated from each other in respect of their users, processes, services, file systems, and installed applications.
- Containers share the same executable code, which greatly saves both RAM and disk space.
- Processes belonging to a Container are scheduled for execution on all available CPUs. Consequently, Containers are not bound to only one CPU, and any application inside each Container 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 security. Any Container user can modify, update, replace, and delete any application file inside a Container like they do it on an isolated standalone server. 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. The main benefits of VZFS are the following:

- It saves memory required for executables and system libraries. A typical Container running a simple web site consumes around 30–50 MB of RAM just for executable images. Sharing this memory improves scalability and total system performance.
- It saves disk space. A typical Windows or Linux server installation occupies several hundred megabytes of disk space. Sharing the files allows you to save more than 90% of disk space.
- Disk quota enables the administrator to limit disk resources available to a Container on-the-fly.

Templates

A template (or a package set) in Parallels Virtuozzo is a set of original application files repackaged for mounting over the Virtuozzo file system. On a Linux system, it is usually just a set of RPM packages for Red Hat like systems. Parallels Virtuozzo provides tools for creating templates, installing, upgrading, adding them to and removing them from a Container. Using templates lets you:

- Securely share the RAM among similar applications running in different Containers to save hundreds of megabytes of memory.
- Securely 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 inside different Containers.

There are two types of templates in Parallels Virtuozzo. These are 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 Virtuozzo 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. Parallels Virtuozzo uses application templates to add extra software to existing Containers. For example:

- On a Windows Hardware Node, you can create a Container on the basis of the Windows Server 2008 OS template and add the Microsoft SQL server application to it with the help of the `MSSql` template.
- On a Linux Hardware Node, you can create a Container on the basis of the Red Hat Linux Enterprise 5 OS template and add the MySQL application to it with the help of the `mysql` template.

Resource Management

Virtuozzo resource management controls the amount of resources available to Containers. The controlled resources include such parameters as CPU power, disk space, a set of memory-related parameters. Resource management allows Parallels Virtuozzo to:

- effectively share available Hardware Node resources among 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 Containers
- manage a multitude of Hardware Nodes in a unified way by means of Parallels Management Console and Parallels Infrastructure Manager
- collect usage information for system health monitoring

Resource management is much more important for Parallels Virtuozzo than for a standalone server since server resource utilization in a Virtuozzo-based system is considerably higher than that in a typical system.

Parallels Virtuozzo Licensing

You need a special license - *Virtuozzo license* - to be able to start using the Parallels Virtuozzo Containers software and Virtuozzo management tools (Parallels Management Console, Infrastructure Manager, and Power Panel). You can install the Virtuozzo license on your server after or when installing Parallels Virtuozzo on it. Every Hardware Node hosting one or more Containers must have its own license. Licenses are issued by Parallels and define a number of parameters in respect of your Node. The main licensed parameters are listed below:

- The number of CPUs that can be installed on the Hardware Node. Keep in mind that each of the Dual Core and Hyperthreading processors is regarded as one CPU.
- The number of users who can simultaneously use Parallels Management Console and Parallels Infrastructure Manager to manage the Hardware Node and its Containers.
- The license expiration date. Any license can be time-limited or permanent.

  Virtuozzo licenses have a start date and, if they are time-limited, can also have an expiration date specified in them. You need to set up your system clock correctly; otherwise, the license validation may fail.
- The number of Containers the Hardware Node is allowed to host.
- The platform and architecture compatible with the Parallels Virtuozzo software.
- The possibility of managing the Hardware Node by means of Parallels Infrastructure Manager.

Virtuozzo licenses are shipped in one of the following forms:

- As an activation code. In this case you are provided with a special alphanumeric code which must be activated before starting to use Parallels Virtuozzo Containers on your Hardware Node. During the activation, the code is sent to the Parallels Key Authentication (KA) server which, in its turn, verifies the code, generates a special license file, sends it back to the Node, and installs it there.
- As a product key. In this case you are provided with an alphanumeric key which is installed on your Hardware Node directly without connecting to the Parallels KA server and exchanging any information with it.

Hardware Node Availability Considerations

Hardware Node availability is more critical than the availability of a typical server. Since the Hardware Node runs multiple Containers providing a number of critical services, its outage might be very costly. Hardware Node outage can be as disastrous as the simultaneous outage of a number of servers running critical services.

To increase Hardware Node availability and security, follow the recommendations below:

- Use RAID storage for critical Container private areas. Do prefer hardware RAIDs to software mirroring RAIDs.
- Do not run software on the Hardware Node itself. Create special Containers and host the necessary services in them. For example, host:
  - FTP or IIS inside special Windows Containers
  - BIND, FTPD, or HTTPD inside special Linux Containers

  Parallels Virtuozzo does not need any standard system services to be run on the Hardware Node. Therefore, you are recommended to disable all the services on the Node except for the Virtuozzo-specific services.
- Use firewalls to make the Hardware Node accept connections from a pre-defined set of IP addresses only.
- Do not create users on the Hardware Node itself. You can create as many users as you need in any Container. Remember: compromising the Hardware Node means compromising all Containers as well.
- Do not remove any of the components installed on the Hardware Node. Removing an installed component (for example, Internet Information Server), even if you do not use it, might cause Parallels Virtuozzo to malfunction.

CHAPTER 4

Evaluating Parallels Virtuozzo Containers

This chapter provides a list of step-by-step procedures that may be performed on an evaluation Parallels Virtuozzo installation to assess the following features:

- creating new Containers on the Hardware Node
- starting and stopping existing Containers
- configuring Container parameters
- migrating a physical server to a Container on the Hardware Node
- migrating a Container from one Hardware Node to another
- backing up and restoring Containers
- managing the physical and logical Parallels Virtuozzo infrastructure
- connecting Containers to external networks
- deploying Windows and Linux clusters in Parallels Virtuozzo-based systems

We assume that you have already installed and configured the Parallels Virtuozzo Containers software on one or more Windows or Linux servers, installed the Virtuozzo license, and set Parallels Infrastructure Manager/Parallels Power Panel to work. If you have not, turn to the previous chapters to learn how to perform these operations.

In This Chapter

Creating Container

To create a new Container in Parallels Infrastructure Manager, do the following:

1. Log in to the Hardware Node where you want to create the Container via Parallels Infrastructure Manager. Detailed information on how you can do it is provided in Setting Parallels Infrastructure Manager to Work (p. 46).
2. Open the Container creation wizard by clicking the New button on the Parallels Infrastructure Manager toolbar and selecting Container on the drop-down menu.

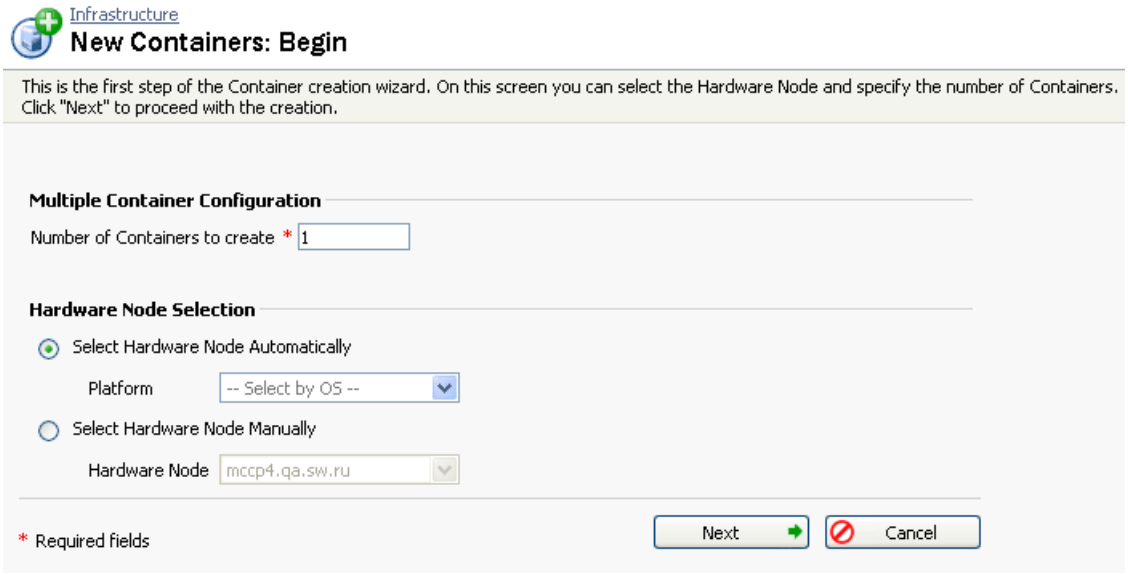

Figure 9: Infrastructure Manager - Creating New Container

3. On the New Containers: Begin screen:
   - Under Multiple Container Configuration, specify the number of Containers you want to create. By default, one Container is created.
   - Under Hardware Node Selection, specify the Hardware Node where the Container is to be hosted. If you have several Hardware Node registered in Parallels Infrastructure Manager, you can select the Select Hardware Node Manually radio button and choose the needed Hardware Node on the drop-down menu. You can also leave the Select Hardware Automatically check box selected and let Parallels Infrastructure Manager choose the right Node for you.

   Click Next to continue.
4. On the New Containers: Setup screen, do the following:

   Under General Configuration:
   - In the Name field, designate a name for the Container. The name can be used when managing the Container with various Virtuozzo tools.
   - In the Description field, type any additional information about your Container.

- Open the Select Container Sample menu and choose a Container sample. Container samples define the amount of system resources available to Containers and the applications to be installed inside Containers.
- Click on the OS Template/Version menu and select an OS template - the Container pre-installed operating system. You can choose any of the available OS templates for the Container creation.

So, your General Configuration group may look like the following after filling the aforementioned fields.

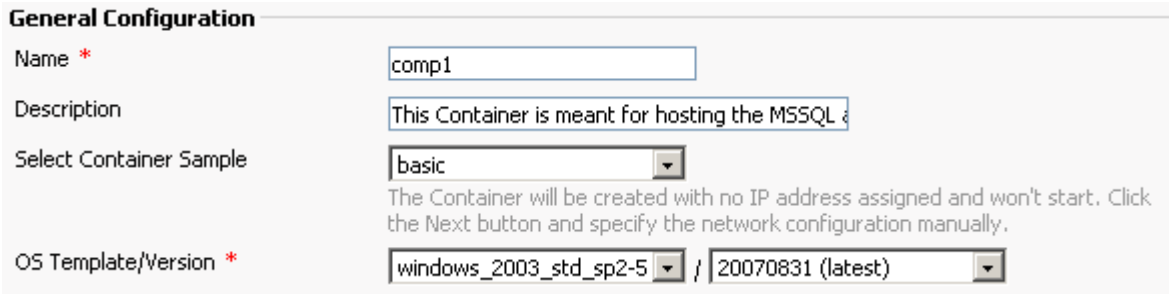

Figure 10: Infrastructure Manager - Setting Container General Configuration Parameters

Next, set the following Container parameters:

- In the Hostname field under Network Configuration, define the Container hostname.
- Under Administrative Password, specify the password to be used to access the Container via SSH (for Linux Containers) or RDP (for Windows Containers).
- Under Offline Management, make sure that the Use the actual settings of the Hardware Node radio button is selected. If enabled, the offline management option allows you to use Parallels Power Panel for managing your Container even if it is stopped.

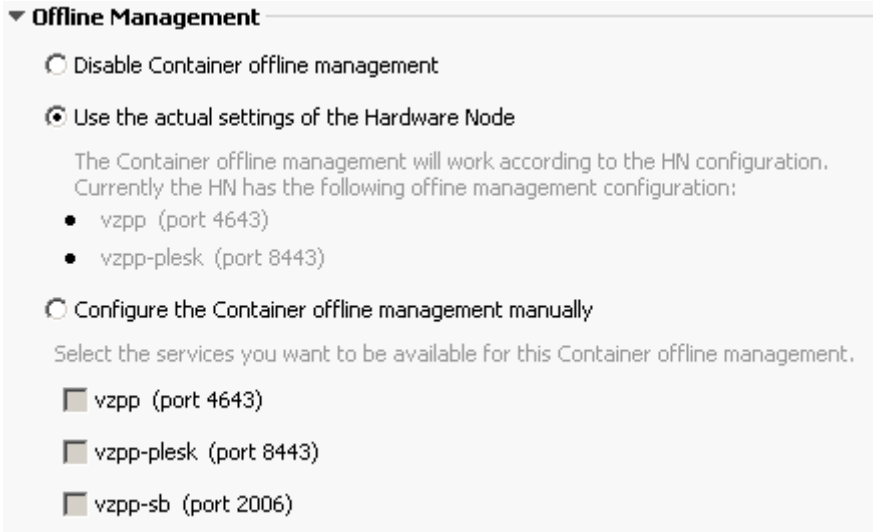

Figure 11: Infrastructure Manager - Enabling Offline Management

Click Next to continue.

5 On the New Containers: Network Configuration screen, ascertain that the Routed Network check box is selected. Using the routed network mode, you can easily configure the Container network interfaces for the immediate connection to the network of the newly created Container. All you have to do is to enter a valid IP address for the Container in the IP Address field.

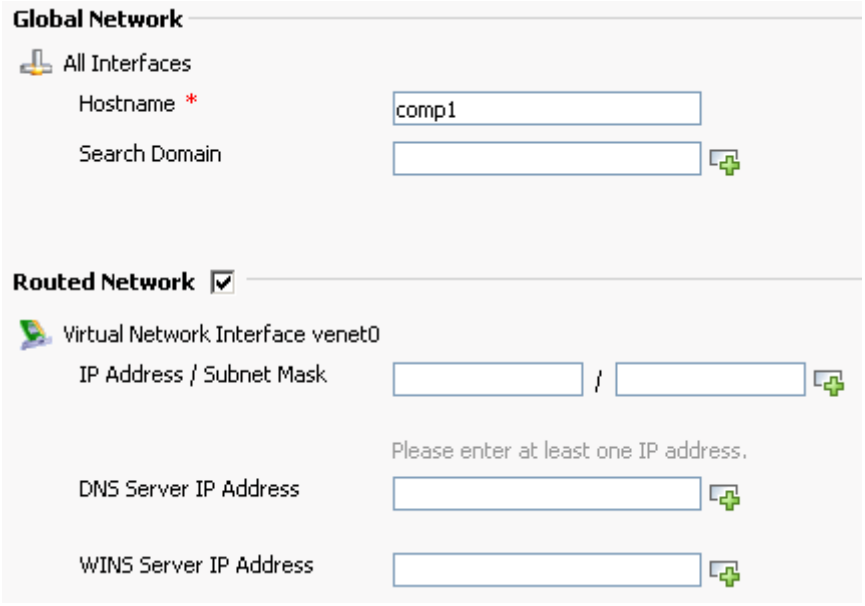

Figure 12: Infrastructure Manager - Setting IP Address

6 Click the Create button to start creating the Container. The Container creation is asynchronous; it is scheduled at the moment you invoke it. You can see the status and progress of this operation by clicking the Details or Active Tasks link.

Performing Main Operations on Container

A Container may be started up, restarted, and shut down like an ordinary computer. Depending on the Container state, only those operations are accessible that comply with its current state. For example, a running Container cannot be started for obvious reasons as well as a stopped Container cannot be shut down.

To start, stop, or restart one or more Containers in Parallels Infrastructure Manager, click the Containers tab in the Infrastructure window, select the check boxes of the corresponding Containers, and click Start, Stop, or Restart to perform the appropriate action.

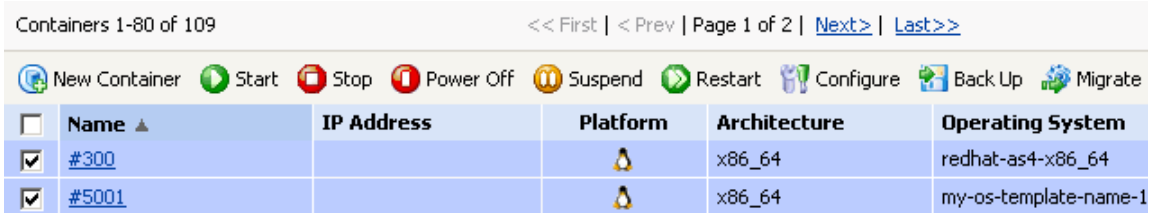

Figure 13: Infrastructure Manager - Starting Container

Keep in mind that starting or stopping a considerable number of Containers may take a rather long run. You can view the progress in the Task Details window displayed on clicking the Details link under the Parallels Infrastructure Manager toolbar:

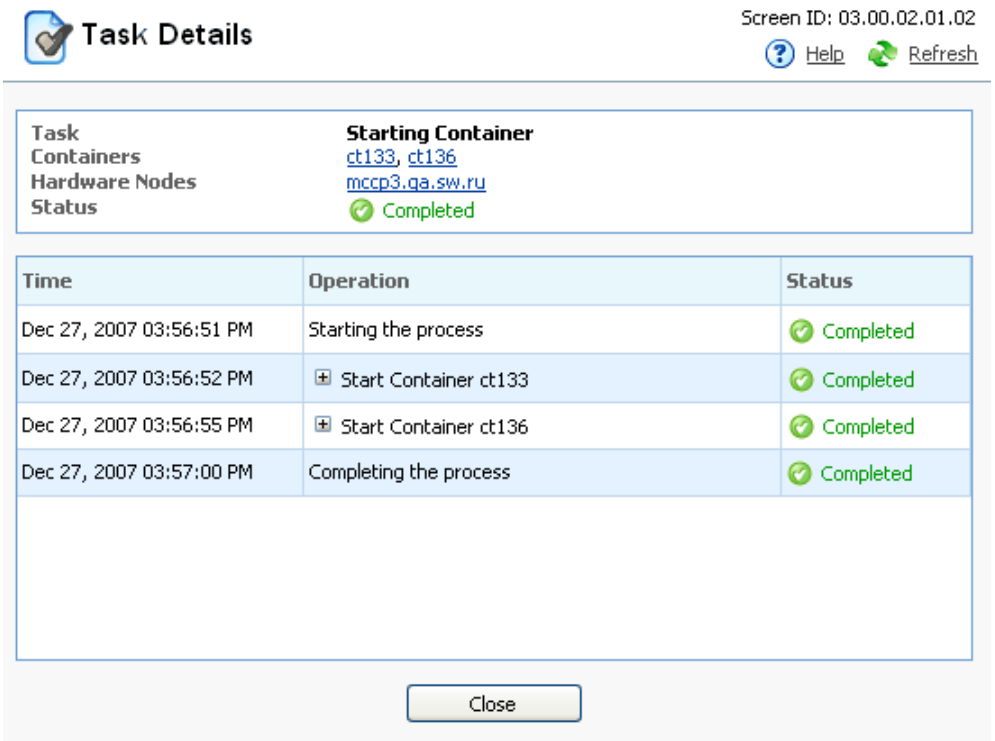

Figure 14: Infrastructure Manager - Viewing Task Progress

To delete a running Container, you must first stop it. To delete one or more Containers that have been already stopped, select their check boxes on the Containers tab of the Infrastructure window, and click Delete on the task toolbar.

Accessing Container

After the Container has been successfully created, you can access it in the same way you would normally access a standalone server:

- using the standard Windows Remote Desktop Protocol (RDP) to access Windows Containers
- using the Secure Shell Protocol (SSH) to access Linux Containers

To connect to your Containers using these protocols, do the following:

1. On the Containers tab on the Infrastructure window, click the name of the Container you wish to log in.
2. In the displayed window, click the Login button on the Parallels Infrastructure Manager toolbar, and select Terminal Login on the drop-down menu.
3. After the connection is established, log in to the Container:
   - To log in to the Windows Container, use the `Administrator` user name and the password you specified when creating the Container.
   - To log in to the Linux Container, use the `root` user name and the password you specified when creating the Container.

Configuring Container Parameters

Parallels Infrastructure Manager allows you to configure the Container parameters specified during the Container creation. To do that, click the name of the corresponding Container in the table on the Containers tab of the Infrastructure window. All the parameters that can be modified are presented on a number of tabs within the Container dashboard:

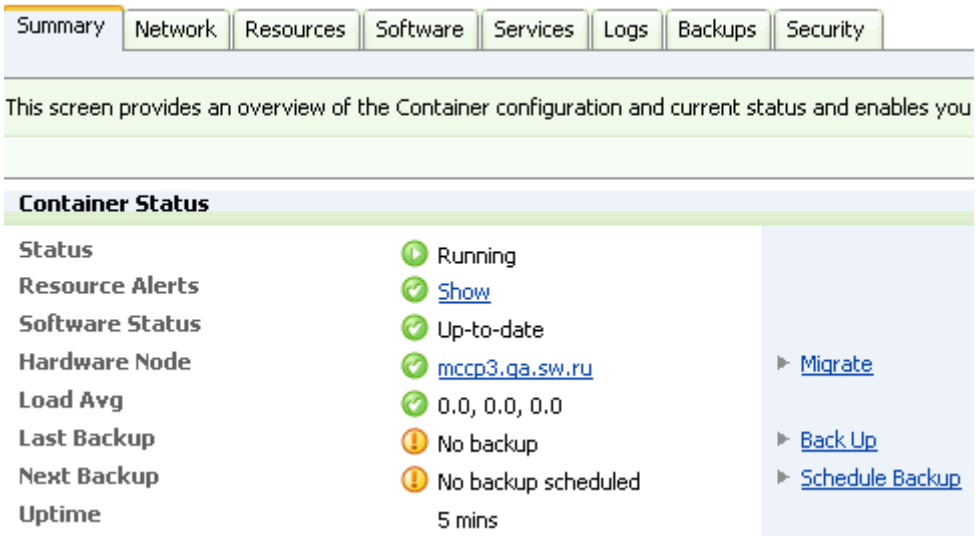

Figure 15: Infrastructure Manager - Container Dashboard Tabs

For example, to add another IP address to the Container, go to the Network tab, click the Configure icon in the toolbar, and use the plus sign to add a new IP address. After configuring the necessary options, click the Submit button.

Managing Container Resources

Parallels Virtuozzo Containers allows you to differentiate the Quality of Service for separate Containers by adjusting the following resource characteristics:

- disk space
- CPU time share
- private memory

Setting Container Disk Quota

The Parallels Virtuozzo disk quota allows you to set the amount of disk space to be available to your Containers. As with any other resource, you can set or change this in near real time, even without a Container restart. To set or change the disk quota for a Container in Parallels Infrastructure Manager, perform the following operations:

1. Click the name of the Container whose disk quota you wish to set or configure on the Containers tab of the Infrastructure window.
2. On the Container dashboard, click the Configure button in the Parallels Infrastructure Manager toolbar, and select Resources on the drop-down menu:

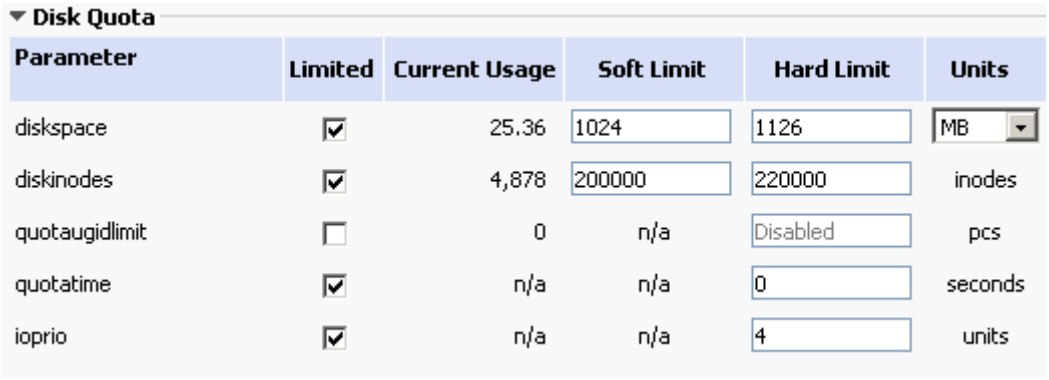

Figure 16: Infrastructure Manager - Setting Container Disk Quota

3. On the Configure screen, you can view and configure, if necessary, a number of disk quota-related parameters. The Container disk space corresponds to the `diskspace` parameter. The hard limit cannot be exceeded by the Container, while the soft limit value can be exceeded for a limited time. To modify the current Container disk space limit, type the needed value in the Soft Limit and Hard Limit fields, and click the Submit button. The Container virtual storage size will be increased immediately.

Managing Container CPU Parameters

A Container's CPU is determined by a combination of several CPU-related parameters. The two most important of them are `CPU UNITS` and `CPU LIMIT`:

- The `CPU UNITS` parameter defines the priorities of Containers accessing the system CPUs concurrently.
- The `CPU LIMIT` parameter allows you to set a hard limit to the Container's CPU consumption even if no other Containers are using the CPU time.

To configure both CPU parameters for a Container in Parallels Infrastructure Manager, do the following:

1. Click the name of the Container whose CPU parameters you wish to configure on the Container tab of the Infrastructure window.
2. On the Container dashboard, click the Configure button in the Parallels Infrastructure Manager toolbar, and select Resources on the drop-down menu:

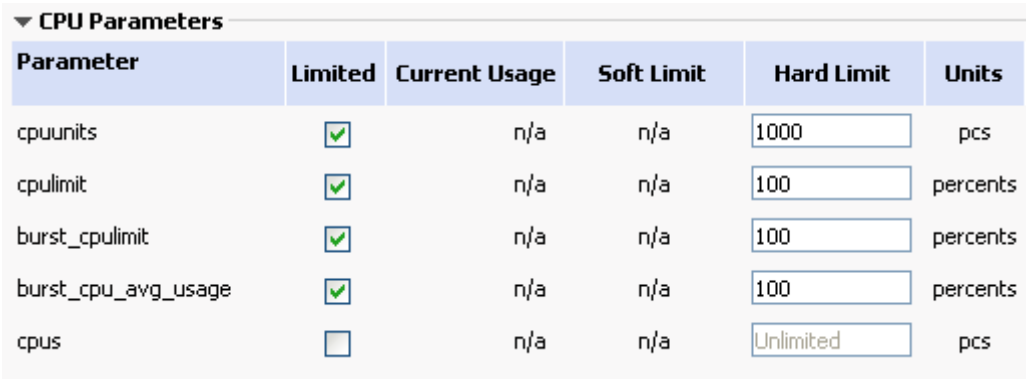

Figure 17: Infrastructure Manager - Managing Container CPU Parameters

3. On the Configure screen, you can view and modify, if necessary, the current value of the `CPU UNITS` and `CPU LIMIT` parameters. For example, if you wish Container #1 to get three times more CPU time than Container #2 when all CPUs on the Hardware Node are fully loaded, you must set the value of the `CPU UNITS` parameter for Container #1 to 3000 and for Container #2 - to 1000. At the same time, if you wish Container #1 to never consume more than 50% of the total CPU time, you can set the value of the `CPU LIMIT` parameter for this Container to 50%.

Setting Container Memory

The amount of physical memory a Container is allowed to consume is determined by the `SLM MEMORY LIMIT` parameter for Linux-based Containers or the `VPRVMEM` parameter for Windows-based Containers. If you need to add extra memory for your Container, you can change the memory allocation at any time by completing the following tasks in Parallels Infrastructure Manager:

1. Click the name of the Container for which you wish to configure the memory limit on the Container tab of the Infrastructure window.
2. On the Container dashboard, click the Configure button in the Infrastructure Manager toolbar, and select Resources on the drop-down menu.
3. On the Configure screen under the Primary UBC Parameters group, you can view and modify, if necessary, the memory limit currently set for the Container. For example, for a Windows Container, you can do it by typing the needed memory value in the Limit field opposite the `vprvmem` parameter.
4. After you click the Submit button, the changes will immediately come into effect.

Managing Application Templates

Parallels Virtuozzo templates technology automates the installation of applications in any number of Containers. To add an application template to several Containers at once in Parallels Infrastructure Manager:

1. Select its name on the Templates tab of the Infrastructure window, and click the Add to Containers link.
2. On the Add to Containers screen, click the Add Containers button.
3. In the Container Selector window, select the check boxes next to the Containers where you with to install the template, and click the Use selected button.
4. Click the Install button.

You can check that the application template has been successfully applied to your Containers by completing the following tasks in Parallels Infrastructure Manager:

1. On the Containers tab of the Infrastructure window, click the name of the corresponding Container.
2. On the Container dashboard, click the Software tab, and then click the Applications Templates subtab:

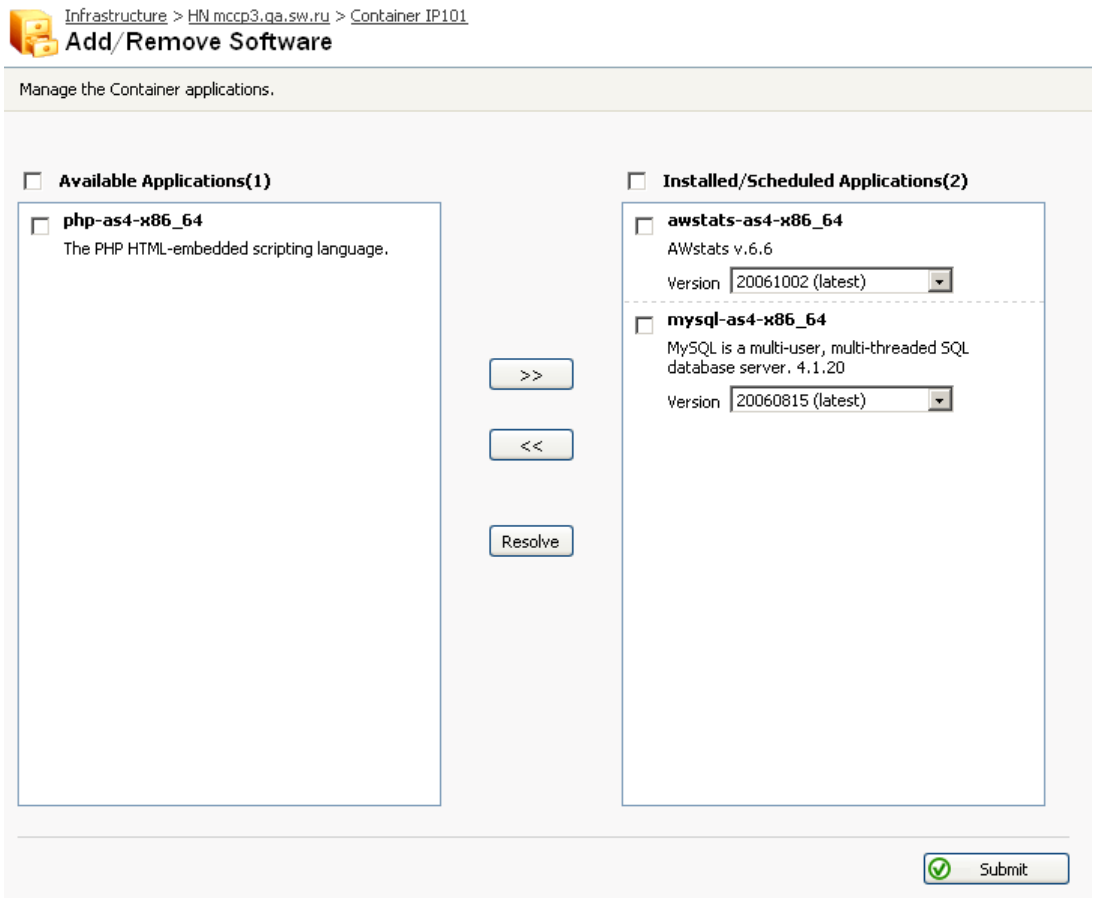

Figure 18: Infrastructure Manager - Managing Container Application Templates

The application template currently installed inside the Container are displayed in the Installed/Scheduled Applications table. On this subtab, you can also do the following:

- Add a new application template to the Container by selecting its check box in the Available Applications table, clicking the >> button, and then clicking Submit.
- Remove those application templates from the Container that you do not need any more from the Container by selecting the check boxes next to the corresponding templates in the Installed/Scheduled Applications table, clicking the << button, and then clicking Submit.
- For Linux Containers, check unresolved dependencies among the selected applications with the help of the Resolve button. To eliminate unresolved dependencies, you can remove one of the problem applications from the Installed/Scheduled Applications table as explained above.

Migrating Physical Server to Container

The physical-to-virtual migration is often used in server consolidation scenarios. During migration, Parallels Virtuozzo connects to the server via the network and copies its data and applications to a Container, leaving the original server intact. Parallels Infrastructure Manager allows you to migrate any physical server in your local network using the Migrate Server to Container wizard. To invoke the wizard, click the Migrate Server to Container link on the Summary tab of the Infrastructure window. In this wizard, do the following:

1 Establish a connection to the server being migrated. To do this, specify the server hostname or IP address, enter the administrator's name and password, and choose the Hardware Node that will host the resulting Container. For example:

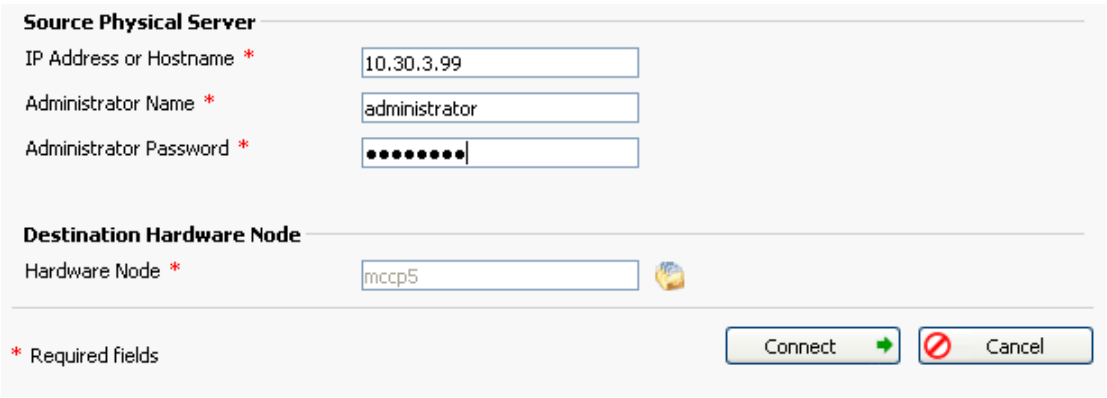

Figure 19: Infrastructure Manager - Specifying Connection Parameters

After providing the necessary information on the server, click Connect. On a successful connection, a summary of the physical server's configuration is displayed:

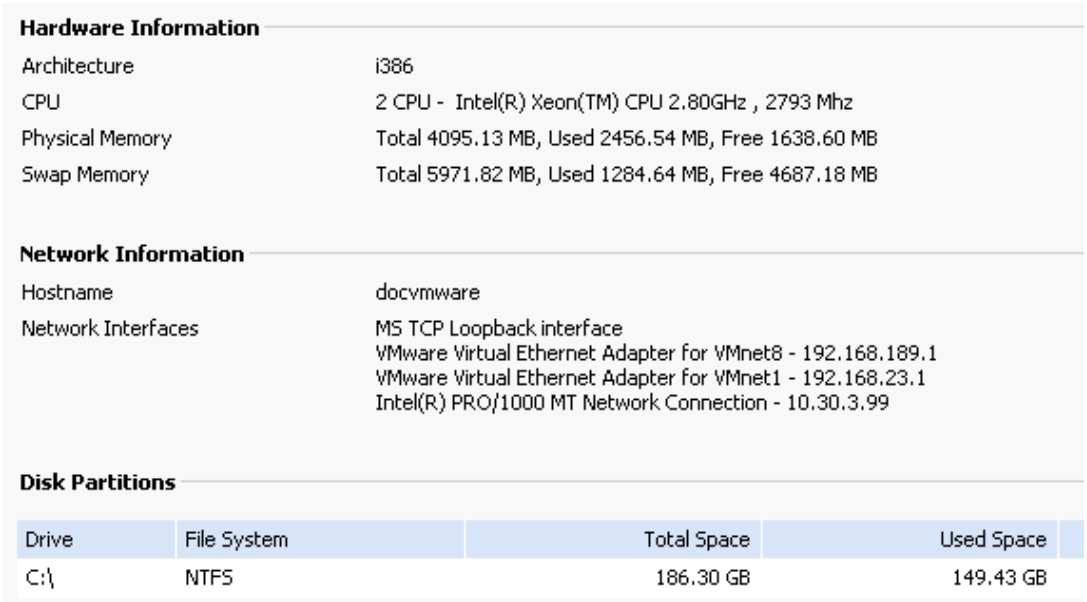

Figure 20: Infrastructure Manager - Reviewing Server Configuration

2 In the second step, you can exclude some of the server's disks from being transferred by specifying their paths in the Exclude Paths field. For example, you may wish to eliminate networked or CD-ROM drives.

3 Next, you can define the parameters of the Container where the physical server will be migrated. Parallels Virtuozzo automatically detects optimal Container settings based on the physical server configuration. So, all you have to do is specify an arbitrary name for the Container in the Name field. For example:

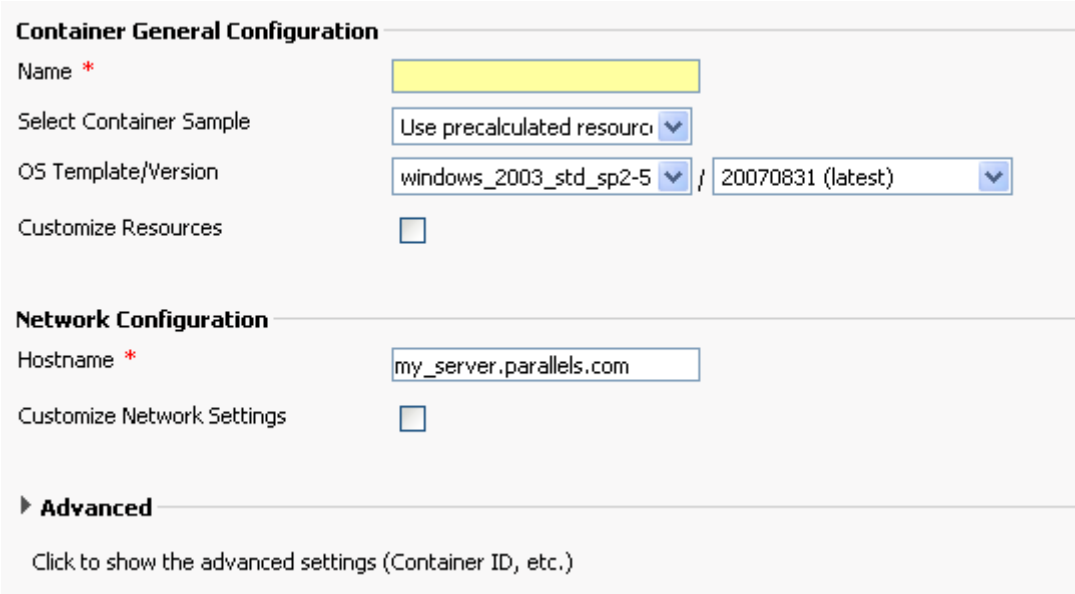

Figure 21: Infrastructure Manager - Specifying Container Name

4 On the Migrate Server to Container: Final screen, click the Migrate button to start the migration. After the migration is complete, you will have the exact copy of the physical server in a Container.

Migrating Container

If you have installed the Parallels Virtuozzo Containers software on two or more servers running either Windows or Linux OS, you can try to migrate a running Container from one Hardware Node to another. For example, Container migration may be necessary if you need to redistribute your virtual workloads between physical servers or need to bring one of the servers offline for planned maintenance. To migrate one or more Containers another Hardware Node using Parallels Infrastructure Manager, perform the following operations:

1. On the Containers tab of the Infrastructure window, select the check boxes next to the Containers you wish to migrate, and click the Migrate button.
2. On the Migrate Containers screen, choose the Destination Node where the Container is to be moved. You can choose any of the Nodes registered in Parallels Infrastructure Manager and having the same operating system installed.

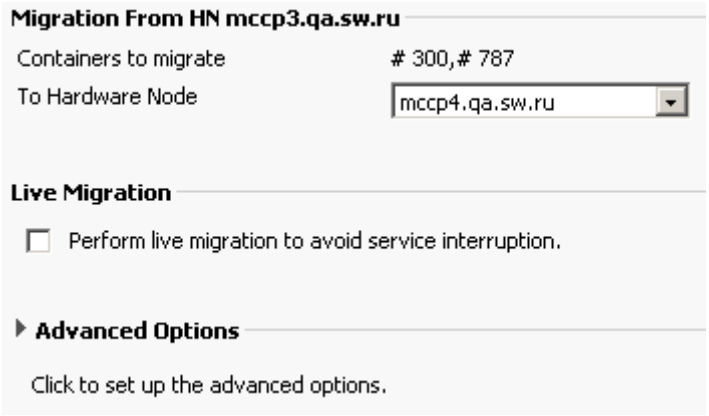

Figure 22: Infrastructure Manager - Migrating Containers

3. Click the Migrate button to start the Container migration.

Backing Up and Restoring Containers

In Parallels Infrastructure Manager, you can easily back up any number of Containers and restore them at any time should the operating Containers become corrupted. This can be done as follows:

1. Select one or more Containers from the Container list on the Containers tab of the Infrastructure window, and click the Back Up link on the toolbar.
2. On the New Container Backups screen, you can define the following Container backup parameters:
   - In the Backup Description field, provide the backup description.
   - Under the Backup Options, set the backup type, compression level, and the Backup Node where the Container backup will be stored:

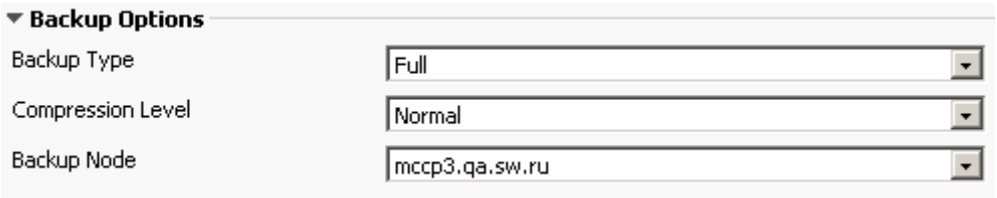

Figure 23: Infrastructure Manager - Defining Container Backup Parameters

   - In the Exclude field, specify Container data to be excluded from the Container backup.
3. Click the Backup button.

You can view all the available Container backups on the Backups tab of the Infrastructure window:

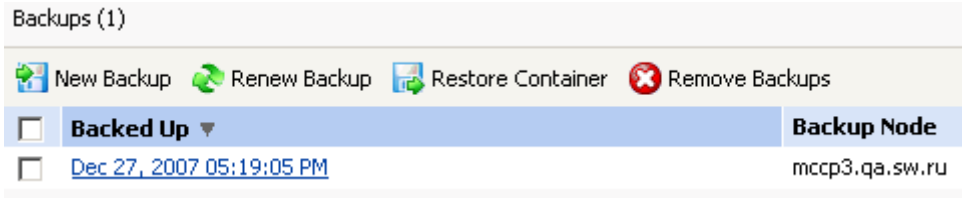

Figure 24: Infrastructure Manager - Listing Container Backups

On this tab, you can also perform the following backup-related operations:

- Create a new Container backup by clicking the New Backup link on the toolbar and following the instructions of the New Container Backups wizard.
- Remove an existing Container backup by selecting its check box and clicking the Remove Backups link on the toolbar.
- Restore a Containers from its backup by selecting the check box next to the backup you wish to restore and clicking the Restore Container link on the toolbar. Note that all the changes made to the Container since this backup will be discarded.

If you wish to restore a particular file or folder, do the following:

1 Click the name of the corresponding Container on the Containers tab of the Infrastructure window.

2 On the Container dashboard, click the Backups tab.

3 Click the corresponding Container backup, and then click the Browse button on the toolbar:

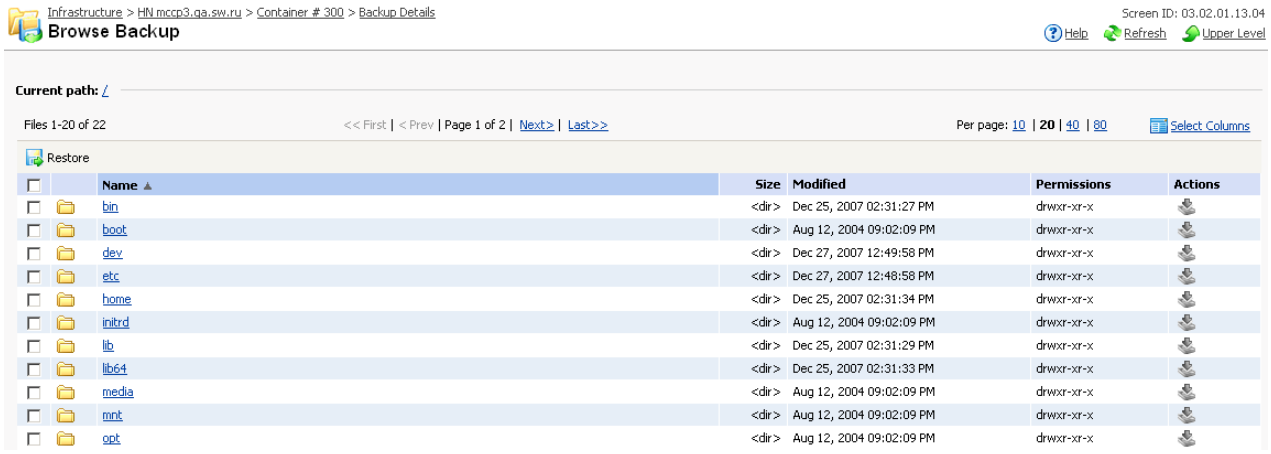

Figure 25: Backing Up and Restoring Containers

4 Choose the files and folders to restore from the backup, and then click the Restore button on the toolbar.

Scheduling Container Backup

Parallels Infrastructure Manager allows you to automate the task of backing up your Containers by setting Container backups to be run on a schedule. So, you can specify certain time intervals when the Container backup will be automatically performed. A schedule can be set for a Container to be backed up at different intervals: daily, weekly, monthly. It is also possible to specify a particular day of month for a Container backup to be executed.

To create an automated backup task, do the following:

1. Click the Scheduler link under the Management group in the left Infrastructure Manager pane, and then click New Task on the toolbar.
2. Select the Back up Containers radio button, and click Next.
3. In the New Task: Back Up Containers window, define the following backup task parameters:
   - Specify a name for the backup task in the Title field, and provide its description, if necessary, in the Description field.
   - Indicate the time and date of the first backup task run in the First Run section, and set the task recurrence by selecting the corresponding radio button in the Recurrence Pattern section.
   - Choose the Containers you want to back up on the set schedule by clicking the Add Containers button, selecting the needed Container in the Container Selector window, and clicking the Use Selected button.
   - Choose the backup type, the backup compression level, and the Backup Node to store the resulting backups.

   For example, your New Task: Back Up Containers window may look like the following after specifying the necessary parameters:

Figure 26: Infrastructure Manager - Scheduling Container Backup

4 Click the Save button.

Reinstalling Container

You may wish to reinstall a Container if it becomes seriously corrupted, and no other means to recover the Container, such as backup, are available. To reinstall a Container in Parallels Infrastructure Manager, follow these steps:

1 On the Containers tab of the Infrastructure window, click the name of the Container you wish to restore.

2 On the Container dashboard, click the Reinstall Container link in the Task section.

3 On the Reinstall Container screen, click the Prepare to Reinstall button:

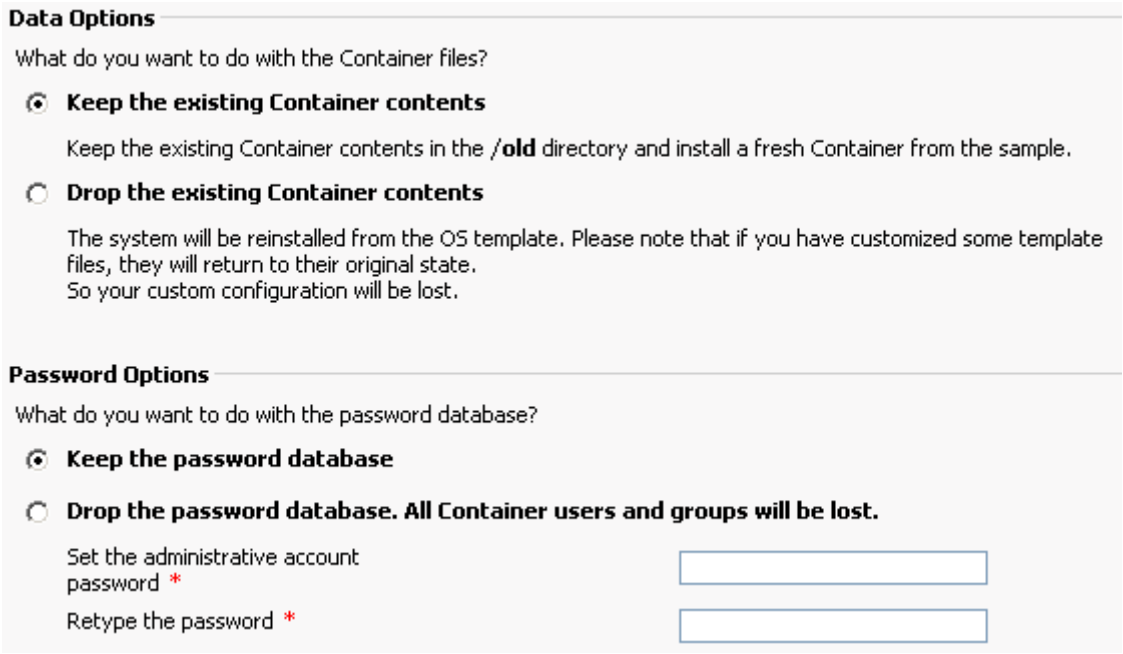

Figure 27: Infrastructure Manager - Reinstalling Container

4 In the displayed window, you can do the following:

- Under Data Options:

  a Select the Keep the existing Container contents radio button if you want to preserve all your personal files inside the reinstalled Container. These files will be moved to the `/old` directory inside the Container during its reinstallation.

  b Select the Drop the existing Container contents radio button if you want to recreate the Container from scratch.

- Under Password Options, decide whether to retain the information on the Container users and groups (select the Keep the password database radio button) or to purge all 'Container users and groups'-related data and create only the `Administrator` (for Windows Containers) or `root` (for Linux Containers) account with the password specified in the Set the administrative account password and Retype the password fields (select the Drop the password database... radio button).

5 On the Reinstall Container: Final Confirmation screen, click Reinstall to start reinstalling the Container.

Managing Parallels Virtuozzo Infrastructure

Parallels Infrastructure Manager allows you to organize the multitude of registered Hardware Nodes and existing Containers in such a way that

- All of them present a logical and easily manageable structure, with as many levels as you like.
- Some Parallels Virtuozzo objects, like OS and application templates and Container backups, are automatically filtered to conform to the current level of the object hierarchy.
- The Infrastructure Manager security policies can be set up not on the Hardware Node or Container level, but on the level of an arbitrary group of objects, provided these objects are united into a folder.

Registering Hardware Node

You can register in Parallels Infrastructure Manager any Windows or Linux Hardware Nodes. The Nodes that are added to an existing group automatically become Client (or Slave) Nodes, as any group can have only one Master Node for storing a centralized database of the main Hardware Node parameters (e.g. IP addresses or Container configuration samples). To register a new Node in Parallels Infrastructure Manager, do the following:

1 On the Summary tab of the Infrastructure window, click New on the Infrastructure Manager toolbar, and select Hardware Node on the drop-down menu:

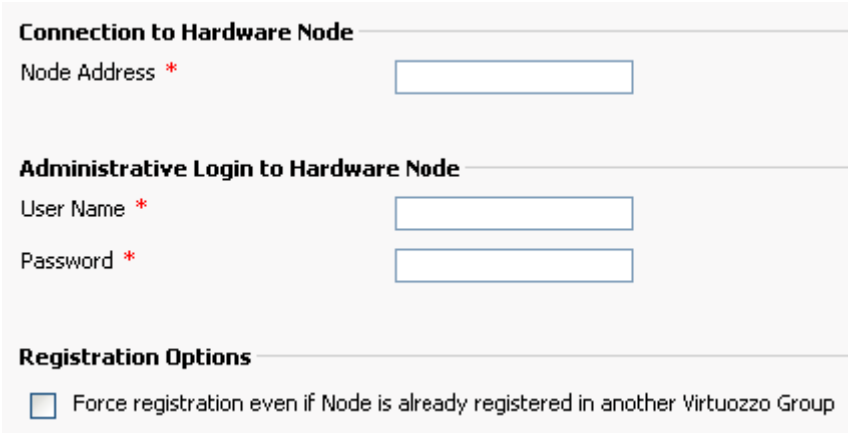

Figure 28: Infrastructure Manager - Registering New Hardware Node

2 On the New Hardware Node: Set Up Connection screen, specify the following information:

- In the Node Address field, enter the IP address or hostname assigned to the Hardware Node and to be used by Parallels Infrastructure Manager to access this Node.
- In the Administrative Login to Hardware Node section, provide the credentials of the `Administrator` (for Windows Nodes) or `root` (for Linux Nodes) user.
- If you are registering a Hardware Node that is already included in some Virtuozzo Group, you must also select the Force registration... check box. In this case the Node will forcibly be removed from the original Virtuozzo Group and added to the one you are currently working with.

3 Click the Register button to initiate the registering procedure.

The newly registered Node is displayed on the Hardware Nodes tab of the Infrastructure window and becomes accessible via Parallels Infrastructure Manager for all the usual managing and monitoring operations.

Managing Parallels Virtuozzo Infrastructure

There are two independent ways to design the Parallels Virtuozzo structure organization. They are called Infrastructure and Logical View and presented as top-level elements in the Parallels Infrastructure Manager left menu:

Figure 29: Infrastructure Manager - Infrastructure and Logical View

You can use either one of them or, better, both at once, as their functions are different:

- Infrastructure allows you to display the physical organization of the Parallels Virtuozzo infrastructure. For example, all the Hardware Nodes will sit one level lower than the datacenter, and all the Containers running on a certain Node will be shown under it. You can create your own folders in the Infrastructure group, but you cannot violate the order of nesting objects. As a way to help with the visual representation of physical objects, the folders you create here can also be called *Datacenters* and *Racks*.
- Logical View allows you to group your Hardware Nodes and Containers in your own way independently of the physical infrastructure. For example, by grouping all the financial department activities under a common `FinDep` folder, your organization will be able to manage them as a single entity by collectively managing permissions, scheduling backups, applying system updates, and more. Another peculiarity of the logical view is that any Hardware Node or Container may simultaneously appear in any number of folders.

Managing Physical Infrastructure Organization

In Parallels Infrastructure Manager, you can manage the Virtuozzo physical infrastructure in the following ways:

- Create new folders under the Infrastructure item and remove existing ones.
- Add Hardware Nodes to and remove them from any of the existing folders.

Both operations are described in the following subsections in detail.

Managing Folders

Depending on whether this is a physical or logical structure of your Parallels Virtuozzo servers to which you are adding a new object, you may create a *Folder*, a *Datacenter*, or a *Rack*, when devising their physical representation, and a *Folder* or a *Datacenter*, correspondingly, if you are working with the logical representation of your servers. The Folder Title field is obligatory: it will be displayed in the Infrastructure Manager left menu after the folder has been created.

When devising the physical representation of your Hardware Nodes in Parallels Infrastructure Manager, you can make use of the following folder types: *Folder*, *Datacenter*, and *Rack*. As a rule, these folder types differ from each other only in the number of Hardware Nodes included in them. However, such subdivision does not impose any restrictions on functional capabilities of Hardware Nodes in these folder types and serves for your convenience only.

To create any of the aforementioned folders, perform the following operations:

1 Click the Add New Subfolder button on the Summary tab of the Infrastructure window.

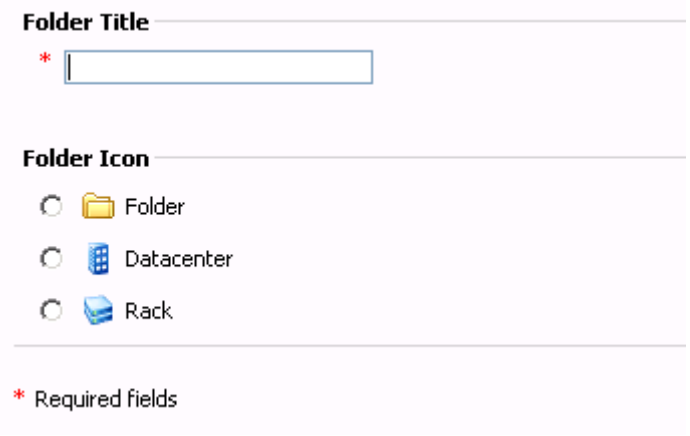

Figure 30: Infrastructure Manager - Adding Folder

2 In the Add Folder window:

- Specify an arbitrary name to be assigned to the folder in the Folder Title field.
- Select the Folder, Datacenter, or Rack radio button depending on what folder you want to create.

3 Click the Save button.

After a while, the newly created folder will be displayed under the Infrastructure item in the Infrastructure Manager left menu:

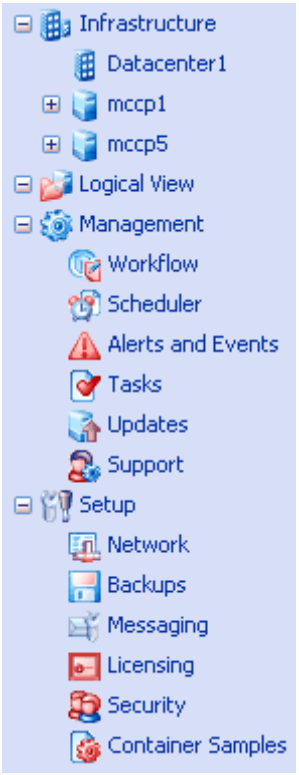

Figure 31: Infrastructure Manager - Viewing Folders

Parallels Infrastructure Manager allows you to manage any of the existing folders as follows:

- Change the name and the type of the folder:
  - Click the folder name on the Infrastructure Manager left menu.
  - Click the Manage Folder link on the Infrastructure Manager toolbar, and select Configure on the drop-down menu.
  - On the Configure screen, type the desired name in the Folder Title field, select the desired folder type, and click Submit.
- Move a folder to another place in the Infrastructure hierarchy:
  - Click the folder name on the Infrastructure Manager left menu.
  - Click the Manage Folder link on the Infrastructure Manager toolbar, and select Move on the drop-down menu.
  - On the Destination Folder drop-down menu, select the item where you wish to move the folder, and click Move.
- Remove a folder that you do need any more:
  - Click the name of the folder you wish to delete on the Infrastructure Manager left menu.
  - Click the Manage Folder link on the Infrastructure Manager toolbar, and select Delete on the drop-down menu.

Managing Hardware Nodes Within Folders

Before you can start using the newly created folder (*Folder*, *Datacenter*, or *Rack*) for your purposes, you should register one or more Hardware Nodes with it. You can use one of these ways to populate your folders:

- Include any of the Hardware Nodes registered in Parallels Infrastructure Manager in any of the existing folders.
- Add new Hardware Nodes, i.e. those Nodes that are currently not registered in Parallels Infrastructure Manager, to any of the existing folders.

Including a Registered Hardware Node

To include any of the Hardware Nodes registered in Parallels Infrastructure Manager in any of the existing folders, do the following

1. Click the Hardware Node tab on the Infrastructure screen.
2. Select the check boxes next to the corresponding Hardware Nodes, and click Move.
3. On the Move to Folder screen, choose the folder where the selected Hardware Nodes are to be moved:

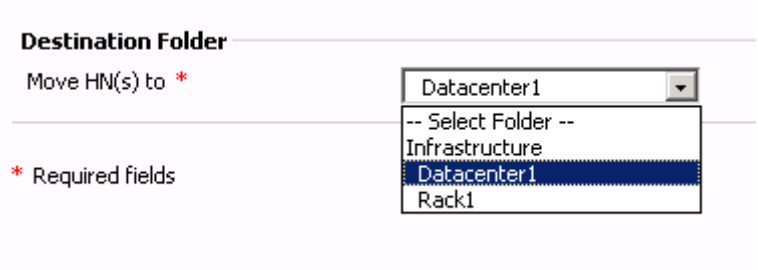

Figure 32: Infrastructure Manager - Selecting Folder

4. Click Submit.

Adding a New Hardware Node

To add a new Hardware Node to an existing folder, do the following:

1. Click the name of the folder where you wish to register the Node.
2. On the Hardware Nodes tab of the *Folder_Name* window, click New Hardware Node:

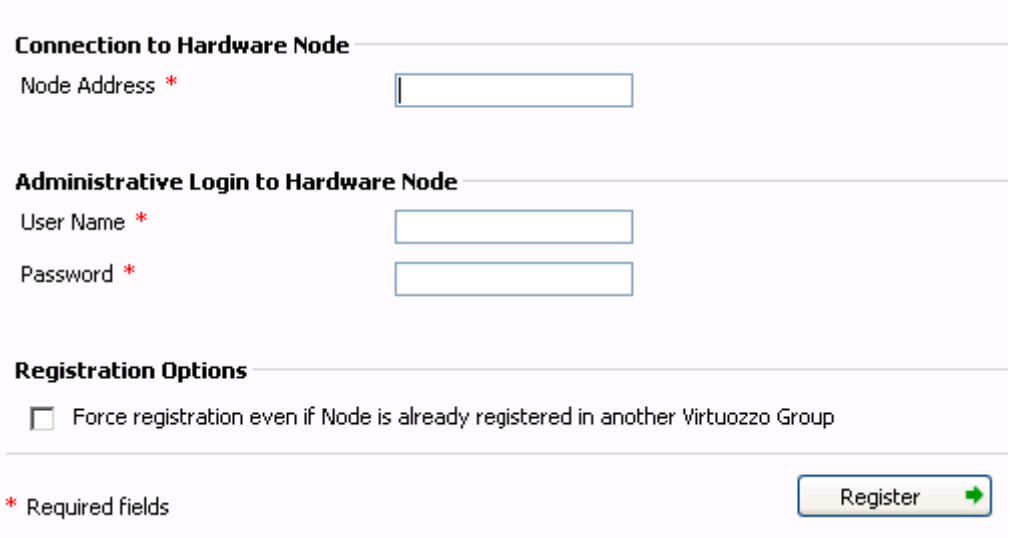

Figure 33: Infrastructure Manager - Registering Node With Folder

3 On the New Hardware Node: Set Up Connection screen, specify the necessary information to be used by Parallels Infrastructure Manager when connecting to the Hardware Node.

4 Click Register.

After the Hardware Node has been successfully registered with the folder, you can perform the following operations on this Node:

- View all the Hardware Nodes included in the folder on the Hardware Nodes tab of the *Folder_Name* window.
- Move a Hardware Node to another place in the Infrastructure hierarchy:
  - **a** On the Hardware Nodes tab of the Infrastructure window, select the check box next to the Node you wish to move and Move on the toolbar.
  - **b** On the Move to Folder screen, select the folder where the Node is to be moved, and click Submit.
- Remove a Hardware Node that you do need any more from the folder. To do this, select the check box next to the Node to be removed on the Hardware Nodes tab of the *Folder_Name* window, and click the Unregister link on the tool bar.

Managing Logical Infrastructure Organization

Along with establishing the physical organization of the Parallels Virtuozzo infrastructure (described in the previous subsections), you may wish to classify your Hardware Nodes included in the Virtuozzo group and their Containers by uniting them into separate logical groups (or *logical units*). For example, you can place all the financial department activities to the `FinDep` group and manage them as a single entity by collectively administering permissions, scheduling backups, applying system updates, and more.

Parallels Infrastructure Manager allows you to manage logical units as follows:

- create new logical units
- populate logical units with Hardware Nodes and Containers
- configure the parameters of existing logical units

Detailed information on all these operations is given in the following subsections.

Creating Logical Unit

Parallels Infrastructure Manager allows you to create logical units of two types:

- *Folders*. As a rule, these logical units are from small-sized to middle-sized and include several Hardware Nodes and/or their Containers.
- *Departments*. As a rule, these logical units are large-sized and include multiple Hardware Nodes and/or their Containers.

Such subdivision does not impose any restrictions on functional capabilities of logical units and serves for your convenience only (i.e. to better distinguish between different logical units).

To create a new logical unit, do the following:

1. Click the Logical View item on the Infrastructure Manager left menu.
2. Click the Add to Folder link on the Infrastructure Manager toolbar, and select Subfolder on the drop-down menu.

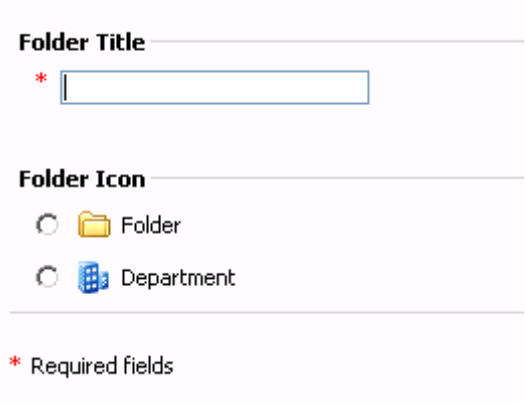

Figure 34: Creating Logical Unit

3. On the Add Folder screen:
   - Specify an arbitrary name to be assigned to the folder in the Folder Title field.
   - Select the Folder or Department radio button depending on what folder you wish to create.
4. Click the Save button.

Populating Folder

Before you can start using the newly created unit (either *Folder* or *Department*) for your purpose, you should populate it with a number of objects which can be represented by the following:

- Hardware Nodes
- Containers
- other *Folders* and *Departments*

To add any of these objects to a logical unit, do the following:

1. On the Infrastructure Manager left menu, click the name of the unit where you wish to include the object.
2. Click Add to Folder on the Infrastructure Manager toolbar, and select *Subfolder*, *Container*, or *Hardware Node* on the drop-down menu depending on what object you wish to add to your logical unit. For example, if you are adding a Container to your logical unit, you will presented with the following window:

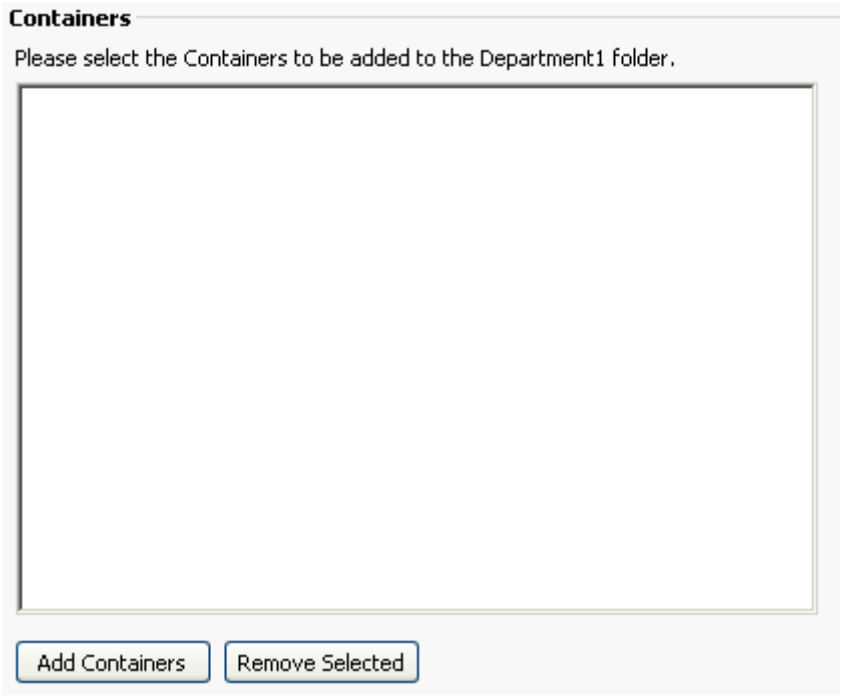

Figure 35: Infrastructure Manager - Adding Containers to Folder

3. Click the Add Containers button, select the Containers to be added to the unit in the Container Selector window, and then click the Use Selected button. The selected Containers are displayed in the table on the Add Containers window.
4. Click the Save button.

Managing Logical Units

Parallels Infrastructure Manager allows you to perform the following operations with any available logical units in the Virtuozzo Group:

- Display the Hardware Nodes and Containers included in the logical unit by clicking the logical unit name on the Infrastructure Manager left menu and selecting the Hardware Nodes and Containers tab, respectively. For example, the following picture represents Container #300 and Container #5001 registered in the `Department1` folder:

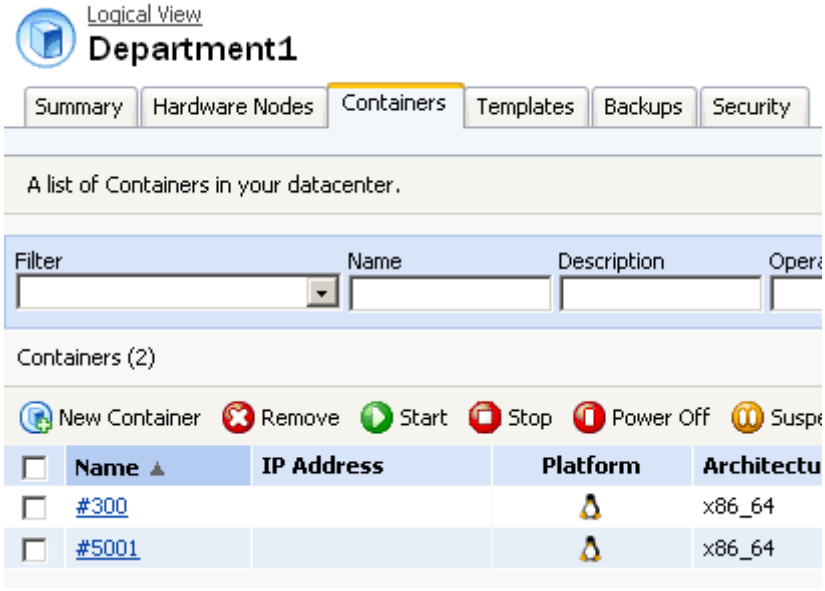

Figure 36: Infrastructure Manager - Viewing Registered Containers

- Add new objects (Hardware Nodes, Containers, and other logical units) to an existing logical unit. This procedure is described in the previous section in detail.
- Change the name and type of a logical unit:
  - **a** Click the logical unit name on the Infrastructure Manager left menu.
  - **b** Click the Manage Folder link on the Infrastructure Manager toolbar, and select Configure on the drop-down menu.
  - **c** On the Configure screen, change the folder name and type to your preferences, and click Submit.
- Remove a logical unit that you do need any more by selecting the unit name on the Infrastructure Manager left menu, clicking Manage Folder on the Infrastructure Manager toolbar, and selecting Delete on the drop-down menu.

Managing Users Access to Hardware Nodes and Containers

As the Hardware Node administrator, you can use the credentials of the `root` (for Linux Hardware Nodes) or `Administrator` (for Windows Hardware Nodes) user having a full administrative access to the Hardware Node to manage this Node and all its Containers by means of Parallels Infrastructure Manager. If you are managing a Virtuozzo Group and have access to the Master Node, you can access all Hardware Nodes included in the Virtuozzo Group and their Containers. At the same time, Parallels Virtuozzo allows you to grant the rights to other users to perform certain operations on the Hardware Node and/or its Containers. For example, you can allow some user to manage certain Containers only without having access to the remaining Containers on the Node and/or to the Node itself or to complete only a restricted set of tasks in the Container context (e.g. start, stop, and restart a Container without having the right to back up this Container or configure its resources).

The following example demonstrates how to grant a user access to certain Hardware Nodes and their Containers, to allow them to log in to these Node/Containers by means of Parallels Infrastructure Manager, and to perform a number of operations on them in accordance with the rights and permissions assigned to the user. In our example, we assume the following:

- 3 Hardware Nodes (`mccp2`, `mccp3`, `mccp4`) are registered in Parallels Infrastructure Manager. `mccp3` is the Master Node.
- Each of these Nodes hosts a number of Containers.
- You wish to grant the `User1` user access to Container #112, Container #113, and Container #114 on the `mccp3` Hardware Node. This user will be able to perform all typical administration tasks inside these Containers, but will not be able to access the `mccp2` and `mccp4` Nodes including all their Containers, as well as to manage the other Containers on the `mccp3` Node.

To create a user with such permissions, do the following:

1 Create the `User1` user:

- Log in to the `mccp3` Node via Infrastructure Manager.
- Click the Security link under Setup on the Infrastructure Manager left menu.
- On the New User screen, type `User1` in the Login field, and provide the user's password in the Type Password and Retype Password fields:

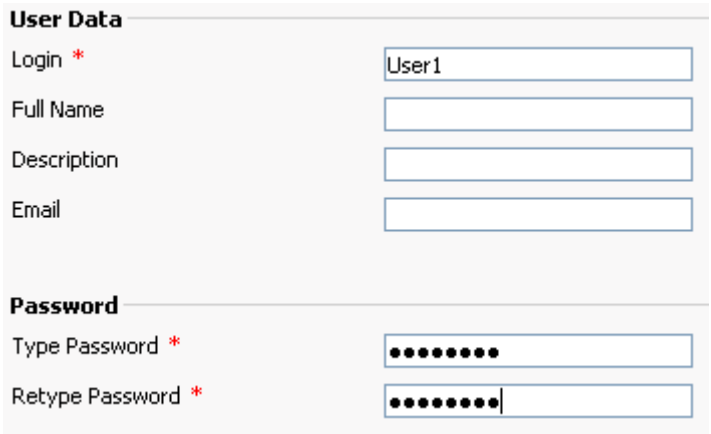

Figure 37: Infrastructure Manager - Creating New User

When you are ready, click the Submit button. After a while, the newly created user will be displayed in the Users table on the Users tab of the Security screen.

2 Next, create a new role. This role will define the user's privileges in respect of Container #112, Container #113, and Container #114:

- Click the Roles tab on the Security screen.
- Click the New Role link on the toolbar.
- On the New Role screen, specify an arbitrary name for the role in the Name field (e.g. `User1_Role`), and select the Container Management check box in the Privileges section.

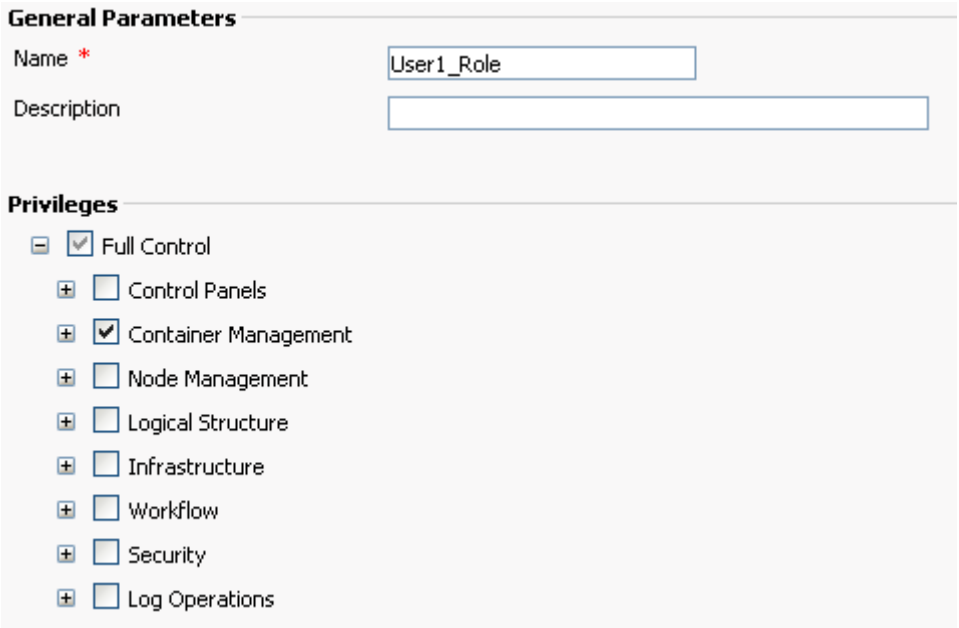

Figure 38: Infrastructure Manager - Creating New Role - Creating New Role

Click the Submit button. After a while, the newly created role will be displayed in the Roles table on the Roles tab of the Security screen.

3 Now assign the `User1_Role` role to the `User1` user. This can be done as follows:

- Click the mccp3 Hardware Node under Infrastructure on the Infrastructure Manager left menu.
- Click the Security tab on the Hardware Node dashboard.
- Click the New Permission link.
- On the Add Permission screen:

a Under Users and Groups, click the Add User button, select the check box next to User1 in the Specify Users window, and click the Add Selected button.

b Under Assigned Roles, select User1_Role in the Available table, and click the >> button:

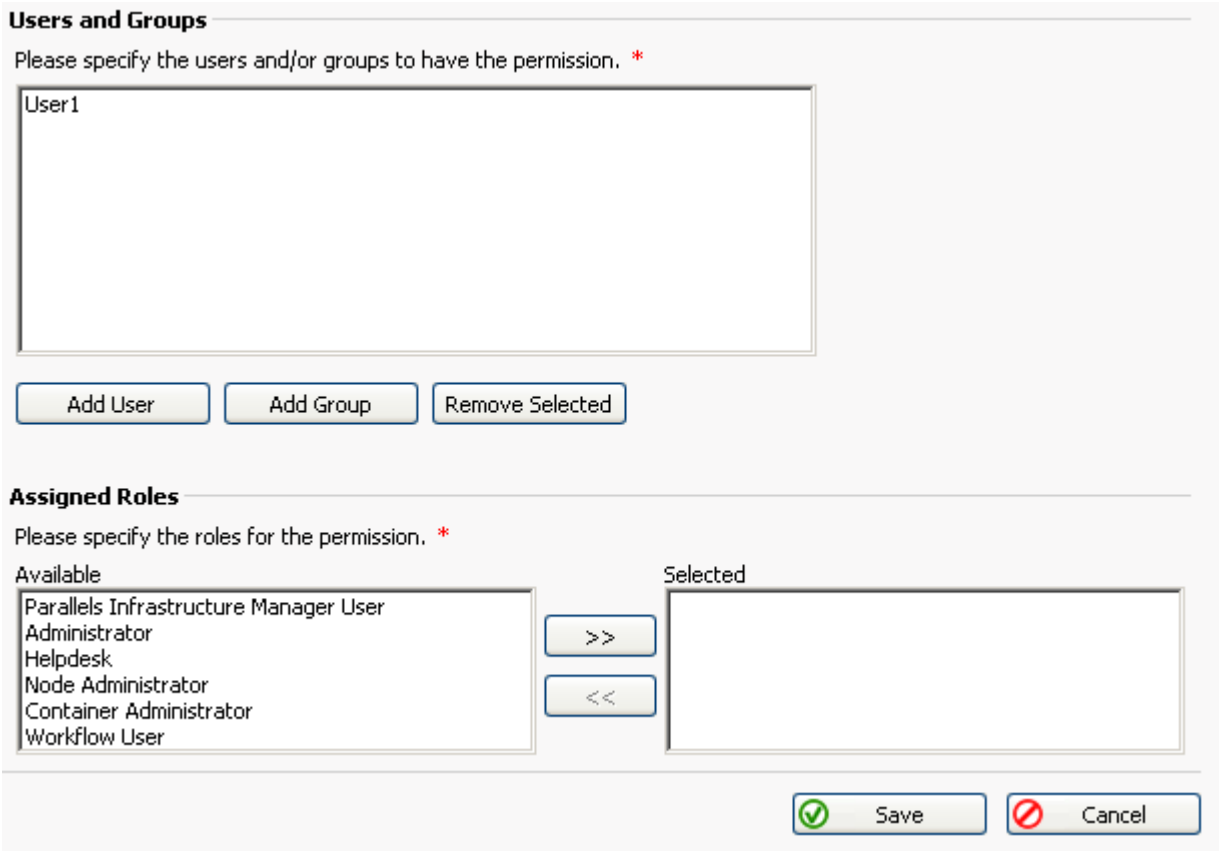

Figure 39: Infrastructure Manager - Creating New Permission

c Click Save.

Now log in to Parallels Infrastructure Manager using the User1 username and the password of this user. As you see, the user's privileges are now limited to only three Containers on the mccp3 Hardware Node: Container #112, Container #113, and Container #114.

Connecting Containers to External Networks

The Parallels Virtuozzo network is designed in such a way as to make Containers communicate with each other and computers on external networks. So, you can include your Containers in a wide range of network configurations the most common of which are Ethernet networks and Virtual Local Area Networks (VLANs). The process of connecting a Container to an Ethernet network or VLAN is carried out using one of the physical or VLAN adapters, respectively, available on the Hardware Node and involves completing the following tasks in Parallels Infrastructure Manager:

- Creating a Virtual Network on the Hardware Node which will act as a binding interface between a Container virtual network adapter and the corresponding physical/VLAN adapter on the Node.
- Joining one or more Containers to the newly created Virtual Network on the Node.
- Connecting the Virtual Network to the physical/VLAN adapter.

Let us join Container 101 to the `eth0` Ethernet adapter on the Hardware Node and, consequently, connect to the Ethernet network behind this adapter. To do this, perform the following operations in Parallels Infrastructure Manager:

1 Create a Virtual Network on the Hardware Node:

- Click the Network link under the Setup item on the Infrastructure Manager main menu.
- On the Virtual Networks tab of the Network window, click New Virtual Network.

Figure 40: Infrastructure Manager - Creating Virtual Network

- Specify an arbitrary name for the Virtual Network in the Virtual Network Name field and provide its description, if necessary. Let us assign the `VirtNetwork1` name to the Virtual Network.
- Click the Submit button.

After a while, the newly created Virtual Network is displayed in the Virtual Network table on the Network screen.

2 Join Container 101 to the `VirtNetwork1` Virtual Network:

- On the Container tab of the Infrastructure window, click Container 101 in the Containers table.
- On the Container dashboard, click the Network Settings link in the Tasks section:

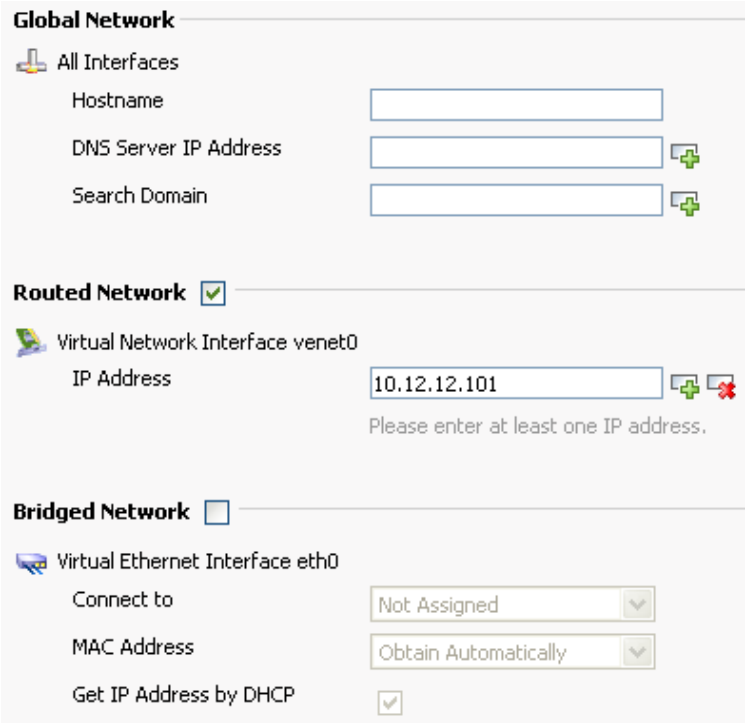

Figure 41: Infrastructure Manager - Connecting Container to Virtual Network

- In the displayed window:

a Select the Bridged Network check box.

b Choose `VirtNetwork1` on the `Connect to` drop-down menu.

c If you have a DHCP server and want Container 101 to get its IP address via this server, leave the Get IP Address by DHCP check selected. Otherwise, clear this check box and provide the necessary information (a valid IP address and the default gateway) in the appropriate fields.

d Click the Submit button.

3 Now that you have joined Container 101 to the `VirtNetwork1` Virtual Network, connect this Virtual Network to the `eth0` physical adapter on the Hardware Node:

- On the Hardware Nodes tab of the Infrastructure window, click the name of the Hardware Node having the `eth0` adapter installed.
- On the Hardware Node dashboard, click the Virtual Networks link in the Tasks section.
- In the displayed window, click the `VirtNetwork1` Virtual Network.
- On the Virtual Network screen, click the Configure button:

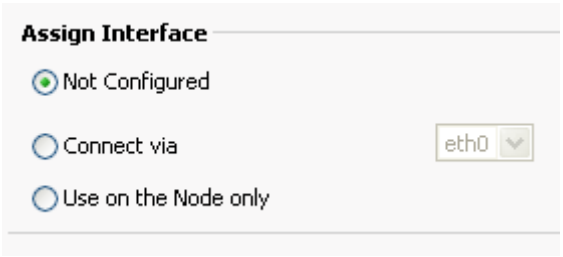

Figure 42: Infrastructure Manager - Connecting Virtual Network to Adapter

- On the Configure screen, select the Connect via radio button, make sure that `eth0` is chosen on drop-down menu, and click the Submit button.

After performing these operations, Container 101 should be able to communicate with any computer on the network where the `eth0` adapter is included.

Deploying Clusters in Virtuozzo-Based Systems

This section provides comprehensive information about how to create clusters on both Windows and Linux Hardware Nodes.

Deploying MSCS Cluster on Windows Nodes

The Microsoft Cluster Server (MSCS) software integrated into the Windows Server 2003 operating system is designed to allow servers to work together as one server, thus, providing greater availability and reliability for your applications and services. In Parallels Virtuozzo 4.5, you can make use of the MSCS technology in one of the following ways:

- Create a cluster of two or more Hardware Nodes that will host the Parallels Virtuozzo Containers software including all its mission-critical services and Containers. If one Hardware Node fails, another Node will take its responsibilities.
- Make Containers participate as full members in the MSCS cluster (like any other standalone server running Windows Server 2003) and increase the availability of your mission-critical applications.

The process of creating a Virtuozzo failover cluster containing two or more Hardware Nodes and providing a high degree of availability for your Parallels Virtuozzo installation is described in the *Deploying Microsoft Clusters in Virtuozzo-Based Systems* document shipped with Parallels Virtuozzo 4.5. In this subsection, we deal only with the way to create MSCS clusters containing one or more Containers.

Parallels Virtuozzo 4.5 allows you to create MSCS clusters by grouping two or more Containers so that they work as a single server providing higher availability for your applications and services. For example, you can unite two Containers into an MSCS cluster and make this cluster host the DHCP service. In this case the Cluster service will keep check of this application and, when detecting a software failure inside the 'active' Container, quickly assign the DHCP service responsibility to the 'passive' Container and start it there. In Parallels Virtuozzo 4.5, you can create an MSCS cluster in one of the following ways:

- using a SAN(Storage Area Network)-based shared storage device
- using a 'loopback file'-based shared storage device

As is evident from their names, these ways differ from each other in the type of the shared storage device used in the cluster. While the first way assumes using a shared physical disk drive as a shared storage device, the second way requires the usage of a special loopback file created inside a Container and emulating a shared physical disk drive in the cluster. Both ways of the MSCS cluster creation are described in the following subsections in detail.

Setting Up SAN-Based Cluster

Parallels Virtuozzo Containers enables you to create a cluster with a SAN-based shared storage device which can include the following components:

- Two or more Containers one of which is to act as an active node in the cluster and all the other Containers as the standby ones. Keep in mind that all Containers participating in the cluster must reside on different Hardware Nodes since one and the same shared storage device on the Node (usually, a shared SCSI disk) can be forwarded to only one Container on this Node.
- One or more Containers and any number of stand-alone servers running the Windows Server operating system. For example, you can use a stand-alone physical server as an active node in the cluster and a Container as the standby one which will take control over your mission-critical applications in the case of an active node failure.

The following example demonstrates how to create a cluster that will include two Containers and use a SAN-based shared storage device (a SCSI disk drive) as a cluster storage - the place where your high-availability applications and all their data will be hosted:

1 Enable the clustering support (which is disabled by default for all Containers on the Node) inside the Container you wish to act as the active node in the cluster. To do this:

a Select the Virtuozzo Containers item under the corresponding Hardware Node name.

b Right-click the Container to be included in the cluster, and select Tasks > Configure Support for Windows Cluster on the context menu:

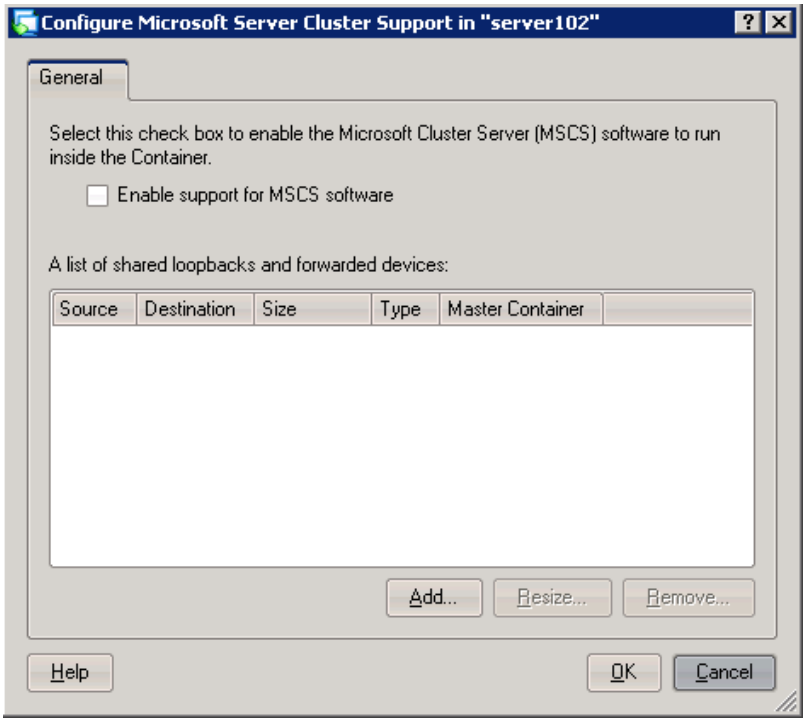

Figure 43: Management Console - Enabling MSCS Support

c In the displayed window, select the Enable support for MSCS software check box.

d Click OK.

e If the Container is running, restart it for the changes to take effect.

2 Forward the shared SCSI disk to be used as a cluster storage to the Container:

a Select the Virtuozzo Containers item under the corresponding Hardware Node name.

b Right-click the Container which is to act as the active node in the cluster, and select Tasks > Configure Support for Windows Cluster.

c In the displayed window, click the Add button:

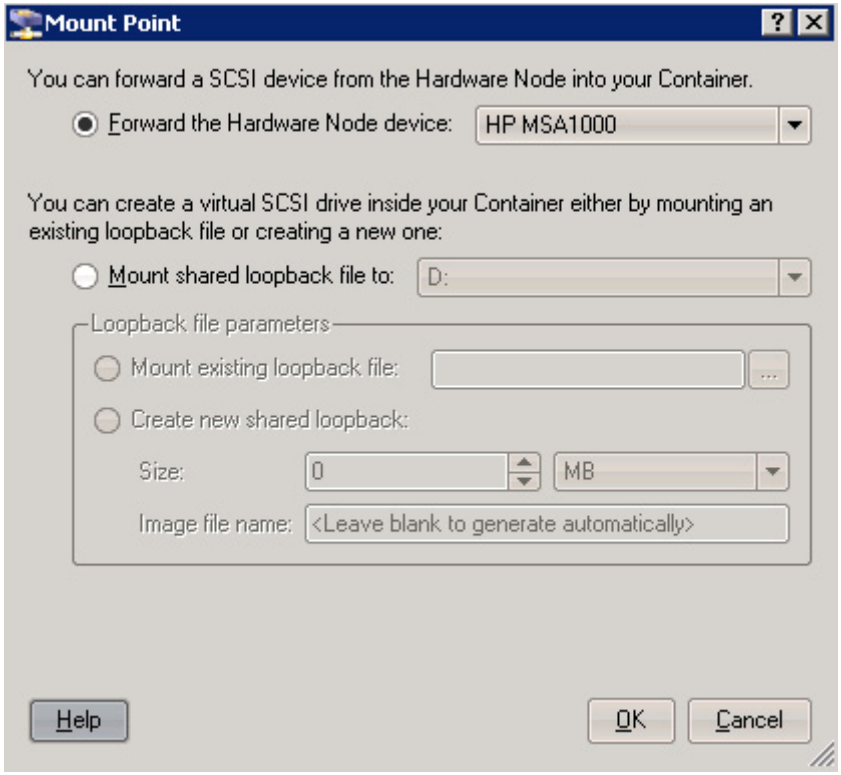

Figure 44: Forwarding Storage Device to Container

d Select the Forward the Hardware Node device radio button, and choose the needed SCSI device on the drop-down menu.

e Click OK.

3 Perform Steps 1-2 for each standby Container to be included in the cluster.

4 Log in to the Container via RDP, create the cluster, and register the necessary both Containers in the cluster. For information on how to create clusters, refer to the Setting Up Cluster section.

Note: All SCSI disk drives forwarded from the Hardware Node to a Container are not kept during the Container migration.

Setting Up 'Loopback File'-Based Cluster

Another way of creating a cluster in Parallels Virtuozzo-based systems is to use loopback files as shared cluster storage devices. These files are mounted inside the corresponding Containers and emulate SCSI devices on a single SCSI bus inside these Containers. To create a cluster using a loopback file as a cluster storage device, perform the following operations:

1. Decide on the Containers to be included in the cluster. Keep in mind that all Containers to participate in the cluster must reside on one and the same Hardware Node (i.e. on the Node where the corresponding loopback file is located).
2. Enable the clustering support (which is disabled by default for all Containers on the Node) inside the Container you want to act as the active node in the cluster. To do this:
   - Select the Virtuozzo Containers item under the corresponding Hardware Node name.
   - Right-click the Container to be included in the cluster, and select Tasks > Configure Support for Windows Cluster.

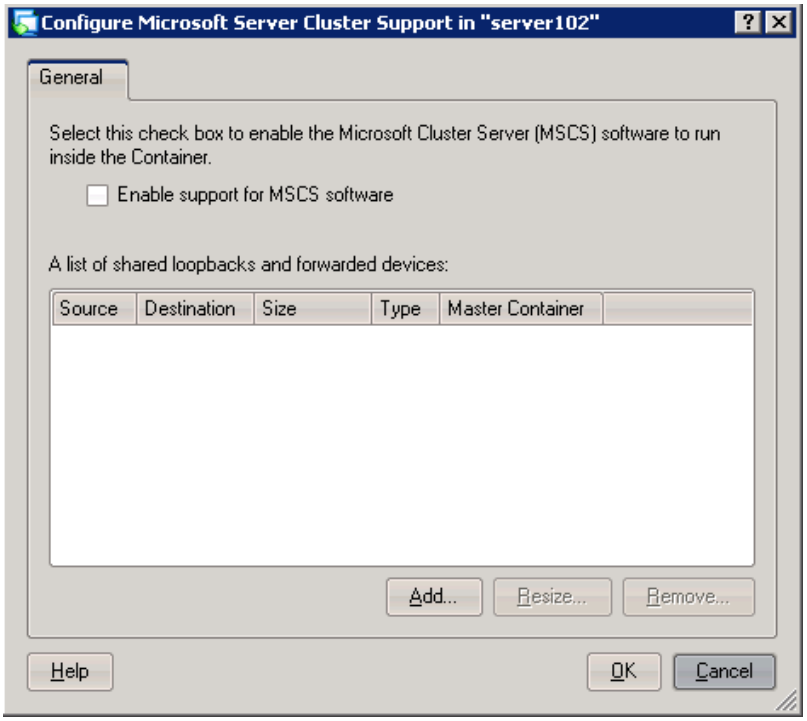

Figure 45: Management Console - Enabling MSCS Support

   - In the displayed window, select the Enable support for MSCS software check box.
   - Click OK.
   - If the Container is running, restart it for the changes to take effect.
3. Create a loopback file to be used as the shared SCSI disk in the cluster:
   - Select the Virtuozzo Containers item under the corresponding Hardware Node name.
   - Right-click the Container which is to act as the active node in the cluster, and select Tasks > Configure Support for Windows Cluster on the context menu.
   - In the displayed window, click the Add button:

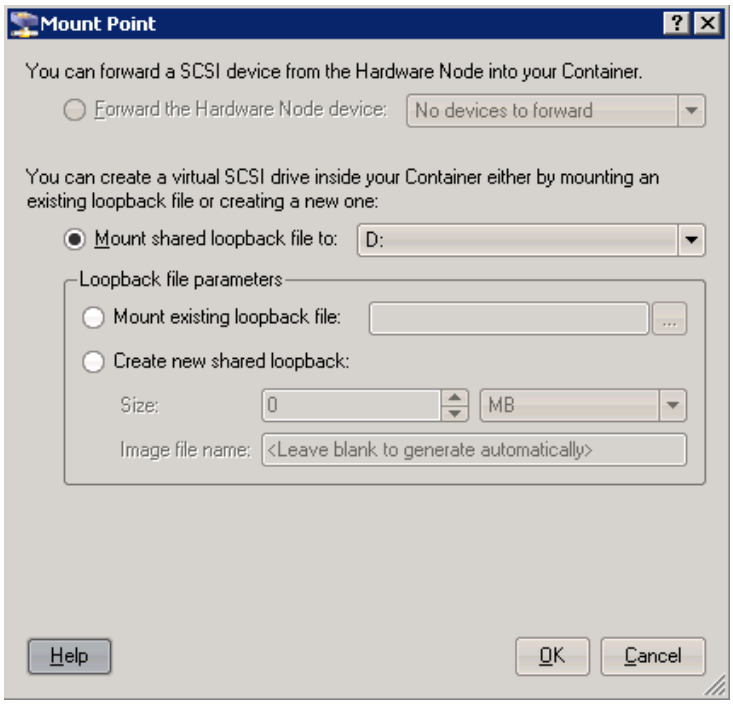

Figure 46: Management Console - Creating Loopback File

- In the Mount Point window, select the Mount shared loopback file to radio button and, on the drop-down menu, choose a drive letter under which the loopback file emulating the SCSI device will be mounted inside the Container. Decide on the loopback file to be used as the shared storage device:

  - Create a new loopback file inside the Container by selecting the Create new shared loopback radio button and specifying the size and the name of the loopback file.

  - Mount an existing loopback file from the Hardware Node by selecting the Mount existing loopback file radio button, clicking the ... button, and specifying the path to the needed loopback file in the displayed window.

- Click OK.

4 Log in to the Container via RDP, and create the cluster. For information on how to create clusters, refer to the Setting Up Cluster section.

5 Perform Steps 2-3 for each 'passive' Container to be included in the cluster. When executing Step 3, mount the same loopback file(s) as the one(s) mounted inside the active Container:

- Select the Mount existing loopback file radio button in the Mount Point window.
- Click the ... button, and in the displayed window, specify the path to the needed loopback file, for example:

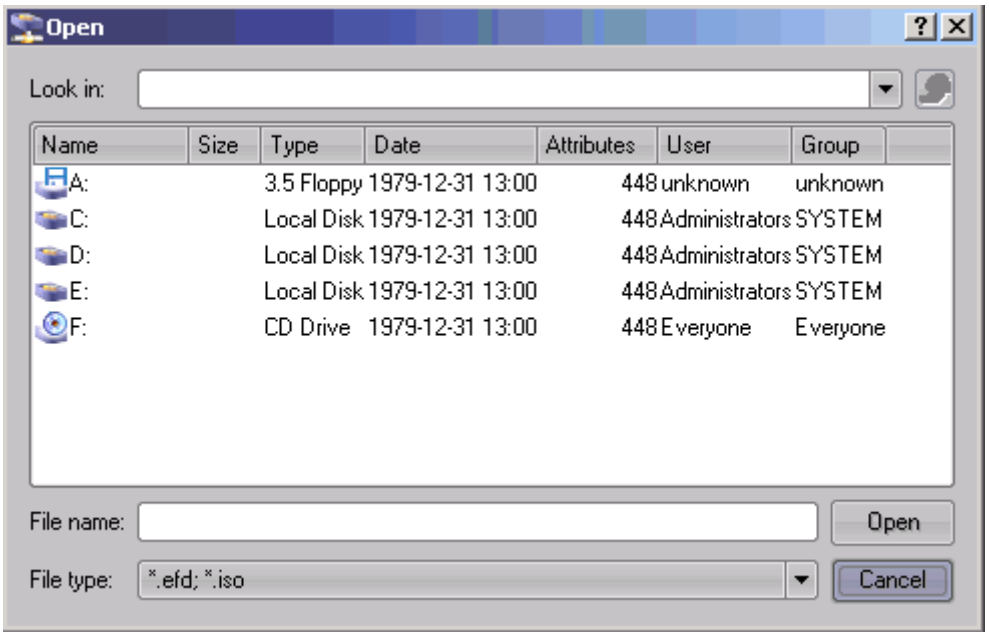

Figure 47: Management Console - Mounting Existing Loopback File

Loopback files are located in the *X*:\vz\private*CT_ID* folder on the Hardware Node where *CT_ID* denotes the ID of the Container where the corresponding loopback file was created.

- Click Open, and then click OK.

6 Add all standby Containers to the cluster. For information on how to add servers to an existing cluster, refer to the Setting Up Cluster section.

Notes:

1. A Container with a shared loopback file created inside cannot be migrated.

2. If a Container has one or more shared loopback files mounted (e.g. all standby Containers in the example above), these loopback files will not be kept during the Container migration.

Deploying Virtuozzo Failover Cluster on Linux Nodes

This section familiarizes you with the way to use the Red Hat Cluster Suite technology to provide greater availability for the Virtuozzo Containers software.

Cluster Configuration Options

Parallels Virtuozzo Containers 4.0 allows you to create a cluster of two or more Hardware Nodes running one and the same version of the Parallels Virtuozzo software to provide a high degree of availability for your Nodes. The implementation of the Parallels Virtuozzo software failover cluster is based on the following statements:

- Red Hat Cluster Suite (RHCS) from the RHEL 5 Linux distribution is used as the clustering software.
- In the given failover clustering scenario, the Virtuozzo service acts as a clustered service, which means the following: if the Hardware Node becomes inaccessible in the case of a hardware or software failure or the Virtuozzo service is stopped accidentally, the clustering software will try to restart the service and all the Containers on the problem Node and, if the latter is not possible, on another (passive) Node in the cluster.
- The cluster configuration is as follows:
  - A shared SCSI storage device (iSCSI or Fibre Channel) is used as a cluster storage.
  - A single LUN (Logical Unit Number) is created per clustered service (in our case each Parallels Virtuozzo installation is regarded as a clustered service).
  - The `/vz` partition is located on the shared SCSI storage device and formatted as ext3.
  - The clustered file system (GFS) is NOT used.
- A typical cluster configuration consists of 'X' + 'Y' servers where 'X' and 'Y' denote the number of active and passive Hardware Nodes in the cluster, respectively. It means that you can run 'X' Parallels Virtuozzo installations and recover from 'Y' Hardware Node failures. For example, if your cluster contains 3 active nodes and 1 passive node, only one active node will be able to fail its resources (the Virtuozzo service and all Containers on that node) to the passive node.
- The minimal hardware requirements include:
  - 'X' + 'Y' physical servers
  - the same architecture for all physical servers (e.g. IA32 or EM64T) to guarantee that Containers can be started on any server in the cluster
  - 'X' shared LUNs
  - 'X' + 'Y' ports on fencing devices

  Cluster configuration examples: 4 active nodes and 1 stand-by node or 10 active nodes and 2 standby nodes.
- One and the same version of the Parallels Virtuozzo software must be installed on all servers in the cluster. However, only one `/vz` partition must be created per clustered service.
- The following cluster resources must be present in the cluster: the `/vz` file system, the `/etc/init.d/vz-cluster` script, and the 'IP address' resource.

Setting Up Cluster Servers

The process of setting up a cluster server includes the following steps:

1. Installing a Host operating system on the server.
2. Installing and configuring the clustering software on the server.
3. Configuring your shared cluster storage to communicate with the server.
4. Installing and configuring the Parallels Virtuozzo 4.0 software on the server.

Installing Host OS

In the case of a clustered Parallels Virtuozzo environment, the server configuration and partitioning requirements slightly differ from those used for a standalone installation. Use the guidelines below when installing a Host OS (Red Hat Enterprise or CentOS) on each of the servers to be included in the cluster:

- If your shared storage is iSCSI, consider using Gigabit Ethernet adapters and the corresponding network infrastructure. In most cases, a 100 Mb network is very likely to become a bottleneck.
- When installing the Host OS on a local storage, make sure that at least 8 GB of disk space is allocated to the root partition; bigger partitions (10 GB or more) are preferred, however, not required.
- When partitioning your server, do not create the `/vz` partition. The servers in the cluster will not need it - the `/vz` partition will be located on a remote SCSI storage.
- As a rule, the “Server” configuration in the installer is sufficient for your needs. However, the cluster administration GUI tool (*system-config-cluster*) requires X-Window to be installed on the server. So, if you plan to use this tool for administering your cluster, install the X-Window component on one of your servers.
- When configuring your Host OS installation, disable the RHEL or CentOS standard firewall since both Parallels Virtuozzo and the data sharing cluster use a multitude of TCP/IP ports. To prevent unsafe network packets from accessing your cluster servers, consider using an external firewall.

Installing and Configuring Cluster Software

After the Host OS installation, you must update your server software to its latest version (e.g. by means of the `up2date` utility) and then complete the following tasks on each of the cluster nodes:

1. Install the clustering software. You can obtain the needed packages using the Red Hat `up2date` utility. The following packages from Red Hat Cluster Suite are required:
   - `perl-Net-Telnet`
   - `cman`
   - `system-config-cluster`
   - `rgmanager`
   - `openais`

   Your typical packages installation session may look as follows:

```
# rpm -ihv openais-0.80.3-7.el5.i386
  cman-2.0.73-1.el5_1.1.i386 rgmanager-2.0.31-1.el5.i386.rpm
  system-config-cluster-1.0.50-1.3.noarch.rpm
  perl-Net-Telnet-3.03-5.noarch
```

   Note: The `dlm` lock manager has been tested and recommended for the production usage; other locking schemes (`quorum disk`, etc.) are not supported.

2. Edit the `/usr/share/cluster/fs.sh` script by locating the following string in this script

```
<parameter name="mountpoint" unique="1" required="1">
```

   and changing it as follows:

```
<parameter name="mountpoint" unique="0" required="1">
```

Configuring Shared Storage

After installing the clustering software, you need to configure the shared storage which is to be used as the `/vz` partition. The shared storage can be configured from a single server or from several servers (it does not really matter). The space requirements for this partition should be calculated on the basis of the space demands for your Containers and Parallels Virtuozzo templates. The number of partitions should correspond to the number of clustered services and be less than the number of physical servers in your cluster.

Please keep in mind that all your servers should be able to access your shared LUNs. The cluster will decide where to start the clustered service by itself; so, it must be able to mount the partition with all the required Containers and templates.

Using volume labels for your partitions will greatly simplify the further management of your cluster. We recommend that you have a match between a clustered service and a partition name. For example, the `Virtuozzo-1` service can use a partition with the `vz-1` label. Also note that these volume labels do not correspond to the mount points which are always `/vz` on all the servers in the cluster.

After the corresponding LUNs have been successfully created, make the partitions on them using the `fdisk` utility or other disk partitioning software, and then create the file system. For example:

```
# mke2fs -j -J size=100 –L vz-1 -b 4096 -i 4096 /dev/sdc1
```

Please do not forget to replace `/dev/sdc1` in the example above with your real disk device and `vz-1` with a label set for a particular clustered service. Now check that the device can be successfully mounted:

```
# mount LABEL=vz-1 /vz
```

After that, unmount the device:

```
# umount /vz
```

Setting Up Clustered Services

Configuring Parallels Virtuozzo Failover Cluster

The configuration procedures described below supposes the usage of the `system-config-cluster` utility. Do the following:

1. Use an existing cluster or create a new one (the creation of a new cluster is recommended).
2. Add your servers to the cluster under the Cluster Nodes tree.
3. If the same cluster manages other services, you need to create a new failover domain (e.g. the `VZ-servers` name can be used) and add all your Parallels Virtuozzo cluster nodes to this domain.
4. Add and configure fencing devices (note that using fencing devices is mandatory). Manual fencing is supported for testing purposes only and should not be used in production.
5. Create resources:
   - *File system*: one resource per each shared SCSI partition. Make sure that the partition is referred to by the volume label instead of by the device name. Also, do not forget to use the `noatime` option. See the picture below:

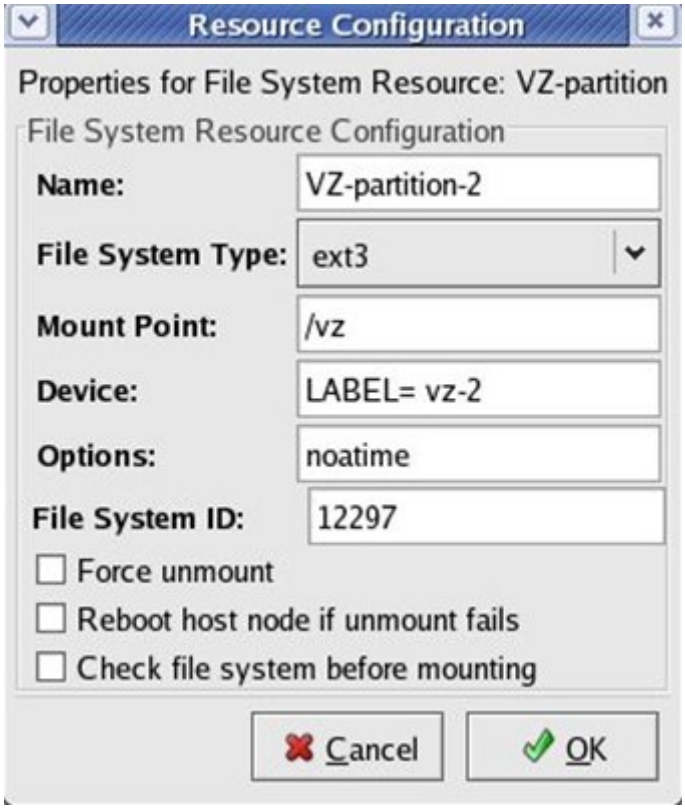

Figure 48: Cluster Resource Configuration - Configuring File System

   - *Script*: one script per cluster:

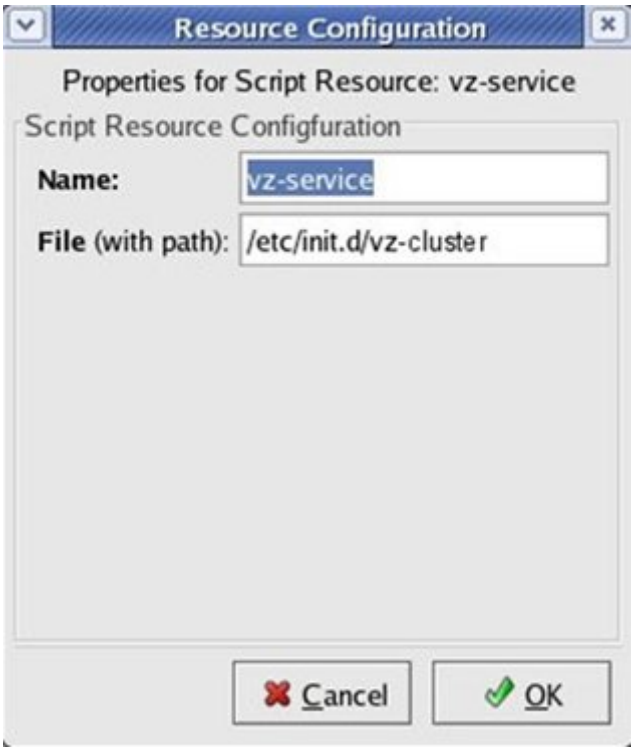

Figure 49: Cluster Resource Configuration - Defining Scripts

- *IP address*: an IP address is needed for each Parallels Virtuozzo service (it will be used to connect to the Service Container and for a direct SSH connection to the host). Note that the IP address will be managed by the cluster; so, it must not be already in use and assigned to the nodes directly:

Figure 50: Cluster Resource Configuration - Assigning IP Address

6 Create the corresponding clustered services. The number of services corresponds to the number of active servers and shared partitions; also make sure that:

- The Service Autostart is enabled.
- The Service is configured to run exclusively; thus, the cluster will not attempt to run more than one Parallels Virtuozzo service on the same physical server (which is not currently supported).
- The Service recovery policy is 'Relocate' or 'Restart'; in the latter case, if the Parallels Virtuozzo service is stopped for some reason, the cluster will attempt to restart the Parallels Virtuozzo software on the same server before relocating it to another one.
- If Parallels Virtuozzo shares the cluster with other clustered applications, make sure that the proper failover domain is specified (in the picture below, the failover domain is not set).
- The 'Script' Resource (`vz-service` in our example) is attached to the 'File System' resource (`VZ-partition-2`). This ensures the proper order of the services startup:

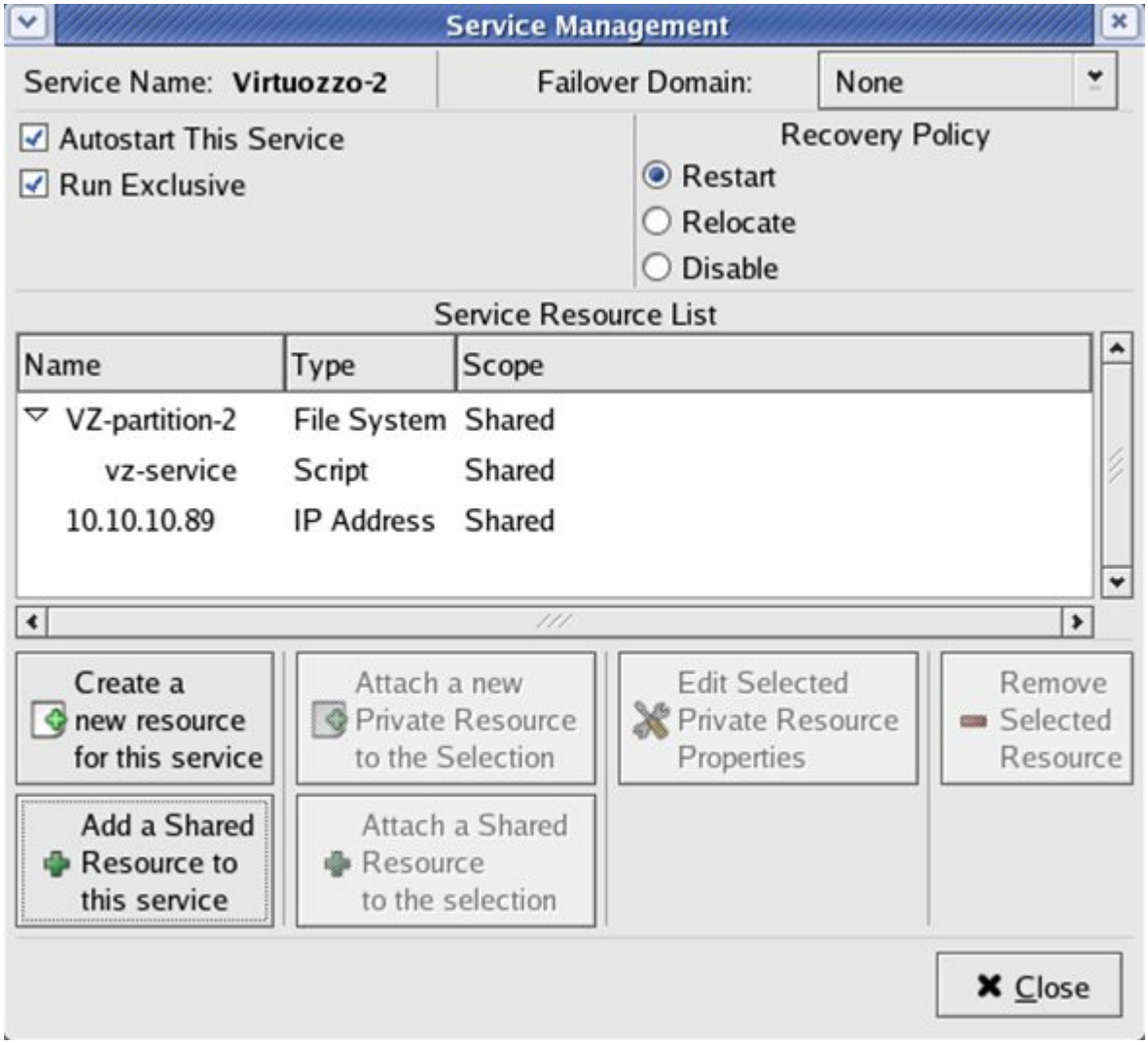

Figure 51: Cluster Configuration - Viewing Cluster Service Parameters

7 Distribute the configuration file (`/etc/cluster/cluster.conf`) to all the servers, and start the clustering service:

```
# service cman start
# service rgmanager start
```

8. Configure the clustering service on each node in the cluster to start in the default runlevel. For example, if your system default runlevel is set to 3, you can enable the service by executing the following commands on each of the cluster nodes:

```
# chkconfig --level 3 cman on
# chkconfig --level 3 rgmanager on
```

9. After starting the service, you may further synchronize your configuration using the Send to Cluster button in the cluster configuration utility.

10. Locate the Cluster Management section of the GUI tool or run the `clustat` command line utility. Make sure that all the services have been successfully started. If they have not, investigate the cluster logs stored in `/var/log/messages` by default. Keep in mind that the information you are looking for may be placed on different servers in the cluster.

Testing Parallels Virtuozzo Failover Cluster

To test the created cluster, you can shut down or unplug a power cord on one of the servers in the cluster which currently runs the Parallels Virtuozzo Containers software (if you are using manual fencing, you may need to use the `fence_ack_manual` tool to inform the cluster of the fenced server). Use any cluster monitoring tool to ascertain that, in less than a minute, the Parallels Virtuozzo service is automatically relocated from the failed server to a standby one.

Glossary

Application template is a template used to install a set of applications in *Containers*. See also *Template*.

Container (or *regular Container*) is 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 *Hardware Node* and one OS kernel. However, they are isolated from each other. A Container is a kind of 'sandbox' for processes and users. *Container 0* and *Container 1* are used to designate the *Hardware Node* and the *Service Container*, respectively.

Container 0 is used to designate a *Hardware Node* where the *Virtuozzo Containers* software is installed.

Container 1 is used to designate the *Service Container*.

EZ template (in Parallels Virtuozzo Containers for Linux only) is a template file that points to a repository with the packages that comprise the template. Unlike *standard templates*, EZ templates cannot be updated because the repository stays the same. However, the packages in the repository can be updated.

Hardware Node (or *Node*) is a server where the Virtuozzo Containers software is installed for hosting *Containers*. Sometimes, it is marked as *Container 0*.

Host Operating System (or *Host OS*) is an operating system installed on the *Hardware Node*.

OS template (or *Operating System template*) is used to create new *Containers* with a preinstalled operating system. See also *Template*.

Package set is a synonym for *Template*.

Parallels Infrastructure Manager (or *Infrastructure Manager*) is a tool designed for managing Hardware Nodes and all *Containers* residing on them with the help of a standard Web browser on any platform.

Parallels Management Console (or *Management Console*) is a Virtuozzo Containers management and monitoring tool with graphical user interface. It is used to control individual *Hardware Nodes* and their *Containers*. *Management Console* is cross-platform and runs on both Microsoft Windows and Linux workstations.

Parallels Power Panel is a means for administering personal Containers with the help of a standard Web browser (Internet Explorer, Mozilla, etc.) on any platform.

Parallels Virtuozzo Containers (or *Virtuozzo Containers* or *Parallels Virtuozzo*) is a complete server automation and 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 is a part of the file system where *Container* files that are not shared with other *Containers* are stored.

SSH stands for Secure Shell. It is a protocol for logging on to a remote machine and executing commands on that machine. It provides secure encrypted communications between two untrusted hosts over an insecure network.

Service Container is a special *Container* automatically created on the Hardware Node during the Virtuozzo Containers installation and needed to manage your *regular Containers* by means of *Parallels Infrastructure Manager*, *Parallels Power Panel*, and *Parallels Management Console*. Sometimes, the *Service Container* is marked as Container 1.

Standard template is a template file that has inside itself all the re-usable files of all the packages comprising the template. If newer versions of any of these packages appear, a standard template can be correspondingly updated. Compare *EZ template*.

Template (or *package set*) is 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 preinstalled operating system. Application templates are used to install an application or a set of applications in *Containers*. See also *Standard template* and *EZ template*.

Virtual Environment (or *VE*) is an obsolete designation of a *Container*.

Virtuozzo Control Center (or *VZCC*) is an obsolete designation of *Parallels Infrastructure Manager*.

Virtuozzo File System (*VZFS*) is a virtual file system for mounting to Container private areas. VZFS symlinks are seen as real files inside *Containers*.

Parallels Virtuozzo license is a special license that you should load to the *Hardware Node* to be able to start using the *Virtuozzo Containers* software. Every *Hardware Node* shall have its own Virtuozzo Server license.

Virtuozzo Power Panels (or *VZPP*) is an obsolete designation of *Parallels Power Panel*.

Virtual Private Server (or *VPS*) is an obsolete designation of a *Container*.

Parallels Agent (or *Parallels Agent Protocol*) is an XML-based protocol used to monitor and manage a *Hardware Node*. The *Parallels Agent* software implements this protocol and is a backend for the *Parallels Management Console*.

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